REPORT OF ARCHAEOLOGICAL RESOURCES SURVEY FOR THE RANCH PLAN, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

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INTRODUCTION

At the request of Laura Coley Eisenberg of Rancho Mission Viejo, L.L.C., personnel from Archaeological Resource Management Corporation (ARMC) conducted an archaeological resources survey for the proposed Ranch Plan on Rancho Mission Viejo in south Orange County. This study concludes the Phase I assessment for the project. The records and literature search was completed earlier (Demcak 1999). That research revealed that only a small portion of the property had been surveyed within the last five years and thus most of the acreage would need to be resurveyed.

The fieldwork consisted of a field walkover survey of approximately 25,000 acres and field checking of all of the recorded sites within or immediately adjacent to the project boundaries. The fieldwork took place from March 13 – June 1, 2000. The author supervised the project. A Society of Professional Archeologists (SOPA) certified field archaeologist and Registered Professional Archaeologist (RPA), she has over 20 years of experience in southern California archaeology. Steve Wakefield served as Field Director for the survey. Chris Demcak acted as Crew Chief for the northern survey area and Steve Dennis for the southern part. Field crew consisted of Kathleen Allen, Aaron Brocamontes, Steve Dibble, Denise Dickinson, David Frietze, Ralph Frietze, Fred Gonzalez, Hugo Lozano, Richard Miller, and John Sunio.

The results were that 19 new prehistoric sites and five new historic sites were recorded. Nine previously recorded sites (CA-ORA-656, -882, -921/1127, -997, -1043, -1048, -1121, -1144, and –1222) are considered eligible for the National Register of Historic Places (NRHP).

NATURAL SETTING

The project area (Figure 1) generally consists of Chiquita Canyon, Gobernadora Canyon south of Coto de Caza, the floodplain of San Juan Creek, a stretch of Ortega Highway, the acreage east of La Pata Avenue and north of Cañada Deshecha, Trampas Canyon, Cristianitos Canyon, Gabino Canyon, and La Paz Canyon. The project is bounded at its southernmost point by Camp Pendleton; on the east by the San Diego and Riverside County lines; and by the developments of Coto de Caza, Las Flores, and Ladera Ranch on the north. To the west a high-voltage power line and grant boundary mark the terminus of the survey.

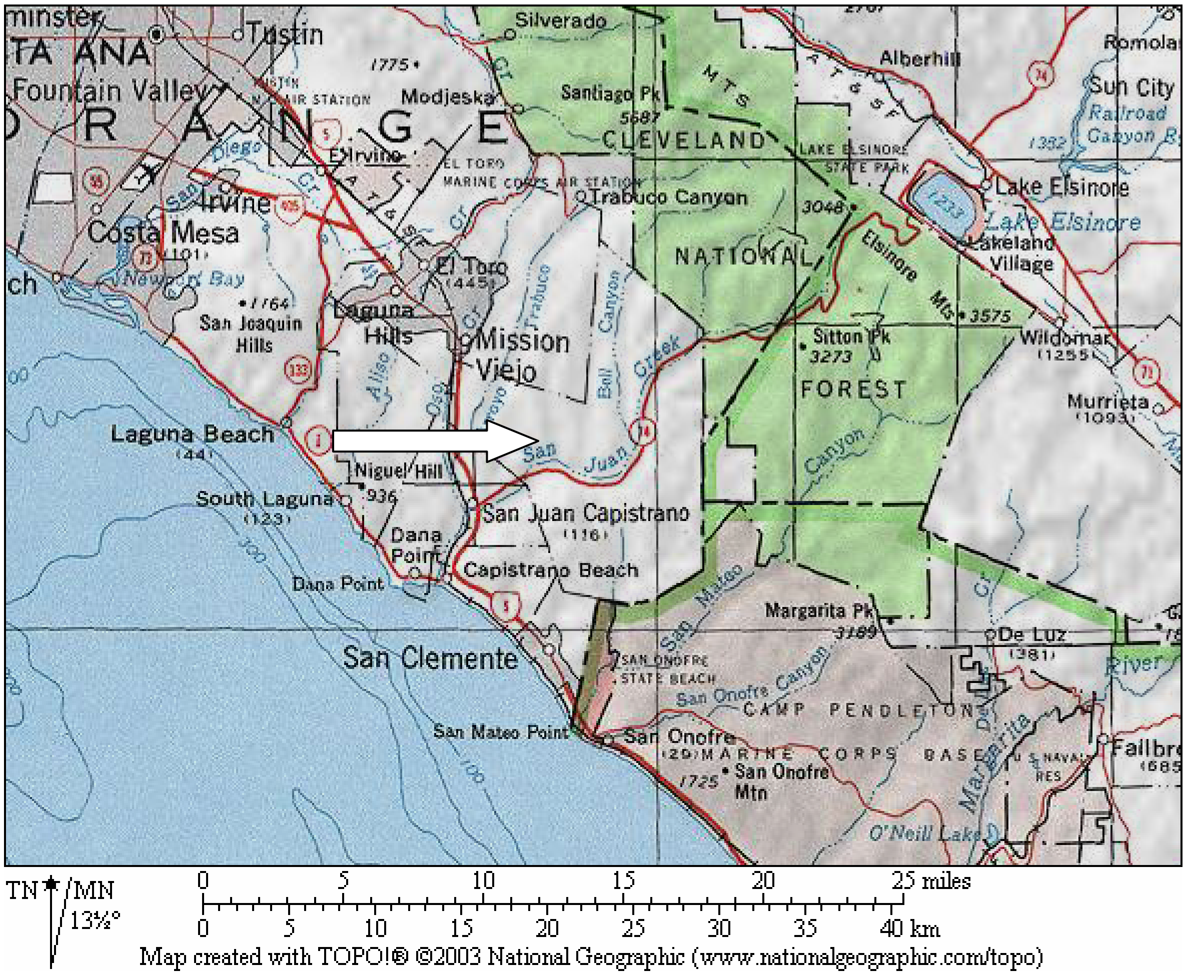

Figure 1. General Project Location.

The project is situated in south Orange County along Chiquita Creek, Gobernadora Creek, San Juan Creek, Cristianitos Creek, and numerous unnamed drainages, their adjacent terraces and foothills that make up Rancho Mission Viejo. The foothills are part of the Santa Ana Mountains that form part of the Peninsular Ranges Province that stretches from the Transverse Ranges through the Los Angeles Basin to the tip of Baja California (Norris and Webb 1976). The climate of the area is Mediterranean type, with dry summers and moist winters. Rainfall averages 10-15 inches annually on the coastal plain and up to 40 inches in the interior mountains (Hornbeck 1983).

Topographically, the study area is characterized by rolling hills, narrow ridgelines, and knolls separated by narrow canyons, localized drainages, and broad watercourses (Orange County Planning Department 1971). Elevations in the project area vary from a low of 160’ in the floodplain of San Juan Creek on the western edge of the survey area to a high of 1260’ in upper Gabino Canyon on the northeastern edge of the survey area.

Geologically, the study area is underlain by marine Upper Cretaceous deposits (Trabuco, Ladd or Williams Formations) and by Tertiary age, marine sedimentary rocks (Morton and Miller 1981), along with Quaternary and recent alluvium. Mapped formations include the marine Upper Cretaceous Ladd and Williams Formations, the marine Paleocene Silverado Formation, the marine Eocene Santiago Formation, the terrestrial Oligocene Sespe/Vaqueros undifferentiated Formation, the marine Middle Miocene Topanga and Monterey Formations, the marine and non-marine Middle Miocene San Onofre Breccia, the Upper Miocene Capistrano Formation, and unnamed Quaternary and recent alluvium. Soils in the study area vary from gray-brown to red-brown clayey loam on the upper terraces and knolls to light tan, sandy/silty sediments with abundant cobbles on the creek bottoms and adjacent terraces.

Lithic raw material derived from these and other formations in the Santa Ana Mountains include the Bedford Canyon metasediments (argillite) and quartzites; the Santiago Peak volcanics and metavolcanics; as well as granitics, quartz, chert, and chalcedony. These lithics occur as stream float in the local drainages. These raw materials were utilized by aboriginal populations to create chipped and ground stone tools and ornaments.

Six plant communities as defined by Munz and Keck (1959) are present in the project area. These communities (Chaparral, Coastal Sage-scrub, Grassland-herbland, Oak Woodland, Riparian, and Freshwater Marsh) would have provided a variety of seasonal plant resources to the prehistoric and early historic inhabitants of the region. For a detailed description of these resources and their uses, see Demcak and Del Chario (1989).

CULTURAL SETTING

Prehistory

Wallace (1955) and Warren (1968) have both proposed syntheses of the local cultural sequence. These summaries continue to be useful in defining the prehistoric period in southern California. The two researchers propose that aboriginal populations remained hunters and gatherers before Spanish contact.

The Millingstone Horizon, or Encinitas Tradition, is the earliest occupation that has been properly documented for Orange County. Highly mobile populations adapted to a littoral, or coastal, environment during this occupation. Small native groups gathered plant foods, including seeds, tubers, and berries, collected shellfish, and hunted small and large game. They used millingstone and muller, more commonly called metate and mano, to grind seeds. Hunting tools included wide, thick, and heavy projectile points. They were presumably utilized as spear points, based on their weights (Fenenga 1953), and launched by atlatls, or wooden spear-throwers. Cogstones and discoidals, wheel-shaped and disc-shaped ceremonial stones respectively, and red argillite beads are diagnostic artifacts, or time-markers, for this earliest known occupation in Orange County.

During the subsequent Intermediate Horizon, or Campbell Tradition, prehistoric populations expanded their resource base to include more hunting and fishing. The mortar and pestle, tools associated with the processing of acorns and other fleshy plant foods, were introduced into the area. Projectile points remained relatively large and heavy.

In the final prehistoric occupation, the Late Horizon Cultures (Shoshonean and Hokan speakers), local economies expanded markedly. Artifact assemblages reveal an increase in the number and types of tools, reflecting population growth and task specialization. Non-utilitarian items, such as beads and ornaments, were also on the increase in the Late Horizon compared to earlier occupations. Local groups continued to rely primarily upon plants, shellfish, and terrestrial game, which they hunted with small, lightweight arrow points and the bow.

Steatite, obsidian, and other non-local lithic resources were traded into the area. Pottery was introduced into Kumeyaay territory in San Diego County and small quantities reached Orange County in the very late prehistoric period. Pestles and portable mortars, especially of the basket-hopper type, and bedrock mortars were utilized locally for acorn processing. Seed grinding continued to be carried out with manos and metates, as well as on bedrock grinding slicks.

Ethnohistory (see N.H. Evans, 2000, accompanying volume)

Historical Overview

The arrival of the Portolá Expedition in 1769 marked the first efforts at extending Spanish control into Alta California through the establishment of Catholic missions. This move by the Spanish King Carlos III was intended to protect Pacific Coast shipping against Russian or English occupation of the area. Beginning in San Diego, the padres surveyed the lands as far north as Monterey Bay and secured them for the Spanish Crown. Mission sites were selected on the way north by Fathers Crespi and Gomez (Hallan-Gibson 1986).

The Portolá party arrived in Orange County on July 22, 1769, at a site in Cristianitos Canyon where two sick children were baptized by the fathers. The following day the travelers camped near the Mission Vieja site (CA-ORA-29) at the mouth of Gobernadora Canyon. The next day the expedition continued northwestward and out of the survey area to the western edge of the Plano

Trabuco and camped at the San Francisco Solano campsite at the present location of the Trabuco Adobe. Altogether they stopped at seven campsites (Smith 1965) in what became Orange County.

Missions, presidios, and pueblos were established by the Franciscan fathers, and in 1775, the Mission San Juan Capistrano was begun. Within days, however, a Native American uprising at the mission in San Diego forced the fathers to abandon the local mission, hastily bury its bells, and with the soldiers hurry southward to assist their fellow priests. The fathers returned the following year to re-establish the mission at a different site. There on November 1, 1776, the mission was officially founded. On October 4, 1778, the mission was removed to its present location closer to the Arroyo Trabuco, a dependable water source (Hallan-Gibson 1986). Substantially expanded in 1784, the mission continues in use and is believed to be the oldest building extant in California, according to Friis (1965).

The Native inhabitants were brought under the control of the mission. They were converted to Catholicism and provided the mission with a large labor pool. The padres taught them the necessary skills to grow crops, tend cattle, make wine, pottery and other crafts. The missions intended to prepare them to look after their own lands, which were held in trust for them. Spanish legislators called for the dissolution of the missions and turning over the lands to the natives as early as 1813. However, it was not until the Mexican Period that secularization was begun.

At the end of the Mexican Revolution, mission lands were seized and turned over to Mexican citizens of the Catholic faith and of good character. The Mission San Juan Capistrano was the first mission to be secularized in 1834. A pueblo for Native Americans was set up at Mission San Juan Capistrano, but, after years of mismanagement, failed (Dixon 1988; Hallan-Gibson 1986). A town was instead chartered and land became available to petitioners, including the Natives. Eventually, the town itself failed, and the mission was sold by Governor Pio Pico to his brother-in-law John Forster and James McKinley, a trader (Hallan-Gibson 1986). Forster maintained his residence at the mission until his claim to the property was denied (Muñoz 1980).

A series of land grants, or grazing rights, was issued by the Spanish Crown. The land between the Santa Ana and San Gabriel rivers was given to Manuel Nieto in 1784; this was the first land grant in Orange County. The second, called Rancho Santiago de Santa Ana, went to Juan Grijalva and Jose Yorba, his son-in-law. The grant was confirmed in 1810 to Yorba and Grijalva's grandson (Hallan-Gibson 1986). There followed a period of growth and development as rancheros built adobe homes, ran large herds of cattle and sheep, engaged in foreign trade, and dabbled in politics.

California was drawn into the Mexican-American War in 1846, and Governor Pico fled the oncoming American Army. His son-in-law John Forster, an American sympathizer, tipped off the Union soldiers marching through Orange County that a large contingent of enemy soldiers was on its way. This may have saved their force from defeat by 600 Mexicans (Hallan-Gibson 1986). After the Treaty of Guadalupe Hidalgo ended the war in 1848 and California entered the Union, the land claims of the rancheros were scheduled to be upheld, but subsequent laws required the land owners to prove their claims, requiring considerable time and expense. Most of the land claims in Orange County were eventually confirmed by the courts.

In the American Period, life on the ranchos continued much as before although squatters, rustlers, and mounting debts grew troublesome. Large landholdings were increasingly broken up; towns and settlements grew in number. Mission San Juan Capistrano was returned to the Catholic Church in 1865 when the U.S. Government denied Forster's claim to the property. Forster took his family and moved southward to Rancho Santa Margarita, home of his relatives, the Picos (Hallan-Gibson 1986).

During the 1860s, severe drought, smallpox, and torrential rains alternately took their toll on the large landholders and other settlers in southern California. The cattle market collapsed, land was devalued, and a diversified economy developed. The end of the Civil War brought an impetus to settlement. Land was cheap, and thousands flocked to the Golden West. A real estate boom ensued in the 1880s. The arrival of the Union Pacific, Southern Pacific, and Santa Fe Railroad provided transportation for people and products into and out of California. Sheep ranching became highly profitable due to the scarcity of cotton in the South. Large land grants were partitioned. Development proceeded at a rapid pace through the late nineteenth and early twentieth century. Improvements in transportation and communication contributed to the boom. The citrus industry with its associated beekeeping was one of the most successful enterprises in the area.

In the post-World War II period, southern California has been characterized by expanding urbanization, business and industry. The aerospace industry, movie and television industries, automobile manufacturing, and tourism have spurred local growth and continue to attract visitors and potential residents. The last ranchos have been developed or are in the process of being developed.

Mission Viejo, or La Paz, and O'Neill Ranch

This large rancho comprising 46,500 acres was granted to Jose Estudillo in 1841. Juan Forster acquired the holding in 1845 after having grazed his cattle there for at least a year. Forster, who played a significant role in the development of southern Orange County and northern San Diego County, was an Englishman by birth but a naturalized Mexican citizen. He was married to Pio Pico's sister, possessed vast land holdings, and was one of the wealthiest and most influential men of his day. His ranching success was partly due to an increased demand for beef that brought about a cattle boom once the gold rush had begun in 1848.

In 1882, the heirs of Juan Forster, whose land was heavily mortgaged due to various business failures, sold the Rancho Santa Margarita y Las Flores to Richard O'Neill and James C. Flood. Thus began the O'Neill Ranch, which includes the project area.

O'Neill, an Irishman, had come to California and established a successful ranching business and later meat-packing establishment. With his friend Flood, he acquired the Forster property. With various innovations, such as installing feedlots, O'Neill was highly successful and bought more land. The land holding reached its maximum of 260,000 acres under the care of Jerome O'Neill, Richard's son, at the turn of the century (Emmons 1974).

After Jerome's death, the ranch became the property of the Rancho Santa Margarita Corporation in 1926; and the O'Neills' stocks were held in trust. The Floods retained half interest in the corporation and ran the ranch until the 1930s when they sold their share (now Camp Pendleton) and the O'Neills divided their half interest. The land itself remained in trust. In 1943, after Richard O'Neill, Jr., died, an effort by trust officers to sell the property was halted by his widow.

In 1964 Mission Viejo Company was formed. The heirs and Richard O'Neill, Jr.'s, widow retained a 20% share of the company. Local development was initiated, and in 1972 the company was sold to the Phillip Morris Company, whose development became the Mission Viejo Planned Community. Santa Margarita Company launched its first large development, Rancho Santa Margarita, on the upper Plano Trabuco and on the adjacent hills to the south and southeast. Development has continued southward and now includes the Las Flores and Ladera Ranch communities.

The O'Neill family continues to operate Rancho Mission Viejo as it has since 1882. Ranching is still being carried out on the project area except for leased acreage. Herds still roam the hills and cowboys still conduct spring round-ups, repair fence lines, and patrol the range. Working windmills and cattle troughs dot the landscape.

FIELD SURVEY: METHODS

The ARMC crews carried out field walkover surveys beginning on March 13 and concluding on June 1, 2000. Visibility varied with project segment. In Chiquita Canyon, much of the land had been disced recently making for excellent ground visibility. Elsewhere in the canyon grassland-herbland, sage-scrub, chaparral, riparian, and oak-woodland vegetation made for limited ground visibility, ranging from 10 – 20%. In the remaining canyons to the east and south of Chiquita, grassland-herbland vegetation allowed reasonable ground inspection (30 – 50%) in the center of the drainages, while scrub and other vegetation permitted only limited inspection (10 – 20%) of the low hills and peaks surrounding the drainages. Narrow, elevated ridgelines in the interior of the study area both north and south of Ortega Highway were often choked with vegetation that precluded close ground inspection.

Surveyors walked 5-meter transects in most areas, shortening to one meter or less on recorded sites or when conducting a close inspection of a newly-discovered site. Transects followed the general direction of ridgelines and varied north-south or east-west in open areas, sometimes repeating in the reverse direction if the terrain and visibility warranted such coverage. Single surveyors walked narrow ridgelines or small drainages, while groups of surveyors covered wider spaces. Fully-disturbed areas, including re-vegetation zones, citrus and avocado groves, SMWD Water Treatment Plant, ranch headquarters and related structures, and sand and gravel plants were not surveyed due to the extreme levels of disturbance.

FIELD SURVEY: RESULTS

The results are given below by project segments, from northwest to southeast. See Confidential Appendix for maps showing site locations.

Segment 1: Upper Chiquita Canyon

CA-ORA-877 is the only site previously recorded in this segment. It was was recorded by ARMC in 1980 as a small milllingstone site. The site was described as a 20 x 20-meter scatter of lithics, consisting of three manos, one hammerstone, and two metate fragments. The recent field inspection revealed the presence of one hammerstone and a mano fragment.

Three new sites (CA-ORA-1559, -1560, and –1561) were recorded during the recent survey. See Confidential Appendix for site locations and site survey records.

CA-ORA-1559 is located on the eastern side of Chiquita Canyon. This moderate scatter of ground stone and chipped stone tools and debitage. The assemblage also includes a discoidal, or ceremonial stone (collected), red bead material, 11 manos or fragments, three metate fragments, a core, a flake, a hammerstone, two core tools, five scraper-planes, and two flake tools. The range of tool types and the presence of the discoidal and red bead raw material suggests that this was an Early Millingstone base camp, or village. Site area is an estimated 60 meters (m) E/W x 50 m N/S. A ranch road cuts into the site on its eastern end. The site has been disced for agriculture. Cows graze on the site currently. The site lies between the 600' and 640' contour elevation. Depth could not be determined.

CA-ORA-1560 is located to the northwest of CA-ORA-1559 on the east side of Chiquita Canyon. This moderate scatter of ground and chipped stone tools occupies an area of 40 m E/W x 30 m N/S. Artifacts include nine manos/fragments, eight metate fragments, three scraper-planes, four flake tools, a hammerstone, and red bead raw material. A possible feature consisted of six fragments of a schist metate and a granitic mano. The site may be a small (40 m N/S x 30 m E/W) base camp associated with CA-ORA-1559. It is probably an early site. It contains no late period indicators. The site lies on the 560' – 580' contours. Depth is unknown.

CA-ORA-1561 lies to the north of CA-ORA-1560 on the eastern side of Chiquita Canyon. This sparse lithic scatter contained three items: two discoidals (both collected) and a hammerstone. The site occupies an area of 30 m E/W x 5 m N/S at an elevation of 720' above mean sea level. The site appears to be a special purpose camp (probably ceremonial) associated with CA-ORA-1559 and CA-ORA-1560. Depth could not be determined.

Segment 2. Lower Chiquita Canyon and Western San Juan Creek

Eighteen prehistoric sites (CA-ORA-1447, -997, -1042, -1043, -880, -881, -902, -882, -1048, -1049, -1050, -1106, -1104, -1105, -27, -26, -28, and –1121) and one historic site (CA-ORA-29, Mission Vieja) were previously recorded in this area. Two new prehistoric sites and two isolates were recorded during the recent field reconnaissance.

CA-ORA-1447 was recorded by Greenwood and Associates (GandA) in 1988 as a ground stone scatter (60 x 50 meters) consisting of more than a dozen metates or fragments, a possible mortar fragment, hammerstone, and three manos. GandA also tested the site (Romani 1997). The site was determined to be ineligible for the National Register of Historic Places (NRHP) in a formal review process. ARMC surveyors found one core tool and a ground stone fragment during the recent field check of the site.

CA-ORA-997 was recorded by ARMC in 1984 as a small (20 x 20 meters) lithic scatter consisting of a mortar fragment, two manos, a core, flake, and fire-affected rock (FAR). It was described as a possible seasonal camp. GandA personnel re-surveyed the site (Van Bueren et al. 1988) and updated the site record to expand its area to 240 x 130 meters. ARMC personnel monitored the site during grading for the Chiquita Water Reclamation Pipeline (Demcak and Van Wormer 1987) and observed no subsurface deposits. A later ARMC crew monitored the area for the South County Pipeline Project (Julien and Demcak 1993) and collected 27 artifacts, including three hammerstones, three metate fragments, four utilized flakes, three plano-convex tools, three whole and two fragmentary manos, one very late projectile point (Sonoran type), a fragmentary pestle, a chopper, core scraper, and drill/reamer. Subsequent testing by GandA revealed an additional deposit east of Chiquita Creek and a calculated total area of 300 meters SW/NE x 180 meters NW/SE for the overall site. The site was described as a probable habitation/village with occupations from the early to the late period. A radiocarbon date of 8950± 70 B.P. was obtained from a shell sample 140-150 cm below datum (Romani et al. 1997). The site was determined to be NRHP eligible in a formal review process.

ARMC surveyors during the recent field check of the site discovered that the site had been freshly disced revealing a dense scatter of ground and chipped stone tools, debitage, and fire-affected rocks (FAR's). Diagnostic artifacts included a pestle and pestle fragment, a dart point fragment, and red bead flake, all of which were mapped and collected, along with a shallow basin metate (90% complete), a large biface (multipurpose tool) and small biface fragment (preform).

CA-ORA-1042 was recorded by ARMC in 1984 as a small lithic scatter (25 x 50 meters) consisting of two manos, a metate fragment, three scraper-planes, two large flake scrapers, and a core. It was described as a probable collecting and processing camp associated with the adjacent freshwater marsh (Chiquita Creek). ARMC personnel carried a test and salvage program within the right-of-way for the Chiquita Canyon Water Reclamation Plant access road and Chiquita Land Outfall Pipeline (Demcak and Van Wormer 1987). No subsurface artifacts were recovered. Surface-collected artifacts included five pieces of debitage, three scraper-planes, three flake scrapers, a hammerstone, two manos, four ground stone fragments, and two metate fragments. The site was again described as a plant processing station. RMW personnel (Bissell 1988) re-surveyed the site and concluded that the site had been adequately mitigated. GandA personnel revisited the site (Van Bueren et al. 1988) and revised the site area to 80 x 35 meters to include an additional deposit of metate fragments, bowl or mortar fragments, debitage, a chopper, and a mano. ARMC personnel monitored during pipeline/road construction and recovered a flake tool, two scrapers, two metate fragments, a complete metate, and a mano fragment (Julien and Demcak 1993). GandA personnel conducted a test program on the site that consisted of the excavation of 14 shovel test pits (STP's) and a surface collection. Site boundaries were extended to 80 x 120 meters. Only two artifacts (flakes) were recovered, both from the surface. As in the previous test/salvage of the site, no subsurface deposit was found. The site was determined to have limited data potential (Romani 1997) and therefore would not be NRHP eligible. The recent field check by ARMC personnel did not discover any artifacts at the site.

CA-ORA-1043 was recorded by ARMC in 1984 as a small, habitation site with a well-developed midden containing shellfish, chipped and ground stone tools. Testing in 1986 by a field school from Saddleback College under the direction of Dr. Patricia Martz yielded additional information. Their excavation uncovered a deep midden (130 cm) with two stratigraphically defined components. Recovered items from five 1x2-meter units included numerous flakes (obsidian among others), chipped stone tools, charcoal, and fire-affected rocks. During boundary testing by ARMC (Demcak and Del Chario 1989) 78 auger holes (24-cm diameter) and one 1x2-meter test pit were excavated. As a result the site area was revised to 6050 square meters. Recovery from the auger holes included shellfish remains, burnt mammal bones, 100 pieces of debitage, a utilized flake, two scrapers, a core tool, as well as two fragments of the same schist pestle, and a ground stone fragment. Subsequent data recovery in the right-of-way for the South County Pipeline (Jones et al. 1995) produced radiocarbon dates and obsidian hydration measurements that bracket site occupation from A.D. 1050 and the 19th century. The midden was continuous and reached a depth of 150 cm. The site was interpreted as a Late Period semi-permanent or permanent village. The site was determined to be NRHP eligible in a formal review process. Human remains were encountered during pipeline construction monitoring at the site. Following a Native American ceremony the remains were reburied nearby.

CA-ORA-880 was recorded by ARMC in 1980 as a thin scatter (100 x 40 meters) of chipped stone artifacts (two hammerstones, two cores, two flakes). A subsequent test of the site (Demcak and Velechovsky 1996) and the recent field check did not uncover any artifacts. This site lacks any research potential and does not qualify for the National Register.

CA-ORA-881 was recorded by ARMC in 1980 as a scatter (300 x 100 meters) of milling stone assemblage artifacts. Artifacts included five metate fragments, two manos, three hammerstones, and chipping waste. A subsequent test by ARMC (Demcak and Velechovsky 1996) uncovered a diverse group of chipped and ground stone artifacts but with no subsurface deposit. The site was determined to be NRHP ineligible. The site has been severely impacted as predicted by the construction of Antonio Parkway. Only the extreme southeasterly portion of the site remains intact. The recent field check produced one biface fragment (collected).

CA-ORA-882 was recorded by ARMC in 1980 as a flake scatter consisting of one flake and two utilized flakes. The area could not be determined due to heavy vegetation. During the Chiquita Canyon Water Reclamation Project (Demcak and Van Wormer 1987) the site was tested/salvaged in the right-of-way. The site was found to extend downslope to the south across Narrow Canyon to a small terrace. This terrace area and the road bed were surface collected and five 1x1-meter units were excavated to a maximum depth of 200 cm. Recovered items included debitage, two Late Period arrowpoints, three flake tools, asphaltum, shellfish, faunal remains (terrestrial and marine). A hearth feature was recorded and dated by shell and bone to A.D. 1750± 70 and A.D. 1460± 60, respectively. Additional samples from the same level of another unit produced dates of A.D. 1710 ± 60 and A.D.1670± 70. The site is interpreted as a small, Late Period base camp. The site possesses considerable research potential and is considered eligible for the National Register. The recent field check revealed only one chalcedony flake on the surface.

CA-ORA-902 was recorded by ARMC in 1980 as a small lithic scatter consisting of chipped stone and ground stone tools with a possible midden. The site was tested by ARMC in connection with the Antonio Parkway alignment (Demcak and Velechovsky 1996) and produced only debitage, waste flakes and cores, and no subsurface deposit. The site was determined to lack research potential, and thus it does not qualify for the National Register. The recent field check revealed no artifacts at this location.

CA-ORA-27 was recorded initially by Romero in 1935 and officially recorded in 1949. The site was described as being part of Camp 26 (CA-ORA-26). ARMC personnel updated the site survey record in 1980 as a substantial scatter of milllingstone assemblage artifacts and a small amount of abalone shell. Metate fragments, manos, hammerstones, cores and flakes were observed there. Three loci (A-C) were delineated: Locus A – original site area north of Ortega and adjacent to Rancho Mission Viejo headquarters; Locus B – smaller area south of Ortega; and Locus C – area along dirt road at end of orange grove west of Locus A. Loci A and B were tested by ARMC (Cottrell 1985). Locus C could not be relocated. Recovery from the ARMC surface collection at Locus A included 16 manos, 6 metate fragments, one pestle fragment, four ground stone fragments, 10 utilized flakes, 17 flake tools, 66 core tools,1348 flakes and 27 cores. Three 1x1-meter test pits produced only three tools and 34 pieces of debitage. No midden was present. Maximum depth of the units was 30 cm below datum. Locus B (Cottrell 1985) produced more than 150 surface artifacts. Two excavation units produced minimal recovery (five flakes); a third was more productive, yielding a metate fragment, mano, chopper, two cores, and four flakes from a maximum deposit of 30 cm. Caltrans archaeologists also tested the site and concluded from their field investigations that CA-ORA-27 may have been a base camp with several activity areas that had been disturbed since the 1930s by various activities such as road building and agriculture (Romani et al. 1987). The research potential of the site has been exhausted as a result of these multiple investigations. CA-ORA-27 would not be eligible for the National Register. The recent field check did not disclose any cultural items at this site.

CA-ORA-26 was recorded by Romero in 1935 and officially recorded in 1949. ARI (Schuster 1977a) updated the site record to indicate that the site was heavily disturbed and to report a wide scatter of ground stone artifacts south of Ortega Highway at the margins of the lemon groves on site. ARMC updated the site record in 1980 and delineated three loci: Locus A – main site area; Locus B – small knoll located due east of main area; and Locus C – small possible quarrying area located on upper knoll southeast of site. Caltrans personnel (Romani et al. 1986) updated the site record during testing of the site area south of Ortega Highway. They concluded that the northern part of the site had been substantially destroyed as a result of nursery operations and that only the southern remnant was partially intact. They described the site as a possible extensive base camp, seasonal village or processing location related to a major village in the area (Romani et al. 1986). Based upon the minimal recovery from their field investigations, they concluded that Locus A lacked research potential and integrity and that it would not qualify for the National Register. ARMC conducted a test of the western edge of Locus A (Demcak and Velechovsky 1996). The recovery from surface finds and excavation units was very limited. The deposit was found to be heavily disturbed. ARMC agreed with the Caltrans evaluation that Locus A lacked integrity and failed to qualify for the National Register. GandA personnel (Toren 1997) tested Locus B and recovered a single surface artifact, a core. They also tested Locus C and recovered a few pieces of debitage. They concluded that both loci possessed little data potential and thus would not be NHRP eligible. A recent field check of CA-ORA-26 did not disclose any cultural items.

CA-ORA-29 (Mission Vieja) was recorded in 1935 by Romero and officially recorded in 1949. Romero concluded that this was the site of the old San Juan Mission. He also reported: "The original burial grounds used by the Indians located on top of the mesa 500' N of the Mission" Romero 1949). This has been labeled Locus B of the site (Demcak et al. 1986). This locus is actually northeast of the site and has been destroyed by nursery operations. Historic accounts link the site with one of the campsites of the Portolá Expedition (Sleeper 1985; Meadows 1965; Smith 1965) and with a later adobe (Sleeper 1985; Smith 1985). Meadows (1966) reports that the adobe was a mission outpost dating to circa 1800. Sleeper (1985) says it may have been a mission outpost or home of the majordomo. Muñoz (1980) asserts that the site is most likely associated with early ranching rather than mission-period developments. On various visits to the site and on the recent field survey, ARMC personnel have sighted roof tile fragments, brick fragments, glass, and historic ceramics. On the most recent field check, ARMC surveyors noted that the site has been capped with fill dirt except for the elevated area nearest the creek.

CA-ORA-1048 was recorded by ARMC personnel in 1984 as a milling stone scatter of moderate density, consisting of scraper planes, flakes, core, manos, a large metate fragment, and fire-affected rock. Depth was unknown. ARMC subsequently tested the site (Demcak and Del Chario 1989) and salvaged in the right-of-way for the South County Pipeline (Jones et al. 1995). The site contained an extensive scatter (23,200 square meters) of ground stone and chipped stone artifacts and debitage along with four discoidals, two from the same subsurface feature. Excavated depth was a maximum of 60 cm below datum. A second activity area, Locus B, was delineated south of the ranch road that bisects the site. The site appeared to be a base camp where a wide range of activities occurred, including ceremonial activities as evidenced by the discoidals. The site was determined to be NRHP eligible in a formal review process. On a recent field check by ARMC, the ground had been freshly disced and surveyors noted seven metate fragments, eight manos or fragments, nine core tools, three flakes, a hammerstone, and a fragmentary discoidal. The discoidal was roughly 80% complete, consisting of three fragments. The pieces were collected and mapped.

CA-ORA-1049 and **CA-ORA-1050** were recorded by ARMC in 1984 on the same survey as was CA-ORA-1048. Artifacts were observed over a wide area, artificially separated by a small drainage; therefore three site numbers were generated. In reality only one continuous scatter or site (CA-ORA-1048) ever existed. There are presently no artifacts at the recorded locations for the other two sites and none was noted when CA-ORA-1048 was tested and salvaged by ARMC (Demcak and Del Chario 1989; Jones et al. 1995). Neither of these recorded sites has any research potential. They do not qualify for the National Register of Historic Places.

CA-ORA-1121 was recorded by RMW Paleo Associates (Bissell 1988) as a midden deposit encompassing 5600 square meters. They noted that the midden might be in excess of one meter in depth. They observed debitage, flake and core tools, metate fragments, and manos. ARMC personnel tested and salvaged the site (Demcak and Del Chario 1989; Jones et al. 1995) and found an intact and well-developed midden soil, a diverse assemblage of ground stone and chipped stone tools, and other evidence of a prehistoric base camp that was occupied into the historic period. Pottery and a glass trade bead were also recovered. The site was determined to be NRHP eligible in a formal review process. Monitoring during construction of the South County Pipeline (Julien and Demcak 1993) resulted in the recovery of a very late Sonoran-style arrowpoint, flake and core tools. The monitor also mapped a hearth feature from which were recovered utilized flakes, two choppers, a biface tip, core scraper, perforator, spokeshave, flake scraper, and a modified flake. A recent field check by ARMC personnel revealed a whole pestle (collected) at the site.

CA-ORA-1106 was recorded by ARMC in 1986 as a large (30 x 100 meters) lithic scatter of chipped and ground stone artifacts. The site was tested by GandA (Toren 1997) who enlarged the site boundaries to 20 x 230 meters. Surface finds numbered 15 and included hammerstones, a core, mano, ground stone fragment, flakes and shatter. There was no subsurface component. The site was determined to have very limited research potential that was exhausted with the test phase. Thus the site would not be NRHP eligible. A recent field check of the freshly-disced site by ARMC surveyors revealed a moderate scatter of chipped and ground stone tools. They included four manos, four metate fragments, two flakes, a core tool, and scraper-plane.

CA-ORA-1104 was recorded by ARMC in 1986 as a small lithic scatter (10 x 20 meters) that consisted of chipped and ground stone artifacts. Five flakes and a mano fragment were observed. The recent field check did not disclose any artifacts at this site.

CA-ORA-1105 was recorded by ARMC in 1986 as a small lithic scatter (20 x 20 meters) consisting of two core-scrapers, a small mano fragment, a ground stone fragment, and fire-affected rock. A recent field check by ARMC personnel did not disclose any cultural items.

Two new sites, CA-ORA-1562 and –1563, as well as two isolated artifacts (30-100334 and 30-100335) were recorded during the recent survey by ARMC personnel. They are described below. See Confidential Appendix for site locations and site survey records.

30-176631 is an historic site located adjacent to Ortega Highway. It is a telephone switching station dating to World War II. The station, built during wartime, is camouflaged as a house of Modified Colonial style. The house has a facade of what appears to be colored concrete blocks with brick inside. It has 1½ stories with false windows, vented on the ground floor and completely bricked in elsewhere, and wooden shutters with no hinges. A wooden outhouse, missing its door, adjoins the house on the west. The structure is currently operated by Pacific Bell and is surrounded by a chain link fence. Walkways surrounding the structure are of more recent age, according to Steven Van Wormer, historian (pers. comm.).

CA-ORA-1562 is a moderate scatter of ground and chipped stone tools and debitage on the east side of Chiquita Canyon. Ground visibility was excellent due to recent discing. The site is interpreted as a small base camp dating to the pre-late to late period in prehistory due to the presence of a pestle. The scatter also includes three fragmentary metates, two mano fragments, a hammerstone, a flake, two flake tools, a core, chopper, and scraper-plane. The site area is an estimated 20 m E/W x 15 m N/S. It is found on the 520' – 540' contours. Depth is unknown.

CA-ORA-1563 is a sparse lithic scatter consisting of three hammerstones, a hammer-abrader, two flakes, a flake scraper, two cores, a mano fragment, and a scraper-plane. The site measures 100 m E/W x 25 m N/S. It occupies the 400' – 420 ' contours on a SW/NE trending knoll on the east side of Chiquita Canyon. It appears to be a chipping station. Depth is unknown.

Two isolated artifacts were recorded during the ARMC survey. **30-100334** is a granitic bifacial mano fragment. The fragment measured 11 x 3 x 5 cm. It was found near the bottom of a ridgeline on the eastern side of Chiquita Canyon just to the northeast of Area B of CA-ORA-997. **R30-100335** is a small (5 x 4.5 x 3 cm) metasedimentary scraper-plane. It was found on a ranch road near the top of an easterly-trending knoll and west of the ridgeline of Gobernadora Canyon.

<u>Segment 3. Gobernadora Canyon and Eastern San Juan Creek</u>

Five prehistoric sites had already been recorded in this area: CA-ORA-984, -1122, -1123, -1123, and -535. Four additional sites were recorded during the ARMC survey: CA-ORA-1564, -1565, -1566, and historic site 30-176632.

CA-ORA-984 was recorded by ARMC in 1981 during a survey of the southern portion of Coto de Caza (Jertberg 1981). The light scatter measured 20 x 30 meters and included a whole metate, flakes, a chopper, hammerstone, and a biface fragment. The site is located at 805' in elevation. A subsequent field check and site update (Allen et al. 1992) recorded mano fragments, a hammerstone, chopper, and flakes. During the most recent ARMC field check, surveyors observed a mano fragment, core tool, core fragment, and flake. Artifacts were visible in the road only.

CA-ORA-1446 is recorded as a light scatter of ground and chipped stone tools (Van Bueren et al. 1988). Artifacts included a metate, two manos/fragments, a chopper, core, and flakes. The site measured 93 m E/W x 121 m N/S at an elevation of 400' – 440' above mean sea level. On the recent ARMC field check no artifacts were observed. Surface visibility was very good.

CA-ORA-1122 was recorded by RMW Paleo Associates (Bissell 1988) as an 80 x 60-meter scatter of flakes and cores. A field check by ARMC (Demcak and Del Chario 1989) did not reveal any cultural items. The most recent ARMC field check again found no cultural items.

CA-ORA-1123 was recorded by RMW (Bissell 1988) as a light scatter of chipping waste, cores, mano, and metate fragment. The site area was as estimated 35 x 20 meters. The site was recorded on the 280' contour. The site was tested by ARMC (Demcak and Del Chario 1989). A surface collection included five utilized flakes, a chopper, a core tool, and nine flakes. Recovery from the two 1x1-meter test units included four utilized flakes, 22 flakes, a mano, and a metate fragment. Maximum depth was 50 cm below datum. A few fragments of shell (unidentified clam) and bone (cottontail, jack rabbit, and boney fish) were also recovered sub-surface, along with a few flecks of charcoal. The site was interpreted as a satellite camp of one of the larger habitation sites along San Juan Creek. A flake scraper was recovered from the site during monitoring for construction of the South County Pipeline (Julien and Demcak 1993).

CA-ORA-535 was recorded by Weaver (1976) as a small scatter of six basalt flakes and one core. The site area was estimated as 50 square meters. The site was located on the 380' contour. During the recent field check by ARMC, surveyors did not observe any artifacts at this location.

Four new sites were recorded in this area: CA-ORA-1564, -1565, -1566, and historic site 30-176632.

CA-ORA-1564 is a light scatter of ground and chipped stone tools on the east side of Gobernadora Canyon. The tools include three scraper-planes, a metate fragment, a flake, three mano fragments, a hammerstone, and a ground stone fragment. The site measures 100 m SE/NW x 60 m SW/NE and occupies the 600' – 620' contours. It is a probable plant processing station. A ranch road cuts through the site on the northwest.

30-176632 is a moderate scatter of historic items in two concentrations: 1) bricks, lumber, metal, and fence post; and 2) three fragments of farm equipment. Piles of cobbles and bricks may be a feature, such as a firepit or possibly a burial. The site measures approximately 80 m NE/SW x 10 m SE/NW. It is located to the east of CA-ORA-1564 in a narrow drainage at 560' – 580' in elevation.

CA-ORA-1565 is a light scatter of ground and chipped stone tools on the east side of Gobernadora Canyon. The scatter consists of three scraper-planes, two manos/fragments, four large metate fragments, a bedrock (boulder) metate or grinding slick, a hammerstone fragment, core, and ground stone fragment. This extensive scatter occupies an area 280 m SW/NE x 140 m NW/SE at an elevation of from 480' – 500' above mean sea level. It is a probably a plant processing station. Depth of the deposit is unknown.

CA-ORA-1566 is a probable plant processing station measuring 60 m E/W x 10 m N/S at an elevation of from 560' – 580' mean sea level. This light scatter of ground and chipped stone artifacts includes six manos/fragments, a metate fragment, flake tool, and a hammer-abrader. A ranch road cuts through the south side of the site. Depth could not be determined.

<u>Segment 4. La Pata Drive to Trampas Canyon Road</u>

Eight prehistoric sites were previously recorded in this project segment: CA-ORA-28, -653, -654, -655, -656, -657, -658, and -1102. One new prehistoric site was recorded during the recent field survey: CA-ORA-1567.

CA-ORA-28 was recorded by Romero in 1935 and officially recorded in 1949 as a large site with plenty of water and other resources. The site record was updated by ARI in 1977 (Schuster 1977b). The surveyors were unable to inspect the site due to the construction of a private residence at the location. The survey team concluded that the construction of the house and roads had destroyed the site. A recent field check by ARMC confirmed that the site had been completely destroyed by the house's construction. Richard J. O'Neill (pers. comm.), its owner, does not recall seeing an archaeological site at the time of construction in 1959. The site now lacks research potential and integrity. It does not qualify for the National Register. The recent ARMC field check did not uncover any artifacts at the site location.

CA-ORA-653 was recorded by A. Peak in 1973 as a scatter of indeterminate area (possibly 200' x 300') south of Ortega Highway and east of a sand operation, then Owens-Illinois. A single mano and volcanic flakes were noted. The recorder noted that the site had been heavily damaged by bulldozing. On a recent field check by ARMC, surveyors confirmed that the site had been bulldozed. Piles of dirt surrounded the recorded site area. No artifacts were sighted.

CA-ORA-654 was recorded by A. Peak in 1973 as a small (30' x 80') scatter of core tools, manos, and flakes on a ridge overlooking Trampas Canyon. The recorder noted that some midden was present and suggested that it was probably an occasional use site. The recent field check by ARMC personnel failed to locate any artifacts at this location.

CA-ORA-655 was recorded by A. Peak in 1973 as a small (30' x 50'), open site with core tools, flake scrapers, and a possible mano. It was interpreted as a probable occasional use site. The recent field check by ARMC personnel failed to discover any artifacts.

CA-ORA-656 was recorded in 1973 by A. Peak as a large, deep shell midden measuring 800' x 200'. Flakes, cores, and core tools were observed on the surface. Caltrans archaeologists re-surveyed the site in 1985 and estimated the site's depth at 100 cm and its area as 200 x 90 m. The site was subsequently tested by Caltrans (Romani et al. 1986) for the proposed widening of Ortega Highway (SR 74). At that time, the site had already been impacted by the construction of Ortega Highway, Trampas Canyon Road, and by a haul road on the west. The extent of modern damage is, however, relatively minor, even now. The test at the site revealed a large, multi-component site totaling 14,520 square meters with a maximum depth of 120 cm. The two components were found to be stratigraphically distinct. The upper component contained sparse remains of a Late Prehistoric occupation that included arrowpoints and pottery. The assemblage from the upper component suggests a temporary or seasonal camp for hunting or plant processing. The lower component indicates a more intensive occupation as evidenced by greater frequencies of artifacts and ecofacts, the presence of a well-developed midden soil, and far greater frequencies of fire-affected rocks. A radiocarbon date of 915±80 years B.P. (before present) and thermoluminescence dates 540±40 and 730±70 years B.P. suggest an Intermediate Period occupation for the lower component. The large numbers of fire-affected rocks suggested a sweat lodge to Caltrans archaeologists (Romani et al. 1986). A human cremation consisting of several burnt skull fragments was uncovered in the lower component in an excavation unit on the north side of Ortega Highway. The site was determined to be NRHP eligible in a formal process of review (John Romani, pers. comm.). ARMC personnel conducted boundary testing on the eastern edge of the site in connection with the South County Pipeline (Demcak and Del Chario 1989). Recovery from a 1x2-meter test pit (maximum depth of 90 cm), auger holes, and a test trench included a whole basket-hopper mortar with asphaltum attached, 32 flakes, one flake tool, one core tool, and one biface. Charcoal from the 40 – 50 cm level of the test pit resulted in a radiocarbon date of A.D. 1720±80. A few ecofacts (bone and shell fragments) were also recovered. Some modern debris (glass, asphalt, and wood) was present in the test trench. A recent field by ARMC failed to locate any artifacts or ecofacts at the site.

CA-ORA-657 was recorded by A. Peak in 1973 as a ridge top site west of the Owens-Illinois sand operation, now the Ogleby Norton Industrial Sands Company. A small (15' x 20') scatter of one core tool and one flake, it was interpreted as a probable occasional use site. The recent field check by ARMC failed to discover any artifacts at this location. The area has been bulldozed, perhaps for fire control. Dirt piles ring the recorded site area.

CA-ORA-658 was recorded by A. Peak in 1973 on the basis of one core tool. There was no evidence of a midden (occupational detritus mixed with soil). The site was interpreted as a campsite. ARMC field personnel found no evidence of this site in a recent field check.

CA-ORA-1102 was recorded by Caltrans archaeologists (Romani et al. 1986). The recorded scatter consisted of ground stone artifacts (manos and metates), flakes, and core tools. The site measured 200 x 40 m. Testing consisted of a surface collection and excavation of seven 1 x 0.5 m units. The units revealed a cultural deposit no deeper than 70 cm. The site was not considered NRHP eligible. The recent field check by ARMC did not reveal any artifacts at this location.

One new prehistoric site was recorded in this area: CA-ORA-1567. **CA-ORA-1567** is a light scatter of ground and chipped stone tools and debitage. The site is found in and along a graded road just south of the recorded location of CA-ORA-28 and was probably associated with that site. Artifacts at CA-ORA-1567 consist of three core tools, a whole mano, a mano fragment, and a flake.

Segment 5. Cristianitos, Talega, Blind, Gabino, and La Paz Canyons

CA-ORA-1103 was recorded by Caltrans (Romani et al. 1986) as a sparse scatter of manos, metates, flakes, pottery, core tools, and arrowpoint, along with a few fragments of bone and shell. The site was tested by Caltrans and revealed a cultural deposit from 20 - 40 cm in depth. The site was not considered NRHP eligible. The recent field check by ARMC did not reveal any artifacts or ecofacts at this site location.

CA-ORA-1111 was recorded by Caltrans personnel (Romani et al. 1986) as a light scatter of flakes and core fragments in a graded road. The artifacts included a hammerstone, mano fragment, three core fragments, and two flakes. The area of the site could not be determined. The ARMC field crew did not see any artifacts at this location during a recent field check.

CA-ORA-535 was recorded by Weaver (1976) as a small (50 m^2) scatter of flakes and cores along both sides of Ortega Highway (SR 74) at the entrance to Caspers Regional Park. The site had been largely destroyed. On a recent field check by ARMC, surveyors noted a few flakes at this location.

CA-ORA-1222 was recorded by RMW (Brown 1989) as a small (20 x 20 m) scatter of flakes, scrapers, and a drill. A field check and test by GandA (Romani et al. 1997) revealed a much more extensive deposit, some 220 x 185 m. Surface finds included five manos, a biface, core tool, and ground stone fragment, as well as two metates and 21 flakes. Shovel test pits (STP's) and excavation units revealed a maximum subsurface deposit of 70 cm. No diagnostic artifacts were recovered. Two obsidian flakes were found but were not submitted for sourcing or hydration band measurements. No organic materials were recovered from the deposit. The site was interpreted as a short-term camp used for lithic production and seed processing. The site was determined to be NRHP eligible in a formal review process. The field check by ARMC personnel turned up only one mano on this site; however, four additional sites were recorded (CA-ORA-1550, -1554, -1555, and -1556) in the vicinity of CA-ORA-1222 and are likely associated with it.

CA-ORA-1124 was recorded as an apparent quarry area (Bissell 1988). The recorded scatter consisted of flakes and cores. The recent field check by ARMC located a few flakes and cores on this site.

CA-ORA-1125 was recorded (Bissell 1988) as a scatter (80 x 70 meters) of flakes, cores, a metate, and flake tools with an estimated depth of 40 cm. ARMC subsequently conducted a test/data recovery program in the right-of-way for the South County Pipeline (Demcak and Del Chario 1989). The recovered items included a metate fragment and whole mano, as well as nine flakes, a chopper, scraper-plane, core tool, flake tool, and utilized flake. GandA (Toren et al. 1997) further evaluated the site and extended its boundaries to a total area of 200 x 90 m. They recorded a maximum depth of 70 cm for the cultural deposit. Three manos, a core/hammerstone, and flakes were recovered. GandA investigators considered the site's research potential to be high and recommended testing for NRHP significance. On the recent ARMC field check surveyors noted a few flakes at this location.

CA-ORA-1452/1126 are the same resource. An RMW (Bissell 1988) crew recorded CA-ORA-1126 as a small (50 x 50 m) temporary or seasonal camp with an approximate depth of 30 cm. The scatter included flakes, cores, a manos, and flake tools. Upon review of the location of Locus C of that site (Jones and Demcak 1991), GandA personnel concluded that it was the same as the southern portion of CA-ORA-1452 (Sorensen et al. 1988). The total area encompasses 21,565m^2. A test program at the combined site revealed a maximum depth of 50 cm for cultural material. Fifteen metate fragments, four manos, a discoidal, ground stone fragment, hammerstone, six cores, five core tools, four utilized flakes, and 54 flakes were recovered. The site was determined to be NRHP ineligible in a formal review process. ARMC surveyors saw no artifacts at this location during the recent field check.

CA-ORA-1021 was recorded by ARMC personnel in 1983 as a small (10 x 15 meters) specialized campsite consisting of 15 – 20 flakes and a scraper-plane. Hatheway and KcKenna personnel (McKenna et al. 1988) field checked the site, extended its area to 100 x 100 meters, and observed two metates, four manos, three hammerstones, 11 pieces of debitage, and eight cores/tools. The ARMC field crew during the recent field check relocated the resource. The site has been severely disturbed by the cutting of an erosion control ditch and by flooding. A pipeline has now been installed along the road (old jeep trail) that bisects the site. Three flakes were observed on site.

CA-ORA-1023 and CA-ORA-1024 are now mapped as the same resource. Both were recorded by ARMC in 1983 as small lithic scatters. CA-ORA-1023 measured 70 x 30 meters, consisting of a scraper-plane, core fragments, 10 flakes, and two fire-affected rocks. CA-ORA-1024 encompassed only 5 x 5 meters and consisted of nine flakes, a core, and fire-affected rocks. Hatheway and McKenna (McKenna1 et al. 1988) field checked the sites, combined them as a continuous scatter, and recalculated the total area as 470 x 170 meters. They observed 12 flakes, two manos, 11 fire-affected rocks, five hammerstones, and three cores/tools. They also noted a possible hearth in the center of the site. ARMC surveyors in a recent field check of the site observed a few flakes at this location.

CA-ORA-921 and CA-ORA-1127 are currently mapped as one site. CA-ORA-921 was recorded by ARMC (1980) as a large scatter (estimated 250 x 150 meters) that included pottery, shell, animal bone, chipping waste, and fire-affected rocks in a midden deposit. Depth was estimated at 40 – 50 cm. A possible hearth was observed in a bank cut by Cristianitos Creek approximately three meters down from the bluff top. The midden was buried beneath a lighter-colored soil. RMW (Bissell 1988) field checked the site. They estimated site area as 125 x 90 meters. Apparently a flood had essentially destroyed the site. RMW (Bissell 1988) also recorded a new site, CA-ORA-1127, as a small (50 x 50 meters) specialty use area. The artifacts recorded were flakes, cores, and flake tools. ARMC conducted a limited test (surface collection, STP's, and surface scrape) in the area. The crew recovered flakes, a flake tool, utilized flake, hammer-chopper, plano-convex scraper/chopper, and a potsherd from the surface. Most of the STP's were sterile; the remainder produced small amounts of shell, bone, and fire-affected rocks. The large surface scrape produced 12 shell fragments. While monitoring during construction, ARMC discovered two buried cultural deposits between the two sites in an area thought to be culturally sterile, and thereby demonstrating that the two sites formed a continuous deposit. Two deeply buried hearths were encountered. The first hearth lay 4.5 m below datum and produced a radiocarbon date of A.D.1040±70. The second lay at 1.5 m below datum and yielded a radiocarbon date of A.D. 1720±70. A third sample from float material yielded a date of A.D. 1300±70. An additional sample from a deposit that included charcoal, flakes, fish bone, and shell yielded a radiocarbon date of A.D. 1300±90. Other artifacts collected during monitoring included a hammer/chopper, utilized flake, two manos, two metate fragments, one mortar, one potsherd, and a bone awl (Jones and Demcak 1991). GandA tested the site (Romani et al. 1997) and estimated the site boundaries as 315 x 140 meters. GandA archaeologists conducted an intensive surface survey and surface scrapes, excavated STP's, performed augering, and then mechanical trenching to create block exposures. A series of 2x2-m units was excavated. One revealed a cairn feature that overlay a human cranium fragment and distal end of a radius. The human remains and overlying cairn were reburied after a Native American ceremony. Depending on the route alignment of the Foothill Corridor, the remains will be left undisturbed or relocated. The GandA investigations uncovered two cultural strata, upper and lower, and resulted in the recovery of several diagnostic items, including Olivella saucer beads, potsherds, projectile points, and a pestle. Radiocarbon samples yielded dates of 590±90 B.P. and 1430±60 B.P. (Romani et al. 1997). The site was determined to be NRHP eligible in a formal review process. No artifacts were observed by ARMC surveyors during the recent field check.

CA-ORA-913 was recorded by ARMC (1980) as a light scatter of flakes, cores, and core tools. It encompassed an area of 50 x 75 meters. Depth was indeterminate. An update by Hatheway & McKenna (McKenna et al. 1988) noted three flake tools and one flake at this location. The recent field check by ARMC found one flake.

CA-ORA-916 was recorded by ARMC in 1980 as a lithic scatter measuring 200 x 75 meters. Artifacts included large flake tools, cores, and hammerstones. Hatheway and McKenna (McKenna et al. 1988) field checked the site and expanded the site size to 400 x 200 meters. They recorded fire-affected rocks, flaked lithics, and a possible hammerstone. Mooney and Associates (Shackley et al. 1989) tested the site and recovered only 13 artifacts. They concluded that the site lacked sufficient research potential to necessitate a data recovery program. GandA personnel were not aware of the previous testing since the report was not submitted to the SCCIC at UCLA, and conducted a test of the site (Romani et al. 1997). The testing produced one ground stone fragment,19 flakes, a cobble tool, a few fragments of animal bone, and shell. The site was determined to be NRHP ineligible in a formal review process. The recent field check by ARMC revealed that the site has been largely (estimated 70%) graded away by home construction and by the realignment of the TRW access road.

CA-ORA-1185 was recorded by Hatheway and McKenna (McKenna et al. 1988) as a relatively extensive scatter of ground and chipped stone items. Area was estimated as 100 x 70 meters. Depth could not be determined. Artifacts included a metate, mano/hammerstone, fire-affected rock, seven cores/tools, and a flake. ARMC surveyors observed a few flakes at this site location.

CA-ORA-1450 was recorded by GandA (Van Bueren et al. 1988) during a survey for the Foothill Transportation Corridor. The area of the lithic scatter was estimated as 68 x 60 meters. Depth was unknown. Artifacts included six flakes and a chopper. ARMC crew members saw no artifacts at this location during the recent field check.

CA-ORA-362 was recorded by Riddell (1972a) as a scatter of approximately 100 x 50'. Artifacts included one core and some flakes. ARMC field checked the site during a survey of the Talega property (Cooley and Cottrell 1980). On a re-survey of the Talega acreage Hatheway and McKenna (McKenna et al. 1988) observed a mano, two metates, a hammerstone, 22 flakes, seven core tools, and fire-affected rock at this location. They estimated the site area as 173 x 77 meters. Depth was unknown. GandA (Toren et al. 1997) conducted a boundary test of the site. They judged that the site was smaller or possibly farther to the south than indicated by Hatheway and McKenna. Subsurface depth reached 40 cm in one of the test STP's. Two flakes were observed on site during the recent ARMC field check.

CA-ORA-363 was recorded by Riddell (1972b) on the basis of two scraper-planes and a core hammer that were collected in the field. It was described as an apparent limited and special use area. Area was estimated as 150' in diameter with a possibility of slight depth. ARMC field checked the site (Cooley and Cottrell 1980) and found scrapers, cores, a mano, and flake tools. Area was estimated as 50 x 75 meters with at least a depth of 30 cm. Hatheway and McKenna (McKenna et al. 1988) also field checked the site and observed flakes, cores, and possibly core tools. They increased the area estimate to 190 x 140 meters. They noted considerable disturbance from graded roads through the site. GandA (Toren et al. 1988) observed 13 artifacts on a surface re-survey of the site. They included eight flakes, three cores, and two core-hammerstones. STP's revealed a subsurface deposit to 60 cm (flakes and cores). Site area was recalculated as 160 x 80 meters. ARMC surveyors noted two cores and three flakes at this location during the recent field check of this site. They also noted that the site has been mostly graded away.

CA-ORA-1449 was recorded by GandA (Sorensen et al. 1988). The site was described as a light scatter of debitage and tools. The artifacts included two drills or awls, three choppers, and a mano. The site is interpreted as a possible hunting camp. Size was estimated as 190 x 170 meters with an unknown depth. ARMC personnel observed flakes and a core at this location during the recent field check of the site.

CA-SDI-5925 was recorded by Hatley (1978a) as a 20 x 20-meter medium intensity scatter of about 25 flakes. Raw materials were varied (rhyolite, andesite, felsite, and basalt). A few bone fragments were also sighted. No artifacts were noted at this location by ARMC surveyors during the recent field check.

CA-SDI-5926 was recorded by Hatley (1978b) as a moderately intense lithic scatter. Site area was estimated as 50 x 40 meters with unknown depth. Artifacts included 500 flakes, three cores, five scrapers, and three retouched tools. He noted some erosion of the site. ASM personnel (Victorino 1997) found only four flake fragments at this location in a field check of the site. ARMC surveyors found no artifacts during the recent field check of the site. The site may have been washed away.

CA-SDI-9571 was recorded by Van Wormer (1981) as a lithic scatter consisting of seven flakes. Neither the area nor the depth of the site could be determined. A recent field check by ARMC found no artifacts at this location.

CA-ORA-753 was recorded by Breece et al. (1978) as a small lithic scatter (40 x 25 meters) consisting of two metate fragments and assorted debitage. Depth could not be determined. A recent field check by ARMC failed to relocate the site.

CA-ORA-754 was recorded by Breece et al. (1978) as small lithic scatter (15 x 10 meters) that consisted of a mano, hammerstone, and assorted debitage. Depth was unknown. Surveyors from ARMC field checked the site recently and found a few flakes at this location.

CA-ORA-1448 was recorded by GandA (Sorensen et al. 1988) as a light to moderate scatter of ground stone tools and debitage measuring 245 x 105 meters. Depth was estimated as roughly 70 cm. Artifacts included a discoidal, mano, several cores, a unifacial tool, and debitage. A recent ARMC field check revealed that the site is now south of Corral Road since the road was re-routed. Several flakes and cores were noted at the site.

CA-ORA-1132 was recorded by RMW (Bissell 1988) as a light scatter of chipped stone consisting of cores, flakes, flake and core tools. Area was estimated as 10 x 20 meters of unknown depth. The recent field check by ARMC revealed several flakes and cores at the site.

CA-ORA-1133 was recorded by RMW (Bissell 1988) as a dense scatter of ground and chipped stone artifacts. The site measured 130 x 90 meters. Depth was estimated to be 40 or 50 cm. Artifacts included manos, metates, cores, flakes, flake and core tools, and hammerstones. The RMW crew noted a cairn consisting of unmodified stones, chipped and ground stone tools and fragments. The ARMC crew recently field checked the site and found many flakes and cores on site.

CA-ORA-1134 was recorded by RMW (Bissell 1988) as a dense scatter of chipped and ground stone tools. The site measured 125 x 75 meters. Site depth was estimated as 40 or 50 cm. Artifacts included manos, metates, flakes, cores, flake and core tools, and hammerstones. Two cairns (unmodified stones, ground and chipped stones) were noted. ARMC surveyors recently field checked the site and noted an extensive scatter of ground and chipped stone tools, cores and flakes. The site area has been redefined as 400 x 15 meters; depth appears to be roughly 50 cm. A ranch road with erosion channels cuts through the site.

CA-ORA-1135 was recorded by RMW (Bissell 1988) as a light scatter of chipped and ground stone tools, a possible seed processing camp. Artifacts included a deep basin metate, and a few flakes and cores. ARMC surveyors recently field checked the site and found the metate and a few flakes.

CA-ORA-1136 was recorded by RMW (Bissell 1988) as a light scatter of chipped and ground stone artifacts over a 50 x 40-meter area. Depth was not determined. A recent field check by ARMC surveyors failed to find any evidence of a site at this location.

CA-ORA-1137 was recorded by RMW (Bissell 1988) as a small (100 x 55 meters) scatter of chipped stone. Depth was not determined. Artifacts consisted of flakes and cores only. ARMC surveyors recently field checked the site and noted a few flakes.

CA-ORA-1138 was recorded by RMW (Bissell 1988) as a small scatter (20 x 45 meters) of chipped stone tools, flakes and cores. Depth was not determined. ARMC surveyors recently field checked the site and noted a few flakes and cores at this location.

CA-ORA-1139 was recorded by RMW (Bissell 1988) as a small (20 x 45 meters) scatter of chipped and ground stone tools and debitage. Depth was estimated as 20 or 30 cm. Artifacts included a mano, flakes, cores, and flake tools. ARMC surveyors recently field checked the site and noted a few flakes and a flake tool.

CA-ORA-1140 was recorded by RMW (Bissell 1988) as a small (35 x 50 meters) scatter of chipped stone tools and debitage. Depth was estimated as 20 or 30 cm. Artifacts included flakes, cores, and flake tools. ARMC surveyors recently field checked the site and noted a few flakes and one core.

CA-ORA-1141 was recorded by RMW (Bissell 1988) as a small (55 x 50 meters) scatter of chipped stone tools and debitage. Depth was estimated to be 20 or 30 cm. Artifacts included flakes, cores, and flake tools. ARMC surveyors recently field checked the site and noted a flake, a core, and two utilized flakes.

CA-ORA-1142 was recorded by RMW (Bissell 1988) as a small (30 x 35 meters) scatter of chipped stone tools and debitage. Depth was estimated to be 20 or 30 cm. Artifacts included flakes, cores, and flake tools. ARMC surveyors recently field checked the site and noted one flake at this location.

CA-ORA-1143 was recorded by RMW (Bissell 1988) as a small (30 x 35 meters) scatter of flakes and cores. Depth was not determined. ARMC surveyors recently field checked the site and noted two flakes at this site location.

CA-ORA-1144 was recorded by RMW (Bissell 1988) as a large (300 x 135 meters) scatter of ground and chipped stone tools, debitage, and fire-affected rocks in and around a Rancho Mission Viejo metal corral. Depth of the midden was estimated to be 50 cm. Artifacts included flakes, cores, flake tools, and manos. GandA tested the site (Romani et al. 1997). The site area was calculated to be 270 x 240 meters. The deposit was 90 cm deep at its maximum. The field crew carried out a surface collection and surface scrapes, and excavated 23 STP's and five test units. The area inside the corral was surface collected but not excavated due to the Ranch's concern for possible injuries to cattle. Based upon their recovery outside the corral, GandA archaeologists concluded that the site lacked the research potential for inclusion in the National Register of Historic Places. During a recent field check ARMC surveyors observed over 80 flakes, three cores, a mano, two metate fragments, and a hammerstone, all within the internal corral area at the site. Grass cover limited visibility elsewhere on the recorded site area.

At recorded location **120004** the ARMC survey team could not detect any cultural activity. This record from the SCCIC did not provide any specific information as to the item/feature recorded. The field check did not find a site at the given location.

Ten new prehistoric sites (CA-ORA-1550, -1551, -1552, -1553, -1554, -1555, -1556, -1557, -1558, and RMV-15) and three historic site (33-176633, RMV-13/H, and RMV-14/H) were recently recorded in this portion of the Project 2000 survey.

CA-ORA-1550 is a light scatter of ground stone tools and debitage located at the head of Cristianitos Canyon on the west. The site measures approximately 50 x 30 meters. Depth could not be determined. A seep (spring) and unnamed drainage are present in proximity to the site. Artifacts include two mano fragments, a core, and a discoidal (collected). The site appears to be a limited use area (possibly ceremonial) that is associated with CA-ORA-1222.

CA-ORA-1551 is a moderate scatter of ground stone tools, chipped stone tools and debitage. It is located on the eastern side of Gabino Canyon adjacent to and north of a ranch road gate. The site measures 100 x 50 meters. Depth is unknown. Artifacts include three flakes, three cores, six flake tools, four core tools, 12 scraper-planes, and six manos. The flake and core tools are unusually large for this region. This is a probable plant processing station.

CA-ORA-1552 is an extensive scatter of ground stone tools, chipped stone tools and debitage. The scatter occurs over an area of 300 x 40 meters. The depth is an estimated 30 cm but may be considerably deeper in the dark, well-developed midden area of the site. The site is located in upper Gabino Canyon near a spring. A modern pond, 1930s water trough, and metal water tank are found on the southwestern end of the site. Artifacts include over 100 flakes, 26 flake tools, a mano, a pestle, three cores, 24 core tools, six scraper-planes, and fire-affected rocks. This appears to be a base camp, or village, where stone tool production was a major activity.

CA-ORA-1553 is a light scatter of ground stone tools, chipped stone tools and debitage. The site measures 75 x 20 meters. Depth could not be determined. The site is located in upper Gabino Canyon on a ridgetop west of the modern pond and CA-ORA-1552. Artifacts include a whole metate (shallow basin), two flake tools, three core scrapers, a mano, and two flakes. This is a probable plant processing station associated with CA-ORA-1552 to the east.

CA-ORA-1554 is a light scatter of ground stone tools, and chipped stone tools and debitage. The scatter measures some 400 x 15 meters and is located along a ridgeline in upper Cristianitos Canyon. Depth could not be determined. Artifacts include two manos, two metate fragments, two flake tools, four hammerstones, nine flakes, one scraper-plane, and a small Cottonwood triangular projectile point.

CA-ORA-1555 is a light to moderate scatter of ground stone tools, chipped stone tools and debitage. The site measures 80 x 60 meters. Depth is unknown. Artifacts include two flake tools, one metate fragment, seven flakes, two scraper-planes, three manos, one drill/reamer, one ground stone fragment (possible pestle). The site is located in upper Cristianitos Canyon north of the ranch road split. It is a probable base camp associated with CA-ORA-1222 immediately to the south.

CA-ORA-1556 is a light to moderate scatter of ground stone tools, chipped stone tools and debitage. The site encompasses approximately 100 x 30 meters. Depth could not be determined. Artifacts include eight metate fragments, two scraper-planes, one hammerstone, a core, three flakes, and three manos (one a possible discoidal). The site is located on a south-easterly trending knoll in upper Cristianitos Canyon and is a possible satellite camp associated with CA-ORA-1222 to the north.

CA-ORA-1557 is a light scatter of ground stone tools, chipped stone tools and debitage over an area of approximately 70 x 30 meters. Depth could not be determined. The site is located in upper Gabino Canyon between two small drainages. A ranch road bisects the site. Artifacts include two scraper-planes, seven flakes, a mano, and a core. This appears to be a plant processing station.

CA-ORA-1558 is a light scatter of ground stone tools, chipped stone tools and debitage. Area of the site is 100 x 50 meters. Depth is unknown. The site is located on a knoll above the western bank of La Paz Canyon Creek. A dirt access road runs along the western boundary of the site. Artifacts include two mano fragments, four flake tools, one metate fragment, two hammerstones, eighteen flakes, and a core. The site is a probable plant processing station.

RMV-15 is a light scatter of chipped stone tools and debitage. Artifacts include two scraper planes, a flake tool, a chopper, and six flakes. Site area is an estimated 30 x 10 meters. Depth could not be determined. The site is found on the TRW leased property west of an unnamed drainage and north and east of the confluence of Talega Creek and Cristianitos Creek. It is a probable plant processing station.

Three historic sites were also recorded in this area: 30-176633, RMV-13/H, and RMV-14/H.

Site No. **30-176633** is an historic scatter consisting of a wood and metal wagon, possible derrick segment, and assorted pieces of lumber on a knoll south of and adjacent to Gabino Canyon Creek. A large clay pit is located immediately down slope and is presently filled with water, forming a freshwater marsh habitat. The wagon, fabricated from old wagon parts and 1900 – 1930's auto and truck parts (Stephen Van Wormer, pers. comm.), is held fast by a toyon bush. See cover photo.

RMV-13H is a military bunker associated with Camp Pendleton, whose northern boundary is located 450 meters to the south of this structure. The structure is found on a small knoll north and east of the confluence of Talega Creek and Cristianitos Creek and on leased land occupied by the TRW Capistrano Test Site. The concrete building has wooden roof and wall supports. The concrete blocks have been poured and roughly finished. Imprints from the wooden forms are clearly visible on the blocks. The structure stands 3.5 m high, 2.5 m wide, and 4.5 m long. The walls are 22 cm thick. Sentry openings are cut into the walls facing to the NW and SE. Graffiti from the 1950s and 1960s are scattered along the interior walls. A few rusted tin cans are also present along with a wooden frame that may have been part of a field telephone installation. The word “Tel” appears on the NW wall near the entrance, and “62-MU-1” appears in larger letters on the rear wall.

RMV-14/H is a military bunker associated with Camp Pendleton to the south. It is found on a small knoll on the leased land occupied by the TRW Capistrano Test Site. The building is constructed of concrete blocks, poured and roughly finished. Graffiti date to the 1940s. The earliest date is 1944, two years after the first troops arrived at Camp Pendleton (Reddy 2000). The structure measures 2.3 m high, 5.05 m long, and 1.95 m wide, with walls 22 cm thick. The expresssion “62-M-U2” appears on the rear wall of the structure. A wooden frame with hooks attached and colored numbers below the hooks is fastened to one wall. There is a large opening to the NE, and smaller slit openings to the east and west.

FIELD SURVEY: HISTORICAL ITEMS

The survey team found a number of historical items on the Rancho Plan survey. These items date to various time periods and reflect different uses of ranch land. They are described below in two groups: Ranch Water Systems and Corrals (windmills, water troughs, water tanks, corrals), and Recent Historic Camps (Campfire Ring/Gobernadora Canyon, Amantes Camp, Portolá Camp, Campfire Rings and Flagpole/Upper Gabino Canyon). None of these items would be NRHP eligible. Although certain of the items (> 45 years of age) could have been recorded as historic isolates, we used a simplified recording mechanism. The following description and recording of their locations we feel will serve as adequate recordation of these historical items. See Figure 2 (rear map pocket) for locations.

Ranch Water Systems and Corrals

Windmills, water troughs, and water tanks were installed and put into use on Rancho Mission Viejo as early as the 1930s. Corrals and chutes for handling cattle were also added. They are described individually below.

R-1: Windmill and water trough. The windmill tower is missing its blades. A metal water trough on a concrete foundation lies adjacent to the tower on the southeast. The float mechanism is still attached. The unit is no longer in service. These items are located in upper Chiquita Canyon.

R-2: Windmill, Holding Pen/chute, and Watering Troughs. The wood and metal windmill is collapsed on its side although otherwise intact. Two metal watering troughs and a metal corral/chute are also present but no longer in service. This group of historic items is located in central Chiquita Canyon immediately south of Tesoro High School.

R-3: Water Trough. This is a metal water trough installed along the fence line at the mouth of Narrow Canyon. The unit is intact and continues to supply water.

R-4: Water Tank, Pond, and Water Trough. This group of historic items includes a rectangular pumping station and water storage tank. This concrete tank was built in the 1930s. Its construction is identical to that of the 1930s concrete water troughs described by Muñoz (1980); the concrete sections are roughly finished with marks of the forms clearly visible. Surrounding the tank is a large fenced pond down slope to the southeast. An abandoned metal water trough rests opposite the other two and down slope across the ranch road to the northeast.

R-5: Water Trough. This concrete trough with intact float and concrete foundation dates to the 1950s. Unlike the 1930s troughs, it has an elevated extension to the basic rectangular trough. This elevated portion holds the wooden protective section above the float. The newer design was probably intended to allow a greater volume of water to flow into the tank; the float rested higher in the structure. The unit is fully functioning. It is found to the east of the ranch road on the eastern side of Gobernadora Canyon.

R-6: Water Trough and Water Tank. The metal trough has a concrete foundation. Two wooden posts that supported the wooden section overlying the float are still present in the concrete. The remains of a collapsed circular, barrel-type water tank on a concrete platform are also present to the north of the trough. The unit is no longer functional. It lies alongside an unnamed tributary drainage to Gobernadora Creek on the eastern side of Gobernadora Canyon and just to the southeast of site CA-ORA-1446.

R-7: Water Trough. This concrete water trough with metal central bars and cobble foundation dates to the 1930s. It is flat in side profile and has beveled corners. A small wooden section protects the float. The concrete is roughly finished with marks of the forms clearly visible. The unit is no longer functioning. The trough is found alongside the ranch road on the eastern side of Gobernadora Canyon near the mouth of the canyon.

R-8: Water Trough. This concrete trough has wooden slabs protecting the float. All features are intact. There is a rectangular poured concrete foundation, very regular in outline compared to platforms at the other troughs. There are no identifying marks on the trough (date, initials, etc.). The shape is 1950s style (flat with inclined section at end). The unit is located immediately east of La Pata Drive and just north of the ranch road and a small drainage.

R-9: Water Trough. This concrete water trough is still functioning. The initials "C.B.", "C.M.", and "P.h".and the date "9-20-50" appear on its face. The basin is made of concrete reinforced with rebar. Wooden slats protect the rubber float. It has a concrete foundation. The unit is found immediately adjacent to the ranch road leading E/SE from La Pata Drive.

R-10: Water Tank. This 1930s water tank is made of poured concrete blocks with visible marks of the forms and it is roughly finished. It is nearly identical to the tank located in Chiquita Canyon

(R-4). It is located adjacent to a microwave tower alongside the ranch road on the knolltop east of Trampas Canyon. The area is fenced with barbed wire.

R-11: Water Trough. This concrete trough with concrete foundation is located just downslope and east of R-10. The initials “P.H.”, “C.M.”, and “F.F.5” appear on the face of the trough along with the date “8/25/50”. A brand , a stylized T over an O, also appears on the trough face. This brand was apparently adopted from the shorthorns imported from Texas and Oklahoma to the ranch in 1883 (Sleeper 1985:7).

R-12: Water Trough. This concrete and wooden structure rests on a concrete and cobble foundation. Its construction date (“8/31/50”) and the initials “FF5”, “CM”, and “PH” appear on face of the trough. It is still operational albeit clogged with aquatic plant life. The unit is located just east of the ranch road and just west of the head of Trampas Canyon.

R-13: Water Trough. This concrete structure with wooden protective slats over the float is located west of Trampas Canyon and east of the ranch road. The foundation is concrete with cobbles. It is of 1950s construction although no date appears on it. The unit is fully operational.

R-14: Water Trough and Corral. The concrete trough with wooden protective slats lies on a rough concrete and cobble foundation. It is no longer functioning. The unit is of 1950s construction. The wooden corral is located just northwest of the trough, is in good repair, and appears to be currently used. The two units are found on south of the O’Neill House, or the location of CA-ORA-28.

R-15: Water Tanks. Two circular metal water tanks are found directly up slope to the southeast of the O’Neill House, or CA-ORA-28. One of the tanks is old and rusted, the other new and painted green with white swirls in a camouflage pattern.

R-16: Water Trough. This metal tank with wooden flats protecting the float is located on site CA-ORA-656 at the mouth of Trampas Canyon west of the paved road. Wooden posts and support pieces provide additional protection from cows stepping onto the trough. The trough is fully operational.

R-17: Water Tank, Water Trough, Natural Gas Tank (?). A round rusted water tank and a metal water trough are located adjacent to and north of the ranch road leading to Amantes Camp. A second tank, rocket-shaped, with a pressure gauge is also present.

R-18: Water Trough. This shallow, boat-shaped metal trough is located west of the entrance to Amantes Camp adjacent to and north of the ranch road. A metal screen protects the float on this trough.

R-19: Water Tank. This round, metal water tank is located on a small knoll above Amantes Camp to the south. A dirt road cuts through the Rancho Mission Viejo Cemetery (established 1987) to the tank.

R-20: This metal and wood trough is almost identical to R-16, described above. It is still operating although it is rusted. It is located to the east of the paved road in Christianitos Canyon. Archaeological site CA-ORA-1124 is also recorded at this location. An old, barrel-type water tank is located on the opposite side of the canyon to the west and out of the project area.

R-21: Windmill and Water Trough. This windmill, made by Aermotor Company of Chicago, is fully operational. The concrete trough adjacent has a construction date of "9-18-50" and the initials "C.M., P.H., and J.T." inscribed on its upper surface. The trough foundation is of irregular outline and is made of concrete and cobbles. The trough is no longer functional. It was partially filled with rainwater during the recent field survey. The two items are found at the mouth of Gabino Canyon between the ranch road and the creek at the point where a second dirt road leads up slope to the TRW facility.

R-22: Windmill, Water Trough, Water Tanks, and Well. This windmill, also made by Aermotor Company, bears a plaque with the following inscription: "BAXTER WINDMILL For all who dare to slip the surly bonds of Earth April 1986" followed by six Chinese or Japanese characters (translation not provided). The concrete trough design dates to the 1950s. The foundation is concrete with cobbles. There are two water tanks, a wooden-barrel type and a metal railroad-car type. A well is located beneath the windmill. The whole system continues to operate. These items are located at the confluence of the La Paz and Gabino drainages.

R-23: Windmill and Water Tank Platform. This is a derelict windmill that is being engulfed by the surrounding vegetation. The adjacent structure is a concrete base for a railroad-car type water tank. Just west of these two are remnants of what may have been a frame for a metal water trough. The items are located north of and adjacent to the ranch road in La Paz Canyon.

R-24: Windmill and Water Tanks. The windmill is fully functioning. A wooden barrel-type tank collects the water alongside. A second, railroad-car tank is located uphill to the east. These items are located inside the "Portolá" Camp in central Gabino Canyon. See C-2 for a description of the other historical items at this location.

R-25: Water Trough, Tank Platform, and Corral. The concrete water trough bears the date "4/11/35" and the number "№ 108-A". It rests on a cobble/concrete foundation. The metal poles and cables of the surrounding metal corral partly overlie the trough and make it possible for cattle to drink from inside or outside the corral. Four concrete pads, the platform for a now-absent water tank, are also present. These items are found just west of the ranch road and adjacent to Gabino Canyon Creek.

R-26: Water Trough, Water Tank, and Tank Platform. This concrete water trough bears the date "5.17.35" and several letters that are badly weathered, possibly an unknown followed by "H" and "A". The trough is a typical 1930s design with a flat profile and beveled corners. It is no longer in use. A large metal, railroad-car type tank with a concrete base is also found at this location just up slope to the northeast along with a hexagonal base for a water tank, no longer in place. Metal pipes are also present, perhaps bringing water from the spring recorded at this location or from the pond to the southwest. These items are found in upper Gabino Canyon at the location of newly-recorded site CA-ORA-1552.

R-27: Water Trough. This 1950s-style concrete trough lies on a concrete and cobble foundation of irregular outline. It is still functioning. It is located adjacent to and north of the dirt road that leads into Verdugo Canyon.

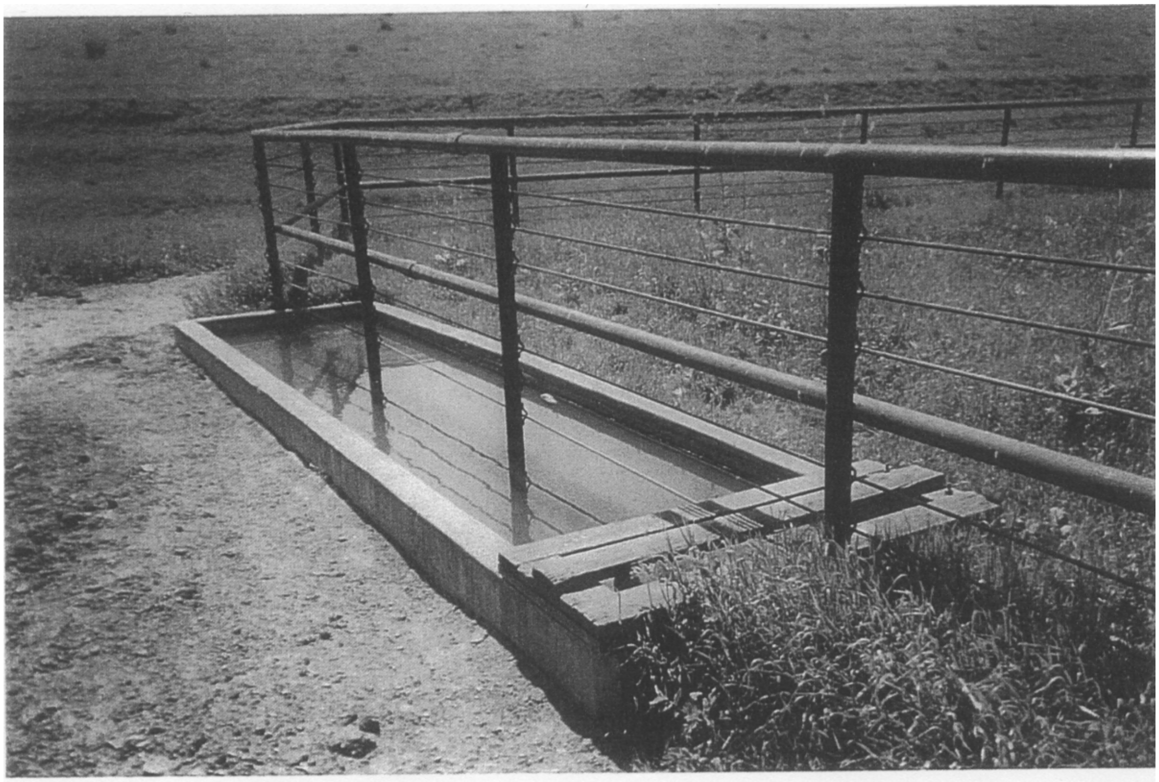

Figure 3. 1930s Water Trough, Upper Gabino Canyon (R-25).

Figure 4. 1930s Water Trough (above) with Number and Date of Installation.

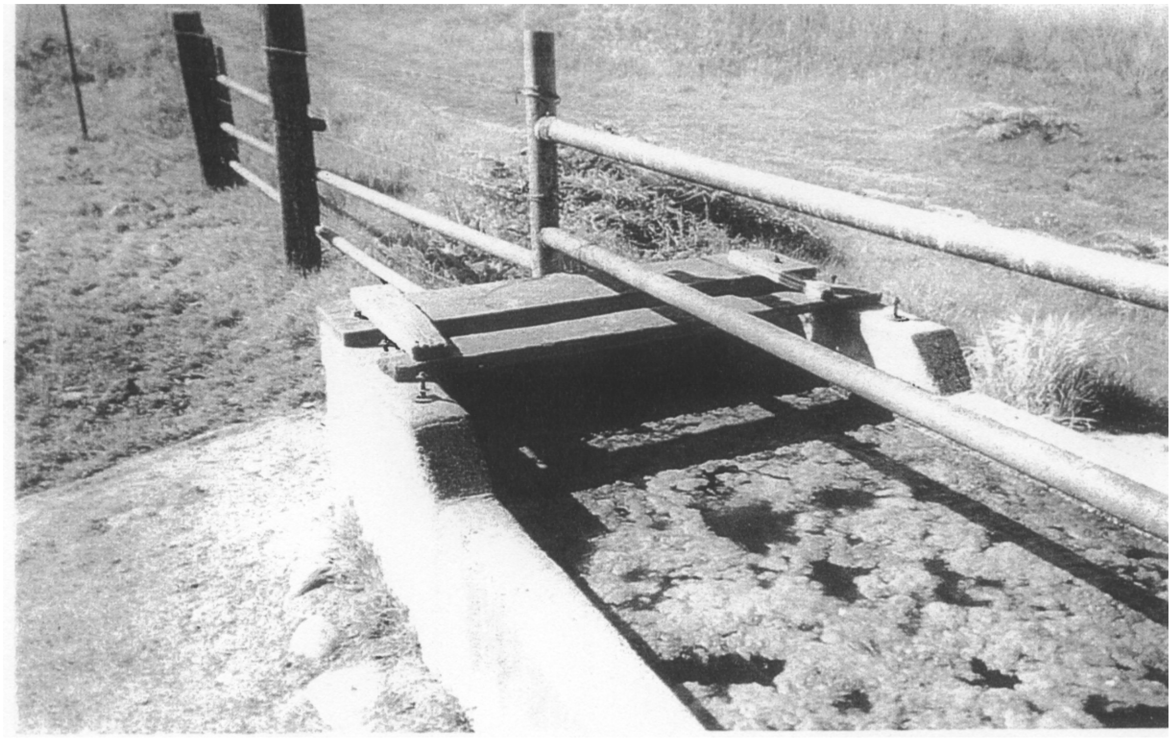

Figure 5. 1950s Water Trough, Trampas Canyon (R-12).

Figure 6. 1950s Water Trough (above) with Installation Date.

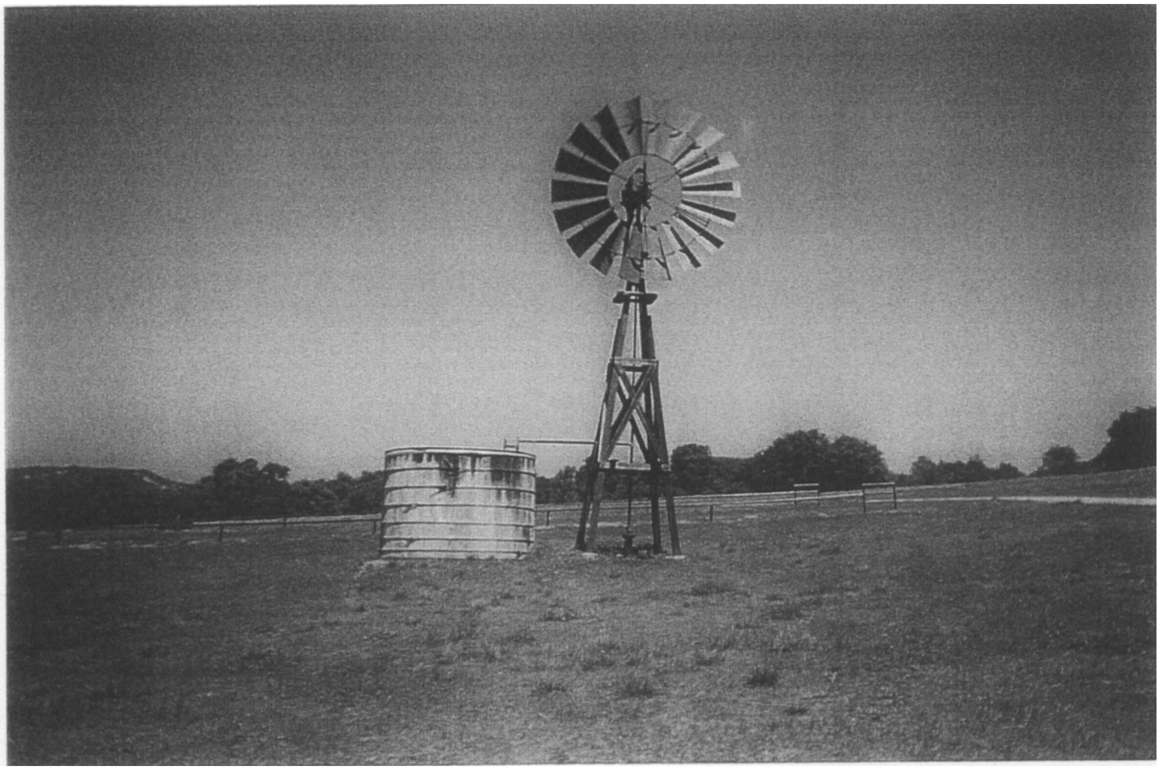

Figure 7. Windmill and Water Tank, Middle Gabino Canyon (R-24, C-3).

Figure 8. 1930s Water Tank, Lower Chiquita Canyon (R-4).

Figure 9. Plaque Dedicated to Founders of "El Viaje de Portolá", Middle Gabino Canyon (C-3).

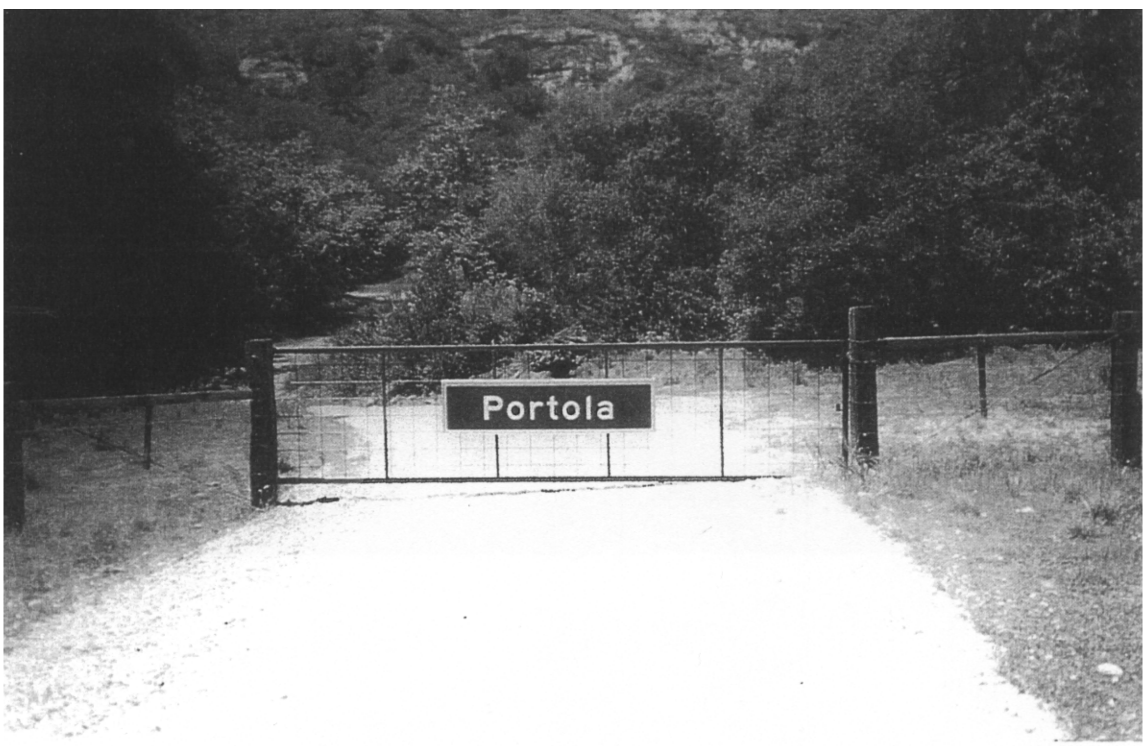

Figure 10. Entrance to "Portolá" Camp, Middle Gabino Canyon (C-3).

R-28: This water tank, fenced in by chain link and barbed wire, lies south of the Santa Margarita Water District pumping station along Ortega Highway. A power line (STA 196-459) passes to the west of the tank.

R-29: Water Troughs. One metal trough lies abandoned, while another is fully functioning in a field south of Ortega Highway.

<u>Recent Historic Camps</u>

C-1: Campfire Ring. This roughly circular (6 x 5 meters) alignment of large rocks, cobble to boulder size, is located in a side canyon east of Gobernadora Creek. A single artifact, a fragment of a green canning jar mouth, was found inside the ring. The configuration suggests a campfire ring perhaps associated with the riders of "El Viaje de Portolá" (see more at C-2, C-3). The rock ring is recent, according to Patrick Forster (pers. comm.). It was not present while his father, Tom Forster, served as Ranch Manager from 1955 - 1965.

C-2: Amantes Camp (Campo de Amantes). This large, modern camp/private park is located along a ranch road that heads east from Trampas Canyon Road. The camp is largely dedicated to activities with the horseback riders that annually retrace the 1769 Portolá expedition through what is now Rancho Mission Viejo. "El Viaje de Portolá" has been recreated each April since 1963. Plaques and an El Camino Real bell pay tribute to O'Neill family members and the annual ride. The bell was dedicated in 1988 and bears the following inscription:

El Viaje de Portolá

They came to California-
A small but hardy band
For God, for King and Viceroy
To claim a fabled land.
Both old Spain and New Spain
Long eyed the northern mystery
But it fell to Don Gaspar
To change the course of history.

C-3: "Portolá" Camp. This camp is located midway up Gabino Canyon on the east side of the drainage. A dirt road leads east from the main canyon road to the camp. This is the second camp dedicated to the annual Portolá ride. Like Amantes Camp (C-2) this campground is well equipped for picnics and other gatherings. A small, one-room log cabin (newly constructed) has been installed at the southwestern edge of the camp near the creek. A corral, windmill, and water tanks (R-18) add to the camp's rustic atmosphere.

C-4: Campfire Rings and Flagpole. This group of historical items is composed of two campfire rings, made up of small to medium cobbles, and a flagpole that is held upright by cobbles at its base. Pieces of firewood are scattered nearby. These items are located just north of C-3 to the east of the ranch road.

NATIVE AMERICAN CONCERNS

The Rancho Mission Viejo survey area is the ancestral home of the Juaneño Band of Mission Indians, or Acjachemem Nation. Thus consultation with the Juaneño Band was part of the scope of work for this project. An ethnohistory was prepared (N.H. Evans, 2000, separate volume). Each group representing the Juaneño community was sent a map of the project area and asked to comment on any concerns they might have regarding Native American resources in the area. Two members of the Juaneño community, David Frietze and Ralph Frietze, served as crew members on the field survey.

The following group representatives received maps and letters regarding these resources:

David Belardes (2/16/00)
Juaneño Band of Mission Indians
31742 Via Belardes
San Juan Capistrano, CA 92675

Sonia and Darrell Johnson (2/16/00)
Juaneño Band of Missions Indians Acjachemem Nation
P.O. Box 25628
Santa Ana, CA 92799

Jean Frietze (3/7/00)
Juaneño Band of Mission Indians, Acjachemem Nation
31877 Del Obispo, Suite 106A
San Juan Capistrano, CA 92675

David Belardes and Joyce Perry contacted ARMC by telephone and through Nancy Evans, the project ethnohistorian. They asked for and received permission to visit the survey area. The author and two ARMC staff members accompanied them on a field trip to the Ranch on Sunday, March 16, 2000. The purpose of the field collaboration was to explore the possible identification of several named historic Juaneño villages with recorded archaeological sites in the study area. See Evans (2000) for a discussion of those possible linkages.

Jean Frietze responded by telephone on several issues. She expressed an interest in obtaining a copy of the survey report and wanted to request that the artifacts from the survey area be turned over to the Juaneño band. She was referred to Laura Eisenberg, Rancho Mission Viejo, to make the requests directly.

Although Sonia and Darrell Johnson were contacted by letter and telephone, ARMC received no feedback from their group.

Future studies on the Ranch will necessarily involve additional contact and consultation with the Juaneño people.

RECOMMENDATIONS

Based upon the results of the records and literature search (Demcak 1999) and field survey, the following are the recommendations for archaeological field investigations at the recorded sites in the project area. They are presented by project segment, beginning in Chiquita Canyon and moving east and south from that point. See Tables 1-5 for summaries.

Upper Chiquita Canyon

Only one site, CA-ORA-877 was previously recorded in this area. Three new sites (CA-ORA-1559, -1560, and –1561) were recorded during the survey. All four sites will need to be tested for NRHP eligibility.

Table 1. Upper Chiquita Canyon: Sites, NRHP Eligibility, and Recommended Actions.

SITE: CA-*	NRHP ELIGIBLE	TESTING NEEDED	DATA RECOVERY NEEDED	MONITORING ONLY NEEDED
ORA-877		X		
ORA-1559*		X		
ORA-1560*		X		
ORA-1561*		X		

* Newly recorded sites

Lower Chiquita Canyon and Western San Juan Creek

Previously recorded sites CA-ORA-29, -1104, -1105, along with new sites CA-ORA-1562, -1563, and historic site 33-176631, will need to be tested for NRHP eligibility. Isolates 30-100334 and 30-100335 should be collected.

Sites CA-ORA-882, -997, -1043, -1048, and –1121 are NRHP eligible and will need to be avoided in future project design or subjected to a data recovery program prior to development. Human remains were found at CA-ORA-1043.

Sites CA-ORA-26, -27, -28, -880, -881, -902, -1042, -1049, -1050, and –1447 are not NRHP eligible and will need only to be monitored during construction if they are to be impacted.

Table 2. Lower Chiquita Canyon and Western San Juan Creek: Sites, NRHP Status, and Recommended Actions.

SITES: CA-	NRHP ELIGIBLE	TEST NEEDED	DATA RECOVERY NEEDED	MONITORING ONLY NEEDED
ORA-877		X		
ORA-1447				X
ORA-997	X		X	
ORA-1042				X
ORA-1043	X		X	
ORA-881				X
ORA-880				X
ORA-882	X		X	
ORA-902				X
ORA-27				X
ORA-26				X
ORA-28				X
ORA-1048	X		X	
ORA-1049				X
ORA-1050				X
ORA-29		X		
ORA-1121	X		X	
ORA-1104		X		
ORA-1105		X		
ORA-1106				X
ORA-1562*		X		
ORA-1563*		X		
33-176631*		X		

* Newly recorded sites

Gobernadora Canyon and Eastern San Juan Creek

Previously recorded sites CA-ORA-984 and –1446, as well as newly recorded sites CA-ORA-1564, -1565, -1566, and historic site 33-176632, will need to be tested for NRHP eligibility.

Sites CA-ORA-1122 and –1123 are not NRHP eligible and will need only to be monitored during construction if project impacts are predicted.

Table 3. Gobernadora Canyon and Eastern San Juan Creek: Sites, NRHP Eligibility, and Recommended Actions.

SITE: CA-	NRHP	TEST NEEDED	DATA	MONITORING

	ELIGIBLE		RECOVERY NEEDED	ONLY NEEDED
ORA-984		X		
ORA-1446		X		
ORA-1122				X
ORA-1123				X
ORA-1564*		X		
ORA-1565*		X		
ORA-1566*		X		
30-176632*		X		

* Newly recorded sites

La Pata Drive to Trampas Canyon Road

Recorded sites CA-ORA-653, -654, -655, -657, -658, -1111, and newly recorded site CA-ORA-1567 will need to be tested for NRHP eligibility.

Site CA-ORA-656 is NRHP eligible and will need to be avoided in project design or subjected to a data recovery program prior to development. Human remains were found at the site.

Site CA-ORA-1102 is not NRHP eligible and will need only to be monitored during construction if impacts are predicted.

Table 4. La Pata Drive to Trampas Canyon Road: Sites, NRHP Eligibility, and Recommended Actions.

SITE: CA-	NRHP ELIGIBLE	TEST NEEDED	DATA RECOVERY NEEDED	MONITORING ONLY NEEDED
ORA-653		X		
ORA-654		X		
ORA-655		X		
ORA-656	X		X	
ORA-657		X		
ORA-658		X		
ORA-1102				X
ORA-1567*		X		

* Newly recorded site

Cristianitos, Talega, Blind, Gabino, and La Paz Canyons

Previously recorded sites CA-ORA-362, -363, -753, -754, -913, -1021, -1023/1024, -1124, -1125, -1132, -1133, -1134, -1135, -1136, -1137, -1138, -1139, -1141, -1142, -1448, -1449, -1450, SDI-

5925, -5926, 9571, as well as newly recorded sites CA-ORA-1550, -1551, -1552, -1553, -1554, -1555, -1556, -1557, -1558, RMV-13/H., RMV-14/H, and RMV-15, will need to be tested for NRHP eligibility.

Sites CA-ORA-921/1127 and –1222 are NRHP eligible and will need to be avoided in project design or subjected to a data recovery program prior to development.

Site CA-ORA-1144 was determined to be NRHP ineligible based upon incomplete testing. An extended test program will be needed for the corral area of the site.

Sites CA-ORA-916, -1103, -and -1452/1126 are not NRHP eligible and will need only to be monitored during construction if impacts are predicted.

Table 5. Cristianitos, Talega, Blind, Gabino, and La Paz Canyons: Sites, NRHP Eligibility, and Recommended Actions.

SITE: CA-	NRHP ELIGIBLE	TEST NEEDED	DATA RECOVERY NEEDED	MONITORING ONLY NEEDED
ORA-1103				X
ORA-1111		X		
ORA-535		X		
ORA-1222	X		X	
ORA-1450		X		
ORA-1124		X		
ORA-1184		X		
ORA-1125		X		
ORA-1185		X		
ORA-1452/1127				X
ORA-1023/1024		X		
ORA-1021		X		
ORA-921/1127			X	
ORA-913		X		
ORA-916				X
ORA-363		X		
ORA-362		X		

Table 5. Cristianitos, Talega, Blind, Gabino, and La Paz Canyons: Sites, NRHP Eligibility, and Recommended Actions (Continued).

SITE: CA-	NRHP ELIGIBLE	TEST NEEDED	DATA RECOVERY NEEDED	MONITORING ONLY NEEDED

SDI-5925		X		
SDI-5926		X		
SDI-9571		X		
ORA-754		X		
ORA-753		X		
ORA-1144		X		
ORA-1448		X		
ORA-1449		X		
ORA-1137		X		
ORA-1138		X		
ORA-1139		X		
ORA-1140		X		
ORA-1141		X		
ORA-1142		X		
ORA-1143		X		
ORA-1132		X		
ORA-1133		X		
ORA-1134		X		
ORA-1135		X		
ORA-1136		X		
ORA-1550*		X		
ORA-1551*		X		
ORA-1552*		X		
ORA-1553*		X		
ORA-1554*		X		
ORA-1555*		X		
ORA-1556*		X		
ORA-1557*		X		
ORA-1558*		X		
RMV-13/H*		X		
RMV-14/H*		X		
RMV-15*		X		

* Newly recorded sites

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REPORT OF PALEONTOLOGICAL RESOURCES SURVEY FOR THE RANCH PLAN, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

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REPORT OF PALEONTOLOGICAL RESOURCES SURVEY FOR THE RANCH PLAN, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

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INTRODUCTION

This report summarizes the results of a paleontological survey for the Ranch Plan, Rancho Mission Viejo, south Orange County, California. Milos Velechovsky, Orange County certified paleontologist, of Archaeological Management Corporation (ARMC) conducted the survey at the request of Laura Eisenberg of Rancho Mission Viejo, L.L.C. The study consisted of a records and literature review, field work, and report preparation. The field work took place between March 21 and April 26, 2000.

According to the California Office of Historic Preservation (1983), fossils are highly sensitive, nonrenewable scientific and educational resources, which in California are protected by the following State and Federal laws:

1. **Federal Antiquities Act of 1906** (P. L. 59-209; 34 Stat. 225, 16 U. S. C. 432, 433). It forbids disturbance of any object of antiquity on federal land without a permit issued by a responsible agency. It also establishes criminal sanctions for unauthorized desecration or appropriation of antiquities.

2. **Historic Sites Act of 1935** (P. L. 74-292; 49 Stat. 666, 16 U. S. C. 461 *et seq*.). It declares a national policy to preserve objects of national significance for public use and gives the Secretary of the Interior broad powers to execute this policy, including criminal sanctions.

3. **Reservoir Salvage Act of 1960** (P. L. 86-523; 74 Stat. 220), as amended 1974 (P. L. 93-921). It requires the Secretary of the Interior to institute a salvage program in connection with federally funded reservoir construction and requires the cooperation of responsible agencies with this program.

4. **National Environmental Policy Act of 1969, NEPA.** (P. L. 91-190; 31 Stat. 852, 42 U.S.C. 4321-4327). It requires important natural aspects of our national heritage to be considered in assessing the environmental consequences of a proposed undertaking.

5. **Archaeological and Historic Preservation Act of 1974** (P. L. 93-291; 88 Stat. 174, U. S. C. 469). It provides for the survey, recovery, and preservation of significant paleontologic data when such data may be destroyed or lost due to a federal, federally licensed, or federally funded project.

6. **California Environmental Quality Act of 1970, CEQA.** (13 Public Resources Code: 21000 *et seq*.) It requires public agencies and private interests to identify the environmental consequences of their proposed projects on any object or site, significant to the scientific annals of California (Division I, Public Resources Code: 5020.1 (b)).

7. **Guidelines for the Implementation of CEQA,** as amended May 10, 1980 (14 California Administrative Code: 15000 *et seq*.) It defines procedures, types of activities, persons, and public agencies required to comply with CEQA and includes

definitions of significant effects to a paleontologic site (Section 15023, Appendix G (j)).

8. **Public Resources Code, Section 5097.5** (Stats. 1965, c. 1136, p. 2792) It defines any unauthorized disturbance or removal of paleontologic remains or sites located on public land as a misdemeanor.

SETTING

The project area covers 36.5 square miles or 94.5 square kilometers and extends on both sides of San Juan Creek and Ortega Highway (Figures 1-7). From San Juan Creek to the north, the property runs 11 km into Cañada Chiquita and 4 km into Cañada Gobernadora. From San Juan Creek, it extends to Talega Canyon and Camp Pendleton in the south and to the Orange County, Riverside County, and San Diego County lines in the east. It covers the area consisting of Trampas, Cristianitos, Gabino, La Paz, Blind, and Talega Canyons.

The survey area covers portions of four USGS 7.5' Quadrangle maps. They include the Cañada Gobernadora, Santiago Peak, San Juan Capistrano, and San Clemente Quadrangles. Table 1 below summarizes the Township-Range-Section data of the study area.

Table 1. Summary of Township-Range-Section data of the survey area.

T6S, R7W, parts of sections 27, 33, and 34
T7S, R7W, parts of sections 3, 4, 9, 10, 14-16, 21-28, and 32-36
T8S, R7W, parts of sections 1-4, 9-13, and 24
T7S, R6W, parts of sections 28-33
T8S, R6W, parts of sections 4-9, and 16-20

RECORDS AND LITERATURE REVIEW

Samuel McLeod of the Los Angeles County Museum of Natural History (LACM), Vertebrate Paleontology Section, carried out a records and literature search. Kathleen C.

Allen and Milos Velechovsky gathered additional information using maps and records housed at ARMC and completed the first portion of the assessment (Allen and Velechovsky 2000). An older record search by Diveley (1994) was also consulted.

According to McLeod (1999), the LACM has no record of any vertebrate localities within the project area. It is important to mention here that many significant vertebrate localities have been discovered within the same formations just outside the survey area.

STRATIGRAPHY

According to Morton and Miller (1981), twelve sedimentary rock units occur in the project area. These rock units ranging in age from Late Cretaceous to Holocene include the Trabuco, Ladd (Baker Canyon Conglomerate), Williams (Schulz Ranch and Pleasants Sandstone Members), Silverado, Santiago, Sespe, Topanga, San Onofre Breccia, Monterey, Capistrano, as well as Quaternary alluvium and colluvium.

PALEONTOLOGY

Trabuco Formation – **Kt**

Sensitivity: low
Stop: 12
Figure: 9

The early Late Cretaceous Trabuco consists of reddish-brown conglomerate and sandstone. This basal unit usually rests on the Santiago Peak Volcanics or the Bedford Canyon Formation. According to Schoellhamer and others (1981), the Trabuco lacks fossils. The Trabuco is relatively rare in the project area. Its outcrop at the head of Gabino Canyon is very poor, but large boulders scattered in the overlying colluvium suggest its presence underground. No fossils were discovered in this formation during the recent field survey.

Ladd Formation – Baker Canyon Member – **Klb**

Sensitivity: moderate
Stops: none
Figures: none

The lower part of the Baker Canyon Member is believed to be of non-marine origin. The rock consists of non-fossiliferous, greenish-gray, poorly bedded conglomerate. The upper part consists of yellow-brown beds of conglomerate and very-coarse sandstone as well as finely laminated sandstone with scattered mollusk shells (Schoellhamer and others, 1981). The Baker Canyon Member, as mapped at the head of Gabino Canyon, does not crop out within the survey area. Only boulders scattered in the overlying colluvium suggest its presence underground. The Baker Canyon Member is very rare in the project area. No fossils were discovered in this formation during the survey.

Williams Formation – Schulz Ranch Member - **Kws**

Sensitivity: moderate
Stops: 9-**11**, 13, 20-23, 59, and 60
Figure: 10

Two members of the Late Cretaceous Williams Formation were studied extensively during the ARMC survey. The Schulz Ranch Member consists of brownish-gray to gray, massive, coarse-grained sandstone and conglomerate. According to Schoellhamer and others (1981), the Schulz Ranch is sparsely fossiliferous. It contains chiefly pelecypods of the shallow marine environment. This unit, occurring mostly in the east and southeast parts of the project area, was studied in ten stops. A large number of trace fossils in this formation was discovered at Stop **11**. This kind of burrowing trace fossil usually occurs in a shallow marine environment.

Williams Formation – Pleasants Sandstone Member - **Kwp**

Sensitivity: high
Stops: 4, **56**, and 61
Figure: 11

The Pleasants Sandstone Member of the Late Cretaceous Williams Formation consists of light-brown to gray, fine-grained marine sandstone and siltstone. Schoellhamer and others (1981) described extensive pelecypod, gastropod, and ammonite faunas from 42 localities in the northern Santa Ana Mountains. Lander (1988) reported additional invertebrates occurring in this unit in the nearby Foothill Transportation Corridor. Morton (1974) lists one invertebrate locality in the northern part of Cristianitos Canyon, which lies within this project area. This unit, occurring mostly in the east and southeast parts of the survey area, was studied in three stops. Many pieces of petrified tree trunks and pelecypod shells were found in this formation at Stop **56,** but the author could not verify the existence of Morton's (1974) locality.

Silverado Formation - **Tsi**

Sensitivity: high
Stops: 3, 6-8, 28, and **29**
Figures: 12-14

According to Morton (1974) and Schoellhamer and others (1981), the Paleocene Silverado Formation consists of interbedded siltstone, sandstone, as well as massive pebble and cobble conglomerates of both marine and terrestrial origin. The mostly marine upper part is brownish-yellow to greenish-gray. The predominantly non-marine lower part includes coarse-grained sandstone, conglomerate, clay, and lignite. The Silverado is a very colorful formation and its outcrops remind the visitor of the Painted Desert of Arizona. Schoellhamer and others (1981) and Lander (1988) reported marine and brackish mollusk assemblages from the Santa Ana Mountains as well as plant remains. This unit, occurring mostly in the east, south, and southeast parts of the survey area was studied in six stops. Pieces of petrified wood were discovered at Stop **29** **(**Figures 13 and 14).

Santiago Formation - **Tsa**

Sensitivity: high
Stops: 1-4, 24–26, 37–51, 53, and 55
Figure: 15

The Eocene Santiago Formation, occurring mostly in the north-central, central, and southern parts of the survey area, was studied extensively during the ARMC survey. Its lower part consists of thin-bedded brown to gray sandstone, sandy siltstone, and conglomerate. The upper part includes white to brownish-yellow, massive coarse-grained sandstone and conglomerate.

Outside our survey area, Schoellhamer and others (1981) reported a diverse marine mollusk fauna from the Santa Ana Mountains. Lander (1988) described several other mollusk occurrences, silicified logs, and a fish locality from the lower part of the Santiago in the vicinity of our survey area. Golz and Lillegraven (1977) listed an extensive assemblage from the nearby San Onofre Canyon, including non-marine fish, lizard, turtle, insectivore, marsupial, rodent, oromerycid, oreodont, protoceratid, hypertragulid, rhinoceros, and primate species.

Within the survey area, Lander (1988) lists silicified logs and a marine vertebrate fauna from a site between Chiquita and Gobernadora Canyons, as well as several sites from within these two canyons. The same author recorded fossil leaves from Gabino Canyon, as well as scaphopods from between Talega and Gabino Canyons. No fossils were found during the recent ARMC file survey at any of the 23 stops where the formation was exposed.

Sespe Formation – **Ts**

Sensitivity: low to moderate
Stops: 30, 31, and 34
Figure: 16

According to Cooper (1980), the non-marine Sespe ranges in age from Late Eocene to Late Oligocene. It consists of coarse sandstone and conglomerate, as well as minor amounts of mudstone. Most of the Sespe in the survey area occurs in upper Chiquita Canyon.

Historically, the Sespe yielded only a few well-documented fossils. Raschke (1984) and Savage and Barnes (1972) reported that several sites in the Santa Ana Mountains produced rare remains of horse, entelodont, camel, and oreodont. Some of these species do not occur elsewhere in California. According to Velechovsky (2000), even the screening of 250 kg random samples of loose sediment failed to produce any fossils. No fossils were discovered in this formation during the survey.

Topanga Formation – **Tt**

Sensitivity: high
Stops: **35** and **36**
Figures: 17 and 18

The shallow marine Topanga Formation is a known fossil producer throughout Orange County. It has yielded a diverse molluscan fauna of Middle Miocene age as well as locally abundant vertebrates such as shark, fish, and marine mammals. The Topanga is poorly exposed in the survey area and makes up less than one percent of its size.

According to Lander (1988), fossil localities in the vicinity of the survey area produced remains of brachiopods, pelecypods, gastropods, sharks, fish, desmostylians, dolphins, whales, turtles, birds, sea lions, and walruses. In addition to the aquatic fossils, it contains Barstovian land mammals, such as horses, camels, deer, and pronghorns. Abundant remains of pelecypods, gastropods, and mammal bone debris were discovered in both stops where the Topanga was exposed.

San Onofre Breccia - **Tso**

Sensitivity: low to moderate
Stops: 15-17, and 33
Figure: 19

The San Onofre Breccia is a coarse, angular deposit derived from the Catalina Schist. This poorly fossiliferous rock unit represents rapidly deposited debris flows. In the study area, Cooper (1980) observed small fragments of whalebone and possible pinniped remains in this formation. The San Onofre Breccia, occurring mostly in the west and north-center parts of the study area, was studied in four stops. No fossils were discovered in this formation during the survey.

Monterey Formation – **Tm**

Sensitivity: high
Stop: **14**
Figure: 20

According to Diveley (1994), the Late Miocene Monterey Formation is a correlative of the Clarendonian North American Land Mammal Age (circa 9 to 12 million years ago). This important, highly fossiliferous lithologic unit consists of gray siltstone, shale, and thin-bedded sandstone. The Monterey occurs in the western part of the survey area and covers less than one percent of it.

The invertebrate specimens frequently occurring in this formation include worms, bryozoans, pelecypods, gastropods, barnacles, and ostracodes. Much more important are remains of aquatic vertebrates such as walruses, sea lions, and whales, as well as fishes and aquatic birds including shearwaters and auks. In addition to animal remains, Lander (1988) also reports algae, leaves, and petrified wood of terrestrial origin. At Stop 14, remains of fish bones and scales, as well as coprolites were discovered.

Capistrano Formation – Siltstone Facies – **Tcs**

Sensitivity: high
Stops: none
Figures: none

According to Diveley (1994), the Late Miocene to Early Pliocene Capistrano Formation, a correlative of the Blancan North American Land Mammal Age (circa 2 to 5 million years ago), is a highly fossiliferous marine deposit. The unit consists of fine sandstone and shale with local limestone concretions, conglomerate, and breccia lenses. The Capistrano Siltstone makes up less than one percent of the survey area, mostly along the western edge of the property.

This deposit yields diverse marine invertebrate and vertebrate faunas. The fossil record for marine invertebrates is not well known. The marine vertebrate fossils include many sharks, such as angel sharks and cow sharks, as well as bat rays, bony fishes, monodontids (beluga/narwhal), baleen whales, dolphins, eared seals, and walruses. Many kinds of sea birds are known from this deposit as well, of which several forms are extinct such as the flightless auk and a species of gannet. In the vicinity of the survey area, Cooper (1980) observed several specimens of whalebone.

Quaternary Non-marine Terrace Deposits – **Qt**

Sensitivity: low to moderate
Stops: 5, 19, 57, and 58
Figure: 21

Late Pleistocene and Holocene alluvial terrace deposits are composed of poorly consolidated gravel and sand. They are quite common in the survey area. Typically, these deposits are poorly fossiliferous, but if they contain fossil remains, these remains can be very important. No fossils were discovered at any of the four stops under investigation during the recent ARMC survey .

Lander (1988) reported an extensive land mammal assemblage including frog, salamander, turtle, lizard, snake, bird, insectivore, ground sloth, rabbit, rodent, dog, weasel, saber-toothed cat, mammoth, horse, camel, deer, pronghorn, and bison. According to Diveley (1994), several important Pleistocene fossil faunas, all of the Rancholabrean North American Land Mammal Age (circa 10,000 to 400,000 years ago), have been recovered in the vicinity of this survey area. These fossils include an extensive and well-studied assemblage of terrestrial animals, many of which are extinct, such as sloth, mammoth, mastodon, camel, horse, bison, birds, and reptiles.

Quaternary Alluvium and Colluvium – **Qac**

Sensitivity: low
Stops: 18, 27, 52, and 54
Figures: 22 and 23

Alluvia and colluvia of mostly Holocene age include soil and slope wash, as well as sand and gravel deposits from creek beds. They may occasionally contain fossil float material derived from older bedrock. No fossils were discovered at any of the four stops under investigation during the recent field survey.

SENSITIVITY

The Natural History Museum of Los Angeles County considers all sedimentary rock units occurring within the survey area to rank high in paleontological sensitivity. According to McLeod (1999):

> Some of the rock units are sparsely fossiliferous, but the known fossils are extremely important. For example, the Ladd Formation contains Late Cretaceous sharks and bony fishes, but has also produced one of the very rare examples of a dinosaur from California. The Paleocene Silverado Formation has produced rare west-coast marine turtles. The Eocene Santiago Formation has produced a diverse assemblage of turtles, crocodiles, and terrestrial mammals. The Oligocene Sespe/Vaqueros undifferentiated Formation has produced an assemblage of mixed terrestrial and marine vertebrates. The Topanga, Monterey, and Capistrano Formations have produced abundant and highly diverse assemblages of marine vertebrates including sharks, bony fishes, sea turtles, sea birds, and marine mammals. Quaternary surface deposits throughout the Los Angeles Basin have produced Late Pleistocene vertebrates such as those found at Rancho La Brea.

Not all paleontologists would agree with ranking all of those formations as high in sensitivity. Large differences certainly exist among the formations in terms of sensitivity. See Table 2 for a summary of differing viewpoints about formations within the project area with regard to sensistivity.

Table 2. Summary of the differing views about formation sensitivities of McLeod (1999) and the author of this report.

	Formation	Sensitivity McLeod (LACM)	Sensitivity Velechovsky (ARMC)
Qac	Alluvium and Colluvium	high	low to moderate
Qt	Quaternary terraces	high	low to moderate
Tcs	Capistrano Formation	high	high
Tm	Monterey Formation	high	high
Tso	San Onofre Breccia	high	low
Tt	Topanga Formation	high	high
Ts	Sespe Formation	high	low to moderate
Tsa	Santiago Formation	high	high
Tsi	Silverado Formation	high	high
Kwp	Pleasants Sandstone Member of the Williams Formation	high	high
Kws	Schulz Ranch Member of the Williams Formation	high	moderate
Klb	Baker Canyon Member of the Ladd Formation	high	moderate
Kt	Trabuco Formation	high	low

See Table 3 for a summary of formation locations and sensitivities by survey areas.

Table 3. Summary of formations and sensitivities by survey areas.

Formation	Sensitivity (Velechovsky)	North	North-central	Central	West	East	South	South-east
Trabuco Formation	Low					X		
Ladd Formation – Baker Cyn. Member	Moderate					X		
Williams Formation – Schulz Ranch Member	Moderate					X	X	X
Williams Formation – Pleasants Sandstone Member	High			X		X	X	X
Silverado Formation	High			X			X	X
Santiago Formation	High		X	X	X	X	X	X
Sespe Formation	Low to Moderate	X	X					
Topanga Formation					X			
San Onofre Breccia	Low to Moderate		X		X			
Monterey Formation	High				X			
Capistrano Formation – Siltstone Facies	High				X			
Quaternary Non-marine Terrace Deposits	Low to Moderate			X		X	X	X
Quaternary Alluvium and Colluvium	Low			X	X		X	

IMPACT ASSESSMENT

Paleontological resources anywhere in the study area could be adversely affected by impacts created by any future ground-disturbing activities. Such activities usually include brush clearing and grading. They might result in the loss of paleontological resources, including important fossil remains or fossil beds due to their removal or covering by fill.

The impact of grading activities on a particular formation is not simply a function of its sensitivity. The size of the area the formation covers is also important. In general, the impact increases with the size of the area. An otherwise poorly fossiliferous formation is more likely to have niches of increased fossil density if traced over a larger area. The following statements reflect the expected impact of future grading activities on individual formations.

The impact on the **Trabuco Formation** by future grading activities is likely to be low. This is due to a combination of its low sensitivity and the small area that it covers.

The impact on the **Baker Canyon Member** of the **Ladd Formation** is also likely to be low. Its sensitivity is moderate, but its extent is so small that future grading activities might even miss it.

The **Schulz Ranch Member** of the **Williams Formation** is likely to be affected to a large extent. Its sensitivity is only moderate, but the area it covers is so large that future grading activities are more likely to expose new important fossil sites.

The **Pleasants Sandstone Member** of the **Williams Formation** is also very likely to be affected significantly by future grading. This is due to a combination of a high sensitivity and the large area that it covers.

The **Silverado** and **Santiago Formations** are likely to be affected significantly for the same reasons.

The sensitivity of the **Sespe Formation** is low to moderate at best. However, due to its large extent, it is likely that significant fossils could be discovered during extensive grading activities. This formation could be then affected to a larger degree than its sensitivity alone would indicate.

The impact on the **Topanga Formation** could be very high, despite its small size. The Topanga in the survey area crops out as an oyster bank, which is even more sensitive than the rest of the Topanga. Any excavation in this formation in the survey area should be done with utmost care.

The sensitivity of the **San Onofre Breccia** is low and it covers a relatively small area. Usually, it occurs on mountaintops and it seems likely that any grading impact would be small.

The **Monterey Formation** covers only a very small part of the survey area. Due to its high sensitivity, the impact on this formation could be high as well. Just like the Topanga, this formation should be excavated under the strictest monitoring procedures.

The **Capistrano Formation** is of high sensitivity and but covers only a small area. When the grading activity reaches this formation, its impact could be very high and strict monitoring procedures must be applied immediately.

The **Quaternary Terrace Deposits** occur throughout the survey area but their extent is only moderate. Due to their low to moderate sensitivity, the impact of grading is expected to be moderate as well.

The sensitivity of the **Alluvium** and **Colluvium** deposits is low to moderate. They cover large parts of the survey area, so there is an increased chance of finding new fossil sites.

RECOMMENDATIONS

The survey area contains 12 formations of variable sensitivity with respect to paleontological resources. Any future grading operations are likely to encounter one or more highly sensitive formations. For that reason, a grading monitoring program is recommended for all such future projects. A monitoring program should follow Orange County guidelines. It should consist of observing grading activities, salvaging, and cataloging of fossils, and should be supervised by a County-certified paleontologist. The paleontologist should attend all pre-grading conferences and set forth the procedures to be followed during the monitoring program. Recovered fossils should be offered to the County of Orange, or its designee, on a first refusal basis.

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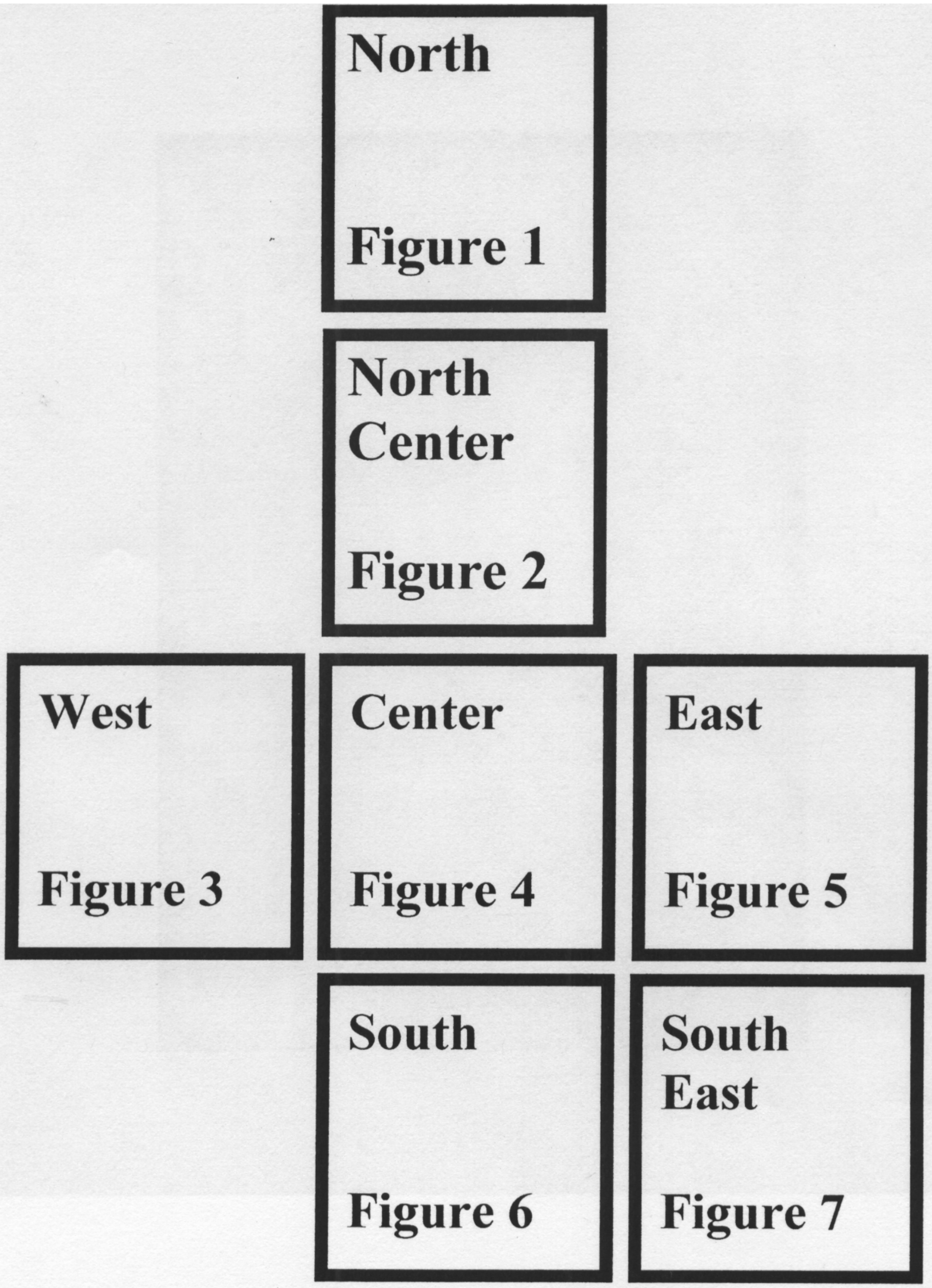

This diagram shows the relative positions of maps from Figures 1 to 7. Overlaps exist among all seven Figures.

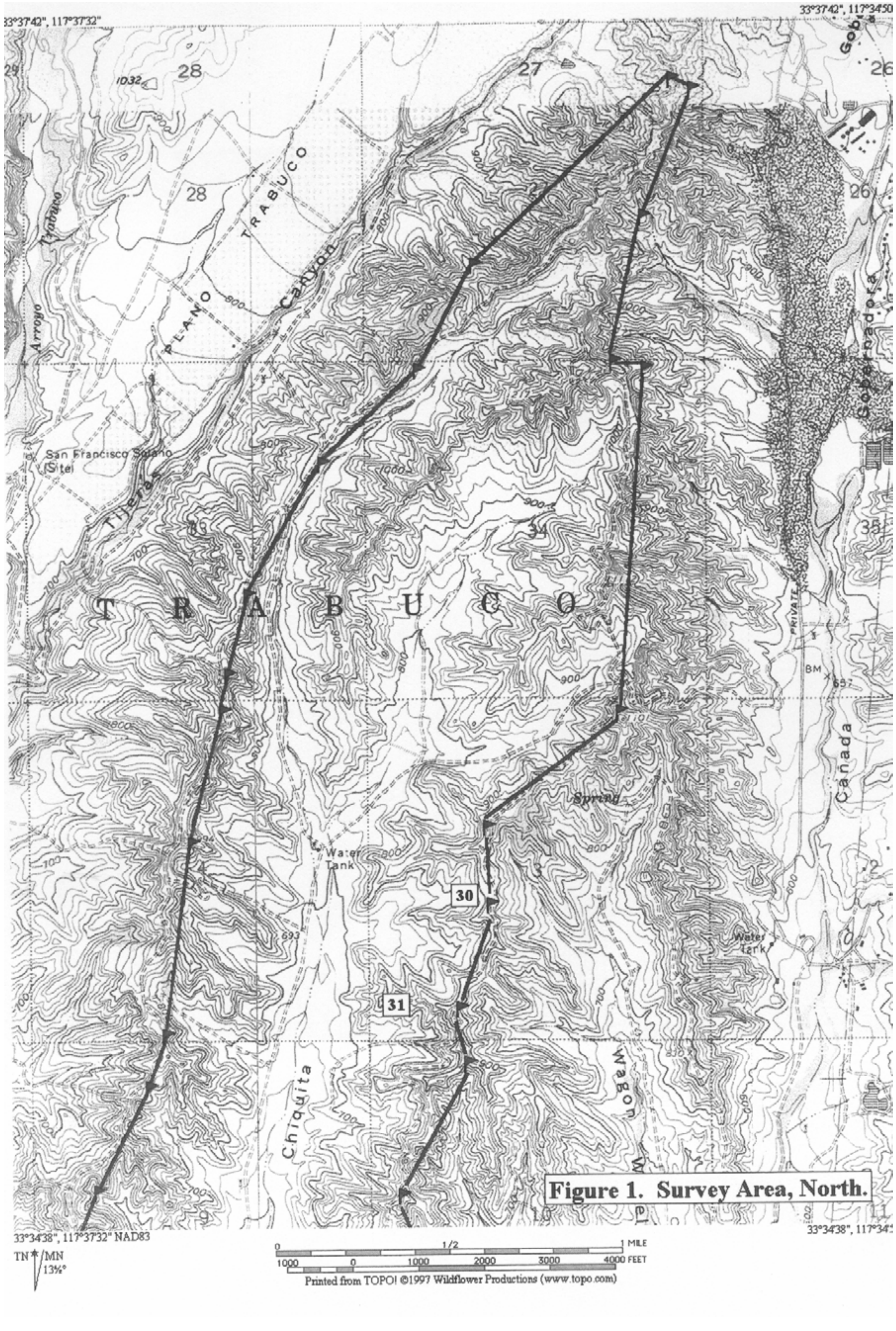

Figure 1. Survey Area, North.

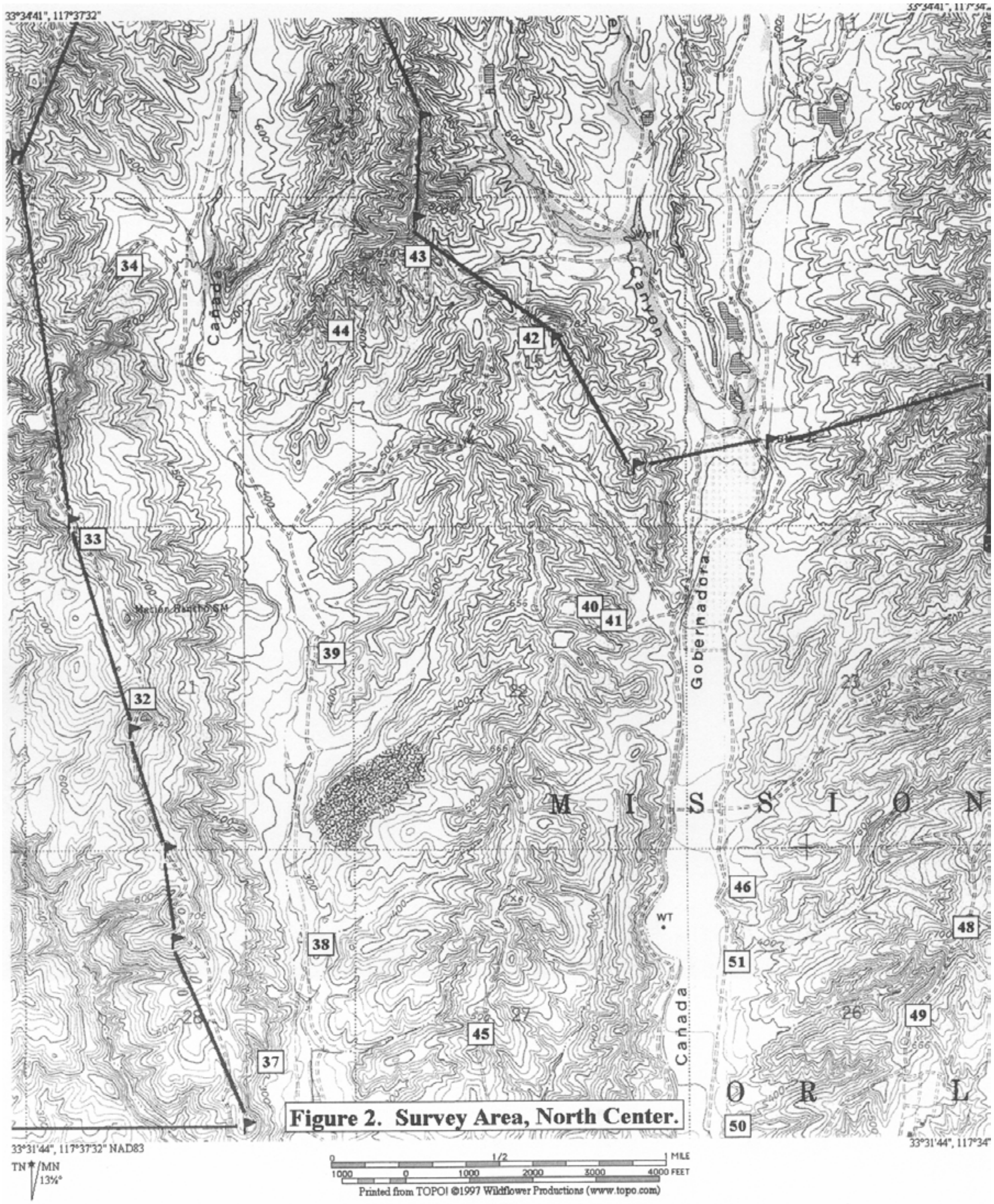

Figure 2. Survey Area, North Center.

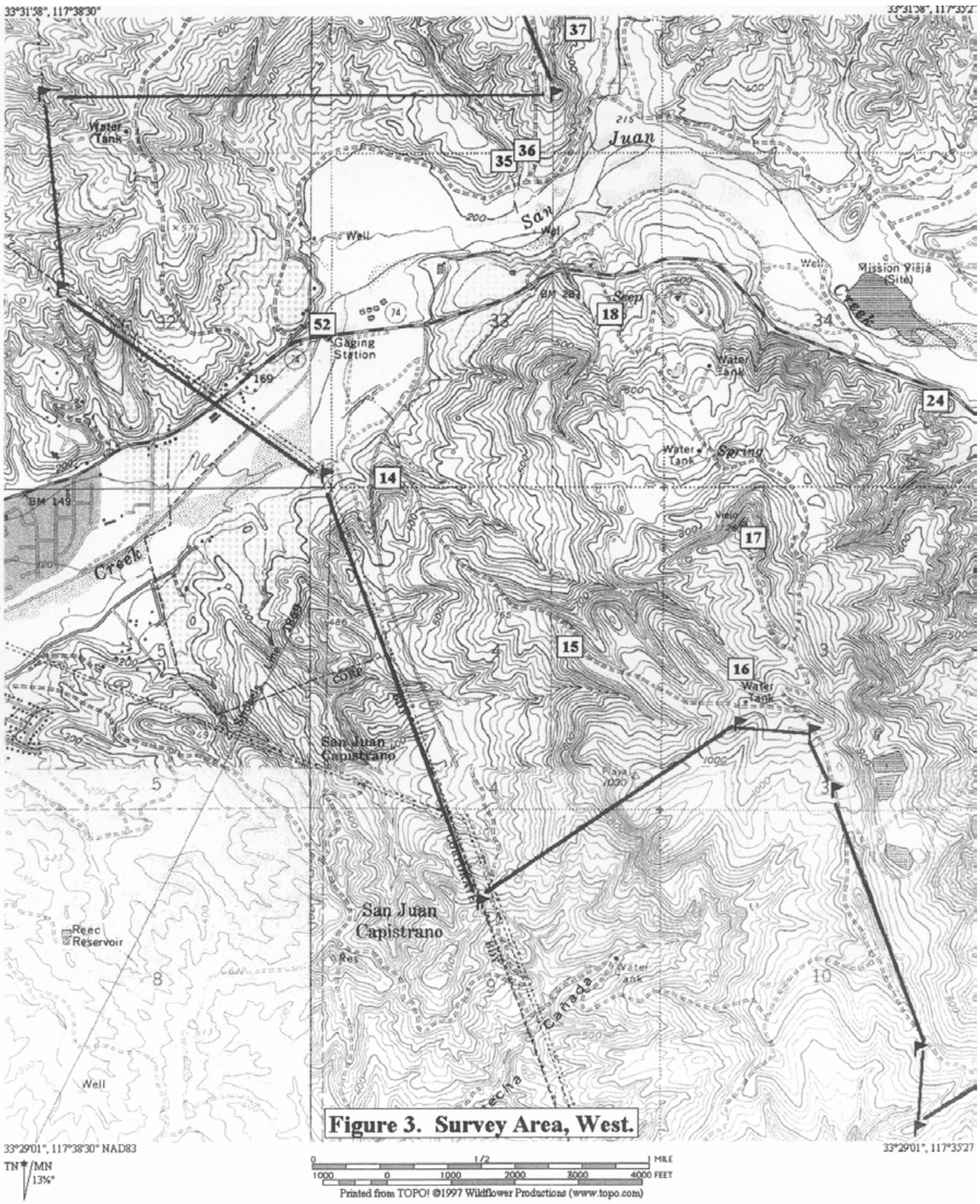

Figure 3. Survey Area, West.

Figure 4. Survey Area, Center

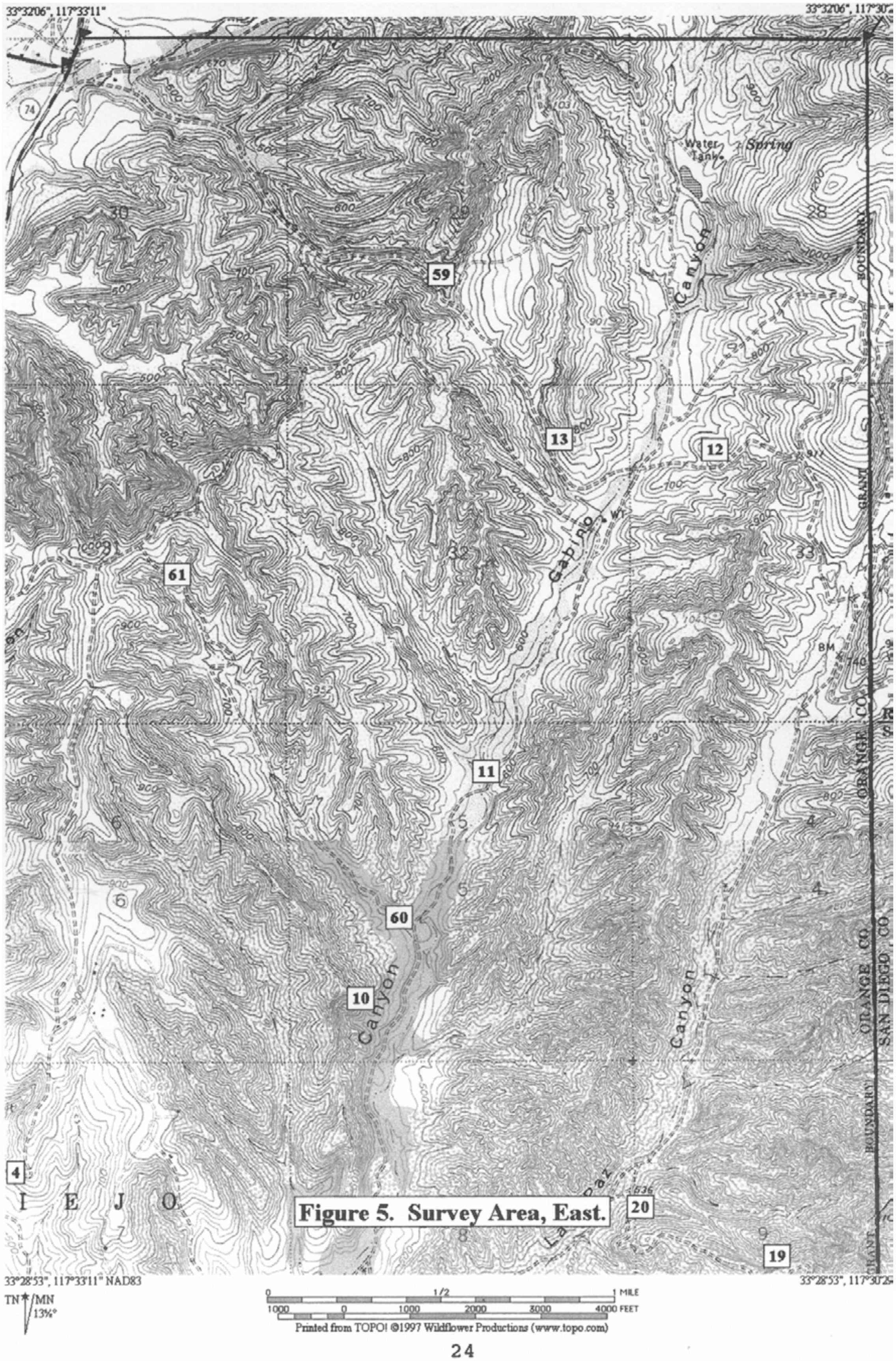

Figure 5. Survey Area, East.

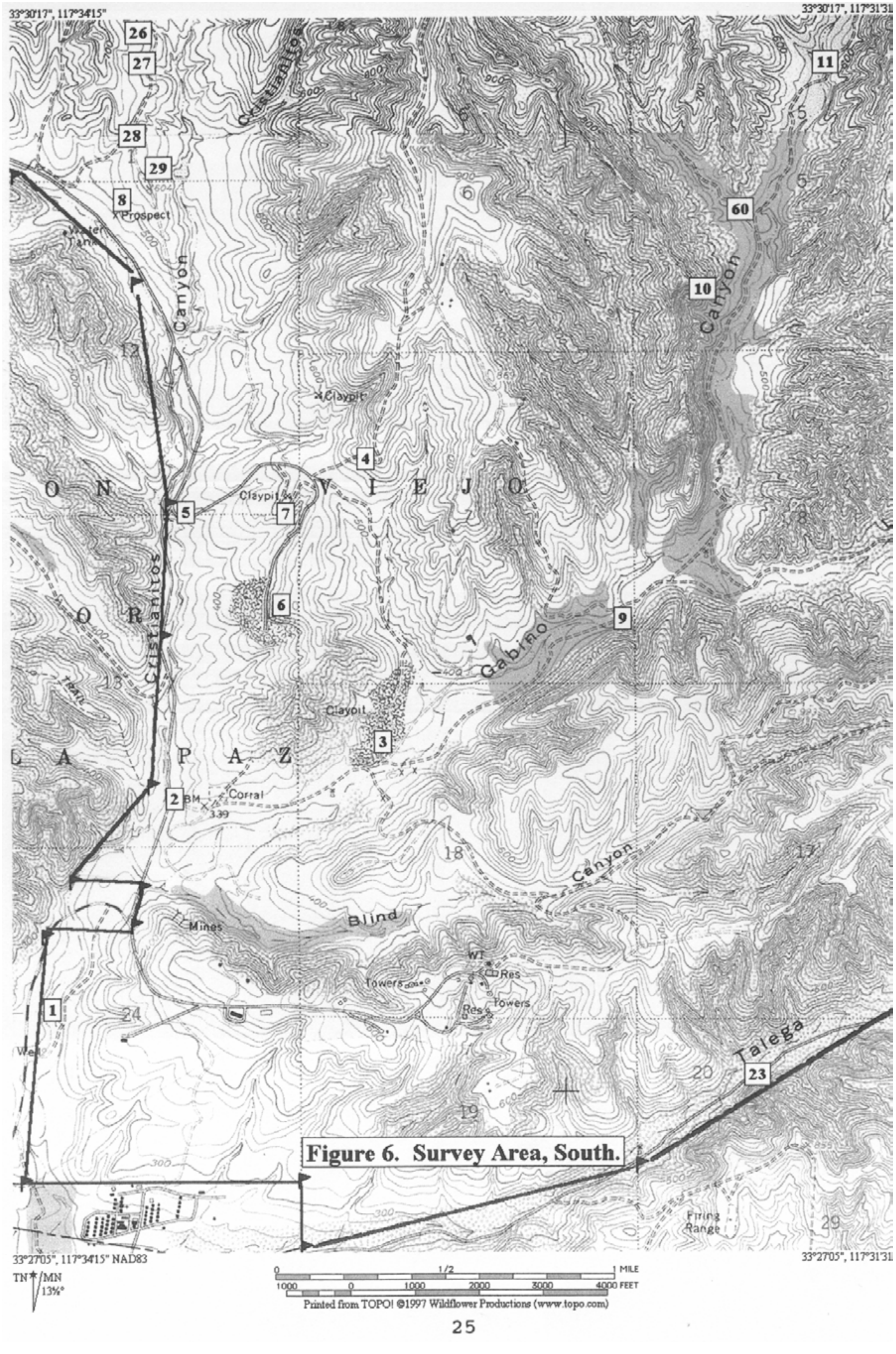

Figure 6. Survey Area, South.

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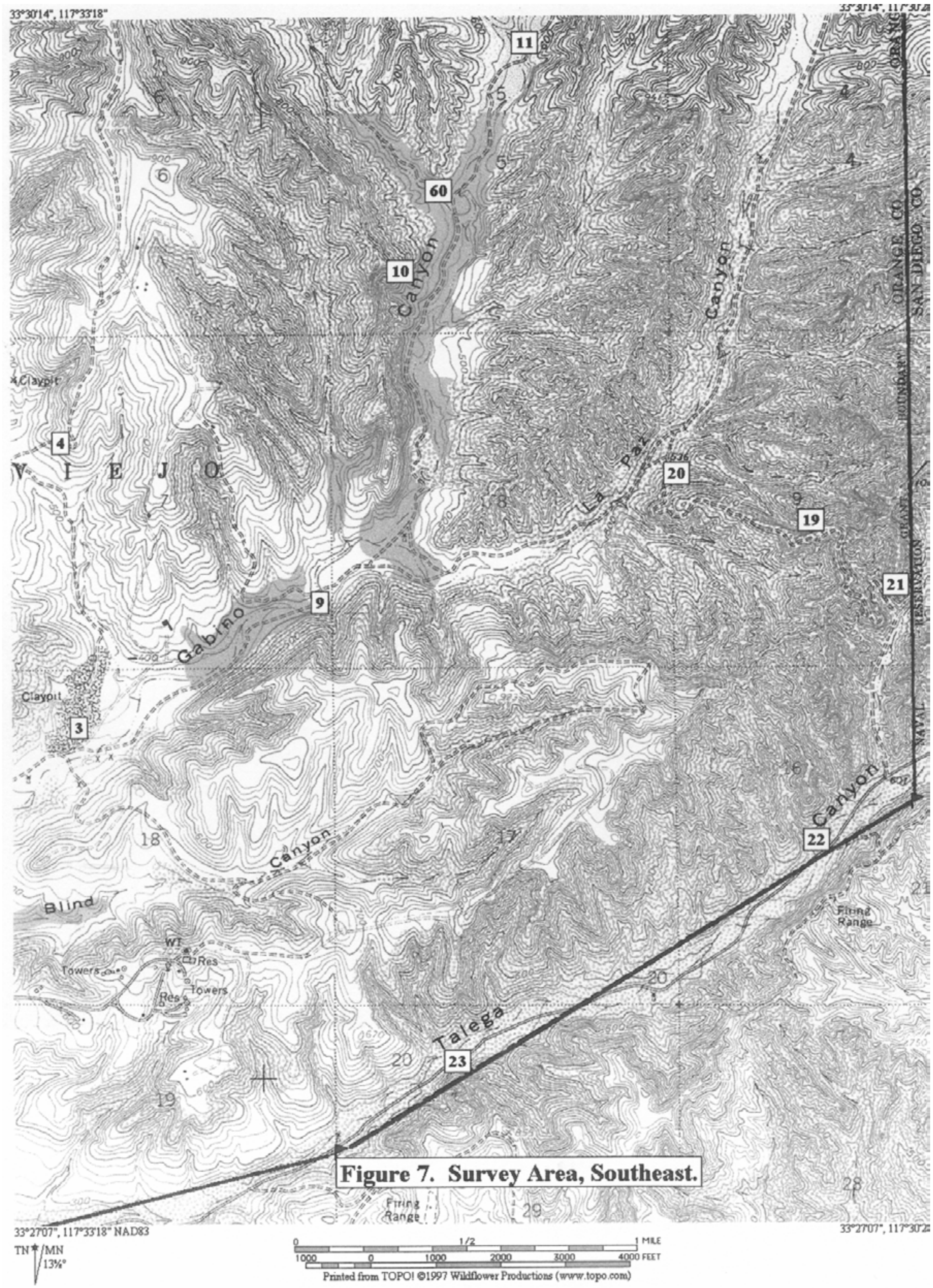

Figure 7. Survey Area, Southeast.

Figure 8 - Stops

This is a complete list of stops or outcrops studied during the fieldwork. Keep in mind, that: (1) Some stops include more than one formation, (2) the latitudes, longitudes, and elevations were taken from computerized TOPO! Maps, and (3) some stops occur on more than one figure due to overlaps.

#	Figures	Latitude	Longitude	Altitude	Formations	Fossils
1	6	33°27'42"	117°34'06"	226 ft	Tsa	not found
2	6	33°28'15"	117°33'44"	344 ft	Tsa	not found
3	6, 7	33°28'28"	117°33"06"	374 ft	Tsa, Tsi	not found
4	5, 6, 7	33°29'09"	117°33'08"	688 ft	Tsa, Kwp	not found
5	6	33°29'01"	117°33'44"	380 ft	Qt	not found
6	6	33°28'44"	117°33'26"	541 ft	Tsi	not found
7	6	33°29'02"	117°33'24"	515 ft	Tsi	not found
8	6	33°29'47"	117°33'55"	488 ft	Tsi	not found
9	6, 7	33°28'45"	117°32'22"	390 ft	Kws	not found
10	5, 6, 7	33°29'35"	117°32'06"	597 ft	Kws	not found
11	5, 6, 7	33°30'10"	117°31'43"	613 ft	Kws	**trace fossils**
12	5	33°30'59"	117°31'02"	784 ft	Kt	not found
13	5	33°31'01"	117°31'31"	718 ft	Kws	not found
14	3	33°30'47"	117°37'18"	337 ft	Tm	**fish**
15	3	33°30'20"	117°36'44"	882 ft	Tso	not found
16	3	33°30'15"	117°36'12"	994 ft	Tso	not found
17	3	33°30'37"	117°36'11"	1089 ft	Tso	not found
18	3	33°31'13"	117°36'36"	337 ft	Qac	not found
19	5, 7	33°28'54"	117°30'52"	862 ft	Qt	not found
20	5, 7	33°29'05"	117°31'16"	633 ft	Kws	not found
21	7	33°28'45"	117°30'36"	836 ft	Kws	not found
22	7	33°28'07"	117°30'49"	587 ft	Kws	not found
23	6, 7	33°27'32"	117°31'58"	462 ft	Kws	not found
24	3, 4	33°31'00"	117°35'37"	314 ft	Tsa	not found
25	4	33°30'38"	117°34'04"	600 ft	Tsa	not found
26	4, 6	33°30'16"	117°33'49"	587 ft	Tsa	not found
27	4, 6	33°30'09"	117°33'50"	583 ft	Qac	not found
28	4, 6	33°30'00"	117°33'53"	557 ft	Tsi	not found
29	4, 6	33°29'55"	117°33'46"	524 ft	Tsi	**petrified wood**
30	1	33°35'28"	117°36'12"	803 ft	Ts	not found
31	1	33°35'13"	117°36'23"	823 ft	Ts	not found
32	2	33°32'53"	117°37'06"	757 ft	Tm	not found
33	2	33°33'21"	117°37'19"	846 ft	Tso	not found
34	2	33°34'05"	117°37'09"	564 ft	Ts	not found
35	3	33°31'35"	117°36'57"	269 ft	Tt	**oyster bank**

Figure 8 – continued

#	Figures	Latitude	Longitude	Altitude	Formations	Fossils
36	3	33°31'37"	117°36'53"	275 ft	Tt	**oyster bank**
37	2, 3	33°31'56"	117°36'43"	311 ft	Tsa	not found
38	2	33°32'14"	117°36'35"	301 ft	Tsa	not found
39	2	33°33'03"	117°36'33"	406 ft	Tsa	not found
40	2	33°33'09"	117°35'44"	505 ft	Tsa	not found
41	2	33°33'06"	117°35'39"	456 ft	Tsa	not found
42	2	33°33'52"	117°35'54"	646 ft	Tsa	not found
43	2	33°34'05"	117°36'14"	738 ft	Tsa	not found
44	2	33°33'53"	117°36'29"	567 ft	Tsa	not found
45	2	33°32'01"	117°36'04"	479 ft	Tsa	not found
46	2, 4	33°32'22"	117°35'16"	400 ft	Tsa	not found
47	4	33°32'42"	117°34'19"	780 ft	Tsa	not found
48	2, 4	33°32'16"	117°34'33"	741 ft	Tsa	not found
49	2, 4	33°32'03"	117°34'43"	629 ft	Tsa	not found
50	2, 4	33°31'47"	117°35'16"	334 ft	Tsa	not found
51	2, 4	33°32'13"	117°35'17"	360 ft	Tsa	not found
52	3	33°31'10"	117°37'31"	157 ft	Qac	not found
53	4	33°31'16"	117°35'18"	311 ft	Tsa	not found
54	4	33°30'54"	117°35'04"	262 ft	Qac	not found
55	4	33°30'58"	117°35'21"	255 ft	Tsa	not found
56	4	33°31'22"	117°33'33"	331 ft	Kwp	**petrified wood**
57	4	33°31'30"	117°33'33"	347 ft	Qt	not found
58	4	33°31'41"	117°33'42"	446 ft	Qt	not found
59	5	33°31'27"	117°31'56"	669 ft	Kws	not found
60	5, 6, 7	33°29'50"	117°32'00"	524 ft	Kws	not found
61	5	33°30'41"	117°32'42"	843 ft	Kwp	not found

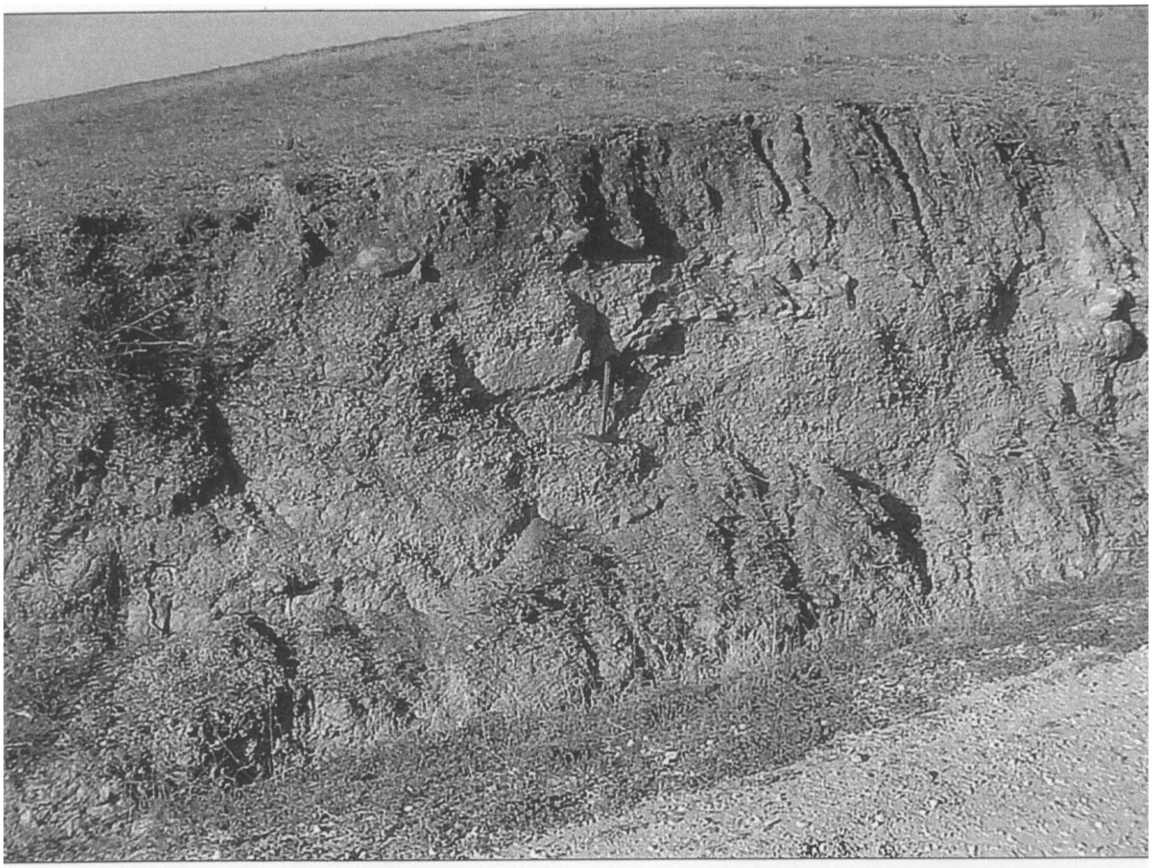

Figure 9. Stop 12, Trabuco Fm – Kt, early late Cretaceous. This is one of the best outcrops of this formation in the project area.

Figure 10. Stop 11, Williams Fm, Schulz Ranch Member – Kws, Late Cretaceous. This is the only stop out of ten stops of this formation where trace fossils occurred.

Figure 11. Stop 56, Williams Fm, Pleasants Sandstone Member – Kws, Late Cretaceous. Several pieces of tree trunks and pelecypod shells occur near the bottom of San Juan Creek. The piece in this figure is almost one foot long. The largest one was over three feet long.

Figure 12. Stop 6, Silverado Fm, Tsi, Paleocene. This formation is very colorful. Notice the thick horizon of lignite in the middle part of the picture. The reddish strata above the lignite are clays and siltstones.

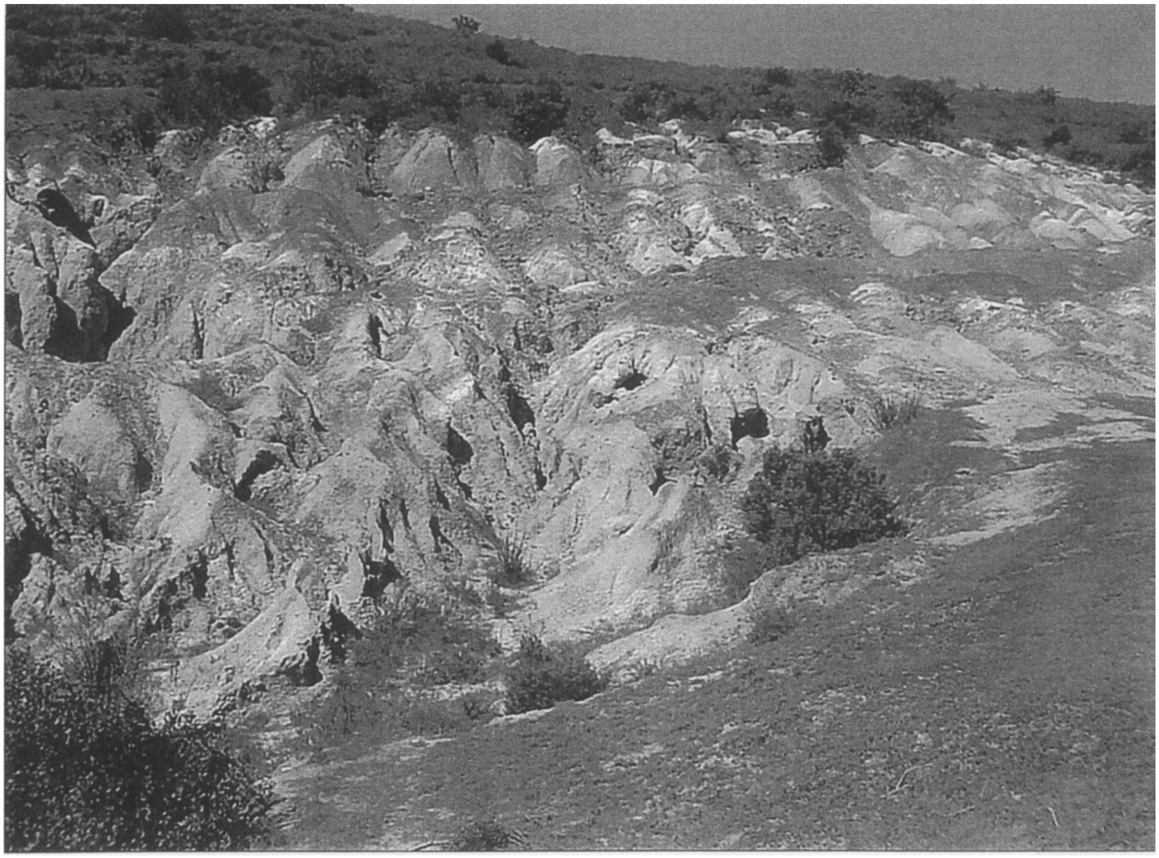

Figure 13. Stop 29, Silverado Formation – Tsi, Paleocene. This stop produced large amounts of petrified wood fragments, found mostly in the lower third of the outcrop.

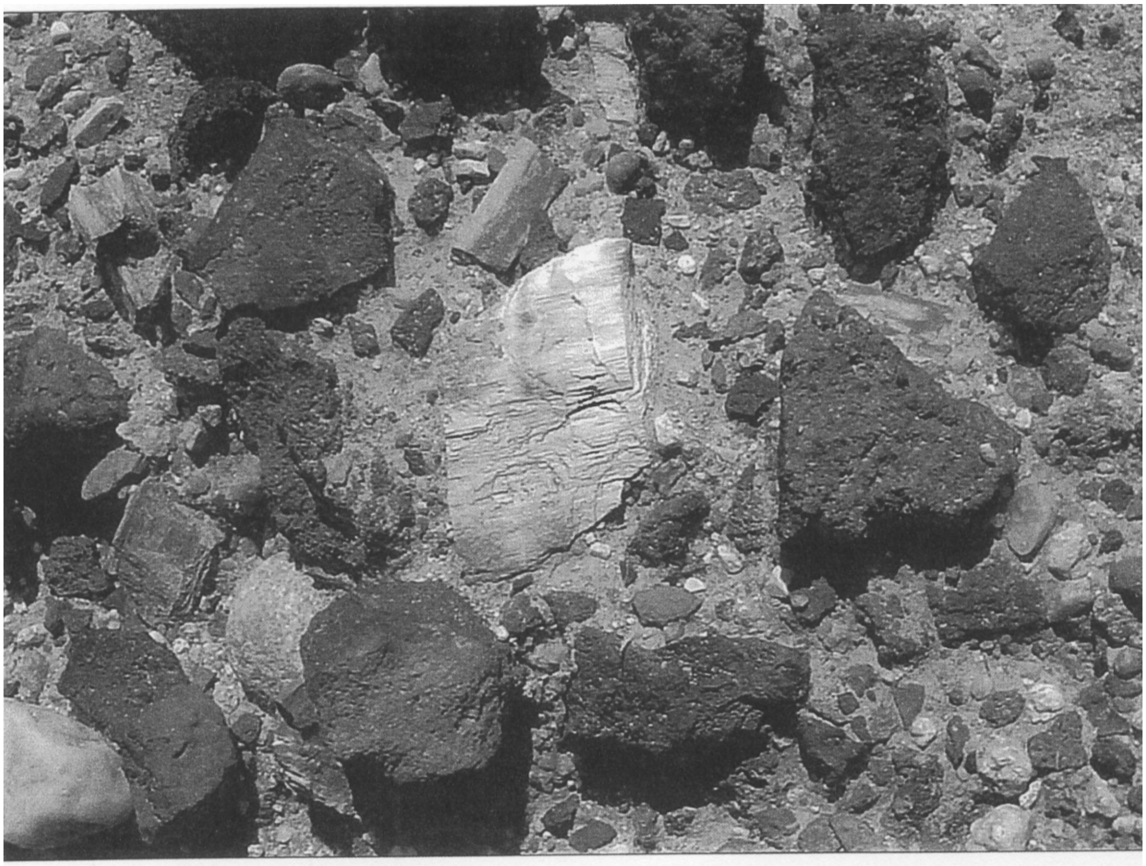

Figure 14. Stop 29, Silverado Fm – Tsi, Paleocene. This stop produced large of petrified wood debris, such as the light-gray fragment in the center of this picture.

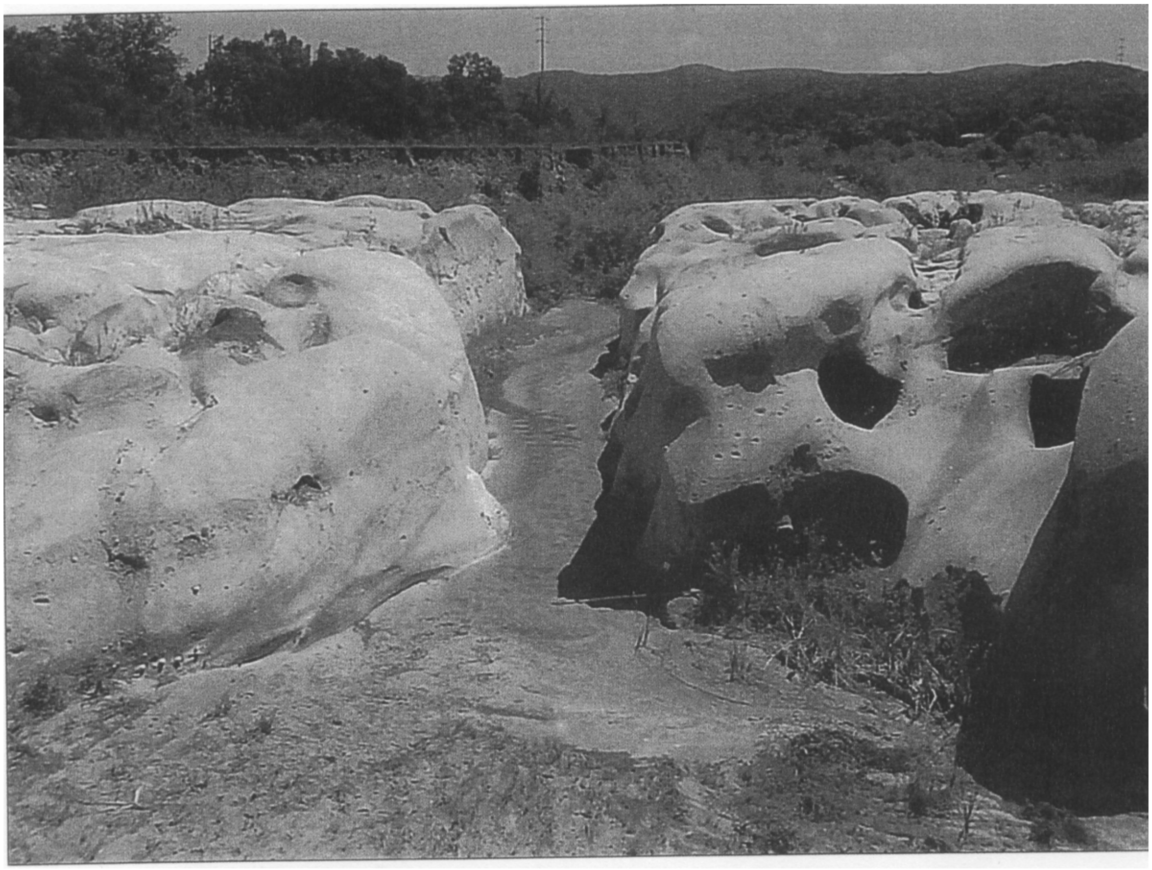

Figure 15. Stop 55, Santiago Fm – Tsa, Eocene. This stop was one of the largest outcrops studied during the Ranch Plan survey. The massive sandstone extends at least 150 m on both sides of San Juan Creek. Despite a large effort, this stop did not produce any fossils.

Figure 16. Stop 31, Sespe Fm – Ts, Eocene. Badland topography quickly develops on freshly exposed Sespe Formation. This outcrop is located on the future Tesoro High School property in upper Chiquita Canyon. Despite excellent exposures and a large effort, no fossils have been found on this site.

Figure 17. Stop 36, Topanga Fm – Tt, Middle Miocene. The Topanga in the survey area is quite rare. At this stop, it forms ledges of exposed fossiliferous oyster bank. The boulders in the middle of the picture came from the oyster bank just above them.

Figure 18. Stop 36, Topanga Fm – Tt, Middle Miocene. The Topanga at this stop forms ledges of exposed fossiliferous oyster bank. This is a detail picture of the oyster bank. The large shell belongs to the genus Pecten.

Figure 19. Stop 16, San Onofre Breccia – Tso, Miocene. This coarse-grained, massive or poorly bedded and sorted rock unit accumulated from and marine and non-marine debris flows and avalanches. No fossils were found during the survey.

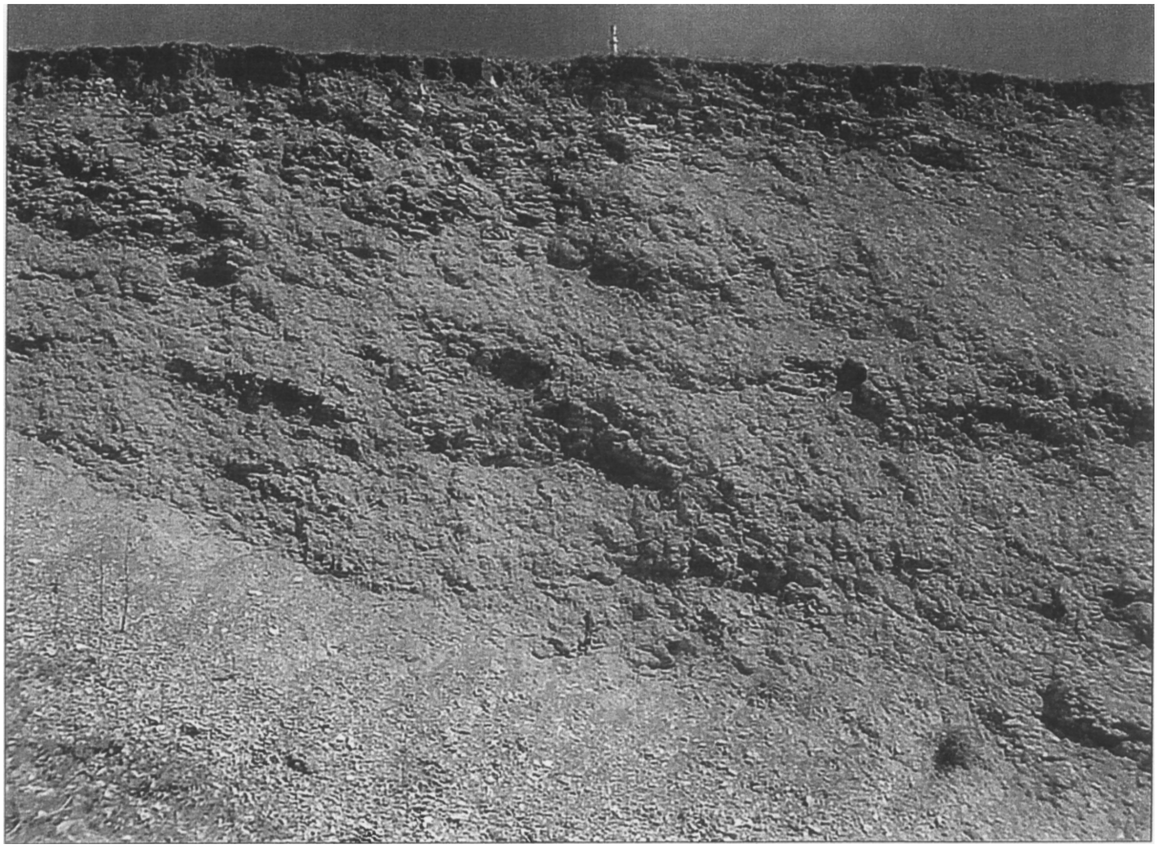

Figure 20. Stop 14, Monterey Fm – Tm, Miocene. This outcrop produced many fossils typical of this formation, including fish bones and scales, coprolites, and indeterminate mammal bone fragments.

Figure 21. Stop 58, Quaternary Non-marine Terrace Deposits – Qt. Such deposits are rarely fossiliferous, but if fossils occur they can be very important.

Figure 22. Stop 54, Quaternary Alluvium Deposits – Qac. Such deposits are rarely fossiliferous, but if fossils occur they can be very important. This particular deposit accumulated in the San Juan Creek bed.

Figure 23. Stop 18, Quaternary Colluvium Deposits – Qac. Such deposits are rarely fossiliferous, but if fossils occur they can be very important.

RANCHO MISSION VIEJO: AN ETHNOHISTORY

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RANCHO MISSION VIEJO: AN ETHNOHISTORY

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RANCHO MISSION VIEJO: AN ETHNOHISTORY

INTRODUCTION

This ethnohistory is part of the archaeological report (see Demcak 2000) for Rancho Mission Viejo's Ranch Plan. It is not a formal history per se but a specialized reconstruction of, at least partially, the prehistoric and ethnic groups whose cultural traditions and lifestyles have not been described completely in the environment in which they took place. Although the written records provide a rich background, they had not been brought together to form a coherent whole. This ethnohistory has included some archaeological research, linguistic data, and oral interviews which emphasize the Native Californians, Californios, and others of Mexican-American descent who have lived on and participated in the environmental, economic and cultural changes on the Rancho Mission Viejo.

Prehistorically, the Rancho Mission Viejo was situated within the domain of the Juaneño Indians. Their name, Juaneño, was derived from the Mission San Juan Capistrano, placed in the heart of their territory by the Spanish missionaries. As the coastal southern California Indians became missionized, the early European and American colonists began to refer to those who lived around and associated with a particular mission by its name, hence they were the Juaneño Indians. The Luiseño Indians in San Diego, to whom the Juaneño are most closely related, were those associated with the Mission San Luis Rey.

Culturally and linguistically, the Juaneño and the Luiseño are so closely related that some anthropologists (Bean and Shipek 1978) have viewed and written about them as the same group with a few dialectical differences. But the Juaneño and Luiseño not only view themselves as separate, but also have had very different post-contact histories. Further, the Juaneño have reclaimed the name "Acjachemen" or "Acjachemen Nation". This was the name by which Father Geronimo Boscana (1978; Harrington 1934) referred to them at the mission. This Franciscan missionary who was stationed at the San Juan Capistrano mission between 1814 and 1826, interviewed and wrote about the Indians there. He referred to the Juaneños by their main village name, Ahachmai, and also recognized the Gabrielinos and the few Cahuillas who also lived there. Currently, most of the Juaneño use both terms, as in the "Juaneño Band of Mission Indians Acjachemen Nation." In this ethnohistory, however, the Juaneño will be discussed as a separate group from the Luiseño, but using the term 'Juaneño' since that is still the most common name by which they are recognized today.

Prehistoric Period

The Juaneño territory extended south into San Diego County to Las Flores (Las Pulgas today) between the San Onofre and Las Pulgas creeks. It spread east to Santiago Peak and the crest of the Santa Ana Mountains, and north to Los Alisos Creek although the Juaneño probably shared the area including Newport Beach (Earle and O'Neil 1994) with the Gabrielino. They shared the southern river valleys with the Luiseño, the eastern mountain crest with the Cahuilla and the Gabrielino, some of which came to the Capistrano mission to be missionized. These groups are all related linguistically. The Juaneño, along with the Luiseño, Gabrielino, Cupeño, and the Cahuilla belong to the Cupan group of the Takic family or subfamily of languages. The Takic sub-family, often called the southern California Shoshonean languages, is part of the Uto-Aztecan stock that includes many other language families (Bean and Shipek 1978; Shipley 1978:90).

The Juaneño Indians had the unique distinction of being the only tribe in California to have had a relatively full description of their culture written down at the advent of the Spanish occupation. Father Boscana, as mentioned above, learned their language, observed their ceremonies and asked questions about the ritual, social, and material world of the Juaneño. Despite a strong racial bias, Boscana's manuscript, of which only two copies were extant but were both translated (Boscana 1978; Harrington 1934), was said to be "easily the most intensive and best written account of the customs and religion of any group of California Indians in mission days" (Kroeber 1925:636). Further, the copious and illustrative annotations by J. P. Harrington (Boscana 1978), an excellent anthropological linguist, provided access to more Juaneño language than would have been available otherwise. But adding to this work, excellent ethnographers (Dubois 1908; Sparkman 1908; Strong 1929) visited the Luiseño, who were not missionized until 1798 and with less disruption than the Juaneño, and these ethnographers added not only new data but much needed analysis.

Like that of most California Indians, the Juaneño world at the time of European contact was built on religion, ritual and social hierarchy. Every Juaneño village was a clan tribelet, that is, a group of people related through the male line which controlled the surrounding area in common and were politically and economically autonomous from other villages. The exception to that rule might have been a particularly large village whose chief also controlled two or three neighboring and small satellite villages. The surrounding area was filled with named places associated with their food products, i.e. the acorn gathering area, raw materials for tools, or sacred beings who determined appropriate behavior in those areas. Each place was owned by an individual, a family, the chief, or the group collectively. Only by getting permission could someone gather on territory other than his own.

The Juaneño were not agriculturalists but they nurtured certain plant species and paid careful attention to how environmental and climatic conditions affected the plant and animal communities. Women, with the occasional help of children, were responsible for gathering most of the vegetable products. Acorns were the most important staple food as with most California groups; six species were used by the Juaneño (Bean and Shipek 1978:552). But a wide variety of seeds, fruit, greens, cactus pods, berries, yucca buds, bulbs, roots, tubers, mushrooms and tree fungi supplemented their vegetable menu, and crustaceans and mollusks were collected at the coast. Men were the most frequent collectors of tobacco (*Nicotiana attenuata*) and toloache or Jimson Weed (*Datura meteloides*) for their sacred rituals. The plants were prepared both for their hallucinogenic powers and their medicinal effects. Men were the large game hunters, but they also snared and shot birds, hunted large sea mammals, and caught fresh and saltwater fish. Juaneño hunting and horticultural efforts included the following:

> Fire was used as a crop-management technique as well as for community rabbit drives. The annual return from certain wild foods and useful plants-grass seed, some greens, yucca, and basket grasses-was maintained by burning at least every third year (Bean and Shipek 1978:552).

Village sites, or “rancherias” as the Spanish called them, were located near a potable water source, rich food resources, some bedrock outcroppings, if possible, for seed and acorn grinding, and, more often than not, a commanding view of the area. Houses were built in an orderly arrangement, and were conical shelters with thatched roofs and sided with tule, brush or bark. Their floors were dug several feet below ground level that, no doubt, provided some insulation, and there was a fire pit in the center. Each house had a ramada, four poles with a rectangular roof, for a shaded work area. The most important structure in each village was the vanquex, or enclosure sacred to Chinigchinich. It “was built at all the rancherias near the house of the chief, which house was always the biggest and tallest one…located at about the middle of the town” (Boscana, in Harrington 1934:35).

Ceremonial ritual took place primarily in front of the vanquex or inside its walls where only the religious chiefs and shamans were allowed. Puberty rites for boys and girls, and death rites for the initiated took place in the front or public area, and it was here that the sand paintings connected with the rites were made. Each painting represented an aspect of the universe, and all were destroyed when the ceremonies were completed. The sanctity of the vanquez was such that a wrong-doer, before his capture, could take shelter inside, and later, when he came out, he was absolved of his crime. This immunity from punishment was due to the perceived power of Chinigchinish who would do the punishing (Boscana, in Harrington 1934:37). The family of the guilty party, however, made restitution to the aggrieved family so that no retribution would be taken on them.

The Juaneño cosmology, which gave meaning to the religious rituals, began with Ouiot, a creator and culture hero combined who was born of a brother and sister, his earth mother and sky father. As the world’s natural resources were also born, including people although they lived only on white clay, the earth increased in size. After Ouiot, their creator god, died, a general council had to make decisions and organize people's conduct for now they had to collect different types of food. After awhile, a spectre appeared who, when questioned, said he was not Ouiot but an even greater captain named Chinigchinich who lived above. He proceeded to assign various powers concerning food production to the individuals around him, e.g., to make rain, or to produce acorns. Then he created the real men and women whose descendents are alive today, and, while he was dancing in special robes with his skin painted black and red, he taught them the laws that he expected them to observe. Then, he separated out the chiefs and the elders, explaining that they alone should dance and robe themselves as he had done, and that they would be responsible for such tasks as curing the sick and relieving drought. They were to be called puplem, meaning that 'they would know all things'. (Boscana 1978:27-30).

The position of chief, whose responsibilities and role were hereditary, was inherited in the male line. He was assisted by a crier, who spread the news and delivered messages, and the puplem, the priest-shaman group who, together, conducted the rites for Chinigchinich in the vanquex in a specialized language which the rest of the community did not understand:

> The authority which the chief exercised in his rancheria was that he was the one to tend to and handle all matters which came up with other rancherias, to call together for war, defensive as well as offensive, and also for peace; to announce the day of all the feasts which they celebrated, which were many; to set the general days for hunting and seed gathering (Boscana, in Harrington 1934:33).

In the final chapters of Boscana's book, Chinigchinich, he (1978, Harrington 1934) related how people came from the north to populate the area and establish new villages. Although the leader of these new settlers, Chief Oyaison, returned home, he left his daughter Coronne, who changed her name to Putuidem and established the village of the same name. As the village name Putuidem grew, some of these newcomers began to move out to found new villages. But Putuidem, the chieftainess, eventually sent word for them to come back and attend a great feast, after which she died and turned into a big pile of earth. These settlers then left sadly for their own villages and on the first night they all stopped at the same place to sleep in a big pile. This place was then named Acagchemem, meaning 'a pile of moving things', later recalled by some as Axatcme (Harrington in Boscana 1978:237). Acagchemem is located very near where the Capistrano Mission stands today, and is the name by which many of the Juaneño people often refer to themselves today. The term, Axatcme, seems to have been expanded into the name of a larger area, possibly the size of the Juaneño territory as it has been described.

Boscana (Harrington 1934:60-62) listed the names of the fifteen villages in _Chinigchinich_ that he was told about by the Juaneño. Those were the villages that those early settlers had founded, as well as the names of their first chiefs, and the translations of both sets of names. The first was Putuidem, quite possibly represented by the site at CA-ORA-855, a large Late Prehistoric village site approximately one-quarter league, or .649 miles (Pauley 2000:5) from the mission. The 6th village Boscana listed, _Panga_, or, written as _Panhe_ on Kroeber map (1925:Pl. 57), and as _Pange_ or San Matheo, alias _Pange_, in Merriam (1968:132), was said to mean 'cañada' or canyon, and "since the arrival of the discoverers has been called San Mateo. Its chief was named _Sequilquix_, which means plant that dries up." (Boscana, in Harrington 1934:61). Rivers (1991:37) equates the complex of archaeological sites CA-ORA-22, and SDI-4282, SDI-4535 and SDI-4412 near the mouth of San Mateo Canyon to _Panhe_ or _Panga_. Others of these named village sites, most of whom are also listed in the Register of Baptisms, vol.1-2, for the Capistrano Mission, are not yet as clearly located, and will be discussed in the next section.

European Contact

European ships had been sailing along the California coast since 1542, and in a few places in northern California, shoreline meetings had been made. But in July,1769, the Spanish exploring party led by Gaspar de Portolá, the new governor of California, left San Diego for a trek northward to Monterey and was the first exploration mounted on land. This party of 63 men and 100 horses and mules (Carrico 1977, Meadows 1965:24) traveled for one week, at the rate of two to four leagues (5-10 miles) per day before they left San Diego County and entered Orange County. In that company, six extant accounts were kept during the expedition. Portolá kept a very brief record along with his second in command, Rivera y Moncada. Lieutenant Fages, Sargeant Ortega, and Engineer Costanso also made records. The final and most complete diary belonged to Father Juan Crespi (1927) who kept quite detailed observations and comments. In the party were 33 soldiers, 7 muleteers, and 15 christianized Lower California Indians carrying tools to break trail if necessary (Bancroft 1883:vol.II:141). The scouts and most of the Indians stayed out ahead of the main party.

Portolá was an experienced leader, and most of the party had just had a long trip from Mexico. In California, the daily marches through unknown lands were not more than half a day long, with frequent day layovers to rest and feed the pack animals. Through southern California, they were almost always following Indian trails, and though the terrain was not difficult, they were a large party and their animals consumed the resources rapidly. The Portolá party marched across Orange County for one week that included one day of rest, and met with friendly and generous Indians all along the way. Those days are listed below, with the activities that took place on each day.

July 22nd -The explorers entered Orange County by way of the entrance to Christianitos Canyon where they camped above a pool of water in a dry arroyo that night. Fathers Crespi and Gomez returned to an Indian village they had passed and baptised two dying children. Crespi (Meadows 1963:38) said of this experience, "For this reason this place is known to the soldiers as Los Christianos: I named it San Apolinario: others call it Valley of Los Bautismos."

July 23rd – According to Father Geronimo Crespi (Palou 1926:123):

> After we two said Mass we started at seven o'clock, going to the north-northwest…we went on over mesas, hills, valleys and dry arroyos, ascending and descending, all the land being well covered with grass. We passed two valleys with two dry arroyos, both grown with alders and large live oaks. In one of the valleys we found a village of heathen, who, as soon as they saw us, began to shout; and they came out, as if to meet us at the watering place, where we went to stop. We must have traveled this day about four leagues in the four hours on the road.
>
> A little before eleven we came to a very pleasant green valley…It has a large arroyo, which at the point where we crossed it carried a good stream of fresh and good water…We halted there, calling it the valley of Santa Maria Magdalena. In the journey of this day we came upon some deposits of fine red ochre, and some others of very white earth. They are on some hills near which we passed, and we inferred at once that from this earth the heathen provide themselves for their paint, which is their gala dress for their visits and their war feasts (Palou 1926:123).

It is at this point that a consideration of the names of the Indian villages Boscana recorded is relevant. <u>Tobe</u>, the eighth village name he recorded, meant "a kind of clay or fine argil, white, similar to white lead, with which the women painted themselves" (Boscana, in Harrington 1934:61). The location of this site is assuredly on the Rancho Mission Viejo, in the neighborhood of Christianitos and Gabino Canyons, which has an abundance of fine clay deposits, several of which were mined there during the early 20th century. And further, there is a site with National Register eligibility, although not yet dated, CA-ORA-1222, (Demcak 2000) in the saddle of northern Christianitos Canyon with an excellent water source and historically worked clay pits located just downhill and south of the site. Discussions during two field visits (4/16/00, 5/20/00; Note1) considered the possibility of this being the site of <u>Tobe</u>.

Studies of Portolá's route made by a historian, Don Meadows (1963:38) and an archaeologist, Helen Smith (1965:29), both suggest that the Portolá party emerged into San Juan Canyon, the "pleasant green valley"...from a ridge west of Trampas Canyon with neither making an explanation for their choice. Perhaps a better choice by Portolá's scouts would have been a selection from one of the following routes: (1) Trampas Canyon itself, (2) a small draw to the east of Trampas, or (3) a recently surveyed trail site, CA-ORA-1554, (Demcak 2000) which leads from the northern saddle of Christianitos Canyon down into the San Juan Creek Valley. In any case, upper Christianitos might well have appeared to be the second of two eastern valleys, Gabino Canyon being the first, and Christianitos the one from which the Indians emerged. It is suggested here that the Portolá party may well have seen Indian people from the village of Tobe.

While camping in San Juan Canyon, the two priests with the Portolá party named their camp and the valley “Santa Maria Magdalena”, for that religious feast day. They were probably camped on the eastern knoll overlooking the mouth of Canada Gobernadora in the heart of the Rancho Mission Viejo. There are a number of late prehistoric village sites nearby, within a mile or two, and although they may have been occupied, the vegetation could have blocked views of them, and possibly these Indian people were somewhat reluctant to show themselves. Note the unique description of the first observed Indian behavior in the next day’s account:

> July 24th – We got up early this morning and broke camp at a quarter past six. Going north-northwest, we descended from the high hill on which we had stopped to a valley in the same direction. Before we left about nine heathen from a village in this valley allowed themselves to be seen. After traveling a short distance in it we came to two good villages, whose people were all very friendly. We greeted them in passing, and they made us their speech, of which we understood nothing. We traveled through this valley for about two leagues; it is of good land, but they had burned all the grass…After two leagues’ travel we turned to the northwest, veering considerably to the west, in order to climb a high pass through a range of grass covered hills; and after traveling about a league over good mesas we descended to a pleasant arroyo, and a valley very full of large alders and live oaks, so that it looked like a fig orchard. After about three hours on the road from the starting place, during which we must have traveled as many leagues, we pitched camp on a very long mesa of earth, which runs to the foot of a high mountain range, from which flows an arroyo of good water. Instantly the Indians from a village in the valley came to visit us. They came without arms, and with a friendliness unequaled; they made us presents of their poor seeds, and we made return with ribbons and gew-gaws (Palou 1926:124).

For the first two leagues (or 5+ miles) the Portolá party appears to have been in Canada Gobernadora whose name, according to Meadows (1963:38) refers to the abundance of artemisia, or white sage, that grows there, Gobernadora being a provincial name for artemisia. The two villages they passed seem, almost certainly, to have been at the entrance to Wagon Wheel Canyon, a western offshoot of Gobernadora. Two archaeological sites, CA-ORA-564 and CA-ORA -991 are located on the west side of Wagon Wheel Canyon with a small gully between them. According to radiocarbon dating and obsidian hydration readings, these two village sites were "in use during the very Late Prehistoric, from as early as A.D. 1400 to perhaps after the time of European contact." (Allen et al. 1992:77)

One of these villages could have been Boscana's (Harrington 1934:61) thirteenth village, Uut, which signified a little stick [foreshaft] which was put on arrows. The evidence supporting this possibile village identification is not very strong, but Kroeber (1924:Pl. 57) places Huumai on a Juaneño territory map toward the center of Canada Gobernadora. In the Juaneño language, according to O'Neil (2000:19), if the noun indicator, the letter 't', is removed and the locative suffix, 'mai', is added, they are the same word. But challenging this location for Uut is a notation by Harrington (Oxendine 1980), that an unknown informant told him Humai was near the San Juan Capistrano Mission. Nonetheless, Humai or Uut could have been located in Wagon Wheel Canyon.

Wagon Wheel Canyon is short, and at its north end where it was described as having been burnt by the local people, it would have been an easy traverse west into and across Chiquita Canyon, and a slight descent into Tijeras Canyon and up along the Plano Trabuco. Crespi (Palou 1926:124) says that they "pitched camp on a very long mesa of earth, which runs to the foot of a high mountain range, from which flows an arroyo of good water". Portolá's party probably camped somewhere near the location of the ruins of the Trabuco Adobe, which on the San Juan Capistrano topographic 7.5" series map appears as the "San Francisco Solano site." That is the name Father Crespi (Palou 1926:125) gave their camp site, with the stated conviction that this was the place they would build a mission of that name. The very friendly Indians who came immediately to their camp, and spent the next day there, could have come from Boscana's fourteenth village, Alume, which signifies the head looking upward. Boscana (in Harrington 1934:92) said that "this alludes to the rancheria having been located at the foot of a very high mountain which today is called El Trabuco." And today, that same mountain is called Santiago Peak, or Kalawpa by the Juaneño Indians.

Recognizable variations of the name Alume in the two Books of Baptism are Alauna, Alaugna, and Alauna, and "alias El Trabuco" for the baptism recordations of at least 60 Indian people whose village it was (Merriam 1968:122). There are several sites that could be Alume, but CA-ORA-876, a huge site that is probably under and certainly surrounds the Trabuco Adobe, is the most acceptable one. It is an extensive site with many late artifacts such as both pre- and post-contact ceramics (Jones et al. 1995) and is eligible for the National Register.

The soldier explorers reported that from the highest point on the Plano Trabuco, they could see six islands including San Clemente and Santa Catalina. During the day of rest, the two priests walked up there but could only verify having seen the largest two islands. The Indians visited them again that day, and since Father Crespi observed in writing that their houses had been made of willows and their reed baskets could hold water, he must have visited the nearby village (Palou 1926:126-127),

When the members of the expedition left the Plano Trabuco on July 26th, they traveled to Tomato Springs on the Irvine Ranch, and there named it, "San Pantaleon". All along this week's trek across Orange County, they had met only friendly Indian people and on July 29th, 1769, one week after entering the County, they crossed the Santa Ana River and moved into Los Angeles County.

Although the Portolá party returned along the same route the following year, having failed to meet with the ship waiting for them in Monterey, in early 1770, the return trip was not only uneventful but much more rapid. Portolá's route of 1769 became the main route through California used for several years by the padres, the soldiers, and the Indians who traveled between the missions and to the headquarters, the presidio, at Monterey. It became known as El Camino Real, the Royal Road.

Mission Period

In Monterey, Father Serra appointed Fathers Lasuen and Amurrio to found a new mission between San Gabriel and San Diego in honor of St. John of Capistrano, an early member of his own order (Hallan 1975:12). Lasuen rode to San Diego for supplies and to request that Lieutenant Joseph Ortega, formerly a sergeant with the Portolá party, accompany him to help select a suitable site. Besides the usual resources of water, fertile soil, pasture, timber, etc., the site selected had the advantage of having many Indians living nearby. Soon however, problems began to arise that made this a less than ideal location. According to Father Mugártegui (Sleeper 1967:340), in his annual report of 1783:

> On the first of November in 1776 on the date dedicated to All Saints, this mission was founded in the glen popularly known as El Arroyo de la Quema at a site three-fourths of a league distant from what is called the Old Road, and about a league and a half distant from the seashore. There the mission remained for two years under many difficulties expecially because of the water scarcity which was insufficient not only for irrigating the plantings but also for drinking purposes…For this reason, taking the necessary measures, the mission was transferred to the site where it stands today, about three-quarters of a league distant from the glen…

This original mission site was located "in a place called by those born there 'Quanis-savit' (Meadows 1967:339) for the Indian village there. But because of the water scarcity and crop failure, the fathers choose a new site and it was inaugurated two years later by Father Serra. On the title pages of the Baptism and Death registers, therefore, Quanis-savit was crossed out, and changed to reflect the new location of Sajirit (Meadows 1967:342) where it is today.

Although everyone must have known the original location of the mission in those days, that knowledge disappeared along with the physical remains of the first mission, some of which was pirated away to be used at the new mission. Eventually, the adobe ruins at the mouth of the Cañada Gobernadora overlooking San Juan Creek which, in fact, had been an adobe building, was thought to have been the old mission. These ruins, which are no longer visible, but are labeled the "Mission Vieja Site" on the 7.5" topographical map, Cañada Gobernadora, California (1968, photorevised 1988), will be discussed later.

The aforementioned mistake would probably not have happened had the Annual Reports of the Mission San Juan Capistrano between 1779 and 1793 not been lost for a century and a half. Fortunately, Reverend Geiger, O.F.M. (1967) found them in the Archivo General de la Nación, Mexico City, and wrote about them. Communication between Father Geiger and Don Meadows (1967:341) allowed the latter to conclude that the original mission had been on the south side of San Juan Creek and more than a mile downstream from the adobe site. This logical place is the Lacouague family citrus ranch, purchased and planted in 1923, and also the location of the large, and reportedly, very rich archaeological site, CA-ORA- 243, two miles east-northeast of the present San Juan Capistrano Mission. The evidence for this site being the original location of the first San Juan Capistrano mission, the Misión Vieja, seems quite conclusive.

The first structures built at the final site were a church, living quarters for the padres, and a shed for the calves. The first crops planted were vineyards and a vegetable garden, which indicate what the padres had with them and felt they needed. Unlike other missions, the Capistrano missionaries wrote that they were besieged with requests for baptism from the Indians. It is unlikely, however, that the missionaries were moving the Indians to the mission site immediately as some were already living there and they would have had no way to feed many others. In fact, although it is seldom mentioned, the Indians must have continued to visit their village sites and collect their own traditional foods for some time. Further, the soldier mission guards immediately began to molest the Indian women. This was a never-ending problem, the priests complained, and in the early days before there were protective structures to house the women, it was probably safer to leave them in their villages.

In 1786, ten years after the mission's founding, the priests had added a dormitory for unmarried girls (1779), a storeroom, a chicken coop, two warehouses (1881), a permanent church (1782), a corral, an adobe calf barn, a winery, and a permanent barracks (Kelsey 1987). There were 544 Juaneño neophytes, most of whom were probably living near the mission most of the time. Joyce Perry, a Juaneño living in Irvine, California, shared her family genealogy for the purpose of illustrating where some of the neophytes had come from. Two of her 8th

generation ancestors were a couple from Alume on the Plano Trabuco, and one ninth generation male and his parents, a married couple from the 10th generation were all from the village of Cuinisavit, near the original Misión Vieja, both villages on the Rancho Mission Viejo (Perry 2000).

Constant building in the next few years could not keep up with the needs of the mission community, and in 1794, forty small adobe houses, some with tile roofs, were built for Juaneño families. This was the only California mission to construct permanent structures for the neophyte families.

By 1797, the mission had baptised 1107 Indians (Engelhardt 1922:175). The mission's most important building, a great stone church was begun that year. When it was completed in 1806, President Tapis of the mission system dedicated it with many visiting priests and dignitaries, and crowds of Indians attending the ceremonies. According to Bancroft (1883, vol. II:110), the three day celebration was remembered for many years.

Mission production had increased significantly by 1810. In 34 years, the cattle had multiplied to 10,213, they had 693 horses and the sheep, while having decreased from a high of 17,030, were still a respectable 11,500 in number. The crops, however, had decreased from 6,240 bushels in 1800 to 5,300 (Bancroft 1883, vol. II:110).

By this time, the number of livestock required large amounts of land for pasturage, and therefore the neophytes' former village areas provided that land. As Rojas (1964:26) commented:

> The padres trained native Indians as vaqueros as the herds increased, despite the Laws of the Indies which forbade Indians, on penalty of death, to ride horses. The Spanish feared the Indians would become warriors like Apaches. Subsequent events proved that the Spaniards were not wrong. The padres were good teachers.

The Juaneño neophytes, now trained in livestock handling, cared for them at outposts built on what was now considered the mission property. All the lands between the San Mateo and Santa Ana rivers fell into the jurisdiction of the Capistrano mission. According to Hallan (1975:20) this land was divided into six huge ranchos and three portreros, or pastures, called Las Flores, the Cerro de Trabuco and the Misión Vieja. Each rancho had its own adobe and mayordomo, and probably his family, and a crew to manage the huge herds. As Sleeper (1988a:195) explains:

> The largest of the mission's outposts was the twenty-by-seventy foot home of the mayordomo of Rancho Trabuco, near Portolá's campsite. Its ruins still survive. Several times enlarged, the

> adobe's origins are conjectural, but construction and statistics suggest a beginning date of 1806 when some 1,400 mustangs bore the "CAP" (mission) brand. Church records mention the Mesa as a horse farm.

In 1812, tragedy struck at the mission. Massive earthquakes shook California and a major part of the stone church collapsed while mass was being given. At least 40 people were killed, and the building programs halted. When they resumed in 1814, a new hospital was constructed, with a church chapel in 1818 (Kelsey 1987:21,24) as various epidemics, such as measles in 1806, and tuberculosis, syphilis, and dysentery were raging throughout the missions (Cook 1943:22-30). As the mission population was declining because of disease, little building took place after that time.

The pirate, Hippolyte Bouchard, caused a huge sensation in 1818 as he began to raid along the California coast. After he left Santa Barbara, messengers were sent to warn Capistrano. The mission fathers packed up the mission valuables and left for the Trabuco adobe with the populace for safety. When the pirates threatened the defensive force under Santiago Arguello, he ordered his men to retreat to a high hill where they watched while Bouchard's 140 men destroyed property, set fires, and drank all the wine and spirits. The pirates left the next day, still intoxicated and hung over. Hallen (1975:20) says that this incident was the beginning of all the stories of buried treasure that persist in San Juan Capistrano.

Mexico won her war of independence from Spain in 1821, and in the following governmental change in California, the Spanish priests were told to leave and plans for the Indian emancipation were begun. The Mexican priests took over the missions, the Indians held mixed emotions—elation, confusion, fear—and many left the missions for the larger communities and the ranchos that had been carved out of mission lands. In 1829, an American, Alfred Robinson (1846:28), was traveling with a friend who knew the priests in Capistrano where he stopped for the night, and noted the current conditions:

> Two aged missionary friars resided here, but one alone attended to the temporal concerns of the Mission; this was Padre Geronimo Boscana; the other, Padre José Zalveder, sic (Zalvidea) though at this time secluded, and apparently weak in mind, once took an active and laborious part in the management of the Missions. This establishment was founded in 1776, and , though in early years the largest in the country, yet is now in a dilapidated state, and the Indians much neglected.

In the first census of Los Angeles, the Padron of 1836, there were 2228 people listed living in the Los Angeles district, 553 of them were Indians enumerated only by a single name but giving their sex and age, and place of birth for some.

Although the census is incomplete, missing whole ranchos and neglecting to show where most of the Indians were born, it lists 19 Indians from San Juan Capistrano living on the Rancho Los Alamitos and four living in Los Angeles. Also on the census was Juan Forster from England, listed as single and living in a boarding house. He would shortly begin to place an illustrious role in the history of southern California (Layne 1936:84,100-109).

San Juan Capistrano was secularized and organized into an Indian pueblo in 1833. The Juaneño Indians were expected to move south along the coast to San Mateo which was to be one of the model Indian towns. Some moved, and some objected, insisting that they wanted to keep their well watered lots in San Juan and areas nearby (Bancroft 1883, vol. III:332). Various administrators were appointed including Santiago Arguello and a Belgian, Augustin Janssens, who lived in the Trabuco adobe while Arguello went north to Monterey to petition for the rancho (Hallan 1975:26). He was successful. In 1840 and again in 1841 Governor Alvarado signed over to his old friend, Santiago Arguello, and to his two sons Santiago and Jose Ramon, the two square leagues (about 8000 acres) located on both sides of Trabuco Creek, which was called De La Victoria at that time (Bowman 1958:840). Some people said this was a trade off, one that ended the administration of Arguello of whom the Indians had complained so bitterly.

Father Zalvidea, however, continued to petition the governor on behalf of the neophytes who were complaining, this time, that several men were trying to get grants of the mission lands. Again, on March 14, he asked that Janssens be prevented from taking the Indians from San Juan which he had no authority to do, and, finally, that Arguello and Estudillo be ordered to remove their cattle from the Trabuco and the Misión Vieja (Bancroft 1883, vol. III:625).

In 1841 also, Governor Alvarado gave the Misión Vieja of sixteen leagues to Jesse A. Estudillo provisionally (Bowman 1958:441). Estudillo must not have fulfilled the provisions as the rancho was soon abandoned, and then renounced in 1843. As conditions in Capistrano continued to deteriorate, Governor Alvarado decided that the Indian pueblo would be dissolved, the property sold, and a new town to be formed and named 'San Juan de Arguello'. Therefore, a commissioner was sent to distribute the San Juan lands among the ex-neophytes, about 100 in number, and about 40 petitioners, only a few of whom ever arrived to occupy the land. Thirty-four settlers and five free neophytes received from 100 to 300 varas. Of the neophytes, each family was given 100 varas, and 50 varas to each single man. Bancroft (1883, vol. III) reported that the San Juan Indians chose the eastern valley, also known as the San Juan Creek Valley. Seventy-six years later, in 1917, a Juaneño couple told Father Sullivan (in Harrington n.d., Reel 121) that:

> When Santiago Arguello was sent here by the Governor he told the Indians they might choose either the valley of the Trabuco or that of the Mision Vieja. They choose the Mision Vieja, and

> lived all along the river, and up in the Gobernadora and the Canada Chiquita, where the remains of their dwellings may be seen.
>
> …A few Indian families remained on the Trabuco side, because they had roots (grapes, etc.) there; (1) Magdalena, the grandmother of Damian Rios, (2) Lazaro, the father of Acu, (3) Zephyrino Parojes and his wife Aguida.

Conditions in San Juan had gone from bad to worse. Of the five or six commissioners that were sequentially appointed, each soon resigned or proved unfit, and the pueblo became badly demoralized. Finally, in 1845, when Pio Pico became governor, a large part of the ex-mission buildings and gardens were sold to Juan Forster and James McKinley by order of the government (Bancroft 1883, vol. III:626-627).

Don Juan Forster

John Forster, who was listed in the Los Angeles Census of 1836, came to California from England in 1833 at the behest of his uncle to work in his import business with headquarters in Sonora, Mexico. In 1836, Forster decided to stay permanently in California, and the following year, he was baptised 'Juan' Forster in the Catholic Church and married Isadora Pico, sister of Pio Pico who, at the same time, became his sponsoring godfather. In late 1837, Juan Forster and his new wife, Isadora, seem to have visited the San Juan Capistrano Mission. In Book 2, the second Book of Baptisms, there is an entry on November 30, 1837, for a female child of 3 years old, Gertrudis, of gentile Yuman parents, their names were not inscribed, therefore probably not known. She may have been an orphan. Her godparents were listed as Juan Forster and Isadora Pico, and the entry was signed by Father Zalvadea.

The Forster family moved to San Pedro where they started a family, and Mr. Forster worked as a shipping agent for his uncle in Mexico, and also as captain of the port. Very soon thereafter, Juan Forster decided to go into stock raising and moved the family to San Juan in 1844. There they purchased the Mission San Juan Capistrano for $710 and moved their family into it (Bancroft 1883, vol. III:744), By that time, they had six children.

In 1845, Forster purchased the Rancho La Paz, later known as the Rancho Mission Viejo, from Agustin Olvera days after Olvera had received this large land grant of 46,432 acres from the new governor, Pio Pico. By 1846, Forster had acquired two more properties, the 26,632 acre Rancho de la Nación near present day Chula Vista, and 10,000 acre Rancho Valle de San Filipe east of Julian (JRP Historical Consulting Service 1991:13). This young man of barely 30 years now managed four ranchos of over 100,000 acres. Although some properties were lost, others were gained after California became part of the United States, and Forster continued for decades in the great tradition of the California ranchero. On the Ranchos Trabuco and Misión Vieja, and later on the Santa Margarita and Las Flores, it was primarily the Juaneño Indians, the former Capistrano mission neophytes, who were his work force. As Marinacci and Marinacci (1980:107) comment:

> The California vaquero was frequently Indian or part-Indian because the padres—the first big cattle ranch proprietors—trained their neophytes to the task…like their cousins on the Plains, but with the special skills needed for ranchos, they soon proved themselves among the best horsemen in the world.

It is not generally known that the Forster family went to live on Rancho La Paz, or the Misión Vieja as it was soon termed, but as Stephenson (1936:59) says:

> It has been generally been understood that in 1846 Forster and his family were living in the mission at San Juan Capistrano. According to the testimony in the proceedings of the land commission, however, it appears that Forster built a fine adobe at Mission Viejo in 1845, and occupied it with his family and all his property. "In the year when the Americans came," testified Brigidio Morillo [mayordomo for the Picos] at the Commission hearing, "the Indians began to steal his stock and Don Juan Forster took his family away from the place for safety. Three civilized Indians were killed by wild Indians." According to the testimony given by J. J. Warner at that time, Forster and his family occupied the adobe part of the time each year.

The fine adobe that Forster built for his family home is, most likely, the ruins today in San Juan Canyon that are thought to have been the original mission, Misión Vieja. It may be, however, that he did not choose a new site but began by adding on to the mission outpost that may have been the first building there.

Governor Pio Pico gave his brother-in-law and godson, Juan Forster, the Trabuco, which had reverted to the state when Arguello abandoned it. Pico increased the size of Trabuco to five leagues, called it 'Rancho Trabuco' and deeded it to Forster in 1846 (Bowman 1958:840). Along with Trabuco, Forster acquired the three mission portreros, or mountain meadows, called Los Pinos, El Carrizo, and La Cienega. Pio Pico had already acquired for himself the 89,742 acres of Santa Margarita y Las Flores, and San Onofre from Governor Alvarado in 1841, so now the two were neighbors in the sense that their lands were contiguous. Juan Forster was selected as a juez de paz for 1846-7, or a Justice of the Peace, and probably worked primarily in San Juan. His family lived there for twenty years, although they visited the rancho on a regular basis.

War was declared between Mexico and the United States by Congress in 1846. In Monterey, the American flag replaced the Bear Flag, which had been there for only one month, and a provisional American government took office. Forster was favorably disposed toward the United States but sympathetic with his brother-in-law, the Governor, who feared for his life. Northern California was pacified, so to speak, by the American Forces, and then General Fremont and his rangers--Kit Carson, backwoodsmen, and a company of Shawnees-- landed in San Diego to march on Los Angeles. There had been sufficient violence from the rough-necked rangers to worry the California government, and they recommended that Governor Pico escape to Mexico and explain what was happening in California to the Mexican government there. Of this escape, Pio Pico (Stephenson 1936:55) testified that:

> "The day I left Los Angeles, I stopped that night at the house of Don Ignacio Yerba (sic). The American forces were also stopping at the house of Don Antonio Yerba (sic). I went from there to San Juan and then to the mountains. I was in the house of Don Juan [Forster].

Under orders from Governor Pico, Forster took possession of Pico's property at Santa Margarita to protect it from the Americans. Then, Forster (Stephenson 1936:57) said that, at the Santa Margarita ranch, they were:

> …getting together horses, mules, provisions, and everything else needful for a sudden start upon an emergency. When all was ready, and an opening appeared for the Governor's successful exit to Lower California, he came to Santa Margarita, made his arrangements, and, having everything ready, he made a sudden start for Lower California on his way to Sonora.

According to Stephenson (1936:59), Pico's escape route from Los Angeles had taken him through Santiago Canyon, and across the Aliso and Trabuco Canyons to Forster's newly built adobe residence on Rancho Mission Viejo, 'located several miles up San Juan Canyon from San Juan Capistrano on a bit of mesa facing Gobernadora Canyon." There he had stayed for several weeks. The American forces were still looking for him while he was making his escape across the border. Pio Pico remained in Sonora until the provisional government in California was in undisputed control and safety was certain. He returned to San Diego on July 6, 1848.

Don Juan Forster, along with Juan Avila, were noted as being two of the typically affluent and generous hosts in the Californio tradition of southern California. In the Census of 1850 (U.S. Bureau of the Census 1850), the first American census in California, it is interesting to examine the occupants of the Forster mission residence. Besides his wife and their five children, there were Forster's two brothers and a sister from England in residence, and, outside the family, a laborer, a school master, and a ship master. The shipmaster was probably just visiting briefly, and the schoolmaster was, no doubt, being housed by Forster, as one of the affluent property owners. In the column for property, Forster has listed 20,000 acres, a small amount of his total acreage but more than anyone else in town had reported. Although a number of men owned I to 3,000 acres, the next largest property owners were Jose Sepulveda with 12,000 acres and Juan Avila with 5,000 acres. The former San Juan Capistrano mission remained the home of Juan Forster and his family until they moved to Rancho Santa Margarita y Las Flores in April of 1865.

The American government had created a legal process whereby the Californios could patent, or “prove up“, their Mexican land titles before the U.S. Land Commission. In 1865, after testimony by the Catholic Bishop, the Land Commission finally restored the missions, and five nearby tracts of land the Capistrano mission owned, to the Catholic Church.

Juan Forster filed his land claims in 1852 for both Rancho Trabuco and Rancho Misión Vieja, and they were accepted by the hearings board on October 31, 1854. Misión Vieja was confirmed by the District Court in 1857, after hearing an opposing appeal which had been dismissed. Both title patents finally were issued to Juan Forster on August 6, 1866, fourteen years after they had been filed (Bowman 1958:441,840). He was fortunate in that only one of his several land grants was never confirmed. His property made relatively rapid process through the bureaucracy, and he had relatively few legal entanglements compared to many of the other ranch owners in California. He was also fortunate, or frugal enough, or both that he had sufficient cash assets to retain his property through this process as many other Californios had not been able to do so.

American Period

In the early years of American citizenship, Californios, with their wealth in cattle, found great and immediate prosperity. The southern California cattle ranchers were amazed as the gold rush created a stampede of prospectors and other newcomers to swell the northern California population. The rapidly rising prices of beef in the new markets up north made the long cattle drives increasingly profitable. The skills of many Juaneño vaqueros were essential for the huge roundups and cattle drives to Sacramento and San Francisco, and all these men might be away for weeks at a time driving and tending cattle, or signing contracts with the butchers. Although some vaqueros owned property in Capistrano, they lived on the ranchos and on the road, and didn’t see their families for months at a time.

The District Judge, Benjamin Hayes (1929:116,198), made frequent trips on his legal circuit between Los Angeles and San Diego. His journal recorded the years between 1849 and 1875, and he always stopped for the night in San Juan

Capistrano. He kept an excellent account of his travels. In 1856, he says of Capistrano:

> San Juan boasts a peaceful population, in general. Sometimes they elect a couple of Justices of the Peace and constables. The "elect" are not of an ambitious class, and have never taken the oath of office since 1851. The last Justice of the Peace there had made several concessions of lots in what they still call their Pueblo—it was a Pueblo once—supposing that he had power to so the same as an alcalde…In all, there are 60 voters here… Fortunately, there is to be no payment of taxes this year. And my Indian friends were rejoiced when I told them this, for, robbed of the use of their lands by some of the worthless Sonorans who infest the county, they were afraid the Sheriff might take the land itself, and turn them out with their families to the mountains…

At this time, the Juaneño Indians were still farming land that had been distributed to them, or so they thought. Four years later, Hayes' notes read that he had just stayed overnight at Juan Avila's house, and before leaving town, stopped to visit with Mrs. Forster at the mission:

> Visit Doña Ysidora, the estimable lady of Mr. John Forster. He is now absent above, but expected on the next steamer. Doña Ysidora is a sister of Don Andrés and Pío Pico. Very lively; praises Nympha highly; insists that we must stop at her house on our return. Photograph of Don Pío hanging upon the wall…

Hayes' observation that Forster is not home suggests that he is probably in San Francisco selling beef contracts. Juan Forster, along with the other Californios of the south, had been facing the prolonged legal expenses of patenting his land, usurious interest rates for new business ventures, and exorbitant taxes on "unimproved" land. The California legislature was dominated by the northern mining interests who placed the burden of taxation on the south in a deliberate attempt to force them to break up their huge ranchos and sell them off, thereby encouraging an influx of small property holders and agriculture (Cleland 1951:122-124), Although Forster seems not to have been as extravagant as his brothers-in-law Pico, nonetheless his expenses were high and he often traveled to San Francisco to sell his beef.

A series of natural disasters hit southern California in the early sixties. The winter floods of 1862, and the following drought years of 1863-1865 devastated the cattle herds. Forster managed to save about half his herd one year by driving them south into the Cuyamaca Mountains. Cleland (1951:131) quoted Juan Forster as saying, "We poor Rancheros have had a damned bad string of luck these last two years and if it is going to continue I don't know what will become of us."

And, the next year, 1863, it got worse. A smallpox epidemic hit southern California, and despite attempts at quarantining whole towns, it took many lives. Judge Benjamin Hayes (1929:282) reported that:

> The Supervisors of Los Angeles County…appropriated $200 for the relief of the citizens of San Juan Capistrano. Regulations and instructions were sent by Judge Hayes in Spanish. At his request Don Juan Abila, Don Juan Forster, and Don Jose António Yorba took charge of the supplies purchased with the donation. They reported on Feb. 14, 1863, that relief had been extended to thirty-four families.

The Judge heard later, however, that their efforts had been ineffectual, or possibly just too late. And even though the smallpox vaccine had been available in San Diego, no one remembered to vaccinate the Indians there until Judge Hayes arrived. Given the size of the population, however, San Juan Capistrano was the hardest hit. Two hundred died, that figure included the Indians. Among the Juaneño, it was particularly devastating. The priest of the San Juan Capistrano mission recorded 129 Indian deaths from November 16th to December 31st, 1862 (Engelhardt 1922:205). Anastasia de Majel, a Luiseño who was born just after the 1862-3 epidemic and moved to San Juan Capistrano with her family, told Harrington that she did not "know all the words" in Juaneño because "all the Indians in San Juan" had died before she was born. Certainly, the epidemic had carried away all the older people, those who still were able to speak Juaneño, and probably many children also.

Almost none of the rancheros survived the widespread ruin of the mid-sixties. But Forster had been able to patent Ranchos Trabuco and Misión Vieja, and seems to have leased some portion of the Trabuco to Basque sheepherders, and possibly the Misión Vieja also. And his son Marcos not only organized the semi-annual rodeos at Las Flores, where he lived, but also grew crops and grains for ranch consumption while son Thomas was in charge of the sheep business, and Chico and Juan, Jr. led the cattle drives north (JRP Historical Consulting Service 1991:19).

As precarious as Forster's income may have been, he was always concerned and helping out with his padrino, Pio's, debts. Noted for their extravagance, the Pico brothers were often the instigators and supporters of the famous horse races in which huge amounts of money changed hands. Andrés Pico had already given his deed for one-half the Santa Margarita to his brother, Pio. To prevent the creditors' seizure of Santa Margarita from the debt-ridden Pio Pico, Forster received 1500 cattle and 140 horses from Pio and the deed to the property, then went to San Francisco to settle Pico's delinquent debt for $44,000 (Stephenson 1936:7). Cave Couts, who owned the neighboring Rancho

Guajome, later testified that Forster had paid far too much money for the rancho as it was only worth $30,000 and the starving cattle had negligible value. In order to pay Pico's debt, Forster took out new promissory notes on the Misión Vieja, the Santa Margarita, and others of his properties, so he could remain solvent. Then he moved his family into the Santa Margarita Rancho where they stayed for the next seventeen years.

There was plenty of work available on the Forster Ranchos. During the Civil War, there was a great demand for wool and all the rancheros increased their sheep herds. Cleland (1951:139) said that in 1870, the California wool clip amounted to 11,400,000 lbs. And according to Sleeper (1988a:196):

> During the 1870's some 20,000 sheep roamed Trabuco Mesa, then under lease to Miguel Erreca. Every other year two flocks of 2,500 each were driven north to San Francisco to market. Similar drives continued, but by rail after 1888 when El Toro got a siding. Much to his regret, in 1881 Erreca turned down a $4 per acre offer to buy the Trabuco.

The $4 per acre must have been the price Forster or his creditors would have taken for it. At that time, vaqueros were earning about $15 per month, and receiving their room and board free, and generous ranchers like Forster might throw in their tobacco and perhaps a gallon or two of <u>aguardiente</u> every month or so. Mayordomos, such as Blas Aguilar at Rancho Santa Margarita, had heavy responsibilities and might make $45 a month (Gray 1998:116). Each vaquero's string of horses was also provided by the ranch, but his saddle, bridle, and other equipment was purchased at his own expense. His <u>reata</u>, or rope, he made himself if he was good at it, or bought one from one of the expert vaqueros. He spent hours preparing his <u>reata</u> for use, stretching and smoothing it very carefully. He knew that the condition of his <u>reata</u> would decide whether its throw would be successful or not, according to Rojas (1964:28, 40) who also commented on the typical vaquero's demeanor:

> The Indian vaquero was sparing in speech, and serene under all circumstances. He was pithy in all his expressions and often spoke in metaphor or ironically. One would have to be well acquainted with him to know his meanings. He had a knack for giving names which never failed to correspond to something risible in their owners. His nicknames told the characteristics of the victim.

Nicknames are a very old tradition in San Juan Capistrano, no doubt stemming from a Hispanic-Indian tradition, and only those people who were well-liked and respected received them to their faces. At the same time, just being an Indian in California during the 19th and most of the 20th century was difficult to say the least. There was serious endemic discrimination, and, almost everywhere, Indians melted into their Hispanic heritage when they could. Nevertheless, on a cattle ranch, the Indian vaquero was highly respected for his skills and good qualities, according to Rojas (1964:24) who worked primarily on the Tejon Ranch in California's central valley where there were fewer Mexicans and more white cowboys. He said:

> When a vaquero was especially skilled, and he was asked how he had reached such a degree of proficiency, his answer would invariably be: "Me crié entre los Indios." I was raised among the Indians. Or when some vaquero had performed his work with great skill, the other men would look at each other, smile approvingly, and say, "Se crió entre los Indios pues." Well, he was brought up among the Indians.

In 1870, the Santa Margarita Rancho household, which composed family and employees, was probably more representative of the previous decade of Californios, but Forster was one of the few who were still quite well off. The 1870 Census (in JRP Historical Consulting Services 1991:15) enumerated 47 persons living in the Forster household. Two of the grown Forster sons, Chico and Juan Jr., ages 19 and 25, were still living at home, Forster's married brother had a house for his family nearby, and Marcos Forster, the eldest, had his own home at Las Flores. The forty-three employees included l0 female servants, one waiter, one houseboy, 12 vaqueros, three laborers, and one gardener. There were three married couples among them, and all these employees were Hispanic-Californians, i.e. Juaneños, and one vaquero from Sonora.

This census list does not include the populations on the outlying ranchos, the Trabuco and Misión Vieja where vaqueros supervised the cattle and sheep herds. Whether the census taker visited these more remote, isolated places is not known. Sleeper's (1985:5) notes say that Manuela Yorba de Pico occupied the Misión Vieja adobe in 1870, although he does not explain who she is or why she is there. He goes on to say that the telegraph now connected Los Angeles and San Diego, and that Forster had a telephone to communicate with Judge Richard Egan in San Juan Capistrano. Mr. Egan, a relative newcomer to San Juan Capistrano, was now the administrator of the Trabuco and Misión Vieja Ranchos. He is also an example of one of the new settlers who either took up lands made available through the Homestead Act, or were able to buy property from a bankrupt rancho. In 1870, he owned acreage near Trabuco Creek and raised barley (Hallan 1975: 44).

In 1872, Forster began to hear that the Picos were making claims that they owned a part share in the Santa Margarita. His brother-in-law Andres claimed that Pio had sold his half share to Forster, and that he owned the rest of the ranch. Pio claimed just the opposite, so each claimed 50% of the Santa Margarita ranch. And the widow of Jose Antonio, the third Pico brother, claimed that she held a quarter interest for herself and her children. Thus, Forster found that his wife's relatives were attempting to establish claim to 125% of the ranch of which he owned 100%.

Juan Forster brought suit to quiet title in the San Diego courts, and the Pico relatives filed suits against him. This very famous suit, Forster vs. Pico, was noted especially for the many prominent men of the time that testified (Gray 1998; Stephenson 1936), and their testimony provided history with an excellent picture of the American actions during the United States' annexation of California and the years of drought faced by the cattle owners which followed. The jury deliberated very briefly, and came back quickly with a decision for Juan Forster. It was said at the time that everyone knew how much Pio Pico enjoyed a good law suit, and that if he couldn't find one, he would buy one! This incident seems not to have destroyed family relationships permanently, and the Forster family watched over the Picos for many years.

Charles Nordhoff (1876:240-242) mentioned that he visited at the Santa Margarita where 30 to 50 persons were fed every day and "that more of the old Spanish Californian life remains than at any other I have visited. Spanish only is spoken in the family, and the old customs are kept up, not from any desire to be different from others, but because they are family habits."

The Californio lifestyle had faded away in most of southern California, but was retained by the Forster family. Nevertheless, Juan was farsighted, too, and took the lead in promoting and serving on the board of a railroad that was considering a coastal railroad route between Los Angeles and San Diego. Looking forward to the availability of modern transportation, he had plans for encouraging colonization of a new settlement to be carved out of his coastal land at San Mateo.

There were still a few Indian families living at San Mateo, probably left over from having moved there in the 1840's. An unknown Juaneño informant told Harrington (n.d.: Reel 121, Frames 0665, 0784,788) that his parents lived at San Mateo and were surrounded by the Forster property. He had been raised there, and his father cultivated land, and although they had eaten many of the Forster calves, the <u>patron</u> or owner didn't say anything. Forster was perceived as a generous patron, even though two families explained that they were "run out by the Foresters", one moved to San Juan Capistrano and the other to the Potrero de Los Indios, near the head of San Mateo Canyon. Teodosio Avelardez (sic) (Belardes), was said to have had a ranch there, a spread where he kept cattle, but he was also employed by Forster. Ambrosio Aguilar (so•'al), as he was called, was one member of the family told to leave San Mateo. He either already worked for the Santa Margarita ranch at that time or was then hired for the Rancho Misión Vieja.

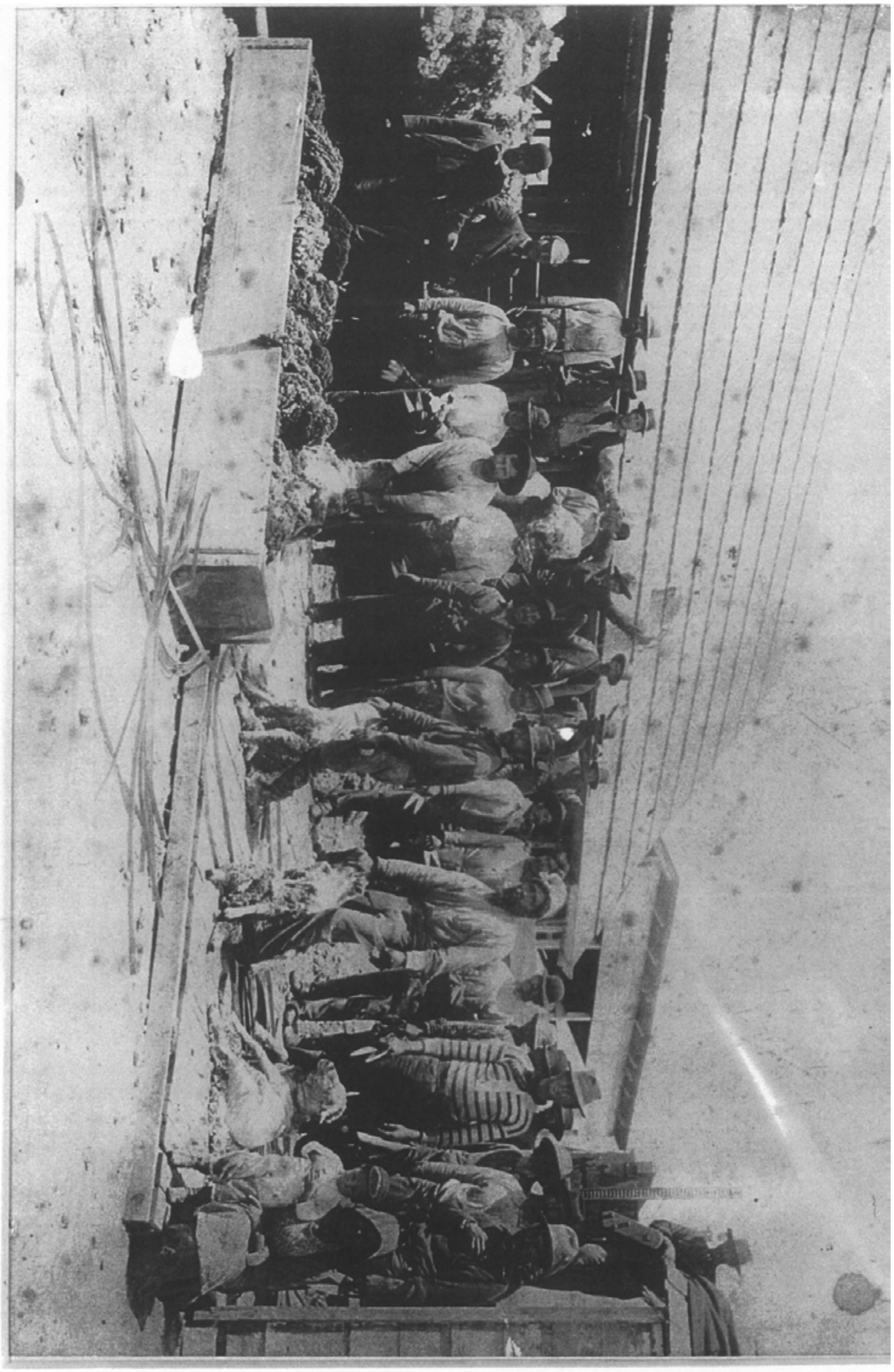
Forcing the Indians to move was a wasted effort. The Forster colonization plan failed anyway when Dutch commissioners reported unfavorably on it, and no Dutch settlers were allowed to migrate. Of course, the Forsters lost a considerable amount of money (JRP Historical Consulting Services 1991:23).

Evidence for what was happening on the Misión Vieja is sketchy. Sleeper (1985:6) reports that Don Louis D'Artigas, the "leading Frenchman in this part of the valley", was living in the Misión Vieja adobe in 1877. He was a sheep rancher (see below). 1877 was also a drought year, and Forster was again hard hit financially along with many others. But at this time, and for many years thereafter, the sheep industry was a mainstay of the ranches in the Capistrano Valley (Figure 1, sheep shearing in 1887).

José de Gracia Cruz, well known in San Juan Capistrano as "Acu" (Harrington n.d.; Saunders and O'Sullivan 1930), was a capitán of a sheep-shearing band from Rincon and Pala, reservations in San Diego County. Acu explained to Father O'Sullivan (Saunders and O'Sullivan 1930:54-55) in his later years just how that worked:

> "'And fifteen hundred sheep at ten cents a sheep, how much is that, padre?'
> "'A hundred and fifty dollars.'
> "'Well, that is what I used to receive from my patron, Luís Lartiga, who lived at Mission Vieja and had ten thousand sheep, and from Don Domingo Oyharzabal in San Mateo cañon, the one that goes up from the ocean down there beyond La Boca de la Playa. The ranch was called San Mateo, and the place where we sheared was el Aguage de la Piedra—the Water-hold of the Stone. I had from fifty to eighty shearers—Indians, Californians, all kinds of shearers. Acú, Indian—a good man, quien sabe! – was capitán. I got the shearers together and had them do the work and got their provisions. Flour and sugar were cheap. I spent twenty-five dollars a day for their meals, and gave them five cents a sheep for shearing.

And brief notes from Harrington's Indian informants provide interesting glimpses of the Misión Vieja. Anastacia de Majel, mentioned earlier as Harrington's linguistic informant, said she visited her uncle, her mother's half brother, Ambrosio só•al, or Aguilar as the white men called him, when he was mayordomo on the Misión Vieja. As Harrington (n.d.:Roll 122, frame 45-R, 54-R,192-L) says of Aj. (Anastacia de Majel):



Sheep shearing 1887. Acu was the major domo of the sheep-shearers. He wore an apron with pockets full of nickels. Each shearer was paid a nickel when he deposited a fleece. Copyright 1887 by I. W. Taber, Photographer, San Francisco

Figure 1. Sheep Shearing, 1897.

24.

Figure 1. Sheep Shearing, 1897.

> Aj got to see Ambrosio make jabon del pais [country soap] at the Mission Vieja adobe house, and also used to take already made soap And rebanan [dissolve] it into water and heat it and add cattle gall, and boil it down, and cool it off, and it makes a cake of greenish hand soap. And used this for wash and girls' face when it estaban mala de granos [was bumpy, had acne] and also hair. It made hair grow to hips and knees.

Another time visiting at the Misión Vieja adobe, she was frightened by ball lightning, a rare phenomenon that she and Ambrosio recognized as Taakwic, pronounced "Tak'-wish", a Juaneño-Luiseño spirit that carried off the souls of people:

> Aj. once at the Mision Vieja. Taakwic went by inf. (informant) as inf. was standing by the door, & it passed in just a moment, but was a powerful thing, and as inf. looked in the distance got to see curling white stuff like cotton. Ambrosio, inf's tio [uncle], was escarbando (digging) a posthole for the potrillos [colts], & He said: "'óonap taakwic", adding in Spanish that is bola de fuego [ball of fire]. Even as they spoke, it was already 4 miles away. And inf. said to her tia (she used to call her tia mother): madre, paso como un pajarito [mother, it passed like a little bird.]

Lucas Canyon on the Rancho Mission Viejo has a long history of individuals searching for gold there. The information for this activity is very sketchy so it won't be discussed here. But two interesting incidents came out of the Harrington (n.d. Roll 122:Frame 216R) notes. First, Marcos Forster, probably the grandson of Juan Forster called "Marquitos", told Harrington that Lucas Canyon, located "this" [west] side of the San Juan Hot Springs, was previously called La Cañada del Islay. The seeds from the Islay or Holly-Leaved Cherry (*Prunus ilicifolia)* were used for soup or a thin beverage but first were dried, ground into meal, and leached (Balls 1972:15). This naming of the canyon is in keeping with the Indian tradition of naming places by virtue of what resources may be found there.

Second, Anastacia de Majel also told Harrington a long story about her uncle living in Cañada de Lucas, or Lucas Canyon on the Misión Vieja. She narrated how her Uncle Ambrosio had "scattered barley seed secretly in this canyon & drove horses to stamp it in, & when the barley was tall, Ambrosio went to the Mision Vieja and told Juan Forster to come." And Forster came in a caleza [buggy], and Ambrosio had the adobe at the barley patch nicely swept to receive him. And when Juan Forster asked him, "How did you sow it?" He just said "it was a long story."

This little joke is readily understood with Anastasia's (Harrington n.d.:Reel 128:Frame 246) explanation that "when my tio came back from the placeres [marketplace], he was like a son of Juan Forster". The 'marketplace' Ambrosio returned from was undoubtedly San Francisco as Forster was reported to have sent large sums of money home concealed on an Indian, and very possibly Ambrosio was the one. And Forster was probably getting older or he would not have arrived in a buggy. Anastasia de Majel went on to suggest that Forster left the Misión Vieja house, probably the adobe in Lucas Canyon, to Ambrosio when he died, and that Ambrosio had died there. By this time, another Ambrosio, Ambrosio Valenzuela, the nephew of Ambrosio Aguilar, was working on the Santa Margarita.

These homely incidents which Harrington (n.d.) preserved as part of his Juaneño linguistic studies demonstrate how the Juaneños perceived the rich landowners for whom they worked during their possibly less-than-romantic Californio period. It is clear that Forster was viewed as a kindly and generous landowner who provided steady work and, occasionally, even food for the taking. In contrast, Anastasia commented that Cave Couts and his wife, a prominent couple of their day, the owners of the Rancho Guajome adjacent to the Santa Margarita, "measured the thickness of every slice of bread that they gave the vaqueros to eat" (Harrington n.d., Roll 121, Frame lll). Further, these few memories provide at least a brief glimpse of life at the Misión Vieja at that time.

In 1878, in anticipation of a coastal railroad soon to be completed, Forster financed an even more ambitious settlement than before, this time at the mouth of San Onofre Creek. He created a plan and proceeded to develop Forster City. Lots were laid out and put under contract to new settlers, and at least 35 families settled there in their house lots and another 20 acres to farm. There was a hotel and post office, and everything looked very promising. In 1880, Marcos Forster had even acquired a 12-horse thresher as an aid in harvesting the larger fields, and he shipped 4,000 sacks of wheat to the San Francisco market that year.

Juan Forster was a director of the San Diego & Los Angeles Railroad Co. and in 1882, the first railroad between Los Angeles and San Diego ran through Temecula Canyon to Fallbrook, and across the southern portion of the ranch (JRP Historical Consulting Service 1991:22-24). Much later, when the coastal railroad was the main line, the line between Oceanside and Fallbrook was just a branch that ran once daily. There were three stops designated on the Rancho Santa Margarita. They were: Ysidora (5.4 miles), Chappo (7.9 miles), and Ranch House (9.2 miles), the mileage calculated from Oceanside. There is no doubt that Juan Forster had named them for the first was for his beloved wife and the second for Ambrosio (Chappo) Valenzuela, the majordomo and best vaquero on his ranch (Baumgartner Jr. 1982: Appendix 8)

But the Forster family could no longer stave off bankruptcy, and foreclosure was barely held off with yet another loan in 1881. Before any financial recovery could be made, Juan Forster died and his wife followed shortly thereafter. All the ranch properties, including Forster City, had to be sold to cover the debts. Forster City was disbanded since the settlers did not have the ownership of their land there.

Rancho Santa Margarita y Las Flores: 1882-1942

Hearing that a huge southern California ranch was for sale, Richard O'Neill, a 57-year old butcher-turned-cattleman traveled south to see it. He had worked hard all his life, and despite all, he had missed out on a fortune thus far. But he had recently spent two years learning to manage a cattle ranch in northern California, and made a grand success of it only to have it sold out from under him. His one advantage was that the new owner had described this opportunity to him.

Born in Brigtown Parish, County Cork, in the heart of Ireland's dairy country, he had left with his family at a very young age to resettle in New Brunswick, Canada. Life was hard in a fishing community where his father was a butcher, and he was apprenticed in the fishing industry. He left for Massachusetts, and there he heard about the gold strike in California, and immediately booked passage on a ship bound for the new lands. His months grubbing in the gold fields brought only a little reward, and so returning to San Francisco, he settled on his family trade and opened a small meat market. Here he prospered, married, and bought a home for his wife, Mary, whose maiden name had also been O'Neill. They had four children.

Among O'Neill's business acquaintances was James C. Flood, an Irishman who had opened a saloon across the street from the Mining Exchange. Flood purchased meat from O'Neill for the food he served in this very popular saloon. Business transactions frequently took place there, and Flood began to speculate in mining stock. In very successful negotiations, he managed to acquire the Comstock Lode in Nevada, America's most famous silver mine, and become fabulously wealthy. O'Neill tried speculating but lost a huge investment, and had to leave his excellent location for a fresh start. By his hard efforts, he repaid everything he had borrowed. Flood was so impressed with his friend's tenacity and honorable behavior that he hired him to manage a run-down cattle ranch in Merced. This was the very success that made O'Neill want to continue in ranching, this time owning his own land (Baumgartner 1989:4)

After a week of inspecting the rich resources of the Santa Margarita ranch, riding all over the various ranchos and probably even inspecting the three high mountain potreros, O'Neill returned to San Francisco to propose to James Flood that he buy the ranch. The Forster heirs wanted $250,000 for their share and the creditors were owed almost that much again. On hearing the proposition, Flood, in return, proposed that he would buy the ranch and they would become equal partners, O'Neill would manage the rancho at $500 a month investment and would eventually own his half. Although at the purchase price of $457,000, it could have taken O'Neill thirty-seven years to own his half, he was convinced that this was a good deal. In fact, James Flood died in 1888, but their contract remained. Although the widow, Mary Flood, received a half share, her son, James L. Flood, had the final control.

Richard O'Neill acquired ownership in his half of the Santa Margarita ranch in 1907, 25 years after the original agreement between the two men. He immediately deeded his undivided half interest to Jerome, his eldest son. His other children received money and other properties such as the home in San Francisco (Sleeper 1985:10; 1989:160-161).

The 1882 sale of the Santa Margarita to the O'Neills included 1000 head of cattle and 500 horses and mares, and sundry personal property. There is no mention of whether the property included the 12-horse thresher Marcos Forster had purchased. But if the cattle mentioned were those in the 1880 agricultural census for Marcus Forster, at least 500 were purebred, 70 were dairy cattle and 200 more were the long-horned, tough Mexican cattle (JRP Historical Consulting Service 1991:24). Further, there was Marcos Forster's very nice house at Las Flores, and the Santa Margarita ranch house, which was considered by many to be the state's most pretentious adobe, being 300 feet long by 80 feet wide (Baumgartner 1992: footnote #5). And there still was a very nice adobe at the Misión Vieja, and the Trabuco adobe where Miguel Erreca, a Basque sheepherder with a lease, was still living (Sleeper 1985:7).

The Richard O'Neill family moved into the Santa Margarita ranch house, and planted 400 acres nearby in alfalfa. The Misión Vieja (Rancho Mission Viejo) was turned into a cattle ranch, and the Rancho Trabuco continued to be used for sheep raising since there still was insufficient water in Trabuco Creek for cattle. Miguel Erreca lost his grazing lease on the Rancho Trabuco after O'Neill took over, and moved his sheep to the Irvine Ranch for nine years (Osterman 1988:11). By 1890, Baptiste Duhart, another Basque shepherd, and his familys had moved into the Trabuco adobe. Decades later, Harrington's (n.d.:Roll 121:Frames 737, 722) Indian consultant from Capistrano remembered that "Pete Dewhart's (sic) is the Trabuco adobe", but thought his family lived there in the early 1900's. He also remembered that the Plano Trabuco was called "tcikwa'xava' in the Juaneño language.

In 1891, it was reported that there were 2,000 head of cattle and 200 head of horses being raised on the Rancho Mission Viejo (Hallan 1975:60-61), and Marcos Forster and Richard O'Neill were the major cattlemen in the Capistrano Valley. They shipped to markets in San Francisco, Los Angeles, and San Diego, and the shipping was all by train from stops at San Mateo and Las Flores on the Santa Margarita Ranch. Figures 2, 3, and 4 show early activities on the ranch.

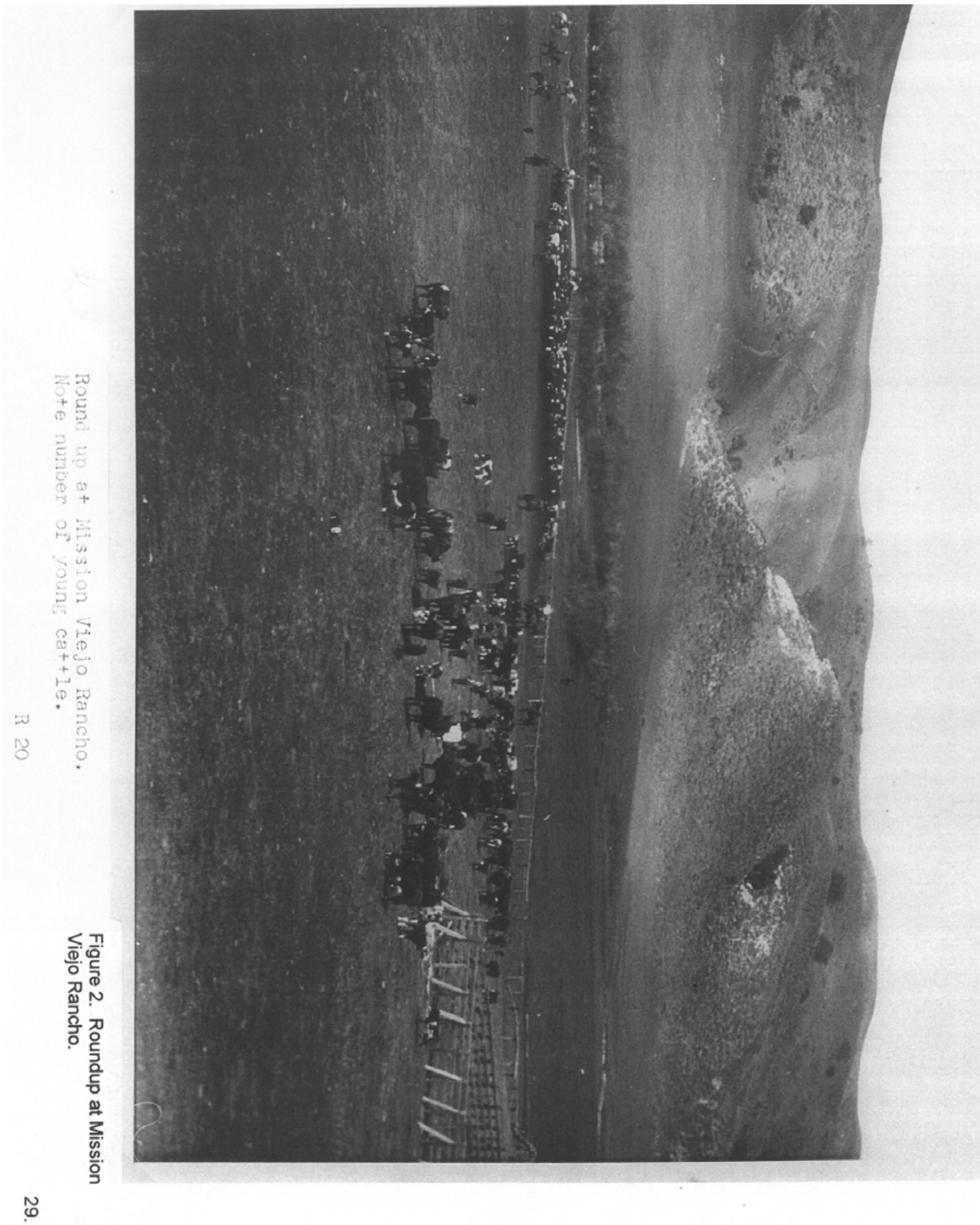


Figure 2. Roundup at Rancho Mission Viejo.

Figure 3. Dehorning Cattle.

The thirty-two mule grain harvester on Rancho Santa Margarita in 1910. R23

Figure 4. Thirty-two Mule Grain Harvester.

31.

Figure 4. Thirty-two Mule Grain Harvester.

As the greater Los Angeles area grew, and especially south county, the residents there wanted more local control. These coastal people felt ignored by the county government in Los Angeles, and after a state lobby failed, some prominent men went to Sacramento and were able to get a bill to create Orange County passed and signed. The bill then had to be ratified by the affected residents, and out of the 3,009 votes, only 500 were against ratification. In San Juan Capistrano, the vote was 80 to 16 for becoming a separate county. Although the Capistrano vote by 96 citizens is an indication of a growing population, it seems to be a very slow growth compared to other areas of Los Angeles and Orange County (Hallan 1975:64).

Orange County had its own special resort which, although it now began to receive publicity, had always been known for its curative attributes. The San Juan Hot Springs, twelve miles east of Capistrano, had been a significant resource for the Juaneño Indians, who called it "ateyva" (Harrington n.d., Roll 121, Frame 745-L). The mission fathers and the Indians under their care visited it for its supposed health values, and, at the turn of the century, increasingly, it attracted tourists and vacationers. At that time, It was enclosed by the Forster holdings, and was sold to Flood and O'Neill as part of the Santa Margarita Ranch.

When Mr. Kraszewski, a retired storekeeper from Capistrano, leased the San Juan Hot Springs from the O'Neills, it already had a hotel, but he added various types of accommodations, such as more cabins and tent areas around the pools. The railroad made it much more convenient to visit by outsiders, and from the new Capistrano railroad station, the visitors could find inexpensive transportation by carriage. After 1902, when Mr. Kraszewski retired, there were a series of proprietors that increased the available social activities with many building additions, more tents, and events.

According to John J. Baumgartner, Jr. (1982:46), grandson of Richard O'Neill, his uncle Jerome O'Neill had a cottage built across the creek from the hot springs, and the grandchildren spent quite a lot of time down there, mostly in the summertime. The residents of Capistrano went there for dancing, concerts and picnics. The Springs were a well-known and popular resort until 1936 when they were closed for health reasons, and the 75 buildings there sold to the various residents of San Juan Capistrano and moved to various locations around town (Hallan 1975:70-72).

On the Santa Margarita Ranch, very soon after he purchased it, Richard O'Neill leased 1500 acres and the Las Flores house, and later added another 1500 acres, to the young Magee family. They were descendents of an American soldier who arrived in 1897 and had been stationed at the San Diego Presidio. The young Lieutenant Magee married Victoria Pedrorena, a daughter of one of the illustrious Californio families, and acquired the Castro Rancho in San Luis Rey Valley. His widowed descendent, Henry Magee died, leaving eight children, the eldest two being Jane, age 22, and Henry, age 24. While Henry took over the field management of Las Flores, and maintained it for 25 years, his sister Jane, who never married, ran the business end and reigned as family matriarch there until 1938. When she retired, other Magees took over. Their long-term relationship with the O'Neills was a close one, the O'Neill children and grandchildren always welcome at the Magee residence and both families spending Christmas and Easter together.

One of the Magee family, described as Jane's sister, Luisa Magee or "Aunt Wee", lived there too. She was the illegitimate child of a Magee uncle and an Indian girl, and had been partially raised by the Estudillo family. In the 1900's, she moved to the O'Neill ranch and took care of Richard O"Neill in his ailing years, then Mary O'Neill, his wife, until she died, and was housekeeper to the O'Neill household at the same time (Baumgartner 1989:101-103).

The Magees raised chickens, pigs, and cattle but their major crop, for which they were locally famous, was lima beans. The climate along this narrow stretch of coastline was mild with constant moisture in the air, perfect for a summer crop that did not demand irrigation. Large-scale mechanized production on 15,000 acres was not uncommon, and the cattle could be brought down from the mountains in the early fall to graze off the stubble and dried vines. Until 1962, all lima and baby lima beans in the United States were raised in California, and the Magees had one third of the total acreage in San Diego County planted to lima beans. Jane Magee was, for years, referred to as the "Bean Queen of Southern California" (JRP Historical Consulting Services 1991:26-28).

Richard O'Neill's four grandchildren, the offspring of his youngest daughter, Mary, spent their early years and most of their summers on the Santa Margarita Ranch. During the school year, they lived in San Francisco with their parents, the Baumgartners, where their father practiced law. John Jay, Jr., born in 1901, and Jerome O'Neill Baumgartner, born in 1903, the two youngest children in the family, have left detailed accounts. The latter, the Jerome O. Baumgartner memoir, was recorded, edited and published by his son, Jerome W. Baumgartner (1989). Both men were in their seventies when they were recalling the life style and events of their childhood on the ranch, and all the family and folk who lived there (Baumgartner 1982, 1989), For the purposes of identification here, I use their first names, John or Jerome, to identify the speaker.

Jerome (Baumgartner 1989:122) or 'Jome' as the family called him, commented that:

> The vaquero camps were always fun for John and me and we'd spend as much of our summers as we could living with the vaqueros. I think we were a nuisance to them, but they were very patient. We were the nephews of the Big Boss and they had to look out for us so we didn't get into trouble.

John Jay, Jr., two years older, was the acknowledged ‘cowboy’ of the two, and as an adult in northern California, was a cattle rancher most of his life. He (Baumgartner 1982:41) described riding into Capistrano and returning at night across the Mission Viejo:

> My brother and I, when we were youngsters, we would be with thevaqueros, and we would stay there at that wonderful restaurant…El Adobe…it’s run by the people that ran the restaurants for the Santa Fe railroad…And we’d ride back toward evening, maybe late after dinner when it would be start getting dark and my brother and I would get frightened when we’d get close to that Mission Viejo, that old place there, because people would go there and dig holes looking for gold that the Fathers left there…Anyway, we were told about it and we’d get scared and we would lope those horses, run those horses clear back to the camp…Don Esteban would make us lead those horses around until they cooled off a little bit.

“Don Esteban” was a term of respect the children used to address Steve Peters, the head vaquero of the main ranch after Ambrosio Valenzuela, or “Chapo” died in 1911. Mr. Peters was from San Luis Rey, possibly a Luiseno on his mother’s side, and his son “Viejo” Alex Peters also went to work for the ranch. In a photograph dated 1920 owned by John J. Baumgartner, he, as a youth, is on horseback side by side with vaqueros named “Cholo” Alvarez, Cecil Martinez, Ambrosio ‘Chappo” Valenzuela, and his son of the same name. By this time, the final Ambrosio Valenzuela discussed here is the 3rd generation of relatives that have worked on the Santa Margarita Ranch. Anastacia de Majel (Harrington n.d.:Roll 122,Frame 39L) who has related most of these stories, is related to all of them. But the oldest two, Ambrosio so’al Aguilar and the first Ambrosio Valenzuela, are her uncle and her half brother. She says of the former, that he won a championship at Coronado and died with honors, and of the two of them that they were the best vaqueros in all of southern California. The 3rd generation, Chappo’s son, Ambrosio, was younger than Baumgartner and worked on the ranch long after the latter was grown.

There were at least six to eight vaqueros on the ranch at all times, and Tiano Bourel, Damian [Rios], “Capitan” Stanislado Morales, “Chulo” (Jose de Gracia, also sometimes called “Gaza”) Olivares, Philip Crosthwaite, Secutha, and “Chico” or “Chio”, the vaquero cook were some of them. Hugo Forster, a third generation Forster, Boyd Sleeper who had a ranch on Trabuco, and Delores Yorba seem to have been cowboys who took part in the roundups. Almost all these vaqueros had nicknames, and so did family members such as Uncle Dick O’Neill, who was teasingly called “flojo” or ‘lazy’. (Baumgartner 1982:11,43, 49).

The vaqueros remembered best were those who lived in the adobe bunkhouse at the ranch house on the Santa Margarita. Those stationed on the Mission Viejo, and possibly there were some on the Trabuco, the boys might have seen only at the big spring and fall roundups when cattle were brought in from all the ranchos, and many extra vaqueros were hired. But the ranch house was connected by telephone to all parts of the ranch: the Magees at Las Flores, the Rodriguez' family at San Mateo, the Capitan's house at the Mission Viejo, and for the outside world, Mr. Everett at the grocery store. He had the telephone exchange in Oceanside and could put a call through outside the area to Los Angeles or San Francisco and, even more important on a daily basis, Mr. Everett would take orders for groceries and send them out to the ranch on the train that day. The daily train to Fallbrook made a stop at the ranch house (Baumgartner 1989:33).

Living conditions for the vaqueros hadn't changed much in a long time. As Jerome Baumgartner (1989:124) put it,

> The ranch provided the workers with three meals a day and a place to sleep, period. The workers provided their own blankets. The ranch gave them three meals a day, seven days a week and paid them. The vaqueros got more money than the laborers. The average laborer got about $30 a month and the vaqueros got about $45, which wasn't as bad as it sounds. It wasn't what you'd called princely pay, but $45 was a lot of money in those days.

In contrast, the Floods would visit the ranch in a private railroad car, loaned by Santa Fe, which would be parked on a siding near the ranch for a couple of weeks. They seldom traveled down from San Francisco more than once a year, usually for the bird-hunting season. Jerome O'Neill, after he was manager, would visit San Francisco a couple of times a year to discuss business with James Flood. In 1910, Richard O'Neill, who had been ailing and partially blind for some time, passed away. He was 88 years old, and as John Clay (1964:19) described him:

> the most clean-cut man he ever met, a master of his business, silent, shrewd, persistent, decisive, with a keen, caustic wit, yet under all a kindly disposition. When alone with him he talked freely, in fact he gave liberally of his experience. He was a well-versed student of the cattle business.

He was taken on the train to be buried in San Francisco, and as the train passed slowly along the tracks through Orange County, people came to the side of the tracks to bid him farewell.

Evidently, there had been an understanding that the oldest son, Jerome O'Neill, would inherit the ranch and the others would receive cash compensation through the years. Jerome had been managing the ranch for some time and was the only O'Neill offspring raised on the ranch and trained to run it. Further, he had had infantile paralysis and, although he was a superb horseback rider, he was not able to drive a car. After he purchased one, he hired Carl Romer, another young man married to a Forster, to chauffeur his automobile. Jerome O'Neill never married.

His married sister, Alice O'Neill McDade, who lived there for many years after she was married, finally left to join her husband in San Francisco and was estranged from the family. She had been the housekeeper, and after that, Aunt Wee McGee took over that role and cared for their mother, Mary, until she died at 93 years in 1916. In that same year, the ranch house was increased in size to 23 rooms, one of which is an office with the first typewriter, and three rooms across from the ranch including a dining hall for the vaqueros. The next year, indoor plumbing and electricity was installed in the ranch house, although the latter at first only with a generator. The next year, San Diego Gas & Electric got a right-of-way through the ranch to Capistrano, and the ranch was connected into the line (Sleeper 1985:11).

Jerome Baumgartner (1989:123) described the temporary vaquero accommodations for roundups as follows:

> In 1915, Uncle Jerome decided to get a little modern and had bunkhouses built where the vaqueros always made camp [probably at San Onofre]. Actually they were more like barracks than bunkhouses. They were just board and batten buildings with wood floors—hotter than hell in the summertime…The vaqueros would pile a little hay on the boards and spread their blankets out on that. It got cold in the wintertime, but it wasn't anything like Wyoming, no blizzards or snow. There weren't any stoves or fireplaces and besides, the camps weren't much used in the wintertime.

Although the ranch didn't reach its peak of 27,000 head of cattle until 1925 with well water then available in San Juan Creek, the ranch was prospering (See Figures 5-7 for ranch life during this time). In 1917, the black-eyed peas, limas, and wheat that were being raised on the Trabuco and Las Flores, and cattle from the Santa Margarita were selling for top dollar. The ranch was selling 1500 cattle and 500 hogs annually, all these crops to the United States Government who was responsible for feeding a large military force during World War I.

But as vaqueros were going off to military service, even more were needed. Abel "Viejo" Majel, Joe Avila, the brothers L. and Tom Ramos, Adolpho Manriquez, and the Jose Gracia Olivares family, all from San Juan Capistrano, were then living and working on the Santa Margarita Ranch. Jose "Chulo" Olivares and his wife, Vivian, already had nine children when they moved to Rancho Mission Viejo

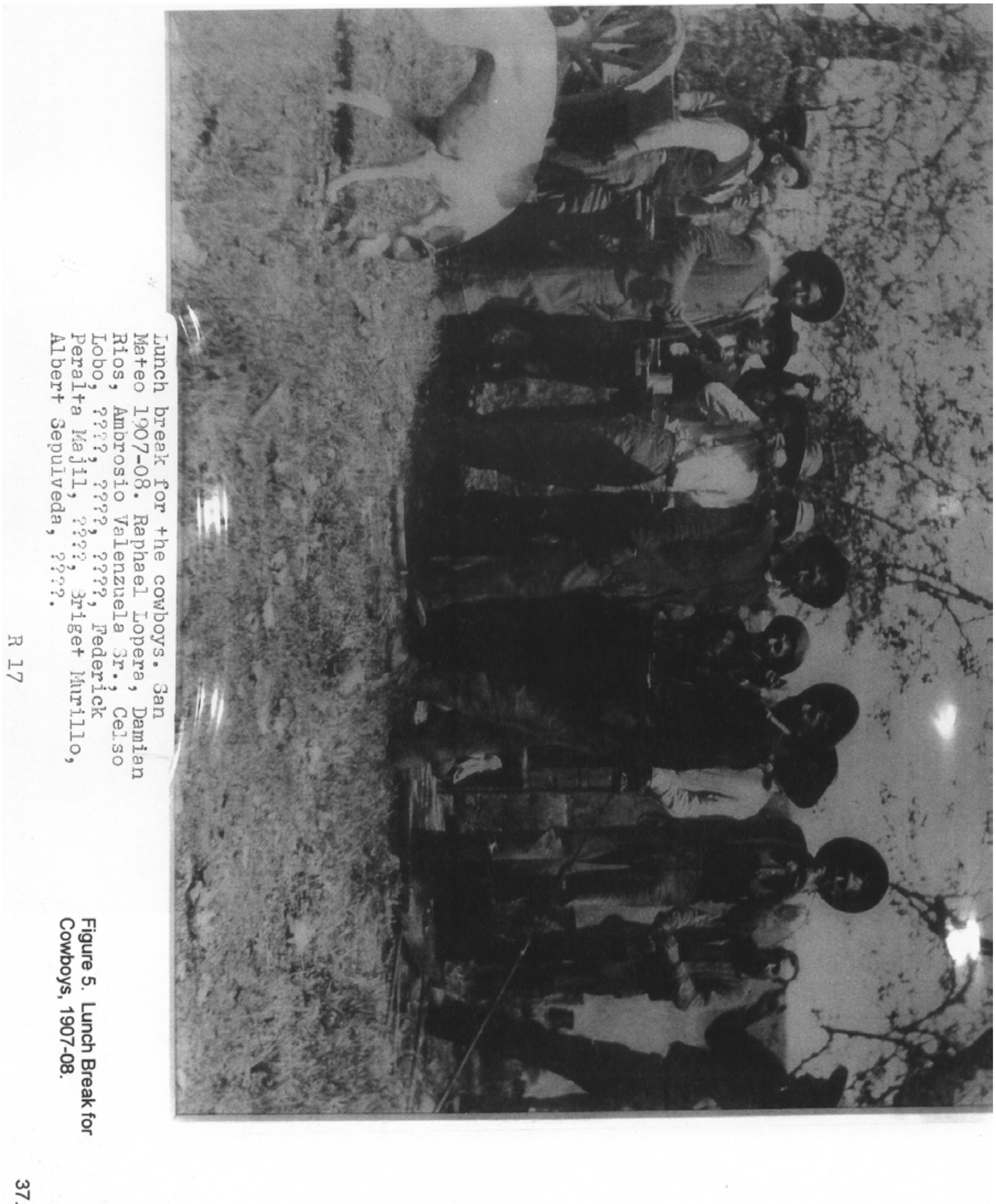


Figure 5. Lunch Break for Cowboys, 1907-08.

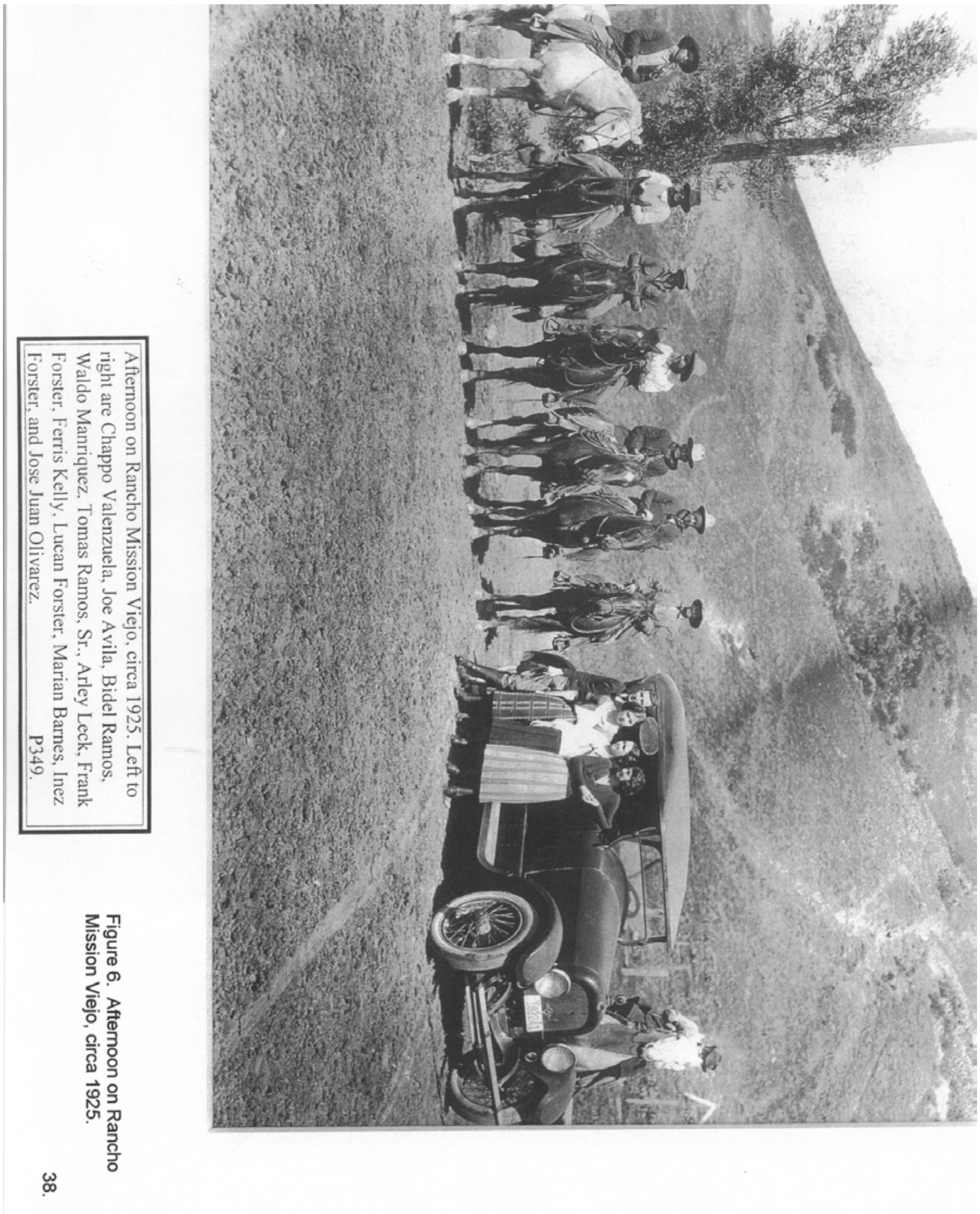


Figure 6. Afternoon on Rancho Mission Viejo, circa 1925.

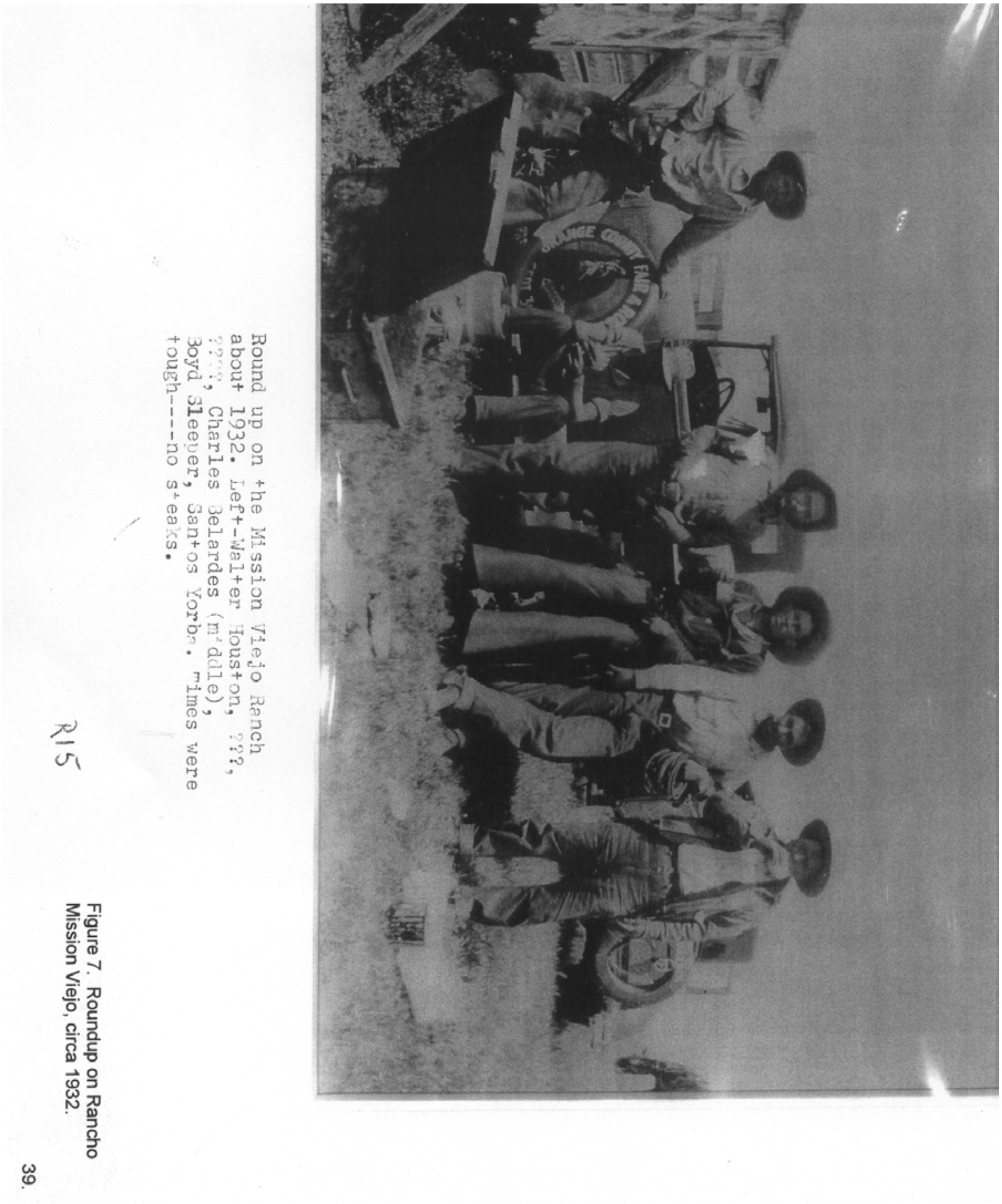


Figure 7. Roundup on Rancho Mission Viejo, circa 1932.

to live in the Line Camp ranch house. Many years before, Vivian's father, Patricio Ricardes, had been a sheepherder out on the ranch but died of pneumonia in the 1890's from tending sheep on a rainy night. She and Chulo had four more children born at the Rancho Mission Viejo, and then they moved to the San Mateo Ranch House when Chulo became foreman there in 1932. Various grandchildren came to visit, but two of them, Teeter Olivares Romero and her brother, came to stay until their grandfather retired.

Clara Olivares Hostler, born in 1913 before the Olivares family left Capistrano, shared her memories of growing up on the ranch with Betty Rivers (1991:47-48) before she passed away. The family lived on the Mission Viejo about two and one half miles east on what would now be the Ortega Highway, and in 1990, their house was still standing. Clara, and her brothers and sisters walked to San Juan Capistrano for school and her brother, Lawrence, the oldest, got to finish high school. The only time that Clara missed school was in 1919, when the family moved to the San Mateo. Their ranch house was in the San Mateo Canyon, near the Christianitos fork:

> The creek ran so high at one time, Clara remembers, that the family could not cross for a month. Jose [her father] "would cross on horseback to get groceries." From a later period, Luis recalls that the creek flooded high enough to carry off the woodpile in back of the house, and that "the ground would shake like Jello" after rain.

Luis, Clara's brother born in 1920, was called "Yo-yo". He went to work for the ranch under his father, the foreman, when he was fourteen years old in 1934. But in 1920, after Clara had briefly attended the newly established school in San Onofre by horse and buggy, they moved back to the Mission Viejo. Her mother, Viviana, took in boarders, grew vegetables, and kept a cow to add to her husband's income. She was also able to order some food wholesale through the ranch. Clara, on the other hand, left the ranch when she was sixteen and found that there wasn't much work available to girls her age in 1939.

In 1923, Jerome O'Neill and James L. Flood decided to incorporate the various ranch parcels under the name "Santa Margarita Ranch, Inc.", and to issue stock to the various family members. But Jerome's brother and sister, Dick O'Neill and Mary Baumgartner, continued to receive money from the ranch. Jerome O'Neill was continually purchasing their ranch stock, again a plan that seems to have been decided beforehand (Baumgartner 1982:4-5).

By this time, the young Baumgartners, who had observed two decades on the ranch were not spending much time there any more. And in their detailed memories of the ranch and particularly the life of the vaqueros, they seem not to have known that the vaqueros were Indians, or at least part-Indians, the Juaneños of San Juan Capistrano. In particular, Jerome Baumgartner (1989:108) remarked that the men spoke Spanish, but explained that by saying:

> A great many of the people who worked on the ranch were not from Mexico but were from Capistrano and San Luis Rey, and their families had come with the padres in the old days. They were fourth-generation as families. In my day on the Santa Margarita, places like Capistrano were made up of people of Spanish descent.

John Baumgartner, on the other hand, seems to have recognized some workers on the ranch as Indians, but not the vaqueros from Capistrano. John Baumgartner (1982:10,14,17) said:

> If someone was hurt on your ranch, why, you took care of them and their family, which the O'Neills did for these vaqueros at San Juan Capistrano, and the Indians from Pala, and Baja California too….

And in answer to a question about hunting, and deer on the ranch, he says:

> …the Indians from here-well, they were really half Indians, and they were good shots with the rifle-would follow a deer for a day and a half before they would catch up with him. But they would get him.

And, finally, with household chores which were not the responsibility of the vaqueros:

> We had Chinese help in the kitchen and then they had an Indian or two to help wash the dishes and to help around when they had lots of men…The bathroom was a bathtub out in an adobe building, right next to the outhouse as we called it. The Indians would have to carry the hot water from the kitchen out to the bathroom if you wanted to take a bath.

Most of the vaqueros were Juaneños on the ranch payroll at this time. In fact, most of the vaqueros were probably part-Indian whether they were from Baja California, Mexico, or Capistrano. With Spanish-Mexican surnames and speaking Spanish as their first language, they were apparently not identified as Indians by the Baumgartner children. Further, the vaqueros were unlikely to have been discussing the subject of their identity, especially in English, and the Baumgartners did not understand Spanish.

During this time, there were various mining experiments, such as tin, gold, silver, and oil going on nearby. One such location was the Trabuco area (Sleeper 1985). Another was the most continuous and long-lived mining venture on the ranch – clay mining – in Gabino Canyon. Joseph Yorba (1976:11), son of John and Marie [Rios] Yorba, and born about 1900 in San Juan Capistrano, was a young worker. One day he was fired from bean threshing, probably on the Trabuco mesa, and hired the same day by a man who had leased the clay fields in Gabino Canyon from the Mission Viejo Ranch. Young Joe Yorba seem to have been hired at the very beginning of the mining venture and worked for a year digging white clay. He was hired by a second company when it took over the workings. Then Yorba had to join a union, and began to work a nighttime, 8-hour shift of a 24-hour operation, but with this second company, he made more money. The white clay, he was told, was used to make spark plugs. Yorba (1976:11) reported this experience:

> Then the day shift came in at eight o'clock until four o'clock. Four trucks hauling clay all the time. One of the loaders, he lived on Los Rios Street…Clarence Lobo! He used to drive the truck. At that mine, I used to do everything. I powdered, dynamited, you know, I drilled, worked on the track. I put in chambers. I used to be a helper for the timberer. The timberer used to lie down and go to sleep.

Mr. Yorba worked there for twelve years, but the mine closed down, he claimed, when the O'Neill family raised the lease another dollar per ton. The Clarence Lobo, mentioned above as the truck driver, was the acknowledged leader of the Juaneño Band of Mission Indians during the late 40's and early 50's.

In 1926, when Jerome O'Neill died unexpectedly at age sixty-five years, he had probably been suffering from the late complications of his infantile paralysis. Somewhat strangely, James Flood, a man of his own age, had passed away just two days previously in San Francisco. But as before, everything had been carefully arranged.

At that time, the corporation was dissolved, and the Santa Margarita left in trust for the O'Neill grandchildren as heirs. Mrs. Flood, the widow, was left the owner of the Flood half of the ranch. A new manager, Charles Hardy, hired in 1925, was well trained and continued until 1931 when he died. During that time, the right-of-way was designated through the ranch for the Ortega Highway, and in 1929, before construction commenced, the last cattle drive up to the potreros in the mountains was completed. When Hardy died, Richard O'Neill, Jr., then sixty-eight years old, began to take an active role in managing the ranch and continued to do so until 1935. He hired both Harry Whitman and John Salisbury, the latter being a former ranch lessee, as superintendents of different parts of the ranch (Sleeper 1985:14).

John Salisbury, who managed the various crop leases and the ranch crops, was also managing a large herd of sheep on the Rancho Mission Viejo. He and Mr. Bidart, the Basque sheep owner on El Toro Ranch, were having a terrible problem with coyotes at lambing time. Following complaints to the federal predatory control officer, the government hired Albert Walter of Orange to trap coyotes in Orange County for several years. Al Walter (1971:17) explained that the various ranches handled lambing differently:

> In Irvine, when they would lamb, they'd bring all of their sheep in and lamb them in the yard. They had their sheepyards down by the saltworks down in Newport, in the back bay country down there. But John Salisbury, on the Rancho Mission Viejo, lambed on the range. When he had so many ewes that were ready to lamb, he'd just run an iron stake fence, or a woven fence, around so many and they'd ewe right on the range. Well, the coyotes got to following them and he just lost them right and left.

The federal government paid a salary and mileage on the car, and although he was supposed to work an 8-hour day, he actually worked an 8-hour night setting traps and then collecting them. Salisbury was very pleased the first season, and said, "This is the first time that I've ever been able to lamb and not lose sheep." But both ranches eventually stopped raising sheep in preference to handling larger numbers of cattle.

The Depression of the 1930's is remembered as a hard time by all. There is no question that urban folk suffered most, that agriculture in rural areas such as Capistrano remained the safety net for local people. But, as Hallan (1975:74) recorded of agriculture from the townspeople of San Juan:

> It provided employment, and food, yet for some there was no work, no money and nothing to eat. One resident recalled subsisting on a diet of fish, cabbage and whatever he could catch in the nearby Cleveland National Forest. Another confessed to poaching on the O'Neill Ranch. The Works Progress Administration put some people to work building roads and firebreaks, and a Civilian Conservation Corps opened in the nearby national forest, though most of its workers were imported from another state. The town was loaded with vagrants, many of them knocking on back doors looking for something to eat. Stomachs were empty and work was scarce.

But 1932 showed two signs of improvement, both of which affected the Santa Margarita Ranch. Construction of the Ortega Highway from San Juan Capistrano to the San Juan Hot Springs began, and not only provided work for many men but a better transportation route for the ranch. And in the same year, the American Fruit Growers leased 700 acres on the Santa Margarita, Echenique, and Forster ranches for growing row crops such as eggplant, lettuce, sweet potatoes and bell peppers. The company also intended to pack and ship local crops, such as tomatoes and oranges, from Capistrano. That year, the Blue Goose label marketed 148,000 boxes of oranges, which provided work for many, especially women, and was one of the town's leading industries (Hallan 1975:96).

During the depression, strangely perhaps, there were the beginnings of concerns for historic preservation, as many old buildings were being razed because they had deteriorated badly and were fire hazards. Building materials were continually being taken for reuse elsewhere, and in fact, tiles from the old Misión Vieja adobe were excavated and taken to be used in the yard of the Santa Margarita ranch house. Among the projects selected to put people to work by the Works Progress Administration (WPA) was a study of the various Orange County adobes and their condition by C.E. Roberts (1936; Sleeper 1985:14), Roberts wrote of the Trabuco Mesa Adobe and the Rancho Mission Viejo Adobe:

> Alone in the middle of a huge cattle range, commanding a long mesa shut in on all sides by rugged hills, its setting is perhaps less changed than that of any other in this area…the big rancho has been joined to some still larger and the house has not been needed.
>
> Tradition has always connected the Trabuco adobe with San Juan Capistrano Mission and the manner of its construction bears out the tradition.

Of the Rancho Mission Viejo Adobe:

> Nothing is left of this adobe save a huge mound of adobe clay and broken tile but it is well remembered by many people living in that region. The last residents were Basque sheepmen, after whose occupancy the building was abandoned.

But on the Santa Margarita Ranch shortly thereafter, momentous changes began to take place. In 1938, for the first time, large parcels of ranch property were being sold, possibly as a result of the continuing economic conditions or efforts to pay taxes, or both, although rumor had it that a Flood paternity suit was involved. In any case, the oil magnate Eugene G. Starr bought 10,000 acres for $40,000 in Bell Canyon, and the two potreros of La Cienega and El Cariso for almost $28,000. A few years later, he also purchased the third potrero, Los Pinos, and San Juan Hot Springs, all of which had traditionally been connected to the Rancho Mission Viejo. Another ranch parcel, the upper portion of Gobernadora Canyon, some 4,636 acres, was sold to Ernest Bryant. Finally, the southern portion of the ranch, the original Santa Margarita y Las Flores, was reduced by 8,853 acres in the Fallbrook area when a property was sold to the U.S. Government for $371,187 to build a naval ammunition dump (Sleeper 1985:15).

The tight economy of the depression and the prospect of war were looming over the ranch and the neighboring community of Capistrano. Further, several of the Flood and O'Neill offspring had reached their majority and seemingly wanted to pursue different goals, the adult Floods more interested in stocks and bonds, and the Baumgartners considering a mixed agriculture and hotel development. The two families began discussing property division, and the final plan they developed gave the Trabuco and Mission Viejo, the Orange County property of

55,000 acres to the O'Neill family. Approximately 55,000 acres of land extending from San Onofre to the Orange County line along the coast was allocated to the Baumgartners, and the rest of the San Diego County portion of the Santa Margarita Ranch went to the Flood family. The negotiations and settlement took more than a year, and details such as cattle herds that had to be rounded up and divided, new brands designed, and equipment distributed were considerable (Baumgartner 1989:18).

Luis "Yoyo" Olivares, the son of Chulo Olivares who had grown up on the ranch, discribed the vaqueros' responsibilities at that time. He remembered that they had to work two and a half months, with no days off, to change the ranch brand and bob the tips of the cows' tails, thereby showing a change of brand. The work, he said, took extra time because the O'Neills had used a bell design, which turned out to be registered to another outfit; and the herd then had to be rebranded (Rivers 1991:50). John Baumgartner took the former Santa Margarita ranch brand, the "T over O" up north and registered it for his ranch in San Benito County, restricted to the cow's left hip. He described the new O'Neill ranch brand (Figure 8) finally selected as "an easy M with a sort of triangle or arch over the top" (Baumgartner 1982:51).

What happened next, in retrospect, might have been anticipated because the government has been shopping and buying large properties along the southern California coast. But according to Jerome Baumgartner (1989:161) it was totally unexpected and began with two big military footlockers arriving on the train from Oceanside:

> We decided that they must have been sent to the Navy base in San Diego and somehow put on the wrong train. But the next morning, Major General Joseph Fegan arrived at the ranch house and announced that the government was taking possession of the ranch to use it as a Marine base for the duration of the war and he was to be the commander of the new base. The Santa Margarita ceased to exist as a ranch at that moment. John had studied all his life to operate the Santa Margarita and almost as soon as he took it over, the government stepped in and made it Camp Pendleton.

According to John Baumgartner (1989:51) this happened on February 1, 1942. He explained that the Second War Powers Act allowed the military, in this case the marines, to use the ranch as a training base only for the duration of the war. But shortly thereafter, the law was amended to condemn the land, allowing for compensation and the right to receive it back after the war and claim damages for any destruction. Later in the war, the law was changed again to give the property, in order of priority, to a county, state or federal agency, and only if they rejected it, back to the original owners. Finally, although the family fought to get the land back, the Marine Corps fought equally hard to keep it for a permanent base.

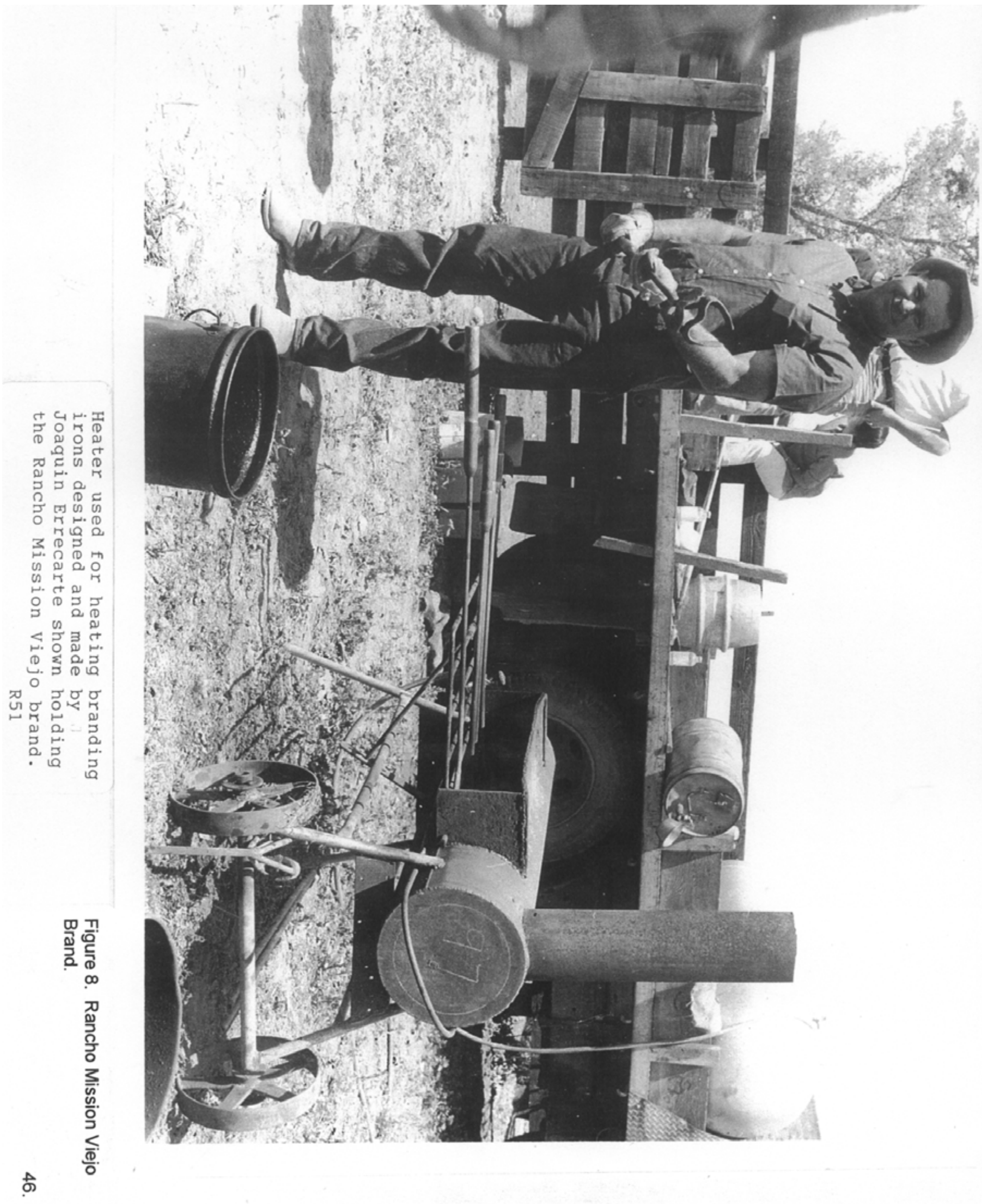


Figure 8. Rancho Mission Viejo Brand.

In May 1943, the United States Government purchased 123,620 (or 124,749 acres) acres from the Flood and Baumgartner families for $4,239,062 (or $4,110,035), the discrepancies stemming from Sleeper's (1985:15) quoting from different newspaper sources. This check was claimed to have been the largest ever cleared in San Diego County. President Franklin D. Roosevelt traveled by train to San Juan Capistrano where he transferred to an automobile to officiate at the dedication of Camp Pendleton. There is a photograph of President Roosevelt receiving a reata from Ralph Brown, the foreman of the Santa Margarita y Las Flores. Mr. Brown continued to work for the O'Neill family on the Rancho Mission Viejo for many years.

At the time of his visit to Camp Pendleton, the President also granted the Magee family lifetime tenure at the Las Flores adobe. And the former brand of the Santa Margarita Ranch, the "T over O" was kept by Camp Pendleton and is probably used today to brand the buffalo herd that resides there.

Rancho Mission Viejo: The O'Neill Family

In 1943, Richard J. O'Neill died at the age of 80 years, and his wife, Marguerite (Daisy), and her children, Alice Moiso and Richard Jerome, inherited the ranch. The trust had already been established, and at age 54, Daisy took over the responsibility of family decisions concerning the ranch. Evidently, the family received various offers to buy the ranch, one of unknown value from James Irvine and another offer at $1.2 million. The trustee representatives of the bank were very favorably inclined toward accepting a cash offer, running cattle ranches not being an expertise they enjoyed (Sleeper 1985:16). As the O'Neill family and the trust bank disagreed over the price, the trust company took the O'Neills to court in San Diego county.

According to John Baumgartner (1989:36), he had advised his Aunt Daisy to keep the ranch, and a very good friend of his, the biggest cattleman in San Diego County, testified for the O'Neill family. Mr. Baumgartner remembered that:

> …The bank attorneys asked him a lot of questions, and one of the questions was, "Was the ranch worth the amount of money that they were offering?" And he said, "It's worth a lot more than that." And they said, "Well, no it isn't. It couldn't be." And, the story is that he looked up at the judge and asked if he could have a pen, and he reached in his pocket and pulled out a checkbook and wrote down a certain number of dollars. That was the first payment for the ranch. …Well, naturally, the judge took a look at this check …that was the end of the case. The bank didn't have anything to say after that….

The population of San Juan Capistrano on the eve of World War II was still only 1200 people, a face-to-face community where most people knew each other. Immediately after the onset of the war, like other American communities, San Juan Capistrano organized a civilian defense council. One of the duties of the council was to turn an old water tower on Mission Hill into an observation tower, and, immediately, volunteers of all ages began to observe the skies for enemy planes. The official responsibility of the airplane observers was to get word to the authorities if they should observe anything suspicious. But Capistrano readiness went one step further, according to Patrick Forster (2000:33) who recently read a reprinted article from the early 1940's:

> …I don't know who organized it and if it was a government deal or what, but they organized the local sportsmen in town, the local hunters, and they formed a group called the Parachuters. P-A-R-A dash S-H-O-O-T-E-R-S. Para-Shooters. It was their job to hold off the Japanese troops. If they parachuted in here, the local guys would get together and be picking off Japanese soldiers until the Army got here!

The town probably had an official home militia, but whether it entailed carrying guns is somewhat dubious, but not at all surprising in a rural community still somewhat isolated, and men who hunted seasonally on the ranches to the east.

Another result of the early war hysteria and invasion fears was the proclamation by President Roosevelt that the west-coast Japanese should be removed to relocation centers. Japanese families farmed in the Capistrano area, both as lessees on large ranches and as property owners. Most of them were sent to the Parker Dam area in Arizona, and their land was distributed to farmers who would grow the same crops. Of the number who left south county, only one or two families returned to farm there after the war (Hallan 1975:109).

The war brought immediate changes to the Olivares family, the family whose father and husband was the vaquero foreman, Jose "Chulo". They had lived and worked on the Santa Margarita ranch for 24 years, but as the Flood and Baumgartner portions of the ranch closed down, Jose Olivares' job was terminated. Clara, his daughter, remembered that he was given nothing, no pension or severance pay, but that he went to work on a ranch at El Toro and made better money there. Louis, her brother, commented that John Baumgartner offered his father any horse he wanted, and "he took old Eleanor, his favorite mare. He could have had any horse on the ranch, and he took that old mare, twenty-five years old". Mr. Olivares was, no doubt, offered better pay at El Toro because all the young men went off to war, leaving the ranches extremely shorthanded, and his vaquero skills were essential to the war effort.

Clara herself, now about 29 years old, was also essential as she went to work in a southern California defense plant, a startling new job type not previously conceived as suitable for women. In the course of the war, she met her future husband, Jasper Hostler, a Hupa who had attended Sherman Indian Institute, at an Indian dance in Los Angeles. Mr. Hostler was stationed at Camp Pendleton for many years until his retirement from the Marine Corps. And with the expected and most essential job, her brother Louis “Yoyo” Olivares, now 22 years old, went into the Army for four years, three of them in the European theater. After the war, typically, he said, “I was never going back to the ranch because I’d found out there was an easier way to make a living” (Rivers 1991:50). Louis did, however, work an occasional roundup for the Rancho Mission Viejo in later years. In many ways, this Indian family serves as a perfect microcosm of families from Capistrano and all over the country where life changed drastically during World War II.

By 1944, the war news sounded very hopeful and fears of invasion had long since dissipated. Local people were still entertaining serviceman at nearby camps, and dances at the Capistrano packinghouse were popular. In the following year young men began to return home and the war was finally over in 1945. Of the O’Neill ranch, Sleeper (1985:16) reported that the year was a low point in ranch income and that the banks’ indecision had stifled development. The bracero program, however, had been bringing agricultural workers here from Mexico who had kept the crops picked, especially oranges in the Capistrano Valley, and probably some of them utilized their skills in the cattle industry, too.

Teeter Olivares Romero (Earle and O’Neil 1994b:20) contributed a final chapter to the Olivares family life in partial retirement:

> My grandfather was the foreman at the Rancho Mission Viejo. He retired here in San Juan Capistrano. He got tired sitting around, so Mr. Starr, who was the one that owned Cota de Caza and Casper Park at that time, gave him a job. And he went over there and he had this south end over here, he was taking care of. That was over there by the hot springs. They put a trailer house over there. My grandfather and grandmother were the same age – 65. And they didn’t want to live in the trailer, they wanted to live outside. So they build themselves a lean-to, and they would sleep outside, and my grandmother had an old stove and she would cook out there. This was in the forties, forty-eight, right around the war. They had an encampment out there. I can still remember what it looked like. The oak tree was very large, we would collect all the oak from there, And we would burn it, and if you really want a good barbecue going use the oak bar, Manzanita wood is used for smoking. We were kids, seven and eight years old, nine, ten years old. We used to go out there; all summer long we lived out there on the ranch.

John Salisbury, the ranch manager retired in 1947, and Arley Leck became the new manager of the Rancho Mission Viejo properties. He was married to a Forster girl, Alice, a sister to Marcos “Tom” Forster, and had cattle ranch experience. In the same year, the largest house in the Cow Camp, the camp near the San Juan Creek where the vaqueros and other workers lived, became available. The second generation Manriquez vaquero to work for the ranch, Waldo “Cabeza” Manriquez had his family living in Capistrano and asked for the cow camp house when it became vacant. His wife, Delores, now a widow living in Capistrano, and her son, Joey, have kindly shared their memories of life on the Rancho Mission Viejo over a period of 31 years, from 1947 to 1978 (Manriquez 2000). Most of the following description is theirs.

Waldo Manriquez had a Juaneño heritage, and his wife, Delores Souffat is a Luiseño, baptised at San Luis Rey Mission. Waldo’s father, Ubaldo Manriquez, had been the vaqueros’ cook years ago for the Santa Margarita Ranch but he had since passed away. Manriquez received permission, and moved his family from Capistrano out to the ranch. At the time, they had one child and his wife, Delores, was pregnant with another. Within a few years, they had four children that they raised on the ranch, just as the Olivares family had done in the 30’s. Delores not only took care of her family but she also cooked regularly for several single cowboys. The foreman, Ralph Brown, and Abel “Viejo” Majel were two of the regulars.

Abel Majel, another Juaneño, had been working for the ranch for thirty years, since 1918 (Sleeper 1985:12), and he probably had not married. People say that his father, Fernando Majel, also worked for a time on the ranch. His mother, Anastacia de Majel, had been one of five linguistic informants for the Juaneño language interviewed by the anthropologist, John P. Harrington (Mills and Brickfield 1986:96), in the 1930’s. Before she passed away in 1937, she had discussed her son’s work on the Santa Margarita with Harrington. As one of the single men, he lived in the bunkhouse, but nowadays the bunkhouse had four separate sleeping rooms, and a washroom, bathroom, and showers. There was another small family house there in the small community along with barns, corrals and equipment.

Roundups were often a monthly event, and created their own schedule. In the preparation, such as ordering extra food, Mrs. Manriquez often asked her mother to come from San Onofre to help her. Delores cooked for all the extra cowboys hired on, and for the very early breakfast, she made bacon, eggs, potatoes, tortillas and coffee. She made her own tortillas, and also her tamales from the small stand of corn they grew on the ranch. If the cowboys were working a distance from the Cow Camp and couldn’t return for lunch, she either packed lunches for them or drove out to the working location and delivered the beans, rice, meat, and “sarsa”, the Californio word for salsa. Although beef was often served, they also had chicken and lamb from the ranch animals kept for that purpose. If they were castrating bulls at this roundup, she served “Mountain Oysters”, floured and fried. At dinner, they often ate leftovers, and she baked pies, too.

The ranch also kept a cow for the milk, and Delores made butter, and although there was a goat, she couldn't figure out how to milk it. Daniel Gilbert, a cowboy from Baja California, did it for her. Mr. Leck, the foreman, also allowed them to keep about two dozen sheep in with the bulls at the Cow Camp. A sheepshearer came from Costa Mesa in spring to shear the sheep, and the wool was sent off to a factory to have blankets made for the ranch. She grew her own herbs such as *yerba manza*, *ruda*, and *yerba buena* from which she brewed a tea that was incidentally good for the kidneys. *Ruda* was excellent for treating earaches, and it was also a traditional remedy for keeping witches away! At that time, Delores father still used it for the traditional purpose. For major equipment, she had a big, square freezer, a wringer washing machine, an Electrolux vacuum cleaner, and a television set by 1947.

Branding was the important late winter activity, sometime in February or March depending on the Farmer's Almanac and the weather. The weather and humidity determined the temperature of the cattle that was a crucial factor. At that time, the ranch used two brands, the O'Neill "M with flying V over it", and a number from I through 10, representing the last digit of the year, and placed just above the ranch brand. The ranch didn't keep the heifers more than 10 years, and they were culled by using the date record. Joey Manriquez (2000) commented that at that time, the ranch had a fine breeding record that had produced excellent stock. Weaning the calves took place at the end of June, but any particular roundup beside those was for selling and shipping, and the timing of the roundup was dependent upon the current market price. The cattle were all shipped by truck by this time.

Another change that seems to have occurred is in language. While almost everyone on the ranch spoke or at least understood Spanish, English appeared to be the primary language. The Mexican cowboys from Baja were the major exception. Further, the consultants I talked to have dropped the Spanish term 'vaqueros' for the American term 'cowboys', but always making the distinction between real working cowboys and those that just perform at rodeos, and ranch hands or 'ground' cowboys that don't work on horseback.

For the big roundups, Philip Crosthwaite, who had worked for the Santa Margarita ranch since 1926, would bring Mexican cowboys north from Baja California. Delores couldn't remember all their last names, or even some of their real first names since everyone had a nickname in those days. Those she could remember were Tio, Jose Samiengo, Daniel, Thomas, John, and Robert Mundo, who brought his wife, Margarita, who helped her with the food. Local folk who came for the roundups included the following: Ray and Frank Serrano, who worked on the Moulton Ranch; Ralph Fury, who lived at Cook's Corners; Marge and Ernest Bryant from their ranch in Gobernadora Canyon; Joe Avila, her sister-in-law's husband from Capistrano; and Theodore and Luis "Yoyo" Olivares, cousins, the latter having grown up on the ranch.

Everyone's favorite cowboy was Chappo Valenzuela who had been a foreman on the Santa Margarita Ranch for many years. He was very sociable, loved jokes and had a voice that never failed to get the cattle moving. Chappo only worked part-time now, and he also chauffeured the Capistrano Mission car in the summertime when it came to get the children for catechism lessons.

The spring roundup was a great social gathering, and it always ended with a huge barbecue to which others were invited. Monty Montana, a cowboy entertainer who did fancy roping tricks, visited southern California schools, and rode in the Rose Parade, came for several years. Joey Manriguez (200:3) said his rope tricks were fun to watch but he couldn't rope anything! Another favorite with the ranch employees was a Mr. Rasmussen from Riverside who attended during the late 50's and early 60's with his movie camera and shot lots of film. When he returned the next year, he had made a film which he would show to everyone at the house.

Before the 1940's were over, the O'Neill family donated approximately 300+ acres to Orange County to make a county park in Trabuco Canyon. It was named for the family, the O'Neill Park, and dedicated in 1950. The family added another 130 acres in 1963. At the same time, the Los Pinos potrero, which had been owned by E. G. Starr, was swapped for another property and became a part of the Cleveland National Forest (Sleeper 1985:16).

In the early 1950's, the Manriquez children were ready to go to school. The San Juan Capistrano public school bus didn't come out to the Cow Camp, so Arlie Leck, the foreman, told Delores Manriquez to call the school every day until they sent one. She said it took a year but they finally sent one. In the meantime the children had to walk to the ranch headquarters which was the end of the school bus line. Charlie Belardes, a grandson of Theodosio Belardes who had worked for the Santa Margarita (discussed earlier), and Grace lived there and had three children who also rode the school bus. After that, the school bus went all the way to San Juan Hot Springs for the children there, and stopped along the way for the children of the farmers who leased property on the ranch.

Charlie Belardes, according to Patrick Forster (2000), was deputized by the County of Orange, and had the authority to write a ticket for trespassing on ranch property. He was not a game warden. Mr. Belardes was also a valuable employee because he could operate a road grader and do road work on the ranch.

Delores Manriquez couldn't remember all the farmers that had leases on the Rancho Mission Viejo. She thought that most of it was dry farming like the barley raised by Joe and Si Chingala, Basques, who developed fields all over the ranch. Fred "Shorty" Nieblas and his wife, Mary had two children. They raised vegetables, trees, watermelon, and other crops for at least 10 years. George Olivares was another farmer who also made beer and was born at the Parra

Adobe on the edge of town. And at possibly a later time, Mike Imata, Japanese groundskeeper for Richard and Donna O'Neill who had built a beautiful home overlooking the ranch on the south side of the Ortega Highway, leased some land. Delores said he didn't speak much English except for swear words!

Richard Kramer (1995:1) took the test to be Game Warden, and was the first one to be assigned to San Juan Capistrano. He spoke of the Rancho Mission Viejo:

> We had all kinds of deer here. In fact, on Ortega Highway, there used to be alfalfa fields up there. Some evenings, I could count 100, 200 deer on the alfalfa fields. That was one of my main patrol duties. From along about July, August, September, these deer would come down and eat the alfalfa. These other hunters would come along and poach the deer at night, spot light them. So that was one of my main jobs, trying to to protect the deer and keep the poachers out of killing them all.

Fanny was the pet deer of the ranch that Delores Manriquez had raised from a fawn. Everyone knew her and she waited for her dinner outside the kitchen door of the cow camp house. The deer followed everyone around the camp, and when she was five years old, she turned up missing. Delores was sure that a poacher had shot Fanny, and in fact he had. Richard Kramer, she said, went all the way to Pasadena to catch and ticket the hunter that shot her deer.

In 1955, Arley Leck, the ranch manager, passed away and Marcos "Tom" Forster was hired to be the new ranch manager. Tom Forster was the great grandson of Don Juan Forster, the former owner of this land 75 years previously. In an extensive and enjoyable interview with his sons, Tony and Patrick Forster, they remembered that their father was pleased to accept the position, and to be responsible for Rancho Mission Viejo and more closely connected with the O'Neill family. He was almost 60 years old when he took the job, and remembered how he had work summers as a kid on the ranch. Since that time, Tom Forster had been on the Capistrano School Board for 25 years, held Badge #1 for the Volunteer Fire Dept., and served as Justice of the Peace for 16 years. Most residents of the ranch and the town called him "Judge" Forster.

Thomas Anthony "Tony" Forster, age 20, was attending the U.S. Military Academy at West Point at that time, but came home during the summer. Patrick, his youngest brother, born in 1945, was only 10 years old and attended the Capistrano Mission School and Mater Dei High School in Santa Ana, California. The Catholic school sent a station wagon, driven by Paul Arbiso, the well-known Juaneño bell ringer, to pick up Patrick and Bunnie, the daughter of Cecil Martinez, another Juaneño cowboy born on (1908) and worked on the Santa Margarita Ranch. The station wagon picked up more children on the way into Capistrano, but the remainder of the ranch children rode the school bus into Capistrano to public school.

Patrick Forster described himself as a “ground” cowboy that just took care of the physical properties. Like most of the ranch hands, he built fences, fixed water troughs and windmills, dug ditches and drove tractors and pickup trucks. Cowboys, or vaqueros, were paid more for their skills but, as Delores explained, they had lots of work to do just to take care of their own equipment. They had to keep their horses shod themselves, except when Tommy Ramos, a blacksmith and former vaquero on the Rancho Mission Viejo, came out to shoe horses on the ranch. In the evenings, they had to oil their saddles, check their bridles, and other tack and wash their saddle blankets regularly. Some, such as Ralph Brown, the foreman, could make their own reatas, woven or braided leather ropes, for roping cattle. And finally, any dogs they kept were carefully trained to be cattle dogs or they might spook the cattle.

Patrick Forster (2000:5) also explained that the Rancho Mission Viejo had a standing herd of 5,000 cattle in the late 50’s and early 60’s. There were 1,200 brood cows, their calves, and the yearlings to be gotten ready for market. The ranch cattle were grown so well and put on so much weight that they could barely fit through the butcher chutes. The butchers complained, so the ranch had to start selling them earlier, just to satisfy the packinghouses. The big roundup was held once a year when they branded a thousand cows in three days:

> Early April. And there was ropers and then there was ground cowboys. I was a ground cowboy. We bulldogged the cows and wrestled them down, held them down, and then they got branded while we held them down. And they got inoculated against disease. They would cut their horns off so they wouldn’t get long and gore other cows. And they had earmarked that a cow, a cowboy could tell from a hundred yards away if that cow belonged to them just by the way their ears were, had been cut as the young cows.

Tony Forster added the following:

> Also was the count. The number of ears that they ended up. They had girls ears and boys ears, so that they’d know how many steers they had and they had branded, and how many cows they had branded.
>
> I think at your house. He’s [speaking of Patrick] got one of those old wires with a bunch of ears strung on it.

In December, 1958, the largest fire Orange County has ever seen burned 66,300 acres (Sleeper 1985:17) beginning more than 20 miles east of the Rancho Mission Viejo at the Stuart Ranch. It was a Sunday, a *santana* wind was blowing and everything was very dry. Patrick (Forster 2000:15), a teenager, observed it Sunday night in a friend’s pickup:

> The embers were flying a quarter mile landing in the brush that was on the hillside in front of us…And pretty soon all these little fires developed their own life, and then they'd get together and then they'd form a huge fire…And when we went out the Ortega, there were no fire trucks. And as we got in around the corner, there were maybe 20 fire trucks there…But the worst thing was rabbits were catching on fire, running…Running across the highway and dying on the other side in the grass, and they'd start that grass on fire.

Delores Manriquez (2000:2) remembered that she took her children down to San Juan Capistrano to stay with her sister and returned to cook for the cowboys while they worked on the fire. There was a herd of bulls at the cow camp that they all stayed to protect. The men were able to back fire the plateau, she said, and that stopped it coming in their direction.

And Tony Forster (2000:18) explained that he was coming home for Christmas from El Paso where he was stationed. He had telephone conversations with his parents about the fire, and remembered that:

> About a week after it started, I said, "Can I come over the Ortega?" and the answer was, "Yeah. We think maybe you can." So, I came over the Ortega, and it just looked like a wasteland. I mean, it just, he [his father] described it as going 20 miles this way, and it was just, you know, smoke was still…it was still smoldering.

During the late 50's and early 60's, the momentum of change began to grow as developers began to recognize Capistrano Valley's appeal. The town became a city by incorporating in 1961 with 6,000 acres and a population estimated at 1,200, still not a large community. They also agreed to bring Metropolitan Water to their new city, and sewer bonds were passed. And once again, the old buildings in the town center were threatened with demolition, and some, indeed, were lost. But the American Institute of Architects listed ten buildings worthy of consideration for the National Registry of Historic Sites, a federal organization deigned to help preserve the architectural history of the United States (Hallan 1975:135), and San Juan Capistrano did continue to maintain something of its early California character.

In 1964, change was in the very air of the Rancho Mission Viejo. The O'Neill heirs formed Mission Viejo Company for development purposes, and discussion took place with Donald Bren to create the new Mission Viejo community on the old Rancho Trabuco. A decades-old water suit reached a final settlement, and the Santa Margarita Water District was formed to service the ranch, and also the Starr, John Clay, and new Cota de Caza properties for a total of 41,000 acres (Sleeper 1985:17).

The spring roundup drew all the old cowboys and friends of the ranch, and there was even a professional photographer enjoying the roundup atmosphere and memoralizing it with her excellent pictures (Figures 9 and 10). Mrs. Richard O'Neill, Jr, or "Daisy" as she was known, was celebrating her 85th year, and enjoying the roundup. The tradition of men cooking the barbecue had been passed on from generation to generation of men in the Capistrano Valley, and is still going strong.

The very first El Viaje de Portolá, a trek to commemorate the discovery of Orange County by land, led to an invitational horseback ride along the route followed by the Portolá expedition. Those invited to ride included honored friends, ranch cowboys and large property owners along the route from San Juan Capistrano to Santa Ana, crossing the Rancho Mission Viejo and the Irvine Ranch and transporting the El Camino Real bell this first year of 1964. The trek was organized by a group that every year since has elected "El Presidente" or the president, and dedicated the ride to an important event, place or person. In the subsequent 36 years of the trek, Rancho Mission Viejo or members of the O'Neill family have been honored seven times.

Within this and the next couple of years, a number of men who had all the vaquero skills passed away. The first to go was Waldo "Cabeza" Manriquez who died in 1964, although his family was allowed to remain living and working on the ranch. The Manriquez boys were still in school at that time, but they later worked on the ranch, and Delores was still cooking for ranchhands. Further, Tom Forster picked that same year to retire as ranch manager, and, sadly he too passed away unexpectedly the following year. Within a very short time, Ralph Brown, the foreman, and Chulo Oliveras also were gone. There were very few "vaqueros" left in and around San Juan Capistrano, and seemingly no young men who were getting the experience to fill those roles.

Then, in 1967, Gilbert Aguirre was hired on the Rancho Mission Viejo as the new cattle manager, a year later he became the ranch's general manager, and in 1970, he was promoted to general manager of operations (Sleeper 1985:18). Mr. Aguirre was a new kind of cowboy, one who had grown up on an Arizona cattle ranch, learning the traditional vaquero skills, and then graduated from the University of Arizona with a bachelor's degree in Animal Science. The Coastline Dispatch (April 3, 1968:l) of Capistrano recognized Mr. Aguirre as being in charge of the two week spring roundup of 4,200 head of cattle in 1968. It is possible that the newspaper reporter confused the number of cattle on the ranch with the number being rounded up for market. The article also mentioned that the five regular ranch cowboys would be working with the ten more from Baja California that were hired just for the roundup. And as of this writing, Mr. Aguirre still holds the managerial position of Rancho Mission some 33 years later, a strong indication of the kind of traditional loyalty and devotion on the part of the O'Neill family and the people who have worked for them.

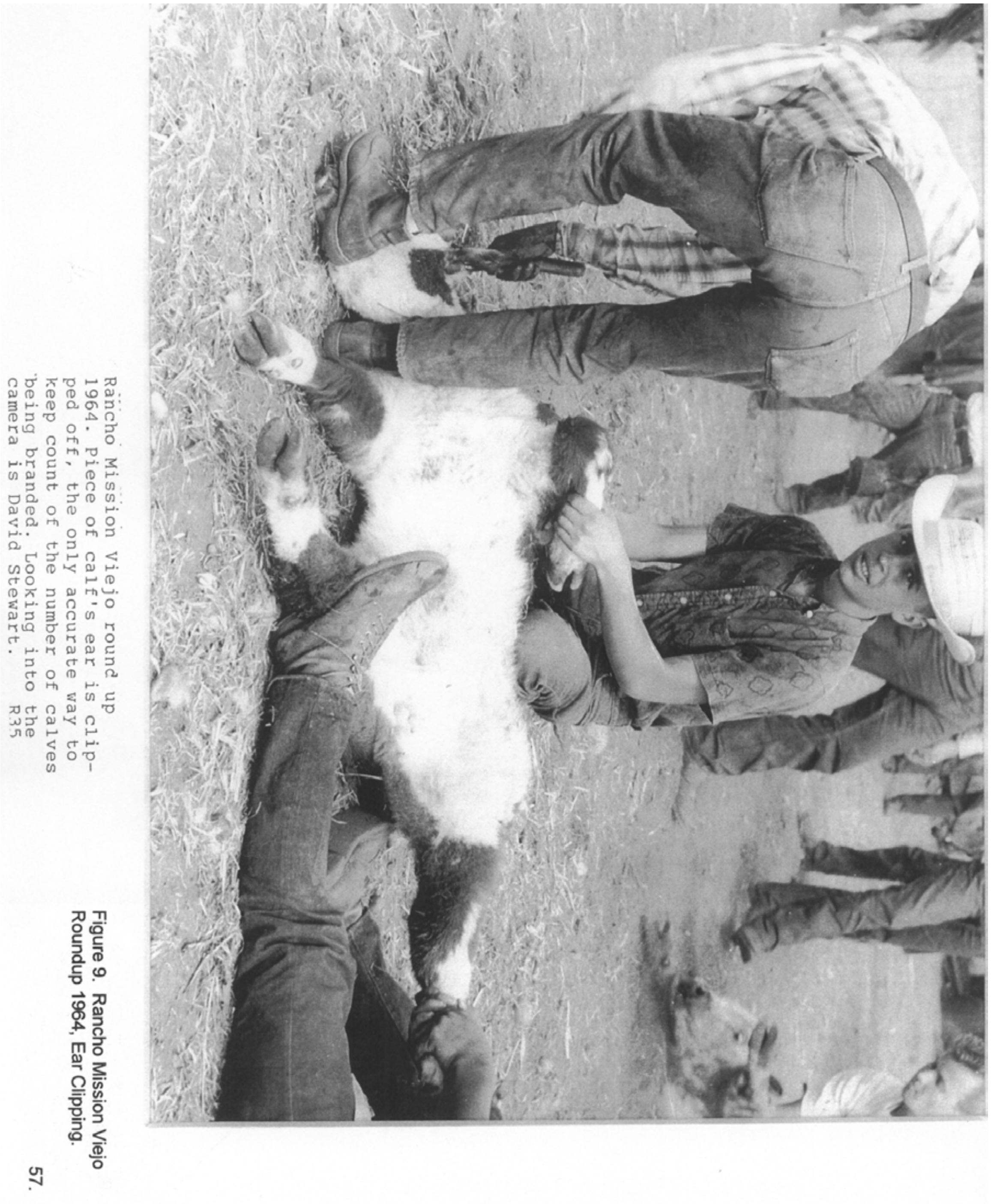


Figure 9. Rancho Mission Viejo Roundup 1964, Ear clipping.

P-360

Mrs. Richard O'Neill, Jr. 85
years old and Marco F. Forster,
manager Rancho Mission Viejo.
Great-grandson of Don Juan Forster, owner of ranch 1864-1882

Figure 10. Mrs. Richard O'Neil and Marco F. Foster, 1964 Roundup.

58.

Figure 10. Mrs. Richard O'Neill and Marco F. Foster, 1964 Roundup.

Anthony “Tony” Moiso, great grandson of Richard O’Neill, became president of the Viejo Management Company in 1976, and from that time has taken an active role in development and ranch management. When his grandmother, Marguerite “Daisy” O’Neill died in 1981 at age 102 years, the ownership of the ranch was then divided among his mother, Alice Avery (40%), his uncle, Richard J. O’Neill (40%), and various family trusts and foundations (20%). In 1985, they were on the Forbes’ “400” list with an estimated wealth of $250 million each (Sleeper 1985:20). The O’Neill family can look back with gratitude and respect to the long struggles of Marguerite O’Neill who fought off the bank trust officers that wanted a quick profit from selling the Rancho Mission Viejo.

The annual spring roundup, which is still a traditional event, was several times referred to in the seventies as a “Cowboy Reunion”. That ‘reunion’ is still taking place for the workers, friends and neighbors of the Rancho Mission Viejo. Although there may be only a few old vaqueros left, there are still “horse” cowboys, wranglers, who can brand those cattle and get them ready for market, and the tradition of the San Juan Capistrano men, Juaneños and cowboys, cooking the barbecue for the big traditional celebrations is still going strong.

In 1982, Rancho Mission Viejo celebrated the centennial of the O’Neill family ownership and management of the Santa Margarita and the Rancho Mission Viejo at Campo Amantes, the large barbecue and picnicking area east of Trampas Canyon set aside by the ranch for this purpose. Every year, the San Juan Capistrano Historical Society has a celebration at the camp, and no doubt other groups do too. They are very grateful for the historical O’Neill Museum building in San Juan Capistrano that the O’Neill family had moved, renovated, and continues to support.

The full, rich history of the Rancho Mission Viejo has hardly been touched on here, especially the very prosperous recent years of residential development. But that is a completely different story, and this one, the story of people who worked and lived on the ranch, especially the Juaneño Indians of San Juan Capistrano, has come to an end although, I suspect, it will never be completed.

ACKNOWLEDGMENTS

I have long been aware that the act of doing research, organizing the rich material and getting it written down teaches far more that the perusal of the finished product does for the reader. This has been another splendid opportunity to enjoy the process again and in doing so, gain a deeper appreciation of the rich environment, the historical processes, and the many players that have created the Orange County of the 21st century. I would like to express my gratitude to Mr. Gilbert Aguirre and Ms. Laura Eisenberg of the Rancho Mission Viejo, and to Carol Demcak of Archaeological Resource Management Corporation (ARMC) for giving me that opportunity.

Along the way, I have enjoyed the hospitable company, invaluable assistance, and the rich observations of David Belardes and Joyce Perry of the Juaneño Band of Mission Indians. And to Steve O'Neill who helped to orient me, untangled the Majel and Valenzuela families, and discussed the potential placement of the villages of Boscana, I am deeply grateful.

And finally, I wish to thank and give credit to the Historical Society of San Juan Capistrano for the use of their excellent historical photographs. In particular, Gwen Vermeulen, Tony Forster, and Patrick Forster provided valuable assistance and historical insights into the evolution of the Rancho Mission Viejo.

NOTES

I. On the first field trip, David Belardes and Joyce Perry accompanied ARMC personnel Carol Demcak, Chris Demcak, Steve Wakefield, and me to various sites on the ranch and contributed their observations as to the sites' possible relevance to Juaneño villages described in the ethnographic literature. On the second field trip, Steve O'Neil (1988:116), who had already noted the possible location of Tobe on the Rancho Mission Viejo because of the Crespi 'white clay' observation, took part in this on-going discussion of the location of the villages reported by Geromino Boscana. My thanks to all who participated in the field trips.

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REPORT OF ARCHAEOLOGICAL TESTING FOR THE RANCH PLAN, PHASE II-A, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

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April 1, 2002

REPORT OF ARCHAEOLOGICAL TESTING FOR THE RANCH PLAN, PHASE II-A, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

PART I: BACKGROUND TO THE STUDY

INTRODUCTION

At the request of Laura Coley Eisenberg of Rancho Mission Viejo, LLC, personnel from Archaeological Resource Management Corporation (ARMC) conducted archaeological testing of 24 sites in south Orange County for the Ranch Plan, Phase II-A. This second phase follows Phase I, (survey level) investigations conducted earlier (Demcak 2000). Sites selected for this test phase were determined according to their likelihood of being impacted by the proposed Ranch Plan project or alternatives to the Ranch Plan project. Due to the number of sites to be tested, this test phase is divided and documented separately as Phase II-A and Phase II-B. The sites are all located on Rancho Mission Viejo. They include the following: CA-ORA-29, -653, -654, -655, -657, -658, -1105, -1124, -1184, -1446, -1450, -1550, -1554, -1555, -1556, -1559, -1560, -1561, -1562, -1563, -1564, -1565, 1566, and 30-176632. The latter 13 sites were recorded during the Phase I investigations in 2000. The remaining sites were recorded at various times, CA-ORA-29 (Mission Vieja) being the earliest. That site is treated in a separate report (Van Wormer 2002).

The author, a Society of Professional Archeologists (SOPA) certified field archaeologist and Registered Professional Archaeologist (RPA), with over 20 years of experience in southern California archaeology, was overall Project Director and supervised the fieldwork on the prehistoric sites. Stephen Van Wormer, historian and Society of Professional Archeologists (SOPA) certified field archaeologist, supervised the fieldwork on the two historic sites; only 30-176632 is treated in this report. Chris Demcak prepared the report graphics. The northern field crew consisted of Kathleen Allen, Jill Cooley, Chris Demcak, and Jack Demcak. Steve Wakefield served as Crew Chief for the southern crew consisting of Karim Pike, Peter Reinke, Paul Staniec, John Sunio, and Eric Wenhold. The fieldwork took place from June 11 – October 23, 2001.

The results are that six prehistoric sites (CA-ORA-1554-, -1555, -1556, –1559, -1560, and -1565) and one historic site (CA-ORA-29; Van Wormer 2002) are considered significant, i.e., potentially eligible for the National Register of Historic Places (NRHP).

NATURAL SETTING

The project area (Figure 1) generally consists of Chiquita Canyon, Gobernadora Canyon south of Coto de Caza, the floodplain of San Juan Creek, Trampas Canyon, and Cristianitos Canyon. Ortega Highway (SR 74) bisects the study area. The foothills that characterize the study area are

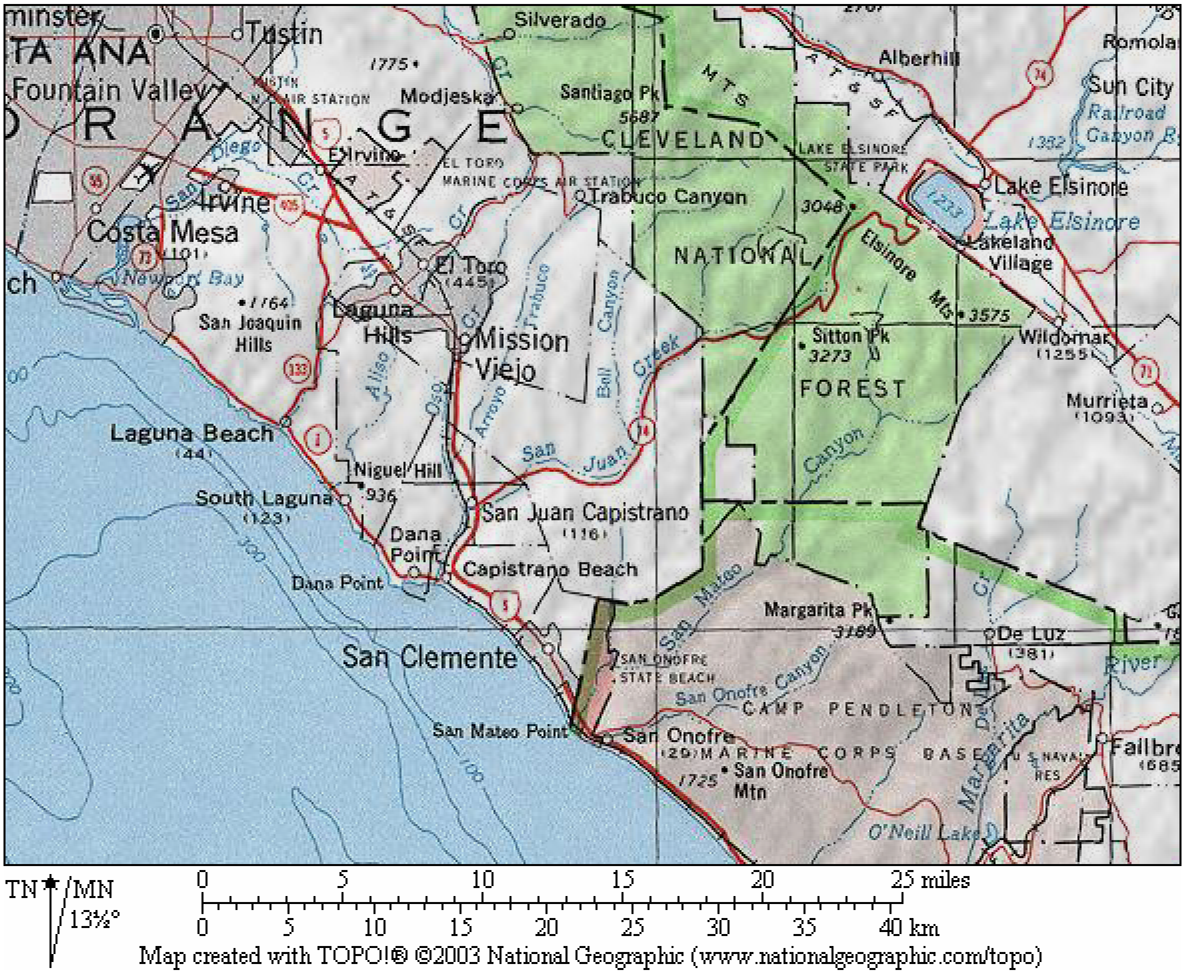

Figure 1. General Project Location.

part of the Santa Ana Mountains and the Peninsular Ranges Province that stretches from the Transverse Ranges through the Los Angeles Basin to the tip of Baja California (Norris and Webb 1976). The climate of the area is Mediterranean type, with dry summers and moist winters. Rainfall averages 10-15 inches annually on the coastal plain and up to 40 inches in the interior mountains (Hornbeck 1983).

The project is situated in south Orange County along Chiquita Creek, Gobernadora Creek, San Juan Creek, Cristianitos Creek, numerous unnamed drainages, and their adjacent terraces. Topographically, the study area is characterized by rolling hills, narrow ridgelines, and knolls separated by narrow canyons, localized drainages, and broad watercourses (Orange County Planning Department 1971). Elevations in the project area vary from a low of 160' in the floodplain of San Juan Creek to a high of 660' in upper Cristianitos Canyon.

Geologically, the study area is underlain by marine Upper Cretaceous deposits (Trabuco, Ladd or Williams Formations) and by Tertiary age, marine sedimentary rocks (Morton and Miller 1981), along with Quaternary and recent alluvium. Mapped formations include the marine Upper Cretaceous Ladd and Williams Formations, the marine Paleocene Silverado Formation, the marine Eocene Santiago Formation, the terrestrial Oligocene Sespe/Vaqueros undifferentiated Formation, the marine Middle Miocene Topanga and Monterey Formations, the marine and non-marine Middle Miocene San Onofre Breccia, the Upper Miocene Capistrano Formation, and unnamed Quaternary and recent alluvium. Soils in the study area vary from gray-brown to red-brown clayey loam on the upper terraces and knolls to light tan, sandy/silty sediments with abundant cobbles on the creek bottoms and adjacent terraces.

Lithic raw material derived from these and other formations in the Santa Ana Mountains include the Bedford Canyon metasediments (argillite) and quartzites; the Santiago Peak volcanics (rhyolite, andesite, and basalt) and metavolcanics; as well as granitics, quartz, chert, and chalcedony. These lithics occur as stream float in the local drainages. These raw materials were utilized by aboriginal populations to create chipped and ground stone tools and ornaments.

Six plant communities as defined by Munz and Keck (1959) are present in the project area. These communities (Chaparral, Coastal Sage-scrub, Grassland-herbland, Oak Woodland, Riparian, and Freshwater Marsh) would have provided a variety of seasonal plant resources to the prehistoric and early historic inhabitants of the region. For a detailed description of these resources and their uses, see Demcak et al. (1989).

CULTURAL SETTING

Prehistory

Wallace (1955) and Warren (1968) have both proposed syntheses of the local cultural sequence. These summaries continue to be useful in defining the prehistoric period in southern California. The two researchers propose that aboriginal populations remained hunters and gatherers before Spanish contact.

The Milling Stone Horizon, or Encinitas Tradition, is the earliest occupation that has been properly documented for Orange County. Highly mobile populations adapted to a littoral, or coastal, environment during this occupation. Small native groups gathered plant foods, including seeds, tubers, and berries, collected shellfish, and hunted small and large game. They used milling stone and muller, more commonly called metate and mano, to grind seeds. Hunting tools included wide, thick, and heavy projectile points. They were presumably utilized as spear points, based on their weights (Fenenga 1953), and launched by atlatls, or wooden spear-throwers. Cog stones and discoidals, wheel-shaped and disc-shaped ceremonial stones respectively, and red argillite beads are diagnostic artifacts, or time-markers, for this earliest known occupation in Orange County.

During the subsequent Intermediate Horizon, or Campbell Tradition, prehistoric populations expanded their resource base to include more hunting and fishing. The mortar and pestle, tools associated with the processing of acorns and other fleshy plant foods, were introduced into the area. Projectile points remained relatively large and heavy.

In the final prehistoric occupation, the Late Horizon Cultures (Shoshonean and Hokan speakers), local economies expanded markedly. Artifact assemblages reveal an increase in the number and types of tools, reflecting population growth and task specialization. Non-utilitarian items, such as beads and ornaments, were also on the increase in the Late Horizon compared to earlier occupations. Local groups continued to rely primarily upon plants, shellfish, and terrestrial game, which they hunted with small, lightweight arrow points and the bow.

Steatite, obsidian, and other non-local lithic resources were traded into the area. Pottery was introduced into Kumeyaay territory in San Diego County and small quantities reached Orange County in the very late prehistoric period. Pestles and portable mortars, especially of the basket-hopper type, and bedrock mortars were utilized locally for acorn processing. Seed grinding continued to be carried out with manos and metates, as well as on bedrock grinding slicks.

Ethnohistory

Ethnographically, the study area falls within the territory of the Juaneño people. The Juaneños were named by their association with the Mission San Juan Capistrano. They are closely related to the Luiseños, who were associated with the Mission San Luis Rey (Bean and Smith 1978; Bean and Shipek 1978). Shoshoneans, they are Takic speakers of the wider Uto-Aztecan family of languages. Uto-Aztecan speakers are presumed to have entered California prior to 2000 B.C. (Moratto 1984:541) and perhaps arrived in the Los Angeles Basin by 1000 B.C. (Kowta 1969:50).

Hunter-gatherers, these Native populations exploited a diverse set of microenvironments from the coast, coastal plain, foothills, Santa Ana Mountains, to the interior valleys of southern California. Their territory is traditionally described as bounded on the north by Gabrielino territory at Aliso Creek. However, David Belardes (pers. comm.), member of the Juaneño Band of Mission Indians, asserts that the northern boundary of Juaneño territory was actually the mouth of the Santa Ana River. Inland, their territory extended to the upper reaches of the Santa Ana Mountains where it adjoined Luiseño territory. Southward, Juaneño territory reportedly exxtended to the area between the San Onofre and Las Pulgas drainages (Kroeber 1925:636) and westward to the Pacific Ocean.

With the coming of the Spanish in 1769, Native populations were brought into the mission system and forced to adapt to a new social and economic order with drastic consequences for the Natives. Their populations were radically reduced in number and their aboriginal way of life was largely eliminated. Certain populations, among them Juaneños who managed to escape into the interior mountains, were spared the forced acculturation for a short time. Then they too were overwhelmed by Spanish, Mexican, and later American Period developments. Despite considerable hardship, many of their descendents still live and work in the area surrounding the Mission San Juan Capistrano.

The Juaneño Band, or Acjachemem Nation, strives to keep its distinct culture and language from extinction. After decades of struggle for recognition, the band was formally recognized by the California State Legislature in September, 1993 as the "...original native tribe of Orange County" (Hall 1993:A3). Band members continue to seek federal recognition as a tribal unit.

Historical Overview

The arrival of the Portolá Expedition in 1769 marked the first efforts at extending Spanish control into Alta California through the establishment of Catholic missions. This move by the Spanish King Carlos III was intended to protect Pacific Coast shipping against Russian or English occupation of the area. Beginning in San Diego, the padres surveyed the lands as far north as Monterey Bay and secured them for the Spanish Crown. Mission sites were selected on the way north by Fathers Crespi and Gomez (Hallan-Gibson 1986).

The Portolá party arrived in Orange County on July 22, 1769, at a site in Cristianitos Canyon where two sick children were baptized by the fathers. The following day the travelers camped near the Mission Vieja site (CA-ORA-29) at the mouth of Gobernadora Canyon. The next day the expedition continued northwestward and out of the survey area to the western edge of the Plano Trabuco and camped at the San Francisco Solano campsite at the present location of the Trabuco Adobe. Altogether they stopped at seven campsites (Smith 1965) in what became Orange County.

Missions, presidios, and pueblos were established by the Franciscan fathers, and in 1775, the Mission San Juan Capistrano was begun. Within days, however, a Native American uprising at the mission in San Diego forced the fathers to abandon the local mission, hastily bury its bells, and with the soldiers hurry southward to assist their fellow priests. The fathers returned the following year to re-establish the mission at a different site. There on November 1, 1776, the mission was officially founded. On October 4, 1778, the mission was removed to its present location closer to the Arroyo Trabuco, a dependable water source (Hallan-Gibson 1986). Substantially expanded in 1784, the mission continues in use and is believed to be the oldest building extant in California, according to Friis (1965).

The Native inhabitants were brought under the control of the mission. They were converted to Catholicism and provided the mission with a large labor pool. The padres taught them the necessary skills to grow crops, tend cattle, produce wine, pottery and other crafts. The missions intended to prepare them to look after their own lands, which were held in trust for them. Spanish legislators called for the dissolution of the missions and turning over the lands to the natives as early as 1813. However, it was not until the Mexican Period that secularization was begun.

At the end of the Mexican Revolution, mission lands were seized and turned over to Mexican citizens of the Catholic faith and of good character. The Mission San Juan Capistrano was the first mission to be secularized in 1834. A pueblo for Native Americans was set up at Mission San Juan Capistrano, but, after years of mismanagement, failed (Dixon 1988; Hallan-Gibson 1986). A town was instead chartered and land became available to petitioners, including the Natives. Eventually, the town itself failed, and the mission was sold by Governor Pio Pico to his brother-in-law John Forster and James McKinley, a trader (Hallan-Gibson 1986). Forster maintained his residence at the mission until his claim to the property was denied (Muñoz 1980).

A series of land grants, or grazing rights, was issued by the Spanish Crown. The land between the Santa Ana and San Gabriel rivers was given to Manuel Nieto in 1784; this was the first land grant in Orange County. The second, called Rancho Santiago de Santa Ana, went to Juan Grijalva and Jose Yorba, his son-in-law. The grant was confirmed in 1810 to Yorba and Grijalva's grandson (Hallan-Gibson 1986). There followed a period of growth and development as rancheros built adobe homes, ran large herds of cattle and sheep, engaged in foreign trade, and dabbled in politics.

California was drawn into the Mexican-American War in 1846, and Governor Pico fled the oncoming American Army. His son-in-law John Forster, an American sympathizer, tipped off the Union soldiers marching through Orange County that a large contingent of enemy soldiers was on its way. This may have saved their force from defeat by 600 Mexicans (Hallan-Gibson 1986). After the Treaty of Guadalupe Hidalgo ended the war in 1848 and California entered the Union, the land claims of the rancheros were scheduled to be upheld, but subsequent laws required the land owners to prove their claims, requiring considerable time and expense. Most of the land claims in Orange County were eventually confirmed by the courts.

In the American Period, life on the ranchos continued much as before although squatters, rustlers, and mounting debts grew troublesome. Large landholdings were increasingly broken up; towns and settlements grew in number. Mission San Juan Capistrano was returned to the Catholic Church in 1865 when the U.S. Government denied Forster's claim to the property. Forster took his family and moved southward to Rancho Santa Margarita, home of his relatives, the Picos (Hallan-Gibson 1986).

During the 1860s, severe drought, smallpox, and torrential rains alternately took their toll on the large landholders and other settlers in southern California. The cattle market collapsed, land was devalued, and a diversified economy developed. The end of the Civil War brought an impetus to settlement. Land was cheap, and thousands flocked to the Golden West. A real estate boom ensued in the 1880s. The arrival of the Union Pacific, Southern Pacific, and Santa Fe Railroad provided transportation for people and products into and out of California. Sheep ranching became highly profitable due to the scarcity of cotton in the South. Large land grants were partitioned. Development proceeded at a rapid pace through the late nineteenth and early twentieth century. Improvements in transportation and communication contributed to the boom. The citrus industry with its associated beekeeping was one of the most successful enterprises in the area.

In the post-World War II period, southern California has been characterized by expanding urbanization, business and industry. The aerospace industry, movie and television industries, automobile manufacturing, and tourism have spurred local growth and continue to attract visitors and potential residents. The last ranchos have been developed or are in the process of being developed.

Mission Viejo, or La Paz, and O'Neill Ranch

This large rancho comprising 46,500 acres was granted to Jose Estudillo in 1841. Juan Forster acquired the holding in 1845 after having grazed his cattle there for at least a year. Forster, who played a significant role in the development of southern Orange County and northern San Diego County, was an Englishman by birth but a naturalized Mexican citizen. He was married to Pio Pico's sister, possessed vast land holdings, and was one of the wealthiest and most influential men of his day. His ranching success was partly due to an increased demand for beef that brought about a cattle boom once the gold rush had begun in 1848.

In 1882, the heirs of Juan Forster, whose land was heavily mortgaged due to various business failures, sold the Rancho Santa Margarita y Las Flores to Richard O'Neill and James C. Flood. Thus began the O'Neill Ranch, which includes the project area.

O'Neill, an Irishman, had come to California and established a successful ranching business and later meat-packing establishment. With his friend Flood, he acquired the Forster property. With various innovations, such as installing feedlots, O'Neill was highly successful and bought more land. The land holding reached its maximum of 260,000 acres under the care of Jerome O'Neill, Richard's son, at the turn of the century (Emmons 1974).

After Jerome's death, the ranch became the property of the Rancho Santa Margarita Corporation in 1926; and the O'Neills' stocks were held in trust. The Floods retained half interest in the corporation and ran the ranch until the 1930s when they sold their share (now Camp Pendleton) and the O'Neills divided their half interest. The land itself remained in trust. In 1943, after Richard O'Neill, Jr., died, an effort by trust officers to sell the property was halted by his widow.

In 1964 Mission Viejo Company was formed. The heirs and Richard O'Neill, Jr.'s, widow retained a 20% share of the company. Local development was initiated, and in 1972 the company was sold to the Phillip Morris Company, whose development became the Mission Viejo Planned Community. Santa Margarita Company launched its first large development, Rancho Santa Margarita, on the upper Plano Trabuco and on the adjacent hills to the south and southeast. Development has continued southward and now includes the Las Flores and Ladera Ranch communities.

The O'Neill family continues to operate Rancho Mission Viejo as it has since 1882. Ranching is still being carried out on the project area except for leased acreage. Herds still roam the hills and cowboys still conduct spring round-ups, repair fence lines, and patrol the range. Working windmills and cattle troughs dot the landscape.

PART II. RESEARCH DESIGN AND FIELD METHODS

RESEARCH QUESTIONS

The project sites were tested to determine their significance, or potential for providing data to answer important questions in prehistory or history. A series of research questions was developed to guide the fieldwork at the sites.

The first set of research questions is directed toward the refinement of the local and regional chronology. The lack of absolute dates available to researchers, when the cultural sequences proposed by Wallace (1955) and Warren (1968) were formulated, has led to problems in recognizing and interpreting the Milling Stone/Intermediate/Late Prehistoric framework. These sequences can be used as hypotheses open to further refinement and/or alteration.

Basic to all research questions is rigorous temporal control of the data, ideally through chronometric dating. A proper ordering of artifact types, assemblages, sites or cultures in time is the necessary first step in detecting patterning on the intersite and regional levels. Once chronological sequences are delineated, contemporaneity of sites and/or components can be established, thus enabling meaningful comparisons to be made.

The presence of ecofacts, chipped and ground stone artifacts, and midden accumulation at the project sites provided an opportunity to address a number of research questions through the recent field and laboratory investigations. Certain of these research questions focused on chronology. Outlined below are the questions as well as the requisite data to answer them.

Chronology

1. When and for how long were the sites occupied?

To answer this question, it is necessary to date the cultural deposit and to gauge the intensity of use. One of the aims of the current investigation, therefore, was to recover datable materials, such as organics for radiocarbon assay, and obsidian for hydration measurements, in careful stratigraphic context. The recovery of time-sensitive artifacts such as projectile points, beads, ceramics, and discoidals, used to assign relative dates, was also a goal. Depth of the cultural deposit would be suggestive of the length of occupation at the site when coupled with the dated items.

2. Was occupation continuous? or was the site occupied successively?

Cultural hiatuses, or sterile levels, would imply a discontinuous occupation. Careful stratigraphic recording would be sought to recognize occupational strata.

3. How do the project sites relate to other sites within the same time frame? Can the sites provide data to refine the regional syntheses?

A comparison of relative frequencies of artifact types, ecofacts, and site types within the same time frame would add to an understanding of settlement and subsistence patterns as well as to the local and regional cultural/historical framework. Providing absolute dating for specific time markers, such as discoidals, would help to clarify their chronological placement.

4. What is the cultural affiliation of the site/component? Do any of the sites contain evidence of pre-Shoshonean or post-European contact?

Several of the project sites are located adjacent to or proximate to the ethnographically known coastal-inland trail called El Potrero de los Pinos/San Juan Hot Springs Trail (present-day Ortega Highway, or SR 74) and thus might contain data relevant to an hypothesized inland to coastal migration of Shoshonean peoples in the late period. The project sites are also located near Mission San Juan Capistrano and the purported mission outpost, or old mission site (Mission Vieja, CA-ORA-29). See Van Wormer (2002) for discussion. The possibility of encountering Mission period occupational levels is recognized for the project area.

Subsistence Strategies

The second set of research questions deals with the reconstruction of subsistence strategies, a past lifeway. In other words, how did the occupants of the site make their living? The recovery of ecofactual material as well as the tools used in food procurement and processing would be helpful to address questions of subsistence, such as:

1. What were the food resources utilized by the site occupants? Was there a change over time?

The range and types of ecofacts (shellfish remains, vertebrate faunal bone) present at the site can be quantified and their relative numbers compared through the occupation levels. The environments of exploitation, or site catchment, can be determined from analyses of the recovered species, and non-local resources can be isolated (exchange?). Analyses of tool types, especially plant processing equipment, and their evolution over the span of occupation at the sites can aid in reconstructing past subsistence practices.

2. In which season were the ecofacts procured?

Seasonality studies on shellfish (Chione) and vertebrate fauna, eg. deer, may shed light on the placement of the site within the seasonal round of subsistence and settlement hypothesized by Hudson (1971) for the aboriginal populations in the area.

3. What tool technology is represented by the artifacts? What raw materials were utilized in tool manufacture? Were they locally derived?

Analyses of technology of manufactured items aid in placing the site and its occupants within the local cultural and historical framework and permit the recognition of novelty, or innovation, in tool production within a regional pattern. Raw material analyses enable researchers to determine preferences for particular raw materials; these data in turn lead to questions regarding sourcing of raw materials, such as geological or physical environment of origin, direct procurement versus exchange for non-local materials, crafts production, etc.

4. What are the range and types of artifacts represented? Is there a change over the span of occupation, e.g., a trend toward increasing specialization in tool types?

Artifact classes and types can be analyzed for the various levels of the sites and their relative frequencies compared. The presence of specialized tools, such as fishhooks, shaft straighteners, arrowpoints, drills, and awls in the upper site levels would be indicative of this trend.

5. Is there variability in the horizontal or vertical distribution of artifact/ecofacts which would indicate internal site patterning such as activity areas?

Analysis of the spatial positioning of individual species of fauna or possibly flora may permit researchers to hypothesize that particular site areas, either vertically or horizontally delineated, were utilized for specific activities or were utilized alternately over the span of occupation of the site.

Settlement Patterns

A third set of research questions is directed toward the reconstruction of another past lifeway, settlement patterning. Data recovered from a group of sites rather than from a single site is more amenable to answering questions of a regional nature such as this. These questions are concerned with the definition of site types and the illustration of their relationship to the landscape and to each other, such as:

1. What are the site types represented within the project area? Are they villages/rancherias? base camps? special activity areas?

A recognition of site types can be accomplished by reference to frequencies and types of artifacts present, frequencies of ecofacts relative to artifacts, accumulation of midden, nature of midden deposit (depth; shell, charcoal, fire-affected rocks; features present?), size of artifact/ecofact scatter, presence of internal patterning reflective of village or rancheria, or specialized assemblage reflective of hunting camp or plant processing station.

2. What is the spatial relationship of the sites to each other and to the environment? What were the determinants of site location? Topography? Access to water, plant, animal or mineral resources? Access to lithic raw materials, trails or trade routes? Does site function relate to these determinants?

Analysis of the spatial patterning of the sites in relation to each other can aid in the prediction of locations of additional sites within the project area. Environmental determinants of site location or site type in the area can be hypothesized and tested in future research.

3. During what periods of the year were the sites occupied and/or utilized?

Seasonality studies on fauna or flora may help to pinpoint the season of occupation or utilization, or specific tool types may be indicative of seasonally-available resources, such as acorns.

4. Can a change in settlement patterns over time be detected in the occupational sequence?

Control of chronology through stratigraphic recording and/or dating of ecofacts or obsidian over the span of occupation is critical to an interpretation of change in settlement. Environmental factors (flooding, drought, bay siltation) may contribute to an explanation of a change in settlement.

Social Networking

The fourth set of research questions deals with social networking. The interaction of various groups of Native Americans in prehistory can be detected in the archaeological record by the presence of non-local, or exotic, goods which moved from group to group through exchange networks (Earle and Ericson 1977; Earle 1982). Examples of an exchanged good in southern California are obsidian, fused shale, steatite, asphaltum, and marine shells usually in bead form (Davis 1961). Motivation for such exchange may be sought in the resource base (site catchment) available to site occupants. The proximity of the project area to El Potrero de los Pinos/San Juan Hot Springs Trail makes exchange issues highly relevant. The following research questions apply to social networking/exchange:

1. What is the local resource base, or catchment, in terms of lithic and other inorganic raw materials, invertebrate and vertebrate fauna, and flora? Are any critical resources (water, salt, lithics, foodstuffs) missing or periodically in short supply?

An analysis of the local environment and its organic and inorganic components will define the effective environment for site occupants. Missing critical resources can be noted and their possible means of procurement suggested.

2. Are non-local resources (obsidian, steatite, shells) present at any of the sites? If so, in what form are the exotic materials found? As finished or partially finished artifacts? Chipping waste? Unmodified? What are the sources of the non-local materials? How are exotic materials obtained? Through trade? Direct procurement?

Analyses of raw materials of artifacts and ecofacts will allow researchers to determine local versus non-local resources. Sourcing studies of obsidian are easily done and can reveal the geological origin of those lithics; other lithic raw materials (fused shale, various cherts) are not yet amenable to such sourcing. The morphology of the exchanged item (modified or unmodified) may indicate whether it was imported in manufactured form or as raw material. Distance (physical and social) from the source can be analyzed and may provide insights into the method of procurement. In general, if the physical distance is not too great, and the social group inhabiting the source area is receptive, direct procurement rather than exchange may be responsible for the presence of a non-local resource in a site.

3. Is there a change over time in the amounts and types of exotic materials present? Are non-local materials preferred over local materials for particular artifacts?

Analyses of site components, or occupation levels, may reveal a change in exotic frequencies over time. Analyses of individual artifact types and their raw materials will permit researchers to isolate examples of preferred materials where local alternatives are available. Motivation for such exchange may be rooted in a need for the perpetuation of social networking even where non-essential items are imported.

4. Are the site functions in any way reflective of a trade corridor location? How do the amounts of non-local materials present at the project sites compare to others in the area?

A comparative study of the project sites and other excavated sites in the area or in the region may allow researchers to detect patterns (group to group; trail utilization) in the exchange relations among the local populations in prehistory.

FIELD METHODS

At each of the prehistoric study sites, ARMC crew members carried out field walkover surveys of each site to locate surface artifacts. Transects, both north-south and east-west, measured 1-5 meters in width to provide maximum coverage. Artifacts were marked with pin flags. Flag locations were then shot in with a surveyor's transit. The artifacts were then labeled, bagged, and returned to the ARMC lab. Although locations sometimes contained multiple items; each item was later given a unique catalog number.

Based upon the number and kinds of items found on various areas of the sites, locations for Test Units or Shovel Test Pits (STP's) were chosen. Where no items or few items were found, test units or STP's were placed evenly around the sites to provide comprehensive coverage. The units and STP's were excavated manually with pick and shovel. Rock picks and trowels were used for finer recovery, such as feature exposure. All matrix was screened through 1/8-inch mesh hardware cloth. STP's were excavated to a minimum of 30 centimeters (cm) below datum (present ground level). Depths of test units varied between 20 and 110 cm below unit datum. The majority reached 30 cm or greater in depth. See Tables 1-4 below for excavation summaries, presented by project segment (canyon). See Appendix A for site maps showing locations of STP's, test units, and surface collection locations.

Table 1. Chiquita Canyon Excavation Summary.

SITE NO.	TEST UNIT/STP	AREA (M^2)	VOLUME (M^3)
ORA-1559	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
	STP 1	0.20	0.06

	STP 2	0.20	0.06
	STP 3	0.20	0.06
	STP 4	0.20	0.06
		Total: 2.80	Total: 0.84
ORA-1560	Unit 1	1.00	0.30
	Unit 2	1.00	0.20
		Total: 2.0	Total: 0.50
ORA-1561	STP 1	0.20	0.06
	STP 2	0.20	0.06
	STP 3	0.20	0.06
	STP 4	0.20	0.06
		Total: 0.80	Total: 0.24
ORA-1562	STP 1	0.20	0.06
	STP 2	0.20	0.06
	STP 3	0.20	0.06
	STP 4	0.20	0.06
		Total: 0.80	Total: 0.24
ORA-1105	STP 1	0.20	0.06
	STP 2	0.20	0.06
	STP 3	0.20	0.06
	STP 4	0.20	0.06
	STP 5	0.20	0.08
	STP 6	0.20	0.06
	STP 7	0.20	0.06
	STP 8	0.20	0.06
		Total: 1.60	Total: 0.50

Table 2. Gobernadora Canyon Excavation Summary.

SITE NO.	TEST UNIT/STP	AREA (M^2)	VOLUME (M^3)
Ora-1446	Unit 1	1.00	0.40
	STP 1	0.20	0.06
	STP 2	0.20	0.06
	STP 3	0.20	0.06
	STP 4	0.20	0.06
	STP 5	0.20	0.06
	STP 6	0.20	0.06
	STP 7	0.20	0.06
		Total: 2.40	Total: 0.82
ORA-1564	Unit 1	1.00	0.20

	Unit 2	1.00	0.15
		Total: 2.00	Total: 0.35
ORA-1565	Unit 1	1.00	0.20
	Unit 2	1.00	0.20
		Total: 2.00	Total: 0.40
ORA-1566	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60

STP's were excavated as bulk samples. Test units were dug by contour excavation and by an arbitrary 10 cm per level. Features were excavated and mapped by level, and then recovered and analyzed as a single entity. All test units and STP's were backfilled after excavation was complete.

Table 3. Trampas Canyon Excavation Summary.

SITE NO.	**TEST UNIT/STP**	**AREA (M^2)**	**VOLUME (M^3)**
Ora-653	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60
Ora-654	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60
Ora-655	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60
Ora-657	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60
Ora-658	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60

Table 4. Cristianitos Canyon Excavation Summary.

SITE NO.	**TEST UNIT/STP**	**AREA (M^2)**	**VOLUME (M^3)**
ORA-1124	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60

ORA-1184	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
		Total: 2.00	Total: 0.60
ORA-1450	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
	Unit 3	1.00	0.30
	Unit 4	1.00	0.30
		Total: 4.00	Total: 1.20
ORA-1550	STP 1	0.20	0.12
	STP 2	0.20	0.10
	STP 3	0.20	0.10
	STP 4	0.20	0.10
		Total: 0.80	Total: 0.42
ORA-1554	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
	Unit 3	1.00	0.30
	Unit 4	1.00	0.30
		Total: 4.00	Total: 1.20
ORA-1555	Unit 1	1.00	0.30
	Unit 2	1.00	0.30
	Unit 3	1.00	0.30
	Unit 4	1.00	0.30
		Total: 4.00	Total: 1.20
ORA-1556	Unit 1	1.00	0.60
	Unit 2	1.00	0.60
	Unit 3	1.00	0.70
	Unit 4	1.00	1.10
	STP 1	0.20	0.12
		Total: 4.20	Total: 3.12

Field methods at the historic site 30-176632 consisted first of a close site walkover survey to relocate the outlines of the cobble, wood, metal, and brick feature observed during the original survey (Demcak 2000). First ARMC crew members found the outer limits of the scatter, laid out a 6 x 8-meter grid over it, and mapped the surface items in plan view. Then the feature was excavated to sterile bedrock.

PART III. PREHISTORIC SITES ARTIFACT ANALYSES

Artifacts from the project sites were all lithic (rock) types. ARMC lithic analysts first sorted the artifacts on the basis of morphology, or form, resulting in their being cataloged as flakes, cores, manos, metates, discoidals, etc. (Appendix B, artifact databases). Then the tools were analyzed as to use wear, or inferred function; edge angles were measured and wear patterns noted. The flakes and cores were measured and checked for presence/absence of cortex, or rind (Appendix C, functional analysis database). The results of the two sets of analysis are presented below by canyon and individual site.

CHIQUITA CANYON

Six sites were tested in Chiquita Canyon: CA-ORA-1105, -1559, -1560, -1561, -1562, and -1563. Site CA-ORA-1105 produced no artifacts. The recovered items from the remaining sites are discussed below by individual site.

CA-ORA-1559

Site CA-ORA-1559 produced artifacts of both chipped stone and ground stone. Twelve types of artifacts were identified. Chipped stone items outnumbered ground stone 40 to 10. See Table 5 for the artifact inventory for the site.

Table 5. CA-ORA-1559 ARTIFACT INVENTORY.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	5
Flakes	12
Cores	3
Utilized Flakes	2
Flake Tools	1
Plano-convex Tools	13
Drills/reamers	2
Utilized Cores	1
Core Tools	1
GROUND STONE	
Manos	7
Metates	2
Discoidals	1
	Total: 50

The five hammerstones were all surface finds and made of metavolcanic raw material. All were angular in form, suggesting their use in the re-roughening of grinding surfaces on such tools as manos and metates. They may also have been utilized in the production of both chipped stone and ground stone tools at the site. Use wear analysis revealed that all five exhibited crushing wear. Edge angles of the wear patterns on the five hammerstones ranged from 75-90°. See Tables 6 and 7 respectively below for the inferred function for the type of wear and for the edge wear angle.

Table 6. Edge Modification and Inferred Function.

MODIFICATION	INFERRED FUNCTION	SOURCE
Nibbling	Transverse action from scraping, shaving, and planing	Tringham et al. (1974)
Crushing	Work on hard materials, eg. antler or bone	Tringham et al. (1974)
Stepflaking	Work on hard materials, eg. antler, bone, and wood; Bone working and wood working	Tringham et al. (1974) Ahler (1971)

Table 7. Edge Angle and Inferred Function.

ANGLE RANGE	INFERRED FUNCTION	SOURCE
30°	Fine cutting Butchering	Wilmsen (1974) Hester et al. (1976)
45°	Whittling	Semenov (1964)
60°	Skinning, hide scraping, and heavy cutting	Wilmsen (1974)
75°	Wood working, bone working	Wilmsen (1974)
90°	Plant pulping, fiber preparation	Kowta (1969)

The waste flakes (n=12) and cores (n=3) represent the discards (debitage) in the production of chipped stone tools. Flakes also result from the reshaping of tools or from the resharpening of tools that have become dull from use. Raw materials of the flakes included chalcedony (n=4), metasedimentary and quartzite (3 each), and one each of chert and felsite. Raw materials were all of local origin. Eleven of the flakes were recovered from STP's or test units; only one came from the surface.

The flakes from CA-ORA-1559 represent three stages of core reduction. Initial reduction of a core produces primary flakes that have full cortex on their bulbs of percussion. In the middle stage, the core is further reduced such that only some of the cortex is still present, resulting in secondary flakes. In the final stage, all cortex has been removed, resulting in tertiary flakes. Most of the flakes (n=8) were tertiary, while some (n=3) were secondary (n=2), and one was a primary flake. The majority (n=9) of the flakes were small, measuring no greater than 1" in length and probably represent tool maintenance, or reshaping following use or damage. Two flakes measured from 1-2"and one from 2-3 inches. These larger flakes may represent the deliberate removal of flakes to create flake or core tools.

The cores consisted of two surface metasedimentary finds and one metavolcanic find from a test unit. The cores measured from 2-3". Each had some cortex remaining and thus had not been fully reduced, or exhausted.

Two flakes were utilized without modification as tools (#15, #48). Both possessed edge angles of 45° and both exhibited nibbling, or small flake removal, as a use wear pattern. One flake (#30) had been modified into a tool, used, and then retouched (re-sharpened) for additional use. This tool had an edge angle of 60° and both nibbling and stepflaking as wear patterns.

Thirteen plano-convex tools, often called scraper-planes (cf. Kowta 1969), were collected at the site. The overwhelming majority (n=11) of the edge angles on these tools fell in the 75-90° range. All of the tools showed nibbling and stepflaking as use wear patterns. These massive core tools were reportedly used by Native populations to scrape hides, process *Agave* sp. pads into food and fiber, and perhaps for woodworking (Hester and Heizer 1972; Castetter et al. 1938).

Two perforators were recovered from the site. Both had been shaped to form a triangular bit for piercing materials, such as hides, stone, or shell. Specimen #6, a surface find, was made of metasedimentary material and had a broken bit. A quartzite specimen (#49) was recovered from STP 2.

One quartz core from the site was utilized as a tool (#13) without modification. Its edge angle measured 60°; nibbling and stepflaking were the two use wear patterns. A metasedimentary core was shaped into a tool (#2). Its edge angle measured 75°; nibbling and stepflaking were the use wear patterns.

Seven manos, hand stones used in grinding, were recovered from the site. Six were made of granitic material; one was made of granitic porphyry. All were oval in form, although only four were complete. All had been pecked for shaping or for resharpening of their working surfaces. All were bifacial, i.e. had two working faces. Four of the manos showed battering wear, suggesting secondary use as hammerstones.

Two fragmentary metates were recovered. One granitic specimen (#27) was a surface find and was too incomplete to be typed. A schist deep-basin type (#46) was recovered from an STP.

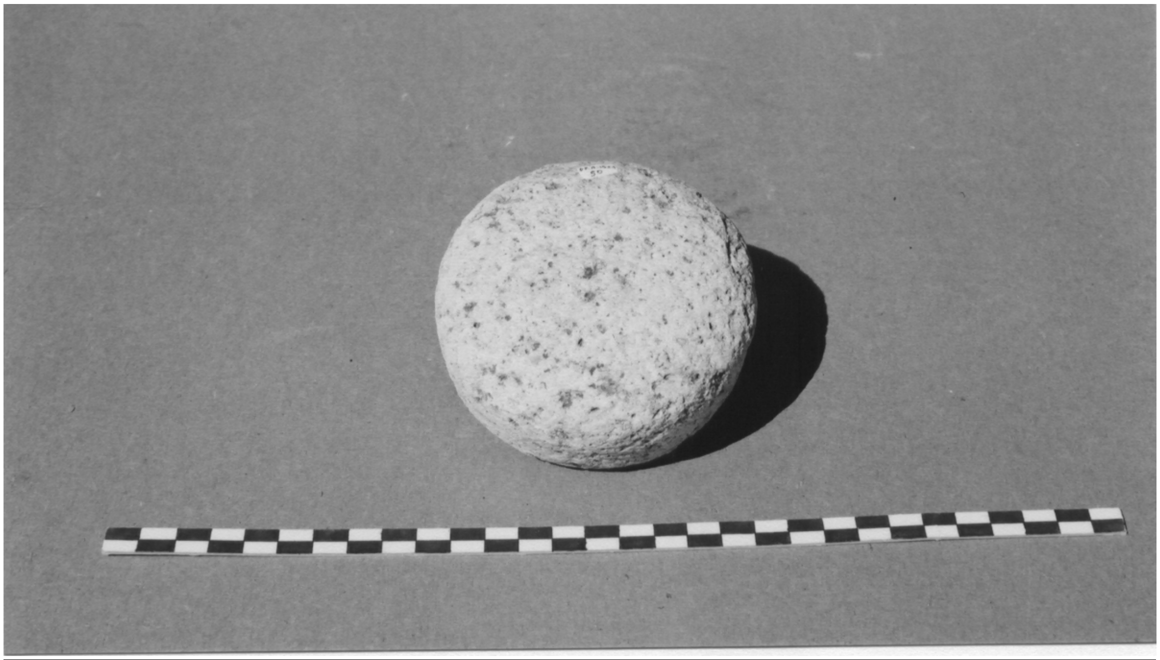

Figure 2. Discoidal from CA-ORA-1559.

A ceremonial stone called a discoidal (#50; Figure 2 above) was recovered from the surface of the site during the survey phase of the study (Demcak 2000) and has been added to the site inventory. This granitic disc-shaped stone measures 9.8 cm in diameter and 5.8 cm in thickness, a ratio of 1.7:1, or common proportion as defined by Moriarty and Broms (1971). Its faces are slightly convex, while its edge, or surface (profile), is concave. This type of ceremonial stone is time sensitive in southern California, reflecting a Milling Stone occupation. See Part VII for a discussion of chronology of discoidals.

CA-ORA-1560

This site produced both ground and chipped stone items during the test phase. Eight individual types of artifact were identified among the 37 items. Twenty-five were ground stone, while 12 were chipped stone. See Table 8 for a complete artifact inventory.

Table 8. CA-ORA-1560 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	1
Flakes	2
Cores	4
Flake Tools	1
Plano-convex Tools	3
Core Tool	1
GROUND STONE	
Manos	16
Metates	9
	Total: 37

The recovered hammerstone (#18) was made of quartzite. It was found on the surface. The item is angular and suggests its use in pecking ground stone surfaces.

Only two flakes were recovered from CA-ORA-1560. They came from the surface of the site at the same location. One was made of metavolcanic material, the other of basalt. One was a tertiary flake, the other secondary. They measured from 2-3" in length.

Four cores were found on the surface. The specimens were made of four different local raw materials: basalt, metavolcanic, metasedimentary, and chalcedony. The cores had some cortex present. They measured from 2-3" in length.

A single basalt flake tool (#19) was recovered from the surface of the site. The flake had been modified into a tool, used, and then retouched. Its edge angle measured 45°, and it exhibited nibbling use wear.

Three plano-convex tools, or scraper planes, were found on the surface of the site. Two were made of metavolcanic raw material (#9, #22) and showed use wear and retouch. A third (#4) was created from volcanic porphyry and revealed a flattened profile compared to the others. Their edge angles measured between 75 and 90° and exhibited nibbling and stepflaking use wear.

A core tool (#10) made of volcanic porphyry was found on the surface. Its edge angle measured 75°. It showed nibbling and stepflaking use wear.

Manos were the most numerous artifacts at CA-ORA-1560. Nine were fragmentary, while seven were whole. Granitic specimens predominated (n=9), followed by granitic porphyry and quartzite (3 each), and volcanic porphyry (n=1). Two showed battering wear, suggesting secondary use as hammerstones. Two showed fire affects and may have been hearthstones at one time, may have been stored too close to a hearth, or may have been exposed to a natural fire.

Fourteen of the manos were bifacial, one was unifacial, and one (#33) was trifacial. This mano had been broken and re-used, producing a third grinding surface (Figure 3). All of the manos were oval, and all had been pecked for shaping or for resharpening the working edges.

Figure 3. Trifacial Mano from CA-ORA-1560.

One of the manos (#21) had been pecked resulting in a small round depression on one face. The specimen has been converted into a nutting stone, or nut anvil. An acorn would have been placed in the depression holding it in place. The acorn would then have been struck and cracked by a blow from a hammerstone (Hudson and Blackburn 1981:89-93). See Chronology, Part VII.

The nine metates from CA-ORA-1560 were all fragmentary. All were made of schist, and all had been pecked for resharpening or shaping. Eight were found on the surface; one was recovered from Test Unit 2, 0-10 cm. Three fragments (#2, #3, #7) were parts of the same shallow-basin metate before it was broken. Two fragments (#8, #11) were parts of the same deep-basin metate. Two fragments (#24, #25) belonged to the same shallow-basin metate originally. Only one metate fragment came from a test unit. Item #1, an untypable fragment, was recovered from the 0-10 cm level of Test Unit 2. Number 15, a surface find, was also untypable due to its incompleteness.

CA-ORA-1561

A single artifact, a plano-convex tool (#1) made of metavolcanic material, was recovered from this site during the test phase. It was a surface find. Its edge angle measured 60°, and it revealed nibbling and stepflaking use wear. See Table 9 for the artifact inventory.

Two discoidals, or ceremonial stones, were recovered from the surface of the site during the survey phase and have been added to the site inventory. One (#2: Figure 4) was made of granitic raw material and measured 9.7 cm in diameter and 6.2 cm in thickness, a ratio of 1.6:1, a common proportion according to Moriarty and Broms (1981). Its faces were convex-convex, and its edge (surface) was flat. The item had been nicely polished into a nearly perfect circle. The second discoidal (#3; Figure 5) was larger, measuring 12.9 cm in diameter and 5.8 cm in thickness, resulting in a ratio of 2.2:1, or common proportion. The faces were flat-flat, and the edge was slightly convex. The specimen was made of diorite raw material and had been very well shaped and polished.

Table 9. CA-ORA-1561 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Plano-convex Tools	1
GROUND STONE	
Discoidals	2
	Total: 3

For a discussion of the chronology of discoidals, see Part VII.

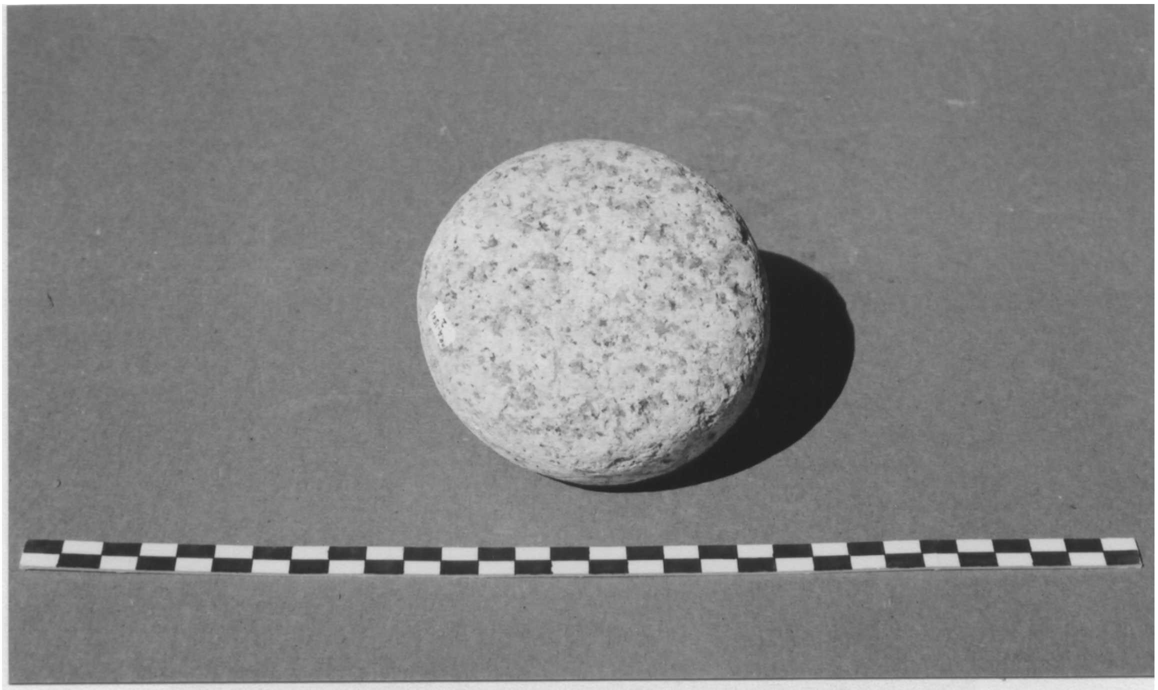

Figure 4. Discoidal (#2) from CA-ORA-1561.

Figure 5. Discoidal (#3) from CA-ORA-1561.

CA-ORA-1562

Only seven artifacts were collected from CA-ORA-1562 during the test phase. Two were chipped stone, and five were ground stone. All were surface finds. Table 10 presents the artifact inventory from the site.

One hammerstone (#4) of metasedimentary raw material was recovered from the site. The artifact was angular in form, suggesting its use in pecking ground stone surfaces. Its edge angle measured 90°, and it revealed crushing wear. A single flake (#3) of metavolcanic material was also recovered. It measured 3" in length and was a secondary flake.

Three fragmentary manos were collected from the surface. All had been pecked for shaping or for re-roughening of the working surfaces. Two unifacial (one working face) manos were made of granitic (#2) and gneiss (#5). A specimen (#6) of granitic porphyry was bifacial.

Two untypable granitic metate fragments were also recovered. Both had been pecked.

Table 10. CA-ORA-1562 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	1
Flakes	1
GROUND STONE	
Manos	3
Metates	2
	Total: 7

CA-ORA-1563

Sixteen artifacts were recovered from the site. Twelve were chipped stone; four were ground stone. Eight came from the surface, all chipped stone. Eight came from units, primarily Test Unit 1. See Table 11 for the artifact inventory for CA-ORA-1563.

One quartz hammerstone (#9) was recovered from the surface. It was angular in form suggestive of use in re-roughening or shaping ground stone surfaces. Its edge angle measured 75°, and it revealed crushing use wear.

Five flakes (three metavolcanic, one each metasedimentary and basalt) were collected from the surface (n=4) and from test units (n=1) at site CA-ORA-1563. Most of the flakes (n=4) were less than 1" in length; these were all tertiary flakes. One flake measured 2" and was a secondary type.

Three cores were also recovered. They consisted of one each of chalcedony, metavolcanic, and quartz. The cores were small, ranging from 1-2"in length. Two had no cortex remaining, and one had some cortex present.

Two plano-convex tools, both metavolcanic, were found at the site, one on the surface and one from a test unit. Their edge angles measured from 60-75°; both showed nibbling use wear.

A single chopper (#50) was also recovered from the site from the 0-10 cm level of Test Unit 1. With an edge angle of 60°, the tool revealed nibbling use wear.

Four manos (three fragmentary) were made of granitic raw material (n=3) or granitic porphyry (n=1). All were oval in outline. One specimen (#12) was fired. Specimen #16 was pecked and bifacial. The others were unifacial.

Table 11. CA-ORA-1563 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	1
Flakes	5
Cores	3
Plano-convex Tools	2
Choppers	1
GROUND STONE	
Manos	4
	Total: 16

GOBERNADORA CANYON

Four sites were tested in Gobernadora Canyon: CA-ORA-1446, -1564, -1565, and –1566. The artifact data are presented below by individual site.

<u>CA-ORA-1446</u>

At CA-ORA-1446 a total of nine artifacts was recovered. Six were chipped stone, and three were ground stone items. Table 12 shows the artifact inventory.

Table 12. CA-ORA-1446 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	1
Flakes	4
Disc bead blank	1
GROUND STONE	
Manos	1
Metates	2

	Total: 9

The chipped stone items were chiefly surface finds (n=4). One flake and the disc bead blank came from Test Unit 1, 0-10 cm and 20-30 cm respectively.

One hammerstone (#1) was found at the site. It revealed crushing wear and an edge angle of 90 degrees.

The six flakes were made of metavolcanic (n=3), andesite, quartzite, and metasedimentary (one each) raw material. They ranged in size from 1-3' in length. Two were tertiary flakes, and two were secondary.

A disc bead blank (#8) of metavolcanic material was recovered. The blank shows shaping by chipping. It has not been drilled or polished and measures 1.5 cm in diameter and 0.3 cm thick. See Chronology, Part VII.

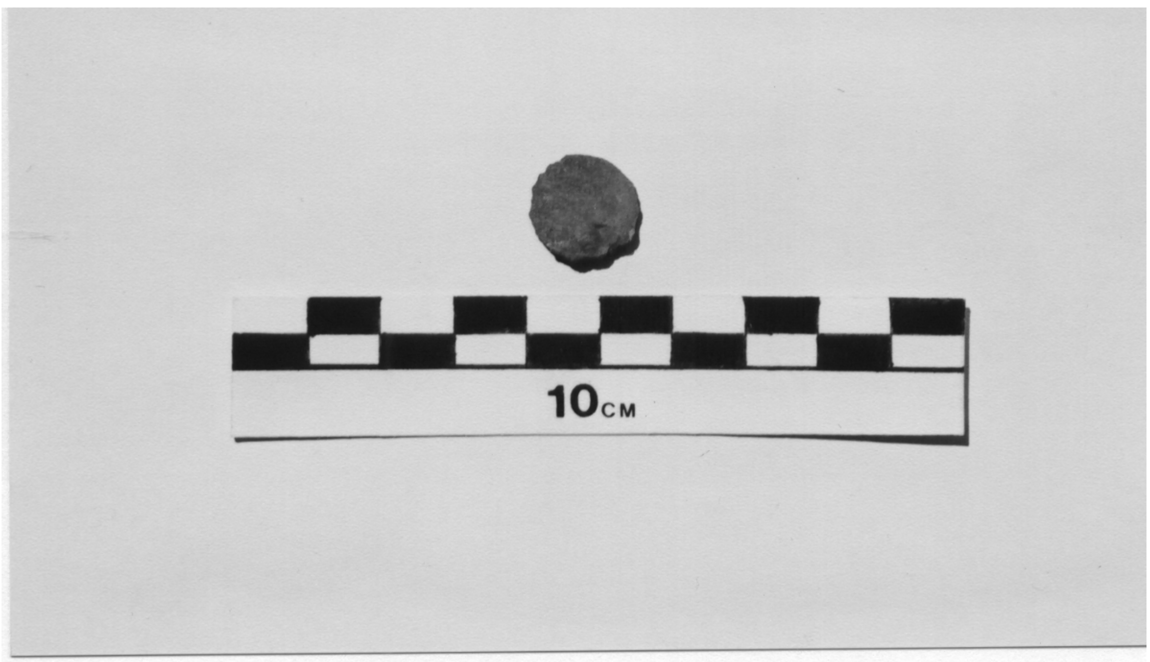

Figure 6. Disc Bead Blank (#8) form CA-ORA-1446

The ground stone tools consisted of one fragmentary mano and two fragmentary metates. The granitic mano (#5) is bifacial, has been shaped by pecking and polishing, and is oval in outline. One of the metate fragments (#6) is a basalt slab type. The other (#9) is granitic, has been pecked for resharpening and shaping, and is a shallow basin type.

CA-ORA-1564

Artifacts at CA-ORA-1564 totaled 13, 12 chipped stone and one ground stone. All were found on the surface of the site. See Table 13 for the artifact inventory.

Among the chipped stone items, there were three metavolcanic flakes. Two measured 3” and were tertiary flakes; one measured 2” and was a secondary flake. A metavolcanic core was also recovered. It measured 3” and had some cortex present.

One metavolcanic utilized flake was recovered from the site. Its edge angle measured 45°; its use wear consisted of nibbling and stepflaking. Two flake tools, one (#4) of felsite and one (#2) of metasedimentary material, were also collected. Their edge angles measured 45°; both showed nibbling wear.

Three plano-convex tools (scraper-planes) were recovered. Each was made of a different material: metasedimentary (#7), metavolcanic (#8), and basalt (#13). All three had edge angles of 75° and showed nibbling wear. One (#8) also revealed stepflaking. Two utilized cores of felsite (#10) and basalt (#11) rounded out the chipped stone items. Both of these tools had edge angles of 45°, and both showed nibbling and stepflaking use wear.

The single ground stone item was a fragmentary mano (#3) of granitic raw material. Both faces had been used in grinding.

Table 13. CA-ORA-1564 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Flakes	3
Cores	1
Utilized Flakes	1
Flake Tools	2
Plano-convex Tools	3
Utilized Cores	2
GROUND STONE	
Manos	1
	Total: 13

CA-ORA-1565

Thirty-three items were collected from CA-ORA-1565. Thirty were chipped stone and three were ground stone. Twenty-eight were surface finds; two came from Test Unit 1, 0-10 cm in depth. Table 14 presents the artifact inventory from the site.

Four hammerstones were found on the surface. Three were metavolcanic; one was metasedimentary. All were angular, indicating their probable use to re-roughen ground stone surfaces. Their edge angles measured 90°; each exhibited crushing wear.

Ten flakes were recovered. Seven metavolcanic and one felsite specimen came from the surface of the site, while two flakes (andesite and basalt) came from Test Unit 1, 0-10 cm. Most were secondary flakes (n=6); a few were tertiary. The single primary flake was also the smallest, measuring ½ inch; the rest measured between 1-3 inches.

Four utilized flakes were recovered. Metavolcanic specimens predominated (n=3); a fourth specimen was made of quartzite (#21). Edge angles varied from 30-60°. Three showed nibbling wear; one of these also showed stepflaking.

Two flake tools were also found. One was made of metavolcanic raw material, another of felsite. Both had 45° edge angles, and both exhibited nibbling wear. Stepflaking was also present on item #9.

Six plano-convex tools were recovered from CA-ORA-1565. Five were metavolcanic, and one was quartzite. Specimen #5 was a spent core that had been used as a scraper-plane. Specimen #12 had been used and retouched on its working edge. Edge angles ranged from 60-90°. All showed nibbling use wear, while most (n=4) also exhibited stepflaking.

One perforator (#14) was found at the site. It revealed a broken triangular bit and was made of quartzite. See Chronology, Part VII.

A metavolcanic chopper (#2) was found on the surface. With an edge angle of 60°, the tool showed nibbling use wear. A utilized metavolcanic core (#22), also found on the surface, had an edge angle of 60° and use wear patterns of nibbling and stepflaking.

A metavolcanic core tool (#29) was also found on the surface of the site. Its edge angle was 60°, and it exhibited nibbling and stepflaking as use wear.

The three ground stone tools were all manos. A whole granitic specimen (24) was bifacial and pecked. Two granitic fragmentary manos (#3, #13) were bifacial and pecked for shaping or re-roughening of their working surfaces.

Table 14. CA-ORA-1565 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Hammerstones	4
Flakes	10
Cores	1
Utilized Flakes	4
Flake Tools	2
Plano-convex Tools	5
Perforators	1
Choppers	1
Utilized Cores	1
Core Tools	1
GROUND STONE	
Manos	3
	Total: 33

CA-ORA-1566

Only fourteen specimens were recovered from site CA-ORA-1566. Twelve were surface finds; two came from test units. Five were chipped stone, while nine were ground stone items. Table 15 shows the artifact inventory.

Two flakes were recovered from the surface; one was metasedimentary, the other metavolcanic. Both were secondary flakes. They ranged in size from 2-3 inches.

One quartzite plano-convex tool (#13) was a surface find. Its edge angle measured 45°; nibbling was the use wear pattern. Two utilized cores, one each of quartz and metavolcanic, showed nibbling wear and edge angles ranging from 60-75 degrees.

The ground stone items consisted of manos and metates. Five fragmentary manos and three whole manos were found at the site. All were bifacial, pecked, and oval shaped. Seven manos showed battering wear suggesting their secondary use as hammerstones; only #4 was not battered. Only one mano (#3) showed fire affects. Half were made of granitic raw material (#'s 1, 2, 3, and 10). Half were made of granitic porphyry (#'s 4, 5, 7, and 14). A single schist metate fragment (#11) was a shallow basin type that had been pecked to shape it.

Table 15. CA-ORA-1566 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Flakes	2

Plano-convex Tools	1
Utilized Cores	2
GROUND STONE	
Manos	8
Metates	1
	Total: 14

TRAMPAS CANYON

Although five sites (CA-ORA-653, -654, -655, -657, and –658) were tested in Trampas Canyon, only one site produced any artifacts: CA-ORA-654.

CA-ORA-654

No surface artifacts were found at this site. One mano (#1), broken into two halves (labeled 1A, 1B), was recovered from the 0-10 cm level of Test Unit 2 at the site. Made of granitic material, the mano was bifacial and had been pecked for re-roughening and shaping.

CRISTIANITOS CANYON

Although eight sites were tested in Cristianitos Canyon, two sites (CA-ORA-1450 and -1184) did not produce any artifacts. The recovered items from CA-ORA-1124, -1550, -1554, -1555, and –1556 are discussed by individual site below.

CA-ORA-1124

Only one artifact, a felsite flake, was recovered from the 0-10 cm level of Test Unit 1. The flake measured 3" and was secondary.

CA-ORA-1550

Four artifacts were recovered from CA-ORA-1550. All were surface finds. Three of them were ground stone, and one was chipped stone. Table 16 provides the artifact inventory.

An andesite plano-convex tool (#3), or scraper plane, was recovered. With an edge angle of 60°, the tool revealed nibbling and stepflaking as use wear patterns.

Table 16. CA-ORA-1550 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Plano-convex Tools	1
GROUND STONE	

Manos	1
Metates	1
Discoidal	1
	Total: 4

An oval, bifacial, granitic mano (#2) from the site showed battering wear, suggesting its secondary use as a hammerstone. A shallow-basin type, granitic metate fragment (#1) was also recovered from the site.

A ceremonial stone, a granitic discoidal (#4), was recovered from the site during the survey phase (Demcak 2000). The item was cracked and discolored from fire effects. The well shaped circular disc measures 10.4 cm in diameter and 5.6 cm in thickness. This ratio of 1.9:1 places it in the common proportion category (Moriarty and Broms 1971). Its faces are convex-convex. Its surface (edge) is also convex in profile. See Part VII for further discussion of this and other discoidals.

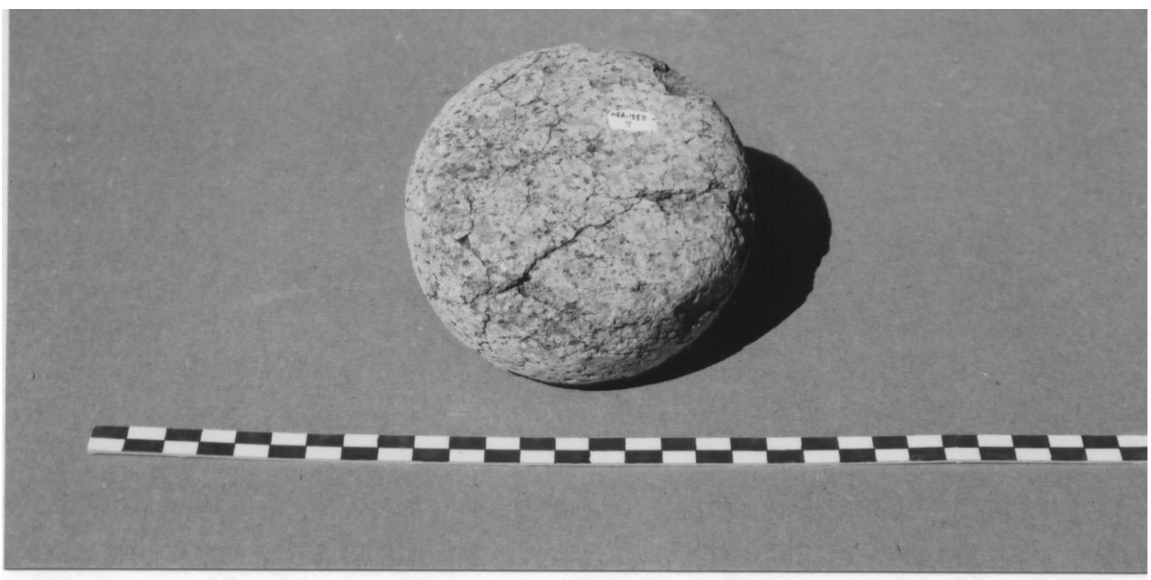

Figure 7. Discoidal (#4) from CA-ORA-1550.

CA-ORA-1554

Artifacts at CA-ORA-1554 included 33 chipped stone and 11 ground stone items. All of the chipped items were surface finds. All of the ground stone items came from Feature 1, Test Unit 1. See Table 17 for the artifact inventory.

Table 17. CA-ORA-1554 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	7
Flakes	17
Utilized Flakes	2
Flake Tools	3
Plano-convex Tools	3
Projectile Points	1
GROUND STONE	
Manos	3
Metates	8
	Total: 44

Seven hammerstones were recovered from CA-ORA-1554. Two each were made of metavolcanic, felsite, and metasedimentary raw material; one was quartzite. All were angular in form suggesting their primary use in re-roughening or shaping of ground surfaces. Edge angles ranged from 60-90°; the majority (n=4) measured 90 degrees. All showed crushing wear from use.

Seventeen flakes were collected. The majority (n=10) were made of metavolcanic raw material, followed in relative frequency by two each of metasedimentary, rhyolite, and quartzite, and one of andesite. A large (3”) flake from the site was primary (#20); no data are available for the remainder of the flakes.

Two utilized flakes, one each of andesite and quartzite, were recovered. Both had been retouched (re-sharpened) after use. Both exhibited nibbling and stepflaking. Edge angles were not measured.

Three flake tools, two of metavolcanic and one of felsite, were collected. Two (#19, #25) had been used and retouched. With edge angles of 60° and 45° respectively, the tools displayed nibbling and stepflaking as use wear patterns.

Three plano-convex tools, all of metasedimentary material, were surface finds. Two specimens (#11, #10) had an edge angle of 60° and exhibited nibbling and stepflaking use wear. The third (#7) has an edge angle of 75° and showed nibbling only.

A single projectile point (#44; Figure 8) was recovered during the earlier survey of the site (Demcak 2000). This small, Cottonwood triangular arrowpoint weighs 1.5 grams, and measures 1.6 x 1.7 x 0.5 cm. Its base is slightly concave and has been lightly thinned by rough pressure flaking. One margin has been carefully shaped (nearly serrated) by pressure flaking on one face; the other face has been only roughly shaped. The other margin has been roughly shaped by pressure flaking on both faces. This artifact is time sensitive and helps to date the site. See Part VII, Chronology for a discussion of the time association of the projectile point.

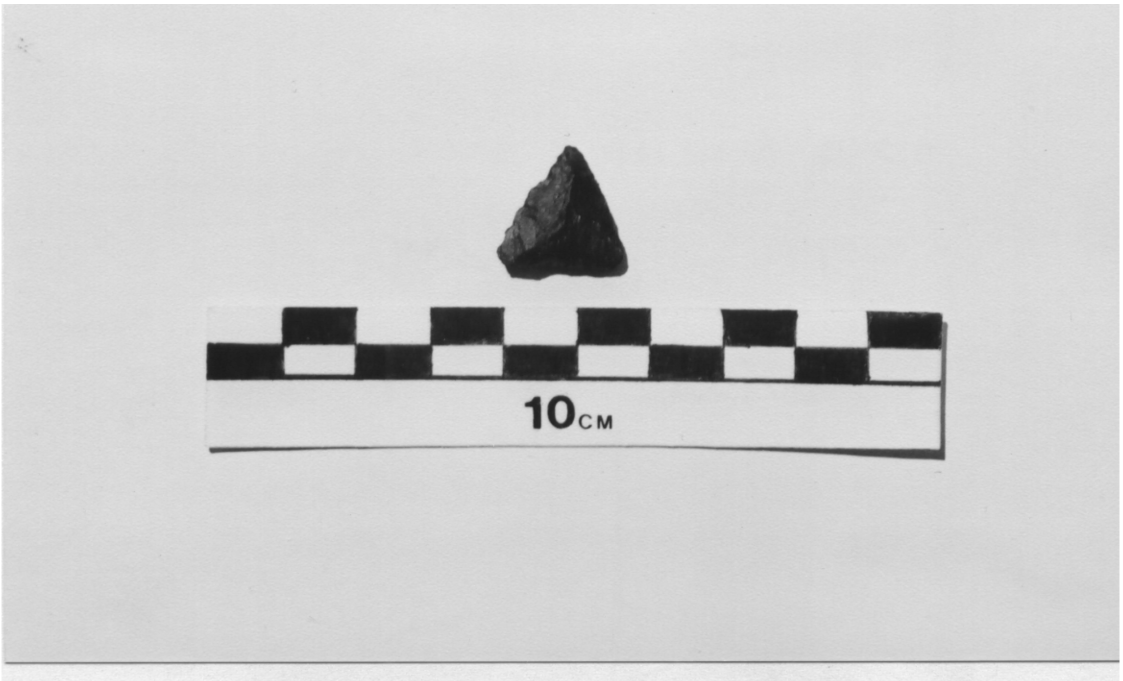

Figure 8. Projectile Point (#44) from CA-ORA-1554.

Ground stone items consisted of three manos and eight metate fragments. The three manos were all whole, bifacial, granitic, and oval shaped. One (#12) came from surface location 10, while two (#35, #37) came from Test Unit 1, Feature 1. Mano #37 also appeared to have had secondary use as an abrader; it exhibited battering and was also fire affected. Two (#12, #37) had been pecked for shaping or re-roughening.

Eight metate fragments were collected at CA-ORA-1554. Two were surface finds (#31, #34), and six came from Test Unit 1, Feature 1. Four were made of schist raw material, and four of granitic raw material. One was a shallow basin type (#31); the remainder were deep basin types. One had been deliberately "killed"; a portion of the metate's center had been punched out. This technique of rendering the item useless would normally be done at the death of the owner/user of the metate. There was no evidence that this was a grave good; no human remains were found at the site, in fact, no bone at all.

CA-ORA-1555

This site produced 92 artifacts: 80 chipped stone, 12 ground stone. Surface finds numbered 81, with 11 items from excavation units. See Table 18 for the artifact inventory.

Three hammerstones were surface finds. Two were made of metasedimentary raw material, and one of andesite. All three were angular, likely used for re-roughening ground stone surfaces. Two (#81, #23) had 75° edge angles; the third (#43) had a 90° angle. All three exhibited crushing use wear.

Flakes (n=63) were the most numerous single artifact type recovered from the site. Fifty-five came from the surface, and eight came from units. Andesite (n=30) were the most frequent, followed by quartzite (n=15) and basalt (n=11). Felsite contributed four flakes, metasedimentary two flakes, and rhyolite one flake. The vast majority (n=51) ranged in size from 2-3". Most were tertiary flakes (n=45); eighteen were secondary, and only one was primary.

Table 18. CA-ORA-1555 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	3
Flakes	63
Cores	4
Utilized Flakes	1
Flake Tools	2
Plano-convex Tools	5
Perforators	2
GROUND STONE	
Manos	9
Metates	3
	Total: 92

Four cores were collected, three from the surface and one from an excavation unit. There were two basalt and two andesite cores. The cores ranged in size from 2-3" and displayed some cortex and thus were not completely reduced, or exhausted.

One utilized flake (#84) was recovered. It revealed an edge angle of 75° and nibbling as use wear.

Two flake tools were also found at the site. A rhyolite specimen (#1) came from Test Unit 2, 0-10 cm level, while #11, a felsite one, was recovered from Test Unit 3, 10-20 cm below datum. The tools had edge angles of 30° and 45°, respectively. Both revealed nibbling and stepflaking as use wear patterns.

Five plano-convex tools, also known as scraper planes, were recovered. Three were made of andesite raw material, and one each of quartzite and rhyolite. Specimen #90 was heeled, i.e., had a hand hold opposite the working edge. Three had edge angles of 90°, and two had 75° angles. One of the specimens (#34) showed crushing wear; the others showed nibbling and stepflaking.

Two perforators (#59, #17) were also collected from CA-ORA-1555. Both were made of andesite and had triangular-shaped bits. Figure 9 below shows perforator #17, a particularly well made specimen. See Chronology, Part VII.

Figure 9. Perforator (#17) from CA-ORA-1555.

Twelve ground stone items included nine manos and three fragmentary metates. All were made of granitic raw material and collected from the surface of the site. Seven manos were whole; two were fragments (#20, #86). Two were battered (#49, #63). Six were bifacial (#'s 20,29,38,48,67,78). Five were pecked (#'s 20,29,38,63,78). All but one oval shaped; #86 was too incomplete to determine its shape.

All three metate fragments were surface finds. Two were made of granitic material (#'s 91 and 92); the former #91 was a deep basin type, the latter a shallow basin type that had been pecked.

CA-ORA-1556

Site CA-ORA-1556 produced the greatest number of artifacts of the project sites. A total of 101 items included 92 chipped stone and 9 ground stone. See Table 19 for the artifact inventory.

Table 19. CA-ORA-1556 Artifact Inventory.

ARTIFACT TYPE	**FREQUENCY**
CHIPPED STONE	
Hammerstones	2
Flakes	79
Cores	5
Flake Tools	2
Plano-convex Tools	2
Choppers	1
Core Tools	1

GROUND STONE	
Manos	3
Metates	5
Discoidals	1
	Total: 101

Two andesite hammerstones were collected, one from the surface and one from Test Unit 2, 20-30 cm level. Both were angular in form, suggesting that they were used in re-roughing or shaping of ground stone tools. Both had 90° edge angles and showed crushing wear.

Seventy-nine flakes were collected. Andesite (n=20), quartzite (n=19) predominated, followed by metasedimentary and basalt (10 each), felsite (n=6), metavolcanic (n=5), rhyolite (n=4), and one each of quartz, chert, chalcedony, jasper, and volcanic porphyry. Only four were surface finds; three came from STP's, and the remaining 72 were from excavation units. The majority (n=68) of the flakes ranged in size from 1-2", 10 flakes were as small as ½ inch in length, and one was 3" in length. Most of the flakes were tertiary (n=66); 11 were secondary and two were primary.

Five cores were recovered. There were two each of andesite and rhyolite, and one of basalt. Two were surface finds, and three came from excavation units. The cores ranged in size from 2-3 inches. Two cores had no cortex present, and three had some cortex left.

Two flake tools were collected from the same excavation unit, Test Unit 1. The felsite specimen (#37) came from the 30-40 cm level and been used and resharpened (retouched). The felsite specimen had a 45° edge angle and showed nibbling and stepflaking, consistent with use and retouch. The rhyolite tool (#41) came from the 40-50 cm level and may be a preform for a projectile point or other biface. The tool had a 45° edge angle and revealed only stepflaking. It would appear that this tool was either being reshaped into a projectile point or other biface, or being resharpened (retouched) after use.

Two plano-convex tools were recovered from the site. One (#1) was made of quartz, had been retouched, and was found at 27 cm below datum in STP 1. It has an edge angle of 60° and shows nibbling and stepflaking use wear. The metavolcanic specimen (#13) was retouched and was found on the surface. Its edge angle is 75° and it exhibits nibbling and stepflaking use wear.

A single chopper (#68) was recovered. It was made of chert and came from the 10-20 cm level of Test Unit 3. It has an edge angle of 60° and shows nibbling use wear.

A basalt core tool (#95) came from Test Unit 2, 20-30 cm below datum. Its edge angle is 60° and it shows nibbling use wear.

Ground stone included manos, metate fragments, and a discoidal. All three manos were fragmentary, oval shaped, bifacial, pecked, and all were surface finds. Two granitic specimens (#20, #21) were fire affected; #20 had been broken and re-used. The third mano fragment (#10) was made of gneiss.

Metate fragments numbered five. All were granitic, fire affected, and surface finds. The five pieces represent three different metates. Fragments #7 and #9 belong to the same shallow basin metate. Fragment #8 belongs to a deep basin metate. Fragments #18 and #19 belong to the same deep basin although a different one than #8.

Figure 10. Discoidal (#17) from CA-ORA-1556.

A single discoidal (#17; see Figure 10 above), a ceremonial stone, was recovered from the surface. The well-shaped disc is made of red volcanic porphyry and is 90% complete; small portions have been fractured off both faces. It has been pecked to produce a very smooth disc shape. The specimen measures a maximum of 10.1 cm in diameter and 5.2 cm in thickness. Its roughly 2:1 ratio of diameter to thickness makes it a regular type, as opposed to either wafer or barrel types (Moriarty and Broms 1972). Its faces are concave, concave. Its surface (edge) is also concave. Discoidals are time sensitive and help to date the site. See Part VII for further discussion of discoidals.

PART IV. PREHISTORIC SITE FEATURE: CA-ORA-1554.

Among the prehistoric project sites, only one produced a feature: CA-ORA-1554. While ARMC crew members were collecting surface artifacts, they noted two ground stone artifacts (#1, a schist metate fragment, and #3, a granitic metate fragment) positioned tightly together on the ground. They marked the area for further investigation and completed the surface collection. Later they returned to the area and set up a 1x1-meter excavation unit, centering it over the two artifacts.

The crew retained the surface artifacts in place and dug an arbitrary 10-cm level into the deposit. They discovered additional artifacts that eventually extended the feature into subsequent levels 10-20 cm and 20-30 cm. As the artifacts and cobbles were exposed, they were mapped in plan view, and their depths below datum were recorded (Figure 11). The feature artifacts were then collected, identified, and bagged for return to the ARMC lab for cataloging and analysis.

The feature was a ground stone cache. Feature artifacts included two whole manos, or hand grinding stones. The manos were bifacial (ground on both faces), granitic, and oval shaped. Three individual metates, or base grinding stones, can be pieced together from the six recovered fragments. Two schist fragments (#38, #39) are part of the same "killed", or intentionally destroyed, deep-basin incomplete metate. Two granitic fragments (#36, #42) together form an incomplete deep-basin metate. Two schist fragments (#40, #41) form part of a third incomplete metate in the feature. The cobbles shown in the plan view in Figure 11 were examined by the ARMC crew. Since the stones did not show any fire effects or any other evidence of cultural activity, they were discarded in the field.

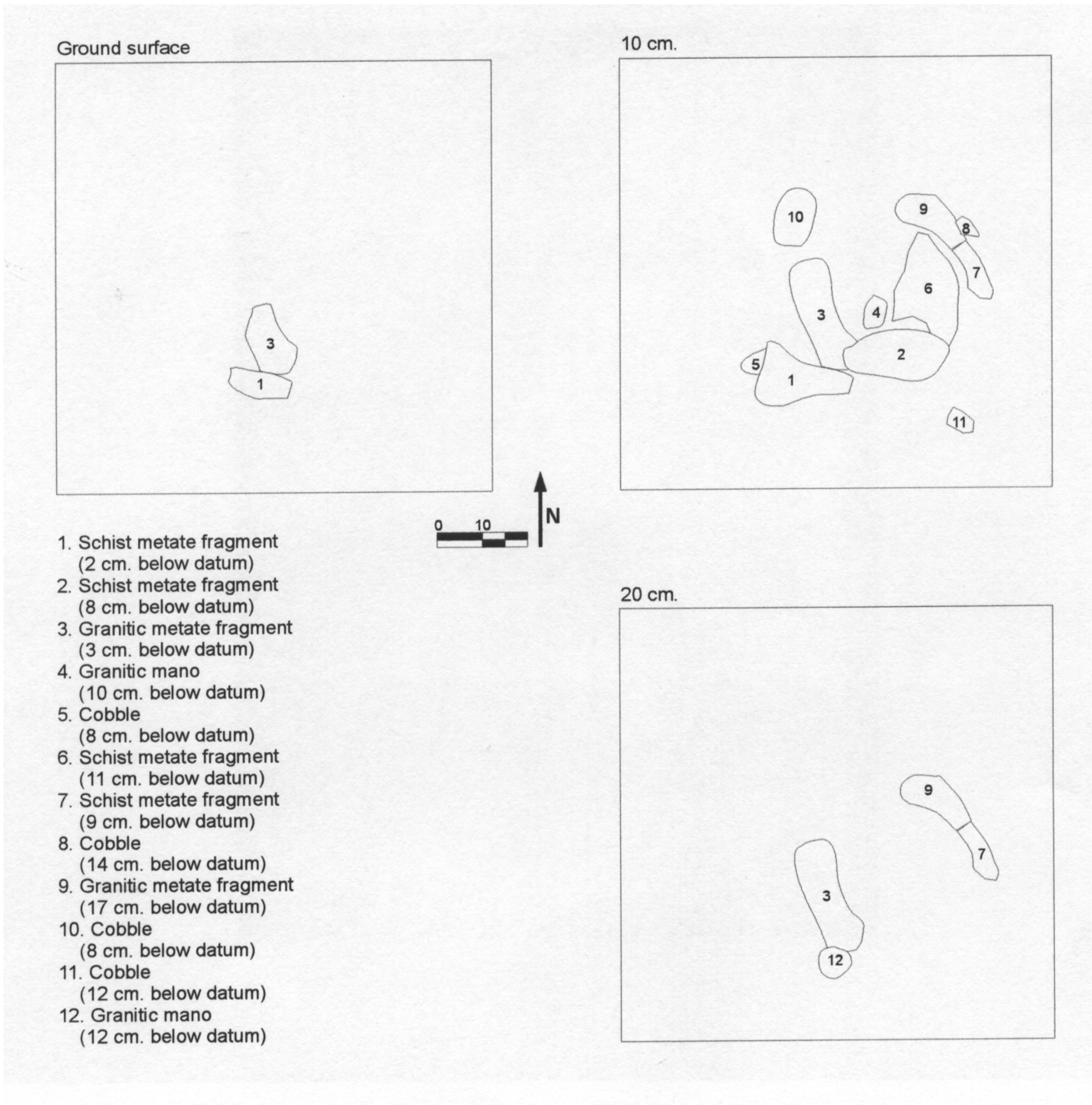

Figure 11. CA-ORA-1554, Feature 1, Plan View, Levels 0-30 cm.

PART V. HISTORIC SITE FEATURE: SITE 30-176632

Two historic sites, 30-176632 and CA-ORA-29, were tested during this project. Only 30-176632 is discussed in this report; CA-ORA-29 (Mission Vieja) is treated in a separate report (Van Wormer 2002). Van Wormer (pers. comm.) also provided the technical analysis for this report.

30-176632

This site consisted of a single large feature, or historic scatter. Feature items consisted of bricks, glass, metal objects, wood and charcoal. The ARMC crew set out a grid measuring 8 x 8 meters to enclose the artifacts. After removing the surface dried grass, the crew members mapped each 2 x 2-meter segment in plan view. See Figure 12 below for a composite map of the feature.

The majority of the artifacts at the site were building materials (Table 20) with bricks being the most numerous. No precise count or weight of the bricks was carried out since they would skew the sample so greatly. The bricks were examined in the field and then were discarded on site. The bricks were handmade of soft mud, pressed into wooden forms, swiped with a wooden slab to remove excess material, then fired in a freestanding kiln composed of the unfired bricks themselves. The bricks showed various levels of firing relative to their position in the kiln, interior bricks closer to the heat source being most heavily fired and more distant ones less well fired. This technique of brick making dates roughly to the period from 1900 to World War II.

Table 20. Historic Artifacts from Site 30-176632.

CAT. NO.	GROUP	ITEM	COUNT	WEIGHT	REMARKS
1	Consumer Item	Bottle	4	12 g	Clear glass
2	Building material8	Window glass	101	167 g	2 mil. thick
3	Building material	Window glass	25	120 g	3-4 mil.thick; green glass
4	Building material	Nails	71	47 g	Round nails except one horseshoe type
5	Building material	Hinge	2	67 g	1 hinge w/screws
6	Hardware	Strapping	43	151 g	1 pc. handcut
7	Building material	Tile backing	36	105 g	Metal grid for tile
8	Hardware	Auto part	1	340 g	
9	Building material	Wood	11	158 g	Partly burned
10	Building material	Charcoal	3	14 g	

11	Household item	Bucket	1	4190 g	Modified/wire handle

Three types of glass were collected from the site: 1) thin, clear, curved bottle glass; 2) thin, clear, flat window glass; and 3) thicker, clear flat auto glass or possibly icebox shelf glass. Only the bottle glass is diagnostic; it dates to post-1930s. It is manufactured, not hand blown; it shows no bubbles.

The bucket, although not a part of the feature proper, was collected from some 60 meters to the southwest because it appeared to be a diagnostic, or time-sensitive, artifact that might help to date the scatter. The item was originally a large steel canister imported from Morris, Little & Son, Ltd., of Doncaster, England. It was modified to serve as a bucket by the addition of a baling wire handle. Its precise date of manufacture or date of import could not be determined. At minimum it dates to pre-World War II.

The nails were all round types, except for one horseshoe nail, and their date of manufacture is indeterminate. The remaining metals were all manufactured and may date to post-World War II; their timing is indeterminate. The age of the wood and charcoal fragments could not be determined.

The historic feature appears to represent one or more dumping episodes of unknown date(s). The lack of diagnostic artifacts rules out any time assignment. Those items that were found provide conflicting data; some are handmade, some manufactured.

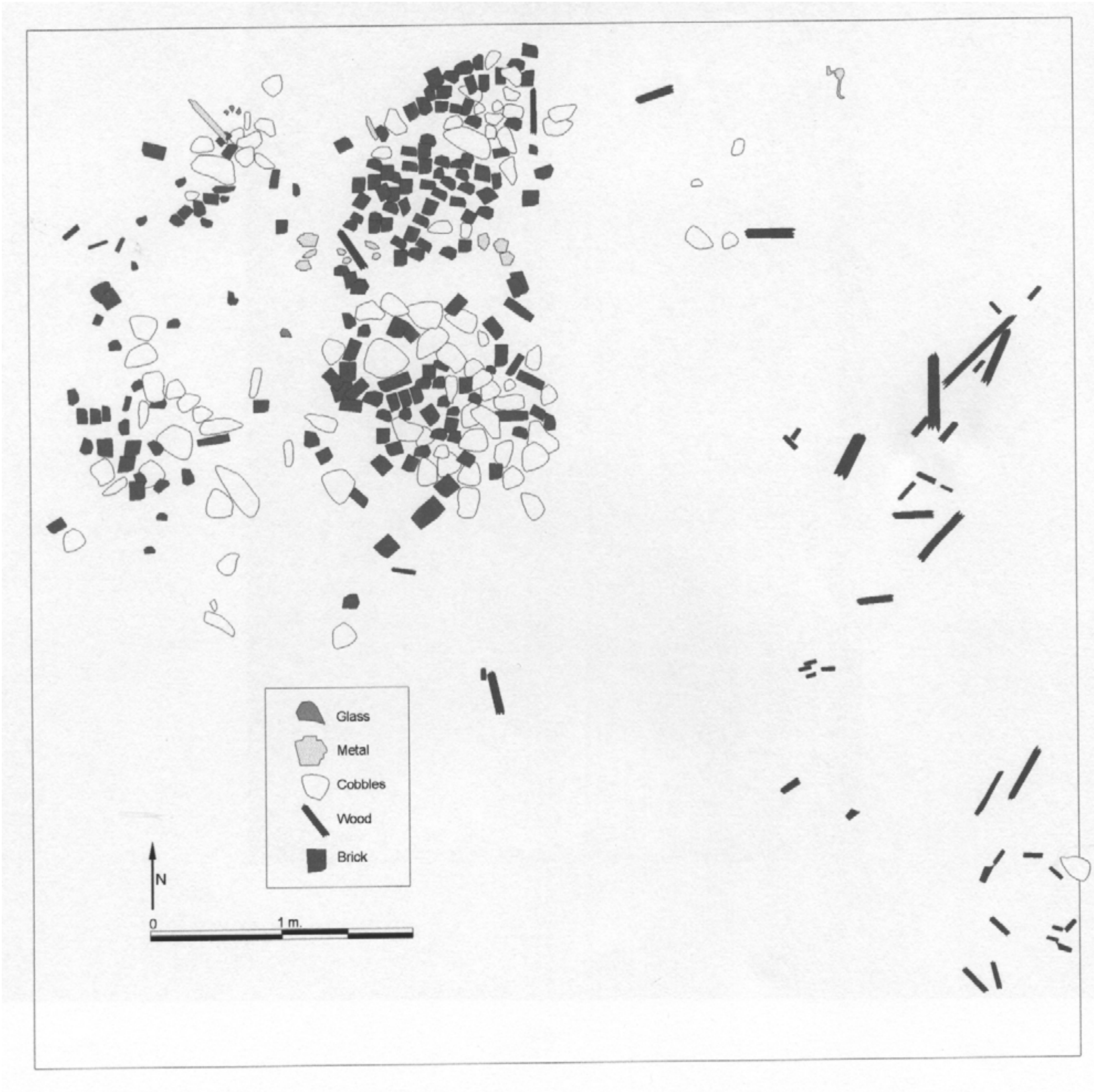

Figure 12. Plan View of Historic Feature, Site 30-176632.

PART VI. STRATIGRAPHY

Only two sites in the study area produced excavation units that revealed any visible stratigraphy: CA-ORA-1555 and CA-ORA-1556. The stratigraphic profiles from each site are presented below.

<u>CA-ORA-1555</u>

Test Unit 1 (Figure 13) revealed a maximum deposit of 60 cm below datum. The uppermost layer consisted of a fine sandy loam matrix, followed by a sandy clay with cobbles. Deeper still came a firm, sandy clay matrix, followed in succession by a compact sandy clay and compact clay (penetrated into but not excavated). Both of the final layers were sterile, i.e., contained no cultural resources. Rodent disturbance was limited to the second layer.

CA-ORA-1556

In Test Unit 1 (Figure 14) the deposit reached a maximum of 60 cm below datum. The upper layer consisted of a light tan, sandy silty loam with gravel. A cobble layer followed. The terminal layer was a sterile clay. No rodent disturbance was noted.

In Test Unit 2, the deposit reached a maximum of 60 cm below datum (Figure 15). The root zone at the top of the deposit was succeeded by a slightly compact sandy clay/loam in which a core (#101) was mapped in place. A more compact sandy clay lay below. The deposit terminated with a very compact sandy clay. Rodent disturbance was minimal and limited to the second layer.

In Test Unit 3 (Figure 16) the deposit reached a maximum of 80 cm below datum. A root zone layer gave way to a less compact, sandy clay/loam. A more compact sandy clay followed. A very compact sandy clay terminated the deposit. Rodent disturbance was limited to the second layer.

Test Unit 4 (Figure 17) reached 110 cm below datum. The root zone was thin. A thick deposit of a less compact, sandy clay/loam followed. A more compact sandy clay succeeded that layer. A very compact sandy clay matrix terminated the cultural deposit. Rodent disturbance was minimal, limited to the uppermost portion of the second layer.

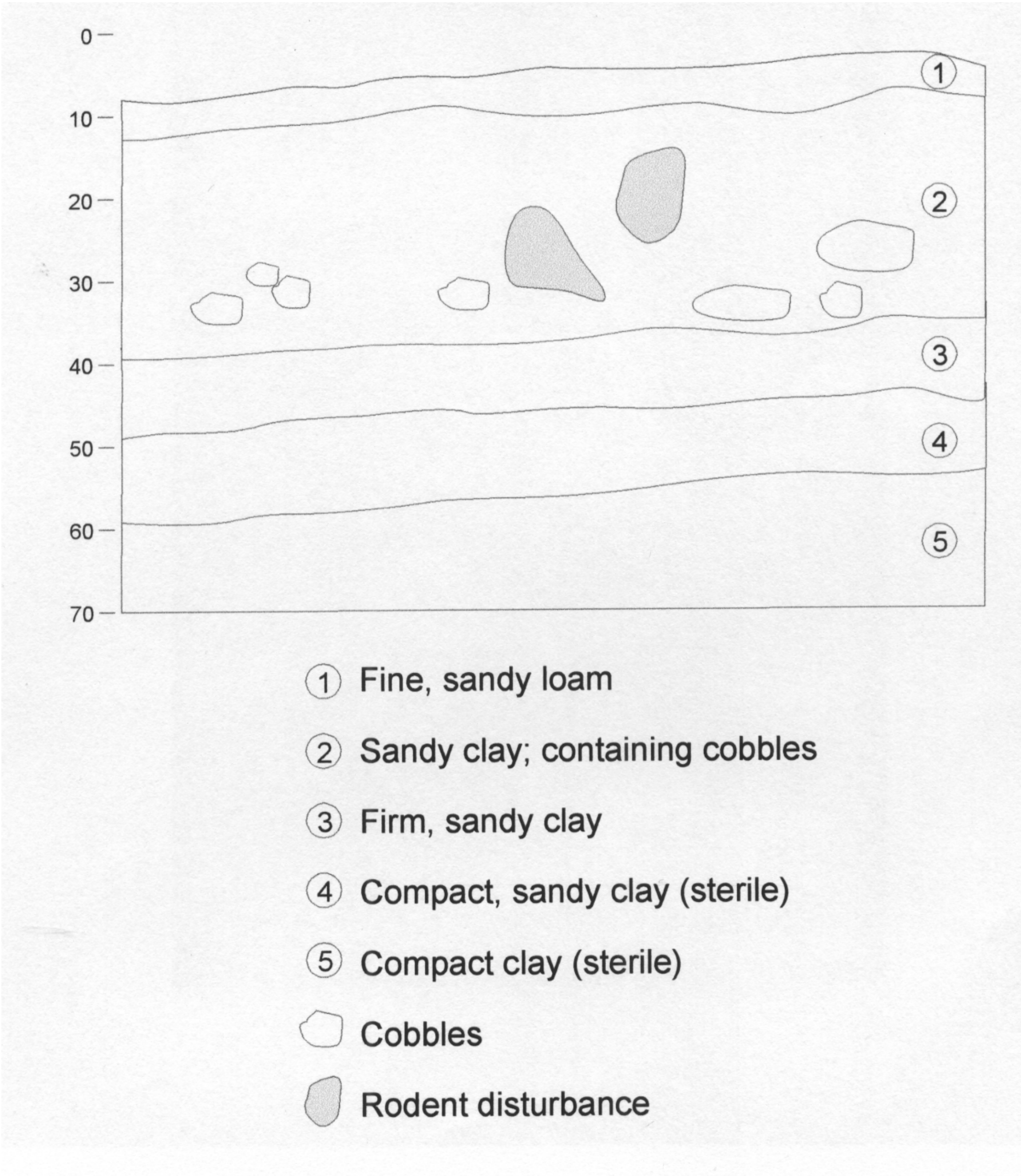

Figure 13. CA-ORA-1555: Test Unit 1, Northern Wall Profile.

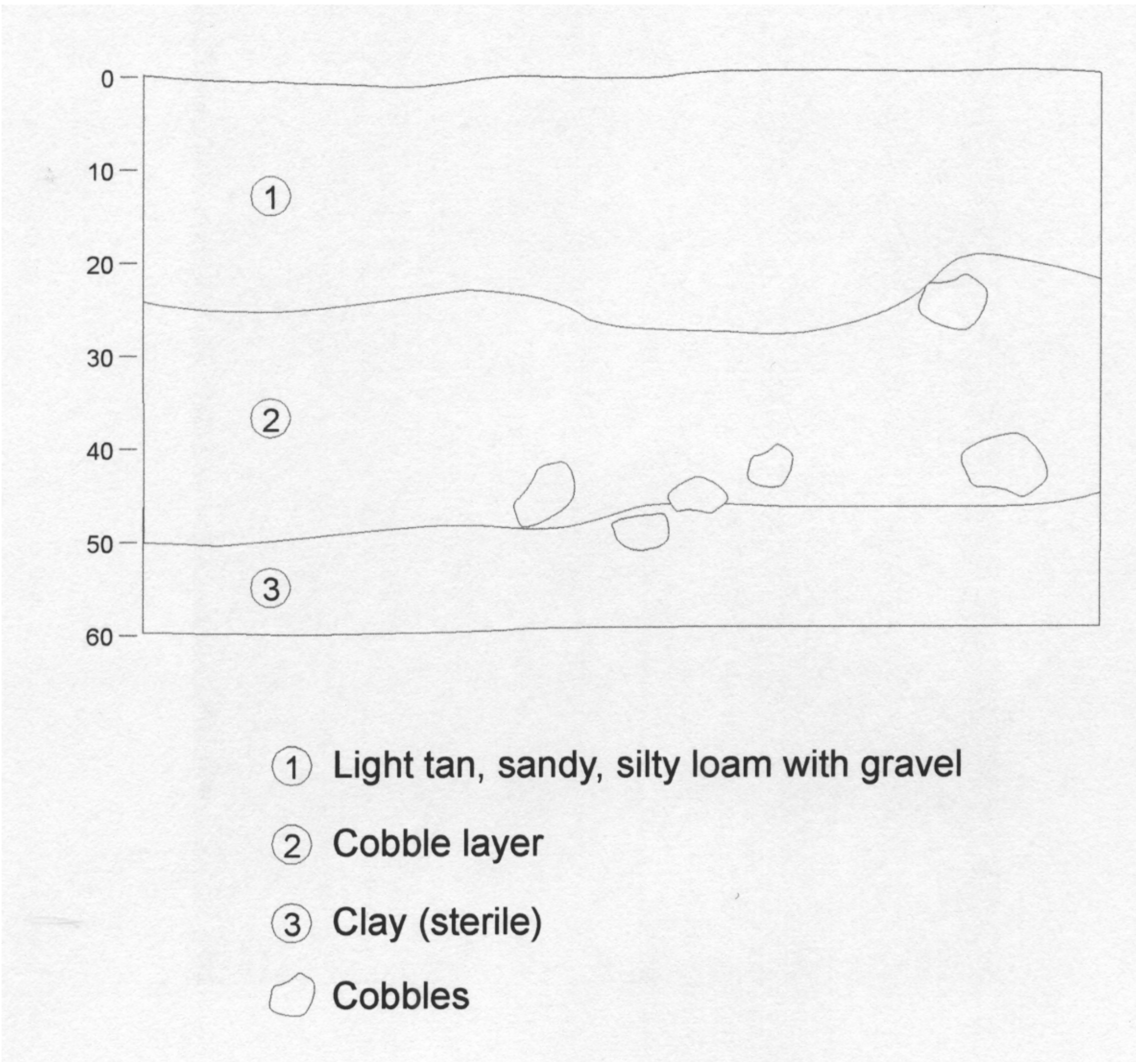

Figure 14. CA-ORA-1556: Test Unit 1, Western Wall Profile.

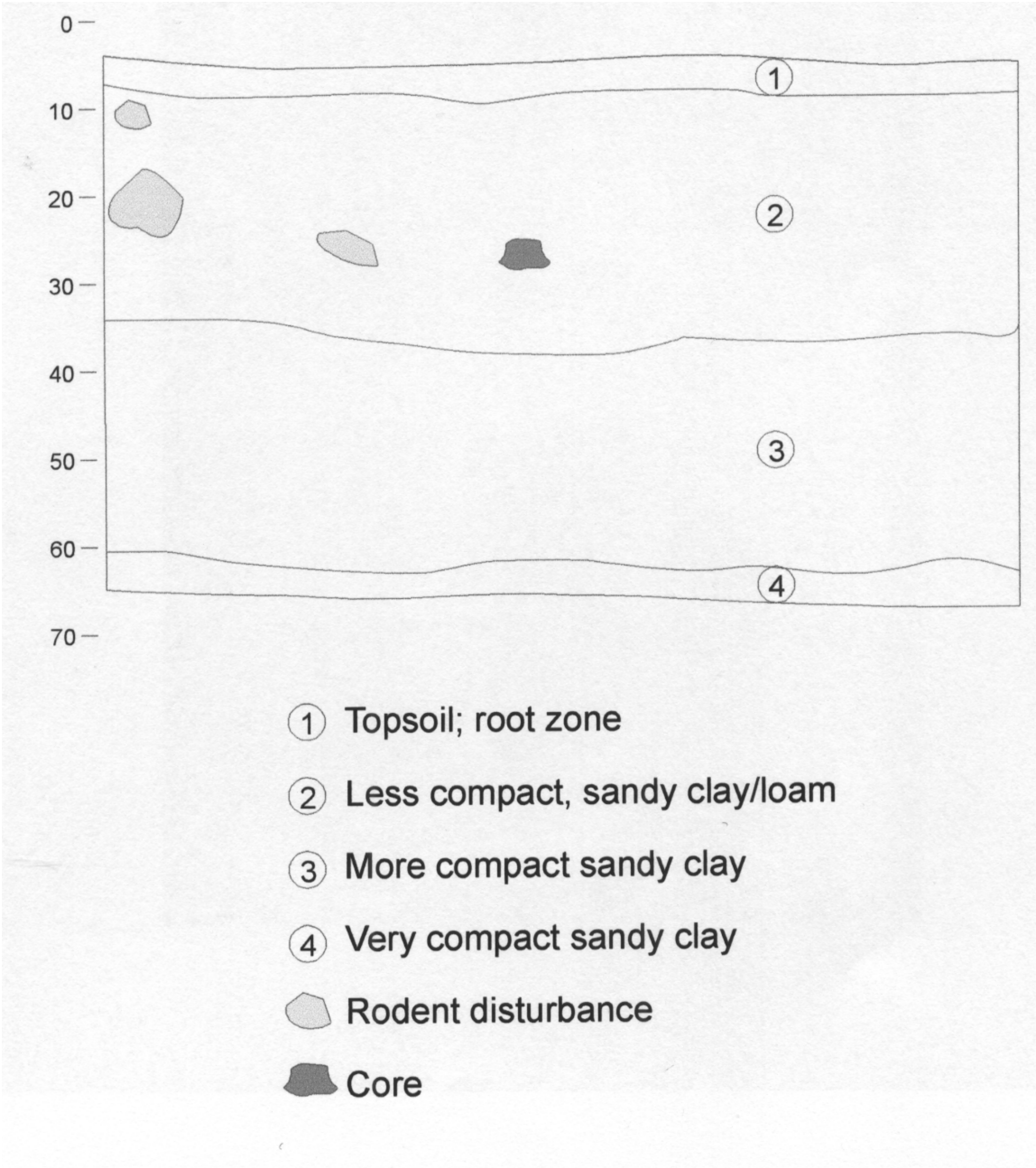

Figure 15. CA-ORA-1556: Test Unit 2, Northern Wall Profile.

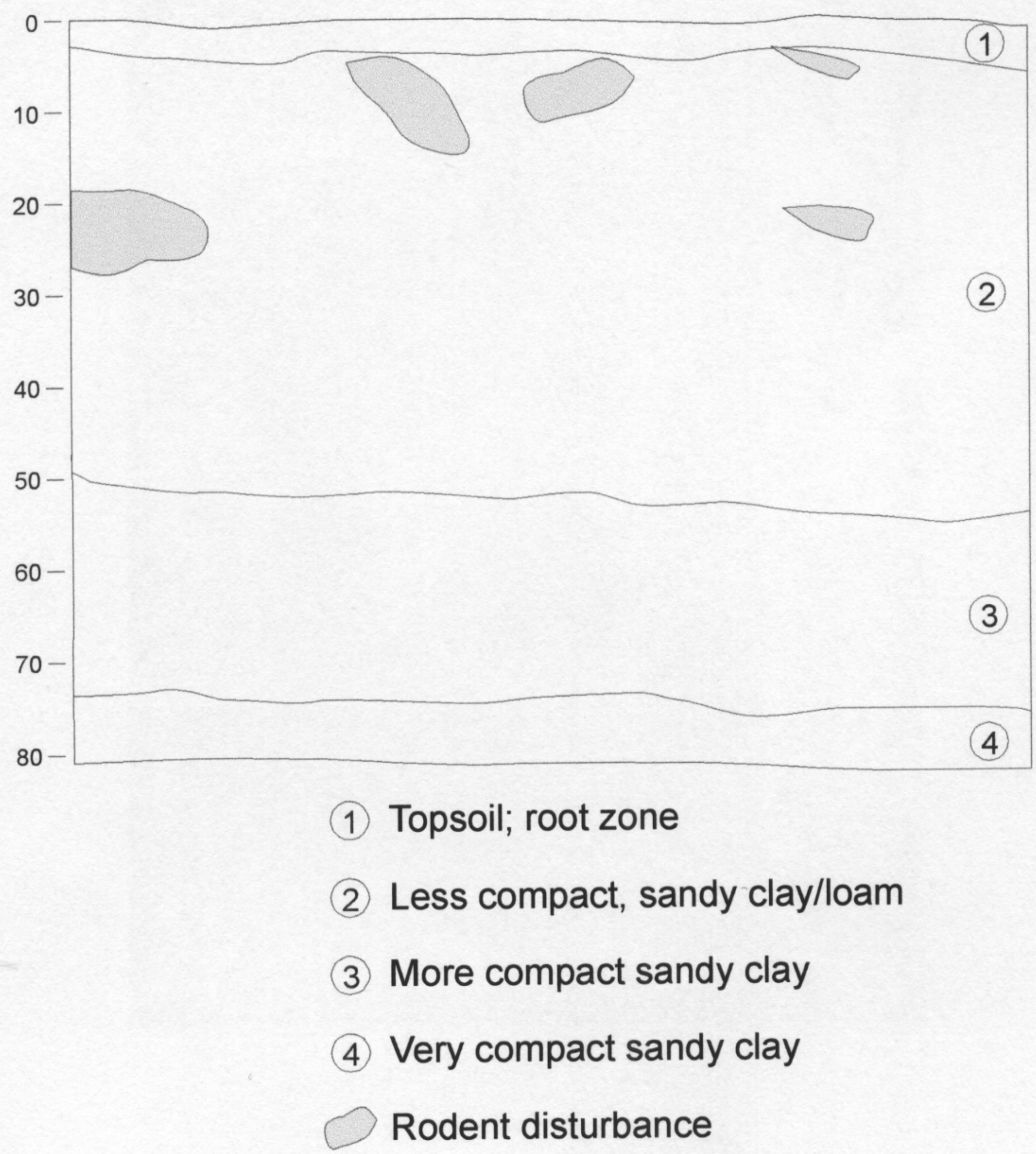

Figure 16. CA-ORA-1556: Test Unit 3, Northern Wall Profile.

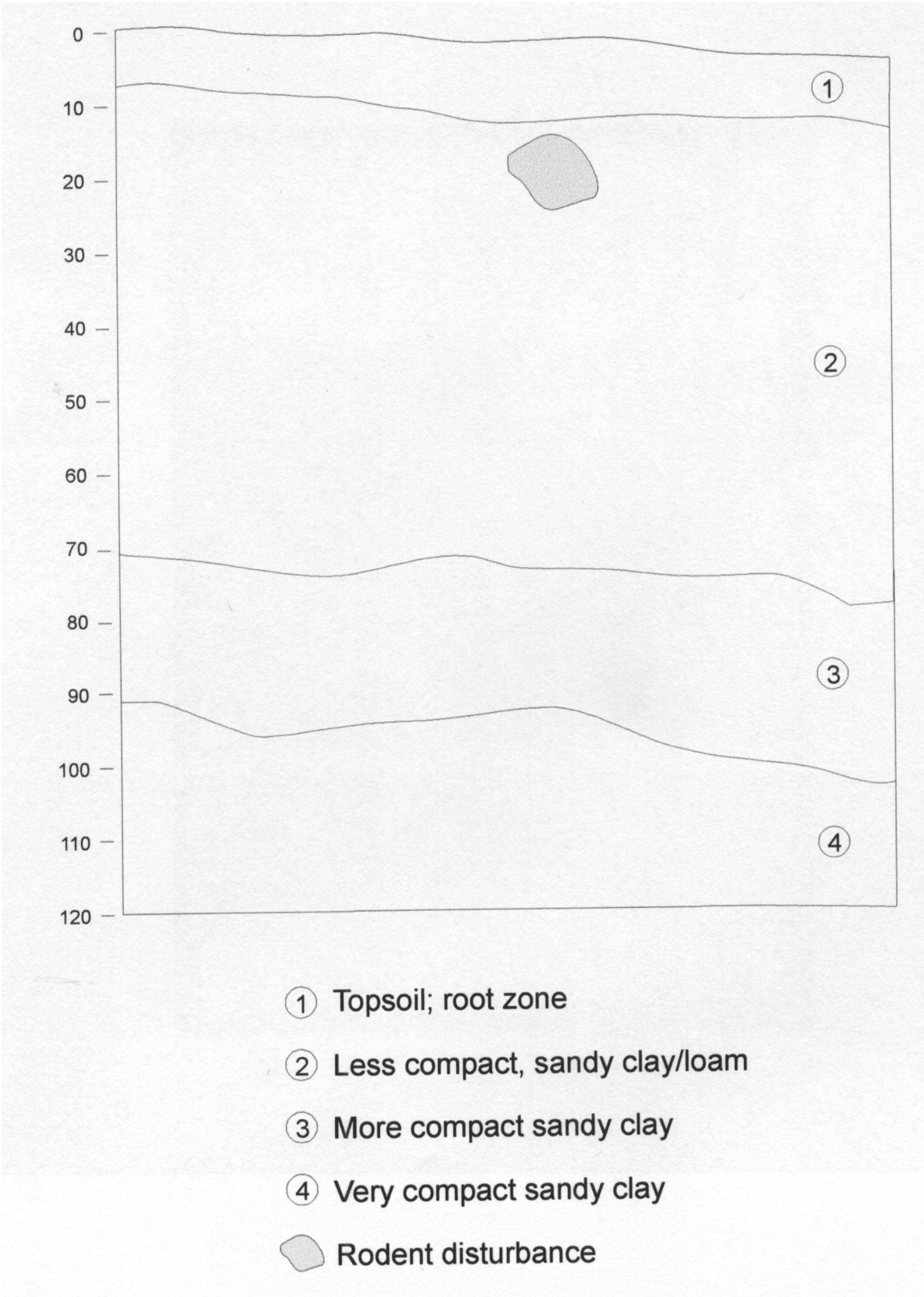

Figure 17. CA-ORA-1556: Test Unit 4, Northern Wall Profile.

PART VII. INTERPRETATION

CHRONOLOGY

The project sites did not yield any materials that could be absolutely dated, eg. charcoal, shell, etc. However, the sites did produce diagnostic artifacts that can be used to provide relative dates for the sites. The diagnostic artifacts are discussed below along with their time associations.

Projectile Point

Only one projectile point was recovered from the project sites. A triangular, concave-based Cottonwood arrowpoint (#1) was found on the surface of CA-ORA-1554 during the survey of Cristianitos Canyon (Demcak 2000). Unlike earlier and larger projectiles that were propelled by an atlatl, or wooden spear thrower, these small, lightweight points were launched with a bow and arrow. The Cottonwood series was first proposed by Lanning (1963) to describe a group of arrowpoints from the Rose Spring Site. He proposed a beginning date of AD 1300 for these points.

Radiocarbon dates from the Great Basin give a range of AD 900 – 1620 for the Cottonwood series (Hester and Heizer 1973). Using data from the Marana Site in Riverside County, Bettinger and Taylor (1974) place the points at circa AD 1300. In Orange County, Koerper and Drover (1983) assign them to the Late Prehistoric tradition and place their occurrence as post AD 750±250. Throughout southern California and the Great Basin, the Cottonwood series co-occurs with Desert Side-notched points and both persist into the early historic period.

Perforators

Perforators may have functioned as drills to place holes in leather, shell or stone beads, ornaments, plaques, gorges, fishhooks, and other items that were to be strung, or may have been used as gravers to incise stone. Three sites produced perforators: CA-ORA-1555, –1559, and -1565.

Two perforators were collected from CA-ORA-1555 in Cristianitos Canyon. Both were made of andesite and had been deliberately shaped. Specimen #59 had a triangular-shaped bit. Specimen #17 had a triangular bit that revealed crushing wear from use.

Two perforators were recovered from CA-ORA-1559 in Chiquita Canyon. Both had been shaped to form a triangular bit. Specimen #6, a surface find, was made of metasedimentary material and had a broken bit. A quartzite specimen (#49) was recovered from STP 2.

A single perforator (#4) made of quartzite was recovered from the surface at CA-ORA-1565 in Gobernadora Canyon. It displayed a triangular bit.

Perforators were most often employed by Late Prehistoric cultures (Wallace 1955: Warren 1968). Small microlith drills of chert were frequent finds in the upper level (Late Prehistoric Horizon) at the Malaga Cove Site (Wallace 1955).

Nut Anvil

One of the manos (#21) at CA-ORA-1560 in Chiquita Canyon had been pecked to create a nutting stone, or nut anvil (Hudson and Blackburn 1981:89-93) to process acorns. Nutting stones, or nut anvils, are part of the mortar-pestle complex of tools. They are among the artifacts used to process acorns into mush. Acorn mush was a staple food for the late Intermediate to Late Prehistoric cultures in southern California, circa 3000 BP to historic times.

Stone Bead

In Gobernadora Canyon, a stone bead blank made of metavolcanic material (#8) was recovered at site CA-ORA-1446 from Test Unit 1, 20-30 cm below datum. Koerper and Drover (1983:20) indicate that drilled, non-steatite stone ornaments are found in Milling Stone occupation sites, suggesting an age of circa 6500 years BP at the earliest.

Discoidals

Discoidals, or disc-shaped stones, are rare finds in southern California. Because of their unusual shapes, lack of use wear, and non-recognition by Native groups at contact or more recently, the function of these artifacts is unknown.

Five discoidals were recovered from the project sites. All were surface finds. Chiquita Canyon produced three discoidals. A granitic specimen (#50) came from CA-ORA-1559. A granitic (#2) and a diorite specimen (#3) came from CA-ORA-1561. All were of regular type, i.e., not wafer or barrel shaped.

Cristianitos Canyon produced two discoidals. A granitic specimen (#4) came from CA-ORA-1550. The specimen (#17) from CA-ORA-1556 was made of granitic porphyry. These two were also of regular type.

Discoidals are often called "gaming stones" in southern California archaeology. Most come from sites with some degree of sedentism, or settled life. The high degree of workmanship is consistent with groups having the time and leisure to develop sophisticated technological traits. Such groups have the leisure time to engage in recreational activities; discoidals were very likely involved in some of these activities. Indeed historical records in the Southeast refer to "chunkey" or "chungke" stones being used in a game in which a man rolled a stone disc forward along a course. Two players then charged the rolling stone; each slid a long forked pole along the ground and attempted to land the pole in such a way that the stone came to rest in the fork of the pole (Martin, Quimby, and Collier 1947:38-39 in Moriarty and Broms 1972:27).

"Chunkey" is viewed as a variant of the widespread "hoop-and-pole " game of North American Indians (Moriarty and Broms 1972). The Luiseño are described by Kroeber (1925:846) as playing a version of this game. The Chumash Indians of the Santa Barbara area reportedly used a barrel-shaped stone ring at which contestants shot arrows in an attempt to penetrate the opening while the stone was in motion (Culin 1907:472).

Some of the discoidals in southern California are perforated. Some are fully perforated and are called “donut stones”. These items are also called digging stick weights.

Discoidals in southern California are most often referred to as “ceremonial stones” due to their apparent non-utilitarian form, their use in rituals (Walker 1951), and their co-occurrence with cog stones in ceremonial contexts (Eberhart 1961). Moreover their use in games strengthens the ceremonial classification of the stone discs. All games played in prehistoric North America were primarily ceremonial. Culin (1907), after lengthy research into the games of these Native peoples, concluded that behind the games and ceremonies there existed some widespread myth that served as the impulse for both. He maintains that the ”...games appear to be played ceremonially, as pleasing to the gods, with the object of securing fertility, causing rain, giving and prolonging life, expelling demons, or curing sickness (Culin 1907:34).

Based upon data from CA-ORA-119A, Koerper and Drover (1983) speculate that discoidals developed during the Intermediate cultures from the earlier cog stones. However, the data accumulated from a variety of sites in southern California (Table 21) suggest that discoidals first appeared in sites with a Milling Stone occupation, circa 6500 years before the present (BP). Based upon their simpler forms, discoidals very likely served as the antecedent for the more complex cog stones.

Table 21. Chronology of Discoidals and Cog Stones in Southern California.

Site No.	Discoidal	Cogstone	C14 (BP)	Obsidian (BP)	Relative Dating	References
LAN-267		X	6310± 100:6870 ±100		Milling Stone Assemblage	King (1967)
La Jolla #1	X		6320± 210			Moriarty and Broms (1971)
LAN-138 (Malaga Cove)	X		6510± 100		Level II, Milling Stone	Flint and Deevey (1960)
Scripps Estates I	X		5410± 100			Moriarty and Broms (1971)
LAN-174 (Zuma Creek)		X	4950± 200		Milling Stone	Flint and Deevey (1960)
LAN-518x			4820-2510		Milling Stone	Wasson et al. (1978)
ORA-183	X		4320± 210;2974± 190			Drummy-Chapel et al. (1983)

ORA-861	X			3890;2860	Milling Stone	Demcak et al. (1990)
ORA-58	X	X	3685± 100	4270-1510		Dixon (1970)
LAN-215	X		3000± 100		Milling Stone	Flint and Deevey (1964);
LAN-283	X	X		2680-1790	Intermed. Component	Butler (1974)
ORA-466	X			2130	Intermed. Component	Cottrell (1982)
LAN-2	X		2550± 150		Milling Stone	Johnson (1966)
LAN-21	x			2550-1480;3120-2450	King's Bead Chronology	Tartaglia (1980)
Porter Ranch	X				Milling Stone	Walker (1952)
LAN-339	X				Milling Stone	Eberhart and Wasson (1975)
ORA-1048	X			2130;1360	Pre-late Component	Demcak et al. (1989)
Torrey Pines	X		2090± 150			Moriarty and Broms (1971)
ORA-119A	X	X	1450± 100	2170	Intermed. Component	Koerper (1981)

To summarize the chronology of the sites in Cristianitos Canyon, site CA-ORA-1554 can be assigned a relative date of AD 1300 based upon the presence of a Cottonwood triangular arrowpoint. Site CA-ORA-1555 may be given a relative placement in the Late Prehistoric Horizon , AD 750±250 years (Koerper and Drover 1983:11) due to the presence of perforators. CA-ORA-1556 had a discoidal linking it to other Milling Stone culture sites and a timeframe of circa 6500 years BP.

In Gobernadora Canyon, a stone bead blank at site CA-ORA-1446 indicates a Milling Stone occupation, circa 6500 years BP.

In Chiquita Canyon, site CA-ORA-1559 can be identified as a multi-component site based on two diagnostic artifacts: discoidal and perforators. The discoidal indicates a Milling Stone occupation, circa 6500 years BP; the perforators suggest a Late Prehistoric occupation, AD 750±250 (Koerper and Drover 1983:11). The nut anvil at CA-ORA-1560 links the site with a Late Intermediate to Late Prehistoric occupation, circa 3000 BP to historic times. The discoidals at nearby site CA-ORA-1561 indicate a Milling Stone occupation, circa 6500 years BP.

SUBSISTENCE AND SETTLEMENT PATTERNS

The data from the test phase established that the inhabitants of the project sites were hunter-gatherers with varying degrees of sedentism, or settled way of life. Some of the project sites served as semi-permanent villages, or base camps, where generalized subsistence and related activities took place (Hudson 1971). Others were temporary camps where specialized activities were carried out.

Chiquita Canyon (CA-ORA-1559, -1560, and –1561)

Site CA-ORA-1559 produced a wide range of activity sets and corresponding artifact types. They included the following: chipped stone tool manufacture (flakes, cores, hammerstones); resharpening of grinding surfaces (angular hammerstones); hard seed processing (manos and metates); bone and wood working (utilized flakes, flake and core tools); and yucca pulping and fiber processing (plano-convex tools); leather piercing, stone or shell beadmaking (perforators); and ceremonial activities (discoidal). This wide range of activities suggests that the site was a village, or base camp. The site did not have much midden (refuse) accumulation (max. 30 cm). It must have been occupied for much of the year, based upon the range of activities. It may have served as a base camp intermittently or non-intensively. With a small population, such an occupation would not result in much midden development.

Site CA-ORA-1560 is located just down slope and northwest of CA-ORA-1559. Six activity sets were identified there. They consist of the following: chipped stone tool manufacture (flakes, cores, hammerstone); resharpening of grinding surfaces (angular hammerstones); hard seed processing (manos and metates); acorn processing (nut anvil); bone and wood working (flake tools and core tool); and yucca pulping and fiber processing (plano-convex tools). The wide range of activities identifies this site as a base camp, or village. Although the midden accumulation was not great (max. 30 cm), the site was apparently occupied for a goodly portion of the year, based upon the range of activities. Perhaps the site was only used as a base camp intermittently or non-intensively. With a small population, the refuse accumulation would not be great.

Site CA-ORA-1561 exhibited a very limited range of activities. Only two activity sets were present: yucca pulping and fiber processing (plano-convex tool), and ceremonial activities (discoidals). This site appears to have served as a ceremonial camp for the inhabitants of CA-ORA-1559 and CA-ORA-1560.

Elsewhere in Chiquita Canyon are found two temporary camps: CA-ORA-1562 and –1563. Neither camp showed much midden accumulation (max. 30 cm), suggesting short-term or non-intensive use. CA-ORA-1562 exhibits only three activity sets: chipped stone tool manufacture (flake, hammerstone); resharpening of grinding surfaces (angular hammerstones); and hard seed processing (manos and metates). The predominance of grinding tools over chipping tools argues that this site was used for hard seed processing, most likely in the summer to fall months when seeds were ripening. CA-ORA-1563 produced four activity sets: chipped stone tool manufacture (flakes, cores, hammerstone), resharpening of grinding surfaces (angular hammerstones); hard seed processing (manos and metates); and yucca pulping and fiber processing (plano-convex tools). A temporary camp used for toolmaking and plant processing, this site may have been associated with the base camp CA-ORA-1559 to the south.

Gobernadora Canyon

Site CA-ORA-1564, northernmost of the four sites tested in Gobernadora Canyon, produced four activity sets: chipped stone tool manufacture (flakes, cores, hammerstones); hard seed processing (mano); bone and wood working (utilized flakes, flake and core tools); and yucca pulping and fiber processing (plano-convex tools). There was minimal midden accumulation (max. 30 cm), so the site was either used intermittently or non-intensively. The range of activities suggests the site served as a temporary camp, perhaps occupied seasonally for plant procurement and processing. It may have been associated with a nearby village, or base camp, such as CA-ORA-1565.

Site CA-ORA-1565 exhibits a wide range of activity sets that include the following: chipped stone tool manufacture (flakes, cores, hammerstones); resharpening of grinding surfaces (angular hammerstones); hard seed processing (mano); bone and wood working (utilized flakes, flake and core tools); and yucca pulping and fiber processing (plano-convex tools and choppers); and leather piercing, stone or shell beadmaking (perforators). Although the midden accumulation was not great (max. 30 cm), the site was apparently occupied for a goodly portion of the year, based upon the range of activities. Perhaps the site was only used as a base camp intermittently or non-intensively. With a small population, the refuse accumulation would not be great.

CA-ORA-1446 produced three activity sets: chipped stone tool manufacture (flakes, hammerstone); hard seed processing (mano and metates); and stone bead making (bead blank). Midden accumulation was slight (max. 30 cm). This site was probably a temporary camp associated with a nearby base camp, perhaps CA-ORA-1565.

CA-ORA-1566 produced only four activity sets: chipped stone tool manufacture (flakes); hard seed processing (manos and metates); bone and wood working (core tool); and yucca pulping and fiber processing (plano-convex tools and choppers). Midden accumulation was minimal (max. 30 cm). This site was probably a temporary camp associated with a nearby base camp, such as CA-ORA-1565.

Cristianitos Canyon: CA-ORA-1550, -1554, -1555, and -1556

CA-ORA-1550 contained only four artifacts reflective of three activity sets: hard seed processing (manos and metates); yucca pulping and fiber processing (plano-convex tools and choppers), and ceremonial activities (discoidal). The site had no midden build-up and no sub-surface cultural deposit. It appears to have been a ceremonial area almost exclusively.

CA-ORA-1554 was a trail site that contained a mano and metate cache/feature, as well as six activity sets: hunting (arrowpoint); chipped stone tool manufacture (flakes, hammerstones); resharpening of grinding surfaces (angular hammerstones); hard seed processing (manos and metates); bone and wood working (utilized flakes, flake tools); and yucca pulping and fiber processing (plano-convex tools). Based upon the wide range of activities, one may infer that this site served as a base camp, or village. The site exhibited only a minimal midden accumulation (max. depth 30 cm), but a small population would not accumulate much refuse, or a group that used the site intermittently. The trail upon which the site is located probably began as a game trail, was used by Native Americans (see social networking, obsidian trade), and may have been used by the Portolá party on its trek northward out of Cristianitos Canyon. The trail is situated in the upper canyon where the travelers sought a path to San Juan Creek.

CA-ORA-1555 exhibited six activity sets, among them the following: chipped stone tool manufacture (flakes, cores, hammerstones); resharpening of grinding surfaces (angular hammerstones) ; hard seed processing (manos and metates); bone and wood working (utilized flakes, flake tools); leather piercing, stone or shell beadmaking (perforators); and yucca pulping and fiber processing (plano-convex tools). Based upon the wide range of activities at the site, CA-ORA-1555 served as a base camp, where generalized activities took place. The site had little midden accumulation (max. 30 cm). It may have been used intermittently or non-intensively; a small population group's occupancy would not have created much midden.

CA-ORA-1555 is part of site CA-ORA-1222 (Romani et al. 1997). Although they were recorded as separate sites (Demcak 2000; Brown 1989), the lithic scatter comprising the sites is continuous. As a result of testing at CA-ORA-1222 (Romani et al. 1997), the site revealed the following activity sets: hunting and butchering (bifaces); chipped stone tool manufacture (flakes, core, abrader); hard seed processing (manos, metates, ground stone fragments); and possibly pulp and fiber processing (core tool). The site contained spatially distinct loci, or activity areas. Area A was deep, reaching 100 cm at its maximum, and was apparently used for lithic reduction and tool production and some hard seed processing. Area A abuts directly on the southern boundary of CA-ORA-1555. Area B reached 900 cm in depth, and was used mostly for lithic reduction. Area C reached 60 cm in depth and was used for lithic reduction along with plant processing, as evidenced by manos and metates on the surface in this area. The site is characterized as a processing station rather than a primary habitation due to the absence of subsistence items (Romani et al. 1997:103). The absence of subsistence items may simply be due to the poor preservation provided by the site soils.

CA-ORA-1556 revealed six activity sets: chipped stone tool manufacture (flakes, cores, hammerstones); resharpening of grinding surfaces (angular hammerstones); hard seed processing (manos and metates); bone and wood working (flake and core tools); yucca pulping and fiber processing (plano-convex tools, chopper); and ceremonial activities (discoidal). The midden accumulation at the site reached 110 cm in depth. The wide range of activities and the heavy midden accumulation both indicate that the site functioned as a base camp, or semi-permanent village, which was occupied for most or all of the year.

SOCIAL NETWORKING

The interraction, or social networking, of Native Americans in prehistory can be traced in the archaeological record by noting the presence of non-local goods at sites. Such non-local, or exotic, goods in the study area would include obsidian, fused shale, pottery, steatite, asphaltum, and marine shells.

No exotic items were recovered from the project sites during the recent testing. All of the recovered items were lithics that are available either directly on site or nearby, or they occur as float in the drainages in proximity to the site, namely Cristianitos Creek and San Juan Creek.

At CA-ORA-1222, immediately down slope from CA-ORA-1555 (one site; parts recorded separately), Greenwood and Associates (Romani et al. 1997) recovered two obsidian flakes during a test phase at the site. The flakes were not sourced (Eastern California, Salton Sea??), so their origin is unknown. The flakes were not submitted for hydration rim measurement (rim increases with time after flaking), so no relative dating for this site is available. The presence of obsidian, a trade good, in the upper canyon argues that the trail (see CA-ORA-1554) served as a conduit for trade as well as a transportation route in prehistory and perhaps the early historic period (Portolá Expedition).

PART VIII. SIGNIFICANCE EVALUATION

The sites in the project area are being evaluated based upon their significance, or research potential, and their integrity. Their significance will be determined by their potential to provide data relevant to the investigation of scientific problems, such as those contained in the research design for this project. Each site will be judged by the data it can provide toward answering research questions now and in the future. Integrity will be measured as it affects potential for data recovery at the sites.

Generally the research design (Part II) for the Ranch Plan is focused on four major research problems:

1) Chronology (cultural-historical framework)
2) Subsistence (provisioning of basic needs, technology)
3) Settlement (placement in space relative to environment, natural or cultural)
4) Social Networking (interactions among groups, eg. exchange).

These research problems, or major research topics, are not unique to the project area; rather, they may be applied universally. Problems of a more nearly local or regional nature have been included as specific research questions under the larger headings.

Six prehistoric sites (CA-ORA-1554, -1555, -1556, -1559, -1560, and –1565) are considered eligible for the National Register of Historic Places (NRHP) and are discussed briefly below. Their significance, or research potential, is outlined with reference to their possession of data that might be applied to the investigation of specific research issues, either outlined in Part II, or elsewhere.

The remaining project sites do not possess the research potential to answer important research questions; therefore they would not be NRHP eligible. These non-eligible sites include CA-653, -654, -655, -657, -658, -1105, -1124, -1184, -1446, -1450, -1550, -1561, -1562, -1563, -1564, –1566, and historic site 30-176632.

CA-ORA-1554

Located in upper Cristianitos Canyon along a trail, CA-ORA-1554 was recorded in 2000 (Demcak 2000) and tested during this project. As a result of the test investigations, one may infer that the site was a base camp, or village, where generalized activities took place (hunting, stone tool making, resharpening of grinding surfaces, hard seed processing, bone and wood working, and pulp and fiber processing). A mano and metate cache was recorded in Feature 1 at the site.

The site contained no organic materials, such as charcoal or shell, which could be used for absolute dating. A Late Prehistoric occupation is recognized there based upon the recovery of a Cottonwood Triangular arrowpoint. A small amount (30 cm. max) of midden accumulation was found during the test of the site, suggesting that it may have been occupied intermittently or non-intensively; a small population group would generally create little accumulated midden.

Although no historic artifacts were found during the fieldwork at CA-ORA-1554, the site is situated on a trail that leads down slope into San Juan Canyon. The trail most likely started as a game trail that was later used by Native Americans (obsidian trade). It may also have been used by the members of the Portolá Expedition as they made their way through Cristianitos Canyon and west, northwest to their campsite, CA-ORA-29 (Mission Vieja) on the banks of San Juan Creek and opposite the entrance to Gobernadora Canyon. The trail would then be part of the historic Camino Real.

The site has demonstrated the potential for providing data to answer questions of chronology (arrowpoint), subsistence (chipped stone tools; ground stone tools; debitage; mano and metate cache), settlement (site's relationship to the environment and to other sites in the canyon), and social networking (Indian trail; trade route; historic trail, part of Camino Real).

The integrity of the site has been slightly affected by erosion, cattle grazing and some vehicular use as part of ranching activities. Overall site integrity is very good.

CA-ORA-1555

This site in upper Cristianitos Canyon was recorded in 2000 (Demcak 2000) during the survey phase of investigations. As a result of the test investigations, it has been determined that CA-ORA-1555 was a base camp, or village, where generalized activities took place (stone tool making; resharpening of grinding surfaces; hard seed processing; bone and wood working; leather piercing, stone or shell beadmaking; and pulp and fiber processing).

The site contained no organic materials, such as charcoal or shell, which could be used for absolute dating; however, a Late Prehistoric occupation is recognized there based upon the recovery of two perforators. A small amount (30 cm. max) of midden accumulation was found during the test of the site, suggesting that it was used intermittently or non-intensively; little midden accumulation would be expected from a small population group.

Site CA-ORA-1555 has the potential for providing data to answer questions of chronology (perforators; obsidian; see further), subsistence (chipped stone tools; ground stone tools; debitage), settlement (site's relationship to the environment and to other sites in the canyon), social networking (obsidian trade, see CA-ORA-1222), and the identification/location of the historic village of *Tobe* (Boscana in Harrington1934:61; Evans 2000:6-7).

Note that CA-ORA-1222 (of which CA-ORA-1555 is a part) is already considered NRHP eligible (Romani et al. 1997:127).

Site integrity is excellent. Although cattle graze in the area, only game animals pass through this site because it is largely covered with vegetation.

<u>CA-ORA-1556</u>

This site is located in upper Cristianitos Canyon and was recorded in 2000 (Demcak 2000) and tested during the current project. As a result of the test investigations, it has been determined that the site was a base camp, or village, where generalized activities took place (stone tool making, resharpening of grinding surfaces, hard seed processing, bone and wood working, pulp and fiber processing, and ceremonial activities).

The site contained no organic materials, such as charcoal or shell, which could be used for absolute dating; however, a Milling Stone occupation is indicated by the recovery of a discoidal. Unlike the other two base camps in the upper canyon, CA-ORA-1556 had an extensive midden buildup (110 cm max.). The site was probably occupied year round and/or over a long period. The earliest inhabitants may have been a Milling Stone group. There is no evidence of a cultural hiatus, or discontinuity, in the site deposit, so the site may have been occupied into the Intermediate, Late Prehistoric or early historic period.

Site CA-ORA-1556 has the potential for providing data to answer questions of chronology (discoidal; depth as indicator of time), subsistence (chipped stone tools; ground stone tools; debitage), settlement (site's relationship to the environment and to other sites in the canyon), and ceremonialism among the Juaneño (discoidal).

The integrity of CA-ORA-1556 has been slightly affected by a road cut and a drainage. The dirt road passes through the uppermost, northwestern portion of the site to a depth of perhaps 15-30 cm below present ground surface. The road affects no more than 5% of the total site area. The drainage to the southwest of the site accounts for minor erosion of site materials. Overall site integrity is very good.

<u>CA-ORA-1559</u>

Site CA-ORA-1559 was recorded in 2000 (Demcak 2000) and tested during the current project. This site, located in middle Chiquita Canyon, has been determined to be a base camp, or village, where generalized activities took place (stone tool making; resharpening of grinding surfaces; hard seed processing; bone and wood working; pulp and fiber processing; leather piercing, stone and shell beadmaking; and ceremonial activities).

The site contained no organic materials, such as charcoal or shell, which could be used for absolute dating; however, a Milling Stone occupation is indicated by the recovery of a discoidal, and a Late Prehistoric occupation is indicated by the recovery of two perforators. CA-ORA-1559 had a minimal midden buildup (30 cm max.). The site may have been occupied intermittently or non-intensively; little midden accumulation would be expected by a small group's use of the site.

Site CA-ORA-1559 has the potential for providing data to answer questions of chronology (discoidal; perforators), subsistence (chipped stone tools; ground stone tools; debitage), settlement (site's relationship to the environment and to other sites in the canyon), and ceremonialism among the Juaneño (discoidal).

CA-ORA-1560

Site CA-ORA-1560 was recorded in 2000 (Demcak 2000) and tested during the current project. This site is located in middle Chiquita Canyon down slope to the northwest of CA-ORA-1559. The site has been determined to be a base camp, or village, where generalized activities took place (stone tool making; resharpening of grinding surfaces; hard seed processing; acorn processing; bone and wood working; and pulp and fiber processing).

The site contained no organic materials, such as charcoal or shell, which could be used for absolute dating. A Late Intermediate to Late Prehistoric occupation is indicated by the recovery of a nut anvil, or nutting stone, part of the mortar-pestle complex used to process acorns. CA-ORA-1560 had a minimal midden buildup (30 cm max.). The site may have been occupied intermittently or non-intensively; a small population group would not generally create much midden buildup.

Site CA-ORA-1560 has the potential for providing data to answer questions of chronology (discoidal; nut anvil), subsistence (chipped stone tools; ground stone tools; debitage; acorn processing technology), and settlement (site's relationship to the environment and to other sites in the canyon).

CA-ORA-1565

Site CA-ORA-1565 was recorded in 2000 (Demcak 2000) and tested during the recent project. This site, located in upper Gobernadora Canyon, has been determined to be a base camp, or village, where generalized activities took place (stone tool making, resharpening of grinding surfaces, hard seed processing, bone and wood working, pulp and fiber processing, and leather piercing, stone and shell beadmaking).

The site contained no organic materials, such as charcoal or shell, which could be used for absolute dating; however, a Late Prehistoric occupation is indicated by the recovery of two perforators. CA-ORA-1565 had a minimal midden buildup (30 cm max.). The site may have been occupied intermittently or non-intensively; occupation by a small population group would not be expected to create much midden accumulation.

Site CA-ORA-1565 has the potential for providing data to answer questions of chronology (perforators), subsistence (chipped stone tools; ground stone tools; debitage), and settlement (site's relationship to the environment and to other sites in the canyon and in other canyons). Although no historic artifacts were found at the site, there exists the possibility that the Portolá Expedition may have visited the site. A research goal would be to recover evidence of that visit.

The site's integrity has been slightly affected by agricultural activities. Disturbance has been limited to vertical movement of artifacts in the upper 15 cm of the deposit. There is minor erosion on the down slope portions of the site. Overall the integrity is very good.

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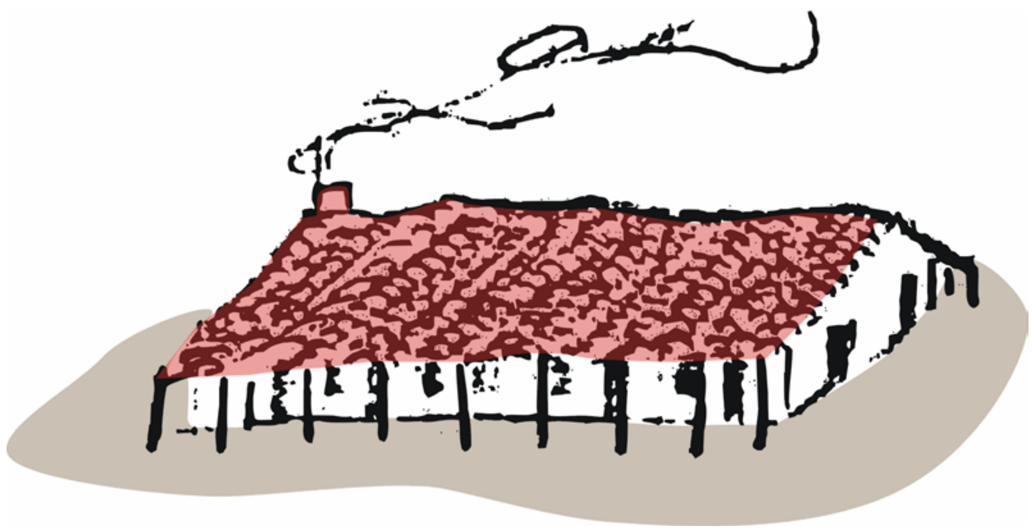

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INTRODUCTION

This report describes results of a limited test excavation of the Misión Vieja Ranch House site (CA-ORA-29) located approximately 3 miles east of the city of San Juan Capistrano in Orange County, California (Figure 1). The purpose of the test was to assess the condition and integrity of the adobe ruins and assess its eligibility for the National Register of Historic Places (NRHP). The project resulted in identification of the remains of two separate structures that probably represent different construction phases. Features included cobble foundations, floors, exterior surfaces and interior dividers. Artifact analysis resulted in identification of an estimated minimum number of 241 items. The majority of the artifacts appear to represent Basque sheep herders who occupied the adobe in the late 1870s and early 1880s.

PART I. HISTORICAL BACKGROUND

The early history of the Misión Vieja site is obscure. Originally a rancho of Mission San Juan Capistrano, buildings may have existed in the vicinity as early as 1800. Following mission secularization in the mid-1830s the area became a privately owned rancho. By the early 1840s it had been granted to Augustin Olvera who probably built a house on the site. In 1845 Olvera sold Misión Vieja to Juan Forster who built a large adobe house at the location of the present ruins. His family occupied the house until 1848 when they returned to San Juan Capistrano. The building was used by ranch employees and Basque and French sheep herders until the end of the nineteenth century when it fell into ruin.

The Juaneño Indians inhabited the area surrounding San Juan Capistrano for centuries before the Spanish colonized upper California. Traditionally hunters and gatherers, their occupation in an area tended to be seasonal, with bands moving throughout a specific territory in order to exploit major food resources

(Kroeber 1925:709-725, plate 57). The permanent founding of Mission San Juan Capistrano in 1776 drastically changed the lifestyle and culture of the area's

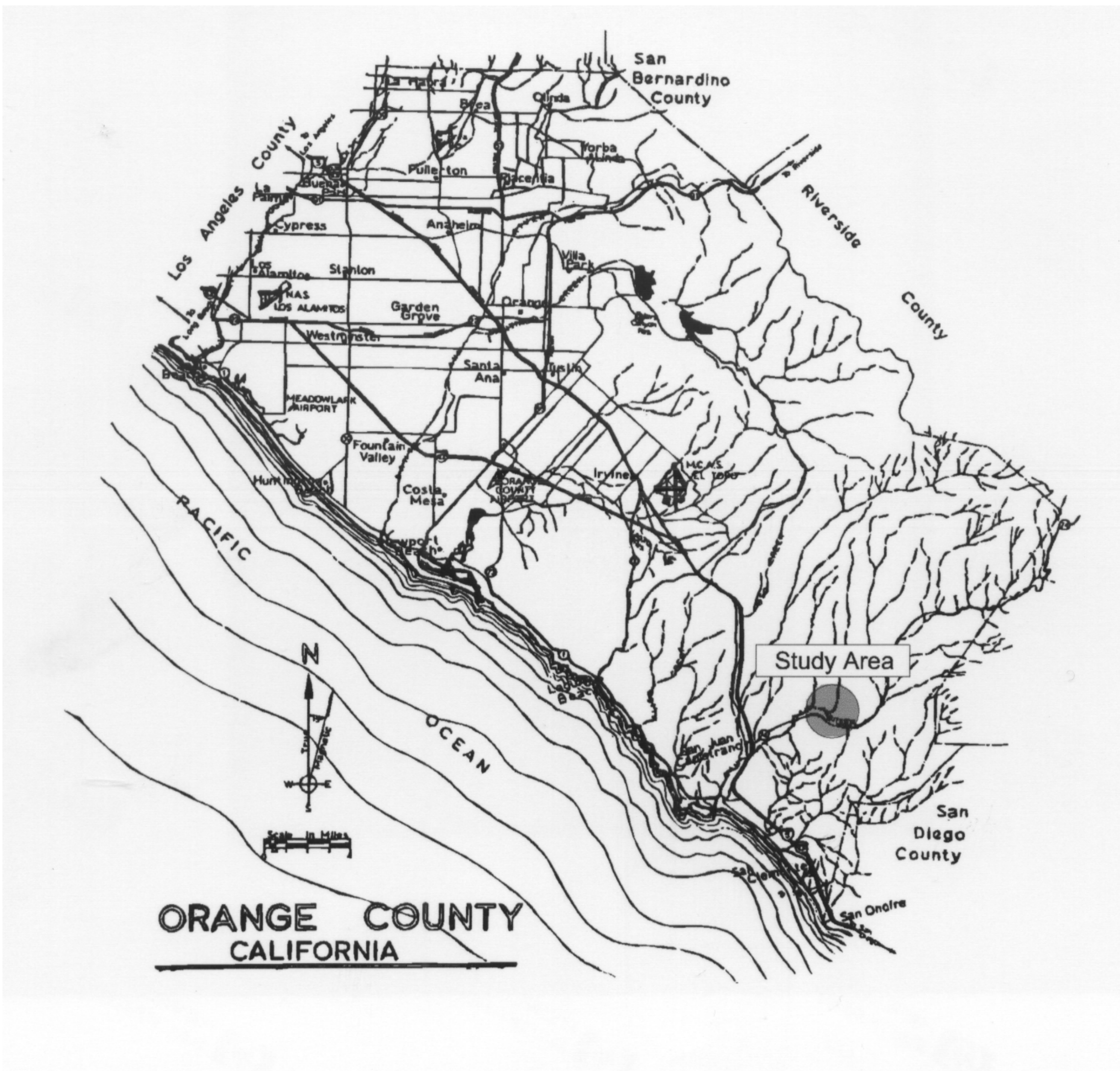


Figure 1. Project Location.

native population. Although the Spanish established missions in California in order to "civilize" the Indians, their efforts resulted in the near destruction of the very people they intended to save (Heizer 1978:121-137).

Mission San Juan Capistrano was founded on October 30, 1775, approximately two miles east of its present location within the area of the present-day Lacouague Ranch (Geiger 1967; Meadows 1967). However, an Indian revolt in San Diego required immediate abandonment of the site. Just over a year later on November 1, 1776, the mission was reestablished at the same place (Bancroft 1886 II:248–249; Englehardt 1922; O'Neill 1977). It was moved to its current site on October 4, 1778 due to the lack of a secure water source at the original location (Geiger 1987:39).

Controversy existed among scholars for several decades over the location of the original mission. Following San Juan Capistrano's reestablishment closer to the coast, the term Misión Vieja, meaning Old Mission, was used to describe the general area of the original site (Evans 2000). San Juan Creek became known as El Arroyo de la Misión Vieja and the name was applied to the rolling hills surrounding the creek and the land along many of its tributary drainages (Bancroft 1886 II:556; Estudillo 1840; Olvera 1842; *Diseño* 1845). Over the centuries the actual location of the original mission structures was forgotten; during the twentieth century many assumed that the dirt and rubble mound that is the subject of this report was the original mission site. This occurred for two reasons. The Annual Reports for Mission San Juan Capistrano from 1779 through 1793 that described the original location remained lost for a century and a half. Later generations, not realizing the true origins of the adobe ruins on the northern side of San Juan Creek at its junction with *Cañada* Gobenadora, assumed they represented the original mission site due to the fact that the area was called Misión Vieja or Rancho Mission Viejo. In 1967 Reverend Geiger O.F.M. found the San Juan Capistrano Annual Reports in the *Archivo General de la Nación* in Mexico City. Research by Geiger and historian Don Meadows provided substantial evidence that the original mission site had been on the southern side of San Juan Creek and more than a mile down stream from the adobe site (Evans 2000, Geiger 1967; Meadows 1967).

San Juan Capistrano was one of a chain of 21 missions established by the Spanish in California. These institutions, combined with military fortifications known as *presidios* at San Diego, Monterey and San Francisco, and a handful of small settlements or pueblos, constituted Spain's tenuous hold on the west coast of its northern provinces. The combined system of missions, presidios, and pueblos was a tested institution by which Spain had successfully extended its colonial frontiers and established Spanish law, language and culture among what were seen as the "uncivilized" tribes of her American possession (Bolton 1917; Bannon 1979; Moorehead 1975). To the Spaniards, Native Americans existed without law or religion, living in unorganized settlements with little apparent sense of moral decency. The Spanish, therefore, believed that rather than imposing their ways upon an existing culture with its own values and social institutions, they were giving civilization and moral salvation to the natives (Heizer 1978). The goal of the missions was to convert the Indians to Christianity and to educate them so that they could eventually be released to lead useful and productive lives. In this manner the frontier could be colonized with its original population (Bolton 1917:46).

The inducement offered by the missionaries for aboriginal cultural conversion rested upon their ability to feed and clothe the native population (Jelinek 1979). Establishment of successful agricultural endeavors was therefore crucial for the mission system. Although crop production played an important role, livestock was the prime emphasis with cattle, horses, and sheep the priorities. Mission Indians became excellent horseman and skilled herders, allowing missions to expand their pasturage well beyond the immediate church compound. All the lands between the San Mateo and the Santa Ana Rivers fell under the jurisdiction of San Juan Capistrano. Outlying ranchos were developed in favorable areas where a native *mayordomo* (foreman) aided by a few *vaqueros* (cowboys) cared for thousands of head of livestock. Ranchos at San Juan Capistrano included Trabuco, Santa Ana, San Joaquin, San Mateo, and Misión Vieja (Bancroft 1886 II:556; III:626). In addition to cattle the missionaries introduced sheep, goats, and swine. Like horses and cattle, these herds also prospered and numbered in the thousands. The livestock was used for much more than supplying meat. Sheep provided the mission looms with wool and were seldom butchered (Jelinek 1979:13). Cattle supplied a ready source of meat for both missions and presidios, as well as hides and tallow for soap and candles.

By the early 1800s, the native inhabitants of the Misión Vieja area had all been relocated to San Juan Capistrano. The rolling hills and canyons became one of the ranchos used to pasture sheep and other livestock. Between 1790 and 1800 horses and cattle belonging to San Juan Capistrano increased from 2,500 to 8,500. At the end of the decade there were also over 17,000 sheep, more than at any other mission (Bancroft I:657). Later decades saw further increases in livestock. In 1810, 34 years after establishment of the mission, cattle had multiplied to 10, 213. The mission also had 693 horses and 11,500 sheep (Evans 2000 from Bancroft 1886 II:110). The size of the herds declined over the next 20 years. In 1817 there were 14,000 cattle, sheep and horses. By 1830 the number had fallen to 10,978 (Bancroft 1886 II: 349, 556).

The Juaneño Indians, trained in livestock handling, cared for the vast herds at the mission's outlying ranchos. Each ranch had its own adobe house for the Indian mayordomo, who lived there with his family and crew of neophyte vaqueros. Orange County historian Jim Sleeper estimates that by1800 Misión Vieja had been occupied and an adobe house built (Sleeper 1985). Reports between 1828 and 1830 list ranchos Santa Ana, San Joaquin, Trabuco, and San Mateo. The 1828 report describes much of the land as useless on account of the mustard which the missionaries found impossible to eradicate; and damage caused by both ocean and stream bed waters which did more harm than the mustard. During dry seasons the arroyos of Trabuco and Misión Vieja had no water, and in winter they became torrents, frequently changing their channels and destroying pasture and crop land. Most of the livestock at that time was pastured near the Santa Ana River (Bancroft 1886 II:556). An 1835 inventory of mission property listed ranchos San Joaquin and Misión Vieja valued at $12,019 suggesting improvements and standing structures at both locations (Bancroft 1886 III: 626).

In spite of several decades of prosperity, the missionaries nearly destroyed the California natives under their control (Cook 1976; Guest 1979). They subjected the Indians to unaccustomed labor and disease and disrupted family ties, social relationships, and cultural values, which caused the physical and cultural decline of the aboriginal population (Heizer 1978). At their peak, the 21 California missions controlled approximately 74,000 neophytes (Bolton 1917). By 1834, the year before secularization took the institutions away from the missionaries, only 17,000 natives remained (Heizer 1978). Population at San Juan Capistrano reached its highest point at 1,361 baptized Native Americans in 1812. For the entire decade of 1810–20, however, population decreased by six percent and deaths exceeded baptisms so that by 1820 the number of native inhabitants stood at 1,064. By 1830 the number of individuals had dropped to 926, and by 1840 there were probably less than 500 natives in the region of San Juan, with fewer than 100 at the pueblo proper (Bancroft 1886 II: 349, 556; III: 625-628).

The late 1820s and early 1830s saw a gradual decline and eventual end to the mission's economic strength, replaced in the rise to power of a secular ranchero aristocracy. The new found power base of privately owned ranchos came from mission secularization and the hide and tallow trade.

Mission secularization resulted from the long standing hostilities between Spanish missionaries and the civilian population of Alta California. By the time Mexico achieved independence from Spain in 1821, California missions were facing an alarming decline in the native population, while the number of secular Hispanic civilians residing in the province numbered over 3,000. As the civilian population continued to grow, their need for land increased. Frustrations began to mount because the missions owned almost all the desirable land in Alta California (Jelinek 1979:15).

Civilian agitation resulted in the Mexican government's secularization of the California missions by 1835. Mission San Juan Capistrano became one of the first missions to experience secularization. As an experiment, Governor Figueroa liberated the Juaneño Indians in October of 1833 and gave them lands they already occupied as well as garden plots. The Indians claimed they already supported themselves upon these lands without the aid of the missionaries (Bancroft 1886 III:332).

Following secularization, former mission lands throughout the province became the property of a small ranchero aristocracy who controlled large estates of grazing land consisting of thousands of acres each. Ranches were several miles from each other and depended upon a small number of coastal pueblos that served as ports, market towns, and social centers (Jelinek 1979:15). By 1846, 16 ranchos had been granted within the boundaries of present-day Orange County which were served by the small pueblo of San Juan Capistrano (Robinson 1948; Hallen 1975).

The ranchero aristocracy established a society based on the one that they and their forefathers had known in Mexico. During the colonial period, Spaniards used various methods of land allotment, combined with an Indian labor force. These were known in turn as *Encomienda*, *Repartamiento*, and *Hacienda*. Although used in different geographical regions and at different times in colonial development, all three systems were based on large tracts of lands, an Indian labor force, and agricultural production, usually involving a single cash product. The system was patriarchal with the male landowner exerting control over his lands, family, and the Indian work force (Burns 1972: 21– 41). Mexican California ranchos were a re-establishment of these institutions. The patriarchal ranchero family usually controlled large tracts of land and numerous Indian servants and vaqueros (Pitt 1966:30).

The California ranchero put little effort into improving his surroundings, allowing cattle and horses to roam freely over open ranges, feeding and reproducing naturally. Cultivation amounted to planting only enough to feed the small population. Grain and other produce for export or livestock feed was not grown and manufacturing was almost nonexistent (Cleland 1941).

The chief economic activity during the period consisted of hides and tallow. Mexican independence in 1821 opened California ports to foreign trade and coincided with the expansion of the American shoe industry. Suddenly cow hides, one of the few items California produced in abundance that could withstand the long transportation by ship to market, were in great demand (Francis 1976:21-55).

By the late 1820s, cattle were raised specifically for their hides and approximately 40,000 were exported annually. By the mid-1830s the number had risen to 100,000 (Bancroft 1886 III: 641). For the first time California began to enjoy the benefits of a reliable source of manufactured goods from the East Coast of the United States and England and a ready market for their products. The California economy, however, was a Neocolonial one, dependent on a single product that resulted in its control by Boston merchants, and the needs of the New England leather market. Neocolonial economies dominated by either the United States or Great Britain were common throughout Latin America during the nineteenth century (Burns 1972:53; Ogden 1927; 1929; Dallas 1955).

Misión Vieja became a typical rancho for the period. It was first occupied in 1840 by José A. Estudillo of San Diego. His petition to the governor requesting ownership of the property stated that the "place named *Misión Vieja* pertaining to the establishment of the Mission of San Juan Capistrano . . . is absolutely vacant, the said establishment not having occupied the same for five years" (Estudillo 1840). In March of 1841 Father Zalvidia, who had remained at San Juan after secularization, complained to Governor Alvarado and requested that Santiago Arguello at Trabuco and Estudillo at Misión Vieja be ordered to remove their cattle from these lands since they belonged to the Indians (Departmental State Papers 5:53). Alvarado, however, felt differently and granted the sixteen square leagues of land known as *Misión Vieja* to Estudillo (Bowman 1958:441). The wealthy San Diegan soon abandoned the rancho and in February 1842. Augustine Olvera, of Los Angeles, petitioned for ownership of the grant claiming "the place of *La Misión Vieja* provisionally granted to Don José Antonio Estudillo during the last year is totally abandoned; for there is no house put up, nor anything else showing a desire to stock and cultivate it as a necessary measure to justify the right he may have of said place." Olvera made the request "in order to put there on some livestock I have acquired…for the support of my mother and my family who depend on my efforts, and to increase said stock and labor there on, according to the nature of the place to induce the improvement there of" (Olvera 1842). Olvera occupied the ranch and built a house there. On April 4, 1845, Governor Pio Pico granted him the rancho that consisted of 46,432 acres. By this time an Englishman, John Forster, living in San Juan Capistrano, had begun to graze cattle on the rancho, undoubtedly with Olvera's permission. Two days after Olvera received clear title to Rancho Misión Vieja he sold it to Forster (Sleeper 1985). A survey (*diseño*) of the grant made at this time by either Olvera or Forster shows a house located on the northern side of Arroyo de la *Misión Vieja* (San Juan Creek) and its junction with Cañada Gobenadora. The tract was called "Rancho de la Paz, formerly known as *Misión Vieja*" (Figure 2).

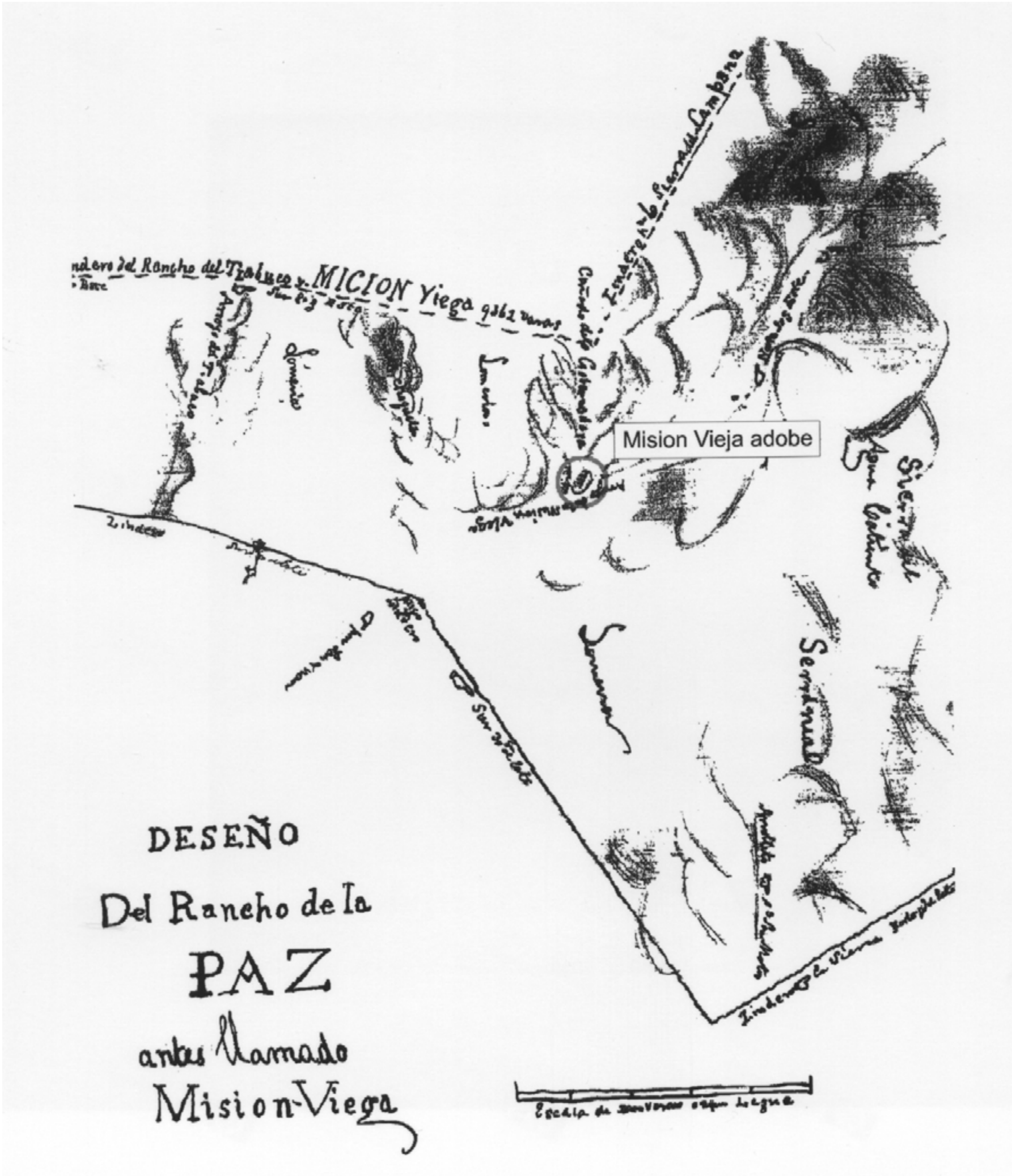


Figure 2. Diseño, 1845.

John Forster became the dominant land owner and cattle baron in present-day Orange and northern San Diego counties between 1840 and 1880. He came to California in 1833 to work for his uncle's import business headquartered in Sonora, Mexico. In 1836 he decided to remain in the province. The following year he was baptized Juan Forster in the Catholic Church and soon thereafter married Isadora Pico. The bride's brother, Pio Pico, stood as godfather at the wedding (Bancroft 1886 III:744; Evans 2000).

The Forsters moved to San Pedro where Juan continued to work as a shipping agent for his uncle. While there he became captain of the port. In 1844 he decided to go into the cattle business and moved his family to San Juan Capistrano, where he purchased the mission buildings for $710 and resided in the complex with his wife and six children (Evans 2000; Bancroft 1886 III:744).

As already noted, the following year Juan Forster purchased Rancho Misión Vieja from Olvera. At this time the Forsters built a large, "fine" adobe house on the ranch. They lived there until 1848 when, due to hostile Indian activities and the War between the United States and Mexico, the family moved back to the mission for safety. After hostilities had ceased the Forster family stayed in the adobe for extended periods each year, dividing their time between the ranch and the mission (Evans 2000; Stephenson 1939:59). There is little doubt that the ruins at the junction of Cañada Gobernadora and San Juan Creek are the remains of Forster's ranch house. As will be discussed in the following sections, he may have added to a smaller building that was already on the site which had probably been built by Olvera but could have been constructed at an earlier date by the mission.

In 1848 the adobe on Misión Vieja provided shelter for Juan's brother-in-law and godfather, Governor Pio Pico, while he eluded capture by the American invaders. Pico stayed at the house for several weeks before fleeing to Mexico (Evans 2000; Stephenson 1936:59).

Following the acquisition of California by the United States, all Mexican period land grants had to be reviewed and their titles confirmed by the U.S. Land Commission. Juan Forster filed claims in 1852 for both Ranchos Trabuco and Misión Vieja. The claims were accepted by the U.S. Land Commission on October 31, 1854. Both patents were issued to Forster on August 6, 1866, fourteen years after they had been filed (Evans 2000:17). In 1864 Pio Pico sold Rancho Santa Margarita in northern San Diego County (currently the U.S. Marine Corps' Camp Pendelton) to Forster. The family left Misión Vieja and San Juan Capistrano to reside on Rancho Santa Margarita. From there Juan Forster oversaw a contiguous tract of grazing land consisting of 46,432.65 acres that included Ranchos Trabuco, Misión Vieja and Santa Margarita (Sleeper 1985).

After the Forster's move to Santa Margarita the Misión Vieja Ranch House became the residence of many different individuals. According to Orange County historian Jim Sleeper, Manuela Yorba de Pico lived in the adobe in 1870 (Sleeper 1985). Given her surname she appears to be related to the Picos by marriage but what she did while living at Misión Vieja has not been recorded. In 1877 a French sheep rancher, Don Luis D'Artigas, lived at the house and pastured a herd of 10,000 sheep on the ranch (Evans 2000; Sleeper 1985). In the late 1870s and early 1880s Misión Vieja was used only for sheep pasturage, and supported an average herd of 15,000 head.

On February 20, 1882 Juan Forster died. In order to pay debts his heirs sold the ranchos to Richard O’Neill and James C. Flood for $250,000. O’Neill lived at the Santa Margarita Ranch adobe from which he managed the property.

The house at Misión Vieja continued to be used by laborers and sheep herders working for the O’Neills. During the closing years of the nineteenth and early twentieth century an Indian mayordomo, Ambrosio Aguilar, and his wife lived in the adobe ranch house (Evans 2000). By the 1890s cattle had once again become the dominant livestock. In 1891 2,000 cattle and 200 horses were shipped from the Rancho (Hallen 1975:60-61).

Sometime before 1920 the adobe house built by the Forster family on Rancho Misión Vieja appears to have been abandoned. It soon fell into ruin and legends of it being the original mission site began to circulate. Richard O'Neill's grandson, John Jay Baumgartner Jr., remembered "I would get frightened when we'd get close to that Mission Viejo, that old place there, because people would go there and dig holes looking for gold that the fathers had left" (Evans 2000:34). It was also during this period that the misuse of the Spanish word "*Viejo*" was commonly applied to the name of the Rancho so that it became known as Rancho Mission Viejo rather than the correct Spanish usage of *Misión Vieja*.

By the early 1930s all standing remains of the Forster adobe had disappeared. Historian C. E. Roberts noted that "nothing is left of this adobe save a huge mound of adobe clay and broken tile, but it is well remembered by many people living in the region. The last residents were Basque sheep men, after whose occupancy the building was abandoned" (Roberts 1936). In 1935 the site was "mined" for roof tile by the O'Neills for the adobe house at Rancho Santa Margarita (Sleeper 1985). The same year San Juan Capistrano historian Alfonso Yorba visited and recorded the ruins. His rough pencil sketch and Spanish text shows a rectangular building with a kitchen (*cocina*), parlor (*sala*), and another room (*cuarto*) (Yorba 1935a) (Figure 3). Yorba also recorded a drawing and floor plan based on an interview with Marcos H. Forster, the son of Don Juan Forster. The drawing show a large rectangular tile roofed building with 10 rooms. The kitchen is located in the northeast corner of the building and long covered corridors run along the eastern and western sides (Yorba 1935b) (Figure 4).

Figure 3. Alfonso Yorba Drawing, 1935.

Figure 4. Alfonso Yorba Drawing, 1935.

PART II. ARCHAEOLOGICAL INVESTIGATIONS

Site Description and Stratigraphy

The site consisted of a roughly rectangular shaped mound measuring approximately 80 by 40 feet and rising about 6 feet above the surrounding terrace on the northern side of San Juan Creek. The mound is oriented with the long axis on a magnetic north–south alignment. Except for a few scattered tile fragments on the northern end, there were no visible architectural features.

Generally the site is covered with a brown colored, fine-grained, adobe melt building rubble. Large amounts of roof tiles and *ladrillos* are mixed throughout this layer. It overlies more specific architectural features and surfaces including foundations, floors, interior dividing wall footings, and exterior surfaces. Some of these surfaces can be easily detected because they are covered with dense concentrations of in situ ceramic roof tile where portions of the roof have collapsed as a single event covering the original surface. The color and texture of the adobe melt is identical to the native soil on which the buildings were constructed and into which the foundation trenches were excavated. This suggests that the adobe blocks of these buildings were made on-site of native soil. Unfortunately, this has made detection of still articulated adobe block wall segments or wall fall extremely difficult.

Field Work and Results

Ten days of field work were conducted between September 3 and September 14, 2001. In order to locate foundation alignments and other features, so that hand excavation could be more precisely focused, a total of 20 trenches of various lengths were excavated using a backhoe with a 12-inch bucket. The backhoe excavated in a slow, meticulous fashion removing the soil in approximately 6-inch increments which allowed the detection of features with minimal disturbance. Field supervisors monitored soil removal. Samples of soil were screened through 1/8-inch mesh from all trenches for artifact retrieval. A sample of 5 to 10 screen fulls of soil from each trench was examined. If productive, screening was continued. Where significant quantities of material were not found screening ceased. A total of 11 Units were excavated by hand in stratigraphic levels adjacent to trenches where major features had been encountered. The same screening procedure was used for units as had been adopted for trenches.

A site datum was established at the highest point on the mound. Trench and unit locations were mapped from this datum using a transit and stadia rod. Unit datum elevations were measured below site datum allowing the determination of the depth of all features and surfaces below site datum. All features encountered in trenches and units were cleaned and photographed. Complex features uncovered in the units by hand excavation were drawn to scale.

Archaeological excavations resulted in the exposure of several architectural features and the recovery of 77.380 kilograms (kg) of artifactual material. The architectural remains represent two structures built adjacent to each other but at different times. They contain a variety of features including cobble foundations, floors, exterior surfaces and interior dividers. Artifact analysis resulted in identification of an estimated minimum number of 241 items.

PART III. ARCHITECTURAL MATERIALS

Remains of two separate and distinct structures were encountered suggesting that the adobe began as a small building at the northern end of the present mound and was extensively expanded later to form the final configuration (Figure 5). A wide variety of building materials was encountered which will be defined first before the description of the architectural features.

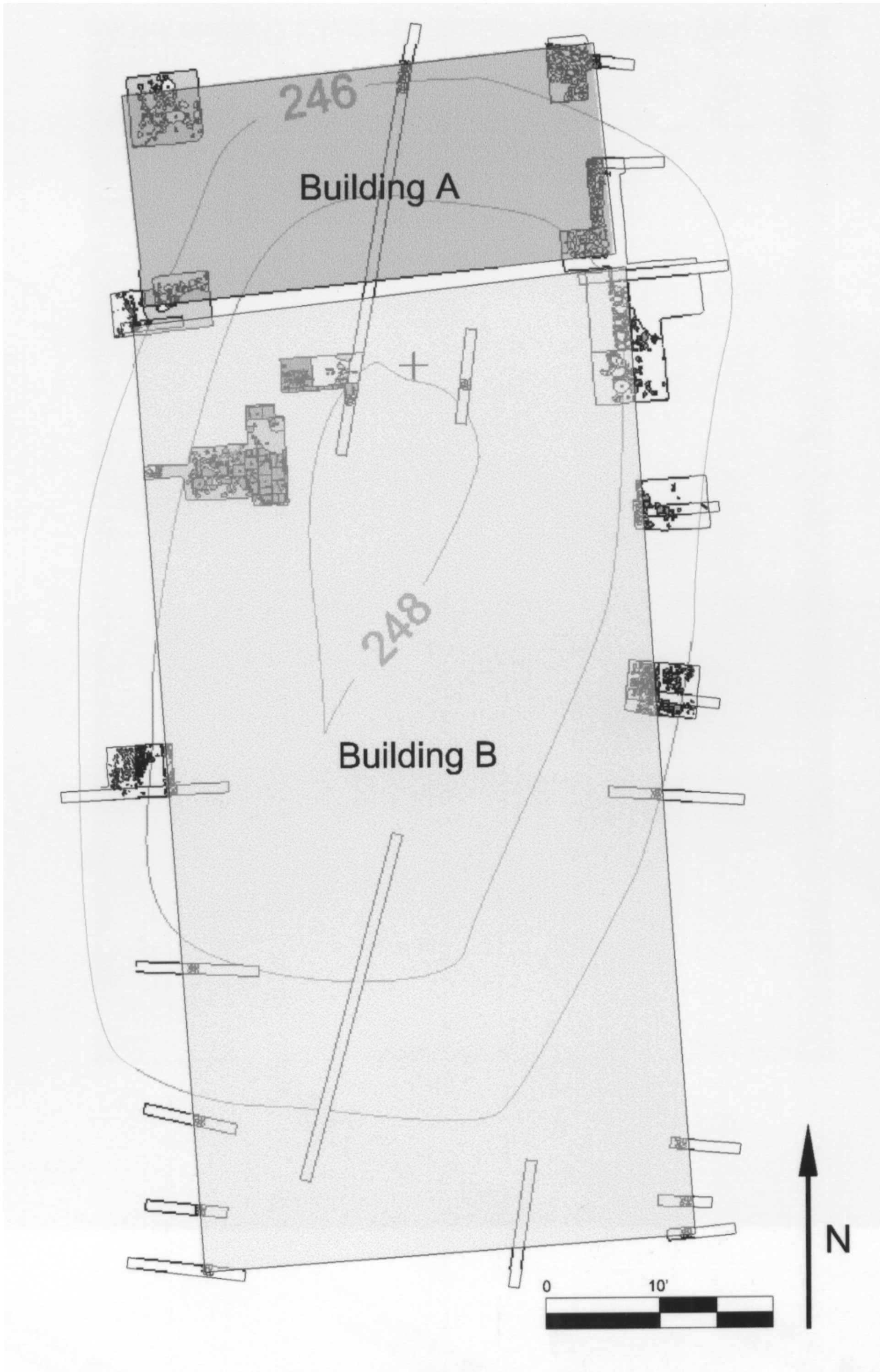


Figure 5. Buildings A and B.

ADOBE BLOCKS

An adobe building is constructed of sun-dried mud blocks. Adobe blocks were not fired and were not made of clay. To make blocks, a trough was dug into the ground and filled with soil and straw or other available tempering material. Water was added to bring the mixture to a stiff mud. Workers (usually Indians) waded and trod the mud and straw until they were thoroughly mixed. The mixture was then placed in wooden molds that consisted of rectangular frames without tops or bottoms. The molds usually had a center partition so two blocks could be formed at one time. After thoroughly wetting the molds laborers set them on a stretch of dry level ground. They next carried the mud mixture to the molds in leather buckets, poured or shoveled it in, tamped it down, and leveled it off. The frame was then lifted and the blocks left to dry. After a number of days in the sun where they were frequently turned, the dried adobe blocks were ready for use. Sizes of blocks varied according to location and the period in which they were made. During the mission period an average size was approximately 11 x 23 x 4 inches. When dry, a block weighed about 60 pounds (Webb 1952:105).

Only in one instance at this site was the characteristic horizontal banding indicating courses of adobe blocks detected. This occurred in the western sidewall of Unit 2 and was west of the foundation alignment uncovered in that unit (Figure 8). The banded material may have represented articulated wall fall. Dimensions of individual blocks could not be determined.

The only other evidence of possibly intact adobe wall construction was associated with Structure A in Unit 7, at the southwest corner of the unit where a very hard, dense segment of soil was in line with a cobble stone foundation encountered in that unit. Although no visible evidence of blocks could be detected, the extreme hardness, general rectangular shape, and alignment with the foundation suggest that this feature represents wall remains left in place.

TILES

Two major types of building tiles were recovered from the excavations: ladrillos and tejadas, or roof tiles. Both are mission tiles and were probably scavenged from the ruins of Mission San Juan Capistrano by Forster when he built the adobe house at Misión Vieja.

Ladrillos are flat, square or rectangular fired tiles used as floor pavers or in construction, similar to the way bricks are used. Two sizes were encountered: 14 by 14 inches by 2.5 to 3 inches thick and 14 by 7 by 1.5 inches thick. Samples show impressions of wooden molds on the sides and contain large amounts of straw temper, indicating the mixture used may have been similar to that for adobe block. No whole roof tiles were recovered. One large, broken specimen in Unit 10 measured 23 ½ inches by 3 and ¾ inches and was approximately ¾ inch thick.

Both ladrillos and roof tiles were made with wooden molds. Simple rectangular or square molds, similar but thinner and smaller than those used for adobe blocks, served for ladrillos. Mission laborers formed roof tiles on a tapered curved mold resembling a half piece of log or tree trunk. At San Juan Capistrano, all tiles were made and fired on a hillside just north of the mission (Webb 1952:100–106).

For the artifact analysis ceramic roof tiles and ladrillos posed a special problem. The site contains immense quantities of these materials. They are by far the most common artifact type anywhere on the site. Only a relatively small sample was collected weighing 69.576 kg. This quantity, however, in no way reflects the relative amounts of ceramic tile from the excavated units, yet it far outweighs any other class of artifacts. So that the weight of ceramic tile would not obscure the true quantitative relationships of other artifact classes it has not been included in the relative percentage calculations by weight of the artifacts in either the discussion of recovery by unit or in the Artifact Analysis section.

PART IV. ARCHITECTURAL FEATURES

Excavation uncovered foundation segments and interior features including dividing wall remains, packed earthen floors, and tile floors. Dense layers of roof fall on original surfaces were identified both inside and on exterior areas. Two separate building episodes could be defined. The foundation of a smaller building at the northern end of the site was designated Structure A. Its remains are adjacent to, yet physically distinct from the building remnants that occupy the southern three-quarters of the site which were designated Structure B. The two foundations are separated physically from each other and at different elevations below site datum. In addition, the Structure A foundation is much wider than the foundation for Structure B.

STRUCTURE A

The foundation alignments designated Structure A represented a small rectangular building measuring approximately 45 by 23 feet and oriented lengthwise on an east–west axis. Portions of this foundation were encountered in Trenches 4, 20, 21, 22, and 24 and Units 4, 7, 8, and 10. Corners were identified in Units 4, 7, and 8. Disturbed cobbles in Unit 10 may be remains of the southwest corner of this building. The foundation was well preserved on the eastern half of the mound where it was encountered at approximately 12 to 30 inches below the surface. Along its western alignment, however, cobbles were at or just below the ground surface and had been disturbed by discing and other activities. This foundation measures approximately 40 inches in width. It extends to a depth of about 12 to 13 inches and is constructed of two courses of water-worn river cobbles ranging from 8 to 12 inches in diameter that have been laid into the brown, fine-grained sandy soil. In places these are overlaid with smaller fist-sized cobbles.

As noted above, foundation segments in the eastern half of the site (Trenches 4, 20, 21, and 22 and Units 7 and 8) were well preserved and consisted of neat rows of tightly packed cobbles. In Unit 7 the southeast corner was encountered (Figure 6). Here an extremely hard, dense segment of soil is in line with the cobble stone foundation in the southwest corner of the unit. Although no visible evidence of blocks could be detected, the extreme hardness, general rectangular shape, and alignment with the foundation suggested that this feature represents wall remains left in place. The northeast corner of the foundation was clearly defined in Unit 8 (Figure 7).

Remains along the western alignment in Units 4 and 10 were highly disturbed and disarticulated. Cobbles in Unit 4 showed nicks from discing or other types of agricultural disturbance. In spite of this the general configuration of the northwest corner could still be detected. Unit 10 was excavated where measurements based on foundation alignments in Units 4,7, and 8 and Trench 4 indicated the southwest corner of Structure A should be located. Highly disturbed cobbles identical to those used in the foundations were encountered. No obvious alignment could be detected.

A variety of artifacts was recovered from the trenches and units where excavation exposed remains of Structure A. Unit 4 produced 9 items (4%), weighing 255 grams (g) (4%). Bottles included an olive oil container and an unidentified bottle that had turned amethyst from exposure to the sun, indicating a manufacturer date between 1880 and 1914 (Hunt 1959). Additional material included pieces of an undecorated earthenware cup, a molded patterned earthenware saucer manufactured by Pinder, Bourne and Hope between 1851 and 1862 (Praetzellis, Rivers & Schulz 1983:66, 207-202), 9 g of window glass, 4

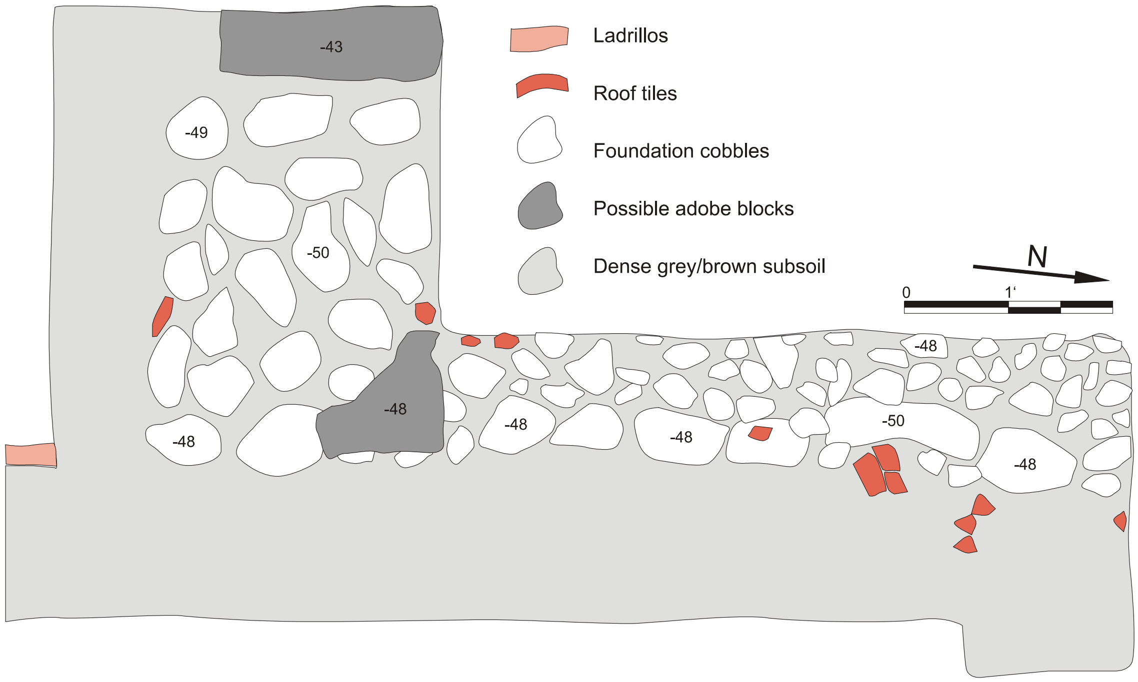


Figure 6. Unit 7, Southeast Corner of Building A.

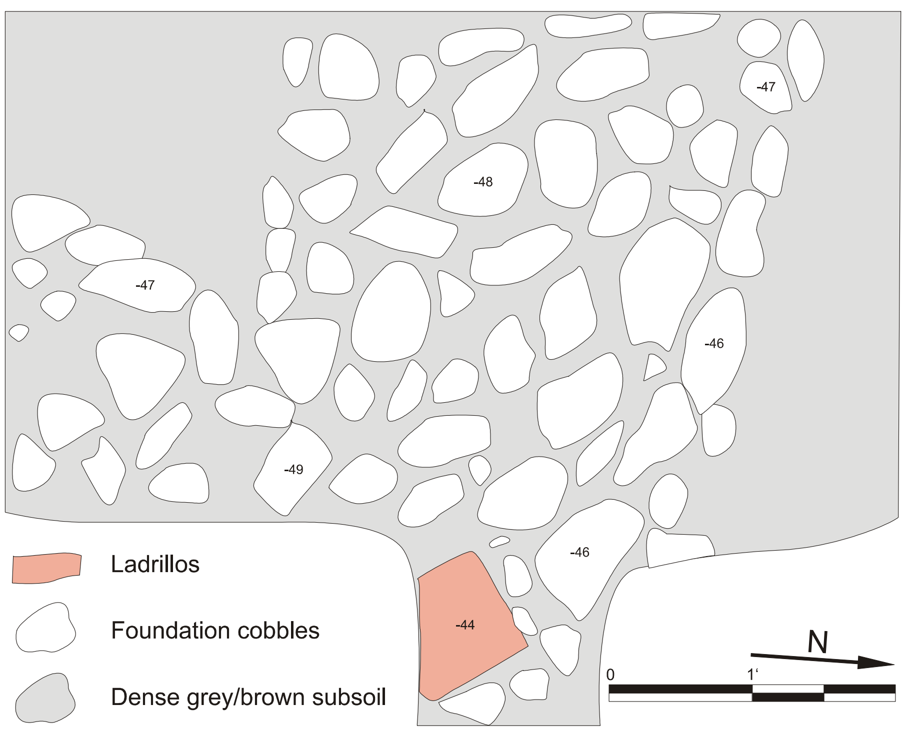


Figure 7. Unit 8, Northeast Corner of Building A.

square nails, 3 g of baling wire, a pair of sheep shears, 75 g of bone, and a piece of sea shell.

Unit 7 produced 30 items which constituted 12 percent by quantity and 16 percent by weight (969 g) of the artifacts recovered. The remains of four bottles were identified, including whisky, wine, olive oil, and spice. The wine bottle exhibited a hand formed kick-up indicating it was probably manufactured before 1885. A fragment of sun-colored amethyst bottle glass weighing 4 g was also recovered. This piece was manufactured between 1880 and 1914 (Hunt 1959). Other artifacts included part of a sun-colored, amethyst drinking tumbler, also manufactured between 1880 and 1914 (Hunt 1959), a blue edge decorated earthenware plate manufactured between 1830 and 1860 (McAllister 2001:11), 220 g of butchered animal bone, a gold-plated jewelry chain loop, a coffee or food mill piece, 1 gram of window glass, 5 g of lumber, 17 square nails, fragments of a leather shoe, and a brass screw.

Unit 8 produced fragments of a meat tin, a square nail, and 72 g of butchered bone. This made up 1 percent by estimated minimum number and .01 percent by weight (103 g) of the artifact assemblage.

From the combined excavation of Trench 17 and Unit 10, thirty-seven items were identified making up 15 percent by quantity and 4 percent (249 g) by weight of the artifactual material. Bottle glass included pieces of a wine and ale bottle both with hand-finished lips indicating they were manufactured before 1885, an unidentified amber liquor bottle, and an additional unidentified bottle. Other material included a fragment of a molded earthenware bowl made in the 1860s (Wetherbee 1985:87), a ceramic female figurine, part of a pair of sheep shears, a glass tumbler, 2 g of window glass, 11 square nails, a screw, a .22 rim fire cartridge casing, 7 g of bone, and 16 pieces of sea shell.

STRUCTURE B

The architectural remains designated as Structure B represent a building that measured 93 x 47 feet and were oriented length-wise on a north-south axis. Exposed features pertaining to this structure consisted of foundation segments, interior dividing wall alignments, tile and packed earthen floors, and dense in situ layers of roof tile resting on original exterior and interior surfaces.

Foundation segments were encountered in Trenches 1 East and 1 West, 2, 7, 8, 9, 11, 12, 13, 14, 15, 16, and 22, and Units 2, 3, 5, and 6. The foundation showed a variety of building techniques. It was previously disturbed on its southwest end.

Units 1 and 3 and Trench 22

Excavation of Trench 22 and Units 1 and 3 exposed the northeast end of the foundation and associated in situ building rubble. Here the feature was very well preserved. The edges of the construction trench could clearly be seen at the foundation surface and in side walls (Figure 8). The trench outline was 24 inches wide and around 16 inches in depth. It had been excavated into a fine brown silty loam that constituted the original topsoil horizon when construction occurred. The foundation measured 20 inches wide and consisted of a single course of elongated cobbles approximately 10–12 inches in length and 7 inches in diameter placed long axis vertically in the foundation trench in two irregular rows (Figure 9). Soil in the trench consisted of a loosely compacted brown silty loam that had been packed around the cobbles during construction. In some areas larger pieces of ladrillo had been placed vertically on the sides of the foundation trench. Small fist sized cobbles along with roof tile and ladrillo fragments were used in some areas on the top of the foundation to form a flat surface.

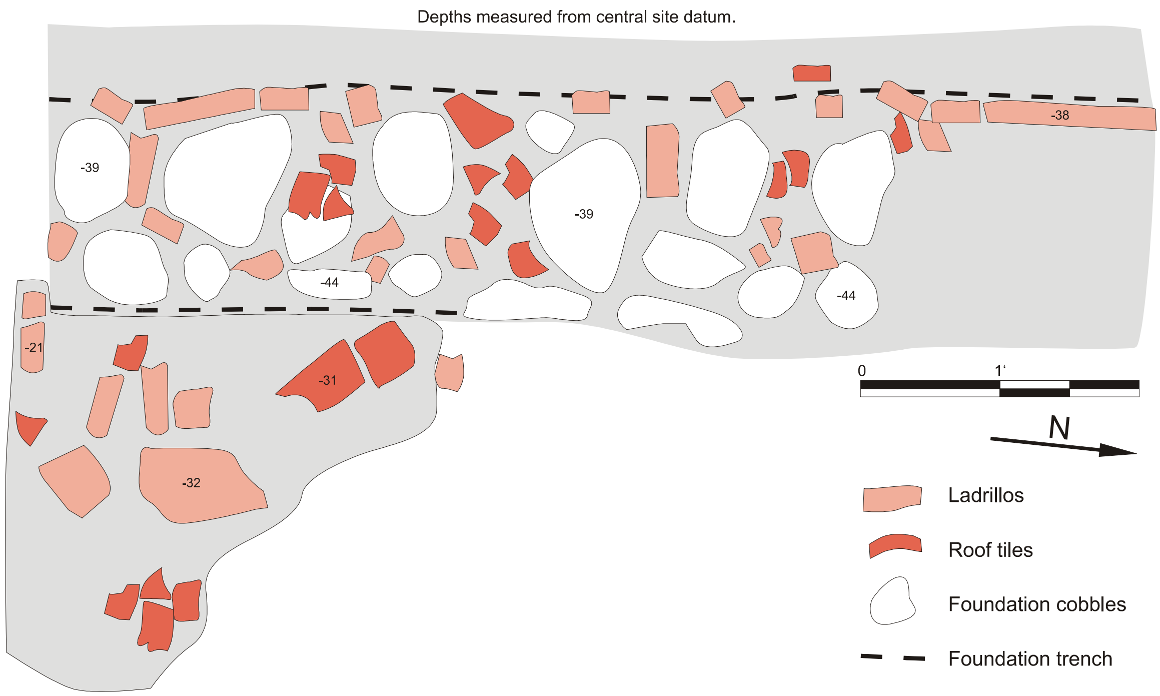


Figure 8. Unit 3 Foundation Trench.

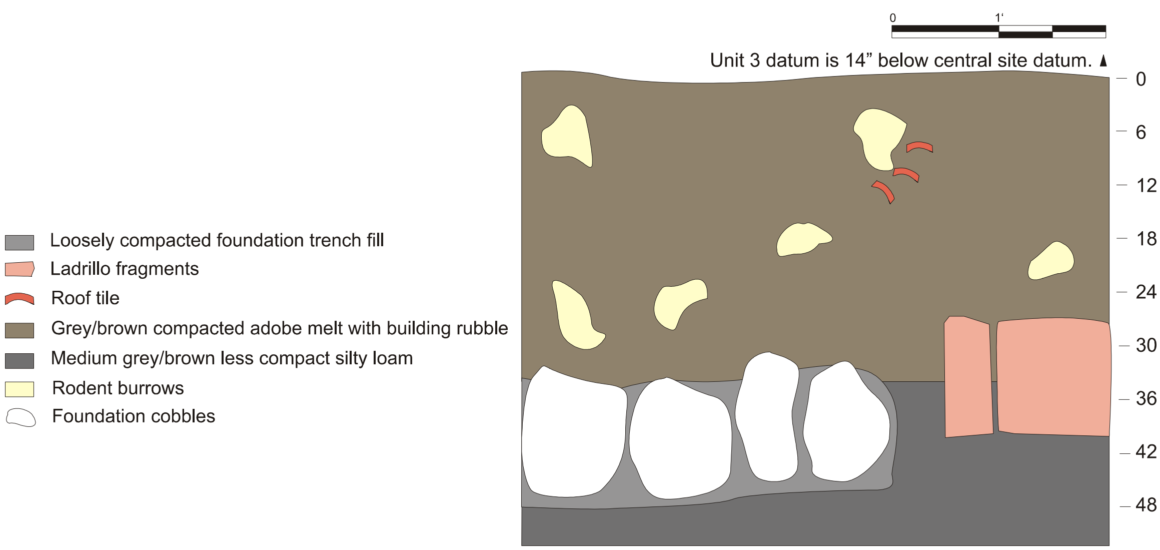


Figure 9. Unit 3 Foundation Profile, Western Wall.

No articulated courses of adobe blocks were detected on the foundation. It appeared that the blocks and mortar were made of the same fine brown silty loam as the original soil and weathering made it impossible to detect diagnostic mortar joints or parallel rows of different colored soils that often indicate intact adobe wall remains. A layer of building rubble, consisting of large cobbles mixed with ladrillo and roof tile fragments, uncovered in Unit 1, and exposed vertically in the southern side wall of Unit 3, was situated 18 inches above and directly over the Structure B foundation. It appeared to represent wall material that had dissolved and settled as the building fell into ruin, yet remained somewhat in place horizontally above the foundation. The 18 inches of soil between this rubble and the foundation may indeed be original adobe block wall material still in place. The distance would be equivalent in thickness to 4 courses of adobe block. However, no mortar joints or horizontal banding in the soil that would represent original blocks or courses could be detected in spite of examining the profile between Units 1 and 3 in various lighting conditions and wetting with a light spray of water. Excessive disturbance by rodent activity made the problem even more difficult.

Very little artifactual material was recovered from Units 1 or 3. Unit 1 produced a fragment of a cut sponge decorated earthenware vessel, 6 square nails, 7 g of bone, and 1 g of lumber fragments. They made up 3 percent by quantity and 0.1 percent by weight of the historic artifact assemblage. Materials from Unit 3 included 6 square nails, 4 g of window glass, and 47 g of bone. They constituted 2 percent by item count and 1 percent by weight of the artifacts identified.

<u>Unit 2 and Trench 23</u>

Unit 2 was a 1 by 2-meter unit placed on the southern side of Trench 23 where a series of articulated ladrillos had been encountered over the foundation. The three courses of ladrillos included both 14 by 14 and 14 by 7-inch sizes. They were located in the northwest corner of the unit and appeared to represent the base of the original wall (Figure 10). It was hoped that by exposing the western side wall of the unit and then scraping this sidewall back with a trowel, that intact adobe wall segments could be encountered both on the southern side of the unit and above the ladrillos. These attempts were unsuccessful. Next the surface of the foundation was exposed to the south of the articulated ladrillos in order to assess the condition of the foundation and possibly detect adobe block remains in the northern and southern sidewalls above the foundation cobbles. No intact wall remains could be identified on the foundation cobbles. The 20-inch wide foundation at this location was constructed in the same manner as in Unit 3.

Unit 2 produced 7 artifacts (3%), weighing 265 g (4%). Items included pieces of two olive oil bottles exhibiting pontil scars which indicate manufacture prior to 1880 (Spillman 1980), fragments of a tin can, a spent lead bullet, 3 square nails, 32 g of bone, and 80 g of lumber.

<u>Unit 5 and Trench 2</u>

Unit 5 was a 1 by 2-meter unit extended to the south from the northern side of Trench 2 to expose an articulated ladrillo feature encountered in the trench. The feature consisted of at least 5 courses of 14 by 7-inch ladrillos on top of large elongated foundation cobbles (Figure 11). A separate east–west ladrillo alignment cornered along the southern wall of the unit and a 2 by 2-inch piece of lumber was vertically situated at this corner. Some ladrillo rubble at the eastern end of the unit had fallen off the feature. These pieces were covered by and mixed with a layer of fallen roof tiles. A lens of articulated roof fall in the eastern half of the unit at 50 to 58 inches below datum indicated original ground surface (Figure 12). The foundation at this location was constructed quite differently than in Units 2 and 3. Large oval-shaped cobbles ranging in size from 20 to 30 inches in length and 16 to 20 inches wide were placed in a shallow

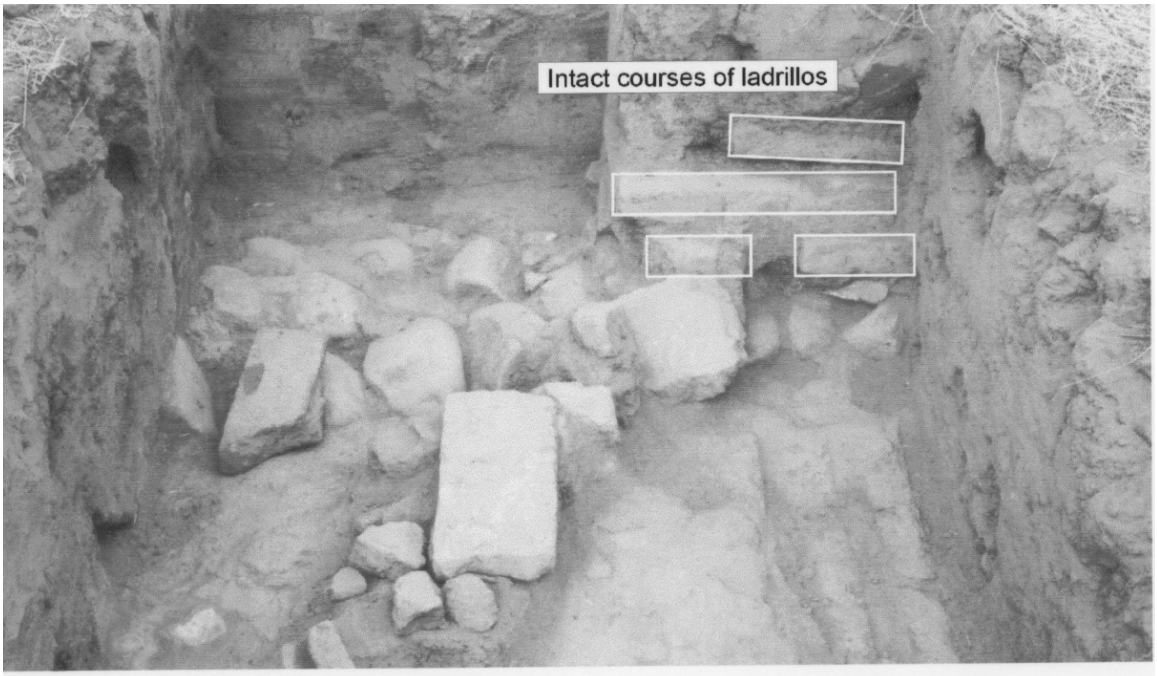


Figure 10. Unit 2, Ladrillo Courses.

Figure 11. Unit 5, Ladrillo Courses.

trench approximately 6 inches in depth so that most of the cobbles extended above the original ground level. Smaller cobbles 4 to 6 inches in diameter were used to fill gaps between the larger ones. The courses of ladrillos extended to a height of around 12 to 16 inches above the foundation cobbles and were around 24 inches wide across the top.

The combined excavation of Unit 5 and Trench 2 produced 11 items (5%) and 248 g (4%) of material. Artifacts included 2 lead bullets, 8 square nails, 166 g of bone, 36 g of metal strapping fragments, and a piece of sulfur weighing 1 gram.

Unit 6 and Trench 1 West

Unit 6 was a 1 by 2 meter unit extended northward from the southern wall of Trench 1 West where a dense lens of in situ roof fall and foundation cobbles for the western wall of Structure B was encountered (Figure 13). It is almost due west of Unit 5. As in Unit 5, foundation layout at this location differed from Units 2 and 3. Here the foundation was 14 inches wide and about 15 inches deep. The construction trench had been excavated approximately 9 inches into the dense gray-brown subsoil so that foundation cobbles extended about 6 inches above original ground surface. The foundation consisted of three courses of cobbles that ranged from approximately 4 to 6 inches in diameter. Fragments of ladrillo were used in the lower courses, especially along the edges of the foundation trench as well as along the top of the foundation to fill in gaps. However, at one point a single boulder 20 inches long and over 12 inches in diameter had been placed in the trench. Pieces of roof tile and ladrillo were used to fill gaps between the boulder and cobbles.

A dense lens of roof tile was uncovered in the western portion of the unit and appears to represent articulated roof fall resting where it fell on the original ground surface (Figure 14). It probably represents an extension of the building's

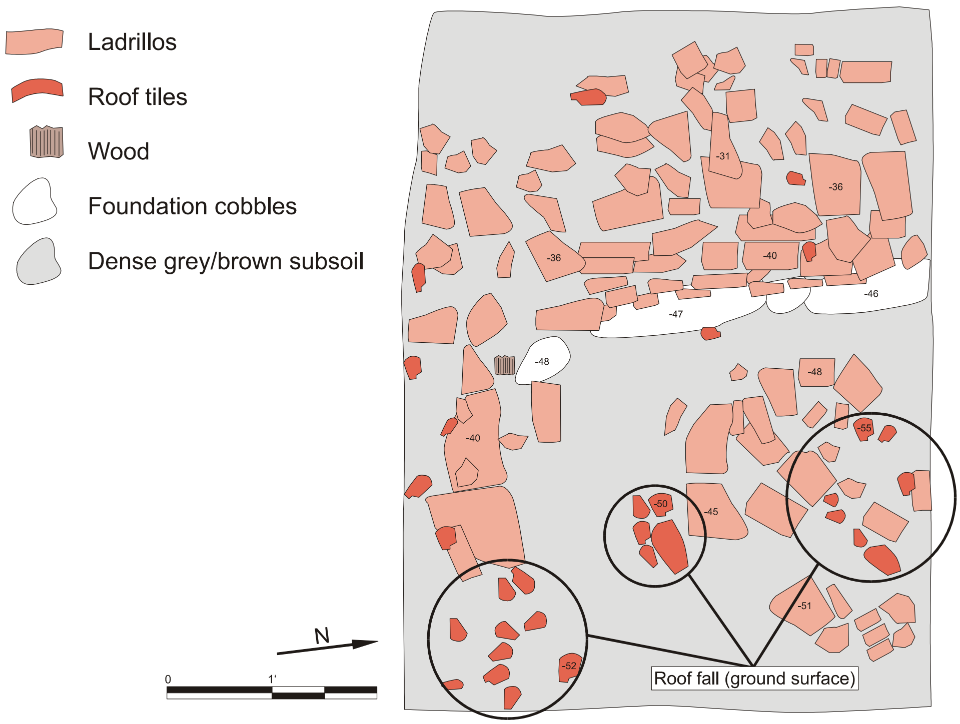


Figure 12. Unit 5, Roof Fall.

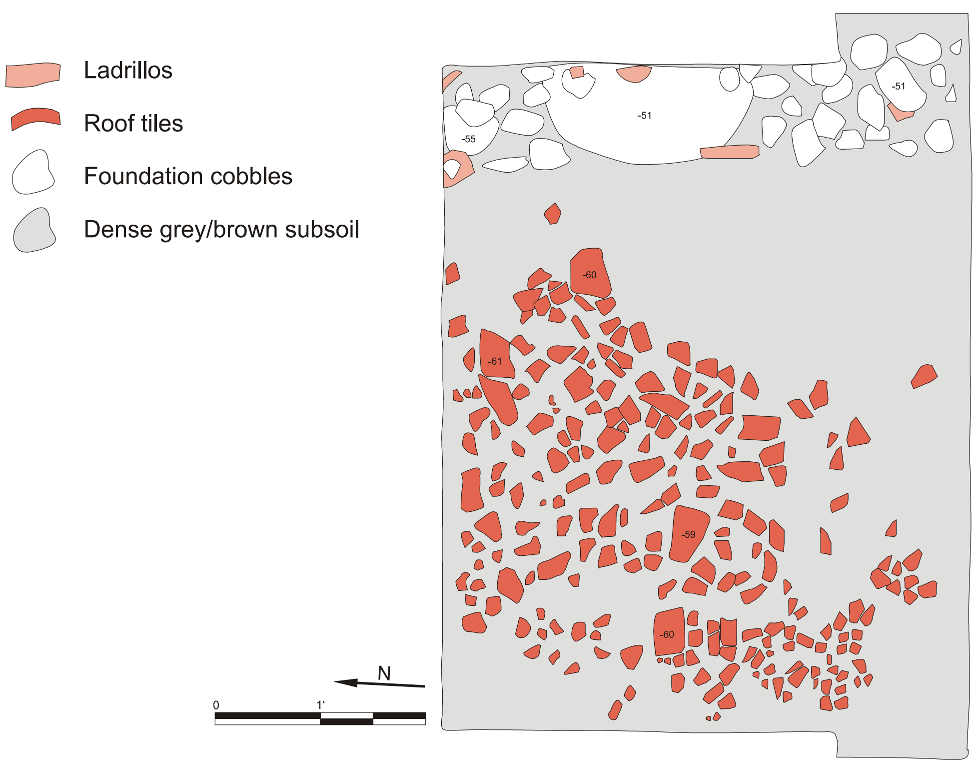


Figure 13. Unit 6, Foundation and Roof Fall.

roof to cover an exterior porch on this side of the house. In Trench 1 West it extended for approximately 12 feet to the west of the foundation. The unit was one of the richest in artifacts, producing 60 identifiable items (24%) and 1096 g (18%) of material. Artifacts are listed in Table 1.

INTERIOR FEATURES

No interior features were identified in Structure A. Interior features of Structure B included remains of an interior divider, packed earthen floors, a ceramic tile floor, and in situ roof fall. A ladrillo alignment encountered in Trenches 3 and 4 and Units 9 and 11 appears to represent an interior dividing wall. A packed earthen floor was detected in Trench 3 and Units 9 and 11. A ladrillo floor over the packed earthen surface was uncovered in Unit 11, and a dense layer of roof fall in the northern portion of Trench 5 appears to rest on an original floor surface.

Unit 9 and Trenches 3 and 4

A 14-inch wide ladrillo alignment on an east–west orientation was encountered in Trenches 3 and 4. This appeared to be the base of an interior dividing wall. On the northern side of the ladrillo alignment a packed earthen floor surface was detected in the Trench 4 sidewalls. A narrow band of broken tightly associated roof tiles paralleling the ladrillo alignment lay 4 to 6 inches above the earthen floor. Unit 9 was a 1 by 2-meter excavation laid out on the west side of Trench 4 along the northern side of the ladrillo alignment to expose a portion of the alignment, earthen floor, and roof tile concentration revealed in the trench (Figure 15). The interior dividing wall alignment consisted of two courses of ladrillos that included both 14 by 14 and 7 by 14-inch sizes (Figure 16). The roof tiles appeared to be a narrow band of roof fall adjacent to and just above the ladrillo footing at approximately 4–8 inches below the unit surface and extending only 12 to 14 inches to the north of the ladrillo alignment. The earthen floor was approximately 4 inches below the roof fall.

Figure 14. Unit 6, Roof Fall.

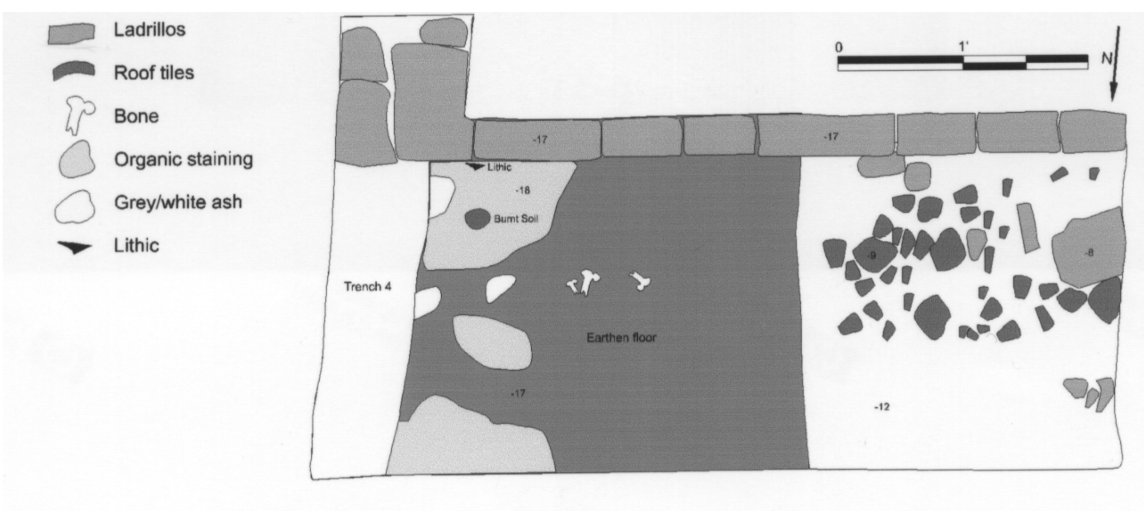


Figure 15. Unit 9, Earthen Floor and Ladrillo Wall.

Table 1. Unit 6 Artifacts.

TR.	UN.	MATERIAL	ITEM	TYPE	PRODUCT	TECHNOLOGY	DATE	REFERENCE	#	WEIGHT
-	6	Glass	Bottle	Culinary	Pepper sauce	2 pc bottom hinge mold/ribbed	1850 - 1885	-	1	150
-	6	Glass	Bottle	Culinary	Meat	Gile's jar rim sun purple	1903 - 1914	Lief 1965; Hunt 1959	1	6
-	6	Glass	Bottle glass	-	-	-	-	-	0	8
-	6	Lead	Seal to wine bottle	-	-	-	-	-	1	2
-	6	Brass	Bullet shell	Center fire	-	-	-	-	1	4
-	6	Rubber, hard black	Comb tooth	-	-	-	-	-	1	1
-	6	Bone	Bone misc.	-	-	-	-	-	0	120
-	6	Ceramic	Plate, large	Undecorated hotelware	-	Earthenware	-	-	1	8
-	6	Shell	Shell misc	California mussel (Mytelus californicus)	-	-	-	McLean 1978:66-67	1	6
-	6	Ceramic	Saucer	Undecorated hotelware	-	Earthenware	-	-	1	8
-	6	Ceramic	Unidentified hollow item	Undecorated	-	Earthenware	-	-	1	3
-	6	Ceramic	Unidentified item	Banded ware	-	Earthenware	-	-	1	1
-	6	Ceramic	Misc unidentified frags	Local native ware	-	Pottery	-	-	0	4
-	6	Ferrous	Nails	Square	-	-	-	-	24	95
-	6	Shell	Button	4 hole	-	-	-	-	1	1
-	6	Porcelain, ferrous, lead	Button	Shank, metal add on	-	-	-	-	1	2
-	6	Ferrous	Button	Shank, metal add on	-	-	-	-	1	3
-	6	Ferrous	Strapping	-	-	-	-	-	0	16
-	6	Ferrous	Wire	Baling	-	-	-	-	0	6
-	6	Glass	Bottle glass	Storage bottle – carboy	-	Blm	-	-	0	8
-	6	Ferrous	Unidentified ferrous item	-	-	-	-	-	1	16
1w	-	Glass	Bottle glass	-	-	-	-	-	0	3
1w	-	Bone	Bone misc	-	-	-	-	-	0	74
1w	-	Ceramic	Plate, large	Three friends	-	Stoneware	-	Mueller 1987:281	1	107
1w	-	Ceramic	Pitcher	Molded	-	Earthenware	1876-pre 1900	Lehner 1988:21; Freeman 1954:78	1	54
1w	-	Ceramic	Plate, unknown size	Transfer-blue	-	Earthenware	1842-1858	Samford 1997:21	1	9
1w	-	Shell	Shell misc	California mussel (Mytelus californicus)	-	-	-	McLean 1978:66-67	1	32
1w	-	Ceramic	Misc unidentified frag	Undecorated	-	Earthenware	-	-	0	2
1w	-	Glass	Window glass	-	-	-	-	-	0	2
1w	-	Ferrous	Nails	Square	-	-	-	-	5	20
1w	-	Brass	Screw	Flat standard head	-	-	-	-	1	1
1w	-	Ferrous	Unidentified ferrous item	-	-	-	-	-	1	3
									11	307
								Total	60	1096

The hard-packed earthen floor had bone and charcoal staining on its surface suggesting a possible hearth area. The floor was exposed in the eastern half of the unit and the roof fall left in place in the western half (Figure 17). The floor consisted of a hard-packed lens of ashy soil approximately 2.5 to 3 inches thick that appeared to be composed of many thin layers and probably represented more than one floor surface. In Trench 4 on the northern side of the ladrillo alignment, the floor lens could be clearly seen under the ladrillos indicating it had existed and continued toward the south before construction of the interior divider these ladrillos represent.

Unit 9 excavation produced 18 quantifiable items (7%) and 560 g of material (9%). Artifacts included remains of an olive oil bottle with a hand-finished lip, manufactured before 1885, a .22 rim fire bullet cartridge, a flowing blue–black transfer decorated earthenware plate manufactured between 1839 and 1856 (Samford 1997:24), a piece of Native American brownware pottery, 4 square nails, a ceramic button, 6 g of baling wire, a brass safety pin, a fragment of worked bone, 7 fragments of shell, and 196 g of butchered bone. A total of 150 g of this bone was encountered on the packed earthen floor further suggesting it was used as a hearth area.

<u>Unit 11</u>

Unit 11 was excavated to the east of Trench 16. The original intent was to better define a disturbed feature of cobble and ladrillo exposed in the trench that appeared to be a portion of the western wall foundation of Structure B. Almost immediately ladrillo floor pavers were encountered on the eastern side of the foundation. They were uncovered toward the east, resulting in an excavated area of 13 by 8.5 feet that revealed a portion of a tiled floor (Figure 18). The majority of the pavers measured 14 by 14 inches with thickness varying from 2.5 to 3 inches. The floor also included some pieces of the smaller 14 by 7 by 1.5-inch ladrillos. Some portions were covered with in situ ceramic tile roof fall. The

Figure 16. Unit 9, Ladrillo Dividing Wall.

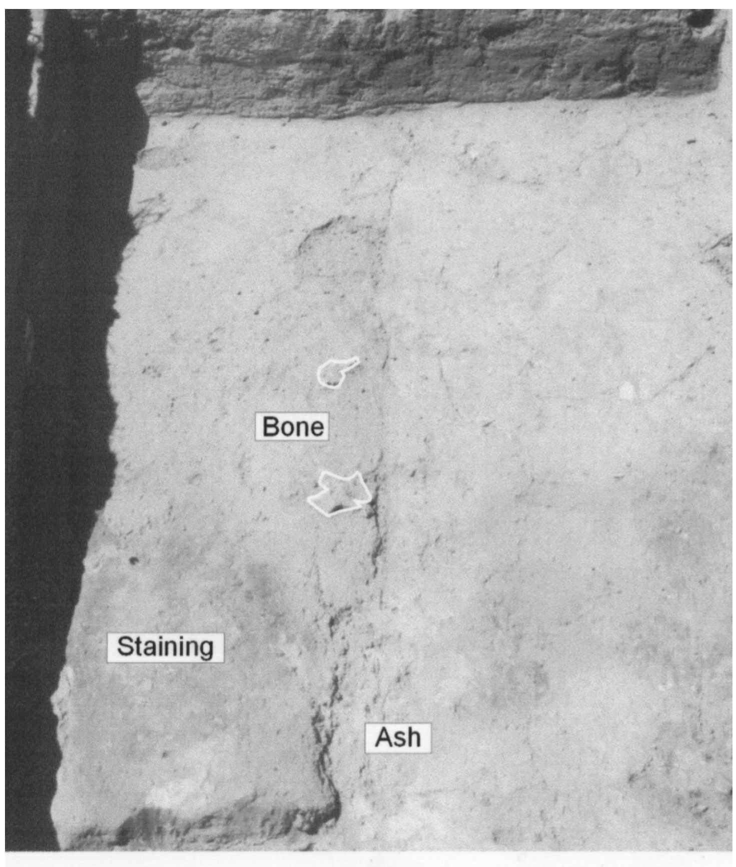


Figure 17. Unit 9, Earthen Floor.

floor is bordered on the northern side by the continuation of the ladrillo dividing wall alignment encountered in Trenches 3 and 4 and Unit 9. In a small area measuring approximately 6 by 8 inches, the same packed earthen floor uncovered in Unit 9 was revealed, indicating the ladrillo floor tiles were placed over the earlier original earthen floor, possibly at the same time as the construction of the interior wall ladrillo alignment (Figure 19).

The unit and trench produced 67 (28%) quantifiable items and 245 g (4%) of material. Artifacts included remains of a case-style bitters bottle, a case gin bottle, two .22 rim fire bullet casings, a footed glass dish, 6 square nails, 1 shell button, a screw, 54 pieces of shell, 67 g of butchered bone, 11 g of lumber, 3 g of baling wire, and an unidentified item of brass and polished bone.

Trench 5 Interior Roof Fall

A dense lens of roof tile approximately 3 inches thick that represented in situ roof fall resting on an original interior floor surface was exposed in the side walls of Trench 5. It began approximately 12 feet from the northern end of the trench and extended in a southerly direction for 10 feet.

DISTURBED AREAS

In the southern end of Trench 5 significant site disturbance was encountered. A concentration of jumbled building materials consisting of broken ladrillos, roof tile fragments, and adobe rubble was encountered to a depth of 5 feet or more below the surface at the southern end of the trench. The disturbance extended northward for a distance of approximately 14 feet (Figure 20). Additional signs of disturbance were encountered in this area of the site. Foundation stones in Trenches 11, 12, 23, 14 and 15 were disturbed and disarticulated. Combined with the rubble deposit in the southern end of Trench 5 it appears that the southwest

Figure 18. Unit 11, Ladrillo Floor.

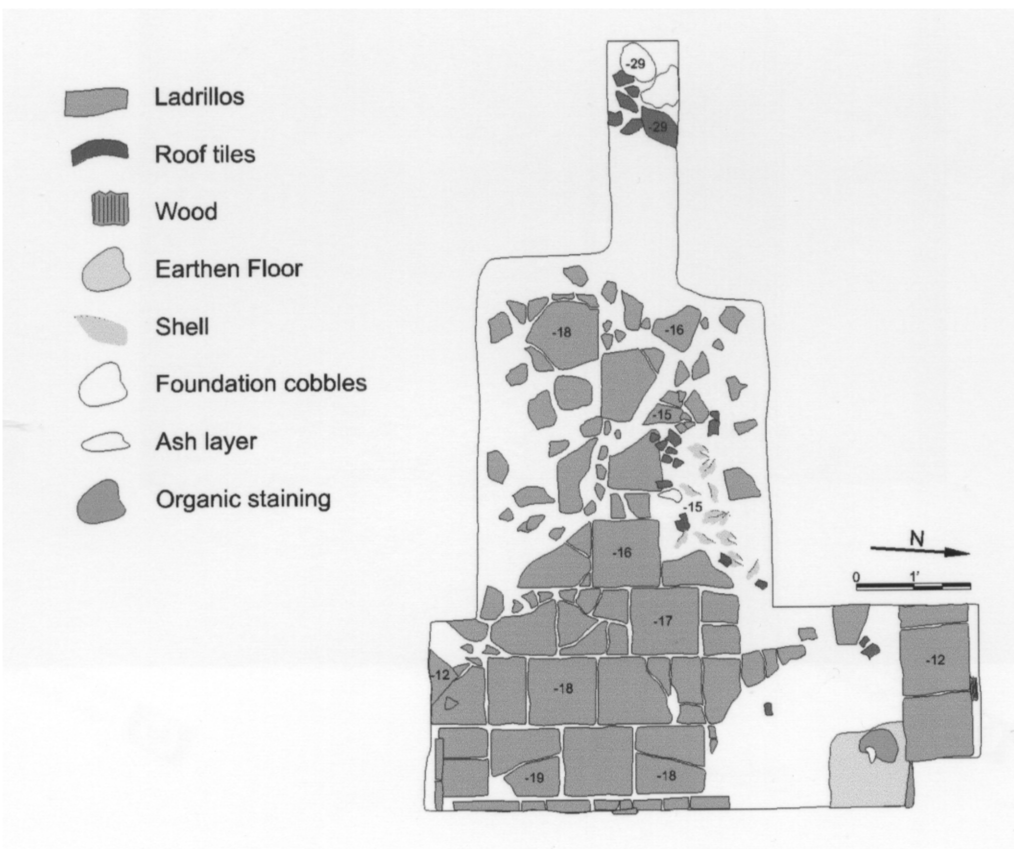


Figure 19. Unit 11; Earthen Floor, Ladrillo Floor, and Foundation.

corner of the site has been highly disturbed. This may be the area that was "mined" for roof tiles in 1935 for the Santa Margarita Adobe (Sleeper 1985).

PART V. ARCHITECTURAL DATA SYNTHESIS

Excavation revealed remains of two structures that probably signify two building episodes. Structure A at the northern end of the site measured approximately 45 by 23 feet, oriented lengthwise on an east–west axis. Structure B, composing the southern three-quarters of the site, measured 93 by 47 feet and was oriented lengthwise on a north–south axis. When both buildings were completed the adobe house at Rancho Misión Vieja measured 116 by 47 feet.

The foundation of Structure A is physically separate from that of B. This is most apparent in Units 7 and 3 (Figure 21). There is a gap of approximately 28 inches between the two foundations. In addition, the foundation alignment for Structure A is 18 inches to the west of the foundation alignment of B. The surface of the Structure A foundation in Unit 7 is approximately 50 inches below site datum, while the surface of Structure B's foundation in Unit 3 is 10 inches higher at 40 inches below site datum.

Measuring approximately 40 inches wide and 12 to 13 inches in depth, the foundation for Structure A was much wider than the foundation for Structure B, which averaged around 20 to 24 inches wide and 14 to 16 inches in depth.

This analysis has assumed that because Structure A was smaller it was built first. There is no evidence at this time to know if this is true, although further excavation could probably provide answers. If it was built first it may represent a home constructed by the missionaries for the Mayordomo of Misión Vieja during the early 1800s. It may also have been built by Augustine Olvera when he occupied the rancho between 1842 and 1845. The assumption that smaller

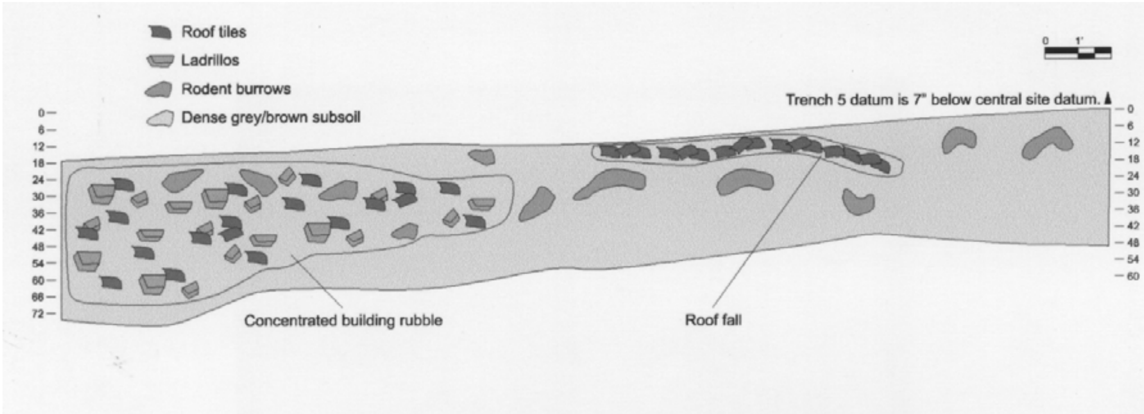


Figure 20. Trench 5, Western Wall Profile.

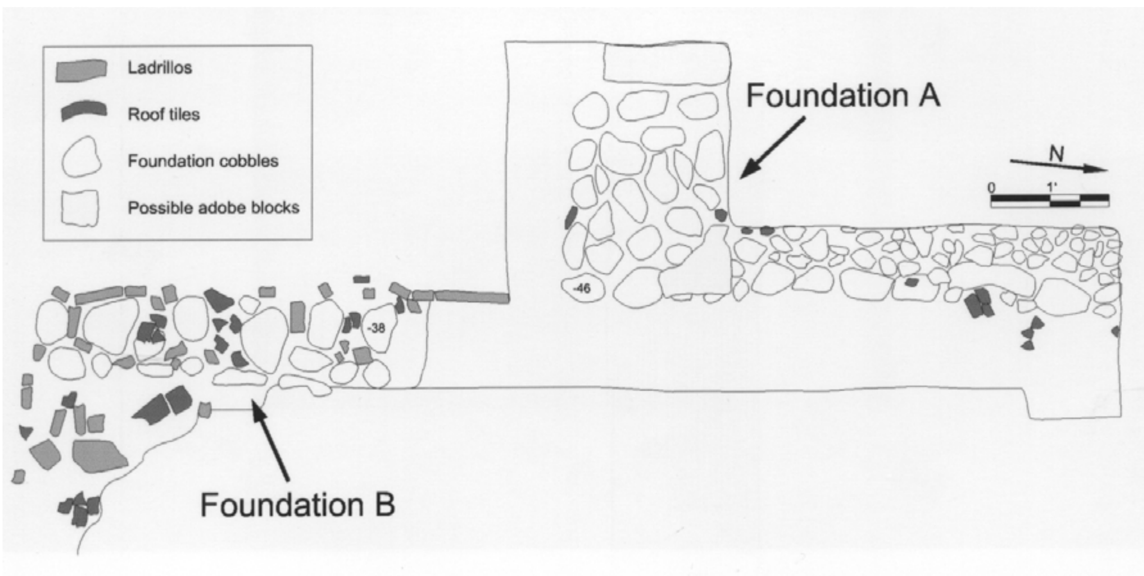


Figure 21. Foundation for Building A and B.

equals earlier, however, is not necessarily true. Structure A could actually represent a later addition to the northern end of an already standing adobe house represented by the remains of Structure B.

Regardless of which section was built first, there is little doubt that Structure B represents the "fine" adobe house built by Juan Forster when he acquired the ranch in 1845 and occupied by his family until 1848. Excavation revealed a large number of intact features that represent this complex building. As already noted this adobe house measured 93 by 47 feet on a north–south axis. Based on in situ roof fall in Trenches 1 and 5 as well as Units 5, 6, 9, and 11, the house was covered with a mission tile roof that extended to cover exterior porches along the eastern and western sides. A ladrillo alignment at the northern end of the structure encountered in Trenches 3 and 4 and Units 9 and 11 may have supported an interior dividing wall. The adobe originally had a packed earthen floor, encountered in Trench 4 and Units 9 and 11. On the northern side of the dividing wall alignment this surface was later covered with the ladrillo floor tile encountered in Unit 11.

One of the more interesting elements of Structure B was the fact that the interior living surfaces were elevated almost 18 to 20 inches above ground level so that one would have had to step up to enter the adobe. Depths below site datum of interior surfaces, foundations, and original ground surfaces have been plotted on a chart in (Figure 22). The ladrillo floor in Unit 11 is approximately 11 inches above the top of the foundation in the same unit. This indicates that there is nearly a foot of fill on the interior of the adobe. Roof fall outside the adobe foundation is between 6 to 8 inches below the top of the foundation. Although no thresholds were located, there must have been steps in the doorways leading up into the raised interior of the house from the covered corridors along the exterior (Figure 23).

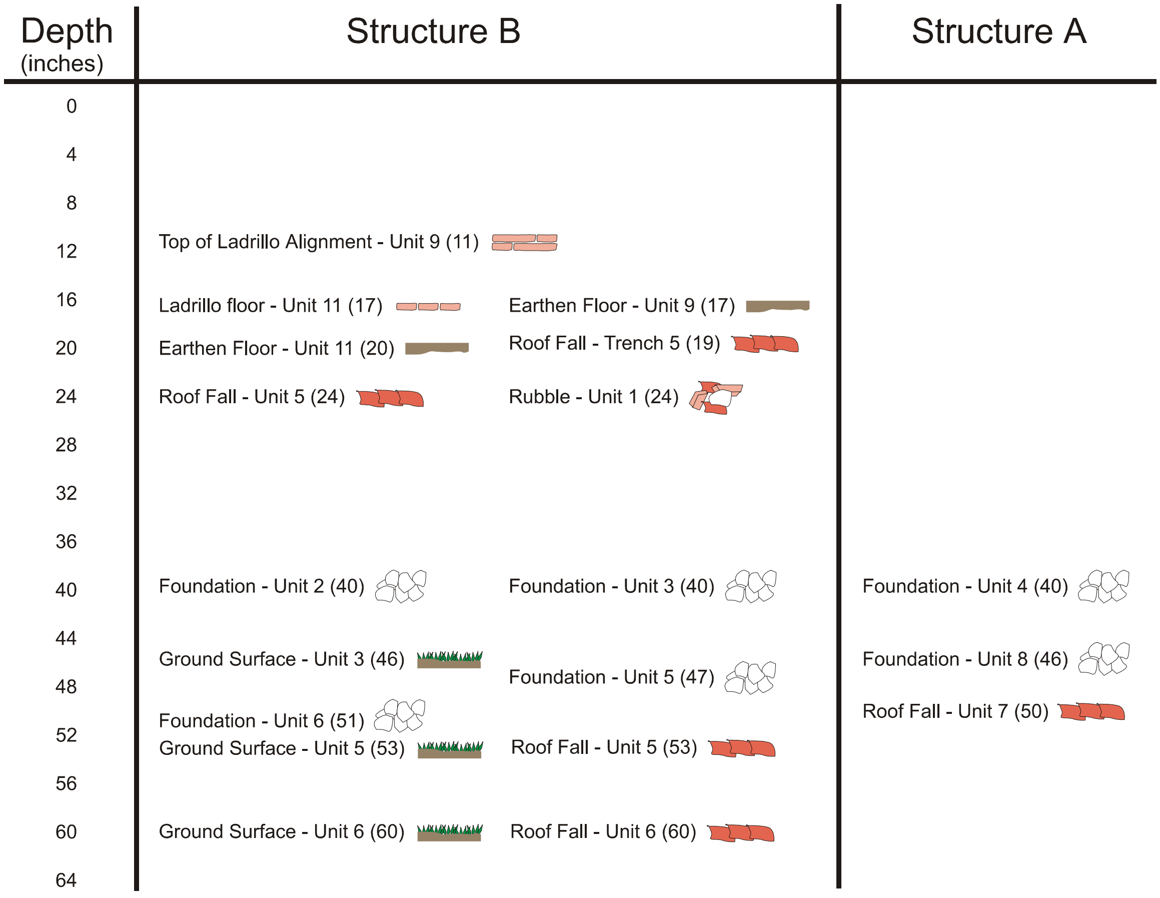


Figure 22. Feature Depths, Building A and B.

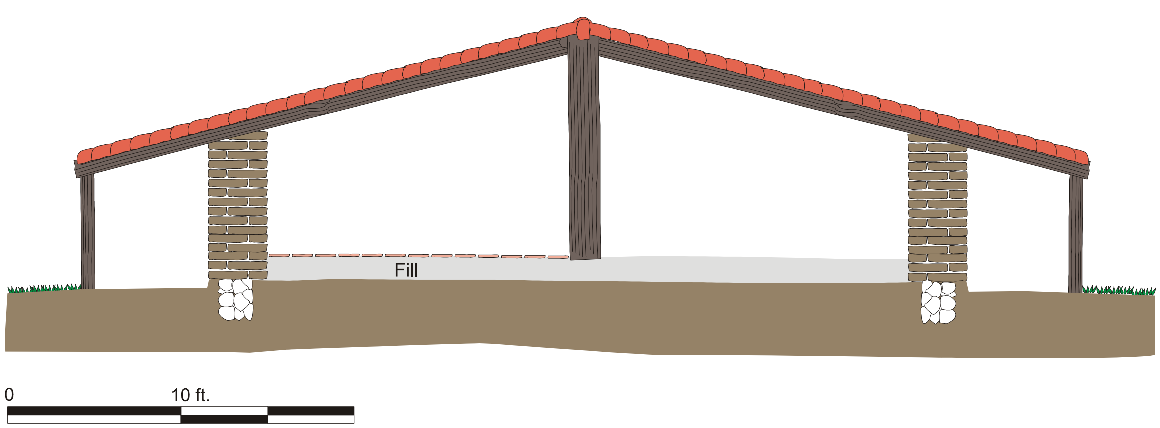


Figure 23. Side Profile, Building B.

The architectural remains conform quite well to the configuration of the Misión Vieja adobe as remembered by Don Marcos Forster and recorded by historian Alfonso Yorba. It was an unusually large rectangular adobe building with a mission tile roof that extended to cover long corridors along the eastern and western sides. Although Yorba recorded only tile (ladrillo) floors, both tile and packed earth interior surfaces were encountered during this investigation.

PART VI. ARTIFACT IDENTIFICATION AND ANALYSIS

INTRODUCTION

From the excavation a total of 77.380 kg of historical material was recovered. Analysis was conducted for the purpose of developing functional artifact patterns or profiles as described by South (1977) and resulted in the identification of an estimated minimum number of 241 items representing 11 of the 20 activity group categories listed on Table 2.

Based on methods originally developed by Stanley South and others, the purpose of functional pattern analysis is to develop functional artifact patterns or profiles. In order to determine the types of activities represented, artifacts are divided into functional categories or groups to allow detection of relationships between functionally defined artifact groups at a generalized level of analysis and to thereby define broad patterned regularities (South 1977). South's models used a classification system with eight artifact groups. This analysis uses a system of 20 artifact groups which has proven successful for various site types in southern California (Van Wormer 1996a, 1996b; Van Wormer and Schaefer 1991; Phillips and Van Wormer 1991). Artifacts in each group are quantified by estimated minimum number of items and weight and the amount converted into a percentage of the total number and weight of artifacts from the deposit. It can thus be determined to what degree different activities are represented, resulting in a functional pattern or profile of the artifact assemblage. Bulk items such as ceramic tile, brick fragments, window glass, and lumber fragments are usually so fragmented that estimated minimum numbers cannot be calculated and in many cases would be inappropriate. These artifact types are quantified by weight only, and are not used in the functional profiles based on estimated minimum number of items.

Table 2. Activity Groups Used In Artifact Pattern Analysis.

Consumer Items Group: Items containing products purchased and consumed on a regular basis	Personal Items Group: Belonging to a single individual
	Eye glasses
Bottles	Jewelry
Bottle caps, can lids, and related items	Musical instruments
Jars	Smoking pipes
Tin cans and other tins	Toiletry items (comb, hairbrush, razor, toothbrush, etc.)
	Toys and gaming items
Kitchen Group: Food preparation and serving	Watches
Butchered bone	Furniture Parts Group: All furniture parts
Canning jars	
Canning jar lids and related items	Bed and other furniture frames and springs
Ceramic kitchen and tableware	Cabinet hinges
Cooking items	Drawer pulls
Flatware	Scroll trim
Glass tableware	Springs
Jelly tumblers	Trunk parts
Seeds	Upholstery tacks
Shellfish	
Stove parts	Hardware Group: Miscellaneous hardware not included in a specific group
Household Items Group: Daily household maintenance	Baling wire
	Bolts and nuts
Batteries	Chain links
Household ceramics	Cotter pins
Household glassware	Metal bands and strapping
Lamp parts	Rivets
Light bulbs	Screws
Medical items	Washers
Miscellaneous household items	Wire fencing
Garment Items Group: All clothing items	Tools Group: All hand tools
Buckles	Artist's tools
Buttons	Carpenter's tools
Clothing rivets	Gardener's tools
Collar stays	Jeweler's tools
Corset Hardware	Mason's tools
Garter clasps	Mechanic's tools
Hook and eyes	Other miscellaneous hand tools
Shoe parts	
Snaps	
Straight pins	
Strap slides	
Suspender clasps	

Table 2. Activity Groups Used In Artifact Pattern Analysis (Continued).

Livery Items Group: Horse and horse-drawn vehicle items

Bridle parts
Buggy parts
Harness parts
Horse shoes and nails
Saddle parts
Wagon parts

Munitions Items Group: All firearms and related items

Bullets, cartridges, musket balls, and shotgun parts

Coins Group: All coinage and tokens

Building Materials and Architecture Group:
Asphalt
Ceramic drain pipe
Ceramic flue lining
Concrete
Construction hardware
Construction materials
Counter glass
Door locks and parts
Electrical hardware
Nails and spikes
Plaster
Window glass

Machinery Items Group: All machine parts except agricultural implements

Forge Materials Group: All forge, furnace, and stove wastes

Coal, clinkers, and slag

Agricultural Implements Group: All farm machinery

Chain belting
Cultivator parts
Harrow parts
Hay rake parts
Manure spreader parts
Mower parts
Plow parts
Threshing machine parts

Other Occupations Group: Specialized occupation items

Factory items
Farmstead items
Mining items

Unique Items Group: Items not included in other groups

Unidentified Items Group: Items that cannot be identified

Intrusive Items Group: Items intrusive to a discrete dated deposit

As already noted, for this analysis ceramic roof tiles and ladrillos posed a special problem. The site contains immense quantities of these very redundant materials. They constitute by far the most common artifact type anywhere on the site. Only a relatively small sample was collected weighing 69.576 kg. This weight, however, in no way reflects the relative huge quantities of ceramic tile from the excavated units, yet it far outweighs any other class of artifacts. So that the weight of ceramic tile would not obscure the quantitative relationships of other artifact classes it has not been included in the relative percentage calculations by weight of the artifact classes. In the preceding discussions of artifact recovery by unit and the following analysis, the total weight of artifacts recovered was considered to be 7.804 kg.

CONSUMER ITEMS

Consumer items consist of packaged items purchased and consumed on a regular basis. Generally these include groceries, cosmetics, medicines, and beverages. Under most conditions consumer items found in archaeological deposits came in containers that do not deteriorate over time such as glass or ceramic bottles and jars, and in some instances, tin cans.

Consumer items constitute 9 percent (21) by item count and 20 percent (1,551 g) by weight of the artifacts recovered. A total of 17 bottles and jars were identified through an analysis of bases, necks, and sidewall fragments. They all represented hand blown in mold (blm) containers. Pontil marks and lips finished by hand without the use of a hand-lipping tool on some bottles indicate a manufacture period prior to 1885. Bottles identified are listed in Table 3. They are quantified by type on Table 4.

Table 3. Bottles.

TYPE	PRODUCT	TECHNOLOGY	PATTERN	ORIGIN	SIZE	DATE	REFERENCE	QUANTITY
Liquor	Wine	Blm - pushed up kick up.	-	-	30 oz	Pre 1885		1
Liquor	Whisky	Blm	-	-	30 oz	-	-	1
Liquor	Wine	Blm hand finished lip	-	-	30 oz	Pre 1885	-	1
Liquor	Ale	Blm junk bottle, shear lip	-	-	30 oz	Pre 1885	-	1
Liquor	Unidentified	Blm amber glass	-	-	30 oz	-	-	1
Liquor	-	Blm - case gin	-	-	16 oz	-	-	1
Culinary	Pepper sauce	2 pc bottom hinge mold/ribbed	-	-	-	1850 - 1885	-	1
Culinary	Olive oil	Blm, sheared hand finished lip	-	-	-	Pre 1880	-	1
Culinary	Olive oil	Blm pontil	-	-	-	-	-	2
Culinary	Olive oil	Blm	-	-	12 oz	-	-	1
Culinary	Spice	Blm	-	-	8 oz	-	-	1
Culinary	Olive oil	Blm - hand finished lip	-	-	-	Pre 1885	-	1
Culinary	Olive oil	-	-	-	-	-	-	1
Patent medicine	-	Blm - case bitters / Schnapps	-	-	16 oz	-	-	1
Unidentified	-	Blm	-	-	-	-	-	1
							TOTAL	17

Table 4. Bottled Products.

TYPE				Type Quantity	Type Percent
	Product	*Product Quantity*	*Product Percent*		
Liquor				6	35.29
	Wine	*2*	*33.33*		
	Whisky	*1*	*16.67*		
	Ale	*1*	*16.67*		
	Unidentified	*2*	*33.33*		
Culinary				8	47.06
	Olive Oil	*6*	*75.00*		
	Pepper Sauce-spice	*2*	*25.00*		
Patent Medicine				1	5.88
	Case bitters / Schnapps	*1*	*100.00*		
Unidentified				2	11.76
	Unidentified	*2*	*100.00*		
TOTALS		*17*		17	100.00

Additional consumer items identified included a lead wine bottle seal, and fragments of a meat or fish tin and another tin can.

KITCHEN ITEMS

Kitchen items made up 38 percent (105) by item count and 62 percent by weight (4898 g) of the artifacts recovered, and are articles used in food preparation, serving, and consumption. The types of artifacts recovered include ceramic tableware, glass tableware, cooking items, faunal remains and shellfish. Ceramic kitchen and tableware analysis used the vessel typology developed by Worthy (1982). Items and types identified are listed in Table 5.

In addition to European manufactured ceramics four pieces of Native American-produced brownware were identified. One had a burnished finish and one may have had a slip finish. Three of the four were burned indicating their use as cooking vessels. Since all four sherds were recovered from different proveniences (Trenches 5 and 1 E, Unit 5 and Unit 6), it was assumed they represented four different vessels.

Table 5. Ceramic Tableware.

ITEM	TYPE	PATTERN / ID	ORIGIN	MANUFACTURER	DATE	REFERENCE	#
Plate, large	Bamboo / three friends	-	China	-	-	Mueller 1987:281	1
Pitcher	Molded	-	Trenton, NJ	American Crockery Co.	1876-pre 1900	Lehner 1988:21; Freeman 1954:78	1
Plate, Large	Undecorated hotelware	-	-	-	-	-	1
Plate, unknown size	Transfer-blue	-	-	-	1842-1858	Samford 1997:21	1
Plate, unknown size	Transfer flowing blue-black	-	-	-	1839-1856	Samford 1997:24	1
Plate, unknown size	Edge decorated blue	-	-	-	1830-1860	McAllister 2001:11	1
Soup plate	Molded	Fig	England	Davenport	1860s	Withered 1985:87	1
Soup plate	Molded	Fig	England	Davenport	1860s	Withered 1985:87	1
Cup	Undecorated hotelware	-	-	-	-	-	1
Saucer	Undecorated hotelware	-	-	-	-	-	1
Saucer	Molded	"Imperial..."; underglaze black	England	Pinder, Bourne & Hope	1851-1862	Praetzellis, Rivers & Schulz 1983:66,207(202)	1
Unidentified hollow item	Undecorated	-	-	-	-	-	1
Unidentified hollow item	Undecorated hotelware	-	-	-	-	-	1
Unidentified hollow item	Cut sponge, green & red	-	-	-	-	-	1
Unidentified item	Banded ware	-	-	-	-	-	1
						TOTAL	15

Glass tableware included remains of two drinking glass tumblers and a footed dish. One tumbler rim was colored amethyst from exposure to the sun indicating a manufacture date after 1880 and before 1914 (Hunt 1959). Cooking items consisted of a cast iron piece to a coffee or food mill.

Additional kitchen items included 1553 g of butchered bone and 85 pieces of sea shell. Dr. Lynn Christenson, of San Diego County Parks, conducted a cursory examination of the bone. A detailed analysis was not undertaken. Approximately 50 percent of the bone by weight consisted of sheep or sheep sized remains (*Ovis aries*). The remainder consisted mostly of cow (*Bos tarus*). There were also a few small rodent bones. The presence of skull and foot bones indicated primary butchering of both cow and sheep took place on site. All butchering marks indicated the use of a meat cleaver. There was no evidence for use of a butcher's saw. Of the shell identified, eighty–one were California mussel (*Mytelus californicus*). The remaining four consisted of chestnut cowry (*Cypraea spadicea*), limpet (*Fissurella volcano*), reversed chama (*Pseudochama exogyra*), and a worm shell (*Vermetidae sp.*).

HOUSEHOLD ITEMS

Household items constituted 0.3 percent (2) by quantity of the assemblage and 0.11 percent by weight (9 g). These artifacts consist of those things that are necessary for the daily maintenance of a household. They included a safety pin and the neck to a gallon size, blown-in-mold carboy, or storage bottle.

GARMENT ITEMS

Garment items made up 2 percent (6) by item count and 0.2 percent by weight (17 g) of the material recovered. This group consists of all the preserved evidence of clothing. Items identified included pieces of a leather shoe. Five buttons were identified: 2 shell 4-holes, 1 ceramic 4-holes, 1 metal shank; and 1 composite of porcelain, iron, and lead, with a metal shank.

PERSONAL ITEMS

Personal items are defined as the possessions of a specific individual. These artifacts made up 0.41 percent (3) by item count and 0.47 percent (37 g), by weight of the historic material recovered and included a tooth from a hard rubber comb, a ceramic female figurine, and a gold-plated loop from a jewelry chain.

TOOLS

Tools included pieces of two different sheep shears that made up 0.83 percent of the artifact assemblage by count and 3 percent (235 g) by weight.

MUNITIONS

Nine munitions made up 3.13 percent of the collection by item count and 0.4 percent (32 g) by weight of the artifact assemblage. Types identified included:

ITEM	TYPE	SIZE	#
Spent bullet	-	D=3/4"	1
Spent bullet	-	D=3/8"	1
Spent Bullet	-	-	1
Bullet shell	Center fire	-	1
Bullet shell	Rim fire	.22	1
Bullet shell	Rim fire	.22 short	1
Bullet shell	Rim fire	.22	1
Bullet shell	Rim fire	.22	1
Bullet shell	Rim fire	.22 short	1
	TOTAL		9

Most of the munitions appear to be intrusive. Five of the six cartridge casings are .22 caliber. Although introduced as early as 1880, the .22 cartridge did not become popular until the beginning of the twentieth century and most were manufactured after 1900 (Berge 1980:227). These munitions are probably the result of hunting or target practice at the site during the twentieth century after it was abandoned and the house had fallen into ruins. They do not appear to represent items lost by occupants of the adobe.

BUILDING MATERIALS

Building materials consists of all architectural materials. They made up 42 percent (101) of the artifacts by count and 7 percent (561 g) by weight of the artifacts identified. Items included lumber fragments (126 g), 100 square cut nails, and 18 g of window glass.

As already noted, immense quantities of roof tile and ladrillos were present throughout the site. In most instances these materials were not collected. The small sample of these materials that was collected included 69.576 kg of roof tile and ladrillo. The bulk of this material was weighed and discarded with only some of the more diagnostic pieces kept as examples for curation. The weight has not been included as part of the building materials for this analysis since the amount was so great it would obscure the relationships of the other artifact types.

LIVERY ITEMS

Livery items consisted of a single horseshoe half. It made up 0.41 percent (1) of the collection by count and 1.5 percent (121 g) by weight.

HARDWARE

Hardware made up 3 percent (8) of the collection by count and 2.5 percent (197 g) by weight. This group includes miscellaneous hardware that does not fit within the other defined groups. A variety of Items were identified and are listed in Table 6.

Table 6. Hardware.

Bar iron	-	1	65
Burr	-	1	2
Screw	Flat standard head	5	23
Screw parts (no head)		1	2
Strapping	-	0	59
Wire	Baling	0	18
	TOTAL	8	167

UNIDENTIFIED ITEMS

Unidentified items constituted 3 percent (7) by item count and 0.08 percent (55 g) by weight of the artifacts recovered. This group consisted of a variety of materials, each representing a single item that could not be identified. They are listed in Table 7.

Table 7. Unidentified Items.

ITEM	#	COMMENTS
Sulfur	1	-
Unidentified ferrous item	1	Flat, thin sheet material similar to tin can but without seams or any other tin can features
Unidentified ferrous item	1	Possibly a clip
Unidentified ferrous item	1	Formed flat ferrous; thickness is increased where 2 tabs of metal are bent at right angles to the flat plane of the item; also a hole to pin or fasten it to another piece
Unidentified ferrous item	1	Looks like a round nail tip in cross section, except the pointed end is squared
Unidentified item	1	Shaped bone w brass posts which held it to another part
Worked bone	1	Identified in the field as worked; looks rodent chewed
TOTAL	7	

PART VII. ARTIFACT DATA SYNTHESIS

Data synthesis will consist of summarizing and interpreting analytical attributes of the artifact assemblage that give indications of the social and economic class of the population it represents. The data synthesis includes distribution analysis, temporal analysis, functional artifact patterning analysis, bottled product consumption pattern analysis, and economic analysis.

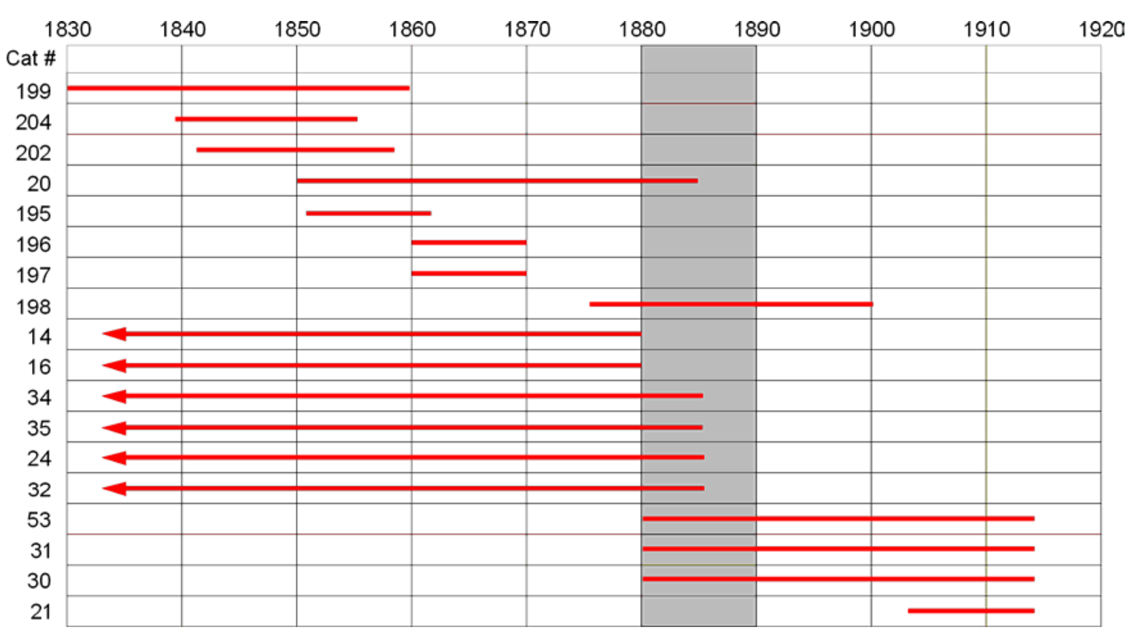
The data suggest that the majority of the artifacts represent Basque sheep herders who occupied the building in the 1880s, using the northwestern portion as a kitchen area and depositing refuse outside the western side of the building.

Artifacts were not distributed evenly throughout the site. They tended to be concentrated on the western side. Units 4, 6, 9, 10, and 11 with their associated trenches produced 79 percent by item count (191) and 40 percent by weight (2.405 kg) of the artifact assemblage. Material was especially concentrated in Unit 6 that produced 60 items (1.186 kg of material) and Unit 11 with 67 items (245 g of material).

In Table 8 a bar graph timeline is used to determine the years of artifact deposition. Manufacturing periods of datable artifacts have been plotted as horizontal lines. Vertical lines were drawn to bracket the period where most of

Table 8. Artifact Deposition Timeline.

Cat #	Trench	Unit	Item	Technology	ID	Date	Reference	#
								1
199		7	Plate, Unk. Size	Earthenware		1830-1860	McAllister 2001:11	1
204		9	Plate, Unk. Size	Earthenware		1839-1856	Samford 1997:24	1
202	1W		Plate, Unk. Size	Earthenware		1842-1858	Samford 1997:21	1
20		6	Bottle		On Bottom: Pat Sep 28, 18_	1850-1885		1
195		4	Saucer	Earthenware	Imperial; Under-glaze Black	1851-1862	Praetzellis, Rivers & Schulz 1983:66,207,202	1
196	IE		Soup Plate	Earthenware		1860s	Wetherbee 1985:87	1
197		10	Soup Plate	Earthenware; Pearlware		1860s	Wetherbee 1985:87	1
198	1W		Pitcher	Earthenware		1876-Pre 1900	Lehner 1988:21; Freeman 1954:78	1
14			Bottle Glass	BLM, sheared Hand Finished Lip		Pre 1880		1
16		2	Bottle Glass	BLM Pontil		Pre 1880	Spillman 1980	2
34		10	Bottle Glass	BLM Hand Finished Lip		Pre 1885		1
35		10	Bottle Glass	BLM Junk Bottle, Shear Lip		Pre 1885		1
24		7	Bottle Glass	BLM-Pushed Up Kick-Up		Pre 1885	Encino	1
32		9	Bottle Glass	BLM Hand Finished Lip		Pre 1885		1
53		4	Bottle Glass	1 Fragment Sun Colored		1880-1914	Hunt 1959	1
31		7	Bottle Glass	1 Fragment Sun Colored		1880-1914	Hunt 1959	1
30		7	Glass Tableware	Manganese Sun-Colored		1880-1914	Hunt 1959	1
21		6	Bottle Glass	Giles Jar Rim Sun-Colored		1903-1914	Lief 1965; Hunt 1959	1



the lines can be intersected which represents the most probable period of artifact deposition. The left bar was placed on the introduction date of the most recent non-intrusive artifact in the assemblage, thereby providing a date after which the deposit was made. The right bar was placed so that it would intersect most of the items included on the graph thereby providing a date before which the refuse was deposited. The area between the bars was shaded to represent the probable years of deposition.

The 19 datable artifacts from the Misión Vieja Adobe show a wide range of dates representing the building's long period of occupation. A series of items date from circa 1875 to 1885, suggesting this is when most of the refuse recovered was deposited. Many of those items manufactured before 1875 are ceramic tableware vessels. These could represent items from earlier occupations or they may simply be old pieces still in use until they were broken and finally discarded in the '80s. One artifact, a Giles jar introduced in 1903 (Lief 1965), has a much later manufacture date than the other items on the graph. It, like the munitions, probably represents an intrusive item deposited after the building had been abandoned.

The material appears to represent kitchen and household refuse. Table 9 and Figure 24 present the activity profile for the artifacts. Building materials and intrusive munitions have been eliminated so that the relationships of the other activity groups can be more clearly seen. In addition, shellfish has been removed from the kitchen items count so only artifacts (as opposed to a mixture of artifacts and faunal material) are represented. The assemblage ranks highest in consumer items at 31 percent followed very closely by kitchen items at 30 percent. Hardware at 12 percent, followed by garment items at 9 percent, also made up significant portions of the assemblage.

Culinary data suggest the cultural material may represent Basque sheep herders. The bone assemblage included large portions of sheep and sheep-sized bones butchered with a knife and meat cleaver. This closely resembles the pattern of meat consumption and butchering from features representing Basque sheep herders excavated at the Encino Road House (Reynolds 1980: 2-2 - 5-3).

Table 9. Site Activity Profile.

ACTIVITY	NO.	%
Consumer	21	31
Livery	1	1
Personal	2	3
Agricultural	2	3
Kitchen	20	30
Garment	6	9
Hardware	8	12
Household	1	1
Unidentified	7	10
TOTAL	68	100

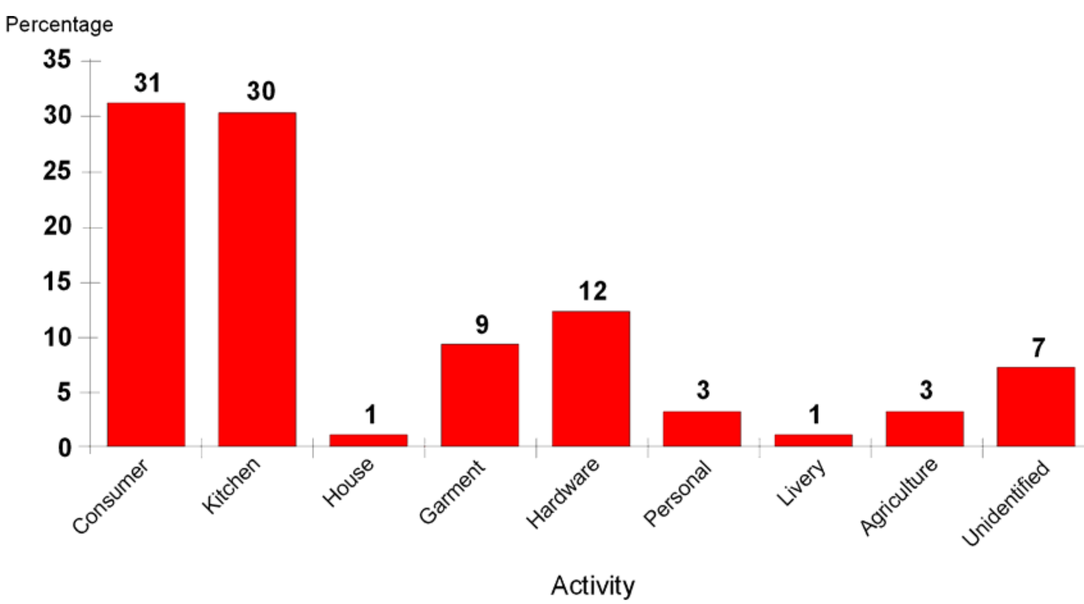


Figure 24. Misión Vieja Activity Profile.

The culinary bottles are also suggestive of Basque cooking. Intersite comparison of culinary bottles is shown in Figure 25. The Misión Vieja assemblages are compared to collections representing Latin American and southern European as well as Anglo-American populations. Five sites were used and include the San Diego 1910 City Dump, refuse from the foundation units of the Encino Roadhouse, Santa Ana, Encino Roadhouse Features 1 and 3, the Pio Pico Adobe in Whittier, the Diaz Adobe in Monterey and the Aguirre Adobe in Old Town San Diego. The San Diego City Dump, Encino foundation units and Santa Ana represent Anglo-American culinary traditions (Van Wormer 1983a; 1991; Elliott 1985). The other sites represent southern European and Hispanic populations. Features 1 and 3 of the Encino Roadhouse represent a Basque population, while the Aguirre, Pio Pico and Diaz adobes were occupied by Mexican Californio families (Van Wormer 1983a; 1983b; Felton and Schulz 1983, Phillips *et al*. 2001).

The Hispanic and southern European assemblages are high in percentages of pepper sauce, spice, and olive oil and exhibit a distinct lack of other culinary products (Van Wormer 1983a). The San Diego, Santa Ana, and Encino foundation unit assemblages resemble each other in the wide variety of products and their dominance by packer lip, club sauce, and catsup bottles. These products make up 10 percent or less of the southern European and Hispanic sites which exhibit far fewer products than the Anglo American assemblages. They are dominated by spice, pepper sauce and olive oil, which constitute four percent or less of the Anglo-American culinary bottle assemblages. The Misión Vieja assemblage shows high percentages of spice-pepper sauce and olive oil bottles while exhibiting very low percentages of other products, suggesting the inhabitants of the adobe during the 1860s followed a Southern European and Hispanic culinary tradition. The patterns closely resemble those of Encino Roadhouse, features 1 and 3, which represent a Basque culinary tradition.

The data suggest that the majority of the artifacts represent Basque sheep herders who occupied the building in the late 1870s and early 1880s, using the northwestern portion as a kitchen area and depositing refuse outside the western side of the building. Scorched areas and concentrations of bone on the earthen floor in Unit 9, as well as concentrations of California mussel in Units 10 and 11 indicate food preparation and disposal in the northwestern portion of Structure B. This, combined with the relatively large number of artifacts from Unit 6, indicates a general refuse scatter along most of the western side of the building. Recovery of sheep shears in Unit 10 and Trench 17 are obvious indications of sheep herding activity. The faunal and culinary bottle consumption patterns are indicative of Basque culinary traditions. The bone remains included large quantities of sheep that had been butchered with a knife and meat cleaver. No saw cut bone was identified.

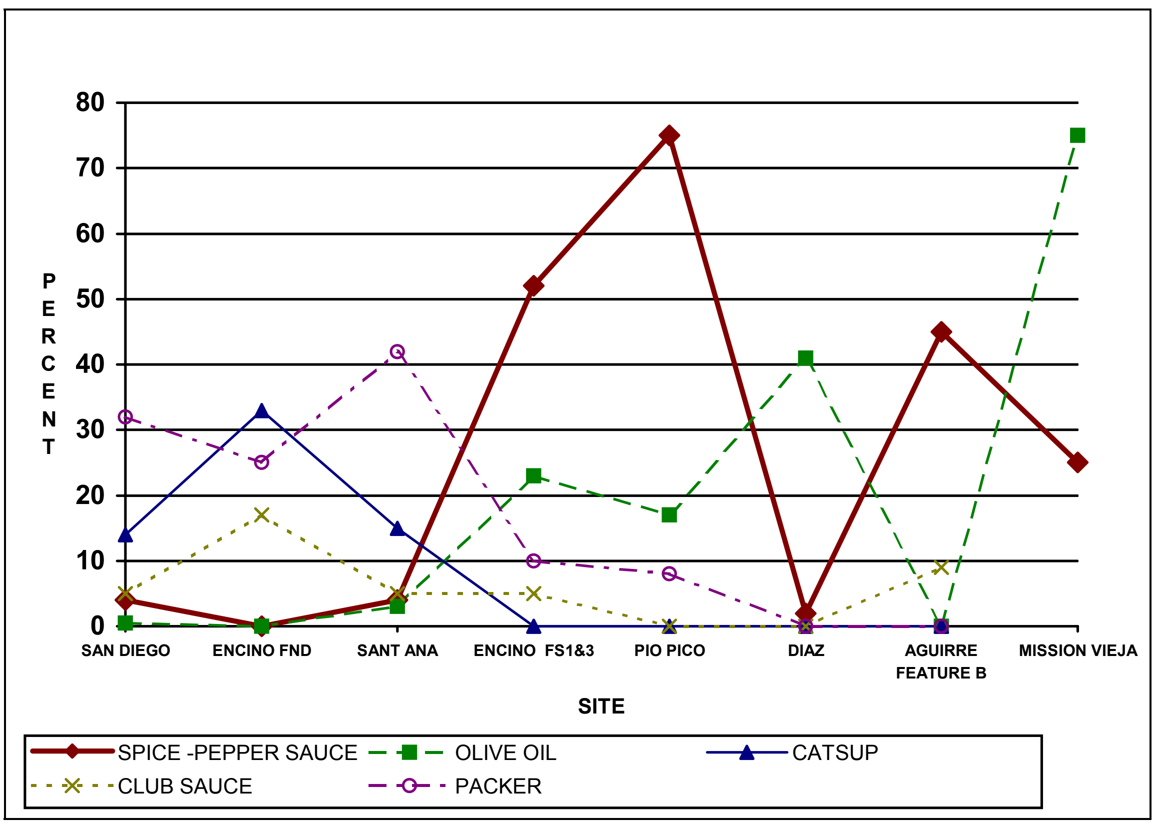


Figure 25. Intersite Culinary Bottle Comparison.

The culinary bottle consumption pattern dominated by olive oil and spice bottles is indicative of a Southern European and Hispanic dietary tradition. Both the bone and culinary bottle patterns closely resemble those representing Basque sheep headers from the Encino Road House excavations (Reynolds 1980; Van Wormer 1983).

PART VIII. NATIVE AMERICAN LITHIC ANALYSIS

In direct association with the historic manufactured artifacts, 51 Native American lithic (stone) artifacts were recovered during the test excavations at CA-ORA-29. Forty-one were flakes, or stone chips struck off a core (nucleus of raw material). One was a core, and six were actual stone tools. The tools included a pestle, two utilized flakes, a flake tool, a chopper, and a plano-convex tool.

The artifacts will be discussed below by their provenience, or origin on site, beginning with trenches and units on the eastern portion of the site, followed by those on the western portion of the site.

EASTERN PORTION

Trench 1, Eastern Half

Excavators recovered 11 flakes and a pestle from this trench. The flakes were made of locally available raw materials. There were four basalt and three metavolcanic flakes, and one each of felsite, chalcedony, quartzite, and quartz. None of the flakes had been modified or used. The schist pestle, artifact #24 (Figure 26), was well shaped (pecked and smoothed) and well used. Native Americans used a pestle in a stone mortar to process acorns into mush. The pestle was recovered at the eastern foundation of Structure B.

Figure 26. Pestle (Catalog # 24).

Unit 1

A single flake tool, or flake that had been modified to create a suitable working edge, was recovered from this unit. The tool (#50) was made of metavolcanic and had not been used.

Unit 2

Six flakes came from Unit 2. Three were made of basalt, two of metavolcanic, and one of quartzite. None of the flakes had been modified or used.

Unit 3

One quartz flake and one basalt chopper were recovered from Unit 3. The chopper (#51) has a well-defined working edge formed by two faces coming together at an approximate 30-45 degree angle. This tool edge showed crushing wear from use. Choppers may have been used by native people to process yucca or other tough materials.

Unit 7

Unit 7 produced a quartzite and a metavolcanic flake, unmodified and unused, and a quartzite utilized flake (#37) that had been re-sharpened (retouched) after use. Its approximate 60-degree working edge angle would be suitable for skinning, hide scraping, and heavy cutting (Wilmsen 1974).

Unit 8

This unit revealed the northeast corner of Structure A. A plano-convex tool (#17) made of basalt was recovered during the excavation of Unit 8. A plano-convex tool, also called a scraper plane, has a flat base with steep sides that is useful in the reduction of yucca and agave fiber into cordage (Kowta 1969) or in processing hides, or other planing activities.

Trench 8

Two flakes, one each of felsite and metavolcanic, were recovered from Trench 8. Neither flake had been modified or used.

WESTERN PORTION

Trench 1, Western Half

One basalt flake came from this trench. It had not been modified or used.

Trench 3

Two unmodified and unused flakes, one each of basalt and metavolcanic, were recovered from Trench 3, along with a felsite utilized flake (#49). The working edge angle of this tool approximated 45 degrees, suitable for whittling (Semenov 1964).

Unit 6

A flake each of basalt and metavolcanic were recovered from Unit 6. Neither flake had been modified or used.

Unit 9

Three flakes, one each of felsite, metavolcanic, and metasedimentary, were recovered from Unit 9. The metavolcanic flake was found on the packed earthen floor of the unit and inside Structure B.

Trench 5

Six flakes (four metavolcanic, one basalt, and one quartzite) were found in this trench. None had been modified or used. These flakes came from a highly disturbed context on the south end of Structure B.

Unit 11/Trench 16

Three flakes, one quartzite and two metavolcanic, were recovered from the excavation. None of the flakes had been modified or used. The flakes were located inside Structure B.

Trench 19

A single flake of basalt came from Trench 19. It was not modified or used. The flake was recovered from the outside of Structure A.

SUMMARY

The presence of these flakes, cores, and tools attests to a continuing tradition of stone tool making and use by Juaneños into the mid to late 1800s on Rancho Mission Viejo. Their presence also suggests that the Indians either did not have regular access to manufactured tools or that they preferred their own stone tools. Note that one of the tools, the pestle, would have been at home in any American household at the time.

PART IX. SIGNIFICANCE EVALUATION

Preliminary test excavations revealed that the Misión Vieja Adobe site possesses a substantial degree of integrity. The site is significant and potentially eligible for the National Register of Historic Places under Criterion D, in that it contains information that can answer valid scientific and historical research questions. The project resulted in identification of the remains of two separate structures that probably represent different construction phases from the 1840s or earlier. Features included cobble foundations, floors, exterior surfaces and interior dividers. The majority of the artifacts appear to represent Basque sheep herders who occupied the adobe in the late 1870s and early 1880s.

PART X. CONCLUSIONS

The test excavation provided evidence that gave some insight into the building's construction history and design. Two distinct building episodes are represented by the remains of two separate structures that are adjacent to each other. Structure A, at the northern end of the site, measured approximately 45 by 23 feet, oriented lengthwise on an east–west axis. Structure B, composing the southern three-quarters of the site, measured 93 by 47 feet and was oriented lengthwise on a north–south axis. When both buildings were completed the adobe house at Rancho Misión Vieja measured 116 by 47 feet.

The period of construction for Structure A is uncertain. It might represent a house built by the missionaries for a Mayordomo of Misión Vieja during the early 1800s. It could also have been built by Augustine Olvera when he occupied the rancho between 1842 and 1845. The possibility also exists that Structure A could actually be a later addition to the northern end of an already standing adobe house represented by the remains of Structure B.

Structure B represents the adobe house built by Juan Forster when he acquired the ranch in 1845. His family lived in the dwelling until 1848, and continued to occupy it for parts of the year until 1864. Based on in situ roof fall the house was covered with a mission tile roof that extended to cover exterior porches along the eastern and western sides. A ladrillo alignment at the northern end of the structure encountered in Trenches 3 and 4 and Units 9 and 11 may have supported an interior dividing wall. The adobe originally had a packed earthen floor. On the northern side of the dividing wall alignment this surface was later covered with the ladrillo floor tile encountered in Unit 11. Interior living surfaces were elevated 18 to 20 inches above ground level.

Analysis indicated that the majority of the artifacts represent Basque sheep herders who occupied the building in the late 1870s and early 1880s. Both butchered bone and culinary bottle patterns closely resembled those representing Basque sheep headers from the Encino Road House excavations. Scorched areas and concentrations of bone on the earthen floor in Structure B, along with concentrations of California mussel, provided evidence of food preparation in the northwestern portion of the structure. The relatively large number of artifacts recovered along the western side of the site indicated a general refuse scatter along most of that side of the adobe. Recovery of sheep shears in Unit 10 and Trench 17 were obvious indications of sheep herding activity.

The presence of the Native American lithic artifacts attests to a continuing tradition of stone tool making and use by Juaneños into the mid to late 1800s on Rancho Mission Viejo. Their presence also suggests that the Indians either did not have regular access to manufactured tools or that they preferred their own stone tools.

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REPORT OF ARCHAEOLOGICAL TESTING FOR THE RANCH PLAN, PHASE II-B, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

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REPORT OF ARCHAEOLOGICAL TESTING FOR THE RANCH PLAN, PHASE II-B, RANCHO MISSION VIEJO, SOUTH ORANGE COUNTY, CALIFORNIA

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SECTION A. PREHISTORIC SITES

PART I. BACKGROUND TO THE STUDY

INTRODUCTION

At the request of Laura Coley Eisenberg of Rancho Mission Viejo, LLC, personnel from Archaeological Resource Management Corporation (ARMC) conducted archaeological testing of eight prehistoric sites and two historic sites in south Orange County for the Ranch Plan, Phase II-B. Sites selected for this test phase were determined according to their likelihood of being impacted by the proposed Ranch Plan project or alternatives to the Ranch Plan project. Due to the number of sites to be tested, the test phase was divided and documented separately as Phase II-A (Demcak 2002) and Phase II-B (present volume). The sites are all located on Rancho Mission Viejo. They include the following: CA-ORA-1111, -1125, -1135, -1449, -1551, -1553, -1557, -1573, and historic sites 30-176634, and 30-176635.

The senior author, a Society of Professional Archeologists (SOPA) certified field archaeologist and Registered Professional Archaeologist (RPA), with over 20 years of experience in southern California archaeology, was overall Project Director and supervised the fieldwork on the prehistoric sites. Stephen R. Van Wormer, historian and Society of Professional Archeologists (SOPA) certified field archaeologist, supervised the fieldwork on the two historic sites. Chris Demcak worked on the field crew and prepared the report graphics. Jack Demcak worked on the field crew and assisted in lithic analysis. The fieldwork took place from January 7 – March 14, 2003.

The results are that three prehistoric sites are considered significant, i.e., potentially eligible for the National Register of Historic Places (NRHP): CA-ORA-1125, -1449 and -1551. The two historic sites (30-176634 and 30-176635) were also considered significant.

NATURAL SETTING

The project area (Figure 1) generally consists of Trampas Canyon, Cristianitos Canyon, and upper Gabino Canyon. The foothills that characterize the study area are part of the Santa Ana Mountains and the Peninsular Ranges Province that stretches from the Transverse Ranges through the Los Angeles Basin to the tip of Baja California (Norris and Webb 1976). The climate of the area is Mediterranean type, with dry summers and moist winters. Rainfall averages 10-15 inches annually on the coastal plain and up to 40 inches in the interior mountains (Hornbeck 1983).

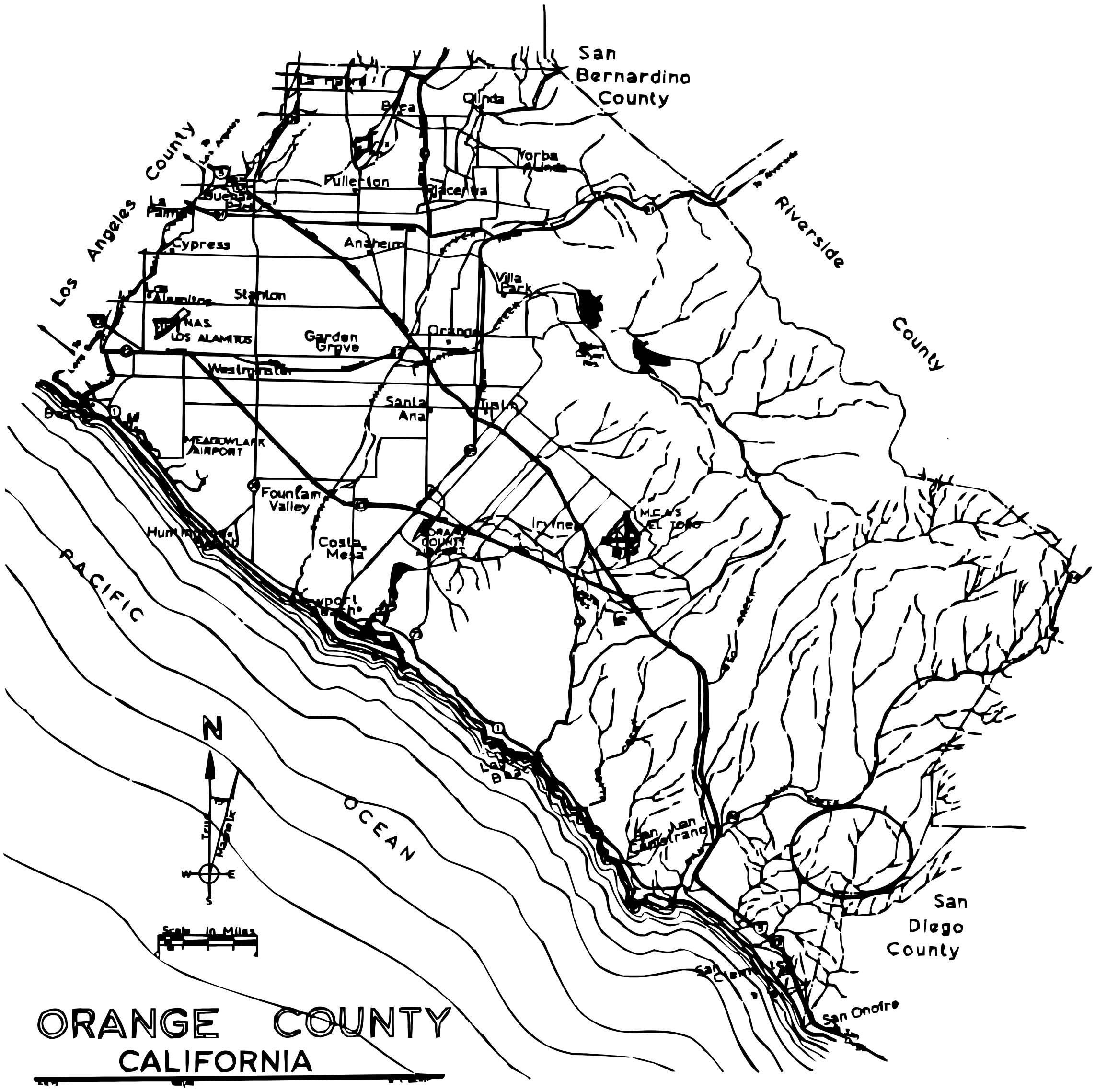


Figure 1. General Project Location.

The project is situated in south Orange County along San Juan Creek and numerous unnamed drainages and their adjacent terraces. Topographically, the study area is characterized by rolling hills, narrow ridgelines, and knolls separated by narrow canyons, localized drainages, and broad watercourses (Orange County Planning Department 1971). Elevations in the project vicinity vary from a low of 160' in the floodplain of San Juan Creek to a high of 900' in upper Gabino Canyon.

Geologically, the study area is underlain by marine Upper Cretaceous deposits (Trabuco, Ladd or Williams Formations) and by Tertiary age, marine sedimentary rocks (Morton and Miller 1981), along with Quaternary and recent alluvium. Mapped formations include the marine Upper Cretaceous Ladd and Williams Formations, the marine Paleocene Silverado Formation, the marine Eocene Santiago Formation, the terrestrial Oligocene Sespe/Vaqueros undifferentiated Formation, the marine Middle Miocene Topanga and Monterey Formations, the marine and non-marine Middle Miocene San Onofre Breccia, the Upper Miocene Capistrano Formation, and unnamed Quaternary and recent alluvium. Soils in the study area vary from gray-brown to red-brown clayey loam on the upper terraces and knolls to light tan, sandy silty sediments with abundant cobbles on the creek bottoms and lower terraces.

Lithic raw material derived from these and other formations in the Santa Ana Mountains include the Bedford Canyon metasediments (argillite) and quartzites; the Santiago Peak volcanics (felsite, andesite, and basalt) and metavolcanics; as well as granites, quartz, chert, and chalcedony. These lithics occur as stream float in the local drainages. These raw materials were utilized by aboriginal populations to create chipped and ground stone tools and ornaments.

Five plant communities as defined by Munz and Keck (1959) are present in the project area. These communities (Chaparral, Coastal Sage-scrub, Grassland-herbland, Oak Woodland, and Riparian) would have provided a variety of seasonal plant resources to the prehistoric and early historic inhabitants of the region. For a detailed description of these resources and their uses, see Demcak and Del Chario (1989).

CULTURAL SETTING

Prehistory

Wallace (1955) and Warren (1968) have both proposed syntheses of the local cultural sequence. These summaries continue to be useful in defining the prehistoric period in southern California. The two researchers propose that aboriginal populations remained hunters and gatherers before Spanish contact.

The earliest recognized culture in southern California belongs to the Early Holocene San Dieguito Tradition (Warren 1968), a manifestation of the Western Pluvial Lakes Tradition (Moratto 1984). Defined primarily by its type site, the C.W. Harris Site (CA-SDI-149), typical San Dieguito artifacts include patinated scrapers (side and end types);

scraper planes, choppers; crescentics; large leaf-shaped knives (bifaces) and projectile points. Lake Mohave and Silver Lake stemmed and shouldered point types also are found in these early assemblages. Manos and metates (hard seed grinding equipment), may be absent or are sparsely represented in the San Dieguito Tradition. It is usually characterized as a hunting tradition as opposed to the seed-gathering tradition that succeeded it in coastal and interior southern California. Sites are generally found on elevated terraces above permanent water sources and with little or no cultural deposit subsurface. The San Dieguito Tradition has rarely if ever been documented in Orange County. It is also not reported for the Camp Pendleton area immediately adjacent to the project area (Reddy et al. 2000).

The Milling Stone Horizon, or Encinitas Tradition, is the earliest occupation that has been properly documented for Orange County. Highly mobile populations adapted to a littoral, or coastal, environment during this occupation. Small native groups gathered plant foods, including seeds, tubers, and berries, collected shellfish, and hunted small and large game. They used milling stone and muller, more commonly called metate and mano, to grind seeds. Hunting tools included wide, thick, and heavy projectile points. They were presumably utilized as spear points, based on their weights (Fenenga 1953), and launched by atlatls, or wooden spear-throwers. Cogstones and discoidals, wheel-shaped and disc-shaped ceremonial stones respectively, and red argillite beads (Demcak 1999) are diagnostic artifacts, or time-markers, for this earliest known occupation in Orange County.

During the subsequent Intermediate Horizon, or Campbell Tradition, prehistoric populations expanded their resource base to include more hunting and fishing. The mortar and pestle, tools associated with the processing of acorns and other fleshy plant foods, were introduced into the area. Projectile points remained relatively large and heavy.

In the final prehistoric occupation, the Late Horizon Cultures (Shoshonean and Hokan speakers), local economies expanded markedly. Artifact assemblages reveal an increase in the number and types of tools, reflecting population growth and task specialization. Non-utilitarian items, such as beads and ornaments, were also on the increase in the Late Horizon compared to earlier occupations. Local groups continued to rely primarily upon plants, shellfish, and terrestrial game, which they hunted with small, lightweight arrow points and the bow.

Steatite, obsidian, and other non-local lithic resources were traded into the area. Pottery was introduced into Kumeyaay territory in San Diego County and small quantities reached Orange County in the very late prehistoric period or early historic period. Pestles and portable mortars, especially of the basket-hopper type, and bedrock mortars were utilized locally for acorn processing. Seed grinding continued to be carried out with manos and metates, as well as on bedrock grinding slicks.

Ethnohistory

Ethnographically, the study area falls within the territory of the Juaneño people. The Juaneños were named by their association with the Mission San Juan Capistrano. They are closely related to the Luiseños, who were associated with the Mission San Luis Rey (Bean and Smith 1978; Bean and Shipek 1978). Shoshoneans, they are Takic speakers of the wider Uto-Aztecan family of languages. Uto-Aztecan speakers are presumed to have entered California prior to 2000 B.C. (Moratto 1984:541) and perhaps arrived in the Los Angeles Basin by 1000 B.C. (Kowta 1969:50).

Hunter-gatherers, these Native populations exploited a diverse set of microenvironments from the coast, coastal plain, foothills, Santa Ana Mountains, to the interior valleys of southern California. Their territory is traditionally described as bounded on the north by Gabrielino territory at Aliso Creek. However, David Belardes (pers. comm.), member of the Juaneño Band of Mission Indians, asserts that the northern boundary of Juaneño territory was actually the mouth of the Santa Ana River. Inland, their territory extended to the upper reaches of the Santa Ana Mountains where it adjoined Luiseño territory. Southward, Juaneño territory reportedly extended to the area between the San Onofre and Las Pulgas drainages (Kroeber 1925:636) and westward to the Pacific Ocean.

With the coming of the Spanish in 1769, Native populations were brought into the mission system and forced to adapt to a new social and economic order with drastic consequences for the Natives. Their populations were radically reduced in number and their aboriginal way of life was largely eliminated. Certain populations, among them Juaneños who managed to escape into the interior mountains, were spared the forced acculturation for a short time. Then they too were overwhelmed by Spanish, Mexican, and later American Period developments. Despite considerable hardship, many of their descendents still live and work in the area surrounding the Mission San Juan Capistrano.

The Juaneño Band, or Acjachemem Nation, strives to keep its distinct culture and language from extinction. After decades of struggle for recognition, the band was formally recognized by the California State Legislature in September, 1993 as the "...original native tribe of Orange County" (Hall 1993:A3). Band members continue to seek federal recognition as a tribal unit.

Historical Overview

The arrival of the Portolá Expedition in 1769 marked the first efforts at extending Spanish control into Alta California through the establishment of Catholic missions. This move by the Spanish King Carlos III was intended to protect Pacific Coast shipping against Russian or English occupation of the area. Beginning in San Diego, the padres surveyed the lands as far north as Monterey Bay and secured them for the Spanish

Crown. Mission sites were selected on the way north by Fathers Crespi and Gomez (Hallan-Gibson 1986).

The Portolá party arrived in Orange County on July 22, 1769, at a site in Cristianitos Canyon where two sick children were baptized by the fathers. The following day the travelers camped near the Mission Vieja site (CA-ORA-29) at the mouth of Gobernadora Canyon. The next day the expedition continued northwestward and out of the survey area to the western edge of the Plano Trabuco and camped at the San Francisco Solano campsite at the present location of the Trabuco Adobe. Altogether they stopped at seven campsites (Smith 1965) in what became Orange County.

Missions, presidios, and pueblos were established by the Franciscan fathers, and in 1775, the Mission San Juan Capistrano was begun. Within days, however, a Native American uprising at the mission in San Diego forced the fathers to abandon the local mission, hastily bury its bells, and with the soldiers hurry southward to assist their fellow priests. The fathers returned the following year to re-establish the mission at a different site. There on November 1, 1776, the mission was officially founded. On October 4, 1778, the mission was removed to its present location closer to the Arroyo Trabuco, a dependable water source (Hallan-Gibson 1986). Substantially expanded in 1784, the mission continues in use and is believed to be the oldest building extant in California, according to Friis (1965).

The Native inhabitants were brought under the control of the mission. They were converted to Catholicism and provided the mission with a large labor pool. The padres taught them the necessary skills to grow crops, tend cattle, produce wine, pottery and other crafts. The missions intended to prepare them to look after their own lands, which were held in trust for them. Spanish legislators called for the dissolution of the missions and the transfer of land ownership to the native populations as early as 1813. However, it was not until the Mexican Period that secularization was begun.

At the end of the Mexican Revolution, mission lands were seized and turned over to Mexican citizens of the Catholic faith and of good character. The Mission San Juan Capistrano was the first mission to be secularized in 1834. A pueblo for Native Americans was set up at Mission San Juan Capistrano, but, after years of mismanagement, failed (Dixon 1988; Hallan-Gibson 1986). A town was instead chartered and land became available to petitioners, including the Natives. Eventually, the town itself failed, and the mission was sold by Governor Pio Pico to his brother-in-law John Forster and James McKinley, a trader (Hallan-Gibson 1986). Forster maintained his residence at the mission until he moved his family to the Mission Viejo Adobe (Van Wormer 2002).

The Spanish Crown issued a series of land grants, or grazing rights. The land between the Santa Ana and San Gabriel rivers was given to Manuel Nieto in 1784; this was the first land grant in Orange County. The second, called Rancho Santiago de Santa Ana, went to Juan Grijalva and Jose Yorba, his son-in-law. The grant was confirmed in 1810 to Yorba and Grijalva's grandson (Hallan-Gibson 1986). There followed a period of growth and development as rancheros built adobe homes, ran large herds of cattle and sheep, engaged in foreign trade, and dabbled in politics.

California was drawn into the Mexican-American War in 1846, and Governor Pico fled the oncoming American Army. His son-in-law John Forster, an American sympathizer, tipped off the Union soldiers marching through Orange County that a large contingent of enemy soldiers was on its way. This may have saved their force from defeat by 600 Mexicans (Hallan-Gibson 1986). After the Treaty of Guadalupe Hidalgo ended the war in 1848 and California entered the Union, the land claims of the rancheros were scheduled to be upheld, but subsequent laws required the land owners to prove their claims, requiring considerable time and expense. The courts eventually confirmed most of the land claims in Orange County.

In the American Period, life on the ranchos continued much as before although squatters, rustlers, and mounting debts grew troublesome. Large landholdings were increasingly broken up; towns and settlements grew in number. Mission San Juan Capistrano was returned to the Catholic Church in 1865 when the U.S. Government denied Forster's claim to the property. Forster took his family and moved southward to Rancho Santa Margarita, home of his relatives, the Picos (Hallan-Gibson 1986).

During the 1860s, severe drought, smallpox, and torrential rains alternately took their toll on the large landholders and other settlers in southern California. The cattle market collapsed, land was devalued, and a diversified economy developed. The end of the Civil War brought an impetus to settlement. Land was cheap, and thousands flocked to the Golden West. A real estate boom ensued in the 1880s. The arrival of the Union Pacific, Southern Pacific, and Santa Fe Railroad provided transportation for people and products into and out of California. Sheep ranching became highly profitable due to the scarcity of cotton in the South. Large land grants were partitioned. Development proceeded at a rapid pace through the late nineteenth and early twentieth century. Improvements in transportation and communication contributed to the boom. The citrus industry with its associated bee keeping was one of the most successful enterprises in the area.

In the post-World War II period, southern California has been characterized by expanding urbanization, business and industry. The aerospace industry, movie and television industries, automobile manufacturing, and tourism have spurred local growth and continue to attract visitors and potential residents. The last ranchos have been developed or are in the process of being developed.

<u>Rancho Mission Viejo, or La Paz, and O'Neill Ranch</u>

This large rancho comprising 46,500 acres was granted to Jose Estudillo in 1841. Juan Forster acquired the holding in 1845 after having grazed his cattle there for at least a year. Forster, who played a significant role in the development of southern Orange County and northern San Diego County, was an Englishman by birth but a naturalized

Mexican citizen. He was married to Pio Pico's sister, possessed vast land holdings, and was one of the wealthiest and most influential men of his day. His ranching success was partly due to an increased demand for beef that brought about a cattle boom once the gold rush had begun in 1848.

In 1882, the heirs of Juan Forster, whose land was heavily mortgaged due to various business failures, sold the Rancho Santa Margarita y Las Flores to Richard O'Neill and James C. Flood. Thus began the O'Neill Ranch, which includes the project area (Muñoz 1980).

O'Neill, an Irishman, had come to California and established a successful ranching business and later meat-packing establishment. With his friend Flood, he acquired the Forster property. With various innovations, such as installing feedlots, O'Neill was highly successful and bought more land. The land holding reached its maximum of 260,000 acres under the care of Jerome O'Neill, Richard's son, at the turn of the century (Emmons 1974).

After Jerome's death, the ranch became the property of the Rancho Santa Margarita Corporation in 1926; and the O'Neills' stocks were held in trust. The Floods retained half interest in the corporation and ran the ranch until the 1930s when they sold their share (now Camp Pendleton) and the O'Neills divided their half interest. The land itself remained in trust. In 1943, after Richard O'Neill, Jr., died, an effort by trust officers to sell the property was halted by his widow.

Developers persisted, and in 1964, Mission Viejo Company was formed. The heirs and Richard O'Neill, Jr.'s, widow retained a 20% share of the company. Local development was initiated, and in 1972 the company was sold to the Phillip Morris Company, whose development became the Mission Viejo Planned Community which is nearly complete. Santa Margarita Company launched its first large development, Rancho Santa Margarita, on the upper Plano Trabuco and on the adjacent hills to the south and southeast. Development has continued southward and now includes the Las Flores and Ladera Ranch communities.

The O'Neill family continues to operate Rancho Mission Viejo as it has since 1882. Ranching is still being carried out on the project area except for leased acreage. Herds still roam the hills and cowboys still conduct spring round-ups, repair fence lines, and patrol the range. Working windmills and cattle troughs dot the landscape.

PART II. RESEARCH DESIGN AND FIELD METHODS

RESEARCH QUESTIONS

The project sites were tested to determine their significance, or potential for providing data to answer important questions in prehistory or history. A series of research questions was developed to guide the fieldwork at the sites.

The first set of research questions is directed toward the refinement of the local and regional chronology. The lack of absolute dates available to researchers, when the cultural sequences proposed by Wallace (1955) and Warren (1968) were formulated, has led to problems in recognizing and interpreting the San Dieguito/Milling Stone/Intermediate/Late Prehistoric framework. These sequences can be used as hypotheses open to further refinement and/or alteration.

Basic to all research questions is rigorous temporal control of the data, ideally through chronometric dating. A proper ordering of artifact types, assemblages, sites or cultures in time is the necessary first step in detecting patterning on the intersite and regional levels. Once chronological sequences are delineated, contemporaneity of sites and/or components can be established, thus enabling meaningful comparisons to be made.

The presence of ecofacts, chipped and ground stone artifacts, and midden accumulation at the project sites provided an opportunity to address a number of research questions through the recent field and laboratory investigations. Certain of these research questions focused on chronology. Outlined below are the questions as well as the requisite data to answer them.

<u>Chronology</u>

1. When and for how long were the sites occupied?

To answer this question, it is necessary to date the cultural deposit and to gauge the intensity of use. One of the aims of the current investigation, therefore, was to recover datable materials, such as organics for radiocarbon assay, and obsidian for hydration measurements, in careful stratigraphic context. The recovery of time-sensitive artifacts such as projectile points, beads, ceramics, and discoidals, used to assign relative dates, was also a goal. Depth of the cultural deposit would be suggestive of the length of occupation at the site when coupled with the dated items.

2. Was occupation continuous? or was the site occupied successively?

Cultural hiatuses, or sterile levels, would imply a discontinuous occupation. Careful stratigraphic recording would be sought to recognize occupational strata.

3. How do the project sites relate to other sites within the same time frame? Can the sites provide data to refine the regional syntheses?

A comparison of relative frequencies of artifact types, ecofacts, and site types within the same time frame would add to an understanding of settlement and subsistence patterns as well as to the local and regional cultural/historical framework. Providing absolute dating for specific time markers, such as discoidals, would help to clarify their chronological placement.

4. What is the cultural affiliation of the site/component? Do any of the sites contain evidence of pre-Shoshonean or post-European contact?

Several of the project sites contain flaked tool assemblages that may be related to an Early Holocene cultural pattern, the San Dieguito Tradition. Thus there is considerable potential for the discovery of a pre-Shoshonean occupation in this area. Some of the project sites are located adjacent to or proximate to the ethnographically known coastal-inland trail called El Potrero de los Pinos/San Juan Hot Springs Trail (present-day Ortega Highway, or SR 74) and thus might contain data relevant to an hypothesized inland to coastal migration of Shoshonean peoples in the late period. The project sites are also located in proximity to Mission San Juan Capistrano and to the Portolá Expedition route in Cristianitos Canyon. The possibility of encountering Mission period occupational levels is recognized for the project area.

Subsistence Strategies

The second set of research questions deals with the reconstruction of subsistence strategies, a past lifeway. In other words, how did the occupants of the site make their living? The recovery of ecofactual material as well as the tools used in food procurement and processing would be helpful to address questions of subsistence, such as:

1. What were the food resources utilized by the site occupants? Was there a change over time?

The range and types of ecofacts (shellfish remains, vertebrate faunal bone) present at the site can be quantified and their relative numbers compared through the occupation levels. The environments of exploitation, or site catchment, can be determined from analyses of the recovered species, and non-local resources can be isolated (exchange?). Analyses of tool types, especially plant processing equipment, and their evolution over the span of occupation at the sites can aid in reconstructing past subsistence practices.

2. In which season were the ecofacts procured?

Seasonality studies on shellfish (Chione) and vertebrate fauna, eg. deer, may shed light on the placement of the site within the seasonal round of subsistence and settlement hypothesized by Hudson (1971) for the aboriginal populations in the area.

3. What tool technology is represented by the artifacts? What raw materials were utilized in tool manufacture? Were they locally derived?

Analyses of technology of manufactured items aid in placing the site and its occupants within the local cultural and historical framework and permit the recognition of novelty, or innovation, in tool production within a regional pattern. Raw material analyses enable researchers to determine preferences for particular raw materials; these data in turn lead to questions regarding sourcing of raw materials, such as geological or physical environment of origin, direct procurement versus exchange for non-local materials, crafts production, etc. The presence or absence of patination (accumulation of cortex) may be used to determine relative age of the artifacts as it represents elapsed time since the tool was created or modified.

4. What are the range and types of artifacts represented? Is there a change over the span of occupation, e.g., a trend toward increasing specialization in tool types?

Artifact classes and types can be analyzed for the various levels of the sites and their relative frequencies compared. The presence of specialized tools, such as fishhooks, shaft straighteners, arrowpoints, drills, and awls in the upper site levels would be indicative of this trend.

5. Is there variability in the horizontal or vertical distribution of artifact/ecofacts which would indicate internal site patterning such as activity areas?

Analysis of the spatial positioning of individual species of fauna or possibly flora may permit researchers to hypothesize that particular site areas, either vertically or horizontally delineated, were utilized for specific activities or were utilized alternately over the span of occupation of the site. Similarly the spatial dimensions of the artifact assemblage would inform on specific use areas.

Settlement Patterns

A third set of research questions is directed toward the reconstruction of another past lifeway, settlement patterning. Data recovered from a group of sites rather than from a single site is more amenable to answering questions of a regional nature such as this. These questions are concerned with the definition of site types and the illustration of their relationship to the landscape and to each other, such as:

1. What are the site types represented within the project area? Are they villages/rancherias? base camps? special activity areas?

A recognition of site types can be accomplished by reference to frequencies and types of artifacts present, frequencies of ecofacts relative to artifacts, accumulation of midden, nature of midden deposit (depth; shell, charcoal, fire-affected rocks; features present?), size of artifact/ecofact scatter, presence of internal patterning reflective of village or rancheria, or specialized assemblage reflective of hunting camp or plant processing station.

2. What is the spatial relationship of the sites to each other and to the environment? What were the determinants of site location? Topography? Access to water, plant, animal or mineral resources? Access to lithic raw materials, trails or trade routes? Does site function relate to these determinants?

Analysis of the spatial patterning of the sites in relation to each other can aid in the prediction of locations of additional sites within the project area. Environmental determinants of site location or site type in the area can be hypothesized and tested in future research.

3. During what periods of the year were the sites occupied and/or utilized?

Seasonality studies on fauna or flora may help to pinpoint the season of occupation or utilization, or specific tool types may be indicative of seasonally-available resources, such as acorns.

4. Can a change in settlement patterns over time be detected in the occupational sequence?

Control of chronology through stratigraphic recording and/or dating of ecofacts or obsidian over the span of occupation is critical to an interpretation of change in settlement. Environmental factors (flooding, drought, bay siltation) may contribute to an explanation of a change in settlement.

Social Networking

The fourth set of research questions deals with social networking. The interaction of various groups of Native Americans in prehistory can be detected in the archaeological record by the presence of non-local, or exotic, goods which moved from group to group through exchange networks (Earle and Ericson 1977; Earle 1982). Examples of an exchanged good in southern California are obsidian, fused shale, steatite, asphaltum, and marine shells usually in bead form (Davis 1961). Motivation for such exchange may be sought in the resource base (site catchment) available to site occupants. The proximity of the project area to El Potrero de los Pinos/San Juan Hot Springs Trail and to the Portolá route (El Camino Real) makes exchange issues highly relevant. The following research questions apply to social networking/exchange:

1. What is the local resource base, or catchment, in terms of lithic and other inorganic raw materials, invertebrate and vertebrate fauna, and flora? Are any critical resources (water, salt, lithics, foodstuffs) missing or periodically in short supply?

An analysis of the local environment and its organic and inorganic components will define the effective environment for site occupants. Missing critical resources can be noted and their possible means of procurement suggested.

2. Are non-local resources (obsidian, steatite, shells) present at any of the sites? If so, in what form are the exotic materials found? As finished or partially finished artifacts?

Chipping waste? Unmodified? What are the sources of the non-local materials? How are exotic materials obtained? Through trade? Direct procurement?

Analyses of raw materials of artifacts and ecofacts will allow researchers to determine local versus non-local resources. Sourcing studies of obsidian are easily done and can reveal the geological origin of those lithics; other lithic raw materials (fused shale, various cherts) are not yet amenable to such sourcing. The morphology of the exchanged item (modified or unmodified) may indicate whether it was imported in manufactured form or as raw material. Distance (physical and social) from the source can be analyzed and may provide insights into the method of procurement.

3. Is there a change over time in the amounts and types of exotic materials present? Are non-local materials preferred over local materials for particular artifacts?

Analyses of site components, or occupation levels, may reveal a change in exotic frequencies over time. Analyses of individual artifact types and their raw materials will permit researchers to isolate examples of preferred materials where local alternatives are available. Motivation for such exchange may be rooted in a need for the perpetuation of social networking even where non-essential items are imported.

4. Are the site functions in any way reflective of a trade corridor location? How do the amounts of non-local materials present at the project sites compare to others in the area?

A comparative study of the project sites and other excavated sites in the area or in the region may allow researchers to detect patterns (group to group; trail utilization) in the exchange relations among the local populations in prehistory.

FIELD METHODS

At each of the prehistoric study sites, ARMC crew members carried out field walkover surveys of each site to locate surface artifacts. The crew walked transects, both north-south and east-west, measuring 1-5 meters in width to provide maximum coverage. Artifacts were marked with pin flags. Flag locations were then shot in with a surveyor's transit. The artifacts were then labeled, bagged, and returned to the ARMC lab. Although locations sometimes contained multiple items, each item was later given a unique catalog number.

Based upon the number and kinds of items found on various areas of the sites, locations for test units were chosen. Where no items or few items were found, test units were placed evenly around the sites to provide comprehensive coverage. Only one shovel test pit (STP) was excavated on the project sites. At CA-ORA-1551 the test units had been located in a sticky clay that was very difficult to excavate, and they were still yielding cultural material at 30 cm. An STP, measuring 75-cm in diameter, was excavated to probe deeper into the cultural deposit.

The test units (1x1-meter) and STP (75-cm diameter) were excavated manually. All matrix (soil) was screened through 1/8-inch mesh hardware cloth. Depths of test units varied between 10 and 80 cm below unit datum, averaging 31.25 cm. The STP was excavated to 80 cm. See Table 1 below for excavation summaries. Appendix A-1 contains site maps with locations of surface collection points, test units, and an STP.

Table 1. Excavation Summary for The Ranch Plan Sites, Phase II-B.

SITE No.	TEST UNIT/STP	MAX. DEPTH (cm)	VOLUME (m^3)
ORA-1111	TU 1	0.50	0.30
	TU 2	0.40	0.35
		Total vol.	0.65
ORA-1125	TU 1	0.50	0.50
	TU 1	0.50	0.45
	TU 3	0.50	0.45
	TU 4	0.50	0.45
	TU 5	0.10	0.10
	TU 6	0.10	0.10
		Total vol.	2.15
ORA-1135	TU 1	0.20	0.20
	TU 2	0.10	0.10
		Total vol.	0.30
ORA-1449	TU 1	0.80	0.75
	TU 2	0.80	0.75
	TU 3	0.10	0.10
	TU 4	0.50	0.45
	TU 5	0.20	0.15
	TU 6	0.10	0.10
		Total vol.	2.30
ORA-1551	TU 1	0.30	0.30
	TU 2	0.30	0.30
	STP 1	0.80	0.80
		Total vol.	0.95
ORA-1553	TU 1	0.20	0.20
	TU 2	0.20	0.20
		Total vol.	0.40
ORA-1557	TU 1	0.20	0.15
	TU 2	0.30	0.30
		Total vol.	0.45
ORA-1573	TU 1	0.20	0.15
	TU 2	0.20	0.15
		Total vol.	0.30

PART III. ARTIFACT ANALYSES

Artifacts from the project sites were all lithic (rock) types. ARMC lithic analysts first sorted the artifacts on the basis of morphology, or form, resulting in their being cataloged as flakes, cores, plan-convex tools, perforators, manos, metates, etc. (Formal Analysis). Then the tools were analyzed as to use wear, or inferred function (Functional Analysis). Their use-wear edge angles were measured using a simple template, and the use-wear patterns were observed using a 10x magnifier. The flakes were checked for presence/absence of cortex (rind) to determine reduction stage (primary, secondary, or tertiary), measured using a template (= or <.25, 0.5, 1.0, 2.0, 3.0, 4.0, or 5.0"). The flakes were then analyzed for biface reduction attributes. The results of the two analyses are presented below by individual site. See Appendix A-2 for database files (catalog).

FORMAL ANALYSIS

<u>CA-ORA-1111</u>

Site CA-ORA-1111 produced 19 artifacts. Eighteen were chipped stone, and one was ground stone. Four artifact types were identified. See Table 2 for the artifact inventory for the site.

Table 2. CA-ORA-1111 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Hammerstones	2
Flakes	15
Flake Tools	1
GROUND STONE	
Ground stone fragments	1
	Total: 19

One of the two hammerstones was a surface find (#4) made of argillite; the second (#19) made of andesite was recovered from TU 2, 30-40 cm level. They are angular rather than cobble form.

The waste flakes (n=15) represent the discards (debitage) in the production of chipped stone tools. Flakes also result from the reshaping of tools or re-sharpening (rejuvenation) of tools that have become dull with use. The 15 flakes were made of quartz (n=8), metavolcanic (n=5) and andesite (n=2). Raw materials were all of local origin. Thirteen of the flakes were recovered from test units; only two came from the surface. Seven (#'s 1, 2, 8, 9, 10, 12, 13, 17) are biface reduction flakes; the remaining eight are core reduction flakes, following Carrico et al. (1991). One may infer biface production and/or rejuvenation (resharpening of the working edge) on site, although no bifaces were recovered.

The flakes from CA-ORA-1111 represent three stages of core reduction. Initial reduction of a core produces primary flakes that have full cortex (surface rind) on their bulbs of percussion. In the intermediate stage, the core is further reduced such that only some of the cortex is still present, resulting in secondary flakes. In the final stage, all cortex has been removed, resulting in tertiary flakes. Fourteen were tertiary flakes and one was a secondary flake; no primary flakes were recovered. The two flake types represent final and intermediate stages of core reduction at the site. The absence of primary flakes indicates that cores, or nuclei of raw material, were partially reduced before being brought to the site.

On the size template seven flakes measured 1”, and eight measured 2” in length. Smaller flakes (1” or less) likely represent rejuvenation flakes or thinning flakes. Larger ones (>1”) may reflect deliberate flake production or preliminary shaping of a core to produce a core tool, biface, or other tool type.

One argillite flake tool (#5) was recovered from the surface. The tool is highly patinated.

A single ground stone fragment (#3) was recovered from the surface. The granite specimen was fire affected, indicating that it had perhaps formed part of a hearth at one time or had been affected by brush fires, common to the project area.

In addition to the artifacts, three small bone fragments, weathered and unidentifiable, were recovered from the 0-10 cm level of TU 1. They may or may not be cultural and are not helpful in defining site activities.

CA-ORA-1125

This site had been tested earlier (Demcak and Del Chario 1989) for a water pipeline project and yielded two ground stone items and 14 flaked items. A subsequent test (Toren et al. 1997) for the Foothill Transportation Corridor produced 104 flakes, 3 manos, amd a core/hammerstone from a test unit that reached 60 cm in depth. During the current testing, a similar assemblage was recovered. Fifty-eight items were flaked stone, and nine were ground stone. Eight individual types of artifact were identified among the 67 total items. See Table 3 for inventory.

Table 3. CA-ORA-1125 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Hammerstones	2
Flakes	48
Cores	2
Flake Tools	1
Plano-convex Tools	4
Bifaces	1
GROUND STONE	

Manos	6
Metates	2
Ground Stone Fragment	1
	Total: 67

Forty-eight flakes were recovered from CA-ORA-1125. Forty were recovered from units, and eight came from the surface. The flakes were fashioned from metavolcanic and argillite (n=11 each), quartzite (n=9), and felsite (n=7) primarily. Other raw materials included andesite (n=5), basalt (n=4), and chalcedony (n=1). All are available in the local area. Six were primary flakes, one was secondary, and the majority (n=41) were tertiary flakes. Based on these data, final core reduction was the focus of flaking activities at the site.

The flakes were varied in size: 0.5" (n=2); 1" (n=21); 2" (n=24); and 3" (n=1). Smaller flakes (1" or less) likely represent rejuvenation flakes or thinning flakes. Larger ones (>1") may reflect deliberate flake production or preliminary shaping of a core to produce a core tool, biface, or other tool type. The majority (n=30) of the flakes can be classified as biface reduction flakes, implying biface production or repair on the site; three bifaces were recovered from the site.

Two cores were found on the site. Specimen #6, made of milky quartz, was recovered from the surface. The second core (#51) was made of felsite and came from the 0-10 cm level of TU 3.

An argillite flake tool (#46) was recovered from TU 2, 10-20 cm level. It was patinated.

Four plano-convex tools were recovered. Specimen #12, made of basalt, was a surface find. Three specimens were found in test units: #34 (felsite), TU 1, 30-40 cm; #57 (quartzite), TU 2, 30-40 cm; and #55 (felsite), a patinated specimen, TU 3, 30-40 cm.

The plano-convex tools from CA-ORA-1125 were classified as either high-back or low-back scraper planes (scrapers), based upon their height to basal length ratio, following Kowta's analysis of the Sayles Complex (1969:20-23). Three of the plano-convex tools were classified as high-back scraper planes (type 1; #'s 12, 34, 55), reflecting a ratio of = or >0.5 ratio of height versus maximum basal dimension. Lengths varied between 4.3 and 6.7 cm. Heights were nearly identical, either 3.2 or 3.3 cm (Table 4). Their profiles, while not carefully flaked, tended toward a dome shape. Specimen #'s 12 and 55 were heeled, i.e., exhibited a heel (handhold) of unworked margin opposite the working edge of the tool (type 1H). The fourth specimen (#57) was a low-back type with a maximum basal dimension of 6.7 cm and a height of 2.5 cm, resulting in a relatively flat profile. This tool was also heeled (type 2H).

The plano-convex tools are subtyped based upon basal outline, dorsal configuration, etc. Descriptions of the plano-convex codes are as follows:

Type 1 – High back (height/base = or >0.5) - Figure 4))
- 1H – Heeled (handhold) – Figure 8
- 1K – Keeled (center ridge) - Figure 5)
- 1M – Multiple basal platforms
- 1T – Thumbnail scraper

Type2 – Low back (height/base <0.5)
- 2C – Half cobble w/cortex surrounding worked margin
- 2H – Heeled
- 2I – Irregular platform w/flat dorsal surface – Figure 9
- 2L – Lunate platform outline
- 2M – Multiple platforms
- 2O – Ovoid platform outline
- 2P – Pyramid shaped platform
- 2R – Rectangular shaped platform – Figure 7
- 2T – Teshoa (primary) flake) – Figure 6

Other characteristics of scraper planes, "crude percussion-flaked implements"(Kowta 1969:20), are the following: 1) edge angle approaching 90°; 2) retained cortex on dorsal surface; 3) asymmetrical angularity on dorsal surface, and 4) made predominately of local felsite material (Kowta 1969:20-21). The scraper planes from CA-ORA-1125 generally conform to this pattern; however, edge angles are generally smaller than Kowta's "approaching 90°". The choice of felsite, basalt or metavolcanic for ¾ of the specimens reveals the same strong preference for raw materials of volcanic origin that is found at the Sayles Complex.

Table 4. Plano-convex Tools from CA-ORA-1125.

Catno	Mat.	Type	Basal Dimension (cm)	Height	Height/ Base Ratio	Edge Angle	Wear	Cortex Dorsal Surface
34	Felsite	1	5.8	3.3	0.6	2	N/S/C	No
55	Felsite	1H	7.1	3.9	0.5	3	N/S	Yes
12	Basalt	1H	4.3	3.2	0.7	3	N/S	Yes
57	Quartzite	2H	6.7	2.5	0.4	2	N/S	Yes

One artifact (#56) was classified as a biface. This pebble tool made of andesite shows flake removal around 75% of its margin. Its surface is patinated. One face has been minimally modified. It was recovered from the 30-40 cm level of TU 3.

Six granite manos or fragments were recovered from the site. Three were whole and oval in form, and three were fragmentary and of uncertain form. One (#7) had a unifacial ground surface and one (#16) a trifacial wear/grinding pattern. The remaining manos were all bifacial. Six came from the surface and one came from a test unit, TU 5, 0-10 cm level, essentially a surface find as well. See Table 5 for the attributes of the manos.

Table 5. Manos from CA-ORA-1125.

CatNo.	Mat.	Proven.	Whole/ fragment	Angle	Pecked	Shape
4	Grt.	Surf. #19	F	2		
5	Grt.	Surf. #19	F	2		
7	Grt.	Surf. #10	F	1		
15	Grt.	Surf. #18	W	2	Yes	Oval
16	Grt.	Surf. #17	W	3	Yes	Oval
67	Grt.	TU 5,0-10	W	2	Yes	Oval

Two metate fragments were also recovered from the surface of the site. Both were too incomplete to type (basin or slab). Specimen #1 was made of granite; specimen #17 was made of diorite.

One ground stone fragment (#2) made of granite raw material was recovered from the surface. The item showed fire affects and thus may have been part of a hearth at one time or may have been subjected to intense burning in brush fires, common to the area.

<u>CA-ORA-1135</u>

This small site produced a correspondingly small collection of artifacts in the test phase. Only seven items were recovered: one core, three plano-convex tools, one crude biface, one mano fragment, and one metate fragment. All were surface finds. Both test units were sterile.

The core (#3) was red argillite, what is locally called “red bead material”. Red beads are a diagnostic artifact for the Milling Stone Horizon in Orange County (Demcak 1999). The raw material is found in the Sespe Formation and apparently occurs naturally at this location.

Two plano-convex tools were recovered. Both are classified as high-back scraper planes. Item #6 has multiple working platforms (type 1M), and item #2 is heeled (1H). They are crude, percussion-flaked tools. See Table 6.

Table 6. Plano-convex Tools from CA-ORA-1135.

Catno	Mat.	Type	Dimensions (cm)		Height to Basal Ratio	Edge Angle	Wear	Cortex on Dorsal Surf.
			Basal	Height				
2	Felsite	1H	8.7	4.7	0.5	3	N/S	Yes
6	Meta-volc.	1M	5.2	5.4	1.0	4	N/S	No

One crude metavolcanic percussion-flaked bifacial tool (#4) was recovered from the site. It is asymmetrical and thick in cross section.

One granite mano fragment (#5) was also found at the site. It has one ground surface. A fragmentary granite metate, approximately 60% complete, was also recovered from the site. It is a deep basin type and appears to have deliberately destroyed, or "killed". A roughly circular hole was punched out of its base, effectively rendering it useless. This ritual "killing" accompanies the death of its user/owner, according to local Shoshonean customs.

CA-ORA-1449

A large collection of chipped stone and ground stone items was recovered from the testing of CA-ORA-1449. A total of 165 artifacts included 160 chipped stone and five ground stone artifacts. Ten formal types of artifacts were analyzed. See Table 7 for an artifact summary.

Table 7. CA-ORA-1449 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Hammerstones	3
Flakes	121
Cores	7
Utilized Flakes	2
Flake Tools	5
Plano-convex Tools	12
Bifaces	7
Amorphous Core Tools	3
GROUND STONE	
Manos	3
Metates	2
	Total: 165

Hammerstones were not numerous at CA-ORA-1449. Only three were recovered, and all were angular, suitable for pecking ground stone and for making and repairing stone tools. Two were surface finds (#'s 45, 49), and one (#124) was found in the 50-60 cm level of TU1 in Feature 1. See Features discussion.

Flakes were the most numerous artifacts and accounted for 121/165 (73.3%) of the total. Andesite, metavolcanic, felsite, and quartzite were the most frequent raw materials, providing 27, 23, 23, and 21 flakes respectively, followed by argillite (n=16), basalt (n=7), chalcedony and quartz (2 each). Forty-five were surface finds; 76 came from test units. Six were primary flakes, 20 secondary flakes, and 95 tertiary flakes.

These data suggest that the terminal stages of core reduction were the focus of flaking on the site. A flake size analysis revealed the following frequencies: 1) 0.25' (n=1); 2) 0.50" (n=22); 3) 1" (n=42), 4) 2" (n=49); 5) 3" (n=6); 6) 5" (n=1). The greater number of smaller flakes (<1") implies that intermediate and final stages of core reduction were predominant at the site, although the full range of reduction is indicated. Roughly half (n=61) appeared to be biface reduction flakes, implying biface production and/or modification at the site.

Seven cores were recovered from the surface. Equal numbers of quartzite, metavolcanic, and argillite (n=2) examples were present. One was made of basalt. Specimen #78 was a multi-platform core.

Two utilized flakes were recovered; both were surface finds. Specimen #31 is made of andesite. Specimen #51 is made of felsite. Both were patinated.

Five flake tools were recovered. Three came from the surface and two from test units. All have been used and retouched. Item #'s 26 and #71 (andesite), as well as #18 (quartzite), were surface finds. Specimen #'s 130 and #151 (felsite) came from the 0-10 cm and 60-70 cm levels respectively of TU 2. Specimens #71 and #130 were patinated.

Twelve plano-convex tools were recovered from CA-ORA-1449. Following Kowta's (1969) typology, six are classified as high-back and six as low-back scraper planes (or scrapers). See Table 8. Seven were from the surface and five from test units. Argillite (n=5), quartzite (n=4), felsite (n=2), and metavolcanic (n=1) were the raw materials of these crude percussion-flaked tools. Eight had cortex present on the dorsal surface, indicative of their being rather minimally shaped for use. Seven had patinated surfaces.

Table 8. Plano-convex Tools from CA-ORA-1449.

Catno	Mat.	Type	Dimensions (cm)		Height to Basal Ratio	Edge Angle	Wear	Cortex on Dorsal surf.
			Basal	Height				
60	MVC	2R	7.0	2.5	0.4	2	N/S	Yes
57	ARG	2H	6.7	3.0	0.4	5	N/S	Yes
79	ARG	2	5.9	2.5	0.4	5	N/S	No
70	ARG	1H	5.2	2.4	0.5	4		Yes
58	QTZ	1R	5.4	2.9	0.5	5	N/S	No
67	QTZ	1R	6.0	2.8	0.5	3	N/S	No
35	ARG	1	5.4	2.6	0.5	4	N/S	Yes
131	FEL	2	6.6	2.6	0.4	4	N/S	No
112	FEL	2H	7.2	2.8	0.4	4	N/S	Yes
163	FEL	2H	14.3	5.8	0.4	3	N/S	Yes
113	ARG	1H	5.8	2.9	0.5	5		Yes
159	QTZ	2H	8.1	2.4	0.3	3	N/S/C	Yes

Three amorphous core tools were recovered from the site. Such tools are too non-poorly defined to be assigned to specific tool types. Item #'s 15 (metavolcanic), #20 (quartzite), and #46 (andesite) are minimally utilized cores.

Crude bifacial tools numbered seven at the site. Five were made of felsite, one of quartzite, and one of argillite. Six were surface finds; one (#163) came from the 0-10 cm level of TU 5. Two were utilized and retouched (#'s 56, 64). Four were patinated (#'s 23, 56, 63, 64).

Three manos or fragments were found at the site. Two were on the surface and one in a test unit. One whole mano (#16) and one fragmentary mano (#39) were surface finds. The other whole mano (#155) was recovered from the 70-80 cm level of TU 2 and was part of Feature 1. Sandstone, granite porphyry, and granite were the raw materials of the manos. Both whole manos were bifacial, had been pecked, and were oval in outline. The fragmentary mano was unifacial and had not been pecked. See Table 9 for a summary of the manos from CA-ORA-1449.

Table 9. Manos from CA-ORA-1449.

CATNO	MATERIAL	WHOLE/FRAG.	FACES	PECKED	SHAPE
16	Sandstone	Whole	2	Yes	Oval
39	Granite porphyry	Fragment	1		Oval
155	Granite	Whole	2	Yes	Oval

Two metate fragments were also recovered from the site. Schist item #12, a surface find, was a slab type. Item #125 was a shallow basin type made of granite porphyry. It was recovered from TU 1, 50-60 cm level, as part of Feature 1.

CA-ORA-1551

The overwhelming majority of artifacts from CA-ORA-1551 were chipped stone (213/227, or 93.8%). Only 14 ground stone items were found at the site (see Table 10). The most numerous chipped stone items were flakes (N=116), accounting for roughly half of the total artifacts recovered at the site. In terms of formal tool types, i.e., excluding flakes and cores, plano-convex tools predominated, accounting for 36 of a total of 97 tools.

Only one hammerstone (#146) was found at the site. This result is quite surprising considering the large numbers of flakes, cores, flake and core tools, and grinding tools that were recovered. Hammerstones were used to produce flakes from cobbles, to shape core and flake tools, and to re-roughen grinding surfaces by native stoneworkers. Made of andesite porphyry, the hammerstone fragment was angular in outline.

Table 10. CA-ORA-1551 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Hammerstones	1
Flakes	117
Cores	15
Utilized Flakes	11
Flake Tools	22
Plano-convex Tools	36
Perforators	2
Projectile Points	3
Bifaces	4
Stemmed Tools	2
GROUND STONE	
Manos	12
Metates	1
Ground Stone Fragment	1
	Total: 227

The 117 flakes were made of nine different raw materials. Volcanics and metavolcanics accounted for 81 flakes (69.8%). Quartzite, argillite, chert, and chalcedony supplied the remaining flakes in order of frequency. See Table 11 for a summary of the flake raw materials. Seventy-eight of the flakes were recovered from the surface, 30 from test units and eight from an STP. Nine were primary flakes, 28 secondary, and 80 tertiary. These data imply that intermediate and final core reduction were the focus of flaking at the site. In terms of size, 57 flakes measured 1" or less in length, 42 flakes measured >1" and >2", and 16 measured >2", the largest being 5" (n=3). This skewing toward the smaller flakes (<1") suggests that indeed final core reduction or tool shaping/sharpening (rejuvenation) was a major task of the stone tool crafters at CA-ORA-1551. The very small flakes (<0.5") attest to fine tool adjustments, more specifically retouching, being carried out there. Sixty-seven of the flakes appear to be biface reduction flakes; thus biface production and/or rejuvenation can be posited as site activities.

Only 17 cores were recovered. Raw materials included the following: felsite (n=7), basalt (n=3), argillite, andesite, and quartzite(2 each), and metavolcanic (n=1). Core #148 was a multi-platform type.

The 11 utilized flakes from CA-ORA-1551 were made of various materials, including argillite (n=5), felsite (n=3), andesite, quartzite, and metavolcanic (1 each). Six had been retouched after use. Only one (#197) came from subsurface, namely the 20-30 cm level of TU 1. One (#2) was made of red argillite, used for red bead making in Orange County. Nine were patinated (#'s 2, 40, 53, 67, 101, 127, 167, 175, 197).

Table 11. Flake Raw Materials from CA-ORA-1551.

RAW MATERIAL	FREQUENCY	PERCENTAGE
Felsite	31	26.7
Metavolcanic	20	17.2
Quartzite	16	13.8
Andesite	16	13.8
Argillite	15	12.1
Basalt	12	10.3
Chalcedony	3	2.6
Chert	2	1.7
Felsite porphyry	2	1.7

Twenty-two flake tools were found at the site. All were used and retouched. Half (n=11) were made of felsite, followed by argillite (n=5), andesite (n=2), quartzite, chert, basalt porphyry, and metavolcanic (1 each). Twenty-one were surface finds; one (#190) came from TU 1, 0-10 cm level. Fourteen were patinated (#'s 10, 24, 27, 37, 76, 83, 95, 104, 118, 130, 158, 168, 169, 170). See Figure 2 for an unusual side scraper (#27) and Figure 3 for three side and end scrapers (#'s 168, 130, 10).

Figure 2. Side Scraper (#27) from CA-ORA-1551.

Figure 3. Side and End Scrapers (#'s 168, 130, 10) from CA-ORA-1551.

Thirty-five plano-convex tools were recovered from CA-ORA-1551. All were surface finds. Ten are classified as high-back (type 1) and 22 as low-back scrapers (type 2). The tools ranged in length from 4.1 to 16.1 cm; heights varied from 1.6 to 6.9 cm. Twenty-seven had retained cortex on the dorsal surface, indicative of the fairly minimal shaping of the tool (Table 12). See Figures 4-9 for examples of these tools.

Table 12. Plano-convex Tools from CA-ORA-1551.

			Dimensions (cm)		Height to	Edge		Cortex on
CatNo	Mat.	Type	Basal	Height	Basal Ratio	Angle	Wear	Dorsal
59	MVC	1M	4.1	2.5	0.6	3	N/S/C	No
71	FEL	1	6.6	3.4	0.5	3	N/S	Yes
117	MVC	2H	9.0	2.1	0.2	1	N/S	Yes
70	ARG	2H	5.8	2.6	0.4	4	N/S	Yes
60	AND	2H	8.7	1.9	0.2	3	N/S	No
113	BAS	2H	9.4	2.5	0.3	2	N/S	Yes
77	FEL	2H	9.1	3.0	0.3	3	N/S	Yes
128	ARG	1P	6.4	3.1	0.5	4	N/S	No
136	AND	2I	16.1	3.4	0.2	4	N/S	Yes
109	FEL	2I	10.1	3.4	0.3	4	N/S	No
91	FEL	2I	12.0	3.8	0.3	3	N/S	Yes
112	ARG	2R	9.1	2.4	0.3	4	N/S	No
39	ARG	1	8.5	6.0	0.7	3	N/S	Yes
72	AND	2L	8.4	3.1	0.4	2	N/S	No
79	MVC	2R	11.3	3.0	0.3	1	N/S	Yes
85	QTZ	2I	10.2	4.0	0.4	3	N/S	Yes
131	BAS	2I	5.5	2.4	0.4	3	N/S	No

135	QTZ	1	7.8	4.8	0.6	4	N/S	Yes
149	APR	2H	11.7	3.9	0.3	3	N/S	Yes
150	FEL	2H	8.8	3.1	0.4	4	N/S	Yes
152	AND	1	13.9	6.5	0.5	3	N/S	No
173	CHT	1T	3.4	2.3	0.7	4	N/S	No
181	FEL	2R	8.3	2.3	0.3	4	N/S	Yes
176	MVC	2O	8.9	1.9	0.2	4	N/S	Yes
172	APR	1	11.0	6.9	0.6	4	N/S	Yes
184	AND	1H	6.5	3.4	0.5	4	N/S	Yes
13	MVC	2P	7.3	3.1	0.4	3	N/S	Yes
28	AND	2L	9.2	3.5	0.4	3	N/S	No
19	AND	2P	6.3	2.1	0.3	4	NS	Yes
26	AND	2R	6.8	2.7	0.4	4	N/S	No
31	APR	2I	11.3	4.1	0.4	4	N/S	Yes
30	FEL	1K	6.4	4.4	0.7	4	N/S	Yes
36	APR	2T	15.3	3.1	0.2	3	N/S	Yes
47	APR	2T	11.0	2.5	0.2	2	N/S	Yes
137	AND	2O	8.2	2.9	0.4	3	N/S	Yes
43	FEL	2R	9.2	2.3	0.3	4	N/S	No

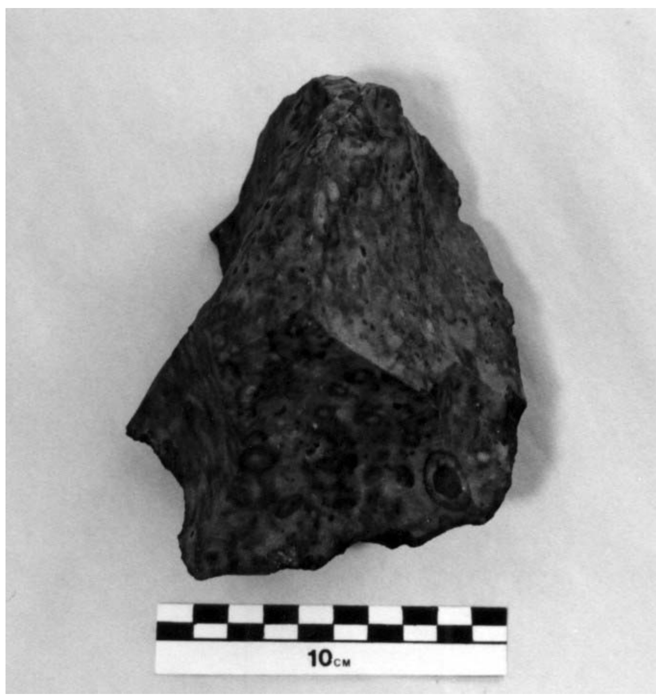


Figure 4. Plano-Convex Tool (#152) from CA-ORA-1551, Type 1.

Figure 5. Plano-Convex Tool (#30) from CA-ORA-1551, Type 1K.

Figure 6. Plano-Convex Tool (#36) from CA-ORA-1551, Type 2T.

Figure 7. Plano-Convex Tools (#43, 137) from CA-ORA-1551, Type 2R.

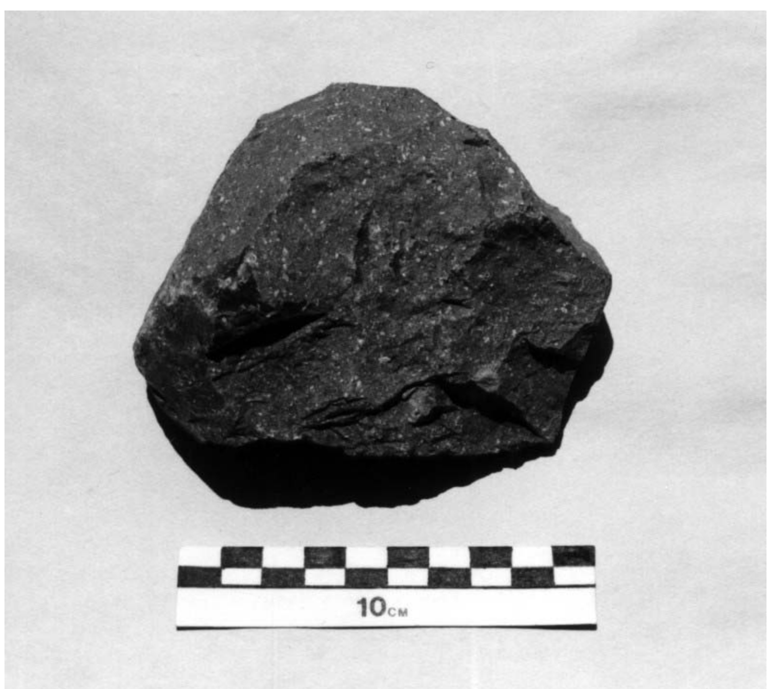


Figure 8. Plano-Convex Tool (#47) from CA-ORA-1551, Type 1H.

Figure 9. Plano-convex Tools from CA-ORA-1551, Type 2I.

Two perforators were recovered from the site. One (#145) is a large primary felsite flake that has been modified to produce a bit, its tip now fractured off. The lunate-shaped margin to either side of the bit may also have a tool function. Perforator #122 is a basalt core fragment that has been flaked to produce a bit, its tip now broken off.

Three artifacts at CA-ORA-1551 have been classified as projectile points. All are foliate dart point fragments that are lenticular in cross-section. Two are preforms; they lack only thinning. The other is a mid-section. All three are patinated. The artifacts are described in Table 13 below. See also Figure 10.

Table 13. Dart Points from CA-ORA-1551.

CATNO	PROVEN.	MAT.	LEN. (cm)	WID. (cm)	THK. (cm)	WT. (g)	REMARKS
92	Surf. #54	Felsite	(5.1)	4.1	1.4	29.9	Preform
132	Surf. #77	Metavolcanic	(5.2)	4.2	1.7	41.5	Preform
185	TU1,0-10	Andesite	(4.9)	3.1	1.0	23.1	Mid-section

Figure 10. Dart Point Fragments (#'s 92, 185, 132) from CA-ORA-1551.

Four bifaces have been identified at the site. All were surface finds. They are unfinished forms. The bifaces are lenticular and thick in cross-section, incompletely reduced in bulk. They represent a stage in manufacturing that lies somewhere between a tool blank and a finished form. They may have been intended as projectile points. All but one were patinated. See Table 14 below for a summary of the bifaces. See also Figure 11.

Table 14. Bifaces from CA-ORA-1551.

CATNO	MATERIAL	LENGTH (cm)	WIDTH (cm)	THICKNESS (cm)	WEIGHT (g)	REMARKS
116	Quartzite	6.3	3.2	1.5	29.0	Foliate knife?
*62	Felsite porphyry	7.1	4.0	2.5	56.4	Bipointed;rough crescent shape
*25	Meta-volcanic	7.1	4.0	2.9	92.5	Ovoid; thinned at base
*49	Meta-volcanic	7.0	4.7	2.8	112.1	Cortex on one face

* Patinated

Figure 11. Biface (#25) from CA-ORA-1551.

Two unifacial stemmed tools have been identified among the chipped stone artifacts. Artifact #84 is made of argillite, is trianguloid in cross-section, unifacial, keeled, and has been stemmed for hafting. The piece is broken at its tip (Figure 12).

Figure 12. Stemmed Tool (#84) from CA-ORA-1551.

The second stemmed tool, also made of argillite (#82; Figure 13), is an ovate form, with extensive flaking of one face, especially at its base where flakes have been removed so that the tool could be hafted. These are unusual tools; only one other site (CA-ORA-1553) produced a stemmed tool during the test phase, and it is considerably larger. Both tools were patinated.

Figure 13. Stemmed Tool (#82) from CA-ORA-1551.

Twelve manos or mano fragments were recovered from the site. All were oval in outline. Eight were whole, and four were mano fragments. Ten were surface finds; two came from units: #186, TU1, 0-10cm, and #205, TU2, 0-10 cm. Ten were made of granite or granite porphyry, and one each of diorite and quartzite. Seven had been pecked to re-roughen the grinding surface or for shaping. See Table 15 for a summary of the manos and fragments.

Table 15. Manos from CA-ORA-1551.

CATNO	MATER.	WHOLE/FRAG.	FACES	PECKED	SECONDARY USE
38	Granite	W	2		
46	Granite	F	2		Poss. pestle
48	Granite	W	2	Yes	

50	Quartzite	W	2	Yes	
54	Granite	W	2	Yes	
103	Granite porphyry	W	2	Yes	
124	Granite	W	2		
133	Granite porphyry	F	1		
162	Granite porphyry	W	2	Yes	
171	Granite porphyry	F	2	Yes	
186	Granite	W	2		Abrader
205	Granite	F	2	Yes	

One metate fragment (#74) was recovered from CA-ORA-1551. Made of granite porphyry, it was a shallow basin type.

One diorite ground stone fragment (#14) was found on the surface at the location of Datum B. It was too incomplete to type.

CA-ORA-1553

Chipped stone artifacts were more numerous (n=48) than ground stone (n=18) at CA-ORA-1553. See summary in Table 16 below.

Two hammerstones, both angular, were surface finds. One (#26) was made of andesite and the second (#32) of felsite porphyry.

Only 11 flakes were recovered from the site. Nine were found on the surface; two came from units: TU 1, 0-10 cm; and TU 2, 0-10 cm. Metavolcanic, quartzite, felsite, and andesite provided two flakes each. Basalt, crystalline quartz, and argillite produced one flake each of the total. Four were secondary flakes, and seven were tertiary; none was primary. Intermediate to final stages of core reduction are implied by these data. Biface reduction flakes numbered four, indicative that some biface production and/or rejuvenation were taking place at the site. Only very small flake of crystalline quartz (0.5”) was present; ten measured 2” or greater. One flake measured 2”, seven measured 3”, one measured 4”, and one measured 5”. These size data indicate that all stages of tool production were taking place, with greater emphasis on the intermediate to final stages.

The crystalline quartz fragment (#55) came from the 0-10 cm level of TU 2. Quartz crystals had magico-religious significance for Shoshonean peoples in prehistory. See Interpretation.

Five cores were recovered. Three were felsite; one was andesite, and one argillite. All were surface finds. Two (#s 10, 33) were multi-platform types.

Eight flake tools were found at the site. All were surface finds. Five were andesite, two argillite, and one metavolcanic. One (#48) had been used and retouched. Five have been classified as side scrapers (#'s 1, 14, 21, 27, 32), two as end scrapers (#'s 25, 48), and one as a side and end scraper (#36). Five were patinated (#'s 1, 14, 21, 25, 36).

Table 16. CA-ORA-1553 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Hammerstones	2
Flakes	*11
Cores	5
Flake Tools	8
Plano-convex Tools	15
Perforators	3
Core Tool	1
Stemmed Tools	1
GROUND STONE	
Manos	6
Metates	11
Ground Stone Fragment	1
	Total: 64

* Included quartz crystal fragment

Fifteen plano-convex tools were recovered from the site. Ten were made of volcanic or metavolcanic raw material: 5 felsite, 3 argillite, 2 andesite, 2 basalt, 2 metavolcanic, and 1 quartzite. Only one (#54, TU 2, 10-20 cm) came from subsurface. Ten may be classified as high-back scraper planes (type 1), while five are low-back types (type 2). Twelve were patinated (#'s 2, 4, 5, 6, 18, 26, 29, 30, 38, 49, 53, 54). See Table 17 for a summary of the plano-convex tools from CA-ORA-1553.

Table 17. Plano-convex Tools from CA-ORA-1553.

Catno	Mat.	Type	Dimensions (cm)		Height to	Edge	Wear	Cortex on
			Basal	Height	Basal Ratio	Angle		Dorsal surface
4	ARG	1	11.4	6.9	0.6	2	N/S/C	Yes
18	FEL	1H	4.1	3.2	0.8	2	N/S	Yes
26	FEL	1	5.2	2.8	0.5	2	N/S	Yes
30	FEL	1I	5.7	5.0	0.9	2	N/S	Yes
49	BAS	1H	5.4	3.1	0.6	2	N/S	Yes

53	MVC	1H	8.3	5.1	0.6	2	N/S	Yes
2	ARG	1I	12.6	5.3	0.5	3	N/S	Yes
5	FEL	2H	6.2	2.7	0.4	2	N/S	Yes
6	ARG	1H	9.1	4.4	0.5	2	N/S/C	Yes
15	MVC	1H	7.2	3.3	0.5	2	N/S	Yes
23	BAS	2H	11.2	4.0	0.4	2	N/S	Yes
29	FEL	2I	9.4	4.2	0.4	2	N/S	Yes
38	FEL	2H	10.2	3.1	0.3	2	N	Yes
47	QTZ	1H	10.6	5.2	0.5	2	N/S/C	Yes
54	AND	2R	7.7	2.4	0.3	2	N	Yes

Three perforators were surface finds at the site. All have their bits fractured off. Two (#'s 11, 31) are made of felsite. A third (#24) is made of metavolcanic material. Perforator #11 has a narrow bit, perhaps intended for initial piercing of leather for sewing, while the others have wider bits, suggesting their use as reamers to widen a hole already begun.

One basalt porphyry stemmed tool (#7: Figure 14) was recovered from this site. It is large (12.5 x 6.8 x 3.7 cm) and weighs 337.5 grams. It is trapezoidal in cross-section and has been minimally modified on the dorsal face; one large flake and one small flake have been removed. The tool is lightly patinated. The ventral face has been thinned and shaped into an ovate form with a narrower stem/base. This tool gives the impression of a dagger, an adze, or possibly a digging implement. It has no use wear.

Figure 14. Large Stemmed Tool (#7) from CA-ORA-1553.

One core tool (#8) was recovered from the surface. It is a large utilized core fragment made of basalt porphyry. The tool is patinated.

Six manos or mano fragments were recovered from the surface of the site. Three were granite, two diorite, and one andesite porphyry. Four were whole and two fragmentary. One (#52) was end battered, suggesting secondary use as a hammerstone. Two had been pecked to re-roughen a ground surface or to shape the tool. Most were oval in outline. See Table 18 for a summary of the manos from CA-ORA-1553.

Table 18. Manos from CA-ORA-1553.

CATNO	FRAGMENT/ WHOLE	MATERIAL	FACES	PECKED	BATTERED	SHAPE
3	W	Diorite	2	Yes		Oval
22	F	Diorite	1			Oval
45	W	Granite	1			Trianguloidl
46	W	Andesite Porphyry	2	Yes		Oval
50	F	Granite	2			Oval
52	W	Granite	2		Yes	Oval

Thirteen metate fragments representing six individual metates were recovered from the surface of the site. Five (#'s 57–61) were pieces of one slab metate (Figure 15). Four pieces (#'s 39 a,b and 40 c,d) were part of the same incomplete metate. Three complete slab metates (#s 62-64) were also recovered. A final metate fragment (#37) represents yet another metate. See Table 19 for a summary of the metates.

Table 19. Metates from CA-ORA-1553.

CATNO	MATERIAL	FIRED	FRAGMENT/ WHOLE	TYPE	REMARKS
37	Granite		F		Isolate
39	Granite porphyry		F		2 pcs.(a,b); see #40
40	Granite porphyry		F		2 pcs. (c,d); see #39
57-61	Granite porphyry		F	Slab	One metate (5 pcs.)
62	Diorite	Yes	W	Slab	Thick oval
63	Diorite	Yes	W	Slab	Thick oval
64	Granite porphyry		W	Slab	Thick oval

Figure 15. Slab Metate (#'s 57-61) from CA-ORA-1553.

CA-ORA-1557

Chipped stone items were the most numerous at CA-ORA-1557, accounting for 139 of 140 total artifacts. One ground stone item was collected. Table 20 summarizes the recovered artifacts.

Table 20. CA-ORA-1557 Artifact Inventory.

ARTIFACT TYPE	FREQUENCY
CHIPPED STONE	
Flakes	109
Cores	3
Utilized Flakes	7
Flake Tools	7
Plano-convex Tools	10
Projectile Points	1
GROUND STONE	
Metates	1
	Total: 140

Flakes were the most frequent of the chipped stone items (n=109). Metavolcanic, felsite, and argillite provided the most flakes (30, 29, and 25 respectively). Quartzite (n=13), basalt N=6), andesite (n=5), and chert (n=1) rounded out the flake collection. Eighty-eight came from the surface and 21 flakes from test units. Eighty-five were tertiary flakes, 18 secondary flakes, and 6 primary flakes, indicating that intermediate and final core reduction were the primary flaking activities at the site. Fifty-four flakes were apparently biface reduction flakes; from these data, it may be inferred that biface production and/or reduction was occurring at the site. The only biface recovered from the site was a dart point fragment.

Four cores were collected from the surface of the site. Two were made of basalt, and one each of basalt and metavolcanic raw material.

Seven utilized flakes were recovered from CA-ORA-1557. Four came from the surface. Three came from the 0-10 cm level of TU 2. Three were made of argillite, two of andesite, and two of felsite. All had been used and retouched. Six have been classified as side scrapers (#'s 40, 53, 114, 118, 119, 123), and one as an end scraper (#65). All were patinated.

Seven flake tools came from the surface of the site. Three were made of felsite, two of argillite, and one each of basalt and metavolcanic raw material. Six had been used and retouched; one (#43) had no retouch. Three have been classified as end scrapers (#'s 11, 80, 116), two as side scrapers (#'s 38, 43), and two as side and end scrapers (#'s 33, 39). All were patinated.

Ten plano-convex tools were collected at the site. Eight were surface finds; two came from the 0-10 level of TU 1. Four metavolcanic, three felsite, two andesite, and one argillite plano-convex tool were found. Eight of the tools were typed as high-back (type 1) scraper planes; height to basal ratios varied from 0.5 to 0.7. Two were classified as low-back scrapers (type 2). Eight exhibited cortex on their dorsal surface, an indication of their being incompletely shaped. All of the plano-convex tools were patinated. See Table 21 for a summary of these tools.

Table 21. Plano-convex Tools from CA-ORA-1557.

SiteNo	Catno	Type	Dimensions (cm) Basal	Height	Height to Basal Ratio	Edge Angle	Wear	Cortex on Dorsal
1557	1	1H	7.8	4.4	0.6	4	N/S/C	No
1557	5	1H	7.3	3.9	0.5	4	N/S	Yes
1557	6	1H	7.1	4.3	0.6	3	N/S	Yes
1557	9	1	9.1	4.7	0.5	3	N/S	Yes
1557	19	1K	5.2	3.4	0.7	4		No
1557	108	1H	9.5	6.3	0.7	4	N/S	Yes
1557	115	1H	6.7	3.7	0.6	3	N/S	Yes
1557	4	2C	9.7	4.0	0.4	4	N/S	Yes
1557	92	2M	7.9	3.1	0.4	4	N/S	Yes
1557	117	1	7.2	3.5	0.5	3	N/S	Yes

An andesite perforator (#25) was recovered from the surface of the site. It has been shaped to form an elongate bit, its tip now blunted (Figure 16). The fairly wide bit suggests use as a reamer, or hole enlarger.

Figure 16. Perforator (#25) from CA-ORA-1557.

One projectile point fragment (#25; Figure 17) was recovered from the surface at CA-ORA-1557. It is the tip and part of the mid-section of a dart point made of metavolcanic raw material. The fragment measures (5.8) x (3.2) x 1.0 cm. The leaf-shaped specimen weighs 20.5 grams. It has been percussion flaked around both margins. The flaking on both faces is fairly random in pattern. The piece is lenticular in cross-section. Its general sloping toward a missing base suggests that it is more than half complete. The finished point may have measured as much as 8 or 9 cm total. One can only imagine its base.

In shape, size, and weight this dart point fragment resembles the illustrated large points from the C.W. Harris site (Moratto 1984:98).

Figure 17. Dart Point Fragment from CA-ORA-1557.

The single ground stone item recovered from the site was a whole granite metate (#1). It is an oval slab type. It was a surface find.

CA-ORA-1573

Only eight items were collected from this small lithic scatter. Six were flakes, two felsite and four andesite. Five were secondary flakes and one a tertiary flake, indicative of intermediate and final core reduction at the site. Flake sizes included four 3" and 2 4" flakes. Such large flakes generally reflect initial flake removal in tool preparation. Three were biface reduction flakes, pointing to some biface production and/or rejuvenation at the site.

Only two formal tools were found at the site. One was a felsite flake tool (#6) that had been retouched. A single plano-convex tool (#4) also was recovered. The item had a basal length of 9.1 cm and a height o 5.3 cm, resulting in a height to length ratio of 0.6. Thus is it classified as a type 1 (high-back) scraper plane. Cortex on its dorsal surface suggests that the tool was minimally shaped. Both tools were patinated.

PART IV. FUNCTIONAL ANALYSIS

In addition to formal traits, ARMC's lithic analysis included functional analysis of the tool types found at the sites. They are discussed below by individual site.

<u>CA-ORA-1111</u>

Both hammerstones exhibited crushing wear, indicative of work on hard surfaces (see Table 22 below).

Table 22. Edge Modification and Inferred Function.

MODIFICATION	INFERRED FUNCTION	SOURCE
Nibbling (N)	Transverse action from scraping, shaving, and planing	Tringham et al. (1974)
Crushing (C)	Work on hard materials, eg. antler or bone	Tringham et al. (1974)
Stepflaking (S)	Work on hard materials, eg. antler, bone, and wood; Bone working and wood working	Tringham et al. (1974) Ahler (1971)

One flake tool (#5) had been used and then retouched (re-sharpened) for additional use. This tool had an edge angle of 45° and both nibbling and stepflaking as wear patterns. Fine cutting, butchering, and whittling may be inferred for this edge angle. Nibbling may indicate scraping, planing, or generally work on softer materials. Stepflaking implies work on harder, more resistant materials such as bone or wood. See Table 23 for the inferred function of use wear angles.

Table 23. Edge Angle and Inferred Function.

ANGLE (code)	INFERRED FUNCTION	SOURCE
30° (1)	Fine cutting Butchering	Wilmsen (1974) Hester et al. (1976)
45° (2)	Whittling	Semenov (1964)
60° (3)	Skinning, hide scraping, and heavy cutting	Wilmsen (1974)
75° (4)	Wood working, bone working	Wilmsen (1974)
90° (5)	Plant pulping, fiber preparation	Kowta (1969)

CA-ORA-1125

One argillite flake tool (#46) was recovered from the 10-20 cm level of TU 2. The tool had been used and retouched. Its edge angle measured 60°, and it exhibited nibbling and stepflaking. These data suggest use in processing meat, hides, and perhaps bone and wood.

The edge angles of the plano-convex tools measured between 45 and 60° (Table 4). All four specimens revealed nibbling and stepflaking; one (#34) also revealed crushing wear. These massive core tools were reportedly used by Native populations to scrape hides, process Agave sp. pads into food and fiber, and perhaps for woodworking (Hester and Heizer 1972; Castetter et al. 1938). The edge angles and wear patterns suggest that the plano-convex tools from CA-ORA-1125 could have served all of the above functions.

The biface (#56) revealed crushing wear, indicative of work on an unyielding surface, such as bone or wood. It may have been used as a hammerstone.

One mano (#67) showed battering wear on its end. This may be evidence that the tool also served as a hammerstone.

CA-ORA-1135

The two plano-convex tools recovered from the site exhibited nibbling and stepflaking, indicative of scraping, shaving, planing, and use on hard materials like wood and bone. The 60° angle is associated with skinning, hide scraping, and heavy cutting; the 75° angle suggests use in wood or bone working. The two sets of data reinforce one another.

A simple bifacial tool (#4) from the site showed nibbling, stepflaking, and crushing wear as well as retouch. It was apparently an all-purpose tool, used for fine and heavy cutting, scraping, and for processing bone and wood, and then reused after resharpening.

CA-ORA-1449

The hammerstones from the site showed crushing wear around their angular margins. This wear is consistent with use on hard materials, such as bone, wood, and stone.

Flake tools (Table 24) from this site show use wear in the form of nibbling and stepflaking, indicating their use in processing game animals (meat, sinew, bone, antlers) and wood. Edge angles range from 30 to 75°, allowing for fine cutting, whittling, heavy cutting, and processing of bone and wood. Both sets of data suggest that the tools saw multiple use.

Table 24. Flake Tools from CA-ORA-1449.

Catno	Mat.	Type	Edge Angle	Wear
31	AND	Utiliz. Flake	2	N/S
130	FEL	Flake Tool	4	N/S
71	AND	Flake Tool	3	N/S
26	AND	Flake Tool	2	N/S
51	FEL	Utiliz. Flake	1	N/S
18	QTZ	Flake Tool	2	N/S

Plano-convex tools from CA-ORA-1449 showed nibbling and stepflaking; these patterns result from use in scraping, planning, shaving, and heavy cutting. The angles ranged from 30 - 90°. These angles would permit light and heavy cutting, wood and bone working.

<u>CA-ORA-1551</u>

One hammerstone, displaying crushing wear, was recovered from the site. This pattern appears when a stone tool makes repeated contact with hard materials, such as bone, antler, wood, or stone.

The utilized flakes and flake tools from CA-ORA-1551 (Table 25) display edge angles from 30 to 75°, allowing for their use in a wide range of activities, including fine cutting (meat, sinew), heavy cutting, and processing of wood and bone. The use wear included nibbling, indicative of scraping, planing, or shaving. Some tools exhibited stepflaking, implying use on hard materials. Some tools revealed crushing wear, suggestive of wood and bone working.

Table 25. Utilized Flakes and Flake Tools from CA-ORA-1551.

Catno	Mat.	Type	Edge Angle	Wear 1/ Wear 2
53	ARG	Util. Flake	2	N
175	FEL	Util. Flake	2	N
197	QTZ	Util. Flake	3	N
67	ARG	Util. Flake	2	N
127	ARG	Util. Flake	2	N
138	MVC	Util. Flake	1	N
101	ARG	Util. Flake	2	N
167	AND	Util. Flake	4	N/S/C
107	FEL	Util. Flake	2	N
40	FEL	Util. Flake	3	N
2	ARG	Util. Flake	1	N

168	ARG	Flake Tool	3	N
169	ARG	Flake Tool	2	N
158	AND	Flake Tool	3	N
170	FEL	Flake Tool	1	N
180	FEL	Flake Tool	4	N
27	FEL	Flake Tool	2	N
118	ARG	Flake Tool	3	N/C
24	FEL	Flake Tool	3	N
95	FEL	Flake Tool	2	N
104	FEL	Flake Tool	1	N
83	ARG	Flake Tool	2	N
110	MVC	Flake Tool	1	N
56	ARG	Flake Tool	2	N
37	AND	Flake Tool	2	N
108	BPR	Flake Tool	4	N/S
141	CHT	Flake Tool	2	N
10	FEL	Flake Tool	3	N
76	FEL	Flake Tool	2	N
130	FEL	Flake Tool	2	N/S
68	ARG	Flake Tool	3	N/C
9	MVC	Flake Tool	3	N

CA-ORA-1553

Two hammerstones showed crushing wear, consistent with use on hard materials, such as bone, wood, or stone.

The flake tools (Table 26) showed nibbling wear, consistent with shaving, planning, and scraping. Edge angles ranged from 30 - 60°; these angles lend themselves to fine and heavy cutting, i.e., processing of meat, sinew, hides, wood, or bone.

Table 26. Flake Tools from CA-ORA-1553.

Catno	Mat.	Type	Edge Angle	Wear
1		Flake Tool	2	N
14		Flake Tool	2	N
21		Flake Tool	2	N
25		Flake Tool	1	N
27		Flake Tool	3	N
32		Flake Tool	1	N
36		Flake Tool	3	N
48		Flake Tool	2	N

The plano-convex tools reveal nibbling, stepflaking, and crushing wear, consistent with use in scraping, shaving, and planing, and in the processing of wood or bone. The edge angles range from 45 - 60°, allowing for wood working, bone working, skinning, hide scraping, and heavy cutting.

CA-ORA-1557

Utilized flakes and flake tools (Table 27) displayed nibbling and stepflaking use wear, consistent with meat, hide, bone, and wood processing. The edge angles of these tools ranged from 30 - 75°, suggesting their use in fine cutting, butchering, whittling, skinning, hide scraping, and heavy cutting.

Table 27. Utilized Flakes and Flake Tools from CA-ORA-1557.

Catno	Mat.	Type	Edge Angle	Wear
40	FEL	Util. Flake	1	N/S
119	ARG	Util. Flake	3	N/S
53	FEL	Util. Flake	1	N/S
123	ARG	Util. Flake	1	N
118	AND	Util. Flake	4	N/S
65	AND	Util. Flake	2	N/S
114	AND	Util. Flake	1	N/S
11	BAS	Flake Tool	1	N/S
43	FEL	Flake Tool	3	N/S
106	FEL	Flake Tool	1	N/S
33	ARG	Flake Tool	2	N/S
39	FEL	Flake Tool	1	N/S
38	MVC	Flake Tool	2	N/S
80	ARG	Flake Tool	2	N/S

The plano-convex tools from the site displayed nibbling and stepflaking, indicative of their use in fine and heavy cutting, wood and bone working. Their angles ranged from 45 - 60°, suggesting their use in skinning, hide scraping, heavy cutting, wood and bone working.

CA-ORA-1573

The flake tool and the plano-convex tool displayed nibbling and stepflaking, suggesting r their use in fine and heavy cutting, wood and bone working. The edge angle of the flake tool was 60°, implying heavy cutting, and 75° for the plano-convex tool, implying wood or bone working.

PART V. FEATURES

Only one of the tested sites produced features. Two features were recorded at CA-ORA-1449. All feature items were mapped in plan view and their depths were measured upon removal.

Feature 1 in TU 2 (Figure18) occurred in the 70-80 cm level. Two cobbles and one mano fragment were mapped in situ. The cobbles were unaltered. The mano, a grinding hand stone, informs on hard seed processing at the site. This feature represents a gender-specific (women’s) activity location on site.

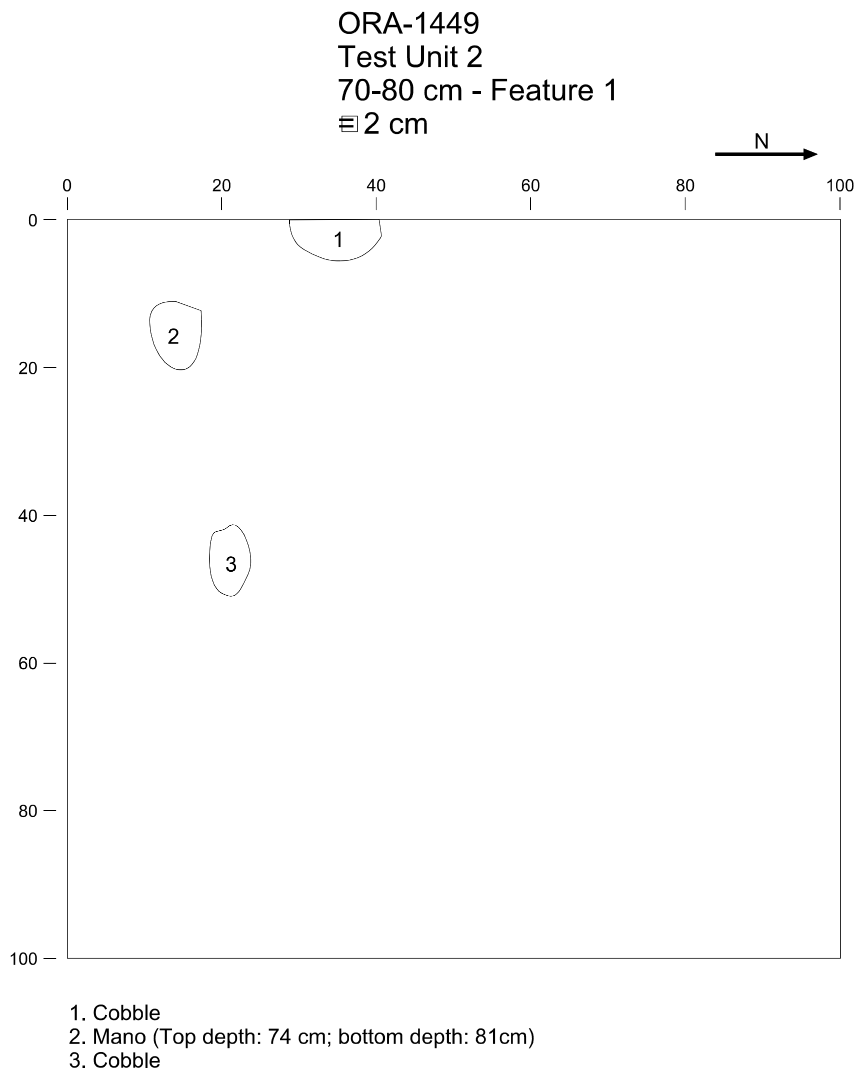
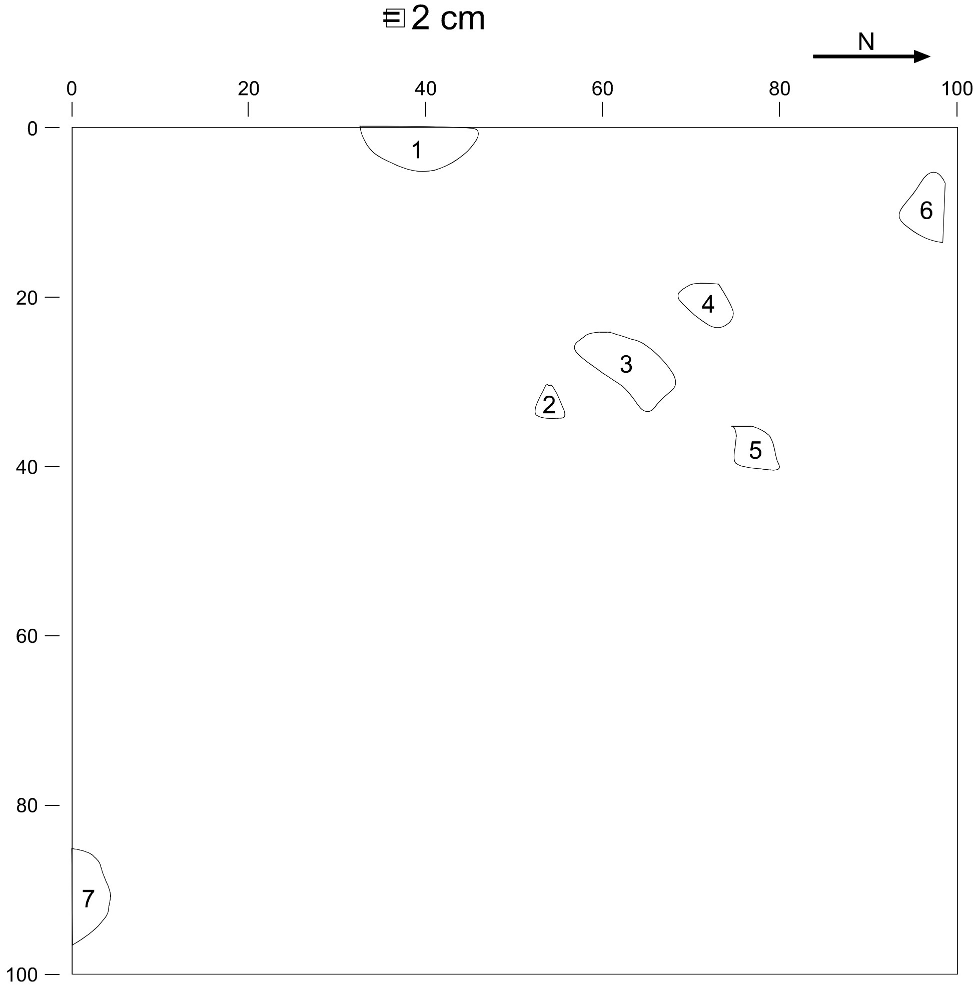


Figure 18. CA-ORA-1449, Test Unit 2, Feature 1, 70-80 cm.

Feature 1 in TU 1 (Figure 19) was uncovered in the 50-60 cm level of the unit. Mapped items included five cobbles, a metate fragment (#125), and a hammerstone (#124). The cobbles were not modified or fire affected; their function is unknown. The two artifacts suggest that hard seeds were being ground at this location (metate) and that the grinding surface needed re-roughening (hammerstone). This would have been a gender-specific work area. Women traditionally carried out grinding tasks.

ORA-1449
Test Unit 1
50-60 cm - Feature 1
2 cm



1. Cobble (Top depth:60 cm; bottom depth: 68 cm)
2. Cobble (Top depth: 61 cm; bottom depth: 65 cm)
3. Metate Fragment (Top depth: 51 cm; bottom depth: 60 cm)
4. Hammerstone (Top depth: 62 cm; bottom depth: 66 cm)
5. Cobble (Top depth: 61 cm; bottom depth: 73 cm)
6. Cobble (Top depth: 60 cm; bottom depth: 66cm)
7. Cobble (Top depth: 59 cm; bottom depth: 63 cm)

Figure 19. CA-ORA-1449, Test Unit 1, Feature 1, 50-60 cm.

PART VI. STRATIGRAPHY

Most of the units in this test phase were too shallow to record stratigraphic levels or none could be detected on the unit walls. Two sites had readable stratigraphy.

<u>CA-ORA-1125</u>

Test Unit 4 (Figure 20) reached 60 cm in depth before becoming culturally sterile. The upper stratum was a compact sandy, silty alluvial deposit, yellow brown on the Munsell chart (10YR 3/4). The middle stratum was a dark reddish brown (5YR 2.5/2) sandy, sillty alluvium that was less compact than the upper stratum, containing more sand. The lower stratum was a brown or pale brown in color (10YR 5.5/3). It was a sterile clay.

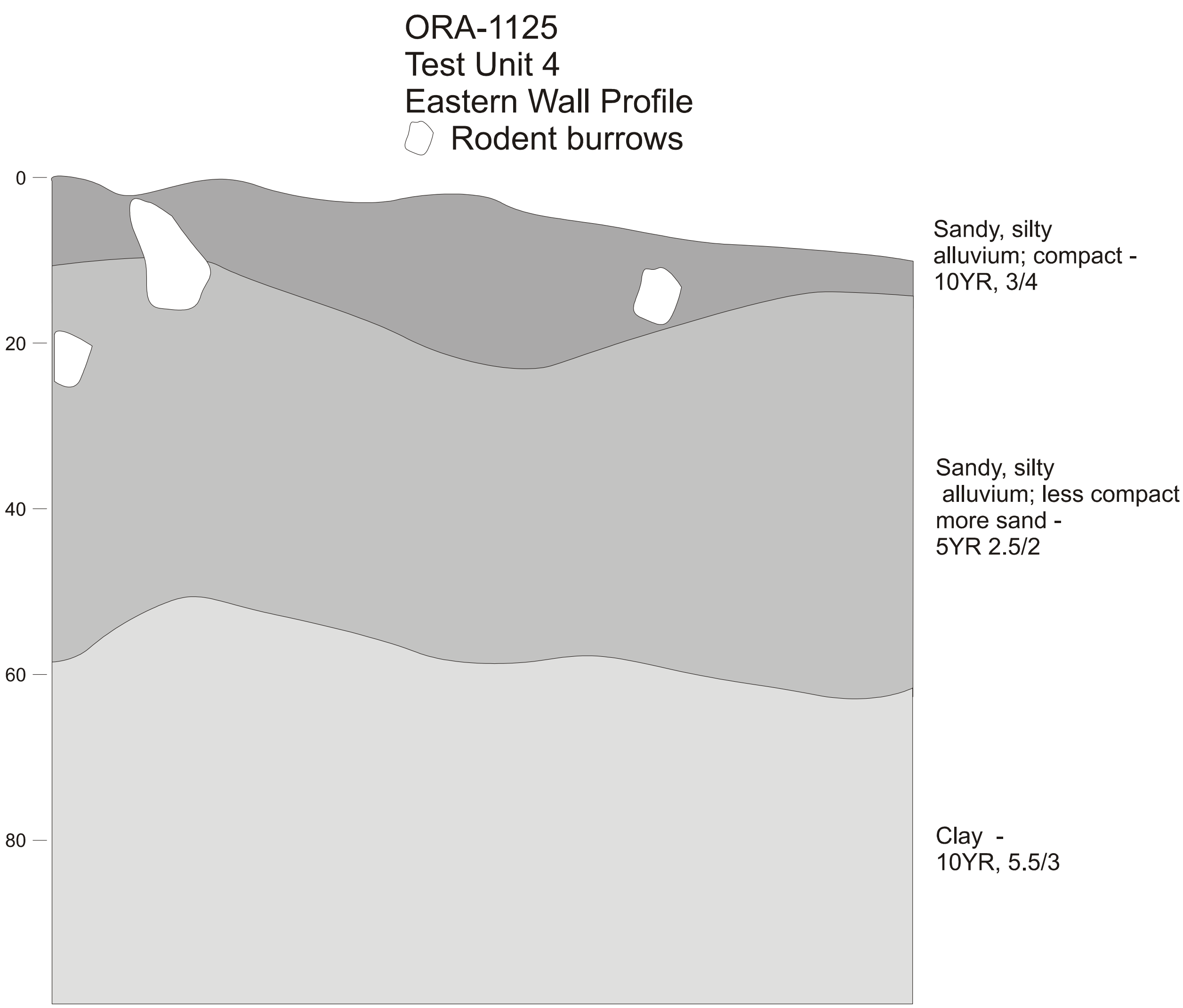


Figure 20. CA-ORA-1125, Test Unit 4, Eastern Wall Profile (0-60 cm).

CA-ORA-1449

Test Unit 1 (Figure 21) reached 80 cm in depth. The upper stratum was a brown/dark brown (10YR 4.5/3) sandy alluvium with silt and gravel. The soil was dry and compact. The lower stratum was a pale brown (10YR 6/3) clay with gravel and occasional cobbles that was culturally sterile.

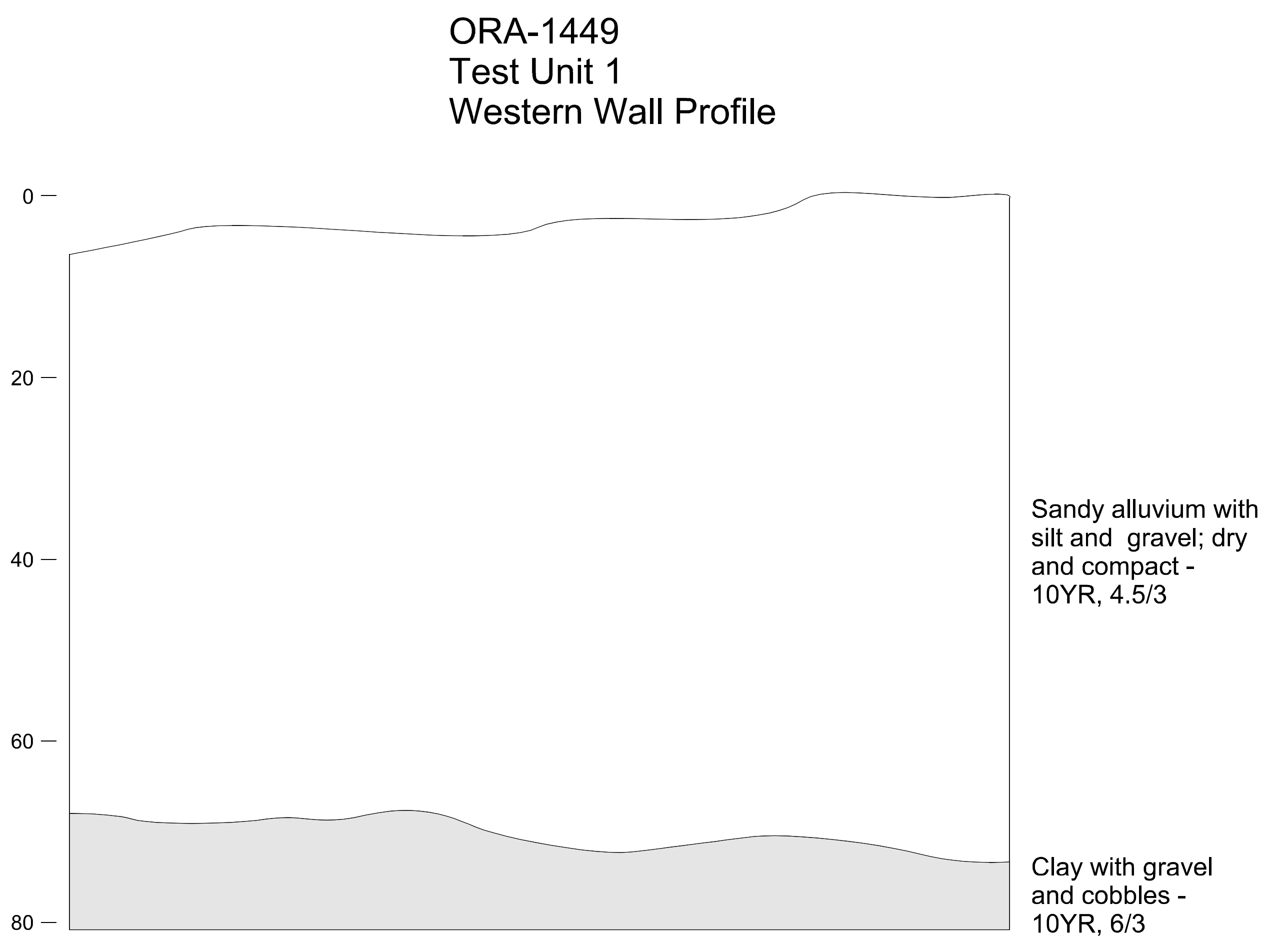


Figure 21. CA-ORA-1449, Test Unit 1, Western Wall Profile (0-80 cm.)

Test Unit 4 (Figure 22) at CA-ORA-1449 reached 60 cm below datum. An overburden of soil scraped from the adjacent dirt road was draped over the unit and was removed without screening the material. The upper stratum, a dark yellowish brown (10YR 4/3) root zone, was the first cultural layer. The middle stratum was a very dark grayish brown (10YR 3/2) clay. The lower stratum was a white (10YR 8/2) deposit (diatomaceous earth) that was culturally sterile.

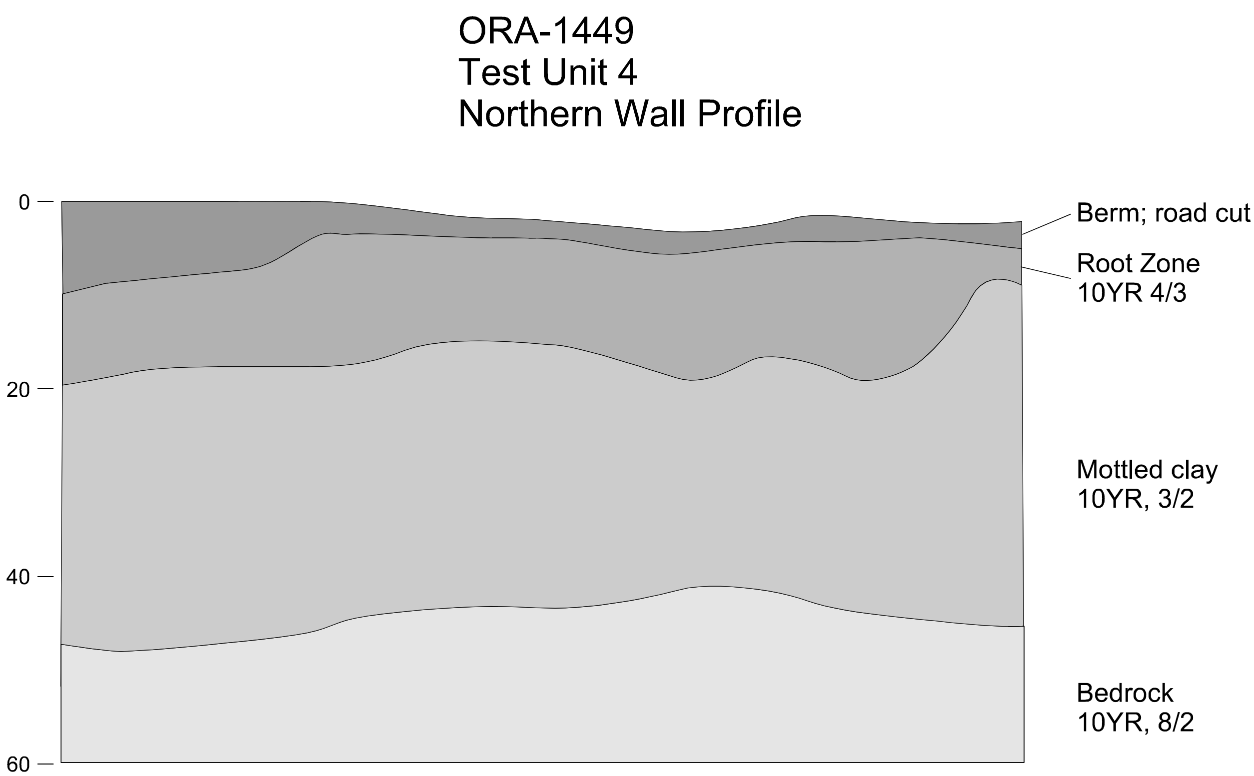


Figure 22. CA-ORA-1449, Test Unit 4, Northern Wall Profile (0-60 cm).

PART VII. SPATIAL ANALYSIS

The study of intra-site patterning can inform on activity areas within sites, or internal living and working arrangements. For this project three sites have sufficient internal differentiation to warrant spatial analysis: CA-ORA-1125, CA-ORA-1449, and CA-ORA-1551.

CA-ORA-1125

This scatter of lithic artifacts had two distinct patterns. The southernmost part of the site featured exclusively chipped stone items, while the north/northwestern portion of the site featured ground stone items. This pattern would appear to be gender based. Women were the ground stone users among local Shoshonean populations in prehistory. The chipped stone items represent largely male tasks (tool making and repairing).

CA-ORA-1449

This site consists of a long, discontinuous scatter of artifacts. On the northwestern edge of the site (Locus A), facing toward Cristianitos Creek, the site displays considerable depth (max. 80 cm) and complexity. Two features with ground stone artifacts were uncovered; these would appear to be gender-specific work areas where women ground hard seeds. Two crude bifaces, two core tools, a slab metate fragment, and flakes are found in the central site area (Locus B), reflecting a mixed working area where grinding, plant and animal processing would have taken place and involving both men and women. The southernmost scatter (Locus C) has an emphasis on scraper planes, accounting for 7/10 of the total, and crude bifaces, accounting for 7/9 of the total recovered. Such tools are useful for a variety of tasks, including the processing of plants into fiber, butchering game, and cutting of bone or wood. These tasks would be largely undertaken by males (butchering, bone or wood cutting, for example), so this locus is male-activity dominated. See Figure 23 for a site map delineating the three loci.

CA-ORA-1551

At this site ground stone items (10/12 total) were concentrated in the southeastern site area. Other tools were also concentrated there, including scraper planes, flake tools, bifaces, and projectile points. Apparently male and female tasks were performed side by side; we lack sufficient data on the time(s) of occupation to determine whether the gender-based tasks did or did not overlap in space and time.

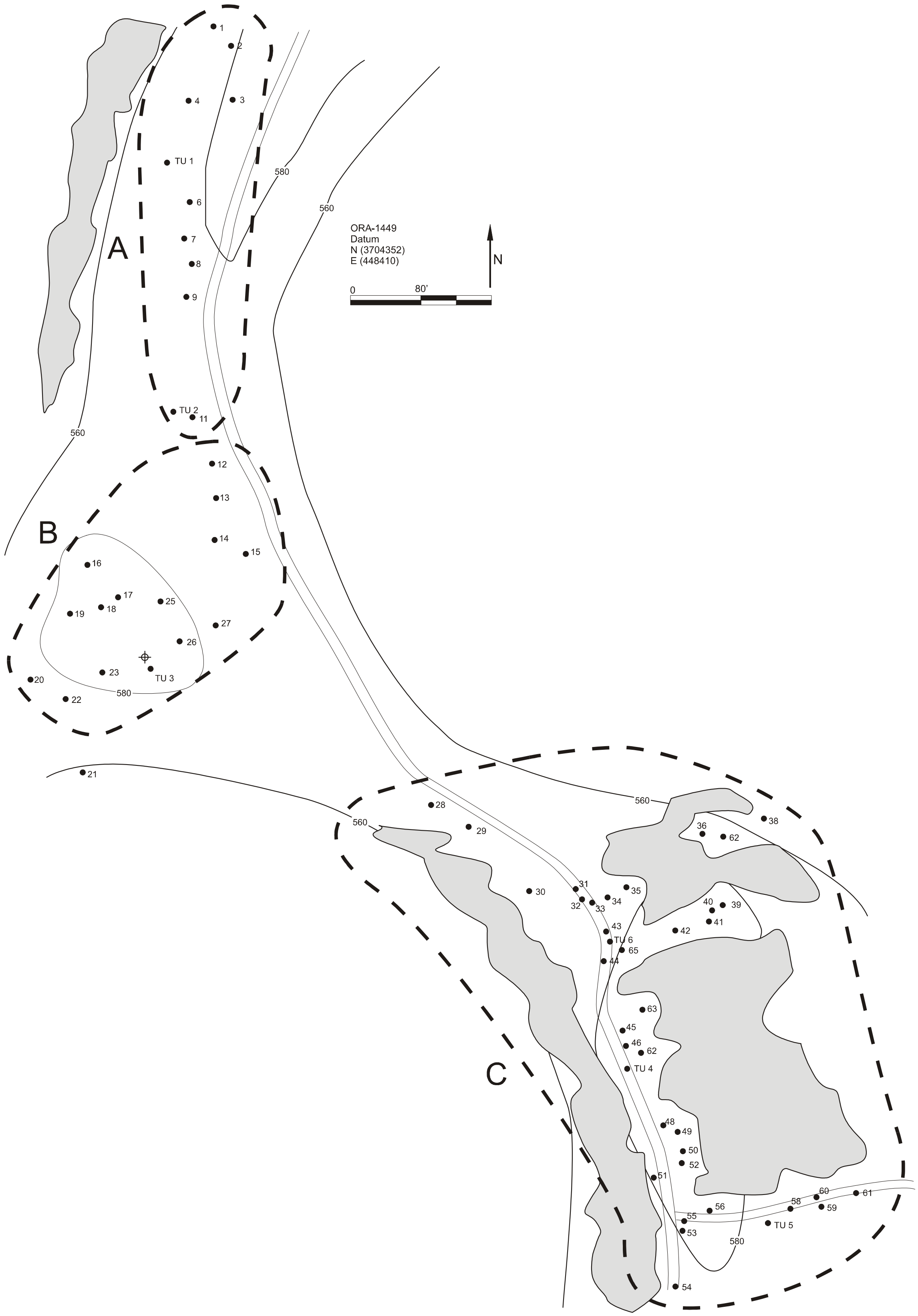


Figure 23. Activity Areas (Loci A-C) at CA-ORA-1449.

PART VIII. INTERPRETATION

CHRONOLOGY

None of the The Ranch Plan, Phase II-B sites contained organic materials (charcoal, shellfish, bone, etc.) that could be used for radiometric dating. Thus no absolute dates are yet available for these sites.

Relative dating is provided by certain diagnostic artifacts and assemblages. CA-ORA-1125 had earlier produced a discoidal (Jones 1991) that is diagnostic of the Milling Stone Horizon. Four sites exhibited flaked tool assemblages, including projectile points, scraper planes, bifaces, and various scrapers, that represent a very early occupation in Orange County. A majority of the flake tools were made of felsite or other volcanics (andesite, basalt, metavolcanic). Felsite is the raw material generally used for San Dieguito artifacts (Koerper et al. 1991:56). The tools from the project sites reveal high percentages (55 - 75% or greater) of patination on their exposed surfaces. “Patination, that is chemical alteration, on certain stone tools, is a result of surface exposure of San Dieguito artifacts, and the degree of alteration can be used as a rough dating technique.” according to Malcolm Rogers and paraphrased in Carrico et al. (1991:3-3). See Rogers (1939:19-20) for further discussion on patination. The flaked tool assemblage, material types and their patination are diagnostic of the San Dieguito Tradition (Rogers 1939; Moratto 1984; Koerper et al. 1991; Reddy et al. 2000), a manifestation of the Western Pluvial Lakes Tradition (Moratto 1984:90-103).

CA-ORA-1449

This extensive scatter of primarily flaked stone artifacts (160/165, or 96.9%) is related to the San Dieguito Tradition. The flaked tools include two utilized flakes, neither patinated, but both volcanics. Among the flake tools 2/5 (40%) were patinated, and 4/5 (90%) were volcanics). Out of 12 scraper planes, 7/12 (58.3%) were patinated, while 3/12 (25%) were volcanics). Three core tools were all patinated, and two (67%) were volcanics. A total of 4/7 (57.1%) of the bifaces were patinated, while 5 (71.4%) were made of volcanics. The total number of patinated flake tools was16/29 (55.2%), and volcanic raw materials accounted for 16/29, or 55.2% of the total flaked tools at the site.

This site also had considerable depth, a maximum of 80 cm below datum. The depth itself is evidence of an occupation of long duration or of intensive use over a shorter term. Milling equipment (mano and metate) was recovered from among the deepest levels of TU 1 and TU 2, 70-80 and 50-60 cm respectively. It would appear that grinding of hard seeds was a part of this assemblage from the earliest occupation of the site. Milling stones were originally thought to be absent from San Dieguito Tradition sites (Rogers 1939; Warren 1967) although they are known to occur (True 1958:262; Ezell 1983; Gallegos 1991).

CA-ORA-1551

At CA-ORA-1551 a flaked stone assemblage included three dart point fragments. Two were performs (#92, patinated felsite; #132, metavolcanic), and one (#185) was a finished specimen made of andesite. Unfortunately it is a mid-section only. The piece is complete enough to determine that it is foliate in form, relatively thin (0.1 cm), and lenticular in cross-section. It has been percussion flaked in a somewhat random pattern. It surface is highly patinated. It resembles the foliate points or knives from the San Dieguito component at the C.W. Harris site (SDI-149) and foliate points “A” and “D” from Lake Mojave (Moratto 1984:94, 98). All appear to be percussion flaked only and have random flaking patterns. The Western Pluvial Lakes Tradition, to which these two assemblages are assigned, is estimated to have begun circa 10,000 years B.P. (before present) and to have terminated circa 7,000 years B.P. (Moratto 1984:103).

The assemblage at CA-ORA-1551 was dominated by flaked stone items, such as scraper planes, scrapers, etc., accounting for 93.8% of the total. Flaked tools included 36 scraper planes 32 (88.8%) of which were patinated. Felsite or other volcanics accounted for 19/36 (52.7%) of the scraper planes. Both stemmed tools were patinated. A total of 20/33 (60.6%) of the utilized flakes and flake tools were patinated; 18/33 (54.5%) were made of felsite or other volcanics. A total of 3/4 (75%) of the bifaces were patinated and made of felsite or other volcanics. Overall 59/78 (75.6%) of the flaked tools at CA-ORA-1551 were patinated, and 43/78 (55.1%) were made of volcanics.. Not only is the patination evidence of considerable age, but the material types and the assemblage itself are diagnostic of the San Dieguito Tradition (Moratto 1984; Rogers 1939; Reddy et al. 2000; Carrico et al. 1991; Gallegos 1991).

CA-ORA-1553

The assemblage at CA-ORA-1553 was dominated by flaked stone items, such as scraper planes, scrapers, etc., accounting for 46/64 (71.8%) of the total. Flaked tools included 36 scraper planes, 32 (88.8%) of which were patinated. Felsite or other volcanics accounted for 19/36 (52.7%) of the scraper planes. Both stemmed tools were patinated. A total of 20/33 (60.6%) of the utilized flakes and flake tools were patinated; 18/33 (54.5%) were made of felsite or other volcanics. A total of 3/4 (75%) of the bifaces were patinated and made of felsite or other volcanics. Overall 59/78 (75.6%) of the flaked tools at CA-ORA-1551 were patinated, and 43/78 (55.1%) were made of volcanics.. Not only is the patination evidence of considerable age, but the material types and the assemblage itself are diagnostic of the San Dieguito Tradition (Moratto 1984; Rogers 1939; Reddy et al. 2000; Carrico et al. 1991; Gallegos 1991).

CA-ORA-1557

A single metavolcanic dart point tip (#82) was recovered from the surface of the site. It is a tip and partial mid-section of a foliate point, and like the CA-ORA-1551 dart point fragment, it is percussion flaked, relatively thin (0.1 cm), and lenticular in cross-section. This point fragment also resembles the Lake Mojave points and points/knives from the C.W. Harris site (Moratto 1984:94, 98). The flaking is roughly transverse parallel but nearly random. This point may also date to the Western Pluvial Lakes Tradition circa 10,000 – 7,000 B.P.

The assemblage at CA-ORA-1557 was dominated by flaked stone items, such as scraper planes, scrapers, etc., accounting for 96% of the total. Flaked tools included 10 scraper planes, all of which were patinated, and 9/10 (90%) were volcanics. Of the utilized flakes and flake tools all were patinated, and 8/14 (57.1%) were made of volcanics. Not only is the patination evidence of considerable age, but the raw materials and assemblage are diagnostic of the San Dieguito Tradition (Moratto 1984; Rogers 1939; Reddy et al. 2000; Carrico et al. 1991; Gallegos 1991).

SUBSISTENCE AND SETTLEMENT PATTERNS

The data from the test phase established that the inhabitants of the project sites were hunter-gatherers with varying degrees of sedentism. Some of the sites served as residential bases (hamlets or villages) where generalized subsistence and maintenance activities took place. Others were temporary camps where limited or specialized activities were carried out. Because only relative dating is available and the sites do not have good stratigraphic controls, any attempt to establish contemporaneity of the sites should be viewed as hypothetical in nature and amenable to further research. The sites will be treated as groups by canyon.

Upper Gabino Canyon

CA-ORA-1551 is a large scatter (10,500 m^2) is the southernmost of the project sites in upper Gabino Canyon. Based upon the artifacts and their use wear, this site experienced a wide range of activities: hunting with atlatl (dart point); hard seed processing (metate); chipped stone tool manufacture (flakes, cores, hammerstone) including biface production and/or rejuvenation; light and heavy cutting, bone and wood working (utilized flakes, flake and core tools); and yucca pulping and fiber processing, wood and bone working, hide processing (plano-convex tools), and leather working (perforators as reamers). The cultural deposit reached at least 80 cm (max. excavated) suggesting a long-term occupation. The site most likely served as a residential base camp. Whether it was occupied year-round cannot be determined from the current data. Hunting equipment implies fall-winter occupation generally. Grinding equipment may imply spring-summer occupation. No ecofacts were recovered for more fine-gained seasonality studies to be undertaken.

CA-ORA-1557 is a medium-sized (2,100 $m^{2)}$ to the north of CA-ORA-1551. It also experienced a wide range of activities, based on the artifacts recovered and the use wear they demonstrated: hunting with atlatl (dart point); hard seed processing (metate); chipped stone tool manufacture (flakes and cores) including biface production and/or rejuvenation; light and heavy cutting, bone and wood working (utilized flakes, flake and core tools); and yucca pulping and fiber processing, wood and bone working, hide processing (plano-convex tools). The cultural deposit was shallow (max. 30 cm). The slight accumulation of cultural deposit, coupled with the relatively small number of artifacts at the site, suggests that this site functioned as a temporary camp, perhaps a satellite camp of CA-ORA-1551. The site may have served as a seasonal camp that was utilized in the fall-winter periods to hunt game and exploit late-maturing plant resources. Stone tool making and repairing may have been carried out at other times during the year.

CA-ORA-1553 is the northernmost of the project sites in Gabino Canyon. This medium-sized (1,500 m^2) scatter of artifacts, although principally flaked stone, included the greatest percentage of ground stone items (18/64, or 28.1%) of any of the project sites. This site appears to have been used extensively for hard seed processing when compared with the other sites in the canyon. Other subsistence and maintenance site activities implied by the flaked stone assemblage were stone tool making and repairing (flakes, cores, hammerstones); biface production or re-sharpening (biface reduction flakes); fine and heavy cutting (flake tools); leather working (perforators as reamers); and possibly hand to hand combat (stemmed tool resembling a dagger). In addition, a quartz crystal fragment hints at ceremonial activities. Quartz crystals were artifacts of magico-religious significance among Shoshonean peoples in southern California prehistory.

CA-ORA-1135 was a small scatter (400 m^2) of a few flaked stone items (scraper planes, core, and biface), a mano and a partial deep basin metate, ritually “killed”, or destroyed at the time of the user’s death. The site was so minimal that it must have been utilized rarely, perhaps only a season. It would be classified as a temporary camp where some hard seed processing took place, along with perhaps some hide processing, wood or bone working. A ceremonial function (“killing” of the metate) was also carried out there; perhaps the site was a particular favorite of the metate user.

Cristianitos/Trampas Canyon

CA-ORA-1573 was the southernmost project site, located in Talega Canyon near the border with Camp Pendleton. This small scatter (300 m^2) of flaked stone artifacts (mostly waste flakes) included evidence of chipped stone tool manufacture (flakes), some light cutting or scraping (flake tool), and perhaps yucca pulping and fiber processing or hide scraping (plano-convex tool). There was minimal midden accumulation (max. 20 cm), so the site was either used intermittently or non-intensively. The range of activities suggests the site served as a temporary camp, perhaps occupied seasonally for stone tool making, as well as animal and plant procurement and processing. It may have been associated with a nearby village, or base camp.

CA-ORA-1449 is a large site (32,300 $m^{2)}$with a diverse set of activities represented by its assemblage: chipped stone tool manufacture and repair (flakes, cores, hammerstone); re-roughening of grinding surfaces (angular hammerstones); seed processing (manos and metates); light and heavy cutting, bone and wood working (utilized flakes, flake and core tools); yucca pulping and fiber processing, wood working, and hide processing (plano-convex tools). This wide range of activities suggests that the site was a residential base, or village. The cultural deposit at the site reached 80 cm. Two features were recorded in TU 1 and TU 2, each having a milling implement recovered at considerable depth. The site also displays spatially discrete work areas for men and women. The site may have been occupied year round, used for procuring fruits, seeds, roots, tubers, and berries through spring and summer. Hunting and harvesting of late-season plant resources could have been carried out into fall and winter.

CA-ORA-1125 was a large site (18,000 m^2) whose deposit consisted of predominantly flaked stone items with a discrete deposit of ground stone items on its northern end, thus revealing gender-specific work areas on site. Activities carried out at the site included flake tool manufacture and repair, biface production and/or rejuvenation (flakes, cores, hammerstones; biface reduction flakes), some light scraping or cutting (flake tool); bone or wood working, hide scraping, fiber processing (plano-convex tools); and hard seed processing (manos and metates). The cultural deposit lay as deep as 60 cm at the site, demonstrating a considerable accumulation of occupational debris. The range of artifacts, the spatial patterning of the site, and the depth of the deposit suggest that CA-ORA-1125 functioned as a base camp where generalized subsistence and maintenance activities took place over many years.

CA-ORA-1111 was a very small scatter of flakes, a flake tool, and a ground stone fragment. A few fragments of weathered small mammal bone were recovered from the 0-10 cm level of TU 1. This must have been a temporary camp where some tool making, grinding of hard seeds, and perhaps some cutting or scraping took place, but for a brief period, perhaps only a day or two.

PART IX. SIGNIFICANCE

The prehistoric sites in the study were tested for significance, or potential eligibility for the National Register of Historic Places (NRHP). The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet at least one of the following criteria:

A) They are associated with events that have made a significant contribution to the broad patterns of our history; or

B) They are associated with the lives of persons significant in our past; or

C) They embody the distinctive characteristics of a type, period or method of construction, or that represents the work of a master, or that possesses high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or

D) They have yielded, or are likely to yield, information important in prehistory or history.

Three of the project sites possess a high degree of integrity of location and qualify under Criterion D: CA-ORA-1125, CA-ORA-1449, and CA-ORA-1551. They have yielded or are likely to yield information important in prehistory. Two might otherwise potentially qualify but their research potential was exhausted with the test phase: CA-ORA-1553 and CA-ORA-1557. Three sites are not considered significant: CA-ORA-1111, -1135, and -1573. They are minimal surface sites and lack research potential.

<u>CA-ORA-1125</u>

This is a large site with a cultural deposit reaching 60 cm. The site has experienced some disturbance over time due to agricultural use (grazing) and the cutting of a ranch road, now paved, through its western edge. In addition a water pipeline was installed east of the roadbed but outside the barbed-wire fence that bounds the site on the west. The site is largely intact; the main deposit (maximum depth) of the site was not affected by the road and pipeline.

The range of subsistence and maintenance tools and tasks implied by those tools suggest that this site functioned as a residential base, or habitation site. Although the assemblage is predominantly flaked stone, a few grinding stones have been recovered. During the recent testing, the ground stone items were recovered in a discrete location on site, suggesting a gender-specific work area on the northern end.

The discoidal recovered from pipeline monitoring at CA-ORA-1125 suggests that the site also served a ceremonial function. Discoidals are believed to have been used in a game whereby two players threw poles at one of the stone discs rolling down a course and attempted to induce the stone to come to rest in the fork of one of the poles (Moriarty and Broms 1971). All games played in prehistoric North America were primarily ceremonial. Culin (1907), after lengthy research into the games of these early peoples, concluded that behind the games and ceremonies there existed some widespread myth that served as the impulse for both. He maintained that the "…games appear to be being played ceremonially, as pleasing to the gods, with the object of securing fertility, causing rain, giving and prolonging life, expelling demons, or curing sickness ." (Culin 1907:34). Discoidals are diagnostic of the Milling Stone Horizon (La Jolla Tradition) in Orange County.

The degree of integrity, depth of the deposit, presence of a diagnostic artifact, and the range of activities and tasks indicated by the assemblage argue for this site's potential NRHP eligibility. It possesses data (artifacts and depth) to answer important research questions in prehistory (chronology, subsistence and settlement patterns, intra-site patterning, relationship with the older assemblages in Cristianitos Canyon and Gabino Canyon). Its position astride the Portolá route (El Camino Real) provides the possibility of finding Mission Period artifacts at this site as well.

CA-ORA-1449

This is a large and complex site with a cultural deposit reaching 80 cm. The site has experienced minimal disturbance over time. A dirt ranch road runs across the ridgeline of the site, and cows graze there. Otherwise it is intact.

The range of tools and tasks implied by those tools suggest that this site functioned as a residential base, or habitation site. Although the assemblage is predominantly flaked stone, a few grinding stones were recovered in a discrete location on site (Locus A). Features involving grinding stones were also uncovered on Locus A. A gender-specific activity area was thus defined for the site. Similarly a male-task oriented area was defined in Locus C.

The overall assemblage with its strong emphasis on flaked stone is diagnostic of the San Dieguito Tradition (Western Pluvial Lakes Tradition) dating to circa 10,000 – 7,000 years B.P. The majority of the flake tools from the site was patinated (55%) and made of locally quarried volcanics (chiefly felsite) and metavolcanics (55%). The raw materials and their patination are themselves diagnostic of the San Dieguito Tradition.

This Early Holocene assemblage is also found at CA-ORA-1551, -1553, and -1557 and is a unique one for interior Orange County, at least to ARMC personnel's knowledge. It is not reported for nearby Camp Pendleton (Reddy et al. 2000). Orange County coastal site CA-ORA-64 reportedly was occupied in this time frame, circa 9500 – 7500 B.P. (Macko et al. 1998), but the assemblage is quite different (large stone balls, ceremonial biface cache, etc.) and has none of the diagnostic flaked stone tools that characterize the San Dieguito Tradition.

The depth of the deposit, its features, diverse tools, internal patterning, uniqueness of assemblage, and the integrity of the site potentially qualify CA-ORA-1449 for the National Register of Historic Places. The site has yielded and can be expected to yield information important in regional prehistory (chronology, intra-site patterning, settlement patterns, flake and core tool production and use, as well as biface production and rejuvenation, etc.). The site may have been occupied during the early Mission Period when the Portolá party traveled up the canyon northward from La Cristianita where the first baptisms took place. Other villages in Talega Canyon and Cristianitos Canyon were visited by the padres and their entourage. There exists the possibility of encountering Mission Period artifacts on this site.

CA-ORA-1551

This large and diverse site has revealed a unique character from its recording in 2000 to the present. ARMC field personnel christened it the “mega-tool site”. The artifacts looked as if they had arrived from an Old World Paleolithic site. The majority of the flaked artifacts on the surface were either large, heavy flakes and cores or large, heavy flake and core tools. Scraper planes were especially common. Mixed in were a few grinding tools, namely manos and metates.

The concentration of artifacts within the southeastern portion of the site was unusually dense. Once the first surface collection was complete, even a casual walk across the site revealed additional flakes and tools, so a second collection was needed because the density of artifacts was so great. Additional surface collections could have been taken at the site, but time did not permit an exhaustive recovery of surface items.

The excavated depth of the site was slight at first, a mere 30 cm below datum. Struggling with the heavy clay in two 1x1-meter test units proved taxing and was complicated by several heavy rains and rain-outs during which the clay became even stickier. The excavation difficulties prompted the excavation of a fresh pit, a 75-cm diameter STP which still had cultural items at 80 cm but had to be abandoned since it was not practical to continue to excavate in the circular pit. Thus the actual depth of the cultural deposit is unknown. It may be a meter or more. Such a deep deposit is rare in the vicinity of the site; CA-ORA-1135, -1553 and -1557 were shallow deposits (max. depths 20, 20, and 30 cm respectively).

The flaked tool assemblage is itself unique to the region, occurring only at the other three project sites: CA-ORA-1449, -1553, and -1557. This assemblage can be related to the San Dieguito Tradition (Western Pluvial Lakes Tradition), circa 10,000 – 7,000 B.P. Unfortunately no absolute dates are available for the project sites. Subsequent recovery at CA-ORA-1551 might provide either datable organics or midden soil to provide an absolute date for the deposit. The typical raw materials of the San Dieguito Tradition (felsite and other volcanics) are local materials in Gabino Canyon and are amenable to measurement of their patinas, as suggested by Rogers (1939:19). A dating technique akin to the obsidian rind measurement may be possible for these early artifacts.

CA-ORA-1551 has good integrity, has yielded and is likely to yield information important in regional prehistory, and is potentially eligible for the National Register of Historic Places under Criterion D. The site has the data to answer research questions regarding chronology, settlement patterns, subsistence patterns, relationship to other early cultures such as Milling Stone (transitional to MS?), resource procurement (lithics, etc.), intra-site patterning, early stone tool manufacture and repair, biface production, hunting behavior, etc. Because of its antiquity, the site provides a unique opportunity to look at the flaking technology that native peoples may have brought with them to the New World.

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SECTION B. HISTORIC SITES

PART I. MILITARY BUNKERS

Two concrete military bunkers are located on the ridges on the north side of the Talega Creek drainage. The two buildings are significant historic resources that are eligible for listing on the National and California registers of historic places. Originally this area was part of Marine Corps Base, Camp Pendleton. Built during World War II as firing range observation bunkers, the buildings contain penciled signatures of military personnel who trained at the base during both World War II and the conflicts of the Cold War. The feeling and association of the use of these buildings during the significant periods of international conflict that occurred between 1942 and 1970 is brought to an intimate and personal level by the penciled records written by the Marines who served during these years, used the facilities for training, and left a record of their passing on the concrete walls.

HISTORICAL BACKGROUND

Camp Pendleton has served as one of the military's most important training centers for over fifty years. In March 1942, just 4 months after the Japanese attack on Pearl Harbor that brought the United States into World War II, the Navy began condemnation against owners of the Santa Margarita Ranch, and President Franklin D. Roosevelt dedicated the area Camp Joseph H. Pendleton. In July, a federal court granted immediate possession of the property to the government while financial compensation was settled in court. Early in 1943 the former property owners were paid over four million dollars for the land (US Army Corps of Engineers 1998a:4-1 - 4-5).

During World War II Camp Pendleton trained elements of the Third Marine Division, the entire Fourth and Fifth Marine Divisions, and thousands of individual replacements for battle in the Pacific Theater. The camp also witnessed the training of the first female Marines (eventually numbering 1000) and several black Marine units. At its wartime peak in 1944, the population of Marines, sailors, and civilians at Camp Pendleton topped 86,000 (US Army Corps of Engineers 1998a:4-1 - 4-5).

Three tent camps housing 5,000 men each were established at Camp Pendleton. Known as Pulgas, San Onofre, and Christianitos, Marines lived in these camps under field conditions. Each camp was placed near a set of firing ranges so the troops could receive rifle, machine gun, and mortar training. In addition to the three tent camp areas, known as Combat Areas 1-3, Combat Areas 4-7, an Amphibious Tank Area, Case Springs Combat Area, and other training areas were also established. The Marine Corps used Camp Pendleton for large-scale, tactical training for entire units prior to their overseas deployment. After costly invasions of some Pacific Islands in 1943, priorities shifted and amphibious assault training became a priority in 1944 (US Army Corps of Engineers 1998a:4-1 - 4-5).

Camp Pendleton has continued to play a vital role in marine training during the Cold War era conflict and into the present. During the Korean War (1950 – 55) 200,000 Marines received training before going into combat on the Korean Peninsula. During the 1962 Cuban Missile Crisis units from the First Marine Division were sent to Guantanamo Bay, Cuba, and other Caribbean locations. By the mid-1960s the camp was in full-scale war time preparation as conflict escalated in Vietnam. Following collapse of the South Vietnamese government in 1975, 25,000 refugees were temporarily housed in eight camps on the base. In the 1980s training shifted from amphibious to more flexible expeditionary systems that combined infantry, armor, air support, and supply systems. These techniques have been used in Grenada, Panama, and the Persian Gulf (US Army Corps of Engineers 1998a:4-1 - 4-5).

BUNKER DESCRIPTIONS

The concrete bunkers are located on southwesterly trending slopes overlooking the Talega Creek drainage to the south. Although currently private property as part of Rancho Mission Viejo, during World War II and for an undetermined time thereafter, this area was part of the extreme northern section of Camp Pendleton (Collier 2003; Battle Map 1943; Training & Command 1944). Two structures are shown at this approximate location on a 1944 map of Camp Pendleton (Training & Command 1944). They are associated with Musketry Range No. 3. This rifle training range was used to teach firing techniques and rifle marksmanship. Musketry No. 3 was associated with Tent Camp No. 3 and can be identified on a 1942 map entitled "Map of Camp Jos. H. Pendleton," a 1953 "General Area Map" of the base, and a 1944 map of "Training Command Combat Training Areas and Ranges" (US Army Corps of Engineers 1998 b:2-55). The two concrete bunkers overlook the firing area of former Musketry Range No. 3 and appear to be observation bunkers associated with use of that range.

Site 30-176635

This single story, rectangular, poured concrete bunker measures approximately 5 by 15 feet. It has a flat concrete roof and floor. An open doorway and large rectangular open window are located along the north side. Small, narrow, horizontally oriented "slit" openings, that appear to be for observation, are located on the east and west ends. A poured concrete flying buttress was added to the west side of the building sometime after original construction and now blocks the view from the slit on the west end. The view from the slit on the east end overlooks a flat terrace to the southeast of the building which would have been within the firing area of Musket Range No. 3. Observers with telescopes or binoculars could have graded the accuracy of Marines firing at targets on the range from this point. Similar firing range observation bunkers dating from World War II are located on Camp Pendleton. The inside of this building contains a remarkable record of military personnel who have used the building since World War II.

In white paint on the interior of the south wall are the letters 62MU2. On the surface of this paint and covering all four interior walls of the bunker are approximately 100 penciled signatures of Marines. The signatures often include a name, home town address, serial number, and date. Three clusters of dates were noticed consisting of 1943 – 1945, 1951 through 1957, and 1961 through 1963.

Site 30-176634

This rectangular poured concrete bunker measures approximately 8 by 12 feet by 10 feet in height. It has a flat poured concrete roof and earthen floor. Narrow, horizontally oriented observation slit windows are located in the east and west walls approximately 7 feet above the floor. The badly deteriorated remains of a wooden platform to access these windows are still present inside the building. A tall open doorway is located on the east side. The window on the south side overlooks the former firing area of Musketry Range Number 3 and would have allowed observation of training sessions from a protected location. The purpose of the window on the north side is undetermined. Identification numbers in white paint on the interior of the west wall read 62-MU-1. A number of penciled signatures of Marines are written on the interior walls of this building. The signatures often include a name, home town address, serial number, and date. They range in time from 1951 through 1988, although most are from the 1950s.

PART II. SIGNIFICANCE

In order to determine if the buildings are historically significant they were evaluated for their eligibility for listing in the National and California Registers of Historic Places. To qualify for the National or California Registers any potential historic resource must retain sufficient integrity of its historic qualities to convey its importance during the defined period of significance. The quality of significance in American history, architecture, archaeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and meet at least one of the following criteria:

A) They are associated with events that have made a significant contribution to the broad patterns of our history; or

B) They are associated with the lives of persons significant in our past; or

C) They embody the distinctive characteristics of a type, period or method of construction, or that represents the work of a master, or that possesses high artistic values, or that represent a significant distinguishable entity whose components may lack individual distinction; or

D) They have yielded, or may likely to yield, information important in prehistory or history.

The two former Musketry Range No. 3 observation bunkers are significant cultural resources. They are eligible for nomination to the California and National Register of Historic Places at both a state and national level of significance. The structures qualify under Criterion A, in that they are associated with the training of Marines who participated in numerous important combat missions during World War II and the Cold War. Their period of significance is from 1942 to 1970. What makes these buildings extremely important is their excellent state of preservation and the penciled graffiti on the inside walls that represent a remarkable and intimate record of military personnel who trained at Camp Pendleton during World War II and the Cold War era. These buildings possess integrity of location, design, setting, materials, and workmanship and have a strong association with combat training at Camp Pendleton during World War II and the Cold War. The feeling and association of their use during these periods is brought to an intimate and personal level to the present day observer by the penciled record written by the Marines who served during these conflicts, used these facilities for training, and left a record of their passing on the concrete walls. Although structures similar in design and use still exist on Camp Pendleton, none has this degree of preservation. Regular maintenance, including interior painting, has obliterated all original interior elements (Jonason 2003).

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PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 1
(ORTEGA GATEWAY)
Ortega Highway at Antonio Parkway
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA1

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PLANNING AREA 1
(ORTEGA GATEWAY)
Ortega Highway at Antonio Parkway
San Juan Capistrano, California

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EEI Project No. V030305-38A-PA1

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* within the Planning Area One (Ortega Gateway) portion of Rancho Mission Viejo, located along Ortega Highway and Antonio Parkway east of the City of San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of previous investigations conducted by EEI.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval program), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area One is located east of the City of San Juan Capistrano boundary in the vicinity of Antonio Parkway and Ortega Highway. This planning area would encompass approximately 810 acres and provide a mix of residential, urban activity center, and open space uses. Approximately 540 acres of residential development is proposed, with construction of 1,020 dwelling units. Approximately 89 gross acres of urban activity center are also proposed as an overlay land use category within this same area. The overlay land uses would support approximately 1,190,000 square feet of urban activity center development, consisting of office space and 180,000 square feet of retail development. Within this planning area there would also be 148 acres of open space. This open space, together with the 540 acres to be developed with urban uses, would be designated I-B-Suburban Residential on the Orange County General Plan. A 122-acre portion of the proposed Rancho Mission Viejo Regional Park also is included in this planning area and would be designated 5-Open Space on the General Plan. Existing authorized land uses would continue until the commencement of any new proposed land use for the affected areas.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located at the intersection of Antonio Parkway and Ortega Highway, and encompasses the lots identified by assessors parcel numbers (APNs) 125-171-52 and 125-171-63, and portions of the lots identified by APNs 125-171-07, -10, -43, -51, -59, -61, -62, -64, -65, and -66 (**Assessor's Parcel Maps, Appendix A**). Access to the property is from several roads, including Ortega Highway, Antonio Parkway, La Pata Avenue, and several ranch access roads.

The property is bounded by undeveloped open land to the north, southeast, and east, and residential property to the west and southwest. San Juan Creek traverses the property from the eastern margin to the southwest margin. Ortega Highway traverses across the southern portion of the subject property from west to east, and Antonio Parkway/La Pata Avenue traverses the eastern portion of the subject property, from north to south. According to the Orange County Planning Department, the site is zoned A-1 (general agriculture). A copy of the County Zoning Map is included in **Appendix B**.

The subject property is currently occupied by various commercial, industrial, and agricultural businesses, the Rancho Mission Viejo headquarters, a few residences, and open fields including the following (**Site Plan, Figure 2**):

- The former Joan Irvine-Smith Pasture (northwest corner Ortega Highway and Antonio Parkway) encompasses approximately 60 acres in the northern portion of the subject property. The site includes a small wooden shed, a grazing field, and an above ground diesel tank;

- The former Les Thompson Transportation lease area (28811-A Ortega Highway) encompasses approximately one acre in the northern portion of the subject property, and includes a large wooden structure and several trailers;

- Lemon groves encompass approximately 150 acres in the western and central portions of the property, and along San Juan Creek south of Ortega Highway. A small supplies shed and three small unlabeled above-ground tanks are located in the western portion, and several electric windmills are located in the grove along San Juan Creek;

- The Rancho Mission Viejo Headquarters (28811 Ortega Highway) area includes approximately 15 acres in the central portion of the subject property. The site includes an office building, a recreation/conference complex, a residential unit (28881 Ortega Highway);

- The Oaks horse corrals (28650 Ortega Highway) encompasses approximately one and a half acres in the southern portion of the subject property. The site is occupied by horse corrals;

- A maintenance shop area (28672 Ortega Highway) which encompasses approximately one acre in the southern portion of the subject property. The site includes two shop buildings, a large garage, and parking lots (gravel and asphalt-covered);

- Residential units (28652 and 28632 Ortega Highway) along Ortega Highway in the southern portion of the subject property;

- The Oaks Polo Fields and Sierra Soils (southwest corner of La Pata Avenue and Ortega Highway) encompass approximately 60 acres in the southern portion of the subject property. The polo fields area is described as a large, multi-function facility that hosts events such as polo, soccer, car shows, and rodeos, and Sierra Soils is a small soil compost processing facility;

- D&M Nursery (29001 and 29813 Ortega Highway) encompasses approximately 22 acres in the southwestern portion of the subject property. The site is currently occupied by a commercial nursery, and includes an office, maintenance shop, storage buildings, greenhouses, various sheds and trailers. In addition, the property contains one source pond, and a water filtration/blending station;

- Miramar Nursery (29813 Ortega Highway) encompasses approximately 25 acres in the southwestern portion of the subject property. The site is currently occupied by a commercial nursery, and includes an office, storage building, greenhouses, shade houses, various sheds, and trailers;

- Miramar Cellular On Wheels (C.O.W.) site encompasses less than one acre at the southeast corner of Ortega Highway and La Pata Avenue. The site is currently used for storage of potted plant stock;

- Open space encompasses approximately 400 acres in the northern and western portions of the property.

EEI previously conducted environmental site assessments on the Oaks Polo Fields and Sierra Soils; D&M Nursery; Miramar Nursery; the former Les Thompson lease; the Former Joan Irvine-Smith Pasture; and The Oaks horse corrals. A brief summary of each ESA is included below in section 4.6.

3.2 Topography

The site is located along San Juan Creek, in a gently sloping, east-west trending alluvial valley. The site elevation ranges from 500 feet above mean sea level (amsl) in the northwestern portion to 120 feet amsl along the San Juan Creek. The topographic gradient in the site vicinity ranges from 0.17 feet per foot to the west (in the southern and eastern areas) to 0.31 feet per foot to the east-southeast (in the northern area). Surface drainage from the site flows into San Juan Creek, then eventually into the Pacific Ocean, approximately 6 miles to the southwest.

Based on the Flood Zone Map published by the Federal Emergency Management Agency (FEMA), portions of the subject property along San Juan Creek lie within an area designated as a 100-year flood plain, while the majority of the property lies within an area designated Zone X (i.e. outside a 500-year flood plain).

3.3 Regional and Local Geology

The site is located in an alluvial valley (San Juan Creek) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the site vicinity are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations (Morton, 1974). These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation.

Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soils in the northern portion of the subject property have been identified by the United States Department of Agriculture - National Resource Conservation Service as clays and clay loams of the Alo, Bosanko, and Sorrento Series (USDA, 1978). Soils in the Alo and Bosanko associations are typically well drained, and form on uplands and foothills from material weathered from calcareous sandstones and shales. These soils are slowly permeable, steep to strongly sloping, the runoff is medium to rapid, and the erosional hazard is moderate to high. Soil in the Sorrento association is typically found alluvial fans and floodplains, in material weathered from sedimentary rocks. The soils are well drained, moderately permeable, nearly level, with a slight to moderate erosional hazard and a slow to medium runoff.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 19.5 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Cristianitos Fault (traverses the eastern portion of the property), the Mission Viejo Fault (east of the site) and the Newport-Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the site lies within the Ortega Hydrologic Subarea of the San Juan Hydrologic Unit. In general, groundwater in this area has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but generally occur at between 5 and 50 feet below ground surface (EEI, 1999).

The Ortega Hydrologic Subarea is located within the San Juan Creek watershed. Cañada Chiquita Creek, San Juan Creek (in the central portion of the site), Trampas Canyon (east of the site), and Cañada Gobernadora (northeast of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the DMB San Juan Investment North, LLC. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 to 1999 were reviewed at Continental Aerial Photo in Los Alamitos, California. In addition, EEI reviewed an aerial photograph dating from 2002 (EDAW). **Table 1** summarizes the results of the aerial photograph review. A copy of a 2000 aerial photograph is included in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1959	261-8-29-114[1]	The area in the central portion of the site was cleared and there were six structures (residential and barns) in the present-day headquarters area. Joan Irvine-Smith pasture area was present, along with the barn at the southwest corner of the pasture, and the property north of the pasture was vacant open space. The western portion of the property (present-day lemon groves, west of the ranch headquarters) was cleared but vacant. The portion of the property south of Ortega Highway and north of San Juan Creek was occupied by six structures that appeared to be residential buildings and barns. The southern portion (present-day polo fields) was cleared and vacant. The area currently occupied by D&M and Miramar Nurseries was vacant (covered by thick vegetation) except for the area adjacent and southeast of San Juan Creek, and north of Ortega Highway, which was cleared and occupied by several trailers and a small fenced area. The remainder of the subject property was noted as vacant and covered by thick vegetation.
1967	2-169[1]	Lemon groves were present in the area south of Ortega Highway and north of San Juan Creek (in their current location). The present-day Oaks Polo Fields area appears cultivated, and the Sierra Soils area was vacant and covered with thick vegetation. The present-day Miramar Nursery area was cleared but vacant. No other pertinent changes were noted to the subject property since the previous photograph.
1970	61-9-214[1]	A barn was noted west of the Former Joan Irvine-Smith pasture in the former Les Thompson lease area, and a pond was noted in the northwest corner of the subject property, adjacent to the present-day lemon groves. The western portion of D&M Nursery was noted as cleared and vacant. The eastern portion of D&M Nursery, the area occupied by present-day Miramar Nursery, and the area that underlies the present-day Antonio Parkway were occupied by orchards. No other pertinent changes were noted to the subject property since the previous photograph.

TABLE 1 (continued)
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1973	132-12-17[1]	The Oaks Corrals (south of Ortega Highway) was noted in its present location. A pond was noted in the central portion of the property. The headquarters area was occupied by orchards and a small residential unit in the southeast corner. The western portion of the property was partially covered by orchards and partially cleared or tilled. The northwestern corner (near pond) was cultivated. The former Les Thompson lease area was occupied by several small structures. The open space areas in the northern portion are cleared and vacant. No other pertinent changes were noted to the subject property since the previous photograph.
1977	181-13-25[1]	No pertinent changes were noted to the subject property since the previous photograph.
1981	13-21[1]	The present-day headquarters office building, conference facility, and helipad were noted in their current configurations. The western portion of the property was occupied by orchards, appearing similar to the configuration of the orchards in the present-day. A small structure was noted adjacent to the former Les Thompson lease area. No other pertinent changes were noted to the subject property since the previous photograph.
1983	218-13-25[1]	The former Joan Irvine-Smith Pasture area appears cultivated, and the current structure in the former Les Thompson lease area was noted. Orchards were noted on the D&M and Miramar Nurseries properties. The Oaks Polo Fields area appears cultivated. No other pertinent changes were noted to the subject property since the previous photograph.
1987	F290/F-289[1]	D&M and Miramar Nurseries were no longer occupied by orchards, and appear in their current configuration with the exception of Antonio Parkway which was not present in 1987. The Oaks Polo Fields area was cleared but vacant in the eastern portion, and vacant in western portion. Two small structures were noted along Ortega Highway (the northern margin of the polo fields). The property south of Ortega Highway was noted in its current configuration. The Oaks Corral area was present and it was unclear whether the corrals were present or the area was only cleared. In addition, four small structures were present along San Juan Creek and five small structures were noted in the central portion. The western portion of the property was partially occupied by orchards and partially cleared. The pond in the northwest corner was noted, and the area around the pond was cultivated. No other pertinent changes were noted to the subject property since the previous photograph.
1992	C85-16-13[1]	Two medium-size buildings were noted along San Juan Creek in the Oaks Polo Field lease area, and Sierra Soils was present in the southern portion. No other pertinent changes were noted to the subject property since the previous photograph.
1993	C90-5-147/148[1]	No pertinent changes were noted to the subject property since the previous photograph.
1995	C101-43-30[1]	Several small structures were noted along the northwest margin of the Oaks Polo Fields area, and a storage area was noted along the northern margin. The western portion of the property was predominantly covered by lemon groves, except for the area on the hillside, which appears terraced and vacant. The former Joan Irvine-Smith Pasture area appeared cultivated and tilled. Three small trailers or storage units were noted north of the headquarters area and adjacent to the former Les Thompson lease area. Open space area north of former Joan Irvine- Smith Pasture was cleared and vacant. No other pertinent changes were noted to the subject property since the previous photograph.
1997	C117-43-48/47[1]	Antonio Parkway was under construction and stockpiled soil, large vehicles, and equipment are present on and adjacent to the road, especially along the eastern side of the road. The D&M Nursery area was noted in its current configuration. The landscape of The Oaks Polo Fields was dotted with a small circular feature, possibly small ponds. Two medium buildings and eight small buildings were noted along the southwest margin of the fields. No other pertinent changes were noted to the subject property since the previous photograph.

TABLE 1 (continued)
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1999	C-136-43-150/151[(1)]	The western portion of the property was occupied by lemon groves, in its current configuration. The former Les Thompson lease area was occupied by a large barn and was also being used to park large trucks. Former Joan Irvine-Smith Pasture area was covered in grass and approximately 30 small structures (possibly water tanks for cattle). The area north of the pasture was vacant open space. D&M Nursery was present on both sides of Antonio Parkway, north of Ortega Highway. The Miramar Nursery lease property was cleared and sectioned, however, there did not appear to be any cultivated plants on the property. Sierra Soil was present in its current location, south of the polo fields. The Oaks Polo Fields lease area was present in its current configuration of corrals and fields, however there were no stables. No other pertinent changes were noted to the subject property since the previous photograph.
2002	EDAW - Ortega Gateway[(2)]	Several rows of horse stables were noted along the northwest margin of the Oaks Polo Fields area, along San Juan Creek. Truck and trailers were noted on the former Les Thompson lease area. No other pertinent changes were noted to the subject property since the previous photograph.

[(1)] Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California
[(2)] Aerial Photograph obtained from EDAW

4.2.2 Historic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. All of the maps reviewed were published by the United States Geological Survey, with the exception of the 1942 map, which was published by the U.S. Army Corp of Engineers. Only partial coverage of the site was available on the 1948, 1968, 1975, and 1980 maps (the western portion is not covered).

The 1942 map notes the presence of two small structures located along the ranch access road near the headquarters area, a small structure located south of San Juan Creek in the D&M Nursery area, and four small structures in the current Oaks Corrals area. Ortega Highway is present traversing the subject property, along with San Juan Creek Haul Road and a dirt road south of former Joan Irvine-Smith pasture. No other pertinent items were noted.

No changes were noted on the 1948 map.

The 1968 map notes the presence of a well in the former Joan Irvine-Smith Pasture. No other pertinent changes were noted.

No changes were noted on the 1975 map.

The 1980 map notes the presence of La Pata Avenue. No other pertinent changes were noted.

The 1988 map notes the presence of orchards in the headquarters area, in the D&M Nursery and Miramar Nursery areas, and in the current lemon groves south of Ortega Highway. The map notes the presence of a small structure in the former Joan Irvine-Smith Pasture area, and a structure in the former Les Thompson area. An irregular surface feature is noted on the D&M property west of Antonio Parkway.

4.2.3 City/County Directories

EEI reviewed available Criss Cross and Haines City/County Directories for Orange County at the Main Library in Santa Ana, California. Within the subject property there are at least 12 addresses along Ortega Highway: 28632, 28650, 28651, 28652, 28653, 28672, 28691, 28731, 28811, 28813, 28881, 29001, and 29813. Most of the addresses associated with the subject property were either not listed in the directories reviewed by EEI, or were residential listings. **Table 2** summarizes the information reviewed in the directories for the non-residential addresses.

TABLE 2
Summary of Historical Tenants

Year	Subject Property Addresses - Ortega Highway				
	28650	28672	28811	28881	29001
1952	Rancho Mission Viejo (No Street Address)				
1972	No Listing	Rancho Mission Viejo	No Listing	Rancho Mission Viejo La Casa	No Listing
1976	Horst Horse Ranch	Rancho Mission Viejo	No Listing	Rancho Mission Viejo La Casa	No Listing
1980	Capistrano Saddle Club	Rancho Mission Viejo	Bayshore Construction	Rancho Mission Viejo La Casa	No Listing
1985	Capistrano Riding Club	Delane Kendall	Rancho Mission Viejo	Rancho La Casa	D&M Nurseries
1990	The Oaks	No Listing	Rancho Mission Viejo	Rancho Mission Viejo	D&M Nurseries
1996	The Oaks	No Listing	Rancho Mission Viejo	Rancho Mission Viejo	D&M Nurseries
2002	The Oaks	No Listing	Rancho Mission Viejo Headquarters Cow Camp, Rancho Mission Viejo	Rancho Mission Viejo	D&M Nurseries Inc.

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

EEI reviewed files at the Orange County Building and Safety Department (OCBSD) regarding historical and present site development. The OCBSD does not issue permits to sites without addresses. Permits were on file for the properties at 28652, 28672, 28691, and 28811 Ortega Highway. The remainder of the subject property addresses did not have files at the OCBSD available for review. The following is a summary of the files reviewed.

28652 Ortega Highway

In December 1965, two building permits were issued at 28652 Ortega Highway to the property owner, Rancho Mission Viejo. One permit was for a two bedroom, one bath addition of approximately 485 square feet, and the second was for the relocation of employee's quarters (dimensions not provided). In April 1966, a building permit was issued to the property owner to add a tool supply room to the same address. No other pertinent items were noted in the files reviewed by EEI.

28672 Ortega Highway

In July 1966, two building permits were issued to the property owner, Rancho Mission Viejo, for the property at 28672 Ortega Highway. One permit was issued to relocate the ranch office, and the second was for an addition of one office to an existing office structure. In November 1974 a permit for three wind machines was issued for the agricultural fields. No other pertinent items were noted in the files reviewed by EEI.

28691 Ortega Highway

In June 1965 a permit was issued to the property owner, Rancho Mission Viejo, for the construction of a dwelling with attached garage to the property at 28691 Ortega Highway. In August 1979, a permit was issued for the construction of a recreational building, accessory to the existing ranch facility. No other pertinent items were noted in the files reviewed by EEI.

28811 Ortega Highway

In August 1979, a grading permit was issued for the property at 28811 Ortega Highway to the property owner, Rancho Mission Viejo. No other detail were provided. In April 1987, a grading permit was issued to the property owner for grading for an accessory building. In November 1991, a permit was issued to the Santa Margarita Company for grading for a lemon orchard. No other pertinent items were noted in the files reviewed by EEI.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix C**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report.

4.3.1 Federal Databases

National Priority List (NPL) - No listings were reported within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No listings were reported within one-half mile of the subject site.

RCRA TSD Facility List (RCRA-D) - No listings were reported within one-half mile of the subject site.

RCRA COR (Corrective Action Sites) - No listings were reported within one mile of the subject site.

RCRA Generators (RCRA-G) - The Environmental Protection Agency (EPA) regulates generators of hazardous material through the Resource Conservation and Recovery Act (RCRA). All hazardous waste generators are required to notify EPA of their existence by submitting the Federal Notification of Regulated Waste Activity Form (EPA Form 8700-12) or a state equivalent form. Four sites within one-quarter mile were identified, including three non-geocoded sites which are actually located greater than one mile from the subject property. **California Silica Products** (31302 Ortega Highway) was identified as a small generator (i.e., generates between 100-1,000 kilograms of hazardous waste per month. Operating permits are not generally considered environmental concerns, unless an unauthorized release has occurred at the site. This site is discussed further in the LUST section below.

RCRA NLR (No Longer Regulated) - No listings were reported within one-eighth of a mile from the subject property.

Emergency Response Notification System (ERNS) - The ERNS is a national computer database used to store information on unauthorized releases of oil and hazardous substances. Twelve listings were reported within one-eighth of a mile from the subject property, including eleven listings that were non-geocoded and are actually located greater than one mile from the subject property. An **unknown** ERNS was reported at Ortega Highway and La Pata Avenue. No details were provided about the nature of the emergency. Based on a lack of information, this site is not considered an environmental concern at this time.

The subject property was not identified on any of the databases researched.

4.3.2 State and Regional Sources

State Listings - One non-geocoded site was identified within one mile of the subject site, however, this site is actually located in San Clemente, and is greater than one mile from the subject property. Therefore, this site is not considered an environmental concern at this time.

Spills 1990 - No listings were reported within one-eighth of a mile from the subject property.

Solid Waste Landfill (SWL) Sites - Nine listings were reported within one half mile of the subject site, including seven non-geocoded sites that are actually located greater than one mile from the subject property. **Solag Disposal** (31641 Ortega Highway) and **Unknown** (31511 Ortega Highway) are located greater than one mile east of the subject property. Therefore, these sites are not considered environmental concerns at this time.

Permits - No listings were identified within one-eighth of a mile from the subject property.

Permitted Underground Storage Tanks (UST) - Fifteen listings were reported within one-quarter mile of the subject site. Four sites were non-geocoded and are actually located greater than one mile from the subject property. Two sites are located within the subject property: **Capistrano Wholesale Nursery** (29812 Ortega Highway), listed as inactive; and **Rancho Mission Viejo** (28672 Ortega Highway), listed as active. No details regarding the tanks were provided. Operating permits are not generally rationale for concern, unless a documented release has occurred at the site. A documented release has occurred on the subject property, and this is discussed further in the LUST section below.

Orange County Groundwater Clean-up List (Other) - Five sites were identified within one quarter of mile of the subject property. One listing identified a site within the subject property, **Rancho Mission Viejo** (28675 Ortega Highway), which is listed for a gasoline release. No other details were provided. Of the remaining listings, one site was non-geocoded and is actually located greater than one mile from the subject property. The other three sites are actually one site, **California Silica Products/Oglebay Norton Industrial Sand, Inc.** (31302 Ortega Highway), which is listed for a gasoline release, and two diesel releases. This site is discussed further in the LUST section.

California State Leaking Underground Storage Tanks (LUST) - Five listings were reported within one-half mile of the subject site, including one site within the subject property. **Rancho Mission Viejo** (28672 Ortega Highway) reported a gasoline leak in April 1992. Impacted soil was excavated and disposed of at an approved site. Reportedly, only the soil is impacted, and the case was closed in May 2001. The case is discussed further in section 4.6.8. One listed site was non-geocoded and is actually located greater than one mile from the subject property. The remaining three are all listings for **California Silica Products Company/Oglebay Norton Industrial Sands, Inc.** (31302 Ortega Highway). A diesel release was reported in October 1990, impacting the soil only, and the case was closed in June 1991. A gasoline release was reported in April 1993, impacting the soil only, and the case was closed in March 1993. Finally, a diesel release was discovered during a tank test in August 1997, impacting the soil only. The case was closed in April 2001. Based on the status of these listings (closed) and the extent of the contamination (soil only), these are not considered as environmental concerns at this time.

Releases (Air/Water) - Two sites were listed within one-quarter mile of the subject property. Both listings were non-geocoded. The sites are listed as occurring on Oso Parkway which is located greater than one mile north of the subject property. Therefore, these sites are not considered environmental concerns at this time.

PCB Activity Database System (PADS) - No sites were listed within one quarter mile of the subject property.

Rancho Mission Viejo (28672 Ortega Highway) is a site within the subject property, and was listed on the UST and LUST databases. The case is closed, and is discussed further in section 4.6.2.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority (OCFA) office for information regarding hazardous materials storage at the subject site. According to previous assessments of the subject property and recent inquiries to the OCFA, most sites within the subject property do not have an official address or hazardous materials permit file, and are not currently under a regular inspection schedule. The sites currently under routine inspection by OCFA include **The Oaks** (28650 Ortega Highway), **D&M Nursery**, and **Rancho Mission Viejo** (28672 Ortega Highway and 28811 Ortega Highway). These sites are permitted to store chemicals such as gasoline, diesel, motor oil, propane, Malathion, urea, sodium nitrate, ammonium sulfate, potassium sulfate, calcium chloride, methyl phenol, ammonium nitrate, metaldehyde, and various small quantities of insecticides, fertilizers, herbicides, and compressed gas. There were no indications of violations, hazardous materials spills, or emergency responses in Fire Department files. Copies of the OCFA records search for the Rancho Mission Viejo addresses (28672 and 28811 Ortega Highway) are included as **Appendix D**.

4.4.2 Orange County Health Care Agency

EEI reviewed Orange County Health Care Agency databases including the Leaking Underground Storage Tank (LUST) list, Underground Tank Facilities (UTF) list, Non-petroleum Underground Tanks (UT) list, Hazardous Waste Generators (HWG), and Land Fill Sites, to determine if the subject site or any properties within the site vicinity were listed as having an environmental concern. Two sites within the subject property were listed. **Vermullen Agricultural Field** at Ortega Highway and La Pata Avenue was listed on the Non-Petroleum UT List. This is not considered an environmental concern at this time. **Rancho Mission Viejo** at 28675 Ortega Highway was listed on the LUST list. The site was given closure on May 9, 2002.

4.4.3 California Regional Water Quality Control Board

EEI reviewed the Underground Storage Tank Information System (LUSTIS) and Spills, Leaks, Investigations, and Cleanup (SLIC) List, published by the California Regional Water Quality Control Board - San Diego Region (SDRWQCB), to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. There were no listings for the subject site.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Based on file data, no petroleum exploration or production has occurred on or adjacent to the site.

4.5 Interview with Site Personnel

In May 2001, EEI contacted Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner), who was interviewed regarding key site information for the **Oaks Polo Fields**. Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property. Mr. Vorhees noted that the property had been used for agricultural purposes in the past, and that pesticides may have been used. No other items of concern were noted during the interview (EEI, 2001a).

In June 2001, EEI contacted Mr. Vorhees, and interviewed him regarding key site information for **D&M Color Express Nursery**. Mr. Vorhees stated that the property had been used for agricultural purposes in the past, and that pesticides may have been used. He also stated that a small underground gasoline tank was removed in 1984 from along the dividing line between D&M and Miramar Nursery. He noted that no contamination was apparent at the time of the removal (EEI, 2001b).

In June 2001, EEI contacted Mr. Vorhees, and interviewed him regarding key site information for **Miramar Nursery**. Mr. Vorhees stated that the property had been used for agricultural purposes in the past, and that pesticides may have been used. He also stated that a small underground gasoline tank was removed in 1984 from along the dividing line between D&M and Miramar Nursery. He noted that no contamination was apparent at the time of the removal (EEI, 2001c).

In November 2001, EEI interviewed Mr. Vorhees regarding key site information for **Cellular On Wheels (C.O.W.) Site near Miramar Nursery**. No items of environmental concern were noted during the interview (EEI, 2001d).

In December 2001, EEI contacted Mr. Vorhees, and interviewed him regarding key site information for the **Former Les Thompson Lease** property. Mr. Vorhees stated that the property had historically been used for agricultural purposes, and that a petroleum pipeline once ran across the entrance to the site. No other items of environmental concern were noted during the interview (EEI, 2001e).

In January 2002, EEI contacted Mr. Vorhees, and interviewed him regarding key site information for the **Joan Irvine-Smith Pasture**. Mr. Vorhees stated that the property had been historically used for agricultural purposes. He also stated that an above-ground diesel tank was located on the property. No other items of concern were noted during th interview (EEI, 2002a).

In July 2002, EEI contacted Mr. Vorhees, and interviewed him regarding key site information for the **Oaks Corrals**. Mr. Vorhees stated that the property had historically been used for agricultural purposes, and that an above-ground diesel tank was located on the site. No other items of environmental concern were noted during the interview (EEI, 2002b).

In April 2003, EEI contacted Mr. Vorhees and interviewed him regarding key site information for the remainder of the subject property, including the open space in the northern area, the maintenance shop area at 28672 Ortega Highway, the orchards, and any other areas within the subject property that had not been previously covered. A list of the questions asked, and a summary of their responses, are included below.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: Yes, parts of the property are used to farm lemon groves.

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: Yes, the land has been farmed for a number of years.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No, with the exception of the maintenance area along Ortega Highway. Years ago we used to dump oil off the corner of the shop building.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: Yes. The maintenance area along Ortega Highway.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: Yes. There are some 55-gallon drums at the maintenance shop.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: Some fill dirt was brought in for one of the lemon groves (i.e., C Field), but it wasn't contaminated.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: At the maintenance shop.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the underground gasoline tank that was removed?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: Yes, waste oil was dumped in the maintenance area.

Q: *Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?*

A: No.

4.6 Previous Assessments

4.6.1 Phase I Environmental Site Assessment - Antonio Parkway Alignment

EEI reviewed a previous environmental site assessment (ESA) performed for the County of Orange as part of the Environmental Impact Report for the Antonio Parkway Roadway Alignment and Land Use Plan. This document was prepared by Michael Brandman Associates in May 1995 and is entitled *Appendix H - Hazardous Materials Environmental Site Assessment*. The ESA included a visual field reconnaissance from public streets and private interior roads, a review of historical aerial photographs and maps, and a review of federal, state and local regulatory databases.

The ESA noted no obvious hazardous materials contamination during a limited visual survey. The existence of USTs, hazardous substances, and agricultural pesticide/herbicide use were noted on properties near, but not adjacent to, the Antonio Parkway Corridor. However, these sites are located well over a mile from the subject property and were not considered environmental concerns.

The ESA identified two underground jet fuel pipelines (16-inch and 10-inch), owned by the Santa Fe Oil Pipeline Company, neither of which is listed on federal, state, or local hazardous materials contamination site databases. The 16-inch pipeline is apparently active, and runs along the western margin of the subject property, mainly following under the San Diego Gas & Electric 220 kV transmission lines. The 10-inch line has apparently been removed, and was located under the subject property, through the central portion underlying the former Joan Irvine-Smith Pasture and the Oaks Polo Fields.

4.6.2 Rancho Mission Viejo Field Office (28672 Ortega Highway) LUST Case

According to documents reviewed regarding the Rancho Mission Viejo Field Office (28672 Ortega Highway) LUST case, two 12,000-gallon UST's were removed from the site (one in 1992 and one in 1998). Soil contamination was documented during the removal of both tanks.

In September 1998, EEI collected three samples from the stockpiled soil generated during the tank removal of the second UST (EEI, 1998). The samples were analyzed for TPH-Gasoline (TPH-G), BTEX, MTBE, and Total Lead. No detectable concentrations of TPH-G, BTEX, or MTBE were reported. Total Lead concentration was reported in one sample at 3.6 milligrams per kilogram, which is below regulatory action levels. The soil was placed back into the tank pit excavation. In October 1998, EEI collected one soil sample from beneath the dispenser location, which was analyzed for TPH, BTEX, and MTBE. No detectable concentrations of contaminants were reported.

Groundwater at the site was monitored to determine if residual soil contamination related to the first UST (removed in 1992) was impacting the groundwater. In August 1999, groundwater conditions beneath the site reflected unconfined conditions. The depth to first water ranged from 13.30 to 16.46 feet bgs. Groundwater gradient was calculated to be approximately 0.027 ft/foot to the southeast. Laboratory analysis results of groundwater samples indicated that detectable concentrations of TPHg were only found in PMW-3 (1,500 micrograms per liter (ug/l)). Benzene was reported in wells PMW-1 and PMW-3, in concentrations of 1.6 ug/l and 190 ug/l, respectively. MTBE was also reported in wells PMW-1 and PMW-3, in concentrations of 21 ug/l (22 by EPA 8260) and 190 ug/l (160 ug/l by EPA 8260), respectively.

In 2000, EEI submitted a letter to the Orange County Health Care Agency requesting closure of the site (EEI, 2000). The basis for closure addressed the following concerns: the threat to San Juan Creek from the saturated soil, the potential for explosive hazards related to residual contamination, the extent of residual soil contamination, and the concentration versus time and concentration versus distance for the contaminants. According to the letter, there was insufficient data to connect the saturated soil at the site hydraulically to San Juan Creek, and therefore, the threat to the creek was deemed minimal. No evidence of subsurface utilities was found in the contaminant plume, thereby ruling out the possibility of an explosion hazard. The extent of residual contamination was estimated at approximately 192 cubic yards, and the plume appeared relatively stabile, and was contained on site. The graphs showed that, with minor fluctuations, average TPH, BTEX, and MTBE concentrations were decreasing over time. The site was closed in May 2001.

4.6.3 Phase I Environmental Site Assessment - The Oaks Polo Field/Creekside Pasture

In May 2001, EEI completed a Phase I environmental site assessment of the property occupied by Oaks Polo Fields and Creekside Pasture, located at the southwest corner of La Pata Avenue and Ortega Highway, in the southeastern portion of the subject property (EEI, 2001a). The site has been occupies by the polo fields since the late 1990's, and previously had been used for agricultural purposes. The property was described as a large, multi-functional facility that is host to polo, soccer, car show, and rodeo events. Also included in the assessment report was southern portion of the property, occupied by Sierra Soils, a small soil compost processing facility that mixes landscaping materials for commercial use.

The site was not listed on any regulatory database as having an environmental concern or operating permit. No evidence of environmental concern was observed at the property during the time of the assessment. However, historical research indicated the use of pesticides use, and EEI recommended a Phase II investigation in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils.

4.6.4 Phase I Environmental Site Assessment - D&M Color Express Nursery

In June 2001, EEI completed a Phase I environmental site assessment of the property occupied by D&M Color Express Nursery, located in the eastern portion of the property, north of Ortega Highway and on both the western and eastern sides of Antonio Parkway (EEI, 2001b). According to the report, the site was occupied by a commercial nursery with numerous small to medium-sized structures (i.e., office, maintenance building, greenhouses, sheds, trailers), a source pond, and a water filtration/blending station. The property has been occupied by the nursery since the mid 1980's, and was occupied by orchards since at least 1970. Prior to 1970, the property was vacant.

The site was identified as a hazardous waste generator, and the most recent inspection report reviewed (2000) did not note any violations. The site was permitted under the Orange County Fire Department to store gasoline, diesel, motor oil, propane, malathion, urea, sodium nitrate, ammonium sulfate, potassium sulfate, calcium chloride, methyl phenol, ammonium nitrate, metaldehyde, and various small quantities of insecticides, fertilizers, herbicides, and compressed gas.

No violations or issues of concern were noted during the site reconnaissance. Historical research of the site revealed the use of pesticides on the property, and the former presence of an underground gasoline storage tank (UST) located beneath a wind machine (removed in 1984).

EEI recommended a Phase II investigation in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils, and the monitoring of any future excavations in the area of the former UST. EEI conducted a limited soil investigation at the location of the former UST, and a discussion of the sample results is included below in section 4.6.6.

4.6.5 Phase I Environmental Site Assessment - Miramar Nursery

In June 2001, EEI completed a Phase I environmental site assessment of the property occupied by Miramar Nursery, located in the eastern portion of the subject property, at the southeast corner of La Pata Avenue and Ortega Highway (EEI, 2001c). According to the report, the site was occupied by a commercial nursery with numerous small to medium-sized structures (i.e., office, storage building, greenhouses, shade houses, sheds, and trailers). The site has been occupied by the nursery since the early 1990's, and previously had been used for agricultural purposes.

The site was not listed on any regulatory database as having an environmental concern or operating permit. Minor spillage of dry agricultural chemicals was noted in the shop area, and minor surficial petroleum staining was noted in unpaved areas of the shop. No other violations or items of concern were noted during the site visit. Historical research of the site revealed the use of pesticides on the property, and the former presence of an underground gasoline storage tank (UST) located beneath a wind machine (removed in 1984).

EEI recommended a Phase II investigation in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils, and the monitoring of any future excavations in the area of the former UST. EEI conducted a limited soil investigation at the location of the former UST, and a discussion of the sample results is included below in section 4.6.6

4.6.6 Limited Soil Investigation at Miramar Nursery

In November 2001, EEI conducted a limited soil investigation at Miramar Nursery per the recommendations of the Phase I ESA performed for the site and for D&M Color Express in June 2001 (EEI, 2001e). The purpose of the sampling was to evaluate the current condition of soil around a former Underground Storage Tank (UST), and to determine if there were any petroleum hydrocarbons present in the soil which could have presented a potential hazard to human health or the environment.

One trench was excavated in the area of the former tank. Three soil samples were collected and analyzed for Total Petroleum Hydrocarbons (TPH), Volatile Organic Compounds (VOC's), and Total Lead. No detectable concentrations of TPH were detected in any samples analyzed. Detectable concentrations of VOC's in the form of lead were reported in all three samples, ranging from 7.5 mg/kg to 12 mg/kg. These concentrations are background levels associated with natural occurring metals in soil and are not considered human or environmental hazards. No further investigation of the site was recommended.

4.6.7 Phase I Environmental Site Assessment - (C.O.W.) Site at Miramar Nursery

In November 2001, EEI completed a Phase I ESA of the Cellular on Wheels (C.O.W.) Site, located near Miramar Nursery (EEI, 2001d). The site was described as currently being used for storage of potted plant stock. Historic property use was agricultural.

The site was not listed on any regulatory database as having an environmental concern or operating permit. No evidence of environmental concern was noted during the site visit. EEI did not recommend any further action at the site.

4.6.8 Phase I Environmental Site Assessment - Les Thompson Transportation Lease

In December 2001, EEI completed a Phase I environmental site assessment of the property occupied by Les Thompson Transportation, north of the ranch headquarters along the ranch access road (EEI, 2001f). According to the report, the site was occupied by a transportation business, which included truck and trailer storage areas and a large wooden shed. The site was occupied by Les Thompson from the late 1990's to 2002, and previously had been used for storage.

The site was not listed on any regulatory database as having an environmental concern or operating permit. However, during the site reconnaissance, hazardous substances such as new and used oil, diesel, solvent, compressed gases, paint, welding materials, truck tires, and vehicle batteries were noted. In addition, several small surface spills of oil were noted on soils in this area, and many of the chemical containers were stored on bare ground.

EEI recommended that the vehicle maintenance at the facility be halted until proper use, handling, storage, and labeling of hazardous materials, waste, and petroleum products is implemented. EEI also recommended that oil-impacted soil be excavated and removed from the site, and that any further use of the facility as a vehicle storage and maintenance are occur only after paving those portions of the property intended for that purpose.

4.6.9 Limited Soil Investigation at Les Thompson Transportation Lease

In November 2002, EEI conducted a limited soil investigation (EEI, 2002c) at the Les Thompson Transportation lease property per the recommendations of the Phase I ESA performed for the site in December 2001. EEI excavated two shallow trenches in the former vehicle storage and maintenance areas of the site to a total depth of approximately 2 feet below ground surface.

Six soil samples were collected and analyzed for TPH-Diesel (TPH-D), TPH-Motor Oil (TPH-MO), VOC's, and Total Lead. No detectable concentrations of VOC's were reported in the samples. Reported concentrations of TPH-D ranged from 13 to 81 mg/kg, and TPH-MO concentrations ranged from 27 to 180 mg/kg. Reported concentrations of Total Lead ranged from 4.5 to 8.5 mg/kg. The reported levels were well below regulatory action levels, and no further action was recommended.

4.6.10 Phase I Environmental Site Assessment - Joan Irvine-Smith Pasture

In January 2002, EEI completed a Phase I environmental site assessment of the property occupied by the former Joan Irvine-Smith Pasture, northeast of the ranch headquarters, along the ranch access road (EEI, 2002a). The majority of the site was vacant at the time of the report, however, a small shed, a booster pump, and an above-ground diesel storage tank (AGT) were located at the southwest corner of the property. The site has been utilized for grazing purposes since at least the 1950's.

The site was not listed on any regulatory database as having an environmental concern or operating permit. During the site reconnaissance, a small gallon-sized container of diesel fuel was noted at the foot of the AGT, and some liquid was noted in the AGT. A pole-mounted transformer and two water wells were also noted on the property. No evidence of contamination was noted during the site visit. EEI recommended that the AGT containing diesel should be emptied and removed from the property.

4.6.11 Phase I Environmental Site Assessment - The Oaks Corrals

In July 2002, EEI completed a Phase I environmental site assessment for the property occupied by The Oaks Corral, along Ortega Highway in the southern portion of the subject property (EEI, 2002b). According to the report, the site was occupied by horse corrals and two electrical towers at the southern end. The corrals have been present since the 1980's, and previously had been vacant. In addition, the Petroleum Pipeline traverses through the center of the property from Ortega Highway and south towards San Juan Creek.
The site was not listed on any regulatory database as having an environmental concern or operating permit. During the site reconnaissance, a 500-gallon above-ground diesel tank was noted along the southern margin of the property. No evidence of environmental concern was noted during the site visit, and EEI did not make any recommendations.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, “thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials” applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as “ floor or ceiling tiles, siding, roofing, transite panels” (i.e., non-friable) are also considered PACM unless tested.

There a several permanent structures located within the subject property that were constructed prior to the 1950s. Therefore, ACM’s are likely to be present.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

There a several permanent structures located within the subject property that were constructed prior to the 1950s. Therefore, lead-based paint is likely to be present.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

EEI conducted a walking reconnaissance of the portions of the subject property occupied by the Oaks Polo Fields and Sierra Soils; D&M Nursery; Miramar Nursery; the former Les Thompson lease; the former Joan Irvine-Smith Pasture; the Miramar C.O.W. site, and the Oaks Corrals during previous environmental site assessment investigations from May 2001 through July 2002. The information collected during those site reconnaissances are included within the individual reports, and a brief summary is included above in section 4.6.

On March 31, 2003, EEI personnel conducted a reconnaissance of the entire site. Photographs 1 through 24 (**Appendix E**) document the site reconnaissance, which is summarized in **Table 3**. EEI personnel conducted a driving inspection around the perimeter of the subject property, then traversed the site from east to west and north to south. The site is located along Ortega Highway, just east of the City of San Juan Capistrano. The majority of the site is located north of Ortega Highway and west of Antonio Parkway, however, approximately 100 acres is located south of Ortega Highway, and approximately 100 acres is located east of Antonio Parkway. Access to the site is through Ortega Highway.

The western portion of the property is predominately developed as lemon groves, with some areas of vacant (undisturbed) open space. Within the lemon grove area, three unlabeled above-ground tanks (AGT's) were noted. A shed (approximately 200 square feet in dimension) located in the southern area of the lemon groves was noted to contain a few empty 5-gallon buckets, an empty 55-gallon drum, an empty 30-gallon drum, and two locked storage containers. The central portion of the shed was locked, and a warning label regarding the storage of pesticides was attached to the door. A pile of broken concrete was located south of the shed, and miscellaneous debris (chairs, wood, and a barbeque) were located along the eastern and northern sides of the shed. Stained soil was noted north and west of the shed.

The northern portion of the subject property is mostly undisturbed open space, including approximately fifteen acres east of Antonio Parkway. The former Joan Irvine-Smith Pasture is currently occupied by a ploughed field, a small shed, and an AGT, all of which are discussed in detail in the Phase I ESA (EEI, 2002a). The former Les Thompson lease area is occupied by a large barn-like structure and approximately 10 small trailers.

The central portion of the subject property is occupied by the Rancho Mission Viejo headquarters office, a recreational and conference facility, a pool, a helipad, lemon groves, several small parking lots, a residence, and a small shed. The eastern portion of the property is occupied by nurseries, D&M Color Express (EEI, 2001b) and Miramar (EEI, 2001c).

The southern portion of the property (south of Ortega Highway) is occupied by lemon groves, a maintenance yard with three structures, three residences, The Oaks horse corral (EEI, 2002b), and The Oaks Polo Fields (EEI, 2001a) which are comprised of horse stables, polo fields, several small parking areas, and a soils company (Sierra Soils). Pole-mounted transformers were noted adjacent to the lemon groves. Two 55-gallon drums labeled "non-regulated waste," two empty 55-gallon drums, one 55-gallon drum containing oily water, and two 55-gallon drums with pooled oil on top were noted in the vehicle maintenance area, along with stained concrete, stained soil, and a waste oil pan containing oil. Tires, scrap metal, wood piles, a sand pile, and many broken-down and/or abandoned automobiles with dripping oil were also noted in this area.

Based on the results of the site reconnaissance, evidence of contamination, petroleum-hydrocarbon staining, waste containers, and improper waste storage/handling were noted in the maintenance area located south of Ortega Highway and north of San Juan Creek.

5.2.2 Adjacent Properties

Adjacent properties are agricultural/undeveloped to the north, south, and east, and residential to the west. No environmental concerns were noted.

TABLE 3
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	Yes	Poor housekeeping practices in vehicle maintenance area located south of Ortega Highway and north of San Juan Creek.
Surface Spills	Yes	Small oil spills observed under vehicles.
Stained Soil/pavement	Yes	Minor spillage around maintenance area.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	None observed.
Surface Impoundments	No	None observed.
AGT's/UST's	No	Three small AGT's containing agricultural chemicals located in lemon orchards in western portion; one AGT containing diesel in former Joan Irvine-Smith Pasture
Distressed Vegetation	No	None observed.
Wetlands	No	Possible wetlands located adjacent to subject property along San Juan Creek south of former Joan Irvine-Smith pasture.
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	Along Ortega Highway
Waste/scrap storage	Yes	Truck tires and various debris/equipment stored in maintenance area south of Ortega Highway.
Chemical use/storage	Yes	Improper waste storage/handling noted in maintenance area south of Ortega Highway

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. Based on conversations with Rancho Mission Viejo personnel and items noted during the site visit, improper waste handling practices at the Field Office maintenance area south of Ortega Highway have resulted in releases of used oil onto the ground. EEI recommends that soil sampling be conducted to assess the possible presence of soil contamination.

2. Two 12,000-gallon UST's were removed from the Rancho Mission Viejo Field Office area (28672 Ortega Highway), one in 1992 and one in 1998. Soil contamination was documented during the removal of both tanks. Groundwater at the site was monitored to determine if residual soil

contamination related to the first UST (removed in 1992) was impacting the groundwater. Dissolved gasoline constituents were reported on groundwater samples. In June 2000, EEI submitted a letter to the Orange County Health Care Agency requesting closure of the site. Based on the fact that the extent of residual soil contamination had been defined, and that the groundwater plume appeared relatively stabile and contained on site, The OCHCA closed the case in May 2001 Based on the status of the site, no further action is warranted at the site at this time.

3. Evidence of a former underground gasoline wind machine tank was noted by the owner during the **D&M Nursery** and **Miramar Nursery** Phase I ESAs. No evidence of contamination was reportedly observed at the time of removal in 1984. In November 2001, EEI excavated a trench in the location of the former UST and collected three soil samples. The samples were analyzed for TPH, VOC's, and Total Lead. No detectable concentrations of TPH were detected in any samples analyzed. Detectable concentrations of VOC's in the form of lead were reported in all three samples. The reported concentrations were background levels associated with natural occurring metals in soil and are not considered human or environmental hazards. No further investigation of the site is warranted at this time.

4. The chemical storage/shop area in the **Miramar Nursery** lease property should be improved to include an impermeable surface (i.e., pavement) and secondary containment for used oil storage.

5. Irrigation runoff was observed leaving **Miramar Nursery** during the Phase I ESA. This practice constitutes a discharge and may be in violation of the Federal Clean Water Act and California Water Code. Measures to limit the offsite flow of irrigation runoff should be implemented.

6. Based on the results of the site reconnaissance during the **Les Thompson Lease** area Phase I ESA, evidence of contamination, petroleum-hydrocarbon staining, waste containers, and improper waste storage/handling were noted. EEI collected soil samples in October 2002 in areas that petroleum-hydrocarbon staining was noted. The samples were analyzed for total petroleum hydrocarbons diesel (TPH-D) and motor oil (TPH-MO) range, volatile organic compounds (VOC's), and lead. Minor concentrations of TPH-D and TPH-MO were reported. However, the reported concentrations are well below regulatory action levels. Therefore, no further action is warranted at the site.

7. The above ground tank should be emptied and removed from the former **Joan Irvine-Smith Pasture**. The contents of the tank should be either reused or transported off site for proper disposal.

8. Evidence of present and past agricultural use has been revealed. If residential or other potentially health-sensitive uses are contemplated (e.g., schools, child care facilities, etc.), EEI recommends that an investigation be conducted to assess the possible presence of residual pesticides in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils dated June 28, 2000.

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PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 2
(CHIQUITA CANYON)
San Juan Creek Haul Road and Cañada Chiquita Road
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA2

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Phase I Environmental Site Assessment

Prepared for:

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Site Location:

PLANNING AREA 2
(CHIQUITA CANYON)
San Juan Creek Haul Road and Cañada Chiquita Road
San Juan Capistrano, California

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EEI Project No. V030305-38A-PA2

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* within Planning Area Two (Chiquita Canyon), located at San Juan Creek Haul Road and Cañada Chiquita Road, approximately two miles northeast of San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.

- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.

- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.

- Interviews with individuals having knowledge of the site.

- A review of previous investigations conducted by EEI.

- A site reconnaissance to ascertain the current condition of the site.

- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area Two is located north of Ortega Highway, east of Antonio Parkway, south of Oso Parkway and Tesoro High School, and west of Canada Gobernadora. The area encompasses approximately 1,680 acres, and would be designated 1B-Suburban Residential on the General Plan. A total of 1,550 units are proposed in approximately 1030 acres within the Planning Area. This planning area also proposed approximately 40 gross acres of business park overlay zone, with an expected 610,000 square feet of business park uses and 50,000 square feet of neighborhood retail (5 acres). Six hundred fifty acres of open space are proposed in this planning area. The proposed Rancho Mission Viejo Regional Park would extend along the southern boundary of this planning area.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property encompasses portions of the lots identified by assessor's parcel numbers 125-161-40, 125-161-39, 125-161-35, 125-171-25 and 125-171-07 (**Assessor's Parcel Map, Appendix A**). Access to the property is available via San Juan Creek Haul Road, Cañada Chiquita Road, and ranch access roads.

The property is bounded by open space and vacant land to the east, vacant land and the Tesoro High School Conservation Easement to the west, San Juan Creek and an access road to the south, and Tesoro High School to the north. The Santa Margarita Chiquita Canyon Water Reclamation Plant is adjacent to the west of the subject property. According to the Orange County Planning Department, the site is zoned A-1 (General Agriculture). A copy of the County Zoning Map is included in **Appendix B**.

The site is currently occupied by lemon tree orchards and open space (**Site Plan, Figure 2**). EEI previously conducted an environmental site assessment of the former Sea Tree Nursery, located in the present-day lemon grove area, and a brief summary of this report is included below in section 4.6.

3.2 Topography

The site is located along Cañada Chiquita Creek, in a gently sloping alluvial valley, north of San Juan Creek. Site elevations range from approximately 200 feet above mean sea level (amsl) along the southern margin of the subject property, to approximately 500 feet amsl along the northern margin. The topographic gradient in the site vicinity is to the south-west at approximately 0.14 feet per foot. Surface drainage from the site flows south into San Juan Creek, and eventually into the Pacific Ocean, approximately three miles to the southwest. Based on the Flood Zone Map published by the Federal Emergency Management Agency (FEMA), the portions of the site along the creek lie within a 100-year flood zone. However, the majority of the subject property does not lie within a flood zone.

3.3 Regional and Local Geology

Cañada Chiquita is situated on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the site vicinity are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations (Morton, 1974). These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to the Botella, Capistrano, and Myford associations (USDA, 1978). Soils in the Botella and Capistrano associations are typically found on gently sloping to moderately sloping alluvial fans and consist mainly of well-drained clays and sandy loams. These soils have a moderately slow to moderately rapid permeability, medium runoff, and the erosional hazard is moderate.

Soils in the Myford association are found on marine terraces and consist mainly of sandy loams. This soil type is very slowly permeable, runoff is medium to rapid, and the erosional hazard is moderate.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 15 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Cristianitos Fault (just west of the site), the Mission Viejo Fault (east of the site), and the Newport Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the site lies within the Gobernadora Hydrologic Subarea of the San Juan Hydrologic Unit. In general, groundwater in this area has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but generally occur at between 10 and 100 feet bgs (Rancho Mission Viejo personnel, personal communication).

The Gobernadora Hydrologic Subarea is located within the San Juan Creek watershed. San Juan Creek (immediately south of the site), Canada Chiquita (adjacent to the west of the site), and Canada Gobernadora (east of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the DMB San Juan Investment North, LLC. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1953 to 1999 were reviewed at Continental Aerial Photo in Los Alamitos, California. In addition, a 2002 aerial photograph (EDAW) was also reviewed. **Table 1** summarizes the results of the aerial photograph review. A copy of a 2000 photograph is provided in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1953	AXK-SK-147[1]	The subject property is vacant and covered by thick vegetation. Adjacent properties are also vacant.
1959	261-8-29-116[1]	No pertinent changes were noted to the subject property since the previous photograph.
1967	2-169[1]	The small canyons in the subject property are cleared and possibly cultivated. Elevated areas of the site are vacant and covered with thick vegetation.
1970	61-8-208[1]	No pertinent changes were noted to the subject property since the previous photograph.
1973	132-12-17[1]	No pertinent changes were noted to the subject property since the previous photograph.
1977	181-13-25[1]	No pertinent changes were noted to the subject property since the previous photograph.
1983	218-13-25/13-24[1]	No pertinent changes were noted to the subject property since the previous photograph.
1987	F290/277[1]	The Chiquita Water Reclamation Plant is present adjacent to the west of the subject property. The area occupied by former Sea Tree Nursery has been cleared, but does not appear cultivated. The remainder of the site is vacant.
1992	C85-13-13/C85-17-13[1]	No pertinent changes were noted to the subject property since the previous photograph.
1993	C90-5-148/149[1]	No pertinent changes were noted to the subject property since the previous photograph.
1995	C102-42-175/176[1]	The area occupied by the former Sea Tree Nursery appears cultivated. A small holding pond at north part of the property was noted. The remainder of the property was noted as vacant.
1997	C117-42-40[1]	The northern portion of the property (north of former Sea Tree Nursery) appears cleared in the canyons, although the cleared areas do not appear cultivated. The remainder of the property is vacant.
1999	C-136-42-81/80[1]	No pertinent changes were noted to the subject property since the previous photograph.
2002	EDAW - Chiquita[2]	No pertinent changes were noted to the subject property since the previous photograph. The property appears in its current configuration.

(1) Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California
(2) Aerial Photograph obtained from EDAW

4.2.2 Historic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. The 1942 map was published by the United States Army Corps of Engineers. The 1948, 1968, 1974, 1980, 1982, and 1988 maps were published by the United States Geological Survey.

None of the maps from 1942 to 1988 show developed structures on the property. All the maps note a dirt road present along Cañada Chiquita. The 1988 map shows the presence of the adjacent Santa Margarita Water Reclamation Plant along the western margin of the subject property. No other pertinent items were noted.

4.2.3 City/County Directories

EEI reviewed available Criss Cross City Directories for Orange County. The subject property has never been assigned a street address, therefore, there were no listings for the subject property.

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

Based on reviews of historic aerial photographs, historic topographic maps and interviews with the property owner, the site has never been developed. Therefore, a review of building department records was not conducted for this ESA.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix C**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report.

4.3.1 Federal Databases

National Priority List (NPL) - No listings were reported within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No listings were reported within one-half mile of the subject site.

RCRA TSD Facility List (RCRA-D) - No listings were reported within one-half mile of the subject site.

RCRA COR (Corrective Action Sites) - No listings were reported within one mile of the subject site.

RCRA Generators (RCRA-G) - Three non-geocoded sites were identified. The sites are actually located greater than one mile from the subject property, and operating permits are no generally considered cause for environmental concern. Therefore, these sites are not considered environmental concerns at this time.

RCRA NLR (No Longer Regulated) - No listings were reported within one-eighth of a mile from the subject property.

Emergency Response Notification System (ERNS) - Eleven listings were reported within one-eighth of a mile from the subject property, all of which were non-geocoded. These sites are actually located greater than one mile from the subject property. Therefore, these sites are not considered environmental concerns at this time.

The subject property was not identified on any of the databases researched.

4.3.2 State and Regional Sources

State Listings - One non-geocoded site was identified within one mile of the subject site, however, this site is actually located in San Clemente, and is greater than one mile from the subject property. The site is not considered an environmental concern at this time.

Spills 1990 - No listings were reported within one-eighth of a mile from the subject property.

Solid Waste Landfill (SWL) Sites - Nine listings were reported within one half mile of the subject site, including seven non-geocoded sites that are actually located greater than one mile from the subject property. **Solag Disposal** (31641 Ortega Highway) and **Unknown** (31511 Ortega Highway) are located less than one-half mile southeast of the subject property. Operating permits are not generally considered cause for environmental concern, unless a documented release has occurred at the property. These sites are not considered environmental concerns at this time.

Permits - No listings were identified within one-eighth of a mile from the subject property.

Permitted Underground Storage Tanks (UST) - Four listings were reported within one-quarter mile of the subject site, all of which are non-geocoded and are actually located greater than one mile from the subject property. Therefore, these sites are not considered environmental concerns at this time.

Orange County Groundwater Clean-up List (Other) - One site was identified within one quarter of mile of the subject property. This site is non-geocoded and is actually located greater than one mile from the subject site. Therefore, these sites are not considered environmental concerns at this time.

California State Leaking Underground Storage Tanks (LUST) - Five listings were reported within one-half mile of the subject site. **Cal Mat** (31511 Ortega Highway) was formerly located approximately one-half mile east of the subject property. A gasoline leak was reported at this site in February 1990, reportedly impacting the soil only. The case was closed in February 1991. Based on the distance from the subject property and the status of the case, the site is not considered an environmental concern at this time. One listed site was non-geocoded and is actually located greater than one mile from the subject property. The remaining three are all listings for **California Silica Products Co./Oglebay Norton Industrial Sands, Inc.** (31302 Ortega Highway). A diesel release was reported in October 1990, impacting the soil only, and the case was closed in June 1991. A gasoline release was reported in April 1993, impacting the soil only, and the case was closed in March 1993. Finally, a diesel release was discovered during a tank test in August 1997, impacting the soil only. The case was closed in April 2001. Based on the distance from the subject site (over one-half mile) and the status of each case (closed) this site is not considered an environmental concern at this time.

Releases (Air/Water) - Two sites were listed within one-quarter mile of the subject property. Both listings were non-geocoded. The sites are listed as occurring on Oso Street, which is greater than one mile north of the subject property. Therefore, these sites are not considered an environmental concern at this time.

PCB Activity Database System (PADS) - No sites were listed within one quarter mile of the subject property.

The subject property was not listed on any state or regional databases researched.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority's (OCFA) office for information regarding hazardous materials storage at the subject site. According to the previous environmental site assessment of Sea Tree Nursery (EEI, 2002), the subject property does not have an official address or hazardous materials permit file. Therefore, it is not currently under a regular inspection schedule.

4.4.2 Orange County Health Care Agency

EEI reviewed Orange County Health Care Agency databases including Underground Storage Tank (UST) Facilities, Non-petroleum Underground Tanks, Leaking Underground Storage Tank (LUST) database, Hazardous Waste Generators and Land Fill Sites, to determine if the subject site or any properties within the site vicinity were listed as having an environmental concern. The subject site was not listed as having an environmental concern.

The adjacent Chiquita Water Reclamation Plant is identified as a closed LUST case (gasoline - File No. 00UT7). The case was issued closure on October 19, 2001. According to the previous ESA completed for Sea Tree Nursery (EEI, 2002), only limited contamination was reported in the vicinity of the tank pit. Based on the information reviewed by EEI, this site is not considered an environmental concern at this time.

4.4.3 California Regional Water Quality Control Board

EEI reviewed the online database GeoTracker, maintained by the California Regional Water Quality Control Board, to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. There were no listings for the subject site nor any adjacent property.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Only the southern portion of the subject site was covered. There are no wells or petroleum production and exploration reported on this portion of the subject site.

4.5 Interview with Key Site Personnel

In April 2002, EEI contacted Mr. Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner) for information regarding the former Sea Tree Nursery lease property (EEI, 2002). Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property. Mr. Vorhees stated that the property had historically been used for agricultural purposes. No other items of environmental concern were noted during the interview.

In April 2003, EEI contacted Mr. Vorhees for information regarding the remainder of the subject property.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: Yes, part of the property is used for farming lemon groves. The rest of it has always been grazing land.

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: Yes. Prior to 1983 the farmed area of the property was used for growing barley. From 1983-1998 it was used by Sea Tree Nursery for growing trees.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: *To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?*

A: No.

Q: *Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?*

A: No.

4.6 Previous Assessments

In April 2002, EEI completed a Phase I Environmental Site Assessment of the former Sea Tree Nursery, located in the central portion of the subject property (EEI, 2002). At the time of the report, the nursery was occupied by lemon groves and a wetlands mitigation area was noted to the west of the property. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling were noted during the site reconnaissance. Historical research indicated that the property was vacant prior to being cultivated, and no environmental concerns were noted regarding the subject property. The adjacent Santa Margarita Chiquita Canyon Water Reclamation Plant was identified as reporting a leaking underground fuel tank, and EEI recommended that the status of the case be monitored. The case has since been closed.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, "thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials" applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as " floor or ceiling tiles, siding, roofing, transite panels" (i.e., non-friable) are also considered PACM unless tested.

There are no structures located on the subject site. Therefore the presence of ACM is not anticipated.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

There are no structures located on the subject property. Therefore the presence of lead-based paint is not anticipated.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

On March 31, 2003, EEI personnel visited the entire site. Photographs 1 through 14 (**Appendix D**) document the site reconnaissance, which is summarized in **Table 2**.

The subject property is situated along Cañada Chiquita Creek, just east of Cañada Chiquita Road. The majority of the property (i.e., the northern, eastern, and southern portions) are undeveloped. Approximately 60 acres in the western portion (north of the Chiquita Water Reclamation Plant) is principally vegetated with lemon trees, although native plant material is present along the western margin and along the creek bed.

Access to the site is through an unpaved access road that runs along the southern margin of the property. Two dirt access roads run along the eastern and western margins of the property.

EEI personnel conducted a driving reconnaissance perimeter of the site, then traversed the site from east to west and north to south, visually observing the physical features of the site. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling were noted during the site reconnaissance.

TABLE 2
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Facility appears well maintained and in good condition.
Surface Spills	No	None observed.
Stained Soil/pavement	No	None observed.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	None observed.
Surface Impoundments	No	None observed.
AGT's/UST's	No	None observed.
Distressed Vegetation	No	None observed.
Wetlands	No	Yes, along creek and ponds.
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	None observed.
Waste/scrap storage	No	None observed.
Chemical use/storage	No	Consistent with facility usage (i.e., agriculture).

5.2.2 Adjacent Properties

The Santa Margarita Water District Chiquita Water Reclamation Plant is located immediately adjacent to the west, and Tesoro High School is located immediately adjacent to the north. Other adjacent properties to the west, east, and south are undeveloped/agricultural. No environmental concerns were noted.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. An adjacent property, Chiquita Water Reclamation Plant, was identified as a closed LUFT case. However, only limited soil contamination was reported, and the case was issued closure by OCHCA on October 19, 2001. Therefore, no further investigation appears to be warranted.

2. Evidence of past agricultural use has been revealed. If residential or other potentially health-sensitive uses are contemplated (e.g., schools, child care facilities, etc.), EEI recommends that an investigation be conducted to assess the possible presence of residual pesticides in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils dated June 28, 2000.

7.0 REFERENCES

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EEI

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PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 3
(GOBERNADORA CANYON)
Gobernadora Canyon Road and San Juan Creek Haul Road
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA3

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Phase I Environmental Site Assessment

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Site Location:

PLANNING AREA 3
(GOBERNADORA CANYON)
Gobernadora Canyon Road and San Juan Creek Haul Road
San Juan Capistrano, California

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* within the Planning Area Three (Gobernadora Canyon) portion of Rancho Mission Viejo, located approximately three miles east of the City of San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of previous investigations conducted by EEI.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area Three encompasses approximately 2,353 gross acres and would be designated 1B-Suburban Residential on the General Plan. This planning area is located north of San Juan Creek, west of Caspers Regional Park, south of Coto de Caza, and east of Canada Gobernadora. Approximately 5,630 dwelling units would be constructed on 2,089 acres. The remainder of the planning area (264 acres) would remain as open space. The residential areas would include apartments, estates, and senior housing. The planning area would also support overlay zones that propose 132 gross acres of core urban activity area with an expected 1,680,000 square feet of urban activity center, including office space, 100,000 square feet of retail, and a Town Center.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located in southeastern Orange County, approximately three miles east of San Juan Capistrano, and encompasses portions of each of the lots identified by assessor's parcel numbers 125-161-03, 125-161-41, 125-161-44, and 125-161-45 (**Assessor's Parcel Map, Appendix A**). Access to the property is through Ortega Highway, San Juan Creek Haul Road, and several ranch access roads.

The property is bounded by San Juan Creek to the south, a conservation easement to the west, a residential development to the north, and vacant land to the east. According to the Orange County Planning Department, the majority of the site is zoned A-1 (General Agriculture) and a portion of parcel 125-161-03 is zoned SG (Sand and Gravel Extraction). A copy of the County Zoning Map and zoning restrictions are included in **Appendix B**.

The majority of the subject property (the northern portion) is vacant and covered by thick vegetation. The remainder of the property (the southern portion) is currently occupied by various commercial, industrial, and agricultural businesses, and a few residences, including the following (**Site Plan, Figure 2**):

- Color Spot Nursery (31101 Ortega Highway) encompasses approximately 245 acres and is located in the central portion of the subject property. The site is a commercial nursery with a maintenance shop, storage buildings, greenhouses, lined ponds, an irrigation recovery system, and a water filtration/blending station;

- Cellular On Wheels (C.O.W.) Site near Color Spot Nursery (31101 Ortega Highway) encompasses approximately one acre and is located in the central portion of the subject property. The site currently contains two telecommunications tower and a small concrete structure, which apparently houses support equipment for the towers.

- St. Augustine's Training Center (31151 Ortega Highway) encompasses approximately one-half acre and is located in the southwest portion of the subject property. The site is occupied by a horse training facility with several stables, a few portable storage trailers, and two residential trailers;

- O'Connell Landscaping (31821 Ortega Highway) encompasses approximately one-half acre and is located in the southeastern portion of the subject property. The site is used as a storage yard which includes several portable storage units;

- Catalina Pacific Concrete (CPC) North (31511 Ortega Highway) encompasses approximately 16 acres and is located in the southeastern portion of the subject property. The site is occupied by a concrete batch plant which includes a truck fueling facility, a truck washout area, office building, scale house, maintenance shop, storage buildings, several storage units, and three sublessee spaces, including Saddleback Materials (materials storage), Chuck Royce Trucking (equipment storage), and Laguna Asphalt Paving (equipment storage);

- Cemex (formerly City Concrete, 31601 Ortega Highway) encompasses approximately four acres and is located in the southeastern portion of the subject property. The site is occupied by a concrete batch plant which includes an office trailer, maintenance trailer, fueling island, truck washout area, and a storage shed;

- Olsen Pavingstone (31511 Ortega Highway) encompasses approximately six acres and is located in the southeastern portion of the subject property. The site is occupied by a paving stone manufacturing plant which includes several office trailers, a residential unit, the manufacturing plant, and several storage units;

- CR&R/Solag Disposal Company (31641 Ortega Highway) encompasses approximately six acres and is located in the southeastern portion of the subject property. The site is occupied by a waste management facility which includes an office building, maintenance shop, fueling station, waste processing unit, and storage units;

- Ewles Materials (32501 Ortega Highway) encompasses approximately two and a half acres and is located in the southeastern portion of the subject property. The site is occupied by a recycling and processing plant which includes an office trailer, employee trailer, storage unit, a fuel compound, and a wash station;

- Campo Vaquero (31471 Ortega Highway) encompasses approximately fifty acres and is located in the southern portion of the subject property. The site includes pasture fields, a maintenance facility, and horse corrals;

- A field and lemon groves north of Ewles Materials;

- Several residences (31121, 31151, 31181, 31221, 31241,31261, 31263, 31265, 31381, and 31825 Ortega Highway) are located along the ridge north of Campo Vaquero, in the southwestern portion of Campo Vaquero along San Juan Creek, and adjacent to the O'Connell Landscaping storage yard.

EEI has previously completed Phase I Environmental Site Assessments for each of these sites, with the exception of Campo Vaquero (Cow Camp), the lemon groves and field, the residential units, and the northern portion (vacant property). A brief summary of each ESA is included below in section 4.6.

3.2 Topography

The site is located on a southward-sloping terrace, just north of San Juan Creek. Site elevations range from approximately 250 feet above mean sea level (amsl) along the southern margin of the subject property, to approximately 750 feet amsl along the northern margin. The average topographic gradient in the site vicinity is to the south/southeast at approximately 0.13 feet per foot.

3.3 Regional and Local Geology

The site is located in an alluvial valley (San Juan Creek) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the San Juan Creek area are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations. These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soils in the southern portion of the site, along the creek, have been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to the Modjeska, Myford, and Riverwash associations (USDA, 1978). Soils in these associations are typically found on broad, gently to moderately-sloping river terraces and consist mainly of well drained gravelly and sandy loams. Soils in the northern portion of the property have been identified by the USDA as belonging to the Cieneba and Corralitos associations. Soils in these associations are typically found on ridgetops and in long narrow areas, respectively. They are somewhat excessively drained sandy loams and loamy sands.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 15 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Cristianitos Fault (just west of the site), the Mission Viejo Fault (east of the site), and the Newport Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the northern portion of the subject property lies within the Gobernadora Hydrologic Subarea of the San Juan Hydrologic Unit and the southern portion of the subject property lies within the Middle San Juan Hydrologic Subarea of the San Juan Hydrologic Unit. In general, groundwater in this area has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but generally occur at between 10 and 100 feet below ground surface (Rancho Mission Viejo personnel, personal communication).

The Middle San Juan Hydrologic Subarea is located within the San Juan Creek watershed. San Juan Creek (immediately south of the site), Trampas Canyon (southeast of the site), and Canada Gobernadora (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

The Gobernadora Hydrologic Subarea is located within the San Juan Creek watershed. San Juan Creek (immediately south of the site), Canada Chiquita (west of the site), and Canada Gobernadora (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the DMB San Juan Investment North, LLC. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.2 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 to 1999 were reviewed at Continental Aerial Photo in Los Alamitos, California. In addition, EEI reviewed an aerial photograph dating from 2002 (EDAW). **Table 1** summarizes the results of the aerial photograph review. A copy of a 2000 aerial photograph is included in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1952	AXK-5K-146 [1]	Six structures were noted along San Juan Creek in the southern portion of the subject property. A residential structure and trailer were noted in the present-day O'Connell area. The cow field south of the present maintenance area was noted, although the maintenance area was noted as vacant. No other structures were noted on the subject property, and the remainder of the property was noted as vacant.
1953	AXK-5K-146 [1]	It appeared that small ponds were located in the present-day Color Spot Nursery area. No other changes were noted since the previous photograph.
1959	261 9-31-49 [1]	No pertinent changes were noted since the previous photograph.
1967	2-151 [1]	CalMat was noted in the southeast corner (on present CPC, Cemex, and Solag lease areas), and two terraces north of CalMat were farmed. Several large ponds were noted between CalMat and San Juan Creek. Houses (in their present configuration) were present along the ridge overlooking cow camp. Three barns were noted along the cow camp entrance road (two that are present today and one in the cow field). The large barn and corrals were noted in the southwest corner of the property, in their current configuration. Two medium sized structures were noted in the maintenance area. A residence and trailer were still noted in the O'Connell area. The canyons along the western margin were noted as cleared and possibly cultivated. The property adjacent to the west was cultivated. All other areas were vacant and covered with thick brush.
1973	132-12-17 [1]	Color Spot Nursery area was cleared but not cultivated. The field in the southwest corner was cultivated.
1975	157-13-22 [1]	Color Spot Nursery was partially present. The maintenance area in cow camp was occupied by two large barns, and the area south (the cow field) was cultivated. The houses in the western portion of cow camp were present in their current configurations. No other changes were noted since the previous photograph.
1983	218-14-24/ 14-25 [1]	A small portion of land in northern area is cleared with a few small structures, possibly vehicles. Western canyons were cleared and cultivated. Cow camp was noted in its current configuration with the exception of two medium-sized structures that were present along the access road from Ortega Highway. CalMat was noted to occupy the southeast portion, including the area currently occupied by Solag, Cemex, and CPC. Olsen Pavingstone area was vacant and covered with thick vegetation. The current Ewles area was occupied by roads, and otherwise vacant. The property occupied by St. Augustin's was cultivated. No other pertinent changes were noted since the previous photograph
1987	F290/F277 [1]	CalMat was noted to occupy the Olsen lease area. Terraces north of CalMat and east of Color Spot were cultivated, as well as the field south of the cow camp maintenance area. Western canyons were cleared and cultivated, and the adjacent property to the west was cultivated. No other pertinent changes were noted since the previous photograph.
1993	C90-5-149 [1]	Cow camp appears in its current configuration. The orchards east of Color Spot Nursery were cleared but not cultivated. The lease areas of Olsen and Ewles were occupied by their current occupants. The Solag, Cemex, and CPC lease areas were occupied by CPC. No other pertinent changes were noted since the previous photograph.
1997	C117-42-40 [1]	The Cemex and Solag lease areas were noted in their present configurations. The western margin and some canyons were cleared and possibly cultivated. The northern portion remained vacant. St. Augustine's area was cleared and vacant. The O'Connell storage yard was vacant, with the adjacent trailer and residence present.
1999	C136-42-82 [1]	The St. Augustine's site was noted in its current configuration. The O'Connell storage yard was noted, however, no fence was noted. No other pertinent changes were noted since the previous photograph.
2002	EDAW [2]	The subject property was noted in its current configuration. No pertinent changes were noted since the previous photograph.

[1] Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California
[2] Aerial Photograph obtained from EDAW

4.2.3 Historic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. The 1942 map was published by the United States Army Corps of Engineers. The 1948, 1968, 1975, 1980, 1982, and 1988 maps were published by the United States Geological Survey.

The 1942 map notes the presence of dirt roads along the western and eastern margins and through the center of the property. There is no indication of development on the property. No other pertinent items were noted.

No pertinent changes were noted on the 1948 map.

The 1968 map notes the presence of mining operations in the southeast portion, and a gravel pit along San Juan Creek. Two water tanks and approximately thirty structures were noted along San Juan Creek Haul Road (the southern margin of the property). No other pertinent items were noted.

No pertinent changes were noted on the 1975 map.

The 1980 map notes the presence of two large structures and two rows (dirt roads) in the cultivation area of Color Spot Nursery. No other pertinent changes were noted.

The 1982 noted the presence of approximately ten more small structures on the subject property along southern margin and two small structures north of Color Spot Nursery. Four rows (dirt roads) are noted across Color Spot Nursery. No other pertinent changes were noted.

The 1988 map notes the presence of three more small structures in Color Spot Nursery property. No other pertinent changes were noted.

4.2.4 City/County Directories

EEI reviewed available Criss Cross and Haines City/County Directories for Orange County at the Main Library in Santa Ana, California. Within the subject property there are at least 17 addresses along Ortega Highway: 31101, 31121, 31151, 31181, 31221, 31241, 31261, 31263, 31265, 31381, 31471, 31511, 31601, 31641, 31821, 31825, and 32501. Most of the addresses associated with the subject property were either not listed in the directories reviewed by EEI, or were residential listings. **Table 2** summarizes the information reviewed in the directories for the non-residential addresses.

TABLE 2
Site Tenants/Occupants

Year	Subject Property Addresses - Ortega Highway					
	31101	31151	31511	31641	31471	32501
1952	No Listing	No Listing	No Listing	No Listing	No Listing	No Listing
1972	No Listing	No Listing	Consolidated Rock Products, Griffith Company	No Listing	Highland Ranch	American Cement Corp
1976	No Listing	Malagon Efren	Conrock Co. Griffith Co.	No Listing	No Listing	American Cement Corp
1980	Oshita Michael	Malagon Efren Orozco Felipe	Conrock Co. Huntmix Inc.	No Listing	Grimmway Farms	American Cement Corp
1985	Axton EDW	Malagon Efren	Huntmix Inc.	No Listing	Kotake Bros	No Listing
1990	Lenz Paul	Malagon Efren	Ewles Materials Olsen Pavingstone	No Listing	No Listing	No Listing
1995	No Listing	Malagon Efren	Catalina Pacific Concrete Ewles Materials Olsen Pavingstone	No Listing	No Listing	No Listing
2002	No Listing	Crosswaite Angel	Bestone Interlock Constr., Ewles Materials, Olsen Pavingstone	Solag Disposal Co	No Listing	No Listing

4.2.5 Orange County Building and Safety Department Files

EEI reviewed files at the Orange County Building and Safety Department (OCBSD) regarding historical and present site development. The OCBSD does not issue permits to sites without addresses. Permits were on file for the properties at 31101, 31181, 31221, 31263, and 31265 Ortega Highway. According to OCBSD personnel, the remainder of the subject property addresses did not have files at the OCBSD available for review. The following is a summary of the files reviewed.

A permit was issued for the construction of a greenhouse at 31101 Ortega Highway in October 1973. A permit was issued in June 1965 for the construction of a dwellings with attached garage at 31181 Ortega Highway and 31221 Ortega Highway. A grading permit was issued at 31263 Ortega Highway for Ranch House Sites in May 1985. A grading permit was issued at 31265 Ortega Highway for Ranch House Sites in May and April 1985. In April the permit was issued for 1,900 cubic yards of grading for a single family home. No other pertinent items were noted.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix C**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report.

4.3.1 Federal Databases

National Priority List (NPL) (Superfund) - No listings within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No listings within one-half mile of the subject site.

No Further Remedial Actions Planned (NFRAP) - No listings within one-eighth of a mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No listings within one-half mile of the subject site.

RCRA Corrective action sites (COR) - No listings within one mile of the subject site.

RCRA Generators (RCRA-G) -The Environmental Protection Agency (EPA) regulates generators of hazardous material through the Resource Conservation and Recovery Act (RCRA). All hazardous waste generators are required to notify EPA of their existence by submitting the Federal Notification of Regulated Waste Activity Form (EPA Form 8700-12) or a state equivalent form. Three other non-geocoded sites were identified. Upon further review of readily available resources, EEI determined that these sites are located greater than one-quarter mile from the subject property. Operating permits are not generally considered rational for environmental concern unless a documented release has occurred at the property. Therefore, these sites are not considered environmental concerns at this time.

RCRA No Longer Regulated (NLR) - No listings within one-eighth of a mile of the subject site.

Emergency Response Notification System (ERNS) - Eleven non-geocoded sites were reported. The calls appear to be mostly highway/railway related with none or minor amounts of materials released. Nine spills that were reported were localized to the site reported at. All eleven sites appear to be at least one-eighth of a mile away from the subject site. Therefore, these reports are not considered environmental concerns at this time.

The subject site was not identified by any of the sources listed above as having an environmental concern or operating permit.

4.3.2 State and Regional Databases

Sites that are Contaminated or Potentially Contaminated by Hazardous Wastes (State Sites) - One non-geocoded site was reported. The **Capistrano Unified School District** proposed a school location within one mile of the subject site. The Department of Toxic Substances Control was called to the location for an inspection. No action was needed. Therefore, this site is not considered an environmental concern at this time.

Sites with a record of spills, leaks, investigations, and cleanups (Spills - 1990) - No listings within one-eighth of a mile of the subject site.

Solid Waste Landfills (SWL) - **Solag Disposal** (31641 Ortega Highway, located in the southeast portion of the subject property) was reported on this database. As of March 4, 1999 the site has been closed. Seven other non-geocoded sites were reported. Upon further review of readily available resources, EEI determined that the other reports were greater than one-half mile from the subject site. Therefore, these reports are not considered an environmental concern.

Establishments Issued a Permit to Track Site Status as a hazardous waste generator, gas station, TSD, underground tanks, violations, or unauthorized releases (Permits) - No listings within one mile of the subject site.

Other Unique Databases (Other) - One non-geocoded site was reported. Upon further review of readily available resources, EEI determined that this site is greater than one-eighth of a mile from the subject site. Therefore, this report is not considered an environmental concern.

Permitted Underground/Aboveground Storage Tanks (REG UST/AST) - **Quest Diagnostic** (33608 Ortega Highway, approximately one quarter of a mile east of the subject site) and the **Casper Wilderness Park** (33401 Ortega Highway, approximately one quarter of a mile east of the subject site) are listed as having active underground storage tanks. Four other non-geocoded sites were reported. Upon further review of readily available resources, EEI determined that these sites are located more than one-quarter mile from the subject site. Operating permits are not generally considered rational for environmental concern unless documented releases have occurred at the property. Therefore, these sites are not considered an environmental concern at this time.

Leaking Underground Storage Tanks (Leaking UST): Three sites were reported within one mile of the subject property. **Ford Aerospace** (33600 Ortega Highway, approximately one half mile south of the subject site) reported as gasoline release on January 1, 1965. Reportedly, only the surrounding soil was impacted. The contaminated soil was removed and the case was closed March 19, 1992. The **Los Pinos Forestry Camp** (39251 Ortega Highway, approximately one half mile east of the subject site) reported a gasoline release on August 14, 1992 and a nearby aquifer was reportedly affected. The current status of this report states a preliminary site assessment is underway. Upon further review of readily available resources, EEI determined the third site (non-geocoded) is greater than one-half mile from the subject site. Based on the distance from the subject site (i.e., over one-quarter mile), the position (i.e., downhill/downgradient), and/or status (i.e., pending closure), these sites are not considered as environmental concerns at this time.

Releases into air and surface water (Releases) - Two non-geocoded sites were reported. Upon further review of readily available resources, EEI determined these sites are located more than one mile from the subject site. Therefore, these sites are not considered an environmental concern at this time.

PCB Activity Database System (PADS) - No listings within one mile of the subject site.

Solag Disposal (located in the southeast portion of the subject property) was reported on the SWL database. An operating permit is not considered rationale for further investigation. Therefore, this site is not considered as an environmental concern at this time.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority's (OCFA) office for information regarding hazardous materials storage at the subject site. According to previous assessments of the subject property and recent inquiries to the OCFA, most sites within the subject property do not have an official address or hazardous materials permit file, and are not currently under a regular inspection schedule. The sites currently under routine inspection by OCFA include **Catalina Pacific Concrete** (31511 Ortega Highway), **Cemex/City Concrete** (31511 Ortega Highway), **Color Spot Nursery** (31101 Ortega Highway), **Olsen Pavingstone, Inc.** (31511 Ortega Highway), **St. Augustine's Training Center** (31151 Ortega Highway), **Ewles Materials** (32501 Ortega Highway), **CR&R/Solag Disposal** (31641 Ortega Highway), and **Cow Camp** (31471 Ortega Highway). With the exception of **Cow Camp**, specific information obtained from the OCFD regarding these sites is included within the respective reports.

According to OCFA inspection records, **Cow Camp** currently holds hazardous materials operating permits for flammable compressed gases, oxidizer compressed gas, combustible liquids, welding and cutting operations, and other health hazardous materials. Permits to operate a motor vehicle fuel dispensing stations and flammable/combustible liquid vehicles, equipment, and tanks were also noted. The site is currently permitted to store the following chemicals: acetylene; antifreeze/coolant; diesel fuel; Formula 40R (alkanolamine salts of 2,4,D); motor oil; compressed oxygen; unleaded gasoline; and waste motor oil. There were no indications of code violations, hazardous materials spills or emergency responses in OCFA files. A list of chemicals stored and the maximum daily volume stored onsite is included in **Appendix D**.

The other sites within the subject property currently hold operating permits for the following: flammable/combustible liquid vehicles, equipment, and tanks; liquified petroleum gases; combustible liquids; corrosives; flammable compressed gases; oxidizers; motor vehicle fuel dispensing stations; and other health hazardous materials. The sites are currently permitted to store diesel fuel; propane; gasoline; motor oil; urea; sodium nitrate; ammonium nitrate; potassium chloride; potassium nitrate; phosphoric acid; calcium hydroxide; metaldehyde; and various small quantities of insecticides, fertilizers, herbicides; compressed gas; oxygen gas; acetylene; MT-55 acculube (Gear Lube); transmission oil; antifreeze; plastic gloss brown paint; Tekusolu II parts cleaner; paraffinic and naphtenic hydrocarbons; and engine oil. There were no indications of code violations, hazardous materials spills or emergency responses in the OCFA files.

4.4.2 Orange County Health Care Agency

EEI contacted the Orange County Health Care Agency (OCHCA) Custodian of Records to obtain copies of any Underground Storage Tank (UST) Operating Permits, Leaking Underground Fuel Tank (LUFT) files and/or any Hazardous Waste Permit (Hazmat) files for the various sites within subject property. The information obtained from the OCHCA regarding the sites previously assessed are included with the respective reports. Information regarding the Cow Camp maintenance facility (31471 Ortega Highway) was requested from the OCHCA and additional data was obtained from the Ranch Manager of Rancho Mission Viejo, Mr. Derek Knobel. The following is a summary of the information contained in OCHCA Files and from the information provided by Mr. Knobel.

Cow Camp (located in the southern portion of the subject property) is currently permitted to operate two underground storage tanks (UST): one 10,000-gallon diesel UST and one 500-gallon waste oil UST, both installed in 1988.

Annual UST inspections have occurred irregularly at the site over the past 15 years. The most recent inspection available for review in the OCHCA files was performed in March 2001. The following violations were noted: failure to correct previous violations within 30 days; failure to obtain or show evidence of financial responsibility; failure to annually test and/or submit proof of installation of pipeline leak detectors; failure to annually test certify continuos monitoring device; and the Ronan monitor was showing an alarm in the diesel sump. The inspector noted that the cause of the alarm needed to be investigated and to make any necessary repairs to the tank system. Other past UST inspections have noted such violations as failure to develop leak response plan to remove an unauthorized release from secondary containment and that, according to an employee, the diesel tank had been empty for over a year (2000).

Hazardous waste annual inspections have occurred at the same irregular periods. The most recent inspection report available for review was performed in March 2001. The inspector noted the following waste streams at the site: waste oil (maximum daily storage volume 500-gallons); used oil filters (maximum daily storage volume 200 filters); floor sweep with oil (maximum daily storage volume 60 pounds); spent radiator coolant (maximum daily storage volume 55-gallons); and parts cleaner (maximum daily storage volume 20-gallons). No violations were noted at the site during the inspection.

4.4.3 California Regional Water Quality Control Board

EEI reviewed the Leaking Underground Fuel Tank (LUFT) Database and the Spills, Leaks, Investigations, and Cleanup (SLIC) List, published by the California Regional Water Quality Control Board - San Diego Region (SDRWQCB), to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. No sites within the subject property were listed on the SDRWQCB databases, with the exception of **Catalina Pacific Concrete (CPC)**, located in the southern margin of the subject property.

CPC was identified as the location of a closed LUFT case. Based on the information reviewed, an unauthorized release of diesel was discovered in February 1990. Only the soil was impacted. The cause of the leak and the source of the leak are unknown. The case received regulatory closure on February 5, 1991. No other pertinent information was noted. The case is discussed in detail in the Phase I ESA completed for the site (EEI, 2002e).

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Based on file data, one petroleum exploration well (Exxon, "O'Neill Estate") was installed in the central portion of the property in 1959 to a total depth of approximately 4,100 feet, and one petroleum exploration well (Texaco Inc., "O'Neill") was installed south of the subject property, along Ortega Highway, in 1964 to a total depth of approximately 3,730. Both wells are marked as "Plugged and Abandoned - Dry Hole."

4.5 Interview with Key Site Personnel

In January 2000, EEI contacted Jim Hessler, Vice President and General Manager for Color Spot Nursery in San Juan Capistrano, who was interviewed regarding key site information (EEI, 2000). Mr. Hessler indicated that he had been working at the facility for approximately 7 years and was familiar with facility operations. Also present during the interview was Bill Miyashiro, who worked as a foreman at the facility (when owned by Oda Nursery) from approximately 1970 through 1997. These site representatives indicated that pesticides were used and stored on-site and that there were above-ground diesel, gas, and propane tanks on-site. No other items of environmental concern were noted during the interview.

In October 2001, EEI contacted Steve Wright, General Manager for **CR & R**, and interviewed him regarding key site information (EEI, 2002a). Mr. Wright stated that the property was used as a waste management transfer station, and that automotive batteries were stored on-site and disposed of by a recycling company. He also indicated that there were several UST's on-site (diesel, gasoline, and waste oil). No other items of environmental concern were noted during the interview.

In October 2001, EEI contacted Ole Hjorth-Olsen, owner of **Olsen Pavingstone, Inc**, and interviewed him regarding key site information (EEI, 2002d). Mr. Hjorth-Olsen stated that the site was used in the production of pavingstones, and that there was an above-ground diesel tank on-site. No other items of environmental concern were noted during the interview.

In October 2001, EEI contacted Christine Jones, Regional Environmental Manager for **Cemex**, who was interviewed regarding key site information (EEI, 2002b). Ms. Jones stated that the site was used for a Ready Mix concrete facility, and that chemicals such as diesel, cement, oil, and antifreeze were stored and used on-site. Ms. Jones also stated that there were concrete-lines pits for truck wash-out. No other items of environmental concern were noted during the interview.

In October 2001, EEI contacted Larry Ewles, Vice President and site operator of **Ewles Materials**, and interviewed him regarding key site information (EEI, 2002c). Mr. Ewles indicated that he had been on the current site approximately 11 years and was familiar with the site. Mr. Ewles stated that the property was used in recycling concrete and asphalt. He indicated that used oil filter storage and fuel tanks were located on-site. No other items of environmental concern were noted during the interview.

In October 2001, EEI contacted Tina Sentner, Senior Manager of Regulatory Matters for **CPC - North**, and interviewed her regarding key site information (EEI, 2002e). Ms. Sentner stated that the property was used for Ready Mix concrete production, and had previously been used as a rock plant. Ms. Sentner also stated that there was historically a repair shop on-site, and that there were several UST's and AGT's (diesel, waste oil, and motor oil) on the property. No other items of environmental concern were noted during the interview.

In April 2002, EEI contacted Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner), who was interviewed regarding key site information regarding the **O'Connell Landscaping** storage yard. Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property (EEI, 2002e). Mr. Vorhees stated that there was an above-ground diesel tank on the property. No other items of environmental concern were noted during the interview.

In July 2002, EEI interviewed Mr. Vorhees regarding key site information for **St. Augustine's Training Center** (EEI, 2002g). No items of environmental concern were noted during the interview.

In November 2001, EEI interviewed Mr. Vorhees regarding key site information for **Cellular On Wheels (C.O.W.) Site near Color Spot Nursery** (EEI, 2001). No items of environmental concern were noted during the interview.

In April 2003, EEI contacted Mr. Vorhees regarding key site information for the remainder of the subject property, including the northern area, **Cow Camp**, the areas around cow camp, the orchards, and any other areas within the subject property that had not been previously covered. A list of the questions asked, and a summary of their responses, is included below.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: Yes.

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: Yes. The western side of the canyon was farmed for peppers, cabbage, and cauliflower. Kotaki used to farm in the southern area until about 1985.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: Yes, there is a maintenance shop on site.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: Yes, in the maintenance shop area.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: Yes. There is one 10,000-gallon UST for diesel, and one 500-gallon UST for waste oil outside the Cow Camp shop area. Also, there is a 1,000-gallon gasoline AGT and a 1,000-gallon diesel AGT in the same area. In the mid 1980's a 500-gallon gasoline tank was removed from the area south of the corrals in Cow Camp.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: Yes, we used to bury old equipment just east of the Cow Camp maintenance area.

Q: Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?

A: No.

4.6 Previous Environmental Assessments

4.6.1 Phase I Environmental Site Assessment Color Spot Nursery

In March 2000,EEI completed a Phase I ESA for **Color Spot Nursery**, located in the central portion of the subject property north of the Cow Camp area since approximately 1974 (EEI, 2000). The property was described as a commercial nursery which included numerous small to medium sized structures, three lined ponds, an irrigation recovery system, and a water filtration/blending station. The site was not listed on any regulatory database as having an environmental concern or operating permit.

No indications of code violations, hazardous material spills, or other concerns were noted in the Fire Department files. EEI also reviewed files regarding the site with the Orange County Health Care Agency files (OCHCA), and noted that the site has been a hazardous waste generating facility since 1991. Two underground storage tanks (one diesel and one gasoline) were removed from the site in 1989, and no contamination was reported under the tanks. Only minor violations were noted in the OCHCA inspection reports. No items of concern were noted in the OCHCA files.

During the site visit, surficial oil spills were noted in the shop area, especially in the area of the waste oil AGT. Surface staining was noted in the dispensing areas around two 1,000-gallon AGTs (one diesel and one gasoline). No other evidence of environmental concern was observed at the property during the time of the assessment.

EEI recommended that the areas of surficial petroleum staining near the AGTs be investigated. EEI further noted that irrigation runoff observed leaving the site is considered a discharge, and that the site may be in violation of the Federal Clean Water Act and California Water Code.

4.6.2 Phase I Environmental Site Assessment CR&R/Solag Disposal Company Inc.

In January 2002, EEI completed a Phase I ESA of the **CR&R/Solag Disposal Company Inc.** facility, located in the southeast portion of the subject property since approximately 1996 (EEI, 2002a). Prior to 1996, the site was occupied by an asphalt/cement batch plant from the early 1960's to 1990. The site was described as a waste management facility, including an office building, maintenance shop, fueling station, waste processing unit, and storage units. The site was not listed on any regulatory database as having an environmental concern or operating permit.

No indications of code violations, hazardous material spills, or other concerns were noted in Fire Department files. The site was identified as a hazardous waste generating facility with the OCHCA, and no violations were noted in the most recent inspection report reviewed by EEI.

During the site visit, EEI noted the presence of a hazardous material storage area, several clarifiers, and underground storage tanks. Minor oil staining was noted in the asphalt parking lot. No other evidence of environmental concern was noted during the site visit.

EEI recommended that, while no acute environmental concerns were noted during the ESA, site soil and groundwater sampling in and around the USTs, dispensers, and clarifiers should take place prior to the termination of the existing tenants lease. Several previous environmental assessment reports performed at the site were reviewed by EEI. A complete discussion of these reports is included within the report.

4.6.3 Phase I Environmental Site Assessment Olsen Pavingstone

In January 2002, EEI completed a Phase I ESA of the **Olsen Pavingstone Inc.** facility, located in the southeastern portion of the subject property since at least 1990 (EEI, 2002d). The site was described as a paving stone manufacturing plant, which includes several office trailers, a residential unit, shop area, and storage buildings. The site was not listed on any regulatory database as having an environmental concern or operating permit.

No indications of code violations, hazardous material spills, or other concerns were noted in the Fire Department files. The site was not identified by the OCHCA as having any operating permits, and no files were available regarding the site.

During the site visit, EEI noted the presence of hazardous material storage area, and a 1,000-gallon diesel AGT. No items of concern were noted, and EEI did not recommend any further investigation.

4.6.4 Phase I Environmental Site Assessment Cemex

In January 2002, EEI completed a Phase I ESA of the **Cemex** facility, located in the southeastern portion of the subject property since the mid 1990's (EEI, 2002b). Prior to that, the site was occupied by a sand and gravel mining operation from at least the early-1960's to the early-1990's. The site was described as a concrete batch plant, including an office trailer, maintenance trailer, fueling island, truck washout area, and a storage shed. The site was not listed on any regulatory database as having an environmental concern or operating permit.

No indications of code violations, hazardous material spills, or other concerns were noted in the Fire Department files. No violations or items of environmental concern were noted in the OCHCA files. EEI also reviewed information regarding the site with the California Regional Water Quality Control Board. The site was identified as existing on a larger parcel, which reported a leaking underground fuel tank (LUFT) case in 1990. According to the information reviewed, a diesel release occurred, reportedly impacting the soil only, and the case was closed in 1991.

During the site visit, EEI noted the storage of oil drums, waste oil drums, lubricant containers, and admixture containers. With the exception of minor oil staining, no evidence of environmental concern was noted on the property. EEI recommended that hazardous substances storage and handling practices at the subject property be improved to prevent spills.

4.6.5 Phase I Environmental Site Assessment Ewles Materials

In January 2002, EEI completed a Phase I ESA for the **Ewles Materials** facility, located in the southeastern portion of the subject property since at least 1990 (EEI, 2002c). Prior to the 1990s, the site was vacant. The site was described as a manufacturing and processing plant, which includes an office trailer, employee trailer, storage unit, fuel compound, and wash station. The site was not listed on any regulatory database as having an environmental concern or operating permit, however, a former occupant of the site, **CalMat** was identified as having a closed LUFT case. This is the same LUFT case discussed in section 4.6.4.

The most recent fire department inspection report noted a house keeping violation and a permit related violation, with no specific details. The OCHCA identified the site as a hazardous materials generating facility, and no violations were noted on the most recent inspection report.

During the site visit, EEI noted the presence of a diesel AGT, an oil AGT, a waste oil AGT, several 55-gallon drums of lubricant, hazardous chemical storage, and minor petroleum hydrocarbon stained soil throughout the site. EEI recommended that, prior to the termination of the existing tenant's lease, sampling of near-surface soils in and around the crushing operation and maintenance area should be performed and the samples analyzed for petroleum hydrocarbons, heavy metals, and PAH's.

4.6.6 Phase I Environmental Site Assessment Catalina Pacific Concrete

In February 2002, EEI completed a Phase I ESA of the **Catalina Pacific Concrete (CPC)** facility, located in the southeast portion of the subject property since the 1990's (EEI, 2002e). The site had been occupied by a sand and gravel mining operation from at least the early-1960's to the early-1990's. The majority of the site was occupied by a concrete batch plant, including a truck fueling facility, truck washout area, an office, a scale house, a maintenance shop, storage buildings, various sheds, and trailers. The eastern portion of the site was occupied by Saddleback Materials (office trailer, storage bin, and materials storage); Solag Disposal (Trash Bin Storage), Chuck Royce Trucking (equipment storage), and Laguna Asphalt Paving (equipment storage).

The site was identified on regulatory databases as holding a permit to operate underground storage tanks. A former occupant of the site, **CalMat**, was identified as having a closed LUFT case (discussed in section 3.6.4). No violations were reported in the Fire Department files. No violations were noted during the most recent OCHCA hazardous waste and underground storage tank site inspection. Soil samples collected during the removal of one 10,000-gallon diesel UST in 1986 reported minor concentrations of total hydrocarbons, and there was no evidence to indicate further action by OCHCA. Soil samples collected during the removal one 5,000-gallon gasoline UST and one 10,000-gallon diesel UST in 1990 reported minor levels of ethylbenzene, toluene, and xylenes, and elevated levels of gasoline range fuel hydrocarbons. However, no evidence to indicate further action by OCHCA was found in the file, and the site was given closure in 1991.

During the site visit, EEI noted the presence of hazardous chemicals, gas, oils, and solvents on the site. EEI recommended that, while no acute environmental concerns were noted during the ESA, site soil and groundwater sampling in and around the USTs, dispensers, and vehicle storage areas should take place prior to the termination of the existing tenants lease. EEI also recommended that the truck washout recycling pond and related chemicals should be dismantled and removed and the pond contents be removed and disposed of prior to termination of the existing tenant's lease, and that a licensed and certified asbestos and lead paint inspector should be contacted prior to demolition or remodeling of site structures. Several previous environmental assessment reports performed at the site were reviewed by EEI. A complete discussion of these reports is included in the report (EEI, 2002e).

4.6.7 Phase I Environmental Site Assessment O'Connell Landscaping

In April 2002, EEI completed a Phase I ESA of the **O'Connell Landscaping** lease, located in the southern portion of the subject property since at least 1999 (EEI, 2002f). Prior to that, the site was predominantly vacant or used for storage. The site was described as a storage yard for O'Connell Landscaping, including several small portable storage structures. The site was not listed on any regulatory database as having an environmental concern or operating permit. There were no files regarding the subject property with either the Fire Department or the OCHCA.

During the site visit, EEI noted the presence of an un-permitted 100-gallon AGT (on a small concrete pad with no secondary containment), as well as waste oil containers, open 5-gallon oil containers, and a 55-gallon drum used for waste oil storage. Evidence of minor chemical storage, waste containers, improper chemical/waste storage and handling, and minor oil staining were noted during the visit.

EEI recommended that the use of the 100-gallon AGT be discontinued until a permit from the Fire Department is obtained; that the tenant contact the Fire Department and OCHCA regarding proper waste storage procedures, and possibly should register as a waste generating facility; and that petroleum-impacted soils noted during the site visit be removed and properly disposed.

4.6.8 Phase I Environmental Site Assessment St. Augustine Training Center

In July 2002, EEI completed a Phase I ESA of the **St. Augustine's Training Center**, located in the southwestern portion of the subject property since 1998 (EEI, 2002g). Prior to 1998, the site was predominantly vacant, although it was farmed for a short period in the mid-1980's. The site was described as a horse training center, including stables, two portable storage trailers, and two residential trailers.

The site was not listed on any regulatory database as having an environmental concern or operating permit. No evidence of environmental concern was noted during the site visit. EEI did not recommend any further action at the site.

4.6.9 Phase I Environmental Site Assessment C.O.W. Site - Colorspot Nursery

In November 2001, EEI completed a Phase I ESA of the Cellular on Wheels (C.O.W.) Site, located near Color Spot Nursery (EEI, 2001). The site was described as currently containing two telecommunications tower and a small concrete structure, which apparently houses support equipment for the towers, and according to ranch personnel has been developed for approximately five years.

The site was not listed on any regulatory database as having an environmental concern or operating permit. No evidence of environmental concern was noted during the site visit. EEI did not recommend any further action at the site.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, “thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials” applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as “ floor or ceiling tiles, siding, roofing, transite panels” (i.e., non-friable) are also considered PACM unless tested.

No ACM was noted in existing structures during the site reconnaissance. However, given that many of the structures were built before 1980, ACM is a potential concern.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

Given the age of the site buildings, the presence of lead-based paint is a potential concern.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

EEI previously conducted site reconnaissances of those sites in the southern portion of the subject property occupied by Color Spot Nursery (EEI, 2000), C.O.W. Site near Color Spot Nursery (EEI, 2001), CR&R/Solag Disposal Company (EEI, 2002a), Olsen Pavingstone (EEI, 2002d), Cemex (EEI, 2002b), Ewles Materials (EEI, 2002c), Catalina Pacific Concrete (North) (EEI, 2002e), O'Connell Landscaping (EEI, 2002f), and St. Augustine's Training Center (EEI, 2002g). The information collected during those site reconnaissances are included within the individual reports, and a brief summary is included above in Section 4.6.

On March 31, 2003, EEI personnel visited the remainder of the subject property, including the Cow Camp area, residential units, lemon groves, and other areas that had not been previously assessed. Photographs 1 through 30 (**Appendix E**) document the site reconnaissance, which is summarized in **Table 3**.

EEI personnel conducted a driving inspection around the perimeter of the subject property, then traversed the site from east to west and north to south. The northern portion of the property is vacant open space, covered predominantly by thick vegetation. The northeastern areas were not accessible due to the poor quality of the access road. San Juan Creek runs just south of the southern margin of the property.

Cow camp includes residences, barns, a maintenance area, pastures, corrals, and open fields. San Juan Creek Haul Road traverses Cow Camp from west to East, and the access road from Ortega Highway traverses the site from north to south. In the eastern portion of Cow Camp (east of the access road), EEI noted one office trailer, a warehouse, two maintenance shops, a storage yard, a fueling station, a heavy equipment storage area, two portable storage units, and a pasture. In the southwestern portion (west of the access road and south of San Juan Creek Haul Road), EEI noted a roping arena, several corrals, two barns, a few open fields, and six residential structures. North of San Juan Creek Haul Road, along the ridge, EEI noted five residences. Two water wells were noted on the property, along the access road from Ortega Highway and along San Juan Creek.

In the Cow Camp maintenance area, the following chemical storage was noted in and around the shop area: approximately 20, 55-gallon drums labeled antifreeze, motor oil, hydraulic fluid, tractor/cat oil, Chevron motor oil, waste coolant, phosphorus acid, and unlabeled (one); several 5-gallon buckets of motor oil and hydraulic oil; used/new tire storage; one 1,000-gallon diesel above ground tank (AGT); one 1,000-gallon gasoline AGT; 275-gallon AGT labeled “omni oil 6E”; one 10,000-gallon diesel underground storage tank (UST); and one 500-gallon waste oil UST. EEI noted oil-stained concrete in and around the shop areas. Two portable storage units were noted in the northern portion of the site. According to Mr. Derek Knobel, Ranch Manager, one storage unit contains mechanical parts, and the other contains various pesticides and fertilizers. According to Mr. Knobel, equipment washing is done at the southern edge of the maintenance shop area, and the run-off drains to the field that lies just south of the shop area.

No other evidence of evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling were noted during the site reconnaissance.

5.2.2 Adjacent Properties

Adjacent properties are residential to the north, agricultural to west and east. San Juan Creek and Ortega Highway are present immediately adjacent to the south.

TABLE 3
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Facility appears generally well maintained and in good condition.
Surface Spills	Yes	Minor spills noted in shop area.
Stained Soil/pavement	No	Minor staining noted in shop area.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	None observed.
Surface Impoundments	No	None observed.
AGT's/UST's	Yes	Diesel and Waste Oil UST in shop area. Diesel, gasoline, and waste oil AGTs in shop area.
Distressed Vegetation	No	None observed.
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	None observed.
Waste/scrap storage	No	In eastern portion of maintenance area.
Chemical use/storage	No	Consistent with facility usage. Chemicals appeared properly labeled and stored.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. Based on conversations with Rancho Mission Viejo personnel , at least one 500-gallon underground fuel tank was removed in the mid 1980's from the **Cow Camp** area. No information was available with the Orange County Health Care Agency regarding the tank removal, or any soil sampling performed. EEI recommends that the exact location of the former UST be identified, and that confirmation soil sampling be performed to determine if any contaminates exist in the tank pit area or in surrounding areas.

2. Based on conversations with Rancho Mission Viejo personnel, the area east of the **Cow Camp** maintenance shop area (currently being used to store equipment) was historically used to bury old equipment and waste scraps. EEI recommends that the exact location of the buried debris be identified

and excavated, and that soil sampling be performed to determine if any contaminates exist in the pit area or in surrounding areas.

3. Two UST's were recently removed from the **Cow Camp** maintenance shop area. The removal was observed by EEI, and conducted under appropriate regulatory guidance. Confirmation soil samples were collected, and the results are pending.

4. Surface stains indicating spillage of gasoline/diesel/motor oil were previously noted on the **Color Spot Nursery** and **O'Connell Landscaping** lease properties. Impacted soils should be excavated, containerized, and disposed of in a permitted facility. Verification sampling should be conducted to verify removal.

5. Minor oil stained pavement was previously noted at the **Solag/CR&R**, **Cemex**, and **Ewles** facilities during the site reconnaissances. However, there appears to be no immediate threat to soil and/or groundwater beneath the subject property. EEI recommends that hazardous substances storage and handling practices at the subject property be improved to prevent spills.

6. While no acute environmental concerns were noted within the **Solag/CR&R**, **Ewles**, and **Catalina Pacific Concrete (CPC)** ESAs, EEI recommends that site sampling take place prior to termination of the existing tenants lease. Sampling should include soils and groundwater in and around any existing UST's, dispensers, clarifiers, crushing operations, and maintenance areas, with analysis for petroleum hydrocarbons, heavy metals, and PAH's.

7. The truck washout recycling pond and related chemicals within the **Catalina Pacific Concrete (CPC)** lease area should be dismantled/removed and the pond contents removed/disposed of prior to termination of the existing tenants lease. All other chemicals related to the current site operations should also be removed from the property and properly disposed of.

8. A licensed/certified asbestos and lead paint inspector should be contacted prior to demolition or remodeling of all site structures built prior to 1980.

9. The above ground gasoline tank previously reported on the **O'Connell Landscaping** lease was installed without fire department review, inspection or permit. As such, the installation is illegal. Use of the tank should be discontinued, and the tank contents removed until a permitted facility can be installed. EEI recommends that the tenant contact Orange County Fire Authority and Orange County Health Care Agency regarding fuel storage requirements.

10. Waste oil at the site were previously observed in open containers on bare ground on the **O'Connell Landscaping** lease. Waste oil should only be stored in appropriate containers with secondary containment. EEI recommends that the tenant contact Orange County Fire Authority and Orange County Health Care Agency regarding proper waste storage procedures. If required, the tenant should register as a waste generating facility.

11. Evidence of past agricultural use has been revealed. If residential or other potentially health-sensitive uses are contemplated (e.g., schools, child care facilities, etc.), EEI recommends that an investigation be conducted to assess the possible presence of residual pesticides in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils dated June 28, 2000.

7.0 REFERENCES

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EEI, January 2002b, Phase I Environmental Site Assessment - Cemex (Formerly City Concrete), 31511 Ortega Highway, San Juan Capistrano, California.

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EEI

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PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 4
(EAST ORTEGA)
Ortega Highway at Verdugo Canyon Road
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA4

456 Arneill Road Camarillo CA 93010 Phone: (805) 987-8728 Fax: (805) 987-0758 e-mail: eeiven@earthlink.net

Phase I Environmental Site Assessment

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Site Location:

PLANNING AREA 4
(EAST ORTEGA)
Ortega Highway at Verdugo Canyon Road
San Juan Capistrano, California

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* within the Planning Area Four (East Ortega) portion of Rancho Mission Viejo, located south of the Ortega Highway and Verdugo Canyon Road intersection, approximately five miles east of San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of previous investigations conducted by EEI.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area Four is located southeast of Ortega Highway. This area is proposed for 216 acres of residential development. The General Plan Land Use designation would be 1B-Suburban Residential. Development proposed would total 150 dwelling units and an overlay zone for a five-acre commercial site with approximately 50,000 square feet of neighborhood center in this planning area. Existing authorized land uses would continue until the commencement of any new proposed land use for the affected areas.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located along Ortega Highway, at Verdugo Canyon road, approximately five miles east of San Juan Capistrano. The property encompasses approximately 1,460 acres, and is located on the lots identified by assessors parcel numbers 125-150-44, -55, -62, -63, -64, -65, and -66 (**Assessors Parcel Map, Appendix A**). Access to the property is through Ortega Highway, Verdugo Canyon Road, and several ranch access roads.

The property is currently occupied by the following: Verdugo Canyon Trailer site, a vacant one-acre site located along Verdugo Canyon Road, east of Ortega Highway; Tree of Life Nursery (33201 Ortega Highway) in the northwest portion, which includes cultivation areas and several structures, including an office building, several green houses, a barn, and various trailers; RJO horse ranch (33101 Ortega Highway) south of the nursery, which includes a barn, grazing land, and two residences; an open field south of RJO and east of Ortega Highway which is used to farm barley; a pump station for the Nichols Institute, maintained by the Santa Margarita Water District; and vacant open space with steep slopes in the eastern portion (**Site Plan, Figure 2**). EEI previously conducted environmental site assessments of Verdugo Canyon Trailer site, Tree of Life, and RJO, and a brief summary of these reports is included below in section 4.6.

The property is bounded by San Juan Creek to the west, vacant/agricultural land and Verdugo Canyon to the north, an access road and vacant land to the east, and vacant land to the south. Ortega Highway traverses the northwest corner of the property. According to the Orange County Planning Department, the site is zoned A-1 (General Agriculture). A copy of the County Zoning Map is included in **Appendix B**.

3.2 Topography

The site is located on a westward-sloping terrace, just east of San Juan Creek. Site elevations range from approximately 330 feet above mean sea level (amsl) along the southwestern margin of the subject property, to approximately 1,000 feet amsl along the eastern margin. The topographic gradient in the site vicinity ranges from 0.12 feet per foot towards the west-northwest to 0.44 feet per foot towards the west. Surface drainage from the site flows west into San Juan Creek, and eventually into the Pacific Ocean, approximately 8 miles to the southwest. Based on the Flood Zone Map published by the Federal Emergency Management Agency (FEMA), the northwestern portion of the site near San Juan Creek lies within a 100-year flood zone. The remainder of the site lies outside of the flood plain.

3.3 Regional and Local Geology

The site is located in an alluvial valley (San Juan Creek) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the San Juan Creek area are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations. These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging predominantly to the sandy loams of the Capistrano and Cieneba associations, and rock outcrops of the Cieneba complex (USDA, 1978). Soils in the Capistrano association are typically well drained, gently to moderately sloping, and form in granitic alluvium of the coastal foothills. They have slow to medium runoff, a moderate erosion hazard, and are found in narrow areas in small valleys. Soils in the Cieneba association consist of excessively drained, moderately steep and form in material weathered from granitic rocks and sandstone. They are found along ridgetops, and are described with rapid runoff and a high erosion hazard.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 15 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Cristianitos Fault (west of the site), the Mission Viejo Fault (runs along the western margin of the site), and the Newport Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the site lies within the Upper San Juan Hydrologic Subarea of the San Juan Hydrologic Unit. In general, groundwater in this area has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but generally occur at between 10 and 100 feet bgs (Rancho Mission Viejo personnel, personal communication).

The Upper San Juan Hydrologic Subarea is located within the San Juan Creek watershed. San Juan Creek (immediately west of the site), Verdugo Canyon (north of the site), and Bell Canyon (northwest of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the DMB San Juan Investment North, LLC. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. United States Geological Survey maps, aerial photographs, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Historic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. The 1942 map was published by the United States Army Corps of Engineers. The 1948, 1968, 1975, 1980, 1982, and 1988 maps were published by the United States Geological Survey.

The 1942 map notes the presence of San Juan Creek to the west and Ortega Highway traversing across the northwest portion of the property. Verdugo Canyon Road and the access road along the northern margin of the site are present. The map does not indicate any development on the remainder of the site. No other pertinent items were noted.

In addition to the features noted on the 1942 map, the 1948 map notes the presence of a well on the RJO horse ranch property and a small structure along the southern margin. No other pertinent items were noted.

In addition to the features noted on the 1948 map, the 1968 map does not include the small structure along the southern margin.

In addition to the features noted on the 1968 map, the 1974 map noted the presence of three small structures and a small corral on the RJO property. A large unpaved race track was noted on the southern half of the Tree of Life property. No other pertinent items were noted.

In addition to the features noted on the 1974 map, the 1980 map notes the presence of two small structures on the site next to the track, and one small structure along the northern margin. No other pertinent items were noted.

In addition to the features noted on the 1980 map, the 1982 map notes the presence of one structure located in the center of the track, and a water tank in the field south of RJO across Ortega Highway. No other pertinent items were noted.

In addition to the features noted on the 1982 map, the 1988 map notes the presence of one more small structure adjacent to the north of the track. No other pertinent items were noted.

4.2.2 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 to 1999 were reviewed at Continental Aerial Photo. In addition, an aerial photograph from 2002 (EDAW) was also reviewed. **Table 1** summarizes the results of the aerial photograph review. A copy of a 2000 photograph from GlobeXplorer is provided in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1952	AXK-4K-45 [1]	The northwestern portion of the property (present-day RJO Horse Ranch, Tree of Life Nursery, and field east of Ortega Highway) are cleared. One trailer was noted on the present-day RJO Horse Ranch property. The remainder of the subject property was vacant and covered by thick vegetation.
1959	261-9-32-87 [1]	No changes to the subject property were noted since the previous photograph.
1967	2-152 [1]	RJO Horse Ranch is present with several residential and barn-like structures; the field area south of RJO and east of Ortega Highway is cleared; the access road along Verdugo Canyon (north of site) is present; and the access road to the southern portion is also present. No other changes were noted since the previous photograph.
1970	61-8-210 [1]	No changes to the subject property were noted since the previous photograph.
1973	132-13-14 [1]	A corral is located in the southern portion of RJO Horse Ranch and a racetrack is located north of RJO, on the present Tree of Life property. The field area south of RJO and east of Ortega Highway is cultivated with a small structure in the center of the property. A small structure was noted along the southern access road, in addition to a small structure along Verdugo Canyon (northern access road). The remainder of the subject property is covered by thick vegetation.
1977	181-15-13 [1]	No changes to the subject property were noted since the previous photograph.
1983	218-15-23 [1]	No changes to the subject property were noted since the previous photograph.
1987	F290 [1]	Tree of Life Nursery is present in the northern portion of its current lease area; the racetrack is still present on the southern portion. The field area south of RJO is occupied by 3 small structures. No other changes to the subject property were noted since the previous photograph.
1992	C85-16-15 [1]	The racetrack south of Tree of Life is no longer present. Tree of Life and RJO Horse Ranch are in their current configuration. No other changes were noted since the previous photograph.
1993	C90-5-150 [1]	No changes to the subject property were noted since the previous photograph.
1995	C101-43-33 [1]	No changes to the subject property were noted since the previous photograph.
1997	C117-43-44 [1]	No changes to the subject property were noted since the previous photograph.
1999	C136-43-149 [1]	No changes to the subject property were noted since the previous photograph.
2002	EDAW [2]	No changes to the subject property were noted since the previous photograph.

(1) Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California

(2) Aerial Photograph obtained from EDAW

4.2.3 City/County Directories

EEI reviewed available Criss Cross and Haines City Directories for Orange County. Information is summarized in **Table 2**. According to the city directories reviewed by EEI, there were no listings for the subject property addresses (33201 and 33101 Ortega Highway) prior to 1979.

TABLE 2
Site Tenants/Occupants

Year	Current Site Address	
	33201 Ortega Hwy	33101 Ortega Hwy
2001	Tree of Life Nursery	No Listing
1998	Tree of Life Nursery	Osvaldo L Gonzales
1993	Tree of Life Nursery	Osvaldo L Gonzales
1987	Tree of Life Nursery	Osvaldo L Gonzales Jack Barnes
1986	No Listing	Osvaldo L Gonzales
1982	No Listing	Al Barba Roberto Casillas
1979	No Listing	Roberto Casillas

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

EEI contacted the Orange County Building and Safety Department for information related to development of the subject property. EEI was able to review one building permit (for an 1800-square foot storage building) and one certificate of occupancy, both issued to the tenant of 33201 Ortega Highway, Tree of Life Nursery, in December 1985. No permits were available for the other subject property address, and no other pertinent information was noted.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix C**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report.

4.3.1 Federal Databases

National Priority List (NPL) (Superfund) - No sites reported within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No sites reported within one mile of the subject site.

No Further Remedial Actions Planned (NFRAP) - No sites reported within one mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No sites reported within one mile of the subject site.

RCRA Corrective action sites (COR) - No sites reported within one mile of the subject site.

RCRA Generators (RCRA-G) -The Environmental Protection Agency (EPA) regulates generators of hazardous material through the Resource Conservation and Recovery Act (RCRA). All hazardous waste generators are required to notify EPA of their existence by submitting the Federal Notification of Regulated Waste Activity Form (EPA Form 8700-12) or a state equivalent form. The first listing, **Ortega Rock Quarry** (33977 Ortega Highway)**,** is located approximately one-third of a mile from the subject site and is listed as a small quantity generator (generates 100-1000 kg a month of hazardous waste). **Nichols Institute**, a medical laboratory (33608 Ortega Highway, greater than one-half mile north of the subject property) is a large quantity generator (generates more than 1000kg/month of hazardous waste). **Ford Motor Company** (33600 Ortega Highway, greater than one-half mile south east of the subject property) is no longer an active site. Operating permits are not generally considered rational for environmental concern unless a documented release has occurred at the property. Therefore, these sites are not considered environmental concerns at this time.

RCRA No Longer Regulated (NLR) - One listing was reported three-quarters of a mile from the subject site. **Loral Aeronutronic** (33600 Ortega Highway) is no longer an active site. Therefore, this site is not considered environmental concerns at this time.

Emergency Response Notification System (ERNS) - Two sites were reported. **Nichols Institute** is reported on the database, however the status of this incident is unknown. One non-geocoded site reported a 5 gallon illegal dumping on May 10, 1990 of liquid caustic soda and reportedly affected the land on the site. Due to the lack of information provided (i.e., site location not provided), these sites are not considered environmental concerns at this time.

The subject site was not identified by any of the sources listed above as having an environmental concern or operating permit.

4.3.2 State and Regional Databases

Sites that are Contaminated or Potentially Contaminated by Hazardous Wastes (State Sites) - No sites reported within one mile of the subject site.

Sites with a record of spills, leaks, investigations, and cleanups (Spills - 1990) - No sites reported within one mile of the subject site.

Solid Waste Landfills (SWL) - No sites reported within one mile of the subject site.

Establishments Issued a Permit to Track Site Status as a hazardous waste generator, gas station, TSD, underground tanks, violations, or unauthorized releases (Permits) - No sites reported within one mile of the subject site.

Other Unique Databases (Other) - Two sites was reported within one mile of the subject property: **The Los Pinos Forestry Camp** (39251 Ortega Highway, approximately one-third mile from the subject site) and **Ford Aerospace Aeroneutronic Division** (33600 Ortega Highway, approximately three-quarter miles from the subject site). These sites are not considered as environmental concerns at this time, and are discussed below in the LUST section.

Permitted Underground/Aboveground Storage Tanks (REG UST/AST) - Eight sites are listed in this database. **Ortega Rock Quarry** (33977 Ortega Highway), **Nichols Institute** (33608 Ortega Highway), and **Quest Diagnostics** (33608 Ortega Highway) are included in this list. The other sites are located greater than one mile from the subject site. Operating permits are not generally considered rational for environmental concern unless documented releases have occurred at the property. Therefore, these sites are not considered an environmental concern at this time.

Leaking Underground Storage Tanks (LUST): Two sites are listed on this database. **The Los Pinos Forestry Camp** (39251 Ortega Highway, approximately one-third mile from the subject site) discovered a gasoline tank leak which was reported on August 14, 1992. The nearby aquifer was affected and has preliminary site assessment status. **Ford Aerospace Aeronutronic Division** (33600 Ortega Highway, approximately three-quarter miles from the subject site) reported a tank leak January 1, 1965. This case was closed on March 19, 1992. Due to the length of time elapsed in both cases, these sites are not considered an environmental concern at this time.

Releases into air and surface water (Releases) - One site is listed on this database. On February 4, 1999, **Santa Margarita Water** (33608 Ortega Highway, approximately three-quarter miles from the subject site) had an industrial plant pump failure which resulted in 55,100 gallons of domestic and reclaimed water released. This action resulted in a pond overflow. The current status is unknown, however due to the distance to our subject site (over one-half mile from subject site), this site is not considered an environmental concern at this time.

PCB Activity Database System (PADS) - **Ford Aerospace Aeronutronic Division** (approximately three-quarter miles away from the subject site), is listed on this database. Operating permits are not generally considered rational for environmental concern unless documented releases have occurred at the property. Therefore, these sites are not considered an environmental concern at this time

The subject site was not listed in any of the databases above.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority during previous environmental site assessments at the subject property. At that time, EEI obtained permits regarding hazardous material storage at the subject property, issued by the Fire Department. According to these records, the subject property currently holds operating permits for a motor vehicle fuel dispensing station, as well as a permit to operate flammable/combustible liquid vehicles, equipment, tanks, and plant. No other site within the subject property has been assigned an address, therefore, no files were available at the Fire Department. No other pertinent information was available.

4.4.2 Orange County Health Care Agency

EEI reviewed Orange County Health Care Agency (OCHCA) databases including Leaking Underground Storage Tank (LUST) sites, Underground Storage Tank (UST) Facilities, Non-petroleum Underground Tanks, Hazardous Waste Generators (HWG) and Land Fill Sites, to determine if the subject site or any properties within the site vicinity were listed as having an environmental concern. Neither the subject site nor any adjacent properties were listed on any of the databases researched.

4.4.3 California Regional Water Quality Control Board

EEI contacted the California Regional Water Quality Control Board - San Diego Region (SDRWQCB) to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. In addition, EEI reviewed the online database GeoTracker, maintained by the SDRWQCB, for listings in the site vicinity regarding Leaking Underground Storage Tank (LUST) cases. There were no listings for the subject site nor any adjacent property.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Based on file data, one exploratory well was drilled in 1964 to 3,730 feet adjacent to the subject property to the southwest. The well is listed as an abandoned plugged hole (no production).

4.5 Interview with Key Site Personnel

EEI provided Mike Evans, President of Tree of Life Nursery, with a Phase I Environmental Assessment Questionnaire during the April 2002 Phase I Environmental Site Assessment of the site (EEI, 2002a). No items of concern were noted on the questionnaire.

In April 2002, EEI contacted Mr. Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner) for information regarding RJO Horse Ranch (EEI, 2002b). Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property. No items of concern were noted during the interview.

In April 2002, EEI contacted Mr. Vorhees regarding key site information for Verdugo Canyon Trailer site. No items of concern were noted during the interview.

In April 2003, EEI contacted Mr. Vorhees for information regarding the remainder of the subject property, the portion east of Ortega Highway.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: Yes. The field across Ortega Highway from RJO is used to farm barley.

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: Yes, that field has been farmed for awhile.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: No.

Q: Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?

A: No.

4.6 Previous Assessment

4.6.1 Phase I Environmental Site Assessment Tree of Life Nursery

In April 2002, EEI completed a Phase I environmental site assessment of the property occupied by the Tree of Life Nursery, located along Ortega Highway in the northwest corner of the subject property (EEI, 2002a). According to the report, the nursery includes cultivation areas, an office building, two greenhouses, a workshop shed, a barn, various trailers, and a vacant field of approximately fifteen acres. The site was not listed on any regulatory database as having an environmental concern or operating permit. During the site reconnaissance, hazardous substances/waste were noted in and around the shop area, including small quantities of pesticides, herbicides, fertilizers, new and used oil, diesel, gasoline, antifreeze, and vehicle batteries. Overall housekeeping was good, and storage containers appeared properly labeled and in good condition, with the exception of several small gasoline containers that were stored on unpaved portions of the shop floor. One 500-gallon above-ground diesel tank and one 250-gallon AGT containing diesel were noted on the property, both of which were within secondary containment. No spills were noted on the property during the site visit. No evidence of environmental concern was observed at the property during the time of the assessment, and EEI did not recommended any additional investigations of the site.

4.6.2 Phase I Environmental Site Assessment RJO Horse Ranch

In April 2002, EEI completed a Phase I environmental site assessment of the property occupied by the RJO Horse Ranch, located along Ortega Highway in the northwest corner of the subject property (EEI, 2002b). According to the report, the ranch includes two barns, a grazing area, a corral, and two residential units. The site was not listed on any regulatory database as having an environmental concern or operating permit. No evidence of environmental concern was observed at the property during the time of the assessment, and EEI did not recommended any additional investigations of the site.

4.6.3 Phase I Environmental Site Assessment Verdugo Canyon Trailer Site

In April 2002, EEI completed a Phase I ESA of the Verdugo Canyon Trailer Site, located in the northern portion of the subject property, along Verdugo Canyon Road (EEI, 2002c). The site is currently vacant, however, two residential trailers were located on the property from approximately 1970 to 1985. Prior to 1970, the site was predominantly vacant.

The site was not listed on any regulatory database as having an environmental concern or operating permit. No evidence of environmental concern was noted during the site visit. EEI did not recommend any further action at the site.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, "thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials" applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as " floor or ceiling tiles, siding, roofing, transite panels" (i.e., non-friable) are also considered PACM unless tested.

An ACM survey was not included as a part of this ESA. However, based on the date of construction of several of the on-site structures (i.e., pre-1980), the presence of ACM is considered likely. EEI recommends that a certified asbestos consultant be contacted prior to any demolition of remodeling of existing structures.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

A lead-based paint survey was not included as part of this ESA. However, based on the date of construction of several of the on-site structures (i.e., prior to 1970), the presence of lead-based paint is considered likely. EEI recommends that a certified Lead Inspector/Assessor be contacted prior to any demolition of remodeling of existing structures.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

EEI conducted a walking reconnaissance of the northwestern portion of the subject property, occupied by Tree of Life Nursery (EEI, 2002a), RJO horse ranch (EEI, 2002b), and Verdugo Canyon Trailer Site (EEI, 2002c) during previous environmental site assessment investigations. The information collected during those site reconnaissances are included within the individual reports, and a brief summary is included above in Section 4.6.

On April 9, 2003, EEI personnel visited the remainder of the subject property located east of Ortega Highway. EEI was accompanied by Rancho Mission Viejo personnel, Mr. Fred Vorhees. Mr. Vorhees provided access to the eastern portion of the property, and answered questions regarding current and historical site usage. Photographs 1 through 16 (**Appendix D**) document the site reconnaissance, which is summarized in **Table 3**.

EEI personnel conducted a driving inspection around the perimeter of the subject property, then traversed the site from east to west and north to south. The property is vacant open space, covered predominantly by thick vegetation. Steep slopes distinguish the eastern portion of the subject property, and a relatively flat, vacant field is located along Ortega Highway, south and east of RJO horse ranch. A ranch access road runs along the northern, eastern, and southern margins of the property, and San Juan Creek runs along the western margin of the property.

Several pole-mounted transformers were noted along Ortega Highway. According to San Diego Gas and Electric Personnel, it is highly unlikely that the transformers serving the facility contain polychlorinated biphenyl (PCB's) at concentration levels requiring special management under the Environmental Protection Agency's rules.

No evidence of evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling were noted during the site reconnaissance.

TABLE 3
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Facility appears well maintained and in good condition.
Surface Spills	No	None observed.
Stained Soil/pavement	No	None observed.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	None observed.
Surface Impoundments	No	None observed.
AGT's/UST's	No	Tree of Life Nursery: 500-gallon AGT containing red diesel and 250-gallon AGT containing diesel.
Distressed Vegetation	No	None observed.
Wetlands	No	West of property, adjacent to San Juan Creek
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	Several pole-mounted transformers located along Ortega Highway.
Waste/scrap storage	No	Equipment bone yard noted along tree line on western portion of Tree of Life lease property.
Chemical use/storage	No	Consistent with facility usage. Chemicals appeared properly labeled and stored.

5.2.2 Adjacent Properties

Adjacent properties to the north, east, and south are undeveloped. San Juan Creek lies immediately adjacent to the west of the subject property, and Ortega Highway traverses across the northwest corner of the subject property. No evidence of environmental concerns from adjacent properties was noted.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. Evidence of past agricultural use has been revealed. If residential or other potentially health-sensitive uses are contemplated (e.g., schools, child care facilities, etc.), EEI recommends that an investigation be conducted to assess the possible presence of residual pesticides in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils dated June 28, 2000.

7.0 REFERENCES

California Division of Mines and Geology, 1973, Geo-Environmental Maps of Orange County, California.

California Division of Mines and Geology, 1994, Fault Activity Map of California and Adjacent Areas.

California Regional Water Quality Control Board - San Diego Region, 1994, Water Quality Control Plan - San Diego Region: California State Water Resources Control Board Publication.

EEI, April 2002a, Phase I Environmental Site Assessment, Tree of Life Nursery.

EEI, April 2002b, Phase I Environmental Site Assessment RJO Horse Ranch.

EEI, April 2002c, Phase I Environmental Site Assessment, Verdugo Canyon Trailer Site.

Morton, P K., 1974*, Geology and Engineering Geologic Aspects of the South Half of the Canada Gobernadora Quadrangle, Orange County, California,* California Division of Mines and Geology.

Norris, Robert M., and Webb, Robert W., 1990, Geology of California, Second Edition, John Wiley, and Sons, Inc., New York.

Southern California Earthquake Center, 1999, Faults in California - Los Angeles Region.

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EEI

Expertise . . Service . . *Solutions*

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 5
(TRAMPAS/OGLEBAY NORTON)
31302 Ortega Highway
San Juan Capistrano, California

May 15, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA5

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Phase I Environmental Site Assessment

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Site Location:

PLANNING AREA 5
(TRAMPAS/OGLEBAY NORTON)
31302 Ortega Highway
San Juan Capistrano, California

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* at Planning Area 5, including the Trampas/Oglebay Norton Facility, located at 31302 Ortega Highway in San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated March 1, 1999 (Proposal 38A), between Morgan, Lewis & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of previous assessment data collected by URS-Greiner Woodward Clyde and Harding Lawson Associated.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan, Lewis & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan, Lewis & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan, Lewis & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The **Planning Area Location Map** is included in **Plate 1**.

2.2 Description of Planning Area

This planning area is located south of Ortega Highway and east of the City of San Juan Capistrano. The project proposes the designation of a total of 1,350 acres of 1B-Suburban Residential. Approximately 2,440 dwelling units are proposed on 1,191 acres for this planning area. This planning area would also have an overlay zone of approximately ten acres for commercial development with a total of 100,000 square feet of neighborhood center. Approximately 159 acres of open space is also planned. Existing authorized land uses would continue until the commencement of any new proposed land use for the affected area.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located in southeastern Orange County, approximately three miles east of San Juan Capistrano. The property occupies the lot identified by the address 31302 Ortega Highway (just south of Ortega Highway and southwest of the intersection of Ortega Highway and Christianitos Road). It encompasses approximately 1,350 acres and is a portion of the parcel identified by assessors parcel number 125-162-05 (**Assessors Parcel Map, Appendix A**).

The property is bounded by Ortega Highway to the north, and by agricultural/pastoral land to the west, east, and south. According to the Orange County Planning Department, the site is zoned SG (Sand and Gravel Extraction). A copy of the County Zoning Map is included in **Appendix B**.

The site is currently occupied by Oglebay Norton Industrial Sands, which operates a sand and gravel surface mining operation at the property. The operation consists of the mining and processing of silica sand for use in building materials such as stucco, grouts, and mortars, and for use in golf courses, playing fields and playgrounds. The facility includes an open pit mine, a large earthen dam and associated reservoir, a processing plant, an office complex, a scale house, a fueling facility, a maintenance shop, several storage buildings, various sheds and trailers, and a number of open vehicle/equipment storage areas.

3.2 Topography

The site is located on a southward-sloping terrace, just north of San Juan Creek. Site elevations range from approximately 300 feet above mean sea level (amsl) along the northern margin of the subject property, to approximately 700 feet amsl along the southern margin. The topographic gradient in the site vicinity is to the north/northeast at approximately 0.07 feet per foot. Surface drainage from the site flows north into Trampas Canyon Creek, then into San Juan Creek, and eventually into the Pacific Ocean, approximately 8 miles to the southwest. Based on the Flood Zone Map published by the Federal Emergency Management Agency (FEMA), the site does not lie within a 100-year flood zone.

3.3 Regional and Local Geology

The site is located in an alluvial valley (Trampas Canyon) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the San Juan Creek area are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations. These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to a number of soil series including Botella loam, Capistrano sandy loam, Cienaba sandy loam, Myford sandy loam, and Riverwash deposits (USDA, 1978). Soils in these series are typically found on alluvial fans, river terraces, and narrow foothill valley, and generally consists of moderate to well drained gravelly and sandy loams.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 15 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Christianitos Fault (just west of the site), the Mission Viejo Fault (just east of the site) and the Newport Inglewood Fault (southwest of the site; California Division of Mines and Geology, 1973).

3.4 Regional and Local Hydrogeology

According to the California Regional Water Quality Control Board - San Diego Region (SDRWQCB, 1994), the site lies within the Middle San Juan Hydrologic Subarea of the San Juan Hydrologic Unit. In general, groundwater in this area has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but generally occur at between 10 and 100 feet below ground surface (bgs).

The Middle San Juan Hydrologic Subarea is located within the San Juan Creek watershed. San Juan Creek (immediately north of the site), Trampas Canyon (the subject site), and Canada Gobernadora (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the San Juan Company. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1953 and 1999 were reviewed at Continental Aerial Photo in Los Alamitos. In addition, aerial photographs dating from 1993 (USGS) and 2003 (EDAW) were also reviewed. **Table 1** summarizes the results of the aerial photograph review. A copy of the 1993 photograph is provided in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1953	AXK-5K-145 [(1)]	The site and vicinity are unoccupied and undeveloped. Christianitos Road is visible to the east and Ortega Highway is visible to the north.
1959	9-31-46 [(1)]	No significant changes were noted since the previous photograph.
1960	C-23870-103 [(1)]	No significant changes were noted since the previous photograph.
1967	2-152 [(1)]	No significant changes were noted since the previous photograph.
1970	61-8-209 [(1)]	No significant changes were noted since the previous photograph.
1973	TG-7300-6-3 [(1)]	The site is occupied by a mining operation. Structures are present in the central portion of the property. Active mining is visible to the west of the structures. Trampas canyon appears undeveloped (i.e., no dam or reservoir).
1975	157-14-22 [(1)]	The mining area and plant appear unchanged. Trampas canyon is being graded and the dam appears under construction.
1983	218-14-28 [(1)]	Mining area to the west of the plant area has been increased. Trampas Dam and reservoir are visible. No other significant changes were noted.
1993	C90-4-140 [(1)]	Mining area has increased to the west. A retention basin is now visible to the north of the mining area Additional structures are visible around plant.
1999	Catalina Pacific [(1)]	No significant changes were noted since the previous photograph.
2003	GeoXplorer [(2)]	Site appears in its current configuration.

[(1)] Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California

[(2)] Aerial Photograph obtained from EDAW

4.2.2 Historic Topographic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. The 1942 map was published by the United States Army Corps of Engineers. The 1948, 1968, 1975, 1980, 1982, and 1988 maps were published by the United States Geological Survey.

The 1948 and 1942 maps indicate that the subject property is undeveloped. San Juan Creek is noted to the north and Christianitos Road is visible to the east. No other pertinent items were noted.

The 1968 map notes the presence of an unpaved road through Trampas Canyon. No other pertinent items were noted.

The 1975 map indicates the presence of several structures and ponds on the property, as well as a large area of disturbance corresponding to the location of the Trampas Dam and reservoir. No other pertinent items were noted.

The 1980, 1982, and 1988 maps indicate no significant change on the property, although significant mining and agricultural activity is visible to the north, across San Juan Creek. No other pertinent items were noted.

4.2.3 City/County Directories

EEI reviewed historic city directories for southern Orange County at the Central Library in Santa Ana, California. **Table 2** lists the results of the city directory search.

TABLE 2
Historical Tenants

Year	31302 Ortega Highway
1952	No Listing
1972	Owens-Illinois, Inc.
1976	Owens-Illinois, Inc.
1980	Owens-Illinois, Inc.
1985	Owens-Illinois, Inc.
1990	Dalton Trucking, Inc. California Silica Products Company
1995	Dalton Trucking, Inc. Oglebay Norton Industrial Sand
2001	Oglebay Norton Industrial Sand

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

EEI contacted the Orange County Building and Safety Department for information related to development of the subject property. EEI was able to review building permits and certificates of occupancy, for the subject property, dating between 1971 and 1987. The following is a summary of the information reviewed by EEI.

Note: Permits issued to "Owens-Illinois" until 1985. From 1985 on the permits are issued to Ca. Silica Products Co.

12/71; Building Permit/Certificate of Occupancy; fencing for electric equipment & pump pads-530 L.F.

12/71; Building Permit/Certificate of Occupancy; 320 square feet; lab storage building for glass-sand process plant

12/71; Building Permit/Certificate of Occupancy; Mill water supply tank

12/71, 1/72; Building Permit/Certificate of Occupancy; Libbey Truck load out #18

12/71; Building Permit/ Certificate of Occupancy; 900 square feet; Tailings booster pump station

12/71; Building Permit; 1920 square feet; office and lab buildings

1/72; Certificate of Occupancy; sulphuric acid storage tank for glass-sand plant

1/72; Building Permit/Certificate of Occupancy; 600 ton storage bin

1/72; Building Permit/Certificate of Occupancy; Office building and lab

1/72; Building Permit/ Certificate of Occupancy; 3300 square feet; Shop building

1/72; Building Permit/Certificate of Occupancy; gathering conveyor turned to mill building

1/72; Building Permit; 150 ton truck bin for glass-sand bin

9/72; Building Permit/Certificate of Occupancy; support structure for scrubber equipment

9/72; Building Permit/Certificate of Occupancy; support structure for sump and pump

10/72; Building Permit; glass structural support for scrubber B & A

10/72; Building Permit; Overflow sump access to ind. bldg.

9/85; Building Permit/Certificate of Occupancy, replace existing harding ball mill (w/300 HP motor) w/ a Marcy Rod mill (200 HP motor), walkway modifications, new monorail system

2/86; Grading Permit; warehouse storage facility for bagged sand

8/87; Building Permit/Certificate of Occupancy; 1600 square feet; screening facility

4.3 Regulatory Database Search

EEI reviewed known data on the hazardous waste generating establishments in the vicinity of the site, as well as on sites with known environmental concerns. These facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from First Search, an environmental information retrieval service. A copy of the First Search report is provided in **Appendix D**. Below is a list of databases that were reviewed in the preparation of this report:

4.3.1 Federal Databases

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCIS) - No listings within one mile of the subject site.

National Priority List (NPL) - No listings within one mile of the subject site.

No Further Remedial Actions Planned (NFRAP) - No listings within one mile of the subject site.

Federal Facilities (FEDFAC) - No listings within one mile of the subject site.

Emergency Response Notification System (ERNS) - No listings within one-half mile of the subject site.

Site Enforcement Tracking System (SETS) - No listings within one mile of the subject site.

Enforcement Docket Systems (DOCKET)/Consent Decree Tracking System (CDETS) - No listings within one-half mile of the subject site.

Criminal Docket System (C-DOCKET) - No listings within one-half mile of the subject site.

Resource Conservation and Recovery Act Violators and Facility list (RCRA) - No listings within one mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No listings within one mile of the subject site.

RCRA Generators (RCRA-G) - The subject site was the only listing within one mile. **California Silica Products Co.** (31302 Ortega Highway) was identified as a small quantity generator of hazardous waste.

4.3.2 State and Regional Databases

Annual Work Plan (AWP) - No listings within one mile of the subject site.

CALSITES (Abandoned Sites Program Information System) - No listings within one mile of the subject site.

CORTESE - No listings within one mile of the subject site.

California State Leaking Underground Storage Tanks (LUST): The only sites identified by LUST within one-half mile of the subject property were from the site itself. **31302 Ortega Highway** was noted as having three closed LUFT cases. **California Silica Products Co.** (Case 9UT1752), was identified as a release of diesel fuel to soil which occurred in October 1990. he case was closed in June 1991. **California Silica Products Co.** (Case 9UT2489), was identified as a release of gasoline to soil which occurred in the 1960's. The case was closed in March 1993. **Oglebay Norton Industrial Sand** (Case 9UT3523), was identified as a release of diesel fuel to soil which occurred in June 1997. The case was closed in April 2001.

Solid Waste Information System (SWIS) - No listings within one mile of the subject site

Toxic Releases (NT) - No listings within one mile of the subject site.

Toxic Pits (TPC) - No listings within one mile of the subject site.

Solid Waste Assessment Test (SWAT)- No listings within one mile of the subject site.

Hazardous Waste Information System (HWIS) - This state hazardous waste tracking system included six sites within one-half mile of the subject property. HWIS listings track the movement of hazardous materials, are not generally considered to be environmental concerns unless releases are documented at listed facilities.

Permitted Underground Storage Tanks (UST) - The only sites identified by UST within one-half mile of the subject property were from the site itself. **California Silica Products Co/Oglebay Norton Industrial Sand** are identified as operators of gasoline and diesel tanks. The presence of operating permit is generally not considered cause for further investigation, unless there is evidence of an unauthorized release.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Department's Clerk of Authority office for information regarding hazardous materials storage at the subject site. According to Fire Department inspection records, **Oglebay Norton Industrial Sand** (31302 Ortega Highway) currently holds hazardous materials operating permits for compressed gases and combustible liquids. Permits to operate a motor vehicle fuel dispensing stations and flammable/combustible liquid vehicles, equipment, and tanks were also noted.

The most recent inspection report, dated March 25, 2003, notes the following chemicals stored onsite: hydraulic oil, solvents, gear oil, oxygen, acetylene, diesel, unleaded gasoline, grease, and motor oil. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files. A list of chemicals stored and the maximum daily amount permitted for storage is given in **Appendix D**

4.4.2 Orange County Health Care Agency

EEI contacted the Orange County Health Care Agency (OCHCA) Custodian of Records to obtain copies of any Underground Storage Tank (UST) Operating Permits, Leaking Underground Fuel Tank (LUFT) files and/or any Hazardous Waste Permit (Hazmat) files for the site. The following is a summary of the information contained in OCHCA Files.

The site is currently permitted as an Underground Storage Tank Facility. Permit 3690-2 indicates that two tanks are present: a 2,500-gallon, double-walled fiberglass tank containing regular unleaded gasoline; and a 10,000-gallon, double-walled fiberglass/plastic tank containing diesel fuel. Both tanks were installed in 1997. Annual UST inspection reports form 1996 through 2001 indicate a variety of violations, all related to record keeping. As of September 2001, all of the violations have been abated.

EEI reviewed Hazardous Waste Inspection Reports for the facility dating from September 1996 through May 2001. Waste streams identified during these inspections included waste oil, used oil filters, grease/sand from rotary drums, and parts cleaner waste. No violations were noted in the inspections dating from 1996, 1997, 2000, and 2001. An inspection from July 1998 noted the following violations: "containers not visibly marked with begin date of accumulation," "each container and tank not clearly labeled 'hazardous waste' with required details," and "hazardous waste stored beyond maximum accumulation time." All of these violations were apparently corrected. The inspection report from March 2000 indicates that soil samples were collected below an existing "old & deteriorated" above ground waste oil tank. A total of four samples were collected, with results ranging from 64 to 790 mg/kg TPH. No further information was provided.

A 10,000-gallon underground diesel storage tank was removed from the site in October 1990 (Case #90UT240). No groundwater or visible signs of contamination were noted by the inspector. Samples collected during removal operations indicated 5,100 milligrams per kilogram (mg/kg) Total Petroleum Hydrocarbons (TPH) as diesel. No other compounds were detected. Additional assessment performed by Harding-Lawson Associates (HLA) in February 1991 indicated additional contamination to the east and west of the tank excavation. Despite the presence of contamination, the OCHCA closed the case in June 1991, based on the fact that: 1) the site is in a rural area; 2) no BTEX was detected; 3)no water producing wells are near the site vicinity; and 4) there are no potential receptors for contamination.

A 10,000-gallon underground diesel storage tank and a 1,000-gallon underground gasoline storage tank were removed from the site in February 1992 (Case #93UT15). Physical signs of contamination were noted by the inspector (staining and gasoline odor). Samples collected during removal operations indicated 40 mg/kg and 650 mg/kg TPH as gasoline. BTEX compounds were also detected. Additional tank pit excavation was directed by OCHCA and performed by HLA in August 1993. Excavated soil was transported offsite for disposal. Confirmation samples collected after excavation indicated that the majority of contamination had been removed, although residual benzene (0.097 mg/kg) was noted.. OCHCA granted site closure in March 1994.

A 10,000-gallon underground diesel storage tank was removed from the site in June 1997 (Case #97UT24). Physical signs of contamination were noted by the inspector (staining and diesel odor). Samples collected during removal operations indicated 13 mg/kg and 2,220 mg/kg TPH as diesel. Additional tank pit excavation was directed by OCHCA and performed in July 1998. Approximately 35 cubic yards of soil were removed and buried onsite 10 feet below grade in an overburden area. Confirmation samples collected after excavation indicated that the majority of contamination had been removed, although residual diesel concentrations (2,900 mg/kg) was noted. Two soil borings were drilled to 40 feet in December 1998 to delineate the vertical extent of contamination. "Low" concentrations of diesel were reported. Groundwater was not encountered. OCHCA granted site closure in April 2001.

4.4.3 California Regional Water Quality Control Board

EEI reviewed the Underground Storage Tank Information System (LUSTIS) and Spills, Leaks, Investigations, and Cleanup (SLIC) List, published by the California Regional Water Quality Control Board - San Diego Region (SDRWQCB), to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. The subject property was identified as the location of closed LUFT cases. These cases are described in section 4.4.2 above. No other pertinent information was noted.

EEI also contacted the SDRWQCB to determine the existence of any surface, stormwater, or groundwater discharge permits. According to the SDRWQCB, the site has a General Permit (Order No. 97-03-DWQ, NPDES No. CAS000001 - Industrial) for Storm Water Discharges associated with Industrial Activities.

The facility was inspected in January 2003 (**Appendix E**), based on a review of an annual report in which elevated levels of total suspended solids (TSS) were reported in the two outfall ponds (i.e., 16,000 milligrams per liter (mg/l) and 3,900 mg/l). The site inspection report summarized operations at the site, and concluded that the only issue on non-compliance was the outdoor storage of batteries at the site. There was no explanation given for the elevated TSS concentrations.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Based on file data, no petroleum exploration or production has occurred on or adjacent to the site.

4.5 Previous Environmental Reports

4.5.1 URS Greiner Woodward Clyde - Phase II Assessment

EEI reviewed the *Draft Report: Phase II Assessment of Conditions, Trampas Canyon Dam, Orange County California*, prepared by URS Greiner Woodward Clyde (URS) in July 1999 (**Appendix F**). The purpose of the report was to summarize an investigation into potentially impacted tailings within the retention dam, related to prior use of chemicals at the quarry site. The work performed included the collection of groundwater samples from two onsite monitoring wells, the drilling of three boreholes within the tailings, and analysis of selected soil and groundwater samples for TPH, Title 22 metals, as well as volatile (VOC's) and semivolatile (SVOC's) organics.

The report indicates that previous to 1990, a number of potentially hazardous chemicals were utilized in the sand washing and separation operations at the site. These reportedly included tallow diamine, sulfuric acid, sodium hydroxide, American cyanamid F065, hydrochloric acid, petroleum sulfonate, reagent fuel oil, pine oil, and hydrofluoric acid. The report also states that some 110,500,000 cubic feet of tailings were contained within the reservoir.

Analytical results of samples collected from soil and groundwater indicated no detectable concentrations of VOC's or SVOC. TPH was reported in soil in concentrations ranging from below 1 mg/kg to 94 mg/kg. Trace metals were reported in concentrations below EPA's preliminary Remediation Goals (PRG's) for residential use. Groundwater concentrations of arsenic were reportedly above the Maximum Contaminant Level (MCL) for drinking water. Based on the results of their investigation, URS stated that there appeared to be "no significant environmental limitations to the re-use of tailings materials."

4.6 Interview with Key Site Personnel

EEI contacted Michael Miclette, Operations Manager for the subject facility, and interviewed him regarding key site information. A list of the questions asked, and a summary of their responses, is included below.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: Yes, there is fuel station and repair shop on site for the plant.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: Refer to the chemical inventory.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: Yes.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: Yes. There is one 10,000-gallon UST for diesel, and one 2,000-gallon UST for gasoline.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?
A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: No.

Q: Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?

A: No. There was a PCB removal about 5 years ago.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, "thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials" applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as " floor or ceiling tiles, siding, roofing, transite panels" (i.e., non-friable) are also considered PACM unless tested.

No ACM was noted in existing structures during the site reconnaissance. However, given that many of the structures were built before 1980, ACM is a potential concern.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface.

The risk classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

Given the age of the site buildings, the presence of lead-based paint is a potential concern.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

On March 31, 2003, EEI personnel walked the entire site. EEI was accompanied by Dan Scott, Facility Manager. Mr. Scott provided access to the property, answered questions pertaining to site operations, and provided EEI with process diagram for the facility (**Appendix G**). Photographs 1 through 32 **(Appendix H**) document the site reconnaissance, which is summarized in **Table 3**.

EEI personnel conducted a walking/driving inspection around the perimeter of the subject property, then traversed the site from east to west and north to south. The site is partially developed, and is located south of San Juan Creek in Trampas Canyon, a north-south oriented alluvial valley. The valley slopes moderately to the north.

A paved road provides access to the northern margin of the property. Unpaved trails and undeveloped land bound the site to the west, south and east. The driveway into the plant runs south from the paved access road to the central portion of the property. A fueling island, truck scale, wash stations, drum storage area, and a boneyard are present along the driveway north of the plant. The fueling area did not appear to be paved, although the drum storage area was a bermed concrete slab.

The central portion of the facility is occupied by the plant and related support structures. The plant includes Rod and Ball Mills to break up mined sand, cleaners/separators to wash and dewater the sand, dryers for washed sand, a screen house to separate the sand size fractions, and a bagging operation. Support structures include an office complex, shops, a scale, several storage areas/units, a fuel island and associated USTs. Associated with the plant operations are a water treatment/recycling system and reservoir/tailings retention area. Wash water from the plant are passed through a separations system to remove solids, then recycled from the storage reservoir back through the plant for reuse. Tailings generated from the sand washing are stored in the reservoir behind Trampas Dam.

Activities in the shop area, located south of the office complex, include welding, vehicle/equipment servicing and repair, and parts storage. Potentially hazardous materials stored/used in the shop area include compressed gases, new and used oil, diesel, gasoline, new and used batteries, grease, and solvents (i.e., parts washer). A mobile service truck is used at the facility, and contains small quantities of fuels and lubricants required to service heavy equipment at the site.

Strip mining operations take place to the northwest of the plant. Sand strata are ripped with a dozer, then the loose material picked up by a scraper for delivery to the plant for processing. To the south of the active mining area, and to the west of the plant, is the original mining area, no longer in use. This area has partially revegetated, and contains a substantial reservoir in its base. An above ground diesel tank and storage unit were noted along the road just north of the original mining area. Surface staining was noted around the base of the diesel tank.

A large vehicle/equipment storage area is located west of the plant, along the eastern margin of the original mining area. Heavy equipment, parts, scrap, tires, and debris were note din this area. An above ground diesel tank (with secondary containment) were noted in this area, as were numerous drums (both covered and uncovered) full of oil and grease. All of the drums had been placed on pallets. The uncovered drums and the diesel secondary containment had recently been exposed to rain, and had obviously overflowed onto the bare ground below.

An earthen dam and large reservoir/tailing storage area are present to the south of the plant/mining area. The reservoir extends the length of Trampas Canyon from the dam to just north of the southern property boundary. An unpaved road provides access to each side of the reservoir, from the base of the dam. The tailings line outfall was noted on the northwest corner of the reservoir. A separate storage pond is present on the northeast corner of the reservoir, near the water supply pipeline. A portable diesel-powered water pump was noted at this location

After completing the reconnaissance fo the plant, mining and reservoir areas, EEI conducted a drive-by inspection along the perimeter road, which runs along the ridgelines on the western, southern, and eastern margins of the property. This road allows relatively unobstructed vistas of the entire property. No evidence of environmental concerns were noted along the outlying portions of the property.

Based on results of EEI's site reconnaissance, evidence of contamination, petroleum-hydrocarbon staining, waste drums, and improper waste storage/handling were noted. This included stained soils under above ground fuel and drum storage, uncovered waste drums, and overflowing secondary containment.

5.2.2 Adjacent Properties

Adjacent properties are undeveloped to the north, east, west, and south. No evidence of environmental concerns was noted.

TABLE 3
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Facility appeared generally well maintained and in good condition.
Surface Spills	No	None observed.
Stained Soil/pavement	Yes	Beneath above ground fuel tanks and in waste drum storage areas
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	Storage reservoirs and retention basins were noted north and south of plant.
Surface Impoundments	No	See above.
AGT's/UST's	Yes	10,000 gallon Diesel UST and 2,500 gasoline UST. Several large portable diesel AGT's.
Distressed Vegetation	No	None observed.
Electrical Substations	No	Relatively modern facility on site.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	Several observed on site.
Waste/scrap storage	Yes	Two boneyards with various debris, derelict vehicles, and waste drums.
Chemical use/storage	Yes	Chemical use/storage included parts washers (solvent), new and used oil, diesel fuel, acetylene, gasoline, , batteries, grease, and paint.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. Improper storage of waste containers was noted in the vehicle/equipment storage area. Principal concerns include open drums, leakage, and unidentified containers. Phase II investigation appears warranted in these areas.

2. Potentially hazardous used equipment/debris was noted in various locations. This included used batteries, tires, used equipment parts, scrap metal, and abandoned vehicles. This equipment/debris should be removed prior to termination of the existing tenants lease.

3. Surface stains indicating spillage of petroleum products were noted in several locations on site. These included drum storage areas and beneath the above ground diesel tanks. The extent of this spillage is unknown. Phase II investigation appears warranted in these areas.

4. A fueling station is present north of the plant location. These tanks were installed in 1997 and appear to be in good condition. However, EEI does recommend that site sampling take place in these areas prior to termination of the existing tenants lease. Sampling should include soils and groundwater in and around the existing UST and dispensers.
5. Two maintenance shops were noted at the facility; a large shop south of the office and a small shop at the base of the screen house. Petroleum lubricants, solvents and waste products are used/stored at these locations. Phase II investigation appears warranted in these areas.

6. UST's have been removed from the site on at least three previous occasions; in 1990, 1991, and 1997. In each case, contamination was reported and only partially removed. In one case, the contamination was simply relocated to the overburden storage area of the property (with permission from OCHCA). The rationale used at the time was the current land use, rural setting, lack of impact to groundwater, and lack of human/environmental receptors. These factors may change in the future if residential development is contemplated in these areas, and additional investigation or remediation may be required.

7. The tailings within Trampas Dam were sampled in three locations by URS-Greiner Woodward Clyde in 1999. The unconsolidated and saturated nature of the tailing limited the sample locations to areas close to the shoreline. Approximately 4 soil samples were analyzed from each of these borings to characterize the approximately 110,500,000 cubic feet of sediment. Given the limited number of samples and sample locations, the results of this sampling may not accurately represent the chemical composition of the tailings. Phase II investigation appears warranted in this area.

8. A licensed/certified asbestos and lead paint inspector should be contacted prior to demolition or remodeling of site structures.

7.0 REFERENCES

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EEI

Expertise . . Service . . *Solutions*

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 6
(CRISTIANITOS MEADOWS)
Cristianitos Road
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA6

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Phase I Environmental Site Assessment

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Site Location:

PLANNING AREA 6
(CRISTIANITOS MEADOWS)
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EEI Project No. V030305-38A-PA6

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* within the Planning Area Six (Cristianitos Meadows) portion of Rancho Mission Viejo, located along Cristianitos Road, south of Ortega Highway and approximately five miles east of the City of San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area Six is located north of the Donna O'Neill Land Conservancy at Rancho Mission Viejo (previously known as the Rancho Mission Viejo Land Conservancy). This planning area would be 308 acres of 1B-Suburban Residential. A total of 110 dwelling units are proposed on 263 acres. Approximately 45 acres of open space are also proposed in this planning area.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located along Cristianitos Road, south of Ortega Highway approximately four miles east of the San Juan Capistrano. The property occupies portions of the lots identified by assessors parcel number 125-162-30, -16, -15, -14, and -27 (**Assessor's Parcel Map, Appendix A**). The property is located within Cristianitos Canyon, and access is from Cristianitos Road.

The property is bounded by undeveloped open land to the north; Cristianitos Road and vacant land to the west; vacant land and the former Riverside Cement lease to the east; and vacant land to the south. According to the Orange County Planning Department, the site is zoned A-1 (general agriculture). A copy of the County Zoning Map is included in **Appendix B**.

The site is currently unoccupied, however old abandoned clay mines are located in the central and southern portions of the site (**Site Plan, Figure 2**).

3.2 Topography

The site is located within Cristianitos Canyon, a north-south trending alluvial valley. The site elevation is approximately 500 feet above mean sea level (amsl). The topographic gradient in the site vicinity is to the southeast at approximately 0.08 feet per foot. Surface drainage from the site flows south along Cristianitos Canyon into Gabino Creek, then eventually into the Pacific Ocean, approximately 6 miles to the southwest. Based on the Flood Zone Map published by the Federal Emergency Management Agency (FEMA), the subject property lies within an area designated Zone X (i.e. outside a 500-year flood plain).

3.3 Regional and Local Geology

The site is located in an alluvial valley (Cristianitos Canyon) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the site vicinity are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations (Morton, 1974). These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to the Botella, Capistrano, and Myford associations (USDA, 1978). Soils in the Botella and Capistrano associations are typically found on gently sloping to moderately sloping alluvial fans and consist mainly of well-drained clay and sandy loams. These soils are moderately slow to moderately rapid permeability, runoff is medium, and the erosional hazard is moderate. Soils in the Myford association are found on marine terraces and consist mainly of sandy loams. This soil is very slowly permeable, runoff is medium to rapid, and the erosional hazard is moderate.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 19.5 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Christianitos Fault (immediately west of the site), the Mission Viejo Fault (east of the site), and the Newport-Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the site lies within the San Mateo Hydrologic Area of the San Juan Hydrologic Unit. In general, groundwater in this subarea has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but should generally occur at between 3 and 25 feet below ground surface (Rancho Mission Viejo personnel, personal communication).

The San Mateo Hydrologic Area is located within the San Mateo Creek watershed. San Mateo Creek (southeast of the site), and Christianitos Creek (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for warm water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the San Juan Partnership. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 and 1999 were reviewed at Continental Aerial Photo in Los Alamitos, California. In addition, a 2002 aerial photograph (EDAW) was also reviewed **Table 1** summarizes the results of the aerial photograph review. A copy of the 2000 aerial photograph is included in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1952	AXK-4K-44 (1)	Unpaved roads are present throughout the property. Three (3) small mining areas (clay mines) appear in the central and southern portion of the site. However, the working status of these mines appears to be inactive.
1959	9-31-46/47/48 (1)	A pond is located in the center of the site. Christianitos road is present to the west of the property. No other changes were noted since the previous photograph.
1967	2-152/2-153 (1)	No pertinent changes were noted since the previous photograph.
1970	61-8-209 (1)	No pertinent changes were noted since the previous photograph.
1973	132 13-14 (1)	No pertinent changes were noted since the previous photograph.
1977	181-14-24 (1)	No pertinent changes were noted since the previous photograph.
1983	14-28/14-27 (1)	No pertinent changes were noted since the previous photograph.
1987	F290 (1)	No pertinent changes were noted since the previous photograph.
1992	C85-16-15 (1)	No pertinent changes were noted since the previous photograph.
1993	C-90-4-140 (1)	No pertinent changes were noted since the previous photograph.
1999	C-136-44-168/167 (1)	No pertinent changes were noted since the previous photograph.
2002	Cristianitos Meadows (2)	No pertinent changes were noted since the previous photograph, and the site appears in its current configuration.

(1) Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California

(2) Aerial Photograph obtained from EDAW

4.2.2 Historic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. All of the maps reviewed were published by the United States Geological Survey, with the exception of the 1942 map, which was published by the U.S. Army Corp of Engineers.

No indication of the development was indicated on any of the maps, with the following exceptions. The 1942 map shows the presence of Cristianitos Road along the western margin of the property. The 1948 map shows the presence of one road traversing the property. The 1968 map show the presence of two roads traversing the property and a "prospect" marking in the southern portion along Cristianitos Road. No changes were noted on the 1975, 1980, 1982, or 1988 maps. No other pertinent features were noted.

4.2.3 City/County Directories

EEI reviewed available Criss Cross City Directories for Orange County. The subject property has never been assigned a street address, therefore, there were no listings for the subject property.

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

Based on reviews of aerial photographs, topographic maps and interviews with the property owner and County personnel, the site has never been fully developed. Therefore, a review of building department records was not conducted for this ESA.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix D**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report

4.3.1 Federal Databases

National Priority List (NPL) (Superfund) - No listings within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No listings within one mile of the subject site.

No Further Remedial Actions Planned (NFRAP) - No listings within one mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No listings within one mile of the subject site.

RCRA Corrective action sites (COR) - No listings within one mile of the subject site.

RCRA Generators (RCRA-G) -The Environmental Protection Agency (EPA) regulates generators of hazardous material through the Resource Conservation and Recovery Act (RCRA). All hazardous waste generators are required to notify EPA of their existence by submitting the Federal Notification of Regulated Waste Activity Form (EPA Form 8700-12) or a state equivalent form. Three non-geocoded sites were identified within one mile of the subject property. The sites are actually located greater than one mile from the subject property. Therefore, these sites are not considered environmental concerns at this time.

RCRA No Longer Regulated (NLR) - No listings within one mile of the subject site.

Emergency Response Notification System (ERNS) - Eleven non-geocoded sites were reported within one mile of the subject property. The calls appear to be mostly highway/railway related with no or minor amounts of materials released. All eleven sites appear to be at least one half mile away from the subject site. Therefore, these reports are not considered environmental concerns at this time.

The subject site was not identified by any of the sources listed above as having an environmental concern or operating permit.

4.3.2 State and Regional Databases

Sites that are Contaminated or Potentially Contaminated by Hazardous Wastes (State Sites) - One non-geocoded site was reported within one mile of the subject property. The **Capistrano Unified School District** proposed a school location within one mile of the subject site. The Department of Toxic Substances Control was called to the location for an inspection. No action was needed. Therefore, this incident is not considered an environmental concern.

Sites with a record of spills, leaks, investigations, and cleanups (Spills - 1990) - No listings within one mile of the subject site.

Solid Waste Landfills (SWL) - Seven non-geocoded sites were reported were reported within one mile of the subject property. **Prima Deschecha Sanitation Landfill** (at the end of La Pata Road) is greater than one mile from the subject site. This site disposes of non-hazardous wastes. **La Pata Greenwaste Facility** (31748 La Pata Avenue) is greater than one mile from the subject site. Other reported sites are either greater than one mile from the subject site or do not have enough information to be properly located. Based on their distances from the subject property, none of these sites are considered environmental concerns at this time.

Establishments Issued a Permit to Track Site Status as a hazardous waste generator, gas station, TSD, underground tanks, violations, or unauthorized releases (Permits) - No listings within one mile of the subject site.

Other Unique Databases (Other) - One site was reported within one mile of the subject property. **Lomas San Juan Model Home Site** was identified as a LUST site. This case is further discussed in the LUST section below.

Permitted Underground/Aboveground Storage Tanks (REG UST/AST) - Four non-geocoded sites were reported within one mile of the subject property. Upon further evaluation, EEI located these sites greater than one mile from the subject site. Based on the distance and the fact that operating permits are not considered rationale for further investigation, these sites are not considered an environmental concern at this time.

Leaking Underground Storage Tanks (Leaking UST): One non-geocoded site was identified within one mile of the subject property. **Lomas San Juan Model Home Site** is non-geocoded and the location of the site is unknown. A gasoline leak was reported on January 1, 1965, and the aquifer is reportedly impacted. Soil at the site was excavated and treated or removed. The site was closed on December 11, 1991. Based on the status of the case (closed), this site is not considered an environmental concern at this time.

Releases into air and surface water (Releases) - Two non-geocoded sites were reported within one mile of the subject property. These sites are located along Oso Street, San Juan Capistrano, which is greater than one mile from the subject site. Therefore, these sites are not considered an environmental concern at this time.

PCB Activity Database System (PADS) - No listings within one mile of the subject site.

The subject site was not identified by any of the sources listed above as having an environmental concern or operating permit.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority's (OCFA) office for information regarding hazardous materials storage at the subject site. According to Fire Department personnel, the site does not have an official address or hazardous materials permit file, and is not currently under a regular inspection schedule. They further stated that they were not aware of any violations, hazardous materials spills, or emergency responses at the subject property.

4.4.2 Orange County Health Care Agency

EEI reviewed Orange County Health Care Agency databases including Leaking Underground Fuel Tank (LUFT) Sites, Underground Storage Tank (UST) Facilities, Non-petroleum Underground Tanks, Hazardous Waste Generators (HWG) and Land Fill Sites, to determine if the subject site or any properties within the site vicinity were listed as having an environmental concern. The subject site was not listed as having an environmental concern or operating permit. However, several sites in the vicinity of the subject property were identified on the LUFT list, including **California Silica Products** and **Oglebay Norton Industrial Sand** (31302 Ortega Highway, approximately one quarter mile west), and **Ford Aerospace Company** (33600 Ortega Highway, approximately one-quarter mile south). All three cases are closed, and reportedly did not impact groundwater. Therefore, these cases are not considered environmental concerns at this time. **Oglebay Norton Industrial Sands** was also listed on the UST and HWG databases. These are listings for operating permits only, and operating permits do not pose an immediate environmental concern. Therefore, this site is not considered an environmental concern at this time.

4.4.3 California Regional Water Quality Control Board

EEI reviewed the online database GeoTracker, maintained by the California Regional Water Quality Control Board - San Diego Region (SDRWQCB), to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. There were no listings for the subject site or any adjacent site.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. According to the information reviewed, no petroleum exploration or production has occurred on or adjacent to the site.

4.5 Interview with Site Personnel

EEI contacted Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner), who was interviewed regarding key site information. Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property. A list of the questions asked, and a summary of their responses, is included below.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: No.

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: Yes, the land was used to mine clay until the early 1960's.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: *To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?*

A: No.

Q: *Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?*

A: No.

4.6 Other Environmental Issues

4.6.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, “thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials” applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as “ floor or ceiling tiles, siding, roofing, transite panels” (i.e., non-friable) are also considered PACM unless tested.

There are no structures on the subject property. Therefore, the presence of ACM is not considered likely.

4.6.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

There are no structures on the property. Therefore the presence of lead-based paint is not considered likely.

4.6.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

On March 31, 2003, EEI personnel visited the entire site. Photographs 1 through 10 (**Appendix D**) document the site reconnaissance, which is summarized in **Table 2**.

EEI personnel conducted a driving and walking inspection around the perimeter of the subject property, then traversed the site from east to west and north to south. The site is located along Cristianitos Road, south of Ortega Highway. The property encompasses approximately three-hundred acres, and is situated within Cristianitos Canyon. Access to the site is through gated driveway from the west, or through the adjacent lease to the east. Several unpaved roads traverse the subject property, from Cristianitos Road towards the north-northeast part of the property.

The majority of the property is vacant, although several areas that had previously been mined for clay were noted in the central and southern areas of the property during the site visit. No evidence of contamination, petroleum-hydrocarbon staining, waste containers, and improper waste storage/handling were noted.

5.2.2 Adjacent Properties

Adjacent properties are agricultural/undeveloped to the north, south, east, and west. No environmental concerns were noted.

TABLE 2
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Property is in good condition.
Surface Spills	No	None observed.
Stained Soil/pavement	No	None observed.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	None observed.
Surface Impoundments	No	None observed.
AGT's/UST's	No	None observed.
Distressed Vegetation	No	None observed.
Wetlands	No	None observed.
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	None observed.
Waste/scrap storage	No	None observed.
Chemical use/storage	No	None observed.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property.

7.0 REFERENCES

California Division of Mines and Geology, 1973, Geo-Environmental Maps of Orange County, California.

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EEI

Expertise . . Service . . *Solutions*

PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 7
(CRISTIANITOS CANYON)
Cristianitos Road and Ford Aerospace Drive
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA7

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Phase I Environmental Site Assessment

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Site Location:

PLANNING AREA 7
(CRISTIANITOS CANYON)
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San Juan Capistrano, California

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EEI Project No. V030305-38A-PA7

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* in the Planning Area Seven (Cristianitos Canyon) portion of Rancho Mission Viejo, located along Cristianitos Road approximately five miles east of San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of previous investigations conducted by EEI.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Ford Motor Company, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area Seven is located north of the existing TRW site, and this planning area would designate 1,442 acres of 1B-Suburban Residential. Approximately 1,480 dwelling units are proposed on 853 acres of this planning area. The remaining 589 acres are proposed as open space within this planning area. This planning area would also support an overlay zone with a ten-acre commercial site providing approximately 100,000 square feet of neighborhood center. Existing authorized land uses would continue until the commencement of any new proposed land use for the affected areas.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located approximately five miles east of San Juan Capistrano, south of Ortega Highway along Cristianitos Road. The property is located on portions of several existing lots, identified by assessors parcel numbers 125-150-62, 125-150-29, 125-150-35, 125-150-61 (**Parcel Map, Appendix A**).

The property is located near Cristianitos Canyon, and is bound by undeveloped land/open range in all directions. Christianitos Meadow is located to the northwest of the property, and TRW is located approximately one-half mile south of the property. According to the Orange County Planning Department, the site is zoned A-1 (general agriculture, **Zoning Information, Appendix B**).

The site is currently undeveloped/vacant, except for single storage structure located in the southeast portion of the property, and for a small area used for agricultural purposes in the northeast portion (**Site Plan, Figure 2**). The eastern half of the property was most recently occupied by Ford Philco, which operated a weapons research and testing facility from 1969 until 1993, while the western half was most recently occupied by Riverside Cement/California Portland Cement (CPC-south), which conducted a limited clay mining operation from 1988 until 1993. A description of the Ford Philco and Riverside Cement/CPC (south) lease properties is included below in section 4.6.

3.2 Topography

The site is located within and adjacent to Cristianitos Canyon, north and west of Gabino Canyon, in a series of moderately sloping, north-south trending alluvial valleys and ridges. The site elevations range from approximately 400 to 1000 feet above mean sea level (amsl). The topographic gradient in the site vicinity ranges from 0.14 to 0.33 feet per foot to the southeast (in the eastern portion) and from 0.08 to 0.20 feet per foot to the southwest (in the central and western portions). Surface drainage from the site flows south and east into Gabino Canyon, then eventually into the Pacific Ocean, approximately 5 miles to the southwest.

3.3 Regional and Local Geology

The site is located in an alluvial valley (Cristianitos Creek) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the site vicinity are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations (Morton, 1974). These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Riverside Cement had previously mined the clay deposits of the Lower Silverado Formation. These clays are of three principal types, which include: 1) smooth gray suitable for refractory use; 2) pisolitic clay; and 3) mottled red clay which grades to siltstone. In addition, coal deposits of up to 10 feet in thickness have been encountered in association with refractory clay.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to the Myford, Cieneba and Alo associations (USDA, 1978). Soil in the Myford association is typically found on nearly level to moderately steep coastal terraces and consists of moderately well drained sandy loams that have a strongly developed topsoil. Soil in the Cieneba association is typically found on steep to very steep coastal foothills and consists of somewhat excessively drained sandy loams. Soil in the Alo association is typically found on strongly sloping to steep ridges and side slopes in the foothills and consists of well drained clays. Runoff in these associations is medium to rapid and the erosion hazard is moderate to high.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 15 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Christianitos Fault (just west of the site), the Mission Viejo Fault (just east of the site), and the Newport Inglewood Fault (offshore, southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the site lies within the San Mateo Hydrologic Area of the San Juan Hydrologic Unit. In general, groundwater in this subarea has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but should generally occur at between 3 and 25 feet below ground surface (Rancho Mission Viejo personnel, personal communication).

The San Mateo Hydrologic Area is located within the San Mateo Creek watershed. San Mateo Creek (southeast of the site), and Christianitos Creek (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for warm water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the San Juan Partnership No. One and San Juan Company. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 to 1999 were reviewed at Continental Aerial Photo in Los Alamitos, California. In addition, EEI also reviewed an aerial photograph dating from 2002 (EDAW). **Table 1** summarizes the results of the aerial photograph review. A copy of a 2000 aerial photograph is included in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1952	AXK-4K-43 [1]	The majority of the site is undeveloped, and several dirt roads are visible traversing the property. The central and northern portions of Riverside Cement/CPC South are being mined.
1959	9-32-83 [1]	A pond was noted in the southeast corner of the property. No other pertinent changes were noted since the previous photograph.
1967	2-154 [1]	Mining was noted in the southeast portion of Riverside Cement/CPC South. No other pertinent changes were noted since the previous photograph.
1970	61-9-213 [1]	Structures were noted along the southeastern margin of the site (former Ford Philco lease area). The mining operation was noted in the southwestern portion of the property. The remainder of the property was noted as undeveloped.
1973	132 13-15 [1]	A few structures were noted along the most northern part of main road (in the former Ford Philco lease area). No other pertinent changes were noted since the previous photograph.
1977	181 15-15 [1]	No pertinent changes were noted since the previous photograph.
1983	14-29/15-25 [1]	Four large structures were noted in the northern portion of the former Ford Philco lease area, and three large structures were present in the central portion of the subject site. A large facility of approximately 10 buildings was noted in the southern portion. Riverside Cement/CPC South mining activities continue in the southwestern portion of the subject site. A large pond was noted along the southwestern margin, and a large structure was noted in the southwest corner of the subject site. No other pertinent changes were noted since the previous photograph.
1985	2761 [1]	The road through the central portion of the site was paved. There were at least nine buildings located along the road in the southeastern portion of the property (former Ford Philco lease area), as well as a heliopad, and vehicle storage. Along the road in the central portion of the property were at least 15 structures. Several roads were noted to traverse the property from north to south, and there was a road along the southern margin. No changes were noted to the Riverside Cement/CPC South area. No other pertinent changes were noted since the previous photograph.
1987	F290-F291 [1]	Three retention basins were noted in the southwestern portion (Riverside Cement/CPC South lease). The structure at the southwest corner was no longer present. No changes were noted to the Ford Philco lease area. No other pertinent changes were noted since the previous photograph.
1993	C90-4-140 [1]	Only one large structure was noted in the southern portion of the subject site (former Ford Philco area). No changes were noted to the Riverside Cement/CPC South lease property. The remainder of the subject site was vacant.
1995	USGS	No pertinent changes were noted since the previous photograph.
1999	C-136-44-168/167 [1]	No pertinent changes were noted since the previous photograph.
2002	EDAW [2]	No pertinent changes were noted since the previous photograph. The site appears in its current configuration.

[1] Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California

[2] Aerial Photograph obtained from EDAW

4.2.2 Historic Maps

EEI reviewed United States Geological Survey topographic maps dating from 1948 to1978 at the University of California at Santa Barbara, Map and Imagery Laboratory. The maps were published by the United States Geological Survey.

The 1948 map notes the presence of two clay mines in the southwestern portion of the property.

The 1968 map notes the presence of two additional clay mines in the western portion, and a corral in the southwestern corner. Cristianitos Road is present to the west, and several dirt roads are noted to traverse the property from north to south. No development of the remainder of the subject site was indicated.

The 1975 map notes the presence of five structures in the northern portion of the property, just north of the access road, two structures in the central portion, and two structures along the southern margin, all in the boundaries of the former Ford Philco lease area. The clay mines and the corral were still noted in the western portion (on the Riverside Cement/CPC South lease area). No other changes were noted.

No changes were noted on the 1978 map.

4.2.3 City Directories

EEI reviewed historic city directories for southern Orange County at the Central Library in Santa Ana, California. There were no listings for the subject property.

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

EEI contacted the Orange County Building and Safety Department for information related to development of the subject property. EEI was previously able to review building permits issued to the tenant of 33600 Ortega Highway (the eastern portion of the subject property), Ford Aeronautics, which indicated building activity from 1969 through at least 1985 (Section 4.6). Other subject property sites do not have physical addresses. Therefore, no permits were available for review.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix C**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report.

4.3.1 Federal Databases

National Priority List (NPL) (Superfund) - No listings within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No listings within one mile of the subject site.

No Further Remedial Actions Planned (NFRAP) - No listings within one mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No listings within one mile of the subject site.

RCRA Corrective action sites (COR) - No listings within one mile of the subject site.

RCRA Generators (RCRA-G) -The Environmental Protection Agency (EPA) regulates generators of hazardous material through the Resource Conservation and Recovery Act (RCRA). All hazardous waste generators are required to notify EPA of their existence by submitting the Federal Notification of Regulated Waste Activity Form (EPA Form 8700-12) or a state equivalent form. Three non-geocoded sites were identified. Upon further evaluation, EEI located these sites to be located greater than one mile from the subject property. Based on this distance, these sites are not considered environmental concerns at this time.

RCRA No Longer Regulated (NLR) - No listings within one mile of the subject site.

Emergency Response Notification System (ERNS) - Eleven non-geocoded sites were reported within one mile of the subject property. The calls appear to be mostly highway/railway related with no or minor amounts of materials released. All eleven sites appear to be at least one half mile away from the subject site. Therefore, these reports are not considered environmental concerns at this time.

The subject site was not identified by any of the sources listed above as having an environmental concern or operating permit.

4.3.2 State and Regional Databases

Sites that are Contaminated or Potentially Contaminated by Hazardous Wastes (State Sites) - One non-geocoded site was reported within one mile of the subject property. The **Capistrano Unified School District** proposed a school location within one mile of the subject site. The Department of Toxic Substances Control was called to the location for an inspection. No action was needed. Therefore, this incident is not considered an environmental concern.

Sites with a record of spills, leaks, investigations, and cleanups (Spills - 1990) - No listings within one mile of the subject site.

Solid Waste Landfills (SWL) - Seven non-geocoded sites were reported were reported within one mile of the subject property. **Prima Deschecha Sanitation Landfill** (at the end of La Pata Road) is greater than one mile from the subject site. This site disposes of non-hazardous wastes. **La Pata Greenwaste Facility** (31748 La Pata Avenue) is greater than one mile from the subject site. Other reported sites are either greater than one mile from the subject site or do not have enough information to be properly located. Based on their distances from the subject property, none of these sites are considered environmental concerns at this time.

Establishments Issued a Permit to Track Site Status as a hazardous waste generator, gas station, TSD, underground tanks, violations, or unauthorized releases (Permits) - No listings within one mile of the subject site.

Other Unique Databases (Other) - One site was reported within one mile of the subject property. **Lomas San Juan Model Home Site** was identified as a LUST site. This case is further discussed in the LUST section below.

Permitted Underground/Aboveground Storage Tanks (REG UST/AST) - Four non-geocoded sites were reported within one mile of the subject property. Upon further evaluation, EEI located these sites greater than one mile from the subject site. Based on the distance and the fact that operating permits are not considered rationale for further investigation, these sites are not considered an environmental concern at this time.

Leaking Underground Storage Tanks (LUST) - The subject property and one other site were identified within one mile of the subject property. The former tenant of the property, **Ford Aerospace** (33600 Ortega Highway, approximately one half mile south of the subject site) reported as gasoline release on January 1, 1965. Reportedly, only the surrounding soil was impacted. The contaminated soil was removed and the case was closed March 19, 1992. EEI also reviewed other documents regarding the LUST case at the site, and a discussion of these reports is included within **Appendix E**. Based on several factors, including the status of the case (closed) this is not considered an environmental concern at this time. The second site, **Lomas San Juan Model Home Site**, is non-geocoded and the location of the site is unknown. A gasoline leak was reported on January 1, 1965, and the aquifer is reportedly impacted. Soil at the site was excavated and treated or removed. The site was closed on December 11, 1991. Based on the status of the case (closed), this site is not considered an environmental concern at this time.

Releases into air and surface water (Releases) - Two non-geocoded sites were reported within one mile of the subject property. These sites are located along Oso Street, San Juan Capistrano, which is greater than one mile from the subject site. Therefore, these sites are not considered an environmental concern at this time.

PCB Activity Database System (PADS) - No listings within one mile of the subject site.

Ford Philco, located in the eastern portion of the subject property was identified on the LUST database. The case is closed and is not considered an environmental concern at this time.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority during previous environmental site assessments at the subject property. According to Fire Department personnel, the site does not currently hold any permits, does not store any chemicals, has no recorded violations, and it is currently not under a regular inspection schedule.

4.4.2 Orange County Health Care Agency

EEI reviewed OCHCA databases including Leaking Underground Fuel Tanks (LUFT), Ground Water Cleanup Sites, Underground Tank Facilities, Non-petroleum Underground Tanks, Hazardous Waste Generators and Land Fill Sites, to determine if the subject site was listed as having an environmental concern. The site was identified as having a closed LUFT case. According to the information reviewed, **Ford Aerospace** (33600 Ortega Highway) reported gasoline and diesel releases in 1990. Reportedly only the soil was impacted, and the cases were closed in March 1992. In January 2003, EEI completed a Phase I ESA for this site (EEI, 2003), and this report is discussed below in section 4.6.2.

4.4.3 California Regional Water Quality Control Board

EEI contacted the California Regional Water Quality Control Board - San Diego Region (SDRWQCB) to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. In addition, EEI reviewed the Underground Storage Tank Information System (LUSTIS) and Spills, Leaks, Investigations, and Cleanup (SLIC) List, published by the SDRWQCB. There were no listings for the subject site nor any adjacent property.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. According to the information reviewed, no petroleum exploration or production has occurred on or adjacent to the site. EEI identified one underground jet fuel pipeline (16-inch), operated by Kinder Morgan, which is located in the southwest corner of the property (**Figure 2**).

4.5 Interview with Property Owner

In August 2001, EEI contacted Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner), who was interviewed regarding key site information for the former Riverside Cement/CPC South lease property (EEI, 2001). Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property. Mr. Vorhees stated that a portion of the property was used for clay mining. No other items of environmental concern were noted during the interview.

In January 2003, EEI contacted Mr. Vorhees and interviewed him regarding key site information for the Ford Philco lease (EEI, 2003). Mr. Vorhees stated that there was historically a maintenance shop on the southwest portion of the property, along with some UST's. No other items of environmental concern were noted during the interview.

In April 2003, EEI contacted Mr. Vorhees and interviewed him regarding key site information for the remainder of the subject property. A list of the questions asked, and a summary of their responses, is included below.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: Yes, a small part of the property in the north is farmed..

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: A portion of the property was used for farming, and the rest as open range.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: No.

Q: Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?

A: No.

4.6 Previous Assessments

4.6.1 Phase I Environmental Site Assessment - Riverside Cement/CPC South

In August 2001, EEI completed a Phase I environmental site assessment of the property occupied by Riverside Cement/CPC South, located at Cristianitos Road and Ford Aerospace road in the western portion of the subject property (EEI, 2001). According to the report, the site was first leased by Riverside Cement, then most recently by California Portland Cement Corporation (CPC South). Approximately 55 acres of the site was used for open clay mining, and the remainder was left as open space. The subject site was not identified by any search database as having an environmental concern or operating permit.

The site was not identified with the Fire Department as holding any permits or storing any hazardous materials, nor was it listed with the Orange County Health Care Agency as an environmental concern. During EEI's site visit, clay pit mining was noted in six locations, along with four ponds associated with clay mining. According to the report, no evidence of recognized environmental concerns were revealed in connection with the subject site.

4.6.2 Phase I Environmental Site Assessment - Former Ford Philco Lease

In January 2003, EEI completed a Phase I environmental site assessment of the property formerly occupied by Ford Philco, located at 33600 Ortega Highway in the eastern portion of the subject site (EEI, 2003). At the time of the report, the site was vacant, except for a single storage structure. However, the site was occupied by Ford Aerospace from 1969 to 1990, and then by Loral Aeronautics (a division of Ford) until 1993. Ford Philco operated a weapons research and testing facility, including gunnery ranges for the M1 Abrams Tank and related systems.

The site was identified on the RCRA generators database as a small waste generator, on the leaking underground fuel tank (LUFT) database, and on the hazardous waste information system (HWIS). According to the report, the LUFT case was described as soil-impacted only, and the case was closed by OCHCA in 1992. The other listings were for operating permits only, which are not considered as environmental concerns. No concerns were identified with the Fire Department or with OCHCA. In addition, no evidence of environmental concerns was observed at the property during the time of EEI's assessment.

Several previous environmental assessment reports performed at the site were reviewed by EEI as part of the ESA. These described investigative and decommissioning activities conducted at the site, and included: 1) Radiological decontamination and decommissioning of the gun range; 2) Underground Storage Tank (UST) closures; 3) Asbestos assessments fo the various structures; 4) Demilitarization of range impact areas; 5) Environmental site investigation and remediation of contaminated areas; and 6) Explosive ordinance disposal (EOD) range closure. A complete discussion of these reports is included in the report. Based on the information reviewed and the fact that regulatory closure of the facility had been granted by the DTSC in 1995, no further investigation was recommended by EEI.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, "thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials" applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as " floor or ceiling tiles, siding, roofing, transite panels" (i.e., non-friable) are also considered PACM unless tested.

An ACM survey was not included as a part of this ESA. However, an ACM survey was included as part of the site decommissioning procedures for the former Ford Philco lease property in 1992. The results of these tests are discussed in the Phase I report (EEI, 2003). Based on the information reviewed and EEI's site reconnaissance, the presence of ACM's in the remaining site structure is considered unlikely.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

A lead-based paint survey was not included as part of this ESA. However, based on the date of construction (1970's), the presence of lead based paint in the remaining structure is considered likely.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon

Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

EEI conducted a drive-by reconnaissance of the Riverside Cement/CPC South and Ford Philco portions of the subject property, during previous environmental site assessment investigations in July 2001, May 2002, and June 2002. The information collected during those site reconnaissances are included within the individual reports (EEI, 2001 and EEI, 2003), and a brief summary is included above in Section 4.6.

On March 31, 2003, EEI personnel conducted a drive-by reconnaissance of the remainder of the property. Photographs 1 through 16 (**Appendix D**) document the site reconnaissance, which is summarized in **Table 2**.

EEI personnel conducted a driving inspection around the perimeter of the subject property, then traversed the site from east to west and north to south on available roads. The site consists largely of undeveloped open range, and is located east of Christianitos Creek. The site is situated along two broad, north-south trending alluvial valleys, which slope moderately to the south and west. A prominent ridgeline separates the two valleys, while a second ridgeline forms the eastern margin of the property.

Clay pit mining is evident in six locations on the western half of the property, principally in the central portion along a distinctive ridgeline. The mines are generally large, multilevel pads surrounded by large stockpiles of clay. Four large ponds, associated with the clay pits, are also present in the southern portion of the site. Unpaved roadways hauls roads provide access to the mine areas and ponds.

A large corral area was noted in the southwestern margin of the site, along Ford Aerospace Road. In addition, a small windmill was noted along the southern property margin, along Talega Creek. A small area in the northern portion of the property is being cultivated for citrus crops.

There is one structure remaining on site. This steel storage building is located in a fenced compound along the southeastern margin of the property. There are paved roads which run along the western and southern margins of the property, and also a paved road which bisects the property, running from south to north until looping west into Cristianitos Road. Several concrete slabs and driveways were noted along this central paved road, indicating the former position of structures and facilities at the former Ford Philco facility. A water tank and utility shed were also noted along this road near the center of the property.

A large graded area was noted along the southern margin of the property, along Talega Creek. This area corresponds to the former impact area of the gunnery range. No evidence of spent ordinance was noted. A second graded area was noted along the southern margin of the property, at the intersection with the central paved road, in the location of the former maintenance shop. No evidence of stained soil or waste storage/handling was noted in this area.

Signs indicating the presence of a buried petroleum pipeline were noted in the southwest portion of the site. The pipeline apparently enters the property from the west, along Cristianitos Road, then cuts southeast across the site, exiting along Gabino Creek onto the adjacent TRW property to the south.

No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling were noted during the site reconnaissance.

TABLE 2
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
Surface Spills	No	None observed.
Stained Soil/pavement	No	None observed.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	None observed.
Surface Impoundments	No	None observed.
Railroad Spurs	No	None observed
AGT's/UST's	No	None observed.
Distressed Vegetation	No	None observed.
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	None observed.
Waste/scrap storage	No	None observed.
Chemical use/storage	No	None observed.

5.2.2 Adjacent Properties

Adjacent properties are agricultural/undeveloped to the north, east, and west. The TRW is located to the south. However, a large buffer (approximately one-quarter mile) was observed between the southern margin of the property and the main TRW facility. Therefore, no environmental concerns were noted.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. A variety of potential environmental concerns were previously identified at the former **Ford Philco** site. These included the manufacturing and testing of depleted uranium ammunition rounds, the presence of three UST's (one 10,000-gallon diesel, one 2,000-gallon gasoline, and one 3,000-gallon wastewater), removed from the site in 1990, the former presence of three target range impact areas, and a number of site locations where surface spillage or contaminated soils had been identified. However, based on a review of documentation provided by Ford Philco, all of these potential concerns have been addressed, and the site has been remediated in accordance with applicable regulatory action levels. Therefore, no further investigation related to these issues appears to be warranted.

2. Evidence of past agricultural uses has been revealed. If residential or other potentially health-sensitive uses are contemplated (e.g., schools, child care facilities, etc.), EEI recommends that an investigation be conducted to assess the possible presence of residual pesticides in accordance with DTSC's Interim Guidance for Sampling Agricultural Soils dated June 28, 2000.

7.0 REFERENCES

California Division of Mines and Geology, 1973, Geo-Environmental Maps of Orange County, California.

California Division of Mines and Geology, 1994, Fault Activity Map of California and Adjacent Areas.

California Regional Water Quality Control Board - San Diego Region, 1994, Water Quality Control Plan - San Diego Region: California State Water Resources Control Board Publication.

EEI, August 2001, Phase I Environmental Site Assessment - Riverside Cement/CPC South, Cristianitos Road and Ford Aerospace Drive, San Juan Capistrano, California.

EEI, January 2003, Phase I Environmental Site Assessment - Former Ford Philco Lease, 33600 Ortega Highway, San Juan Capistrano, California.

Morton, P K., 1974*, Geology and Engineering Geologic Aspects of the South Half of the Canada Gobernadora Quadrangle, Orange County, California,* California Division of Mines and Geology.

Southern California Earthquake Center, 1999, Faults in California - Los Angeles Region.

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EEI

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PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 8
TRW (Northrop Grumman Space Technology)

33000 Avenida Pico
San Clemente, California

May 15, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA8

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Phase I Environmental Site Assessment

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Site Location:

PLANNING AREA 8
TRW (Northrop Grumman Space Technology)
33000 Avenida Pico
San Clemente, California

Prepared under the direction of:

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* at Planning Area 8, including the TRW (currently known as Northrop-Grumman Space Technology) Capistrano Test Site (CTS) located at 33000 Avenida Pico in San Clemente, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated March 1, 1999 (Proposal 38A), between Morgan, Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other related information to evaluate historical site usage and development.
- A review of previous environmental investigation reports prepared by Tetra Tech, Inc., McLaren Environmental Engineering, and Riedel Environmental Services.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents EEI's findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan, Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan, Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan, Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a quantitative evaluation of the site, but is rather intended to provide a preliminary and qualitative indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this report does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, TRW (Northrop Grumman Space Technology), Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The **Planning Area Location Map** is included in **Plate 1**.

2.2 Description of Planning Area

This planning area is located south of Planning Area 7 and north of the southern RMV property boundary. The plan proposes 1,264 gross acres of 1B-Suburban Residential, supporting 1,400 dwelling units on 1,092 acres. Open space (172 acres) is also proposed within this planning area. Within an overlay zone, an additional ten acres of commercial development would provide a total of 100,000 square feet of neighborhood center. This area would also support overlay zones of approximately 80 acres of proposed business park with 1,220,000 square feet of business park uses, and 20 acres for a golf-oriented resort. Existing authorized land uses would continue until the commencement of any new proposed land use for the affected area.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located in southeastern Orange County, approximately five miles northeast of San Clemente. The property encompasses approximately 2,700 acres, and is part of several existing lots, identified by assessors parcel numbers 124-100-09, 124-100-33, 124-100-54, 125-150-23 and 125-150-49 (**Parcel maps, Appendix A**).

The property is located at the northeast terminus of Avenida Pico. It is bounded by undeveloped land/open range to the north, by residential and undeveloped property to the west, and by Camp Pendleton to the south and east. According to the Orange County Planning Department, the site is zoned A-1 (general agriculture, **Zoning Information, Appendix B**).

The site has been occupied by the TRW (now Northrop Grumman Space Technology) Capistrano Test Site (CTS) since 1963 (**Site Plan, Figure 2**). CTS is used to develop and test directed energy systems, spacecraft and rocket propulsion systems, and antennas. Prior site uses have also included the development and testing of "clean coal" technology. Facilities at the property include office and research facilities, a chemical laboratory (Chem Lab), a fossil energy test site (FETS), a number of testing and monitoring facilities including the high energy propulsion test site (HEPTS), vertical engine test site (VETS), and high altitude test stand (HATS), and various maintenance and support structures.

3.2 Topography

The site is located on an east-west rending ridge, north of Talega Canyon and south of Gabino and La Paz Canyons. The site elevations range from approximately 100 feet to over 1100 feet above mean sea level (amsl). The topographic gradient in the site vicinity ranges from 0.14 to 0.33 feet per foot to the southwest and from 0.14 to 0.20 feet per foot to the southeast. Surface drainage from the site flows west and south into Christianitos Creek, or south into Talega Creek, then eventually into the Pacific Ocean, approximately 4 miles to the southwest.

3.3 Regional and Local Geology

The site is located on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the site vicinity are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations (Morton, 1974). These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to a number of soil series including Alo varient clays, Cienaba sandy loam, Myford sandy loam, and Yorba cobbly sandy loam (USDA, 1978). Soils in these series are typically found on foothill slopes, ridgetops, terraces, and terrace escarpments, and generally consists of moderate to well drained gravelly and sandy loams.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 15 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the Christianitos Fault (just west of the site), Mission Viejo Fault (eastern portion of the site), and the Newport Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the site lies within the San Mateo Hydrologic Area of the San Juan Hydrologic Unit. In general, groundwater in this subarea has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but should generally occur at between 15 and 50 feet below ground surface (Tetra Tech, 1987).

The San Mateo Hydrologic Area is located within the San Mateo Creek watershed. San Mateo Creek (southeast of the site), and Christianitos Creek (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for warm water habitat, wildlife habitat, and recreational uses 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the San Juan Company. The owners address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, Sanborn Maps, City Directories and other sources were researched.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 to 1999 were reviewed at Continental Aerial Photos in Los Alamitos, California. In addition, EEI also reviewed select photographs from 1974, 1975, 1977, 1978. 1979, 1981, 1987, and 1993 from TRW (Northrop-Grumman) archives, a 1995 photograph from USGS, and a 2003 aerial photograph from GlobeXplorer. **Table 1** summarizes the results of the aerial photograph review. A copy of the 1995 aerial photograph is included in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1952	AXK - 4K- 43 [1]	Property is vacant and covered by thick vegetation. An unpaved road cuts through the property from west to east.
1959	9-32-82[1]	No significant changes since the previous photograph noted.
1967	2-154[1]	Buildings are present in several areas. In the CHEM LAB area the Chemical Laboratory Building is present. Two structures are present in the ADMIN/RANGES area, south of the main road (Test support Building and the Central Services Building). In the HEPTS area three structures are present (Buildings 43A, 43D, 43F), in the Main Control area the Control Center Building (42A) is present, in the VETS area Building 42E is present, and west of Main Control Building 45A is present.
1970	61-9-213[1]	No significant changes since the previous photograph noted.
1973	132 13-15[1]	Development of the RANGES area north of the ADMIN area (Buildings 41L, 41NA and 41NB) and south of ADMIN area (Building 41M) is viewed. Chem Lab only contains two structures.
1975	157 15-25[1]	Parking Lot present in the current location of Boneyard Storage. Chemical Laboratory Building and two test cells present in CHEM LAB area.
1977	181 15-16[1]	The Office Building (41P) and Guard Post (41J) in ADMIN/ RANGES area is present. In the VETS area Building 42K is present. FETS area is a vacant lot. The road to FETS area does not yet exist.
1983	15-27[1]	Storage structures are present in CHEM LAB (Building 44F). The Boneyard Storage area contains two structures (42T, 42Z). Structures are also present in FETS (Building 46A), and VETS (Buildings 42Y).
1987	F291[1]	Many new structures are present. In the VETS area Buildings 42A and 42J are present. In the Boneyard Storage area south of main control an additional structure is present (42AT). In the HEPTS area, Buildings 43G and 43GA are present. The FETS and HATS areas have many new structures present. The HPM Facility Building south of the HATS area is also present.
1995	USGS[2]	No significant changes are noted.
1999	C-136-45-176[1]	No significant changes are noted.
2003	GlobeXplorer [3]	The site appears in its current configuration.

[1] Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California
[2] Aerial Photograph obtained from USGS
[3] Aerial Photograph obtained from Mapquest GlobeXplorer

4.2.2 Historic Maps

EEI reviewed United States Geological Survey topographic maps dating from 1948 to 1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. No development of the subject site is indicated on any of the maps reviewed from 1948 to 1968. The 1975 map notes the presence of five structures in the northern portion of the property, just north of the access road, two structures in the central portion, and two structures along the southern margin. No changes were noted in the 1988 map.

4.2.3 City Directories

EEI reviewed historic city directories for southern Orange County at the Central Library in Santa Ana, California. There were no listings for 33000 Avenida Pico from 1972 through 2001, except for an entry from 1980, which identified the site occupant as MIT Lincoln Laboratory. TRW Systems Group was identified as the occupant at 32502 Avenida Pico from 1980 through 1990.

4.2.4 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI's research, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.5 Orange County Building and Safety Department Files

EEI contacted the Orange County Building and Safety Department for information related to development of the subject property. EEI was able to review building permits issued to the tenant, TRW, from 1970 to 1994. These permits included:

9/70 - Electrical Permit; vacuum pumps

11/80 - Building Permit; 320 square feet; aluminum cover over existing compressor

8/85 - Grading Permit; cut 40 cubic yards-borrow fill 1290 cubic yards for test installation building

8/86 - Certificate of Occupancy; high energy light system (laser) facility

8/86 - Building Permit; 3250 square feet; see above

10/86 - 2 Certificates of Occupancy; test facility shop building for alterations

11/86 - Certificate of Occupancy; water tank foundation #1202 accessory to proposed "alpha" test facility

2/87 - Plumbing Permit; building #41A office, building #42A office

2/87 - Plumbing Permit; building #42T storage

2/87 - Plumbing Permit; building #41D office and storage

2/87 - Building Permit; 2160 square feet; temporary office trailer

8/87 - Electrical Permit; electronics room

10/87 - Electrical Permit; unspecified

11/88 - Building Permit; 426 square feet; concrete pad, steel support for alpha test facility-fuel module

10/89 - Plumbing Permit; unspecified building

2/91 - Plumbing-Building Permit; building sewer/cesspool to modular office building

2/91 - Building Permit; 6420 square feet; foundation for modular building

3/91 - Plumbing-Building Permit; fire sprinklers to existing office

4/92 - Building Permit; 500 square feet; Issued to "San Juan partnership"; no.6 retaining wall

6/92 - Certificate of Occupancy; electrical power station

9/94 - Certificate of Occupancy; 900 square feet; new weathershield structure for gas pump/roof only,

4.3 Regulatory Database Search

EEI reviewed known data on the hazardous waste generating establishments in the vicinity of the site, as well as on sites with known environmental concerns. These facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from First Search, an environmental information retrieval service. A copy of the First Search report is provided in **Appendix C**. Below is a list of databases that were reviewed in the preparation of this report:

4.3.1 Federal Databases

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCIS) - No listings within one mile of the subject site.

National Priority List (NPL) - The was one listing within one mile of the subject site. Camp Pendleton Marine Corps Base was listed as having multiple releases to soil and groundwater of petroleum hydrocarbons, solvents, and pesticide residues. Based on the relative distance and position downgradient, this site is not considered an environmental concern at this time.

No Further Remedial Actions Planned (NFRAP) - No listings within one mile of the subject site.

Federal Facilities (FEDFAC) - No listings within one mile of the subject site.

Emergency Response Notification System (ERNS) - No listings within one-half mile of the subject site.

Site Enforcement Tracking System (SETS) - No listings within one mile of the subject site.

Enforcement Docket Systems (DOCKET)/Consent Decree Tracking System (CDETS) - No listings within one-half mile of the subject site.

Criminal Docket System (C-DOCKET) - No listings within one-half mile of the subject site.

Resource Conservation and Recovery Act Violators and Facility list (RCRA) - No listings within one mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No listings within one mile of the subject site.

RCRA Generators (RCRA-G) - No listings within one mile of the subject site.

The subject site was not identified on any of the databases reviewed.

4.3.2 State and Regional Sources

Annual Work Plan (AWP) - No listings within one mile of the subject site.

CALSITES (Abandoned Sites Program Information System) - No listings within one mile of the subject site.

CORTESE - No listings within one mile of the subject site.

California State Leaking Underground Storage Tanks (LUST): No listings within one mile of the subject site.

Solid Waste Information System (SWIS) - No listings within one mile of the subject site.

Toxic Releases (NT) - No listings within one mile of the subject site.

Toxic Pits (TPC) - No listings within one mile of the subject site.

Solid Waste Assessment Test (SWAT)- No listings within one mile of the subject site.

Permitted Underground Storage Tanks (UST) - The subject site was identified as a permitted UST facility. There were no other listing within a one mile radius.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Department's Clerk of Authority office for information regarding hazardous materials storage at the subject site. According to Fire Department inspection records, **TRW** (33000 Avenida Pico) currently holds hazardous materials operating permits for eight separate site locations. These include the administration area, FETS, ChemLab, Drum Farm, VETS Plate, HEPTS Plateau, Alpha Plateau, and a general (unspecified) location. A list of chemicals stored and the maximum daily amount permitted for storage are given in **Appendix D.**

Administration Area

The most recent inspection report for the administration area, dated March 25, 2003, indicates permits for flammable, inert and oxidizer compressed gases, flammable/ combustible liquids, oxidizing and corrosive hazardous materials, liquified petroleum gases, motor vehicle fuel dispensing stations, spraying/

dipping, and welding/cutting operations. The following chemicals are stored onsite: acetylene (building 41A, 41AB), argon, gasoline, helium, liquid propane (building 41A, 41P, 41D), nitrogen, and oxygen. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

Fossil Energy Test Site (FETS)

The most recent inspection report for the FETS area, dated March 25, 2003, indicates permits for flammable and inert compressed gases, non-flammable and oxidizer cryogens, explosives or blasting agents, flammable/ combustible liquids, and oxidizing hazardous materials. The following chemicals are stored onsite: deuterium, ethylene, helium, hydrogen, hydrogen peroxide, nitrogen, and nitrogen trifluoride. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

Chemical Laboratory (CHEMLAB)

The most recent inspection report for the ChemLab area, dated March 25, 2003, indicates permits for flammable, highly toxic, and oxidizer compressed gases, explosives or blasting agents, and oxidizing, corrosive, and unstable/reactive hazardous materials. The following chemicals are stored onsite: hydrogen, hydrogen peroxide, oxygen, fluorine, squib ignitor, nitrogen, and helium. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

Hazardous Fuel Storage Area (Drum Farm)

The most recent inspection report for the Drum Farm area, dated March 25, 2003, indicates permits for unstable reactive compressed gas, flammable and combustible liquids, and oxidizing, water reactive, highly toxic, unstable reactive or other health hazardous materials. The following chemicals are stored onsite: chlorine, diesel fuel, ethylene glycol, ethanol, fluorine, hydrazine, monomethylhydrazine (MMH), nitrogen tetroxide, JP-8 jet fuel (kerosene) and nitrogen dioxide. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

Vertical Engine Test Stand (VETS)

The most recent inspection report for the VETS Plate area, dated March 25, 2003, indicates permits for toxic, unstable/ reactive, flammable and inert compressed gases, corrosive, highly toxic, and non-flammable cryogens, combustible liquids, water reactive, corrosive, highly toxic, toxic, and unstable/ reactive hazardous materials, and liquified petroleum gases . The following chemicals are stored onsite: ammonia (building 42B, 42U) chlorine, deuterium (building 42W, 42U), diesel fuel (building 42N, 41UR), ethylene glycol, Potassium phosphate dibasic, liquid fluorine, helium, hydrogen (building 42W, 42U), hydrogen peroxide, Diala type A oil, liquid propane, liquid nitrogen, nitrogen (building 42E, 42U-H-10, B-9) potassium hydroxide(50%) sodium chloride, sodium hydroxide , waste ammonium hydroxide, and petroleum distillate. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

High Energy Propulsion Test Site (HEPTS)

The most recent inspection report for the HEPTS Plateau area, dated March 25, 2003, indicates permits for unstable/ reactive, inert, and oxidizer compressed gases, highly toxic, non-flammable and oxidizer cryogens, flammable/ combustible liquids, and oxidizing, corrosive, and highly toxic hazardous materials, and liquified petroleum gases. The following chemicals are stored onsite: betz entec 367, argon, deuterium, n,n-diethylethanolamine, cyclohexylamine, morpholine, ethylene glycol, potassium dibasic, ethanol, fluorine (43B J-13), helium (at ox-inert storage, yard, test cell), hydrazine, hydrogen, hydrogen peroxide 30%, propane, ethane, propene, butanes, hydrogen peroxide 70%, methylhydrazine, carbon black, nitrogen (43D- J-2, 43C- B-7, 43G- F-8), liquid nitrogen (43B- N-6, 43D- F-13, 43D- L-7), nitrogen tetroxide (43C- C12), nitrogen trifluoride, Mobil DTE oil, oxygen, Diala oil AX, kerosene, potassium hydroxide, potassium hydroxide 50%, tolytriazole, phosphonic acid, sodium chloride, sodium hydroxide 50% (42X-D-11,43C-A-5), sulfur fluoride, Cortrol IS 104, triphenyl phosphate, nitrogen tetroxide (43C-B5), and fluorine (43B-K-11). There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

Alpha Plateau

The most recent inspection report for the Alpha Plateau area, dated March 25, 2003, indicates permits for flammable, inert, and limitant/OHH compressed gases, non-flammable and oxidizer cryogens, flammable/ combustible liquids, and corrosive hazardous materials. The following chemicals are stored onsite: sodium fluoride, deuterium, ethylene glycol, helium, hydrogen, isopropanol (Room 41G, 42M), nitrogen liquid, nitrogen gas, oil- mineral petroleum distillates, oxygen (Room 42M, 42D), mineral oil, paraffinic mineral oil, sodium hydroxide 30%, sodium hydroxide 50%, sodium molybdate (V), and sodium nitrite. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

General (Facility Wide) Permit

The most recent inspection report for the general (unspecified) area, dated March 25, 2003, indicates permits for toxic, flammable, inert, irritant/OHH, and oxidizer compressed gases, corrosive hazardous materials, and liquified petroleum gases. The following chemicals are stored onsite: chlorine, propane, ethane, propylene, butanes, air, deuterium, helium, hydrogen, petroleum distillate, oxygen, sodium hydroxide, sodium fluoride, and propene. There were no indications of code violations, hazardous materials spills or emergency responses in Fire Department files.

4.4.2 Orange County Health Care Agency

EEI contacted the Orange County Health Care Agency (OCHCA) Custodian of Records to obtain copies of any Underground Storage Tank (UST) Operating Permits, Leaking Underground Fuel Tank (LUFT) files and/or any Hazardous Waste Permit (Hazmat) files for the site. The following is a summary of the information contained in OCHCA Files (**Appendix E**).

The site is currently permitted as an Underground Storage Tank Facility. Permit 3947-3 indicates that one tank is present. The tank is a 3,000 gallon, fiberglass-reinforced, double-walled, steel tank containing unleaded gasoline. The tank was installed in 1988. Annual inspection reports from 1995 through 2001 indicate no violations have been issued.

EEI reviewed Hazardous Waste Inspection Reports for the facility dating from June 1995 through August 2001. Waste streams identified during these inspections included coal caustic, waste oil, parts cleaner, aerosol waste, acid/caustic detergent cleaner, thinner waste and solvent (flammables), PCB waste/ ballasts, asbestos floor tile, coal caustic tank, paint filters, lab sink drains, waste water, hydrazine waste water, miscellaneous lab pack waste/ solvent wipes etc, ammonium hydroxide (3%), basic hydrogen peroxide (50% water, 50% sodium/ potassium hydroxide, and hydrogen peroxide (30-98%). No violations were noted in the inspections.

A 500-gallon plastic underground storage tank (UST) was removed from a concrete vault in August 1992 (42A). The vault appeared intact with no apparent cracks. The vault was filled with sand and capped with concrete.

A 4' x 4' x 7' blind concrete sump was removed in November 1990 (44B). Samples were collected directly from the sump site and from a location approximately 30' north of the site. The samples were analyzed for pH, total kjeldahl nitrogen, nitrates, nitrites, sulfates and hydrazine. No further action was required.

Two underground storage tanks were removed and replaced from sites in August 1988. The 1,000 and 2,000 gallon gas tanks were replaced with a 3,000 gallon unleaded gas tank. Soil samples were taken from the excavation pits of each tank and analyzed for aromatic volatile organics. Samples revealed concentrations below detection limits.

An above ground tank (AGT) containing approximately 300 gallons of hydrogen peroxide exploded and destroyed another tank containing sodium hydroxide in August 1999. There were no other details provided in the file. According to TRW personnel, cleanup of the accident site was performed by TRW.

4.4.3 California Regional Water Quality Control Board

EEI contacted the California Regional Water Quality Control Board - San Diego Region (SDRWQCB) to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. In addition, EEI reviewed the Underground Storage Tank Information System (LUSTIS) and Spills, Leaks, Investigations, and Cleanup (SLIC) List, published by the SARWQCB. There were no listings for the subject site nor any adjacent property.

File data from December 1988 and January 1989 indicated the closure of surface impoundments at the subject facility. In a letter dated December 9, 1988, the SDRWQCB indicates that all hazardous substances have been completely removed from surface impoundments at the facility, and that the reported data do not indicate the presence of contamination in soil or groundwater beneath the impoundments. The letter states that closure of the impoundments has been completed, and that TRW had complied with the requirements of the Toxic Pits Cleanup Act.

EEI reviewed the Waste Discharge Requirements for the Disposal of Treated Domestic Sewage at the TRW Capistrano Test Site (Order No. 94-78 dated October 1994). The permit regulates the operation of a sewage treatment system at the facility, consisting of a 3,000-gallon septic tank, aeration pond, and spray irrigation network. A Facilities Inspection Form for the sewage treatment system, dated June 2000, indicated that the aeration pond was in service and appeared to be working properly. Mosquito larvae were noted in the pond. Aside from the mosquito larvae, the system was deemed to be in satisfactory compliance. The Semi-Annual Aeration Pond Effluent Monitoring Report dated January 2003 indicates that pond effluent analysis results exceeded requirements for Total Dissolved Solids (TDS). The reported value was 1,400 milligrams per liter (mg/l). The maximum allowable limit stated was 1,000 mg/l. No other analytes of concern were noted.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Based on file data, no petroleum production has occurred on or adjacent to the site.

4.5. Previous Assessment

As a part of this Phase I ESA, EEI reviewed various documents provided by TRW (**Appendix F**). There have been several investigative and decommissioning activities conducted at the site. These include: 1) Investigation and clean closure of seven surface impoundments; 2) inventory of underground tanks; 3) removal and closure of other underground storage tanks; 4) remediation of diesel contaminated soils; and, 5) soil investigations at various locations. The following is a summary of the information reviewed by EEI.

4.5.1 Investigation and Clean Closure of Surface Impoundments

Until the late 1980's there were seven surface impoundments on the TRW property whose principal function was to hold recirculating cooling water for the various testing operations at the facility. According to a Tetra Tech, Inc., document entitled "Geologic Summary Report for the Capistrano Test Site" August 1987, these surface impoundments were known as:

- FETS Scrubber (capacity: 63,000 gallons)
- FETS Quench (capacity: 63,000 gallons)
- Upper VETS (capacity: 150,000 gallons)
- Lower VETS (capacity: 150,000 gallons)
- Fire extinguishing reservoir (capacity; 150,000 gallons)
- HATS (capacity: 24,000 gallons)
- CHEM (capacity: 76,000 gallons)

Five of these surface impoundments were determined to be subject to the requirements of the Toxic Pits Cleanup Act of 1984 (TPCA) because sodium dichromate corrosion inhibitor was added to these recirculating cool systems. The San Diego Regional Water Quality Control Board (RWQCB) determined that hexavalent and trivalent chromium were constituents of concern in these impoundments due to the use of sodium dichromate. The use of sodium dichromate was discontinued in 1986. The five impoundments were the two at FETS, the upper and lower VETS, and the FIREX. These impoundments were subject under TPCA to the preparation of a Hydrologic Assessment Report (HAR). The above reference document was an interim document prior to the submission of the HAR). The other two impoundments, HATS and CHEM, were not subject to TPCA and not required to be part of the HAR, but TRW chose to conduct subsurface investigations nonetheless.

These impoundments were put into service in the 1960's and 70's. Their construction consisted of 0.05 inch Hypalon liners placed directly over sand (with an accompanying hot tar mop over the sand in the VETS and fire extinguishing reservoirs). There were no double liners, leachate collection, or leak detection monitoring devices on any of the impoundments. Sludge from the bottom of the impoundments was periodically removed by vacuum pump truck and reportedly disposed of in an appropriate facility.

TRW was notified by the RWQCB in October 1986 to establish a detection monitoring program under TPCA. A field program was then designed by TRW and its consultant, Tetra Tech, Inc., to detect the presence of waste constituent in surface water or groundwater down gradient from the impoundments and in the unsaturated zone beneath and adjacent to the impoundments. Field work was performed under the direction of a California Registered Geologist and conducted between February and May 1987.

Seven shallow soil borings (one at each surface impoundment) were drilled to approximately 50 feet and sampled. Samples were collected in each boring in the following manner; 1) in sand immediately above the uppermost clay layer of thickness greater than 5 feet (potential permeability barrier); or 2) at the approximate depth of the bottom of each impoundment; or 3) at the terminus of each hole. Per the RWQCB, the soil samples were analyzed for heavy metals (including hexavalent chromium), total organic carbon (TOC), and total organic halogens. Some samples were analyzed for total petroleum hydrocarbons (TPH).

Analyses indicated TOC ranging from 100 to 3500 mg/kg. Background TOC ranged from 1,200 to 3,000 mg/kg. The TPH sample analyses had results above detection limits ranging from 0.27 to 5.45 mg/kg. Analyses for total organic halogens resulted in no detection of such compounds (detection limit was 0.5 mg/kg). Heavy metals analysis indicated very low levels of heavy metals, generally in the range of normal background range for sandstones and shales. No samples had metals exceeding (or even approaching) total metal threshold levels as specified in Title 22 of the California Code of Regulations.

Four groundwater monitoring wells proposed to meet the requirements of TPCA. Two wells, at the FETS and HATS sites, were completed. The other two wells drilled did not encounter groundwater. The groundwater monitoring wells completed were sampled principally for the presence of hexavalent and trivalent chromium. Neither constituent was found above the chromium maximum concentration level (MCL) of 0.05 mg/L.

According to a reviewed document prepared by Tetra Tech, Inc. (entitled "Final Closure Report for Surface Impounds at the TRW Capistrano Test Site) in 1988, the seven surface impoundments were removed and sites closed. During the removal activities soil borings were advance at each impoundment to determine the extent, if any, of soil contamination beneath the impoundment liners. The soil borings were advanced from 11 to 20 feet, with samples collected by split-spoon samples and brass sleeves at depths of 0, 2.5, 5, 7.5, 10, 15, and 20 feet (where applicable). Sample analysis was limited to hexavalent chromium, total chromium, nickel, and molybdenum (under the approval of the RWQCB). Actual laboratory analyses was conducted under a tiered approach, i.e., if the surface and 2.5 foot samples indicated elevated levels of a metal then the next level down would be analyzed. Results indicated that at the 2.5 foot level concentrations were much less than the total metals threshold levels established in Title 22 of the California Code of Regulations. Most results were either non-detect (less than 0.05 mg/kg) or under 1% of the threshold levels.

The impoundments were considered clean closed by the RWQCB in a letter dated December 8, 1988 to TRW and no post closure monitoring was required. Based on the above reports it appears that the seven surface impoundments did not contaminate the soil or groundwater in these areas.

4.5.2 Inventory of Underground Tanks

In 1987, TRW retained Tetra Tech, Inc., to conduct an inventory of all existing inground and underground storage tanks at its Capistrano Test Site (CTS). A document was prepared which summarized the locations, descriptions, use, and applicable regulations affecting each tank inventoried. This report, entitled "Capistrano Test Site Underground and Inground Tank Inventory" (November 1987) was reviewed and conclusions are summarized below.

The document reported 32 different storage structures, ranging from underground and above ground storage tanks, to sumps and cooling towers. Tetra Tech reported that all of the underground storage tanks (and related facilities) appeared to be in compliance with state underground storage tank requirements with the exception of the following:

- Two inground concrete sumps at Building 44A and 44B,
- Two underground gasoline storage tanks near Building 41Q,

- Building 41C pump drain tank,
- Brine tank at Building 41G.

Regarding bringing these facilities into compliance, the report summarized the next steps necessary. Additional reports (as described below) were also reviewed for this assessment.

Inground concrete sumps at Building 44A and 44B

The two concrete sumps, which received chemical wastewater from the Chemical Laboratory, were to be upgraded to meet the state underground storage tank requirements. This upgrade was performed in 1988 and hypalon liners and leak detection systems were installed to meet Subchapter 16, Title 23, California Code of Regulations requirements. The upgrade are described in the Tetra Tech document entitled "Final Report for the Retrofit of Chem Lab 44A and 44B Sumps at the TRW Capistrano Test Site"

During the upgrade of the sumps, soil sampling of these concrete sumps was conducted as required for the closure of the sumps as primary, since the hypalon liners become the primary containment with the concrete as the secondary containment. Under the direction of the Orange County Environmental Health Agency a hole was cut out of the bottom of each concrete sump and a sample of the soil beneath was taken using a Shelby-tube sampler. The hole in the sump was then resealed with a non-shrink grout. The samples were then analyzed for pH and metals. Results indicated all soil samples were non-hazardous. The Orange County Environmental Health Agency considered the sump retrofit successfully completed.

Underground Gasoline Storage Tank Replacements

The two underground gasoline storage tank near Building 41Q were removed in August 1988 and reported in a Tetra Tech, Inc., document entitled "Final Report for Underground Gasoline Tank Replacements at the TRW Capistrano Test Site" (October 1988). The two single-walled tanks (1,000 and 2,000 gallons) were replaced with a new 3,000-gallon double-wall fiberglass coated steel tank in order to satisfy the state underground storage tank regulations.

Two soil samples were were taken from the excavation of each tank as they were removed. Two more soil samples were taken from the stockpiled excavated soil. The six soil samples were analyzed by Thermo Analytical Labs, Inc., for VOCs per EPA Test Method 8020. All VOCs were determined to be below the detection limit of 0.002 mg/kg. It was noted in the review of the underground storage tank removals that there appears be no testing reported for the fuel dispenser area and underground piping runs. This was due to the fact that the dispensers and associated piping where located directly above the removed tanks.

The new 3,000-gallon double-wall tank was installed in the excavation where the 2,000-gallon tank was located. The Orange County Environmental Health Agency approved the permit and plans for this new tank. A leak detection system was also installed for both the tank and associated piping.

Building 41C pump drain tank and brine tank at Building 41G

The underground tank inventory report indicates that the tank at Building 41C was under evaluation to bring it into compliance with state underground storage tank requirements. In addition the report stated that the 40,000 brine tank at Building 41G required secondary containment. A containment curb was subsequently installed in 1988.

4.5.3 Removal and Closure of Other Underground Storage Tanks

Four additional reports were reviewed regarding the removal and closure of an underground gasoline storage, wastewater sump, and concrete tanks. The results of these closure reports are as follows.

Closure of the HEPTS Concrete Tank

A concrete tank, used for cooling water storage at the HEPTS (High Energy Propulsion Test Stand), was removed from the TRW facility. A Tetra Tech, Inc., document entitled "Final Closure Report for the HEPTS Concrete Tank at the TRW Capistrano Test Site" November 1988 summarized the closure activities.

Closure activities including removing the concrete walls and floors of the tank and taking soil samples once the soil underneath the concrete tank were exposed. Four soil samples, using a Shelby-tube sampler were taken. Two samples were taken directly at the soil surface, with the other two taken at approximately six inches deep. One sample each were also taken of the concrete and loose soil from the debris storage pile. All sampling was performed under the direction of the Orange County Environmental Health Agency. The six samples were analyzed for heavy metals. Laboratory results indicated that all samples were significantly less than hazardous waste threshold levels. The concrete and soils were classified as nonhazardous and could be disposed of as nonhazardous materials.

The closure report recommended no further investigation and a TRW memo to the file (dated 4/10/89) indicated that Orange County Environmental Health Agency concurred that closure was complete.

Closure of the HATS Concrete Tank

Two adjoining concrete tanks, used for cooling water storage at the HATS (High Altitude Test Stand), were converted to secondary containment for new aboveground storage tanks. In this conversion to secondary containment, its use as primary containment had to be closed. Thus, the closure activities were summarized in the Tetra Tech document entitled "Final Closure Report for the HATS Concrete Tanks at the TRW Capistrano Test Site" (November 1988).

Soil under the concrete tanks was sampled by cutting two holes in the bottom of each of the concrete tanks and using a Shelby-tube sampler to collect the soil sample. The holes in the concrete were then sealed with non-shrink grout which allows the tanks to serve as secondary containment. The four soil samples were analyzed by Thermo Analytical, Inc., for heavy metals. All results were either non-detect or significantly less than the hazardous thresholds.

The closure report recommended no further investigation and a TRW memo to the file (dated 4/10/89) indicated that Orange County Environmental Health Agency concurred that closure was complete.

4.5.4 Remediation Of Diesel Contaminated Soils

A report entitled "Final Report for TRW Fossil Energy Test Site" (February 1991) was reviewed regarding the investigation and remediation of diesel impacted soil on the TRW property. The results of that investigation and remediation follow.

In January 1990, a leak was discovered in a 1.5-inch diameter underground diesel fuel pipeline at the Fossil Energy Test Site (FETS). This pipeline was used to convey diesel fuel for use in a FETS compressor. TRW commissioned CKY, Inc, to collect soil samples adjacent to the pipeline in the attempt to determine the amount of diesel soil contamination. Soil samples analyzed for total petroleum hydrocarbons (TPH) resulted in concentrations ranging from 600 to 18,000 mg/kg..

The report further reported that in April 1990 Tetra Tech, Inc, performed additional subsurface investigations to delineate the extent of soil contamination. It was estimated from that investigation that approximately 1,000 cubic yards of contaminated soil would have to be excavated in order to meet the San Diego Regional Water Quality Control (RWQCB) cleanup criteria for TPH (as diesel) of 100 mg/kg (i.e., the level of contamination in the soil at which remediation is not required). Further, the RWQCB cleanup objectives for soils contaminated in the adjoining ravine were set at 10 mg/kg to protect surface and groundwater.

When the RWQCB investigation requirements were met, a workplan for the remediation of the contaminated soil was prepared in November 1990 was prepared by Woodward Clyde Consultants. Remediation activities were performed by Riedel Environmental Services, Inc. Soil excavation was conducted, with soil sampling and analyses for TPH, yielding approximately 3,000 cubic yards of potentially contaminated soil. This soil was stockpiled and covered. Subsequently, the stockpile was sampled under supervision of Orange County Integrated Waste Management Department and analyzed in accordance with Orange County Class III Landfill requirements. The analytical results determined that the soil could be take to the nearby Prima Deshecha Class III Landfill. In Janauary 1991, approximately 3,350 tons of hydrocarbon-contaminated soil was disposed at the Prima Deshecha Landfill.

The excavated areas, which met the RWQCB cleanup criteria, were backfilled with clean native soil and compacted to a minimum 90% capacity. Field screening using an Organic Vapor Meter was used to confirm the absence of contaminated soil in the backfill material. The subject site was restored to its original condition, with restoration including resurfacing of approximately 1,200 square feet with asphalt and hydroseeding of the ravine and borrow areas. On May 23, 1991, TRW was issued a letter from the San Diego RWQCB stating that Board staff had determined that soils at the site exceeding cleanup objectives established by the Board had been removed and disposed of in a Class III facility.

Based on the remediation report and accompanying data, it appears that the diesel contaminated soils at the FETS were successfully removed.

4.5.5 Soil Investigations at Various Locations

In 2002, soil investigations were conducted at 14 different investigation areas on the TRW property by the Equipoise Corporation of San Juan Capistrano, California. The stated purpose of these soil investigations was to assess the presence or absence of select constituents of concern in areas of the TRW facility used for, or associated with, the TRW Space Based Laser (SBL) Program. The execution and results of this soils investigation were presented in a report prepared by Equipoise entitled "Space Based Laser Program Initial Soil Investigation" (prepared for TRW, Inc., July 31, 2002).

The fourteen investigation areas where SBL Program activities were conducted are:

- Fire X Reservoir (former fire x and cooling water reservoirs),
- Alpha Chill Water Tank, Building 42E,
- VETS, specifically Shop Building 42Y and the former laser area behind Buildings 42J and 42K,
- HEPTS Former Reservoir,
- Isopropyl Alcohol (IRA) Tank, 41G
- Upper HATS,

- Lower HATS,
- Former Reservoir, 41H,
- Boneyard Storage, 42T,
- PAR (Preliminary Assessment and Research), Building 45A,
- Drum Storage Area, 41E (Hazardous Fuel Storage Area),
- Spray Booth Building, Building 41D (Central Services Building),
- Valve Shop/Clean Room, Building 41A (Test Support Building),
- Surface Irrigation Area.

During the soil investigations, the environmental consultant drilled, sampled, and subsequently abandoned 23 hollow-stem auger and 11 hand auger borings at the 14 sites listed above. The hollow-stem auger borings ranged from 5 to 20 feet deep, with the hand auger borings ranging from 1 to 9 feet deep. Fifty-three discrete soil samples from the 34 borings were collected from various depths in the borings and submitted for laboratory analyses.

Laboratory analyses for the collected samples included: Volatile Organics Compounds (VOCs including acetone, Freon 113, and isopropyl alcohol) via EPA Test Method 8260B; Semi-Volatile Organic Compounds (SVOCs) via EPA Test Method 8270C; Polynuclear Aromatic Hydrocarbons (PAHs) via EPA Test Method 8270; Priority Pollutant Metals via EPA Test Method 6010B and 7421 for mercury; Petroleum Hydrocarbon Distribution via EPA Test Method 8015-Modified; Volatile Fuel Hydrocarbons, Benzene, Toluene, Ethylbenzene, Xylene (BTEX), and Methyl-tert-butyl Ether (MTBE) via EPA Test Methods 8015M and 8021B; and hydrazines (including hydrazine, methylhydrazine, and 1,1-dimethylhydrazine) via gas chromatography.

Laboratory analysis results indicated that a majority of the analyzed constituents of concern (VOCs, SVOCs, PAHs, metal, PCBs, and hydrazines) were not detected at concentrations above their respective analytical method detection limits and none were detected above their respective EPA Preliminary Remediation Goals (PRGs). PRG's have been established to aid in site "screening" i.e., to help identify areas, contaminants, and conditions that do not require further attention at a particular site. Generally, at sites where contaminant concentrations fall below PRGs, no further action or study is warranted. In the case of TRW, residential PRGs were used for comparison sake. Residential PRG's represent the most conservative category of PRG's for soil. For the Petroleum Hydrocarbons, the Los Angeles Regional Water Quality Control Board's Level A Soil Screening guidelines were used and none were detected above the guidelines level. Metals concentrations above their respective detection levels were either below or the within the background range published for California soils.

4.6 Interview with Property Owner

EEI contacted Jerry Buckley, Manager of Facility Operations for TRW Northrop Grumman Space Technology), who was interviewed regarding key site information. Mr. Buckley indicated that he has been working at the facility for over 15 years and is familiar with the subject property. Mr. Buckley also provided EEI with facility maps, a building inventory, photographs, and a variety of other pertinent information regarding site usage and history (**Appendix G**). A list of the questions asked, and a summary of their responses, is included below.

Q: Are you aware of any current or previous uses of the site or adjoining properties which have created an unresolved environmental concern?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No, to the best of our knowledge.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: Yes (documentation provided).

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: Yes (Documentation provided)

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul chemical odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No unresolved issues.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: Yes (Documentation provided).

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: Yes, after passing through a sewage treatment system. CTS has a discharge order from the CRWQCB for surface discharge (irrigation) from one aeration pond. This is restricted to 3,000 gpd. Typical discharge rates have been 1 gpd to 315 gpd over the past 5 yrs. 1998 was especially heavy and averaged 2,043 gallons per day due to El Nino events.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: No.

Q: Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?

A: Not any more. Reports documenting removal of PCB liquids is on file.

4.7 Other Environmental Issues

4.7.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, “thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials” applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as “ floor or ceiling tiles, siding, roofing, transite panels” (i.e., non-friable) are also considered PACM unless tested.

An ACM survey was not included as a part of this ESA. However, based on the age of the majority of site structures (i.e., pre-1980), the presence of ACM's is considered likely.

4.7.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

A lead-based paint survey was not included as part of this ESA. However, based on the date of construction, the presence of lead based paint is considered likely.

4.7.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

On April 7, and April 11, 2003, EEI personnel conducted a reconnaissance of the entire site. On April 7, 2003, EEI was escorted by Jerry Buckley, Manager of Facility Operations. Mr. Buckley provided access to site facilities and answered questions regarding site operations. It should be noted that CTS is a secure facility, engaged in research involving issues of national security. Therefore, not all areas of the property were accessible to EEI personnel. However, all areas of the property involving the use and/or storage of hazardous substances or waste were included in the site reconnaissance. Photographs 1 through 44 **(Appendix H**) document the site reconnaissance, which is summarized in **Table 2**.

Prior to initiating the site reconnaissance, EEI was provided with a site-specific security and safety orientation. EEI was familiarized with the facility layout, access control information, emergency procedures, hazard communication, and environmental health issues. EEI also reviewed and was provided with the facilities Safety, Health, and Environmental Affairs Manual dated March 2, 1998.

The property consists largely of undeveloped alluvial valleys separated by a prominent, east-west trending ridge lines. The property is bounded by the residential properties and undeveloped land to the west, Talega Creek and Camp Pendleton Marine Corps Base to the south and east, and Rancho Mission Viejo (undeveloped) and Gabino Creek to the north. Only a small fraction (i.e., less than 10 percent) of the property is developed. These developed portions are all located in the western half of the property.

The principal access (main gate - Guard Post #2) to the property is located at the northeast terminus of Avenida Pico. The main gate includes a guarded kiosk. The driveway into the CTS facility proceeds northward from the main gate along Christianitos Creek, crossing the creek near the northwest corner of the property before looping east through the facility.

Two groundwater wells (Well No. 1 and Well No. 2) and related structures were noted along the creek east of the driveway. An area west of the road, near the driveway to Water Well No. 1, was formerly used as a pistol range for the facility security officers until the mid-1990's.

After looping to the east the driveway meets an intersection with Cristianitos Road, which leads north through a gated entrance into Rancho Mission Viejo. Further east is a second intersection with roads leading southwest and south into the Chemical Laboratory (Chemlab) and Fossil Energy Test Site (FETS), respectively. Chemlab is a support facility built in the mid-1960's and used for “clean coal” research and liquid fuel quality assurance/quality control for various rocket propulsion projects at the site. It includes several structures such as the laboratory (44A), warehouse (44F), utility shed (44E), utility sheds, a concrete-block chemical storage room, two explosive storage “igloo” bunkers, and several test cells (empty).

The "clean coal" research involved the use of the "gravimelt" process to "scrub" coal, thereby facilitating desulfurization and deminerlization, resulting in minimal emissions combustion. The gravimelt process included the use of molten caustics (such as sodium hydroxide) to chemically remove sulfur and various minerals from coal. Spent caustics and sulfur/mineral by-products were processed/recovered at Chemlab through a wastewater treatment system for reuse. "Clean coal" research at this facility has ceased, and many of the related systems dismantled. However, this facility is still used for liquid rocket fuel testing. Chemicals used/stored in this location included hydrogen peroxide, nitrogen, hydrogen, oxygen, fluorine, helium, and squib ignitors. Chemical storage was either in drums, located in a concrete-lined and covered containment area, or in bulk storage tanks within a concrete block wall containment structure. Both lined and unlined drainage channels were noted in this area along the western and eastern margins. The drainage channels flow west/southwest toward Cristianitos Creek. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted in the Chemlab area during the site reconnaissance.

FETS was designed as a demonstration plant for the burning of clean coal generated by the gravimelt process. This facility was constructed in the late 1970's and operated extensively during the 1980's, but has since been out of use. The facilities at FETS include a control center, warehouse, three test cells, two coal bays, cooling towers, emissions control structures and a number of support structures. Also located at or adjacent to this facility are an equipment boneyard (directly to the south), a concrete pad formerly used as a laser test pad, and an explosives storage area, which includes several "igloo" bunker structures. A large patch was noted in the asphalt driveway, near the water cooling plant. This was apparently the area excavated in 1990 to remediate diesel-impacted soil related to a piping leak.

Chemicals used and/or stored in FETS included deuterium, ethylene, helium, hydrogen, hydrogen peroxide, nitrogen, and nitrogen triflouride. Chemical storage was either in drums, pressurized cylinders, container trucks, or in bulk storage tanks. Surface drainage at the site was generally to the south, toward Cristianitos Creek. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted the FETS area during the site reconnaissance.

The Administrative (Admin) area of the property is located to the east along the main driveway, and includes office, maintenance, and other support facilities. These include Guard Post #1, Test Support Building (41A), Main Office (41P), Central Services Building (41D), Spray Booth Building (41DA), Auto Repair Shed/Fueling Station (41Q), Radome Facilities for Ranges 1 and 2, parking lots and helipad, and two receiver sites.

The Test Support Building includes office space, security services, workshop, valve shop/clean room and chemical testing area. A chemical storage area and wastewater treatment system are located along the south side of the structure, along the driveway. A sewage treatment system is located south of and below the driveway.

The Central Services Building includes office space, workshops, records storage, fire/emergency response services, and shipping/receiving. The Spray Booth Building includes a spray paint booth, storage sheds, and welding area. The Auto Repair Shed/Fueling Station includes a 3,000-gallon underground gasoline storage tank, dispenser island, and support structure.

Chemicals used and/or stored in the Admin area include acetylene, argon, chlorine, deuterium, helium, hydrogen, nitrogen, oxygen, propane, petroleum distillates, trichloroethylene, sodium hydroxide, and sulfur fluoride. Chemical storage is generally in small containers, drums, pressurized cylinders, or bulk storage tanks. Drainage in the Admin area is to the south and west, toward Cristianitos Creek. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted in the Admin area during the site reconnaissance.

East of the Admin area and north of the driveway is the Hazardous Fuel Storage Area (41E; Drum Farm). The Drum Farm is a concrete paved, fenced, and covered storage area divided into two enclosures and separated by a large berm. The divided areas include fuels storage enclosure, in the western half, and oxidizers storage enclosure, in the eastern half. The Drum Farm is set down in elevation from the road and is isolated from any other structures. Two large concrete-lined containment sumps were noted on either end of the Drum Farm. Drainage in this area is to the north into Blind Canyon. Chemicals stored at the Drum Farm include chlorine, diesel fuel, ethylene glycol, ethanol, fluorine, hydrazine, monomethylhydrazine (MMH), nitrogen tetraoxide, JP-8 jet fuel, and nitrogen dioxide. A spill kit and fire extinguisher were noted adjacent to the enclosures. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted the Drum Farm area during the site reconnaissance.

East of the Drum Farm and south of the driveway is the Preliminary Research and Assessment Research building (PAR; 45A). This building was constructed in 1967 and is used for optics research. Compressed gas storage (oxygen, hydrogen, deuterium) was noted along the western margin of the building, while a wastewater treatment system and plastic storage tank were noted along the northern margin. The system was enclosed in a concrete containment structure. A spill kit was noted adjacent to the containment structure. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted in the PAR area during the site reconnaissance.

East of PAR the driveway continues into the test plateau, which is divided into a number of separate test sites involving propulsion systems and chemical lasers. These are the High Energy Propulsion Test Site (HEPTS), the Naval Advanced Chemical Laser (NACL)/Baseline Demonstration Laser (BDL) area, the Vertical Engine Test Stand (VETS), the Propulsion Integration Test Stand (PITS), and the High Altitude Test Stand (HATS), which includes the Alpha Plateau. Most of the structures in this area were constructed in the mid-1960's, with additions in the 1970's and 1980's. HEPTS, VETS, and PITS were designed for propulsion system testing and monitoring. NACL/BDL, and HATS were designed for the testing and monitoring of chemical lasers. Support structures/facilities in the test plateau include the Boneyard storage area and warehouse (42T/42Z), bulk fuel storage area (41G), steam plant (42G), pump house and cooling water treatment plant (41C), control center building (42A), and a number of storage and utility structures.

In general, propulsion systems tested at the facility involve the burning of liquid rocket fuels, such as hydrazine and monomethylhydrazine (MMH), in combination with nitrogen tetroxide or nitric acid. The other principal fuels are liquid hydrogen, in combination with liquid oxygen, and hydrogen peroxide.

Chemical lasers tested at the facility include the use of deuterium, which in combination with nitrogen trifluoride and helium creates fluorine. This in turn is mixed with hydrogen to create the hydrogen fluoride (HF) laser. Other chemical reactions used include a mixture of liquid hydrogen peroxide and potassium hydroxide, along with chlorine gas and iodine gas, to create the chemical oxygen iodine (COIL) laser.

Chemicals used and/or stored in the test plateau include the following: (HEPTS) argon, deuterium, ethlyene glycol, ethanol, flourine, helium, hydrazine, hydrogen, hydrogen peroxide, propane, MMH, nitrogen, lubricating oil, oxygen, JP-8, potassium hydroxide, sodium chloride, sodium hydroxide, sulfur hexafluoride, and nitrogen tetroxide; (Alpha Plateau) sulfur hexafluoride, deuterium, helium, hydrogen, isopropanol, nitrogen, paraffinic oil, liquid oxygen, mineral oil, sodium hydroxide, and sodium nitrite; (VETS) ammonia, chlorine, deuterium, diesel fuel, ethylene glycol, potassium phosphate, flourine, helium, hydrogen, hydrogen peroxide, propane, nitrogen, potassium hydroxide, sodium chloride, sodium hydroxide, ammonium hydroxide, paraffinic oil. Chemical storage is generally in small containers, drums, pressurized cylinders, or bulk storage tanks.

Drainage in the northern portion of the test plateau is to the north, toward Blind Canyon, while drainage in the southern and eastern portions of the test plateau is to the south, toward Talega Creek. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted in the test plateau area during the site reconnaissance.

A separate road leads north and east from the test plateau, past the cooling water treatment facility. Just east of the cooling water treatment facility, the main road intersects the Kinder Morgan 16-inch petroleum pipeline, which runs across the property from north to south. This pipeline serves military facilities to the south, and has no connection with the subject property. A road running south along the pipeline leads to the former high power microwave laser test site (HPM) and the Omega Shield Building (42RA).Continuing east from the petroleum pipeline, a second road intersects the main road. This road leads north into Blind Canyon, to two receiver sites, and eventually to a gated entrance into Rancho Mission Viejo. Further east along the main road several portable office buildings were noted to the south. These are apparently being stored in this location on a temporary basis. The main road continues east approximately 1.5 miles, past a pistol range on the north side of the road, before curving north and west toward the 10,000-foot receiver site (41KA). There was no chemical use or storage noted on the property east of the test plateau.

EEI personnel conducted a driving inspection on accessible roads, then attempted to obtain vistas of backcountry areas by walking along ridgetops and river terraces in the northern, eastern, and southeastern portions of the property. EEI was not able to access the eastern or southeastern property boundaries, although these areas are undeveloped. No evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, illegal dumping, or improper waste storage/handling were noted in backcountry areas during the site reconnaissance.

TABLE 2
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Facility appears well maintained and in good condition. Hazard communication, health and safety, and spill prevention programs in place and in use.
Surface Spills	No	None observed.
Stained Soil/pavement	No	None observed.
Surface Impoundments	No	Fire water storage pond observed 42W, north of pump house 41C.
Fill Materials	No	None observed.
Holding Ponds	No	Holding basins (concrete) observed at Drum Farm (41E).
Surface Drainage	No	To the south and west
Pits/ponds/lagoons	No	Sewage aeration pond observed below (south of) Building 41A.
AGT's/UST's	Yes	One 3,000-gallon gasoline UST observed at the fueling station (41Q). Numerous AGT's on site, containing a variety of chemicals including diesel, waste water, propane, nitrogen, oxygen, helium, hydrogen peroxide, nitrogen triflouride, hydrazine, ammonia, deuterium, argon, methylhydrazine, sulfur hexafluoride, isopropanol, and chlorine.
Electrical Substations	No	Several observed on site. SDGE facilities located along western and southwestern margin of property.
Distressed Vegetation	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	Several observed on site.
Solid Waste Disposal	No	Municipal trash service.
Waste scrap storage	No	Boneyards at FETS and at 42T
Water supply/wells	No	Two water supply wells observed along Cristianitos Creek near western margin of property.
Chemical use/storage	Yes	Large quantities of highly toxic, flammable, and oxidizing chemicals used and stored on site.
Other issues	Yes	Two pistol ranges present on site (one no longer in use).

5.2.2 Adjacent Properties

Adjacent properties are agricultural/undeveloped to the north, east, southeast, and northwest. Barracks from the Camp Pendleton Marine Corps Base and residential properties are present to the southwest. No environmental concerns were noted.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property, except for the following:

1. Two pistol ranges are present at the subject property. One (no longer in use) is located near the main gate. The second is located along the road to the 10,000-foot receiver site. These sites represent a potential lead and/or copper hazard and should be assessed and abated. Spent ammunition should be removed and site soils tested to assess residual lead and copper concentrations. Soil with residual lead or copper concentrations exceeding US EPA's Preliminary Remediation Goals' (PRG's) for Region 9 should be removed from the property and disposed of at an appropriate facility.

2. In January 1990, a leak was discovered in a 1.5-inch diameter underground diesel fuel pipeline at the Fossil Energy Test Site (FETS). This pipeline was used to convey diesel fuel for use in a FETS compressor. Soil samples analyzed for total petroleum hydrocarbons (TPH) resulted in concentrations ranging from 600 to 18,000 mg/kg. Soil excavation was conducted, with soil sampling and analyses for TPH, yielding approximately 3,000 cubic yards of potentially contaminated soil. This soil was stockpiled on site, and in January 1991, approximately 3,350 tons of hydrocarbon-contaminated soil was disposed at the Prima Deshecha Landfill. On May 23, 1991, TRW was issued a letter from the San Diego RWQCB stating that Board staff had determined that soils at the site exceeding cleanup objectives established by the Board had been removed and disposed of in a Class III facility. Based on the remediation report and accompanying data, it appears that the diesel contaminated soils at the FETS were successfully removed. Therefore, no further investigation appears to warranted.

3. Operations at the site involve the use of highly toxic, flammable, and oxidizing chemicals. Prior to lease termination, a comprehensive closure plan should be prepared and implemented By TRW (Northrop Grumman Space Technology) to assess, monitor, and mitigate any residual threats to human health or the environment which may remain as a result of site operations. This includes any existing, historical, or threatened releases of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property at any of the many locations where these chemicals are used.

4. Most of the site structures were built prior to 1980, therefore, EEI recommends that a complete asbestos /lead-based paint survey be conducted prior to any demolition or remodeling.

7.0 REFERENCES

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EEI

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PHASE I ENVIRONMENTAL SITE ASSESSMENT

PLANNING AREA 9
(GABINO CANYON)
Verdugo Canyon Road
San Juan Capistrano, California

May 1, 2003
(Revised February 2004)

EEI Project No. V030305-38A-PA9

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Phase I Environmental Site Assessment

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PLANNING AREA 9
(GABINO CANYON)
Verdugo Canyon Road
San Juan Capistrano, California

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EEI Project No. V030305-38A-PA9

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this Phase I Environmental Site Assessment (ESA) was to assess the possible presence of *recognized environmental conditions* within the Planning Area Nine (Gabino Canyon) portion of Rancho Mission Viejo, located along Verdugo Canyon Road and east of Ortega Highway in San Juan Capistrano, California (**Site Location Map, Figure 1**). *Recognized environmental conditions* include those property uses that may indicate the presence or likely presence of an existing, historical, or threatened release of any hazardous substances or petroleum products into structures, soil, and/or groundwater beneath the property. The term *recognized environmental conditions* is not intended to include *de minimus* conditions that generally do not present a material risk of harm to public health or the environment.

This ESA was performed in general conformance with the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process,* designation E1527-00.

1.2 Scope of Services

The scope of services outlined below was performed in accordance with the Agreement for Professional Services dated February 12, 2003 (Proposal 39A), between Morgan Lewis, & Bockius, LLP, and EEI.

- A review of available documents for topographic, geologic, and hydrogeologic data affecting the site.
- A review of available maps, aerial photographs and other documents to estimate historical site usage and development.
- A review of federal, state, county, and city documents concerning hazardous material storage, generation, and disposal, active and inactive landfills, nearby environmental concerns, and associated permits.
- Interviews with individuals having knowledge of the site.
- A site reconnaissance to ascertain the current condition of the site.
- The preparation of this report which presents our findings, conclusions, and recommendations.

1.3 Reliance

This ESA has been prepared for the sole use of Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. This assessment should not be relied upon by other parties without the express written consent of EEI, Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo. Therefore, any use or reliance upon this assessment by a party other than Morgan Lewis, & Bockius, LLP, and Rancho Mission Viejo, shall be solely at the risk of such third party and without legal recourse against EEI, its employees, officers, or directors, regardless of whether the action in which recovery of damages is brought is based upon contract, tort, statute or otherwise.

This assessment should not be interpreted as a statistical evaluation of the site, but is rather intended to provide a preliminary indication of on-site impacts from previous site usage or the release of hazardous materials. If no significant indicators of the presence of hazardous materials are encountered during this search, this does not preclude their presence.

The findings in this report are based upon a review of published geologic and hydrogeologic information, information (both documentary and oral) provided by Rancho Mission Viejo, Orange County Planning/Building and Safety Department, Orange County Fire Authority, Orange County Health Care Agency, Orange County Agricultural Commissioner, First Search (an environmental database retrieval system), various state and federal agencies, and field observations. Some of these data are subject to change over time. Some of these data are based on information not currently observable or measurable, but recorded by documents or orally reported by individuals.

2.0 PROPOSED PROJECT

2.1 Overall Description of Proposed Project

As proposed by Rancho Mission Viejo, the project includes 22,815 acres general planned and zoned for development of up to 14,000 dwelling units in nine planning areas and other uses and open space within four planning areas. Other uses include 91 acres of urban activity center uses, 240 acres of business park uses, 50 acres of neighborhood retail uses, up to four golf courses and approximately 15,576 acres of open space area which includes a proposed 1,034 acre regional park. Within the nine planning areas proposed for development, approximately 7,694 acres would be developed. Ranching and other agricultural activities would also be retained within a portion of the proposed open space area. Infrastructure would be constructed to support all of these uses, including road improvements, utility improvements and schools. The Planning Area Location Map (**Plate 1**) illustrates the boundaries of the proposed project.

2.2 Description of Planning Area

Planning Area Nine would cover approximately 9,272 acres in the southeastern portion of the project site, and would retain its existing 5-Open Space land use designation under the General Plan. Preservation of acreage within this Planning Area, as part of the Southern Subregion NCCP/HCP program, will constitute a key component of that program's habitat reserve. The Project applicant also proposes to continue ranching operations. In recognition of the biological sensitivity of the area, a grazing management plan would be developed to ensure the continued coexistence of ranching operations and sensitive species. The grazing management plan will be developed in conjunction with the Southern Subregion NCCP/HCP program.

Also, within a 420-acre overlay zone, known as the O'Neill Ranch, the Project would provide for a total of 100 estate homes on approximately 200 acres, along with 120 casitas on 20 acres, and a 218-acre golf course. The very low-density housing to be developed in this overlay zone would be incorporated within the surrounding open space.

Existing authorized land uses would continue until the commencement of any new proposed land use for the affected areas.

3.0 PHYSIOGRAPHIC SETTING

3.1 Site Description

The subject property is located on a portion of the parcels identified by assessors parcel numbers 125-150-62, 125-150-63, and 125-150-52 (**Assessors Parcel Map, Appendix A**). Access to the site is from Ortega Highway, Verdugo Canyon Road, and several ranch access roads. The site is currently vacant (**Site Plan, Figure 2**).

The property is bounded by Ortega Highway and open space to the west, and by open space/grazing land to the north, east, and south. According to the Orange County Planning Department, the site is zoned A-1 (General Agriculture). A copy of the County Zoning Map is included in **Appendix B**.

3.2 Topography

The site is located southeast of San Juan Creek. Site elevations range from approximately 500 feet above mean sea level (amsl) to 800 feet amsl throughout the property. The topographic gradient in the site vicinity is to the south/southwest at approximately 0.15 feet per foot. Surface drainage from the site flows south west into San Juan Creek, and eventually into the Pacific Ocean, approximately 12 miles to the southwest. Based on the Flood Zone Map published by the Federal Emergency Management Agency (FEMA), the site does not lie within a 100-year flood zone. The nearest flood plain is San Juan Creek, approximately 1000 feet west of the subject property.

3.3 Regional and Local Geology

The site is located in an alluvial valley (San Juan Creek) on the southwestern slopes of the Santa Ana Mountains (Norris and Webb, 1990). The Santa Ana Mountains form the northwest margin of the Peninsular Ranges Geomorphic Province, and are comprised principally of granitic, metavolcanic, and sedimentary rocks of Jurassic to Pliocene age. The mountains are the result of relatively slow, late-Quaternary uplift which has shaped the range into a dissected horst block.

Sedimentary deposits in the San Juan Creek area are a homoclinal sequence of marine and nonmarine formations including the Pliocene Capistrano and Monterey Formations, the Miocene Topanga Formation, the Eocene Sespe and Santiago Formations, the Paleocene Silverado Formation, and the Upper Cretaceous Williams and Ladd Formations. These deposits lie unconformably upon the older metamorphic and volcanic rocks, including the Jurassic Santiago Peak Volcanics and the Bedford Canyon Formation. Quaternary alluvial soils, derived primarily from weathering of the Santa Ana Mountains, form the gently sloping river terraces in the site vicinity.

Soil in the vicinity of the site has been identified by the United States Department of Agriculture - National Resource Conservation Service as belonging to the Soboba and Capistrano associations (USDA, 1978). Soil in these associations are typically well- to excessively- drained clay and sandy loams, and form from granitic to calcareous sandstone and shale of the Santa Ana mountains. The soils are slow to moderately permeable, runoff and erosion is high if slopes are bare.

Structural deformation in the vicinity of the site is related to the Elsinore Fault Zone, a major northwest-southeast trending strike-slip fault zone located approximately 12 miles to the northeast. Motion along the Elsinore Fault Zone is primarily right-lateral, although a vertical component may also be present. The Elsinore Fault Zone is considered active, with major ruptures occurring roughly every 250 years at magnitudes of between 6.5 - 7.5 (SCEC, 1998). Other major faults in the vicinity of the site include the

Cristianitos Fault (west of the site), the Mission Viejo Fault (just west of the site) and the Newport Inglewood Fault (southwest of the site).

3.4 Regional and Local Hydrogeology

According to the Basin Plan published by the San Diego Regional Water Quality Control Board (SDRWQCB, 1994), the northern portion of the site lies within the Upper San Juan Hydrologic Subarea of the San Juan Hydrologic Unit, and the southern portion lies within the San Mateo Hydrologic Area of the San Juan Hydrologic Unit. In general, groundwater in this area has been designated as beneficial for domestic/municipal, agricultural, and industrial uses. Groundwater levels in the vicinity of the site are seasonally variable, but generally occur at between 10 and 100 feet bgs.

The Upper San Juan Hydrologic Subarea is located within the San Juan Creek watershed. San Juan Creek (immediately north of the site), Verdugo Canyon (east of the site), and Bell Canyon (northwest of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for agricultural, industrial, warm water habitat, cold water habitat, wildlife habitat, and recreational 1 and 2.

The San Mateo Hydrologic Area is located within the San Mateo Creek watershed. San Mateo Creek (south of the site), and Christianitos Creek (west of the site) are the major drainages within this watershed. According to the SDRWQCB, the drainages within this watershed are exempt from municipal use, but have been designated as beneficial for warm water habitat, wildlife habitat, and recreational 1 and 2.

4.0 SITE BACKGROUND

4.1 Site Ownership

Information regarding site ownership was provided by Rancho Mission Viejo. The current owner is listed as the San Juan Partnership No. 1 and No. 5. The owner's address is listed as PO Box 9, San Juan Capistrano, California, 92693.

4.2 Site History

EEI reviewed available information sources to evaluate historic land use in and around the property. Aerial photographs, United States Geological Survey maps, and Sanborn maps were researched. The site does not have an assigned address, therefore a review of city directories and other sources requiring a specific address were not included as a part of this ESA.

4.2.1 Aerial Photograph Review

Aerial photographs were reviewed to identify historical land development and any uses which may have impacted the site. Photographs dating from 1952 to 1999 were reviewed at the Continental Air Photo. In addition, an aerial photograph from 2002 (EDAW) was reviewed. **Table 1** summarizes the results of the aerial photograph review. A copy of the 2000 photograph is provided in **Figure 3**.

TABLE 1
Summary of Aerial Photograph Review

Year	Photo ID	Comments
1952	AXK-4K-46 (1)	The site and vicinity are unoccupied and undeveloped with thick brush throughout the property.
1959	9-33-131 (1)	No pertinent changes are noted since the previous photograph.
1970	61-8-210 (1)	No pertinent changes are noted since the previous photograph.
1973	B2-14-11 (1)	No pertinent changes are noted since the previous photograph.
1977	181-15-13 (1)	A pond is located in the central portion of the site along Gabino Canyon. No additional changes are noted since the previous photograph.
1983	15-23 (1)	A small area (approximately 4 acres) in the southern portion of the site is cleared and partly cultivated with a small trailer on the property. The rest of the site is vacant with thick brush.
1997	C-117-43-48/47 (1)	No structures were noted, and the majority of the property was vacant with thick brush.
1999	C-136-43-149 (1)	No pertinent changes are noted since the previous photograph.
2002	EDAW (2)	A few small structures were noted in the southern portion of the site (possibly beehives). The remainder of the site is vacant and appears in its current configuration.

(1) Aerial Photograph viewed at Continental Aerial Photographs, Los Alamitos, California

(2) Aerial Photograph obtained from EDAW

4.2.2 Historic Maps

EEI reviewed topographic maps dating from 1942 to1988 at the University of California at Santa Barbara, Map and Imagery Laboratory. The 1942 map was published by the United States Army Corps of Engineers. The 1948, 1968, 1975, 1980, 1982, and 1988 maps were published by the United States Geological Survey.

The 1942 map noted the presence of a water tank along Verdugo Canyon and one along Gabino Canyon in the southern portion.

No changes were noted on the 1948 map, except for the presence of a water tank in the cental portion of the property, in Gabino Canyon, and the presence of Verdugo Canyon Road and the other ranch access roads.

The 1986 through 1988 maps note the presence of the three afore-mentioned water tanks, along with a windmill near the water tank along Verdugo Canyon. No other changes were noted.

4.2.3 Sanborn Maps

EEI researched available Sanborn Fire Insurance Maps of the subject site. Sanborn Maps provide detailed information on site structures, uses, and occupancies and were typically utilized by insurance companies to evaluate potential fire risk. Based on EEI’s review, no Sanborn Fire Insurance Maps are available for the area surrounding the subject site, indicating little commercial development prior to 1950.

4.2.4 Orange County Building and Safety Department Files

Based on reviews of historic aerial photographs, historic topographic maps and interviews with the property owner, the site has never been developed. Therefore, a review of building department records was not conducted for this ESA.

4.3 Regulatory Database Search

EEI reviewed known electronic database listings for possible hazardous waste generating establishments in the vicinity of the site, as well as on sites in the area with known environmental concerns. Facilities were identified by county, state, or federal agencies and either generate, store, or dispose of hazardous materials. The majority of information in this section was obtained from FirstSearch®, an environmental information/database retrieval service. A copy of the FirstSearch® report is provided in **Appendix C**, along with a description of the individual databases. The subject property was not listed in any of the databases reviewed as having environmental concerns. For discussion purposes, the term "non-geocoded" is applied to sites that either have non-existent or incomplete addresses. EEI has attempted to locate these sites, based on the location description provided in the records search. Below is a list of databases that were reviewed in the preparation of this report.

4.3.1 Federal Databases

National Priority List (NPL) (Superfund) - No listings within one mile of the subject site.

Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) - No listings within one mile of the subject site.

No Further Remedial Actions Planned (NFRAP) - No listings within one mile of the subject site.

RCRA TSD Facility list (RCRA-D) - No listings within one mile of the subject site.

RCRA Corrective action sites (COR) - No listings within one mile of the subject site.

RCRA Generators (RCRA-G) -The Environmental Protection Agency (EPA) regulates generators of hazardous material through the Resource Conservation and Recovery Act (RCRA). All hazardous waste generators are required to notify EPA of their existence by submitting the Federal Notification of Regulated Waste Activity Form (EPA Form 8700-12) or a state equivalent form. Four sites were identified within one mile of the subject property. **Ortega Rock Quarry** is approximately one mile north of the subject site. They are listed as a small quantity generator (generates 100-1000 kg a month of hazardous waste). Three other non-geocoded sites were identified. The sites are actually located greater than one mile from the subject property. Operating permits are not generally considered rational for environmental concern unless a documented release has occurred at the property. Therefore, these sites are not considered environmental concerns at this time.

RCRA No Longer Regulated (NLR) - No listings within one mile of the subject site.

Emergency Response Notification System (ERNS) - Eleven non-geocoded sites were reported. The calls appear to be mostly highway/railway related with no or a minor amount of material released. All eleven sites appear to be at least one half mile away from the subject site. Therefore, these reports are not considered environmental concerns at this time.

The subject site was not identified by any of the sources listed above as having an environmental concern or operating permit.

4.3.2 State and Regional Databases

Sites that are Contaminated or Potentially Contaminated by Hazardous Wastes (State Sites) - One non-geocoded site was reported within one mile of the subject site. The Capistrano Unified School District proposed a school location within one mile of the subject site. The Department of Toxic Substances Control was called to the location for an inspection. No action was needed. Therefore, this incident is not considered an environmental concern.

Sites with a record of spills, leaks, investigations, and cleanups (Spills - 1990) - No listings within one mile of the subject site.

Solid Waste Landfills (SWL) - Seven non-geocoded sites were reported were reported within one mile of the subject property. **Prima Deschecha Sanitation Landfill** (at the end of La Pata Road) is greater than one mile from the subject site. This site disposes of non-hazardous wastes. **La Pata Greenwaste Facility** (31748 La Pata Avenue) is greater than one mile from the subject site. Other reported sites are either greater than one mile from the subject site or do not have enough information to be properly located. Based on their distances from the subject property, none of these sites are considered environmental concerns at this time.

Establishments Issued a Permit to Track Site Status as a hazardous waste generator, gas station, TSD, underground tanks, violations, or unauthorized releases (Permits) - No listings within one mile of the subject site.

Other Unique Databases (Other) - Two sites were reported within one mile of the subject property. **Lomas San Juan Model Home Site** and **Los Pinos Forestry Camp** (39251 Ortega Highway) were identified as LUST sites. They are further discussed in the LUST section below.

Permitted Underground/Aboveground Storage Tanks (REG UST/AST) - Six sites were identified within one mile of the subject site. **Ortega Rock Quarry** (33977 Ortega Highway) was listed twice, although no details were provided on the tanks located on the site. The four other listed sites were non-geocoded, and after further inspection, EEI located the sites greater than one mile from the subject property. Based on the distances from the subject property and the fact that operating permits are not generally considered rational for environmental concern (unless documented releases have occurred at the property), these sites are not considered as environmental concerns at this time.

Leaking Underground Storage Tanks (Leaking UST) - Two sites were reported within one mile from the subject property. **Los Pinos Forestry** (approximately one mile north of the site) reported a gasoline leak on August 14, 1992 (case number 9UT2481). Reportedly the aquifer is impacted, and a preliminary site assessment is underway. Based on the distance from the subject site (i.e., over one-quarter mile) and the position relative to the subject property (i.e., downhill/downgradient) this site is not considered an environmental concern at this time. The second site, **Lomas San Juan Model Home Site** is non-geocoded and the location of the site is unknown. A gasoline leak was reported on January 1, 1965, and the aquifer is reportedly impacted. Soil at the site was excavated and treated or removed. The site was closed on December 11, 1991. Based on the status of the case (closed), this site is not considered an environmental concern at this time.

Releases into air and surface water (Releases) - Two non-geocoded sites were reported within one mile of the subject property. These sites are located along Oso Street, San Juan Capistrano, which is greater than one mile from the subject site. Therefore, these sites are not considered an environmental concern at this time.

PCB Activity Database System (PADS) - No listings within one mile of the subject site.

The subject site was not listed in any of the databases above.

4.4 Regulatory Agency Review

4.4.1 Orange County Fire Authority

EEI contacted the Orange County Fire Authority's office for information regarding hazardous materials storage at the subject site. According to Fire Department personnel, the site does not have an official address or hazardous materials permit file, and is not currently under a regular inspection schedule.

4.4.2 Orange County Health Care Agency

EEI reviewed Orange County Health Care Agency (OCHCA) databases including Leaking Underground Storage Tank (LUST) sites, Underground Storage Tank (UST) Facilities, Non-petroleum Underground Tanks, Hazardous Waste Generators (HWG) and Land Fill Sites, to determine if the subject site or any properties within the site vicinity were listed as having an environmental concern. Neither the subject property nor any adjacent properties were listed on any of the databases researched.

4.4.3 California Regional Water Quality Control Board

EEI contacted the California Regional Water Quality Control Board - San Diego Region (SDRWQCB) to determine whether the site or any nearby property was listed as having a leaking underground tank, spill, leak, or aboveground tank problem. In addition, EEI reviewed the Underground Storage Tank Information System (LUSTIS) and Spills, Leaks, Investigations, and Cleanup (SLIC) List, published by the SDRWQCB. There were no listings for the subject site nor any adjacent property.

4.4.4 Review of Division of Oil, Gas and Geothermal Resources Files

EEI reviewed information regarding oil production near the site provided by the California Division of Oil, Gas, and Geothermal Resources. Based on file data, one exploratory well, drilled in 1964 to approximately 3,370 feet below ground surface was drilled adjacent to the subject property to the southwest. The well is listed as an abandoned plugged hole (no production) and is not considered as an environmental concern at this time.

4.5 Interview with Key Site Personnel

EEI contacted Fred Vorhees, Ranch Manager for Rancho Mission Viejo (property owner), who was interviewed regarding key site information. Mr. Vorhees indicated that he has been working at the Ranch for approximately 30 years and is familiar with the subject property. A list of the questions asked, and a summary of their responses, is included below.

Q: Is the property or any adjoining property used for an industrial or agricultural use?

A: No.

Q: To the best of your knowledge, was the property or any adjoining property used for industrial or agricultural purposes in the past?

A: No.

Q: Are you aware of any current or previous uses of the site or adjoining properties which may create an environmental concern?

A: No.

Q: To the best of your knowledge has the property or any adjoining property ever been used as a gasoline station, motor repair facility, commercial printing facility, dry cleaners, photo developing laboratory, junkyard or landfill, or as a waste treatment, storage, disposal, processing or recycling facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any damaged or discarded automotive or industrial batteries, or pesticides, paints or other chemicals in individual containers of greater than 5 gal (19 L) in volume or 50 gal (190 L) in the aggregate, stored on or used at the property or at the facility?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any industrial drums (typically 55 gal) or sacks of chemicals located on the property or at the facility?

A: No.

Q: Has fill dirt been brought onto the property that may have originated from a contaminated site or that is of an unknown origin?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any pits, ponds, or lagoons located on the property in connection with waste treatment or waste disposal?

A: No.

Q: *Is there currently, or to the best of your knowledge has there been previously, any stained soil on the property?*

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any registered or unregistered storage tanks (above or underground) located on the property, aside from the existing aboveground waste oil tank?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any vent pipes, fill pipes, or access ways indicating a fill pipe protruding from the ground on the property or adjacent to any structure located on the property?

A: No.

Q: Are there currently, or to the best of your knowledge have there been previously, any flooring, drains, or walls located within the facility that are stained by substances other than water or are emitting foul odors?

A: No.

Q: If the property is served by a private well or non-public water system, have contaminants been identified in the well or system that exceed guidelines applicable to the water system or has the well been designated as contaminated by any government environmental/health agency?

A: No.

Q: Does the owner or occupant of the property have any knowledge of environmental liens or governmental notification relating to past or recurrent violations of environmental laws with respect to the property or any facility located on the property?

A: No.

Q: Has the owner or occupant of the property been informed of the past or current existence of hazardous substances or petroleum products or environmental violations with respect to the property or any facility located on the property?

A: No.

Q: Does the owner or occupant of the property have any knowledge of any environmental site assessment reports prepared for the property or facility that indicated the presence of hazardous substances or petroleum products on, or contamination of, the property or recommended further assessment of the property?

A: No.

Q: Does the owner or occupant of the property know of any past, threatened, or pending lawsuits or administrative proceedings concerning a release or threatened release of any hazardous substance or petroleum products involving the property by any owner or occupant of the property?

A: No.

Q: Does the property discharge waste water on or adjacent to the property other than storm water into a sanitary sewer system?

A: No.

Q: To the best of your knowledge, have any hazardous substances or petroleum products, unidentified waste materials, tires, automotive or industrial batteries or any other waste materials been dumped above grade, buried and/or burned on the property?

A: No.

Q: Is there a transformer, capacitor, or any hydraulic equipment for which there are any records indicating the presence of PCBs?

A: No.

4.6 Other Environmental Issues

4.6.1 Asbestos Containing Materials

Asbestos is a natural mineral fiber used in the manufacture of a number of different building materials. Asbestos has also been identified as a human carcinogen. Most friable (i.e., those that are easily broken or crushed) asbestos-containing materials (ACM) were banned in building materials by 1978. By 1989, most major manufacturers had voluntarily removed non-friable ACM (i.e., flooring, roofing, and mastics/sealants) from the market. However, these materials were not banned completely.

In October 1995, the Federal Occupational Safety and Health Administration (OSHA) redefined the manner by which building materials are classified in regards to asbestos and the also the way these materials are to be handled. Under this ruling, "thermal system insulation and sprayed-on or troweled on or otherwise applied surfacing materials" applied before 1980 are considered presumed asbestos containing materials (PACM). Other building materials such as " floor or ceiling tiles, siding, roofing, transite panels" (i.e., non-friable) are also considered PACM unless tested.

There are no structures located on the subject site. Therefore the presence of ACM is not anticipated.

4.6.2 Lead-Based Paint

Lead-based paint is identified by OSHA , the Environmental Protection Agency (EPA) and the Department Housing and Urban Development Department (HUD) as being a potential health risk to humans, particularly children, based upon its effects to the central nervous system, kidneys, and bloodstream. The risk of lead-based paint has been classified by HUD based upon the age and condition of the painted surface. This classification includes the following:

- maximum risk is from paint applied before 1950
- a severe risk is present from paint applied before 1960
- a moderate risk is present from paint applied before 1970
- a slight risk is present from paint applied before 1977
- paint applied after 1977 is not expected to contain lead.

There are no structures located on the subject property. Therefore the presence of lead-based paint is not anticipated.

4.6.3 Radon

Radon is a radioactive gas which has been identified as a human carcinogen. Radon gas is typically associated with fine-grained rock and soil, and results from the radioactive decay of radium. EPA recommends that homeowners in areas with radon screening levels greater than 4 pCi/L (picocurries per liter) conduct mitigation of radon gas to reduce exposure.

Sections 307 and 309 of the Indoor Radon Abatement Act of 1988 (IRAA) directed EPA to list and identify areas of the U.S. with the potential for elevated indoor radon levels. EPA's Map of Radon Zones (EPA-402-R-93-071) assigns each of the 3,141 counties in the U.S. to one of three zones based on radon potential:

- Zone 1 counties have a predicted average indoor radon screening level greater than 4 pCi/L.
- Zone 2 counties have a predicted average indoor radon screening level between 2 and 4 pCi/L.
- Zone 3 counties have a predicted average indoor radon screening level less than 2 pCi/L.

Based on such factors as indoor radon measurements; geology; aerial radioactivity; soil permeability; and foundation types, EPA has identified Orange County as Zone 3 (i.e., low potential for radon gas). Therefore, EEI does not consider radon as a concern at this time.

5.0 SITE RECONNAISSANCE

5.1 Purpose

The purpose of the site reconnaissance was to visually and physically observe the site, site structures, and adjoining properties for conditions indicating an existing release, past release, or threatened release of any hazardous substances or petroleum products into structures of the site, or into soil and/or groundwater beneath the site. This would include any evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling.

5.2 Results of Site Reconnaissance

5.2.1 Subject Site

On April 9, 2003, EEI personnel visited the entire site. Photographs 1 through 10 (**Appendix D**) document the site reconnaissance, which is summarized in **Table 2**.

EEI personnel conducted a driving inspection around the perimeter of the subject property, then traversed the site from east to west and north to south. The site is an undeveloped and unoccupied area located along Verdugo and Gabino Canyons, east of Ortega Highway and west of the county line. The property encompasses approximately 90 one-acre lots and a larger, approximately 300-acre area along Gabino Canyon. Verdugo Canyon is a northeast-southwest trending valley stretching from Riverside County towards San Juan Creek and Ortega Highway. Gabino Canyon is a north-south trending valley stretching from Verdugo Canyon south-southwest.

Access to the site is through a gated entrance on Ortega Highway. An unpaved access road crosses through the site along Verdugo Canyon and continues to the northeast towards the county line and into the adjacent hills. A second unpaved access road heads south through Gabino Canyon, where it meets up with several other unpaved (and unnamed ranch access roads).

The subject property is predominantly vacant, used for grazing and open space. A windmill was noted along Verdugo Canyon Road, within one of the one-acre parcels.

No evidence of evidence of contamination, distressed vegetation, petroleum-hydrocarbon staining, waste drums, illegal dumping, or improper waste storage/handling were noted during the site reconnaissance.

5.2.2 Adjacent Properties

Adjacent properties are undeveloped in all directions. Ortega Highway and a nursery are located to the west. No environmental concerns were noted on any of the adjacent properties.

TABLE 2
Summary of Site Reconnaissance

ITEM	CONCERNS	COMMENTS
General Housekeeping	No	Property appears well maintained and in good condition.
Surface Spills	No	None observed.
Stained Soil/pavement	No	None observed.
Fill Materials	No	None observed.
Pits/ponds/lagoons	No	A medium-sized pond was noted in the central portion of the property, in Gabino Canyon.
Surface Impoundments	No	None observed.
AGT's/UST's	No	None observed.
Distressed Vegetation	No	None observed.
Wetlands	No	None observed.
Electrical Substations	No	None observed.
Areas of Dumping	No	None observed.
Pole-mounted Transformers	No	None observed.
Waste/scrap storage	No	None observed.
Chemical use/storage	No	None observed.

6.0 CONCLUSIONS/RECOMMENDATIONS

EEI conducted a Phase I Environmental Site Assessment (ESA) at the subject property in March/April 2003. The ESA included a review of regulatory database lists as per ASTM 1527-00. Pursuant to the requirements of Section 65962.5 of the California Government Code, the subject property was not located on the State list of identified hazardous waste and/or hazardous substance sites.

Based on a site reconnaissance, a review of physiographic, historical and regulatory information, and information provided by the property owner, no evidence of *recognized environmental conditions* has been revealed in connection with the subject site, nor any adjacent property. Therefore, no further investigation is recommended at this time.

7.0 REFERENCES

California Regional Water Quality Control Board - Los Angeles Region, 1994, Water Quality Control Plan - San Diego Region: California State Water Resources Control Board Publication.

Norris, Robert M., and Webb, Robert W., 1990, Geology of California, Second Edition, John Wiley, and Sons, Inc., New York.

Southern California Earthquake Center, 1999, Faults in California - Los Angeles Region.

United States Department of Agriculture - Soil Conservation Service, 1978, Soil Survey of Orange County and Western Part of Riverside County, California.

Appendix J

Introduction

The RMV Open Space would be managed and monitored over the long term to protect, maintain and, where feasible, to enhance/restore habitat values (Figure 1). A complete description of the existing biological resources and values documented within the RMV Open Space is contained in Section 4.9 of GPA/ZC Draft EIR.

The RMV Open Space Monitoring and Adaptive Management Program (collectively called the Adaptive Management Program) is the framework for the policies and programs that would guide the future uses and activities in the RMV Open Space.

The Adaptive Management Program is comprised of several components. These components are discussed in the following sections:

1.1. Characteristics of the Adaptive Management Approach
1.2. Overview of the Biological Management and Monitoring Program
1.3. Elements of the RMV Open Space Adaptive Management Program
1.4. Major Vegetation Communities and Associated Species
1.5. Site-specific Resources
1.6. Habitat Linkages and Wildlife Corridors
1.7. Fire Management Plan
1.8. Grazing Management Plan
1.9. Habitat Restoration Plan
1.10. Invasive Species Control Plan

This document provides the programmatic framework for the Adaptive Management Program and general descriptions of the key components of the program for each section listed above. Although some template examples are provided for illustrative purposes, the full details of the following key components of the Adaptive Management Program are provided in separate technical appendices:

- Plant Species Translocation, Propagation and Management Plan (*Appendix X-1*)
- Habitat Restoration Plan (*Appendix X-2)*
- Invasive Species Control Plan (*Appendix X-3*)
- Grazing Management Plan (*Appendix X-4*)
- Fire Management Plan (*Appendix X-5*)

Each of these components is attached to this document and would be approved by the County of Orange as a part of the overall approval of this management program.

Implementation of the Adaptive Management Program will be tied to the phased dedication of RMV Open Space, which in turn is tied to development phasing. Management by RMV in accordance with the Adaptive Management Program will occur upon dedication of a specific phase of Open Space. For example, it is likely that dedication of Chiquita Ridge would be tied to development in Planning Area 2. Upon this dedication occurring, RMV would initiate management of the biological resources associated with Chiquita Ridge based on the management priorities and stressor models established in the Adaptive Management Program. Until such time as the dedication occurs, RMV would continue to implement its current management practices which to date have protected the biological resources found on RMV lands. In this way, the mitigation provided by the RMV Open Space and Adaptive Management Plan is properly tied to impacts resulting from development of RMV lands.

Although not part of the Adaptive Management Program, the Water Quality Management Plan for the Ranch Plan project has an adaptive management program of its own, which will coordinate with this Adaptive Management Program. In particular, the WQMP addresses three stressors; 1) "pollutants" generated by urban development with the potential to impact species and habitats; 2) "altered hydrology" due to urban development with the potential to impact species and habitats and 3) "altered geomorphic processes" with potential to impacts species and habitats. By addressing these stressors, the WQMP helps assure that these stressors will not significantly impact net habitat value.

1.1 Characteristics Of The Adaptive Management Approach

1.1.1 NCCP Conservation Guidelines

The NCCP Conservation Guidelines adopted by the CDFG (1993) and incorporated into the Section 4(d) Special Rule (Special Rule) for the coastal California gnatcatcher recommend that an "adaptive management" regime should be implemented to manage biological resources in the Southern Subregion.

> *Management and restoration practices should be addressed as part of a well-coordinated research program. Management and restoration research will be valuable to subregional NCCP planning. Even after a NCCP is adopted, ongoing restoration research will be essential to adaptive management of coastal sage scrub habitat.*
> (NCCP Conservation Guidelines, November 1993, CDFG, at pg. 7)

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As used in this program, adaptive management is defined as a flexible, iterative approach to long-term management of biotic and abiotic resources that is directed over time by the results of ongoing monitoring activities and other information.

The NCCP Conservation Guidelines identified three key areas relevant to the management of coastal sage scrub:

- *Exotic species control, including both animals (in particular, cowbirds and feral and domestic mesopredators such as house cats and introduced red foxes) and plants (weedy species, especially annuals of old world origin).*

- *Recreational use of coastal sage scrub and other open space reserve areas, including identification of suitable low impact recreational pursuits consistent with preservation goals.*

- *The role of fire in natural ecosystem dynamics and processes, including the application of control burns and the control of ignitions of accidental and vandal origin.*

(NCCP Conservation Guidelines, November 1993, CDFG, at pgs. 7-8).

The science of adaptive management has evolved since the NCCP Conservation Guidelines were adopted in 1993, but the concept of adaptive management remains essentially the same. By definition, adaptive management is an experimental and flexible approach to resource management that integrates ecological theory, modeling, hypotheses generation, field manipulations and interventions, and feedback that allows for refinement of the model(s) and hypotheses and, ultimately, improved management of the resource. As stated by Gunderson (1999), adaptive management is adaptive because it acknowledges that managed resources will always change as a result of human intervention, that surprises are inevitable, and that new uncertainties will emerge. A key concept of adaptive management is that the world is uncertain and flexibility in resources management is crucial (Holling 1995; Holling and Meffe 1996). This approach requires a departure from the traditional command-and-control approach to management, which assumes that the managed system is relatively simple and predictable (Holling and Meffe 1996).

Adaptive management programs exhibit the following characteristics:

- Available theory, empirical information, and expertise are used to develop dynamic models that make predictions about the outcomes of different management actions (Carpenter et al. 1999; Walters 1997). Modeling is a powerful tool to simulate the spatial and temporal dynamics of key ecosystem factors, or what Holling (1995) terms Astructuring variables, and to generate and screen hypotheses that may not yield useful data or are unlikely to be effective management policies (Walters 1997).

- Models, hypotheses and experiments must meet on-the-ground managers' needs and should be developed in collaboration with managers (Rogers 1998). As part of this process, the monitoring tools, the options and strategies available to managers, and strategies for utilizing new data and information should be developed (Bosch et al. 1996).

- Adaptive management is a "dual control problem" where short-term management goals and objectives need to be met while also learning about the managed system (Nichols 1999).

- Adaptive management strategies may not yield decisive results for a decade or two and, thus, the agencies and stakeholders must be patient (Lee 1993; Walters 1997).

- Adaptive management strategies may pose risks for some populations and habitats of endangered and rare species (Johnson 1999a; Walters 1997), but the focus should be on restoring and maintaining ecological resiliency such that risk and catastrophe to other resources are avoided. In other words, there are likely to be difficult tradeoffs in the adaptive management of habitats and species.

- Reversible treatments should be used where possible so that if hypotheses turn out to be incorrect, the resource is not permanently lost (e.g., loss of a population, state-transition of a habitat) (Walters 1997).

The purpose of adaptive management within the framework of the statewide NCCP/HCP Program and HCPs is to help maintain and, where feasible, enhance the long-term net habitat value within a subregion. The NCCP Conservation Guidelines define the manner in which the creation and management of the RMV Open Space contributes to assuring no net reduction over the long term in the ability of the subregion to maintain viable populations of Identified Species (termed "target species" in the Conservation Guidelines) and their associated habitats:

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…subregional NCCPs will designate a system of interconnected reserves designed to : (1) promote biodiversity, (2) provide for high likelihoods for persistence of target species in the subregion, and (3) provide for no net loss of habitat value from the present taking into account management and enhancement. No net loss of habitat value means no net reduction in the ability of the subregion to maintain viable populations of target species over the long-term.

With improved techniques for management and restoration, the goal of no net loss of habitat value may be attainable even if there is a net loss of habitat acreage.
(NCCP Conservation Guidelines, November 1993, CDFG, pg. 9)

While the NCCP Process and Conservation Guidelines provide the regulatory framework and general guidance for an adaptive management approach, they do not address specific management issues in the subregion. The Southern Orange County Science Advisors (Science Advisors) elaborated on the principles of adaptive management and their "Principles for Adaptive Management" are discussed in detail in *Section 18.2.1*.

1.1.2 Consistency with U.S. Fish and Wildlife Service "Five Points Policy"

The "Five Points Policy" was promulgated by the U.S. Fish and Wildlife Service (USFWS, 2000) to provide guidance for the preparation of habitat conservation plans (HCPs) to agency staff, landowners and other public agencies. RMV will be preparing a HCP to provide the basis to obtain required federal Endangered Species Act (FESA) Section 10 "incidental take permits" for impacts to impacts to federally-listed species and their habitat. This AMP has been designed to address the policies and recommendations contained in the USFWS "Five Points Policy" including:

- Long-term adaptive management of designated habitats that support listed species and other sensitive species;

- "Compliance monitoring" determine whether implementation of the adaptive management program is consistent with terms of agency approvals;

- "Effectiveness monitoring" of designated species and habitats to determine the effectiveness of specific adaptive management measures in terms of promoting species survival and recovery;

- Funding to support the adaptive management and monitoring program; and

- Consideration of alternative conservation actions and approaches.

1.2 Overview Of The Biological Management And Monitoring Program

The Science Advisors identified five fundamental elements of an adaptive management program that were reflected in the Southern " Draft NCCP/HCP Planning Guidelines" (Southern NCCP/HCP Guidelines):

1. **Setting Management Objectives:** The specific goals and objectives of the adaptive management program need to be established before specific management actions can be identified; i.e., what is the future desired condition of the RMV Open Space? The objectives should be measurable, meet the regulatory requirements of the program, should incorporate the diverse views of the stakeholders, and be feasible to implement.

2. **Preparing Management Plans and Conceptual Models:** Specific management plans should be prepared for RMV Open Space. These plans will incorporate the management objectives for the RMV Open Space and be tied to conceptual models of each focal vegetation type that describe known and/or hypothesized dynamic relationships for the vegetation type (e.g., fire effects on coastal sage scrub) that can be empirically tested and refined through management.

3. **Identifying Uncertainties and Knowledge Gaps in Management Plans:** Concurrent with preparation of the conceptual models and management plans, it is important to identify the knowledge gaps and weaknesses in the conceptual models. These gaps and weaknesses form the basis for posing management questions that can be tested empirically in the field. The feedback from hypothesis-driven management actions is used to refine the conceptual models and lead to better models and management over time.

4. **Monitoring the Management Program:** As stated by the Science Advisors, "The biological monitoring program should be developed specifically to measure and evaluate the effects of management activities. It should identify and measure variables that permit iterative refinement of the management program."

5. Incorporating Monitoring and Research Results Into Revised Management Plans: As management actions yield information, the conceptual models and management plans will be revised to reflect the new information, leading to new hypotheses, refined models and more effective management actions better able to meet the goals and objectives of the Adaptive Management Program.

Figure 2 shows a conceptual flowchart for adaptive management that incorporates these fundamental concepts and which are addressed in the description of the Adaptive Management Program that follows.

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1.2.1 Environmental Stressor Approach

The Science Advisors and Southern NCCP/HCP Guidelines identify three broad land management goals for the Southern Subregion that can be translated to apply to and establish the foundation for the Adaptive Management Program for the RMV Open Space:

1. Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.

2. Restore or enhance the quality of degraded vegetation communities and other habitat types.

3. Maintain and restore biotic and abiotic natural processes, at all identified scales, for the RMV Open Space.

The first and underlying guiding principle of the Adaptive Management Program is that management and monitoring should be directed towards environmental factors known or thought to be directly or indirectly responsible for ecosystem changes that would be inconsistent with meeting the three broad goals cited above. For example, allowing fire to type-convert coastal sage scrub to non-native annual grassland would be inconsistent with the goal of ensuring the persistence of a native-dominated mosaic in the planning area. These factors, called "environmental stressors," may have both adverse and beneficial effects on ecosystem characteristics such as vegetation communities and species. Fire is necessary for sustaining healthy stands of chaparral, and likely coastal sage scrub, but fire at frequent intervals can result in the conversion of these communities to annual grassland. Environmental stressors may be natural or human-caused, and some may be both. For example, ignitions of wildfires can be both natural (lighting strikes) and human-caused (arson and accidental human-caused ignitions). Natural and human-caused stressors that significantly affect vegetation communities and species in the Southern Subregion include wildfires, over-grazing, exotic plants and animals, altered hydrology, altered geomorphic processes, and, to a lesser extent, drought. This emphasis on "environmental stressors" has increasingly become the central focus of adaptive management in large-scale ecosystem programs such as the Northwest Forest Plan.

It is important to understand that the vegetation communities and associated species in the RMV Open Space are basically in good general health, but that certain known and potential stressors operate and can be identified (e.g., giant reed invasion of San Juan Creek, three recent fires in the Upper Chiquita Canyon Conservation Area). For this reason, the stressor approach is particularly appropriate and the basic management needs are to: **(1)** address existing stressors so that net habitat value can be increased; and **(2)** identify future stressors that could reduce or adversely alter long-term net habitat value.

In conclusion, the environmental stressor approach is the guiding principle of the Adaptive Management Program both because it is state of art science for management and monitoring of ecological systems (e.g., Noon 2003) and is particularly appropriate for theRMV Open Space.

a. Characteristics of Conceptual Environmental Stressor Models

The second fundamental element of an adaptive management program identified by the Science Advisors and reflected in the Southern NCCP/HCP Guidelines is the preparation of management plans and conceptual models. Conceptual models are the theoretical bases for the management plans because they illustrate known and hypothesized dynamic ecological relationships that can be empirically tested and refined through management. Conceptual models can range from basic qualitative models (e.g., unidirectional cause-and-effect) to extremely complex quantitative ecosystem models. The adaptive management approach described here relies on relatively simple qualitative conceptual models that show known and hypothesized directional and interactive relationships between “environmental stressors” (as described below) and vegetation community and species-level responses. In contrast, complex ecosystem models, while having great value for testing and understanding basic and complex ecological relationships, tend to be too unwieldy for the purpose of identifying specific, practical management and monitoring actions. Direct application of such relatively abstract information to on-the-ground monitoring and practical management of the RMV Open Space would be difficult. Furthermore, because not all components of general ecosystem models are relevant to monitoring and management, a complex ecosystem model may obscure the variables most important for monitoring and management.

The Adaptive Management Program would be implemented based on the assumption that practical management and monitoring should focus on the issues most relevant to the managed system. The “environmental stressor” approach to monitoring and managing natural resources is receiving more attention in recent years because it provides a conceptual method more amenable to an enhanced understanding of causal relationships that can be addressed through management actions. Laying the foundation for the environmental stressor approach, Noon (2003) states:

> *To be most meaningful, a monitoring program should provide insights into cause-and-effect relations between environmental stressors or between specific management practices and anticipated ecosystem responses. Prior knowledge of the factors likely to*

> *stress an ecological system or the expected outcomes from management should be incorporated into the selection of variables to measure and the sampling design. Indicators should be chosen based on a conceptual model that clearly indicates stressors (e.g., pollutants, management practices) and indicators with pathways that lead to effects on the structure and function of the ecological system (NRC 1995, 2000). This process enables the monitoring program to investigate relations between anticipated stressors, or between management practices and environmental consequences, and provides the opportunity to develop predictive models.* (pg 34)

This environmental stressor approach is currently being applied to other adaptive management programs, and, for example, is an integral component of the *Adaptive Management and Monitoring Program* prepared for the Coachella Valley Multiple Species Conservation Plan and Natural Communities Conservation Program (Center for Natural Lands Management 2002)

In order to identify causative environmental factors responsible for ecosystem changes, Noon (2003) distinguishes between two kinds of "disturbance events" or stressors related to ecological change: intrinsic drivers and extrinsic drivers of ecological change. *Intrinsic drivers* are factors that occur naturally in the system and cause expected changes, such as stochastic variation, successional trends following disturbance events, and cyclic variation. Intrinsic drivers are not human-induced impacts and generally are not directly amenable to management nor, in many cases, would management be appropriate (Noon 2003). The ecosystem response should behave as a self-regulated system because the system presumably has evolved in the context of the intrinsic driver (e.g., coastal sage scrub has evolved in the context of wet/dry cycles and natural wildfires, riparian habitats have evolved in the context of regular flooding).

In contrast, e*xtrinsic drivers* are those external factors, usually human-induced, that in combination with intrinsic factors, can adversely drive the ecosystem to a degraded state. These extrinsic drivers push the system beyond its natural resilience (i.e., expected range of variation) and essentially "break" the system. Noon (2003) describes extrinsic drivers and the way they can affect an ecosystem system as follows:

> *Of most interest to monitoring programs are extrinsically driven changes to environmental indicators that arise as a consequence of some human action. Concern arises when extrinsic factors, acting singly or in combination with intrinsic factors, drive ecosystems outside the bounds of sustainable variation. Thus, one key goal of a monitoring program is to discriminate between extrinsic and intrinsic drivers of change; that is, a mechanism to filter out the effects of expected intrinsic variation or cycles*

> *(noise) from the effects of additive, human-induced patterns of change (signal).* (pg. 29, underline added for emphasis)

Noon (2003) suggests that a goal of monitoring is to develop a "structural model" of how the ecosystem responds to both intrinsic and extrinsic drivers. Indicator variables that are sensitive to intrinsic drivers should be selected and regularly measured to determine their range of natural variation. The model indicates the range of natural variation and provides a benchmark to compare future deviations (*noise* + *signal*) from the expected natural variation (noise). For example, arroyo toad breeding success appears to vary with wet/dry years in a fairly predictable pattern with reasonably well understood causes (i.e., extent and duration of breeding pools). A model of this cyclic behavior would indicate the "natural" variation in breeding success (e.g., measured by recruitment into the breeding population a following year) in relation to rainfall patterns. Two or three consecutive dry years would be expected to result in low recruitment over those years. However, poor recruitment following an otherwise good year (i.e., adequate extent and duration of breeding pools) would suggest that an extrinsic driver (stressor) (e.g., bullfrog proliferation) has adversely affected toad breeding success.

b. Formulation of Stressor Models for Vegetation Communities

Preliminary stressor models have been formulated for each of the five major vegetation communities in the RMV Open Space: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. The models are based both on the available scientific literature and on the professional judgment and experience of biologists familiar with the RMV property. As such, the models represent an amalgam of basic ecological theory, empirical scientific studies and direct observation of current Ranch conditions.

Two kinds of models were generated for each vegetation community. The first set of models (Figures 3-7) postulates the relationships between general landscape-level environmental stressors and vegetation community responses. This set of models provides a broad overview of the stressor-response relationships and identifies six general environmental stressors known or likely to be relevant to the Habitat Reserve[1]:

1. Too frequent/too infrequent fire

[1] The six stressors are intended to address "changed circumstances" as defined in the federal "No Surprises" rule. Changed circumstances are defined under No Surprises rule as "changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably anticipated by the plan developers and the USFWS and that can be planned for."

2. Over-grazing
3. Exotics (plants and animals)
4. Altered hydrology
5. Altered geomorphologic processes
6. Drought

At the scale of the Habitat Reserve, all but the drought stressor have human-induced components, and thus would be extrinsic drivers that may require management and monitoring. Although at a global scale, drought also may have a human-induced component (e.g., global warming-induced climate change), it cannot be directly managed at the RMV Open Space scale. However, drought can have direct effects on other stressors (e.g., fire) that, in turn, have direct effects on vegetation communities.

Under the first set of models, the "line weights" in Figures 3 through 7 represent the postulated strength of the relationship between an environmental stressor and the community response. For example, for coastal sage scrub (Figure 3), fire is considered to have a stronger direct influence in driving sage scrub to annual grassland than exotic species. Although exotic species directly influence sage scrub and help drive it to grassland, fire is a strong mediator of exotic invasion, as depicted by the arrow from the fire component to the exotics component of the model. Likewise, drought increases the likelihood and intensity of fire through reduced moisture content and greater dead fuel loads, and thus can cause a state-transition of coastal sage scrub to annual grassland. Although Figures 3 through 7 depict conceptually simple models, they reveal quite complex interactions between environmental stressors and community responses.

The second set of models depicted in Figures 8 through 12 focuses on selected "focal species."[2] For the purpose of RMV Open Space monitoring and management,

> "Focal species serve an umbrella function in terms of encompassing habitats needed for many other species, play a key role in maintaining community structure or processes, are sensitive to changes likely to occur in the area, or otherwise serve as an indicator of ecological sustainability." (as defined by the Committee of Scientists, 1999).

Noon (2003b) further refines focal species categories:

[2] Focal species generally are species that provide information about other species or community structure or processes, are sensitive to environmental changes, or serve as indicators of ecological sustainability. See Section 1.2.2.c for a detailed discussion of the approach used to select and species considered as candidate focal species.

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(1) *<u>Indicator species</u>: "An organism whose characteristics (presence or absence, population density, dispersion, reproductive success) are used as an index of attributes too difficult, inconvenient, or expensive to measure for other species or environmental conditions of interest" (Landres et al. 1998). In addition, Patton (1987) describes an indicator as a organism so intimately associated with particular environmental conditions that its presence indicates the existence of those conditions. Indicator species can further be broken down into 3 categories (Caro and O'Doherty 1999).*
   - *<u>Early warning indicator</u>: Provides an early warning of a stressor acting on a key ecosystem process. (Traditional interpretation of an indicator species from ecotoxicology.)*
   - *<u>Population surrogate indicator</u>: Species whose status and trend are indicative of the status and trends of other species.*
   - *<u>Biodiversity indicator</u>: A species, or more commonly a taxonomic group, that functions as a surrogate measure of the number of poorly known taxonomic groups.*

(2) *<u>Umbrella species</u>: A species that needs such large areas of habitat that managing for its viability meets the needs of numerous other species with similar resource requirements but smaller area requirements (Wilcox 1984). The principal requirement for an umbrella species is its range is large compared to sympatric species.*

(3) *<u>Keystone species</u>: A species that significantly affects one or more key ecological processes or elements to an extent that greatly exceeds what would be predicted from its abundance or biomass (Mills et al. 1993, Power et al. 1996).*

(4) *<u>Flagship species</u>: A species that can be use to anchor a conservation campaign because it arouses public interest and sympathy (normally a charismatic large vertebrate) (Simberloff 1998).*

(5) *<u>Link species</u>: A species that occupies a key position in a food web and efficiently transfers energy and matter between trophic levels.*

(6) *<u>Ecological engineer</u>: A species that directly or indirectly controls the availability of resources to other organisms by causing physical state changes in biotic or abiotic materials (Jones et al. 1994, 1997).*

Of these various focal species categories, "indicator species" and "umbrella species" likely will be the most useful for the Adaptive Management Program. The RMV Open Space may support a "keystone species" but no information is yet available to indicate that such a species occurs in the subregion. The subregion also does not support a candidate "flagship species." The mountain lion and golden eagle would be two obvious candidates, but while the RMV Open Space will accommodate these two species, neither is "symbolic" of the conservation effort. As with "keystone species," there is insufficient information at this time to identify candidate "link species" or "ecological engineers" in the subregion.

Both Identified Species and other non-covered species may serve as focal species for the purposes of overall RMV Open Space monitoring and management. Monitoring and management of these species will facilitate management of the overall RMV Open Space.

The models show more detail and postulate the relationships between stressors, community responses and their consequent impacts on selected focal species. These more detailed models incorporate the postulated relationships between human-induced environmental stressors and community responses of the first set of models depicted in as well as postulated relationships between these and additional environmental stressors and focal species. For example, for coastal sage scrub (Figure 8), additional species-based stressors include mesopredators, human collection/harassment, roads and trails, and pesticides. The pathways between stressors and species may be both direct (e.g., Argentine ants displace native prey of San Diego horned lizards) or indirect via community responses (e.g., long-term spatiotemporal changes to habitat structure and function cause the gradual decline of a species).

18.2.2 Goals and Objectives

As stated in the previous section, the three broad goals of the Adaptive Management Program are to:

1. Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.

2. Restore or enhance the quality of degraded vegetation communities and other habitat types.

3. Maintain and restore biotic and abiotic natural processes, at all identified scales, for the RMV Open Space.

The previous section also described the "environmental stressor" approach as the foundation of the Adaptive Management Program for achieving these goals and presents conceptual stressor models for the five major vegetation communities: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. However, as stated, these are general goals and do not define specific management objectives and activities that would enable management actions and outcomes to be systematically monitored and measured in the Habitat Reserve.

The conceptual environmental stressor models address management and monitoring of resources at three fundamental scales: **(1)** natural community landscape mosaic; **(2)** specific vegetation communities and habitats; and **(3)** species and species assemblages. Although there is overlap, dependence, and interaction among the difference scales, clearly stated conceptual relationships and coordinated management objectives at all three scales are needed to meet the management goals of the program.

1. Landscape management pertains to the dynamic and interacting biotic natural communities and abiotic factors within the entire subregion, and focuses on the natural processes that maintain the condition and dynamics of the natural communities. For example, the interaction of geomorphic and hydrologic processes, periodic events such as flooding, fire, and weather (i.e., drought/wet cycles), and the structure and function of vegetation communities, species and species assemblages must be understood in order to manage resources. A question that may be asked in this landscape context, for example, is: what is the role of flooding in maintaining southern willow scrub that is suitable breeding habitat for the least Bell's vireo?

2. Management and monitoring of specific vegetation communities and habitats refers to site-specific conditions, as contrasted with the broader landscape scale that focuses on the dynamic interaction of biotic and abiotic processes. Vegetation communities would be monitored and managed in terms of *net habitat value*, as discussed above, thus providing flexibility in the management and monitoring in recognition of the natural stressor-induced changes (i.e., intrinsic drivers) that occur in vegetation community associations that alter the relative amounts of the community at any give time (e.g., natural succession, fire, flooding, etc.).

3. Management and monitoring of species and species assemblages refers to maintaining species populations, including Identified Species or other "focal species" (e.g., indicator or umbrella species as defined below in *Section 1.2.2.c*). Management and monitoring of species and species assemblages would be important for both permit compliance monitoring for Identified Species (see *Section 1.2.3.a*) and adaptive management of the RMV Open Space (*Section 1.2.3.b*).

The next section provides a review of the ecological processes that operate at the three management scales identified above -- community landscape, vegetation communities and habitats, and species and species assemblages -- and proposes adaptive management objectives related to each of the processes.

a. Landscape Processes

The Adaptive Management Program addresses several landscape processes in the subregion that were identified by the Science Advisors in their refinement of the NCCP Tenets of Reserve Design: (1) fire; (2) hydrology and geomorphology; (3) habitat connectivity; and (4) edge effects and encroachment. These landscape processes and their relation to the Adaptive Management Program and the environmental stressor approach are discussed in this section.

1. Fire

Fire is considered to be a fundamental component of the coastal southern California ecosystem, and particularly of the coastal sage scrub and chaparral shrub communities (see Chapter 3, Section 3.2). While it is generally acknowledged that fire is essential for maintaining healthy shrub communities over the long term, there is considerable debate about the natural frequency and intensity of fires in the southern California (e.g., Keeley 1986, 1992; Keeley and Fotheringham 2001a,b; Minnich 2001). That is, under what regime does fire drive shrub communities beyond their natural range of variation or resilience to the extent that natural successional processes are disrupted? High fire frequency (i.e., short intervals between fires) may permanently alter the floristic composition and structure of a site, including the extirpation of weak resprouting species such as California sagebrush (Malanson and O'Leary 1982). Fires at five- to 10-year intervals may result in type conversion from chaparral to coastal sage scrub (Keeley 1987; O'Leary et al.1992). Type conversion from coastal sage scrub or chaparral to grassland may result from repeated burning in successive or alternate years (Zedler et al. 1983).

These empirical observations in southern California provide the framework for managing and monitoring shrub communities in the Habitat Reserve. As an example, recent fires in the subregion provide the opportunity for examining the response of coastal sage scrub and associated species to frequent fire. Portions of the Upper Chiquita Conservation Area experienced three burns in six years: 1996, 1997 and 2002, with the 2002 wildfire re-burning the 1997 burn area. Prior to the most recent burn in 2002, Harmsworth (2001) had documented that after three and four years post-burn, the 1997 and 1996 burn areas were recovering to mature coastal sage scrub composition, with general declines in fire-followers such as deer weed (*Lotus scoparius*) and morning glory (*Calystegia macrostegia*), and an increase in the dominance of shrubs such coastal sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), black sage (*Saliva mellifera*), and laural sumac (*Malosma laurina*).

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An important observation would be the response of the 1997 fire area that was burned again in 2002.

It also should be noted that middle and lower Chiquita Canyon south of Oso Parkway have not burned since the 1950s according to the Orange County wildfire record. The Wiegand fire in 1954 burned lower Chiquita Ridge and Chiquadora Ridge. The Steward fire burned Chiquadora Ridge again in 1958. Notably these areas support the highest densities of the California gnatcatcher in the subregion, so absence of fire for more than almost 50 years does not appear to be an adverse situation for this species. However, this area also has been subject to grazing during that period of time, so an important interaction between fire and grazing may be related to sustaining highly suitable gnatcatcher habitat in this area (e.g., a more open, lower habitat structure). Understanding the potential interaction between these two stressors (i.e., grazing and fire) will be crucial for managing the system, especially because allowing wildfires to burn or conducting prescribed burns in some areas of the RMV Open Space would not be feasible due to public safety and property concerns.

The Adaptive Management Program must address the role of fire (and possibly in conjunction with managed grazing) in maintaining a healthy ecosystem in the subregion such that the planning area at any given time would support a mosaic of upland habitats in stands of various ages (i.e., time since last burn).

Based on the current understanding of the fire ecology of southern coastal shrub and grassland communities, objectives of the Adaptive Management Program for fire that are consistent with the management objectives of species and habitats include:

- Identify appropriate spatial scales and patterns for the long-term management of fire.

- Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species.

- Quantify effects of varying fire regimes on selected wildlife species.

- Utilize prescribed fire to reduce unplanned fire events from known ignition corridors.

- Define fire prescriptions that aid in the restoration of degraded shrublands.

- Investigate active restoration techniques following fire treatments.

- Develop a social environment supportive of active fire management.

The Fire Management Plan to achieve these objectives is described in more detail in *Section 1.7.*

2. Hydrology and Geomorphology

Abiotic hydrologic and geomorphic processes shape and alter creek systems in the planning area over time and thus are fundamental components of the regional landscape. Maintaining natural hydrologic and geomorphic process to the maximum extent possible is essential for preserving natural ecosystem structure and function. Alterations in hydrologic and morphologic processes have significant impacts on spatial and temporal distributions, structure, and function of riparian and wetland vegetation communities that provide essential habitat for numerous species.

The Draft Watershed and Sub-basin Planning Principles (Draft Watershed Principles) should be used as management objectives of the Adaptive Management Program as follows :

a) Surface and Groundwater Hydrology

- Emulate, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground cover.
- Address potential effects of future land use changes on hydrology.
- Minimize alterations of the timing of peak flows of each sub-basin relative to the mainstem creeks.
- Maintain and/or restore the inherent geomorphic structure of major tributaries and their floodplains.
- Utilize infiltration properties of sandy terrains for groundwater recharge and to offset potential increases in surface runoff and adverse effects to water quality.

b) Water Quality

- Protect and manage water quality using a variety of strategies, with particular emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas.

c) Geomorphology/Terrains

- Recognize and account for the hydrologic response of different terrains to new development, rainfall/climate and proposed management/restoration activities at the sub-basin and watershed level.

d) Sediment Sources, Transport and Storage

- Maintain coarse sediment yields, storage and transport processes.

3. Habitat Connectivity

Disruptions in habitat connectivity results in habitat fragmentation. Fragmentation, in addition to increased "edge" area addressed in the next section, has two main effects that are generally accepted as adverse to ecosystem function: (1) reduction in total habitat area (which affects population sizes and extinction rates); and (2) redistribution of the remaining area into disjunct fragments (which affects dispersal and thus immigration rates) (Wilcove et al. 1986). Habitat fragmentation has been shown to alter avian species composition and distribution in southern California (e.g., Bolger et al. 1997a) and smaller habitat fragments may lose native species assemblages across taxa (e.g., Bolger et al. 1997b). The mechanisms for these changes are several, and include differential responses by species to edge effects, isolation of habitat fragments by intervening land uses that species cannot cross (e.g., some small mammals and reptiles will not cross roads) or distances that are beyond their dispersal capabilities, increased predation by mesopredators, and other sources of mortality (e.g., vehicle collisions).

The main goal of the Adaptive Management Program concerning habitat connectivity is to ensure that habitat linkages and wildlife corridors connecting large habitat blocks in the RMV Open Space function as designed (see General Policies 3 and 4 described in the Draft NCCP Guidelines) by managing "live-in" and dispersal habitat. Specific objectives to achieve this goal are to:

- Determine an appropriate suite of "focal species" for monitoring the use of habitat linkages and wildlife corridors (see discussion of "focal species" in *Section 8.2.1.c*).

- Monitor the use of key identified habitat linkages and wildlife corridors (as discussed in the existing biological conditions section of the GPA/ZC EIR and illustrated in Figure 13) by selected focal species. Monitoring sites would be selected based on their risk of being affected by existing or future development (e.g., areas where the habitat linkage or wildlife corridor narrows down to less than 1,000 feet or is crossed by an arterial roadway). Sites would be monitored through various methods as appropriate, including transects, track stations, and remote cameras.

- Identify and measure any ongoing stressors on wildlife such as harassment, lighting, noise, vehicle collisions based on monitoring data at key linkages and corridors. In some cases the stressor may be immediately apparent (e.g., a roadkill hotspot), but in other cases the stressor may be more subtle (e.g., interspecific competition for resources) and several years of monitoring may be required to detect a negative trend (e.g., a decline in tracks or scat of a species at a particular location).

- Identify and implement feasible remedial actions, to improve the function of the habitat linkage/wildlife corridor to an acceptable level (e.g., measurable reduction in vehicle collisions, increase in tracks or scat), such as restoring habitat to improve cover for refugia, placing fencing along roads to funnel wildlife and reduce vehicle collisions, erecting sound walls (as feasible), or redirecting lighting.

4. Edge Effects and Encroachment

Edge effects and encroachment into habitat areas are in large part related to, and exacerbated, by habitat fragmentation. Edge effects may be directly human-caused, such as lighting, noise, increased moisture, invasive plants, pesticides and pollutants, pets and feral animals, recreational activities, species collections, trash dumping, etc., or related to natural distributions of species (e.g., edge vs. interior species). Argentine ants, which rely on moist conditions, may invade naturally xeric areas along habitat edges where there is urban runoff or irrigation for landscaping or agriculture. Fuel modification zones (FMZ) may be considered edge areas because the natural vegetation composition and cover is altered to reduce fire loads. Longcore (2000), for example, observed effects on the coastal sage scrub arthropod community in FMZs, including an increase in the Argentine ant and other exotic arthropod species (European earwigs, pillbugs and sowbugs, and the sowbug killer) and a concomitant in decline predator species such as scorpians and trap-door spiders.

Edge effects also may be abiotic in origin, but have their effects on biological resources. Examples of abiotic edge effects are increased exposure to sun and wind and changes in soil ecology, with consequent effects on the microclimate at the edge of the habitat area (Lovejoy et al. 1989).

Fire also is an edge effect in the sense that human-caused fires (either accidental or deliberate ignitions) are most likely to occur along edges of roads (e.g., cigarettes, exhaust sparks or catalytic converter combustions, and arson) or at the urban-wildland interface (e.g., sparks from lawnmowers, rototillers, accidental or intentional ignitions by children, etc.), but because of the potential for spread of a wildfire, its impacts may be much greater than other types of edge effects that have more discrete and linear incursions into habitat ranging from a few to hundreds of feet (e.g., lighting, noise, urban run-off).

Human encroachment also may go beyond simple edge effects, and can include unauthorized public access into sensitive areas, illegal trails, and other activities within reserve areas that may have negative effects on biological resources.

General Policy 5 (Draft NCCP Guidelines) addresses long-term indirect impacts which can be applied to the RMV Open Space. Broad objectives of the Adaptive Management Program concerning edge effects and encroachment are stated below, along with specific objectives designed to meet the broad objective.

- Control invasion of the RMV Open Space by exotic plants and animals.

    - Prohibit plants identified by the California Exotic Plant Pest Control as an invasive risk in Southern California from development and fuel management zones adjoining the Habitat Reserve.

    - Create fuel management zones combining irrigated and non-irrigated native plantings separating the RMV Open Space from adjacent urban uses.

    - Provide barriers, fencing and walls to control access to the RMV Open Space by domestic animals.

    - Implement the Invasive Species Control Plan throughout the RMV Open Space where pest plant and wildlife species are a demonstrated problem. The Invasive Species Control Plan (described in detail in *Section 8.10*) addresses invasive riparian plants (giant reed, pampas grass, tamarisk, castor bean, tobacco tree, and Spanish sunflower), invasive upland species (artichoke thistle), and invasive animals (bullfrog, brown-headed cowbird, Argentine ant, and red fire imported ant).

- Control potential edge impacts such as lighting, increased moisture, pollutants and pesticides.

    - Shield and/or direct lighting away from habitat areas through the use of low-sodium or similar intensity lights, light shields, native shrubs, berms and other shielding methods.

    - Manage pesticide and herbicide use and fertilizer application techniques in landscaped areas, including golf courses, located adjacent to the RMV Open Space or preserved wetlands and provide comprehensive water quality treatment, which may include, but not be limited to, the use of natural treatment systems, prior to discharge of urban runoff into the RMV Open Space.

- Protect sensitive resource areas from unauthorized public access and associated impacts such as off-road vehicles (including motorized vehicles and mountain bikes), trampling of vegetation, and harassment and collection of native species.

        - Prohibit collection or removal of any native plant, animal or microorganism;
        - Prohibit the introduction of any non-native plant, animal or microorganism;
        - Prohibit firearms, weapons, and fireworks;
        - Restrict vehicle operations to designated roads.
        - Restrict hiking, mountain biking and equestrian uses to designated trails; and
        - Restrict pets to designated locations and trails and restraint of pets by leash at all times.

Wildfire control and fuel modification zones and treatments are addressed through the Fire Management Plan, as described below in *Section 8.7*.

b. Major Vegetation Communities

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As stated above, the purpose of the Adaptive Management Program is to maintain and, where feasible, enhance the long-term net habitat value within the RMV Open Space. Habitat value may be defined as the ability (quality, suitability or functional level) of a unit area to support a particular organism. Simply put, if a unit of habitat is reduced in quality and is less capable of supporting a particular organism (i.e., the carrying capacity of the area has declined), its habitat value for that organism has declined. Likewise, if a species assemblage is diminished within a habitat area, its net habitat value has declined. With the recognition that habitat systems are dynamic, implementation of the Adaptive Management Program is an essential element in contributing to assuring no net long-term loss of habitat value in the subregion. The Adaptive Management Program contributes to maintaining net long-term habitat value in the RMV Open Space in two fundamental ways.

- Existing habitat value in the RMV Open Space is conserved through implementation of the Adaptive Management Program.

- Through restoration activities, the Adaptive Management Program provides opportunities for increasing habitat value in areas with lesser existing habitat value such that long-term net habitat value in the RMV Open Space is increased over current conditions.

The Adaptive Management Program addresses the five major vegetation communities in the Habitat Reserve: coastal sage scrub, chaparral, native grassland, riparian and wetland, and oak woodland. Overall goals and associated management objectives/actions of the Adaptive Management Program concerning vegetation communities and net habitat value are stated below. It is important to note that the application and timing of management actions to achieve these goals would be tied to specific environmental stressors that are known or suspected to be operating in the Habitat Reserve, management priorities, and available funding. Goals and management objectives specific to each of the five major vegetation communities are set forth in *Section 1.4*.

- Maintain major vegetation communities and associated species and species assemblages, with the recognition that acreages and net habitat values for a particular community will oscillate in relation to natural events (e.g., flood, fire, drought).

    - Establish the “baseline condition” of existing vegetation communities through aerial mapping of the entire RMV Open Space.

- Conduct periodic (e.g., every 5 years) landscape-level vegetation monitoring using remote sensing methods to identify significant disturbances to vegetation communities. Determine whether disturbance is of natural or human-caused origin.

- Periodically (e.g., every 5 years) quantify the acreage of five major vegetation communities. The RMV Open Space acreages among the major native vegetation communities would be allowed to vary such that net acreage of native vegetation communities remains relatively constant (e.g., coastal sage scrub converts to chaparral, or either converts to woodland) unless it is clear that *major* or *important populations* of Identified Species in *key locations* are being adversely affected, in which case a management action may be required (e.g., prescribed burn). If annual grassland increases more than 10 percent in areas formerly supporting coastal sage scrub or chaparral, a restoration action may be warranted (e.g., managed grazing, prescribed fire, or revegetation). If the increased grassland is native grassland, no management intervention would be required.

- Conduct annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space. Selection of plots would be based on a stratified pseudorandom sampling procedure to ensure a representative sample of the RMV Open Space, including both interior and edge areas adjacent to urban development (the interior areas serve as controls for edge areas).

- Focus restoration activities in areas where, due to either human-caused or natural disturbances, the area would continue to degrade without management intervention (e.g., repeated fire in a coastal sage scrub area may require active restoration to avoid type-conversion to annual grassland).

- Contribute to the ability of the subregion to support populations of Identified Species.

  - Conduct monitoring of habitats supporting Identified Species, with a focus on stressors in selected areas in the RMV Open Space identified as supporting *major* or *important populations* in *key locations*.

  - Implement management activities in any areas where habitat degradation has been determined to adversely affect habitat use by Identified Species **and** it is unlikely that the area would naturally regenerate without management intervention; e.g., where giant reed invades arroyo toad breeding habitat.

- Maintain and, where feasible, enhance long-term net habitat value in order to mitigate for proposed Incidental Take and to contribute to recovery of listed Identified Species in the subregion. Note that initial habitat restoration and invasive species control activities to address the most of the following objectives have been identified and are described in their respective plans.

  - Conduct restoration of coastal sage scrub in designated areas along Chiquita and Chiquadora ridges to improve habitat connectivity and carrying capacity for the California gnatcatcher.

  - Conduct restoration of native grasslands in designated areas of upper Cristianitos Canyon to improve habitat quality for thread-leaved brodiaea.

  - Manage native grasslands in areas supporting thread-leaved brodiaea through timed-grazing, prescribed burning, and/or selective weeding.

  - Implement invasive plant and animal species control plans along San Juan and Cristianitos creeks to improve breeding habitat for the arroyo toad and least Bell's vireo.

  - Maintain flow characteristics of episodic events and assure water quality in drainages supporting the arroyo toad.

  - Protect existing habitat in Gobernadora Creek (GERA) through management and restoration actions.

- Identify and restore existing areas with little or no habitat value to increase long-term net habitat value.

  - Conduct restoration of coastal sage scrub in designated areas along Chiquita and Chiquadora ridges and in Sulphur Canyon to improve habitat connectivity and carrying capacity for the California gnatcatcher and other sage scrub species.

- o Conduct restoration of native grasslands and coastal sage scrub/native grassland mix in designated areas such as Chiquita Ridge, upper Cristianitos Canyon, and upper Gabino canyon to improve habitat quality for grassland species such as the grasshopper sparrow.

- As opportunities arise in the future, use restoration to increase long-term net habitat value in the Habitat Reserve.

c. Wildlife Species

The Adaptive Management Program addresses two general classes of wildlife species: **(1)** Identified Species; and **(2)** "focal species."

1. Identified Species

The Conservation Strategy is designed in part to conserve a suite of Identified Species and associated habitats. The Adaptive Management Program component of the Conservation Strategy is designed to help ensure that habitats supporting Identified Species are sustained and, in so doing, would " contribute to recovery" of Identified Species on a subregional basis. Management and monitoring of Identified Species would occur at the habitat landscape level (e.g., Science Advisors Group 2 species) or at the site- and/or species-specific level (e.g., Science Advisors Group 3 species).

Two main goals of the Adaptive Management Program concerning Identified Species are:

1. **Maintain conditions that will allow for normal evolutionary processes and genetic integrity and exchange through management of functional open space, including functioning vegetation communities, habitat linkages and wildlife corridors.**

   This goal generally would be achieved by meeting the objectives stated above for habitat connectivity, edge effects and encroachment, and major vegetation communities (as well as specific goals and management objectives for each of the five major vegetation communities set forth in *Section 1.4*) because they all address the long-term function of the RMV Open Space for Identified Species and associated habitats

2. **Manage habitat and populations of Identified Species to ensure that Identified Species are sustained, and in so doing "contribute to recovery" of Identified Species on a subregional basis.**

Objectives designed to achieve this goal are to:

- Monitor populations of selected Identified Species and/or their habitats to detect population trends in relation to environmental stressors and management issues. Monitoring would focus on *major* and *important populations* and *key locations* of Identified Species where possible.

- Implement appropriate management actions, as necessary, to stabilize or enhance populations of Identified Species, such as habitat restoration, and pest controls (e.g., cowbird trapping, invasive species control).

All Identified Species would be managed and monitored at some level, either as an integral aspect of the program or through data gathered through specific monitoring efforts.

2. Focal Species

a) Methods for Selecting Focal Species

The focal species approach assumes that only a limited number of species can be effectively and practically monitored and managed because of the need to focus on species that provide feedback for management decision-making and the finite resources typically available for programs. Murphy, Noon and Collopy (2003) provide a practical and logical method for selecting focal species. This method is essentially a step-down, filtering approach whereby a “long list” of focal species candidates is enumerated and progressively subjected to a series of questions pertaining to their suitability as focal species. Ideally, the selection process identifies a set of species that represent the various taxonomic groups and the relevant aspects of the ecological system being monitored.

The method described here to select focal species is a slight modification of the method suggested by Murphy et al. (2003) and uses the currently available Science Advisors species groupings (i.e., Group 1, 2, or 3) described the GPA/ZC EIR Biological Resources Section as the foundation for a “long list” of candidate focal species. The definitions of these three groups are restated in the context of the Adaptive Management Program.

Group 1 species require minimal conservation or management action. Their conservation would be minimally affected by management based on the following criteria:

- Management would have a very limited impact on the species;
- The species is not found or is insignificant in the study area; and/or
- The species has very high population numbers in the study area.

Based on these criteria, and particularly the first bullet, no Group 1 species would be selected as focal species.

Group 2 species are best conserved by protecting habitats at a landscape level through general NCCP/HCP reserve design tenets and through adaptive management. Their conservation can be inferred from a well-planned and managed network of protected open space in a functioning landscape. Criteria for Group 2 species include one or more of the following:

- The species is relatively widespread in the study area;
- The species occurs in relatively robust populations within the study area and possibly elsewhere;
- Life history characteristics respond to habitat/landscape-level conservation;
- Detailed surveys or inventories are not crucial in order to conserve the species;
- The species is known to, or likely to, respond well to habitat management;
- The species is locally genetically indistinct; or
- No individual action is needed other than habitat conservation and management.

Group 2 species exhibit several characteristics that are desirable in focal species, and in particular, they are common enough to be effectively monitored and that they may respond well to management actions.

Group 3 species are best conserved at the species-specific level. They require one or more of three types of conservation action: **(1)** fine-tuning of protected open space or specific management activities; **(2)** reintroduction and/or specific enhancement; or **(3)** additional data and research are necessary to determine basic needs. Criteria for Group 3 species include one or more of the following:

- The species is known or predicted to occur in extremely low populations;
- The species is narrowly endemic in the study area;

- The species has highly specialized life history requirements;
- The study area is known to be crucial to the survival of the entire species;
- The species is known or suspected to respond poorly to management;
- The species is highly sensitive to small changes in the landscape or habitat;
- The species is dependent on intensive conservation activities; or
- The species is widespread, but extremely uncommon.

The conservation and adaptive management requirements for Group 3 species are site-specific and species-specific. By definition, regulatory coverage for these species would involve monitoring the status of these species, or a selected subset of species, to ensure their persistence in the study area. In some cases, Group 3 species such as arroyo toad or least Bell's vireo may be valuable focal species because they are sensitive to environmental stressors known or likely to affect other species (e.g., altered hydrology and exotic species). Other Group 3 species, such as San Diego and Riverside fairy shrimp, may not be useful focal species because their habitat requirements and life-history characteristics are more unique (however, they would be managed and monitored as Identified Species).

In addition to using the Group 2 and 3 species as a basis for the "long list" of candidate focal species, umbrella species and other species considered by the Science Advisors to be "indicative of the quality of select habitat-types" also were included. Finally, several invasive species (e.g., brown-headed cowbird, bullfrog) and indicators of disturbance or declining habitat quality, such as "edge-enhanced" species (e.g., Anna's hummingbird, mockingbird; see study on habitat fragments in urban environments by Bolger et al. 1997a) were added to the list. Monitoring these potential "early warning" indicator species may be valuable for detecting negative trends in RMV Open Space function and Identified Species populations. Species that do not rely on one of the five major vegetation communities – coastal sage scrub, chaparral, grassland, riparian and wetland, and oak woodland – were removed from the list (e.g., open water species such as American white pelican, double-crested cormorant, etc.). This vetting process resulted in the "long list" of 70 candidate focal species shown in Table 1-1.

Following Murphy et al. (2003), a selection filter was applied to the species on the long list that consists of seven questions:

a. Does the species have an unambiguous taxonomy (i.e., are there species or sub-species naming issues)?

b. Is the biology and life history of the species reasonably well known?

c. Is the species "easy" to detect and measure?

d. Does the species exhibit low sampling variability (consistent and high detectability)?

e. Does the species exhibit low demographic and genetic variability?

f. Does the species exhibit detectable trends in occurrence and population size?

g. Are there known relationships between occurrence, population size, and stressors or ecosystem processes?

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TABLE 1-1
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
Arroyo Toad	Yes	Yes	Yes	No	?	Possible	Yes	EW
Bullfrog	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
California Slender Salamander	Yes	?	?	?	?	?	?	Rejected
California Treefrog	Yes	Yes	?	?	?	?	No	Rejected
Pacific Chorus Frog	Yes	Yes	Yes	?	?	?	No	Rejected
Western Spadefoot Toad	Yes	No	No	No	?	?	No	Rejected
Acorn Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	EW, BI
Anna's Hummingbird	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Ash-throated Flycatcher	Yes	Yes	Yes	?	?	?	Yes	EW
Barn Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Black-chinned Sparrow	?	No	No	?	?	No	Yes	Rejected
Brown-headed Cowbird	Yes	Yes	Yes	?	?	Yes	Yes	EW
Burrowing Owl	Yes	Yes	No	?	?	No	Yes	Rejected
Cactus Wren	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
California Gnatcatcher	Yes	Yes	Yes	No	No	Yes	Yes	EW
California Horned Lark	?	Yes	Yes	No	?	No	Yes	Rejected
California Thrasher	Yes	Yes	Yes	?	?	?	Yes	BI
Common Yellowthroat	Yes	Yes	Yes	Yes	?	?	No	Rejected
Cooper's Hawk	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected
Costa's Hummingbird	Yes	Yes	Yes	?	?	?	Yes	EW, BI
European Starling	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Golden Eagle	Yes	Yes	No	No	?	No	Yes	Rejected
Grasshopper Sparrow	Yes	Yes	Yes	No	No	Possible	Yes	BI
Great Horned Owl	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Greater Roadrunner	Yes	Yes	No	?	?	?	Yes	Rejected

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TABLE 1-1
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
House Finch	Yes	Yes	Yes	Yes	?	Yes	Yes	EW
Lark Sparrow	Yes	Yes	Yes	?	?	?	Yes	EW
Least Bell's Vireo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Loggerhead Shrike	Yes	Yes	Yes	?	?	?	Yes	Rejected
Long-eared Owl	Yes	Yes	Yes	?	?	?	Yes	Rejected
Northern Mockingbird	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Nuttall's Woodpecker	Yes	Yes	Yes	Yes	?	Yes	Yes	BI
Red-shouldered Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Red-tailed Hawk	Yes	Yes	Yes	Yes	?	Yes	No	Umbrella
Red-winged Blackbird	Yes	Yes	Yes	Yes	?	Yes	No	Rejected
Rufous-crowned Sparrow	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Savannah Sparrow	Yes	Yes	?	?	?	?	No	Rejected
Snowy Egret	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Sora	Yes	No	No	?	?	?	Yes	Rejected
Southwestern Willow Flycatcher	No	Yes	?	No	?	No	Yes	Rejected
Spotted Towhee	Yes	Yes	Yes	?	?	?	No	Rejected
Swainson's Thrush	Yes	Yes	?	?	?	?	No	Rejected
Tricolored Blackbird	Yes	Yes	Yes	No	No	No	Yes	Rejected
Western Screech Owl	Yes	Yes	No	?	?	?	Yes	Rejected
White-tailed Kite	?	Yes	Yes	No	No	No	Yes	Rejected
Wrentit	Yes	Yes	Yes	Yes	?	?	Yes	BI
Yellow Warbler	No	Yes	Yes	?	?	?	Yes	EW, BI
Yellow-breasted Chat	?	No	Yes	?	?	?	?	Rejected
Northern Red-diamond Rattlesnake	No	No	No	No	?	No	Yes	Rejected
Orange-throated Whiptail	Yes	Yes	Yes	?	?	?	Yes	EW
Rosy Boa	No	No	No	?	?	?	?	Rejected

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TABLE 1-1
SPECIES CONSIDERED FOR SELECTION AS FOCAL SPECIES

Common Name	Clear Taxonomy	Biology and Life History Known	Easy to Find and Measure	Low Sampling Variability	Low Demographic and Genetic Variability	Detectable Trends in Occurrence and Population Size	Known Relationships Between Occurrence/ Populations and Stressor of Ecosystem Process	Focal Species Category
San Diego Horned Lizard	No	Yes	Yes	?	?	?	Yes	EW, BI
Silvery Legless Lizard	No	No	No	?	?	?	No	Rejected
Southwestern Pond Turtle	Yes	Yes	Yes	Yes	?	Yes	Yes	EW, BI
Spotted Night Snake	Yes	No	No	No	?	No	No	Rejected
Two-striped Garter Snake	Yes	No	No	No	?	?	No	Rejected
Bobcat	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Coyote	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Dulzura California Pocket Mouse	No	Yes	Yes	Yes	?	Yes	No	Rejected
Dulzura Kangaroo Rat	Yes	Yes	Yes	Yes	Yes	Yes	No	Rejected
Gray Fox	Yes	Yes	Yes	?	?	?	No	Rejected
Mountain Lion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Mule deer	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Umbrella
Arroyo Chub	Yes	Yes	Yes	?	?	?	Yes	EW, BI
Threespine Stickleback	No	No	Yes	?	?	?	Yes	Rejected
Argentine Ant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Behr's Metalmark	?	?	?	?	?	?	?	Rejected
Imported Fire Ant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	EW
Riverside Fairy Shrimp	Yes	Yes	Yes	No	?	?	Yes	Rejected
San Diego Fairy Shrimp	Yes	Yes	Yes	No	?	?	Yes	Rejected

EW – Early warning indicator; BI – Biodiversity Indicator

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Questions “d-f” require more explanation to understand the importance of these issues in selecting focal species. Generally these questions relate to the issues of species *generation times* and *population sampling*.

Generation Times

Generation times are the species’ average life cycle time between birth and death. Species with very long generation times (e.g., decades) may not be suitable for monitoring because population turnover may too slow to detect population changes in relation to environmental stressors until its too late to reverse the trend. This problem may be overcome to some extent by closely monitoring demographic factors such as age-group distributions, recruitment, etc., but in some long-lived species with low reproductive rates, significant demographic changes may be undetectable for long periods. On the other hand, species with short generation times and highly volatile reproductive cycles also may not be suitable focal species because apparent extirpations, leading to management actions, may simply be part of the natural population oscillation (i.e., *intrinsic driver*) exhibited by the species, and it may be difficult to separate the human-induced stressor component (i.e., *extrinsic driver*) from the natural oscillations because of the high variability. If the population oscillations primarily are caused by intrinsic natural factors and are self-regulating, management would not be warranted and would be wasteful of management and monitoring resources. Ideally, focal species will have generation times that are significantly correlated with the environmental stressors operating in the RMV Open Space so that if a population decline is detected, it can be clearly tied to the stressor; e.g., the lag time between the observed stressor and population response it short enough to correlate the two variables and separate out natural causes of population oscillations. While some causal relationships between stressors and the species’ response may be obvious (e.g., cowbird parasitism on native passerines), some experimentation may be required to demonstrate causality between the stressor and species response and the efficacy of a management action. In response to information compiled over time, thresholds for triggering management actions would be established and refined.

Population Sampling

In order for management and monitoring to proceed efficiently and for trends and causal relationships to be detectable in relation to stressors, the focal species must be amenable to reasonable sampling regimes. If a species is so rare or occurs in low densities over a wide distribution such that it is rarely encountered, even with effective detection methods, its use as a focal species would be limited. For example, rare winter migrant birds would make poor focal species because their occurrence is sporadic and linking their presence or absence to environmental stressors would be virtually impossible. That is, the noise (*intrinsic driver*) to signal (*extrinsic driver*) ratio is too large to reliably or practicably measure the signal component. Gibbs (2000) estimated the necessary sampling intensities (i.e., the number of sample plots related to the number of samples per year) that would provide the statistical power for reliably detecting certain population changes (e.g., 10, 25, or 50 percent population reduction) in different taxonomic groups (e.g., large mammals, small-bodied birds). The statistical power of the monitoring program is closely related to the variability of the population index used (e.g., how much does the population vary from year-to-year?). The power to detect a trend is inversely related to the magnitude of index variability; the more variable a population is, the more power the monitoring program has to have. For small-bodied birds, for example, which have moderately high population variability, Gibbs estimated that 30 plots sampled four times per year for 10 years would be required to detect a 25 percent change in the population. To detect a 10 percent change would require 130 plots sampled four times per year for 10 years; i.e., as the change threshold becomes finer-grained, the sampling intensity is magnified for species with high index variability. In contrast, for large mammals that have relatively low variability, Gibbs estimated that only 10 plots sampled four times per year for 10 years would be needed to detect a 10 percent change; i.e., the large mammals are more amenable to statistically reliable sampling with less effort than small-bodied birds because they have lower population variability.

The selection of focal species will need to consider the amount of effort needed to establish population trends for the focal species (i.e., question “f”). Species that exhibit high variability indices may not be suitable focal species if an adequate sampling effort cannot be made with the available management funding and resources.

Known Environmental Stressors and Ecosystem Processes

A key question for selecting focal species is whether there are known relationships between occurrence, population size, and stressors or ecosystem processes (i.e., question ‘g”). Some species already have a demonstrated sensitivity to certain stressors, and, in some cases, a demonstrated positive response to management; these would be useful focal species. Known and possible stressors on Identified Species, and positive management actions, if known, are summarized in the Species Accounts (Section 4 Draft NCCP Guidelines), and are reflected in the management and restoration objectives for each of the vegetation communities. For example, the least Bell’s vireo is nest-parasitized by the brown-headed cowbird. Cowbird trapping has been accepted as an effective management technique and appears to be a primary factor in the rebound of the vireo population in southern California (USFWS 1998). Likewise, the bullfrog is a documented predator on arroyo toads in general (USFWS 1999) and on RMV (Ramirez 2003), as well as the California red-legged frog (e.g., Kiesecker 1998; Lawler et al. 1999). Control of bullfrogs therefore would be an important tool for managing the arroyo toad, and possibly western spadefoot toad, but it would be important to demonstrate a positive response to bullfrog control and to determine what kinds of controls techniques are most effective.

The relationship between ecosystem processes and species occurrence and population size also is reasonably well known for some species. Again, using the arroyo toad as an example, it is known that arroyo toad breeding success depends on breeding pools persisting into May and June to allow sufficient time for metamorphosis from larvae to juvenile age class. Hydrology, therefore, is a well-understood component of arroyo toad biology.

An example of an analysis of a species as a potential focal species for coastal sage scrub is a study by Chase et al. (1998) on the California gnatcatcher, where the research question was whether sites that supported gnatcatchers also supported significantly more other species than sites without gnatcatchers; i.e., is the gnatcatcher an indicator of coastal sage scrub species richness. If it could be shown that gnatcatcher presence is positively correlated with bird-species richness, the species could be a valuable habitat indicator. Bird-species richness was evaluated at 17 sites Riverside, San Diego and Orange counties where gnatcatchers were both present and absent. Although there were slightly more species of birds at sites where gnatcatchers were present, the difference was small and not statistically significant; i.e., the gnatcatcher was not a good indicator or predictor of bird-species richness. This finding is not surprising given that gnatcatchers appear to persist in relatively small, highly fragmented habitat patches (e.g., Dudek 2003) and may occur where overall species richness is relatively low (Chase et al. 1998). It is likely that several species, ultimately at different trophic levels (i.e., level in the food chain), would need to be monitored to ensure that the diversity and dynamics of the coastal sage scrub system are being successfully monitored and managed.

b) Selection of Candidate Focal Species

Table 1-2 presents the results of this filtering process for selecting a “short list” of candidate focal species from the 70 species on the “long list.” With regard to taxonomy and life history questions (i.e., questions “a” and “b”), the California Wildlife Habitat Relationships database was consulted where other information was not readily available. The answers to the questions of whether the species is easy to detect and whether there is low sampling variability primarily relied on local professional experience or published and/or generally accepted species survey protocols (e.g., for California gnatcatcher, least Bell’s vireo, arroyo toad, pond turtle, etc.). The answers to whether the species exhibits low demographic and genetic variability and whether it exhibits detectable trends in occurrence and population size are the two most difficult questions to answer with any certainty because of the general lack of information. In most cases, these questions were answered with a "?" indicating that the adequate information is unavailable. It should be noted, however, that in some cases, we may not know the demographic and genetic variability of the species. If such a species is a high priority for monitoring, the monitoring effort may need to be adjusted to collect adequate data. An important consideration for selecting a focal species thus is the tradeoff between the value of the monitoring data to the overall Adaptive Management Program and the effort required to collect the data.

The answer to whether there are known relationships between environmental stressors, and population size and occurrence is based on published and anecdotal reports of threats to species. For example, too frequent fire is reported to be a threat to gnatcatchers, bullfrogs are known predators of arroyo toads, etc. For the invasive species on the lists, such as brown-headed cowbird, starling, mockingbird, etc., they are either the direct environmental stressor (e.g., cowbirds are nest parasites and European starlings potentially compete with native species for nesting cavities [see Koenig 2003 for caveats in drawing inferences about the effects of invasive species]) or possibly indicators of degraded edge habitat (e.g., mockingbirds are common along the urban-wildland interface). In many cases causal relationships underlying the presence of an invasive species, and the decline or absence of a native species are not known; i.e., the observation is correlational. It may be unclear, for example, whether the invasive species actively displaces the native species (e.g., starlings outcompeting native species for nest cavities), directly reduces reproductive success of the native species (e.g., nest parasitism by brown-headed cowbirds), or, on the other hand, more passively colonizes available habitat because the native species has declined or disappeared for some other unrelated reason.

Generally, if a species could not be tied to a specific environmental stressor or ecosystem process or characteristic (e.g., habitat quality), it was rejected as a potential focal species. In addition, if the answers regarding taxonomy, biology and life history, ease of detection and measurement, and low sampling variability were consistently "No," the species was rejected for further consideration. For example, reptiles such as the rosy boa typically are little known and hard to reliably detect, and thus are poor candidates as focal species. In most cases, the answer to whether the species has low demographic or genetic variability is unknown, so this factor was not considered as strongly in whether the species was rejected or not as a potential focal species.

The initial filtering process using the seven questions posed above narrowed the species list to 32 candidate focal species, including 20 birds, two amphibians, three reptiles, four mammals, one fish and two invertebrates (*Table 1-2*). Species that passed the first filter and were retained as potential focal species for further consideration were assigned to one or more of the focal species categories described above. For potential umbrella species, the recommendations of the Science

Advisors were followed. For indicator species, two types of indicators were identified: early warning and biodiversity indicators. As used here, early warning indicators included species that are known or strongly suspected to be sensitive to environmental stressors that have broad implications for habitat integrity and other species. For example, arroyo toad is designated an early warning indicator because it vulnerable invasions by exotic plants such as giant reed and tamarisk and to bullfrog predation, which in turn affect the entire riparian/wetland ecosystem. Coyote also was designated an early warning indicator because their absence from habitat patches is related to "mesopredator release" and loss of small native species (Crooks and Soule 1998). Edge-enhanced species (see Bolger et al. 1997a), such as the Anna's hummingbird and mockingbird, also are designated as early warning indicators because their presence indicates habitat degradation and potential competition with native species vulnerable to edge effects. The grasshopper sparrow is designated a biodiversity indicator because it is associated with structurally diverse grassland habitats, which presumably would support a more diverse species assemblage than a monotypic grassland. It should be kept in mind, however, that these assignments reflect hypothesized relationships based on the best science available, rather than empirically validated relationships. Thus, they are only a starting point for the Adaptive Management Program and would be adjusted as new information becomes available.

TABLE 1-2
CANDIDATE FOCAL SPECIES

Common Name	Vegetation Type(s)	Focal Species Category	Environmental Stressor(s)
Birds			
California Gnatcatcher	Coastal sage scrub	Early warning indicator	Fire, drought, cowbirds
Least Bell's Vireo	Riparian	Early warning and biodiversity indicator	Flood regime, invasive species, mesopredators, over-grazing, noise
Cactus Wren	Coastal sage scrub	Early warning indicator	Fire, mesopredators
Grasshopper Sparrow	Grassland	Biodiversity indicator	Loss of structural habitat diversity, mesopredators, cowbirds
Yellow Warbler	Riparian	Early warning and biodiversity indicator	Flood regime, exotic species, mesopredators, over-grazing
Acorn Woodpecker	Oak woodland	Early warning and biodiversity indicator	Invasive species, low acorn productivity, acorn and nest competitors
Anna's Hummingbird	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Ash-throated Flycatcher	Oak woodland	Biodiversity indicator	Nest competitors
Barn Owl	Grassland, riparian, woodland	Umbrella species	

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TABLE 1-2 CANDIDATE FOCAL SPECIES			
Common Name	**Vegetation Type(s)**	**Focal Species Category**	**Environmental Stressor(s)**
Brown-headed Cowbird	All types (?)	Early warning indicator	Nest parasite of native passerines
California Thrasher	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive
European Starling	Riparian and oak woodland	Early warning indicator	Edge-enhanced species and nest competitor. Indicator of habitat degradation
Great Horned Owl	All types	Umbrella species	
House Finch	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Lark Sparrow	Grassland, oak woodland	Early warning and biodiversity indicator	Edge-reduced species
Northern Mockingbird	All types	Early warning indicator	Edge-enhanced species. Indicator of habitat degradation
Red-tailed Hawk	All types	Umbrella species	
Rufous-crowned Sparrow	Coastal sage scrub	Biodiversity indicator	Edge-reduced species
Snowy Egret	Wetlands	Early warning and biodiversity indicator	Sensitive to human disturbance
Wrentit	Coastal sage scrub, chaparral	Biodiversity indicator	Habitat fragmentation sensitive
Amphibians and Reptiles			
Arroyo Toad	Riparian and wetlands	Early warning indicator	Flood regimes, water quality, invasive species, over-grazing, road kill
Bullfrog	Riparian and wetlands	Early warning indicator	Predator of several native species
Orange-throated Whiptail	Coastal sage scrub, chaparral, woodland	Early warning indicator	Frequent fire, Argentine ants, over-grazing
San Diego Horned Lizard	Coastal sage scrub, chaparral	Early warning and biodiversity indicator	Frequent fire, Argentine ants, over-grazing, collection
Southwestern Pond Turtle	Riparian and wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs, mesopredators, over-grazing, collection
Mammals			
Bobcat	Chaparral, riparian, woodland	Umbrella species	
Coyote	All types	Early warning	Absence from habitat patches indicates potential mesopredator release and loss of native species
Mountain Lion	Chaparral, riparian, woodland	Umbrella species	
Mule Deer	Coastal sage scrub,	Umbrella species	

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TABLE 1-2 CANDIDATE FOCAL SPECIES			
Common Name	**Vegetation Type(s)**	**Focal Species Category**	**Environmental Stressor(s)**
	chaparral, riparian, woodland		
Fish			
Arroyo Chub	Wetland	Early warning and biodiversity indicator	Hydrologic alterations, water quality, predation by bullfrogs and exotic fish, invasive plants
Invertebrates			
Argentine Ant	All types where there is adequate moisture	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives
Imported Fire Ant	All types where there is adequate moisture	Early warning indicator	Edge-enhanced species that displaces native prey and directly kills natives

A summary by focal species types, vegetation community and taxonomic group is provided in *Table 1-3.*

TABLE 18-3 SUMMARY OF CANDIDATE FOCAL SPECIES BY TYPE AND VEGETATION COMMUNITY					
Taxonomic Group	**Vegetation Community**				
	Coastal Sage Scrub	**Chaparral**	**Grassland**	**Riparian and Wetland**	**Oak Woodland**
Birds					
Early Warning	California Gnatcatcher Cactus Wren Anna's Hummingbird House Finch Mockingbird	Anna's Hummingbird House Finch Mockingbird	Anna's Hummingbird House Finch Lark Sparrow Mockingbird	Least Bell's Vireo Yellow Warbler Anna's Hummingbird Brown-headed Cowbird European Starling House Finch Mockingbird Snowy Egret	Acorn Woodpecker Anna's Hummingbird European Starling House Finch Lark Sparrow Mockingbird
Biodiversity	California Thrasher Rufous-crowned Sparrow Wrentit	California Thrasher Wrentit	Grasshopper Sparrow Lark Sparrow	Least Bell's Vireo Yellow Warbler Snowy Egret	Acorn Woodpecker Ash-throated Flycatcher Lark Sparrow
Umbrella	Great Horned Owl	Great Horned Owl	Barn Owl	Barn Owl	Barn Owl

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TABLE 18-3 SUMMARY OF CANDIDATE FOCAL SPECIES BY TYPE AND VEGETATION COMMUNITY					
Taxonomic Group	**Vegetation Community**				
	Coastal Sage Scrub	**Chaparral**	**Grassland**	**Riparian and Wetland**	**Oak Woodland**
	Red-tailed Hawk	Red-tailed Hawk	Great Horned Owl Red-tailed Hawk	Great Horned Owl Red-tailed Hawk	Great Horned Owl Red-tailed Hawk
Amphibians					
Early Warning				Arroyo Toad Bullfrog	
Biodiversity					
Umbrella					
Reptiles					
Early Warning	Orange-throated Whiptail San Diego horned Lizard	Orange-throated Whiptail San Diego horned Lizard		Southwestern Pond Turtle	Orange-throated Whiptail
Biodiversity	San Diego Horned Lizard	San Diego Horned Lizard		Southwestern Pond Turtle	
Umbrella					
Mammals					
Early Warning	Coyote	Coyote	Coyote	Coyote	Coyote
Biodiversity					
Umbrella	Mule deer	Bobcat Mountain Lion Mule Deer		Bobcat Mountain Lion Mule Deer	Bobcat Mountain Lion Mule Deer
Fish					
Early Warning				Arroyo Chub	
Biodiversity				Arroyo Chub	
Umbrella					
Invertebrates					
Early Warning	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant	Argentine Ant Imported Fire Ant
Biodiversity					
Umbrella					
Total					
Early Warning	10	8	7	15	10
Biodiversity	4	4	2	5	3
Umbrella	3	5	3	6	6

Focal species from *Table 1-3* that would also be managed and monitored as Identified Species include:

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- California gnatcatcher
- Cactus wren
- Yellow warbler
- Least Bell's vireo
- Arroyo toad
- Orange-throated whiptail
- San Diego horned lizard
- Southwestern pond turtle
- Arroyo chub

To select the remaining species, one or more of the following criteria were considered applicable:

1. The species fill a unique management and monitoring niche
2. The species poses a substantial direct threat to the structure and function of the RMV Open Space and native species
3. The species is a demonstrated edge-enhanced species.
4. The species is particularly sensitive to environmental stressors (e.g., edge effects).
5. The species can be cost-effectively managed and monitored through standard survey techniques

Based on these selection criteria, of the remaining candidate focal species, the following are recommended as focal species.

Species that fill a unique management and monitoring niche:

- Acorn woodpecker
- Lark sparrow
- Wrentit

Species that are particularly sensitive to environmental stressors:

- Snowy egret
- Rufous-crowned sparrow

Species that are demonstrated edge-enhanced species:

- Anna's hummingbird
- House finch
- Northern mockingbird

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Species that may pose a substantial threat to the RMV Open Space and native species:

- Brown-headed cowbird
- European starling
- Bullfrog
- Argentine ant
- Imported fire ant

Species that can be easily and cost-effectively managed and monitored through standard survey techniques:

- Coyote
- Mountain lion
- Bobcat
- Mule deer
- Red-tailed hawk

Species that appear to be redundant with 28 focal species identified above and thus would not be recommended as focal species are:

- California thrasher
- Ash-throated flycatcher
- Great horned owl
- Barn owl

Table 1-4 summarizes the characteristics of the selected focal species.

TABLE 1-4
SUMMARY OF SELECTED FOCAL SPECIES

Focal Species	Identified Species	Other Focal Species	Focal Species Type		
			Early Warning	Biodiversity	Umbrella
Birds					
Acorn Woodpecker		?	?	?	
Anna's Hummingbird		?	?		
Brown-headed Cowbird		?	?		
Cactus Wren	?		?		
California Gnatcatcher	?		?		
European Starling		?	?		
Grasshopper Sparrow	?			?	
House Finch		?	?		

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Lark Sparrow		?	?	?	
Least Bell's Vireo	?		?	?	
Northern Mockingbird		?	?		
Red-tailed Hawk		?			?
Rufous-crowned Sparrow		?		?	
Snowy Egret		?	?	?	
Wrentit		?		?	
Yellow Warbler	?		?	?	
Amphibians					
Arroyo Toad	?		?		
Bullfrog		?	?		
Reptiles					
Orange-throated Whiptail	?		?		
San Diego Horned Lizard	?		?	?	
Southwestern Pond Turtle	?		?	?	
Mammals					
Bobcat		?			?
Coyote		?	?		
Mountain Lion		?			?
Mule Deer		?			?
Fish					
Arroyo Chub	?		?	?	
Invertebrates					
Argentine Ant		?	?		
Imported Fire Ant		?	?		

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Table 1-5 summarizes the distribution of focal species by taxonomic group and focal species type; i.e., early warning indicator, biodiversity indicator or umbrella species.

TABLE 1-5
DISTRIBUTION OF SELECTED FOCAL SPECIES BY TAXONOMIC GROUP AND FOCAL SPECIES TYPE

	Vegetation Community				
	Coastal Sage Scrub	Chaparral	Grassland	Riparian and Wetland	Oak Woodland
Taxonomic Groups					
Birds	8	5	7	9	7
Amphibians	0	0	0	2	0
Reptiles	2	2	0	1	1
Mammals	2	4	1	4	4
Fish	0	0	0	1	0
Invertebrates	2	2	2	2	2
Focal Species Types					
Early Warning	10	9	7	16	10
Biodiversity	3	2	2	5	2
Umbrella	2	4	2	4	4

Table 1-5 shows that the majority of the selected focal species are early warning species, which is consistent with the focus of the Adaptive Management Program on environmental stressors; i.e., the selection of species was skewed toward those species that are known or strongly suspected to be sensitive to specific stressors.

1.3 Elements Of The RMV Open Space Adaptive Management Program

The Adaptive Management Program provides the technical and institutional framework for monitoring and undertaking management actions necessary or helpful to sustain and facilitate recovery of Identified Species and their habitats over the long-term, while adapting management actions to new information and changing habitat conditions.

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The USFWS provides a general definition of adaptive management in the "five-point policy" as a final addendum to the HCP Handbook.

> *Adaptive management is an integrated method for addressing uncertainty in natural resource management (Holling 1978, Walters 1986, Gundersen 1999). It also refers to a structured process for learning by doing. … Therefore, we are defining adaptive management broadly as a method for examining alternative strategies for meeting measurable biological goals and objectives, and then, if necessary, adjusting future conservation management actions according to what is learned.*

As part of the "five-point policy" the USFWS distinguishes between two types of monitoring:

> *(1) Compliance monitoring, which monitors the permittee's implementation of the requirements of the HCP, permit, and/or IA; and (2) effects and effectiveness monitoring, which investigates the impacts of the authorized take and the operating conservation program implemented to verify progress toward the biological goals and objectives. A monitoring program should incorporate both types in order to examine effectively all aspects of an HCP, and ensure the ultimate success of the HCP.*

The USFWS goes on to say:

> *Monitoring measures should be commensurate with the scope and duration of the project and the biological significance of its effects. The monitoring program should be flexible so that it can be modified, if necessary, based on the need for additional information.*
>
> (Addendum to the HCP Handbook, USFWS, May 2000)

"Compliance monitoring" includes specific actions required by the Section 10(a) permit and/or the IA, such as monitoring the Incidental Take and conservation of acreage, types and locations of habitat, Incidental Take and conservation of Identified Species, and implementation of mitigation requirements. Compliance monitoring ensures that the permittee is implementing the NCPP/HCP according to the terms and conditions of the IA.

The "effects and effectiveness monitoring" referred to in the USFWS Addendum is an important part of the Adaptive Management Program that ensures that the overall long-term goals and objectives of the NCCP/HCP are being met and that impacts subject to the requirements of CEQA are addressed. Effects and effectiveness monitoring relate both to permit compliance monitoring and long-term viability and function of the Habitat Reserve. Needs revising to fit GPA approach

1.3.1 Adaptive Management Program

This section describes how the Adaptive Management Program would address the three previously stated broad goals of the program:

- Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.
- Restore or enhance the quality of degraded vegetation communities and other habitat types.
- Maintain and restore biotic and abiotic natural processes, at all identified scales, for the RMV Open Space.

The Adaptive Management Program includes two main types of management activities to address these three broad goals:

1. Passive management
2. Active management
   (a) Routine management
   (b) Experimental management

"Passive management" does not involve direct and active manipulation of resources. If through the 5-year vegetation assessment and annual monitoring of the sample plots, areas in the RMV Open Space are determined to be functioning well without intervention, no management actions would be taken.

"Active management" would be the second tier of management. In the case where routine monitoring reveals a declining trend in coastal sage scrub amount or quality in an area, either as a result of natural or human-caused disturbances, direct management actions may be warranted. The key issue in implementing active management is what is the threshold or trigger for a direct management action? In some cases, the need for direct management is obvious, such as an area heavily infested with exotic species or exhibiting extreme erosion. However, in most cases the decline in habitat value is subtle or insidious and cumulative, such that it often is not easy to detect the change until its too late to reverse the trend. The monitoring program would need to be sensitive to early warning signs that an adverse trend is occurring and that active management is needed. A key to the adaptive management program is collecting the appropriate data for teasing out natural habitat oscillations from stressor-induced negative trends in habitat quality such that warning signs can be identified.

Active management is further divided into "routine management" and "experimental management."

"Routine management" includes management actions that have been identified as necessary components of the Adaptive Management Program based on known environmental stressors. For example, brown-headed cowbird and bullfrog controls would be implemented as a pre-defined, standard management action because of the known adverse effects of these exotic species on native species.

Experimental management is a subset of active management and is comprised of two elements:

1. *A priori* (pre-defined) management experiments that inform the management of the overall Habitat Reserve; and

2. Opportunistic or *ad hoc* (after the fact) experimental management actions that are implemented in response to a natural or human-caused disturbance event that provide an opportunity for applying different management treatments.

"*A priori*" management experiments may be conducted within the RMV Open Space, in another area within the South Coast Ecoregion with comparable ecological conditions, or within a controlled laboratory setting. It is anticipated that ongoing management experiments may be conducted in the RMV Open Space by independent scientists not directly affiliated with the management of the RMV Open Space. However, independent studies must be authorized by RMV. Such studies also must be coordinated and consistent with the ongoing adaptive management goals and objectives of the RMV Open Space.

"Opportunistic or *ad hoc*" experimental management actions in response to natural or human-caused disturbances provide a "natural laboratory" to conduct management and are a bridge between management experiments conducted under highly controlled conditions and management in the real world. As an example, the conceptual stressor model for coastal sage scrub considers the interactive effects of fire and grazing (Figure 3). This conceptual model leads to the experimental management hypotheses that were listed previously. For example, based on this model, one could hypothesize that an established (late successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn species diversity than a same-aged stand that has been grazed. If a wildfire burns an established stand of coastal sage scrub, part of which has been grazed and part of which has not, a component of the adaptive management of these areas would be to establish study plots in the grazed and ungrazed burn areas and monitor post-burn species diversity during the recovery of the study plots. If the grazed plots show lower post-burn diversity the hypothesis has been confirmed. As a follow-up study to this finding, an experimental management action could be to enhance some grazed areas post-burn through seeding while other burned control plots are not seeded. If the seeded plots show greater long-term diversity than the unseeded plots, the practice of seeding grazed areas of coastal sage scrub post-burn would become a standard management action to "jump start" the recovery of the site.

The distinction between "routine management" and "experimental management" as described here is sometimes blurred. In some cases management actions may be clear or obvious and thus are implemented as routine management; experimental manipulation would not be needed. In other cases, there may be no clear or obvious management action and experimental testing of several management methods may needed to determine the most effective alternative. However, whatever form of management action is taken (i.e., routine or experimental), monitoring the results of the action would be important to determine whether the action was effective and how, if necessary, it could be modified to make it more effective. For example, a routine management action that was thought to be effective may be found to not work very well, thus triggering the need to conduct experimental management.

Thus, the Adaptive Management Program cannot be designed to anticipate all the possible scenarios or opportunities for adaptive management, but rather is the framework for employing the adaptive management strategies.

The proposed management approach to the three broad goals of the program are described in detail below.

a. Ensure the Persistence of a Native-dominated Vegetation Mosaic in the RMV Open Space.

The Adaptive Management Program would achieve this goal through periodic management and monitoring of the five major native-dominated vegetation communities in the Habitat Reserve: coastal sage scrub, chaparral, native grassland, riparian/wetlands, and woodlands. The general approach to monitoring and managing native-dominated vegetation communities is described in this section and the detailed programmatic approach for specific communities and associated focal species is described below in *Section 1.4.*

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What specifically is monitored and why it is being monitored would be tied to hypotheses generated by the conceptual environmental stressors models described in *Section 8.2.1*. As stated by the Science Advisors,

> *The biological monitoring program should be developed specifically to measure and evaluate the effects of management activities. It should identify and measure variables that permit iterative refinement of the management program.*
> (Science Advisors, Principles for Adaptive Management, pg. 4)

As discussed in *Section 1.2.1,* conceptual stressor models are useful tools for providing a framework and focus for management actions. They provide a synthesis of current scientific understanding, field observation, and professional judgement. Models may range from relatively simple unidirectional models to extremely complex, interactive and quantitative ecosystem models. The conceptual models recommended for the Adaptive Management Program are qualitative, relatively simple and pragmatic top down "environmental stressor" models that reflect possible broad cause-and-effect relationships between natural and human-induced stressors and effects on ecosystem processes, vegetation communities and species. For example, short fire intervals in coastal sage scrub promotes the proliferation of non-native invasive species.

The monitoring program is structured such that the monitoring information allows hypotheses generated by the conceptual models to be tested and refined. In some cases the monitoring would be routine and passive (as described below). In other cases, the monitoring would be tied specifically to ongoing management programs (e.g., fire, grazing, exotics control, etc.). The various management programs would be integrated with the conceptual environmental stressor models so that "field experiments" can be conducted in a more rigorous and systematic scientific manner; typically on relatively small experimental plots where a defined variable or set of variables (i.e., the independent variables) can be manipulated, while controlling other extraneous variables. In addition, large-scale natural disturbances (e.g., a 10-year flood) create "natural field laboratories" for opportunistically conducting studies on both a local habitat and landscape level and allow managers and scientists to study processes that cannot be completely understood working at a small scale on experimental plots with a limited set of independent variables.

The Adaptive Management Program is comprised of four steps to ensure the persistence of a native-dominated vegetation mosaic in the planning area: **(1)** preparation of conceptual stressor models and conceptual management plans for vegetation communities; **(2)** periodic assessment of the status of the vegetation communities; **(3)** management of the vegetation communities; and **(4)** evaluation of the effect of the management actions.

- This chapter includes draft conceptual stressor models for the five major vegetation communities in the RMV Open Space (Figures 3 though 7). These conceptual models are based on the best scientific information available and depict known and hypothesized relationships between environmental stressors and vegetation community responses. They also help to identify uncertainties and knowledge gaps in our understanding of these complex relationships. In conjunction with the conceptual stressor models, conceptual management plans keyed to these stressors have been prepared to address fire, grazing, habitat restoration, invasive species and water quality. These management plans reflect the most current understanding of how a particular vegetation community functions and responds to environmental stressors and management actions. The information gained through implementation of the management plans would be used to modify and refine the conceptual stressor models, which, in turn, would be used to generate new adaptive management actions and hypotheses.

- An assessment of vegetation communities throughout the entire RMV Open Space would be conducted at a minimum of five (5) year intervals. These assessments would consist of: **(1)** aerial photograph interpretation (i.e., remote sensing) of vegetation conditions throughout the RMV Open Space to detect any coarse, landscape changes in the vegetation mosaic (e.g., are large areas of coastal sage scrub converting to grasslands?); and **(2)** permanent sample transects established using GPS within representative plots within the vegetation mosaic. For example, several plots within coastal sage scrub, chaparral, native grassland, oak woodland, etc. that represent the physiographic gradients within the RMV Open Space (elevation, slope, distance from coast, etc.) would be established. The precise number, distribution and site-specific features of the sample plots would need to be established and would be based on the requirements for cost-effective, but statistically valid sample regimes (i.e., sampling methods that are feasible and practical and achieve acceptable statistical power for detecting trends [in statistics power refers to the probability of actually detecting a trend that exists, or in the parlance of statistics, it is the probability of correctly concluding that the null hypothesis that no trend exists is wrong]).

- Based on the results of the vegetation monitoring, two courses of action can be taken:

    1. Passive or "hands-off" management whereby nature is allowed to take its course. Because the southern California ecosystem presumably is adapted to natural

events such as drought cycles and periodic wildfires (e.g., Keeley 1986, 1992; Keeley and Fotheringham 2001a,b; Minnich 2001), passive management would be the default initial approach to such natural, periodic perturbances or disturbances of vegetation communities. In most cases, vegetation changes over time following the natural disturbance would be expected to reflect the natural successional stages of the adaptive ecosystem (e.g., flooding may cause destruction of riparian forest, that over time comes back as mule fat scrub, southern willow scrub, and ultimately riparian forest as the climax community). Attempting to actively manage a natural successional system would be wasteful of valuable management resources and could result in more harm than good if the natural successional trajectory of the system is altered. However, in the case of a severe wildfire (or a too frequent series of wildfires) or major flood event, more frequent monitoring than the standard 5-year interval may be warranted on a case-by-case basis to ensure that irreversible adverse changes in the vegetation community do not occur (e.g., a state-transition from coastal sage scrub to grassland as a result of too frequent fire or invasion of a recovering riparian area by giant reed).

2. Active or "hands on" management whereby direct active manipulation is required to maintain net habitat value of the vegetation community or the ecosystem at a broader scale. Active management would occur where, based on the monitoring program, it is clear that a vegetation community is becoming degraded and no longer responding naturally (e.g., converting irreversibly to another vegetation type or being overrun by invasive species). Depending on the cause of the impact, active management can include a variety of actions, such as specific fire management actions (e.g., prescribed burns or suppression), grazing management (e.g., increased, reduced or timed grazing), exotics control (e.g., mechanical or hand-labor weeding) and restoration (e.g., seeding and planting of native species).

- Evaluation of both routine monitoring and passive and active management actions would be conducted to determine whether the monitoring regime is adequate and whether management actions had the desired outcome. What is learned from the monitoring results and management action would be used to improve the management and monitoring program. Evaluating the monitoring program and the effects of management actions is a crucial stage of the overall Adaptive Management Program because it completes the information feedback loop necessary to reassess the conceptual model, make adjustments, generate new or revised hypotheses for testing, and revise the management actions based on the new or revised hypotheses (i.e., it is the definitive step of adaptive management). Over time, the knowledge base and the management actions would be systematically improved and better able to achieve the overall conservation and adaptive management goals of the RMV Open Space.

b. Restore the Quality of Degraded Vegetation Communities and Other Habitat Types.

Habitat restoration is broadly defined as the process of intentionally altering a degraded habitat area or creating new habitat to re-establish a defined pre-existing habitat or ecosystem or enhance function of a degraded habitat or ecosystem. The goal of restoration is to emulate the structure, function, diversity and dynamics of the habitat or ecosystem. This goal generally would be achieved through implementation of several coordinated/integrated restoration plans and related management plans, including:

- A coastal sage scrub and valley needlegrass grassland (CSS/VGL) restoration plan;
- A wetland and riparian restoration plan focusing initially on Gobernadora and San Juan creeks.
- A Fire Management Plan
- A Grazing Management Plan
- An Invasive Species Control Plan

As the Adaptive Management Program progresses, other habitats may be identified for restoration, such as oak woodland and chaparral.

The above plans generally would be guided by the following policies:

- Restoration will be defined to include all activities and measures in this chapter that are designed to maintain and improve net habitat value over the long-term, including, but not limited to the control of invasive and exotic species, reseeding or planting with native species, fire management, grazing and other agricultural management, and controlling public access. Restoration permitted within the RMV Open Space would include the full range of habitats occurring within the RMV Open Space.

- Restoration will be important to the long-term viability and function of the RMV Open Space and would be implemented to contribute to overall biological diversity and productivity in the RMV Open Space in a manner consistent with the broad NCCP Planning Guidelines and the more detailed Draft NCCP Guidelines.

- Phased implementation of the plans will reflect the available funding, locations and kinds of species and habitat impacts, and initial priorities.

- RMV would target areas for restoration and set revised priorities over time. RMV would review restoration priorities for consistency with the overall goals and objectives of the Adaptive Management Program. This review would consider the restoration priorities in the context of existing and changing conditions (e.g., habitat or species trends) in the RMV Open Space, as well as the availability of funding for the restoration activity.

- The restoration activities would be implemented in a manner that facilitates the Adaptive Management Approach. These projects would be planned to yield systematic data that can be used to test experimental management hypotheses to the extent possible, including establishing adequate experimental and control plots, different treatment regimes, rigorous data collection, etc. RMV should confer with outside scientists to the extent necessary to ensure that scientifically-justified and sound methods are used.

- Enhancement and restoration activities would be monitored as part of the Adaptive Management Program to evaluate effect, effectiveness and progress. Ongoing monitoring would also identify new enhancement and restoration opportunities/priorities within the RMV Open Space.

c. Maintain and Restore Abiotic Natural Processes, at All Identified Scales, Capable of Supporting the Habitat Reserve.

The Science Advisors fashioned a new tenet of reserve design – Tenet 7 – to focus on maintaining ecosystem processes and structure, with a particular emphasis on fire and on hydrologic/erosional processes. The objectives of the Adaptive Management Program for fire were listed in above in *Section 1.2.2a.1.* For hydrologic/erosional processes, the objectives of the Adaptive Management Program were listed in *Section 1.2.2.a.2.*

1.4 Major Vegetation Communities and Associated Species

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This section describes the programmatic approach for the adaptive management of major vegetation communities and associated species. The five major vegetation communities addressed by the Adaptive Management Program are:

- Coastal sage scrub
- Chaparral
- Grassland
- Riparian/wetland
- Woodlands

Adaptive management of the above major vegetation communities, and their function as habitat for species, is an essential element to receiving regulatory coverage for the Identified Species. As discussed in detail in *Section 1.2*, adaptive management would address Identified Species' habitat needs as they evolve over time in response to natural and human-induced environmental stressors. An example of adaptive management for the habitat needs of specific species is the proposed invasive species control program directed toward benefiting specific aquatic species such as the arroyo toad and the least Bell's vireo within the mainstem channel of San Juan Creek.

Consistent with the concept of natural communities planning, however, vegetation communities would also be managed as broad scale habitat systems functioning within watershed level hydrologic and geomorphic influences and other "process" influences such as fire regimes. Restoration programs such as those proposed for native grasslands and management programs such as grazing management and fire management would be undertaken within the context of goals and objectives for habitat systems at a sub-basin, watershed and planning area scale.

Species Monitoring

Species monitoring would be provided for Identified Species either through monitoring directed at individual species or for broader groupings of species that can be effectively monitored collectively at a habitat scale. As discussed in *Section 1.2.2.c*, several Identified Species also may be valuable "focal species" for the purposes of applying management actions at the broad scale of habitat systems. However, not all Identified Species are useful as focal species for management purposes; for instance, some Identified Species may be too rare or difficult to monitor or an Identified Species may simply not be a good indicator of changes in large-scale habitat systems or of the various factors that influence habitats (see Table 1-1 for selection criteria to identify potential focal species). Likewise, the Identified Species that are suitable as focal species may not adequately cover all the management issues. Consequently, it will be important to assess the characteristics of other focal species that are not Identified Species, but that can be used as additional focal species for RMV Open Space management purposes. Taken together, those Identified Species that are good focal species and the additional focal species listed in Table 1-4 (or other species selected over time) would serve as the initial suite of focal species for management and monitoring purposes at the broad "habitat systems" scale. For purposes of adaptive management of major vegetation communities, "species monitoring" thus may be grouped as follows:

- *Identified Species Monitoring* – the monitoring of species "identified" for regulatory coverage in order to: (a) assess and gain a greater understanding of population trends and other conditions affecting Identified Species; and (b) provide feedback from specific habitat restoration or management initiatives into the broader, habitat-scale management of the RMV Open Space System.

- *Focal Species Monitoring* – the monitoring of those Identified Species that serve as good focal species for habitat-scale management of the RMV Open Space and other focal species that serve as surrogates for the same purposes.

Focal species monitoring would provide a vehicle to address the management needs of several Identified Species. Other Identified Species with very site-specific habitat characteristics or specific management needs (e.g., fairy shrimp) will be addressed through individually tailored management and monitoring efforts and are addressed in *Section 1.5.*

Vegetation Communities Monitoring

Management and monitoring of vegetation communities is focused on understanding vegetation changes and the influences of natural and human-induced factors on the functioning of habitat systems over time. Vegetation transect surveys, monitoring of hydrologic regimes such as groundwater, and tracking wildlife movement are examples of monitoring tools available for assessing physical changes to habitat systems. Such measures would be coupled with the different types of species monitoring summarized above to assess enhancement/restoration undertakings, adaptive management experiments and large-scale habitat management decision-making. Monitoring would thus emphasize measuring physical conditions so that management can be adapted over time. Basic research would be encouraged through cooperation with research scientists, but the fundamental emphasis of the Adaptive Management Program would be on generating information that can be used for adaptive management purposes within the RMV Open Space. The various techniques potentially available for assessing physical changes to habitat systems over time are reviewed in conjunction with the topical review of each of the five vegetation communities in sections *1.4.3* through *1.5.7*

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The following section applies the environmental stressor approach to prioritizing immediate and near-term management and monitoring actions in the RMV Open Space.

1.4.1 Prioritization of Vegetation Communities for Management and Monitoring

Prioritization of management and monitoring actions is crucial to the success of the Adaptive Management Program. The Adaptive Management Program described herein in provides a comprehensive "tool box" for data acquisition, analytic methods, and adaptive management actions that can be used over time to inform the long-term management of the Habitat Reserve. However, given the stressor focus of the Adaptive Management Program, only those tools appropriate to a particular management action would be employed at that point in time. With diverse vegetation communities and widely varying existing conditions, an objective method to rank monitoring/management needs of the RMV Open Space was developed to help prioritize and guide management actions. The goal of the ranking outcome, therefore, is to develop a method that allows the reserve owner/managers to allocate available management resources for the greatest net benefit to the RMV Open Space. This approach also provides a framework for establishing an initial set of management and monitoring priorities. It is anticipated that as monitoring and adaptive management proceeds, and as more empirical information is incorporated, these initial rankings would be revised.

Given the stressor approach of the Adaptive Management Program and finite management resources, it is important to identify those vegetation communities that should be the focus of initial adaptive management activities. For this reason, the conceptual stressor models were used to rank and prioritize the vegetation communities for the initial management and monitoring efforts. For example, a vegetation community that has high ecological importance for the RMV Open Space and is highly sensitive to stressors would have a high priority ranking. Alternatively, a community may have high ecological value, but is not as sensitive to existing stressors in the RMV Open Space. This community would have a lower management and monitoring priority.

The rankings were applied at the level of vegetation communities to be consistent with the community-level focus of the Adaptive Management Program. The rankings are based on two key indices: (1) the **Importance Value** of the vegetation community; and (2) the **Index of Disturbance** of the vegetation community. **Importance Value** generally is defined here as the sum of *species richness* and *species uniqueness* of a particular vegetation community. Rather than enumerating the total or absolute species richness of a particular community (i.e., alpha diversity), which both in theory and practice is difficult, species richness as used here is based on the number of Group 2, Group 3 and Umbrella Species defined by the Science Advisors, as well a few additional species since identified as potential conservation issues (e.g., red racer), that use the major vegetation communities in the subregion. Using this set of species as a surrogate for species richness is justified in this case because the purpose of the Importance Value index is to rank management priorities. For example, 36 of 70 wildlife species on this list use coastal sage scrub, while 19 use oak woodland, so coastal sage scrub would be considered to have higher species richness than oak woodland. *Species uniqueness* is simply the number of species from the Group 2, Group 3, and Umbrella Species list that exclusively (or almost exclusively) occur in a single vegetation community. For example, the California gnatcatcher is considered an "obligate" coastal sage scrub species while the least Bell's vireo is an obligate riparian habitat species. Although both species may occasionally use other vegetation communities, their occurrence depends on the presence of the obligate habitat.

The **Index of Disturbance** reflects the vulnerability of different vegetation communities to various human-caused and natural environmental stressors. The models for the environmental stressor-community responses for the five major vegetation communities are depicted in Figures 3-7, respectively. For example, fire is a key stressor on coastal sage scrub; frequent fire can result in type-conversion of coastal sage scrub to non-native grassland (Figure 5). Likewise, altered hydrology is a stressor on riparian systems; too much or too little water can significantly alter the composition, structure and function of a riparian system. The Index of Disturbance of a vegetation community is a composite index score for the effects of stressors that is generated by summing the individual index scores of various stressors on the vegetation community.

In a next step, **Importance Value** and **Index of Disturbance** are multiplied to yield a **Vegetation Community Ranking**, or **R**. It is important to combine these two indices because a vegetation community that scores high in Importance Value but low in Index of Disturbance may not need much management. Likewise, a vegetation community that scores high in Index of Disturbance, but low in Importance Value would not be a high management priority. Vegetation communities that have both a high Importance Value and a high Index of Disturbance would receive the highest management priority ranking.

The methods used to develop the Importance Value, Index of Disturbance and Vegetation Community Rankings are described below, followed by the results of the analysis.

Selection and Community Assignment of Species

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The *species richness* and *species uniqueness* variables were parameterized by using the Science Advisors' list of Group 2, Group 3 and Umbrella Species, as well as a few additional species that since have been identified as potential conservation issues (e.g., red racer). These species were used because they include many of the species that the original NCCP Stakeholder Working Group and the wildlife agencies were considering for conservation. They include listed species, state Species of Special Concern, state Protected Species, U.S. Forest Service Species, USFWS Species of Management Concern, Migratory Nongame Birds of Management Concern, and non-sensitive species that may provide "focal species" value. The Science Advisors Group 1 species were not included because the overall Conservation Strategy, including adaptive management activities, would have little or no impact on these species. Thus, including these species potentially could skew the ranking results toward communities supporting species that would be unaffected by management actions, and, conversely, away from communities that support species that could benefit from management.

The original Science Advisors list of Group 2 and Group 3 species included species that do not use, or do not depend on, at least one of the five major vegetation communities: coastal sage scrub, chaparral, grassland, riparian/wetland, and oak woodland. Open water species such as American white pelican, black skimmer and double-crested cormorant thus were deleted from the list. Likewise, species that have narrow microhabitat requirements, such as fairy shrimp, were deleted because their conservation and management would be site-specific rather than at a vegetation community level. Analyses also were run with and without sensitive plants, which in some cases can be addressed at a community level, while others may require site-species conservation and management. The lists of species selected for the analysis and their vegetation community associations are shown in *Table 1-6*.

TABLE 1-6
SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES

Common Name	Coastal Sage Scrub	Chaparral	Grassland	Riparian/ Wetland	Oak Woodland
Barn Owl			?	?	?
Bell's Sage Sparrow	?	?			
Bewick's Wren	?	?		?	?
Burrowing Owl	?		?		
Cactus Wren	?				
California Gnatcatcher	?				
California Horned Lark			?		?

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TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
California Thrasher	?	?			
Cooper's Hawk				?	?
Ferruginous Hawk			?		
Golden Eagle	?	?	?		
Grasshopper Sparrow			?		
Lark Sparrow			?		?
Lawrence's Goldfinch	?	?			
Least Bell's Vireo				?	
Loggerhead Shrike	?	?	?		
Long-eared Owl				?	?
Merlin			?		
Mountain Plover			?		
Northern Harrier	?		?	?	
Pacific Slope Flycatcher		?			?
Prairie Falcon			?		
Red-breasted Sapsucker					?
Red-shouldered Hawk				?	?
Rough-legged Hawk			?		
Rufous-crowned Sparrow	?				
Sharp-shinned Hawk	?		?		?
Short-eared Owl			?		
Southwestern Willow Flycatcher				?	
Swainson's Hawk			?		
Tricolored Blackbird			?	?	
Western Yellow-billed Cckoo				?	
White-tailed Kte	?		?	?	?
Yellow-breasted Cat				?	
Yellow Warbler				?	
Arboreal Salamander		?			?
Arroyo Toad				?	
California Glossy Snake	?	?	?		

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TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
Coast patch-nosed Snake	?	?	?		
Coast Range Newt	?	?			
Coastal Rosy Boa	?	?			
Coastal Western Whiptail	?				
Northern Red-diamond Rattlesnake	?	?	?		
Orange-throated Whiptail	?	?			?
Red Racer (coachwhip)	?	?	?		
San Diego Banded Gecko	?				
San Diego Horned Lizard	?	?			
San Diego Mountain Kingsnake		?			
San Diego Ringneck Snake		?		?	?
Silvery Legless Lizard	?	?		?	
Southwestern Pond Turtle				?	
Two-striped Garter Snake				?	
Western Skink	?	?	?		
Western Spadefoot Toad	?	?	?		
American Badger	?		?		
Dulzura California Pocket Mouse	?	?			
Gray Fox	?	?		?	
Long-legged Myotis				?	?
Mountain Lion	?	?		?	?
Northwestern San Diego Pocket Mouse	?				
Pallid Bat	?	?			?
San Diego Black-tailed Jackrabbit	?	?	?		
San Diego Desert Woodrat	?				
Southern Grasshopper Mouse	?		?		
Southern Mule Deer	?	?			?
Spotted Bat				?	
Townsend's Big-eared Bat			?		?
Arroyo Chub				?	
Threespine Stickleback				?	

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TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
Catalina Mariposa Lily	?	?	?		
Chaparral Beargrass	?	?			
Coulter's Matalija Poppy	?	?			
Coulter's Saltbush			?		
Curving Tarweed	?	?	?		?
Heart-leaved Pitcher Sage		?			
Many-stemmed Dudleya	?	?	?		
Mud Nama				?	
Ocellated Humboldt Lily					?
Palmer's Grapplinghook	?		?		
Parish' Saltbush			?		
Parry's Tetracoccus	?	?			
Prostrate Spineflower	?	?	?		
Rayless Ragwort	?				?
Salt Spring Checkerbloom				?	
San Miguel Savory		?			?
Southern Tarplant			?		
Summer-holly		?			
Thread-leaved Brodiaea	?	?	?	?	
Western Dichondra	?	?			
Wildlife and Plants Combined					
Species Richness	**49**	**41**	**38**	**27**	**23**
Relative Species Richness	**0.27**	**0.23**	**0.21**	**0.15**	**0.13**
Species Uniqueness	**6**	**3**	**11**	**13**	**2**
Relative Species Uniqueness	**0.17**	**0.09**	**0.31**	**0.37**	**0.06**
Importance Value	**0.44**	**0.32**	**0.52**	**0.52**	**0.19**
Wildlife Only					
Species Richness	**36**	**27**	**28**	**24**	**19**

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TABLE 1-6 SPECIES RICHNESS, UNIQUENESS AND IMPORTANCE VALUE FOR MAJOR VEGETATION COMMUNITIES					
Common Name	**Coastal Sage Scrub**	**Chaparral**	**Grassland**	**Riparian/ Wetland**	**Oak Woodland**
Relative Species Richness	**0.27**	**0.20**	**0.21**	**0.18**	**0.14**
Species Uniqueness	**6**	**1**	**8**	**11**	**1**
Relative Species Uniqueness	**0.22**	**0.04**	**0.30**	**0.41**	**0.04**
Importance Value	**0.49**	**0.24**	**0.51**	**0.59**	**0.18**

Species Richness and Uniqueness Indices

Species richness for a particular vegetation community was calculated by summing the number of species that use that community. Assigning species' use of vegetation communities is based on the California Wildlife Habitat Relationships System (WHR) (Zeiner et al. 1990), as well as other scientific literature and local biological expertise. Species richness in vegetation community type j (s_j , where j = 1, …, 5) is simply expressed as:

$$s_j = \sum_{1}^{S} x_i$$

Where $x_i = 1$ if species i occurs in vegetation community type j, and $x_i = 0$ otherwise, and S is the number of unique species expected to occur across all five vegetation community types.

Based on the species richness value, a relative species richness index was calculated by dividing the species richness value for each vegetation community by the total species richness value summed across the five vegetation communities. Relative species richness rs_j of vegetation community j can be expressed as:

$$rs_j = \frac{s_j}{S}$$

The relative species richness index indicates the extent to which a single vegetation community represents the richness of all five vegetation communities. Note that

$$\sum_{1}^{S} rs_j = 1.0$$

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Species uniqueness for a particular vegetation community was calculated by summing the number of species that "exclusively" use that community. Because virtually all of the species on the list sometimes use other vegetation communities at least opportunistically some time in their life cycle (e.g., gnatcatchers dispersing through riparian), exclusivity of use is operationally defined here as a vegetation community that is necessary for the presence of the species. For example, California gnatcatchers require coastal sage scrub; therefore coastal sage scrub is a unique vegetation community for this species. The loss of coastal sage scrub equates to the loss of California gnatcatchers. Unique species richness of vegetation community j (us_j) can be expressed as:

$$us_j = \sum_{1}^{S} x_i$$

Where x_i = 1 if species i occurs **only** in vegetation community type j, and x_i = 0 otherwise, and S is the number of unique species expected to occur across all five vegetation communities.

Relative species uniqueness of a vegetation community can be expressed as:

$$rus_j = \frac{us_j}{S}$$

Relative species uniqueness measures the proportion of the total species richness represented by vegetation community j **alone**. If this community type were lost from the landscape, the species that contribute to rus_j would be missing. Note that

$$\sum_{1}^{S} rus_j = 1.0$$

Importance Value for vegetation community j (I_j) is simply the sum of the species richness and species uniqueness values for that vegetation community, expressed as:

$$I_j = rs_j + rus_j$$

It should be noted that I, as calculated here, gives equal weighting to species richness and species uniqueness, and thus they are simply additive. Different weightings could be given to these two variables if one was considered relatively more important than the other.

Index of Disturbance

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Six general environmental stressors were used to calculate the **Index of Disturbance**: too frequent/too infrequent fire, over-grazing, exotics, altered hydrology, altered geomorphologic processes, and drought. These six stressors where chosen based on their demonstrated or hypothesized impacts on one or more of the five vegetation communities and as illustrated in the environmental stressor models for each community (Figures 3-7).

For each environmental stressor/community response combination (e.g., fire/coastal sage scrub), a scale value ranging from 1 to 5 was assigned to the combination, using the following definitions:

1 = not a stressor or a very low stressor
2 = low stressor
3 = moderate stressor
4 = high stressor
5 = very high stressor

Because the purpose of the analysis is to rank the relative importance of management and monitoring of the six vegetation communities, the value assigned to each stressor/community combination primarily reflects the relative impact of the stressor on a vegetation community compared to another community. For example, as shown in Table 1-7, hydrologic stressors such as dewatering have a relatively greater impact on riparian systems (rated 5) than upland systems such as coastal sage scrub or grassland (rated 1's). Coarse-grain rankings of the stressor impacts in most cases are fairly straightforward, but, for example, whether fire is a "high" stressor versus a "very high" stressor on chaparral is somewhat subjective. In this case chaparral was assigned a "high" rating (4), while coastal sage scrub was assigned a "very high" rating (5), because coastal sage scrub is more likely than chaparral to type-convert to grassland with frequent, short-interval fires. In any case, this analysis reflects a first attempt to quantify the stressors and rank vegetation communities and is subject to revision based on additional information.[3]

As shown in Table 1-7, each raw score was converted to an index score using the following formula:

$$(x_s - x_{min})/(x_{max} - x_{min})$$

[3] A more fine-grained Index of Disturbance can be calculated using several variables of disturbance, including frequency, extent, magnitude, selectivity, and variability of the stressor. Values for each of these variables would be assigned to each stressor to generate a composite score for the stressor. This method would allow a more precise estimate of the absolute impact of the stressor, but requires substantial information to generate the value assigned to each variable. As new information becomes available through the Adaptive Management Program or the scientific literature, the Index of Disturbance may be refined.

where

x_s = the value for the stressor/vegetation community combination
x_{min} = the minimum value for the rating scale (1), and
x_{max} = maximum value for the rating scale (5).

The composite Index of Disturbance (ID) score is the sum of the individual index scores, or

$$ID = ?\ ((x_s - x_{min})/(x_{max} - x_{min}))$$

as shown in *Table 1-7*.

Vegetation Community Ranking

The **Vegetation Community Ranking** score (R) was calculated by taking the product of the IV and the ID, expressed as

$$R = (IV)(ID)$$

The R values are shown in *Tables 8-8a* (including plants) and *8-8b* (excluding plants).

Table 1-6 presents the results of species richness and species uniqueness analyses for both wildlife and plant species combined and for wildlife species alone. Including both wildlife and plants, coastal sage scrub has the highest relative species richness (0.27) and oak woodland has the lowest relative species richness (0.13). In contrast, riparian/wetland has the highest relative species uniqueness (0.37), with 13 species only occurring in riparian/wetland; compared to oak woodland which has only two species unique to the community and a score of 0.06. Summing the relative species richness and species uniqueness indices results in a ranking of Importance Value (IV) as follows:

1. Riparian/wetland and Grassland (tie)
3. Coastal sage scrub
4. Chaparral
5. Oak woodland

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TABLE 1-7
INDEX OF DISTURBANCE FOR MAJOR VEGETATION COMMUNITIES

	Coastal Sage Scrub		Chaparral		Grassland		Riparian/Wetland		Oak Woodland	
Stressor	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**	**Raw Score**	**Index Score**
Too Frequent/ Too Infrequent Fire	5	1.00	4	0.75	2	0.25	4	0.75	4	0.75
Over-grazing	3	0.50	2	0.25	4	0.75	2	0.25	4	0.75
Exotics	4	0.75	2	0.25	5	1.00	5	1.00	4	0.75
Altered Hydrology	1	0.00	1	0.00	1	0.00	5	1.00	5	1.00
Altered Geomorphological Processes	1	0.00	1	0.00	3	0.50	5	1.00	1	0.00
Drought	3	0.50	3	0.50	2	0.25	5	1.00	4	0.75
Index of Disturbance		**2.75**		**1.75**		**2.75**		**5.00**		**4.00**

TABLE 1-8a
VEGETATION COMMUNITY RANKINGS WITH PLANTS

Index	Coastal Sage Scrub	Chaparral	Grassland	Riparian/Wetland	Oak Woodland
Importance Value	0.44	0.32	0.52	0.52	0.19
Index of Disturbance	2.75	1.75	2.75	5.00	4.00
Ranking Score	**1.21**	**0.56**	**1.43**	**2.60**	**0.76**

TABLE 1-8b
VEGETATION COMMUNITY RANKINGS EXCLUDING PLANTS

Index	Coastal Sage Scrub	Chaparral	Grassland	Riparian/Wetland	Oak Woodland
Importance Value	0.49	0.24	0.51	0.59	0.18
Index of Disturbance	2.75	1.75	2.75	5.00	4.00
Ranking Score	**1.35**	**0.42**	**1.40**	**2.95**	**0.72**

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The tie between grassland and riparian/wetland for IV may seem counterintuitive, but the species list includes several raptors that depend on grassland foraging habitat. These raptors are considered highly sensitive by the resource agencies and conservation groups (e.g., Audubon), hence their relatively heavy weighting on the richness and uniqueness indices. Grasslands also score relatively high in uniqueness because several plants only occur in grassland areas, such as the saltbushes and southern tarplant.

Table 1-6 also shows the same analysis for wildlife species only. The relative IV's of the vegetation communities generally remain the same, but with the exclusion of plants, grassland drops to the number 2 ranking behind riparian/wetland, which has a substantially higher relative IV when only considering wildlife.

The results of the Index of Disturbance (ID) analysis are shown in *Table 8-7*. The vegetation community ranks on ID are:

1. Riparian/wetland
2. Oak woodland
3. Coastal sage scrub/grassland (tie)
4. Chaparral

Riparian/wetland has the highest ID rating, reflecting its high vulnerability to all of the stressors, except over-grazing (although over-grazing generally is cited as a major stressor of riparian systems, its impact on the Ranch is not severe). Oak woodland, in contrast to its relatively low IV, has a relatively high ID. The stressor scores for oak woodland primarily are based on the general scientific literature, however, and may not reflect existing conditions in oak woodlands on the Ranch. Field investigations would be required to determine the actual impact of these potential stressors. The three major upland vegetation communities have lower ID's, primarily because they are not affected to any great degree by altered hydrology and geomorphologic processes, except for moderate impacts of geomorphology on grasslands (e.g., erosion in upper Gabino and Cristianitos canyons).

The Vegetation Community Rankings (R) are shown in Table 8-8a (with plants) and Table 8-8b (excluding plants). With and without plants in the analysis the overall ranking of the vegetation communities is the same:

1. Riparian/wetland
2. Grassland
3. Coastal sage scrub
4. Oak woodland
5. Chaparral

The riparian/wetland system clearly has the highest priority for management, borne out by the fact that it is highly vulnerable to hydrologic and geomorphic alterations, such as flooding, dewatering, overwatering, sediment transport and deposition, etc. It also is highly vulnerable to invasion by exotic plants (e.g., giant reed, tamarisk, and pampas grass) and animals (e.g., brown-headed cowbirds, bullfrogs, and Argentine ants). These stressors are readily observed in the planning area. For example, giant reed is common in San Juan Creek below Bell Canyon and occurs to a lesser extent in Verdugo and lower Cristianitos Creek. Pampas grass is common in lower Cristianitos and present, but less common, , Chiquita, and San Juan creeks. Bullfrogs are found anywhere where there is adequate perennial water to support breeding populations (e.g., Calmat and lower Gabino reservoirs). Lack of adequate water in San Juan Creek is a possible contributing cause of limited arroyo toad reproduction below Bell Canyon. Erosion in upper Cristianitos and upper Gabino is a source of fine sediments that have adverse effects on downstream water and habitat quality. Substantial management and habitat restoration efforts (e.g., invasive species control) would be conducted in the RMV Open Space to address these stressors.

Coastal sage scrub and grasslands have similar R values, with and without plants included in the analysis. They both score relatively high on IV and ID because they are both rich in species and vulnerable to several stressors, as shown in Tables 1-8a and 1-8b. Both vegetation communities have been identified for substantial management and restoration efforts.

For coastal sage scrub, too frequent or infrequent fire, exotics, over-grazing and drought are key stressors. Fire and over-grazing would be addressed through the fire and grazing management plans. The Invasive Species Control Plan targets the artichoke thistle. Other invasive plants such as black mustard and annual grasses primarily would be addressed through fire and grazing management because these two stressors likely are causal factors in the proliferation of exotic plants in coastal sage scrub. Drought, as natural stressor, cannot be managed directly, but through appropriate fire and grazing management, its effects can be moderated. For example, during drought, fire control responses may need to be more aggressive to prevent catastrophic fire.

A goal of the Adaptive Management Program for grassland is to restore native grassland and enhance the quality of degraded existing native grassland in the Habitat Reserve. The key stressors on native grasslands are over-grazing, exotics (including non-native, annual grassland), and altered geomorphologic processes (primarily erosion). Although uncontrolled fire can be a stressor, generally fire would be a beneficial management tool because many plant and wildlife species respond positively to periodic fires that serve to remove dead thatch and control invasive species. Management of grassland stressors would include implementation of the fire and grazing management plans. In addition, artichoke thistle control would be a major component of grassland management. Finally, native grassland restoration would be implemented in upper Gabino and Cristianitos canyons to address the problems of erosion in those areas.

Chaparral and oak woodlands have relatively low R values. Overall, based on general observations, these vegetation communities in the planning area appear to be in good health. No specific active management and restoration activities are planned at this time. However, to ensure program flexibility and the ability to respond to unexpected changes, the general health of chaparral and oak woodlands would be monitored as part of the Adaptive Management Program. At such time as degradation of these vegetation communities becomes apparent, or unanticipated stressors are identified (e.g., Sudden Oak Death), active management actions would be developed and implemented.

1.4.2 Coastal Sage Scrub and Focal Species

This section addresses adaptive management of coastal sage scrub and associated focal species. Through the **Vegetation Community Ranking** process, coastal sage scrub was identified as a high priority vegetation community for management and monitoring based on its high **Importance Value** and relatively high **Index of Disturbance**.

a. Adaptive Management Issues

Conceptual stressor models were presented in *Section 1.2.1.b* for coastal sage scrub and associated focal species (Figures 8 and 12). The key stressors on the coastal sage scrub vegetation community are fire, over-grazing, and exotic species, and drought to a lesser extent (Figure 3). These stressors can result in reduced nutrient cycling, loss of spatial and temporal habitat structure and diversity, invasions by exotic species, temporary or permanent state-transitions to non-native annual grassland, and alteration of the food web. Temporary vegetation state-transitions at a moderate patch size scale in response to natural stressors such as fire and drought probably are normal and may reflect adaptations to these natural processes. Such temporary state-transitions actually may contribute to overall diversity of the ecosystem and reflect a healthy, dynamic system. On the other hand, permanent, large-scale state-transitions -- for example, resulting from frequent fire in association with over-grazing and/or invasions by exotic species -- are associated with loss of habitat value because of a decline of plant and wildlife abundance and diversity. The stressor model also shows interactions among the stressors and among the community responses. For example, prolonged drought can increase the likelihood and intensity of fire, which can, in turn, expose coastal sage scrub to invasion by exotic plant species.

The stressor model for focal species (Figure 8) includes additional stressors that affect wildlife, such as mesopredators and pesticides. Mesopredators can act directly on species, such as increased predation on cactus wrens by domestic and feral cats, or indirectly if mesopredators are competing for resources used by native species.

As an example of how the conceptual stressor models can be used to guide adaptive management actions, several experimental hypotheses are identified, as well as possible ways to measure community responses. For example:

<u>Hypothesis</u>: Fire intervals of less than 10 years will result in a decrease in diversity of native species and an increase in the frequency of non-native grasses and forbs.

1. Conduct retrospective study of historic wildfire patterns in subregion and adjacent areas (e.g., Central/Coastal subregion and Camp Pendleton) to determine if areas with history of frequent burning show a decreased diversity of native species and increased frequency of non-native grasses and forbs (i.e., a retrospective study).

2. Conduct future studies of unplanned wildfires and prescribed burns in coastal sage scrub and measure return diversity of native species and frequency of non-native grasses and forbs (i.e., a prospective study). Prescribed burns may be conducted on small plots of varying age stands (i.e., time since last burn).

This hypothesis could be refined to include seasonal or grazing effects. For example, winter and spring burns will magnify the loss of native diversity and increase non-native grasses and forbs. Similarly, grazing in post-fire, early and mid-successional coastal sage scrub will result in decreased species diversity over time, or an established (late-successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn species diversity than a same-aged stand that has been grazed. To test these more refined hypotheses, information about the season(s) in which burns occurred, or the grazing history of a burn site would be needed. A retrospective study likely would answer the hypothesis at a coarse scale, but additional prospective studies likely would be needed to test more refined hypotheses as variables such as differential season or grazing effects are added. Also, as variables are added a large data set (e.g., number of sample sites) would be necessary to maintain adequate statistical power greater.

Hypotheses also can be posed for relationships between stressors and focal species. For example, as described in *Section 1.2.2.a*, three recent fires in the Upper Chiquita Conservation Area would provide an opportunity for examining the response of coastal sage scrub and associated species to frequent fire. Of particular interest would be the response of the 1997 fire area that was burned again in 2002. Also it was noted that middle and lower Chiquita Canyon south of Oso Parkway have not burned since the 1950s according to the Orange County wildfire record, but these areas have been grazed in the meantime. Notably these areas support the highest densities of the California gnatcatcher in the subregion, so absence of fire for more than almost 50 years and the presence of cattle grazing appears to not have been an adverse situation at least for this species. On the surface, this observation makes sense because gnatcatchers prefer habitat that is more open and with a broken canopy, and they tend to be absent or occur in low densities in scrub dominated by tall shrubs or with a closed canopy. In the absence of fire, if some level of grazing maintains low shrubs and an open canopy, the habitat may be more suitable for the gnatcatcher. This will be an important management issue because there are areas of coastal sage scrub in the RMV Open Space where prescribed burning would not be feasible and wildfires would be fought aggressively to protect the public and property. Some level of grazing may beneficial as a surrogate for fire.

Based on the anecdotal observation of a potential positive relationship between grazing and gnatcatcher habitat suitability, an adaptive management question is whether managed grazing by cattle (or goats) is an effective management tool for sustaining coastal sage scrub habitat quality for species such as the California gnatcatcher. This anecdotal observation can be used to state a hypothesis about the relationship between California gnatcatcher occurrence and populations and grazing.

> <u>Hypothesis</u>: In the absence of periodic fire, light to moderate grazing in coastal sage scrub maintains habitat structure and diversity suitable for the California gnatcatcher.

1. Conduct retrospective study of gnatcatcher occurrence in areas of coastal sage scrub in southern and central Orange County and San Diego County comparing areas that have not burned in several decades, including areas that have been grazed and areas that have not been grazed.

2. Conduct prospective study of gnatcatcher occurrence comparing areas where grazing is precluded in the future and where light to moderate grazing is allowed to continue.

b. Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for coastal sage scrub and associated focal species:

- Maintain the physiographic diversity of coastal sage scrub and associated focal species in the RMV Open Space.

- Restore coastal sage scrub and enhance the quality of degraded existing coastal sage scrub in the RMV Open Space such that the net habitat value of the existing coastal sage scrub system is maintained.

- Consistent with these goals, the following management objectives would be addressed to help maintain and enhance long-term habitat value:

- Conduct monitoring of coastal sage scrub and focal species to track the long-term habitat value of the coastal sage scrub system.

- Restore approximately 375 acres of coastal sage scrub in designated locations that currently are in agriculture, grazed or otherwise do not currently support coastal sage scrub to enhance habitat carrying capacity and connectivity (see Habitat Restoration Plan, Appendix X-2).

- Manage coastal sage scrub fire regimes such that a natural diversity of age-stands is maintained throughout the RMV Open Space.

- Manage cattle grazing to sustain net habitat value and diversity of coastal sage scrub.

- Control exotics invasions of coastal sage scrub, especially along the RMV Open Space-urban interface or other identified vulnerable areas (e.g., along existing paved and dirt roads, utility easements).

c. Monitoring of Coastal Sage Scrub and Focal Species

The monitoring program described here for coastal sage scrub, as well as the other vegetation communities discussions that follow, provides the conceptual approach to the monitoring program, along with a few examples of monitoring schemes to indicate the kinds of detail that would be necessary for the site-specific monitoring plans. The detailed monitoring plans for the Habitat Reserve, including specific monitoring locations (i.e., sample plots, transects, etc.), monitoring schemes and schedules, personnel, etc., would need to be developed once the institutional structure of the Adaptive Management Program is constituted. Accordingly, specific details of the management and monitoring program described below would be somewhat different from the examples presented here.

Coastal sage scrub would be monitored at the landscape, habitat and species levels. The routine passive, long-term monitoring of coastal sage scrub and focal species would include two main tasks:

1. Evaluation and update of the entire coastal sage scrub vegetation datebase at 5-year intervals using aerial photographs.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the RMV Open Space and in keys areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Periodic evaluation and update of the vegetation database would allow RMV to track large-scale landscape changes in the vegetation communities in the RMV Open Space. Any adverse changes (e.g., type conversion of coastal sage scrub to grassland or exotic invasion) that may affect the integrity and function of the RMV Open Space would be documented and appropriate management actions would be taken.

Within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later, the RMV Open Space vegetation communities would be remapped in detail to establish a baseline for long-term tracking of the Open Space. This baseline mapping should use year 2007 color infrared aerial photography (digital orthophotos, 1-m resolution), or an available equivalent imagery. It is important that the entire RMV Open Space be mapped at the same time to create a seamless vegetation database, rather than at different times and cobbling together various maps with inherent conflicts along vegetation polygon boundaries (i.e., edge-matching). This mapping would include all major vegetation communities and would follow the Orange County vegetation classification system (Gray and Bramlet 1992), with modifications as may be required at the time of the mapping (e.g., the RMV Open Space may include mapping some classifications not described under the County system). Personnel responsible for the mapping would establish the appropriate mapping unit for each vegetation type to allow for tracking of any long-term trends in the vegetation communities. In addition, clearly-stated, objective protocols and decision rules for naming vegetation communities would be established for the baseline mapping so that future assessments against the baseline database can as precise and accurate as possible.

Following the initial baseline vegetation mapping, at 5-year intervals updated imagery of at least the same quality as the baseline imagery would be used to evaluate and update the vegetation database for the RMV Open Space. Although this assessment and update primarily would be based on remote interpretation of the imagery, areas that appear to have undergone substantial change in vegetation, and with no known or obvious natural causes of the change (e.g., wildfire or drought), would be field-checked to determine whether a change in the vegetation community has occurred and what the possible cause may have been (e.g., invasion by exotics).

Appendix J

In conjunction with landscape-scale habitat monitoring, regional climate, weather and air quality information would be collected in order to examine potential correlations between vegetation changes and these environmental variables.

Annual field studies within the designated plots would be conducted to monitor fine-grained changes within the coastal sage scrub community for at least the first five (5) years of the monitoring program. A set of permanent plots, each with several semi-permanent sample belt-transects, for example, would be established throughout the coastal sage scrub system in the RMV Open Space . The sample plots would be as regularly-shaped as possible (square to rectangular), given site conditions (topography, vegetation characteristics and survey logistics), in order to standardize the number of transects within a sample plot and allow for comparable data from different management areas. Baseline data for pre-established sample points for each transect would be recorded, such as dominant and sub-dominant associated species, visually-estimated percent cover, percent native and non-native plant species, slope, aspect, substrate/soils, and any disturbance conditions or possible threats. Photo-stations would be established at these sample locations along transects to capture the environmental diversity or gradient of the transect. Sample plots, transects, and sample points along each transect would be mapped using GPS accurate to the nearest 0.5-1.0 m (based on year 2003 available GPS technology).

Concurrent with focal species surveys (as described below), botanists would conduct annual floral surveys along the belt-transects in the coastal sage scrub sample plots, typically within the March-May timeframe, but at a time that maximizes the detection of perennial and especially annual plants in any given year. While many floral sampling regimes are possible (e.g., Elzinga et al. 1998), based on the sample plots and belt-transects established for wildlife monitoring, the following method is suggested.

Semi-permanent 25-m segments along the center of the belt transect would be established in a pseudo-random fashion. Based on the baseline data for the belt-transects, these segments would cover the diversity/gradient along the transect. Data would be collected by recording each species that intersects an imaginary vertical plane at each 0.5-m mark along the 25-m segment of the sample transect. All species present within a 5-m band centered on the transect line would be recorded. Relative species cover and species diversity would be derived from these data. Additional data collected for the sample transect include evidence of natural or human-induced stressor (e.g., drought, fire, grazing, off-road vehicles, unauthorized trails, trampling, trash, etc.). Each sample transect would be photographed to document the status of the vegetation at the site on an annual basis.

After the first five years of the Adaptive Management Program, RMV would assess the results of the monitoring plans and make adjustments and recommendations as to the appropriate schedule for future sampling (e.g., every two or three years), as well as modifications to the sample plots (e.g., numbers, locations, etc). These assessments and recommendations, as well as the sampling strategy for the upcoming five years would be included in the 5-year comprehensive report. The appropriate long-term monitoring interval would be based on the resources being managed and monitored and the time scale of potential adverse changes. For example, areas vulnerable to volatile edge effects (e.g., invasion by Argentine ants) probably need to be monitored more frequently than interior areas where adverse changes are more likely to occur, or only be detectable, over a longer time frame.

From a pure statistical perspective, sample plots, transects within the plots, and points within a transect, ideally would be randomly selected throughout the RMV Open Space to control for sample bias. Practically, however, the selection of sample areas (i.e., sample plots, transects, and points) should reflect the diversity of the RMV Open Space so that important or unique biological resources, as well as where environmental stressors are, or thought to be, operating, are not overlooked. Thus, the number and location of the sample plots within the Habitat Reserve, the number and locations of sample transects with a sample plot, and the number and locations of sample points along a transect would depend on landscape, habitat and species factors. At the landscape level, it would be important to monitor the physiographic diversity of the RMV Open Space such as the coastal-inland gradient and elevation. At the habitat level, it will be important to sample to the extent practical the diversity of microhabitats within coastal sage scrub such as different slopes, aspects, soils, plant and wildlife community structure, ecotones, proximity to water, and rock outcrops to the extent feasible. At the species level, it will be important to tie sample areas to representative populations of focal species (as described below). Although these three levels have somewhat different selection criteria, they also are interdependent in that an efficient monitoring program will maximize the relative number of sample areas that meet the selection criteria at all three levels. For example, selecting a location for monitoring habitat linkage function may include selection criteria such as: **(1)** provides a crucial linkage between two large habitat blocks (landscape level); **(2)** provides high quality "live-in" habitat for coastal sage scrub focal species (habitat level); and **(3)** supports an *important population* in a *key location* of an Identified Species (species level).

Although precise locations for sample plots cannot be specified here, areas supporting *major* and *important populations* of the California gnatcatcher and key habitat linkages can be identified and provide good indicators for selecting initial monitoring locations in coastal sage scrub. For example, a set of monitoring locations could be selected from the following areas over time:

- Chiquita Ridge south of Oso Parkway – *major gnatcatcher population* in *key location*, Linkage C

- Chiquita Ridge/San Juan Creek – *major gnatcatcher population* in *key location*, Linkages C and J
- Chiquadora Ridge - *major gnatcatcher population* in *key location*, Linkage G
- Chiquita Canyon north of wastewater treatment plant - *major gnatcatcher population* in *key location*, Linkage E
- Trampas Canyon *important gnatcatcher population* in *key location,* Linkage K
- Upper Cristianitos Canyon *important gnatcatcher population* in *key location*, Linkage N

The efficacy of these potential monitoring locations would need to be evaluated in the context of other landscape-, habitat- and focal species-level monitoring requirements discussed above in order to select the set of sample plots that provide an efficient information return on the monitoring effort. Initially, short-term studies to collect baseline information for focal species occupation and use would be conducted at selected monitoring sites prior to development. Initiation of long-term monitoring of the sample plots would be phased in concert with development that may affect the function of the habitat linkage or wildlife corridor; i.e., the long-term monitoring of the site would be linked to a potential constraint or stressor at the site.

2. Focal Species Monitoring

A suite of candidate focal species for coastal sage scrub was identified in *Section 1.2.2.c*, including ten (10) early warning indicators, four (4) biodiversity indicators, and three (3) umbrella species (*Table 1-9*).

TABLE 1-9
COASTAL SAGE SCRUB CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Cactus Wren	•		
California Gnatcatcher	•		
California Thrasher		•	
Great Horned Owl			•
House Finch	•		
Mockingbird	•		
Red-tailed Hawk			•
Rufous-crowned Sparrow		•	
Wrentit		•	
Reptiles			
Orange-throated Whiptail	•		

San Diego Horned Lizard	•	•	
Mammals			
Coyote	•		
Mule Deer			•
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**10**	**4**	**3**

The cactus wren, California gnatcatcher, California thrasher, rufous-crowned sparrow, wrentit, orange-throated whiptail, and San Diego horned lizard all are general indicators of relatively high coastal sage scrub habitat quality; i.e.; their absence from a patch of coastal sage scrub (or southern cactus scrub for the cactus wren) may indicate a loss of function. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The dynamic relationships between the "high habitat quality" indicators and edge-enhanced species (e.g., direct, interspecific competition or simply a negative correlation caused by some other factor) are not understood at this time. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the Adaptive Management Program needs to be determined. Likewise, mule deer are still relatively common in the planning area and they are easy to detect. Their main value as an umbrella species likely would be in regard to the function of habitat linkages and wildlife corridors because they are sensitive to undercrossing design and size (e.g., bridges and culverts). In addition, as the main prey of mountain lions, their occurrence would be important for maintaining this species in the study area and in turn the Southern Subregion.

One objective of the Adaptive Management Program would be to determine the efficacy of these candidate focal species for management and monitoring of coastal sage scrub in the RMV Open Space. As such, at minimum the occurrence of these species in the RMV Open Space would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (e.g., scat, tracks nests, etc.).

The survey methods used for focal species would need to be tailored to the species and management issue(s) being addressed in relation to the identified or potential environmental stressor. For example, several standard avian survey methods that provide different levels of information can be used. CalPIF (2002) described five standard methods ranging from the least labor-intensive to the most intensive:

1. **Area Search:** This is a habitat specific, time constraint census method to measure relative abundance and species composition. Can provide breeding status, but may not be as reliable as other more intensive methods. This is the standard method used for general presence/absence surveys and does not imply repeated samples over several years.

2. **Point Count:** This method specifically intended to monitor population changes of breeding birds at fixed points and spatial and temporal differences in species composition among habitat areas. This method is appropriate for monitoring bird populations over time.

3. **Mist Netting:** This method provides information about the health and demographics of a population because birds are directly handled. It provides valuable information about productivity, survivorship and recruitment and possible cause and effect relationships (e.g., effects of parasites on health).

4. **Territory Mapping:** This method provides information about spatiotemporal habitat use based on repeated observations of birds' locations. This method provides information about population densities and distributions and intraspecific (within species) and interspecific (between species) interactions. This method is very labor intensive and is very sensitive to the sampling protocol (e.g., number of visits, season, time of day, weather conditions, etc.). If this method is used, it is critical to carefully define the management question in order to develop the appropriate protocol.

5. **Nest Monitoring:** Similar to mist netting, this method provides information on health and demographics, particularly with regard to nesting activities and reproductive success, such as clutch size, number of broods, number of nesting attempts, etc. Because nests have to be located and frequently monitored, this method tends to be the most labor-intensive. In addition, this method poses the greatest risk to the monitored species because of the risk of causing nest failures of disruption essential activities.

As mentioned above, survey information should be relevant to the management and monitoring goals and issues (e.g., stressors) for the species. For example, if a study site is on the edge of the RMV Open Space adjacent to urban development, is it being colonized by mockingbirds or some other "edge-enhanced" species? An initial monitoring approach in Habitat Reserve-urban edge study areas may simply be to compile information about focal species composition using a relatively low-intensity method such as point counts. Generally, monitoring presence/absence of species through methods such as point counts limits inferences to correlational relationships and provides little cause-and-effect inferential information. However, if an increase in mockingbirds coincides temporally with a decline in California gnatcatchers, a potential cause-and-effect relationship may be operating and further study or an experimental action would be warranted. Correlational data can be used to generate testable alternative hypotheses that allow for "crucial experiments" of cause-and-effect relations; i.e., the classic "strong inference" model described by Platt (1964). For example, observations of antagonistic interactions between mockingbirds and gnatcatchers may suggest that mockingbirds are actively excluding gnatcatchers and that some type of experimental control of mockingbirds at selected sites along the Open Space-urban edge is warranted. On the other hand, if there is a time lag between the disappearance of gnatcatchers and the appearance of mockingbirds, some other factor may be responsible for the change (e.g., habitat degradation) and the mockingbird may simply be expanding into available habitat in the absence of the gnatcatcher.

As another example, the correlation observed between lack of fire, grazing and gnatcatcher occurrence in middle and lower Chiquita Canyon leads to the hypothesis that "In the absence of periodic fire, light to moderate grazing in coastal sage scrub maintains habitat structure and diversity suitable for the California gnatcatcher." Because this hypothesis questions the relationship between gnatcatcher occurrence, fire and grazing levels, an appropriate study would be to examine gnatcatcher occurrence in areas that have not burned in several decades, including areas that have been grazed and areas that have not been grazed. If grazing in the absence of fire is positively associated with gnatcatcher occurrence, one could then ask the question of how grazing affects coastal sage scrub structure such that it is suitable for gnatcatchers. However, the long-term value of this information for management of coastal sage scrub may not warrant the additional cost of conducting the study, or at least, it may have a low priority as part of the Adaptive Management Program.

In order to allocate funds in the most cost-effective and efficient manner, it will be critical to identify the appropriate level of monitoring for informing the Adaptive Management Program.

In addition to monitoring of focal species, experienced field biologists typically record every wildlife species they encounter in an area. Accordingly, the species data would not be limited to focal species and collection of presence/absence data for other species would be important. Species not considered here as focal species may prove to be valuable in the future and the monitoring program should maintain the flexibility of adding new focal species. Hence, it would be important for the monitoring biologists to record the number of individuals of each species they encounter or have some metric for estimating relative abundance. By having both the number of species and the abundance of each species, it would be possible to generate a diversity index, which in this case would be the number of species in the sample plot and their relative abundance. There are several standard diversity indices that can be used: Shannon-

Weiner index, richness index, Brillouin index, and Simpson index. The index or set of indices used would be determined by RMV in coordination with the Wildlife Agencies, but would need to be applicable across the RMV Open Space and be appropriate for the species assemblage. As the reserve owner/managers develop their survey protocols, they would need to coordinate the field data collection methods so that data are standardized and can be collated into a single database.

d. Management of Coastal Sage Scrub and Focal Species

The Adaptive Management Program for coastal sage scrub includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

The conceptual stressor model for coastal sage scrub focal species (Figure 8) depicts known and potential stressors of these species. These stressors also are summarized in Table 1-2. Stressors generally fall into two categories: **(1)** general, habitat-wide stressors; and **(2)** species-specific stressors. However, the distinction between the general and species-specific stressors often is blurred. For example, control of Argentine ants is specific to San Diego horned lizards because of specific impacts on their native prey base, but this problem is also more generic because the adverse impacts of Argentine ants on native habitats and species goes beyond the horned lizard.

e. Restoration of Coastal Sage Scrub

The Adaptive Management Program includes a coastal sage scrub restoration plan that would restore approximately 375 acres of coastal sage scrub and be comprised of two main components:

1. Restoration of pre-designated areas to mitigate over the near-term for authorized losses of coastal sage scrub to development and/or to increase net habitat value of the coastal sage scrub community; and

2. Case-by-case restoration opportunities undertaken during the course of long-term adaptive management of the RMV Open Space in response to changing conditions and emergencies.

The coastal sage scrub restoration plan is discussed in detail in the Habitat Restoration Plan.

Appendix J

The goal of the coastal sage scrub restoration plan is to establish coastal sage scrub in areas that would contribute habitat value to the RMV Open Space by increasing the carrying capacity for the California gnatcatcher and other sage scrub species. With this goal in mind, several areas have been tentatively identified for coastal sage scrub restoration (Figure 14).

- Sulphur Canyon in the Gobernadora sub-basin was identified for restoration to provide additional habitat and enhance connectivity between Chiquita Canyon and Wagon Wheel Canyon to the west and Gobernadora and Bell canyons to the east. Sulphur Canyon is currently characterized by coastal sage scrub on the slopes of the canyon and grazed annual grasses on the valley floor. Opportunities to improve "live-in" habitat and connectivity for California gnatcatchers through enhancement of existing coastal sage scrub will be identified.

- Several side canyons along Chiquita Ridge and adjacent to Chiquita Creek were identified for restoration. Restoration of the two large canyons just northwest and southwest of the "Narrows" would greatly improve the habitat integrity of Chiquita Ridge, which narrows to less than 2,000 feet in width at the top of these side canyons, and provide substantial "live-in" habitat for California gnatcatchers and other species, and improve the integrity of the reserve system.

Final selection of areas for restoration would require additional field study to determine the likelihood of a successful program, including analysis of factors such as soil conditions and presence of exotic species both within the restoration area and surrounding habitat. In some areas, the desired habitat is a mosaic of coastal sage scrub and native grassland that emulates the surrounding habitat characteristics. Such areas would provide suitable habitat for coastal sage scrub and grassland species, and especially species that use sage scrub-grassland ecotones (e.g., gnatcatchers and grasshopper sparrows). These primarily are areas that support clay soils and are highly suitable for restoring native grasslands. The following areas are recommended for coastal sage scrub/valley needlegrass grassland (CSS/VGL) restoration: Upper Gabino and in the Chiquita sub-basin in the area east of the Santa Margarita Water District wastewater treatment plant, the citrus groves west of Chiquita Creek and the disced areas west of the creek to the Chiquita ridgeline (Figure 14).

- Upper Gabino currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for a mix of coastal sage scrub and native grassland restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse sage scrub. Allowing a mixed community to regenerate may represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for restoration and several patches of low quality native grassland suitable for enhancement.

- As discussed above for coastal sage scrub, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work would be needed to identify the areas best suited for revegetation with coastal sage scrub alone and coastal sage scrub/native grassland.

Case-by-case active/experimental restoration of coastal sage scrub also would occur under the Adaptive Management Program as RMV identify further areas suitable for restoration. Instances that may warrant an active restoration include the following:

- Existing areas of degraded coastal sage scrub that are not naturally recovering through passive management;

- Areas that are degraded or disturbed by future natural events and that are unlikely to recover naturally (e.g., an area that has burned too frequently);

- Areas that have been temporarily disturbed either by authorized (e.g., an approved infrastructure project) or unauthorized (e.g., an illegal trail) activity; and

- Specific adaptive management research involving restoration treatments.

Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, the effort should be made to undertake a coordinated restoration project to provide the greatest net benefit for coastal sage scrub and coastal sage scrub species. .

As discussed above, the Adaptive Management Program focus is on conducting restoration activities in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

The details of the coastal sage scrub restoration program are provided in the CSS/VGL Restoration Plan. The key management activities proposed by the plan are listed here:

- Identification of priority coastal sage scrub restoration areas (areas on RMV are described above);
- Revegetation of existing degraded habitat;
- Re-establishment of coastal sage scrub in areas that have been converted to annual grassland or disturbed habitat due to human activities or too frequent fires;
- Control of invasive or exotic plant and wildlife species, such as artichoke thistle, black mustard, Argentine ants, red imported fire ants, and brown-headed cowbirds;
- Fire management activities;
- Management of grazing and other agricultural activities that adversely affect habitat values and diversity; and
- Controlling public access and recreation to protect/enhance habitat values, including seasonal restrictions during nesting or temporary restrictions designed to provide opportunities for recovery of overused areas.

1.4.3 Chaparral and Focal Species

This section addresses adaptive management of chaparral and associated focal species. Chaparral is the lowest priority for management and monitoring because of its low **Vegetation Community Ranking** score relative to the other major vegetation communities addressed by the Adaptive Management Program (Tables 1-8a and 1-8b). For this reason, the primary focus of management and monitoring of chaparral would be passive management.

a. Adaptive Management Issues

Conceptual stressor models were presented in *Section 1.2.1.b* for chaparral and associated focal species (Figures 4 and 9). The main stressor on the chaparral vegetation community is fire. Over-grazing, exotic species, and drought also are identified as stressors, but their effects are considered to be significantly less important than fire. However, frequent fire can provide the opportunity for exotic plant species invasions and type conversion of chaparral to annual grassland. Conversely, infrequent fire can result in fuel buildups and, in combination with drought, result in extremely intense, devastating fires. In addition, lack of fire may result in type conversion of chaparral to oak woodland (e.g., Cooper 1922; Wells 1962), although this type of conversion would not necessarily be considered adverse or needing management. These stressors generally result in reduced nutrient cycling, loss of spatial and temporal habitat structure and diversity, invasions by exotic species, temporary or permanent state-transitions to non-native annual grassland, and alteration of the food web. Temporary state-transitions at a moderate patch size scale probably are normal and may reflect adaptations to the natural fire regime. Permanent state-transitions, on the other hand, may be associated with loss of habitat value because of a decline of plant and wildlife abundance and diversity. The stressor model also shows interactions among the stressors and among community responses. For example, prolonged drought can increase the likelihood and intensity of fire, which can, in turn, expose chaparral to invasion by exotic plant species.

As noted above, fire appears to a key factor for chaparral based on the many adaptations of its characteristic species and its resilience[4] in form and composition to periodic burning (Keely 1986, 1992). Post-fire species composition, however, varies substantially in relation to fire frequency, season and intensity and other environmental variables. In particular, the life history characteristics of "resprouters" versus "obligate seeders" appear to be quite different in relation to fire intervals, xeric versus mesic slopes, and root systems (e.g., resprouters may be more resistant to drought than seeders because they have deeper tap roots) (Keeley 1986).

Several experimental hypotheses relevant to managing chaparral were identified based on this model and the scientific literature:

- Chaparral left undisturbed by fire will convert to oak woodland, especially in areas with well-developed soils, and exhibit a decrease in diversity.

- Fire intervals of less than 10 years will result in a decrease in a diversity of chaparral species in favor of "resprouters" compared to "obligate seeders" (e.g., Keely 1977, 1986; Zedler et al. 1983).

- Recovery of resprouters and obligate seeders varies in relation to mesic versus xeric slopes, with resprouters favoring mesic slopes and seeders favoring xeric slopes (Keeley 1986).

- Fire intervals of less than 10 years will result in type conversion of chaparral to coastal sage scrub and eventually grassland (e.g., Haidinger and Keeley 1993).

- Fire intervals of less than 10 years will result in recruitment of exotics species such as mustards and bromes (e.g., Haidinger and Keeley 1993).

[4] Resilience can be defined as a rapid return to pre-perturbation (equilibrium) state (Keeley 1986).

- Suppression of fire in a stand of coastal sage scrub will result in type-conversion to chaparral.

- Sustained drought will result in domination of chaparral by obligate resprouters such as scrub oak and facultative resprouters such as chamise (e.g., Keeley 2000).

- With over-grazing, chaparral will be invaded by exotics and type-convert to oak woodland.

These are just some examples of the many experimental management hypotheses that can be generated. The hypotheses to be tested in the RMV Open Space should be selected on the basis of their relevance to known or potential environmental stressors and to the long-term management of the Open Space.

The adaptive management issues for chaparral are similar to those for coastal sage scrub, although the state-transition pathways and relationships are somewhat different; e.g., a response to fire by chaparral is a possible transition to coastal sage scrub whereas as burned coastal sage scrub has a moderate probability of converting to grassland. In addition, according to the state-transition model and supporting scientific evidence, chaparral is fairly resilient to state-transitions unless burned frequently

b. Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for chaparral and associated focal species:

- Maintain the physiographic diversity of chaparral and associated focal species in the RMV Open Space.

- In the event that existing chaparral in the RMV Open Space is degraded, restore and enhance the quality of future degraded chaparral in the RMV Open Space such that net habitat value of the existing chaparral system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value:

- Conduct monitoring of chaparral and focal species in manner that allows RMV to track the long-term habitat value of the chaparral system.

- Manage chaparral fire regimes such that a natural diversity of age-stands and resprouters/obligate seeders is maintained throughout the RMV Open Space and that existing chaparral stands do not irreversibly type-convert to grassland.

- Manage cattle grazing such that adverse impacts to chaparral are controlled to preserve net habitat value and that existing chaparral stands do not irreversibly type-convert to grassland.

- Control exotics invasions of chaparral, especially along the Open Space-urban interface or other identified vulnerable areas (e.g., along existing paved and dirt roads, utility easements).

Chaparral received a low **Vegetation Community Ranking** score relative to the other major vegetation communities and is a low priority for management and monitoring. The chaparral vegetation community in the RMV Open Space generally is healthy, and at this time no specific areas warranting restoration have been identified. Therefore, in contrast to coastal sage scrub, native grassland and riparian/wetland habitats (described below), a specific *a priori* restoration objective for chaparral has not been formulated, even though restoration of chaparral is a stated goal of the Adaptive Management Program. However, areas within the RMV Open Space requiring restoration may identified in the future, either as a result of more detailed field investigation of existing conditions or as triggered by natural or human-induced events (e.g., frequent wildfires).

c. Monitoring of Chaparral and Focal Species

The monitoring program for chaparral would use the same general methods described above for coastal sage scrub and the reader is directed to that section for more detail. The key points for the monitoring program for chaparral are summarized here:

1. Evaluation and update of the entire chaparral vegetation database at 5-year intervals.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Periodic evaluation and update of the chaparral vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described in detail above for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later.

- Evaluation and update of the vegetation map based on remote interpretation and spot field verification as part of the overall RMV Open Space 5-year mapping effort.

- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables.

- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program.

- Concurrent focal species surveys (as described below).

After the first five years of monitoring of chaparral, individual reserve owner/managers would assess the results of their individual monitoring plans and make adjustments and recommendations as to the appropriate schedule for future sampling (e.g., every two or three years), as well as modifications to the number of sample plots (e.g., numbers, locations, etc.).

2. Focal Species Monitoring

A suite of candidate focal species for chaparral was identified in *Section 1.2.2.c*, including eight (8) early warning indicators, three (3) biodiversity indicators, and five (5) umbrella species (*Table 1-10*).

The wrentit, California thrasher, San Diego horned lizard and orange-throated whiptail are indicators of high quality chaparral, and their absence may indicate a loss of function. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the Adaptive Management Program needs to be determined. Likewise, mule deer, bobcat and mountain lion are still relatively common in the planning area and they are easy to detect. Their main value as umbrella species likely will be in regard to the function of habitat linkages and wildlife corridors because they are sensitive to undercrossing design and size (e.g., bridges and culverts).

TABLE 1-10
CHAPARRAL CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
California Thrasher		•	
Great Horned Owl			•
House Finch	•		
Mockingbird	•		
Red-tailed Hawk			•
Wrentit		•	
Reptiles			
Orange-throated Whiptail	•		
San Diego Horned Lizard	•	•	
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**8**	**3**	**5**

One objective of the Adaptive Management Program would be to determine the efficacy of these candidate focal species for management and monitoring of chaparral in the RMV Open Space. As such, at minimum the occurrence of these species in the RMV Open Space would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (e.g., scat, tracks nests, etc.).

General sample methods for monitoring focal species are described above for coastal sage scrub.

d. Management of Chaparral and Focal Species

The Adaptive Management Program for coastal sage scrub includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Because chaparral appears to be more resilient to state-transitions than coastal sage scrub, for example, it is anticipated that passive management would be the predominant management approach for this community within the Habitat Reserve. Furthermore, partly reflecting this greater resiliency and because it has a relatively low **Importance Value** score, chaparral received a low **Vegetation Community Ranking** score relative to the other major vegetation communities and is a low priority for management and monitoring.

The greatest risk to maintaining healthy stands of chaparral in the RMV Open Space appears to be too frequent fire. Short fire intervals (< 25 years) in chaparral may eliminate obligate seeding species in favor of resprouters and very frequent fires (1, 2 or 3 year intervals) may result in invasion by exotic weeds and annual grasses (e.g., *Brassic nigra*, *Bromus* spp., *Schismus barbatus*) (e.g., Haidinger and Keeley 1993; Keeley 1986; Zedler 1983). The fire management of chaparral is treated in detail in the Fire Management Plan. Although over-grazing also is a potential stressor, biologists familiar with the RMV property have not observed a significant adverse effect of grazing on chaparral. Grazing management is not anticipated to be a high priority for this community in the RMV Open Space.

Because the primary management approach likely would be passive, fewer management resources would be expended for active or experimental management of chaparral compared to coastal sage scrub, native grassland and riparian and wetland communities. Nonetheless, reserve owner/managers should take advantage of opportunities to conduct experimental management actions in chaparral in response to natural or human-induced disturbances such as fire.

The conceptual stressor model for chaparral focal species (Figure 9) depicts known and potential stressors. The stressors for chaparral focal species are essentially the same as for coastal sage scrub species because of the large overlap between the two lists.

e. Restoration of Chaparral

There is no identified need for restoring chaparral. The Adaptive Management Program includes as-needed, case-by-case restoration of chaparral undertaken during the course of long-term adaptive management of the RMV Open Space, with the overall goal of maintaining the existing diversity of chaparral in the RMV Open Space.

The objective of the chaparral restoration program is to restore chaparral in areas that are degraded or disturbed by future natural events and are unlikely to recover naturally (e.g., an area that has burned too frequently).

Restoring areas that are disturbed in the future is important for maintaining long-term net habitat value. As documented in several studies noted above, frequent disturbances of chaparral (e.g., fire) can result in state-transition to annual grassland and weedy, disturbed habitats. Likewise, areas that have been temporarily disturbed either by authorized (e.g., an approved infrastructure project) or unauthorized (e.g., an illegal trail) activity may be at risk of long-term degradation. In such cases restoration may be required to re-establish chaparral to both maintain existing habitat value and protect adjacent areas from invasions by exotic species that could be established without intervention.

As part of the management of the RMV Open Space supporting chaparral, RMV would identify areas suitable or desirable for restoration. Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, RMV would consult with adjacent landowners in an the effort should be made to undertake a coordinated restoration project to provide the greatest net benefit for chaparral and chaparral species.

As discussed above, a key feature of the Adaptive Management Program is that restoration activities will be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

1.4.4 Native Grassland and Focal Species

This section addresses adaptive management of native grasslands and associated focal species. Native grassland received a relatively high **Vegetation Community Ranking** score, primarily because of its high **Importance Value**, and thus has a high priority for management and monitoring.

a. Adaptive Management Issues

Adaptive management of grasslands in the RMV Open Space is complicated by the fact that the system supports both sensitive native grasslands and non-native annual grasslands. Although both types provide valuable habitat for many wildlife species, and annual grassland may be considered a "naturalized" vegetation community or a "new native" (Heady 1977), management and monitoring primarily is geared to native grasslands. Moreover, in some cases, the management of native grassland and other valuable uplands such as coastal sage scrub and chaparral would focus on converting annual grassland back to what was likely the native vegetation community on the site. Over time there likely would be a net loss of non-native annual grassland in favor of net increases in native habitats. The CSS/VGL restoration plan, for example, targets several areas of annual grassland.

The environmental stressor models for native grassland and associated focal species are presented in Figures 5 and 10. The primary stressor on native grassland is exotic annual grasses and weedy forbs that dominate much of the remaining native grassland in the planning area. Exotic species reduce nutrient cycling, affect structure and diversity of native species, promote state-transition to annual grassland and alter the natural prey base. Over-grazing is a significant stressor that can directly affect nutrient cycling, structure and diversity, promote state-transition from native to non-native grassland, and alter the food web, but also indirectly can facilitate invasions by exotic species. Native grasslands in upper Gabino Canyon, and upper Cristianitos Canyon to a lesser extent, also suffer from altered geomorphologic process (i.e., erosion) affecting clay soils that result in the generation of fine sediments. Finally, while periodic fire can favor native grasslands, too frequent fire can inhibit native grasses and forbs and favor invasion of non-native species.

Under undisturbed conditions, such as a lack of periodic fire, native and annual grasslands may convert to coastal sage scrub. However, this hypothesized relationship must be tempered with the observation that at least in some regions annual grasslands appear to have stabilized, perhaps due to permanent changes in soil nutrients and moisture regimes caused by the presence of exotic species (Heunneke and Mooney 1989) and air pollution (Allen et al. 1996; Padgett et al. 1999; Minnich and Dezzani 1998). Without intervention, such areas can no longer naturally convert to coastal sage scrub and, in fact, the presence of exotics adjacent to coastal sage scrub may cause continued degradation of sage scrub without management intervention.

The relationship between native grasslands and shrub habitats in the context of fire also is unclear. Some have suggested that the distribution of native grasses is related to a long history of burning by Native Americans (e.g., Sampson 1944; Bean and Lawton 1973; Timbrook et al. 1982), while others attribute the distribution of native grasses to lightning-caused fires (e.g., Heady 1977). Evidence supporting this assertion regarding the importance of fire includes the finding that more common native grassland dominants (*Nassella pulchra, N. lepida*) are adapted to fire by resprouting and producing greater volumes of seed following fire (Ahmed 1983; Keeley and Keeley 1984). Several field studies have reported an increased cover of *Nassella* spp. after burn treatments (Hatch et al. 1991; Dyer et al. 1996), while other studies have shown mixed effects of burning on species abundance (Hatch et al. 1999). Though research has demonstrated increased abundance of native grasses following fire, there is relatively little research describing the role of fire on maintaining other native species within valley and foothill grassland habitat. One example of a positive effect of fire (and grazing) management on native wildflowers is on The Nature Conservancy's Vina Plains Preserve in southern Tehama County (Griggs 2000).

The effects of grazing on valley and foothill grasslands also remain unclear. In spite of the fact that a long history of intensive grazing in California has been cited as one of the primary reasons for the demise of native grasslands (Burcham 1957; Dasmann 1966 as cited; Keeley 1990; Bartolome and Gemmill 1981), most research has found that some intensity of grazing is beneficial to, or at least does not negatively affect, native grasses (Huntsinger *et al*. 1996). Several researchers have documented cases where native grasses have not increased in abundance on sites that have been excluded from grazing over 20- to 40-year periods (White 1967; Bartolome and Gemmill 1981; Goode 1981). Heady (1968, 1977) suggested that large native herbivores present prior to European colonization may have been an important factor in grassland formation and ecology. This assertion supports findings that some form of managed grazing may be useful as part of efforts to maintain or restore native grasses. Menke (1996) considers "Prescribed grazing to constitute the primary component of the first phase of a perennial grass restoration program." (pg. 23). Furthermore, as noted above, using grazing as a management tool on the Vina Plains Preserve to control non-native grasses has resulted in a greater abundance of native wildflowers on grazed sites (Griggs 2000).

Another management issue is maintaining the structural diversity of grasslands, whether they are native or non-native. Identified Species such as the grasshopper sparrow and white-tailed kite are sensitive to the structure of the grassland habitat as it relates to perching and foraging activity. For example, grasshopper sparrows require substantial vertical and horizontal structural diversity, with thick grasses and forbs for nest concealment, and tall forbs and grasses for perching, but also open, bare areas for foraging (Payne et al. 1998; Smith 1963; Vickery 1996; Zeiner et al. 1990). White-tailed kites forage preferentially for voles (*Microtus* spp.), which are limited to tall, dense grasses (Fanes and Howard 1987).

Fuhlendorf and Engle (2001) concluded that natural grassland heterogeneity in the Great Plains of North America reflects a grazing-fire interaction whereby fire and grazing disturbances distributed spatially and temporally over the landscape produce a heterogeneous shifting grassland mosaic that enhances biodiversity and enriches wildlife habitat. The native valley and foothill grasslands of California appear to have been subject to an analogous fire-grazing evolutionary history. The grassland management program therefore should emulate the natural heterogeneity of the grassland ecosystem to promote diversity and enhance wildlife habitat value.

As shown in the conceptual stressor model for native grassland (Figure 10), invasive exotics and over-grazing are the key stressors of the native grassland ecosystem in the Southern Subregion. While fire would be a management tool to control invasives, it is not depicted in the model as a significant current direct stressor of native grassland.

Erosion is a management issue for native grasslands in upper Gabino and Cristianitos canyons.

For annual grasslands, management issues generally are related to maintaining the highest wildlife habitat value of the existing grasslands. A significant management issue for annual grasslands within the RMV Open Space would be controlling the proliferation of artichoke thistle. Mustards and sweet fennel also are herbaceous species that can dominate grassland habitats and reduce their value for wildlife species.

b. Adaptive Management Goals and Objectives

The conservation goals for vegetation communities can be restated in the context of adaptive management for grasslands and associated focal species:

- Ensure the persistence of the physiographic diversity of native and annual grasslands and associated focal species in the RMV Open Space.

- Restore native grassland and enhance the quality of degraded existing native grassland in the RMV Open Space such that net habitat value of the existing grassland system is maintained.

- Improve the quality of annual grasslands as wildlife habitat (e.g., through artichoke thistle control).

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value:

- Conduct monitoring of grassland and focal species in manner that allows reserve owner/managers to track the long-term habitat value of the grassland system.

- Restore __ acres of native grassland to maintain and enhance habitat quality, diversity, and connectivity over the long-term.

- Manage native grassland fire regimes such that germination of native grasses (*Nasella* spp.) is enhanced

- Manage cattle grazing to facilitate restoration of existing areas of native grassland.

- Control invasions of herbaceous exotic species in both native and annual grasslands, including cardoon, mustards and sweet fennel.

c. Monitoring of Grassland and Focal Species

The monitoring program for grasslands would use the same general methods described above for coastal sage scrub and the reader is directed to that section for more detail. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire grassland vegetation database at 5-year intervals.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Period evaluation and update of the grassland vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described in detail above for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later;

- Evaluation and update of the vegetation map at 5-year intervals based on remote interpretation and spot field verification;

- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;

- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program; and

- Concurrent focal species surveys (as described below).

After the first five years of monitoring of grasslands, individual reserve owner/managers would assess the results of their individual monitoring plans and make adjustments and recommendations as to the appropriate schedule for future sampling (e.g., every two or three years), as well as modifications to the number of sample plots (e.g., numbers, locations, etc.).

3. Focal Species Monitoring

A suite of candidate focal species for grasslands was identified in *Section 1.2.2.c*, including eight (8) early warning indicators, three (3) biodiversity indicators, and five (5) umbrella species (*Table 1-11*).

TABLE 1-11
GRASSLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Barn Owl			•
Grasshopper Sparrow		•	
Great Horned Owl			•
House Finch	•		
Lark Sparrow	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Mammals			
Coyote	•		
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**7**	**2**	**3**

The grasshopper sparrow and lark sparrow are indicators of high quality grassland, and their absence may indicate a loss of function. Likewise, absence of the coyote from a habitat patch is associated with an increased occurrence of mesopredators such raccoon, opossum, striped skunk, and feral and pet cats, and consequent reduction of small native species. Anna's hummingbird, house finch, and mockingbird are "edge-enhanced" species whose occurrence may indicate some level of habitat degradation. The Argentine and red imported fire ants are demonstrated threats to native species along habitat edges. The great horned owl, barn owl and red-tailed hawk, as candidate umbrella species, are relatively common in the planning area (and thus measurable), yet have broad enough ranges and habitat requirements to encompass a large number of sympatric species. How sensitive these two species are to environmental stressors and their value to the Adaptive Management Program needs to be determined.

One objective of the Adaptive Management Program would be to determine the efficacy of these candidate focal species for management and monitoring of grassland in the Habitat Reserve. As such, at minimum the occurrence of these species in the RMV Open Space would be monitored. All of these species, and especially the birds, are easily detected, either directly or through indirect indicators (e.g., scat, tracks nests, etc.).

Sample methods for monitoring focal species in general are described above for coastal sage scrub.

d. Management of Grasslands and Focal Species

The Adaptive Management Program for grasslands includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Because the management issues related to annual and native grasslands are quite different, they are discussed separately.

1. Annual Grassland

For the most part management of annual grasslands would be passive, except for the control of artichoke thistle. This species readily invades disturbed annual grassland and is especially pernicious in southern Orange County where control programs are absent. On RMV ongoing control efforts over the past 30 years have limited the occurrence and spread of artichoke thistle. The control of artichoke thistle is discussed in the Invasive Species Control Plan. Other common exotic species such as black mustard and sweet fennel may be kept in check by fire and grazing management.

Much of the management related to annual grasslands would be directed toward limiting the conversion of other upland native communities (coastal sage scrub, chaparral, oak woodland, and native grassland) to annual grassland so that the long-term net habitat value of these native communities in the RMV Open Space is not diminished. From the perspective of habitat value, passive conversion of annual grassland to native grassland and shrub habitats in the RMV Open Space is not considered an adverse effect that would require management.

Because the primary management approach likely would be passive, fewer management resources would be expended for active or experimental management of annual grassland compared to coastal sage scrub. As with coastal sage scrub, reserve owner/managers should take advantage of opportunities to conduct experimental management actions in grassland in response to natural or human-caused disturbances. In these cases, experimental management actions probably would focus on how to re-establish native habitats in areas at risk of converting to annual grasslands or what are the stabilizing factors that prevent annual grasslands from converting to native habitats.

The Adaptive Management Program must retain the flexibility to respond to future management issues for annual grassland that arise through the monitoring program or independent research on the grassland ecosystem.

2. Native Grassland

The primary management approaches to native grasslands would be active and experimental. Existing native grasslands in the RMV Open Space likely would require substantial active management because they are subject to invasions by annual grasses and other exotic forbs. For example, of the approximately 1,020 acres of valley needlegrass grasslands mapped by Dudek on RMV in 2001, or included from other mapping efforts, only 17 acres (2 percent) were mapped as high quality (> 25 percent cover of needlegrass), 580 acres (57 percent) were medium quality (10-25 percent cover), 294 acres (29 percent) were low quality (~10 percent cover), and 128 acres (12 percent) had no rating (these areas were from previous mapping efforts that did not quantify native grassland quality). All native grasslands in the RMV Open Space have a substantial non-native component that likely would need to be actively managed to sustain and enhance the quality of the existing native grassland. Common non-native species observed by Dudek in native grasslands include filarees (*Erodium* spp.), bromes (*Bromus hordaceous*, *B. diandrus*, *B. madritensis*), wild oat (*Avena* spp.), black mustard (*Brassica* nigra), tocalote (*Centaurea* melitensis), smooth cat's-ear (*Hypochoeris glabra*), common catchfly (*Silene gallica*), bristly ox-tongue (*Picris echiodes*), and Russian-thistle (*Salsola tragus*). As stated by Menke (1996):

> *Introduced, alien grasses and forbs native to southern France, Spain and Portugal present a formidable obstacle to restoration and enhancement of native perennial grass populations in California foothill and valley grasslands. … Their diverse set of plant growth forms and phonologies cause fierce resource competition for light and water beginning soon after fall germination and often continue for the entire growing season.* (page 22)

Another management issue for native grasslands, even in the relative absence of non-natives, is the buildup of thatch (dead culm-base of native grass) that affects the vigor of the plant. To remain healthy the plants require the removal of the upper portions of the leaves and reproductive culms by grazing, clipping or burning to stimulate new growth (Menke 1991).

Based on the existing habitat quality, the objective for active management would be to maintain existing grasslands at a level of at least medium quality (i.e., greater that 10 percent cover by native grasses. Considering that at present only 2 percent of the native grasses mapped on RMV have a high quality rating (>25 percent cover), and the difficulties inherent in native grassland restoration, setting a "higher quality" objective for native grassland may be unrealistic and would be a lower priority than riparian/wetland, coastal sage scrub, and oak woodland areas.

Management of native grasslands would be achieved by two primary methods:

1. Grazing management
2. Fire management

Grazing would be the preferred management technique in the RMV Open Space because it meshes well with the existing and future cattle operations on the Ranch. Also, as suggested by Menke (1991), grazing is a primary component of native grassland restoration and management, with fire as a secondary component. Appropriately timed grazing can have several beneficial effects on the vigor native grasslands:

- Removal of litter and thatch
- Recyling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses

Fire can also have beneficial effects on native grassland, especially with regard to reducing litter and thatch and alien species, but frequent burning can damage native grasses. Menke (1991) recommends that burning be used every third or fourth year. In addition, burning may be an effective management tool for native grasslands in conjunction with managing coastal sage scrub and chaparral. In natural mosaics of shrublands, openings often support small patches of native grassland. Periodic burning of sage scrub and chaparral likely would help maintain these native grassland patches and enhance biodiversity and habitat value in these areas.

The Grazing Management Plan provides more detail on the role of grazing management on maintaining native grasslands in the RMV Open Space. A key part of grazing management, in the context of the overall Adaptive Management Program, would be developing a grazing management plan that supports the Ranch's cattle operation while providing adequate management of native grasslands, as well as other native habitats. It is anticipated that experimental range management would be a component of the Grazing Management Plan to determine the most appropriate grazing system for the RMV Open Space within the framework of the ongoing cattle operation. Experimental management actions may include the timing and density of cattle on a pasture. For example, is short, intense grazing more effective in enhancing the sustainability of native grasslands than long-term, moderate grazing densities?

e. Restoration of Native Grassland

The Adaptive Management Program includes a native grassland restoration plan comprised of three main components:

1. Pre-designated restoration of areas with native grassland to mitigate for authorized losses to development;

2. Pre-designated restoration of coastal sage scrub/grassland; and

3. Case-by-case restoration undertaken during the course of long-term adaptive management of the Habitat Reserve.

The native grassland restoration plan in discussed in detail in the Habitat Restoration Plan (Appendix X-2).

The main goals of the native grassland restoration program are to: **(1)** enhance native grasslands in selected areas that currently support low quality grasslands (i.e., less than 10 percent cover of native grass); **(2)** restore native grasslands in appropriate areas that currently support annual grasslands; and **(3)** restore a mix of coastal sage scrub and native grassland in appropriate areas.

With these goals in mind, several areas have been tentatively identified for native grassland restoration or CSS/VGL restoration (see Figure 12). Final selection of areas for enhancement/revegetation would require additional field study to determine the likelihood of a successful restoration program, including factors such as soil conditions and presence of exotic species both within the restoration area and surrounding habitat.

Areas identified for potential native grassland restoration include areas that **(1)** currently support annual grasses, but have suitable soils and are adjacent to existing VGL; **(2)** currently support low quality grassland; and **(3)** would contribute to an overall native grasslands ecosystem (i.e., small, isolated patches of native grasslands would not be considered valuable to the overall system). Because establishing a functioning native grassland system is a goal of the restoration program, impacts to native grasslands in a particular sub-basin may be mitigated in another sub-basin to achieve greater value for the overall open space. Upper Cristianitos and portions of Blind Canyon mesa are targeted for native grassland restoration, with the ability to conduct future restoration in Blind Canyon dependent upon the ultimate configuration of the RMV Open Space.

- Upper Cristianitos is targeted for restoration in order to reduce the generation of fine sediments from clayey terrains, promote stormwater infiltration and to enhance the value of upland habitats adjacent to Cristianitos Creek. This area includes areas of annual grassland underlain by clay soils suitable for revegetation and low quality native grassland suitable for enhancement. These areas also are contiguous with existing medium quality grassland, suggesting a high likelihood of successful restoration.

- Portions of Blind Canyon mesa are targeted for grassland restoration. This area has at least one patch of annual grassland suitable for revegetation and possibly two patches of low quality native grassland suitable for enhancement. These areas are adjacent to existing medium quality native grassland, suggesting a high likelihood of successful restoration. Additional fieldwork in the area may reveal additional restoration opportunities. The ability to conduct restoration in Blind Canyon, however, is dependent on the ultimate configuration of the RMV Open Space.

In some areas, the desired habitat is a mosaic of coastal sage scrub and native grassland that emulates the surrounding habitat characteristics. Such areas would provide suitable habitat for coastal sage scrub and grassland species, and especially species that use sage scrub-grassland ecotones (e.g., gnatcatchers and grasshopper sparrows). These generally are areas that support clay soils and are highly suitable for restoring native grasslands. The following areas are recommended for coastal sage scrub/valley needlegrass grassland (CSS/VGL) restoration: Upper Gabino Canyon and in the Chiquita sub-basin in the area east of the Santa Margarita Water District wastewater treatment plant; the citrus groves west of Chiquita Creek; and the disced areas west of the creek to the Chiquita ridgeline (Figure 12).

- Upper Gabino Canyon currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for a mix of coastal sage scrub and native grassland restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse sage scrub. Allowing a mixed community to regenerate may represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for restoration and several patches of low quality native grassland suitable for enhancement.

- As discussed above for coastal sage scrub, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work would be needed to identify the areas best revegetated with coastal sage scrub alone and coastal sage scrub/native grassland.

Case-by-case restoration of native grassland also may occur under the Adaptive Management Program. As part of the management of the RMV Open Space, RMV may identify further areas suitable or desirable for restoration. Instances that may warrant active restoration consist of the following:

- Existing areas of degraded or low quality native grassland that are not naturally recovering through passive management;
- Areas that are degraded or disturbed by future natural events and it is determined that they would not, or are unlikely to, recover naturally (e.g., an area that has burned too frequently or is infested with exotic species);
- Areas that have been temporarily disturbed either by authorized (e.g., an approved infrastructure project) or unauthorized (e.g., an illegal trail) activity; and
- Specific adaptive management research involving restoration treatments.

Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. These decisions would, in large part, be based on information from the previous year's annual report and would consider the overall budget available for restoration activities in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, RMV would consult with adjacent landowners in anthe effort should be made to undertake a coordinated restoration project to provide the greatest net benefit for grassland and grassland species.

As discussed above, a key feature of the Adaptive Management Program is that restoration activities would be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

The details of the native grassland restoration program are provided in the CSS/VGL Restoration Plan (Appendix X-2). The key management activities of the plan are listed here:

- Identification of priority native grassland restoration areas (areas on RMV are described above);
- Revegetation of existing degraded habitat;
- Re-establishment of native grassland in selected areas in upper Cristianitos Canyon that currently support annual grassland;
- Grazing management;
- Fire management; and
- Control of invasive or exotic plants such as non-native grasses (bromes, wild oats, wild rye), artichoke thistle, black mustard, and other non-native forbs.

1.4.5 Riparian/Wetland and Focal Species

This section addresses the adaptive management of riparian/wetland resources within the RMV Open Space. Resources addressed here include riparian/wetland habitats and watercourses. Vernal pools and vernal pools species are treated separately in *Section 1.5* because they addressed on a site-specific basis.

Through the **Vegetation Community Ranking** process, riparian/wetland was identified as a high priority vegetation community for management and monitoring because of its high **Importance Value** and high **Index of Disturbance**.

a. Adaptive Management Issues

Conceptual stressor models were presented in *Section 1.2.1.b* for riparian/wetland vegetation and associated focal species (Figures 7 and 12). The key stressors on the riparian/wetland vegetation communities are altered hydrology, altered geomorphologic processes, exotic species and drought. These stressors are related to a broad range of adverse community responses, such as reduced community size and distribution, altered flow rates, altered water quality, altered natural stand dynamics, and an altered food web. In addition, as depicted in Figure 12, specific impacts on focal species are related to these broad environmental stressors (e.g., changes in habitat structure) as well as species-specific stressors such as predation of native species by bullfrogs.

As illustrated in the conceptual model for focal species (Figure 12), direct and interactive effects of the stressors can be quite complex. For example, the least Bell's vireo is thought to be affected by several stressors, including too infrequent flood regime, upstream diversion and/or ground water extraction, prolonged drought, exotic plant invasions (giant reed and tamarisk), exotic wildlife invasions (cowbird parasitism, possibly Argentine ants, feral cats, etc.), and human harassment (e.g., noise). Likewise, the model shows the factors which have the broadest impacts on a range of species. For example, upstream water diversions and/or ground water extraction and exotic plants directly cause reduced habitat size, and/or vigor, less surface water and soil moisture, altered flow rates and seasonality and water quality, which, in turn, adversely affects all riparian/wetland focal species; i.e., arroyo toad, snowy egret, least Bell's vireo, southwestern pond turtle and arroyo chub. A management action, for example, would be to control exotic plant invasions, with the goal of maintaining or enhancing habitat quality for all of the native riparian/wetland focal species.

As with the uplands conceptual models, this model would allow RMV to develop experimental management hypotheses. It also would allow RMV to weigh tradeoffs in management actions. For example, different species probably will respond differently to episodic events. While arroyo toads and least Bell's vireo are hypothesized to benefit from periodic flooding, red-tailed hawks and great horned owls may benefit more from maintaining mature riparian woodlands through less frequent flooding.

b. Adaptive Management Goals and Objectives

The Science Advisors conservation goals for vegetation communities and the Southern NCCP/HCP Guidelines can be restated in the context of adaptive management for riparian/wetland habitats and associated focal species:

- Ensure the persistence of the physiographic diversity of riparian/wetland habitats and associated focal species in the RMV Open Space.

- Restore riparian/wetland habitats and enhance the quality of degraded riparian/wetland habitats in the RMV Open Space such that the net habitat value of the existing riparian/wetland habitat system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance habitat value of the riparian/wetland habitat system in the RMV Open

Space. These primary objectives are captured by the SAMP tenets (Draft Watershed Principles) and restated here:

1. *No net loss of acreage and functions of the waters of the U.S./State*
2. *Maintain/restore riparian ecosystem integrity*
3. *Protect headwaters*
4. *Maintain/protect/restore riparian corridors*
5. *Maintain and/or restore floodplain connection*
6. *Maintain and/or restore sediment sources and transport equilibrium*
7. *Maintain adequate buffer for protection of riparian corridors*
8. *Protect riparian areas and associated habitats of listed and sensitive species.*

With respect to objective number 8, the "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" document was prepared in support of the NCCP/HCP and SAMP/MSAA process and is used here to provide information on the physical processes that significantly affect structural habitat and life history requirements of listed riparian/wetland species in the planning area – arroyo toad, least Bell's vireo and southwestern willow flycatcher.

The relationship of the Draft Watershed Principles to the SAMP tenets is such that a direct translation to appropriate management actions can be made. As an example, Tenet 1 of no net loss of acreage and functions of the waters of the U.S./State is related to the following Watershed Planning Principles:

- Principle 2: emulate existing runoff/infiltration patterns
- Principle 3: address potential effects of future land uses on hydrology
- Principle 5: maintain geomorphic structure of major tributaries/floodplains
- Principle 8: protect existing groundwater recharge areas.

Although these are stated as "planning principles," they are also adaptive management principles because their function would have to be monitored and potentially managed over the long term. The reader is directed to Draft Watershed Principles for a full treatment of the planning principles in relation to the SAMP tenets.

c. Monitoring of Riparian/Wetland and Focal Species

The monitoring program for riparian/wetland habitats would use the same general approach described above for upland habitats. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire riparian/wetland vegetation database as part of the RMV Open Space 5-year mapping.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., downstream of development areas and along the Open Space-development edge).

1. Vegetation and Abiotic Systems Monitoring

Periodic evaluation and update of the riparian/wetland vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described for coastal sage scrub. However, riparian/wetland systems pose a more complex monitoring challenge than uplands because of the number of interacting processes, including geomorphology, hydrology and biology. Consequently the monitoring program for riparian/wetland habitats also would include monitoring channel morphology and hydrology. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever is later;
- Evaluation and update of the vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program (as described below);
- Monitoring of channel morphology (as described below); and
- Monitoring of stream and groundwater hydrology (as described below).

Channel morphology would be monitored by using transect lines for measuring cross-sectional profiles to monitor sediment movement (transport and deposition), peak discharges, and changes in stream morphology. Selection of transect line areas would be based on stressor-related management issues within the Habitat Reserve, such as areas adjacent to, or downstream of, urban development. Selection of specific transect lines within an area would be based on a sampling for various factors such as existing channel pattern characteristics, instream riparian/wetland communities and adjacent upland vegetation communities, and adjacent land uses or extent of human-caused disturbances. Variables to be measured include elevations, breaks of slope in the channel, active floodplain, bankfull elevations, and stream terraces. Permanent endpoints of the transect locations would be recorded using GPS.

Stream hydrology would be monitored through stream gauges placed at representative sites in major drainages, or other locations determined to relevant to management of the Habitat Reserve. These data would be used to monitor long-term water supplies and changes in streamflow characteristics in relation to the health of the riparian/wetland system.

Groundwater monitoring would be accomplished through collection of well data where groundwater plays a significant role in streamcourse hydrology. Long-term information on subsurface water fluctuations is key to understanding discharge/recharge cycles in relation to natural wet/dry cycles and development-related influences (e.g., extractions, urban runoff, etc.), and to determine whether groundwater levels are in disequilibrium.

Riparian/wetland plant community monitoring would be conducted in tandem with the channel morphology monitoring along the transects described above. Because riparian systems are long and narrow, sample areas will be perpendicular to the channel transects and generally will be rectangular in shape, following the natural shape of the riparian system. The Orange County vegetation classification system would be used (Gray and Bramlet 1992). Functional variables that would be measured within the riparian/wetland community include species composition and heterogeneity (abundance and richness), native recruitment, density, trunk diameter, plant roughness, coarse woody debris, surfaces suitable for microbial activity, aerial net primary productivity, and percent vegetative cover in each strata. To the extent feasible, sample plots would be within homogeneous plant communities and ecotones would be avoided to reduce the influence of adjacent plant communities.

2. Focal Species Monitoring

A suite of candidate focal species for riparian/wetland habitats was identified in *Section 1.2.2.c*, including 14 early warning indicators, five (5) biodiversity indicators, and six (6) umbrella species. These species are presented in *Table 1-12*.

TABLE 1-12
RIPARIAN/WETLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Anna's Hummingbird	•		
Barn Owl			•
Brown-headed Cowbird	•		
European Starling	•		
Great Horned Owl			•
House Finch	•		
Least Bell's Vireo	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Snowy Egret	•	•	
Yellow Warbler	•	•	
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Amphibians			
Arroyo Toad	•		
Bullfrog			
Reptiles			
Southwestern Pond Turtle	•	•	
Fish			
Arroyo Chub	•	•	
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**14**	**5**	**6**

T*able 1-2* summarizes the stressor known or expected to act on these focal species. For example, the least Bell's vireo, yellow warbler and snowy egret, as avian indicators of high riparian/wetland habitat quality, also are sensitive to various kinds of stressors and thus may serve as valuable early warning indicators. The vireo and warbler are sensitive to flood regimes and nest predation by the brown-headed cowbird. The snowy egret nests in ponds and slow-moving streams with dense emergent wetlands and reportedly is extremely sensitive to pesticides and human disturbance (Zeiner et al. 1990).

In addition to these focal species, the southwestern willow flycatcher, as a listed Identified Species, would be specifically monitored.

Although the specific monitoring sites for riparian/wetland species have not been selected, and additional field studies would need to be conducted to select the most appropriate sites, several areas for monitoring the three listed species – least Bell's vireo, southwestern willow flycatcher, and arroyo toad – are identified, along with the species occurring in the area.

1. GERA – *important populations/key locations* of least Bell's vireo and southwestern willow flycatcher
2. San Juan Creek between Antonio and RMV boundary – *major population* of arroyo toad
3. Upper San Juan Creek – *major population/key location* of arroyo toad
4.
5. Talega Canyon – *major population/key location* of arroyo toad
6. Lower Gabino Canyon – *important population/key location* of arroyo toad
7. Lower Cristianitos Canyon – *important population/key location* of arroyo toad

As with the California gnatcatcher, survey methods that are appropriate for avian species in relation to the specific management issues being addressed would need to be developed, including the number of surveys per breeding season and whether surveys entail area search, point counts, mist netting and/or territory mapping (e.g., CalPIF 2002). Typically surveys for vireos and flycatchers, as well as many other riparian species such as yellow warbler, can be conducted concurrently.

The survey methods employed for the arroyo toad likewise should be tailored to the kinds of management questions being asked. For example, the number of calling males is the question, surveys would occur early in the breeding season on nights conducive to high activity levels, as noted below. Likewise, studies of breeding pool persistence and local recruitment may focus on periods later in the breeding seasons. The timing of surveys for the arroyo toad is complicated by the fact that toad activity during the breeding season can be variable, with some nights having little activity and others having high activity in relation to factors such as air and water temperature, cloud cover, moonlight and other factors.

d. Management of Riparian/Wetland and Focal Species

Appendix J

The Adaptive Management Program for riparian/wetland habitats includes the two types of management described above in *Section 8.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

These general approaches are described in detail above for coastal sage scrub. However, the riparian/wetland systems are often much more complex than the upland systems, probably more sensitive to biotic and abiotic stressors (e.g., giant reed or tamarisk invasion, surface flow and ground water levels, sedimentation, water quality, etc.), and likely would require more active long-term management than the upland systems.

The "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" summarizes the landscape processes and specific habitat requirement for listed riparian species that occur in the RMV Open Space- arroyo toad, least Bell's vireo and southwestern willow flycatcher. General issues that likely would require near-term active management at a landscape watershed and sub-basin level, include:

- Emulating natural flood regimes to maintain coarse sediment yields, storage and transport processes.

- Emulating, to the extent feasible, the existing runoff and infiltration patterns in consideration of specific terrains, soil types and ground covers.

- Emulating natural timing of peak flows of each sub-basin relative to mainstem creeks.

- Managing existing groundwater recharge areas supporting riparian zones and maximize groundwater recharge of alluvial aquifers to the extent consistent with aquifer capacity and habitat management goals.

- Managing water quality through various strategies, with an emphasis on natural treatment systems such as water quality wetlands, swales and infiltration areas and application of Best Management Practices.

These management principles are explained in more detail in the Draft Watershed Principles.

Issues that likely would require near-term active management at a site-specific, vegetation community level include:

- Management of excessive surface and subsurface water flows and sediment in Gobernadora Creek.
- Potential changes in water supplies to San Juan Creek.
- Control of invasive exotic plant species such as giant reed, tamarisk, and pampas grass in riparian zones, particularly in San Juan and lower Cristianitos creeks.
- Management of ponds and other open waters with lacustrine and fresh emergent vegetation.
- Grazing management.
- Fire control.

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- Control of human access and recreational activities in riparian/wetland habitat areas.
- Management of sand and gravel mining operations.

Issues that likely would require near-term active management at the focal species level include:

- Control of brown-headed cowbirds.
- Control of Argentine and imported red fire ants.
- Control of human activities around sensitive nesting areas.
- Control of vehicular traffic in the RMV Open Space.
- Control of exotic aquatic predators (bullfrogs and possibly crayfish and introduced fishes)
- Control of terrestrial mesopredators (feral cats, dogs, skunks, raccoons, opossums)
- Control of collections and harassment by humans.
- Provision of adequate wildlife crossings/habitat linkages and fences along roadways at key crossing locations.
- Control of artificial lighting and noise.

As emphasized above for upland systems, adaptive management actions should be undertaken within the framework of experimental management hypotheses to the extent feasible. A substantial amount of baseline work has already been completed regarding the hydrology, geomorphology and biology of RMV aquatic systems that would provide a basis for experimental management hypotheses. For example, the document "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" provides information on the physical processes that significantly affect structural and life history requirements on listed riparian/wetland habitat species. Other documents that provide valuable background information for the Adaptive Management Program are the "Baseline Geomorphic and Hydrologic Conditions," the Watershed Planning Principles, and the Southern NCCP/HCP Guidelines.

A number of management hypotheses can be generated from the stressor models illustrated in Figures 7 and 12. Some of these hypotheses could be examined opportunistically in response to natural events at a watershed or sub-basin level. For example:

- Frequent floods resulting in scouring of mature vegetation and replacement by younger stands causes a temporary decline in suitable raptor nest sites.

- Infrequent flood regimes result in maturation of the riparian zone and cause the decline of species dependent upon periodic flooding, including least Bell's vireo, southwestern willow flycatcher, yellow warbler, and arroyo toad.

Tracking the change in habitat composition and quality and associated species composition following disturbance events should be included in the monitoring program. For example, after a significant flood event or wildfire, what is the temporal pattern of species use in relation to riparian stand recovery and age?

Other experimental management hypotheses were identified to be tested in an *a priori* fashion by setting up experimental and control study plots: For example:

- Control of bullfrogs from Calmat Lake will increase the arroyo toad and southwestern pond turtle populations.

- Control of giant reed in San Juan Creek below the RMV boundary will increase the local arroyo toad population and nesting habitat for species such as least Bell's vireo, southwestern willow flycatcher, yellow warbler and southwestern pond turtle. Initiation of such a control program should only be undertaken in coordination with the upstream landowners (i.e., County of Orange as landowner of Casper's Regional Park) to provide for a reasonable likelihood of a successful control program.

- Increasing spring stormwater flows into San Juan Creek will increase breeding habitat quality for the arroyo toad by providing breeding pools that persist longer and support toad metamorphosis.

- Control of Argentine ants will increase the reproductive success of least Bell's vireo, southwestern willow flycatcher, and yellow warbler.

Appendix J

To illustrate how the Adaptive Management Program would address the management and monitoring of a riparian system and associated focal species using the environmental stressor approach, an example using the arroyo toad population in San Juan Creek is provided here.

Information on the autecology of the arroyo toad, as summarized in the "Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species" document, provides the scientific foundation for the management and monitoring approach. This document summarizes the key arroyo toad habitat components, including:

- Low-gradient streams with periodic scouring and filling regimes characterized by features such as late season or near perennial flow, shallow pools persisting until at least midsummer, open streamside sand/gravel flats, and sparsely vegetated low sandy benches within the channel and along shoreline.

- Sandy and loamy sand soils in both riparian and adjacent upland zones suitable for burrowing.

- Breeding pool substrates of sand or well-sorted fine gravel.

- Adjacent riparian habitats extending up to 100 meters from stream channel, supporting sycamores, cottonwoods, oaks, and willows, with understories of mule fat, short grasses, herbs, leaf litter and patches of bare ground.

- Floodplain connectivity allowing free access between estivation areas and breeding pools.

- Adjacent upland habitat that may be outside 100-year floodplain and used for foraging and estivation. Characterized by friable soils for burrowing and stabilized by brush and trees.

- Periodic and unpredictable hydrology (probably < 10 year cycle) that alters channels, breeding pool locations, sand deposition and vegetation.

- Ponded areas fed by surface flows that persist for a least a few months of the year and have low surface area to volume ratios to prevent premature evaporation.

The known or highly likely "extrinsic" stressors (now and in the future) in San Juan Creek are:

- Bullfrog (there may be other exotic predators on RMV, but bullfrog is clearest problem)

- Giant reed
- Lack of adequate surface water to support breeding pools for duration of season (probably exacerbated by giant reed infestation)
- Groundwater pumping
- Human activities (to a lesser degree)

Based on these habitat requirements and identified stressors, several hypotheses that could be tested through management and monitoring are listed below, along with experimental approaches to test the hypothesis.

- Initial elimination/control of giant reed will increase surface and subsurface water flows and provide for natural regeneration of suitable arroyo toad habitat.

  1. Remove giant reed from RMV property within San Juan Creek and concurrently monitor groundwater and surface flows.

  2. Take cross-sectional profiles to measure sediment transport, peak discharges, changes in stream morphology and changes in vegetation characteristics.

  3. Monitor colonization of restored areas by arroyo toad.

- Timed-grazing will keep giant reed proliferation in check.

  1. Allow cattle into selected areas where mature stands of giant reed have been removed but new growth is appearing; i.e., will the cattle eat the giant reed shoots? Compare with control areas where cattle are excluded.

- Elimination/control of bullfrogs will increase productivity of arroyo toad populations.

  1. Establish arroyo toad baseline population levels at experimental bullfrog elimination/control locations (e.g., Calmat lake and elsewhere they are found within San Juan Creek on RMV property) and at control sites that support toads but do not have a bullfrog problem (e.g., upper San Juan Creek or Bell Canyon).

  2. Eliminate/control bullfrogs at experimental sites.

  3. Monitor reproduction of arroyo toads (e.g., numbers of adult toads, metamorph survival) in proximity to bullfrog locations and at control sites to control for natural variation on toad populations.

- Changes in land uses, such as removal of nursery and agricultural operations for development, may change groundwater and surface flows and affect arroyo toad populations.

  1. Monitor groundwater and surface flows in areas likely to be affected by land use changes and control sites in order to control for short-term weather and long-term climatic variation.

  2. Monitor reproduction of arroyo toads (e.g., numbers of adult toads, metamorph survival) in areas likely to be affected by land use changes and at control sites.

e. Restoration of Riparian/Wetland

The Adaptive Management Program includes a riparian/wetland restoration plan comprised of two main components:

1. Pre-designated enhancement and revegetation areas; and

2. Case-by-case restoration undertaken during the course of long-term adaptive management of the Habitat Reserve.

The riparian/wetland restoration plan is intended to complement and supplement the protection and management measures for the riparian/wetland ecosystem in the Habitat Reserve. The goals of this integrated protection and restoration program are to:

- Maintain and restore riparian ecosystem integrity; and.

- Maintain/protect/restore riparian corridors.

To achieve these goals, restoration is recommended for middle San Juan Creek, Gobernadora Creek, upper Gabino Creek, and lower Cristianitos Creek. Identification of these areas for restoration is based on riparian system invasive species mapping completed by PCR (2002) and GLA (2003) as well as the Draft Watershed Principles.

- Middle San Juan Creek between the creek crossing south of the Colorspot Nursery and the RMV boundary near Bell Canyon supports abundant giant reed and scattered locations of pampas grass and tamarisk. This reach of San Juan Creek supports a *major population* of the arroyo toad and an *important population* of the yellow warbler.

- Gobernadora Creek is targeted for riparian/wetland restoration to address: **(1)** the historic meander conditions; and **(2)** excessive sediment input resulting from upstream land uses. Restoration may include the construction of a detention/water quality basin below Coto de Caza. There are at least four scattered locations of giant reed in Gobernadora Creek, two in the reach just south of Coto de Caza and two in GERA. The GERA portion of the creek supports *important populations* of the least Bell's vireo, southwestern willow flycatcatcher, and yellow warbler. Creation of wetland breeding habitat for an Identified Species, the tricolored blackbird, should be considered a priority in the Gobernadora area because breeding populations have regularly occurred in the ponds in southern Coto de Caza. Northward extension of riparian habitats from GERA also would provide additional breeding habitats for Least Bell's vireo, southwester willow flycatcher, and yellow warbler, as well as raptors and other riparian/wetland species such as yellow-breasted chat and two-striped garter snake.

- Upper Gabino Creek currently generates fine sediments due to extensive gully formation in the headwaters area. To address this excessive sediment generation and reduce downstream impacts, both upland and riparian/wetland habitat restoration is recommended. Depending on the type of riparian/wetland restoration in upper Gabino Canyon, various riparian/wetland species could benefit, including focal species such as the yellow warbler and southwestern pond turtle, Identified Species such as the tricolored blackbird, and other riparian/wetland species such as the yellow-breasted chat and two-striped garter snake.

- Lower Cristianitos Creek supports patches of tamarisk near the confluence and giant reed and pampas grass west of the TRW facility south to the RMV boundary. This reach support an *important population* of the arroyo toad, a well as several nest sites for least Bell's vireo and other riparian species such as yellow-breasted chat. Restoration in this area also would benefit several listed species downstream of the RMV boundary Cristianitos and San Mateo creeks: least Bell's vireo, southwestern willow flycatcher, tidewater goby and southern steelhead.

In addition to habitat restoration focused on the control of invasive exotic species, several smaller scale creek stabilizations are recommended to address locally-induced headcuts in Chiquita Creek and upper Cristianitos Creek.

Locally-induced headcuts (as contrasted with valley deepening reflecting longer-term sea level change and geologic processes) are present in Chiquita Creek and Upper Cristianitos Creek. Some headcuts in Chiquita Creek and upper Gabino Creek are caused by the placement of road crossings or other human-induced causes. Headcuts in Cristianitos Creek may have a similar origin but may also be strongly influenced by long-term geologic processes. Further investigations of the causes of the

Cristianitos Creek headcuts, as well as monitoring the results of native grassland restoration in upper Cristianitos Canyon, would be necessary before identifying a specific restoration approach.

The reader is directed to the Habitat Restoration Plan (Appendix X-2) for the details of the riparian/wetland restoration approach.

Riparian/wetland restoration also would be conducted on a case-by-case basis over the long-term management and monitoring of the RMV Open Space. Through periodic monitoring of the overall vegetation communities and focused frequent monitoring of potential exotics hotspots, RMV would target areas for local enhancement and restoration. Because the invasion of the riparian/wetland areas by giant reed, tamarisk and pampas grass is related to dynamic and unpredictable natural events, RMV would need to develop protocols for checking areas susceptible to invasions.

As discussed above for upland habitats, case-by-case restoration actions primarily would be the decision of RMV consistent with the goals and objectives of the Adaptive Management Program. For example, because exotic species invasions of riparian/wetland systems have profound implications for downstream resources, it would be crucial for RMV to coordinate with upstream landowners. Restoration in a downstream location within the RMV ownership would have little long-term beneficial effect if upstream sources of invasives also are not controlled. Generally, restoration should start in the upstream locations and work downstream.

Experimental restoration projects (e.g., testing different methods of control) would be conducted in a manner that the specific management action can be rigorously tested.

1.4.6 Woodlands and Focal Species

This section addresses the adaptive management of woodlands resources within and focal species. Woodlands in the RMV Open Space encompass coast live oak woodland, coast like oak savanna, coast live oak forest and canyon live oak forest. For the purposes of the management and monitoring program, these woodlands are considered upland habitats, as distinct from riparian woodlands and forests. Oak woodland is a lower priority for management and monitoring because of its low **Vegetation Community Ranking** score relative to the other major vegetation communities addressed by the Adaptive Management Program (Tables 1-8a and 1-8b).

a. Adaptive Management Issues

As illustrated in the conceptual stressors models (Figures 6 and 11) a number of natural and human-induced factors have been recognized as important for the conservation and management of oak woodlands in California.

A major stressor of oak woodlands is altered hydrology. Subsurface de-watering or prolonged drought may affect the viability of mature coast live oak that are thought to utilize the water table in some areas by developing deep taproots (Callaway 1990). Loss of available surface water has a detrimental effect on the sprouting of seedlings (Stephenson and Calcarone 1999). Alternatively, over-watering resulting from urban run-off and summer irrigation can make oaks more susceptible to various oak root diseases resulting from water mold fungi such as *Phytopthora* (Raabe 1990).

Fire also is a key stressor of oak woodlands. Oaks are adapted to wildfires and oak recruitment appears to depend on relatively frequent fires (e.g., McClaran and Bartolome 1989). Although fire can kill the tops of seedlings and saplings, they can resprout in the first year after a fire. In addition, Fry (2002) found that scorching of oaks was positively correlated with the crown damage and the likelihood of resprouting. On the other hand, a high intensity fire can severely damage or kill mature trees. Fires that cause trunk scars can make the tree more susceptible to disease (Fry 2002). Also, if fires occur too frequently, ground cover can become dominated by annual grasses that compete for available surface water and affect acorn recruitment and growth.

Grazing and browsing can have both detrimental and beneficial effects on oak woodlands. On the one hand, cattle and mule deer browse on seedlings and saplings, and thus depress oak recruitment. In addition, trampling of soils in the winter results in soil compaction that reduces their ability to absorb water or seeds. On the other hand, managed grazing can control the proliferation of annual grasses and invasive weeds that compete with oak seedlings and saplings for available surface water and soil nutrients, as well as reduce the risk of "laddering" fires than can kill oaks.

Predation on acorns, seedlings, and saplings can have substantial effects on oak woodlands. For example, ground squirrels, deer mice, scrub jays, and acorn woodpeckers prey on acorns, while pocket gophers, cattle, and deer consume seedlings and saplings. Although most of these predators are native species, and presumably oaks have evolved in their presence (i.e., these native predators are examples of *intrinsic drivers*), in combination with non-native predators such as cattle, and other *extrinsic drivers* such as exotics, altered hydrology, and short fire intervals and/or intense fire, the predation pressure on acorns, seedlings and saplings may exceed the ability of the oak woodland system to withstand these stressors. That is, the system may be pushed beyond its natural resilience.

b. Adaptive Management Goals and Objectives

Appendix J

The Science Advisors' conservation goals for vegetation communities and those of the Southern NCCP/HCP Guidelines can be restated in the context of adaptive management for oak woodland habitats and associated focal species:

- Maintain the physiographic diversity of oak woodland habitats and associated focal species in the RMV Open Space.

- Restore oak woodland habitats and enhance the quality of oak woodland habitats in the RMV Open Space such that the net habitat value of the existing oak woodland system is preserved.

Consistent with these goals, the following management objectives would be addressed to help maintain and enhance long-term habitat value of the oak woodland habitat system in the RMV Open Space.

- Conduct monitoring of oak woodlands and focal species to track the long-term habitat value of the oak woodland system.

- Maintain appropriate subsurface hydrology to avoid under- and over-watering.

- Manage fire regimes in oak woodlands such that a natural diversity and balance of age-stands are maintained throughout the RMV Open Space; i.e., there is an appropriate mix of mature trees and recruitment of new trees.

- Manage cattle grazing such that adverse impacts to oak woodlands are controlled to preserve net habitat value.

- Control exotics invasions of oak woodlands, especially along the Open Space-urban interface or other identified vulnerable areas (e.g., along existing paved and dirt roads, utility easements).

- Maintain suitable nesting habitat in oak woodlands, and specifically potential nest cavities in snags, dead or decaying limbs, and hollow trunks for acorn woodpecker. (As a primary cavity nester (i.e., species that excavate their own holes for nests), acorn woodpeckers may be a keystone species for secondary cavity nesters that utilize abandoned holes. Other native cavity nesters that would benefit from management and monitoring of acorn woodpecker include ash-throated flycatcher, Nuttall's woodpecker and western screech owl.)

- Retain large oaks (greater than 50 in. dbh) to the maximum extent possible to provide granaries for acorn woodpeckers.

- Identify trees with high acorn productivity.

- Maintain acorn production and protect seedlings and saplings to support establishment of new trees. Management would entail addressing the following issues:

    - Maintain acorn production to provide forage for native wildlife such as acorn woodpeckers, scrub jays, squirrels, mice and mule deer. (It is important to maintain native predators of acorns, seedlings and saplings because they may be important components of the oak woodland ecosystem, especially in regard to dispersal of acorns or mycorrhizal fungi. Acorn predators such as mice also provide food for other oak woodland species such as Cooper's hawk and white-tailed kite. The challenge is to balance these natural predators with viable oak woodland systems that can naturally regenerate.)

    - Protect seedlings and saplings in stands of oak woodlands in the RMV Open Space where predation by native and non-native species is excessive, including by the use of protective structures where necessary.

- Maintain the complex understory of shrubs, grasses annual forbs, leaf litter and downed woody debris that provide habitat for the lark sparrow and orange-throated whiptail, as well as variety of other wildlife species.

- Maintain native habitats adjacent to oak woodlands in the RMV Open Space to the extent possible to preserve the landscape mosaic.

- Protect habitat supporting upper trophic predators such as bobcats and coyotes within oak woodlands to control native and non-native mesopredators.

- Restore oak woodlands in areas that currently support stands that are damaged or stressed by natural or human-induced factors, and where the adverse impact may not be naturally reversible (e.g., irrigation of drought-stressed trees). (Note that a specific *a priori* restoration objective for oak woodlands has not been formulated, even though restoration of oak woodland is a stated goal of the Adaptive Management Program because at this time specific areas warranting restoration of oak woodlands have not been identified. However, areas within the RMV Open Space requiring restoration may be identified in the future, either as a result of more detailed field investigation of existing conditions or as triggered by natural or human-induced events.)

- Conduct management activities (e.g,, prescribed fire, discing, mowing, timed grazing) in a manner that minimizes impacts oak woodland wildlife species to the extent feasible. It should be noted that some management activities, that over the long-term benefit oak woodlands and associated species (e.g., controlling exotics to enhance seedling and sapling viability or reduce fire intensity) may temporarily affect focal species such as lark sparrow and orange-throated whiptail. These short-term impacts are considered acceptable in the interest of long-term benefits.

c. Monitoring of Woodlands and Focal Species

The monitoring program for oak woodland habitats (including coast live oak woodland and coast live oak forest) would use the same general approach described above for other upland habitats. The key points for the monitoring program are summarized here:

1. Evaluation and update of the entire oak woodland vegetation database as part the overall RMV Open Space 5-year mapping effort.

2. Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the diversity of the Open Space and in key areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

1. Vegetation Monitoring

Periodic evaluation and update of the oak woodland vegetation community would be part of the overall review of the RMV Open Space vegetation database that would occur at 5-year intervals, and as described for coastal sage scrub. Key aspects of the monitoring program are:

- Establishment of a baseline vegetation map for the RMV Open Space within two (2) years of executing the Development Agreement or required Wildlife Agency approvals whichever comes later;
- Evaluation and update of the baseline vegetation map at 5-year intervals based on remote interpretation and spot field verification;
- Collection of regional climate, weather and air quality information to examine potential correlations between vegetation changes and these environmental variables;
- Annual field studies on selected permanent sample plots for at least the first five (5) years of the monitoring program; and
- Concurrent focal species surveys (as described below).

Selection of specific monitoring locations for oak woodlands would require additional field work, but would be selected to provide physiographic representation within the Habitat Reserve. Areas with substantial stands of oak woodlands that should be considered for monitoring include:

- Lower Gabino Canyon
- La Paz Canyon
- Upper Gobernadora Canyon
- Lower Cristianitos Canyon
- Blind Canyon
- Donna O'Neill Land Conservancy at Rancho Mission Viejo
- Wagon Wheel Canyon
- The "Narrows" area of Chiquita Canyon
- Lower Chiquita Canyon

Monitoring of oak woodlands would be drawn from the following methods:

- Establish pseudo-randomized plots around stands. Sample plots should include the range of existing habitat conditions within the RMV Open Space, including elevation, slope and aspect, proximity to roads and urban development, and uses within the RMV Open Space(e.g., recreation, grazing, fully protected areas, etc.). Exclude plots with less than 10 percent cover and less than at least three oak trees that meet or exceed 4 in dbh (diameter at breast height, or 4.5 ft from the ground).
- Tag trees and record species, tag number, dbh (in), height (ft) and dominance (i.e., is the tree in the canopy of another tree or does it form the canopy?). Note slope and aspect of each tree, understory species (including proportion of natives to exotics), presence of debris and litter, soil type, depth, and parent material and elevation.
- Assess the status of trees as stressed or dead by examination of bark and small branches for dryness and brittleness. Trees would be classified as "healthy" if less than 50 percent brown and leafless, "partially dead" if at least 50 percent brown and leafless, and "dead" of entire tree appears brown and leafless (following Tietje et al., UC Cooperative Extension, Integrated Hardwood Management Program).
- Assess acorn production.
- Create oak tree database through the use of software specially developed to track discrete resources (e.g., TreePro software that links the database to GIS mapping capabilities).

2. Focal Species Monitoring

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A suite of candidate focal species for oak woodlands was identified in *Section 1.2.2.c*, including ten (10) early warning indicators, three (3) biodiversity indicators, and six (6) umbrella species. These species are presented in *Table 1-13*.

TABLE 1-13
OAK WOODLAND CANDIDATE FOCAL SPECIES

Species	Early Warning	Biodiversity	Umbrella
Birds			
Acorn Woodpecker	•	•	
Anna's Hummingbird	•		
Ash-throated Flycatcher		•	•
Barn Owl			•
European Starling	•		
Great Horned Owl			•
House Finch	•		
Lark Sparrow	•	•	
Mockingbird	•		
Red-tailed Hawk			•
Mammals			
Bobcat			•
Coyote	•		
Mountain Lion			•
Mule Deer			•
Reptiles			
Orange-throated Whiptail	•		
Invertebrates			
Argentine Ant	•		
Imported Fire Ant	•		
Total	**10**	**3**	**6**

Table 8-2 summarizes the stressor(s) known or expected to act on these focal species. The acorn woodpecker, in particular, should be an extremely valuable early warning and biodiversity indicator. As stated in the "Oak Woodland Bird Conservation Plan (CalPIF 2002),

> *Of all the birds that rely upon California's oaks, the Acorn Woodpecker is the one most intimately linked to the habitat.* (page 45)

The acorn woodpecker is highly dependent on acorn production and a reduction in oaks and acorns production may cause a decline of this species in an area. Furthermore, as a primary cavity nester, it excavates its own cavities and provides potential nest sites for secondary cavity nesters such as ash-throated flycatcher and western screech owl.

Both the lark sparrow and orange-throated whiptail use the understory litter and debris associated with oak woodlands. Both species are likely to be sensitive to invasions of the oak understory by non-native annual grasses and weedy forbs, as well as over-grazing and frequent burning. In addition, the orange-throated whiptail is sensitive to invasions by Argentine and red imported fire ants that displace native prey.

Oak woodlands also provide potential nesting and roosting habitat for the three avian umbrella species: red-tailed hawk, great horned owl and barn owl.

d. Management of Woodlands and Focal Species

The Adaptive Management Program for woodlands includes the two types of management described above in *Section 1.3.2*: (1) passive management; and (2) active management. "Passive management" does not involve direct and active manipulation of resources, whereas "active management" implies direct action, and may include both "routine" and "experimental" management.

Issues that likely would require active management at a habitat level include:

- Control of invasive exotic plant species, especially annual grasses.
- Management of surface and subsurface hydrology to avoid both over- and under-watering.
- Grazing management.
- Fire management.
- Control of predation on seedlings and saplings.
- Maintain snags, decaying wood, and dead limbs to provide nesting habitat for primary and secondary nesting-cavity focal species; i.e., acorn woodpecker and ash-throated flycatcher.
- Maintain understory litter and debris to provide habitat for understory focal species; i.e., orange-throated whiptail, and lark sparrow.

Issues that likely would require active management at the focal species level include:

- Control of Argentine and red imported fire ants.
- Control of human activities around sensitive nesting areas.
- Control of vehicular traffic in the RMV Open Space.
- Control of terrestrial mesopredators (feral cats, dogs, skunks, raccoons, opossums)

- Control of artificial lighting and noise.

As stressed above for upland systems, adaptive management actions should be undertaken within the framework of experimental management hypotheses to the extent feasible. A number of management hypotheses can be generated from the stressor models illustrated in Figure 6 and 11. Some examples of management hypotheses that were identified for oak woodlands incude:

1. Managed grazing that reduces the cover of annual grasses and weedy forbs while also protecting seedlings and saplings and soils from cattle (i.e., exclosures) will facilitate oak reproduction by reducing competition between oaks and exotic species for surface water and nutrients.

2. Managed fire regimes that reduce the cover of annual grasses and forbs will facilitate oak reproduction by reducing competition between oaks and exotic species for surface water and nutrients.

3. The abundance of starlings (i.e., cavity nesters) in stands of oak woodland will be inversely related to the abundance of native cavity nesting species.

4. Presence/absence of dead standing trees and limbs, snags, decaying woodland will be correlated with the abundance of cavity nesting species.

5. Presence/absence of understory debris and litter will be correlated with the abundance of understory species.

e. Restoration of Woodlands

The Adaptive Management Program provides for case-by-case restoration of oak woodlands undertaken during the course of long-term adaptive management of the Habitat Reserve, with the overall goal of maintaining the existing diversity and habitat value of oak woodlands in the RMV Open Space.

The two main objectives of the oak woodlands restoration program are:

1. To restore oak woodlands in areas that support existing mature trees, but where recruitment and regeneration are being inhibited by factors such as exotic weeds and annual grasses or over-grazing.

2. To restore oak woodlands in areas that are degraded or disturbed by future natural events and it is determined that they would not, or are unlikely to, recover naturally (e.g., an area that has burned too frequently);

The first objective of restoring oak woodlands would be achieved by (a) identifying any degraded oak woodlands, and (b) focusing the restoration effort in degraded areas adjacent to healthy stands of oak woodland to the extent possible. A near-term management task would be to identify any such areas in the Habitat Reserve. Following management recommendations of CalPIF (2002), sites identified for restoration should then be prioritized on basis of their proximity to high quality sites and their likely success of regeneration and transplanted oak viability. Restoration of sites in close proximity to existing high quality sites have a better chance of being colonized by oak woodland species.

The second objective of restoring areas that are disturbed in the future is important for maintaining long-term net habitat value. For example, sites that currently support high quality oak woodlands but are damaged by a high intensity fire or several fires at short intervals may be identified for restoration.

As part of the management of the various lands in the RMV Open Space supporting oak woodlands, RMV would identify areas suitable or desirable for restoration. Generally it would be the RMV's decision whether to undertake a restoration project in the RMV Open Space. However, where the project may affect adjacent lands managed by different managers or be affected by habitat conditions on the other ownership(s), a coordinated effort may be desirable. For example, if restoration is called for following a wildfire that affected lands adjacent to the RMV Open Space, RMV would consult with adjacent landowners in an effort to provide the greatest net benefit for oak woodlands and oak woodland species.

Restoration sites would be evaluated for their suitability including water table and soil conditions. Merrick et al. (1999) describe a knowledge-based model to evaluate sites for restoration suitability for valley oak (*Q. lobata*). If oaks currently are present or the site supported oaks in the recent past, it is considered to be suitable. If the site is not currently occupied by oaks, but has high soil water holding capacity, a high water table and loam soils, it is considered favorable for restoration.

As discussed above, a key feature of the Adaptive Management Program is that restoration activities would be conducted in a systematic and scientific manner such that experimental management hypotheses can be rigorously tested.

8.5 Adaptive Management Of Site-Specific Resources

This section addresses the monitoring and Adaptive Management Program for site-specific resources, including vernal pools and associated species and plants that are Identified Species.

1.5.1 Vernal Pools and Associated Species

The RMV Open Space supports two main areas of vernal pools. The Dudek/PCR study conducted in 2001 mapped three pools on Chiquita Ridge and three pools on the Radio Tower Road mesa located between Highway 74 and Trampas Canyon (Figure 15). Both areas supporting the vernal pools are characterized by native and non-native grasslands. The Chiquita Ridge area formerly was used for cattle grazing but is now in the Ladera Open Space and cattle have been excluded from the area. The Radio Tower Road area currently is grazed, generally from October through May, and planned for continued grazing as part of long-term cattle ranch operations.

The large pool on Chiquita Ridge (pool 4) supports both the Riverside and San Diego fairy shrimp and a smaller pool (pool 3) supports only the San Diego fairy shrimp. Two of the three pools on the Radio Tower Road mesa (pools 2 and 7) support both species and the third (pool 1) supports only the San Diego fairy shrimp).

Notably only one special status plant species – the CNPS List 2 mud nama – is known from the vernal pools in the RMV Open Space. Because mud nama is not state- or federally-listed and no impacts related to development are anticipated, this species is not an Identified Species for regulatory coverage.

a. Adaptive Management Issues

Five main issues typically are considered in the management of the vernal pools and associated species:

1. Hydrology
2. Water quality
3. Grazing
4. Invasive exotic species
5. Human disturbance

Hydrology is a key management issue because the flora and fauna of the vernal pools have evolved adaptations to the unique hydrological conditions of vernal pools. Although dramatic year-to-year variations in rainfall occur, and vernal pools species are well-adapted to this variation, over the long term too little inundation may not support the full life cycle of the vernal pool species and extended inundation may lead to mortality of the species that are not truly adapted to an aquatic existence (Barry 1998; USFWS 1998). Extended runoff from developed areas can be a substantial problem for vernal pools (e.g., Clark et al. 1998). Hydrological alterations of the vernal pools in the RMV Open Space due to direct disturbance of the local contributing watershed (e.g., from grading) or increased urban runoff, are not anticipated to be management issues because existing and planned development areas are at least 1,000 ft from the vernal pools and at lower elevations. However, effects of cattle grazing and exotic species on hydrology are considered to be important management issues and, thus, are addressed below.

The Radio Tower Road vernal pools are located in an active pasture and grazing is planned in this area in the future as part of planned long-term cattle operations. Grazing can have both positive and negative impacts on vernal pools and associated species. Grazing can help control the proliferation of invasive exotics species such as annual grasses that choke out native plants and alter the natural hydrology of the pool and local contributing watershed (e.g., Barry 1998), but poorly timed grazing can result in trampling of fairly shrimp cysts and hatchlings, as well as increase water turbidity. As stressed by Barry (1998), “When resource managers and landowners develop plans to conserve vernal pool habitats, it is imperative they recognize that the current vernal pool landscape has been altered with the proliferation of exotic plant species and the impact of livestock grazing.” (pg. 237).

In addition to increasing water turbidity, cattle may have other negative impacts on water quality. Vernal pool species have adapted to specific water quality tolerances, and alterations in pH, and water temperature may have significant impacts on these species (Simovitch et al. 1996). Cattle are potential sources of nutrients such as phosphorus and nitrogen, as well as organic wastes (manure and urine), that may trigger rapid growth of microorganisms (and thus increased biochemical oxygen demand) and/or aquatic macrophytes (e.g., algae) (Bowling and Jones 2003).

The management issue for the Radio Tower Road pools thus is timing grazing in way that helps control non-native plants, but does not interfere with the functions and values of the vernal pools, most importantly, the reproductive cycle of vernal pool plant and animal species. Lis and Eggeman (2000) describe an adaptive management study where a combination of grazing and burning was used to control invasive species in vernal pools in the Dales Lake Ecological Reserve in Tehama County, California. They found that carefully timed grazing did not interfere with fairy shrimp reproduction or cause any immediate negative effects on rare plants. They concluded that while grazing “may not return the vernal pool landscape to its condition five hundred years ago…it is likely to move the landscape in that direction.” (pg. 23)[5].

[5] Lis and Eggeman (2000) also found that vernal pools burned during a wildfire on the Hog Lake Plateau, resulting in the burning of dense mats of dried spikerush, had no apparent adverse effect on the hatching of fairy shrimp. The

As described above, invasive exotic species threaten vernal pools because they compete with and displace native plants, and they also interfere with normal surface runoff patterns in the local contributing watershed essential for sustaining vernal pool hydrology (e.g., Barry 1998). The problem with most non-natives occurs in drier years when moisture conditions are conducive to annual grasses such as bromes (*Bromus* spp.) and wild oats (*Avena* spp.) (USFWS 1998). During wetter years these annual grasses are reduced, but several other non-native species such as rabbit's-foot grass (*Polypogon monspeliensis*), wild rye (*Lolium* spp.) and brass-buttons (*Cotula coronopifolia*) still can dominate vernal pools (USFWS 1998). As discussed above, grazing, and possibly prescribed burns, may be used to control exotic species at the Radio Tower Road pools, but other control methods would be required at the Chiquita Ridge pools because cattle are excluded from the area and prescribed burns may not be feasible so close to residential development.

Human disturbances, primarily trampling and vehicular impacts on species and soils, are ongoing threats to vernal pools throughout the state. Because the vernal pools in both the Chiquita Ridge and Radio Tower Road areas are at least 1,000 ft from the nearest residential development, human disturbance may be less of a long-term problem in the RMV Open Space than typically observed elsewhere. Nonetheless human activities would have to be addressed in the Adaptive Management Program.

b. Adaptive Management Goals and Objectives

The overall goal of the Adaptive Management Program for vernal pools and associated species is to maintain existing vernal pools and associated species that occur in the pools within the RMV Open Space (see Vernal Pool Assessment, PCR 2003). The management objectives designed to meet this goal are to:

- Conduct monitoring of vernal pools and associated species in a manner that allows reserve owner/managers to track the long-term status of the vernal pools and species.
- Manage the hydrological regime of the pools by maintaining the existing local contributing hydrological sources (i.e., the local contributing watershed of the vernal pool).

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study is ongoing, but Lis and Eggeman suggest that timed grazing and prescribed burning may be effective management tools to control non-natives in vernal pools. Prescribed burning as a management tool for grasslands generally, and for vernal pools specifically, also is recommended by Pollack and Kan (1998) based on studies on the Jepson Prairie Preserve showing that late-spring burning reduces non-native grasses and increases the dominance of native species. They also suggest that a combined burning-grazing regime can be used to reduce fire intensity.

- Eliminate or control any identified existing threats to existing vernal pools, including poorly-timed grazing and invasion of pools and the local contributing watershed by non-native species.
- Develop management tools to control the proliferation of non-native species, including time-grazing, prescribed burns, mowing and selective weeding.
- Manage water quality to emulate baselines conditions in the vernal pools in the RMV Open Space known to support the Riverside and San Diego fairy shrimp.
- Control public access to vernal pools.

c. Monitoring of Vernal Pools and Associated Species

Each vernal pool in the RMV Open Space would be assigned a unique identifying code. GPS locations have already been recorded for the vernal pools on Chiquita Ridge and the Radio Tower Road mesa.

A pre-established monitoring schedule for vernal pools has not been set. The monitoring schedule needs to be flexibly tied to local climatic conditions. All vernal pools would be evaluated within two (2) years of executing the IA by recording variables as described below. This evaluation would include an assessment of existing habitat quality and the need for specific management actions. For pools that do not warrant immediate management, periodic monitoring would take place on a schedule dictated by predicted climatic conditions for a particular year. In conjunction with predicted climatic patterns, at minimum, pools would be monitored at least three (3) times per decade. The years selected for monitoring would be tied to the predicted rainfall patterns for the year. Pools would be monitored at least once each decade during a year with predicted high (e.g., El Nino), normal, and low (e.g., La Nina) rainfall in order to collect information in relation to variable amounts of rain. Pools subjected to a specific management actions (e.g., grazing, prescribed burning, mowing, weeding, etc.) would be monitored more frequently, as appropriate to the management action(s) (e.g., for three consecutive years following a management action). Monitoring may also occur more frequently in certain pools if discrete field studies by outside scientists are being conducted. Any outside scientist proposing to conduct a study of vernal pools within the RMV Open Space would be required to submit a detailed proposal outlining the work program to RMV, who would then evaluate the proposal and ensure that the study is compatible with the goals and objectives for managing the vernal pool resources.[6]

[6] Such studies also would require the researcher to obtain a separate Incidental Take permit for the study.

Typical hydrology and water quality variables to be measured include time from inundation to dehydration, periodicity of pool, size of pool, depth, water temperature, pH, dissolved oxygen, specific conductance and salinity. Having baseline measurements for these variables would be essential for detecting any cause and effect relationships between characteristics of the vernal pools and changes in Riverside and/or San Diego fairy shrimp, and, in turn, identifying the cause of any declining trends in these species.

The floral characteristics of vernal pools also would be monitored. Species presence and relative cover would be monitored for each pool. An example of a standard monitoring protocol is described here. Two line transect locations in each of the pools are established with rebar stakes. Species presence and frequency on the transect, species present within the pool but not on the transect and relative cover of each species are recorded. A 50-meter tape is be strung tightly between the two rebar stakes at either end of the transect, and all measurements are taken along a pre-determined side of this line at two decimeter (dm) intervals. A wire, square decimeter is placed on the ground and all species present within the square, as well as their percent cover, are recorded.

The status of the Riverside fairy shrimp and San Diego fairy shrimp, as well as other animal species (to measure species richness or diversity), would be monitored in both pools known to support the shrimp and pools where the shrimp were absent in Year 2001 surveys. During the aquatic phase of the pools, pole-mounted dip-nets can be used to sample the basins for tadpoles, ostracods, branchiopods and cladocerans. Representative species lists of plants should be recorded at each pool within 45 days of the dissipation of standing water. Permanent photo stations should be established for each of the pools and color images should be taken throughout the monitoring period in accordance with the following schedule:

- After the first heavy rain;
- After three weeks of standing water, or, if standing water is not present for this period continuously, after the wettest period of the season, to reveal mortality of upland plants;
- After storm events that generate greater than two (2) inches of precipitation;
- After water levels fall; and
- During the dormant season.

d. Management of Vernal Pools and Associated Species

Appendix J

The Adaptive Management Program for vernal pools and associated species includes three types of management activities:

1. Passive management
2. Active management
3. Experimental management

The general approaches to these three types of management are explained above in the discussion for coastal sage scrub in *Section 1.4.2*. The primary management approach for vernal pools in the RMV Open Space would be passive. These pools are unlikely to be exposed to the same "edge" disturbances characteristic of preserved pool complexes situated in close proximity to urban development, such as increased runoff, pesticides, trampling by the public, off-road vehicles, trash dumping, and pets and feral animals. The Chiquita Ridge pools are located in the Ladera Open Space approximately 1,000 feet east of the Ladera Ranch development. The Radio Tower Road pools are located approximately 1,000 feet west of planned development in Trampas Canyon and approximately 3,500 feet southeast of planned Ortega Gateway development. The Ladera, Trampas Canyon, and Ortega Gateway developments have no connection to the local contributing watersheds of the vernal pools and thus no direct, development-induced impacts on hydrology or water quality are anticipated. Furthermore, the vernal pools are located far enough away from development, that trespass by the public into vernal pools areas should be minimal.

For the Radio Tower Road pools, the primary management action would be timed-grazing to take advantage of grazing for exotic species control while protecting pools from impacts by cattle during the fairy shrimp reproductive season; i.e., from inundation to dehydration. During the 2001 fairy shrimp surveys these pools showed evidence of grazing impacts, including trampling and feces in the pools. Grazing prior to the onset of the rainy season would be allowed, but once significant rainfall occurs, pools would be protected by exclosures or by excluding cattle altogether from pastures supporting vernal pools until pools dry. The Grazing Management Plan provides more detail on the timing of grazing in relation to these vernal pools. Prescribed burning, in conjunction with grazing, also may be tested at these vernal pools if grazing alone does not appear to be effective in controlling exotics. Prescribed burning should be given a high priority as a supplemental or replacement management tool because, in combination with herbivory, it probably best emulates the natural disturbance regime in which vernal pool systems evolved (see Lis and Eggeman 2000 and Pollack and Kan 1998). Any areas of artichoke thistle would be treated with herbicides as part of the overall thistle control program on RMV.

Control of exotic plant species also would be a focus of active management at the Chiquita Ridge pools. Because cattle are excluded from this area and prescribed burning may not be feasible, mowing and selective weeding are two potential management actions to control exotic species at these sites.

Control of human activities may be needed at the Chiquita Ridge site because it is located in Ladera Open Space. The vernal pools should be identified as sensitive resources with interpretive signs that indicate prohibited activities within or in proximity to pools that could affect pool integrity, water quality or fairy shrimp reproduction (e.g., wading in pools, dog feces, etc.).

Control of human activities in the vicinity of the Radio Tower Road pools should be less problematic because the area would continue to be part of the private Ranch operation, but Ranch personnel should be made aware of the sensitive nature of the pools and procedures to avoid impacts.

1.5.2 Plant Identified Species

This section addresses adaptive management of the plant Identified Species presented in Table 1-14. Regional and subregional background information for these species is provided in the Species Accounts in the Draft NCCP Guidelines. It is important to note that the data base for the plant Identified Species on RMV property is comprehensive and reflects several survey efforts over the past decade. It is unlikely that additional *major* or *important populations* in *key locations* will be discovered on the RMV property, although small populations may still be discovered.

a. Adaptive Management Issues

The environmental stressor approach is applied to plant Identified Species in the same manner as to the major vegetation communities and associated focal species. Potential stressors for each of the plant species are identified in *Table 8-14*.

The main stressor of the plant species in the RMV Open Space is exotic plant species, which affect thread-leaved brodiaea, many-stemmed dudleya, southern tarplant, and Coulter's saltbush. The exotic plants that are most troublesome are artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, mustards, and wild radish. These exotic species directly displace the native species, disrupt native habitats, and compete for water and nutrients.

As noted in the stressor models for upland vegetation communities (Figures 3-7), the impact of exotic species can be exacerbated by drought, too frequent fire and over-grazing. Thus, the control of exotic species needs to consider the effects of these stressors as well.

TABLE 1-14
IDENTIFIED PLANT SPECIES

Species	Known or Potential Stressor(s)
Chaparral beargrass	• Too frequent fire (?)
Coulter's saltbush	• Non-native plants (wild radish and mustards) • Over-grazing
Many-stemmed dudleya	• Non-native plants (artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, mustards) • Over-grazing • Human activities (hiking, mountain bikes, equestrian)
Salt spring checkerbloom	• Altered hydrology
Southern tarplant	• Non-native plants (wild radish and mustards) • Over-grazing
Thread-leaved brodiaea	• Non-native plants (artichoke thistle, ryegrass, bromes, wild oats, mustards) • Over-grazing • Human activities (hiking, mountain bikes, equestrian)

Relatively little is known about stressors on chaparral beargrass and salt spring checkerbloom. As a chaparral species, it can be hypothesized that fire management would be important for chaparral beargrass, but no information is available on the relationship between fire intervals and this species. Likewise, little is known about potential stressors of salt spring checkerbloom. However, it only occurs in slope wetlands in the RMV Open Space and thus it is assumed that this species would be sensitive to changes in subsurface hydrology.

b. Adaptive Management Goals and Objectives

The overall goal for plant Identified Species is to maintain *major* and *important populations* of Identified Species in the RMV Open Space.

This overall goal would be addressed through the following management objectives:

- Conduct periodic monitoring of *major* and *important populations* of Identified Species in a manner that allows RMV to track the long-term status of the species in the RMV Open Space.

- Control invasions of herbaceous exotic species in areas supporting *major* and *important populations* of Identified Species.

- Manage grazing to avoid adverse impacts to, and to the extent feasible benefit, *major* and *important populations* of Identified Species.

- Manage fire to avoid adverse impacts to, and to the extent feasible benefit, of *major* and *important populations* of Identified Species.

- Maintain habitat to support plant dispersal and pollinators between *major* and *important populations* to the extent possible.

c. Monitoring, Management and Restoration of Plant Identified Species

The plant Identified Species management and monitoring program would focus on *major* and *important populations* because these areas by definition are considered to be important for the conservation of the species in the subregion (Southern NCCP/HCP Guidelines).

Permanent monitoring areas would be established for most species. Selection of sample areas for species with variable spatiotemporal distributions (e.g., southern tarplant), selection of monitoring sites would need to be flexible from survey to survey in order to track the status of the species. In areas where subpopulations of the total population are widely distributed (e.g., many-stemmed dudleya locations in Cristianitos Canyon), sample plots would be established in representative locations within the population. Where populations are relatively discrete and boundaries are definable (e.g., thread-leaved brodiaea on Chiquadora Ridge), the entire local population would be monitored.

The frequency and timing of plant surveys would need to be flexible in order to respond to varying environmental conditions. In general, monitoring should be conducted on a periodic basis and frequently enough to detect population trends; generally, species exhibiting high year-to-year variability need to be monitored more frequently than species with low variability to detect trends. Fairly intensive baseline monitoring of plant populations would be needed to establish the appropriate monitoring schedule. Site visits within a given survey season should be timed to coincide with peak production for the season, possibly requiring more than one site visit per season. Furthermore, because many plant species, and geophytes in particular, are highly opportunistic and responsive to weather conditions, flexibility in timing surveys over different years needs to be retained in the overall monitoring schemes to ensure that surveys capture the variability exhibited by the species, including both years with high and low productivity. Finally, timing of surveys for species known or possibly influenced by major disturbance events (e.g., southern tarplant by flood and chaparral beargrass by fire) should take advantage of these disturbance events to measure species responses.

Each of the plant Identified Species have different management and monitoring needs, and thus, are addressed separately below.

1. Thread-leaved Brodiaea

Thread-leaved brodiaea occurs in five discrete locations (Figure 16). Two of the five locations comprise *major populations* in *key locations*; the location supporting approximately 2,000 individuals on Chiquadora Ridge and the location supporting more than 6,100 individuals in the southern portion of Cristianitos Canyon. The main stressors of these populations are non-native invasive species such as artichoke thistle, ryegrass, bromes, wild oats, and mustards. Over-grazing also is a potential stressor for the Cristianitos Canyon population. Conserved areas also would need to be protected from human disturbance such as trampling (by hikers, mountains bikers and equestrians) and collection of flowers.

a) Monitoring

The monitoring of thread-leaved brodiaea would be focused on the two *major populations* since they account for approximately XX% of the counted individuals in the Habitat Reserve. Monitoring would use direct counts or estimates of flower stalks as the index of the population size. Typically there are many corms in the ground for every flower stalk, with an estimated potential range of 5-100 corms for every flowering stalk (pers. comms. Bomkamp and Elvin 2002). Because the two *major population* of brodiaea occur in two fairly discrete locations, complete counts or estimates to the nearest 100 flowering stalks in each location would be conducted.

The two locations would be monitored annually for the first five (5) years following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. Annual monitoring over the first five years is important to establish baseline information on the variability of the populations in terms of number of flowering stalks produced annually and to identify any necessary near-term management actions. Following the initial five-year baseline study period, periodic monitoring surveys would be conducted at intervals to be determined by RMV in coordination with the Wildlife Agencies. If specific management actions (e.g., a prescribed burn) are implemented during the five-year period, it is anticipated that frequent follow-up monitoring to assess the outcome of the management action would be required. On the other hand, if a population appears to be stable after the initial five years, and no imminent threats to the population have been identified, less frequent monitoring may be warranted.

Monitoring would be conducted during the blooming period of this species, which typically is March to June. Timing of surveys would take advantage of the local weather patterns and at least one survey would be timed to coincide with the expected peak flowering period. This would require at least three site visits during the blooming period – one each in the early, middle, and late portions of the season (e.g., March, April and May). As flowering individuals are counted or estimated during each site visit, pin flags would be placed to mark counted/estimated individuals to avoid double counting.

In addition to direct counts or estimates of thread-leaved brodiaea flowering stalks, the presence of native and exotic species would be recorded at sample sites using a standard sampling protocol, an example of which is provided here.

One-meter sample quadrats would be randomly established in each brodiaea population each year. The number of locations would be adequate to provide a representative sample of the area. The sampling methodology would consist of randomly tossing a 1-meter quadrant frame in front or to the side of the field monitor. Native and non-native vegetation cover would be estimated within the quadrat. A count of individual species would be made for each quarter quadrat in a clockwise pattern beginning in the lower left quarter. Individuals would be categorized by size class within one of the quadrat quarters, alternating in a clockwise pattern for each successive quadrat sample. In addition to the random quadrats, permanent photostations would be established through the area to document existing conditions during each survey period.

Additional data that would be recorded during each site visit include observations of pollinators such as sweat bees (Halictidae) and tumbling flower beetles (Mordellidae), soil conditions (e.g., surface disturbances, cracking, etc.), and other evidence of disturbance (e.g., deep hoof prints, human activities).

b) Management

The main stressor of thread-leaved brodiaea in the RMV Open Space is anticipated to be exotic species which compete with native species for space, nutrients, and water. Exotic invasions may be exacerbated by too frequent fire and over-grazing. As such, the monitoring program described above is geared to measure the presence of invasive species at the monitoring locations. A variety of techniques can be used to control exotic species, including time-grazing, prescribed burns, mowing, manual removal (weed-whacking and hand-pulling), and herbicide treatment. Timed-grazing and prescribed burns are the most efficient forms of exotics control, especially where non-native annual grasses such as bromes, wild oats and wild ryes are widespread and for which site-specific, selective manual treatments are not very effective. Herbicide treatment of artichoke thistle has been a successful control method on RMV. A potential limitation of timed-grazing as a management tool is that peak production of annual grasses on RMV coincides with the early growing season of thread-leaved brodiaea and the fleshy stalks are likely to be grazed before they have a chance to flower and set seed. Likewise, a prescribed burn in the spring would also burn stalks before they mature. Given that the locations being managed are by far the two largest populations in the Habitat Reserve, untested management actions that may depress productivity in these locations even temporarily may not be desirable.

The management recommendations for the two *major populations* are different because the practical long-term management opportunities are different.

1. For the Chiquadora Ridge population, timed-grazing is the recommended management approach and essentially would continue the existing grazing pattern. The "Chiquita Pastures" are grazed from late spring through September, with the focus of grazing on the cultivated barley fields and low levels of grazing in the adjacent natural vegetation. Grazing in this time period would allow the thread-leaved brodiaea on Chiquadora Ridge to bloom and set seed before cattle are introduced. Furthermore, because this location is within a few hundred feet of the eastern edge of planned development in lower Chiquita Canyon, it is unlikely that prescribed burns would be an acceptable management tool for exotic species (although occasional wildfires in the area may benefit the brodiaea over the long-term).

2. For the lower Cristianitos Canyon population, grazing may be a problem because cattle are in the area from October through May during the period of peak annual grass production and the period brodiaea are growing and flowering. Given that the existing population appears to be healthy under the existing grazing regimen, the benefits of grazing may outweigh the negative impacts. Removal of grazing from the area may allow exotics to proliferate, with a consequent net loss of the brodiaea population. It is recommended grazing continue in this area and that the population be monitored for the first five years of program to determine if grazing is in fact detrimental to the brodiaea population. If it is found that grazing has a net negative impact on the brodiaea, this area may be suitable for prescribed burns in the future because it is more remote from planned development. However, before any active management actions are undertaken, it is recommended that an experimental grazing/burn study, as described below, be carried out on smaller populations of brodiaea before being applied to this *major population*.

An experimental adaptive management study of grazing and prescribed burning should be conducted on the smaller populations of thread-leaved brodiaea in Cristianitos Canyon. Several questions could be addressed:

1. What is the effect of grazing on brodiaea during the growing season?

2. What is the effect of prescribed burns on brodiaea during the growing season?

3. What is the effect of combined burning and grazing (e.g., fall burn followed by winter/spring grazing)?

This experiment could be set up as a 2 x 2 factorial design with four combinations as set out in *Table 1-15*. For the grazed/burned site, a combination of fall burning to remove dead thatch and winter/spring grazing to control new annual growth/seed setting may be an effective double treatment to control invasives.

TABLE 1-15
SAMPLE EXPERIMENTAL TREATMENTS FOR
THREAD-LEAVED BRODIAEA ADAPTIVE MANAGEMENT

Treatments	**Burned**	**Unburned**
Grazed	Grazed/Burned	Grazed/Unburned
Ungrazed	Burned/Ungrazed	Control (Ungrazed/Unburned)

c) Restoration

Thread-leaved brodiaea, along with associated clay topsoils to the extent feasible, would be salvaged and translocated to suitable receiver sites where coastal sage scrub and/or native grassland restoration is underway. Potential receiver sites include Chiquita Ridge, Chiquadora Ridge, Sulphur Canyon, upper Cristianitos Canyon, Ladera Open Space adjacent to the Arroyo Trabuco Golf Course, and upper Gabino Canyon. Receiver sites should support clay soils suitable for brodiaea and should be placed in locations that maximize connectivity and genetic exchange; i.e., habitat areas accessible to pollinators from other locations. Details of the translocation approach are described in detail in the Plant Species Translocation, Propagation and Management Plan.

2. Chaparral Beargrass

Chaparral beargrass occurs in one location in the RMV Open Space comprised of five individuals in the eastern portion of the Talega sub-basin (Figure 16). Single individuals also have been recorded in non-reserve open space adjacent to the planned TRW development areas and in the Foothill-Trabuco Specific Plan area between Live Oak Canyon Road and Trabuco Oaks Road, but outside the Habitat Reserve. Because of the rarity of this species in the subregion, the population in the Talega sub-basin is considered an *important population* in a *key location*.

Very little information is available for chaparral beargrass from which to base a management program. The USFS identified protection of the species from frequent fire as a management issue, for example, but no scientific information is available on the relationship between the species and fire frequency to support this management approach.

The management and monitoring program for chaparral beargrass focuses on monitoring the population in the Talega sub-basin at three-year intervals following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. The initial monitoring survey would document the current status of the population and note general habitat conditions such as species composition, native/non-native ratio, any observable disturbance conditions, etc. Photostations would be established at the site. It is recommended that the site be visited at least every three (3) years during the blooming season (April-June) to assess reproductive activity of the plants. This species is an evergreen shrub and unlikely to exhibit significant year-to-year variation. If a fire occurs at the site, follow-up surveys should be conducted for at least five (5) consecutive years to determine the species' response to fire. New fires within the area should be suppressed to the extent feasible within this five-year period. If, based on a lack of new vegetative growth or flowering, the individuals do not appear to have recovered from the original fire within this five-year period, additional monitoring and possibly protection of this population from fire may be required beyond this period.

Management actions cannot be determined until more information about the species is collected. With only one population in the Habitat Reserve, experimental management actions are not recommended at this time.

3. Coulter's Saltbush

Coulter's saltbush occurs in three general locations in the RMV Open Space (Figure 16). A *major* and two *important populations* occur in Chiquita Canyon, an *important population* occurs in the upper Cristianitos Canyon, and an *important population* occurs in upper Gabino Canyon. This species occurs in alkaline soils, and in Chiquita Canyon is associated with southern tarplant, also an Identified Species.

Little information is available for this species to guide management. It is hypothesized that exotic species and trampling by cattle are likely to be the primary stressors of this species in the RMV Open Space and management and monitoring actions would be focused on this assumption. For example, populations in Chiquita Canyon may be threatened by proliferation of wild radish and mustards and/or by cattle grazing in the meadows adjacent to Chiquita Creek during the summer.

Because little is known about the variability of this species, the management and monitoring program for Coulter's saltbush focuses on monitoring the population in all three locations annually for the first five (5) years following execution of the Development Agreement or required Wildlife Agency approvals whichever is later. These initial monitoring surveys would document the annual status of the population and note general habitat conditions such as species composition, native/non-native ratio, any observable disturbance conditions (e.g., from cattle). Because of this species affinity for alkalinity, soil samples should be taken during surveys to measure pH. Maintaining an appropriate range of soil alkalinity may be crucial for managing this species. Photostations would be established at each of the sites. The site should be visited during the blooming season (March-October) to assess reproductive activity of the plants. The frequency of surveys beyond the first five years with a given year would be determined by RMV in coordination with the Wildlife Agencies and would be based on the variability of the species and identified stressors.

If Coulter's saltbush is directly impacted, individuals, and associated soils to the extent feasible, should be experimentally translocated to suitable receiver sites in the same sub-basin where the impacts occur. Receiver sites should support alkali soils suitable for the species and should be placed in locations that maximize connectivity and genetic exchange. Details of the translocation approach are described in detail in the Plant Species Translocation, Propagation and Management Plan (Appendix X-1).

4. Many-stemmed Dudleya

Many-stemmed dudleya occurs in four general *key locations* in the RMV Open Space (Figure 17). Three of the four locations comprise *major populations* in *key locations*: the Chiquadora Ridge complex, the Cristianitos Canyon complex, and the middle/upper Gabino Canyon complex. Chiquita Ridge supports an *important population* in a *key location*. The main stressors of these populations are non-native invasive species such as artichoke thistle, ryegrass, bromes, wild oats, smooth cat's-ear, Crete hedypnois, and mustards. Over-grazing also is a potential stressor on the Cristianitos Canyon and Gabino Canyon populations because grazing in the southern pastures coincides with the dudleya growing season. Conserved areas also would need to be protected from human disturbance by hikers, mountains bikers and equestrians.

Appendix J

a) Monitoring

The monitoring of many-stemmed dudleya would be conducted in the three *major populations* and one *important population* because XX% of the estimated individuals in the RMV Open Space occur in these four areas. Monitoring would use direct counts of observed individuals or estimates to the nearest 100 individuals as the index of the population size. Similar to thread-leaved brodiaea, it is likely that only a fraction of plants in a population bloom during any given year.

Each of the four general monitoring areas encompasses a relatively broad area and it would not be possible to conduct exhaustive counts of the populations. Representative sample plots would be selected at each of the four monitoring areas that reflect the general size, distribution and habitats within the population complex. An emphasis would be placed on selecting sample plots where potential stressors such as exotic species, over-grazing, and human activities could pose risks to the population.

The four locations would be monitored annually for the first five (5) years following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. Annual monitoring over the first five years would establish baseline information on the variability of the populations in terms of number of flowering individuals produced annually and to identify any necessary near-term management actions. Following the initial five-year baseline study period, periodic monitoring surveys would be conducted at intervals to be determined by the reserve owner/managers in coordination with the RMA. If specific management actions (e.g., a prescribed burn) are implemented during the five-year period, it is anticipated that frequent follow-up monitoring to assess the outcome of the management action would be required. On the other hand, if a population appears to be stable after the initial five years, and no imminent threats to the population have been identified, less frequent monitoring may be warranted.

Monitoring would be conducted during the blooming period of this species, which typically is March to June. Timing of surveys would take advantage of the local weather patterns and at least one survey would be timed to coincide with the expected peak flowering period. This likely would require at least three site visits during the blooming period – one each in the early, middle, and late portions of the portions of the season (e.g., March, April and May). As areas of flowering individuals are counted or estimated during each site visit, pin flags would be placed to mark the areas of counted/estimated individuals to avoid double counting.

The presence of native and exotic species would be recorded at sample sites using a standard sampling protocol, such as described above for thread-leaved brodiaea, as would general soil conditions (e.g., evidence of ground surface disturbances) and other evidence of disturbance.

b) Management

The main stressor of many-stemmed dudleya in the RMV Open Space is anticipated to be exotic species which compete with native species for space, nutrients, and water. Exotic invasions may be exacerbated by too frequent fire and over-grazing. As such, the monitoring program described above is geared to measure the presence of invasive species at the monitoring locations. As discussed above for thread-leaved brodiaea, a variety of techniques can be used to control exotic species, including time-grazing, prescribed burns, mowing, manual removal (weed-whacking and hand-pulling), and herbicide treatment.

Similar to thread-leaved brodiaea, the management recommendations for the three *major populations* and one *important population* are different because the practical long-term management opportunities are different.

1. For the Chiquadora Ridge and Chiquita Ridge populations, timed-grazing is the recommended management approach and essentially would continue the existing grazing pattern. The "Chiquita Pastures" are grazed from late spring through September, with most grazing in the cultivated barley fields and low levels of grazing in the adjacent natural vegetation. This grazing period would allow the many-stemmed dudleya in these two areas to bloom and set seed before cattle are introduced in the late spring. Furthermore, because these locations are relatively close to residential development in Ladera Ranch and lower Chiquita Canyon, it is unlikely that prescribed burns would be acceptable as a management tool (although occasional wildfires may benefit the many-stemmed dudleya over the long-term).

2. For the Cristianitos Canyon and middle/upper Gabino Canyon populations, grazing may be a problem because cattle are grazed in the area from October through May during the period of peak annual grass production and the dudleya growth period. Given that the existing populations appear to be healthy under the existing grazing regimen, the long-term benefits of grazing may outweigh the negative impacts. Removal of grazing from the areas may allow exotics to proliferate, with a consequent net loss of the dudleya population. It is recommended that these populations be monitored for the first five years of program to determine if grazing is in fact detrimental. If grazing is found to have a net negative impact on many-stemmed dudleya, these areas also may be suitable for prescribed burns because they are more remote from planned development.

d) Restoration

Translocation of many-stemmed dudleya has been demonstrated to be successful (e.g., the San Joaquin Hills Tollroad [SR-73]). Many-stemmed dudleya, along with associated clay topsoils to the extent feasible, would be salvaged and translocated to suitable receiver sites where coastal sage scrub and/or native grassland restoration is underway. Potential receiver sites include Chiquita Ridge, Chiquadora Ridge, upper Cristianitos Canyon, upper Gabino Canyon, and the Radio Tower Road area (although there are no documented locations along Radio Tower Road, the area supports clay soils that might be suitable for the dudleya). Receiver sites should support clay, cobbly loam and sandy clay loam soils suitable for many-stemmed dudleya, and should be areas that maximize connectivity and genetic exchange; i.e., habitat areas accessible to pollinators from other locations. Details of the translocation approach are presented in the Plant Species Translocation, Propagation and Management Plan (Appendix X-1).

5. Salt Spring Checkerbloom

Salt spring checkerbloom occurs in two slope wetlands in the RMV Open Space in lower Chiquita Canyon (Figure 17). Both sites are *important populations* in *key locations*. The slope wetlands that support this species are perennially moist wetlands that are maintained by subsurface water movement (Slope Wetland Functional Assessment, PCR 2000).

Little information is available for this species to guide management. The most important factor for managing this species likely is maintaining slope wetland hydrology.

The management and monitoring program for salt spring checkerbloom focuses on monitoring populations at the two locations at a minimum three-year intervals following execution of the IA. The initial monitoring survey would document the current status of the populations and note general habitat conditions such as hydrological conditions, species composition, native/non-native ratio, any observable disturbance conditions, etc. Photostations would be established at each of the sites. It is recommended that the sites be visited at least every three (3) years during the blooming season (March-June) to assess reproductive activity of the plants.

6. Southern Tarplant

Southern tarplant occurs in two sub-basins in the RMV Open Space (Figure 17). Three population complexes occur in the Chiquita sub-basin, including two *major populations* and one *important* population. A *major population* also occurs in Gobernadora in the northern portion of GERA. This species occurs in alkaline wet meadow, and in Chiquita Canyon is associated with

Coulter's saltbush, also an Identified Species. Southern tarplant is well adapted to disturbance associated with flood events and even appears to benefit from occasional discing or other soil disturbing activities. Consistent with this association with disturbance events, southern tarplant populations appear to exhibit high spatiotemporal variation.

It is hypothesized that exotic species are likely to be the primary stressor of this species in the RMV Open Space and management and monitoring actions would be focused on this assumption. For example, populations in Chiquita Canyon may be threatened by proliferation of wild radish and mustards.

The management and monitoring program for southern tarplant focuses on monitoring the populations in both the Chiquita and Gobernadora sub-basins at a minimum three-year intervals following execution of the Development Agreement or required Wildlife Agency approvals, whichever is later. Monitoring in years following major disturbance events such as floods also should conducted. The initial monitoring survey would document the current status of the population and note general habitat conditions such as species composition, native/non-native ratio, any observable disturbance conditions, etc. Because this species can occur in local populations of tens of thousands and direct counts are not feasible, population estimates to the nearest one thousand individuals would be based on area density estimates. Because of this species affinity for alkalinity, soil samples should be taken during surveys to measure pH. Maintaining an appropriate range of soil alkalinity may be crucial for managing this species. Photographs would be taken during surveys, but the locations likely would be different each time because of the variable distribution of this species from year to year. It is recommended that the site be visited at least every three (3) years during the blooming season (May-November) to assess reproductive activity of the plants.

If southern tarplant is directly impacted by development, individuals, and associated soils to the extent feasible, should be translocated to suitable receiver sites in the same sub-basin where the impacts occur. Receiver sites should support alkali soils suitable for the species and should be placed in locations that maximize connectivity and genetic exchange. Details of the translocation approach are presented in the Plant Species Translocation, Propagation and Management Plan (Appendix X-1).

1.6 Adaptive Management Of Habitat Linkages And Wildlife Corridors

This section describes the approach to management and monitoring of key habitat linkages and wildlife corridors. Both avian and ground-dwelling species would be managed and monitored to ensure that the habitat linkages and wildlife corridors are functioning as designed.

Appendix J

a. Adaptive Management Issues

Maintaining functional habitat linkages and wildlife corridors both within the RMV Open Space and to habitat areas outside the Open Space (i.e., CNF, Camp Pendleton) will be essential for conserving landscape ecosystem processes, habitats and species in the subregion. In principle, human-related threats to habitat linkages and wildlife corridors are greater than to "interior" habitat blocks within the RMV Open Space because linkages corridors have a greater perimeter edge-to-area ratio than large habitat blocks (i.e., they tend to be longer and more narrow or have more edge variations), though this generally is not the case for stressors such as fire and altered geomorphology. Mostly as a result of proportionally greater edge area, potential stressors on functioning habitat linkages and wildlife corridors include:

- Disturbance and degradation of habitat quality such that the habitat linkage may no longer provide suitable "live-in" habitat for resident species (e.g., small native fauna) or that mobile species such as the larger mammals (mountain lion, bobcat, mule deer) no longer use corridors for movement or dispersal. Disturbance or degradation of habitat may include loss of protective cover that provides refugia for wildlife or invasion by exotic wildlife and plant species that displace native vegetation communities and native wildlife species.

- Higher levels of human disturbance such as illegal trails, off-road vehicles, trampling of vegetation, trash and garbage dumping, and accidental and deliberation ignitions of fires.

- Increased chance of vehicle collisions with wildlife where roads cross habitat linkages and movement corridors.

- Increased lighting and noise.

- Increased urban run-off.

b. Adaptive Management Goals and Objectives

The adaptive management goals for habitat linkages and wildlife corridors include the following:

- Maintain the function of key habitat linkages and wildlife corridors within the RMV Open Space

- Maintain the function of key habitat linkages and wildlife corridors that connect to important resources areas outside the study area, including the Casper's Regional Park, CNF and Camp Pendleton.

These broad goals would be achieved by meeting the following management and monitoring objectives:

- Monitor occupation and/or uses of identified key habitat linkages and wildlife corridors by the species identified as using or depending on these linkages and corridors.

- Maintain suitable habitat in the key habitat linkages and wildlife corridors for the species associated with the specific linkage/corridor.

- Identify and rectify constraints to use or movement (e.g., physical obstacles or bottlenecks) or sources of habitat disturbance or degradation in key habitat linkages and wildlife corridors.

- Implement the comprehensive Water Quality Management Plan addressing "Pollutants of Concern" and "Hydrologic Conditions of Concern."

c. Management of Habitat Linkages and Wildlife Corridors

Identified habitat linkages and wildlife corridors in the planning area are depicted in Figure 13. Identification of these linkage and corridor functions is based on field studies of wildlife movement in the planning area (e.g., Beier and Barrett 1993, DUDEK 1995; MBA 1996; Padley 1992), input from the Science Advisors and the wildlife agencies, and the consultant team's review and analysis of the species, vegetation, and physiographic information for the subregion.

The specific linkages and corridors and associated species recommended for monitoring are shown in *Table 1-16.* Theses linkages and corridors were selected because they are located in likely strategic areas for maintaining connectivity in the RMV Open Space and/or are likely to be the greatest risk of disturbance or degradation from nearby development and human activities. Some important habitat linkages shown in Figure 13 were not selected for monitoring because they are remotely located away from development and activity (e.g., Middle Gabino Canyon, La Paz Canyon, etc.). Other linkages/corridors may be added for monitoring in the future if conditions warrant. Likewise, linkages/corridors proposed for monitoring may be deleted in the future if the monitoring program demonstrates that they are functioning properly and that the risk of disturbance or degradation is low.

]

Appendix J

TABLE 1-16 PROPOSED HABITAT LINKAGE AND WILDLIFE CORRIDOR MONITORING LOCATIONS			
Habitat Linkage/Wildlife Corridor[1]	**Description and Function**	**Key Species[2]**	**Existing or Future Constraints/Threats**
			•
C	Habitat linkage along Chiquita Ridge and Chiquita Creek that connects San Juan Creek to "horseshoe" of habitat at northern end of Coto de Caza	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Oso Parkway
D	"Narrows" area separating middle and lower Chiquita Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	• Road connection between Oso Parkway and Gobernadora development area
E	East-west wildlife corridor located north of wastewater treatment facility in Chiquita Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	**TBD – will be issue if development occurs in north of treatment plant**
G	North-south habitat linkage along Chiquadora Ridge and Gobernadora Creek	Large mammals such as mountain lion, mule deer, coyote and bobcat. Avian species such as California gnatcatcher and cactus wren	• Road connection between Oso Parkway and Gobernadora development area
H	East-west habitat linkage between Chiquita Canyon and Wagon Wheel Canyon and Gobernadora to provide connection to Caspers Wilderness Park and north-south connection to San Juan Creek.	East-west linkage primarily for large mammals such as mountain lion, mule deer, coyote and bobcat. North-south connection primarily for avian species such as California gnatcatcher and cactus wren	• Coto de Caza residential development north of linkage
I	East-west habitat linkage through Gobernadora south of Coto de Caza residential development connecting Chiquita Canyon and Caspers Wilderness Park	East-west linkage primarily for large mammals such as mountain lion, mule deer, coyote and bobcat.	• Coto de Caza residential development north of linkage • Gobernadora residential development south of linkage
J	Habitat linkage along San Juan Creek that is central nexus for connecting to Bell, Verdugo, Gobernadora, Chiquita and Trampas canyons in the central portion of planning area.	Large mammals such as mountain lion, mule deer, coyote and bobcat. Mobile avian species such as California gnatcatcher	• Ortega Highway; corrugated steel pipe near Radio Tower Road and concrete box culvert west of Cristianitos Road provide only undercrossings of Ortega Highway.
M	Habitat linkage between upper Gabino Canyon and Verdugo Canyon	Large mammals such as mountain lion, mule deer, coyote and bobcat, as well as cactus wren.	**TBD – will be issue if development occurs in upper Gabino**
N	Habitat linkage along Cristianitos	California gnatcatchers and large	**TBD – will be issue if**

TABLE 1-16 PROPOSED HABITAT LINKAGE AND WILDLIFE CORRIDOR MONITORING LOCATIONS			
Habitat Linkage/Wildlife Corridor[1]	**Description and Function**	**Key Species[2]**	**Existing or Future Constraints/Threats**
	Creek connecting San Juan Creek with drainages in San Mateo Watershed, including off-site lower Cristianitos and San Mateo creeks.	mammals such as mountain lion, mule deer, coyote and bobcat.	**development occurs in Cristianitos Canyon**
O	Habitat linkage along lower Gabino Creek connecting RMV Open Space to CNF.	Large mammals such as mountain lion, mule deer, coyote and bobcat, as well as cactus wren.	**TBD – will be issue if development occurs in Cristianitos Canyon and/or Blind Canyon/TRW**

[1] Based on habitat linkages and wildlife corridors depicted in Figure 13.
[2] The key species issues are those identified in Section 3.5 of Chapter 3.

The selection of specific monitoring sites within these general linkage and corridor areas would require additional field work in the early stages of implementing the Adaptive Management Program. Each potential site would be field-checked to identify potential movement routes of large species such as mountain lion, mule deer, coyote and bobcat, as well as potential "live-in" habitat for smaller species such as California gnatcatcher and cactus wren. Site security for long-term monitoring also is an important practical consideration because of the potential of vandalism and theft of monitoring equipment, or simply dense public activity that can interfere with reliable data collection (e.g., trampling of tracking areas). Short-term pilot studies may be required to document wildlife use and the long-term security of an area.

Generally following the methods used by Crooks and Jones (1998) for the Nature Reserve of Orange County, survey transects would be established at primary and critical habitat linkages and wildlife corridors expected to be used by these species. Mammals such coyote, bobcat, mountain lion, and mule deer would be monitored through standard tracking techniques and calculation of indices of occurrence most appropriate for the survey transect. Indices to be used may include scat counts, track counts, and remotely-triggered cameras. These indices allow for estimations of distribution, relative abundance, movement patterns and corridor use (Crooks and Jones 1998). Scat and track surveys are economic and reliable measures that can be used in a variety of settings. Remotely-triggered cameras are useful for long-term monitoring of wildlife movement with minimal manual labor and supervision, but should be established only where they can be effectively concealed and risk of theft is minimal. These indices cannot be used to estimate absolute abundance of individuals because many observations of a single individual cannot reliably be distinguished from observations of many individuals (unless an individual has a unique identifying feature such as a missing toe).

Other focal species also would be monitored sites using survey methods appropriate for the management question being asked at the site (see discussion above in *Section 1.4.2* for focal species monitoring). For example, simple presence/absence by a species at a site can be demonstrated through areas search or points counts. A more specific question regarding the long-term function of a habitat linkage may require more detailed information on breeding status and dispersal patterns through mist nesting or nest monitoring. For example, if the question is whether the habitat linkage is functioning to convey dispersing individuals, banding of fledglings may be necessary or intensive monitoring of habitat use within the linkage during dispersal may be required; if juveniles are observed using the habitat linkage it may be possible to infer that the linkage is an effective dispersal corridor. As another example, if there is a concern that a particular linkage or corridor is vulnerable to mesopredators or cowbird nest parasitism, monitoring of nest sites to assess reproductive success may be necessary.

Along focal species data, other variables that would be recorded at monitoring sites include presence of native and non-native mesopredators (e.g., raccoon, striped skunk, opossum, and domestic and feral dogs and cats), proximity to residential and commercial development, evidence of human activity (footprints, trash and garbage, off-road vehicles, mountain bikes, equestrian), amount of natural vegetation cover, substrate, and presence of noise and artificial lighting. At underpasses, bridges and culverts, the dimension of the structure would be determined and correlated with species use.

Based on the results of the monitoring program, if certain desired species are absent or uncommon at important habitat linkages or wildlife corridors in the RMV Open Space, appropriate management actions may be taken, including, but not limited to:

- Enhancement or restoration of the corridor with natural vegetation to provide additional cover.
- Placement of fencing to funnel wildlife to safe crossings and away from exposed roadways.
- Redirection or placement of lighting.
- Placement of sound walls or other methods of attenuating noise.
- Fencing or gating to control unauthorized human access and activities.

- Control of native and domestic mesopredators.

1.7 Fire Management Plan

The Fire Management Plan for the RMV Open Space provides details for meeting the following management objectives.

- Identify appropriate spatial scales and patterns for the long-term management of fire.
- Develop active fire management prescriptions for shrublands (coastal sage scrub and chaparral) and grasslands focused on increasing abundance and diversity of native plants and promoting structure and composition favored by focal wildlife species.
- Quantify effects of varying fire regimes on selected wildlife species.
- Utilize prescribed fire to reduce unplanned fire events from known ignition corridors.
- Define fire prescriptions that aid in the restoration of degraded shrublands.
- Investigate active restoration techniques following fire treatments.
- Develop a social environment supportive of active fire management.

The Fire Management Program describes both tactical and strategic fire protection plans.

The Tactical Fire Suppression Plan is a stand alone plan that would be used by OCFA Field Officers as their wildland fire protection by specific fire management units (FMU). The tactical plan includes policies for bulldozer use, creation of new roads, backfiring, ground unit tactics, off-road use, road grading and erosion, water saturation, and fire prevention techniques. The tactical plan includes delineations of fire management compartments (FMC's) in the planning area, generally watersheds, and FMU's, which are sub-divisions of the FMC's. Within these FMC's and FMU's different tactical operational modes are identified, including "aggressive" (direct attack), "standard" (combination of direct and indirect attack) and "modified" (indirect attack – light on land concept).

The Strategic Fire Protection Plan is a subcomponent of the overall Adaptive Management Program. It addresses the relationship between fire protection and the appropriate role of fire in the RMV Open Space. The Strategic Fire Protection Plan identifies the structure on ignition sources (i.e., radiation, convection, firebrands [embers]) and determines the appropriate fire protection policies for each FMC and FMU in the context of the biological resources being managed and the fuel model classifications and expected fire behavior in the Habitat Reserve. Expected fire behavior depends on several variables, including fuel model (e.g., tall dense mature chaparral vs. short grass), slope percents, and weather conditions (e.g., wind speed and direction and humidity).

Based on these analyses, the Strategic Fire Protection Plan specifies fuel treatment options to protect both life and property and biological resources within each FMU. These include: determination of appropriate Fuel Modification Zones (e.g., irrigated zones and thinning zones); determination of appropriate setbacks from slope based on type of building materials, height of structure, fuel model and expected fire weather conditions; and establishment of short- and long-term fire protection planning criteria for new developments.

The Fire Management Program component of the Strategic Fire Protection Plan provides the detailed fire program for habitats such as coastal sage scrub, chaparral and native grassland, including programs for restoration sites for these habitats. This program considers the current understanding of fire ecology in the southern California ecosystem.

Finally, the Strategic Fire Protection Plan includes a validation and monitoring component, which is vitally important to the overall Adaptive Management Program. This component includes a monitoring approach (i.e., general tests and sampling methods) to evaluate and validate fire management actions or non-actions. The response of vegetation communities and wildlife species to wildfires, prescribed burns, and fuel treatments (e.g., mechanical crush and burn, hand labor fuel treatment and burn) are addressed.

1.8 Grazing Management Plan

1.8.1 Overview of Grazing Management Plan

A Grazing Management Plan was prepared for the RMV. General Policy 6 of the Southern NCCP/HCP Guidelines addressed grazing management as follows:

> *Cattle grazing shall be permitted within the Rancho Mission Viejo portion of the Habitat Reserve provided that grazing activities are consistent with a "grazing management plan" approved as part of the certified NCCP/HCP.*

Rancho Mission Viejo has grazed cattle on the property since 1882. Since that time, RMV has practiced a rotational grazing pattern that takes into consideration available water and forage and the goal of maintaining an average of 25 percent residual dry matter (RDM) for natural grass pastures (i.e., pastures not planted in a forage crop such as barley). In turn, available water, forage and RDM dictate the stocking levels of the RDM pastures.

The Grazing Management Plan reviews the literature on grazing as it affects native valley and foothill grasslands. In brief, it has been suggested that grazing by large herbivores has been an important factor in the evolution of native grasses in California (e.g., Heady 1968, 1977). While cattle are not a native herbivore, and over-grazing clearly can damage the grassland ecosystem, timed grazing can be a useful part of a native grassland restoration and management program (Menke1996). Some of the beneficial effects of timed grazing include:

- Removal of litter and thatch
- Recycling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available fpr native grasses.

1.8.2 Goals and Objectives

The broad goals of the Grazing Management Plan are as follows:

- Identify suitable grazing areas and allowable grazing practices that are consistent with NCCP/HCP policies and the aquatic resource management plan.

- Incorporate grazing management techniques (e.g., timed grazing) to address the needs of species and habitat identified for protection, promote native grasses, and allow for continued cattle grazing sufficient to support cattle operations, and where appropriate, reduce fuel loads for fire.

- Within the upper subunit of the Gabino sub-basin, protect the headwaters through restoration of existing gullies using a combination of slope stabilization, grazing management, and native grassland and/or coastal sage scrub restoration. Grazing management would be modified in this headwater area to support restoration and vegetation management.

To achieve these goals, eight objectives of the Grazing Management Plan are to:

1. Establish a minimum residual dry matter (RDM) per acre for active existing pastures and adjust as necessary to accommodate changes in pasture configuration and stocking levels.

2. Identify interim and long-term changes to existing pasture configurations and stocking levels to maximize use of available forage and facilitate restoration and management of native vegetation communities.

3. Identify a timed rotational grazing scheme to maximize use of available forage and facilitate restoration and management of native vegetation communities.

4. Identify sensitive resource areas where cattle grazing shall be excluded seasonally or permanently.

5. Identify additional facilities required to promote better distribution of cattle within pastures (e.g., water sources, shade, supplemental feed/nutritional blocks).

6. Outline methods (e.g., exclosures) for monitoring forage levels in order to assess range conditions and provide guidance for the introduction and removal of cattle.

7. Identify pastures that may be appropriate for prescribed fire. Identify appropriate pasture rest periods following prescribed and wildfire burns to promote vegetation recovery.

8. Outline procedures for re-evaluating grazing management practices every 3 to 5 years to ensure that existing practices are achieving desired results.

1.8.3 General Description

The Grazing Management Plan includes a description of the pastures on RMV in terms of existing environmental conditions (vegetation communities and species) and current grazing status, including stocking levels, timing and rotational practices, estimates of RDM for different pastures and goal RDM values (e.g., 25% as a minimum standard for pastures with natural forage).

The Grazing Management Plan describes future grazing strategies designed to meet the goals and objectives stated above. These future strategies include:

- Recommended RDM parameters for each active pasture, taking into consideration rainfall patterns, soils and slopes.

- Recommended stocking rates to achieve the recommended RDM based on projected annual forage per pasture and using Animal Unit (AU) as the standard measurement of livestock forage requirements (UC Extension Leaflet 21456).

- Recommended timed grazing patterns for specific areas of the Ranch, depending on the resource issues (e.g., native grassland restoration in upper Cristianitos).

- Sensitive habitat exclusions to protect important resources, including both permanent and seasonal exclusions.

1.9 Habitat Restoration Plan

1.9.1 Overview of Habitat Restoration Plan

The Habitat Restoration Plan is a key component of the overall Adaptive Management Program for the RMV Open Space. It describes the spectrum of possible upland and riparian/wetland restoration activities within the RMV Open Space and in areas subject to the aquatic resource management plan. The term "restoration" is used very broadly in this plan and covers a range of activities from enhancement of existing degraded habitats to creation of new habitats. The restoration activities described in this plan would be undertaken in accordance with Wildlife Agency approved restoration plans .

The Habitat Restoration Plan identifies several restoration areas on the basis of their important location and function in the RMV Open Space. The overall goal of restoration in these areas is contribute to and help maintain *net habitat value* in the RMV Open Space on a *long-term* basis for Identified Species that receive regulatory coverage under Section 10.

1.9.2 Upland Habitat Restoration Areas

Several areas were identified for coastal sage scrub (CSS) and valley needlegrass grassland (VGL):

- CSS restoration in Sulphur Canyon elsewhere along Chiquadora Ridge in the Gobernadora sub-basin;
- CSS and VGL restoration along Chiquita Ridge in the Chiquita sub-basin;
- VGL restoration in the upper Cristianitos sub-basin and portions of Blind Canyon Mesa in the Gabino and Blind Canyons sub-basin; and
- CSS/VGL restoration in upper Gabino Canyon sub-basin; and
- CSS/VGL restoration in the Chiquita Canyon sub-basin.

1.9.3 Riparian/wetland Restoration Areas

Areas identified for riparian/wetland restoration includeconsist of the following:

- Gobernadora Creek to address historic meander condition and excessive sediment resulting from upstream land uses;
- Creation of breeding habitats in Gobernadora Creek for tricolored blackbird, least Bell's vireo, southwestern willow flycatcher and other riparian species;
- Upper Gabino Creek to address erosion and excessive sediment generation (this restoration program would occur in combination with upland CSS/VGL restoraion); and
- Chiquita Creek and upper Cristianitos to address locally-induced headcuts.

Although not specifically part of the riparian/wetland restoration plan discussed here, additional riparian/wetland areas have been identified for enhancement through control of invasive species such as giant reed (*Arundo donax*), tamarisk (*Tamarix* spp.), pampas grass (*Cortaderia selloana*), castor bean (*Ricinus communis*), and tree tobacco (*Nicotiana glauca*). Major targeted areas include San Juan Creek, Arroyo Trabuco Creek and lower Cristianitos Creek. Details of this program are provided in *Section 8.10* below and in the Invasive Species Control Plan.

1.9.4 Approaches to Restoration

As indicated above, the term "restoration" is used in the broad sense to refer to the spectrum of restoration activities to be conducted in the RMV Open Space. Restoration activities may be passive or active, depending on the needs and/or response of a site to restoration.

Passive Restoration generally refers to removing or controlling disturbance events such as discing that perpetuate non-native or disturbed habitats. Passive restoration may involve some site preparation and maintenance such as weed control, and trash and debris removal, but generally the site would be allowed to revegetate naturally without extensive intervention. Some initial seeding may be used if the natural seed bank onsite is inadequate. Passive restoration sites would be monitored, and if the site is not meeting performance standards by a designated period, active restoration may be applied.

Active Restoration broadly refers to the specific application of restoration techniques. On a large scale (e.g., 10s to 100s of acres), active restoration techniques may include timed grazing or prescribed burning. On a smaller scale (e.g., a few acres or less), active restoration may include site-intensive techniques such as soil preparation, planting and/or seeding, irrigation, weed control, erosion control, etc. Active restoration implies a higher level of effort than passive restoration and typically is used on sites that would not regenerate naturally, or would only regenerate over an unacceptably long period of time without direct intervention. For example, a mitigation requirement that a site meet certain performance standards such as percent native plant cover or species occupation within five years probably would require active restoration to ensure that the performance standards were met.

Along with passive and active restoration, it is important to distinguish between enhancement and revegetation activities

Enhancement generally refers to restoration of sites that support degraded forms of the target native vegetation community. The level of effort needed to enhance a site typically is less than revegetating a site because the target native community is already present. A primary enhancement approach in the RMV Open Space where low quality native habitat is already present would include timed grazing and prescribed burning to control non-native invasive grasses and weeds. Seeding may be used to supplement the existing native vegetation, but planting of container plants and irrigation generally are not used on enhancement sites. Enhancement tends to be more passive, letting nature take its course.

Revegetation involves active restoration of a site whereby container plants and/or seeds are used to create or restore habitat. Typically the target native vegetation community is absent from the site; e.g., a site supporting non-native annual grasslands revegetated with VGL. Site preparation and maintenance may include annual grass and weed control, and trash and debris removal. Depending on site conditions, soil remediation and/or irrigation may be necessary to support a viable revegetation site. Generally, revegetation sites would have higher performance standards than passively restored sites and the monitoring and maintenance program is more specific as far as the responsibilities of the Restoration Ecologist and the Installation/Maintenance Contactor.

In practice, there often is not a clear distinction between active and passive restoration, revegetation and enhancement because each site has its own distinct requirements for successful restoration. The Restoration Ecologist and reserve owner/manager would have the flexibility to implement the appropriate restoration techniques in an adaptive fashion to produce the desired results in the most efficient manner. However, specific performance standards would be set for each restoration site so that success can be objectively measured.

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1.9.5 Components of Specific Restoration Plans

A detailed restoration plan would be prepared for each restoration site. The appropriate restoration approach would be taken, and may include, but not be limited to:

- Removal or control of the disturbing event
- Specific site preparation such as weeding or trash and debris removal
- Prescribed burning
- Timed grazing
- Active revegetation, including site preparation, seeding and/or container plant installation, and monitoring

For each site, a set of success criteria would be established to measure whether the restoration project has achieved the desired result. Depending on the type or size restoration project the success criteria may be qualitative or quantitative. For example, for a large passive CSS restoration area, success criteria may be as simple as measuring a consistent increasing trend of percent cover of CSS shrub species and concomitant decline in non-native invasive species such as black mustard or artichoke thistle. For a smaller active revegetation area, specific quantitative performance criteria can be set, such as X percent cover of weedy species after 1, 2, 3, 4 and 5 years. Active revegetation projects also typically specify plant palettes, planting techniques, seed application, irrigation systems and schedules (if necessary), weed control, erosion control, pest control, other maintenance activities, and monitoring and data collection methods.

8.10 **Invasive Species Control Plan**

1.10.1 Overview of Invasive Species Control Plan

An Invasive Species Control Plan was prepared to address the existing and foreseeable impacts of invasive plant and animal species on the RMV Open Space. This Plan provides the long-term management guidelines for the control of invasive species on RMV. The objectives of the Invasive Species Control Plan are to:

- Census and map invasive plants and introduced vertebrate predators on RMV.
- Review the ecology and habitat requirements of invasive species targeted control.
- Provide an overview of species-specific and density-dependent control methods.
- Analyze the impacts and benefits of the Plan on focal species and habitats.

The Invasive Species Control Plan is comprised of three main components: (1) invasive plants; (2) invasive invertebrates; and (3) invasive vertebrates.

1.10.2 Invasive Plant Species

The invasive plant species targeted for control include several riparian species and one upland species. The riparian invasive plants along with their priority rankings are:

Riparian Species

- Giant reed (*Arundo donax*) – Priority 1

- Pampas grass (*Cortaderia selloana*) – Priority 2
- Castor bean (*Ricinus communis*) – Priority 2
- Tamarisk (*Tamarix ramosissima*) – Priority 3
- Tree tobacco (*Nicotiana glauca*) – Priority 3
- Spanish sunflower (*Pulicaria paludosa*) – Priority 3

The upland plant species targeted for control is artichoke thistle (*Cynara cardunculus*).

For the riparian invasive species, several control methods can be used:
- Manual
- Foliar spray
- Cut stem/stump spray
- Cut, resprout and spray
- Mechanical

Each of these methods has advantages and disadvantages, and application, timing and equipment considerations. The selection of treatment method would depend on site-specific characteristics. For example, in large monotypic areas with minimal other sensitive resource present, mechanical removal with heavy equipment may be the most effective and efficient control technique. On the other hand, in areas with sensitive resources (e.g., arroyo toad breeding habitat), a more "surgical" method such as manual removal (i.e., hand pulling, digging with a shovel, or using a pick-ax, loppers or machete) may be more appropriate.

The control of artichoke thistle has been an ongoing program on RMV property and the problem is much less severe on the Ranch compared to other untreated areas of southern Orange County. While mechanical removal of this species in possible, the most effective treatment is the use of herbicides.

1.10.3 Invasive Invertebrate Species

Two invasive invertebrate species are targeted for control: Argentine ant (*Linepithema humile*) and red imported fire ant (*Solenopsis invicta*). Both species pose direct and indirect threats to native species, including direct predation of native vertebrates and competition/displacement of important invertebrate prey of native species.

The Invasive Species Control Plan acknowledges that eradication of either Argentine or red imported fire ants is not feasible or practical because of their ubiquity in southern California and their ability to colonize new areas. The goal of the program would be to control their populations and prevent their spread into new areas of the RMV Open Space. Control methods would include:

- Managing the urban-RMV Open Space interface to minimize opportunities for colonization (e.g., by controlling moisture).
- Direct nest/mound treatments with insecticides.
- Broadcast applications of insecticides.

The direct nest/mound and broadcast insecticide treatments would be used with great caution in areas of the RMV Open Space in consideration of the inadvertent impacts on sensitive species and habitats as well as other non-target, native invertebrate species.

1.10.4 Invasive Vertebrate Species

The vertebrate control component of the Invasive Species Control Plan addresses four invasive species:

- Bullfrog (*Rana catesbeiana*)
- Crayfish ((*Procambrus* spp.)
- Brown-headed cowbird (*Molothrus ater*)
- European starling (*Sturnus vulgaris*)

a. Bullfrog

Bullfrogs may be the most pernicious invasive animal in the RMV Open Space. They have a voracious appetite that includes almost any living thing, including other amphibians, arthropods, fish, snakes, birds, and small mammals (including bats). Bullfrogs have few natural predators and have explosive reproductive potential, producing up to 20,000 eggs per female per year. Bullfrog impacts appear to be a significant factor in the decline of native amphibian populations in much of western North America, including the endangered arroyo toad. Most of the ponds, lakes and creeks on RMV support populations of the bullfrog, although some may be too ephemeral to support successful reproduction.

The bullfrog control program would take a watershed approach, as opposed to a pond-by-pond approach, because there may be extensive movement among ponds. Unless source populations in the larger waterbodies are controlled, bullfrogs would continue to be a significant problem in the Habitat Reserve. Control methods would be site-specific and field experiments would be conducted to determine the most effective and cost-efficient control method for a particular site. Potential control methods, ranging from broad approaches to more labor-intensive specific methods, include:

- Pond draining and then killing all bullfrogs left behind, including those burrowing in banks.
- Fencing to prevent movement from the pond areas as it dries and recolonization of the pond.
- Gill netting, seining, and/or sifting water for eggs.
- Shooting and gigging (spearing or hooking)

Public awareness and education also would be an important part of the bullfrog control program. Signs and posting warning of the risks of invasive plants and animals would be placed in key areas at risk for reintroductions of the bullfrog.

b. Crayfish

Crayfish (*Cambarus* spp.) are recognized predators of amphibian eggs and their larvae and thus can contribute to population declines. The arroyo toad and crayfish evolved independently of each other, suggesting that arroyo toad larvae may be considerably more vulnerable to crayfish than bullfrog tadpoles, which share the same historic distribution with crayfish and thus have a linked evolutionary history (i.e., a co-evolved predator-prey relationship). Arroyo toad tadpoles, being relatively small detrital feeders, are more vulnerable to crayfish predation than the huge algal feeding bullfrog larvae.

Rancho Mission Viejo has two species of crayfish: the widely distributed *C. clarkii* and another relatively recent arrival whose species identity currently is unknown. *C. clarkia* is common in San Juan Creek and portions of Gobernadora Creek Both species are abundant in San Juan Creek, and on some reaches are actually super abundant with 3-4 crayfish/sq. m being standard for certain 100-m reaches of creek. *C. clarkii* seems to be the more abundant of the two species overall on RMV. The source of the Gobernadora Creek population may be from upstream areas of Coto de Caza, which has perennial ponds within golf course areas from which crayfish may be washed downstream. Control of this source would be important as it provides a source to invade areas of San Juan Creek subject to ongoing crayfish control.

Arroyo toad breeding distribution in the San Juan Creek Watershed probably is affected by the presence of crayfish in San Juan Creek, and possibly in Gobernadora Creek. Any future detailed survey of arroyo toad populations in San Juan Creek should also survey for the presence of crayfish. Potential control methods for crayfish would be similar to those described above for the bullfrog.

c. Brown-headed Cowbird and European Starling

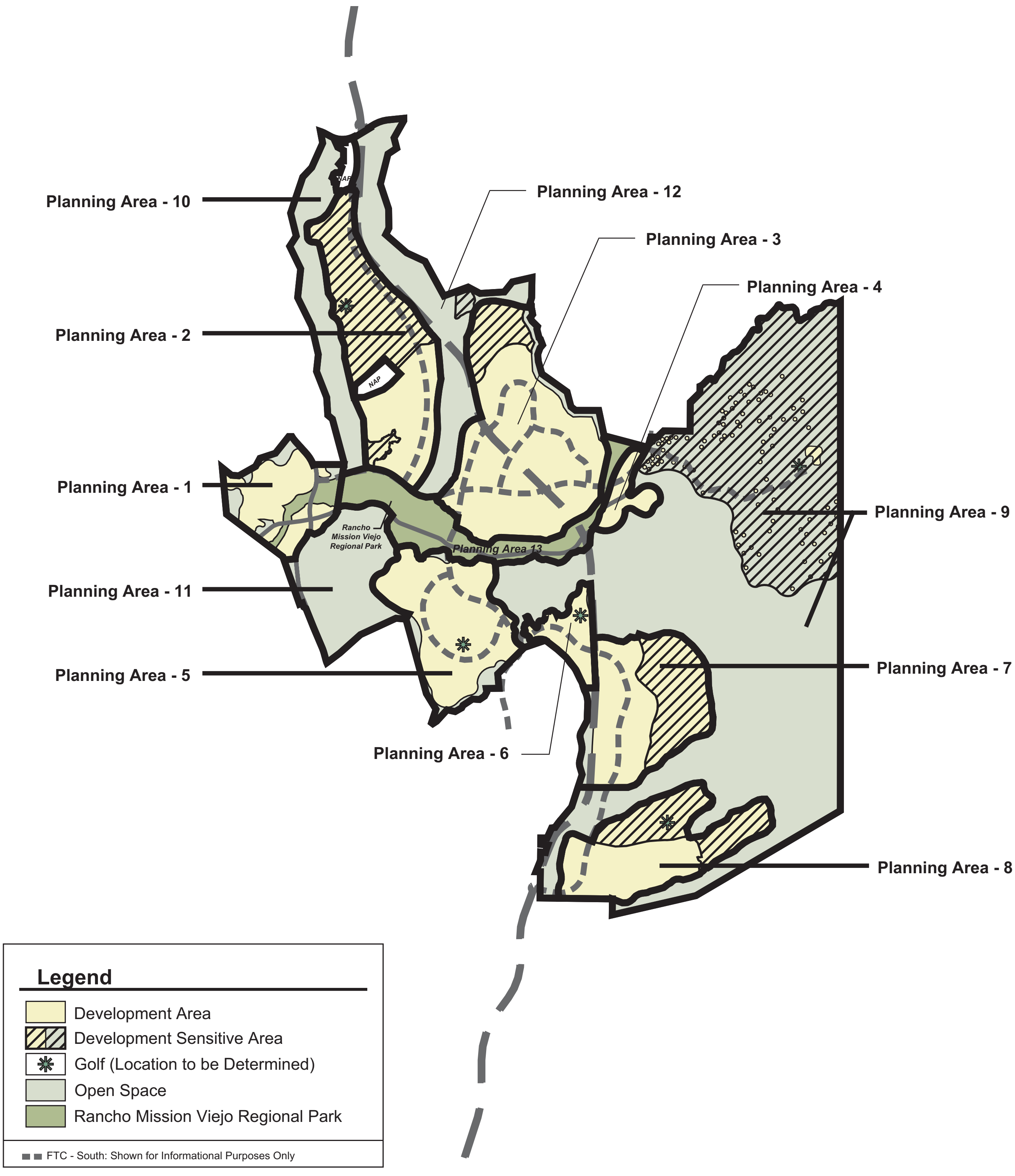
Brown-headed cowbirds are native to the central plains of North America where they co-evolved with bison. The cowbird's range has expanded to the west with the increase in cattle grazing and irrigated agriculture. As a nest parasite, they now pose a serious threat to native passerine species, and were implicated in the decline of the least Bell's vireo.

The European starling is a non-native species that only arrived in California in the early 1940's. The starling is a secondary cavity nester that usurps nests built by woodpeckers and used by other secondary nesters such as the ash-throated flycatcher. They are an aggressive species that has successfully outcompeted native species. Starlings occur throughout the RMV property, but are particularly common around Cow Camp along San Juan Creek, where they are concentrated in western sycamores and man-made structures.

Brown-head cowbirds and starlings would be controlled by strategically placing Australian cowbird traps in areas where these species are a problem for native host species (e.g., vireos and gnatcatchers for the cowbird and acorn woodpeckers for the starling). The effectiveness of the trapping program would be evaluated annually and trap locations the trapping effort would be adjusted. In addition for starlings, management may include the placement of species-specific nest boxes that are not accessible to starlings (e.g., small holes) or the use of mist-netting where starling populations are particularly dense (e.g., Cow Camp).

1.11 Interim Protection of Habitat Values on Lands Within the Proposed RMV Open Space

It will require several years to assemble the entire RMV Open Space area following execution of the Development Agreement and obtaining necessary Wildlife Agency approvals. Therefore, to the extent feasible, RMV will take the steps necessary to assure that lands designated for inclusion in the Open Space system are not degraded in a way that results in a net loss of habitat value prior to their inclusion in the RMV Open Space. Accordingly, during the interim period prior to inclusion of lands in the Open Space, RMV shall not develop or otherwise permit uses within the Open Space area that would significantly degrade biological values with the proposed RMV Open Space.



Planned Community Development Map

Figure 1

RMV Adaptive Management Plan

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Source: EDAW, Inc. 2003

S:/GIS_Exhibits/RMVJ008/Ex1_RMV_AMP_050604.pdf

ADAPTIVE MANAGEMENT FLOWCHART

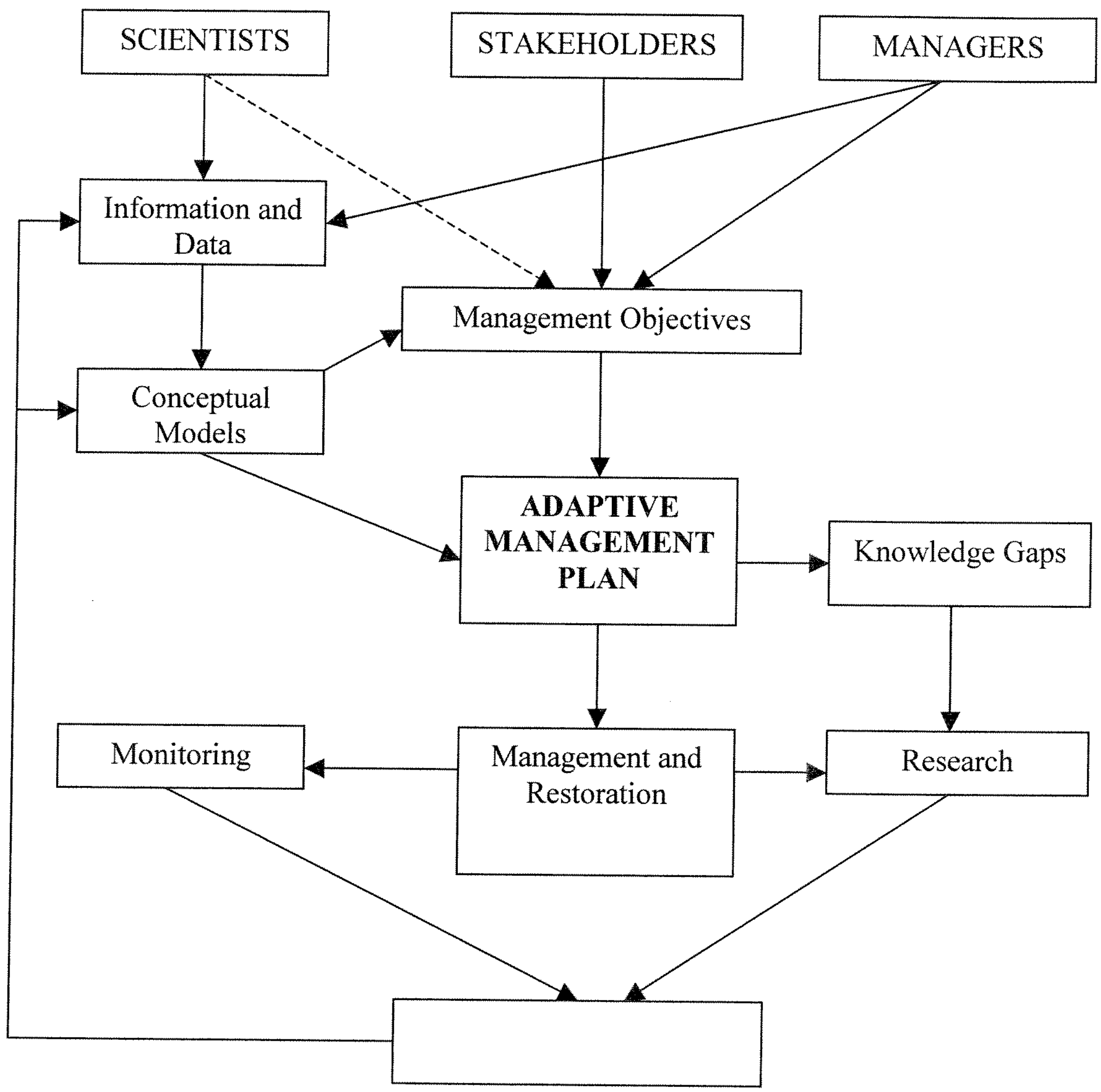


Figure 2

Source: Southern Orange County NCCP Science Advisors. 1997. Principles of Adaptive Management for the Southern Orange County NCCP.

COASTAL SAGE SCRUB GENERAL STRESSOR MODEL

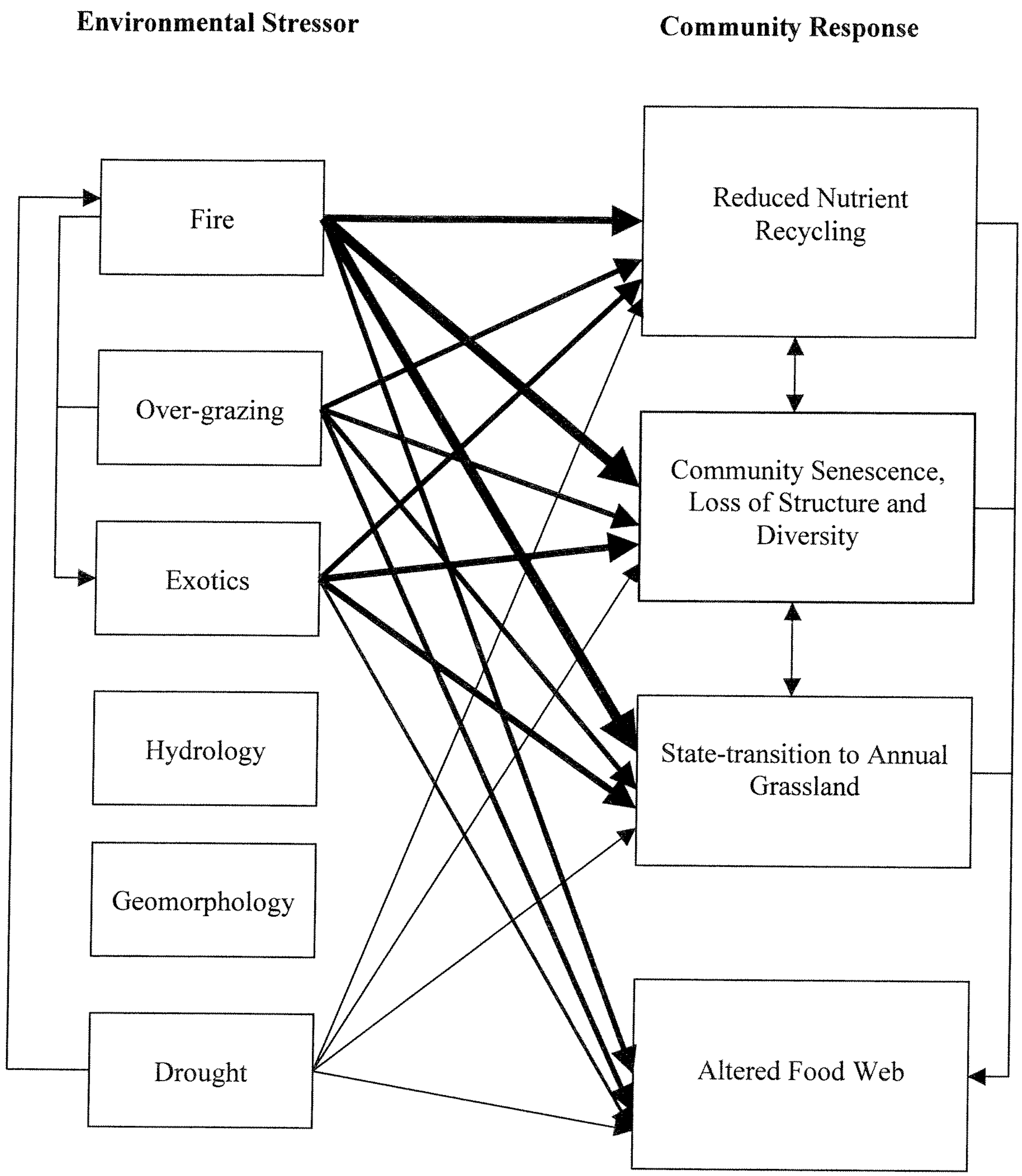


Figure 3

CHAPARRAL GENERAL STRESSOR MODEL

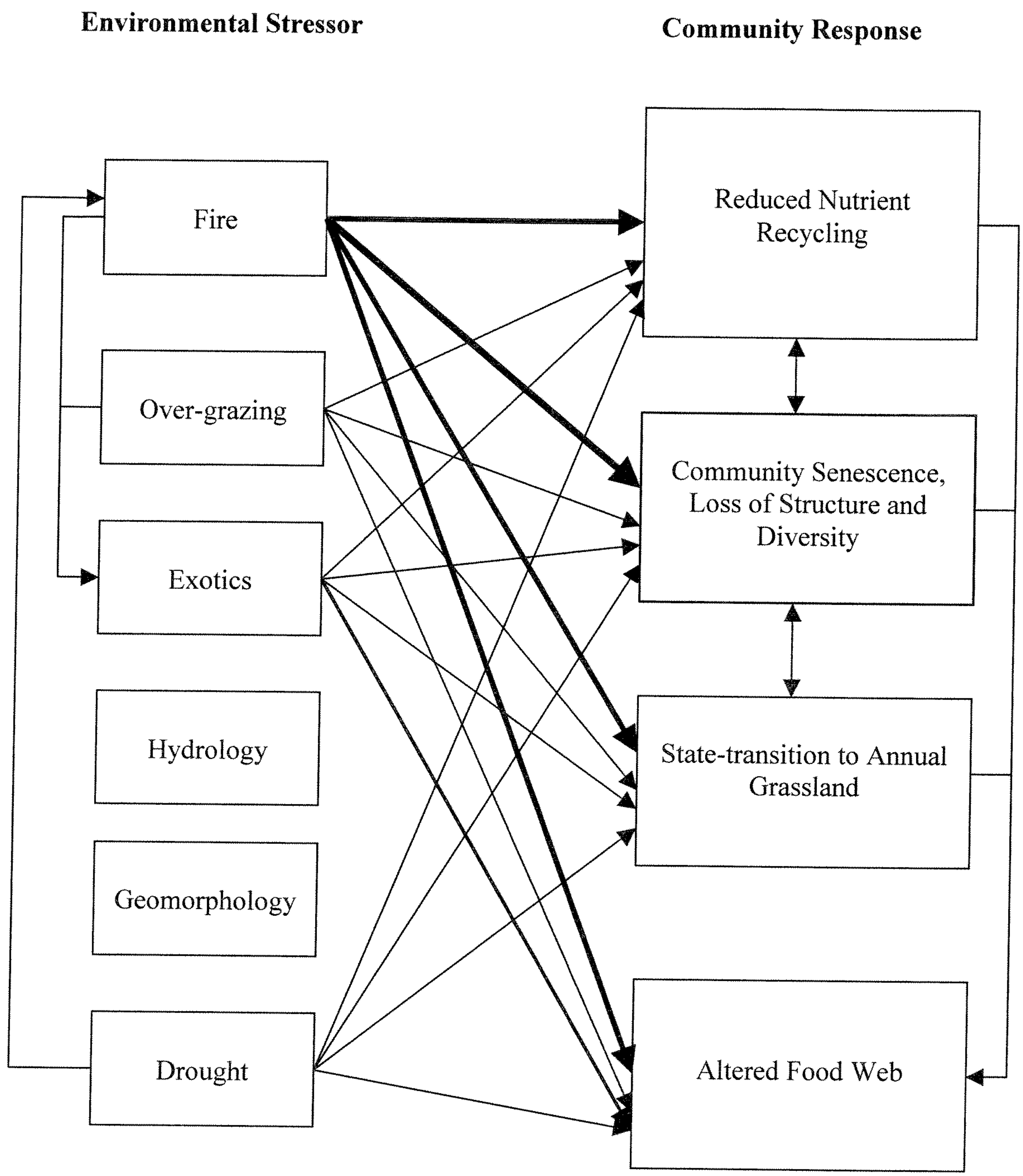


Figure 4

NATIVE GRASSLAND GENERAL STRESSOR MODEL

Environmental Stressor **Community Response**

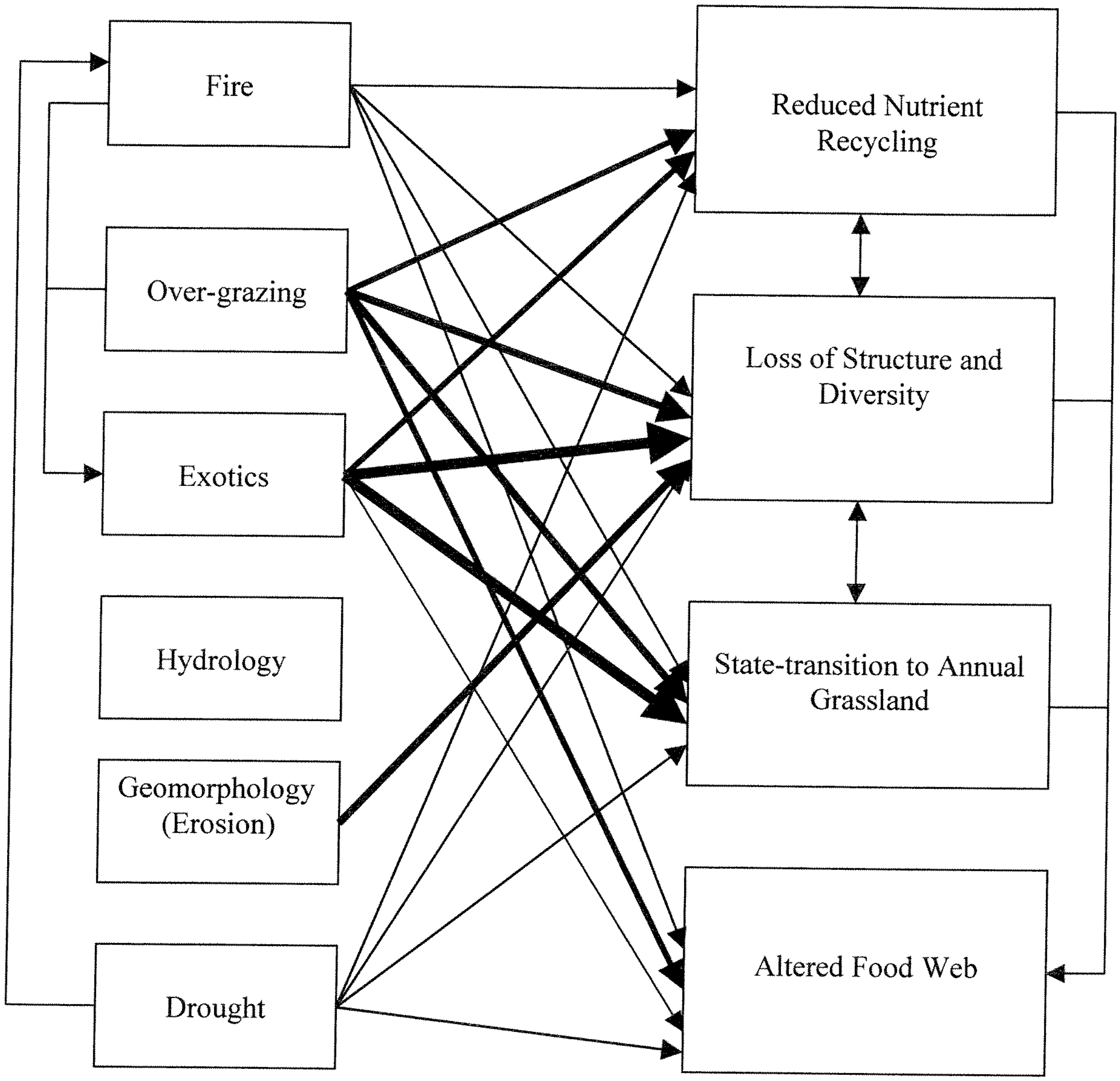


Figure 5

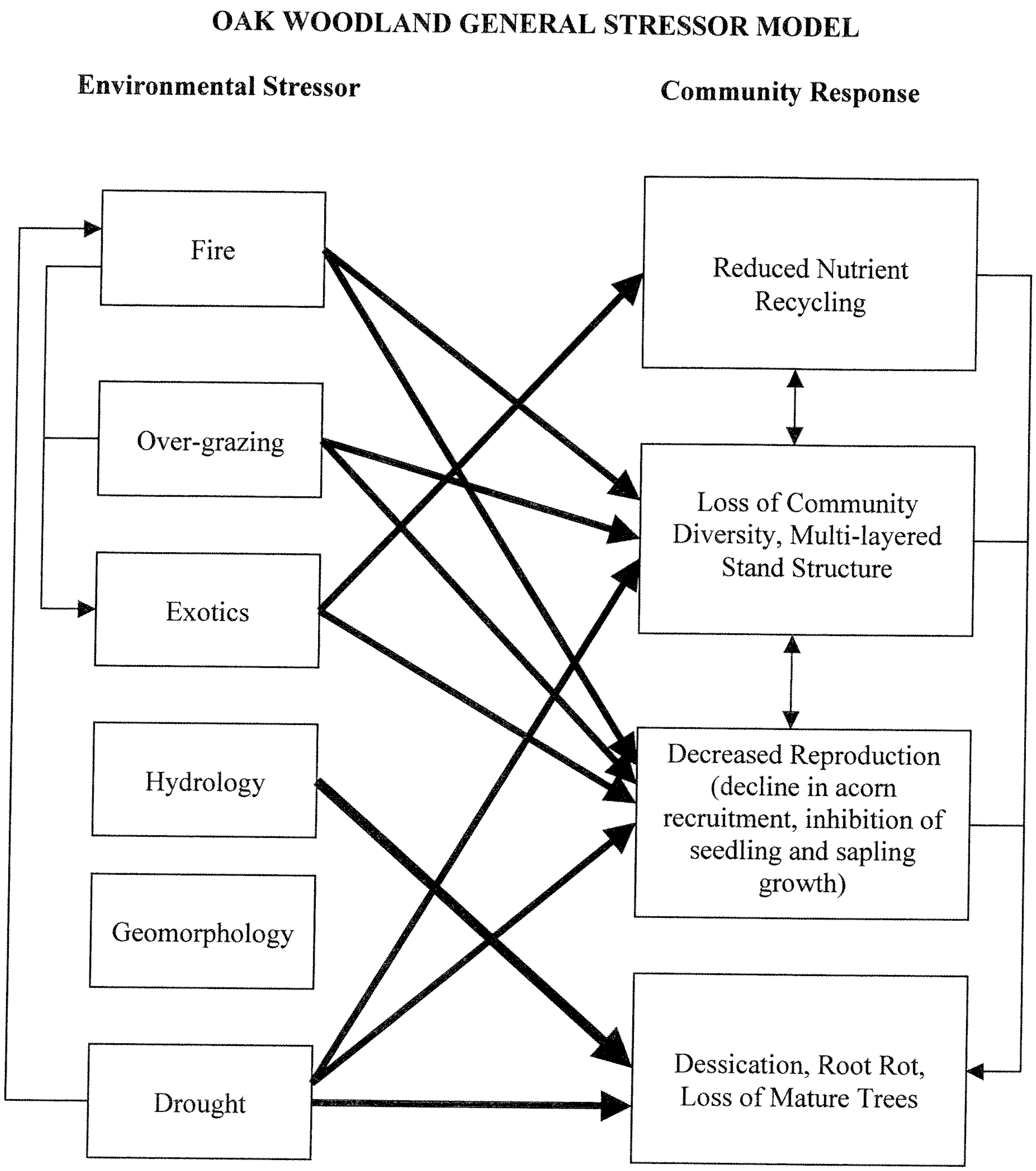

OAK WOODLAND GENERAL STRESSOR MODEL
Environmental Stressor
Community Response
Fire
Over-grazing
Exotics
Hydrology
Geomorphology
Drought
Reduced Nutrient Recycling
Loss of Community Diversity, Multi-layered Stand Structure
Decreased Reproduction (decline in acorn recruitment, inhibition of seedling and sapling growth)
Dessication, Root Rot, Loss of Mature Trees

Figure 6

RIPARIAN/WETLAND GENERAL STRESSOR MODEL

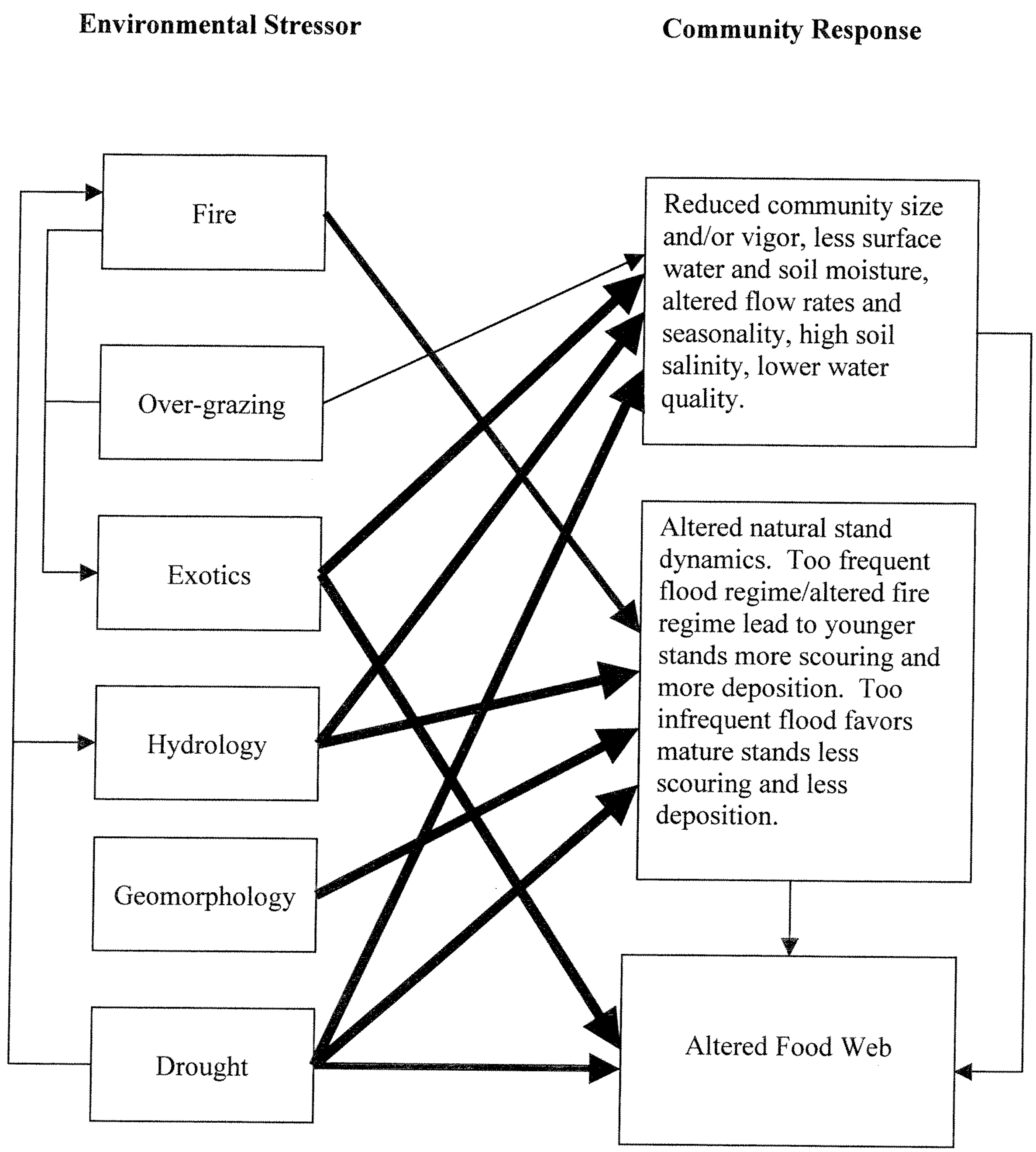


Figure 7

Figure 8. COASTAL SAGE SCRUB FOCAL SPECIES STRESSOR MODEL

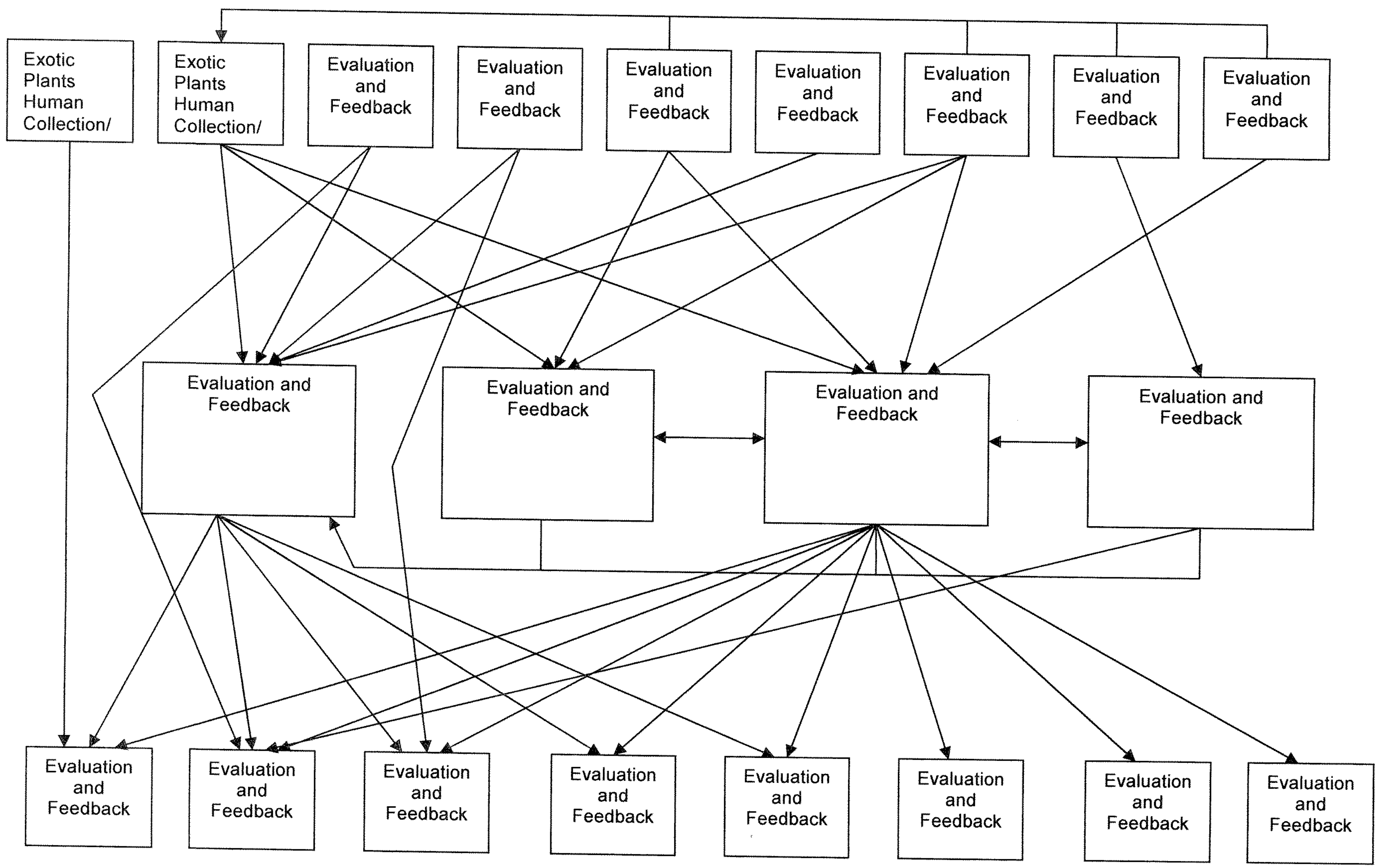


Figure 9. CHAPARRAL FOCAL SPECIES STRESSOR MODEL

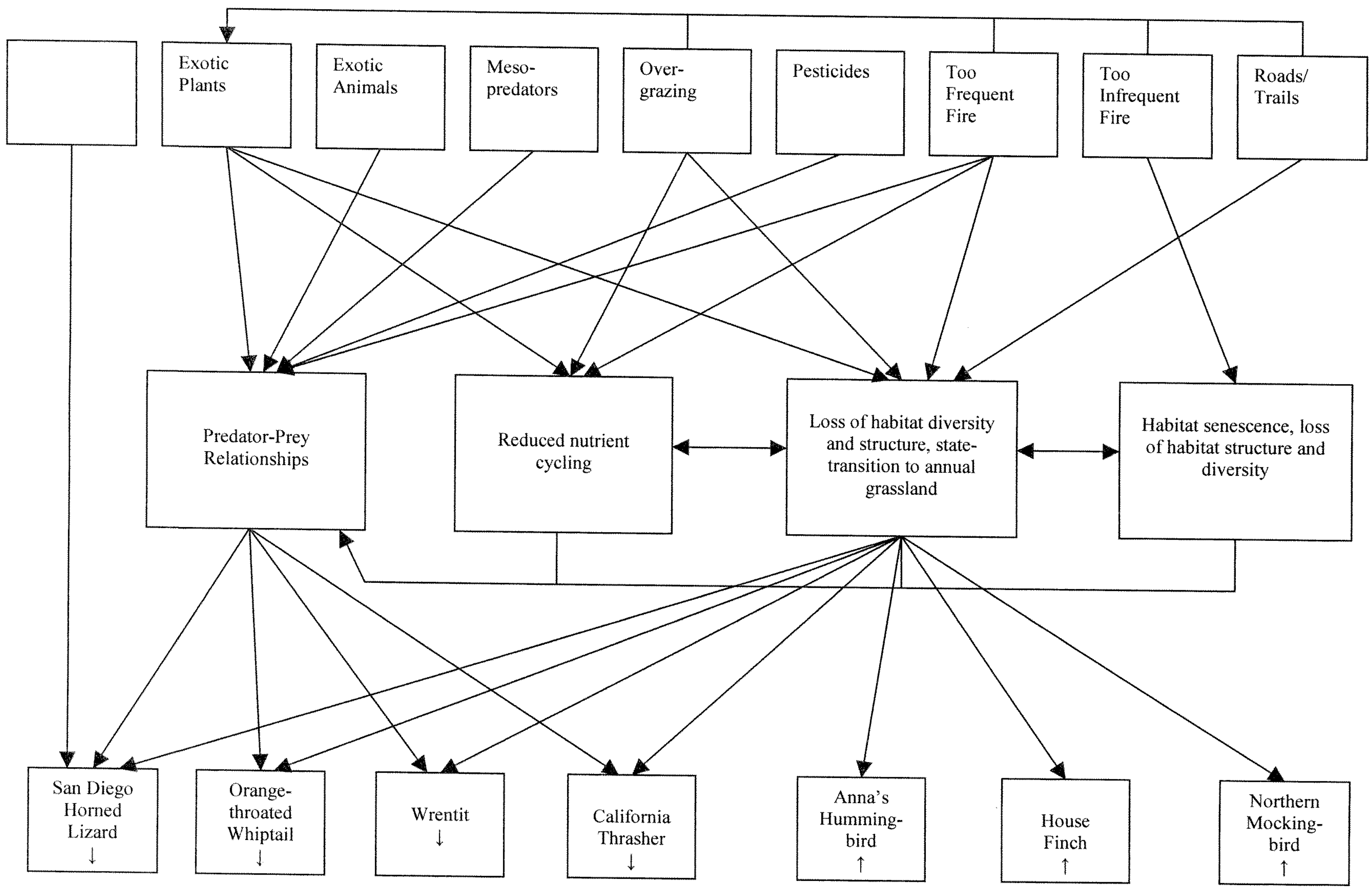


Figure 10. NATIVE GRASSLAND FOCAL SPECIES STRESSOR MODEL

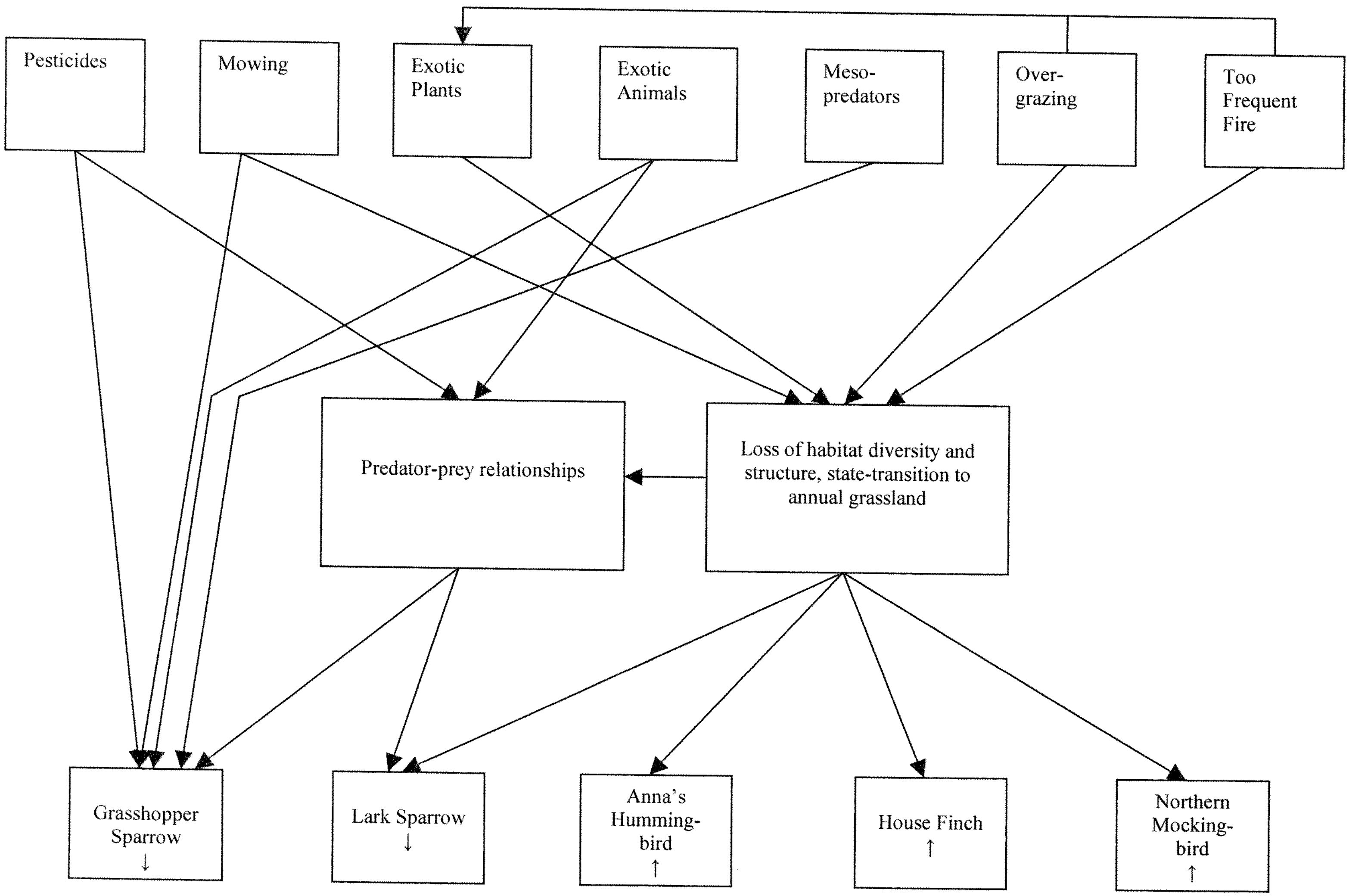


Figure 11. OAK WOODLAND FOCAL SPECIES STRESSOR MODEL

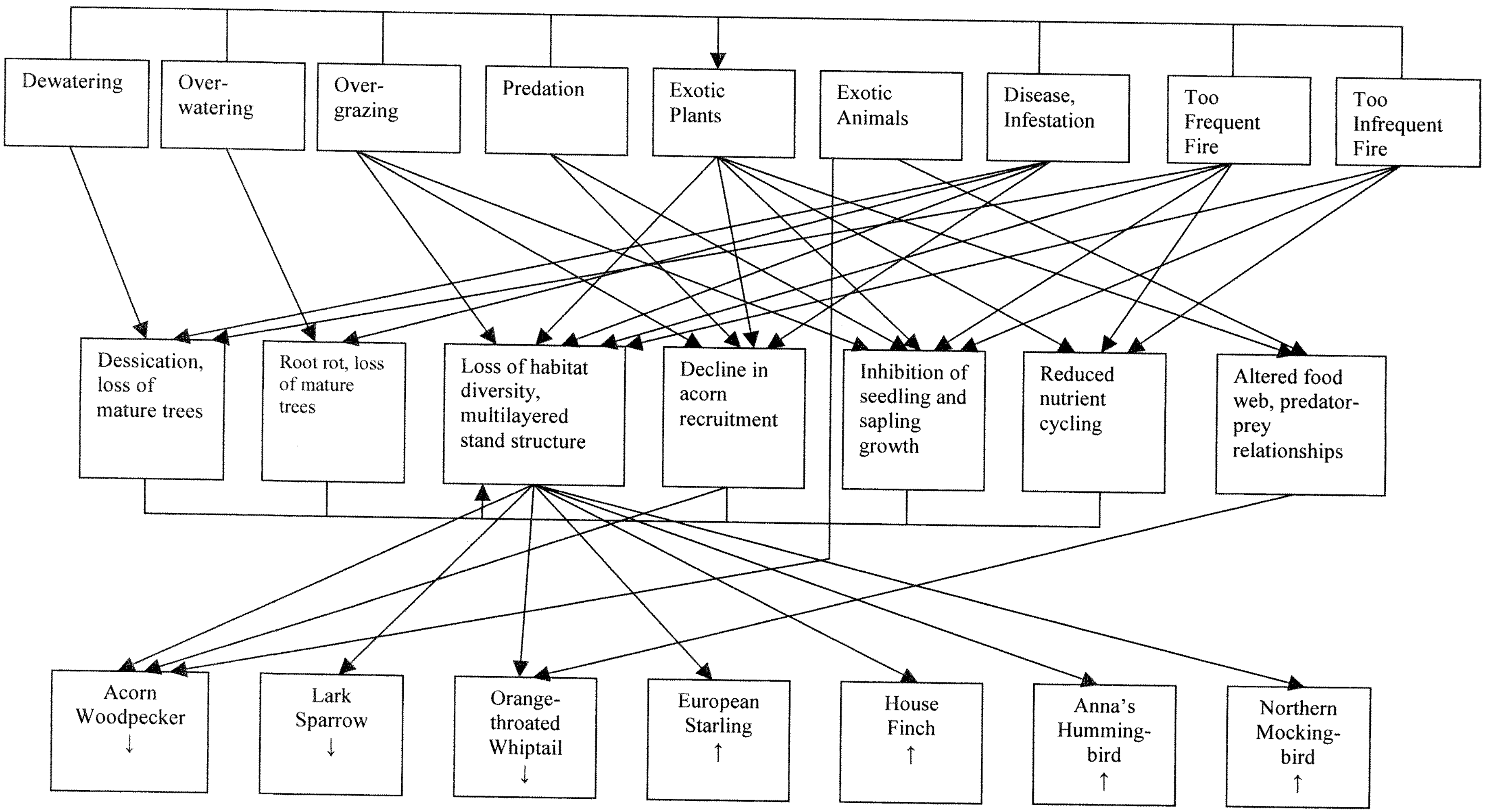
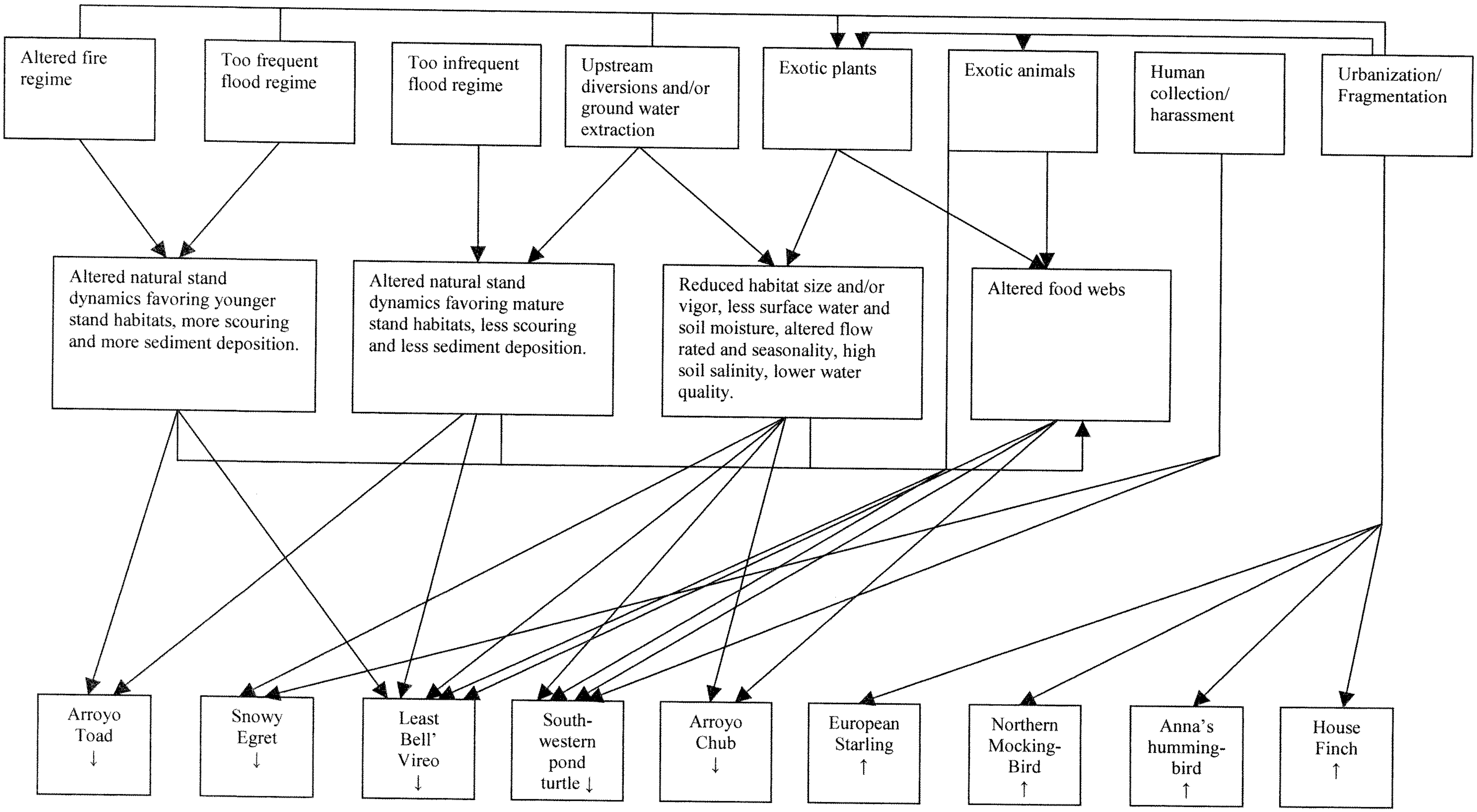
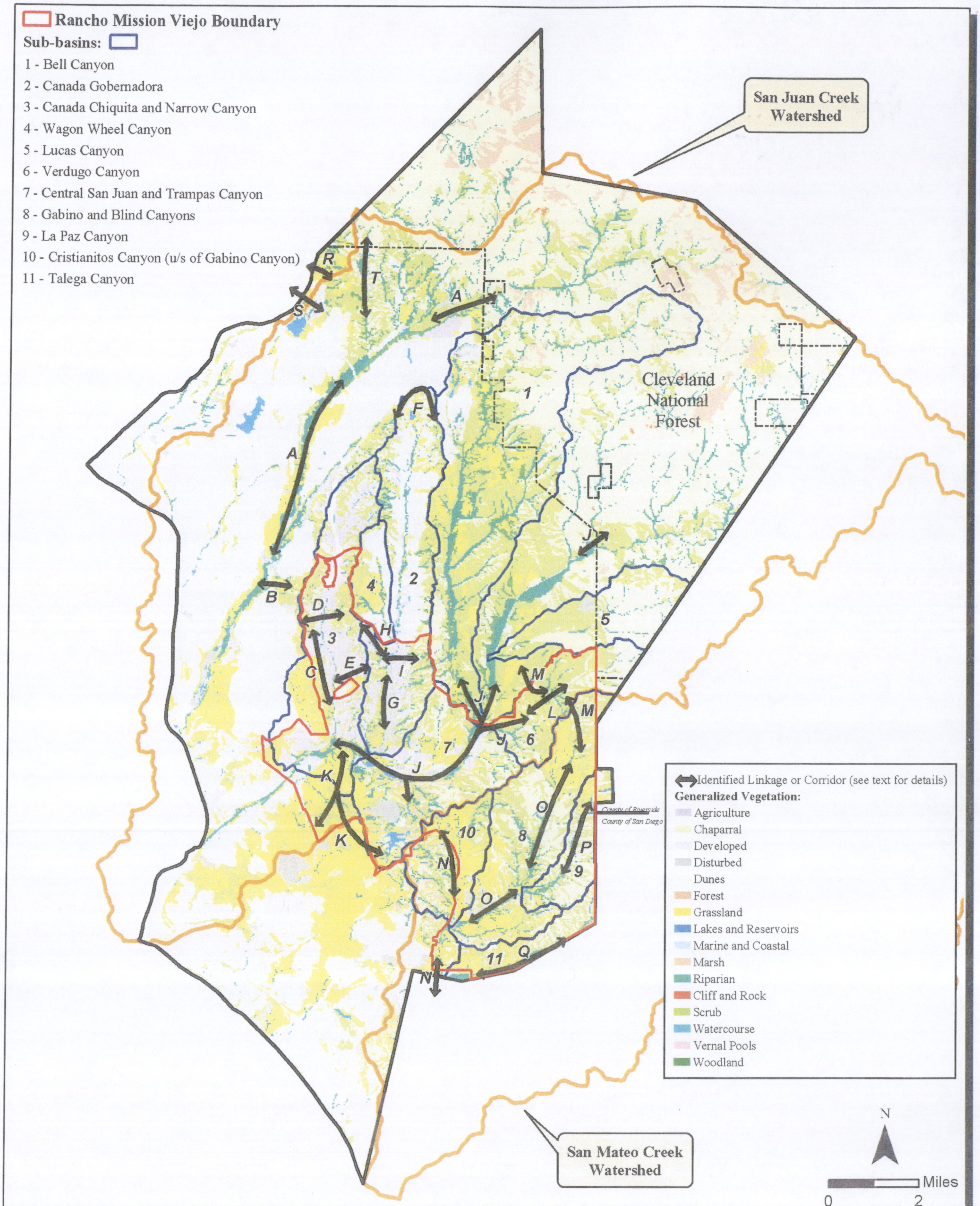


Figure 12. RIPARIAN/WETLAND FOCAL SPECIES STRESSOR MODEL

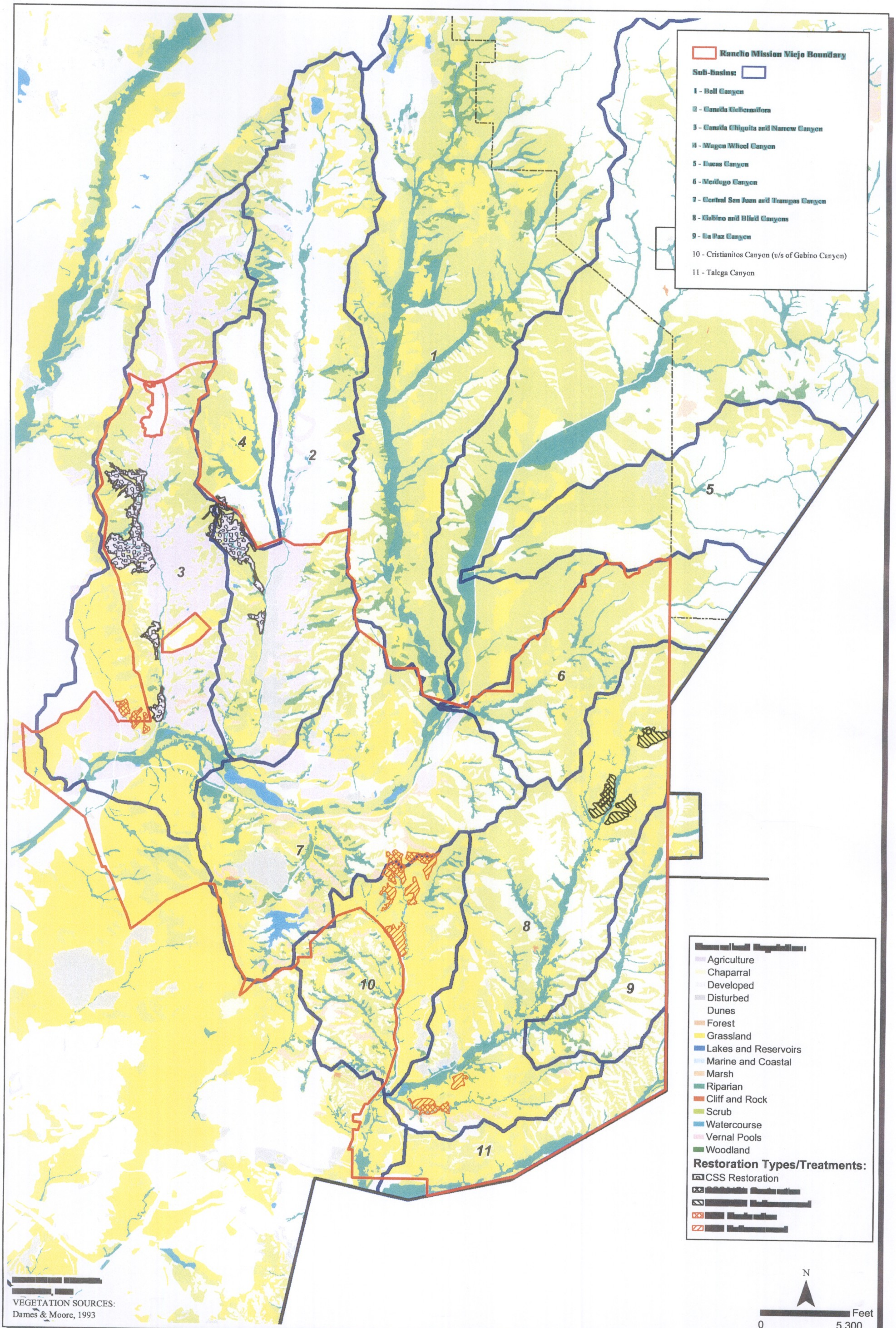




RMV Adaptive Management Program

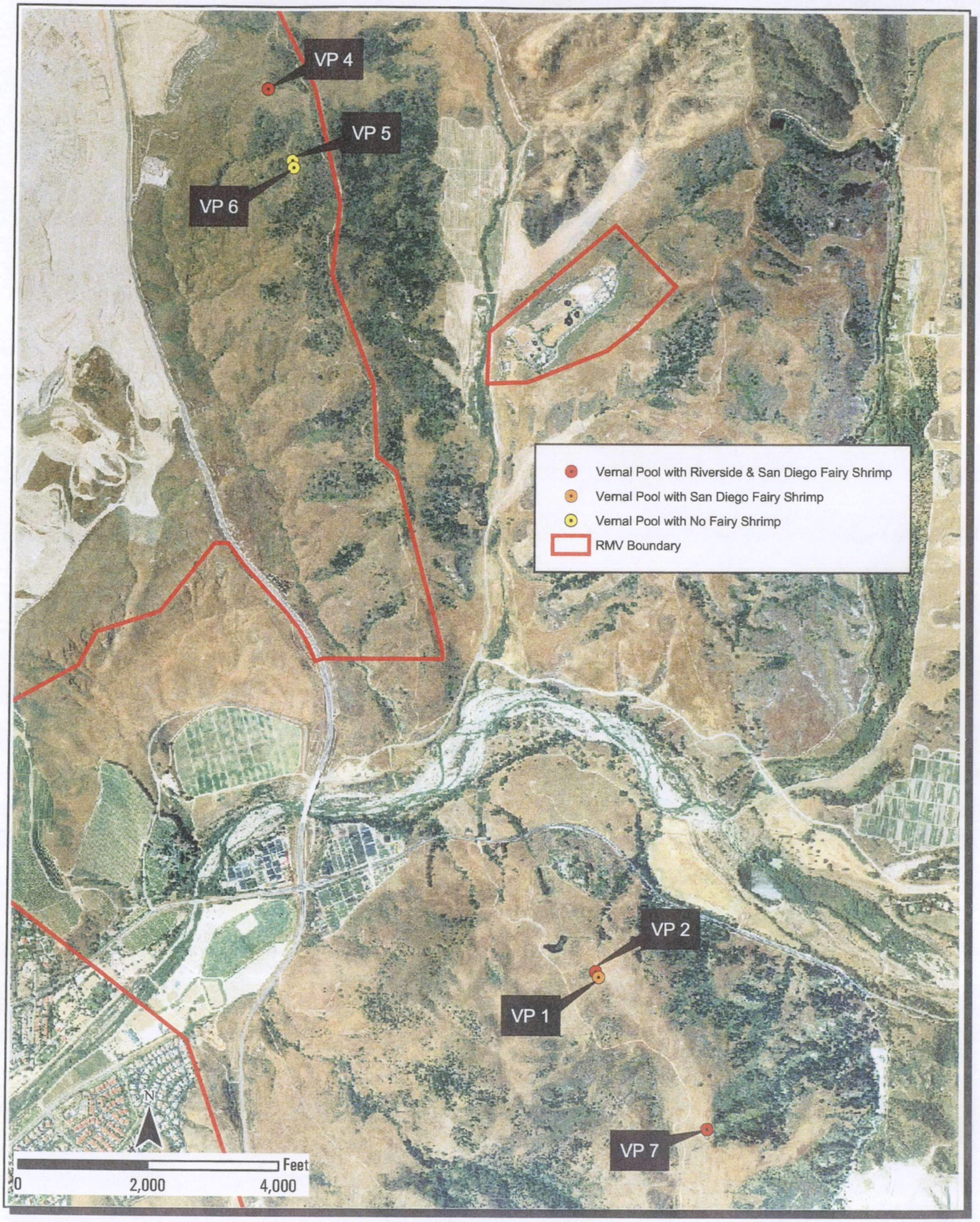
FIGURE 13

Habitat Linkages and Wildlife Corridors Map



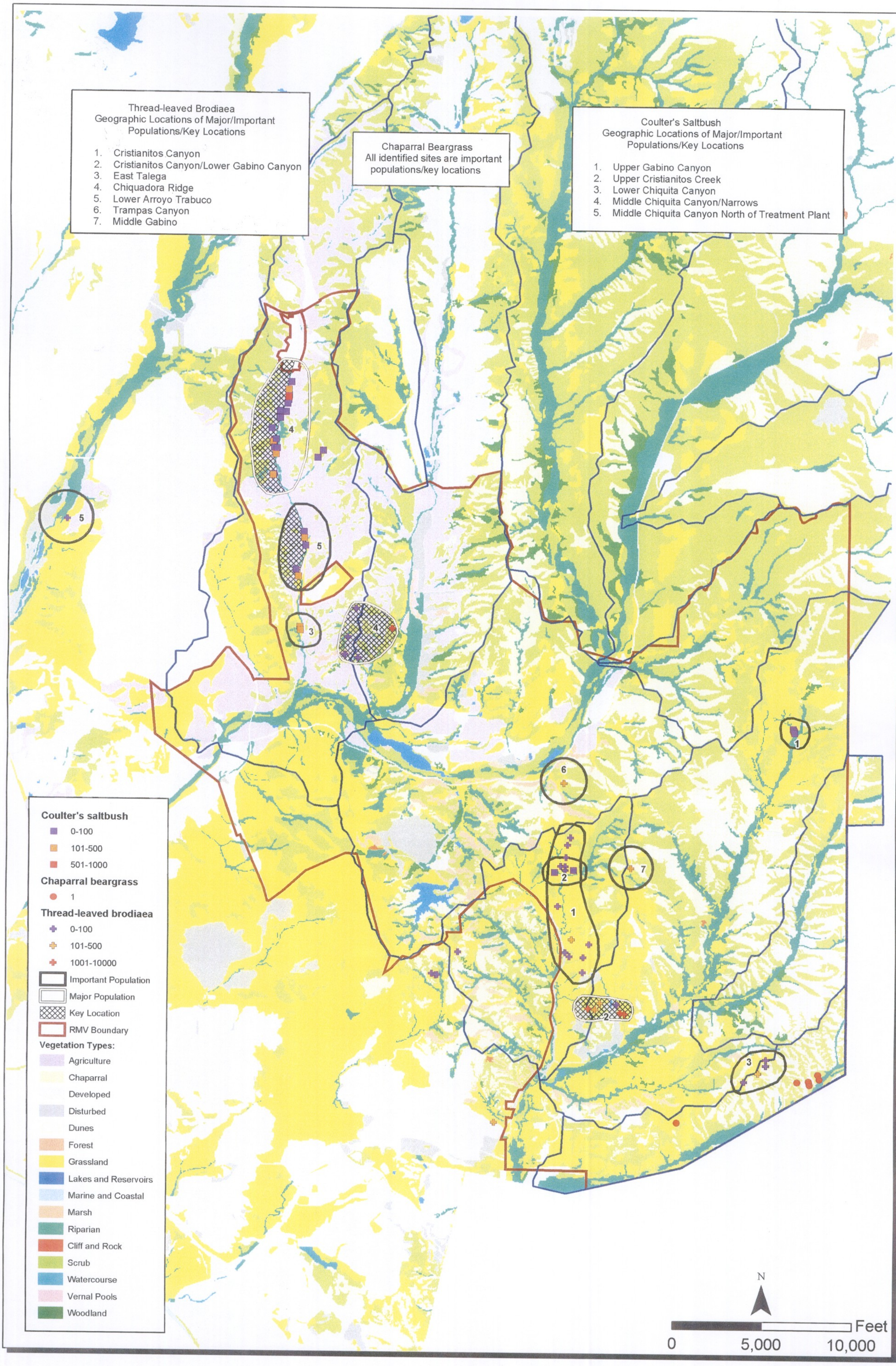
RMV Adaptive Management Program
Preliminary Restoration Areas

FIGURE 14



RMV Adaptive Management Program
Vernal Pools

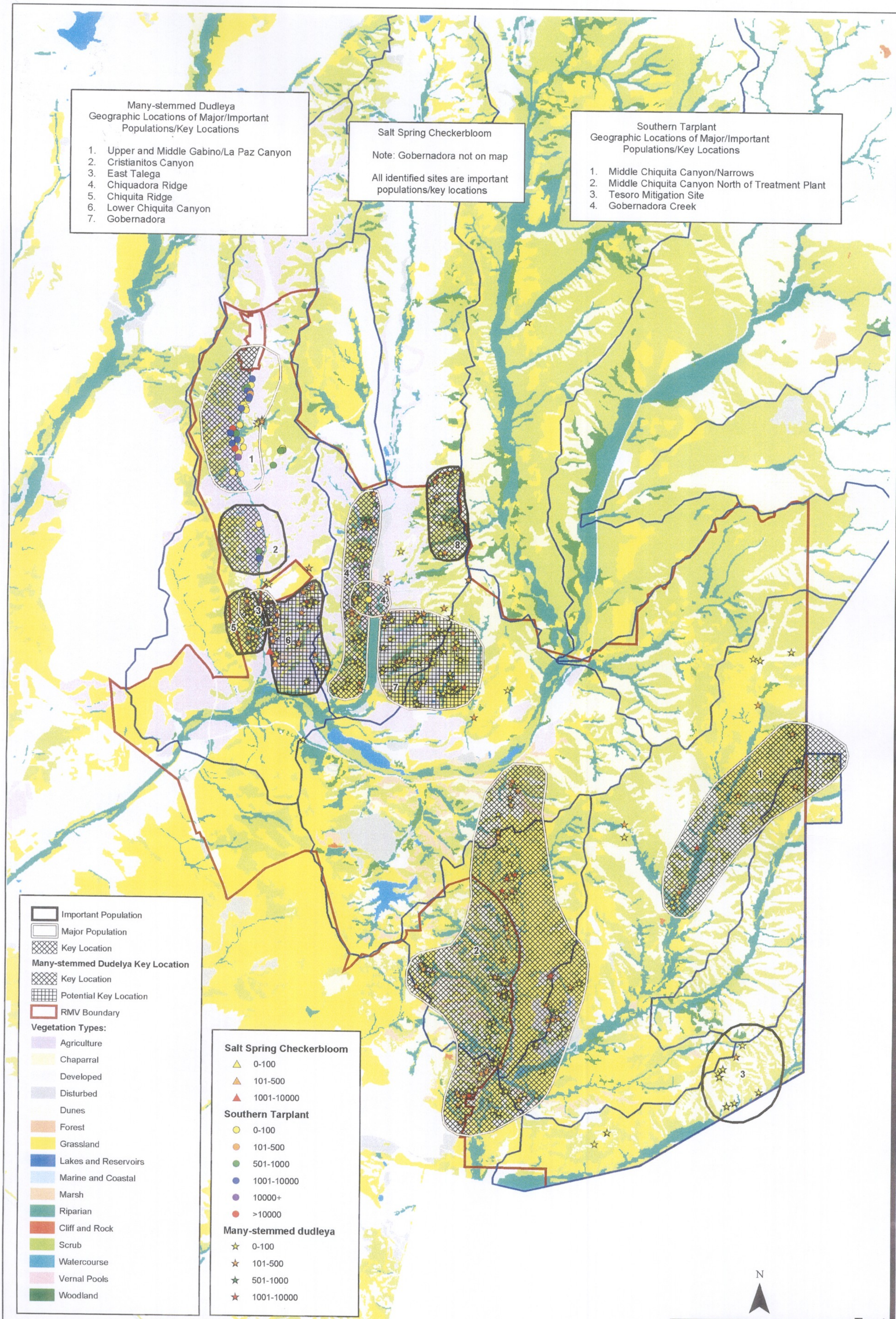
FIGURE
15



RMV Adaptive Management Program

Thread-leaved Brodiaea, Chaparral Beargrass, and Coulter's Saltbush

FIGURE 16



RMV Adaptive Management Program

FIGURE 17

Many-stemmed Dudleya, Salt Spring Checkerbloom, and Southern Tarplant

Appendix J

Rancho Mission Viejo Open Space
Adaptive Management Program

J-1 Plant Species Translocation, Propagation and Management Plan

J-2 Habitat Restoration Plan

J-3 Invasive Species Control Plan

J-4 RMV Grazing Management Plan

J-5 Wildland Fire Management Plan

APPENDIX J-1
PLANT SPECIES TRANSLOCATION, PROPAGATION AND MANAGEMENT PLAN

I. INTRODUCTION

This Plant Species Translocation, Propagation and Management Plan describes the management methods for four special-status plant species potentially affected by development on RMV. This section also addresses two additional plant species that may require mitigation pursuant to CEQA with translocation as a potential component of the mitigation. The program set forth in this section provides the methodologies for implementing translocation as necessary to compensate for significant impacts (as identified in the GPA/ZC EIR) for each development planning area.

The four species addressed in this Plan include thread-leaved brodiaea (*Brodiaea filifolia*), many-stemmed dudleya (*Dudleya multicaulis*), southern tarplant (*Centromadia parryi* ssp. *australus*), and Coulter's saltbush (*Atriplex coulteri*). The additional plants addressed in this Plan consist of **(1)** an intergrade between the common Weed's mariposa lily (*Calochortus weedii* var. *weedii*) and the intermediate mariposa lily (*Calochortus weedii* var. *intermedius*), which is a CNPS List 1B taxon; and **(2)** the mud nama, a CNPS List 2 taxon. Mitigation for impacts to these species will include avoidance of existing populations and, where appropriate, translocation of populations to be impacted.

II. THREAD-LEAVED BRODIAEA

A. Background

Thread-leaved brodiaea (*Brodiaea filifolia*) is Federally listed as threatened, State listed as endangered, and is designated by the California Native Plant Society (CNPS) as a List 1B species (Plants rare, threatened, or endangered in California and elsewhere). The thread-leaved brodiaea is a member of the lily family (Liliaceae). It is a perennial geophyte that has a corm with a dark brown, fibrous tunic. The flowering stalk is 8-16 inches high and the narrow leaves are generally shorter than the flowering stem. The flowers are dark blue to violet and have six perianth segments. There are three stamens and three staminodia (sterile stamens), which are narrow and thread-like in each flower.

Thread-leaved brodiaea grows in clay soils that are typically poorly drained. The species preferred habitat is native perennial grassland or grassland/sage scrub ecotones, but it will tolerate a component of weedy annual grasses, such as ryegrass (*Lolium* sp.) and to a lesser extent wild oats (*Avena* sp.), and, within the RMV Open Space, is often associated with somewhat dense areas of low-growing fascicled tarplant (*Deinandra fasciculata*), and even a small component of black mustard (*Brassica nigra*). Thread-leaved brodiaea is usually absent in areas that are dominated by other annual grasses, such as bromes (*Bromus* sp.). Besides grasslands, the species is also associated with vernal pools; however, on RMV all occurrences are in grasslands. In general, the brodiaea occurs in areas of gentle topography, including broad ridge tops and low gradient slopes.

B. Restoration Program

The proposed restoration program for thread-leaved brodiaea within the RMV Open Space would include some or all of the following key components. The methods ultimately employed will depend on the extent of impact, conditions associated with the impacted populations, habitat conditions associated with individuals determined suitable for translocation and site conditions associated with receptor sites.

- Pre-Translocation Monitoring
- Seed collection
- Selection of Receptor Sites
- Site preparation
- Direct seeding at translocation sites
- Translocation of existing populations by means of corm salvage and relocation
- Maintenance and Monitoring

Pre-Translocation Monitoring

Once it has been determined which brodiaea populations will require translocation, each population will be monitored annually, for three seasons prior to relocation, to delineate the location of flowering individuals associated with the population to be relocated.[1] This information will be important for locating and marking the extent of each population because the number of individuals that flower in any given year can vary based on rainfall and other

[1] It most instances, two years of pre-translocation monitoring would be sufficient; however, by extending the monitoring period to three years, low rainfall years, or otherwise years with suboptimal conditions would be addressed.

environmental factors. Monitoring for multiple seasons will ensure that the maximum number of individuals will be subject to translocation efforts.

For the first growing season of pre-translocation monitoring, the existing population(s) will be divided into distinct clumps to be translocated. The size of each clump will be approximately two-feet by two-feet, and will be determined based on the size that is feasible for translocating without damaging brodiaea corms. The limits of each clump will be clearly demarcated (pin-flags, stakes, etc.) to identify them at each stage of the translocation process. Each clump will be given a unique identification number.

Seed Collection

In preparation for future direct seeding of translocation sites, biologists will collect seed from brodiaea populations to be translocated. To ensure that an adequate amount of seed is collected, seed can be collected from populations to be relocated for as many seasons as determined necessary by the Restoration Specialist/Plant Ecologist, prior to translocation. Seed will be collected from individuals once they have set seed. Seed will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Receptor Sites

Due the small amount of thread-leaved brodiaea expected to be translocated, receptor sites for the translocation of thread-leaved brodiaea will likely include existing populations to be enhanced, but may also include native grassland sites that do not currently support the species if enhancement opportunities are limited in the occupied areas. Additional opportunities would be associated with areas subject to coastal sage scrub (CSS)/valley grassland (VGL) creation or restoration, as described in the upland restoration plan. Such areas would also receive high priority, as candidate brodiaea relocation sites based on site-specific conditions. Physical and biological criteria will be used in evaluating suitability, and ultimately in the selection of receptor sites.

Physical criteria will largely be based on the presence of suitable soils. Using the Soil Conservation Service (CSC) soil survey for Orange County, soil types will be identified for areas supporting existing brodiaea populations. Priority for receptor sites will be given to those areas that have the same (or similar) soil type as existing populations. Another primary physical selection criterion will be soil texture, to be determined through the collection of soil samples at existing populations as well as receptor sites for comparison. Receptor sites will exhibit clay soils, or will contain a clay lense within a larger matrix of cobbly loams, clay loams, or sandy clay loams. Soil moisture also appears to be important for brodiaea as areas supporting brodiaea typically exhibit soil moisture at depths of six to eight inches during July and August whereas adjacent unoccupied areas typically do not exhibit similar soil moisture (Bomkamp and Young, 2001). Other physical characteristics of the site may include slope angle and position, and slope aspect.

Biological selection criteria will include the vegetation community, the presence of dispersal vectors (i.e., pollinators), any soil mycorrhizal associations, an evaluation of the overall similarity of the proposed site to the existing sites, and an evaluation of the presence of potential competitors (i.e., non-native invasives) and herbivores.

Site Preparation

Exotic Control

Once selected, receptor sites will be prepared by eradication of non-native, invasive vegetation as needed. Non-native species targeted for removal will include artichoke thistle (*Cynara cardunculus*), mustard (*Brassica* sp.), and non-native grasses such as Italian ryegrass (*Lolium multiflorum*), bromes (*Bromus* sp.), and oats (*Avena* sp.). For areas of existing VGL or VGL/CSS ecotone that contain a minor component of non-native invasives, the sites will be weeded to remove the non-natives prior to translocation of brodiaea. Receptor sites will be weeded early in the growing season, to remove plants after they have germinated and established, but before they flower and set seed. For non-native vegetation occurring around established native shrubs and bunchgrasses, the invasives will be removed by hand. Herbicides may be used for spraying larger areas of non-native grasses and herbs.

Creation of Native Habitats

For sites that are dominated by non-native invasives, the existing vegetation will be removed completely, and a habitat of native vegetation will be created in its place. As noted above, where physical conditions are suitable, brodiaea will be relocated to needlegrass-dominated areas of CSS/VGL restoration or creation sites associated with the upland restoration program. Restored or created habitats that will serve as brodiaea receptor sites will consist of VGL or an ecotone of CSS/VGL, with the goal of attaining a 10 to 15 percent maximum cover of shrub species. Table 1 provides a conceptual plant palette for brodiaea translocation areas, and is a brodiaea-specific subset of the CSS/VGL plant palettes described in the upland restoration plan.

Habitat creation or restoration will occur at least one full growing season prior to translocation of brodiaea populations to allow for establishment of the planted natives and maintenance of non-native invasives. The first step in the creation of native VGL habitat to where brodiaea will be relocated will be to remove the existing non-native vegetation and as much of the soil seed bank as possible. As needed, and where directed by the Restoration Specialist/Plant Ecologist, a bulldozer may be used to scrape the topsoil and remove the existing vegetation. Hydroseeding or hand broadcasting will be used to distribute the native seed mix, followed by the planting of container stock. Since the non-native seed bank is still expected to be a problem at some receptor sites, a five-year maintenance program will be conducted prior to and following brodiaea translocation to prevent the establishment of non-natives within the translocation site.

TABLE 1
PLANT PALETTE FOR HABITAT CREATION
AT THREAD-LEAVED BRODIAEA RECEPTOR SITES

Species	Common Name	Type
Nasella pulchra	purple needlegrass	container stock & seed
Ericameria palmeri var. *pachylepis*	grassland goldenbush	container stock
Lupinus microcarpus	white-whorled lupine	container stock
Corethrogyne filaginifolia	sand aster	container stock
Sisyrinchium bellum	blue-eyed grass	Seed
Bloomeria crocea	golden stars	Seed
Dodacatheon clevelandii	shooting star	Seed
Cryptantha intermedia	forget-me-not	Seed
Deinandra fasciculate	fascicled tarweed	Seed
Daucus pusillus	wild carrot	seed

Translocation of Existing Populations

As stated above, translocation of brodiaea populations will occur in late summer after seed has set and been collected and the plants have become dormant. Clumps of individuals will first be flagged at existing sites in order to identify distinct soil sections for translocation. Once clumps of brodiaea are removed, they will be transported to the receptor sites on the same day for installation.

Flagging of Plants to be Translocated

As previously mentioned, clumps to be translocated will be demarcated during the pre-translocation monitoring period to identify them later for translocation. As each clump is flagged, the clump will be given a unique identification number for reference. A translocation map will be prepared for each receptor site that identifies where each translocated clump will be placed. Where areas of created or restored VGL will sever as the receptor sites, specific brodiaea translocation sites should be identified prior to beginning the VGL creation/restoration to ensure that access routes are provided that limit disturbance to created/restored areas and to ensure that the appropriate plants have been installed in the vicinity of the brodiaea receptor areas.

Removal of Brodiaea Clumps

Translocation of existing brodiaea populations will occur in late summer after individuals have set seed and entered the period of dormancy. Removal of previously flagged clumps will be conducted using a front-end loader with a closed-bucket. As the loader removes clumps of brodiaea, each clump will be placed onto two-foot by two-foot plywood boards and hand carried to a flatbed truck for transport to a receptor site. Since the goal is to install clumps on the same day as they are removed, time allowed for removal and transport will be limited.

To minimize the damage to the corms of other flagged brodiaea, the loader will be positioned carefully throughout the site. Access to clumps will be planned in advance to minimize disturbance. To remove the brodiaea clumps, the loader bucket will penetrate the ground to approximately eight inches. The bucket should then be angled horizontally and driven forward for about three feet, undercutting the clump and forcing it into the bucket. It is expected that removing a clump will break the clump into a number of small clods. Once a clump is securely in the bucket, it will be lifted clear of the ground and the intact clods will be transferred to the plywood boards for hand loading onto the flatbed truck. As clumps are loaded onto the truck, a numbered pin-flag will be placed with the clump for identification that will allow the clump to be installed at the predetermined location within the receptor site.

Installation of Brodiaea Clumps

Prior to translocation efforts, specific receptor areas will be identified within receptor sites. A minimum number of access paths will also be identified to reduce the impacts to existing native habitat. To minimize disturbance to the existing habitat, a bobcat with rubber tires will be used to access the site and rip the soil in areas where brodiaea clumps are to be installed. Larger dirt clods will be broken up and smoothed to leave the soil in a condition suitable for digging planting holes.

Brodiaea clumps will be transferred by hand into the site and set into the planting holes. The larger, intact clods will be placed together in the center of the hole and the smaller clods will be packed around the larger ones to fill in the hole. As it can be determined, the clods will be placed right side up in the holes. Loose soil and debris, including loose corms, will be poured in between and around the clods. Finally, finely crumbled soil will be poured down cracks between clods to minimize underground crevices, and additional soil will be placed one to two inches over the top of the surface. Pin-flags will be placed to mark the perimeter of the installed clump.

After all clumps have been installed at a receptor site, a water truck will be used to provide deep watering to the brodiaea clumps. The main purpose of the watering will be to consolidate the finely crumbled soil in the crevices between clods, and so to improve the integrity of the clumps. The intent will be to minimize the clumps drying out and to exclude herbivores from eating the corms. After the deep watering, additional fine soil will be added to each clump to replace the soil that is washed down into the crevices. A second, lighter watering will be conducted to consolidate the added soil. Mulch will be placed over the clumps to a depth of three inches. The use of mulch is intended to retain soil moisture, reduce soil overheating from the sun, and to inhibit the germination of weedy species. Orange plastic fencing or stakes with flagging will be placed around each of the installed clumps for future identification and monitoring purposes. Finally, another thin layer of mulch will be placed over entire area to provide additional coverage to the clumps, as well as to cover spaced in between clumps.

Direct Seeding at Translocation Sites

As noted, translocation of existing brodiaea populations will occur in late summer after individuals have set seed, seed has been collected, and the plants have entered their period of dormancy. Following brodiaea translocation, translocation sites will be seeded directly with seed previously collected from the existing populations. Seed will be hand dispersed through the sites in late September or early October to be in place for the start of the rainy season (October 15). Seed will be hand broadcast to ensure a uniform distribution.

Long-Term Maintenance and Monitoring

Brodiaea translocation sites will be monitored for a period of five years to determine the success of the translocation efforts. The five-year program will include active weeding of the sites to minimize the establishment of non-native invasives. Monitoring will be conducted for the entire five-year period by a qualified Restoration Specialist/Plant Ecologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated brodiaea. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand or controlled with an appropriate herbicide as determined by a licensed Pest Control Advisor (PCA). Weed control shall occur monthly following the first rainfall for the first growing season, and not less than quarterly for the remainder of the maintenance period. All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Translocated brodiaea clumps will be monitored annually for a five-year monitoring period. The number of flowering brodiaea individuals can vary significantly from year to year based primarily on rainfall. Because population sizes can vary from year to year, the relative sizes of extant and translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should be increase to carrying capacity over time; however, in any given year, brodiaea may not even emerge if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

<u>First-Year Monitoring</u>

Brodiaea can flower between late March and late June, with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in mid-March and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted, using the population data collected during a three-year monitoring program conducted prior to translocation.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

The Adaptive Management Program provides for ongoing long-term monitoring and management of target species in the RMV Open Space. Replacement of the 75 percent of impacted brodiaea individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for brodiaea occurs within the RMV Open Space.

III. MANY-STEMMED DUDLEYA

A. Background

The many-stemmed dudleya (*Dudleya multicaulis*) is a small geophyte in the stonecrop family (Crassulaceae) and is designated by CNPS as a List 1B species. Many-stemmed dudleya originates from a corm, and usually grows in shallow weathered cobbly loam or clay soils in clay soils, rocky places, or thinly vegetated openings in chaparral, coastal sage scrub, and foothill and valley needlegrass grassland.

B. Restoration Program

The proposed restoration program for many-stemmed dudleya within the RMV Open Space would include some or all of the following key components. The methods ultimately employed will depend on the extent of impact, conditions associated with the impacted populations, habitat conditions associated with individuals determined suitable for translocation and site conditions associated with receptor sites.

- Pre-translocation monitoring
- Seed collection
- Selection of receptor sites
- Greenhouse propagation
- Site preparation
- Translocation of natural populations
- Introduction of cultivated plants
- Direct seeding at translocation site
- Maintenance and Monitoring

Pre-Translocation Monitoring

Once it has been determined which dudleya populations will require translocation, each population will be monitored annually, for up to three years prior to translocation, to identify the number of flowering individuals associated with the population to be relocated.[2] This information will be important for locating and marking the extent of each population because the number of individuals that flower in any given year can vary based on rainfall and other

[2] It most instances, two years of pre-translocation monitoring would be sufficient; however, by extending the monitoring period to three years, low rainfall years, or otherwise years with suboptimal conditions would be addressed.

environmental factors. Monitoring for multiple seasons will ensure that the maximum number of individuals will be subject to translocation efforts.

For the first growing season of pre-translocation monitoring, the existing population(s) will be divided into distinct sections to be translocated. The size of each section will be approximately two-feet by two-feet, and will be determined based on the size that is feasible for translocating without damaging dudleya corms. The limits of each section will be clearly demarcated (pin-flags, stakes, etc.) to identify them at each stage of the translocation process. Each section will be given a unique identification number.

Seed Collection

Biologists will collect dried dudleya fruits from populations to be translocated, in order to obtain seeds to be used in the cultivation of seedlings under greenhouse conditions, and to a much lesser extent, for direct seeding of translocation sites. The highest priority will be given to cultivated seedlings grown under greenhouse conditions. Geurrant (1996) showed that cultivated plants, when grown to even slightly larger than seedling size, have a greater survivorship than field-germinated seeds, and are much more likely to create a larger final population size.

To ensure that an adequate amount of seed is collected, dried fruits will be collected for as many seasons as determined necessary by the Restoration Specialist/Plant Ecologist, prior to translocating candidate populations. The fruits will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Receptor Sites

Receptor sites for the translocation of many-stemmed dudleya may include existing populations to be enhanced, but may also include sites that do not currently support the species if enhancement opportunities are limited. Since the habitat requirements of many-stemmed dudleya and mariposa lily intergrade (*Calochortus weedii* var. *intermedius* x *weedii* var. *weedii*) are very similar, and the two species are known to co-exist, receptor sites may be used for the translocation of both many-stemmed dudleya and the mariposa lily. Therefore, existing habitats of CSS/VGL supporting one species, but not the other, may be suitable for translocation of the species that does not currently exist.

Physical and biological criteria will be used in evaluating suitability, and ultimately in the selection of receptor sites to be used for new introductions of many-stemmed dudleya. Physical criteria will largely be based on the presence of suitable soils. Receptor sites will have rocky clay or cobbly loam soils on slopes and ridgelines. Other physical characteristics of the site may include slope angle and position, and slope aspect.

Biological selection criteria will mainly include the vegetation community, targeting open areas of CSS or VGL. Preferably, receptor sites will support an ecotonal habitat of VGL/CSS, with a maximum shrub cover of 15 to 35 percent. If there is a lack of available native habitats for translocation, areas of created restored/created CSS/VGL, including specific areas dominated by CSS, VGL or VGL/CSS ecotone with suitable soils. Finally, areas supporting non-native grassland may be used for habitat creation if the soils are suitable to support many-stemmed dudleya and other sites noted above are not suitable.

Greenhouse Propagation

As stated above, priority will be given to cultivated seedlings grown under greenhouse conditions, with the direct seeding of translocation sites being a secondary use of seed collected from natural populations. Many-stemmed dudleya will be cultivated in a greenhouse setting for transplanting later to the receptor sites. The facility used for seed storage will also be used for greenhouse cultivation. Cultivation should begin at least two seasons prior to translocation of natural populations to ensure enough time for cultivated individuals to be large enough for transplanting. Individuals will be cultivated from seed collected from natural populations to be translocated.

Seed germination efforts will begin early in the growing season. Soil will be salvaged from the sites of natural populations to be translocated. The salvaged soil will be placed in standard greenhouse flats and mixed with washed builder's sand in an approximate ratio of three parts soil to one part sand. The sand will be used to loosen the soil and prevent from becoming too hard upon moistening, due to the high clay content.

The dried dudleya fruits will be broken open and seeds sprinkled on the moist soil surface, but the seeds will not be covered by the soil. The seeds will be watered immediately with a fine mist and this procedure will be repeated three times daily to keep them continuously moist. The greenhouse flats will be covered with shade cloth to reduce evaporative water loss from the soil and to minimize mechanical disturbance from watering.

Each flat will be weeded throughout the growing season. Supplemental water will be given as needed during the dry periods. Supplemental watering will be discontinued by late April or early

May to allow the cultivated plants to enter the natural dormancy cycle for the species, which begins at the onset of summer drought.

Site Preparation

Exotic Control

Once selected, all receptor sites will be prepared by eradication of non-native, invasive vegetation. Non-native species targeted for removal and control will include artichoke thistle, mustard, smooth cat's-ear (*Hypocharis glabra*), Crete hedynopsis (*Hedynopsis cretica*), and non-native grasses such as ryegrass (*Lolium* sp.), bromes (*Bromus* sp.), and wild oats (*Avena* sp.). For areas of existing native CSS/VGL ecotone that contain a minor component of non-native invasives, the sites will be weeded to remove the non-natives prior to translocation of many-stemmed dudleya. Receptor sites will be weeded early in the growing season, to remove plants after they have germinated and established, but before they flower and set seed. For non-native vegetation occurring around established native shrubs and bunchgrasses, the invasives will be removed by hand. Herbicides may be used for spraying larger areas of non-native grasses and herbs.

Creation of Native Habitats

For candidate VGL and/or CSS areas within the CSS/VGL restoration sites that are dominated by non-native grasses and forbs, the existing vegetation will be removed completely, and a habitat of native vegetation will be created in its place. Created habitats to receive the many-stemmed dudleya will consist of VGL, CSS, or VGL/CSS ecotone, with the goal of attaining a 15 to 35 percent cover of shrub species. Table 2 provides a site-specific conceptual plant palette for creation of the dudleya relocation sites where the sites are to be located in CSS/VGL creation areas.

Habitat creation will occur at least one full growing season prior to translocation of dudleya populations to allow for establishment of the planted natives and maintenance of non-native invasives. The first step in the creation of native habitat will be to remove the existing non-native vegetation, note above, and as much of the soil seed bank as possible. As needed, and where directed by the Restoration Specialist/Plant Ecologist, a bulldozer can be used to scrape the topsoil and remove the existing vegetation. Hand seeding will be used to distribute the native seed mix, followed by the planting of container stock.

TABLE 2
PLANT PALETTE FOR HABITAT CREATION
AT MANY-STEMMED DUDLEYA RECEPTOR SITES

Species	Common Name	Type
Salvia apiana	white sage	container stock
Galium angustifolium	narrow-leaved bedstraw	container stock
Bothriochloa barbinodis	silver beardgrass	container stock & seed
Nasella pulchra	purple needlegrass	container stock & seed
Agrostis exarata	spike redtop	Seed
Harpagonella palmeri	Palmer's grappling-hook	Seed
Osmadenia tenella	southern rosinweed	Seed
Dudleya edulis	ladies'-fingers	Seed
Chorizanthe staticoides	Turkish rugging	Seed

Since it will be important to maintain a habitat with adequate open areas between shrubs, the establishment of shrubs will be limited to container stock since shrub species in the seed mix would encourage a broad distribution of shrub species. Container stock of shrubs will be placed in the more-fertile areas of sites, leaving the rocky, less fertile areas for the translocation of dudleya, since it is in these areas that dudleya will be most successful due to lack of competition.

Since the non-native seed bank may continue to persist at reduce levels and may still pose a problem at some receptor sites, a five-year maintenance program will be implemented following dudleya translocation to provide appropriate control of non-natives within the translocation site, necessary to achieve performance standards.

Translocation of Natural Populations

Translocation of dudleya populations will occur in late summer after seed has been collected and the plants have become dormant. Clumps of individuals will first be flagged at existing sites in order to identify distinct soil sections for translocation. Once sections of dudleya are removed, they will be transported to the receptor sites on the same day for installation.

Flagging of Plants to be Translocated

As previously mentioned, dudleya sections to be translocated will be demarcated during the pre-translocation monitoring period to identify them later for translocation. As each section is flagged, the section will be given a unique identification number for reference. A translocation map will be prepared for each receptor site to plan for where each translocated soil section will be placed.

Removal of Dudleya Sections

Removal of previously flagged sections will be conducted using a front-end loader with a closed-bucket. As the loader removes sections of dudleya, each section will be placed onto two-foot by two-foot plywood boards and hand carried to a flatbed truck for transport to a receptor site. Since the goal is to install soil sections on the same day they are removed, time allowed for removal and transport will be limited.

To minimize the damage to the corms of other flagged dudleya, the loader will be positioned carefully throughout the site. Access to sections will be planned in advance to minimize disturbance. To remove the dudleya sections, the loader bucket will penetrate the ground to approximately eight inches. The bucket should then be angled horizontally and driven forward for about three feet, undercutting the soil section and forcing it into the bucket. It is expected that removing a soil section will break the section into a number of smaller fragments. Once a section is securely in the bucket, it will be lifted clear of the ground and the intact fragments will be transferred to the plywood boards for hand loading onto the flatbed truck. As soil sections are loaded onto the truck, a numbered pin-flag will be placed with the section for identification that will allow the soil section to be installed at the predetermined location within the receptor site.

Installation of Dudleya Sections

Prior to translocation efforts, specific receptor areas will be identified within (1) areas supporting dudleya that exhibit high potential for enhancement and expansion of existing populations (2) areas of native habitat, unoccupied by dudleya, selected due to the presence of appropriate physical and biotic conditions, or (3) within areas of created/restored VGL, CSS or VGL/CSS ecotonal areas, or (4) areas of non-native grassland or degraded CSS that would be restored as part of the dudleya relocation program. A minimum number of access paths will also be identified to reduce the impacts to existing native habitat. To minimize disturbance to the existing habitat, a bobcat with rubber tires will be used to access the site and rip the soil in areas where dudleya sections are to be installed. Larger dirt clods will be broken up and smoothed to leave the soil in a condition suitable for digging planting holes.

Dudleya sections will be transferred by hand into the site and set into the planting holes. The larger, intact clods will be placed together in the center of the hole and the smaller clods will be packed around the larger ones to fill in the hole. As it can be determined, the clods will be placed right side up in the holes. Loose soil will be poured in between and around the clods. Finally, finely crumbled soil will be poured down cracks between clods to minimize underground crevices, and additional soil will be placed one to two inches over the top of the surface. Pin-flags will be placed to mark the perimeter of the installed clump.

After all soil sections have been installed at a receptor site, a water truck will be used to provide deep watering to the dudleya sections. The main purpose of the watering will be to consolidate the finely crumbled soil in the crevices between clods, and so to improve the integrity of the soil sections. The intent will be to minimize the soil sections drying out and to exclude herbivores from eating the corms. After the deep watering, additional fine soil will be added to each section to replace the soil that is washed down into the crevices. A second, lighter watering will be conducted to consolidate the added soil. Mulch will be placed over the sections to a depth of three inches. The use of mulch is intended to retain soil moisture, reduce soil overheating from the sun, and to inhibit the germination of weedy species. Orange plastic fencing or stakes with flagging will be placed around each of the installed soil sections for future identification and monitoring purposes. Finally, another thin layer of mulch will be placed over entire area to provide additional coverage to the soil sections, as well as to cover spaced in between sections.

Introduction of Cultivated Plants

Cultivated plants will be translocated to receptor sites while they are in their dormancy period and early in subsequent growing seasons, immediately prior to or after a rainfall event. To introduce the dudleya, soil blocks with plants will be sliced out of the flats. Immediately prior to planting a soil section, a hole slightly larger than the section of plants will be excavated. The section will then be lowered into the hole and the gap between the section and hole edge will be filled with soil and lightly compacted. Each section will be placed into the hole, either flush with or slightly below the existing soil surface. If the sections are placed above the soil surface, the soil may eventually erode, which causes the dudleya roots and caudex to become exposed above ground, which may eventually lead to plant death.

Direct Seeding at Translocation Site

Following the translocation of the salvaged dudleya populations (i.e., corms) and/or transplanting of cultivated individuals, translocation sites will be seeded directly with seed previously collected from the natural populations. Seed will be hand dispersed within areas where translocation will occur. Dried fruits collected from natural populations will be broken open and the seeds placed into a coffee can. Soil collected from the site of a natural population will be added to the coffee can and mixed with the seeds. This mixture will be spread throughout areas where individuals have been transplanted.

Long-Term Maintenance and Monitoring

Dudleya translocation sites will be monitored for a period of five years to determine the success of the translocation efforts. During the five-year program, active weeding of the sites to limit the establishment of non-native invasives will be performed. Monitoring will be conducted for the five-year period by a qualified Restoration Specialist/Plant Ecologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated dudleya. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand or controlled with an appropriate herbicide as determined by a licensed Pest Control Advisor (PCA). Weed control shall in general occur monthly following the first rainfall for the first growing season, and then as needed for the remainder of the maintenance period. Quarterly visits are recommended following the first by the Restoration Specialist/Plant Ecologist to qualitatively evaluate the sites. All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Translocated dudleya sections will be monitored annually for the five-year monitoring period. As with most geophytes, the number of flowering dudleya individuals can vary significantly from year to year based primarily on rainfall. Because population sizes can vary from year to year, the relative sizes of extant and translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, dudleya may not even emerge or may emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Many-stemmed dudleya typically flowers between mid April and early July and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in on or about April 1, and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. counts of flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data collected during a three-year monitoring program conducted prior to translocation.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the target species within the RMV Open Space. Replacement of 75 percent of impacted many-stemmed dudleya individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for many-stemmed dudleya occurs within the RMV Open Space.

V. SOUTHERN TARPLANT

A. Background

Southern tarplant (*Centromadia parryi* ssp. *australis*) is designated by CNPS as a List 1B species. The tarplant is an annual herbaceous member of the sunflower family (Asteraceae) that blooms from June to November. It is a densely glandular, erect plant with spine tipped leaves and yellow flowering heads. Habitat of the southern tarplant includes marshes (estuary margins), valley and foothill grasslands (vernally mesic), vernal pools, and seasonally moist (saline) grasslands. The tarplant also establishes well in highly disturbed areas.

B. Restoration Program

The proposed restoration program for southern tarplant within the RMV Open Space would consist of the following key components:

- Seed collection
- Selection of introduction sites
- Site preparation
- Direct seeding at introduction site
- Maintenance and Monitoring

Seed Collection

Biologists will collect seed from populations to be impacted, and the collected seed will be used in the direct seeding of introduction sites. Seed will be collected for as many seasons as possible prior to impacts to ensure that an adequate amount of seed. Existing populations will be monitored to determine when collection should begin. Seed collection is expected to occur in early to mid fall (mid September to early November). Tarplant individuals will be shaken over storage boxes to collect seeds. All materials falling from plants will be collected, including seeds, chaff, and other vegetative material. The boxes will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Introduction Sites

Receptor sites for the translocation of southern tarplant will consist of mesic areas with alkaline soils adjacent to existing alkali marsh habitats, alkali meadows, and riparian habitats within the RMV Open Space, including riparian/wetland mitigation sites.

Site Preparation

Site preparation for the mitigation areas will consist of site grading to locate the reintroduction area closer to the groundwater table as well as to provide suitable microtopography. Grading is would also serve to remove the "weedy" seed bank where present at the reintroduction site(s).

Direct Seeding of Introduction Sites

Of the tarplant seed collected, fifty percent of the seed will be spread throughout the introduction site during the first year of introduction. The remaining seed will be kept in storage, to be used to for additional seeding of introduction sites, in the event that establishment is low, due to factors such as low rainfall, and further treatment is necessary in some areas. The method of seed dispersal will be to spread the collected materials (seed, chaff, etc.) evenly throughout the sites by hand broadcasting. The materials will be spread prior to October 1 of the year that seed is collected.

Long-Term Maintenance and Monitoring

Maintenance

Because southern tarplant does not emerge until late spring and does not flower until July or August, the potential for removing this species accidentally during weeding is high. Therefore, no weeding will be performed in areas where southern tarplant is introduced. In addition, no herbicides will be used within the southern tarplant reintroduction areas.

Monitoring

Translocated southern tarplant will be monitored annually for the five-year monitoring period. As with most annuals, the number of germinating individuals can vary significantly from year to year based on rainfall and for this species, disturbance. Because population sizes can vary from year to year, the relative sizes of extant and translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, southern tarplant may emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Southern tarplant typically flowers as early June and sometimes into October and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in on or about July 1, and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. counts of flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 30 percent of number of individuals impacted using the population data based on pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 45 percent of number of individuals impacted using the population data based on pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 90 percent of number of individuals impacted using the population based on pre-impact surveys.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the Planning and Identified Species within the RMV Open Space. Replacement of the 90 percent of impacted southern tarplant individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for southern tarplant occurs within the RMV Open Space.

VI. COULTER'S SALTBUSH

A. Background

Coulter's saltbush (*Atriplex coulteri*) is designated by CNPS as a List 1B species. This species occurs on coastal bluffs and on alkaline and saline flats. The leaves are subsessile, elliptic to lanceolate, somewhat greenish, sparsely fine scaly and dentate. The plants are monoecious (male and female flowers on the same plant) with the inconspicuous female flowers subtended by bracts and the male flowers in panicles. The seeds are found within a fruiting bract, which is sharply dentate, 2-3 mm long, and with small tubercles (sometimes smooth) covering the surface of the bract.

B. Restoration Program

The proposed restoration program for Coulter's saltbush within the RMV Open Space would consist of the following key components:

- Seed collection
- Selection of receptor sites
- Greenhouse propagation
- Site preparation
- Translocation of natural populations
- Introduction of cultivated plants
- Direct seeding at translocation site
- Maintenance and Monitoring

Seed Collection

Biologists will collect seed from populations to be impacted, and the collected seed will be used in the direct seeding of introduction sites. Seed will be collected for as many seasons as possible prior to impacts to ensure that an adequate amount of seed. Existing populations will be monitored to determine when collection should begin. Fruits will be removed from saltbush plants and placed in dry paper bags for storage. The bags of seed will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Introduction Sites

Receptor sites for the translocation of Coulter's saltbush will generally be within areas used for southern tarplant (*Centromadia parryi* ssp. *australus*) as these species often co-occur and therefore exhibit similar habitat requirements. However, Coulter's saltbush typically occupies specific micro-sites, such as clay barrens or alkali flats with limited cover by species such a shining peppergrass (*Lepidium nitidum*), alkali peppergrass (*Lepidium latipes*), and alkali plantain (*Plantago elongata*). As such, translocation sites will consist of mesic alkaline barrens or clay barrens adjacent to existing alkali marsh, alkali meadow or riparian habitats within the Habitat Preserve, including riparian/wetland mitigation sites with suitable micro-sites.

Greenhouse Propagation

Priority will be given to cultivated seedlings grown under greenhouse conditions, with the direct seeding of translocation sites being a secondary use of seed collected from natural populations. Coulter's saltbush will be cultivated in a greenhouse setting for transplanting later to the receptor sites. The facility used for seed storage will also be used for greenhouse cultivation. Cultivation should begin at least two seasons prior to translocation of natural populations to ensure enough time for cultivated individuals to be large enough for transplanting. Individuals will be cultivated from seed collected from natural populations to be translocated.

Seed germination efforts will begin early in the growing season. Soil will be salvaged from the sites of natural populations to be translocated. The salvaged soil will be placed in standard greenhouse flats for use in cultivating seedlings. Saltbush individuals will be cultivated in the flats until they are ready for introduction at the translocation sites.

Site Preparation

Site preparation for the mitigation areas will consist of site grading to locate the reintroduction area closer to the groundwater table. Grading is expected to remove the "weedy" seed bank currently established on the reintroduction site.

Translocation of Natural Populations

Removal of Existing Individuals

Coulter's saltbush populations will be translocated in early to mid fall, prior to the first rainfall of the next growing season. Individuals will first be flagged at existing sites in order to identify plants for translocation. Once individuals are removed, they will be transported to the receptor sites on the same day for installation.

Biologists will remove soil sections containing saltbush individuals using hand tools, generally excavating areas around the small plants to a depth of about six to eight inches to ensure that the entire root system is collected with the individual plants. Each soil section will be placed onto two-foot by two-foot plywood boards and placed on a flatbed truck for transport to a receptor site. Since the goal is to install soil sections on the same day as they are removed, time allowed for removal and transport will be limited.

Installation of Saltbush Sections

Planting holes will be excavated at receptor sites by using a bobcat with rubber tires. Saltbush sections will be transferred by hand into the site and set into the planting holes. Loose soil will be poured in between and around the installed soil section. Pin-flags will be placed to mark the installed sections.

After all soil sections have been installed at a receptor site, a water truck will be used to provide deep watering to the installed saltbush individuals. After the deep watering, additional soil will be added to each section to replace the soil that is washed down into the space around the installed section. A second, lighter watering will be conducted to consolidate the added soil. Orange plastic fencing or stakes with flagging will be placed around each of the installed soil sections for future identification and monitoring purposes.

Introduction of Cultivated Plants

Cultivated plants will be translocated to receptor sites in mid fall, prior to the first rainfall of the new growing season. To remove the cultivated plants, soil blocks with plants will be sliced out of the flats. Immediately prior to planting a soil section, a hole slightly larger than the section of plants will be excavated. The section will then be placed into the hole and the gap between the section and hole edge will be filled with soil and lightly compacted. Each section will be placed into the hole, either flush with or slightly below the existing soil surface. If the sections are placed above the soil surface, the soil may eventually erode, which may causes the roots to become exposed above ground, which may eventually lead to plant death.

Direct Seeding at Translocation Site

Following the translocation of the natural saltbush individuals and planting of cultivated individuals, translocation sites will be seeded directly with seed previously collected from the natural populations. Seed will be hand dispersed within the translocation areas.

Long-Term Maintenance and Monitoring

Coulter's saltbush translocation sites will be monitored for a period of five years to determine the success of the translocation efforts. The five-years program will include active weeding of the sites to minimize the establishment of non-native invasives. Monitoring will be conducted for the entire five-year period by a qualified biologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated Coulter's saltbush. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand. Weed control shall occur monthly following the first rainfall for the first growing season, and then as needed for the remainder of the maintenance period (quarterly qualitative monitoring visits are recommended to evaluate the success of the sites). All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Translocated Coulter's saltbush sections will be monitored annually during the five-year monitoring period. Success will be based on 75 percent survivorship of translocated individuals. Where mortality occurs with translocated individuals, these individuals will be replaced by greenhouse-cultivated plants and/or germinated seed.

Population sizes of the Coulter's saltbush can vary significantly from year to year based primarily on rainfall. Because population sizes can vary from year to year, the relative sizes of translocated populations are expected to vary widely from year to year. Because of this, development of performance standards can be difficult and as such the performance standards are intended to provide general trends relative to performance and are not intended to be used a "hard and fast' standards. Rather, the overall trends should be increasing over time; however, in any given year, the plant may not even emerge if conditions are not appropriate. If during any of the five-year period, the standard set forth for year five is achieved, the program will be considered as having achieved the five-year performance standard.

<u>First-Year Monitoring</u>

Coulters saltbush typically re-emerges from underground rootstock as early as mid February, extending into May with peak flowering varying according to seasonal rainfall patterns; however, flowering is not necessary to conducted surveys for this species. Monitoring of translocated populations will begin on March 1 and will be conducted every two weeks until survey conditions are optimal. When survey conditions are optimal, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted using the population data based on pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the population data based on pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data based on pre-impact surveys.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the Planning and Identified Species within the RMV Open Space. Replacement of the 75 percent of impacted Coulter's saltbush individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for Coulter's occurs within the RMV Open Space.

VII. MUD NAMA

A. Background

Mud nama is an annual species designated by CNPS as a List 2 species (rare in California but more common elsewhere) that occurs in vernally wet areas including vernal pools, the drying margins of lakes and ponds, and other intermittently wet areas. This species occurs within muddy embankments of marshes and swamps, and within lake margins and riverbanks between 5 and 500 m (16-1,640 ft) (CNPS 2001; Rieser 1994). Mud nama is a prostrate to ascending annual with short soft silky hairs, short glandular hairs, and some stiff hairs that are swollen at the base. The leaves vary from 5-30 mm and are typically oblanceolate or spoon shaped with wavy margins and rolled edges. The flowers are white to cream and the corolla is funnel shaped and 4-6 mm long. The annual/ perennial herb blooms from January to July (CNPS 2001).

B. Restoration Program

All occurrences of this species within the RMV lands are associated with the margins of seasonal ponds including one vernal pool, two stockponds, and one sediment basin. In all cases, the plants germinate following dry-down of the ponds following their filling during winter and spring rains. The annual habitat of this species along with its diminutive stature and adaptability make it an easy species to relocate. The methods employed will follow methods used for relocation of vernal pool species that exhibit similar characteristics and life history. The relocation program will consist of the elements listed below.

- Pre-Translocation Monitoring
- Collection of Inoculum (topsoil and dried plants to obtain seed)
- Selection of Receptor Sites
- Intoduction of Inoculum to Receptor Sites
- Maintenance and Monitoring

Pre-Translocation Monitoring

Pre-translocation monitoring will be conducted for two years prior to impacts at sites proposed for impacts. Because the species is an annual and will germinate in different locations every season, flagging of plants is not appropriate. Rather, the limits of occupied areas within ponds to be impacted will be marked by staking or other appropriate means as determined by the Restoration Specialist/Plant Ecologist.

Inoculum Collection

Two methods for inoculum collection will be employed, according to site-specific conditions at the time of collection (described below). Prior to collection, the collection sites must be monitored for flowing period and seed set which can vary widely based on rainfall patterns which dictate filling and drying of occupied ponds. Collections sites (i.e., seasonal ponds) will be monitored during the rainy season beginning in March, and every two weeks until the plants flower and set seed. Because some portions (e.g., margins) of ponds will dry-down in advance of other areas, the flowering and seed set may be somewhat staggered and may actually require two or three collection efforts timed according to the drying of the plants (the timing will be determined by the Restoration Specialist/Plant Ecologist at the time of the collection based on site specific conditions as dictated by the particular rainy season).

Inoculum (Soil and Dried Plants) Collection

The most effective method to collect the dried plants, including their seed, and the soil seed bank is collect the upper one to two centimeters of topsoil, including the dried plant remains using square-end shovels. Areas supporting dried remains of the mud nama are carefully picked-up/scraped using square-end shovels so as to gather all of the above-ground plant material plus the top one or two centimeters of pond surface. The materials are placed directly into cardboard boxes for transport to receptor sites or for storage if collection occurs before inoculation of the receptor sites.

This method should only be employed where the percentage of non-native pond species is less than ten percent. Portions of the seasonal ponds in the RMV Open Space support substantial numbers (sometimes exhibiting 100 percent cover) of swamp timothy (*Crypsis vaginiflora*) and/or hyssop loosestrife (*Lythrum hyssopifolium*), both non-native invasive pond species. Where the swamp timothy or hyssop loosestrife occur, collection should be accomplished to as to transfer as little as possible of either species to receptor sites. Where swamp timothy and/or hyssop loosestrife occur in moderate or high density, then hand collection of the mud nama would be the preferred method.

Hand Collection

Where collection of mud nama using square-end shovels would result in collection of swamp timothy or hyssop loosestrife, hand collection will be employed. In some instances, portions of a pond may be subject to the square-end shovel method while other areas are subject to hand collection. Hand collection will be accomplished by carefully removing each plant by pulling it up from the base. In order to increase the effectiveness of this method collections should be performed just after the plant has dried out and before the capsules have broken apart, dispersing the seed. Plants should be place in paper sacks as they are collected for transport to receptor sites or for storage if collection occurs before inoculation of the receptor sites. All inoculum collected using either method will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Introduction Sites

A number of suitable receptor sites occur within the RMV Open Space, including the vernal pools on Chiquita Ridge (one of which has a small population of mud nama that could be substantially expanded), the vernal pools in the vicinity of Radio Tower Road (none of which support mud nama), and/or the three Tijeras Creek vernal pools (none of which support mud nama).

Intoduction of Inoculum to Receptor Sites

Inoculum will be introduced to the receptor sites by hand. Boxes containing inoculum (i.e., salvaged soil dried plants) will be carefully distributed around the outer one-third of the receptor pools (which corresponds to its typical distribution). Once distributed, the inoculum should be carefully raked (using the flat side of the rake rather than the toothed side) to ensure a depth of no more than one centimeter at any location in the receptor site.

For pools that support listed fairy shrimp, salvaged soil will not be placed in the pond as this could potentially bury or damage cysts. Pools occupied by listed fairy shrimp will receive the hand-collected inoculum that will be evenly spread around the outer one-third of each receptor pond.

Maintenance and Monitoring

Maintenance

Maintenance is not proposed for the vernal pool receptor sites for a number of reasons. First, many of the potential receptor pools support federally listed fairy shrimp, including the San Diego fairy shrimp and/or the Riverside fairy shrimp. Maintenance would require regular access of the pools, causing trampling and potential damage to cysts. Furthermore, the action of weeding could require soil disturbance, which also could damage cysts and is therefore not recommended. All of the seasonal ponds within the RMV Open Space that support mud nama also support high densities of swamp timothy and/or hyssop loosestrife and appears to persist in the presence of these invasives.

Monitoring

A qualified biologist will monitor mud nama introduction sites for a period of five years to determine the success of the introduction efforts. As with most annuals, the number of germinating individuals can vary significantly from year to year based on rainfall for this species, as well as with ponding depth and duration. Because population sizes can vary from year to year, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, mud nama may not emerge or may only emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

First-Year Monitoring

Mud nama typically flowers as early April and sometimes into July and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in on or about April 1, and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements (i.e. counts of flowering individuals) will be obtained.

Success Standard: translocated populations combined to achieve 30 percent of number of individuals impacted using the population data based on pre-impact surveys.

Second-Year Monitoring

Success Standard: translocated populations combined to achieve 45 percent of number of individuals impacted using the population data based on pre-impact surveys.

Third-Year Monitoring

Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fourth-Year Monitoring

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the population data based on pre-impact surveys.

Fifth-Year Monitoring

Success Standard: translocated populations combined to achieve 90 percent of number of individuals impacted using the population data based on pre-impact surveys.

The Adaptive Management Program provides for ongoing long-term monitoring and management of the Planning and Identified Species within the RMV Open Space. Replacement of the 90 percent of impacted mud nama individuals by the end of the five- year monitoring and maintenance program, in the context of the long-term management goals, ensures that no functional loss for mud nama occurs within the RMV Open Space.

VIII. MARIPOSA LILY

A. Background

As noted in the Introduction to this section, one additional plant addressed in this program consists of an intergrade between the common Weed's mariposa lily (*Calochortus weedii* var. *weedii*) and the intermediate mariposa lily (*Calochortus weedii* var. *intermedius*), which is a CNPS List 1B taxon. Both mariposa lily varieties are perennial geophytes in the lily family (Liliaceae) that occur in coastal sage scrub, chaparral, and grassland/scrub ecotones. Both varieties typically produce from three to four campanulate flowers. The petals of Weed's mariposa lily are typically bright yellow and the petals or the intermediate mariposa lily are broadly cuneate-obovate and light yellow, tinged with purple and usually fringed with yellow hairs.

It is difficult to determine the number of individuals of the intermediate mariposa lily occurring on RMV lands because of the questionable taxonomic status of the individuals documented on RMV. During surveys conducted over the last eight years many of the individuals identified consist of the intergrade noted above and more fully described below.

The more common *C .w. weedii* occurs on Camp Pendleton and in the Cleveland National Forest to the south and east of RMV while *C .w. intermedius* occurs, as noted above, in the foothill and coastal areas associated with the Central and Coastal NCCP/HCP subregions to the north and west of RMV, as well as in the Foothill-Trabuco which is north of RMV. Populations of *C. weedii* on RMV lands exhibit characteristics of both *C .w. weedii* and *C .w. intermedius*, with a discernible south-to-north gradient, based on field observations and directed field sampling in 2003. *C. weedii* populations associated with the southeast portion of RMV (e.g., Gabino

Canyon) exhibit a strong *C. w.weedii* influence, with more than 50 percent of the individuals exhibiting characteristics consistent with *C. w. weedii* and another 42 percent that are intergrades between *C. w. weedii* and *C .w. intermedius.* Only about 7 percent of the individuals evaluated in this portion of the subregion exhibited characteristics consistent with *C .w. intermedius.*

Individuals exhibiting characteristics consistent with *C .w. intermedius* become more common along the gradient from south-to-north. For example in the Trampas Canyon area, plants with characteristics consistent with *C .w. intermedius* account for approximately 30 percent of the individuals, with intergrades comprising another 50 percent and plants consistent with *C. w. weedii* accounting for about 20 percent. Further north, in upper Gobernadora, plants exhibiting characteristics of *C. w. weedii* account for only 2 percent of the population, with intergrades comprising 75 percent and plants with a strong *C .w. intermedius* influence accounting for about 23 percent of the population. *Table 3* summarizes the results surveys conducted in 2003 to evaluate relative proportions of *C. w. intermedius, C. w. weedii,* and intergrades at ten locations along a generally south-to-north gradient on RMV.

Work by other botanists in the subregion support this characterization of *C. weedii* in the planning area. Qualitative observations by Mr. Fred Roberts and Mr. David Bramlet during surveys conducted in 2003 and in previous years support the conclusion the *C. w. weedii* exhibits an influence on RMV lands, with the influence strongest in the southeast portion (e.g., Gabino Canyon) (Roberts, pers. comm.. 2003). Freshly collected specimens from Gabino Canyon were evaluated by Mr. Steve Boyd at Rancho Santa Ana Botanical Gardens and were determined to be *C. w. weedii,* with other populations on RMV exhibiting intergrades between *C. w. weedii* and *C .w. intermedius* (Boyd, pers. comm.. 2003).

Given the unclear taxonomy of the *C. weedii* populations on RMV, it is not appropriate to consider the population on RMV as *C .w. intermedius.*

TABLE 3
GEOGRAPHIC DISTRIBUTION *CALOCHORTUS WEEDII* VARIETIES AND INTERGRADES ON RANCHO MISSION VIEJO

Population Location	Species in Percent (%)		
	C. w. weedii	Intergrade	*C. w. intermedius*
Gabino	51	42	7
Upper Gabino	40	51	9
Cristianitos (north of TRW)	30	45	25
Cristianitos Meadows	27	30	43
Trampas	20	50	30
Color Spot Nursery	6	84	10
Verdugo	4	71	25
Chiquadora Ridge	4	75	21
Upper Gobernadora	2	75	23
Tijeras	0	3	97

B. Provisional Restoration Program

Populations of the "clean" intermediate mariposa lily occur outside of RMV and would not be affected by proposed development. Impacts would occur only to the intergrade populations. Based upon further evaluation, it may be necessary to perform some level of mitigation pursuant to CEQA for the intergrade population(s). The provisional program is set forth below.

The proposed restoration program for the *C .w. weedii* x *C .w. intermedius* intergrade, to the extent that mitigation is required under CEQA would consist of the following key components:

- Pre-translocation monitoring
- Seed collection
- Selection of receptor sites
- Greenhouse propagation

- Site preparation
- Salvage and introduction of bulbs
- Direct seeding at translocation site
- Long-term maintenance and monitoring

Pre-Translocation Monitoring

Once it has been determined which *C .w. weedii* x *C .w. intermedius* intergrade, populations will require translocation, each population will be monitored annually, for as many seasons as possible prior to development, to identify the maximum number of flowering individuals. This information will provide part of the baseline for establishing success criteria for the future monitoring of translocated populations.

For the first growing season of pre-translocation monitoring, biologists will re-survey the areas supporting the *C .w. weedii* x *C .w. intermedius* intergrade and will demarcate the areas with pin flags or stakes and flagging. In addition, each plant (or group of plants as determined appropriate by the biologist) will be marked with pin flags to optimize future salvage. For two growing seasons leading up to translocation, biologists will repeat surveys of the known populations and will use pin flags to mark all flowering individuals not marked during previous pre-translocation surveys. A different color pin flag will be used for each season that surveys are conducted in order to easily identify in the field individuals that flowered in the most recent growing season versus those that flowered in previous season.

Seed Collection

Biologists will collect seed from populations to be translocated, to be used in the cultivation of seedlings under greenhouse conditions, and to a much lesser extent, for direct seeding of translocation sites. The highest priority will be given to cultivated seedlings grown under greenhouse conditions. Geurrant (1996) showed that cultivated plants, when grown to even slightly larger than seedling size, have a greater survivorship than field-germinated seeds, and are much more likely to create a larger final population size.

Seed will be collected in mid to late summer (July or August) once the capsules have begun to open, and as determined by a qualified biologist. To ensure that an adequate amount of seed is collected for direct seeding of receptor sites, seed will be collected for as many seasons as determined appropriate by the Restoration Specialist/Plant Ecologist prior to translocating the natural populations. Seed will be stored in a climate-controlled facility under appropriate storage conditions, with candidate institutions to include California State University, Fullerton (CSUF) or Rancho Santa Ana Botanic Garden.

Selection of Receptor Sites

Receptor sites for the translocation of intermediate mariposa lily may include existing populations to be enhanced, but may also include sites that do not currently support the species if enhancement opportunities are limited. Areas that support non-intergraded populations (i.e., "clean" populations) of the intermediate mariposa lily will not be used to ensure the range of intergrade populations is not artificially expanded as a result of the translocation program. Since the habitat requirements of the *C .w. weedii* x *C .w. intermedius* intergrade, and many-stemmed dudleya (*Dudleya multicaulis*) are very similar, and the two species are known to co-exist, receptor sites may be used for the translocation of both the intergrade mariposa lily and many-stemmed dudleya. Therefore, existing habitats of CSS/VGL supporting one species, but not the other, may be suitable for translocation of the species that does not currently exist.

Physical and biological criteria will be used in evaluating suitability, and ultimately in the selection of receptor sites to be used for new introductions of the *C .w. weedii* x *C .w. intermedius* intergrade. Physical criteria will largely be based on the presence of suitable soils. Receptor sites will have rocky clay or cobbly loam soils on slopes and ridgelines. Other physical characteristics of the site may include slope angle and position, and slope aspect.

Biological selection criteria will mainly include the vegetation community, targeting open areas of CSS/VGL. Preferably, receptor sites will support an ecotonal habitat of CSS/VGL, with a maximum shrub cover of 15 to 35 percent. If there is a lack of available native habitats for translocation, areas supporting non-native invasives may be used for habitat creation if the soils are suitable to support the *C .w. weedii* x *C .w. intermedius* intergrade.

Greenhouse Propagation

As stated above, priority will be given to cultivated seedlings grown under greenhouse conditions, with the direct seeding of translocation sites being a secondary use of seed collected from natural populations. *C .w. weedii* x *C .w. intermedius* intergrade, will be cultivated in a greenhouse setting for transplanting later to the receptor sites. Plants will be germinated and raised to a sufficient size necessary for transfer of the bulbs to the restoration site. The facility used for seed storage will also be used for greenhouse cultivation. Cultivation should begin at least two seasons prior to translocation of natural populations to ensure enough time for cultivated individuals to be large enough for transplanting. Individuals will be cultivated from seed collected from natural populations to be translocated.

Seed germination efforts will begin early in the growing season. Soil will be salvaged from the sites of natural populations to be translocated. The salvaged soil will be placed in standard greenhouse flats and mixed with washed builder's sand in an approximate ratio of three parts soil to one part sand. The sand will be used to loosen the soil and prevent from becoming too hard upon moistening, due to the high clay content.

Seed will be sprinkled on a moist soil surface, but the seeds will not be covered by the soil. The seeds will be watered immediately with a fine mist and this procedure will be repeated three times daily to keep them continuously moist. The greenhouse flats will be covered with shade cloth to reduce evaporative water loss from the soil and to minimize mechanical disturbance from watering.

Each flat will be weeded throughout the growing season. Supplemental water will be given as needed during the dry periods. Supplemental watering will be discontinued by late spring/early summer to allow the cultivated plants to enter the natural dormancy cycle for the species, which begins at the onset of summer drought.

Site Preparation

Exotic Control

Once selected, all receptor sites will be prepared by eradication of non-native, invasive vegetation. Non-native species targeted for removal and control will include artichoke thistle, mustard, non-native grasses such as ryegrass, bromes, and wild oats. For areas of existing native coastal sage scrub/grassland ecotone that contain a minor component of non-native invasives, the sites will be weeded to remove the non-natives prior to translocation of the lily. Receptor sites will be weeded early in the growing season, to remove plants after they have germinated and established, but before they flower and set seed. For non-native vegetation occurring around established native shrubs and bunchgrasses, the invasives will be removed by hand. Herbicides may be used for spraying larger areas of non-native grasses and herbs.

Creation of Native Habitats

For candidate VGL and/or CSS creation/restoration sites that are dominated by non-native grasses and forbs, the existing vegetation will be removed completely, and a habitat of native vegetation will be created in its place. Created habitats will consist of VGL, CSS, or VGL/CSS ecotone, with the goal of attaining a 15 to 35 percent cover of shrub species. Table 4 provides a site-specific conceptual plant palette for creation of the intergrade mariposa lily relocation sites where the sites are to be located in VGL or CSS creation areas.

TABLE 4
PLANT PALETTE FOR HABITAT CREATION AT MARIPOSA LILY RECEPTOR SITES

Species	Common Name	Type
Salvia apiana	white sage	container stock
Galium angustifolium	narrow-leaved bedstraw	container stock
Bothriochloa barbinodis	silver beardgrass	container stock & seed
Nasella pulchra	purple needlegrass	container stock & seed
Agrostis exarata	spike redtop	seed
Harpagonella palmeri	Palmer's grappling-hook	seed
Osmadenia tenella	southern rosinweed	seed
Dudleya edulis	ladies'-fingers	seed
Chorizanthe staticoides	Turkish rugging	seed

Habitat creation will occur at least one full growing season prior to the introduction of salvaged/cultivated bulbs to allow for establishment of the planted natives and maintenance of non-native invasive plants. The first step in the creation of native habitat will be to remove the existing non-native vegetation and as much of the soil seed bank as possible. A bulldozer will be used to scrape the topsoil and remove the existing vegetation where determined appropriate by the Restoration Specialist/Plant Ecologist. Hand broadcast seed will be used to distribute the native seed mix, followed by the planting of container stock.

Since it will be important to maintain a sage scrub/grassland ecotone with adequate open areas between shrubs, the establishment of shrubs will be limited to container stock since shrub species in the seed mix would encourage a broad distribution of shrub species. Container stock of shrubs will be placed in the more-fertile areas of sites, leaving the rocky, less fertile areas for the translocation of *C .w. weedii* x *C .w. intermedius* intergrade, since it is in these areas that the mariposa lily will be most successful.

Since the non-native seed bank may continue to persist at reduce levels and may still pose a problem at some receptor sites, a five-year maintenance program will be implemented following mariposa lily translocation to provide appropriate control of non-natives within the translocation site, necessary to achieve performance standards.

Salvage of *C .w. weedii* x *C .w. intermedius* Intergrade Bulbs

Translocation of the *C .w. weedii* x *C .w. intermedius* intergrade populations will occur upon determination that individuals have become dormant. It is expected that salvage will occur in late summer/early fall.

All flowering individuals identified in the growing season immediately prior to translocation will be salvaged by hand (using only hand tools). Once all visible plants have been removed by hand, marked plants that flowered during previous growing seasons will be salvaged. A front-end loader with a closed bucket will be used to excavate a small section of soil at each location of pin flags.

As the loader removes soil sections, each section will be placed onto two-foot by two-foot plywood boards and hand carried to a staging area. Using hand tools, biologists will carefully break apart the soil sections to salvage additional bulbs. All salvaged bulbs will be placed in paper sacks and stored within a cool dry place until time for relocation to the receptor sites.

Introduction of Salvaged/Cultivated Bulbs to Receptor Sites

In late fall, prior to first rainfall of the new growing season, salvaged/cultivated bulbs will be planted at the receptor sites. Dense populations of the mariposa lily typically exhibit densities of one to five plant per square meter; however, lower densities of 1 to 2 plants per 10 sq m is also common in high quality habitat. Planting of the bulbs should generally average two individuals per square meter; however, in areas where the substrate appears particularly good (few or no non-natives and the presence of associate species), densities can be increased to three per square meter.

For planting bulbs, a hole slightly larger than the bulb itself will be excavated. The bulb will then be placed into the hole and the gap between the section and hole edge will be filled with soil and lightly compacted. Each bulb will be planted either flush with or slightly below the existing soil surface. If the bulbs are placed above the soil surface, the soil may eventually erode, which causes the roots and caudex to become exposed above ground, which may eventually lead to plant death.

Direct Seeding at Translocation Site

Following introduction of the salvaged/cultivated bulbs, translocation sites will be seeded directly with seed previously collected from the natural populations. Seed will be hand dispersed within translocation areas.

Long-Term Maintenance and Monitoring

The *C .w. weedii* x *C .w. intermedius* intergrade introduction sites will be monitored for a period of five years to determine the success of the introduction efforts. The five-year program will include active weeding of the sites to minimize the establishment of non-native invasives. Monitoring will be conducted for the five-year period by a qualified Restoration Specialist/Plant Ecologist.

Maintenance

Weed eradication will be conducted as necessary to minimize competition that could prevent the successful establishment of the translocated intergrade mariposa lily. The crucial period for weed control is the first two years of project establishment. As weeds become evident, they should be immediately removed by hand or controlled with an appropriate herbicide as determined by a licensed Pest Control Advisor (PCA). Weed control shall occur monthly following the first rainfall for the first growing season, and not less than quarterly for the remainder of the maintenance period. All maintenance personnel will be trained to distinguish weedy species from native vegetation.

Monitoring

Intermediate mariposa lily translocation sites will be monitored annually for the five-year monitoring period. During the pre-translocation monitoring period, flowering individuals will be flagged during each growing season.

For each flowering period (for five years) following the introduction of salvaged/cultivated bulbs, flowering individuals will be counted within the limits of the translocation site. Population sizes of mariposa lily vary significantly from year to year based primarily on rainfall. Because of this, development of performance standards can be difficult. As such, the performance standards are intended to evaluate general trends relative to performance and include flexibility, recognizing the inherent variability of this species. Under average conditions, populations should increase to carrying capacity over time; however, in any given year, *C .w. weedii* x *C .w. intermedius* intergrade may not even emerge or may emerge in very low numbers if conditions are not appropriate. Therefore, if during any of the five-year period, the standard set forth for flowering individuals for year five is achieved, the program will be considered as having achieved the five-year performance standard. The performance standards set forth below are based on expected average conditions; however, there is a high likelihood that numbers will vary substantially from year to year.

<u>First-Year Monitoring</u>

The *C .w. weedii* x *C .w. intermedius* intergrade typically flowers between late May and July and with peak flowering varying according to seasonal rainfall patterns. Monitoring of translocated populations will begin in May and will be conducted every two weeks until peak flowering occurs. When peak flowering occurs, as determined by the Restoration Specialist/Plant Ecologist, quantitative measurements will be obtained.

Success Standard: translocated populations combined to achieve 20 percent of number of individuals impacted using the data collected during pre-impact surveys.

<u>Second-Year Monitoring</u>

Success Standard: translocated populations combined to achieve 35 percent of number of individuals impacted using the data collected during pre-impact surveys.

<u>Third-Year Monitoring</u>

Success Standard: translocated populations combined to achieve 50 percent of number of individuals impacted using the data collected during pre-impact surveys.

<u>Fourth -Year Monitoring</u>
Success Standard: translocated populations combined to achieve 60 percent of number of individuals impacted using the data collected during pre-impact surveys.

<u>Fifth-Year Monitoring</u>

Success Standard: translocated populations combined to achieve 75 percent of number of individuals impacted using the data collected during pre-impact surveys.

Replacement of the 75 percent of impacted *C.w. weedii* x *C.w. intermedius* intergrade individuals by the end of the five- year monitoring and maintenance program, ensures that no functional loss for *C.w. weedii* x *C.w. intermedius* intergrade occurs within the RMV Open Space.

APPENDIX J-2
HABITAT RESTORATION PLAN

CHAPTER 1.0 INTRODUCTION

The Habitat Restoration Plan is a key component of the Adaptive Management Program for the proposed Rancho Mission Viejo (RMV) Open Space. It describes the spectrum of possible upland and wetland/riparian restoration activities within the proposed RMV Open Space and in areas subject to the aquatic resource management plan. The term "restoration" is used very broadly in this plan and covers a range of activities from enhancement of existing degraded habitats to creation of new habitats. The conceptual restoration activities described in this plan would be undertaken in accordance with certified/approved restoration plans for sites within RMV.

The remainder of Chapter 1 provides background information for the Habitat Restoration Plan as it relates to the proposed RMV Open Space. Chapter 2 describes the upland component of the Habitat Restoration Plan and Chapter 3 describes the wetland/riparian component.

1.1 Background

1.1.1 Relationship to the Southern Subregion NCCP/HCP

As noted above, the Habitat Restoration Plan is a key component of the Adaptive Management Program for the RMV Open Space, and is intended to be complementary to any NCCP/HCP Program completed in the future for the Southern Subregion. Implementation of an Adaptive Management Program is one of the three fundamental conservation planning principles set forth under the NCCP Conservation Guidelines (*Appendix F*). As stated in the NCCP Conservation Guidelines "…a status quo strategy of 'benign neglect' management likely will result in substantial further loss of CSS biodiversity…" The Guidelines concluded that habitat reserves…should be managed in ways responsive to new information as it accrues." Although the Conservation Guidelines were directed toward coastal sage scrub (CSS) in a habitat reserve context, the same adaptive management principles apply to the diversity of vegetation communities and habitat types in protected open space such as the RMV Open Space.

a. NCCP/HCP Planning Guidelines Restoration Recommendations

The "Draft Southern NCCP/HCP Planning Guidelines" set forth in *Section 6* a set of restoration recommendations for upland and wetland/riparian habitats in the various sub-basins within the San Juan Creek and San Mateo Creek watersheds.

The upland restoration addressed in *Section 6* of the Draft Southern NCCP/HCP Planning Guidelines includes CSS and valley needlegrass grassland (VGL). Several restoration areas were selected within the RMV boundary on the basis of their important location and function in the Open Space area. Restoration in these areas would contribute to the Open Space function and would help maintain *net habitat value* on a *long-term basis* for sensitive species. The selected CSS and VGL restoration areas consist of the following:

- CSS restoration in Sulphur Canyon and elsewhere along Chiquadora Ridge in the Gobernadora sub-basin;
- CSS and VGL restoration along Chiquita Ridge in the Chiquita sub-basin;
- VGL restoration in the upper Cristianitos sub-basin and portions of Blind Canyon Mesa in the Gabino and Blind Canyons sub-basin; and
- CSS/VGL restoration in upper Gabino Canyon sub-basin; and
- CSS/VGL restoration in the Chiquita Canyon sub-basin.

The Draft Southern NCCP/HCP Planning Guidelines recommendations for wetland/riparian restoration include both abiotic (geomorphology and hydrology) and biotic (vegetation communities and habitats) components. Abiotic and biotic components must to be addressed together because their functions are closely linked (e.g., excessive fine sediment generation adversely affects downstream habitat of the arroyo toad). Several areas within proposed RMV Open Space have been identified for restoration based on their impacts on habitat quality and long-term function. It should be noted that some of the wetland/riparian areas targeted for restoration may not be in designated Open Space *per se*, but may have a downstream habitat impacts that affect the function of the Open Space area. Areas identified for wetland/riparian restoration consist of the following:

- Gobernadora Creek to address historic meander condition and excessive sediment resulting from upstream land uses;
- Creation of breeding habitats in Gobernadora Creek for tricolored blackbird, least Bell's vireo, southwestern willow flycatcher and other riparian species;
- Upper Gabino Creek to address erosion and excessive sediment generation (this restoration program would occur in combination with upland CSS/VGL restoration);
- Chiquita Creek and upper Cristianitos to address locally-induced headcuts; and
- San Juan Creek to address invasive plants and animal species.

Although not part of the wetland/riparian restoration plan discussed here, additional wetland/riparian areas have been identified for enhancement through control of invasive species such as giant reed (*Arundo donax*), tamarisk (*Tamarix* spp.), pampas grass (*Cortaderia selloana*), castor bean (*Ricinus communis*), and tree tobacco (*Nicotiana glauca*). Major targeted areas include San Juan Creek, and lower Cristianitos Creek. Details of this program are provided in the Invasive Species Control Plan.

1.1.2 Relationship to the San Juan Creek Watershed and Western San Mateo Creek Watershed SAMP/MSAA

The Adaptive Management Program and this Habitat Restoration Plan are intended to be complementary to any SAMP/MSAA program that is completed in the future, and as such, have been structured to comply with the goals, objectives, and Tenets and Principles of the SAMP/MSAA. The U.S. Army Corps of Engineers (USACE) has stated the Purpose of the SAMP as follows:

> *The purpose of the effort is to develop and implement a watershed-wide aquatic resource management plan and implementation program (SAMP), which will include preservation, enhancement, and restoration and development within the study area.* (underline added for emphasis)

One of the Objectives of the SAMP pertaining specifically to enhancement and restoration is as follows:

> *Preserve and enhance existing aquatic resources and establish a regional restoration management plan for aquatic resources in the study area, including development of a comprehensive aquatic resource reserve program. The aquatic resource reserve system would accommodate mitigation requirements for contemplated development within the watershed, and other conservation efforts. To the extent feasible, the ultimate goal is to provide for a comprehensive reserve and adaptive management program for both aquatic and upland natural resources.* (underline added for emphasis)

This overall goal and restoration objective are reflected in several of the SAMP Tenets developed by the USACE:

- i. No net loss of acreage and functions of waters of the U.S./State
- ii. Maintain/restore riparian ecosystem integrity
- iv. Maintain/protect/restore riparian corridors
- v. Maintain and /or restore floodplain connection
- vi. Maintain and/or restore sediment sources and transport equilibrium

For example, restoring historic meander conditions and controlling excessive sediment being generated by upstream development in Gobernadora Creek, in conjunction with restoring riparian habitats in association with the Gobernadora Ecological Restoration Area (GERA), addresses all five of the Tenets expressed above.

The Watershed and Sub-basin Planning Principles (Watershed Planning Principles) provide a link between the goals and objectives of the SAMP/MSAA and the Tenets and Principles. The Watershed Planning Principles provide Planning Recommendations for relevant sub-basins that, in turn, have been translated into the specific restoration actions (including wetland/riparian and upland restoration) described in this plan. The Watershed Planning Principles Recommendations and associated restoration actions are as follows:

- Within the Chiquita sub-basin, address existing areas of channel incision that result from primarily localized processes/land uses, as contrasted with terrace-forming valley-deepening areas that are primarily a result of long-term geologic conditions. Site by site geomorphic analysis would be undertaken to define these areas.

    - This recommendation would be addressed through implementing creek stabilizations at locally-induced headcuts in Chiquita Creek that have been caused by road crossings and other anthropogenic causes.

- Within the Gobernadora sub-basin, protect the valley floor above the knickpoint to provide for creek meandering (as occurred historically) and for restoration of riparian processes and habitat. Floodplain restoration should account for both the existing and potential future sediment regimes and potentially excessive surface and groundwater. The existing channel that has isolated the creek from the floodplain in some areas also should be addressed as part of the restoration effort.

    - These recommendations would be addressed by implementing wetland/riparian restoration in the portion of the Gobernadora Creek below the Ranch boundary with Coto de Caza. Riparian restoration would provide a northward extension of riparian habitats suitable for the least Bell's vireo, southwestern willow flycatcher and other riparian species. Restoration may include construction of a detention/water quality basin below Coto de Caza and also may include creation of breeding habitat for the tricolored blackbird.

- Within the Cristianitos sub-basin, where feasible, protected headwater areas should be targeted for restoration of native vegetation to reduce the generation of fine sediments from the clayey terrains and to promote infiltration, and to enhance the value of upland habitats adjacent to streams. In addition, stream stabilization opportunities should be examined in Cristianitos Creek (above the confluence with Gabino Creek) in the context of longer-term geological processes.

    - These recommendations would be addressed both by VGL restoration in uplands in upper Cristianitos adjacent to the creek to reduce erosion-generated fine sediments and by stabilizing locally-induced headcuts to the extent feasible (the origin of the headcuts as anthropogenic and/or geologic needs further investigation).

- Within the upper Gabino sub-basin, protect headwaters through restoration of existing gullies, using a combination of slope stabilization, grazing management, and native grasslands and/or scrub restoration. To the extent feasible, restore native grasses to reduce sediment generation and promote infiltration of stormwater.

  - These recommendations would be addressed by a three-pronged approach: (1) restoration of eroded gullies; (2) upland CSS/VGL restoration to reduce erosion-generated fine sediments; and (3) wetland/riparian restoration. Grazing in upper Gabino is addressed in the Grazing Management Plan.

1.2 Purpose of the Habitat Restoration Plan

The Habitat Restoration Plan is a key component of the Adaptive Management Program which is designed to fulfill the following purposes of the proposed RMV Conservation Plan:

1. The Adaptive Management Program is one of the four programmatic elements of the Conservation Strategy to carry out the Scientific Review Panel (SRP) and NCCP Science Advisors conservation planning principles and tenets of reserve design.

2. The Adaptive Management Program, and the Habitat Restoration Plan component, contribute to recovery of listed species in the Southern Subregion.

3. The Adaptive Management Program, and the Habitat Restoration Plan component, would be complementary with any future NCCP/HCP and SAMP/MSAA Programs.

CHAPTER 2.0 UPLAND HABITAT RESTORATION PLAN

This chapter describes the conceptual approach for the restoration of coastal sage scrub (CSS), valley needlegrass grassland (VGL), and mixed CSS/VGL vegetation communities in the RMV Open Space. The term "restoration" is used very broadly in this conceptual plan. It is intended to cover the spectrum of possible restoration activities within the Open Space areas, from creation of new habitats to enhancement of existing degraded habitats through timed grazing, prescribed burning, and other more direct, intensive measures. As an RMV-wide comprehensive program, this section summarizes restoration recommendations for several sub-basins and explains how these recommendations could contribute to a more effective Open Space and Adaptive Management Program. In addition, this section provides a conceptual approach to site preparation, general plant palettes for revegetation, timed grazing and prescribed burning, short-term, long-term monitoring and maintenance, and reporting of the restoration program. This conceptual upland habitat restoration plan is considered preliminary and will be subject to refinement and modification during environmental documentation processes. This section includes the following components of the upland portion of the Habitat Restoration Plan:

- Definition of Terms
- Habitat Restoration Goals
- Success Criteria
- Preliminary Designation of CSS Restoration Areas
- Preliminary Designation of VGL Restoration Areas
- Preliminary Designation of CSS/VGL Restoration Areas
- Implementation Plan
- Maintenance Plan
- Monitoring Program

2.1 Definition of Terms

As indicated above, the term "restoration" is used in the broad sense to refer to the spectrum of restoration activities to be conducted in the RMV Open Space. Where appropriate, several other terms will be used throughout this document to refer to specific kinds of restoration activities. These other terms are defined here.

Passive Restoration: Passive restoration generally refers to removing or controlling disturbance events such as discing that perpetuate non-native or disturbed habitats. Passive restoration may involve some site preparation and maintenance such as weed control, and trash and debris removal, but generally the site would be allowed to revegetate naturally without extensive intervention. Some initial seeding may be used if the natural seed bank onsite is inadequate.

Passive restoration sites would be monitored, and if habitat quality on the site does not appear to be improving by a designated period, active restoration may be applied.

Active Restoration: Active restoration broadly refers to the specific application of restoration techniques. On a large scale (e.g., 10s to 100s of acres), active restoration techniques may include timed-grazing or prescribed burning. On a smaller scale (e.g., a few acres or less), active restoration may include site-intensive techniques such as soil preparation, planting and/or seeding, irrigation, weed control, erosion control, etc. Active restoration implies a higher level of effort than passive restoration and typically is used on sites that would not regenerate naturally, or would only regenerate over an unacceptably long period of time without direct intervention. For example, a mitigation requirement that a site meet certain performance standards such as percent native plant cover or species occupation within five years probably would require active restoration to ensure that the performance standards were met.

Revegetation: Revegetation involves active restoration of a site whereby container plants and/or seeds are used to create or restore habitat. Typically the target native vegetation community is absent from the site; e.g., a site supporting non-native annual grasslands revegetated with VGL. Site preparation and maintenance may include annual grass and weed control, and trash and debris removal. Depending on site conditions, soil remediation and/or irrigation may be necessary to support a viable revegetation site. Generally, revegetation sites would have higher performance standards than passively restored sites and the monitoring and maintenance program is more specific as far as the responsibilities of the Restoration Ecologist and the Installation/Maintenance Contactor.

Enhancement: Enhancement generally refers to restoration of sites that support degraded forms of the target native vegetation community. The level of effort needed to enhance a site typically is less than revegetating a site because the target native community is already present. A primary enhancement approach in the Open Space where low quality native habitat is already present would include timed grazing and prescribed burning to control non-native invasive grasses and weeds. Seeding may be used to supplement the existing native vegetation, but planting of container plants and irrigation generally are not used on enhancement sites. Enhancement tends to be more passive, letting nature take its course.

In practice, there often is not a clear distinction between active and passive restoration, revegetation and enhancement because each site has its own distinct requirements for successful restoration. The Restoration Ecologist and RMV would have the flexibility to implement the appropriate restoration techniques in an adaptive fashion to produce the desired results in the most efficient manner. However, specific performance standards would be set for each restoration site so that success can be objectively measured.

2.2 Habitat Restoration Goals

The goal of this conceptual restoration plan is to provide a framework that would guide the restoration of CSS and VGL vegetation communities that would maintain or enhance biological values (e.g., ecosystem and species) in the Open Space. The restored vegetation communities should provide habitat values and functions that are equal to, or greater than, that of the vegetation communities prior to development.

The CSS restoration component of this plan primarily is intended to provide habitat within the Open Space that would be suitable for forage, cover, nesting and dispersal by the California gnatcatcher. The VGL revegetation component of this plan is intended to provide suitable habitat within the Open Space for VGL plant and animal species, such as the grasshopper sparrow.

Careful site selection is extremely important for the long-term success of a restoration program. Sites that are selected for restoration of CSS and VGL must contribute to the long-term net habitat value of the Open Space. The preliminary designation of restoration areas, as described below, considered both onsite and adjacent habitat conditions in order to provide the best opportunity for a successful restoration program that contributes to the long-term habitat values and functions of the Open Space. For example, the proposed CSS restoration areas are sited in locations along Chiquita and Chiquadora ridges that would augment existing high quality CSS that supports a *major population* of the California gnatcatcher. Successful restoration of CSS in these areas would increase the carrying capacity of these areas for the gnatcatcher. Similarly, the proposed VGL restoration areas are sited in locations that currently support low quality VGL or annual grasslands considered restorable to VGL because they are situated on clay soils and adjacent to existing VGL. Areas proposed for CSS/VGL restoration are sited in locations that appear to naturally support a mosaic of CSS and VGL, based on recent observations that grasslands in nearby areas appear to be gradually type-converting to a CSS/VGL mix. Furthermore, mature CSS vegetation is better able to withstand significant pressure from non-native plant species invasion than more uniform grasslands and therefore could provide a natural barrier that would protect VGL habitat, which typically suffers from invasive species dominance. The CSS/VGL matrix increases habitat diversity and value and likely reestablishes the historical condition of these areas. The co-occurrence of CSS and VGL habitats in this manner would increase the likelihood of the persistence of high quality native habitat in the long-term.

2.1.1 Time Lapse

With active restoration, CSS that is suitable cover, foraging, nesting and dispersal habitat for the California gnatcatcher may be achievable in three to five years from the initial installation of seed and container plants if environmental conditions are consistent with those that are optimal for the vegetation. It is estimated that it would take three to four years for VGL habitat to develop enough structure to provide the functions and values needed for occupation by wildlife species. As CSS or VGL habitat matures, it would become increasingly suitable for a greater variety and higher number of plant and wildlife species.

For both CSS and VGL, the length of time to develop high quality habitat is largely dependent on a variety of factors, including weather, pest herbivory (e.g., pocket gophers, ground squirrels, rabbits), and weed competition. A longer time period may be required when any of the above factors is unusual (e.g., weather) or exceeds what normally occurs (e.g., abnormally high pest levels). As a hedge against drought conditions, the addition of temporary irrigation systems may be needed in some areas to ensure timely seed germination and seedling survival until seedlings have become established and are capable of surviving without supplemental water. The anticipated increase in the survival rate would help the vegetation develop more quickly than would be expected from a non-irrigated revegetation effort.

2.3 Success Criteria

The goal of the CSS restoration program is the establishment of self-sustaining habitat that would provide foraging, cover, nesting and dispersal habitat for the California gnatcatcher, as well as other resident sage scrub species. Similarly, the goal of VGL habitat revegetation and enhancement is to provide suitable habitat for various grassland plants, including native needlegrass and annual herbs and wildlife species such as the grasshopper sparrow. Performance criteria have been established to define when the restoration effort is successful and are outlined in *Section 2.3.3*.

2.3.1 Rationale for Expecting Success

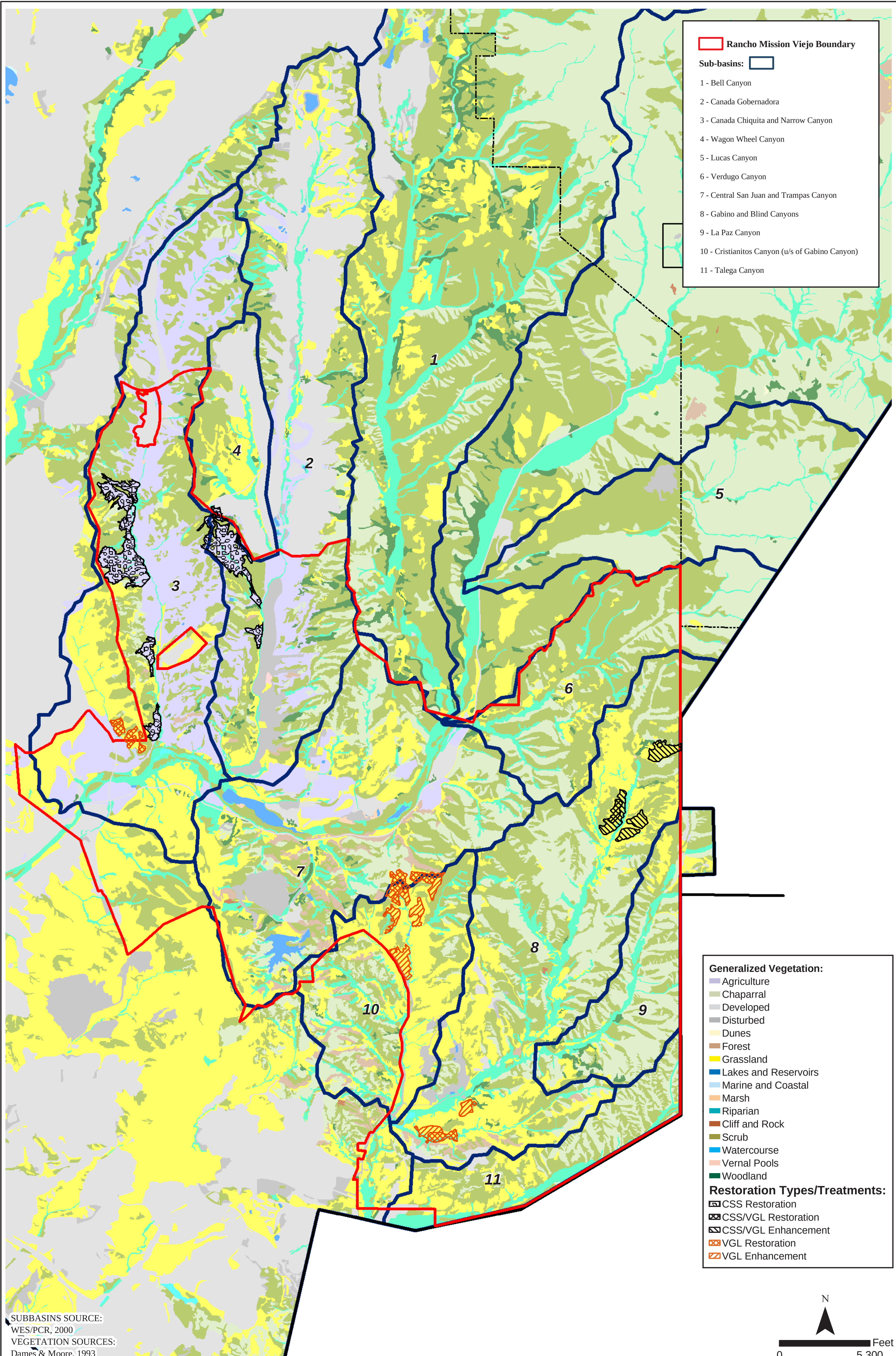
Based on current understanding of the preliminary restoration sites (including enhancement and revegetation sites), existing soils within the restoration sites would remain essentially undisturbed from the current condition. Soil texture, slope, and solar aspect are similar to other native vegetation areas in the vicinity. The target vegetation types are modeled after the existing native vegetation types adjacent to each area, i.e., CSS restoration areas are contiguous with existing CSS, etc. Planted species would be located according to the micro-climate and topography in which the species commonly occurs. The presence of adjacent existing native vegetation would accelerate the time required for animals to utilize these new biological resources as these sites establish and the vegetation matures.

2.3.2 Target Functions

The primary target function of the restored CSS is habitat that provides cover, foraging, nesting and dispersal habitat for the California gnatcatcher. To achieve the target functions and values of the proposed restoration, the plan would create a diversity of CSS subassociations that are most often used by the California gnatcatcher.

The primary target function of the restored VGL is habitat that includes a diversity of grassland plant species and an environment suitable for colonization by additional native grassland plant (including perennial bunch grasses and annual forbs) and wildlife species. A primary target animal species for restored VGL is the grasshopper sparrow, which prefers grasslands that contain vertical (e.g., perch sites) and horizontal (e.g., openings) structural diversity. Also, the restored VGL would provide foraging habitat for several raptors. Finally, certain areas of VGL would exhibit soil characteristics that are suitable for the introduction of special status plant species such as thread-leaved brodiaea, many-stemmed dudleya and intermediate mariposa lily.

The areas proposed for CSS/VGL restoration are located in upper Gabino Canyon and lower Chiquita Canyon (see description below). Target wildlife species have not been designated for upper Gabino Canyon because neither the California gnatcatcher or grasshopper sparrow is known to occur in this area nor have these areas been determined to be important for these species. However, it is expected that restoration of CSS/VGL in this area would attract a variety of native wildlife species, and it would not be surprising if the grasshopper sparrow used restored habitat in the future. CSS/VGL restoration in lower Chiquita Canyon would be consistent with the proposed CSS restoration in this area; some areas preliminarily designated as CSS restoration in *Figure 1* may be more suitable for CSS/VGL restoration over the long-term considering that small patches of VGL often occur in small openings in CSS. In any case, both the gnatcatcher and grasshopper sparrow would be target species for CSS/VGL restoration in Chiquita Canyon. It is expected that a variety of raptors would forage in CSS/VGL restoration areas in both upper Gabino and lower Chiquita canyons.



RMV Habitat Restoration Plan
Preliminary Restoration Areas

FIGURE 1

2.3.3 Performance Standards

A key component for evaluating the success of a restoration plan is setting appropriate performance standards. For example, survival of all container plants typically is required at the end of an initial four-month maintenance period. With such a performance standard, if it was determined that plant mortality, erosion problems, or seed germination progress was unacceptable, a replanting program would be initiated within the restoration area at the end of the first summer.

Specific performance standards must be attained within both passive and active restoration areas at the end of each year of the five years following initiation of the restoration effort. For passive restoration of CSS and VGL, the primary focus of the restoration effort is to control the cover of non-native grasses and weeds in the restoration area while native species are naturally reestablishing. Table 1 shows proposed performance standards for the allowable percent of non-native cover for CSS and VGL. For example, for VGL in year 3 the allowable non-native cover would be up to 60 percent. The proposed CSS performance standards are based on observed performance of other CSS restoration areas in coastal southern California such as the Palos Verdes Peninsula (Dudek, pers. obs.) and Turtle Rock (O'Connnell and Erickson 1998). The proposed VGL performance standards are based on observed cover of VGL on portions of RMV in 1989 by St. John and 2001 by Dudek. St. John mapped some areas in the range of 80-100 percent needlegrass while Dudek mapped areas in the 50 percent range in a drought year.

Within CSS/VGL restoration areas, the non-native cover performance standard would be weighted by the acreage ratio of CSS/VGL. For example, for a 10-acre site with 8 acres of CSS and 2 acres of VGL the Year 1 calculation of percent non-native cover would be as follows:

% non-native cover = (((8 ac CSS x 0.1) + (2 ac VGL x 0.7))/10 ac) x 100 = 22%

Because, by definition, passive restoration allows for the natural regeneration of the native vegetation community, quantitative yearly performance standards for native species cannot be prescribed *a priori* because each likely would regenerate at a different rate.

In contrast to passive restoration, specific performance standards for revegetation of native species can be set for active restoration sites. The long-term performance standards shown in Table 1 for native vegetation cover, species diversity, the overall survival rate of container plantings, and non-native cover are established to measure the success of the restoration program. For example, the criterion for CSS native vegetation cover in year 4 is 70 percent. Should it be determined that any part of the plantings have failed to meet yearly performance standards, corrective measures would be taken. The corrective measures would be implemented to bring the restoration effort into compliance with the required performance standards as quickly as possible. These corrective measures may include replanting failed areas with container plantings of appropriate species, re-seeding, or adjustments to irrigation and maintenance practices.

For the CSS restoration areas, habitat occupation or utilization by gnatcatchers would likely offset apparent vegetation deficiencies such as cover and diversity in the first three years of monitoring. Multiple years of foraging and nesting by gnatcatchers within restoration areas would satisfy the overall success requirement of the CSS restoration, together with sufficient conformance to the performance criteria. Likewise, for VGL and CSS/VGL restoration areas, occupation by the grasshopper sparrow would likely satisfy the overall success requirement.

TABLE 1
RECOMMENDED CSS AND VGL HABITAT PERFORMANCE STANDARDS FOR ACTIVE REVEGETATION AREAS

YEAR	% COVER[1]		% DIVERSITY[2]		% SURVIVAL[3]		% NON-NATIVE COVER[4]	
	CSS	VGL	CSS	VGL	CSS	VGL	CSS	VGL
Year 1	20%	5%	70%	40%	70%	60%	10%	70%
Year 2	30%	15%	70%	40%	80%	80%	10%	70%
Year 3	50%	30%	70%	50%	80%	90%	10%	60%
Year 4	70%	50%	70%	50%	80%	90%	10%	50%
Year 5	80%	80%	70%	60%	80%	90%	10%	50%

[1] % Cover = Percent cover of native species (aggregate of all layers) within the designated area.

[2] % Diversity = Percent of species diversity originally installed that shall be represented. Replacement plantings shall be required if the total number of species lost exceed this percentage.

[3] % Survival = Survival of all container stock and shrub transplants originally planted. This measure may include survival of individual volunteers. Any quantity of dead plants exceeding this percentage shall require replacement plantings, unless the project meets or exceeds the total native cover performance standard.

[4]% Non-native Cover = Maximum % cover of non-native species present during any given year.

2.4 Preliminary Designation of CSS Restoration Areas

The main goal of the CSS restoration program is to establish CSS in areas that would: **(1)** contribute to the Open Space by increasing the carrying capacity for the California gnatcatcher and other sage scrub species; and /or **(2)** would contribute to connectivity in certain important locations. With these goals in mind, the following areas have been tentatively identified for CSS restoration. As portrayed in *Figure 1*, these restoration areas total approximately 375 acres. Final selection of these areas for restoration/enhancement would require additional field study to determine the likelihood of a successful restoration program, including factors such as soil conditions and presence of exotic species both within the restoration area and surrounding habitat.

- Sulphur Canyon in the Gobernadora sub-basin was identified for restoration to provide additional habitat and enhance connectivity between Chiquita Canyon and Wagon Wheel Canyon to the west and Gobernadora and Bell canyons to the east. Sulphur Canyon is currently characterized by CSS on the slopes of the canyon and grazed annual grasses on the valley floor. The Sulphur Canyon restoration area totals approximately 131 acres. An additional 13-acre restoration area lies south of Sulphur Canyon on Chiquadora Ridge. Restoration in this area would help create a continuous band of CSS along the ridgeline.

- Several side canyons between Chiquita Ridge and Chiquita Creek were identified for restoration. Restoration of the two large canyons, totaling about 190 acres, located just northwest and southwest of the "Narrows" would greatly improve the habitat integrity of Chiquita Ridge, which narrows to less than 2,000 feet in width at the top of these side canyons. This restoration area would provide substantial "live-in" habitat for California gnatcatchers and other species, and improve the integrity of the Open Space along Chiquita Ridge. Two areas totaling about 21 acres each are located along lower Chiquita Ridge. Restoration of these two areas would extend native vegetation to the western edge of Chiquita Creek and provide additional habitat for the gnatcatcher and other resident CSS species.

2.5 Preliminary Designation of VGL Restoration Areas

The main goal of the VGL restoration program is to restore native grassland and enhance the quality of existing degraded native grassland in the Open Space such that net habitat value of the existing grassland system is maintained. Restoration of native grassland also would help stabilize areas that currently suffer from erosion such as upper Cristianitos and upper Gabino canyons. Areas identified for VGL restoration includes areas that: **(1)** currently support annual grasses, but have suitable clay soils and are adjacent to existing VGL; **(2)** currently support low quality VGL (i.e., areas with less than 10 percent cover of native grasses); and **(3)** would contribute to an overall native grasslands ecosystem (i.e., small, isolated patches of native grasslands would not be considered valuable to the Open Space). Because establishing a functioning native grassland system is a goal of the restoration program, impacts to native grasslands in a particular sub-basin may be mitigated in another sub-basin to achieve greater value for the overall Open Space areas. Upper Cristianitos, portions of Blind Canyon mesa, and lower Chiquita Ridge totaling approximately 200 acres are recommended for VGL restoration.

- Upper Cristianitos is recommended for VGL revegetation and enhancement because of adjacent existing VGL and to reduce the generation of fine sediments from clayey terrains, promote stormwater infiltration and to enhance the value of upland habitats adjacent to Cristianitos Creek. This area includes patches of annual grassland underlain by clay soils suitable for revegetation and low quality VGL suitable for enhancement. These recommended revegetation and enhancement areas also are contiguous with existing medium quality grassland, suggesting a high likelihood of successful restoration. The revegetation and enhancement areas in upper Cristianitos total approximately 127 acres.

- Portions of Blind Canyon mesa totaling approximately 45 acres are recommended for grassland revegetation and enhancement. This area has at least one patch of annual grassland suitable for revegetation and possibly two patches of low quality VGL suitable for enhancement. These areas are adjacent to existing medium quality VGL, suggesting a high likelihood of successful restoration. Additional fieldwork in the area may reveal additional restoration opportunities.

- Three relatively small patches of potential VGL revegetation totaling approximately 28 acres were identified in the southern portion of Chiquita Ridge. These areas currently support annual grassland but are located in an area supporting a mosaic of medium quality VGL and CSS, indicating a high likelihood of successful revegetation.

2.6 Preliminary Designation of CSS/VGL Restoration Areas

Areas proposed for CSS/VGL restoration are sited in locations adjacent to areas that may naturally support a mosaic of CSS and VGL. A comparison of recent aerial photos (Year 2000) with the NCCP vegetation map and site-specific native grassland mapping by Dudek in 2001 indicates that some areas of upper Gabino Canyon mapped in the early 1990's as grassland appear to be type-converting to a CSS/VGL mix. This type conversion may be a result of the natural drought-wet cycle and the current mosaic of CSS and VGL in this area may reflect natural successional processes. CSS/VGL mosaics provide important biological and structural diversity and valuable habitat for a variety of plant and wildlife species.

The following areas are recommended for CSS/VGL restoration: upper Gabino Canyon; and in the Chiquita sub-basin in the area east of the Santa Margarita Water District wastewater treatment plant, the citrus groves west of Chiquita Creek and the disced areas west of the creek to the Chiquita ridgeline.

- Upper Gabino Canyon suffers from moderate to severe erosion and currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration would reduce sediment generation and promote infiltration of stormwater which would reduce downstream impacts. This area has been identified for CSS/VGL restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse CSS. Allowing a mixed community to regenerate may thus represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for revegetation and several patches of low quality VGL suitable for enhancement. The revegetation area totals about 13 acres and the enhancement areas total about 87 acres.

- As discussed above for CSS, restoration of disturbed areas of Chiquita Canyon west of Chiquita Creek would provide additional habitat for upland species occupying Chiquita Ridge, and particularly the gnatcatcher. Restoration of areas previously used for agricultural purposes, including grazing and citrus, would also benefit riparian species by removing uses that may contribute to downstream impacts. Additional field work, including an anlysis of soils, would be needed to identify the areas best revegetated with CSS alone or CSS/VGL.

2.7 Implementation Plan

Implementation of the upland component of the Habitat Restoration Plan would be comprised of several steps, including:

1. Assessment of the sites to determine the most effective restoration approach; i.e., passive restoration or active restoration, revegetation, or enhancement.
2. Determination of the appropriate restoration treatment.
3. Appropriate planting techniques.
4. Weed control.
5. Erosion control.

2.7.1 Site Assessment

A Restoration Ecologist would inspect each of the designated restoration sites and prepare a detailed restoration plan for each of the sites. A key initial determination would be whether the site can be passively restored or whether it would require active restoration (i.e., timed grazing, prescribed burning, planting, irrigation, etc.).

a. Passive Restoration

Passive restoration would receive first priority and primarily would involve removal or control of disturbance factors that perpetuate the non-native characteristics of the site (e.g., discing, over-grazing, non-native grasses and weeds). Depending on existing site conditions, passive restoration may involve active site preparation and treatment such as weed control (as described below). The key concept of passive restoration is that the native habitat would naturally reestablish if disturbance factors are kept in check. For passive restoration to be effective, the site likely would need to be relatively small and mostly bounded by native vegetation (to facilitate colonization by native species) and/or have an adequate seed bank to support the growth of native species.

b. Active Restoration

Active restoration would be implemented if passive restoration is considered to be inappropriate for the site; i.e., the native vegetation community is unlikely to naturally reestablish itself because of its large size, lack of immediately adjacent native habitat, and/or lack of a native seed bank. The key difference between passive and active restoration is that focused restoration activities would be implemented. Active restoration can take the form of enhancement or revegetation, as defined in *Section 2.1*. The two primary approaches to enhancement of large areas (i.e., 10s to 100s of acres) would be timed grazing and prescribed burning. For smaller areas, or where timed grazing or prescribed burning is not practical, enhancement actions may include mowing, selective use of herbicides, and pulling of weeds. On active revegetation sites native species would be planted through container stock and/or by seeding and closely monitored and maintained until success criteria are achieved.

2.7.2 Restoration Treatments

a. Site Preparation

Whether the restoration effort is passive or active, proper site preparation is critical to successful habitat restoration. Site preparation would include the removal of weeds and debris such as scattered rocks and concrete that may interfere with restoration efforts. Initial weed eradication would be concentrated on removing standing biomass from the sites.

For both passive and active restoration sites, initial weed control efforts may involve a variety of treatments, including timed grazing, prescribed burning and chemical and mechanical (e.g., mowing, weed whacking, hand-pulling) treatments of non-native grasses and other exotic invasive species such as artichoke thistle (*Cynara cardunculus*), sweet fennel (*Foeniculum vulgare*) and mustard (*Brassica* spp.). Depending on the site, one or a combination of these treatements would be used. For example, chemical treatment of artichoke thistle on the Ranch has proven to be effective for this species, which is highly resistant to other forms of control such as grazing. Repetitive treatments are desirable over a prolonged period to effectively reduce the weed seed bank that is present in the soil. This process is anticipated to require one year to reduce the seed bank to the greatest extent possible within that time period. A "grow and kill" procedure involving site irrigation to promote weed seed germination followed by herbicide treatment to kill weed seedlings would be conducted where appropriate. Additional cycles of irrigation and herbicide treatment may be required in these areas.

b. Timed Grazing

For large areas of VGL restoration, and where appropriate, timed grazing (including cattle and goats) would be the primary enhancement technique. The use of cattle grazing to enhance and manage native grasslands is well established in the literature and meshes well with the existing and future cattle operations on the Ranch. Appropriately timed grazing can have several beneficial effects on the vigor of native grasslands:

- Removal of litter and thatch
- Recycling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses.

Goats could be used on an "as-needed" basis in the spring to control weeds in native grasslands. As browsers, goats forage on leaves, flower buds and fibrous materials of noxious weeds that cattle may ignore. Removal of the leaves inhibits critical functions such as photosynthesis, transpiration and respiration. Goats tend to leave plant stems (as opposed to mowing and herbicides) and thus the plant is inhibited from sending out more roots and shoots. Removal of flower buds inhibits reproduction. Thus goats provide a biological control alternative to herbicides and more labor-intense hand-pulling.

The use of timed cattle grazing to enhance and maintain CSS has not been well established in the literature and uncontrolled grazing generally is considered to be detrimental. Removal of intense grazing from grasslands may encourage establishment of CSS (Vogl 1976; Burcham 1957; Hobbs 1983; Kirkpatrick and Hutchinson 1980). The Southern Orange County NCCP Science Advisors hypothesized that grazing in post-fire and mid-successional CSS would result in decreased species diversity overtime. On the other hand, the relatively low intensity cattle grazing on RMV has not appeared to seriously affect of the quality of CSS in the subregion for the California gnatcatcher. The highest densities of the gnatcatcher occur in Chiquita Canyon in areas that have not burned since the 1950's, but have been consistently grazed. A management issue is whether some level of grazing is consistent with, or even beneficial to, managing CSS. A management hypothesis is that timed grazing benefits CSS by controlling the proliferation of annual grasses and maintaining a habitat structure suitable for the California gnatcatcher. This issue can be addressed by establishing grazing exclosures in Chiquita Canyon and monitoring the response of the CSS to the absence of cattle. Understanding the relationship between cattle grazing and CSS quality would be important for the long-term management of the Open Space because prescribed burning, for example, may not be practical in Chiquita Canyon, and because of the Ranch's desire to continue a viable ranching operation.

Timed grazing is anticipated to be used in the near-term for enhancement in the following areas:

- Upper Gabino Canyon CSS/VGL enhancement areas
- Upper Cristianitos VGL enhancement areas
- Blind Canyon enhancement areas

Timed-grazing may be used in the future on Chiquita Ridge and Chiquadora Ridge in the CSS and VGL restoration areas, as well a management tool for existing high quality VGL and CSS if management experiments demonstrate its efficacy for the latter habitat.

The Grazing Management Plan provides more detail on the use of timed grazing for the enhancement and management of VGL and potentially CSS.

c. Prescribed Burning

Prescribed burning, in conjunction with timed grazing, would be used to enhance both CSS and VGL where appropriate. It is envisioned that prescribed burning primarily would be used in the San Mateo Watershed portion of the Open Space where there are fewer constraints on its use (e.g., risks to property, public opposition, etc.).

It is generally believed that CSS is adapted to a fire regime, although the nature of this adaptation is not completely understood. High fire frequencies may be detrimental to the floristic composition and structure of CSS (Malanson and O'Leary 1982). Alternatively, too long of fire intervals may result in senescence and reduced productivity. However, the CSS in lower and middle Chiquita Canyon south of Oso Parkway has not burned since the 1950's and this area supports the highest densities of California gnatcatchers in the subregion. A potential confounding factor is that this area has been consistently grazed, which suggests that in the absence of fire grazing may be a positive contributing factor to the productivity of the area for the gnatcatcher by helping to maintain the appropriate habitat structure and control the proliferation of invasive species. As noted above in the discussion of grazing, the use of grazing as an enhancement/management tool in the Open Space needs to be tested.

Prescribed burning is anticipated to be used in the San Mateo Watershed in conjunction with timed grazing in the following areas:

- Upper Gabino Canyon CSS/VGL enhancement areas
- Upper Cristianitos VGL enhancement areas
- Blind Canyon enhancement areas

Following Menke's (1996) recommendation, prescribed burning would be used a secondary component of enhancement, with grazing as the primary component. While fire has a beneficial effect in reducing litter, thatch and alien species, frequent burning can damage native grasses. Menke recommends burning only every third or fourth year.

The Fire Management Plan provides more detail on the use of prescribed burning for the enhancement and management of VGL and CSS.

d. Revegetation

In smaller areas that require intensive revegetation of CSS, VGL and CSS/VGL, restoration would be achieved through a process involving site preparation, installation of temporary irrigation (where necessary), selective container plant installation, and seed installation throughout all active restoration areas. Container plants would be installed in all CSS and VGL revegetation areas. Native grass container plants would be salvaged from development sites or from nursery grown stock.

Habitat enhancement for VGL and CSS/VGL would primarily involve long term control of annual grasses and exotic species that now coexist with native grassland species. Selected enhancement areas have been identified in previously mapped VGL habitat where non-native species are dominant. These areas would receive native grass plants that are salvaged from development areas, where possible and practical, and the grassland seed mix.

The following sections describe the revegetation treatments that would be used for each habitat type. Long-term maintenance is described in *Section 2.8* and would begin after the mitigation installation work receives final approval and acceptance.

1. CSS Habitat Revegetation

The revegetation treatment for CSS would rely upon the use of container plants and a native seed mix to reintroduce CSS species to the revegetation sites. Container plant installation would be an important component of the revegetation treatment at these sites to facilitate more rapid plant establishment and area coverage, particularly on the steeper slopes. Species with seed that is not readily available or that do not readily germinate would be introduced using nursery-grown container plants. Container plants would be inoculated with appropriate mycorrhizae by the nursery staff to promote more healthy, vigorous growth. Most native CSS species that are installed from nursery containers are capable of seed production within the first year after installation. This on-site seed production is an important part of the revegetation process.

Native seed would originate from local sources in Southern California to the greatest extent feasible. The seed mix would contain appropriate mycorrhizae to help promote healthy, vigorous plant growth. Common CSS species such as California sagebrush (Artemisia californica), California bush sunflower (*Encelia californica*), orange bush monkey-flower (*Mimulus aurantiacus*), coastal goldenbush (*Isocoma menziesii*), white sage (*Salvia apiana*), California buckwheat (*Eriogonum fasciculatum*), and native bunchgrass (*Nassella* spp.) would be included in the seed mix.

Revegetation would consist of a native seed mix and container plants of coastal sage scrub species. The seed mix also would contain nurse crop species that would provide initial soil surface stabilization. Although each site would need to be evaluated for the most appropriate species, a sample plant palette for the revegetation areas based on typical CSS stands in the Southern NCCP/HCP planning area is provided in *Tables 2 and 3.*

TABLE 2
CONCEPTUAL CSS RESTORATION CONTAINER PLANT PALETTE[1]

Botanical Name	Common Name	Size	Typical Spacing (in feet)
Artemisia californica	California sagebrush	1 gal.	4
Baccharis pilularis	Coyote bush	1 gal.	6
Bothriochloa barbinodis	Beard-grass	1 gal	20
Encelia californica	California bush sunflower	1 gal.	4
Eriogonum fasciculatum	California buckwheat	1 gal.	5
Galium angustifolium	Narrow-leaved bedstraw	1 gal.	20
Heteromeles arbutifolia	Toyon	1 gal.	12
Isocoma menziesii	Coastal goldenbush	1 gal.	4
Isomeris arborea	Bladderpod	1 gal.	6
Keckiella cordifolia	Heart-leaved penstemon	1 gal.	12
Leymus condensatus	Giant wild rye	1 gal.	5
Malosma laurina	Laurel sumac	1 gal.	12
Marah macrocarpus	Manroot	1 gal.	6
Melica imperfecta	Coast range melic	1 gal.	?
Mimulus aurantiacus	Orange bush monkey-flower	1 gal.	6
Mirabilis californica	Coastal wishbone plant	1 gal.	6
Nassella lepida	Foothill needlegrass	1 gal.	?
Opuntia littoralis	Coastal prickly pear	1 gal.	6
Opuntia prolifera	Coast cholla	1 gal.	6
Rhus integrifolia	Lemonadeberry	1 gal.	12
Salvia apiana	White sage	1 gal.	4
Sambucus mexicana	Mexican elderberry	1 gal.	12

1 The plant palette for any given revegetation site would be site-specific to reflect the species composition of the native vegetation in the vicinity and other site conditions such as slope, aspect and soil conditions.

TABLE 3
CONCEPTUAL CSS REVEGETATION SEED MIX

Botanical Name	**Common Name**	**%P/%G[1]**	**Lbs/Ac**
Ambrosia psilostachya	Western ragweed	20/30	1.0
Artemisia californica	California sagebrush	15/50	6.0
Deinandra fasciculata	Fascicled tarweed	10/25	1.0
Dichelostemma capitatum	Blue dicks	95/50	0.5
Encelia californica	California bush sunflower	40/60	6.0
Eriogonum fasciculatum	California buckwheat	10/65	20
Galium angustifolium	Narrow-leaved bedstraw	80/30	1.0
Gnaphalium californicum	California everlasting	10/25	0.5
Gnaphalium canescens	Felty everlasting	10/25	0.5
Isocoma menziesii	Coastal goldenbush	30/30	6.0
Lotus scoparius	Deerweed	90/60	1.0
Lupinus bicolor	Miniature lupine	98/80	2.0
Lupinus succulentus	Arroyo lupine	95/85	6.0
Melica imperfecta	Coast range melic	90/60	1.0
Mimulus aurantiacus	Orange bush monkey-flower	2/60	1.0
Nassella lepida	Foothill needlegrass	60/60	1.5
Nassella pulchra	Purple needlegrass	70/60	3.0
Salvia apiana	White sage	70/30	8.0

[1] %P = seed purity or the amount of seed vs. other non-seed material such as stems, leaves, chaff, anthers , etc. %G = percent viable seed. These two measures are used as minimum standards for seed. Together they define the amount of Pure Live Seed (%PLS) in each pound of seed. Seed is tested for these standards because it can have a significant effect on the vegetation coverage that would result from putting down a pound of seed with a high PLS vs. a low PLS.

2. VGL Habitat Revegetation and Enhancement

Revegetation and enhancement of VGL would require a variety of treatments that would vary depending on the site location and feasibility. Where timed grazing and prescribed burning are not appropriate, treatments would consist of container plant installations, native bunchgrass salvaged plant transplantations (where practical), and seeding. In areas where a CSS/VGL plant species matrix is appropriate, the CSS plant palette would supplement the VGL plant palette. A list of proposed VGL plant and seed species is provided in *Tables 4 and 5.*

TABLE 4
CONCEPTUAL VGL REVEGETATION AND ENHANCEMENT CONTAINER PLANT PALETTE

Botanical Name	Common Name	Size	Typical Spacing (in feet)
Artemisia californica	California sagebrush	1 gal.	4
Ericameria palmeri var. pachylepsis	grassland goldenbush	1 gal.	20
Eriogonum fasciculatum	California buckwheat	1 gal.	20
Isocoma menziesii	coast goldenbush	1 gal.	20
Leymus condensatus	giant wild rye	1 gal.	5
Nassella lepida	foothill stipa	1 gal.[1]	3
Nassella pulchra	Purple needlegrass	1 gal.[1]	3

[1] Use 1-gallon containers for salvaged plants and C-10 leach tube (1 5/8"x8 1/4") for nursery grown plants. Nursery plants would be used only to supplement quantities of salvage plants to achieve the total quantity.

TABLE 5
CONCEPTUAL VGL REVEGETATION AND ENHANCEMENT SEED MIX

Botanical Name	Common Name	%P/%G[1]	Lbs/Ac
Agrostis diegoensis (?)	Leafy bentgrass	90/80	1.0
Aristida ternipes var. hamulosa	Hook three-awn grass	?90/70	1.0
Bloomeria crocea var. crocea	Common golden star	90/60	3.0
Calochortus splendens	lilac mariposa	90/80	2.0
Castilleja exserta	Common owl's-clover	50/50	2.0
Dichelostemma capitatum	blue dicks	90/80	1.0

TABLE 5
CONCEPTUAL VGL REVEGETATION AND ENHANCEMENT SEED MIX

Botanical Name	Common Name	%P/%G[1]	Lbs/Ac
Eschscholzia californica	California poppy	90/80	2.0
Deinandra fasciculata	Fascicled tarweed	20/80	0.5
Deinandra paniculata	paniculate tarweed	20/80	0.5
Lasthenia californica	coast goldfields	50/60	1.0
Lupinus bicolor	Lindley's annual lupine	98/85	4.0
Melica imperfecta	California melic	80/60	2.0
Nassella lepida	foothill stipa	90/60	6.0
Nassella pulchra	purple needlegrass	90/80	6.0
Osmadenia tenella	rosin-weed	unknown	0.5
Plantago erecta	California plantain	90/80	3.0
Sisyrinchium bellum	blue-eyed grass	95/75	1.0

[1] %P = seed purity or the amount of seed vs. other non-seed material such as stems, leaves, chaff, anthers , etc. %G = percent viable seed. These two measures are used as minimum standards for seed. Together they define the amount of Pure Live Seed (%PLS) in each pound of seed. Seed is tested for these standards because it can have a significant effect on the vegetation coverage that would result from putting down a pound of seed with a high PLS vs. a low PLS.

Treatments for the enhancement areas would rely heavily on weed removal and replacement by salvaged plants from within developed areas. Native bunchgrass plants within the limits of grading would be salvaged prior to grading and relocated in the VGL enhancement areas to the extent feasible. If feasible, depending on the progress of site preparation activities, plants shall be removed and immediately relocated to a receptor hole in the enhancement area. Otherwise, salvaged plants would be potted and stored until the following fall when the receiving site is ready. A receptor hole shall be dug in the enhancement areas to the same depth and twice the width of the salvaged bunchgrass. The salvaged bunchgrass shall then be planted according to the techniques described in *Section 2.7.3*. If it is determined that a plant salvage is not feasible, container plants would be substituted.

2.7.3 Planting Techniques

All container plants and salvaged plants shall be installed using industry standard techniques. A hole twice the diameter of the rootball would be excavated to the depth of the rootball. Each hole would be filled with water and allowed to drain prior to plant installation. Each container plant rootball shall be scarified prior to installation if dead roots occur on the surface of the rootball. Salvaged plant rootballs do not need scarification. Planting backfill shall be native soil.

CSS species would receive a 2-inch thick layer of bark mulch 18 inches out from the base of each plant to reduce weed growth and water evaporation. After installation, each plant shall be irrigated to the depth of the rootball.

2.7.4 Seed Application

A two-step hydroseed technique would be used to install all seed mixes. This technique involves an initial application of a hydroseed slurry composed of water, seed, fertilizer (if any), and a low volume of fiber mulch. The second hydroseed slurry application contains water and a heavier volume of fiber mulch. The purpose of the two-step process is to achieve the greatest seed-soil contact. In any cases where seed applications are within small in-fill enhancement areas, installation would be performed using hand broadcast methods.

2.7.5 Irrigation System & Schedule

Where needed, temporary on-grade irrigation systems would be installed to enhance germination and establishment of native seedlings. The systems would be controlled automatically by irrigation clocks, and may be designed to shut off during rains events. Areas of similar topography may be controlled by a single remote control valve. The precipitation rate of the system would be approximately 0.2 inch per hour for any given area of the system.

The frequency and duration of irrigation are critical to seed germination and establishment. The application of water shall be keyed to existing conditions and water requirements of each stage of seed germination and seedling establishment. Irrigation shall be used to maximize container plant survival and deep root growth while minimizing non-native species growth and seed production. During September and October of each year, the plants should show signs of water stress and dormancy; a condition that is typical for CSS and VGL species during the fall season.

The sites shall be reviewed by onsite personnel regularly for appropriate soil moisture. Visibly moist, but not saturated, soil in the top 3-4 inches is the desired condition during seed germination and seedling establishment. As the winter season progresses, soil moisture would naturally penetrate to deeper soil horizons. As seedlings reach 3-4 inches in height, irrigation frequency should be reduced to weekly, biweekly, and monthly intervals.

During each inspection, holes shall be dug with a hand shovel or using a soil probe to determine the depth and amount of soil moisture. Enough holes shall be dug to establish a representative sample of the site, i.e., until soil conditions are the same in more than three holes dug across the site. The irrigation schedule shall be modified as necessary based on this inspection. Irrigation heads shall be adjusted or capped where wet areas occur next to dry areas to facilitate additional irrigation of the drier areas.

Irrigation system operation shall be suspended in anticipation of rain events. The system shall be shut-off at a master control valve three to five days prior to a predicted rain storm or series of storms. System operation shall be resumed immediately if a predicted storm does not materialize and if the site requires supplemental irrigation to maintain soil moisture conditions that are sufficient for seed germination and seedling establishment. System operation shall be resumed after a rain event upon a site inspection to determine soil moisture levels.

2.7.6 Weed Control

In restoration areas where a considerable weed seed bank has built up in the soil, weed control activities would be performed for the first year prior to container plant and seed installation. Weed abatement is most effective when time is given to repeated treatment of resprouting weeds. This is especially true for persistent weeds such as artichoke thistle, black mustard, sweet fennel (*Foeniculum vulgare*), smooth cat's-ear (*Hypochoeris glabra*), tocalote (*Centaurea melitensis*), wild radish (*Raphanus sativus*), Crete hedypnois (*Hedypnois cretica*), Italian thistle (*Carduus pycnocephalus*), bull-thistle (*Cirsium vulgare*), milk-thistle (*Silybum marianum*), and annual grasses. Early treatment and regular follow-up treatment of these species would reduce the weed density in the restoration areas over the long-term. Herbicide treatment of non-native grasses and follow-up treatment to reduce seed production would be essential for establishing native vegetation cover.

2.7.7 Erosion Control

Where needed, rice straw wattles would be installed on the slopes and a silt fence at the bottom of the slopes as erosion control devices. The location of these applications would be determined by the Restoration Ecologist. Soil stability would be inspected by the Restoration Ecologist during the rainy season to establish any further erosion control applications that might be necessary.

2.8 Maintenance and Monitoring Plan

Maintenance and monitoring activities that are necessary to ensure successful habitat revegetation and enhancement would be conducted according to this plan. The Maintenance and Monitoring Plan provides direction to the Restoration Ecologist, RMV, and the Installation/Maintenance Contractor for routine maintenance of the restoration projects to be conducted throughout the initial plant establishment period and five-year monitoring period. This section is intended to provide a brief description of those activities.

2.8.1 Maintenance Activities

Maintenance activities shall apply to all areas of revegetation and enhancement. Immediately following implementation of the restoration program, a maintenance program would be initiated to ensure successful germination and growth of the installed native species.

Because mature CSS effectively controls non-native species, restored CSS and CSS/VGL areas likely would become self-sustaining over time, needing very little or no maintenance once established. Maintenance activities for CSS and CSS/VGL would thus focus on ensuring the establishment of self-sustaining habitat during the five-year maintenance period. Maintenance activities shall include weed control, supplemental irrigation (as appropriate), pest control (as appropriate), and site access restrictions.

Restored VGL likely would require additional maintenance to reduce the buildup of non-native biomass. Native perennial grasses benefit from biomass reduction because it removes thatching that begins to crowd out new growth. Historically grasslands were grazed to prevent this and consequently, grasses have adapted to this condition. Depending on the restoration site, the grass thatch that is built up should be removed periodically. In the first few years of revegetation sites, mowing and/or with hand tools such as rakes and weed whip machines should be used. Once native grasses are well established timed grazing and prescribed burning can be used for long-term management. Biomass reduction for VGL restoration areas should begin in the summer or fall after two years of active growth, and continue annually. A determination of which method would be most effective and feasible would be made by the Restoration Ecologist and RMV.

2.8.2 Four-Month Maintenance and Monitoring Period

During the four-month period following completion of restoration activities, weed control measures, irrigation schedules, and special management needs would be determined. A replanting program would be initiated at the completion of the four-month maintenance period if 100 percent container plant survival is not attained. The plant establishment period shall be included in the installation contract to be performed by the Installation/Maintenance Contractor.

Successful completion of the contract shall include 100 percent survival of all container plants at the end of the plant establishment period. New replacement plants shall be provided and installed for the Installation/Maintenance Contractor to obtain final contract sign-off and payment.

2.8.3 Five-Year Maintenance and Monitoring Program

Following the four-month maintenance period, a long-term five-year maintenance program would be initiated. Long-term maintenance would be initiated following the end of the plant establishment period. Maintenance shall occur on an as-needed basis throughout the five-year maintenance period. Maintenance personnel are expected to conduct maintenance activities on a timely basis by conducting work at a frequency and intensity that would result in the greatest potential for native vegetation to establish and become the dominant vegetation type within the restoration area. If necessary, corrective measures (such as re-seeding or container planting) would be promptly implemented to bring the restoration effort into compliance with the performance standards shown in Table 1.

Supplemental irrigation of restoration sites would be conducted only when determined to be necessary by the Restoration Ecologist. Irrigation schedules would provide adequate water to maximize the survival of installed container plants and seedling establishment without creating conditions that promote non-native species that are dependent upon constant moist soil conditions.

Irrigation of the restoration sites would be closely monitored, and if necessary, the irrigation schedule and rates for each area would be modified to provide moisture and ensure successful germination and growth. The Restoration Ecologist would determine the need for changes in irrigation schedules in consultation with the Installation/Maintenance Contractor. An accurate record of these activities would be maintained by the Installation/Maintenance Contractor.

2.8.4 Weed Control

It shall be the Installation/Maintenance Contractor's responsibility to control weeds within the restoration areas. Before initiating any weed control measures, the Installation/Maintenance Contractor would meet onsite with the Restoration Ecologist and RMV to determine the extent and methods of weed control. The Installation/Maintenance Contractor would notify RMV at least three days prior to implementing approved weed control measures. Weed control would be conducted in all active restoration areas for the duration of the five-year maintenance period. As outlined in *Section 2.3.3* and Table 1 no more than 10 percent non-native cover in any given year during the five-year maintenance period would be tolerated within CSS restoration areas. In VGL restoration areas the percent of non-native cover ranges from 70 percent in Year 1 to 50 percent in Year 5. In CSS/VGL restoration areas the allowable percent non-native cover is a function of the ratio of CSS to VGL in the restoration area, as described in *Section 2.3.3*.

During the five-year maintenance program, non-native grasses shall be removed with hand tools, by hand, or treated with a monocot-specific herbicide. Hand tools such as "weed whips" shall be used only where solid patches of non-native grasses are present and in the absence of native seedlings. Hand removal shall be used where native shrub seedlings are present. Chemical treatment shall be limited to large areas of non-native grass with no native species present. Target non-native grass species include Italian ryegrass (*Lolium multiflorum*), wild oat (*Avena* spp.), Bermuda grass (*Cynodon dactylon*), brome grasses (*Bromus* spp.), and any future investations of veldt grass (*Ehrharta calycina*), which is expanding into Orange County. After the five-year maintenance program, or sooner if deemed appropriate by the Restoration Ecologist, timed grazing or prescribed burning may used for long-term weed control, as described in the Grazing and Fire Management plans.

Herbicide treatments would be used on non-native weedy forbs such as smooth cat's-ear, tocalote, Crete hedypnois, Italian thistle, bull-thistle, milk-thistle, Carolina geranium (*Geranium carolinianum*), scarlet pimpernel (*Anagallis arvensis*), red-stemmed filaree (*Erodium cicutarium*), white-stemmed filaree (*E. moschatum*), and broad-lobed filaree (*E. botrys*).

Species such as black mustard (*Brassica nigra*), wild radish (*Raphanus sativus*), etc. that can be successfully removed by hand shall be hand-pulled once individuals reach approximately 12 inches of height. Artichoke thistle, sweet fennel and other weeds that cannot be successfully removed by hand, shall be spot-sprayed with a broadleaf herbicide. Weeding should focus on the elimination of weed seed production and weed plant removal. All weeds shall be disposed of off-site at an approved disposal location.

The prime period for weed removal is in the spring during the months of March and April. Weed eradication at this time is ideal because soils are typically still moist enough for hand-pulling and therefore can be removed before their detrimental effects of robbing native plants of sunlight, moisture, and nutrients occur. Additionally, it is imperative that weeds are removed before they can successfully produce seeds and contribute to the weed seed bank. If weeds are not controlled during this period of time, successful establishment of CSS species or VGL species would be prolonged or reduced.

This ideal weeding period happens to coincide with the California gnatcatcher breeding season (February 15 - July 30). Therefore, in the event that a gnatcatcher or multiple gnatcatchers inhabit a restoration site, special arrangements for weed removal would be made. Those arrangements would include: **(1)** The presence of a wildlife biologist during the weed removal event and the establishment of flagging to determine the allowable proximity of weeding activities to the gnatcatchers, and especially nest sites; **(2)** Hand weeding only would be allowed within the area designated by the wildlife biologist; and **(3)** Restrict weeding to no more than four hours between 11:00 am and 5:00 pm to allow for sufficient foraging time. Weed removal activities would be discontinued if the wildlife biologist notes any obvious gnatcatcher distress.

Although the welfare of the gnatcatchers is paramount, it is critical that successful weed eradication take place during the spring to ensure establishment of quality CSS habitat. Mature CSS habitat has the capacity to withstand invasive weed species. Therefore, careful attention to the exclusion of weedy invasive species during the maturation of CSS species is key to the long-term success of the restoration program.

2.8.5 Clearing and Trash Removal

Pruning or clearing of native revegetation plantings would be prohibited. The revegetation areas would be allowed to develop naturally. Plant debris of native shrubs would not be removed from the restoration sites. Native plant debris provides valuable micro-habitats for invertebrates, reptiles, small mammals, and birds; all necessary elements of normally functioning CSS and VGL communities. The decomposition of the plant debris also is essential for the replenishment of the soil's nutrients and minerals.

Trash shall be regularly removed from restoration areas by hand and appropriately disposed of offsite. Such trash shall be removed as needed, but at no less than at 1-month intervals for the first year, and quarterly thereafter.

2.8.6 Pest Control

Pests, including insects, mites, snails, rabbits, and rodents, are expected to occur within the restoration areas. In accordance with an Integrated Pest Management Program, active control of pests with the use of chemical pesticides would be avoided in favor of allowing natural environmental controls to take effect or the use of directed controls (e.g., trapping). If destruction of the habitat plantings by pests becomes a problem, the Installation/Maintenance Contractor would consult with RMV and the Restoration Ecologist to determine remedial measures to be taken.

2.9 Monitoring Program

Monitoring of the restoration areas shall be accomplished by the Restoration Ecologist, under direction of RMV. Restoration efforts would be considered successful when the performance standards stated in *Section 2.3.3* and Table 2 for the specific vegetation type have been met. At that point, the restoration project would be considered to be established. Vegetation monitoring would continue to the end of the full five-year monitoring period. Vegetation monitoring would consist of qualitative and quantitative data collection and analysis. The results of these surveys would be recorded and included in annual reports submitted to RMV for incorporation into the overall Open Space report.

2.9.1 Monitoring Period for Project Success

Qualitative surveys consisting of a site walkover and characterization of the restoration sites would be conducted. For active restoration sites, the Installation/Maintenance Contractor shall be present during qualitative surveys to review maintenance activities and requirements.

Quantitative surveys would involve the collection and analysis of transect data to describe the vegetation structure, identify trends in habitat development, and identify existing and potential problems that could negatively affect project success.

2.9.2 Qualitative Data Collection

After the initial planting effort has been completed in a revegetation or enhancement area, the area would be monitored every two weeks for the initial four-month period, quarterly through the end of year 2, and semi-annually for years 3-5. For passive restoration sites, the areas would be monitored quarterly through the end of year 2, and semi-annually for years 3-5. Qualitative surveys would be conducted by the Restoration Ecologist and consist of a general site walkover and a characterization of the revegetation planting on active restoration sites. General observations, such as health of planted species, signs of over watering, and drought stress would be noted. Revegetation plantings would be examined to visually estimate percentage of cover, species mortality, species composition, seedling recruitment, and soil, weed, and pest problems. Maintenance needs would be recorded and submitted by the Restoration Ecologist to RMV and Installation/Maintenance Contractor for appropriate action subsequent to each survey.

The irrigation system would be tested regularly by the Installation/Maintenance Contractor during the irrigation season to ensure that it is functioning properly. Maintenance needs would be recorded and submitted to the Restoration Ecologist and RMV for appropriate action.

2.9.3 Quantitative Data Collection Methods

To augment qualitative survey data, more precise data would be collected and analyzed by the Restoration Ecologist to document and evaluate the progress of the restoration program toward meeting habitat goals. Immediately following project initiation (i.e., site preparation for passive and active restoration sites and installation on active sites), permanent sampling locations would be established within the restoration areas, marked and recorded on maps. These sampling stations would be surveyed two times per year to determine germination and transplant success, species mortality, pest problems, percentage of relative cover, and species composition. The frequency of data collection may be reduced to one time per year at the discretion of the Restoration Ecologist and RMV. Consistent sampling techniques would be used throughout the monitoring process to ensure accuracy in comparative analysis.

Quantitative plant distribution data would be collected from sampling locations (transect lines for CSS and CSS/VGL and quadrats for VGL) to compare the restored vegetation with the habitat characteristics of comparable existing CSS and VGL vegetation in the general project area. All transects would be 25 meters long and would be established randomly within the revegetation areas. The number and locations of transect lines and quadrats within a restoration area would be determined at the time of project installation, but would be adequate to provide a representative sampling of the restoration area.

CSS and CSS/VGL transect data would be collected by recording each species that intersects an imaginary vertical plane located at each half-meter mark along the transect. All species present within a 5-meter wide band centered on the transect line would be recorded. Relative species cover and species diversity would be derived from these data.

One-meter quadrat samples within the VGL enhancement areas would be taken randomly each year. The sampling methodology would consist of randomly tossing a 1-meter quadrant frame in front or to the side of the field monitor. Native and non-native vegetation cover would be estimated within the quadrat. A count of individual species would be made for each quarter quadrat in a clockwise pattern beginning in the lower left quarter. Individuals would be categorized by size class within one of the quadrat quarters, alternating in a clockwise pattern for each successive quadrat sample.

A reference transect of existing established CSS and VGL habitat occupying similar topography and subject to similar environmental conditions would be established as a control. Each transect sampling area would be photographed to document the progress of revegetation over the five-year monitoring period. Photo-documentation would be included in all status reports.

Transect data collection shall be achieved by recording each plant species that intersects an imaginary vertical plain at each half-meter along the transect line. Data would be converted to relative cover.

2.9.4 Record Keeping

Following each monitoring visit, the Restoration Ecologist would recommend actions, as needed, to RMV that would promote survival and coverage criteria as described in the performance standards. The Restoration Ecologist, RMV, and Installation/Maintenance Contractor would work together to monitor, maintain, and replant restoration areas, if necessary.

Over the five-year period following restoration implementation, an annual report prepared by the Restoration Ecologist that discusses the results of the restoration monitoring and maintenance efforts for that year would be submitted to RMV for incorporation into the overall report for the Open Space. Vegetation cover by species, compliance with required performance standards, species heights, seedling recruitment, pest problems, weed control problems, pest control measures implemented, additional required maintenance procedures, and the general health of the revegetation plantings would be summarized in these reports. Photo-documentation of the sites would be included in the reports to provide a visual record of the restoration progress.

2.10 Completion of Restoration

2.10.1 Notification of Completion

Upon completion of Year 5 of the monitoring period or when the restoration area(s) have achieved the Year 5 performance criteria, the Restoration Ecologist shall prepare a final report for RMV that describes the relative success of each restoration area.

2.10.2 Contingency Measures

Contingency measures would be implemented if restoration efforts fail to meet performance criteria at the end of the five-year monitoring period. Such measures shall include additional container plant and/or seed installation, additional weed control efforts, an evaluation and appropriate modification of the irrigation system, and the extension of the maintenance and monitoring period until such time that the performance criteria are achieved.

2.10.3 Long-Term Management

Long-term management beyond the five-year monitoring program would be in accordance with the Adaptive Management Program for the proposed RMV Open Space. RMV would determine whether a restoration site would be subject to long-term monitoring and management.

CHAPTER 3.0 AQUATIC RESOURCES HABITAT RESTORATION PLAN

This chapter describes the conceptual approach for the creation, restoration and/or enhancement of wetlands and non-wetland riparian habitats in the proposed RMV Open Space. This section includes a summary of the invasive exotic control program for San Juan Creek as set forth in greater detail in the Invasive Species Control Plan (*Appendix I*). As with the upland habitats, the term "restoration" is inclusive in this conceptual plan for aquatic resources as it addresses the spectrum of possible restoration activities within the Open Space, ranging from creation of new habitats that in some instances may require substantial grading to enhancement of existing degraded habitats that could include limited grading or may require far less intensive measures such as minor recontouring, removal of invasive species and/or some replanting.

As an RMV-wide comprehensive program, this section summarizes restoration recommendations for several sub-basins and explains how these actions, as part of the Adaptive Management Program, could contribute to a more effective Open Space. The restoration recommendations have been developed to ensure no-net-loss of either acreage or function associated with waters of the United States subject to the jurisdiction of the U.S. Army USACE of Engineers (USACE) pursuant to Section 404 of the Clean Water Act and waters of the State subject to the jurisdiction of the California Department of Fish and Game (CDFG) pursuant to Section 1600 of the Fish and Game Code. The approach taken in this program is consistent with recent Regulatory Guidance Letter No. 02-2, dated December 24, 2002, issued by the USACE regarding mitigation, which emphasized watershed-wide and function-based programs where feasible.

Although a watershed and function-based approach, this section also describes site preparation, plant palettes, short-term and long-term monitoring and maintenance, and reporting of the restoration program to provide a framework and guidance for the restoration plan. This Conceptual Aquatic Resources Habitat Restoration Plan (ARHRP) is a working draft and would be subject to refinement and modification during environmental documentation and approval processes; however, it is important to note that substantial data have been collected on the aquatic ecosystems on the RMV. These data, along with data collected during monitoring of approximately 120 acres of created and restored wetland and riparian areas on RMV, provide a robust data set that can be used to inform and guide future restoration projects.

Finally, this plan provides for low intensity monitoring and maintenance (as necessary) for approximately 18 acres of existing created alkali marsh, alkali meadow, and southern riparian scrub in the Gobernadora Ecological Restoration Area (GERA). These 18 acres of existing wetland habitat were created in 1998 and 1999 as part of the Ladera Ranch wetland restoration program that, according to conditions in the Section 404 and 1603 Authorizations from the USACE and CDFG, included a sliding scale whereby excess creation areas (i.e., not specifically needed to offset impacts associated with Ladera Ranch) could be utilized for future projects within RMV. The 18 acres have achieved the five-year performance standards and would be subject to ongoing monitoring until such time as they are used to offset future impacts association with RMV development authorizations.

This section includes the following components of the aquatic resources portion of the ARHRP:

- Regulatory Considerations
- Definition of Terms
- Habitat Restoration Goals
- Success Criteria
- Preliminary Designation of Streams to be Restored
- Preliminary Designation of Wetland Restoration/Enhancement Areas
- Preliminary Designation of Non-Wetland Riparian Restoration/Enhancement Areas
- Implementation Plan
- Maintenance Plan
- Monitoring Program

3.1 Regulatory Considerations

The USACE and U.S. Environmental Protection Agency (EPA) regulations at 33 CFR 320-330 and 40 CFR 230 authorize the USACE to require compensatory mitigation for unavoidable impacts to waters of the U.S., including wetlands. CDFG similarly requires mitigation to compensate for impacts to streambeds and lakes and associated aquatic-dependent resources pursuant to Section 1600 of the Fish and Game Code. Both the USACE and CDFG recognize the value of providing mitigation that maximizes the functions of the compensatory mitigation and, in particular the USACE has been moving away from evaluation of compensatory mitigation on a purely acre-for-acre basis to a function-based evaluation. This approach is set forth in a Regulatory Guidance Letter (RGL) published by the USACE on December 24, 2002[1] and in a Special Public Notice published by the Los Angeles District on January 27, 2003.[2] In both documents the USACE encouraged utilization of functional assessments for evaluating impacts to aquatic resources and determining appropriate mitigation ratios. On page 2 of the December 24, 2002 RGL, the USACE notes:

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[1] U.S. Army Corps of Engineers. 2002. *Regulatory Guidance Letter No. 02-2: Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899.* December 24, 2002, 16pp.
[2] U.S. Army Corps of Engineers, Los Angeles District. 2003. *Special Public Notice: Mitigation and Monitoring Requirements.* January 27, 2003, 41pp.

The USACE has traditionally used acres as a standard measure for determining impacts and required mitigation for wetlands and other aquatic resources, primarily because usefil functional assessment methods were not available. However, Districts are encouraged to increase their reliance on functional assessment methods.

3.2 Definition of Terms

As indicated above, the term "restoration" is used in the broad sense to refer to the spectrum of restoration and enhancement activities to be conducted in the Open Space. Where appropriate, several other terms would be used throughout this section to refer to specific kinds of restoration activities. Most of these terms were generally defined in the previous section for upland habitats, but are presented here again because they are tailored for aquatic resources. These other terms are defined here.

Wetland Functional Assessment: A methodology whereby various hydrologic, biogeochemical and habitat functions typically associated with wetlands or other components of the aquatic ecosystem are qualitatively or quantitatively scored or rated. The USACE has developed one approach, the Hydrogeomorphic (HGM) Approach, which utilizes "variables" to define or describe each function associated with a particular wetland type. The HGM approach has been designed for evaluating functional losses associated with specific projects and can be used for very small projects with minor impacts (e.g., impacts to fractions of an acre) or for projects that cover thousands of acres on the landscape that affect multiple areas of the aquatic ecosystem. The USACE has also developed a functional assessment tool for evaluating large areas at a coarser scale that is often utilized for evaluating large watershed areas.[3] In addition to using the functional assessment to evaluate impacts, the approach can be used to design wetland restoration sites to ensure that the target functions are achieved.[4]

Passive Restoration: Passive restoration generally refers to removing or controlling disturbance events such as intrusion by cattle that degrade wetland or riparian areas resulting in conversion from native to non-native or disturbed habitats. Passive restoration may involve some site preparation and maintenance such as weed control, and trash and debris removal, but generally the site would be allowed to revegetate naturally without extensive intervention. Where non-native cover is particularly high, weed removal may be more intensive. Some initial seeding or planting of cuttings or container stock may be used if the natural seed bank onsite is inadequate, particularly in areas where removal of substantial weed cover has left areas somewhat

[3] Smith, RD. 2000. *Assessment of Riparian Ecosystem Integrity In the San Juan and San Mateo Creek Watersheds, Orange County, California.* U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, USA.
[4] RMV has created and performed associated monitoring of approximately 125 acres of wetland and/or riparian habitat between 1989 and 1993. Of the 125 acres, approximately 45 acres were designed, implemented and monitoring for a variety of variables/functions using the HGM approach. Performance standards have been achieved for all 125 acres.

unvegetated. Passive restoration sites would be monitored, and if the site is not meeting performance standards by a designated period, more intensive restoration approaches may be implemented.

Active Restoration: Active restoration broadly refers to the specific application of restoration techniques. On any scale (e.g., from less than 1 acre to 100 acres such the GERA), active restoration may include site-intensive techniques such as grading, soil preparation, planting and/or seeding, irrigation, weed control, erosion control, etc. Active restoration implies a higher level of effort than passive restoration and typically is used on sites that would not regenerate naturally, or would only regenerate over an unacceptably long period of time without direct intervention. For example, a mitigation requirement that a site meet certain performance standards such as percent native plant cover or species occupation within five years probably would require active restoration to ensure that the performance standards were achieved. Two types of active restoration are "Enhancement" and "Revegetation."

A. Enhancement: Enhancement generally refers to restoration of sites that support degraded forms of the target native vegetation community. The level of effort needed to enhance a site typically is less than revegetating a site because the target native community is already present. For aquatic ecosystems, primary enhancement measures may include timed grazing, complete elimination of grazing by fencing aquatic resources, and removal of invasive plant species. Seeding may be used to supplement the existing native vegetation, but planting of container plants and irrigation generally are not used on enhancement sites. Enhancement tends to be more passive, letting nature take its course; as contrasted with other types of active wetland/riparian restoration.

In practice, there often is not a clear distinction between active and passive restoration, revegetation and enhancement because each site has its own distinct requirements for successful restoration. The Restoration Ecologist and RMV would have the flexibility to implement the appropriate restoration techniques in an adaptive fashion to produce the desired results in the most efficient manner. However, specific performance standards would be set for each restoration site relative to hydrologic, biogeochemical and habitat functions so that success can be objectively measured.

B. Revegetation: Revegetation involves active restoration of a site whereby container plants and/or seeds are used to create or restore habitat. Typically the target native vegetation community is absent from the site; e.g., a site supporting ruderal vegetation revegetated with wet meadow vegetation or mulefat scrub. Depending on site conditions, some grading may be required to restore or enhance site hydrology. Irrigation, though not necessary, may be desirable to hasten establishment of the target species, which in turn reduces the amount of non-native species able to colonize the site. Generally, revegetation sites would have higher performance standards than passively restored sites and the monitoring and maintenance program is more specific as far as the responsibilities of the Restoration Ecologist and the Installation/Maintenance Contactor.

3.3 Habitat Restoration Goals

The goal of this conceptual restoration plan, as a component of the Adaptive Management Program, is to provide a framework to guide restoration of the aquatic ecosystem in a manner that would maintain or enhance hydrologic, biogeochemical and habitat functions that would be impacted by development. The restored aquatic ecosystem should exhibit hydrologic, biogeochemical and habitat functions that are equal to, or greater than, those exhibited by the aquatic ecosystem(s) prior to development.

Like the CSS and VGL restoration program described in Chapter 2.0, the aquatic habitat restoration program is intended to provide replacement aquatic habitat and/or enhanced aquatic functions within the Open Space that would compensate for loss of hydrologic, biogeochemical functions and habitat functions and also ensuring no-net-loss in the amount of the aquatic ecosystem.

The primary focus of the restoration program would be on the hydrogeomorphic processes, which are key in achieving other goals such as establishment of target vegetation communities and associated faunal components. Failure to restore degraded or lost hydrogeomorphic processes would generally result in ultimate failure in achieving the goals of establishing target biotic communities.

Site selection is extremely important for the long-term success of a restoration program. Sites that are selected for restoration of aquatic habitat areas, including wetlands and/or riparian areas must contribute to the long-term net aquatic resource values and fully mitigate the loss of aquatic resources and associated hydrologic, biogeochemical and habitat functions. The preliminary designation of restoration areas, as described below, is based upon detailed investigations of the aquatic resources within the RMV study area and provides the best opportunity for a successful restoration program that contributes to the long-term aquatic functions of the Open Space.

As noted above, significant restoration efforts within portions of the Open Space have already been successfully implemented within the GERA, Cañada Chiquita, and Narrow Canyon (approximately 120 acres combined among the sites, of which approximately 18 acres in GERA have been "banked" for future projects).[5] Besides creating habitat currently occupied by a

[5] Department of the Army Permit 97-00342-ES and Streambed Alteration Agreement 5-081-98.

number of listed or other special-status species such as least Bell's vireo, southwestern willow flycatcher, yellow-breasted chat, yellow warbler, southwestern pond turtle, southern tarplant, and Coulter's saltbush, these efforts have demonstrated that where suitable conditions exist, habitat creation or restoration can be very successful.

Finally, invasive exotic control has also been implemented in Cristianitos Creek by Northrop Grumman (formerly TRW), and this program would continue until the lease with RMV expires.

3.3.1 Relationship of Restoration Timing to Project Phasing

Timeframes for the establishment of wetland and/or riparian habitats vary significantly according to the type of habitat subject to restoration/creation. For example, creation of emergent marsh habitats requires little time, and it is possible to establish functioning marsh habitat in as little as 1.5 to 2 years when sufficient hydrology is present. Similarly, creation of alkali or wet meadow habitat can be achieved in approximately 2 to 3 years with irrigation to hasten establishment and early growth. Habitats with woody vegetation such as mulefat scrub, southern willow scrub, or willow forest require more time, with substantial function achieved at between four and seven years. Southern coast live oak or coast live oak-sycamore riparian forest requires substantially longer time to reach maturity and exhibit a full suite of habitat functions.

Phasing of development associated with the proposed development alternatives is expected to extend over a 15- to 25-year time period. Development of the first planning area is expected to begin in 2005. Development of other planning areas would follow in 2007. Project phasing would provide opportunities to implement and, in many instances, finalize compensatory mitigation in advance of impacts. The existing 18 acres of created habitat in GERA, that includes alkali marsh, alkali meadow, southern riparian scrub, and southern willow scrub, would be used to compensate for impacts associated with the initial phases of development.

Use of a function-based evaluation of affected resources in conjunction with the use of a function-based (e.g., HGM or similar methodology) mitigation design would ensure full replacement of aquatic functions in advance of essentially all project impacts. This function-based approach, coupled with the opportunity to implement, monitor, and complete the aquatic resource creation, restoration, and/or enhancement in advance of impacts would provide high levels of certainty that all impacted functions are replaced.

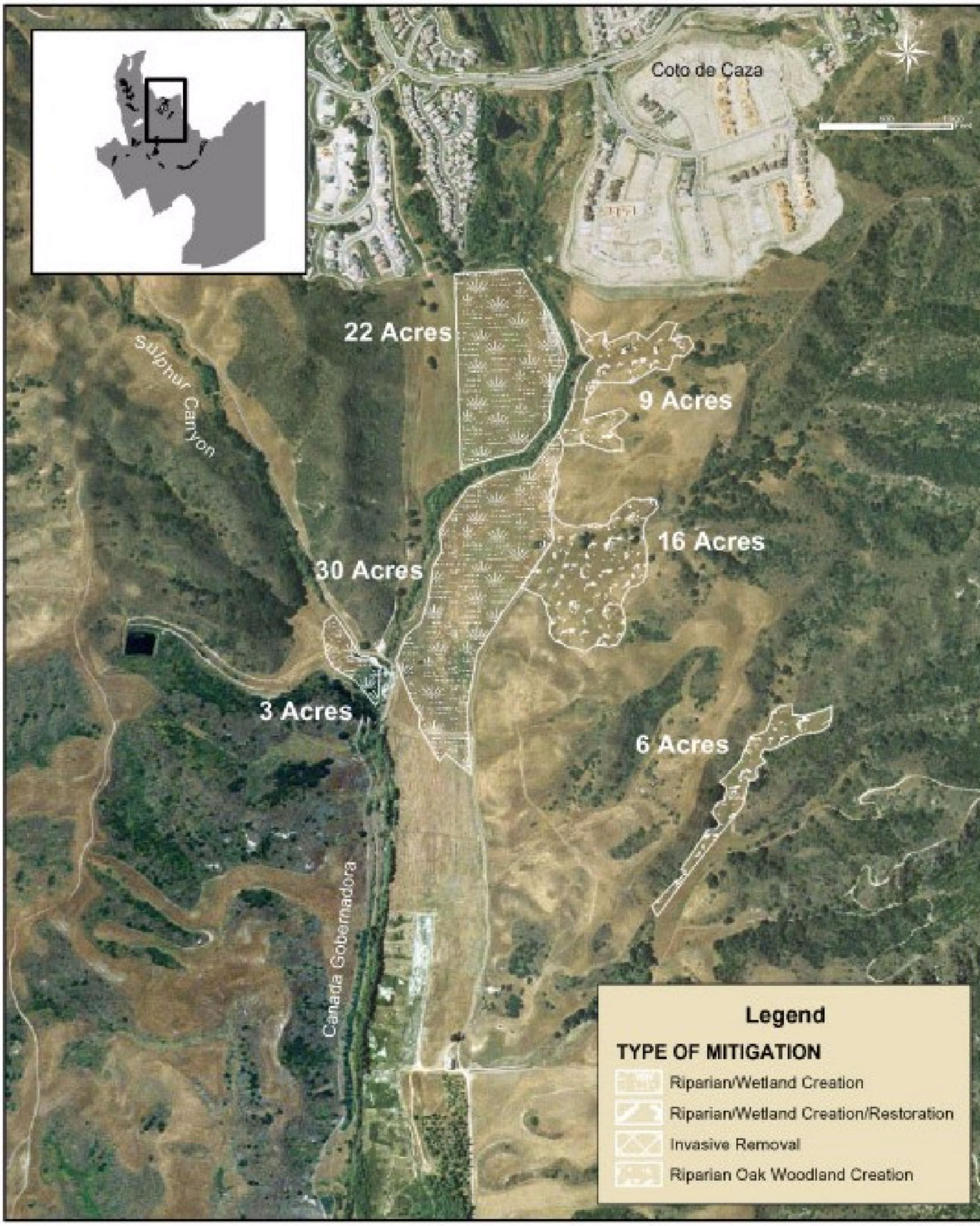
3.4 Preliminary Designation of Wetland and/or Riparian Restoration Areas

The main goal of the ARHRP is to describe the methodologies for: **(1)** enhancement or restoration of wetland and/or riparian habitats that have been substantially degraded such that measurable losses of hydrologic, biogeochemical or habitat functions have occurred, and whereby the lost function(s) can be restored or reintroduced; **(2)** creation of wetland and/or riparian habitats to replace wetland or riparian areas lost to development, ensuring a no-net-loss of wetland/riparian acreage; and **(3)** enhancement, restoration, or creation wetland and/or riparian habitats that would replace hydrologic, biogeochemical and habitat functions such that there is no-net-loss of wetland functions. As noted above, a substantial portion of the compensatory mitigation can be implemented in advance of impacts, providing a high level of certainty that no-net-loss of function or acreage occurs. Areas evaluated and identified as potential restoration sites are set forth below. Based on the detailed evaluations performed all of these sites represent excellent candidate sites; however, it may not be necessary or desirable to use each site, or only portions of these sites may ultimately be utilized. The final selection of restoration sites will be determined in conjunction with USACE and CDFG as part of the permitting of project impacts.

3.4.1 Potential Habitat Creation/Restoration Areas

- **GERA** currently includes approximately 18 acres of alkali marsh, alkali meadow and southern riparian scrub habitat created for the Ladera Ranch Project that was not needed to compensate for project impacts and, as established in the Ladera Ranch 404 and 1603 Authorizations, is available to use as compensation for impacts associated with future RMV projects. This existing creation area would be subject to ongoing monitoring and maintenance until it is "utilized" to offset impacts associated with the early phases of the development program.

- **Gobernadora Canyon** immediately downstream of Coto de Caza, extending to below the confluence with Sulphur Canyon (*Figure 2*. This includes the proposed location of a multi-purpose basin and wetland complex that would cover an estimated 40 acres and would serve a number of functions including detention and harvesting of storm waters by the Santa Margarita Water District (SMWD) and creation of riparian habitat along with re-establishment of a meander of the channel through the upper reaches of Gobernadora Creek. The 40-area extends to where Gobernadora Creek crosses from the east to the west side of the valley bottom. Approximately 22 acres have been identified that would be available for creation of riparian habitat that would not be subject to manipulation by SMWD.



SOURCE: Glen Lukos Associates

RMV Habitat Restoration Plan

Canada Gobernadora Proposed Mitigation Areas

FIGURE 2

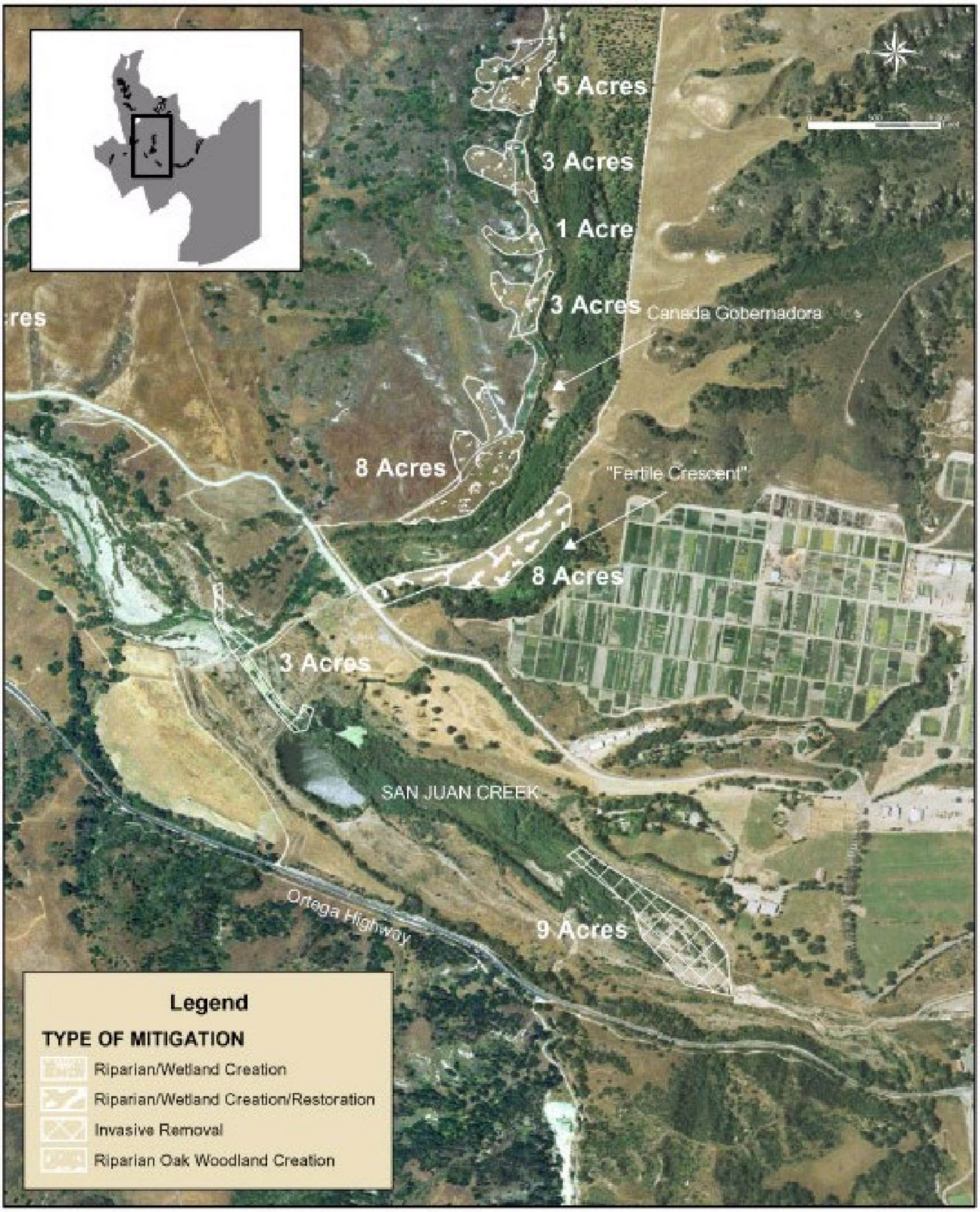
Below the area where the creek crosses the valley bottom, an additional 30 acres have been identified as candidate areas for creation of alkali marsh, alkali meadow, southern willow riparian habitat and mulefat scrub. In addition to the marsh, meadow, willow and mulefat creation areas, an additional 51 acres have been identified as potential southern coast live oak riparian habitat creation areas.

- **Gobernadora Canyon/Fertile Crescent** at the "mouth of Cañada Gobernadora (*Figure 3*). This area exhibits appropriate hydrology for restoration due to the presence of high groundwater and sheet flow from Gobernadora Creek. This area has been degraded by grazing and past agricultural practices. Some site grading and site preparation would be necessary to restore hydrology to a larger area and to provide for a mosaic of aquatic habitat types. Habitat creation/restoration in this area would, among other things, be targeted at the southwestern pond turtle which has recently colonized a pond created nearby in GERA in 1999/2000. Approximately 8 acres have been identified as available for habitat restoration or creation.

- **Sulphur Canyon** at the confluence with Gobernadora Creek (*Figure 2*). This area exhibits appropriate hydrology for restoration due to the presence of high groundwater and sheet flow from Sulphur Canyon Creek. This area has been degraded by grazing and past agricultural practices. Some site grading and site preparation would be necessary to restore hydrology to a larger area and to provide for a mosaic of aquatic habitat types. Approximately 3 acres have been identified as available for habitat restoration or creation.

- **Chiquita Creek between the "Narrows" and the SMWD Treatment Facility.** Approximately four acres have been identified in this area for creation of mulefat scrub immediately adjacent to Chiquita Creek (*Figure 4*). An additional 64 acres have been identified as candidate areas for southern coast live oak riparian habitat.

- **Chiquita Creek between SMWD Treatment Facility and New Ortega Highway (*Figure 5*).** Detailed investigations of the slope wetlands on both sides of lower Chiquita Canyon indicate subsurface flows to the creek along with typically perennial flows (but intermittent flows during dry climatic cycles) would allow for expansion of the wetlands in this area with only minimal grading. Approximately 11 acres have been identified as available for alkali marsh, alkali meadow, or willow riparian habitat creation.

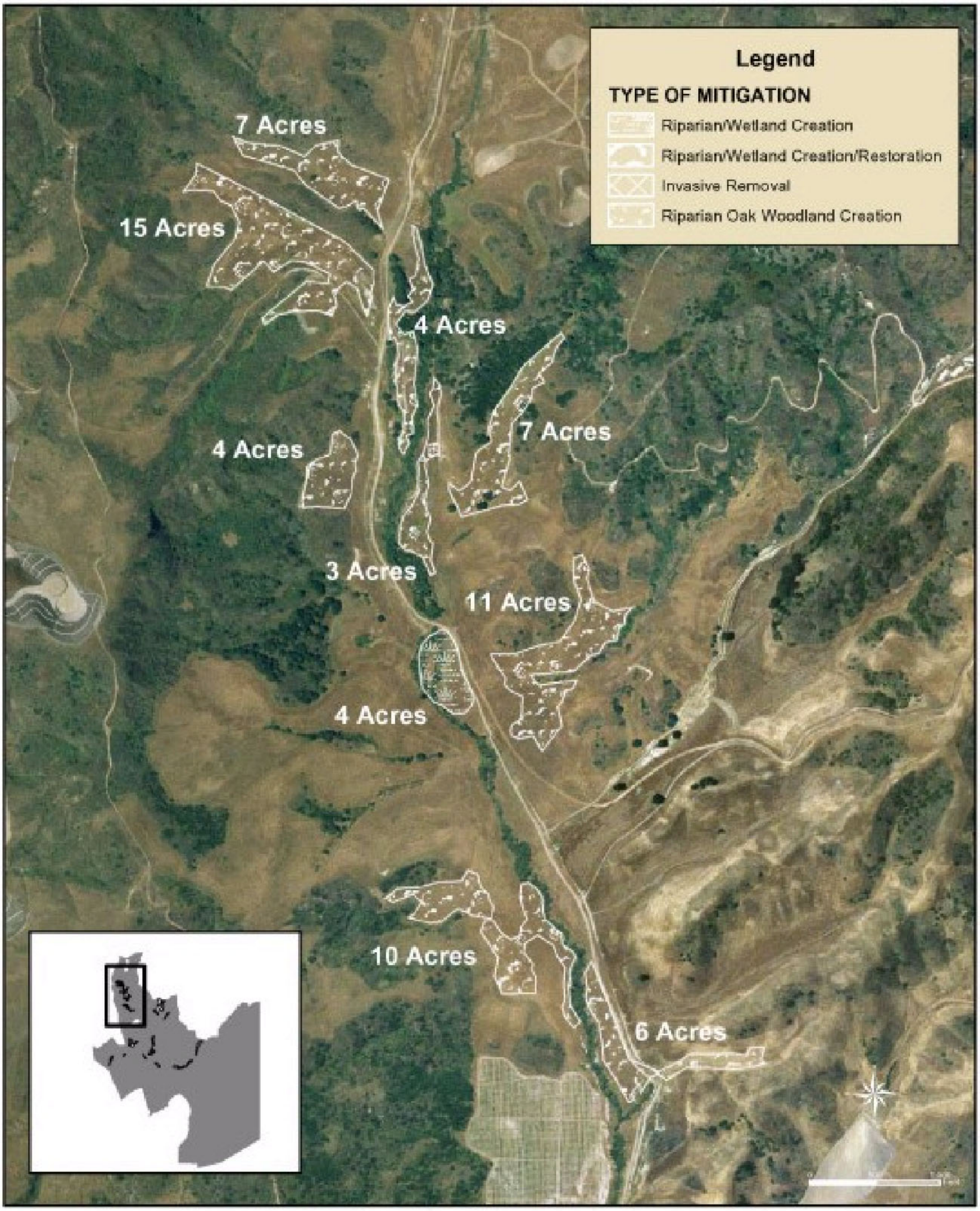


SOURCE: Glen Lukos Associates

RMV Habitat Restoration Plan

San Juan Creek and Canada Gobernadora Proposed Mitigation Areas

FIGURE 3

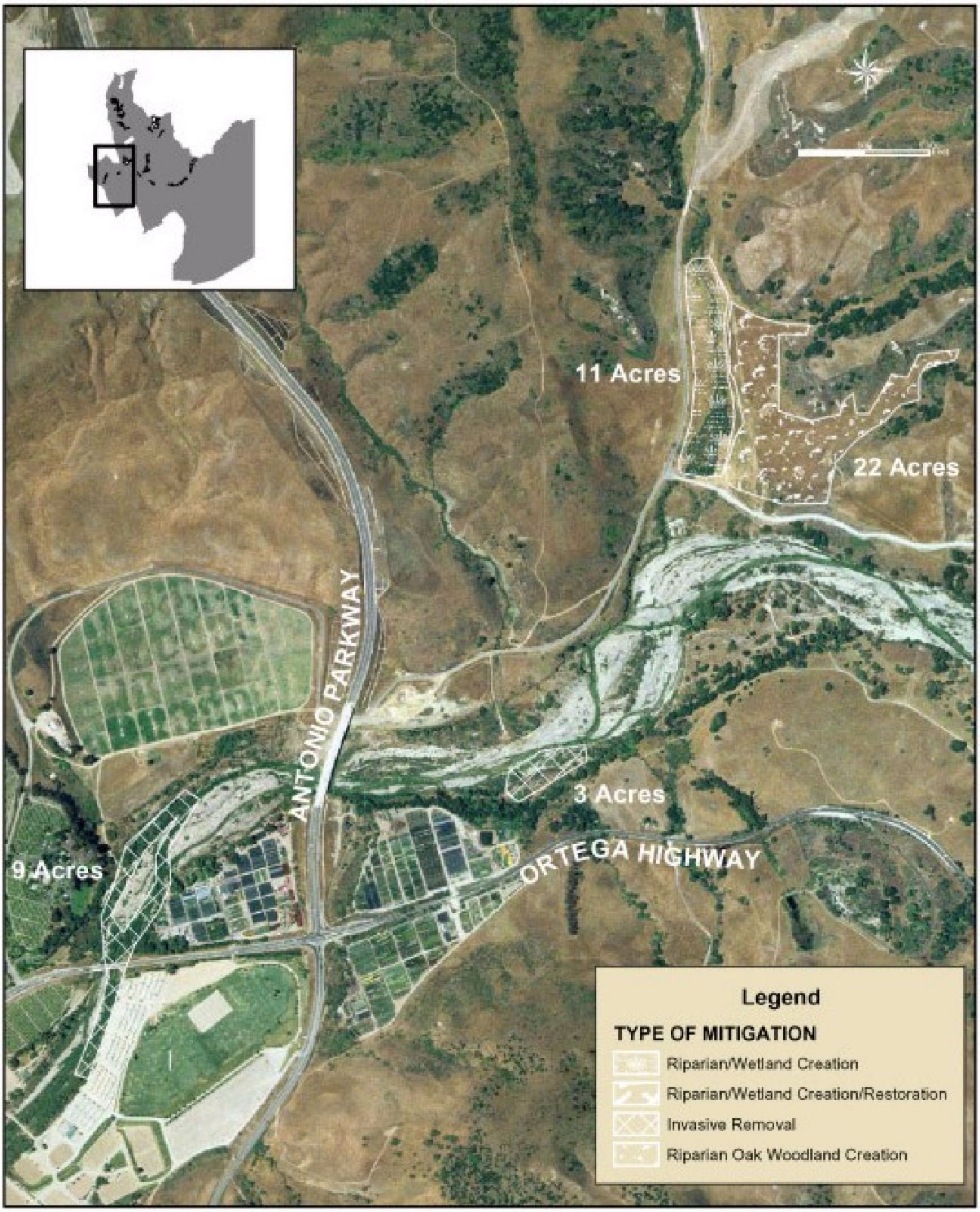


SOURCE: Glen Lukos Associates

RMV Habitat Restoration Plan

Canada Chiquita North of SMWD Treatment Facility Proposed Mitigation Areas

FIGURE 4



SOURCE: Glen Lukos Associates

RMV Habitat Restoration Plan

San Juan Creek and Canada Chiquita Proposed Mitigation Areas

FIGURE 5

In addition to candidate sites for alkali marsh, alkali meadow, or willow riparian habitat creation, an additional 22 acres in proposed lower Chiquita Canyon in Open Space, have been identified as potential southern coast live oak riparian habitat creation.

3.4.2 Stream Restoration

- **Gobernadora Creek at the knickpoint** located adjacent to GERA. Detailed investigations by Balance Hydrologics indicate that the knickpoint is a key area in preventing continuing headcutting and incision in the middle reach of Gobernadora Creek. Restoration of this area would ensure long-term functioning of the upper one-half of GERA which supports approximately 40 acres of wetland habitats, including southern willow riparian forest, alkali marsh and alkali meadow, and mulefat scrub. This 40-acre portion of GERA supports least Bell's vireo, southwestern willow flycatcher, yellow-breasted chat, as well as southern tarplant.

- **Chiquita Creek between the "Narrows" and the SMWD Treatment Facility.** Studies indicate areas of significant entrenchment of the channel at various points along Chiquita Creek, which supports a mosaic of southern arroyo willow riparian forest, alkali meadow, alkali marsh and freshwater marsh. Reversal of the entrenchment would ensure long-term functioning of substantial portions of Chiquita Creek. Reversal of the entrenchment would also provide for passive- or active-expansion of the wetland and riparian vegetation adjacent to the creek.

- **Restoration of Upper Reaches of Gabino Creek**, which exhibits areas of headcutting, entrenchment, and channel degradation. This restoration effort would be conducted in conjunction with restoration of adjacent uplands with CSS/VGL that would serve to enhance runoff and fine sediment regimes that have contributed to the loss of aquatic function.

3.4.3 Invasive Exotic Control

- **Removal of Giant Reed from San Juan Creek** has been identified as a "high priority" component of the Invasive Species Control Plan (*Figures 3, 5* and *6*). San Juan Creek supports populations of the arroyo toad and least Bell's vireo, along with other special-status species such as the yellow-breasted chat, yellow warbler, southwestern pond turtle, and two-striped garter snake. As set forth in the Invasive Species Control Plan, giant reed can have a number of adverse impacts on native riparian ecosystems including alteration of hydrologic regimes, alteration of fire regimes, elimination of native riparian habitat (i.e., willow scrub and forest) by direct competition. Elimination of giant reed would substantially enhance the ability of the reach of San Juan Creek associated with the RMV portion of the Open Space to support the arroyo toad and least Bell's vireo, contributing significantly to recovery of these species within the subregion.

3.5 Success Criteria

The goal of the wetland/riparian restoration program is the establishment of self-sustaining habitats that provide hydrologic, biogeochemical and habitat functions typical of the target geomorphic settings and associated wetland and/or riparian habitat types.

3.5.1 Rationale for Expecting Success

There are a number of reasons why wetland and/or riparian enhancement, restoration, or creation would be successful within the RMV Open Space.

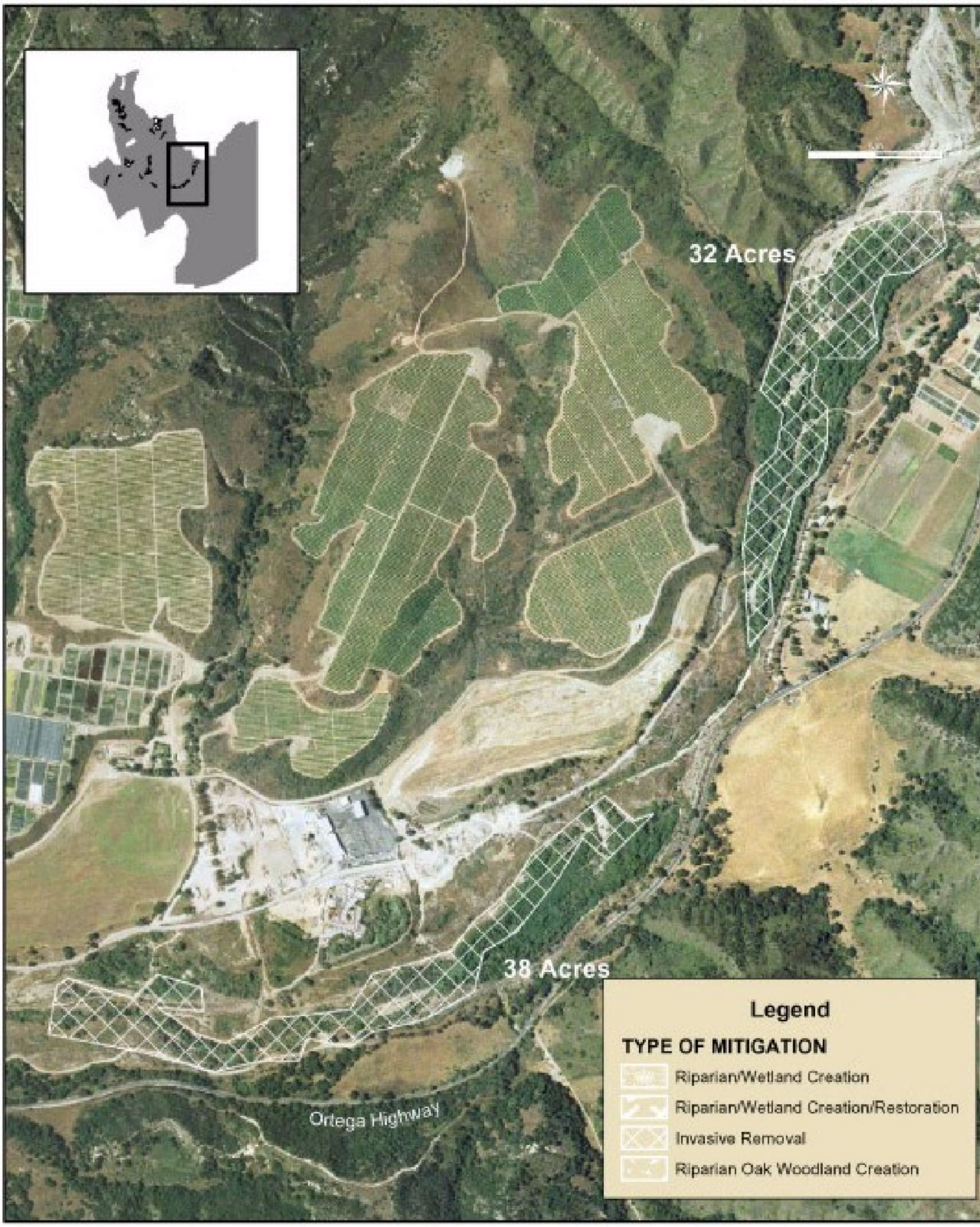
A variety of investigations have been completed that address the aquatic resources within the RMV study area. These investigations include the following:

- PCR Services Corporation, PWA Ltd., and Balance Hydrologics, Inc. 2002. *Baseline Geomorphic and Hydrologic Conditions, Rancho Mission Viejo: Portions of the San Juan and Western San Mateo Watersheds.*

- PCR Services, Dudek & Associates. 2002. *Geomorphic and Hydrologic Needs of Aquatic and Riparian Endangered Species.*

- PCR Services. 2003. *Functional Evaluation of Slope Wetlands, Rancho Mission Viejo.*

- PCR Services. 2003. *Functional Evaluation of Vernal Pools, Rancho Mission Viejo.*



SOURCE: Glen Lukos Associates

RMV Habitat Restoration Plan

San Juan Creek Invasives Eradication

FIGURE 6

- Balance Hydrologics. 2002. *Preliminary Technical Memo: Geologic and Hydrogeologic Framework for Restoration Design of Lower Gobernadora Canyon*
- NCCP/SAMP Working Group. 2002. *Watershed and Sub-Basin Planning Principles.*
- Glenn Lukos Associates. 2002. *Ladera Ranch Wetland Mitigation Monitoring: Fourth Annual Report.* October 2002.

These studies provide sufficient data relative to surface water and groundwater conditions to provide detailed planning, including site design, for aquatic habitat restoration at the candidate locations. All of the candidate restoration sites have been subject to detailed investigations and sufficient hydrology data have been collected for each of the sites, to ensure successful implementation.

In addition to these detailed studies, RMV has established a successful aquatic habitat track record by creating approximately 120 acres of wetland and or riparian habitat within the GERA and Chiquita Canyon. Habitat created in GERA within the last 13-14 years, has variously supported least Bell's vireo, southwestern willow flycatcher, southwestern pond turtle, yellow-breasted chat, and yellow warbler. In addition, both the GERA and Chiquita sites support over 10,000 individuals of southern tarplant, a CNPS List 1B taxon and an identified species that were targets of the restoration efforts.

3.5.2 Target Functions

Target functions to be enhanced, restored or created, vary from site to site based on site-specific conditions and associated site-specific goals. For example, there are two primary goals associated with restoration efforts in Upper Gobernadora: **(1)** reestablishment of sinuosity/meander to the creek; and **(2)** creation of a large block of wetland/riparian habitat that would serve as replacement habitat to compensate for losses of wetland/riparian habitats in other portions of RMV. Reestablishment of sinuosity/meander to the creek would in turn result in restoration of a variety of hydrologic, biogeochemical and habitat functions that can be directly measured. Similarly, creation of a large block of wetland and riparian habitat would result in establishment of a variety of hydrologic, biogeochemical and habitat functions that can be directly measured. Specific target functions would be determined upon selection of the candidate sites. Selection of candidate sites would be determined by **(1)** mitigation needs for planned activities and **(2)** contribution of the candidate site to the overall function of the Open Space.

In a similar manner, removal of giant reed from San Juan Creek would result in enhanced hydrology because water usage by this species is approximately twice that of native riparian habitats (i.e., southern willow riparian forest, mulefat scrub, etc.). Giant reed removal would also provide for restoration of sediment regimes and would allow for expansion of native riparian vegetation into the areas that are currently infested. These changes are expected provide a measurable benefit to two listed species, the arroyo toad and least Bell's vireo, both of which occur in San Juan Creek.

3.5.3 Performance Standards

Performance standards for each of these restoration program components would be markedly different because they would be developed to address the desired function. For example, as noted above, the primary purpose for removal of giant reed from San Juan Creek is to enhance/increase usable or potential habitat for the arroyo toad and least Bell's vireo. As such, performance standards would be developed that **(1)** measure use by these species or **(2)** measure habitat functions typical of areas occupied by these species.

As discussed above in *Section 3.1* (and summarized below), a representative number of wetland functions, as described in *A Guidebook for Application of Hydrogeomorphic Assessments to Riverine Wetlands*, would be evaluated as part of the overall quantitative monitoring program to ensure no-net-loss of wetland function through successful implementation of the mitigation program components. Because of the varying nature of the mitigation program components, they have been separated into three categories for purposes of establishing performance standards. The categories to be addressed below are:

- Emergent Marsh, Wet Meadow, and/or Riparian Scrub/Forest Creation
- Southern Coast Live Oak Riparian Forest
- Invasive Exotic Removal from San Juan and/or Trabuco Creeks

Habitat Creation or Restoration: Emergent Marsh, Wet Meadow, and/or Riparian Scrub/Forest

The HGM variables to be evaluated for performance were determined based upon their use in mitigation programs that have already been completed in GERA, Chiquita Canyon, and the Arroyo Trabuco. Variables to be monitored include: Plant Roughness, Coarse Woody Debris (for woody riparian areas only), Aerial Net Primary Productivity, Surfaces Suitable for Microbial Activity, Percent Cover of Vegetation (in each strata), and Species Composition. The quantitative vegetation sampling would provide sufficient data to determine performance for the following variables: Plant Roughness, Aerial Net Primary Productivity, Surfaces Suitable for Microbial Activity, Percent Cover of Vegetation (in each strata), Species Composition, Recruitment of Natives, and Habitat Heterogeneity. Coarse Woody Debris would be evaluated using direct visual estimates.

In addition to the identified wetland functions that would be evaluated by measuring specific variables, a variety of hydrological indicators would be evaluated because the presence of such indicators provide valuable information regarding wetland functioning. Hydrological indicators that would be monitored include the presence of debris rack, sediment deposits, drainage patterns, water marks, ponding duration, ponding depth, and extent of ponding.

Standard Vegetation Monitoring procedures would be as follows:

- **First-Year Monitoring**. During the first year, monitoring would occur every month. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the first year:

  -- 30 percent coverage of native species relative to reference standard (5 percent deviation allowed);

  -- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

  -- recruitment of native hydrophytes ratio of seedlings to saplings would be at least 50 percent of that of reference site;.

  -- habitat heterogeneity would be 50 percent (or greater) of the reference site.

  Replanting would be performed, as necessary, during the appropriate planting period, with the appropriate-sized stock or by seeding to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the first year, a report summarizing the performance of the emergent marsh, and riparian habitats would be submitted to the USACE and CDFG.

- **Second-Year Monitoring**. During the second year, monitoring would occur on a quarterly basis. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the second year:

  -- at least 45 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

-- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

-- recruitment of native hydrophytes ratio of seedlings to saplings would be at least 75 percent of that of reference site;.

-- habitat heterogeneity would be 75 percent (or greater) of the reference site.

Replanting would be performed, as necessary, during the appropriate planting period, with the appropriate-sized stock to ensure that these performance standards are met. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the second year, a report summarizing the revegetation site performance would be submitted to the USACE and CDFG.

- **Third-Year Monitoring**. During the third year, monitoring would occur quarterly. One quantitative survey would be performed to determine planted species growth performance. The following performance standards would be achieved at the end of the year:

-- at least 65 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

-- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);
-- recruitment of native hydrophytes ratio of seedlings to saplings would be at least 75 percent of that of reference site;.

-- habitat heterogeneity would be 75 percent (or greater) of the reference site.

Replanting would be performed, as necessary with the appropriate-sized stock to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the third year, a report summarizing the revegetation site performance would be submitted to the USACE and CDFG.

- **Fourth-Year Monitoring**. During the fourth year, monitoring would occur quarterly. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the year:

  -- at least 75 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

  -- percent cover of non-native species not exceeding the reference site by more than 10 percent (includes tree and shrub layers only and does not include herb layer);

  -- recruitment of native hydrophytes ratio of seedlings to saplings would be at least 75 percent of that of reference site;.

  -- habitat heterogeneity would be 75 percent (or greater) of the reference site.

  Replanting would be performed as necessary, during the appropriate planting period, with the appropriate-sized stock to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the fourth year, a report summarizing the revegetation site performance would be submitted to the USACE and CDFG.

- **Fifth Year Monitoring**. During the fifth year, monitoring would occur quarterly. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the year:

  -- at least 85 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

  -- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

  -- recruitment of native hydrophytes ratio of seedlings to saplingss would be at least 75 percent of that of reference site;.

  -- habitat heterogeneity would be 75 percent (or greater) of the reference site;

  Replanting would be performed, as necessary, during the appropriate planting period, with the appropriate-sized stock to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the fifth year, a report summarizing the revegetation site performance would be submitted to the applicant for distribution to the USACE and CDFG.

Hydrological Indicators

- **First-Year Monitoring**. One quantitative survey would be performed, at the end of the first year to determine compliance with the following performance standards:[6]

  -- The presence of Debris Rack, Sediment Deposits, Water Marks and/or Drainage Patterns individually or in combination, within the created wetland would achieve between 25 percent and 75 percent of the reference standard based upon visual estimates.

  -- If the collective measure of hydrologic indicators does not achieve the performance standard, additional grading, planting, or configuration of the wetland would be performed to ensure hydrological functioning within the created wetlands.

- **Second-Year Monitoring**. One quantitative survey would be performed, at the end of the second year to determine compliance of the referenced variables with the following performance standards:

  -- The presence of Debris Rack, Sediment Deposits, Water Marks and/or Drainage Patterns individually or in combination, within the created wetland would achieve between 25 percent and 75 percent of the reference standard based upon visual estimates.

  -- If the collective measure of hydrologic indicators does not achieve the performance standard, additional grading, planting, or configuration of the wetland would be performed to ensure hydrological functioning within the created wetlands.

- **Third-Year Monitoring**. One quantitative survey would be performed, at the end of the third year to determine compliance of the referenced variables with the following performance standards:

[6] The performance standards are adapted from the USACE HGM Riverine Guidebook .

-- The presence of Debris Rack, Sediment Deposits, Water Marks and/or Drainage Patterns individually or in combination, within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

-- If the collective measure of hydrologic indicators does not achieve the performance standard, additional grading, planting, or configuration of the wetland would be performed to ensure hydrological functioning within the created wetlands.

- **Fourth-Year Monitoring**. One quantitative survey would be performed, at the end of the fourth year to determine compliance of the referenced variables with the following performance standards:

  -- The presence of Debris Rack, Sediment Deposits, Water Marks and/or Drainage Patterns individually or in combination, within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the collective measure of hydrologic indicators does not achieve the performance standard, additional grading, planting, or configuration of the wetland would be performed to ensure hydrological functioning within the created wetlands.

- **Fifth-Year Monitoring**. One quantitative survey would be performed, at the end of the fifth year to determine compliance of the referenced variables with the following performance standards:

  -- The presence of Debris Rack, Sediment Deposits, Water Marks and/or Drainage Patterns individually or in combination, within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the collective measure of hydrologic indicators does not achieve the performance standard, additional grading, planting, or configuration of the wetland would be performed to ensure hydrological functioning within the created wetlands.

***Coarse Woody Debris* (For Woody Riparian Sites Only)**

- **First-Year Monitoring**. One quantitative survey would be performed, at the end of the first year to determine compliance with the following performance standard:

-- The amount of coarse woody debris within the created wetland would achieve between 25 percent and 75 percent of the reference standard based upon visual estimates.

-- If the measure of coarse woody debris in the created wetland does not achieve the performance standard, additional coarse woody debris would be added in the form of willow, sycamore, and/or oak snags.

- **Second-Year Monitoring**. One quantitative survey would be performed, at the end of the second year to determine compliance of the referenced variables with the following performance standard:

  -- The amount of coarse woody debris within the created wetland would achieve between 25 percent and 75 percent of the reference standard based upon visual estimates.

  -- If the measure of coarse woody debris in the created wetland does not achieve the performance standard, additional coarse woody debris would be added in the form of willow, sycamore, and/or oak snags.

- **Third-Year Monitoring**. One quantitative survey would be performed, at the end of the third year to determine compliance of the referenced variables with the following performance standard:

  -- The amount of coarse woody debris within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the measure of coarse woody debris in the created wetland does not achieve the performance standard, additional coarse woody debris would be added in the form of willow, sycamore, and/or oak snags.

- **Fourth-Year Monitoring**. One quantitative survey would be performed, at the end of the fourth year to determine compliance of the referenced variables with the following performance standard:

  -- The amount of coarse woody debris within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

- -- If the measure of coarse woody debris in the created wetland does not achieve the performance standard, additional coarse woody debris would be added in the form of willow, sycamore, and/or oak snags.

- **Fifth-Year Monitoring**. One quantitative survey would be performed, at the end of the fifth year to determine compliance of the referenced variables with the following performance standard:

  -- The amount of coarse woody debris within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the measure of coarse woody debris in the created wetland does not achieve the performance standard, additional coarse woody debris would be added in the form of willow, sycamore, and/or oak snags.

Microtopographic Complexity

- **First-Year Monitoring**. One quantitative survey would be performed, at the end of the first year to determine compliance with the following performance standard:

  -- The number of depressions and/or hummocks per unit area (e.g., 10 x 10 m) within the created wetland would achieve between 25 percent and 75 percent of the reference standard based upon visual estimates.

  -- If the measure of microtopographic complexity does not achieve the performance standard, additional grading would be performed to increase the number of depressions and hummocks in the created wetlands.

- **Second-Year Monitoring**. One quantitative survey would be performed, at the end of the second year to determine compliance of the referenced variables with the following performance standard:

  -- The number of depressions and/or hummocks per unit area (e.g., 10 x 10 m) within the created wetland would achieve between 25 percent and 75 percent of the reference standard based upon visual estimates.

  -- If the measure of microtopographic complexity does not achieve the performance standard, additional grading would be performed to increase the number of depressions and hummocks in the created wetlands.

- **Third-Year Monitoring**. One quantitative survey would be performed, at the end of the third year to determine compliance of the referenced variables with the following performance standard:

  -- The number of depressions and/or hummocks per unit area (e.g., 10 x 10 m) within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the measure of microtopographic complexity does not achieve the performance standard, additional grading would be performed to increase the number of depressions and hummocks in the created wetlands.

- **Fourth-Year Monitoring**. One quantitative survey would be performed, at the end of the fourth year to determine compliance of the referenced variables with the following performance standard:

  -- The number of depressions and/or hummocks per unit area (e.g., 10 x 10 m) within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the measure of microtopographic complexity does not achieve the performance standard, additional grading would be performed to increase the number of depressions and hummocks in the created wetlands.

- **Fifth-Year Monitoring**. One quantitative survey would be performed, at the end of the fifth year to determine compliance of the referenced variables with the following performance standard:

  -- The number of depressions and/or hummocks per unit area (e.g., 10 by 10m) within the created wetland would achieve between 75 percent and 125 percent of the reference standard based upon visual estimates.

  -- If the measure of microtopographic complexity does not achieve the performance standard, additional grading would be performed to increase the number of depressions and hummocks in the created wetlands

Habitat Creation or Restoration: Southern Coast Live Oak Riparian Forest

The HGM variables to be evaluated for performance are generally related to habitat structure composition, and diversity. Variables to be monitored include: Aerial Net Primary Productivity, Percent Cover of Vegetation (in each strata), and Species Composition. The quantitative vegetation sampling would provide sufficient data to determine performance for the following variables: Aerial Net Primary Productivity, Percent Cover of Vegetation (in each strata), Species Composition, Recruitment of Natives, and Habitat Heterogeneity.

Standard Vegetation Monitoring procedures would be as follows:

- **First-Year Monitoring**. During the first year, monitoring would occur every month. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the first year:

  -- 20 percent coverage of native species relative to reference standard (5 percent deviation allowed);

  -- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

  -- recruitment of native canopy or woody understory ratio of seedlings to saplings would be at least 50 percent of that of reference site;.

  -- habitat heterogeneity would be 50 percent (or greater) of the reference site.

  Replanting would be performed, as necessary, during the appropriate planting period, with the appropriate-sized stock or by seeding to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the first year, a report summarizing the performance of the emergent marsh, and riparian habitats would be submitted to the USACE and CDFG.

- **Second-Year Monitoring**. During the second year, monitoring would occur on a quarterly basis. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the second year:

-- at least 35 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

-- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

-- recruitment of native canopy or woody understory ratio of seedlings to saplings would be at least 50 percent of that of reference site;.

-- habitat heterogeneity would be 75 percent (or greater) of the reference site.

Replanting would be performed, as necessary, during the appropriate planting period, with the appropriate-sized stock to ensure that these performance standards are met. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the second year, a report summarizing the revegetation site performance would be submitted to the USACE and CDFG.

- **Third-Year Monitoring**. During the third year, monitoring would occur quarterly. One quantitative survey would be performed to determine planted species growth performance. The following performance standards would be achieved at the end of the year:

-- at least 45 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

-- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

-- recruitment of native canopy or woody understory ratio of seedlings to saplings would be at least 75 percent of that of reference site;.

-- habitat heterogeneity would be 75 percent (or greater) of the reference site.

Replanting would be performed, as necessary with the appropriate-sized stock to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the third year, a report summarizing the revegetation site performance would be submitted to the USACE and CDFG.

- **Fourth-Year Monitoring**. During the fourth year, monitoring would occur quarterly. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the year:

  -- at least 60 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

  -- percent cover of non-native species not exceeding the reference site by more than 10 percent (includes tree and shrub layers only and does not include herb layer);

  -- recruitment of native canopy or woody understory ratio of seedlings to saplings would be at least 75 percent of that of reference site;.

  -- habitat heterogeneity would be 75 percent (or greater) of the reference site.

  Replanting would be performed as necessary, during the appropriate planting period, with the appropriate-sized stock to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the fourth year, a report summarizing the revegetation site performance would be submitted to the USACE and CDFG.

- **Fifth Year Monitoring**. During the fifth year, monitoring would occur quarterly. One quantitative survey would be performed to determine planted species' growth performance. The following performance standards would be achieved at the end of the year:

  -- at least 75 percent coverage of native species relative to reference standard (<5 percent deviation allowed);

  -- percent cover of non-native species not exceeding 10 percent (includes tree and shrub layers only and does not include herb layer);

  -- recruitment of native canopy or woody understory ratio of seedlings to saplings would be at least 75 percent of that of reference site;.

  -- habitat heterogeneity would be 75 percent (or greater) of the reference site;

Replanting would be performed, as necessary, during the appropriate planting period, with the appropriate-sized stock to ensure that these performance standards are achieved. If substantial non-compliance with the performance standards listed above occurs, RMV would consult with the USACE and CDFG to determine whether corrective measures and an extension of the five-year monitoring period would be necessary. At the end of the fifth year, a report summarizing the revegetation site performance would be submitted to the applicant for distribution to the USACE and CDFG.

3.6 Implementation Plan

Implementation of the ARHRP would be comprised of several steps, including:

1. Assessment of site hydrology, including preparation of water budgets where appropriate (preparation of water budgets would typically be needed for wetland creation projects to ensure that sufficient hydrology is present to support the target community; but would not be required for activities such as giant reed or pampas grass removal);

2. Assessment of the sites to determine the most effective restoration approach; i.e., passive restoration or active restoration, amount of grading where necessary, revegetation, or enhancement;

3. Appropriate planting techniques; and

4. Assessment of site-appropriate methods for invasives control (see Invasive Species Control Plan, *Appendix I*).

3.6.1 Assessment of Site Hydrology

As noted above, detailed investigations regarding site hydrology have already been conducted for Gobernadora Creek and Canyon, Chiquita Creek and Canyon, and portions of San Juan Creek. Prior to implementation of site-specific restoration at any of the sites addressed in this program, a site-specific implementation plan would be developed that includes an appropriate level of hydrological analysis, including, as appropriate, a detailed water budget, grading plans (where necessary) that address proposed hydrological modifications and/or enhancements, and performance standards relative to site hydrology.

3.6.2 Assessment of Restoration Approach

Upon completion of the hydrological assessment and (as necessary) preparation of water budgets, the restoration approach would be determined. Where grading is determined to be a necessary component of the program, grading plans would be developed that provide the restoration personnel with sufficient detail to properly implement the program. It is important to note that "in-the-field" adjustments are often necessary during final grading to ensure the highest level of function. Where substantial grading is required, it is expected that the majority of the non-native seed banks would have been removed and that grow-and-kill programs or other intensive site preparation would not be necessary.

For projects where significant grading is not required it may be necessary to conduct grow-and-kill programs or other types of weed/invasives removal. A variety of approaches, including hand removal, mechanical removal, or herbicide use may be appropriate depending on site-specific conditions. It is also likely that some sites may receive a variety of treatments, including heavy grading in some areas, light grading in other areas, and no grading with only weed control in other areas.

For many restoration sites, it is often necessary to evaluate soil conditions and, as appropriate, augment or rehabilitate poor or damaged soils. Soils on the RMV are, however, generally well understood and past restoration projects have been conducted without the need for soil augmentation.

a. Passive Restoration

Unlike the CSS and VGL restoration programs, where passive restoration would receive first priority, for the ARHRP passive restoration would typically follow invasive exotic species control. For example, as giant reed is removed from portions of San Juan Creek, it is expected that native riparian habitats such as southern arroyo willow or mulefat scrub would reestablish. The key concept of passive restoration, in the context of the aquatic ecosystem, is that the native habitat would naturally reestablish if the removal sites are kept free of the target invasives. For passive restoration to be effective, however, the site likely would need to be bounded by native vegetation (to facilitate colonization by native species) and/or have an adequate seed bank to support the growth of native species.

b. Active Restoration

Active restoration would be implemented if passive restoration is considered to be inappropriate for the site; i.e., the native vegetation community is unlikely to naturally reestablish itself because of its large size, lack of immediately adjacent native habitat, and/or lack of a native seed bank. Furthermore, if passive restoration is determined not to work, active restoration would be implemented. The key difference between passive and active restoration is that focused restoration activities would be implemented.

3.6.3 Revegetation Efforts

The revegetation treatment for Alkali or Freshwater Marsh, Wet Meadow, Southern Willow Riparian Forest and Southern Coast Live Oak Riparian Forest would rely upon the use of container plants and a native seed mix to reintroduce the appropriate wetland/riparian species to revegetation sites. *Tables 6 through* 9 provide conceptual plant palettes for each of these vegetation communities.

Container plant installation would be an important component of the revegetation treatment at these sites to facilitate more rapid plant establishment and area coverage. Species with seed that is not readily available or that do not readily germinate would be introduced using nursery-grown container plants. Both container stock and seed would originate from the San Juan and San Mateo Creek watersheds. All of the target species are available within the GERA and/or Chiquita Canyon restoration areas, having been documented during extensive monitoring programs.

TABLE 6
CONCEPTUAL ALKALI OR FRESH WATER MARSH RESTORATION CONTAINER PLANT PALETTE

Botanical Name	Common Name	Size	Typical Spacing (in feet)
Scirpus americanus	Olney's bulrush	liners	4
Scirpus californicus	California bulrush	1 gal.	4
Scirpus acutus	Hardstem bulrush	1 gal	4
Juncus xiphioides	Iris-leaved rush	liners	4
Scirpus pungens	Three-square	liners	4
Eleocharis macrostachya	Creeping spikerush	liners	3
Typha domingensis	Southern cattail	1 gal	5
Scirpus maritimus	Alkali bulrush	Liners	4
Paspalum distichum	Knot grass	Liners	4
Berula erecta	Water parsnip	Liners	10
Polygonum lapathifolium	Willow smartweed	seed	scattered
Baccharis douglasii	Douglas baccharis	1 gal.	6
Cyperus eragrostis	Tall nutsedge	seed	scattered
Epilobium ciliatum	Willow herb	seed	scattered
Bidens laevis	Burr marigold	seed	scattered
Pluchea odorata	Marsh fleabane	seed	scattered
Anemopsis californica	Yerba mansa	liners	6

TABLE 7
CONCEPTUAL ALKALI MEADOW CONTAINER PLANT PALETTE

Botanical Name	Common Name	Size	Typical Spacing (in feet)
Distichlis spicata	Saltgrass	liners	4
Juncus Mexicanus	Mexican rush	liners	4
Juncus rugulosus	Wrinkled rush	liners	4
Muhlenbergia rigens	Deer grass	liners	4
Leymus triticoides	Alkali ryegrass	liners	5
Carex preagracilis	Clustered field sedge	liners	5
Centromadia parryi australis	Southern tarplant	seed	random
Anemopsis californica	Yerba mansa	liners	5
Eleocharis macrostachya	Creeping spikerush	liners	3
Juncus bufonius	Toad rush	seed	scattered
Spergularia marina	Marsh sand-spurry	seed	scattered
Atriplex coulteri	Coulter's saltbush	seed	site-specific

TABLE 8
CONCEPTUAL SOUTHERN WILLOW RIPARIAN FOREST

Botanical Name	Common Name	Size	Spacing
Salix lasiolepis	Arroyo willow	liners or gallon	10 to 20 ft
Salix laevigeta	Red willow	liners or gallon	10 to 20 ft
Salix gooddingii	Black willow	liners or gallon	10 to 20 ft
Salix exigua	Narrow-leaf willow	liners or gallon	10 to 20 ft
Populus trichocarpa balsamifera	Black cottonwood	liners or gallon	10 to 20 ft
Baccharis salicifolia	Mulefat	liners or gallon	10 to 20 ft
Baccharis emoryi	Emoryi baccharis	liners or gallon	10 to 20 ft
Baccharis douglasiana	Douglas baccharis	liners or gallon	10 to 20 ft
Eleocharis montevidensis	Slender creeping spikerush	liners	4 ft
Juncus mexicanus	Mexican rush	liners	4 ft

Botanical Name	Common Name	Size	Spacing
Juncus rugulosus	Wrinkled rush	liners	4 ft
Juncus macrophyllous	Large-leaved rush	liners	4 ft
Artemisia douglasiana	Mugwort	liners	6.0
Cyperus eragrostis	Tall nudsedge	liners	4 ft
Leymus triticoides	Alkali ryegrass	liners	4 ft

TABLE 9
CONCEPTUAL SOUTHERN COAST LIVE OAK RIPARIAN FOREST RESTORATION CONTAINER PLANT PALETTE

Botanical Name	Common Name	Size	Typical Spacing (in feet)
Quercus agrifolia	Coast live oak	1 gal	20
Platanus racemosa	Western sycamore	1 gal.	30
Sambucus mexicanus	Mexican elderberry	1 gal	20
Heteromoles arbutifolia	Toyon	1 gal	20
Rhamnus ilicifolia	Redberry	1 gal	16
Rhamnus californica	Coffee berry	1 gal.	16
Ribes speciosum	Fuschia flowered gooseberry	1 gal.	16
Leymus triticoides	Alkali ryegrass	1 gal.	8
Leymus condensatus	Giant ryegrass	liners	8
Muhlenbergia rigens	Deergrass	1 gal	8
Baccharis salicifolia	Mulefat	1 gal	8
Baccharis douglasii	Douglas baccharis	1 gal.	8
Artemisia douglasiana	Mugwort	liners	8
Pholistima auitum	Fiesta flower	seed	scattered
Anemopsis californica	Yerba mansa	liners	6

3.6.4 Planting Techniques

All container plants and salvaged plants would be installed using industry standard techniques. A hole twice the diameter of the rootball would be excavated to the depth of the rootball. Each hole would be filled with water and allowed to drain prior to plant installation. Each container plant rootball would be scarified prior to installation if dead roots occur on the surface of the rootball. Salvaged plant rootballs do not need scarification. Planting backfill would be native soil.

Oak woodland species would receive a 2-inch thick layer of bark mulch 18 inches out from the base of each plant to reduce weed growth and water evaporation. After installation, each plant would be irrigated to the depth of the rootball.

3.6.5 Seed Application

A two-step hydroseed technique would be used to install all seed mixes. This technique involves an initial application of a hydroseed slurry composed of water, seed, fertilizer (if any), and a low volume of fiber mulch. The second hydroseed slurry application contains water and a heavier volume of fiber mulch. The purpose of the two-step process is to achieve the greatest seed-soil contact. In any cases where seed applications are within small in-fill enhancement areas, installation would be performed using hand broadcast methods.

3.6.6 Irrigation System and Schedule

Where needed, temporary on-grade irrigation systems would be installed to enhance germination and establishment of native plantings. The systems would be controlled automatically by irrigation clocks, and may be designed to shut off during rains events. Areas of similar topography may be controlled by a single remote control valve. The precipitation rate of the system would be approximately 0.2 inch per hour for any given area of the system.

The frequency and duration of irrigation are critical to seed germination and container plant establishment. The application of water would be keyed to existing conditions and water requirements of each stage of seed germination and seedling establishment. Irrigation would be used to maximize container plant survival and deep root growth while minimizing non-native species growth and seed production.

During each inspection, holes would be dug with a hand shovel or using a soil probe to determine the depth and amount of soil moisture. Enough holes would be dug to establish a representative sample of the site, i.e., until soil conditions are the same in more than three holes dug across the site. The irrigation schedule would be modified as necessary based on this inspection. Irrigation heads would be adjusted or capped where wet areas occur next to dry areas to facilitate additional irrigation of the drier areas.

Irrigation system operation would be suspended in anticipation of rain events. The system would be shut-off at a master control valve three to five days prior to a predicted rain-storm or series of storms. System operation would be resumed immediately if a predicted storm does not materialize and if the site requires supplemental irrigation to maintain soil moisture conditions that are sufficient for seed germination and seedling establishment. System operation would be resumed after a rain event upon a site inspection to determine soil moisture levels.

3.6.7 Weed Control

In wetland and riparian restoration areas, weed seed bank build up can occur quickly if weeds are not controlled. The suite of weeds that colonize wetland and riparian sites on RMV and south Orange County vary with annual rainfall patterns, hydrologic characteristics of specific wetland sites, seasonality and types of disturbance that site receive (e.g., regular flood scour, sediment deposition, etc.). Weed abatement is most effective when time is given to repeated treatment of resprouting weeds. The following species are those most likely to require some level of control during the establishment phase of restoration projects: bristly ox-tongue (*Picris echioides*), Spanish sunflower (*Pulicaria paludosa*), yellow sweet-clover (*Melilotus indica*), white sweet clover (*Melilotus albus*), burr clover (*Medicago polymorpha*), English plantain (*Plantago major*), prickly lettuce (*Lactuca serriola*), Bermuda grass (*Cynodon dactylon*), Italian ryegrass (*Lolium multiflorum*), bull-thistle (*Cirsium vulgare*), sugar beets (*Beta vulgaris*), and poison hemlock (*Conium maculatum*). Where they become established, other invasives such as giant reed, tamarisk, and African umbrella sedge (*Cyperus involucratus*), should also be removed immediately. Early treatment and regular follow-up treatment of these species would reduce the weed density in the restoration areas over the long-term. Herbicide treatment of non-native grasses and follow-up treatment to reduce seed production would be essential for establishing native vegetation cover.

3.7 Maintenance and Monitoring Plan

Maintenance and monitoring activities that are necessary to ensure successful habitat revegetation and enhancement would be conducted in accordance with this plan. The Maintenance and Monitoring Plan provides direction to the Restoration Ecologist, RMV, and the Installation/Maintenance Contractor for routine maintenance of the restoration projects to be conducted throughout the initial plant establishment period and five-year monitoring period. This section is intended to provide a brief description of those activities.

3.7.1 Maintenance Activities

Maintenance activities would apply to all revegetation and enhancement areas. Immediately following implementation of the restoration program, a maintenance program would be initiated to ensure successful germination and growth of the installed native species.

Because mature habitats effectively control non-native species, restored wetland and riparian areas likely would become self-sustaining over time, needing very little or no maintenance once established. Maintenance activities for wetland and restoration areas would thus focus on ensuring the establishment of self-sustaining habitat during the five-year maintenance period. Maintenance activities would include weed control, supplemental irrigation (as appropriate), pest control (as appropriate), and site access restrictions.

3.7.2 Four-Month Maintenance and Monitoring Period

During the four-month period following completion of restoration activities, weed control measures, irrigation schedules, and special management needs would be determined. A replanting program would be initiated at the completion of the four-month maintenance period if 100 percent container plant survival is not attained (woody species only).[7] The plant establishment period would be included in the installation contract to be performed by the Installation/Maintenance Contractor. Successful completion of the contract would include 100 percent survival of all container plants at the end of the plant establishment period (woody species only). New replacement plants would be provided and installed for the Installation/Maintenance Contractor to obtain final contract sign-off and payment.

3.7.3 Five-Year Maintenance and Monitoring Program

Following the four-month maintenance period, a long-term five-year maintenance program would be initiated. Long-term maintenance would be initiated following the end of the plant establishment period. Maintenance would occur on an as-needed basis throughout the five-year maintenance period. Maintenance personnel are expected to conduct maintenance activities on a timely basis by conducting work at a frequency and intensity that would result in the greatest potential for native vegetation to establish and become the dominant vegetation type within the restoration area. If necessary, corrective measures (such as re-seeding or container planting) would be promptly implemented to bring the restoration effort into compliance with the performance standards noted above in *Section 3.5.3*.

[7] Up to ten percent loss of herbaceous container stock (e.g., *Scirpus* spp. *Juncus* spp. or *Carex* spp. is acceptable as these species reproduce vegetatively, often making it difficult to determine which individual represents the original planting. Where die-off greater than ten percent is evident in the first four months, other problems such as insufficient hydrology or soil chemistry may need to be evaluated to determine reasons for high mortality.

Supplemental irrigation of restoration sites would be conducted as necessary as determined by the Restoration Ecologist. Irrigation schedules would provide adequate water to maximize the survival of installed container plants and seedling establishment. Irrigation of the restoration sites would be closely monitored, and if necessary, the irrigation schedule and rates for each area would be modified to provide moisture and ensure successful germination and growth. The Restoration Ecologist would determine the need for changes in irrigation schedules in consultation with the Installation/Maintenance Contractor. An accurate record of these activities would be maintained by the Installation/Maintenance Contractor.

3.7.4 Weed Control

It would be the Installation/Maintenance Contractor's responsibility to control weeds within the restoration areas. Before initiating any weed control measures, the Installation/Maintenance Contractor would meet onsite with the Restoration Ecologist and RMV to determine the extent and methods of weed control. The Installation/Maintenance Contractor would notify RMV at least three days prior to implementing approved weed control measures. Weed control would be conducted in all active restoration areas for the duration of the five-year maintenance period. No more than 10 percent non-native cover in any given year during the five-year maintenance period would be accepted within wetland or riparian retoration areas.

During the five-year maintenance program, the non-native species noted above in Implementation Section, would be removed with hand tools, by hand, or treated with appropriate herbicides. Hand tools such as "weed whips" would be used only where solid patches of non-native grasses are present and in the absence of native seedlings. Hand removal would be used where native herb, shrub or tree seedlings are present. Chemical treatment would be limited to large areas of non-native grass with no native species present.

The prime period for weed removal is in the spring during the months of March and April. Weed eradication at this time is ideal because soils are typically still moist enough for hand-pulling and therefore can be removed before their detrimental effects of robbing native plants of sunlight, moisture, and nutrients occur. Additionally, it is imperative that weeds are removed before they can successfully produce seeds and contribute to the weed seed bank. If weeds are not controlled during this period of time, successful establishment of target wetland habitats would be extended in duration and potentially reduced in extent.

3.7.5 Clearing and Trash Removal

Pruning or clearing of native revegetation plantings would be prohibited. The revegetation areas would be allowed to develop naturally. Plant debris of native shrubs would not be removed from the restoration sites. Native plant debris provides valuable micro-habitats for invertebrates, reptiles, small mammals, and birds; all necessary elements of normally functioning wetland and/or riparian communities. The decomposition of the plant debris also is essential for the replenishment of the soil's nutrients and minerals.

Trash would be regularly removed from restoration areas by hand and appropriately disposed of offsite. Such trash would be removed as needed, but at no less than at 1-month intervals for the first year, and quarterly thereafter.

3.7.6 Pest Control

Pests, including insects, mites, snails, rabbits, and rodents, are expected to occur within the restoration areas, especially in southern coast live oak riparian forest. In accordance with an Integrated Pest Management Program, active control of pests with the use of chemical pesticides would be avoided in favor of allowing natural environmental controls to take effect or the use of directed controls (e.g., trapping). If destruction of the habitat plantings by pests becomes a problem, the Installation/Maintenance Contractor would consult with RMV and the Restoration Ecologist to determine remedial measures to be taken.

3.8 Monitoring Program

As noted above under the Performance Standards in *Section 3.5.3*, each of the three specific components of the Restoration Program (i.e., habitat creation, stream restoration/rehabilitation, invasive exotic removal) each has its own set of performance standards and as such, each has a separate monitoring program relative to the methods used. The monitoring program set forth below is separated accordingly.

3.8.1 Habitat Creation or Restoration: Emergent Marsh, Wet Meadow, Riparian Scrub/Oak Forest

Monitoring would be performed by an agency-approved biologist (or Restoration Ecologist) with appropriate credentials and experience in native habitat restoration, restoration monitoring, wetland delineation, and the USACE's HGM approach. The performance of the mitigation would be evaluated by evaluating the target function variables described above in *Section 3.5.2*. Due to overlap among the variables, field data collected for Percent Vegetative Cover, Coarse Woody Debris (based upon direct visual estimates), Microtopographic Complexity, Species Composition, Seedling Recruitment, and Habitat Heterogeneity would provide the information necessary to determine performance compliance for all variables. RMV or a designated Restoration Ecologist would be responsible for development of data sheets to be used in collection of the information associated with each variable (it should be noted that Appendix 3 of the Guidebook provides examples of data sheets that can be used or modified for use in the field during monitoring of the variables). The target function variables are described below.

Percent Vegetative Cover

The Percent Vegetative Cover would be determined using standard quantitative vegetation sampling methodologies which utilize transects or quadrats that characterize each vegetation strata (canopy, shrub, and herbaceous) in terms of total cover. Included in this variable would be percent cover by non-native invasive species. Data regarding non-native invasive species would be used in determining the types of remedial measures needed to ensure that the mitigation area remains healthy.

Species Composition

Data regarding Species Composition would be collected during the quantitative vegetation sampling discussed above.

Recruitment of Native Hydrophytes

Beginning with year three of the five-year monitoring program, recruitment of native hydrophytes would be evaluated by comparison with the reference site. The measurement of recruitment of native hydrophytes would be conducted during performance of quantitative vegetation surveys (by transect or quadrat sampling method) and would be conducted for appropriate vegetation strata.[8] Comparison of the mitigation site with the reference site could be accomplished by measuring the ratio of seedlings/saplings/or clonal shoots to established shrub/trees or by absolute numbers as determined appropriate by the Restoration Ecologist.

Habitat Heterogeneity (Vegetation Patchiness)

Beginning with year three of the five-year monitoring program, vegetation patchiness would be evaluated by comparison with the reference site. Characterization of habitat heterogeneity or patchiness greatly depends upon scale and would be based upon direct visual observations made during performance of quantitative sampling.

[8] For example, areas of willow riparian forest would include three strata - canopy, shrub, and herbaceous layers whereas, mulefat scrub would include only the shrub and herb layers.

Coarse Woody Debris (Riparian Habitats Only)

Coarse Woody Debris would be evaluated by direct visual observation, comparing the reference site with the GERA mitigation areas. For purposes of this mitigation program, Coarse Woody Debris is defined as woody vegetation deriving from trees and/or shrubs greater than 2.5 inches in diameter.

Microtopographic Complexity (Oak restoration areas not included)

Microtopographic Complexity would be evaluated by direct observation, comparing the restoration sites with reference sites. Microtopographic complexity would be measured during performance of vegetation transects, recording number of hummocks/mounds and depressions along with the change in topographic relief by class.[9]

Specific Conductance (Oak habitats not included)

Specific conductance would be measured using appropriate devices. Measurements obtained during monitoring of mitigation areas in Chiquita and GERA used and Oakton hand-held conductivity meter. Any similar device is appropriate/acceptable.

Hydrological Indicators (Oak habitats not included)

In addition to the variables referenced above, observations regarding field indicators for hydrology would be recorded during quantitative sampling for comparison with the reference site(s). Hydrological indicators to be recorded (as appropriate for each site), by direct observation, include Debris Rack, Sediment Deposits, Ponding Duration, Ponding Depth, Ponding Extent, Water Marks, and Drainage Patterns in the Wetland.

Wetland Delineation (Oak habitats not included)

Determination that the mitigation wetlands, expected to meet Section 404 wetland criteria, exhibit wetland hydrology, soils, and vegetation would be made using the 1987 Corps Manual.

Selection of Reference Site(s)

A reference site (or sites) would be identified in Chiquita Canyon, Canada Gobernadora, or other appropriate canyons in the Open Space as determined appropriate by the Restoration Ecologist in coordination with the USACE and CDFG. The reference sites would be located in areas that would be preserved in perpetuity and would correspond to wetlands to be impacted relative to the

[9] The HGM Guidebook for Riverine Wetlands suggests microdepression size classes of 0.5, 1.0, and 1.5 meters with depths of 5, 10, and 15 centimeters.

functions, and related variables, discussed throughout this mitigation program. The reference site(s) would be approved by the USACE and CDFG prior to implementation of the mitigation program.

3.8.2 Record Keeping

Following each monitoring visit, the Restoration Ecologist would recommend actions, as needed, to RMV that would promote survival and coverage criteria as described in the performance standards. The Restoration Ecologist, RMV, and Installation/Maintenance Contractor would work together to monitor, maintain, and replant restoration areas, if necessary.

Over the five-year period following restoration implementation, an annual report prepared by the Restoration Ecologist that discusses the results of the restoration monitoring and maintenance efforts for that year would be submitted to RMV for incorporation into the overall report for the Open Space. Vegetation cover by species, compliance with required performance standards, species heights, seedling recruitment, pest problems, weed control problems, pest control measures implemented, additional required maintenance procedures, and the general health of the revegetation plantings would be summarized in these reports. Photo-documentation of the sites would be included in the reports to provide a visual record of the restoration progress.

3.9 Completion of Restoration

3.9.1 Notification of Completion

Upon completion of Year 5 of the monitoring period or when the restoration area(s) have achieved the Year 5 performance criteria, the Restoration Ecologist would prepare a final report for RMV that describes the relative success of each restoration area.

3.9.2 Contingency Measures

Contingency measures would be implemented if restoration efforts fail to meet performance criteria at the end of the five-year monitoring period. Such measures would include additional container plant and/or seed installation, additional weed control efforts, an evaluation and appropriate modification of the irrigation system, and the extension of the maintenance and monitoring period until such time that the performance criteria are achieved.

3.9.3 Long-Term Management

Long-term management beyond the five-year monitoring program would be in accordance with the overall Adaptive Management Program for the RMV Open Space. RMV would determine whether a restoration site would be subject to long-term monitoring and management.

APPENDIX J-3
INVASIVE SPECIES CONTROL PLAN

CHAPTER 1: INVASIVE SPECIES CONTROL PLAN OVERVIEW

Invasive exotic plant and animal species adversely affect native habitats, sensitive species, and valuable crops worldwide. The adverse impacts occur because invasive exotic species out-compete native species for valuable resources, invasive exotic animals often act as predators upon native species, and in some instances invasive exotic plants can cause type changes within entire ecosystems, altering fire or hydrologic regimes. Given the seriousness of the effects of non-native species introductions, both ecologically and economically, many agencies, land managers, and the scientific community have begun to recognize the importance of regulating, controlling and studying this phenomenon.

Many of the vegetation communities, both upland and aquatic, on RMV have been adversely affected by the proliferation of non-native invasive plant and animal species. Using baseline data, plans have been prepared to protect, restore, and enhance the affected natural vegetation communities that support sensitive species. The Invasive Species Control Plan (ISCP) is an element of the overall Adaptive Management Program.

Examples of invasive species addressed by this plan include the problematic giant reed (*Arundo donax*), which can overrun and clog riparian reaches. Removal/eradication of this species will increase the function of these habitat linkages and wildlife corridors by enhancing dispersal and movement by both large and small animals (NCCP/SAMP Working Group 2003). Similarly, control of the brood parasitic brown-headed cowbird (*Molothrus ater*) through trapping efforts will reduce their impacts on songbird nests, especially adverse effects on listed species such as the California gnatcatcher (*Polioptila californica*) and least Bell's vireo (*Vireo bellii pusillus*). Bullfrog (*Rana catesbeiana*) controls will reduce predation on native amphibians and fish species, especially the federally-listed endangered arroyo toad (*Bufo californicus*). Long-term control of invasive plants and introduced predators on RMV will enhance habitat functions for native plant and animal species, which use and occupy Open Space lands. It will substantially increase the likelihood that the RMV Open Space will function successfully and provide for persistence and recovery of target species.

The Adaptive Management Program has adopted an "Environmental Stressor" approach that recognizes invasive plants and animals as key stressors that can adversely affect sensitive species, either directly (e.g., predation of arroyo toad larvae by bullfrogs) or through habitat degradation or type conversion (e.g., loss of willow riparian breeding areas for least Bell's vireo to invasive giant reed or tamarisk). This plan is intended to serve as a guideline for the eradication and control of invasive plant and animal species that occupy RMV. As with the upland coastal sage scrub and grassland restoration program, this plan is intended to serve as a "tool box" that provides the necessary tools for successful invasives control. As part of the Adaptive Management Program it will be subject to modifications and expansion as data collection warrants.

This initial Invasive Species Control Plan includes:

(1) Census and mapping of invasive plant species and introduced predators on RMV.

(2) A review of the ecology and habitat requirements for invasive species profiles targeted for control.

(3) An overview of species-specific and density-dependent eradication methods.

(4) An analysis of short- and long-term impacts and benefits to habitats and target/sensitive species that will derive from implementation of the ISCP.

The plan is divided into three major sections

- The invasive plants section discusses the specific concerns surrounding invasive plants, details the current status of invasive plants species targeted for control on RMV, describes characteristics of the invasive plants, outlines species-specific control method options, and analyzes the benefits and impacts of invasive plant control. Invasive plant species can have negative impacts on entire ecosystem processes where infestations are severe. Typically there are more than one, sometimes several, invasive encroachments occurring in a habitat at any given time (e.g., giant reed and bullfrogs occur in areas of San Juan Creek inhabited by the arroyo toad, representing separate and distinct threats).

- The second section discusses introduced vertebrates. Like invasive plants, introduced vertebrates can affect both native plants and animals; although, their direct impact on native animals (e.g., predation) is most easily documented.

- Finally, non-native Argentine ants and fire ants will be addressed as invasive species that will be subject to various levels of control within RMV.

The report integrates results of an invasive plant species investigation and mapping within riparian areas, and associated adjacent uplands of RMV, performed by PCR Services Corporation (PCR), invasive species management information (PCR), additional riparian and upland invasive plant analysis by Glenn Lukos Associates (GLA), overview of site-specific control methods (GLA), report integration and compilation (GLA), and an analysis of introduced vertebrates and eradication methods by Peter H. Bloom. The mapping effort consisted of a review of historic literature and aerial photography followed by a series of field surveys. The field assessments were conducted to determine areas of particularly pernicious invasive exotic plant and animal species occurrence and infestation in support of future land use and natural resource planning. The initial phase of the investigation focuses on the RMV riparian systems and associated adjacent upland areas, which occur within portions of the San Juan Creek and San Mateo Creek watersheds where additional data were available relating to other lands and prior invasive species control efforts they have been included. Importantly, the methods set forth herein are applicable to the entire RMV Open Space area.

Successful control of invasive plants and animals within RMV will require a cooperative effort among the various stakeholders including RMV, the County of Orange, Santa Margarita Water District, and Coto de Caza. As noted above, coordination with the Cleveland National Forest will also be important. Timing and geographic coordination (e.g., starting control programs for some species at the top of the watershed) will be critical in creating a program that is effective for the long-term. For example, elimination of species such as giant reed or bullfrogs from portions of RMV, without eliminating source populations from upstream areas within County of Orange lands or the Cleveland National Forest will not ultimately benefit the Identified Species.

CHAPTER 2: INVASIVE PLANTS

2.1 Introduction

According to *Invasive Plants of California's Wildlands*, non-native invasive plant species can alter ecosystem processes such as nutrient cycling, hydrological cycles, and frequencies of wildfires, erosion and sediment deposition (see Stressor Models depicted in *Figures 2-11* of the Adaptive Management Program that shows the relationships between invasive species, other stressors, and selected focal species). Invasive plants interfere in ecosystem functions by out-competing and displacing native plants and animals, by providing refuge for non-native animals, and by hybridizing with native species (Bossard *et al.* 2000). Several organizations, such as the California Native Plant Society (CNPS) and the California Exotic Pest Plant Council (Cal EPPC), have provided detailed documentation regarding invasive plant species that threaten California's native flora and fauna.

Although fewer than ten percent of the 1,045 non-native plant species that have established in California are identified as threats, they have dramatically changed the landscape of the state (Bossard et al. 2000). Although numbering less than 100 species, those exotic plants that are of highest concern are aggressive invaders that displace natives and disrupt natural habitats (CalEPPC). Many species, like black mustard (*Brassica nigra*) and non-native annual grasses of Mediterranean origin (e.g., *Bromus* spp., *Hordeum* spp., and *Avena* spp.) have become naturalized to the point that they are beyond realistic control measures at a landscape level and are not addressed specifically by this program plan although they are addressed as part of the AMP through restoration, grazing and fire management. Generally, invasive plants that are targeted for eradication and control are those that inflict the most damage on native plants and animals and which are to some degree controllable.

In the last two decades, as the problems with invasive species have become better understood, more public and private action to control invasive species has occurred. In southern California, for example, the Southern California Wetlands Recovery Project is an organization that largely is involved with funding wetland and watershed restoration projects, many of which employ eradication of non-native species as an effective tool in the restoration process (Southern California Wetlands Recovery Project 2003). Other local efforts to remove invasive plants include mapping, monitoring and control programs by the California Department of Parks and Recreation Inventory, Monitoring and Assessment pilot program (Chino Hills State Park removal of sweet fennel, giant reed, and tree of heaven) (Marsden 2001), and eradication programs sponsored by the Santa Ana Watershed Project Authority (giant reed removal along the Santa Ana River) (Santa Ana Watershed Project Authority 2003). Additionally, at the 4,000-acre Starr Ranch Audubon Sanctuary in the Southern NCCP/HCP planning area there is ongoing extensive research and eradication of invasive plant species (artichoke thistle and Italian thistle research and removal studies and programs) (DeSimone 2002).

The invasive species identified initially for eradication and control on RMV were selected based on the degree to which they affect or potentially affect selected focal species and habitats (see Adaptive Management Program). Generally, portions of the RMV Open Space include both aquatic habitats and upland habitats that exhibit moderate to high levels of habitat function and large portions of the RMV Open Space do not exhibit impacts from many of the invasive species addressed in this plan. Nevertheless, each of the invasive exotic species addressed in this plan, exhibits at least some potential for impacts on one or several listed or otherwise Identified special status animal species or vegetation communities and/or (to a lesser extent) special-status plants that occur on RMV.

Invasive plant species identified as threats within some reaches of the RMV riparian and wetland ecosystems and mapped as part of this effort include giant reed, pampas grass (*Cortaderia selloana*), tamarisk (*Tamarix ramosissima*), castor bean (*Ricinus communis*), tree tobacco (*Nicotiana glauca*) and Spanish sunflower (*Pulicaria paludosa*). The upland invasive plant targeted for eradication in this plan is the artichoke thistle (*Cynara cardunculus*).[1] Through time, other invasive species may become established within RMV. As threats from previously undocumented species are recognized, they will be addressed through the Adaptive Management Program.[2]

Many of the identified and other focal planning species will benefit from the ISCP implementation. In riparian areas the removal of giant reed, pampas grass, and tamarisk will allow native vegetation to reestablish, providing for expanded and enhanced breeding and foraging habitat for avian species such as least Bell's vireo, southwestern willow flycatcher (*Empidonax traillii extimus*), and several raptors including the white-tailed kite (*Elanus leucurus*). Removal of the same species would also benefit species such as southwest pond turtle (*Clemmys marmorata*) and arroyo toad, along with improved aquatic environments for native fish species.

Removal of artichoke thistle will benefit the California gnatcatcher and other scrub birds and grassland species like the grasshopper sparrow (*Ammodramus savannarum*), by allowing for areas previously occupied by the thistle to become established with native coastal sage scrub or

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[1] Invasive species such as castor bean or tree tobacco can also occur in upland areas; however, their impacts in upland areas is typically minimal and do not affect Identified Species and as such, the focus on these species in this plan is in riparian areas where their effects are more severe.
[2] One of the goals of the Adaptive Management Program will be to identify threats from newly arrived species during the early stages of infestation, when eradication efforts are most effective and least costly.

grasslands used for nesting and foraging. Identified native plants like the state and federally listed thread-leaved brodiaea (*Brodiaea filifolia*) and CNPS List 1B many-stemmed dudleya (*Dudleya multicaulis*) will benefit from artichoke thistle eradication in that they will not have to compete against this aggressive invasive for valuable resources.

2.2 Existing Setting

The proposed RMV Open Space includes a diversity of aquatic and terrestrial habitats. Habitats associated with the aquatic ecosystem include southern willow riparian forest, mulefat scrub, and localized areas of freshwater marsh associated with large, high-energy streams such as San Juan Creek, Trabuco Creek, Gabino Creek, and Cristianitos Creek. Gobernadora and Chiquita creeks support areas of southern willow riparian forest mixed with areas of alkali marsh and alkali meadow. Southern willow riparian forests are dominated by willows including black willow (*Salix gooddingii*), arroyo willow (*Salix lasiolepis*), red willow (*Salix laevigata*), mulefat (*Baccharis salicifolia*), and narrow-leaved willow (*Salix exigua*). Marsh habitats are generally dominated by southern cattail (*Typha domingensis*), California bulrush (*Scirpus californica*), hardstem bulrush (*Scirpus acutus*), Iris-leaved rush (*Juncus xiphioides*), creeping spikerush (*Eleocharis macrostachya*), and Olney's bulrush (*Scirpus americanus*).

Upland habitats most affected by artichoke thistle include coastal sage scrub and native grasslands. Coastal sage scrub on RMV is represented by a variety of subassociations dominated by a variety of shrubs or sub-shrubs including California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), sage (*Salvia* spp.), coast brittlebush (*Encelia californica*), and coyote brush (*Baccharis pilularis*). Native grasslands are dominated by purple needlegrass (*Nassella pulchra*), with other native grasses such as beardgrass (*Bothriochloa barbinodes*), San Diego agrostis (*Agrostis diegonensis*) and three-awned grass (*Aristida* spp.) locally common. Common forbs associated with native grasslands include shooting stars (*Dodecatheon clevelandii*), golden stars (*Bloomeria crocea*), wild hyacinth (*Dichelostemma capitatum*), and wild carrot (*Daucus pusillus*). For a further description of vegetation communities on RMV see the Biological Resources Section of the EIR.

2.3 Summary of Prior and Ongoing Eradication Efforts

Invasive species eradication has been conducted within portions of RMV and the Northrop Grumman Capistrano Test Site (formerly TRW).

2.3.1 Rancho Mission Viejo

As part of its cattle ranching operations, RMV has performed eradication of artichoke thistle across most of the RMV property since the 1970s and efforts continue annually. A comprehensive artichoke thistle removal program has also been implemented for the approximately 1,600-acre Ladera Open Space area that has been ongoing since 2001. RMV has also begun a program to control Spanish sunflower in Gobernadora Creek and Chiquita Creek; however, this program is currently in the beginning phases with a pilot program that is comparing control methods (i.e., hand removal versus spraying).

2.3.2 Northrop Grumman

Pursuant to Biological Opinion 1-6-00-F-6 and Department of the Army Permit 199915591 RLK, Northrop Grumman has conducted invasive species eradication in lower Cristianitos Creek. This program is to be continued through the life of the lease. The program has achieved performance standards to date.

2.4 Invasive Plant Species Mapping and Results

Invasive species mapping within RMV riparian systems and adjacent or contiguous upland areas was conducted by PCR.[3] This effort began with a review of previous riparian mapping and classification of the RMV drainages, and included photographic interpretation of historic and current aerial imagery, field mapping and data collection, and report preparation. Artichoke thistle was mapped in the Ladera Land Conservancy open space areas by PCR. Artichoke thistle mapping throughout the rest of RMV was performed by GLA.

2.4.1 Literature Review

Previous mapping efforts, performed for a variety of landscape-level evaluations, were evaluated and included: **(1)** an assessment of riparian ecosystem integrity for San Juan and San Mateo Creek watersheds by the U.S. Army Corps of Engineer's (ACOE) Waterways Experiment Station (the "WES Investigation") (Smith 2000); **(2)** the riparian vegetation communities mapping performed as part of the ACOE (WES) Planning Level Delineation performed by Robert Lichvar (the "Planning Level Delineation") (Lichvar 2000); and **(3)** the giant reed distribution mapping of southern California's coastal watersheds by Bill Neill and Jason Giessow (the "Neill and

[3] The mapping of invasives conducted by PCR included areas outside the proposed RMV Open Space discussed in the plan, including Arroyo Trabuco.

Giessow Investigation")(Neill and Giessow 2002), and supporting GIS data developed by PCR (the "GIS Index") (PCR Services Corporation 2001).

The overall objective of the WES Investigation was to conduct a baseline assessment of riparian ecosystem integrity for the evaluation of potential impacts of future development projects within the San Juan and San Mateo Creek watersheds. The riparian systems were divided into assessment units, or "riparian reaches" and assessed utilizing a suite of indicators of ecosystem integrity. The riparian reaches were defined segments numbers of the mainstem, bankfull stream channel, and the adjacent riparian ecosystem exhibiting relatively homogeneous characteristics with respect to geology, geomorphology, channel morphology, substrate type, vegetation communities, and cultural alteration (Smith 2000) (Olson and Harris 1997).[4] Reach lengths were determined by changes in stream gradient or channel morphology. Reach widths were delineated by either the 100-year flood elevation contour, the extent of identifiable historic alluvial terraces, or the base of valley wall or artificial structure. Field data sheets used during the assessment provided information on the occurrence of invasives for each reach and included codes for abundance (dominant, common, or present) and geomorphic setting (channel, floodplain, side slope, or terrace).

The Planning Level Delineation included mapping of riparian vegetation at a minimum mapping unit of approximately 0.25 acre. Riparian vegetation units were assigned Federal jurisdictional probability ratings (as regulated under the Clean Water Act). Jurisdictional probabilities were based on the results of the field verification sampling, evaluation of the hydrologic parameters for each geomorphic surface, and the vegetation/land use type. These designations were further evaluated using GIS software to compare their spatial distribution patterns with those of other types (e.g., watersheds, human disturbance, and geomorphic surfaces). Areas of giant reed dominance were identified as separate communities.

The Neill and Giessow Investigation resulted in a regional-scale giant reed survey of southern California's coastal watersheds from the Santa Ynez River in Santa Barbara County to the Mexican border. Giant reed distribution was mapped based on visual inspection from accessible routes and based on knowledge of local experts and verbal reports. The survey adopted the reconnaissance mapping protocol developed by Team Arundo del Norte (Team Arundo del Norte). The abundance of giant reed was classified according to the average number of clumps per mile (minimum mapping unit of 0.25 mile) within relatively narrow corridors, or the average distance between clumps in a broad floodplain. The survey was conducted during the second half of 1999, early 2000, and January 2002 and included potions of RMV.

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[4] *As an example, riparian reaches, as defined by Smith are depicted on Figure 1. Riparian reaches TB-06b, TB-06c, and TB-06d are depicted along Arroyo Trabuco Creek in red on the west-central portions of the map.*

The GIS Index previously developed by PCR was utilized to aid the current investigation's information and data consolidation, mapping, and classification effort. The interactive aerial photograph GIS Index contains copies of existing aerial photography taken in 1999 and 2000 by Hammon, Jensen, Wallen and Associates, Inc., boundaries of dia-positive prints, links to the odd numbered images, flight lines, and U.S. Geological Survey topographic maps. The Index provided as an organizational tool for locating images for locating invasive species both in the office and in the field.

2.4.2 Aerial Photography Review

A review of historic aerial photographs was conducted to identify previous and current drainage patterns on RMV, and to make preliminary determinations on the occurrence of invasive species. Photographic interpretation of invasive species occurrence began with aerial photographs taken in June 1999 (San Juan Creek watershed) and March 2000 (San Mateo Creek watershed) at 1-meter resolution by Eagle Aerial. Images of the RMV in its entirety were available as 9-inch by 9-inch, 1:4,800 scale (1"= 400') dia-positive prints. The dia-positives were viewed with the aid of a magnifying glass and light table to identify invasive species occurrence. Additional, more recent imagery taken by Eagle Aerial in 2001 and obtained from EDAW was digitally viewed in combination with other project-specific GIS data. Point locations of invasive plant species were marked on the aerials. Areas were then "ground-truthed" during field observations from October 28 to November 5 2002 to obtain specific density counts and heights.

2.4.3 Field Mapping and Data Collection

Following the initial data gathering and preliminary photo-interpretation of RMV imagery, field visits were scheduled to determine invasive species occurrences. Large, E-sized maps (RMV overview maps) identifying previously mapped areas of invasive species infestation with sub-basin designations were prepared for use in the field. Additional information obtained from the WES Investigation's data sheets and giant reed distribution from the Planning Level Delineation were accessed and occurrences were noted on maps. These maps were generated at a scale of 1:480 (1"=40') for the entire RMV property.

PCR implemented a modified reconnaissance mapping protocol established by Team Arundo del Norte similar to the Neill and Giessow Investigation. The "windshield" survey methodology was originally developed to determine general characteristics of giant reed growth, habitats, and other factors that may promote or inhibit its spread, and areas that are at risk of invasion. Instead of just recording giant reed abundance based on average numbers of individuals per one-mile units, this mapping effort identified five invasive species (giant reed, pampas grass, tamarisk, castor bean, and tree tobacco) by point locations on field maps and dia-positives. Species distribution was based on visual inspection of riparian corridors, viewed from roads, bridges, paths, and readily accessible riparian reaches where possible. Special attention was paid to the primary drainages of San Juan Creek watershed (Cañada Chiquita, Cañada Gobernadora, Verdugo, Central San Juan) and San Mateo Creek watershed (Gabino, Cristianitos, and Talega) on RMV. Occurrences within tributaries to these mainstems and adjacent upland habitats outside the riparian zones were also noted as encountered.

Each PCR Biologist was assigned one of the major tributaries (mainstems) to map. RMV overview maps and dia-positives corresponding with that watershed were distributed. Field Biologists mapped invasive species following these steps:

1. Positions were located on the RMV overview map.

2. Dia-positive photographs were identified from the overview map.

3. Invasive species were mapped as points onto the dia-positives with colored markers. Each point represented 1 to 5 individuals spaced a minimum of 100 feet apart.

4. Each point marked on the dia-positives was identified with the following species codes[5]: Priority 1 Species: AD – *Arundo donax* (giant reed) Priority 2 Species: CS – *Cortaderia selloana* (pampas grass), TR – *Tamarix ramosissima* (tamarisk), RC – *Ricinus communis* (castor bean) Priority 3 Species: NG – *Nicotiana glauca* (tree tobacco)

5. For each data point, the average maximum height of the populations was indicated on the dia-positives (<6, 6-12, 12-18, >18 feet).

6. The abundance of each invasive species within each sub-basin was indicated on the RMV overview map with the following abundance codes:

    a. "Absent" – areas not containing invasive species during observation.

    b. "Isolated" – 1 to 5 individuals/clumps; >1,000 feet average spacing between clumps/individuals.

[5] *Invasive species are listed in order of importance. When other invasive species not listed above were found, they were noted on dia-positives (time permitting).*

c. " Scattered" – 5 in a single 328 feet (100 meters) section; fewer than 20 clumps/mile; 250 to 1,000 feet average spacing.

d. "Abundant" – less than 25 in a single 328 feet (100 meters) section; 20 to 200 clumps per mile; 25 to 250 feet average spacing.

e. "Dominant" – Amalgamated clumps, continuous in places.

f. "Cleared" – areas cleared by equipment or restoration activities.

2.4.4 Data Interpretation and Map Classifications

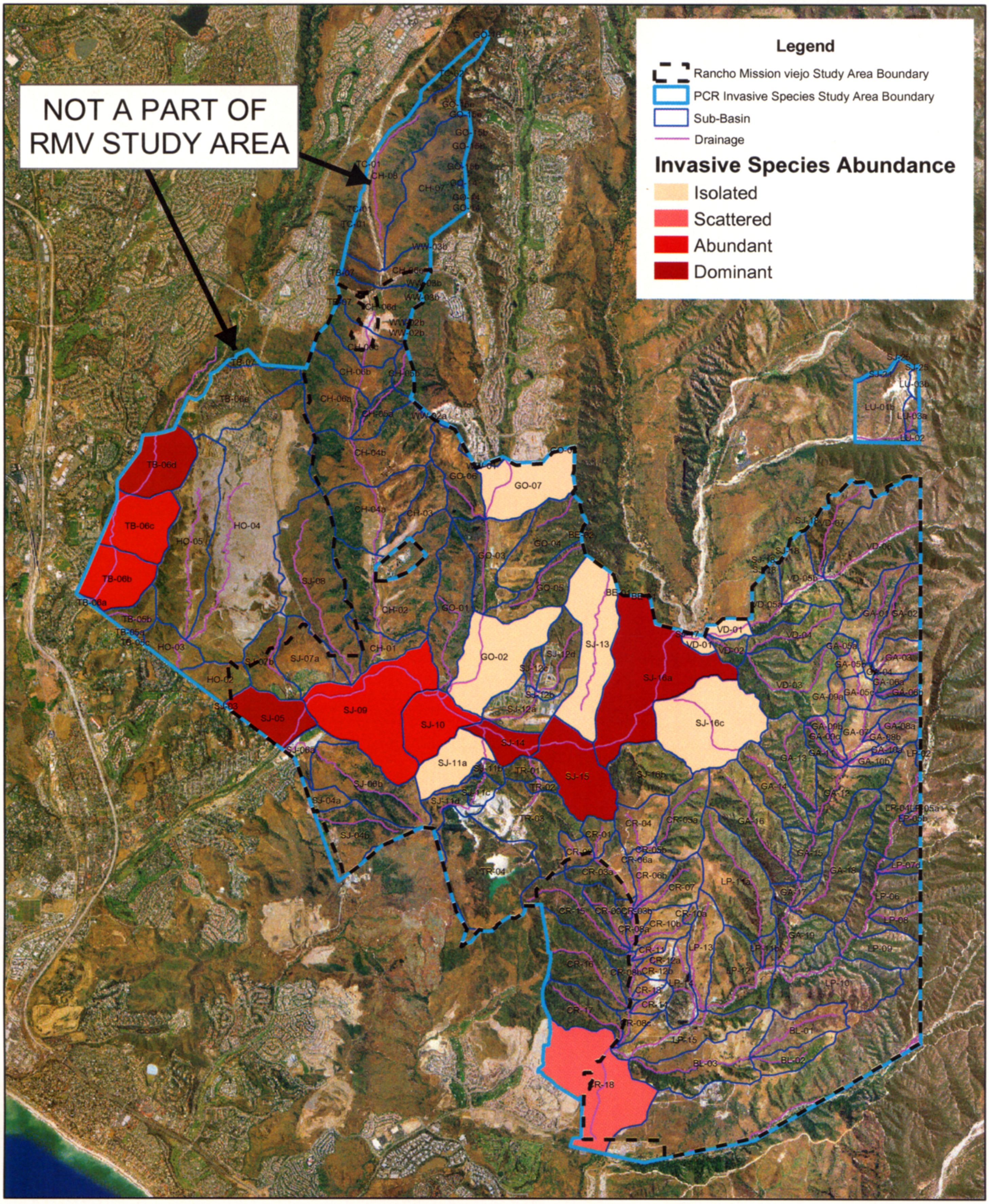
Riparian system invasive species mapping conducted during this effort included two mapping classifications: species densities and abundances. Following field mapping, invasive species occurrences were digitized from hard copy maps to PCR's project GIS with the aid of high-resolution, onscreen imagery (Eagle Aerial 2001 photography) and other key spatial data. Point locations, representing between 1 to 5 individuals or clumps, were attributed with the species code, exact number of individuals, and average maximum height. The digitized point locations provided "density", or distribution, maps focused on four general areas on RMV (Cañada Chiquita & Gobernadora, San Juan (East), San Juan (West), and Cristianitos). The second type of mapping products are watershed-scale "abundance", or dominance, maps that were developed to give the end-user an idea of each species dominance within the WES Investigation's functional sub-basin "reaches." The hydrogeomorphic, functional sub-basin reaches (polygons) were attributed with the species (Priority 1, 2, and 3) and abundance codes (Absent, Isolated, Scattered, Abundant, Dominant, and Cleared) listed above.

Maps displaying the abundance of each invasive species over the entire property are attached as Figures 1 through 5.[6] Maps displaying invasive species densities focused on five areas of the property are attached as Figures 6 through 9.

2.4.5 Results

PCR's invasive exotic species mapping effort was limited to riparian habitats within the RMV property and focused on five invasive species: giant reed, pampas grass, tamarisk, castor bean, and tree tobacco. The initial literature and data review proved extremely useful in identifying

[6] Note that the PCR study area extended beyond that of the RMV study area addressed in this plan.

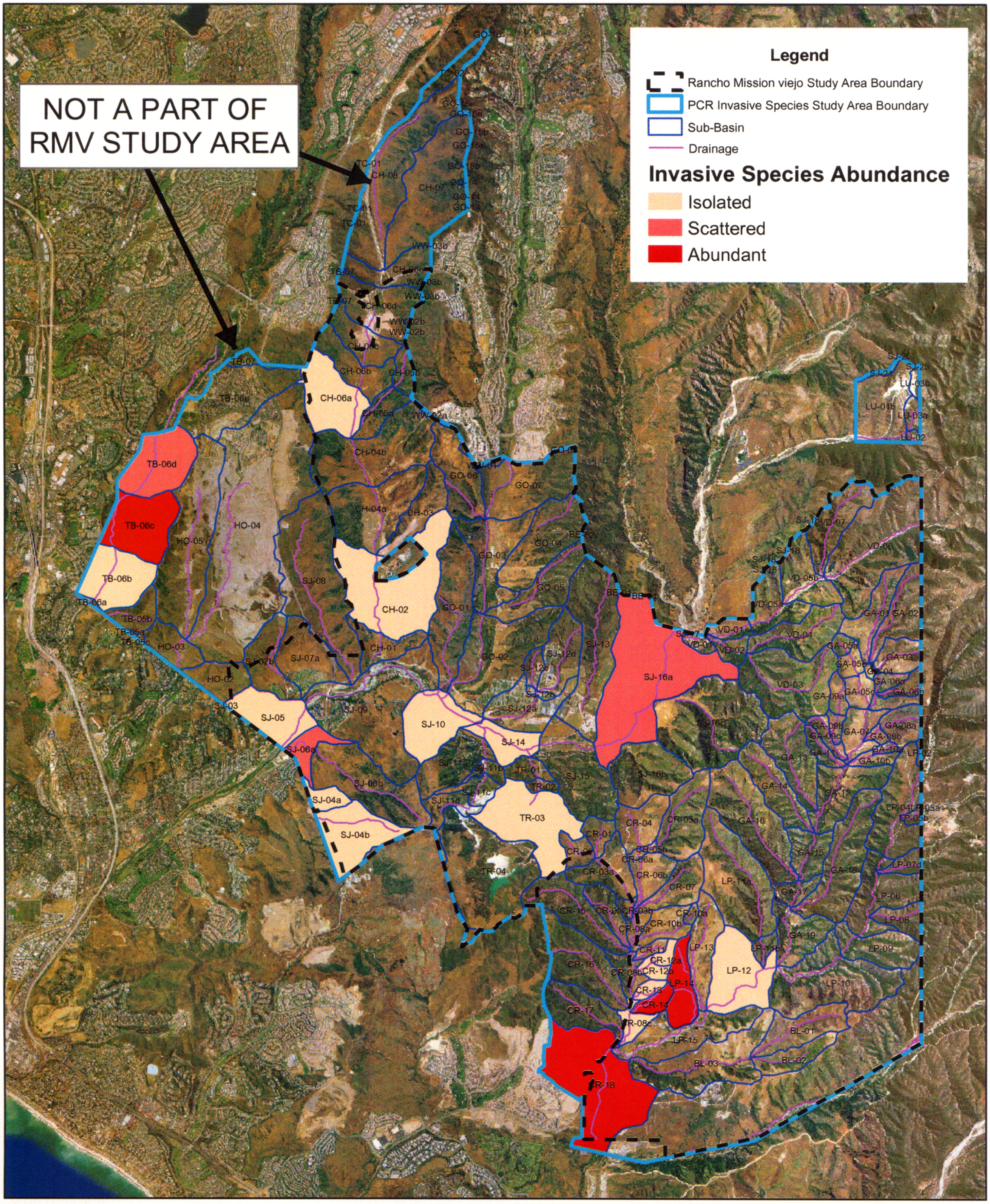


Adapted from Digital Data provided by PCR Services Corporation
Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001

N

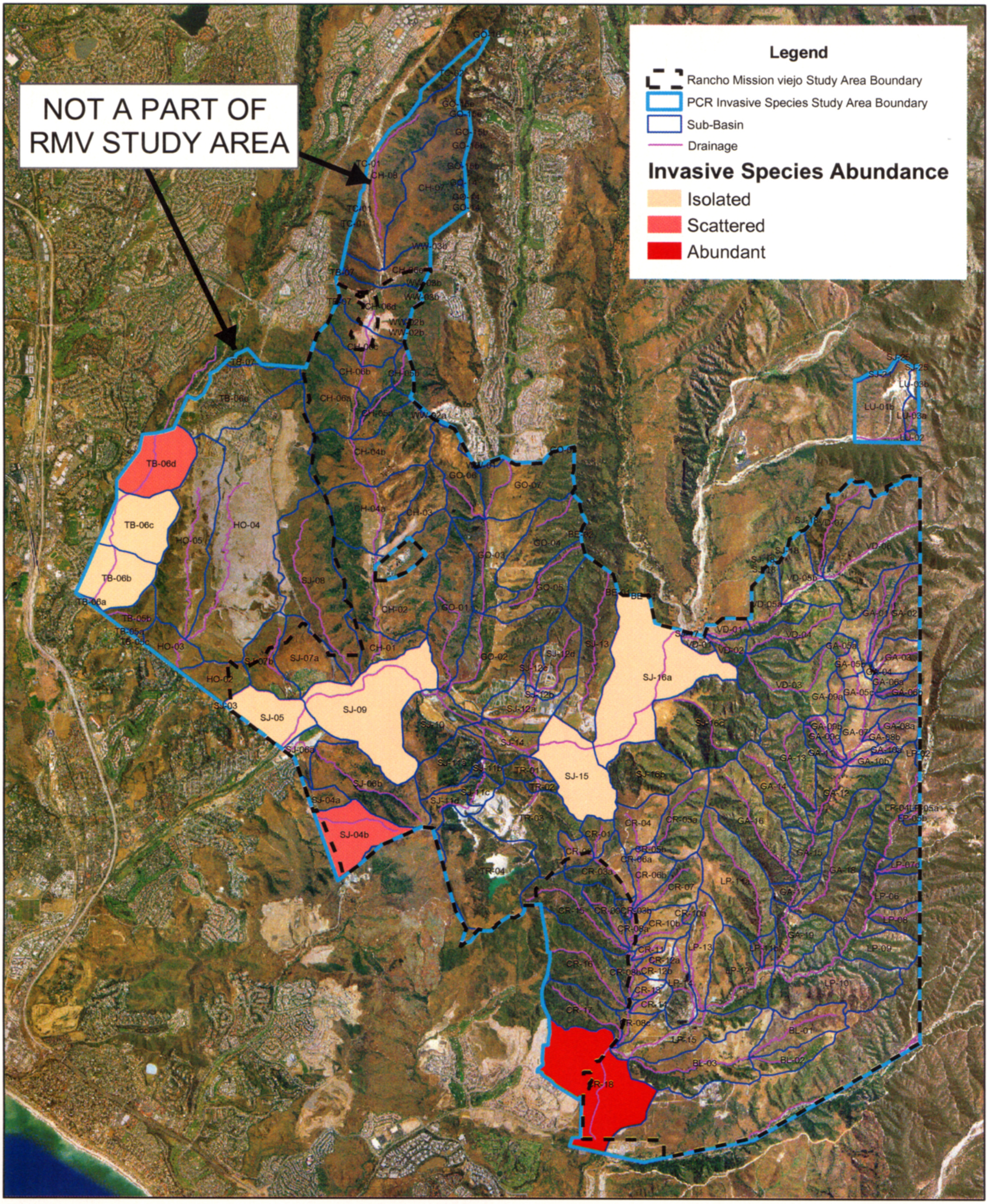
0 1.5 3 Miles

Figure 1
Rancho Mission Viejo
Arundo Donax Abundance



Adapted from Digital Data provided by PCR Services Corporation
Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001

Figure 2
Rancho Mission Viejo
Cortaderia Selloana Abundance

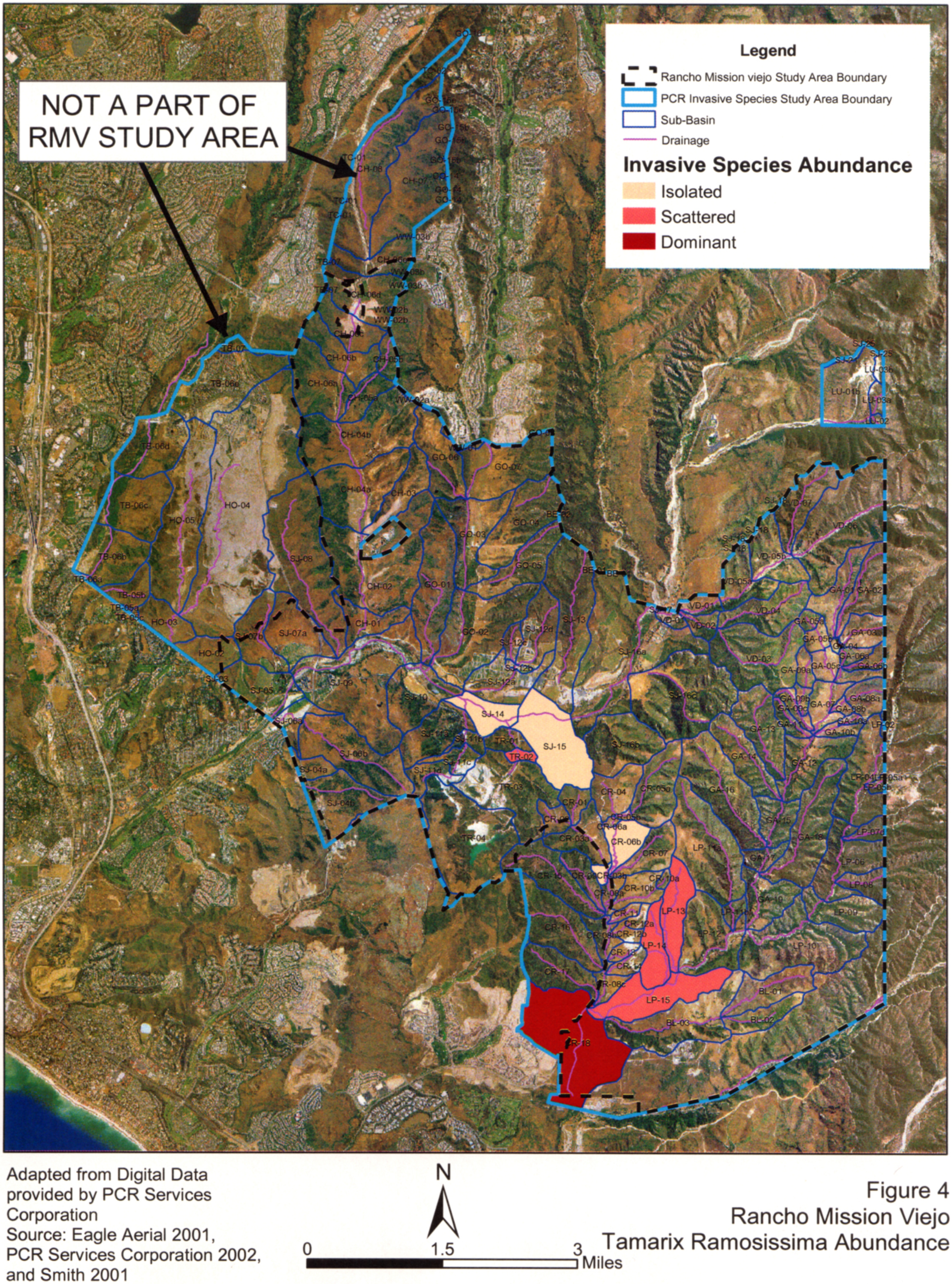


Adapted from Digital Data provided by PCR Services Corporation
Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001

N

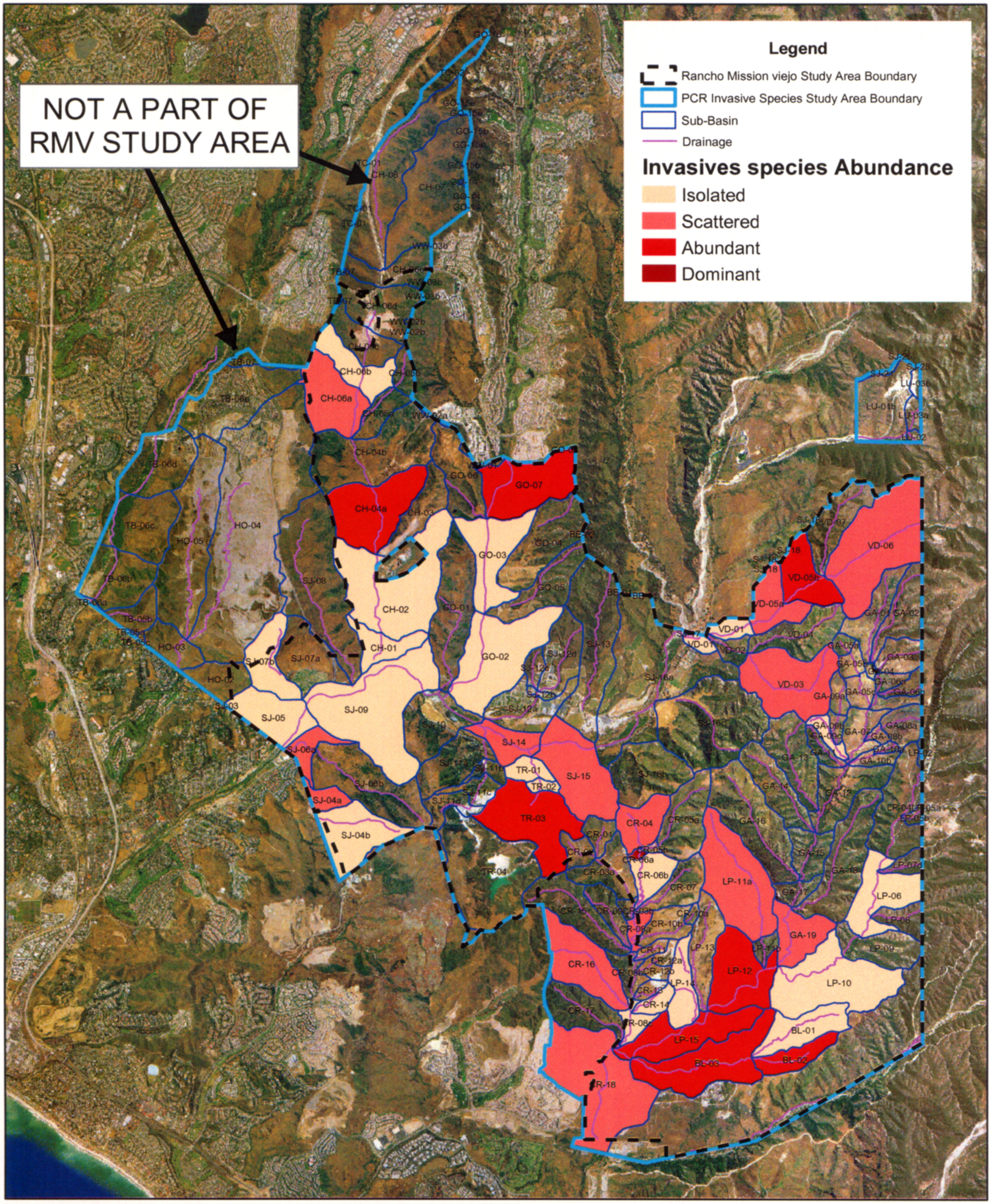
0 1.5 3 Miles

Figure 3
Rancho Mission Viejo
Ricinus Communis Abundance



Adapted from Digital Data provided by PCR Services Corporation
Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001

Figure 4
Rancho Mission Viejo
Tamarix Ramosissima Abundance



Adapted from Digital Data provided by PCR Services Corporation
Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001

N

0 1.5 3 Miles

Figure 5
Rancho Mission Viejo
Nicotiana Glauca Abundance

PCR

N

1600 0 1600 Feet

Source: Eagle Aerial 2001, PCR Services Corporation 2002, Smith 2001

Figure 6
Rancho Mission Viejo
Invasive Species Occurrences
Canada Chiquita & Gobernadora

PCR

N
1600 0 1600 Feet

Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001.

Figure 7
Rancho Mission Viejo
Invasive Species Occurrences
San Juan (East)

PCR

1600 0 1600 Feet

N

Source: Eagle Aerial 2001, PCR Services Corporation 2002, and Smith 2001.

Figure 8
Rancho Mission Viejo
Invasive Species Occurrences
San Juan (West)

PCR

Figure 9
Rancho Mission Viejo
Invasive Species Locations
Cristianitos

areas of historic invasive species occurrence. Field data sheets obtained from the WES Investigation provided information on the occurrence, abundance, and geomorphic setting of invasives within select reaches of La Paz, and Cristianitos. Riparian vegetation mapping provided in the Planning Level Delineation identified areas of giant reed infestation within the central and northeastern portions of San Juan Creek's channel. The Neill and Giessow Investigation identified reaches of riparian corridors where giant reed was "present" and "abundant."

The review of available aerial photographs of RMV was useful for the preliminary identification of invasive exotic species. However, only the 1:4,800 scale dia-positives combined with the use a hand lens and light table allowed appropriate identification of individuals. Evidence of invasive species on the dia-positives was primarily limited to mature stands of giant reed identified along San Juan Creek and Cristianitos Creek, and pampas grass along Cañada Gobernadora. The rest of the invasive species occurrences were determined during the field surveys.

Data from all of the previous investigations were used to focus the current investigation's surveys on invasive species "hot spots," data gaps, and allowed development of short- and long-term approaches to control. PCR's field verification of previously identified invasive exotic species occurrences as well as documenting new occurrences throughout the RMV's riparian corridors was completed by five PCR Biologists within three days. Combined information from these resources is provided below and organized by watershed, drainage, and invasive species priority classifications.

a. San Juan Creek Watershed

Cañada Chiquita – Invasive species occurrences were not previously documented within this drainage. The current investigation identified only Priority 2 species, pampas grass, and Priority 3 species, tree tobacco. Two, isolated pampas grass individuals were located within reaches CH-02 and CH-06a. Isolated tree tobacco individuals were located within downstream reaches CH-01, CH-02, CH-06b; scattered within reach CH-06a; and abundant within reach CH-04a (central). Spanish sunflower (*Pulicaria paludosa*) occurs at scattered locations, typically in wetter areas associated with Chiquita Creek.

Cañada Gobernadora – Invasive species occurrences were not previously documented within this drainage. The PCR investigation identified Priority 1 species, giant reed, and Priority 3 species, tree tobacco. Isolated individuals of giant reed were located within reaches GO-02 and GO-07. Isolated individuals of tree tobacco were located within downstream reaches GO-02 and GO-03 and abundant within GO-07 upstream. In addition, Spanish sunflower (which was not mapped by PCR) has been identified by GLA as an invasive exotic within localized portions of the riparian areas associated with Gobernadora Creek.

San Juan Creek – Results from the Neill and Giessow Investigation performed in 2002 characterized the upstream and downstream on-site portions of San Juan Creek as containing an "abundance" of giant reed; whereas, the central portion of the drainage contained "scattered" populations of the same species. This mapping effort documented the spread of giant reed downstream from early plantings at San Juan Hot Springs and nearby cabins outside the Cleveland National Forest boundary. According to the Neill and Giessow Investigation, giant reed was cleared within Caspers Wilderness Park during 1997-98. Other efforts to clear infestations of giant reed occurred downstream and south of the RMV portion of the Habitat Reserve in San Juan Capistrano between La Novia Avenue and Interstate 5 during 1995, but the species has subsequently reinvaded. The current investigation identified all of the Priority 1, 2 and 3 species. Giant reed is abundant throughout San Juan Creek. Isolated castor bean and tamarisk individuals were located throughout the on-site portions of this drainage. Scattered tree tobacco occurrences were located within the mainstem as well as tributary reaches along the southern bank of the mainstem, as was Spanish sunflower.

Verdugo Creek – Invasive species occurrences were not previously documented within this drainage or its tributaries. The current investigation identified Priority 1 species, giant reed, and Priority 3 species, tree tobacco. One, isolated giant reed individual was located within reach VD-01. Isolated tree tobacco occurrences were located within downstream reach VD-01 and increased in abundance upstream with a dominance of this species located within reach VD-05b.

b. San Mateo Creek Watershed

Gabino Creek – The WES Investigation identified tamarisk, a Priority 1 species in the San Mateo Creek watershed, as being "present" within the LP-13, LP-14, which are tributary to Gabino Creek as well as associated with Gabino Creek (LP-15) near the confluence with Blind Canyon Creek. These occurrences were confirmed during field reconnaissance by GLA. The PCR investigation also identified Priority 2 species, pampas grass, and Priority 3 species, tree tobacco associated with Gabino Creek and its tributaries. These included abundant occurrences of pampas grass within reach LP-14 and scattered occurrences in LP-12. Tree tobacco was identified within the mainstem of Gabino (GA-18, LP-10, LP-12, and LP-15).

La Paz Creek – Previous investigations did not identify invasive species as associated with La Paz Canyon Creek. Two occurrences of tree tobacco were identified in LP-10 immediately upstream of the confluence of La Paz and Gabino creeks.

Cristianitos Creek – Invasive species occurrences were not previously documented within this drainage or its tributaries. The current investigation identified all of the Priority 1, 2 and 3 species. Giant reed is scattered in the downstream portion of this drainage (CR-18). Isolated castor bean and tamarisk individuals were located throughout the on-site portion of this drainage. Abundant occurrences of pampas grass were located within the central (CR-14) and southern (CR-18) portion of the drainage. Scattered tree tobacco and Spanish sunflower occurrences were located along the entire mainstem.

Talega Creek – Invasive species occurrences were not previously documented within this drainage. Furthermore, the current investigation did not detect any new occurrences.

2.5 Eradication Approaches for Invasive Plants

In order to eradicate exotic species, various methods of weed management are often used in different combinations depending on the most effective methods. Methodologies include mechanical (hand pulling, digging, machetes, axes, etc), biological (although none yet approved for the target species), competition, and chemical (use of herbicides) (Jackson 1998). Recommended methods for control of particular species have been cross-referenced using the California Interagency Noxious Weed Coordinating Committee and Invasive Plants of California Wildlands' CalWeed Database, a series of published papers from the 1998 *Workshop on Combating the Threat from Arundo and Saltcedar*, and a various other sources (Bossard *et al.* 2000).

Methods of control will depend on the characteristics of each species, including considerations associated with site-specific density, area of infestation, and the ecological sensitivity of the habitat. Hand or mechanical means are preferred methods for control of weed species around sensitive flora and fauna because of potential adverse effects on sensitive native species. Some species may be controlled by a combination of cutting and removal followed by spot foliar herbicide spray application immediately following the cut or upon re-growth depending on level of infestation. All exotic plants and their associated humus should be removed and disposed of at an off-site location in order to minimize effects of the biomass on downstream locations and to minimize the possibility of resprouting by cuttings.

Because of the cost and potential effects on native flora and fauna, herbicide treatment should be conducted only when weather conditions are conducive to effective uptake of the herbicide by the target species (e.g., sunny, dry with ambient temperatures 65 degrees Fahrenheit, and when plants are at the specified growing stage), and when wind conditions are such that herbicide drift is minimized (five mph or less). The preparation of herbicide solutions should also be allowed only in approved staging areas more than 100 feet from a stream course or body of water such that accidental spills are quickly contained.

Herbicides that are registered for use in California for natural areas are specified for particular weed species at specific rates noted on the labels. Because the target species on the RMV property are near or immediately adjacent to aquatic sites, glyphosate-based herbicides (e.g., Round-up Pro® or Rodeo®) and triclopyr-based herbicides (Garlon 3-A®) are recommended. Only EPA approved, glyphosate-based, systemic herbicides (e.g., Rodeo®) are legally allowed when applying herbicides within 100 feet of a natural watercourse or body of water. Glyphosate is a non-selective type of herbicide, and its mode of action works against both broadleaf weeds and grasses. Triclopyr acts on woody and broadleaf species. Treated plants or stumps shall not be disturbed until the applied herbicide has had time to take effect per the manufacturer's instruction. A third type of herbicide, imazapyr (Arsenal®) is suggested for use on tamarisk in upland areas. Herbicide concentrations should be used according to the type of application required as per the product label. For glyphosate-based herbicides, a minimum of two percent solution is recommended for foliar spray applications, a 33 percent solution is recommended for foliar wick applications, and a 100 percent solution is recommended for cut stump treatments. For triclopyr-based herbicides, a 15 percent solution is recommended for foliar spray applications, and a 100 percent solution is recommended for cut stump treatments. For imazapyr-based herbicides, a 25 percent solution diluted with diesel or natural oils is recommended for cut stump treatments.

Because the above described herbicides are not species-specific and over-spray often occurs with foliar spray methods, the application of these herbicides must be performed by an experienced professional in order to minimize effects on native species. The chosen contractor must have a pest control business license which requires that at least one individual employed by the business be in possession of a pest control applicator's (PCA) license. All licenses are issued by the State of California and should be registered in Orange County, and be of current status. If a PCA is not present during the herbicide treatment, all applicators should have undergone documented herbicide application training. Personnel must wear all protective clothing required by law and follow all label directions and precautions. All re-entry times specified on an herbicide label should be observed and posted. During herbicide application, it is recommended that a brightly colored dye or food coloring be used to aid the applicator in achieving good coverage of the target species. The material should be a non-toxic material, such as Blazon, Turfmark, or equivalent. The dye should be mixed with the herbicide at no more than half the rate specified on the label.

Below are brief descriptions of each invasive plant species organized by management priority. The relative abundances of the invasive plants mapped, their accessibility, and their proximity to sensitive habitats and species are considered in the specific eradication method recommendations. Those abundance codes were defined and described in Section 2.3.3 Field Mapping and Data Collection.

Areas categorized as sub-basins by PCR and as depicted in the attached figures correspond to the riparian reaches as defined by Smith (2000). This document follows Smith and refers to each segment as a riparian reach.

RMV is known to have a number of listed or other special-status species that are either residents or which seasonally occur onsite. For the purposes of this plan those species which are of greatest concern and most likely to be influenced by an eradication program are addressed within the recommendations for control. For a complete list of "planning species" considered for conservation within RMV see the Draft Southern NCCP/HCP Planning Guidelines Section 3.2 General Policy 2. Also, Section 3.1 General Policy 1 provides definitions of major populations, important populations, and key locations as they pertain to identified and focal species.

2.6 Riparian Species

2.6.1 Priority 1 Species: Giant Reed (*Arundo donax*)

Giant reed was introduced into the southwestern United States from the Mediterranean Region and is thought to have become the most destructive invasive weed found in many riparian areas (Jackson 1998). Giant reed occurs throughout elevations less than 1,000 feet within central and southern California. This species is abundant in wet and dry streams and creeks, but is also found in isolated clumps in moist sites such as springs or seeps (Bossard *et al.* 2000). The species was originally used in bank stabilization projects and harvested from the Los Angeles River for roofing material and fodder as early as 1820. The species is also commercially grown for various other domestic and horticultural uses such as erosion control, wind breaks, and noise barriers.

Giant reed is a perennial grass appearing much like bamboo with hollow fibrous stems partitioned by nodes. Heights of giant reed stands range from 9 to 30 feet and it grows in large clumps often made up of a single individual because it reproduces vegetatively from underground stem structures (rhizomes). The stems root at the nodes along the stalk and can span of up to 40 feet in diameter allowing the species to grow as much as ten inches a day (Bossard *et al.* 2000). This growth rate produces a large amount of above-ground biomass that can quickly monopolize local resources and restrict native species. Giant reed has alternate leaves and a tall, plume-like head with closely packed flowers. From summer to early fall, the flowers are creamy-brown and the culms are green in color. Later the culms transition to brown during semi-dormancy through the winter months or drought (Bossard *et al.* 2000).

Effects on native environments by giant reed include exclusion of riparian species and subsequent reduction in wildlife habitat and species diversity. The species also reduces soil moisture through evapotranspiration rates three times that of native riparian species, converts channel morphology through trapping large amounts of sediment, and increases water temperature by providing little shade (Jackson 1998). Furthermore, giant reed has a shallow rooting system that is often uprooted by large precipitation events causing increased erosion. Finally, the massive amounts of biomass associated with giant reed are increasing fire frequency and intensity in riparian systems, which in turn hastens the process of conversion to monocultural stands of giant reed (Jackson 1998).

Sparse or small isolated clumps of giant reed of less than six feet in height or that occur in proximity to identified or other focal species can be removed by manual methods such as hand pulling, digging, using weed eaters, axes, and machetes. These removal measures are not always the most effective due to the resilience of underground rhizomes that easily resprout (Jackson 1998). Cut material is often burned onsite as it is difficult to chip the fibrous stalks as the massive amounts of biomass can cause problems to downstream facilities. However, fire should not be used as the primary removal techniques as it does not kill the underground rhizomes and plants regenerate rapidly with often greater levels of infestation due to the removal of native competitors. Currently, the most effective techniques for controlling giant reed is through chemical treatment (foliar and cut stump applications) of glyphosate-based herbicides. For large clumps or monocultural stands, foliar methods can be applied using a backpack, handgun or handwand or by aerial application (fixed or rotor wing). In order to use the cut stump method (for small patches), cut the plant at two to four inches above the surface and paint with a cloth covered wand or sponge or spray with a hand mister within two to five minutes from cutting (Jackson 1998). Both methods should be applied post-flowering and pre-dormancy, usually late August to early November when plants are translocating nutrients into root and rhizomes, at which time the rate of downward translocation of glyphosate is greatest.

Because the size and density of giant reed stands can vary substantially the method selected for a given site should be based specifically on the site conditions where it will be used. As such, it is not likely that multiple methods will be employed in removing this invasive within RMV. Each method exhibits advantages and disadvantages and the methods can often be used in combination to achieve the desired result. The primary consideration for giant reed eradication is the presence of identified and other focal species, such as the arroyo toad, and their proximity and use of the area where the removal will occur. It is recommended that no removal activity occur during the avian breeding/nesting season March 15 to September 15, unless surveys indicate that identified or other focal species are not present.

Other considerations include proximity to water, accessibility, topography, degree of infestation and costs.

There are five commonly used methods considered for this program.

Manual Removal -This method uses techniques like hand pulling, digging with a shovel, using a pick-ax, loppers or machete. It is usually most effective when dealing with plants that are less than six feet tall and easiest when the soil is loose (Bossard *et al.* 2000). This is the most favorable method when working in and around sensitive species. For more difficult stands of vegetation weed-whackers and chainsaws can be used. It is important to note that the rhizomes must be thoroughly removed, by sifting them from the soil, or the reeds will resprout this is a major disadvantage to manual removal alone. If conditions permit it can be followed up with a herbicidal treatment of any resprouts. Presumably, herbicide treatment following mechanical removal can be more focused than a broader herbicide treatment without prior mechanical removal.

The following giant reed or Arundo removal methods are adapted/summarized from the Santa Margarita and San Luis Rey Watershed Weed Management Area website (Santa Margarita and San Luis Rey Watershed Weed Management Area 2003).

> **Foliar Spray Herbicide Application** - This method involves herbicide application by spraying the stems and leaves of Arundo with no cutting. The most effective agent is a glyphosate based herbicide. If treatment is to occur in or adjacent to water then Rodeo®, which is the only product approved by the EPA for use in aquatic environments, must be used. When using this technique, it is important that leaves and stems are thoroughly sprayed (in some cases this is difficult due to the height of the vegetation and the presence of non-target native vegetation nearby). Pressurized sprayers (mounted on an ATV) and the use of ladders maybe helpful where the Arundo is tall. In some cases non-target plants can be trimmed if there is concern of overspray. The Arundo can be 'prepped' prior to spraying by pulling the stem away from non-target vegetation. The stems should not be cut too soon after the herbicide application otherwise the herbicide does not fully kill the plant and resprouting occurs. Due to the potential for resprouting, since the Arundo biomass remains in the ground, this method requires follow-up for at least three years and preferably five. Follow-up treatments require much less herbicide and effort. There is no mechanical disturbance to the soil or vegetation with this method and it should be consideration where endangered species such as the arroyo toad may be impacted,

or if there is concern about non-native herbaceous plant colonization post-treatment.

Cut Stem/Stump Herbicide Application- This method involves cutting the Arundo stems followed by immediate application of herbicide to the cut stem surface. Application can occur by spraying (generally with a backpack sprayer using glyphosate) or for smaller projects herbicide may be applied using a hand pump sprayer or a sponge dauber. There are varying success rates for this method, ranging from about 50% to 90% kill in the first year. The difference in success rate may be due to factors such as: size and age of the Arundo clump, proximity to water, herbicide concentration, time between cutting and herbicide application, etc. When this method is used, there is typically some degree of resprouting; therefore, this method almost always requires follow-up treatment. Follow-up treatment of resprouts can either be the foliar spray method or by repeating the cut and spray method.

Cut, Resprout, and Spray (using foliar herbicide application): This represents a combination of the cut and spray method and the foliar application method. The Arundo stems are cut and the plants are allowed to resprout. The resprouts are then sprayed using the foliar application method (described in the foliar application section). The best time to cut the Arundo and force resprouting is during the spring and summer. Resprouts should be treated when they are still relatively small and easy to reach, but enough time should elapse to ensure that a full 'crop' of resprouts are produced before spraying.

Mechanical Removal of Arundo Stems and Rhizomes - Mechanical removal of Arundo is effective where it is possible to remove entire rhizome. If any of the rhizome mass is left in the ground resprouting will occur. This method requires heavy equipment such as an excavator or other specialized equipment. Because this technique can be very time consuming and costly, an alternative approach includes less thorough excavation and then follow-up treatments with herbicide as described above. Resprouting from rhizome pieces that are left behind during the mechanical removal process can be treated with a foliar application of glyphosate herbicide. Alternatively, resprouting rhizomes can be excavated if the number is limited and manageable.

This method causes soil disturbance and may lead to colonization of predominantly non-native weedy herbaceous plants. Soil disturbance, may have both biological and regulatory consequences. Soil disturbance could result in impacts to aestivating arroyo toads and must be seriously considered. Furthermore, such soil disturbance may require authorizations from the Corps or CDFG.

Arundo Biomass Disposal – An important aspect to consider when conducting Arundo control is the handling and disposal of the dead Arundo biomass. When conditions allow, it can be left on site to decompose naturally over time. However, this is often not acceptable due to its potential as a flood or fire hazard, aesthetics, or the biomass may need to be removed for native re-planting. The cost of removing Arundo stems and disposing of them can be rather expensive. There are two commonly used options for dealing with the Arundo stems are chipping and mowing.

Conventional chippers often do not work well in chipping Arundo, however a high powered (at least 80hp) drum chipper has been shown to be effective. The high cost of high powered drum chipper rental is off set by the increased safety factor for workers, their production of finely chipped material, and their speed. The chipped material should be spread out for faster drying. Drum chipped material is similar to straw and could be used for similar purposes.

Mowing is carried out in place using a hammer-flail mowing attachment that is mounted on the front of a rubber-tired tractor. Alternatively, slope mowers and other mowing devices can be used. Generally, all these devices work very well on relatively flat even terrain. Some newer machines are articulated, allowing them to maneuver over more difficult terrain while others have been attached to a mechanical arm, allowing them to mow banks. Mowing is generally best suited to dense Arundo stands. Mowing dead cane is much easier and produces finely mulched material. The limitations to mowing include site access, terrain, amount of native vegetation, and noise issues.

The following eradication methods and timing in *Table 1* below are recommended for RMV.

TABLE 1
ERADICATION METHODS FOR
GIANT REED AND OTHER RIPARIAN INVASIVES

Method	Recommended Application	Time	Equipment	Advantage	Disadvantage
Manual	Best on isolated individual patches	Remove late summer to early fall	-Shovel -Weed wacker -Loppers -brush cutters	-No herbicide use -Low soil disturbance	-Low effectiveness -Resprouting likely to occur
Foliar Spray	Small or moderate stands of pure invasive	Spray late summer to early fall	-Sprayer (backpack or mounted) -Glyphosate Herbicide	-Low soil disturbance -Relatively effective	-Use of herbicide -Drift spray on non-target plants -leave above ground biomass
Cut Stem/Stump Spray	Large pure stands of invasive or for stands near or mixed with native vegetation	Cut & Spray late summer to early fall	-Weed wacker -Loppers -brush cutters -wand applicator -Glyphosate Herbicide	-Reduction of overspray on non-target -Can remove above ground biomass	-Resprouting likely to occur -Cost of removing biomass off site if necessary
Cut, Resprout, & Spray	Large pure stands of invasive	-Cut in spring - Spray resprouts late summer to early fall	-Weed wacker -Loppers -brush cutters -Sprayer (backpack or mounted) -Glyphosate Herbicide	-Reduction of overspray on non-target -Can remove above ground biomass	-Resprouting likely to occur -Cost of removing biomass off site if necessary
Mechanical	-Large pure stands of invasive	-Cut or mow canes outside of nesting season -Excavate in dry season	-Specialized excavator	-Root/ rhizome removal	-High soil disturbance -Some resprouting likely to occur if all roots are not removed

a. Site-Specific Eradication and Control Measures

1. San Juan Creek Watershed

Cañada Chiquita - PCR reported no giant reed occurrences in Cañada Chiquita and their review of previous investigations confirmed this. These areas should be monitored periodically and if patches appear they should be removed by mechanical methods following spot spraying.

Cañada Gobernadora - In previous investigations no giant reed was found in Cañada Gobernadora. However, the PCR survey found four isolated individuals of giant reed in two of the seven riparian reaches (two per reach) (*Figures 1* and *6*). This likely indicates a recent invasion. Arroyo toad habitat is located downstream of the giant reed location at the mouth of the creek, near its confluence with San Juan Creek. Least Bell's vireo nesting sites have been documented both upstream and downstream of giant reed locations and a southwestern willow flycatcher nesting site downstream only (PCR Services Corporation and Dudek & Associates, Inc. 2002). Although, these species have not been found to occupy the riparian reaches where the giant reed occurs, it is possible that they could use the areas and thus giant reed removal in this area warrants special precautions presumably outside the breeding season. In both riparian reaches, the giant reed can be removed by the foliar spray method or the cut stem/stump method.

San Juan Creek - The PCR investigation noted that of the 17 riparian reaches associated with San Juan Creek four were found to be dominated by giant reed, two have an abundance of the species and four more contained isolated individuals (*Figure 1, 7* and *8*]. The other investigations indicated a long standing presence of giant reed both onsite and upstream of RMV. A major population of arroyo toad occupies portions of San Juan Creek through RMV and nesting of least Bell's vireo has occurred in areas of the creek where eradication is proposed.

Eradication of giant reed in San Juan Creek will require a combination of techniques. Some portions of San Juan Creek may topographically allow for mechanical eradication. However, the majority of the giant reed removal in the creek should include foliar spray treatments where pure stands occur and the cut stem/stump method where native riparian habitat and sensitive species occur. Avoidance of native vegetation and minimization of soil disturbance to the extent possible will be an important consideration due to the potential presence of the arroyo toad.

Verdugo Creek - PCR found one isolated giant reed individual detected in a riparian reach of Verdugo Creek, there were no previous records of occurrence there, indicating a recent invasion (*Figures 1* and *8*). The arroyo toad may occur near the mouth of Verdugo Creek where it confluences with San Juan Creek. Because of its isolated distribution, and the potential impact on arroyo toads the foliar spray treatment or cut stem/stump method is appropriate here.

2. San Mateo Creek Watershed

Gabino Creek - PCR reported no giant reed occurrences in Gabino Creek and their review of previous investigations confirmed this. This area will continue to be monitored and a cut stem/stump method would be used if detected during future monitoring.

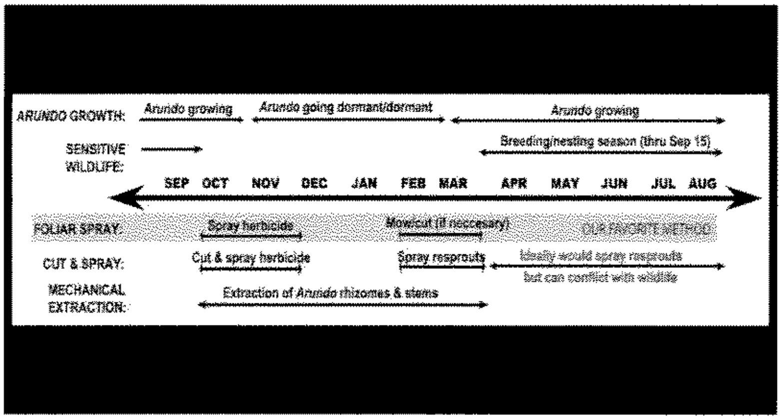
La Paz Creek - PCR reported no giant reed occurrences in La Paz Creek and their review of previous investigations confirmed this. This area will continue to be monitored and a cut stem/stump method would be used if detected during future monitoring.

Cristianitos Creek - Although previous investigations found no giant reed in Cristianitos Creek, the PCR survey found three scattered clumps of giant reed in the southernmost riparian reach of the creek within RMV [*Figures 1* and *9*]. These occurrences thus appear to be of recent origin. This reach of the creek is documented arroyo toad habitat and currently supports an important population in a key location. There also are least Bell's vireo nesting sites in the vicinity. In the areas of the creek where the giant reed occurs there is a broad canopy of willow riparian vegetation therefore the cut stem/stump method would be appropriate here. Access to the locations is good.

Talega Creek - PCR reported no giant reed occurrences in Talega Creek. This area will continue to be monitored and a cut stem/stump method would be used if detected during future monitoring.

Based on the findings of the PCR investigation and their review of previous investigations, the greatest infestation of giant reed occurs in the high order creeks, such as San Juan Creek. Infestations initially take hold in the mainstems of the high order creeks and from there they spread into the lower order tributary creeks, perhaps by cattle or human activities. Eradication efforts should first be concentrated on removing the isolated and scattered clusters of giant reed from the upstream low order tributaries and then focused on the larger downstream infestations in the mainstem creeks. This "watershed down" approach will prevent reinfestation of the mainstem creeks by ensuring that upstream infestations are controlled. In order to effectively accomplish watershed-wide eradication and control of giant reed, and so that reinfestation is minimized on RMV, it will be necessary to partner with upstream landowners/managers to ensure that upstream efforts are in place to manage infestations.

The graphic below depicts optimal treatment timelines of three common giant reed removal methods (Giessow 2002).



(From Santa Margarita and San Luis Rey Watershed Weed Management Area Website)

2.6.2 Priority 2 Species: Pampas Grass (*Cortaderia selloana*)

Pampas grass was introduced to the southern United States from South America. Pampas grass is a perennial herb that is known for its tall seed plumes and long leaves with sharply serrated edges. Mature plants produce large quantities of wind-dispersed seeds. Throughout its range in California, this species is found in wetland and riparian areas and in some upland habitats within a wide range of soil types and hydrologic regimes. However, within RMV, nearly all occurrences are within riparian areas or on the margins of riparian or wetland areas from where they can readily colonize the wetland and riparian areas. For purposes of this plan, this species is treated as a riparian species because its overwhelming potential for harm is associated with wetland and riparian areas. Where it occurs in uplands, it should be removed to limit potential threats to wetland or riparian areas. Apart from being planted as an ornamental species throughout southern California, this species colonizes areas disturbed by landslides, fire, and erosion. Its environmental effects are native species displacement through its quick seed germination and rapid growth. Plants produce millions of seeds that develop without pollination.

Seedling and medium size plants can be removed manually by pulling or digging when the soil is moist. Removal can be accomplished during winter or spring. The mature plants are more difficult to remove by hand and often require the use of a winch and a choker cable around the plant's base. Prior to removal, the inflorescences should be cut off and placed in bags to prevent further seed dispersal. When inflorescences are cut and left on bare ground germination may result. After removal, the plant should be removed from the site. If main roots are left behind, the cut-stump chemical treatment using glyphosate-based herbicides, at a 25 percent solution should be applied within two to five minutes. Plants should be checked about one month after application to determine the success of the herbicide treatment. Re-application may be necessary for mature individuals.

Strategies for elimination of pampas grass from a watershed area differ from those employed for giant reed, which generally is performed from the top of the watershed down. Pampas grass is dispersed by seed, and prevailing wind patterns must also be considered in determining strategies. Large source populations, such as occurs in the lower portions of Trabuco Creek between Oso Parkway and Avery Parkway should be subject to initial efforts with upstream areas that exhibit lower densities to follow once source of wind-blown propagules are eliminated.

a. Site-Specific Eradication and Control Measures:

1. San Juan Creek Watershed

Cañada Chiquita - Two isolated individuals of pampas grass were detected within two of the riparian reaches of Cañada Chiquita (*Figures 2* and *6*). These plants occur near locations previously documented to support least Bell's vireo nesting sites. There is easy access to these plants and they can be removed by hand, or the cut stem/stump method. Removal should be performed outside the nesting season.

Cañada Gobernadora - PCR reported no pampas grass occurrences in Cañada Gobernadora and their review of previous investigations confirmed this. This area will be monitored for future invasions, and plants will be removed as necessary.

San Juan Creek - Within six of the San Juan Creek riparian reaches there are scattered individuals of pampas grass and in two riparian reaches there are scattered clusters (*Figures 2, 7* and *8*). A major population of arroyo toad occupies portions of San Juan Creek where eradication is proposed. There is easy access to these plants and they can be removed by hand, cut stem/stump or foliar spray methods when conditions allow.

Verdugo Creek - PCR reported no pampas grass occurrences in Verdugo Creek and their review of previous investigations confirmed this. This area will be monitored for future invasions, and plants will be removed as necessary.

2. San Mateo Creek Watershed

Gabino Creek - PCR reported no pampas grass occurrences in Gabino Creek and their review of previous investigations confirmed this. This area will be monitored for future invasions, and plants will be removed as necessary.

La Paz Creek - Abundant occurrences of pampas grass were reported by PCR in one riparian reach of La Paz Creek and there are two isolated individual plants in another (*Figures 2* and *9*). In the reach characterized as abundant, the plants occur in patches around ponds and in some upland areas. These areas are in very close proximity to riparian reaches of Cristianitos Creek that support arroyo toad habitat noted as an important population in a key location. There is easy access to these plants and they can be removed by hand, cut stem/stump or foliar spray methods when conditions allow.

Cristianitos Creek - In two of the riparian reaches of Cristianitos Creek on RMV pampas grass is abundant and there are isolated individuals within four of the reaches (*Figures 2* and *10*). These reaches are known arroyo toad habitats, which support an important population in a key location, and there are some previously documented least Bell's vireo nesting sites in the southernmost reach of Cristianitos Creek on RMV. Those plants occurring in the upstream reaches are easily accessible and those in the downstream reach are more difficult to access. Removal can be accomplished by hand, cut stem/stump or foliar spray methods when conditions allow.

Talega Creek - PCR reported no pampas grass occurrences in Talega Creek and their review of previous investigations confirmed this. This area will be monitored for future invasions, and plants will be removed as necessary.

Pampas grass is most problematic in Cristianitos Creek with some patches of infestation in San Juan Creek that may be expanding. Previous investigations indicated that there were no invasive plants documented in Cristianitos Creek; therefore the invasion of pampas grass is recent and may be rapidly aggressive. Unlike the vegetative spread of the giant reed, pampas grass is dispersed by seed. It is likely spread through the watershed in a watershed up pattern, where coastal winds carry seeds up the valleys where these creeks are located. Therefore, a "watershed up" approach to eradication is appropriate for pampas grass eradication as noted above. Plants downstream should be removed first to prevent any more upstream infestations, in the meantime seed heads of upstream plants can be removed while downstream eradication is being implemented to prevent its spread further upstream.

In general, the same basic techniques used to remove giant reed can be used to control pampas grass- note the overview of pampas grass control methods above. However, pampas grass infestations on RVM are not as extensive as the giant reed infestation and the least aggressive control method options should be used when applicable.

2.6.3 Priority 2 Species: Castor Bean (*Ricinus communis*)

Castor bean was introduced to the southern United States from Asia and Africa where it was cultivated as an oil crop and grown as an ornamental plant. The species appears to have been naturalized below 1,000 feet in elevation throughout southern California. The species is found in riparian areas and upland habitats in full sun, but in wide range of soil types and hydrologic regimes. The species most commonly escapes from frequently disturbed areas such as agricultural fields, farm drainages and ditches, and along roadsides.

Castor bean is a perennial shrub that ranges in height from three to 15 feet, with alternating leaves on the stem, and deep green palmately lobed leaves. The species has monoecious flowers (separate male and female) and small round spiny fruit containing up to three shiny seeds that resemble ticks (Bossard *et al.* 2000). Propagation is through dropping seed near the parent plant and dispersing through moving water, disturbances, and, less likely, animals. This species is susceptible to cold temperatures and will often show signs of mortality within a 24-hour period at two degrees Fahrenheit or less (Bossard *et al.* 2000).

Its environmental effects are native species displacement through its quick seed germination, rapid growth, shading native seeds, and subsequently creating monotypic stands, thus lowering species diversity. Seed can germinate throughout the year depending on weather and a plant can grow up to six and a half feet in a single season (Bossard *et al.* 2000).

Seedling and medium size plants can be removed manually using a weed wrench in wet sandy soils, removing the bulk of the root system to insure that the plant does not resprout. If main roots are left behind, chemical treatment of 25 percent solution immediately following is recommended. Larger individuals should be removed using either the foliar spray treatment method or the cut-stump treatment using glyphosate-based herbicides: Rodeo® near aquatic sites, and Roundup® in upland areas at the prescribed minimum two percent solution with a non-ionic surfactant. If using the foliar spray method, the plants should be sprayed during active growth in the spring. For cut-stump treatments, use saws or loppers to remove the above ground biomass down to two to four inches in height and a 25 percent solution applied within two to five minutes. Plants should be checked about one month after application to determine the success of the herbicide treatment. Re-application may be necessary for mature individuals. All visible seeds should be removed.

a. Site-Specific Eradication and Control:

1. San Juan Creek Watershed

San Juan Creek - There are some isolated and scattered castor bean plants occurring within and along riparian reaches of San Juan Creek [*Figures 3, 7* and *8*]. In total these patches contain fewer than thirty plants [*Figures* 7 and *8*]. The same sensitive species concerns apply along these reaches of the creek as mentioned in previous sections. Most of the plants occur in accessible areas and can be removed manually, by the cut stem/stump or by the foliar spray techniques.

PCR reported no castor bean occurrences in Cañada Chiquita, Cañada Gobernadora, and Verdugo Creeks. Review of previous investigations indicated similar conditions. These areas will be monitored for future invasions, and plants will be removed as necessary.

2. San Mateo Creek Watershed

Cristianitos Creek - There is a substantial infestation of castor bean plants in the southernmost reach of Cristianitos Creek on RMV [Figure 3]. There are over 100 plants exhibiting moderate to high density in an upland area adjacent to the creek (*Figure 9*). This area is in the vicinity of known least Bell's vireo nesting sites, and also proximate to arroyo toad occupied habitat that is identified in the guidelines as an important population in a key location. Outside of breeding season these mostly upland areas can be treated using the foliar spray technique.

PCR reported no castor bean occurrences in Gabino Creek, La Paz Creek, and Talega Creek. Review of previous investigations found the same conditions. These areas will be monitored for future invasions, and plants will be removed as necessary. Castor bean has some limited infestations on RMV, the most notable occurring in the downstream reach of Cristianitos Creek. Manual eradication is the best method for removal within the flood plain and in the upland areas cut stem/stump or foliar spray techniques are acceptable when conditions are appropriate.

2.6.4 Priority 1 Species: Tamarisk (*Tamarix ramosissima*)

Tamarisk, also called saltcedar, is a many-branched shrub or tree with scale-like leaves and salt glands that exude salt crystals (Bossard *et al.* 2000). Like giant reed, tamarisk was introduced into the American Southwest from the Mediterranean region.

The genus has reddish brown stems, inflorescence of white or pink flowers, and is usually less than 26 feet tall. Four species of *Tamarix* have been identified as occurring in southern California, but *Tamarix ramosissima* is the species identified on RMV and is the only species expected to occur in the Habitat Reserve. This species is abundant where surface or subsurface water is available intermittently or perennially, including stream banks, ditches, and washes where saline soils are common. The species is also extraordinarily good at establishing disturbed sites such as recently burned, graded, or flooded areas where native vegetation has been removed. Tamarisk reproduces, in part, by vegetative growth; i.e., producing new plants from existing structures without sexual reproduction. The species flowers year round, allowing for individuals to propagate by seed and produce an estimated 500,000 tiny seeds per year that are easily dispersed by wind and water (Jackson 1998). As a result, this species is difficult to eradicate (Bossard *et al.* 2000).

Tamarisk adversely affects the stream environment by changing the geomorphology, groundwater availability, soil chemistry, fire frequency, plant community composition, and native wildlife diversity. Stream morphology is impacted through alteration of sediment regimes. The evapotranspiration rate of tamarisk is much higher than native vegetation and consequently is contributing to decrease base flows and lowed groundwater tables. Soil chemistry is altered and fire frequency is increased through the deposition of large amounts of saline leaf litter and fine woody debris. The reduction in native wildlife diversity is directly related to the reduction in habitat diversity and structure as areas convert to monocultures of tamarisk (Bell 1998).

Singly, and especially in combination the above-noted impacts of tamarisk, including changes in stream morphology, changes sediment regimes and reduction in water availability makes this species very undesirable in areas occupied or potentially occupied by the arroyo toad. Tamarisk poses a potentially serious threat to arroyo toad populations, if not addressed, and should be eliminated from areas such as Cristianitos Creek or Gabino Creek where it is established but in low enough numbers to be fully controllable. As noted above, Northrop Grumman has been very successful in controlling tamarisk within the reach of Cristianitos Creek that traverses the Northrop Grumman lease, providing a template for future control programs.

Hand removal of small trees and saplings is easiest if sediment is wet, loose, or sandy allowing for the entire root structure to be pulled out. However, complete eradication of adult tamarisk is especially difficult with only mechanical methods because the species is able to resprout vigorously following cutting or burning. Therefore, if biomass is removed initially in large infestations, follow up with herbicides when resprouting occurs is essential. Similar to giant reed, the most effective way of eradicating tamarisk is through the use of herbicides. Currently, six herbicides are used to combat the species: imazapyr-based (Arsenal®), triclopyr-based (Garlon 3A®, Garlon 4®, and Pathfinder II®), and glyphosate-based (Rodeo® and Roundup®). Unfortunately, only Rodeo® has an EPA approval for aquatic sites; therefore, infestations in creeks and streams would require initial removal of biomass followed by the cut-stump method in late spring or early fall during good growing conditions.

a. Site-Specific Eradication and Control Measures:

1. San Juan Creek Watershed

San Juan Creek- There are a few isolated clusters of tamarisk in the San Juan Creek riparian reaches which can be removed by hand (*Figures 4, 7* and *8*). The same sensitive species concerns apply along these reaches of the creek as mentioned in previous sections. Most of the plants occur in accessible areas and can be removed manually, by the cut stem/stump or foliar spray techniques where appropriate.

Previous investigations did not report tamarisk in Trabuco Creek, Chiquita Creek, Cañada Gobernadora and Verdugo Creeks. Similarly, PCR reported no tamarisk occurrences in Cañada Chiquita, Cañada Gobernadora and Verdugo Creeks. These areas will be monitored for future invasions, and plants will be removed as necessary.

2. San Mateo Creek Watershed

Cristianitos Creek - The southernmost riparian reach of Cristianitos Creek, just below the confluence with Blind and Gabino Creeks, has exhibited a substantial infestation of tamarisk (*Figures 4* and *9*); however, the areas within the Northrop Grumman lease have been subject to control and will be subject to continuing control for the life of the lease. This reach of Cristianitos Creek is in the general vicinity where least Bell's vireo nesting sites have been documented and within the arroyo toad habitat or potential arroyo toad habitat. Due to the extent of the infestation the cut stem/stump or foliar spray treatments should be considered for use here outside of breeding/nesting seasons. As noted above, control of tamarisk in this area is important for the arroyo toad and would be among the first areas where invasive species eradication should begin.

Gabino Creek - Three of the riparian reaches of Gabino Creek (LP-13, LP-14, and LP-15) support scattered clusters of tamarisk (*Figures 4* and *9*). These areas are in very close proximity to reaches of Gabino Creek and Cristianitos Creek that are known arroyo toad habitat, which have been identified in the guidelines as an important population in a key location. There is easy access to these plants and they can be removed by hand, cut stem/stump or foliar spray methods when conditions allow.

PCR reported no tamarisk occurrences in Talega and La Paz creeks. These areas will be monitored for future invasions, and plants will be removed as necessary. Tamarisk presents the same removal challenges as giant reed therefore the same techniques should be used to eradicate it. This plant reproduces both vegetatively and by seed dispersal making it difficult to control. Like pampas grass the seeds are easily carried by wind and water and should be subject to the "watershed up" approach in control efforts.

2.6.5 Priority 3 Species: Tree Tobacco (*Nicotiana glauca*)

Tree tobacco was introduced to the southern United States from South America. This species is believed to have naturalized in waste places below 3,000 feet in elevation. The species is found in riparian areas and upland habitats and is commonly found in frequently disturbed areas such as drainage ditches and roadsides. Tree tobacco is a perennial woody, evergreen shrub that ranges in height from six to 20 feet, with erect sparsely branched stems and long, tubular yellow flowers. The capsule fruit produces many seeds that are dispersed by wind and water.

This species of tobacco has been used ritually and medicinally by man, but due its to high level of alkaloids it can be deadly. This plant's toxicity also makes it dangerous to grazing wildlife. It establishes rapidly in disturbed or recently burned areas, preventing reestablishment of native plants. The long yellow flowers are attractive to hummingbirds, making it a popular and readily available ornamental species. Its widespread appeal with gardeners and its ability to disperse well have made this a successful invader.

Seedling and small plants can be removed by hand pulling. For larger individuals, stump treatment with glyphosate-based herbicides is recommended. The plants should be treated in spring when actively growing. A phased treatment is recommended, starting with horizontal cutting close to the ground using a saw, rotary brush cutter, or similar tool (Bossard *et al.* 2000). All the cut vegetation should be removed from the vicinity the same day it is cut and disposed of at an authorized dump site. Later, the stumps or stems should be re-cut, cleared of sawdust, and immediately painted with a 100 percent glyphosate-based herbicide within two minutes of cutting before the cut surface begins to congeal to ensure penetration of the herbicide (Bossard *et al.* 2000). Plants should be checked a month after application to determine the success of the herbicide treatment. Any re-growth from the treated stumps should be treated with the foliar herbicide application in the same season or as re-growth appears in the next growing season.

a. Site-Specific Eradication and Control:

1. San Juan Creek Watershed

Cañada Chiquita - There are four riparian reaches (CH-02, CH-04a, CH-06a and CH-06b) with isolated clusters of tree tobacco, two with scattered clumps, and one with abundant numbers along Cañada Chiquita (*Figures 5* and *6*). These plants occur near locations where there are documented or at least potential least Bell's vireo nesting sites. There is easy access to these plants and they can be removed by hand or the cut stem/stump methods.

Cañada Gobernadora - There were no previous reports of tree tobacco in Cañada Gobernadora; however, PCRs investigation noted that there are now two reaches (GO-02 and GO-07) with isolated individuals of tree tobacco and one with numerous large individuals [Figure 5 and 7]. There is a major population of arroyo toad downstream where Gobernadora Creek discharges to San Juan Creek. There have been documented least Bell's vireo nesting sites in both upstream and downstream locations and southwestern willow flycatcher nesting site downstream in The Gobernadora Ecological Restoration Area (GERA). These species have been shown to occupy reaches of the creek supporting tree tobacco, thus eradication in these reaches may warrant special precautions. This invasive should be removed by hand or the cut stem/stump treatment method.

San Juan Creek - In San Juan Creek there are four riparian reaches (SJ-05, SJ-09, SJ-15, SJ-15) with scattered clusters of tree tobacco (*Figures 5, 7* and *8*). A major population of the arroyo toad occurs along San Juan Creek on RMV. In addition nesting of least Bell's vireo is documented in areas of the creek where eradication is proposed. Thus eradication of tree tobacco in this creek warrants special precautions. This invasive should be removed by hand or the cut stem/stump treatment method.

Verdugo Creek - PCR found tree tobacco to be abundant in one riparian reach in Verdugo Creek, scattered in three areas, and isolated in three areas (*Figures 5* and *8*). There were no previous records of occurrences in Verdugo Creek, indicating a recent invasion. The arroyo toad may occur near the mouth of Verdugo Creek at the confluence with San Juan Creek. To avoid potential impacts, tree tobacco should be removed by hand or the cut stem/stump method.

2. San Mateo Creek Watershed

Gabino Creek - Although there were no documented occurrences mapped of tree tobacco in Gabino Creek, PCR did locate numerous scattered clusters of the plant in their investigation (LP-10, LP-12, LP-15, and GA-18), thus possibly indicating a recent invasion (*Figures 5* and *9*). The downstream riparian reaches of Gabino Creek support an important population of the arroyo toad and overlaps where eradication for tree tobacco is necessary. The invasive should be removed by hand or by the cut stem/stump method.

There is also a concentration of tree tobacco in Blind Canyon Creek, upstream of the confluence with Gabino Creek (BL-01, BL-02, and BL-03). The invasive should be removed by hand or by the cut stem/stump method.

La Paz Creek - Tree tobacco was recorded in one riparian reach of La Paz Creek, immediately upstream of the confluence with Gabino Greek (*Figures 5* and *9*). The entire downstream reach of Gabino Creek is known to support a major arroyo toad population in this a key location. Tree tobacco is rather abundant in this area as noted above). Hand removal is the best option for removal in La Paz and Gabino with the sensitive species concerns but due the heavy infestation the cut stem/stump method is more practical if implemented outside of the breeding season.

Cristianitos Creek - In one of the upstream riparian reaches of Cristianitos Creek tree tobacco was reported as dominant. It was found to be scattered within four reaches and isolated in three, essentially appearing along the entire mainstem of the creek (*Figures 5* and *9*) These reaches are included a major population of arroyo toad in this key location. Also, there are some previously documented least Bell's vireo nesting sites in the southernmost reach of Cristianitos Creek on RMV. As with La Paz Creek, the sensitive species issues warrant hand removal. However, the high degree of infestation could be better dealt with using the cut stem/stump method in this location.

PCR reported no tree tobacco plant occurrences in Talega Creek. These areas will be monitored for future invasions, and plants will be removed as necessary.

2.6.6 Priority 2 Species: Spanish Sunflower (*Pulicaria paludosa*)

Spanish sunflower is a large herb to small shrub of Mediterranean origin. This species was first collected in California in the early 1960s and was first described as occurring in California by Raven in 1963 (Raven 1963).

This large herb to small shrub commonly reaches up to three feet tall (sometimes four) and exhibits multiple branches, each which has numerous flowering heads, each which produces numerous seeds. Exact dispersal mechanisms are unknown, but given the success that this species exhibits along streams and in seasonally wet areas, it is likely that the seeds float and can be transported along streams via floods. Once established, this species can form dense monocultures, crowding out most understory species. Although this species grows in full sun in wet environments, it also appears to tolerate shade well and can form dense thickets in the understory of willow riparian forest.

The ability of the Spanish sunflower to form dense monocultures is troublesome because it can dominate the herb layer once established, crowding out native hydrophytes such a *Juncus* spp., *Eleocharis* spp., and *Carex* spp. This species also occurs in habitats that support special-status plants such as southern tarplant (*Centromadia parryi var. australis*), Coulter's saltbush (*Atriplex* *coulteri*), salt spring checkerbloom (*Sidalcea neomexicana*), and mud nama (*Nama stenocarpum*).

In Orange County, this species has only recently been recognized as an invasive exotic that exhibits the potential for adverse impacts to native riparian and wetland habitats. As such, effective control techniques have not yet been developed.

a. Site-Specific Eradication and Control:

Because this species has been detected within wetland restoration/mitigation sites associated with the GERA as well as in Chiquita Canyon, it has been subject to eradication efforts. It has also been identified as patchy in San Juan Creek and Cristianitos Creek but, has not been subject to removal in these areas. To date, the primary methods of control have been hand weeding. Foliar spraying has not been implemented; however, a pilot spraying program might be useful to begin development of a long-term approach to controlling this species. Removal in areas where it is beginning to occur may be important because removal during the early stage of infestation would likely have a higher chance of success.

1. San Juan Creek Watershed

Cañada Chiquita - Spanish sunflower occurs within the willow understory associated with Chiquita Creek. To date it has not become a dominant understory component, but early eradiction is recommended.

Cañada Gobernadora - Spanish sunflower occurs within the willow understory associated with Gobernadora and it also occurs within portions of the GERA where it has been subject to control efforts. In some areas along Gobernadora Creek, this species forms dense monocultures and intensive eradication efforts should be undertaken.

San Juan Creek - Spanish sunflower occurs within the willow understory associated with San Juan Creek. To date it has not become a dominant understory component, but early eradiction is recommended.

Verdugo Creek - Spanish sunflower does not occur with regularity in Verdugo Creek. Eradication efforts are not recommended at this time, but the area should be periodically monitored for future infestations.

2. San Mateo Creek Watershed

Gabino Creek - Spanish sunflower does not occur with regularity in Gabino Creek. Eradication efforts are not recommended at this time, but the area should be periodically monitored for future infestations.

La Paz Creek - Spanish sunflower does not occur with regularity in La Paz Creek. Eradication efforts are not recommended at this time, but the area should be periodically monitored for future infestations.

Cristianitos Creek - Spanish sunflower occurs within the willow understory associated with Cristianitos Creek to date it has not become a dominant understory component, but early eradiction is recommended.

Talega Creek - Spanish sunflower does not occur with regularity in Talega Creek. Eradication efforts are not recommended at this time, but the area should be periodically monitored for future infestations.

2.7 Upland Species

2.7.1 Priority 1 Species: Artichoke Thistle (*Cynara cardunculus*)

Artichoke thistle escaped cultivation and began to infest California rangelands in the 1860s. This plant is native to the Mediterranean and has taken well to the similar climate is California. It has also been introduced into South America and Australia. Also known as wild artichoke and cardoon this spiny wild type differs form the cultivated globe artichoke which produces an edible flowerhead.

This very prickly perennial can reach five feet in height and has a taproot that can grow down nearly six feet deep. Each plant can have three to five or more flowerheads which each produce hundreds of seeds (DeSimone 2002). Artichoke thistle has large heavy seeds. They can be spread by water and animals, but typically are deposited within only six feet of the parent plant. The flower looks like a striking purple ball of bristles with pinnate petals. This invasive is common in annual rangelands, disturbed grasslands, and can be found up to 1,650 feet elevation throughout the state (Bossard *et al.* 2000). It is also found in riparian, coastal sage scrub, native grassland, and chaparral vegetation communities where it poses a larger ecological threat in these native habitats.

Due to its unpleasant spines and dense patches this invasive plant inhibits cattle and wildlife movement. Its inhibitive nature and root system displaces native vegetation. Occurring mostly in upland areas in coastal regions artichoke thistle competes with native vegetation for space, water, and nutrients. Although some birds and other animal species are known to feed on the pollinators of the plant or its seeds, overall it is ecologically less valuable because it provides very limited habitat value for wildlife.

The spiny nature of artichoke thistle makes it a difficult species to remove manually, but it can be done. Although difficult, when plant densities are low hand removal is possible. It is important to remove as much of the taproot as possible; if not removed entirely plants can resprout. Root plowing can be done to remove roots. One way of preventing the spread of the thistle is to cut the seed heads off, when removal of the entire plant is not possible. The cut stump treatment with the application of glyphosate-based herbicide can be affective for thistle removal. For artichoke thistle this would involve removing the top growth of the plant with brush cutters and quickly applying a glyphosate solution to the stump (Bossard *et al.* 2000). This method is appropriate where foliar spray treatment could adversely affect surrounding vegetation and wildlife. This species can have a seed bank that lasts for up to five years, often several treatments maybe necessary.

A detailed plan for artichoke thistle eradication has been prepared for the Ladera Open Space by RMV and is attached as Appendix A. Methods described in this plan are appropriate for use on RMV.

a. Site-Specific Eradication and Control:

1. San Juan Creek Watershed and San Mateo Creek Watershed

Based on observations made during general reconnaissance, jurisdictional delineation visits, and focused botanical surveys no areas of RMV have significant infestations of artichoke thistle. On going treatment of Artichoke thistle has occurred on RMV property for over 30 years. This spot and treat (spraying plants with an approved herbicide) method along with cattle grazing has kept this invasive suppressed on RMV lands. However, continued control is needed as this invasive is problematic on adjacent lands and could readily invade portions of RMV if neglected.

2.8 Implications of Control Methods for Invasive Plants

Removal and control of primary riparian invasive plants, including giant reed, pampas grass, castor bean, tamarisk, tree tobacco, and Spanish sunflower will increase ecosystem functions and habitat quality throughout RMV and the surrounding areas. Removal of these invasives immediately benefits native plants. Native plants like willows (*Salix* spp.) and mulefat (*Baccharis salicifolia*) will no longer compete with the invasive plants for space, soil moisture, nutrients, and other resources. Areas where removal occurs become available for revegetation by native species. In some locations where invasive plants have been cleared, depending on the extent of the area, it maybe appropriate plant plugs or seeds of natives in order to enhance their chances of reestablishment and to avoid rapid re-colonization of unwanted invasives. Increased native species cover increases nesting and foraging habitat for riparian bird species. Giant reed and the other targeted invasives overall provide poor habitat for native insects, birds and other species. Giant reed, for example, excludes native riparian species, causing an increase in water temperatures of streams as a result of not providing the shading typical in riparian areas, which in turn, reduces the aquatic habitat quality (Bossard *et al.* 2000).

Upland vegetation and animal communities will benefit from the removal of artichoke thistle. Artichoke thistle eradication will allow for ecologically valuable native species to reestablish in areas where the thistle has been cleared. Birds like the threatened California gnatcatcher and other scrub birds will benefit from the potential increase in coastal sage scrub habitat. Areas cleared of thistle, particularly wildlife corridors, will enable wildlife to move and disperse more readily.

Impacts of giant reed and the other targeted riparian invasives removal on riparian habitats vary based on removal methods. Manual removal with hand tools causes little to no impact except for the temporary disturbance while removal is being completed. It is important that all eradication and control efforts occur outside of the breeding/nesting season so as not to disturb the wildlife during this sensitive period. Heavy mechanical removal methods can cause soil disturbance and consequent sediment and debris loading of streams. Impacts of chemical removal treatments can include inadvertent spraying of non-target plants and accidental contamination of waterways if type and directions of chemicals is not closely monitored. Impact concerns with the upland removal of artichoke thistle also include inadvertent spraying of non-target plants and disruption to wildlife.

2.9 Performance Standards

Performance standards associated with eradication of the invasive exotic plant species are set forth below. As noted above, removal of giant reed and pampas grass is proposed as a component of compensatory mitigation that will be implemented to ensure no-net-loss of wetland/riparian area and function within the RMV Open Space. Because eradication of these particular species will be part of the mitigation program for impacts to Corps and CDFG jurisdictional waters specific performance standards have been developed. While it is recognized that one of the primary goals associated with removal of these species is enhancement and expansion of habitat for special-status species such as the arroyo toad and least Bell's vireo, the performance standards relate directly to the effectiveness of the eradication efforts. Successful eradication of giant reed and pampas grass will result in enhanced hydrology, natural fire regimes, natural sediment regimes, and habitat structure conducive to occupation by both special-status and common native wildlife species. As such, performance standards are aimed at measuring the effectiveness of the eradication efforts.

2.9.1 Giant Reed, Tamarisk[7], and Pampas Grass

Because the level of infestation for these species is higher than for the other wetland/riparian invasives, the following performance standards will be applied to these species alone. A description of performance standards for castor bean, tree tobacco, and Spanish sunflower is provided below.

Standard Vegetation Monitoring procedures (see below for detailed description of proposed monitoring methods) will be employed, regardless of which eradication methods (e.g. foliar spray, mechanical removal, cut-stump method, etc.) are used to eradicate giant reed, tamarisk, and pampas grass.

- **First-Year Monitoring.** During the first year, beginning one month from eradication efforts monitoring will occur every month. One quantitative survey will be performed during the first year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the first year:

  -- 50-percent reduction in coverage of live giant reed, tamarisk, or pampas grass (5-percent deviation allowed);

  Treatment will be required during the first year, with timing to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the first year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG.

- **Second-Year Monitoring.** During the second year, beginning one month from eradication efforts monitoring will occur every other month. One quantitative survey will be performed

[7] Tamarisk is a Priority 1 species and poses substantial risk to stream geomorphology, sediment regimes, and water availability for native plants and animals. As such, early and ongoing control will be important.

during the second year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the second year:

-- 70-percent reduction in coverage of live giant reed, tamarisk, or pampas grass (5-percent deviation allowed);

Treatment will likely be required during the second year, with timing and method to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the second year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG.

- **Third-Year Monitoring**. During the third year, beginning one month from eradication efforts monitoring will occur every quarter. One quantitative survey will be performed during the third year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the third year:

  -- 80-percent reduction in coverage of live giant reed, tamarisk, or pampas grass (5-percent deviation allowed);

  Treatment will likely be required during the third year (though substantially reduced), with timing and method to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the third year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG.

- **Fourth-Year Monitoring**. During the fourth year, beginning one month from eradication efforts monitoring will occur every quarter. One quantitative survey will be performed during the fourth year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the third year:

  -- 90-percent reduction in coverage of live giant reed, tamarisk, or pampas grass (5-percent deviation allowed);

  Treatment may be required during the fourth year (though substantially reduced), with timing and method to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the fourth year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG.

- **Fifth-Year Monitoring**. During the fifth year, beginning one month from eradication efforts monitoring will occur every quarter. One quantitative survey will be performed during the fifth year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the fifth year:

  -- 100-percent reduction in coverage of live giant reed, tamarisk, or pampas grass (0-percent deviation allowed);

  Treatment will likely not be required during the fifth year; although, it will be performed as necessary, with timing and method to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the fifth year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG. If treatment is required during the fifth year, monitoring will be performed during the sixth year to verify that giant reed and/or pampas grass have been removed as set forth above.

2.9.2. Castor Bean, Tree Tobacco, and Spanish Sunflower

Because the level of infestation for these species is lower and eradication typically requires only one or two treatments, a less intensive approach is required (as data is collected on the efficacy of the treatment approaches and the relative success, species may be shifted to more comprehensive monitoring programs as appropriate).

Standard Vegetation Monitoring procedures (see below for detailed description of proposed monitoring methods) will be employed, regardless of which eradication methods (e.g. foliar spray, mechanical removal, cut-stump method, etc.) are used to eradicate castor bean, tree tobacco, tamarisk, and Spanish sunflower.

- **First-Year Monitoring**. During the first year, beginning one month from eradication efforts monitoring will occur every month. One quantitative survey will be performed during the first year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the first year:

  -- 60-percent reduction in coverage of live castor bean, tree tobacco, and Spanish sunflower (5-percent deviation allowed);

Treatment will be required during the first year, with timing to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the first year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG.

- **Second-Year Monitoring**. During the second year, beginning one month from eradication efforts monitoring will occur every other month. One quantitative survey will be performed during the second year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the second year:

  -- 80-percent reduction in coverage of live castor bean, tree tobacco, and Spanish sunflower (5-percent deviation allowed);
  Treatment will likely be required during the second year, with timing and method to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the second year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG.

- **Third-Year Monitoring**. During the third year, beginning one month from eradication efforts monitoring will occur every quarter. One quantitative survey will be performed during the third year to determine growth by re-sprouting plants or re-colonization. The following performance standards will be achieved at the end of the third year:

  -- 100-percent reduction in coverage of live castor bean, tree tobacco, and Spanish sunflower (0-percent deviation allowed);

  Treatment will likely be required during the third year (though substantially reduced), with timing and method to be determined by the project biologist based upon phenology of the treated plants and the potential presence of resident or migratory special-status species. At the end of the third year, a report summarizing the success of the eradication efforts will be prepared and submitted to the Corps and CDFG. If treatment is required during the third year, monitoring will be performed during the fourth year to verify that castor bean, tree tobacco, and Spanish sunflower have been removed as set forth above.

2.10 Monitoring Methods

A variety of monitoring methods are appropriate to use in determining success of the eradication program. Appropriate methods include standard vegetation transects, use of high-resolution aerial photographs, or in some instances, the releve approach (Mueller-Dombois 1974). The approach used at any given site will be dictated by the density and distribution of giant reed, tamarisk, and/or pampas grass prior to implementation of eradication efforts. In all instances, direct visual inspection on a regular basis will provide the most reliable and meaningful information. The annual quantitative sampling will provide important information regarding trends but direct observations of treated areas will be a key component of any eradication program. Under any monitoring regime, it will be necessary to accurately record the pre-removal conditions to provide a baseline against which subsequent years can be measured.

2.10.1 Aerial Photographs

For areas where giant reed, tamarisk, or pampas grass are particularly dense, making access difficult and performance of vegetation transects impossible, aerial photographs will be used to monitor the performance of specific sites. The use of aerial photographs will require that annual flights with low-altitude photographs of target areas obtained. Where this method is employed, walking transects will be performed and the percentage of untreated, re-sprouting, or re-colonizing giant reed or pampas grass will be recorded. All surviving giant reed, tamarisk or pampas grass will be marked on maps or flagged in the field for future treatment.

2.10.2 Vegetation Transects

For areas that are accessible, sampling will be conducted using the point-intercept sampling method. This sampling method is based on a 50-meter long point-transect centered in a 50-meter by 2-meter belt plot. At each 0.5-meter interval along the transect (beginning at the 50-cm mark and ending at 50-meter) a point is projected vertically into the vegetation. Each living/surviving giant reed and/or pampas grass intercepted by the point will be recorded, providing a tally of hits for these species. Percent cover for each invasive species can be calculated.

2.10.3 Releve Method

For areas of low-density infestations of giant reed or pampas grass, it may not be possible to detect many of the individuals of the giant reed, tamarisk or pampas grass on the photographs. Similarly, transects may miss many of the individuals. In such cases, the releve approach, which depends on visual estimates by trained vegetation ecologists can be used. Similar to the approach used with aerial photographs, this method requires percent estimates of living, surviving and/or recolonizing giant reed and/or pampas grass. When using this method, all individuals subject to future treatment should be marked with flagging tape so as not to be missed by personnel responsible for treatment/eradication.

CHAPTER 3: INTRODUCED VERTEBRATES

3.1 Background for Invasive Animals

As discussed in the invasive plant section above, biologists consider exotic, or non-native, species to be one of the greatest threats to ecosystem function. Many experts believe the threat to be at least as severe as habitat loss. In terms of exotic vertebrates, RMV has a nearly full complement of the exotic vertebrates known to occur in Orange County. Many of the introduced species appear to have a relatively innocuous and do not appear to be obviously detrimental to the native fauna. However, some exotic species are known to pose a serious threat to the persistence of several native species of amphibians and birds. While most of the exotic vertebrates present on RMV are aquatic, including the bullfrog (*Rana catesbeiana*) and several species of fish, there are also four mammals and four bird species that have become well established.

While exotic mammals on the ranch appear to be having little negative impact on native populations, some introduced birds, amphibians, and fish are thought to be part of the root cause behind the federal endangered species listing of the least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), coastal California gnatcatcher (*Polioptila californica californica*), arroyo toad (*Bufo californicus*), and California red-legged frog (*Rana aurora draytonii*). Several amphibian declines in the western United States have been associated with introduced aquatic predators (Doubledee *et al.* 2003). Furthermore, several Orange County species of now rare to uncommon, but currently unlisted, amphibians and reptiles (e.g., western pond turtle, red-sided garter snake, two-striped garter snake, coastal glossy snake) are thought to have suffered from population declines as a result of exotic amphibians and fish. The two exotic vertebrate species that pose the most serious threat to the greatest number of native species on RMV at this time are the bullfrog and the brown-headed cowbird (*Molothrus ater*). Crayfish (*Cambarus clarkia*), which are common in San Juan Creek and portions of Gobernadora Creek, also pose a threat to the arroyo toad and are addressed in this plan in conjunction with the bullfrog, as bullfrog control efforts would also serve to control crayfish.

Although predation by introduced bullfrogs is only one of the factors negatively impacting native populations, it is one that can no longer be ignored. While red-legged frogs have not been observed on RMV since the mid 1960s, the impact of bullfrogs on this species has been well documented in other locations throughout California (Jennings and Hayes 1985). Several experiments, field studies, and observations have found red-legged frog abundance to be negatively correlated with the presence of bullfrogs (Doubledee *et al.* 2003). Of greatest concern at this time is the impact that bullfrogs are having on arroyo toad populations within the San Juan Creek and San Mateo watersheds. Loss of habitat, coupled with habitat modification, degradation and loss in central and southern California, as well as predation from introduced aquatic species, caused arroyo toads to disappear from about 75 percent of previously occupied habitat in California (Jennings and Hayes 1994).

Brown-headed cowbirds, which lay their eggs in the nests of other species, have been shown to significantly lower productivity in several species of songbirds, including least Bell's vireo (USFWS 1998). Cowbirds also parasitize willow flycatcher (Sogge *et al.* 1997) and California gnatcatcher nests. Although cowbird parasitism nearly always causes lowered individual productivity, the overall range-wide impact to flycatcher and gnatcatcher populations appears to be negligible. However, when there are only a few breeding individuals, as is the case of the willow flycatcher on RMV, the effects of brood parasitism are obviously detrimental.

Arroyo toad breeding distribution is potentially affected by the presence of crayfish in San Juan Creek. Any future detailed survey of arroyo toad populations in San Juan Creek should also survey for the presence of crayfish. The arroyo toad and crayfish evolved independently of each other suggesting that arroyo toad larvae may be considerably more vulnerable than bullfrog tadpoles, which share the same historic distribution with crayfish. Arroyo toad tadpoles being relatively small detrital feeders are more vulnerable to crayfish predation than the huge algal feeding bullfrog larvae. As discussed below under Section 3.5, eradication efforts aimed at controlling the bullfrog will also serve to control crayfish.

This section of the invasive species control plan is intended to lay out the groundwork for controlling, and in some cases hopefully eliminating, the most threatening exotic animal species present on RMV at this time.

3.2 Existing Setting

The current exotic mammal list on RMV includes Virginia opossum (*Didelphis virginiana*), black rat (*Rattus rattus*), house mouse (*Mus musculus*) and house cat (*Felis cattus*). The first three species are established throughout the ranch, with non-native grasslands as the habitat where these species are most often found. For the most part, black rats are uncommon while the house mouse is ubiquitous across the landscape. Opossum, black rat, and house mouse populations have been established in this area for probably over a century, and are thus unlikely to be successfully controlled. All three species thrive in urban environments and on the urban/wildland interface. At this time it is not clear what, if any, direct negative impacts these species are having on local ecosystem health. At the very least, these species may be potential indicators of degraded habitat quality.

The house cat is recognized as a major exotic predator of small native fauna, and has had a measurable impact on native southwestern California animal populations. Impacts of house cats on native fauna in Orange County have not been scientifically measured, but are believed to be significant. At present, healthy coyote and possibly mountain lion populations on RMV may be helping to prevent feral house cat populations from becoming established. Domestic house cats wandering onto ranch lands are also subject to predation by larger native carnivores.

Excluding the occasional parrot species escapee, there are currently four exotic bird species that inhabit RMV on a regular basis: brown-headed cowbird (*Molothrus ater*), European starling (*Sturnus vulgaris*), rock dove (*Columba livia*), and house sparrow (*Passer domesticus*). Only two of these species, the brown-headed cowbird and European Starling are known to have major negative impacts on native bird species. The cowbird is a nest parasite, laying its eggs in native species nests, while the starling competes with native birds for nest cavities. The rock dove and house sparrow are considered urban species, but they also live on the edge of natural habitats. While the house sparrow tends to be a bird of mainly urban environments, the rock dove may travel long distances away from urban areas. On RMV rock doves regularly visit agricultural fields in Cañada Gobernadora and Cañada Chiquita. However, the impact of the rock dove is probably positive since it feeds mainly on non-native plant seeds and is a regular prey item for several pairs of resident hawks.

Aquatic exotic predators currently known to occur on RMV include the bullfrog, mosquito fish (*Gambusia affinis*), catfish (*Ictalurus punctatus*), crayfish (*Cambarus clarkii*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*Micropterus dolomieui*)), and bluegill (*Lepomis macrochirus*).

3.3 Problematic Introduced Predators on RMV

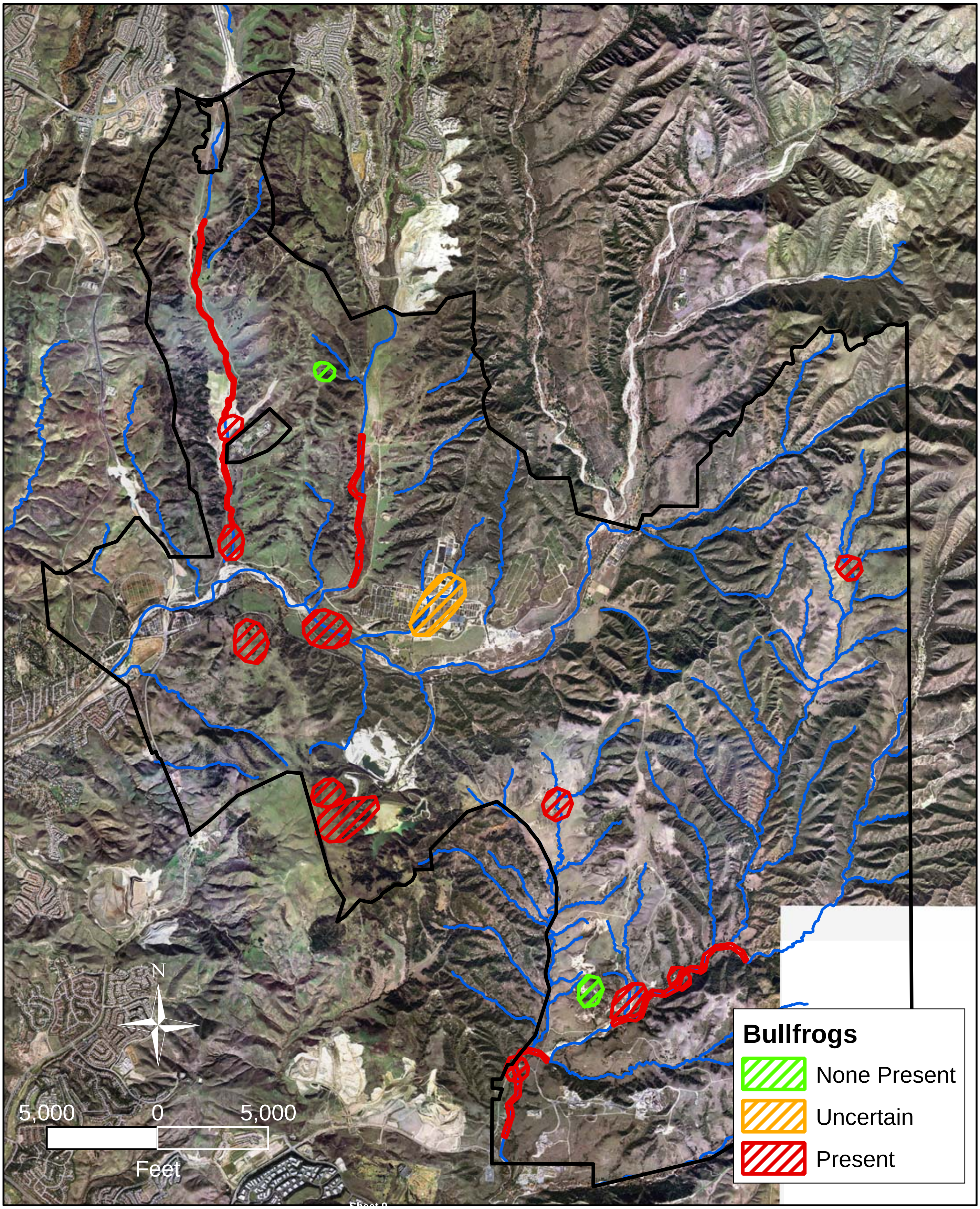
The following introduced aquatic and bird species appear to be having the most significant impact on local bird and amphibian populations, and thus will be dealt with in more detail.

Bullfrog. The bullfrog is a large amphibian with a voracious appetite that feeds on any living thing that it can fit into its mouth, from arthropods, fish, tadpoles, and snakes, to bats and birds. One individual was even observed attempting to swallow an adult American coot (*Fulica americana*) in Gabino Reservoir (R. Jackson, pers. com). It is also cannibalistic and commonly preys upon its own young. Native to southeastern United States, the bullfrog has since been introduced to the southwestern states where it has proliferated and expanded its range. This is explained in part by the fact that bullfrogs have few natural predators and can produce up to 20,000 eggs per female frog per year. Bullfrogs require permanent water for successful reproduction, and its larvae require two years to develop. Tadpoles require only perennial water and grazeable plant material; hence, transforming young can sustain a dense adult bullfrog population even if alternate prey is depleted (Rosen and Schwalbe 1995).

Bullfrogs have been blamed as part of the cause for amphibian population declines in much of western North America (e.g., Hayes and Jennings 1986, Leonard *et al.* 1993, Vial and Saylor 1993). The bullfrog has been implicated in the decline of the California red-legged frog (Doubledee *et al.* 2003), a federally listed threatened species and once a common southwestern California frog and resident amphibian on RMV. It has also been suggested that the bullfrog has played a role in the decline of the federally listed endangered arroyo toad, evidenced by the presence of individuals found in the stomachs of bullfrogs collected from San Juan Creek (R. Ramirez pers. comm.) and San Mateo drainage (J. Kidd pers. comm.). If allowed to go unchecked, bullfrogs will likely play a significant role in the continued downward population trend of garter snakes and pond turtles in Orange County.

The ponds and creeks on RMV support healthy populations of bullfrogs (*Figure 10*). When full, Gabino and Calmat (San Juan Creek) reservoirs each produce thousands of metamorphs annually (P. Bloom pers. obs.). Historically, bullfrogs likely arrived by dispersal from stock and irrigation ponds outside the ranch, but may also have arrived via fisherman using the larvae as bait, or simply as a result of someone's personal affinity for the call of the bullfrog. Most of the small to large ponds on the ranch are occupied by breeding bullfrogs, although some ponds are ephemeral and preclude successful bullfrog reproduction. Likewise, Gabino, La Paz, Cristianitos, Chiquita and Gobernadora creeks all contain bullfrogs, but usually only metamorphs. Permanent ponds within these drainages are occupied year-round by adults and represent the sources for most temporary ponds that dry up.

Brown-headed cowbird. The brown-headed cowbird is native to the central plains of North America, where it apparently co-evolved with the American bison (*Bison bison*). When the bison was essentially eliminated, the brown-headed cowbird's range and numbers expanded westward with the increase in cattle grazing and irrigated agriculture. While the previously mentioned exotic vertebrates are considered predators of native species, the brown-headed cowbird is known as a brood parasite. A brood parasite lays its eggs in the nests of other bird species, thus leaving all parental responsibilities to the host species. The end result is a much lower productivity for the native bird species. Together with riparian habitat loss, brood parasitism by brown-headed cowbirds is thought to be the principle reason for the decline of least Bell's vireo in southwestern California (USFWS 1998). The brown-headed cowbird regularly



GLENN LUKOS ASSOCIATES
FIGURE 10

RANCHO MISSION VIEJO

Bullfrog Distribution Map

parasitizes nests of many other songbird species as well, including the California gnatcatcher and willow flycatcher (Lowther 1993). Brown-headed cowbirds are found throughout RMV at any time of the year but are most problematic during the breeding season from about March 1 to August 1. They utilize the nests of many other songbirds in a wide variety of habitats including riparian and coastal sage scrub. During the non-breeding season cowbirds tend to form large flocks and are most common at Cow Camp and the Thoroughbred Farm. Several brown-headed cowbirds banded at Cow Camp have been recovered on the Irvine Ranch and in the Prado Basin of the Santa Ana River (P. Bloom pers. obs.).

European Starling. The European starling is another firmly established exotic bird species throughout the United States. Starlings are particularly abundant in urban environments that may provide many potential artificial nest cavities, and in wooded environments such as mature western sycamore groves that contain numerous natural cavities. During winter they often concentrate around livestock yards and agricultural areas.

The starling is a secondary cavity nester, meaning that it is incapable of creating its own cavity and thus relies on nest sites created naturally, or artificially by other avian species. As a result, starlings compete with native bird species for the relatively small number of woodpecker cavities, natural cavities, or artificial man-made structures (nest boxes, bridges, etc.). Starlings are aggressive birds that can cause the direct failure of native species' nests by adding sticks on top of the eggs and young. Populations of native obligate cavity nesters such as western bluebird *(Sialia mexicana)*, purple martin (*Progne subis*) and others, are thought to have declined due in large part to competition for nest cavities.

European starlings can be found throughout the ranch at any time of the year, but are particularly abundant at Cow Camp, and where nests are concentrated in mature western sycamores or among dwellings and other man-made structures. Starlings nest from about March 1 to August 15 and produce 3-5 nestlings per successful nest.

Fish (*bluegill, bass, mosquitofish, catfish*). Several exotic species of fish are known to occur in the ponds and streams on RMV, though there are currently no estimates available on population sizes. The direct effect of these fish on native species on the ranch has not been well documented. Fish most often eat the eggs and young of amphibians and reptiles, and, therefore, may be considered a threat to native species.

Arroyo toad breeding distribution is probably effected by the presence of crayfish in San Juan Creek. Any future detailed survey of arroyo toad populations in San Juan Creek should also survey for the presence of crayfish. The arroyo toad and crayfish evolved independently of each other suggesting that arroyo toad larvae may be considerably more vulnerable than bullfrog tadpoles which share the same historic distribution with crayfish. Arroyo toad tadpoles being relatively small detrital feeders are more vulnerable to crayfish predation than the huge algal feeding bullfrog larvae.

Possible future exotic predators. The African clawed frog (*Xenopus laevis*), which has spread through watersheds in northern and coastal Orange County (Bloom pers. obs.), could pose a serious threat to native amphibian populations on RMV if it becomes established. Measures, such as public education and removal of individuals, should be taken early on to prevent populations from expanding.

3.4 Introduced Predator Species Mapping and Results

3.4.1 Aerial Photograph Review

Aerial photographs of RMV show locations of many ponds and wetlands where bullfrogs are currently found (*Figure 10*). Also apparent are potential and existing brown-headed cowbird and starling locations. Aerial photos also show the juxtaposition of creeks and ponds, and may be used for easily measuring distances between breeding sites and potential dispersal sites. These measurements may aid in determining the likelihood of re-colonization of cleared ponds by nearby occupied sites. Aerial photographs are an excellent time-saving tool for examining existing and potential invasive species habitat, and will be used in combination with field checks to develop management strategies for the control of exotic species, as well as for documenting populations of sensitive native species.

3.4.2 Field Mapping and Data Collection

Field surveys of RMV have documented the presence of exotic species, as well as threatened and endangered native species. High concentrations of bullfrogs have been documented in stock ponds, creeks, and wetlands throughout the ranch. Brown-headed cowbirds likewise have been observed throughout the ranch, but are most abundant in and around Cow Camp and the Thoroughbred Farm. During the breeding season they may be more abundant near popular native bird breeding habitat (e.g., riparian corridors).

3.4.3 Results

San Juan Creek Watershed. San Juan Creek supports a sizable population of bullfrogs, as do several ponds within the watershed (*Figure 10*). The creek also supports one of the largest remaining populations of arroyo toads in southern California. Calmat reservoir annually produces several thousand bullfrogs, which then are able to disperse to Chiquita and

Gobernadora creeks. Bullfrog eradication in San Juan Creek will be more difficult than in creeks found in the Orange County portion of the San Mateo Watershed due to large bullfrog populations upstream in Cañada Gobernadora and within Casper's Park and extending at least 0.5 miles upstream into the Cleveland National Forest.

San Mateo Watershed. As mentioned previously, the source of bullfrogs for most creeks within this watershed is likely upper Gabino Reservoir and the old clay mine reservoirs in lower Gabino Canyon since these are the only permanent ponds in the drainage, and thus the only ponds where successful bullfrog reproduction can occur (*Figure 10*). Bullfrog metamorphs originating from Gabino Reservoir may be found in Cristianitos, Gabino, and La Paz creeks. Arroyo toad populations also occur in Gabino Creek from ¼ mile above the confluence with La Paz Creek and through the boundary of Camp Pendleton Marine Corp Base and beyond.

3.5 Eradication Approaches for Introduced Predators

An eradication program must be a permanent program and needs to be approached that way. Because of the widespread proliferation of bullfrogs and cowbirds, complete elimination of their populations from RMV may seem like an insurmountable task. Therefore, an eradication program needs to be initially approached with the goal of significantly reducing species' numbers, instead of entirely eliminating populations. However, the complete elimination of bullfrogs from some local water bodies is conceivable. Thinking in terms of 'management' or 'control' may make an eradication effort more plausible. Management efforts should be focused on those exotic species known to be most detrimental to native species currently inhabiting the ranch, especially those species listed as threatened or endangered. Efforts should also be concentrated in areas where impacts from these exotic species are known to be greatest. The following recommendations will focus mainly on bullfrogs and brown-headed cowbirds, with brief mention of other exotic species currently present on the ranch, and which may pose a significant future threat if not dealt with early on. It must be remembered that eradication efforts in suitable (optimal) habitat within core areas may leave survivors in unsuitable (suboptimal) habitat and outside core areas, which may re-invade the areas from which they were locally eradicated, thus stressing the fact that any eradication program must be on-going and wide-spread.

3.6 Introduced Predator Controls Methods

3.6.1 Bullfrog (*Rana catesbeiana*)

In order to successfully manage, and ultimately eradicate bullfrog populations, it is vital that efforts be viewed from a watershed perspective since there may be extensive movement between and among ponds. Eradication success, however, may be measured on a pond-by-pond basis. Ponds in close proximity should be managed as one unit and measures should be taken to minimize immigration from nearby streams and ponds. This may include erecting permanent or temporary structural barriers (fences) around managed ponds to prohibit re-colonization. Eradication efforts conducted during drought conditions when successful juvenile dispersal potential is lowest may be the most effective time for control efforts. In most cases, ponds prove to be the source population for nearby rivers and streams, so managing the pond sources may help to decrease bullfrog populations elsewhere (Doubledee *et al.* 2003). However, caution must be used in erecting barriers around ponds and streams so as to not adversely affect dispersal of native species, such as pond turtles and arroyo toads.

Public awareness should be raised on the issue of invasive plants and animals, in the form of signs, postings, and educational seminars, so that eradication efforts won't be destroyed by accidental and/or deliberate reintroduction of harmful exotic species. In addition, all private ponds and golf course ponds within the watershed need to be cleared of invasive species to ensure that cleared ponds will not be re-colonized by nearby occupied ponds. It must be understood that all future ponds will have drains or will be small enough so that they can be periodically pumped dry in order to maintain the bullfrog eradication program. A successful program would require cooperation from the public, from private housing associations, and from golf courses, as well as any person working in the field (biologists, ranchers, landscapers, etc).

The ultimate goal for a bullfrog management program is to eliminate bullfrog populations from the watershed. There are several possible solutions to the bullfrog problem. Most methods are time-consuming and costly, and therefore should be executed only after rigorous small-scale field experiments and testing are completed. In addition, for maximum effectiveness, each method needs to be timed with the appropriate periods of the bullfrog's life cycle. All methods should be used with care so as to not adversely affect native amphibian and reptile populations. The following are potential methods that could be used to eradicate bullfrogs:

> *Shooting:* the goal would be to shoot individuals from all age groups, metamorphs to adults; activities, would be conducted at night using a spotlight, and shooting with small caliber pistols and rifles using pellets and bird shot (steel).

Dip nets: bullfrogs will be individually swept up using hand nets.

Gigging: activities would be performed at night using a spotlight; individuals would be speared with multi-pronged harpoons.

Gill nets: a large net would be positioned vertically underwater to catch individuals, which would be retrieved several times per day; net mesh size would be rotated regularly and nets relocated if necessary.

Seine: pertains again to catching frogs in a net, but this method requires dragging the net through the water, as opposed to a stationary net; different gauged nets can be used to target different age groups.

Pond draining: this would consist of temporarily draining all of the water from a pond, then killing all bullfrogs and larvae left behind; depending on the season, the banks of the pond would also be searched for burrowing adults.

Structural barrier around ponds: this should be done in conjunction with pond draining; a tall silt fence erected prior to dormancy period will prohibit bullfrog movement in and out of pond area as the ponds drain; adults caught along fence line will be killed. Pitfall traps along the fence line would also help to capture individuals on the move. Efforts would also be made to dig up and kill burrowing adults and young.

Sifting water for eggs: a fine sifter or net can be used to extract identified bullfrog egg masses from ponds; this would be a key measure in reducing reproductive output.

Chemicals: such as Rotenone (derived from an aquatic plant), to be added to the water; used most affectively on the larval stage. Preferably use in ponds that no longer contain native species.

Electroshocking: stun and/or kill bullfrogs, then scoop them from the surface.

Bullfrog traps: experiment with different types of traps and lures; bullfrogs may be lured by calls from other species.

Bullfrog eradication efforts are expected to substantially reduce the number of crayfish within San Juan Creek and Gobernadora Creek, where they have been observed. Crayfish are recognized predators of amphibian eggs and their larvae and can contribute to population declines. Most of the methods noted above for bullfrog control would also eliminate crayfish by means of gill netting and trapping, particularly when the streams begin to dry up and the crayfish are forced into smaller and shallower pools. It might also involve electro-shocking and Rotenone. Fortunately, the female crayfish carries her eggs with her on the ventral side of the tail suggesting that crayfish population control may be more easily dealt with than bullfrogs, which lay their eggs in the water and are far more mobile.

3.6.2 Brown-headed cowbird (*Molothrus ater*)

Whereas the ultimate goal for bullfrogs would be complete extirpation, the goal for cowbirds would be to manage, or control, their populations to a level in which passerines can reproduce successfully and maintain high productivity levels. The most popular and effective method of managing cowbird populations is to trap and remove individuals from the population using modified Australian crow traps. Traps would be strategically placed in areas where cowbirds visit regularly, and preferably within or near host species habitat (especially sensitive species habitat) in order to target individuals that are having the greatest direct impact on native songbird populations. Trapping efforts must be ongoing since individuals from outside the trapping area will continue to move into target areas. Mist netting may be employed in concentration areas such as Cow Camp and the Thoroughbred Farm in summer and early fall months. Aerial photographs and field data will help to locate target trap sites based on cowbird numbers observed and on habitat type.

Thus far, the preferred breeding season locations for traps on RMV would be in Chiquita Canyon (3 traps), Gobernadora Canyon (3), Cristianitos Canyon at Northrop Grumman (1), and along San Juan Creek (5), particularly with a continued non-breeding season focus around Cow Camp and the Thoroughbred Farm.

All traps would remain open and monitored throughout the breeding season (March – mid July) to target breeding adults and to minimize exposure of native species to parasitism events. Trapping past the breeding season (until September) would target fledgling cowbirds, which would help to reduce the number of future breeders and the local population in general. The first 2 years of trapping would have experimental components, with all traps operating at least from March through September. Subsequent years would involve only those traps that captured a significant number of individuals per season. Some traps may be moved to new locations to ensure maximum capture rates.

3.6.3 European Starling (*Sturnus vulgaris*)

Due to their widespread distribution in the region and their high dispersal ability, complete eradication of European starlings from RMV would be an impossible, and basically unnecessary, task. The goal for starling population management on the Ranch would be to minimize their impact on native bird species. This may be accomplished by taking steps such as trapping individuals in cowbird traps and mist nets at known concentration areas such as Cow Camp. Providing species-specific nest boxes that restrict use by starlings (e.g., small holes) may help boost native populations.

3.7 Implications of Control Methods for Introduced Predators

Using model simulations, Doubledee *et al.* (2003) concluded that shooting adult bullfrogs in combination with pond draining was successful at decreasing bullfrog densities. Although these results were based only on computer model simulations, these methods are worth testing in the field, particularly in an area where the bullfrog threat on native amphibian populations is high. Decreasing bullfrog densities on RMV may increase arroyo toad densities in some areas, although the results may not be immediately apparent. Ongoing monitoring of bullfrog and arroyo toad populations will be necessary to discern the actual benefits of particular management methods in different locations.

In some areas, cowbird trapping has successfully removed enough breeding individuals from the population to reduce parasitism rates and thus allow native songbird populations to increase. This is most clearly exemplified by the long-term cowbird trapping effort conducted on Marine Corps Base, Camp Pendleton. This cowbird management effort resulted in a dramatic drop in nest parasitism (from 47% of nests parasitized in the early 1980's to less than 1% by 1990), and a subsequent dramatic increase in productivity of least Bell's vireo (USFWS 1998). Similar results have been documented in other areas as well, such as the San Luis Rey River, San Diego River, and Santa Ana River. Favorable results can be expected to occur on RMV once a management program has been initiated and secured.

Negative impacts of bullfrog pond management may include incidental netting of non-target species, as well as inhibiting movement and dispersal of native species by placement of fencing around ponds. However, close attention to netting activities and frequent checking of fence lines and pitfall traps will minimize adverse effects on non-target species. Barriers may be removed and replaced regularly depending on season. Frequent checking of cowbird traps, as well as keeping them well equipped with food, water, and shade, will minimize negative impacts to non-target species that inevitably enter traps.

3.8 Research Recommendations

More information is needed on local cowbird dispersal and movement in the breeding and non-breeding seasons, as well as their tendency to return to or remain in the same areas to nest (site fidelity). In addition to potentially eliminating several thousand cowbirds annually, a trapping program also offers the opportunity to band and release individuals in an attempt to learn more about survivorship and dispersal patterns. Therefore, a cowbird trapping effort on RMV should also include banding and releasing a large sample of individuals each year (numbers released to be based on numbers captured), in the hopes of obtaining recaptures and recoveries over an extended period of time.

In conjunction with any large-scale effort to manage bullfrog populations on RMV, there should be research projects directed at dispersal behavior, movement patterns, and over-wintering behavior of adult and young bullfrogs, as well as measuring the effectiveness of eradication methods. Dispersal and movement of amphibians are best studied by marking individuals with pit tags and/or radio-tags, and then subsequently monitoring their locations throughout the year. Eradication method experiments should be conducted within a small area (single pond(s)) before deciding which method to use on a large-scale effort. Experiments with new and innovative bullfrog trapping techniques should also be undertaken.

Similar approaches are recommended for the crayfish to ensure that an adequate understanding of their distribution within the RMV Open Space is developed. During surveys for bullfrogs, as well as during vegetation monitoring in wetland and riparian areas, crayfish occurrences should be mapped and investigated relative to densities and species composition. As more information is developed on potential impacts of crayfish within the RMV Open Space, additional measures may be added as part of the Adaptive Management Program.

Rigorous scientific monitoring designed to determine the effectiveness of exotic species removal programs should be implemented. In addition, the opportunity that management programs, such as these, offer to gain information on species behavior and ecological relationships should not be overlooked. Specific research questions and experimental designs may be determined after the initial year of management programs on RMV. Research project development will be an ongoing goal and consideration as invasive species management programs are established and progress.

CHAPTER 4.0 NON-NATIVE ANTS

4.1 Introduction

Non-native ants, like the Argentine ant (*Linepithema humile*), are most often viewed by humans as a simply a nuisance pest. Concerns about ants are typically from the perspective of how they affect humans and human activities like household invasions and agricultural crop damage. In recent years the aggressive Red Imported Fire Ant (RIFA) (*Solenopsis invicta*) has managed to expand its invasion of the southern United States in to southern California. This was a highly publicized event due to terrible toxic multiple stings these ants deliver when disturbed.

What is less often recognized is the affect non-native ants have on native plant and animal communities. Argentine ants have managed to monopolize resources and kill off many ants native to California, this has resulted in declines of coastal horned lizards since native ants make up half of their diet (Case *et al.* 2002). Recently published work suggests that the Argentine ants in California are all from a "supercolony" (Mc Donald 2000). The genetic similarities keep the ants from fighting each other as they do when they are from separate distinct colonies, which keeps their numbers in check (Mc Donald 2000). They tend to occupy urban areas and consequently urban sprawl is bringing them ever closer to natural sensitive habitats where they adversely impact native animals.

The RIFAs have similar destructive abilities, like Argentine ants, but they tend to be more aggressive and lethal. These ants occupy both urban and rural areas and prefer to be near water sources such as, streams, lakes, ponds, and irrigation basins. As studies in Texas, where RIFA infestation is severe, have shown these ants affect wildlife and reduce biodiversity of native plants and animals (Jetter 2002). Researchers warn that if RIFA is allowed to establish in California the ecological cost to sensitive species will be great.

The encroachment of these non-native ants has substantial edge effects on native habitats and species, such as the extirpation of wildlife from portions of high quality habitats near urban areas (NCCP/SAMP Working Group 2003). Complete infestation of natural habitats can have large-scale severe ecological consequences in southern California native habitats.

4.2 Eradication Approaches for Non-native Ants

In general complete ant eradication is not a practical undertaking, especially, when dealing with invasive species, which tend to be very prolific reproducers and have large colony sizes. A more practical objective is to control their populations and prevent their spread into new areas.

Ant control generally has two distinct approaches. One approach is source or nest/mound treatment. This requires locating the colonies nest or mound and applying an insecticidal treatment in or around the nest. Delivery of the ant poison can be through a liquid drench treatment, dust or granule cover, or by fumigation. Ants must come in contact with the insecticidal agent and killing the colonies queen is imperative to success. Nest/mound treatment can be effective, but it can also be costly because it is labor intensive.

The second approach involves broadcast applications. This treatment involves the distribution of insecticidal bait over large infested areas. Baits work because ants share food and nutrients among one another. If food contains a slow-acting toxicant that is not detected it gets passed from ant to ant and eventually to the queen. Baits can also be applied in a source treatment at the nest/mound. Specific site conditions will dictate which treatment method will be appropriate to use. With any of these treatments special consideration must be given to sensitive wildlife and plants that may be affected by the treatments, as well as the affects on non-target native ants and/or other beneficial insects.

It is also important to apply treatment at optimal times. Ant populations are low during the winter and build during the warm months of spring and summer (University of California Cooperative Extension Ventura County 2003). If baits are used, the best control usually results when temperatures are between 70 and 85 F, when ant workers are most actively foraging for food (Orange County Fire Ant Authority 2003). Control with drench treatments is more difficult to achieve during very hot summer months because ants remain deep within their mounds and are hard to reach with liquid insecticides (Apperson *et al.* 1993).

4.3 Non-native Ant Species Targeted for Control

4.3.1 Argentine Ants (*Linepithema humile*)

Argentine ants were introduced to North America via coffee and sugar shipments to New Orleans about 1890. They have spread to the east from the Carolinas south to Florida and west through Texas to California (Insecta Inspecta World Argentine Ants 2003).

Argentine ants are small bodied, about one sixteenth of an inch long, and are dark-brown to black in color. They are very social and live in large colonies functioning as one interdependent group. Colonies can consist of hundreds to thousands of members. These ants have more than one queen per colony, typically there are about eight queens for every 1,000 workers (Insecta Inspecta World Argentine Ants 2003). New colonies form from old ones when a queen leaves with a band of workers to start a new one. Argentine ants usually occupy the top six feet of soil. They prefer moist soil underneath buildings and sidewalks. Food sources and temperature dictate where they create their nests.

Argentine ants drive out or kill native ants of a newly invaded territory. In southern California, for example, this has greatly reduced the numbers of the coastal horned lizard which predominately feeds on native harvester ants. Argentine ants feed on seeds within the seed beds and they can damage crops by gnawing on ripening fruit. They are aggressive with other insects and are known to eliminate native termite colonies, paper wasps, and carpenter bees. These ants are even capable of driving off poultry from their nests and killing newly hatched chicks (Insecta Inspecta World Argentine Ants 2003). As urban development brings these aggressive ants closer to native habitats the threat of their aggressive behavior is more severe, particularly when considering the delicate nests of native songbirds and other sensitive animal species that can fall prey to these scavenging ants.

Control methods appropriate for Argentine ants in natural or rural settings employ a combination of methods. Because these ants thrive in urban areas and nest in moist soils under structures, development adjacent to natural areas brings them in closer proximity to these sensitive areas and increasing their likelihood of invading natural habitats. These ants prefer the moist soils that urban runoff provides. Zones between urban and natural habitats where there is little moisture may act a barrier for the ants and inhibit them from invading the natural areas. An interface zone around the RMV Open Space may inhibit the encroachment of invasives from developed and fuel modification areas. These interface zones can be planted with native drought resistant vegetation.

For specific control problems, Argentine ants can also be controlled by sprays and insecticidal baits, granules, and dusts as detailed below in the fire ant control section below. Treatment for this species can be done in tandem with a fire ant treatment regime.

4.3.2 Red Imported Fire Ants (*Solenopsis invicta*)

Red Imported Fire Ants (RIFA) are native to the lowland areas of South America. They were first introduced to the southeastern United States around 1930. Their aggressive behavior overwhelmed native fire ant species and they spread at a rate of more than 100 miles per year (Jetter 2002). They have spread throughout the south and are now in parts of southern California and areas within the Central Valley.

The Red Imported Fire Ant is a small ant ranging from one eighth to one quarter inch in length and is dark red in color with a dark brown shiny abdomen (Orange County Vector Control 2003).

Known for its painful bite the ant has one pair of toothed mandibles for grasping the skin before stinging. This ant is considered dangerous because, unlike most ants, this species delivers a venomous sting, which is relatively toxic and potentially lethal to pets, wildlife, livestock and sensitive humans (Orange County Vector Control 2003). The ants nest in the soil of open areas, pastures and agronomic fields, but are found occasionally in wooded areas (Cooperative Agriculture Pest Survey Program 2003). Several hundred thousand worker ants live in large mounds which conceal a nest. When nests are disturbed ants swarm out and sting the animal or human responsible for the disturbance. They prefer warm temperatures and moist locations and can be found in areas such as, golf courses, irrigated farmland, housing developments, and near ponds, lakes and streams (Jetter 2002).

Aside from the tremendous agricultural damage RIFAs can cause the ecological damage is also severe. They are omnivorous indiscriminate feeders and their usual diet consists of insects, spiders, myriopods, earthworms, and other small invertebrates (Cooperative Agriculture Pest Survey Program 2003). However, it has become increasingly evident that RIFAs are preying on the eggs and young of many sensitive wildlife species including other insects, birds, young mammals, reptiles, and amphibians (Jetter 2002). It is estimated that 58 of California's 79 endangered animal species either are directly susceptible to predation by the ants or indirectly affected by competition for food resources (Jetter 2002). They also feed on plants. They are known to devour saplings, seedlings and eat the seed of 139 species of native wildflowers and grasses (Lockey 1996).

Fire ant mounds are conically-shaped domes of soil. The average mound is one foot tall, but mound size its proportional to the size of the colony. Treatment over large areas is both difficult and impractical; however, there are some localized treatments that can successfully control fire ants in limited areas. Individual mound treatments can be effective however time consuming and costly. One such method is to flood or drench the mound with large volume of liquid containing an approved contact insecticide (Lockey 1996). The drench solution should be applied at a rate of approximately one gallon per six inches of mound diameter (Apperson, *et al.* 1993). It is important that enough liquid be used to ensure contact with the queen, who is often deep within the colony. Therefore saturating the mound and wetting the ground two feet around the mound is advised. Insecticidal surface dusts or granules spread on and around the mound have a limited effect on the colony, and the queen may never come in contact with these dusts or granules. Fumigants are also commercially available, but can be dangerous if not handled properly.

Broadcast treatment usually involves the use of baits or sometimes spraying. The bait is treated with a toxicant such as a slow-acting insecticide, an insect growth regulator, or a metabolic inhibitor (Apperson *et al.* 1993) (Lockley 1996). Baits containing only a stomach poison require several applications each season to control newly emerging workers when the if the queen is not killed, and when new colonies arise. Baits containing only and insect growth regulator can provide year long control with one or two applications when followed in 7-10 days with liquid residual application to kill the active foragers (Kills Fire Ants 2003). New baits containing avermectin, which acts as both an insect growth regulator and slow-acting stomach poison, provide good control without liquid application (Kills Fire Ants 2003). The bait is found by the foraging ants and taken back and feed to the colony. The advantage of this method is that the mounds don't have to be located the bait can be distributed in general areas and the ants will locate it which cuts down on labor costs per acre. The disadvantage is that baits deactivate if they get wet or are exposed to high temperatures and baits are slow-acting.

4.4 Implications of Control Methods for Non-native Ants

Although complete eradication of undesirable destructive non-native ants is impractical, control and exclusionary efforts to prohibit or lessen their negative impacts on native plants and animals within RMV is ascertainable. Native habitats of RMV will benefit from control of Argentine ants and RIFAs for several reasons. Control efforts will reduce predation pressures on native plants, seedlings, and seeds. RIFAs are especially destructive to plants particularly agricultural crops, they feed on bark, cambium, fruit, seeds and roots causing tremendous economic losses (Jetter 2002). Perhaps even more devastating, as increased evidence suggests, is their potential to reduce biodiversity of native plants and animals (Jetter 2002). RIFAs ability to out compete other insects and be formidable predators on bird, reptile, and amphibian hatchlings or other young animals can cause ecosystem wide devastation if they are allowed to become established. Control and exclusion of RIFAs and Argentine ants, which can be similarly harmful, from wildlife areas such the RMV Open Space is imperative to maintaining balanced ecosystem functions.

Impacts of non-native ant control are treatment type dependent. A contact insecticide can be delivered via a liquid solution (spray or drench treatment), a dust powder, granular form, or in a gaseous phase as a fumigant. Primarily contact insecticides are not species specific and therefore can be harmful to beneficial insects and other organisms. Baits which are coated with either a growth inhibitor or a stomach toxicant can be less harmful to other species.

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DRAFT – APPENDIX J-4
RMV GRAZING MANAGEMENT PLAN

CHAPTER 1

1.1 Background

This Grazing Management Plan (GMP) has been prepared to guide the management of grazing on Rancho Mission Viejo (RMV), located in southern Orange County, California. RMV has grazed cattle on its lands since 1882 and intends to continue to do so in the long term on lands which may, as part of approval of the GPA/ZC application, become dedicated as open space (RMV Open Space). As discussed later, this GMP is an integral part of the Adaptive Management Program for the proposed RMV Open Space and further implements certain key NCCP/HCP and SAMP/MSAA policies.

RMV is surrounded by the planned community of Ladera Ranch and the cities of Mission Viejo, San Juan Capistrano and San Clemente on the west. The City of Rancho Santa Margarita bounds the northern edge of RMV; the southern edge is bounded by Marine Corps Base (MCB) Camp Pendleton in San Diego County. Caspers Wilderness Park and the Cleveland National Forest bound the property on its eastern edge.

1.1.1 Relationship to Southern Subregion NCCP/HCP

As noted above, the Grazing Management Plan is a key component of the Adaptive Management Plan for the RMV Open Space and is intended to be complementary to any NCCP/HCP program completed in the future for the Southern Subregion. Implementation of an Adaptive Management Program is one of the three fundamental conservation planning principles set forth under the NCCP Conservation Guidelines. As stated in the NCCP Conservation Guidelines "…a status quo strategy of 'benign neglect' management will likely result in substantial further loss of CSS diversity…" The Guidelines concluded that habitat reserves … should be managed in ways responsive to new information as it accrues." Although the Conservation Guidelines were directed towards coastal sage scrub (CSS) in a habitat reserve context, the same adaptive management principles apply to the diversity of vegetation communities and habitat types in protected open space such as the RMV Open Space.

a. Draft Southern NCCP/HCP Planning Guidelines

Section 3.3 of the Draft EIR discusses the project history including the development of Draft Southern NCCP/HCP Planning Guidelines by the NCCP/SAMP Working Group. Using the broader NCCP Tenets as a framework and starting point, the Draft Southern NCCP/HCP Planning Guidelines provide guidance for decision-makers that are keyed to local biologic, hydrologic and geomorphic conditions. Although considered a "work in progress" the guidelines represent the most current thinking regarding protection, restoration and management priorities for the resources within the study area and for this reason are discussed here. These guidelines address resources at both the landscape (watershed) and more detailed hydrologic/geomorphic sub-basin levels. For each sub-basin planning unit, the guidelines identify the important biological resources and key hydrologic/geomorphic processes. Protection, restoration and management recommendations for each sub-basin also are included.

The Daft Southern NCCP/HCP Planning Guidelines are comprised of three primary components:

1) NCCP Tenets outlined in the 1993 NCCP Conservation Guidelines;
2) Reserve Design Principles prepared by the panel of NCCP Science Advisors convened by The Nature Conservancy; and
3) A set of draft sub-basin specific planning recommendations prepared by the NCCP/ SAMP working group.

In addition to these components the Draft Southern NCCP/HCP Planning Guidelines also set forth general policies for resource protection, management and restorations that apply at the planning (landscape) area scale. General Policy 6 of the guidelines addresses grazing management as follows:

- Cattle grazing shall be permitted within the Rancho Mission Viejo portion of the Habitat Reserve provided that grazing activities are consistent with a "grazing management plan" approved as part of the certified NCCP/HCP

- The grazing management plan (GMP) approved as part of the NCCP/HCP shall identify suitable grazing areas and allowable grazing practices that are consistent with certified NCCP/HCP policies and the aquatic resource management program. The GMP will address grazing practices following approval of the NCCP/HCP and prior to transfer of lands to the Habitat Reserve.

- The GMP will incorporate grazing management techniques designed to address the needs of species and habitat identified for protection, promote perennial grasses including native grasses, allow for continued cattle grazing sufficient to support cattle operations and, where appropriate, reduce fuel loads for fire. (Page 3-11, Draft Southern NCCP/HCP Planning Guidelines)

The following specific grazing management recommendation is made for the Cristianitos Sub-basin and the upper and middle sub-units of the Gabino sub-basin:

- Pursuant to the GMP, implement grazing management techniques to help protect listed and other selected species and habitat, promote perennial grasses including native grasses, allow for continued cattle grazing sufficient to support cattle ranching operations, and, where appropriate reduce fuel loads for fire.

In addition, management of grazing is to be factored into the management program for sensitive plant locations in the Chiquita sub-basin, Gobernadora sub-basin, Central San Juan/Trampas sub-basin, Cristianitos sub-basin and the Gabino sub-basin as follows:

- Implement a management program for protected sensitive plant locations in the sub-basin, including control of non-native invasive species, management of grazing as part of the adaptive management program, and prevention of human disturbance

1.1.2 Relationship to San Juan Creek Watershed and Western San Mateo Creek Watershed SAMP/MSAA

The Adaptive Management Program and this Grazing Management Plan are intended to be complimentary to any SAMP/MSAA program that is completed in the future, and, as such, have been structured to comply with the goals, objectives, and Tenets and Principles of the SAMP/MSAA.

b. SAMP/MSAA Planning Principles Management Recommendations

Section 3.3 of the Draft EIR discusses the project history including the development of Draft Watershed and Sub-basin Planning Principles ("Draft Watershed Planning Principles') by the NCCP/SAMP Working Group. The Draft Watershed Planning Principles provide a link between the broader SAMP/MSAA Tenets for protecting and conserving aquatic and riparian resources and known, key physical and biological resources and processes. Although considered a "work in progress" the principles represent the most current thinking regarding protection, restoration and management priorities for the resources within the study area and for this reason are discussed here.

The planning principles provide specific grazing management recommendations for Gabino sub-basin as follows:

- Protect headwaters through restoration of existing gullies using a combination of slope stabilization, grazing management, and native grassland and/or scrub restoration. To the extent feasible, restore native grasses to reduce sediment generation and promote infiltration of stormwater.

- Modify grazing management in the upper portion of the sub-basin to support restoration and vegetation management in the headwater areas.

1.2 Purpose of the Grazing Management Plan

Grazing management policies are under review in numerous government agencies. A common thread in the review of policies and ongoing discussion about grazing management is the recognition of its importance to the ecology of our grasslands. According to Menke (1996), herbivory and fire are natural and necessary processes, which remove litter, recycle nutrients, stimulate tillering and reduce seedbanks of competitive annual plants. Recognition that grazing is important to the evolved ecology of grasslands, however, as Edwards (1992) notes, is not license to use it indiscriminately; nor is understanding that grazing is not always needed license to eliminate it in advance of analyzing site-specific needs.

The purposes of this GMP are to: **(1)** demonstrate consistency with the Draft Southern NCCP/HCP Planning Guidelines and the Draft Watershed Planning Principles regarding grazing management (see above); and **(2)** contribute an important element of the long term Adaptive Management Program (AMP) goals of enhancement/restoration of native habitats. The GMP will address grazing practices following approval of the Southern NCCP/HCP and prior to transfer of lands to the Habitat Reserve and practices following transfer of lands into the Habitat Reserve.

1.3 Participants in the Grazing Management Plan

Participants in the development of this plan included Rancho Mission Viejo, USFWS, CDFG, USACE and the County of Orange. Consultant support was provided by Rod Meade NCCP/SAMP consultant, Bill Boyd Esq., Phil Behrends of Dudek & Associates, Inc., and Huitt Zollars.

CHAPTER 2: EXISTING CONDITIONS

The following descriptions of the existing setting are provided to familiarize the reader with the climate, geomorphology and vegetation communities of RMV. An understanding of the factors which influence where, when and how grazing is conducted is vital to the development of a successful grazing management plan.

2.1 Biological Setting

RMV is located within the San Juan Creek watershed and the western portion of the San Mateo Watershed.

2.1.1 Climate

The Mediterranean Climate in Southern California is characterized by brief, intense storms between November and March. It is not unusual for a majority of the annual precipitation to fall during a few storms in close proximity to each other. Average annual rainfall on Rancho Mission Viejo resulting from this Mediterranean precipitation pattern is 12 to 16 inches. The higher elevation portion of the watershed (typically the headwater areas) typically receive significantly greater precipitation due to orographic effects. In addition, rainfall patterns are subject to extreme variations from year to year and longer term wet and dry cycles. The combination of steep, short watersheds; brief intense storms; and extreme temporal variability result in "flashy" systems where stream discharge can vary by several orders of magnitude over very short periods of time.

Wet and dry cycles, typically lasting up to 15 to 20 years, are characteristic of southern California. The region presently appears to be emerging from a wetter-than-normal cycle of years beginning in 1993. Previously, five consecutive years of sub-normal rainfall and runoff occurred in 1987 through 1991.

Prior droughts of recent note include the brief, 'hard' drought of 1976 and 1977, and 1946 to 1951. Previous notable wet periods of the recent past were observed in 1937 to 1944 and 1978 to 1983. An unusually protracted sequence of generally dry years began in 1945 and continued through 1977. During this period, rainfall was approximately 25 percent below the average for the prior 70 years (Reichard, 1979; Lang et al., 1998). Both recharge and (especially) sediment transport were diminished to even greater degrees during this period. Although wet years did occur during this period, dry conditions were sufficiently persistent to lower groundwater levels and contract the extent of riparian corridors.

2.1.2 Geomorphology

a. Regional Geology

The San Juan and San Mateo creek watersheds are located on the western slopes of the Santa Ana Mountains, which are part of the Peninsular Ranges that extend from the tip of Baja California northward to the Palos Verdes Peninsula and Santa Catalina Island. The geology of the region is complex and has been dominated by alternating periods of depression and uplift, mass wasting, and sediment deposition. Within the watersheds, the Santa Ana Mountains are composed of igneous, metavolcanic, and metasedimentary rocks of Jurassic age and younger. The exposed rocks in the mountainous areas are slightly metamorphosed volcanics, which have been intruded by granitic rocks of Cretaceous age, principally granites, gabbros, and tonalites. Overlying these rocks are several thousand stratigraphic feet of younger sandstones, siltstones, and conglomerates of upper Cretaceous age, composed largely of material eroded from the older igneous and metavolcanic rocks now underlying the Santa Ana Mountains.

Younger sedimentary rocks comprise the bedrock between the Santa Ana Mountains, their foothills, and the Pacific Ocean. Most of the study area is underlain by these marine and non-marine sandstones, limestones, siltstones, mudstones, shales, and conglomerates, many of which weather, erode, and/or hold groundwater in characteristic ways. Overlying them are Quaternary stream terrace deposits and Holocene stream channel deposits. During the past two million years or longer, at least three processes that fundamentally affect structure and process along the major stream channels have affected the two watersheds:

1. Continuing uplift, typically 400 feet or more, which has left at least four major stream terrace levels along the major streams.

2. Downcutting of the main canyons to sea levels, which have fluctuated widely during the global glaciations. The flat valley floors were deposited as sea level rose, leaving often-sharp slope breaks at the base of the existing hillsides and tributary valleys. These materials are geologically young, soft, and prone to incision under certain conditions.

3. Soils formed under climates both warmer/colder and drier/wetter than at present, which led to development of hardpans that have been eroded to form mesas. These hardpan mesas have minimal infiltration and presently channel flows into headwater streams.

b. Terrains

Terrain designations are largely based on soils, geology and topography, as these provide many of the fundamental factors that influence the hydrology and geomorphology characteristic of each terrain. Bedrock is the raw material from which soils are weathered, and, as such, it determines the size and types of particles that will comprise the soil. The resistance of different kinds of bedrock to weathering and erosion also controls the topography of the landscape within a given terrain and, therefore, influences the hydrology of the watersheds and morphology of the drainage networks. Watershed hydrology is also strongly influenced by the climatic patterns typical of Southern California.

There are three major geomorphic terrains found within the San Juan Creek and San Mateo Creek watersheds: **(1)** sandy and silty-sandy; **(2)** clayey; and **(3)** crystalline. These terrains are manifested primarily as roughly north-south oriented bands of different soil types. The soils and bedrock that comprise the western portions of the San Juan Creek watershed (*i.e.,* Oso Creek, Arroyo Trabuco, and the lower third of San Juan Creek) contain a high percentage of clays in the soils. The soils typical of the clayey terrain include the Alo and Bosanko clays on upland slopes and the Sorrento and Mocho loams in floodplain areas. In contrast, the middle portion of the San Juan basin, (*i.e.,* Cañada Chiquita, Bell Canyon, and the middle reaches of San Juan Creek) is a region characterized by silty-sandy substrate that features the Cieneba, Anaheim, and Soper loams on the hill slopes and the Metz and San Emigdio loams on the floodplains. The upstream portions the San Juan Creek watershed, which comprise the headwaters of San Juan Creek, Lucas Canyon Creek, Bell Creek, and Trabuco Creek, may be characterized as a "crystalline" terrain because the bedrock underlying this mountainous region is composed of igneous and metamorphic rocks. Here, slopes are covered by the Friant, Exchequer, and Cieneba soils, while stream valleys contain deposits of rock and cobbly sand. The upland slopes east of both Chiquita and Gobernadora canyons are unique in that they contain somewhat of a hybrid terrain. Although underlain by deep sandy substrates, these areas are locally overlain by between 2 and 6 feet of exhumed hardpan.

2.1.3 Vegetation Community Description

The following descriptions of vegetation communities are taken from the NCCP vegetation database. *Appendix A* contains a general description of the vegetation communities discussed more specifically here for RMV. The reader is also referred to the Draft EIR for a full description of the NCCP vegetation database, its sources and the history of its development.

a. Grasslands on Rancho Mission Viejo

The NCCP/HCP vegetation database for RMV does not distinguish between annual and native grasslands. However, several individual mapping efforts have been conducted in various areas of RMV, which allows for a general characterization of the annual and native grasslands.

1. Annual Grasslands

Annual grasslands on RMV are dominated by bromes (*Bromus madritensis, Bromus diandrus, Bromus hordaceous*), wild oats (*Avena barbata, Avena fatua*), rat-tail fescue, barleys (*Hordeum* spp.) and Italian ryegrass (*e.g.,* Gray and Bramlet 1992; MBA 1996; Dudek 2001). Annual forbs common to non-native grasslands in the RMV include Indian milkweed (*Asclepias eriocarpa*), tocalote, common fiddleneck (*Amsinckia menziesii*), popcornflower (*Plagiobothrys* spp.), black mustard (*Brassica nigra*), field mustard (*Brassica rapa*), common catchfly, stickwort (*Spergularia arvensis*), miniature lupine (*Lupinus bicolor*), white-whorl lupine (*Lupinus densiflorus* var. *austocollium*), burclover (*Medicago polymorpha*), bristled clover (*Trifolium hirtum*), red-stemmed filaree, white-stemmed filaree (*Erodium moschatum*), and fluellin (*Kickia spurria*) (MBA 1996). Tarweeds and doveweed become dominant in later summer and fall (MBA 1996). Cardoon also occurs in portions of the grasslands on RMV. .

Gray and Bramlet (1992) also describe a ruderal grassland that consists of early successional grassland dominated by pioneering herbaceous species of several genera such as *Centaurea, Brassica, Malva, Salsola, Eremocarpus, Amaranthus* and *Atriplex.*

2. Native Grasslands

Native grasslands on RMV are designated as Valley needlegrass grassland (called southern coastal needlegrass grassland by Gray and Bramlet). Gray and Bramlet define needlegrass grassland as a grassland with more than 10 percent cover of purple needlegrass (*Nassella pulchra*). It is associated with the annual grasses listed above, leafy bentgrass (*Agrostis pallens*), junegrass (*Koeleria macrantha*), cane bluestem (*Bothriochloa barbiodis*), coast range melic (*Melica imperfecta*) and annual forbs such as common goldenstar (*Bloomeria crocea*), blue dicks, Cleveland's goldenstar (*Dodecatheon clevelandii*), smooth cat's-ear (*Hypocharis glabra*), lilac mariposa lily (*Calochortus splendens*), many-stemmed dudleya (*Dudleya multicaulis*), blue-eyed grass (*Sisyrinchium bellum*) and rosin weed (*Calycadenia truncata*) (Gray and Bramlet 1992; Dudek 2001; MBA 1996).

3. Distribution of Grasslands on Rancho Mission Viejo

Grasslands are scattered throughout the lower elevations of the Ranch, with the largest, contiguous concentration in the south Ranch. Other areas supporting large patches of grassland include Chiquita Ridge, Ladera Open Space, Cristianitos Canyon, the TRW lease area, and upper Gabino Canyon.

Although annual and native grasslands are not differentiated in the NCCP vegetation database, some survey work was done on RMV by St. John in 1989 (St. John 1990) and later mapping in specific areas has been completed by Dudek (1997, 2001) and MBA (1996). Generally, native grasslands are patchy north of Highway 74, with patches occurring in Ladera Open Space east of Arroyo Trabuco (Dudek 2001) and Chiquita Canyon (St. John 1990; Dudek 1997; MBA 1996). Much of the native grassland on RMV is located in the southern San Juan and San Mateo watersheds in upper Gabino Canyon (St. John 1990; Dudek 2001), Verdugo Canyon (St. John 1990), and Cristianitos Canyon (St. John 1990; MBA 1996; Dudek 1990). St. John made a preliminary estimate of approximately 3,300 to 4,000 acres of native grassland on RMV property, but based on the Dudek's refined mapping of native grasslands, the total appears to be closer to 1,100 acres. Major areas of native grassland include Cristianitos Canyon (~405 acres) and upper Gabino Canyon (276 acres), with smaller areas of native grassland in Blind Canyon (102 acres) and middle and lower Chiquita Canyon (76 acres). There are likely to be several smaller patches of unmapped native grassland scattered throughout the RMV, but individual patches are unlikely to be more than a few 10s of acres in size. The cumulative total of these unmapped areas is likely to be no more than a few hundred acres.

b. Coastal Sage Scrub Communities on Rancho Mission Viejo

Coastal sage scrub is dominated by a characteristic suite of low-statured, aromatic, drought-deciduous shrubs and subshrub species. Composition varies substantially depending on physical circumstances and the successional status of the habitat. Characteristic species include California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), laurel sumac (*Malosma laurina*), California encelia (*Encelia californica*), and several species of sage (*e.g.*, *Salvia mellifera, Salvia apiana*) (Holland 1986; Sawyer and Keeler-Wolf 1995). Other common species include brittlebush (*Encelia farinosa*), lemonadeberry (*Rhus integrifolia*), sugarbush (*Rhus ovata*), yellow bush penstemon (*Keckiella antirrhinoides*), Mexican elderberry (*Sambucus mexicana*), sweetbush (*Bebbia juncea*), boxthorn (*Lycium* spp.), prickly-pear (*Opuntia littoralis*), coastal cholla (*Opuntia prolifera*), tall prickly-pear (*Opuntia oricola*), and several species of *Dudleya*. Sage scrub often is patchily distributed throughout its range (O'Leary 1990). Over a scale of several miles, it can be found in diverse habitat mosaics with other plant communities, particularly grassland and chaparral, and oak/riparian woodland in more mesic areas. Coastal sage scrub may convert to chaparral or grassland, depending on slope, aspect, climate, fire history, and other physical factors and biological phenomena. Conversely, chaparral or grassland areas may convert to coastal sage scrub (Axelrod 1978; White 1995; O'Leary 1995; Allen *et al.* 1999).

Coastal sage scrub typically is found on xeric sites, notably steep, south-facing slopes with thin and/or rocky soils. It also is found on exposed sea bluffs, coastal and river terraces composed of coarse alluvial outwash, and coastal dunes (Axelrod 1978). The more open nature of the canopy permits persistence of a diverse herbaceous component of forbs, grasses, and succulents in mature stands than usually is associated with chaparral. It often is mixed with chaparral and grassland communities and the distinct boundaries between each can sometimes be difficult to delineate.

Gray and Bramlet (1992) proposed a complex and highly detailed classification system, modified from Holland (1986), for use in mapping vegetation types in Orange County, California. Within "scrub" habitats, Gray and Bramlet (1992) identified eight major subtypes: **(1)** southern coastal bluff scrub; **(2)** maritime succulent scrub; **(3)** Venturan-Diegan transitional coastal sage scrub; **(4)** southern cactus scrub; **(5)** Riversidean coastal sage scrub; **(6)** floodplain sage scrub; **(7)** chenopod scrub; and **(8)** sage scrub-grassland ecotone. Within the Venturan-Diegan transitional coastal sage scrub subtype, 12 distinct subassociations were identified based on the dominant species. Within the sage scrub-grassland ecotone subtype, five distinct subassociations were identified based on the same criterion. For a description of these subassocations the reader is referred to the Southern NCCP/HCP.

"Scrub" as defined for RMV, roughly corresponds to Holland's (1986) descriptions of Venturan-Diegan coastal sage scrub (a transitional community containing elements of two major types described by Holland), southern coastal bluff scrub, and Riversidean coastal sage scrub. In RMV, scrub is a more or less open community composed of low, drought deciduous shrubs, with a sparse understory of annual and perennial grasses and forbs.

c. Riparian Vegetation on Rancho Mission Viejo

Eight distinct associations of riparian vegetation are included in the vegetation database for the RMV study area (*Table 2*).[1] In order of their prevalence in the study area, they are coast live oak riparian forest, willow riparian scrub (southern willow scrub), sycamore riparian woodland, southern arroyo willow riparian forest, herbaceous riparian, mule fat scrub, white alder riparian,

[1] The riparian and wetland habitat acreages are based on the 1993 NCCP vegetation database and provide a general characterization of the study area. This original mapping was based on aerial photo interpretation and field checking, but was not performed using the USACE and CDFG formal criteria for jurisdictional waters of the U.S./State, including wetlands. Formal USACE/CDFG delineations have been performed by GLA and confirmed by the USACE and CDFG [pendind?]. The location and acreage information for riparian and wetland habitats based on this refined work is used to assess impacts, make significance findings, and identify appropriate mitigation.

and cottonwood-willow riparian forest. The descriptions of these riparian communities primarily are based on Gray and Bramlet (1992) and MBA (1996).

Riparian communities typically consist of one or more deciduous tree species with an assorted understory of shrubs and herbs (Holland and Keil 1995). The transition between riparian habitats and adjacent non-riparian habitats often is abrupt (Grenfell 1988). Vegetation height can vary from three to ten feet in scrub habitats to 100 feet in riparian forest habitats (Grenfell 1988). Riparian habitats generally occur among mid- to large-order streams below about 4,000 feet above msl, primarily within the foothills and valleys (Stephenson and Calcarone 1999). Riparian communities are not restricted to specific climates or soil types, but are primarily dependent on a permanent supply of water. In southern California, most streams have very low flow during the summer, and in many cases surface flow may dry up (Stephenson and Calcarone 1999).

Riparian communities are dynamic systems. The stream channels may be swept clean of vegetation during floods as sediments are shifted during erosion flood events. Some have deep root systems that anchor them against the floodwaters and some have flexible stems that bend with floodwaters.

In addition to riparian communities, RMV supports several distinct wetland communities, including open water, freshwater marsh, water courses, and vernal pools, which support their own unique plants and wildlife and contribute additional biodiversity and ecological functions.

d. Woodlands and Forest on Rancho Mission Viejo

Oak woodlands consist of multilayered vegetation with a canopy that is 20 to 80 percent tree cover (Gray and Bramlet 1992). Oak woodlands occur throughout the lower elevations of western California, generally from sea level to 4,900 feet (Holland and Keil 1995). Oak forests are similar to oak woodlands, but have 80 percent or more canopy cover (Gray and Bramlet 1992).

Thorne (1976) distinguishes between northern, foothill, southern, and island oak communities in California. Southern and coastal woodlands, including coast live oak woodland found in the RMV, extend from eastern Mendocino County at 40° N latitude through the North Coast, Central Coast, and Transverse ranges on north-facing and coast-facing slopes and in canyons below 3,900 feet (Barbour and Minnich 2000). The range continues through the interior valleys and foothill slopes of the Peninsular ranges, mainly between 500 and 4,600 feet, and south to the Sierra San Pedro Martir at 30° N latitude in Baja California, Mexico (Barbour and Minnich 2000). According to Munz and Keck (1949), the southern oak woodlands are found in the valleys of southern California between Los Angeles and San Diego counties east to about 5,000 feet in the San Jacinto Mountains of western Riverside County. According to Holland and Keil (1995), coast live oak woodlands range from Sonoma County to Baja California, generally in mesic areas including canyon bottoms and north-facing slopes, whereas southern oak woodlands extend from Ventura County southward. This roughly corresponds with Griffin (1977) who distinguishes oak woodlands from the Santa Ynez Mountains of Santa Barbara County southward as southern oak woodland.

Generally, oak woodlands are open where moisture is limited in drier more exposed aspects, and densest in moist areas (Holland and Keil 1995). North-facing slope occurrences are also denser than south-facing slope occurrences (Holland and Keil 1995). Average annual rainfall of areas supporting oak woodlands is between 15 and 25 inches. Runoff tends to be rapid. The growing season is seven to 10 months (Munz and Keck 1949). Oak trees, in general, require 60 to 80 years to mature (Holland 1988).

Common soils that support coast live oak include sandstone and shale-derived soils (Sawyer and Keeler-Wolf 1995). Coast live oak typically occupies slopes with deep soils, alluvial terraces, and the recent alluvium of canyon bottoms (Griffin 1977; Brown 1982). Open woodlands form when soils are shallow (Holland and Keil 1995).

Canyon live oak forest is similar in composition to coast live oak forest, but is dominated by canyon live oak.

Many understory shrubs in woodlands and forest are shade tolerant and include scrub oak (*Quercus berberidifolia*), California blackberry, snowberry (*Symphoricarpos mollis*), California walnut (*Juglans californica*), California-lilac (*Ceanothus* spp.), laurel sumac, gooseberry, toyon, California laurel, manzanita (*Arctostaphylos* spp.), poison-oak, Mexican elderberry, mountain-mahogany, sugarbush (*Rhus ovata*), big-leaf maple and white alder. Herbaceous understory species include California goldenrod (*Solidago californica*), western wild rye (*Elymus glaucus*), giant ryegrass, *Melica* spp., *Stellaria* spp., *Claytonia* spp., ripgut grass, wild cucumber, nightshade, *Phacelia* spp., and common eucrypta (*Eucrypta chrysanthemifolia*) (Gray and Bramlet 1992).

Live oak forest primarily occurs on the Donna O'Neill Land Conservancy , at the head of Cristianitos Creek, on the northern slopes of Blind Canyon, and in small patches in lower Chiquita Canyon and east of Cañada Gobernadora.

e. Chaparral Communities on Rancho Mission Viejo

Gray and Bramlet (1992) identify several scrub-chaparral ecotone/sere and chaparral subassociations in the Orange County. These subassociations generally are self-descriptive by their titles. The scrub-chaparral ecotone/sere subassociations are characterized gradations between scrub and chaparral vegetation communities. Two scrub-chaparral ecotone/sere subassociations known from the RMV are chamise-sage scrub and maritime chaparral-sagebrush, the former dominated by chamise and California sagebrush and the latter dominated by lemonadeberry, laurel sumac, and toyon. Chaparral subassociations known from the RMV include southern mixed chaparral, chamise chaparral, scrub oak chaparral, toyon-sumac chaparral, snowball ceanothus chaparral, and manzanita chaparral.

TABLE 1

VEGETATION COMMUNITIES/LAND COVERS IN THE STUDY AREA

Vegetation Community/Land Cover[1]	Acres
Natural Habitats	
Grassland	5,040.9
Coastal Sage Scrub	7,682.0
Riparian[2]	1,919.7
Open Water	135.7
Freshwater Marsh	25.2
Slope Wetland	2.2
Watercourses	13.2
Vernal Pools	19.9
Woodland	275.9
Forest	311.9
Chaparral	3,792.9
Cliff and Rock	6.2
Subtotal – Natural Habitats	**1,9225.7**
Non-habitat Land Covers	
Developed	534.7
Disturbed	501.2
Agriculture	2554.8
Sub-total – Non-Habitat Land Covers	**3,590.7**
TOTAL	**22,816.4**

[1] Source: Southern NCCP/HCP Vegetation Database (1993), as revised by Dudek in 2004 (file date 3/24/04).

[2] See Table 2 for a breakdown of specific riparian vegetation communities.

TABLE 2
RIPARIAN VEGETATION COMMUNITIES IN THE STUDY AREA

Riparian Community[1]	Acres[2]
Herbaceous Riparian	17.2
Willow Riparian Scrub (Southern Willow Scrub)	357.5
Southern Arroyo Willow Riparian Forest	168.1
Coast Live Oak Riparian Forest	1,116.2
Cottonwood—Willow Riparian Forest	1.2
Sycamore Riparian Woodland	246.9
White Alder Riparian Forest	1.6
Mule Fat Scrub	11.0
TOTAL	**1,919.7**

[1] Source: Southern NCCP/HCP Vegetation Database (1993), as revised by Dudek in 2004 (file date 3/24/04).

[2] Acres not representative of USACE or CDFG jurisdiction, see Tables 4.9-5 and 4.9-6 of EIR for USACE and CDFG jurisdiction.

2.1.4 Sensitive Species

The following are summary descriptions of listed and non-listed sensitive species which may benefit from this GMP. For a complete species account for these species, the reader is referred to Biological Resources Section of the EIR.

a. Listed Species

California Gnatcatcher

The California gnatcatcher (*Polioptila californica*) is federally listed as threatened. It is a small, long-tailed member of the thrush family (Muscicapidae). The gnatcatcher typically occurs in or near coastal sage scrub, which is a broad category of vegetation that includes the following plant communities as classified by Holland (1986): Venturan coastal sage scrub, Diegan coastal sage scrub, maritime succulent scrub, Riversidean sage scrub, Riversidean alluvial fan sage scrub, southern coastal bluff scrub, and coastal sage-chaparral scrub. Coastal sage scrub is composed of relatively low-growing, dry-season deciduous, and succulent plants. As described above, characteristic plants of this community include coastal sagebrush, various species of sage (*Salvia* sp.), California buckwheat, lemonadeberry, California encelia and *Opuntia* spp. Ninety-nine percent of all gnatcatcher locality records occur at or below an elevation of 300 meters (m) (984 feet [ft]) (Atwood 1990). Gnatcatchers on RMV are concentrated in two locations, namely Chiquita and Gobernadora Canyons, and in more scattered locations in Cristianitos and Trampas Canyons.

Arroyo Toad

The arroyo toad (*Bufo californicus*) is federally-listed as endangered It is found in foothill canyons and inter-mountain valleys where rivers are bordered by low hills and the stream gradients are low (Miller and Miller 1936; Sweet 1992). The arroyo toad uses riparian environments for breeding and adjacent uplands for foraging and estivation. Arroyo toads are known to either breed, forage, and/or aestivate in aquatic habitats, riparian, coastal sage scrub, oak, and chaparral habitats. The species is restricted to medium- to large-sized, slow-moving streams. The majority of arroyo toad population studies occur within third and fourth order drainages that are characterized by decomposed granite bedrock. However, toad populations have been found in a wide range of stream orders, including lower, second order, and higher, fifth and sixth order coastal streams characterized by sedimentary rock (PCR 2002). According to USFWS, streams supporting arroyo toads range from first to sixth order in the central part of the species' range (Orange, Riverside and San Diego counties) (USFWS 1999). Within RMV, the arroyo toad is associated with riparian, streamcourses with sandy benches along streams in both the San Juan Creek and San Mateo Creek watersheds, specifically San Juan Creek from about the mouth of Chiquita Canyon upstream to the RMV boundary and beyond to about Hot Springs Creek and in lower Bell Canyon. In the San Mateo Watershed the toad occurs in Talega, lower Gabino and lower Cristianitos creeks.

Least Bell's Vireo

The least Bell's vireo (*Vireo belli pusillus*) is state and federally listed as endangered. It occupies a more restricted nesting habitat than the other subspecies of Bell's vireo, as summarized in USFWS (1986). Least Bell's vireos primarily occupy riverine riparian habitats that typically feature dense cover within one to two meters of the ground and a dense, stratified canopy. It inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically it is associated with southern willow scrub, cottonwood forest, mule fat scrub, sycamore alluvial woodland, coast live oak riparian forest, arroyo willow riparian forest, wild blackberry, or mesquite in desert localities. It uses habitat that is limited to the immediate vicinity of watercourses below about 457 m (1,500 ft) elevation in the interior (USFWS 1986; Small 1994). In the coastal portions of southern California, the least Bell's vireo occurs in willows and other low, dense valley foothill riparian habitat and lower portions of canyons and along the western edge of the deserts in desert riparian habitat. On RMV, surveys have documented nesting locations in Gobernadora Creek, middle San Juan Creek (between the Ortega Highway bridge and Casper Wilderness Park), Chiquita Creek and lower Cristianitos Creek.

Southwestern Willow Flycatcher

The southwestern willow flycatcher (*Empidonax traillii extimus*) is state and federally listed as endangered. It is restricted to riparian woodlands along streams and rivers with mature, dense stands of willows (*Salix* spp.), cottonwoods (*Populus* spp.) or smaller spring fed or boggy areas with willows or alders (*Alnus* spp.) (Sedgwick and Knopf 1992). It is an insectivore that forages within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage (USFWS 1993). This species also forages in areas adjacent to nest sites which may be more open (USFWS 1995). On RMV, the southwestern willow flycatcher is known from the Gobernadora Ecological Restoration Area (GERA) in Gobernadora Canyon.

Riverside Fairy Shrimp

The Riverside fairy shrimp (*Steptocephalus wootonii*) is federally-listed as endangered. It is restricted to deep seasonal vernal pools, vernal pool-like ephemeral ponds, and stock ponds and other human modified depressions (Eng et al. 1990; USFWS 1993, USFWS 2001). Riverside fairy shrimp prefer warm-water pools that have low to moderate dissolved solids, are less predictable, and remained filled for extended periods of time (Eriksen and Belk 1999). Basins that support Riverside fairy shrimp are typically dry a portion of the year, but usually are filled by late fall, winter or spring rains, and may persist through May (USFWS 2001). All known vernal pool habitat lies within annual grasslands, which may be interspersed through chaparral or coastal sage scrub vegetation. On RMV, the Riverside fairy shrimp in very large population in a large pool on Chiquita Ridge (this pool is within Ladera Open Space) and in two pools located along Radio Tower Road (pools 2 and 7).

San Diego Fairy Shrimp

The San Diego fairy shrimp (*Branchchinecta sandiegonensis*) is state-listed as endangered and federally-listed as threatened. It occurs in small, shallow vernal pools ranging in depth from 5.1 to 30.5 cm (2 to 12 in) and in water temperatures from 10 and 14.5 degrees C (50 to 58 degrees F). Water temperature and chemistry are important factors in the species' distribution. Adults are usually observed in January-March when pools hold water from winter rains, although the breeding season may be extended in association with early winter or mid-spring rains (USFWS 2000). Eggs are either dropped to the pool bottom or remain in the brood sac until the adult female dies and sinks. The shrimp hatch and mature in seven days to two weeks, depending on water temperature. "Resting eggs" of cysts are capable of withstanding heat, cold and prolonged drying (USFWS 2000). Because the high variability rainfall in southern California, and thus the success of any given breeding season, only a fraction of cysts may hatch in a given year and reproductive success can be spread out over several years (USFWS 2000).

The San Diego fairy shrimp occurs two locations on RMV: in the large and small vernal pools on Chiquita Ridge (vernal pools 3 and 4) and in three pools located along Radio Tower Road south of Ortega Highway (vernal pools 1, 2 and 7).

Thread-leaved Brodiaea

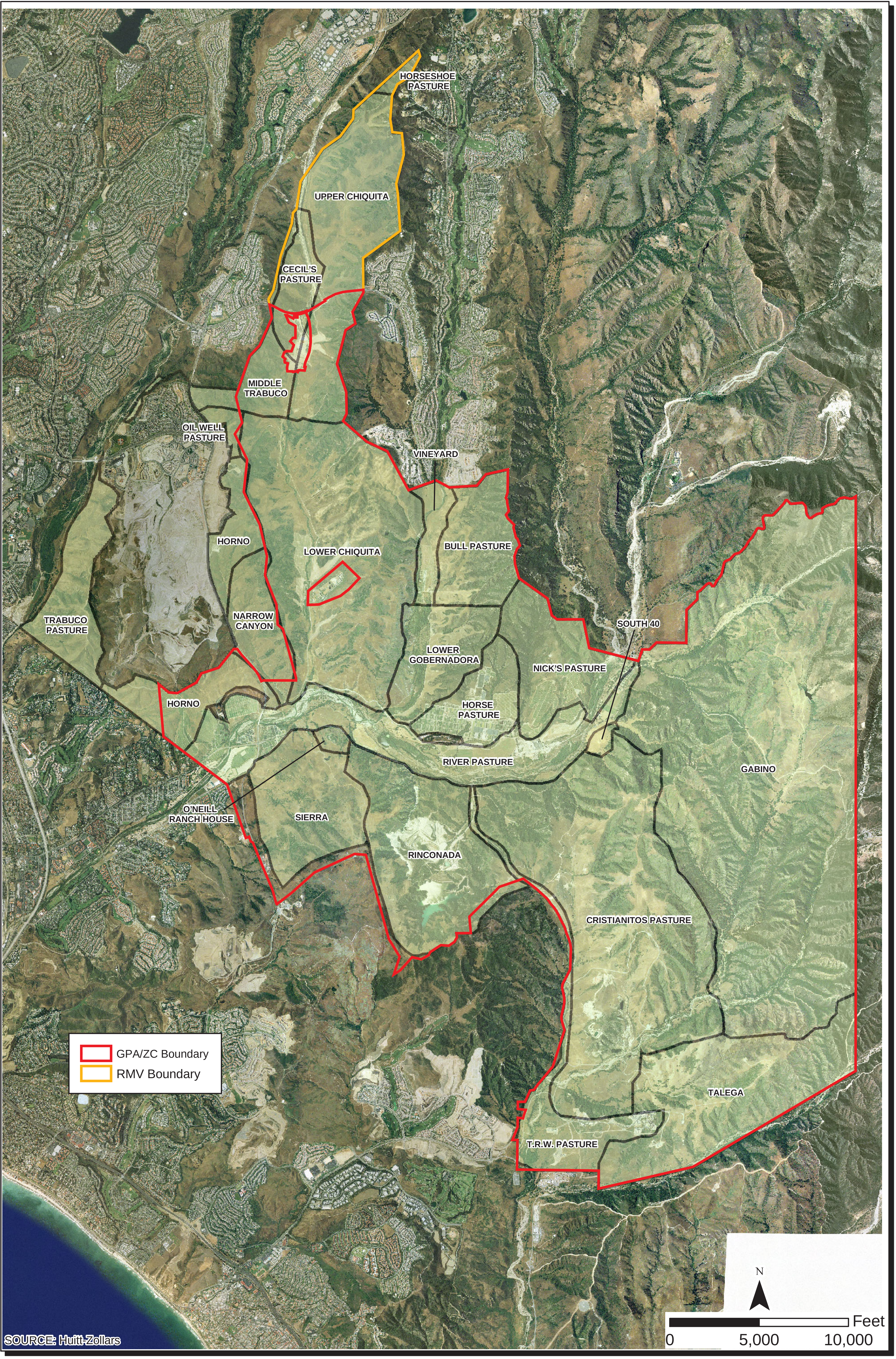
Thread-leaved brodiaea (*Brodiaea filifolia*) is state-listed as endangered and federally-listed as threatened. It is a perennial geophyte, that has a corm with a dark brown, fibrous tunic. The flowering stalk is 20.3-40.6 cm (8-16 in) high and the narrow leaves are generally shorter than the flowering stem. The flowers are dark blue to violet and have six perianth segments. There are three stamens and three staminodia (sterile stamens), which are narrow and thread-like in each flower. In Orange County, populations are known from Aliso-Woods Canyon Regional Park (several thousand), RMV (4,500 to 5,500 flowering stalks), Forster Ranch (approximately 5,000 flowering stalks associated with a restoration/relocation program), Prima Deshecha Landfill, and the Talega Development where one small population will be preserved in open space and a second population is slated for translocation.

b. Non-listed Species

Several non-listed species also occur on RMV which that are likely to be affected by grazing management program either directly (e.g., species such as grasshopper sparrow that nest in grasslands with high structural diversity) or indirectly (species whose prey may be affected by grazing practices such as kite, horned lizard and whiptail). These species are: cactus wren, yellow warbler, yellow-breasted chat, grasshopper sparrow, white-tailed kite, merlin, western spadefoot toad, southwestern pond turtle, San Diego horned lizard, and orange-throated whiptail. For a complete species account for these species, the reader is referred to the Biological Resources Section of the EIR.

2.2 Pastures

Figure 1 shows the general location of the historic RMV pastures within the RMV property boundary. Trabuco Pasture, Oil Well, Horno, Lower Chiquita, Middle Trabuco, Cecil's Pasture, Horseshoe Pasture, Upper Chiquita, the Vineyard, Bull Pasture, Lower Gobernadora, Horse Pasture and Nick's Pasture are located north of San Juan Creek in the San Juan Watershed. River Pasture straddles San Juan Creek. South of San Juan Creek located partially within the San Juan



RMV Grazing Management Plan

Historic RMV Pastures on Aerial Base

FIGURE
1

Creek Watershed and partially within the San Mateo Watershed are Sierra, Rinconada, Cristianitos Pasture, Gabino, Talega and TRW Pasture. South 40 is located adjacent to Ortega Highway in the San Juan Creek watershed.

2.2.1 Pasture Description

The following is an overview of the location by sub-basin, soils, vegetation community, sensitive species, fencing and water resources for each of the historic pastures listed above. The current status of the pasture is also discussed, i.e., whether it is actively grazed or not. *Figures 2, 3,* and *4a-c* depict terrain types, vegetation and listed and selected sensitive species for the pastures.

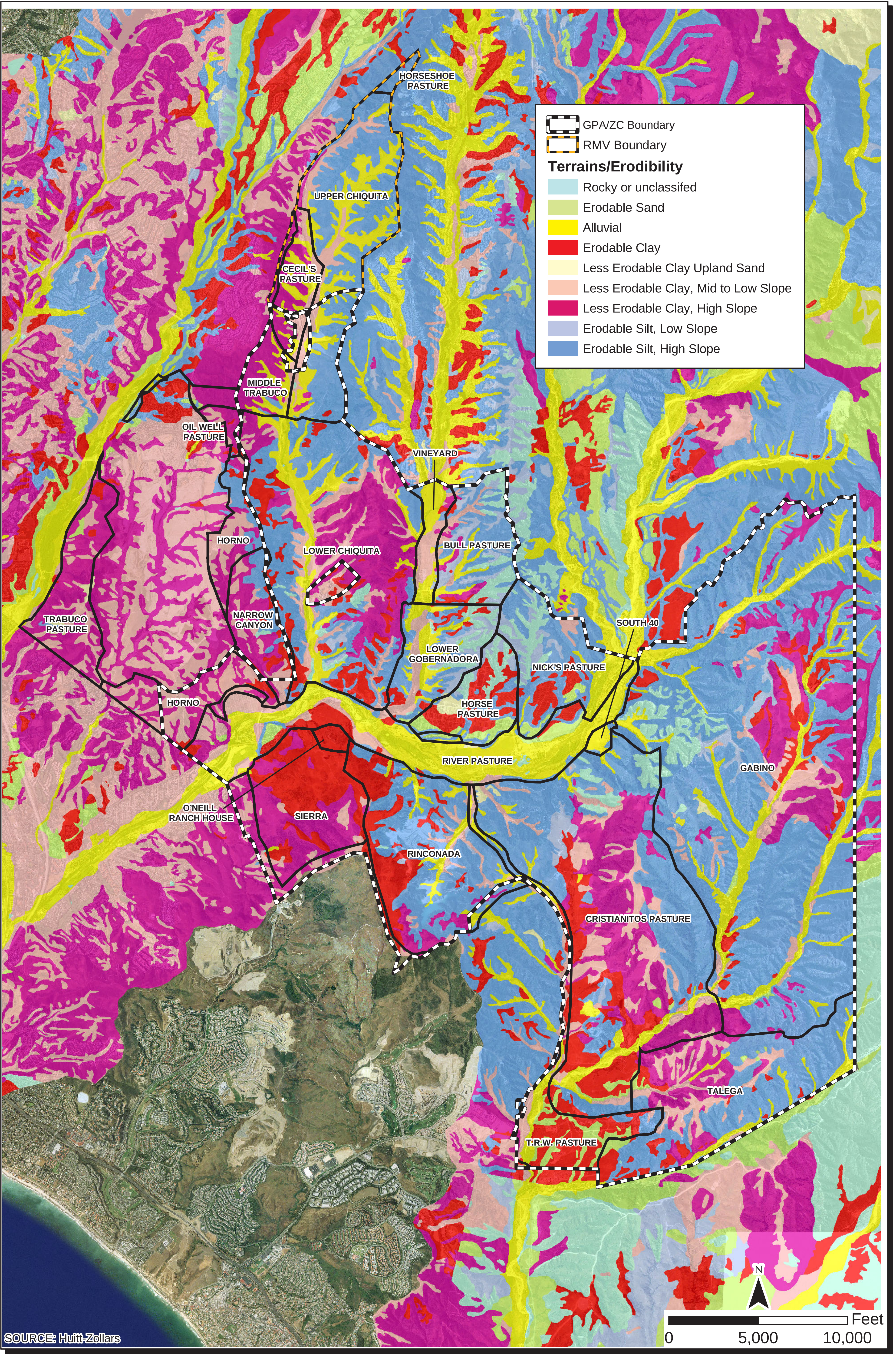
a. Trabuco Pasture

Trabuco Pasture is located in the Trabuco sub-basin Terrains in this sub-basin are low to high slope less erodable clays (*Figure2*). Vegetation is this pasture is dominated by grassland and coastal sage scrub (*Figure 3*). Other vegetation types occurring in the pasture to a lesser degree include riparian and chaparral. Agriculture, distributed and developed also occur in this pasture. Thread-leaved brodiaea occurs in this pasture. No other sensitive plant species occur. Eleven California gnatcatcher locations occur in this pasture (*Figure 4a*). Other species of note include American badger, Bell's sage sparrow, coastal cactus wren, grasshopper sparrow, red-tailed hawk and white-tailed kite (*Figure 4b*).

Trabuco Canyon pasture has been set aside for conservation purposes in accordance with the terms and conditions of the USACE, UFSWS and CDFG permits for Ladera Ranch and the Arroyo Trabuco Golf Course. No active grazing occurs on this pasture. In accordance with the terms and conditions of the Ladera Open Space Conservation Easement grazing is a reserved use subject to the preparation and approval of a grazing management plan by the County of Orange. A subsequent amendment to the Ladera Open Space Easement associated with approval of the Arroyo Trabuco Golf Course revised this provision of the easement to state "No grazing shall be permitted within the Conservation Easement Area without the written consent of CDFG and the Service." It is not the intent of RMV to resume grazing in the Trabuco Pasture, therefore this pasture will not be further addressed by this GMP.

1. Narrow Canyon

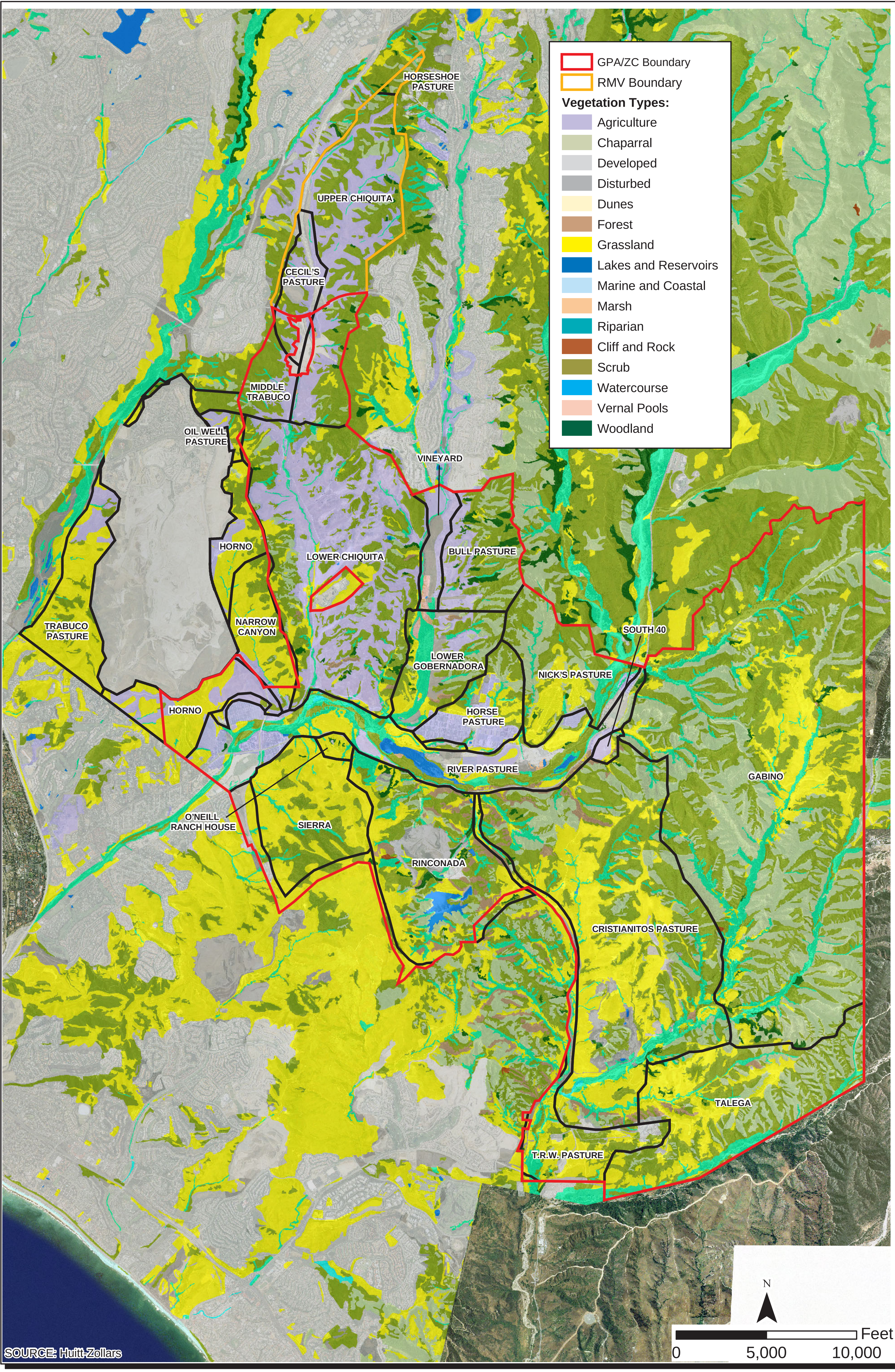
Narrow Canyon pasture is located in the Narrow Canyon sub-basin. This pasture is characterized by high to low slope and less erodible clays (*Figure 2*). Vegetation types in Narrow pasture include agriculture, annual and native grasslands, coastal sage scrub and minor amounts of chaparral and riparian (*Figure 3*). No sensitive plant species occur within this pasture. Recorded locations of listed species include 11 locations for California gnatcatcher (*Figure 4a*). Other



RMV Grazing Management Plan

Historic RMV Pastures on Terrains/Erodibility

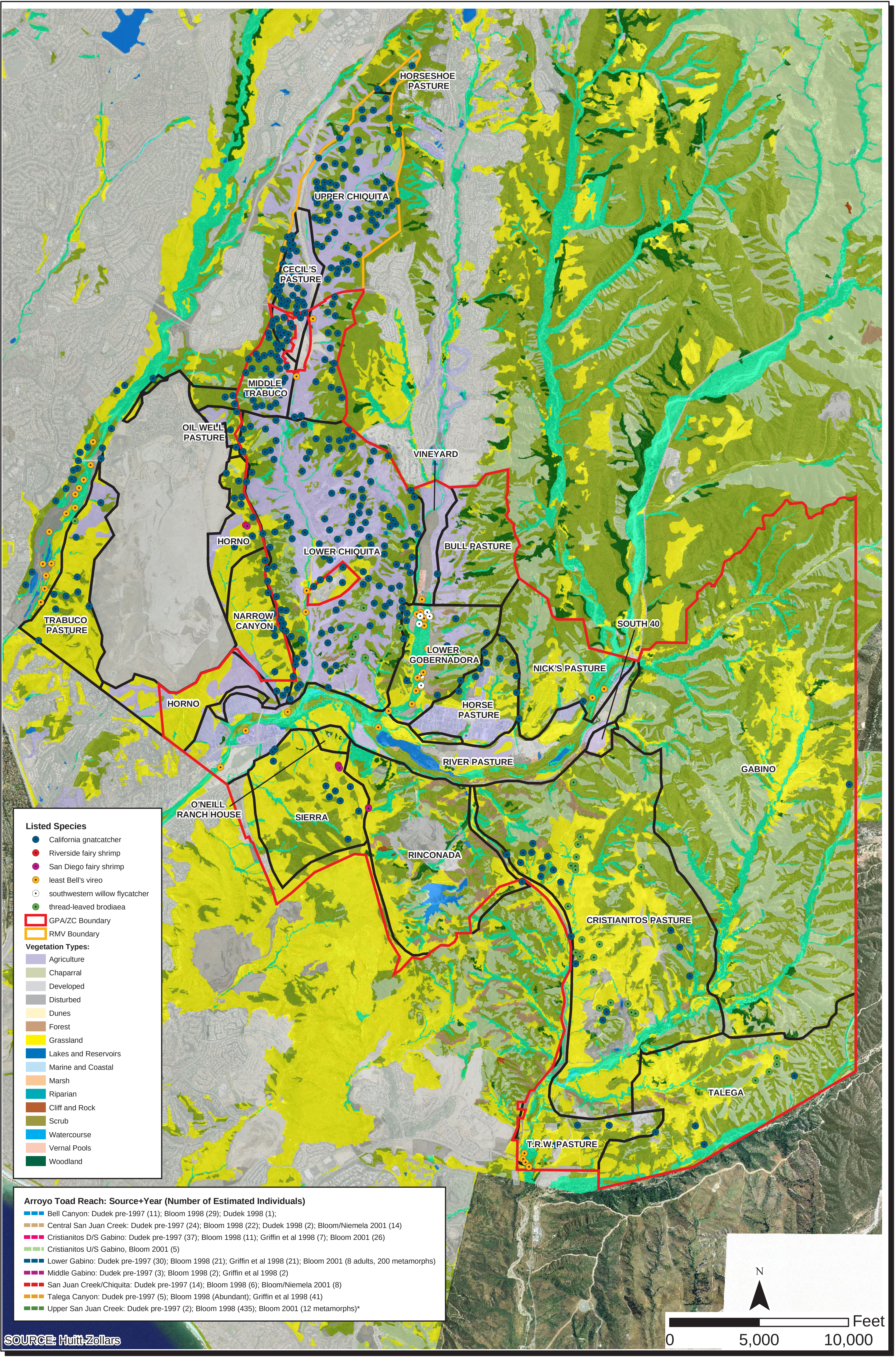
FIGURE 2



RMV Grazing Management Plan

Historic RMV Pastures on Vegetation Base

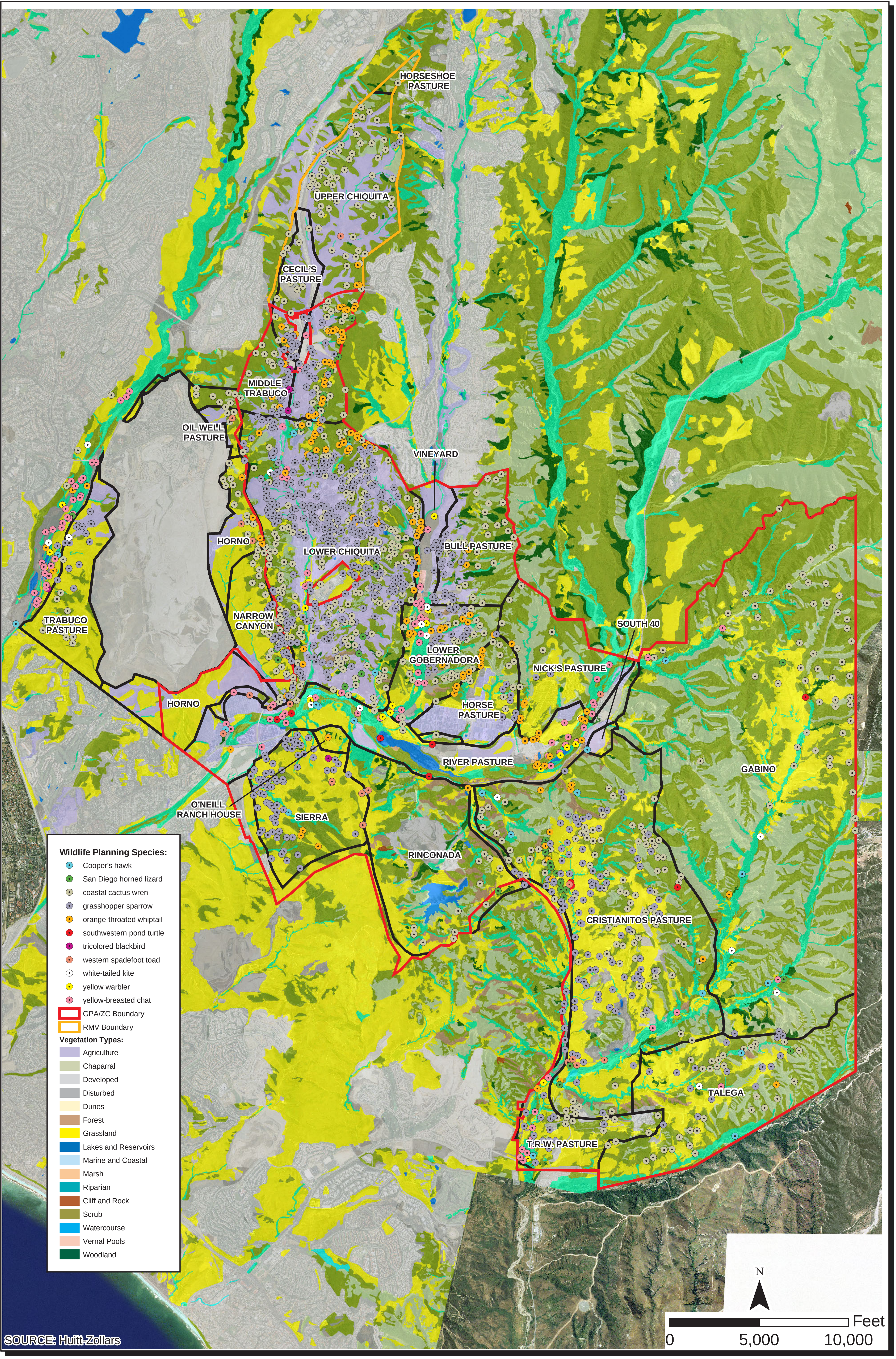
FIGURE 3



RMV Grazing Management Plan

FIGURE 4a

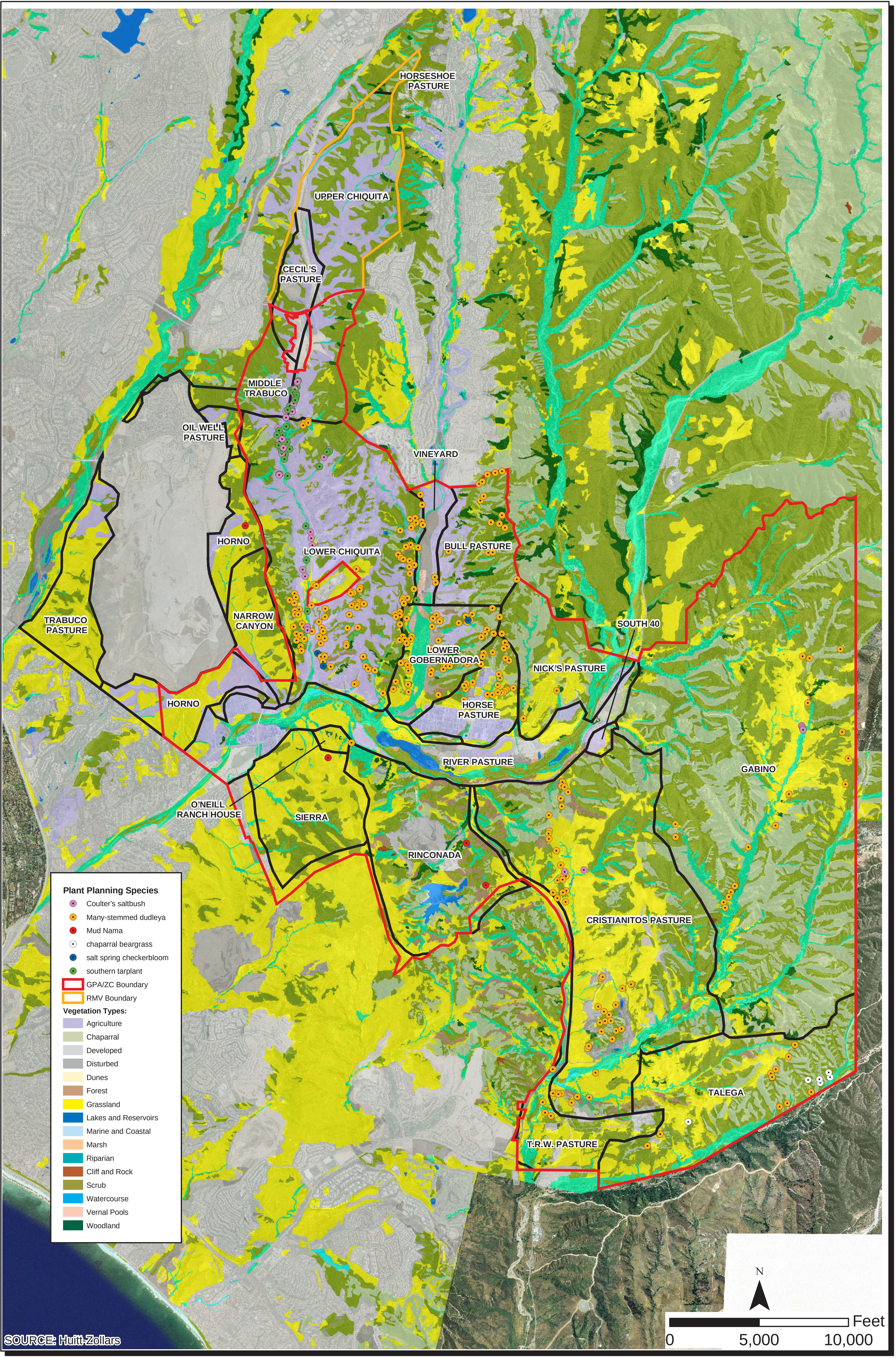
Listed Species within Historic RMV Pastures on Vegetation Base



RMV Grazing Management Plan

Wildlife Planning Species within Historic RMV Pastures on Vegetation Base

FIGURE 4b



RMV Grazing Management Plan

FIGURE 4c

Plant Planning Species within Historic RMV Pastures on Vegetation Base

species of note recorded within this pasture include coastal cactus wren, grasshopper sparrow, loggerhead shrike, northern red-diamond rattlesnake, orange-throated whiptail, *rufous-crowned* sparrow, San Diego horned lizard, western spadefoot toad and western whiptail (*Figure 4b*).

Grazing is excluded from Narrow Canyon in accordance with the terms and conditions of the 404 permit issued by the USACE for Ladera Ranch and is also partially within the Ladera Open Space Conservation Easement (discussed above), therefore this pasture will not be further discussed in this GMP.

2. Horno

Horno pasture straddles the Horno and Narrow/Chiquita Sub-basins as shown on *Figure 1*. This pasture is characterized by high to low slope and less erodible clays (*Figure 2*). Vegetation types in Horno pasture include agriculture, annual grasslands, coastal sage scrub and very minor amounts of native grasslands, chaparral, lakes and riparian (*Figure 3*). No sensitive plant species occur within this pasture. Recorded locations of listed species include one location for California gnatcatcher (*Figure 4a*). Other species of note recorded within this pasture include barn owl, great horned owl and western spadefoot toad (*Figure 4b*).

Horno pasture is also part of the Ladera Open Space and is subject to the Ladera Open Space Conservation Easement and its subsequent amendment. As noted above for the Trabuco Pasture, RMV does not intend to resume grazing in the Ladera Open Space Conservation Easement, therefore this pasture will not be discussed further in this GMP.

3. Oil Well Pasture

Oil Well Pasture straddles the Horno and Narrow/Chiquita Sub-basins as shown on *Figure 1*. This pasture is characterized by high to low slope and less erodible clays (*Figure 2*). Vegetation types in Oil Well Pasture pasture include agriculture, annual grasslands, coastal sage scrub and minor amounts of native grassland, riparian and developed (*Figure 2*). No sensitive plant species occur within this pasture. Recorded locations of listed species include three locations for California gnatcatcher (*Figure 4a*). Other species of note recorded within this pasture include coastal cactus wren and western spadefoot toad (*Figure 4b*).

Oil Well Pasture is also part of the Ladera Open Space and is subject to the Ladera Open Space Conservation Easement and its subsequent amendment. As noted above for the Trabuco, Narrow Canyon and Horno pastures, RMV does not intend to resume grazing in the Ladera Open Space Conservation Easement, therefore this pasture will not be discussed further in this GMP.

4. Lower Chiquita, Middle Trabuco, Upper Chiquita and Cecil's Pasture – "Chiquita Pastures"

Lower Chiquita, Middle Trabuco, Upper Chiquita and Cecil's Pasture are all located within the Chiquita sub-basin and include the majority of Chiquadora ridge located in the Gobernadora sub-basin. Portions of Middle Trabuco, Cecil's Pasture, Upper and Lower Chiquita have been removed from active grazing for development purposes (Cecil's Pasture below Oso Parkway) or set aside for conservation purposes (Cecil's Pasture and Upper Chiquita above Oso Parkway, Horseshoe Pasture, Narrow Canyon and portions of Horno. The remaining portions of these pastures are grazed as one pasture today. For purposes of this overview this group of pastures will be called the "Chiquita Pastures". These pastures are characterized by sandy or silty terrains in the main and side canyons. Ridges on the east side of the valley are characterized by rock outrcroppings and areas of hardpan (eroded remnants of claypans formed in the geologic past that have eroded to form mesas) and locally steep slopes (*Figure 2*).

Vegetation in the Chiquita Pastures includes coastal sage scrub, agriculture (in the form of citrus and avocado orchards and barley fields), patches of annual and native grasslands and patches of chaparral (*Figure 3*). Chiquita Creek supports herbaceous riparian, southern willow scrub, arroyo willow riparian forest and coast live oak riparian forest. Slope wetlands also occur in this pasture. Several listed and other species of note occur in the Chiquita Pastures including the federally-listed California gnatcatcher, the state/federally-listed thread leaved Brodiaea, the state/federally-listed least Bell's vireo, California Native Plant Society (CNPS) List 1B plants many-stemmed dudleya, southern tarplant, Coulter's saltbush and salt spring checkerbloom (*Figures 4a,c*). Other wildlife of note includes coastal cactus wren, ferruginous hawk, prairie falcon, merlin, northern harrier, wintering burrowing owls, loggerhead shrike, grasshopper sparrow, rufous-crowned sparrow, California horned lark, tricolored blackbird, (nomadic colonies), orange-throated whiptail, coastal western whiptail, San Diego horned lizard, northern-red diamond rattlesnake, mule deer and mountain lion (*Figure 4b*).

The actively grazed portion of the Chiquita Pastures is enclosed by a four-strand barbed wire fence located below Tesoro High School for the northern boundary, along Chiquita Ridge for the western boundary and the west side of Gobernadora Creek for the eastern boundary. Internal fencing to separate cattle from other uses, such as the orchards, the Chiquita wetland mitigation sites and the reclamation plant also divides the pasture. Fencing along San Juan Creek for the River Pasture forms the southern boundary of the actively grazed portion of Chiquita Pastures. Water is provided by a cattle trough in the lower part of the pasture and via Chiquita Creek.

The portion of Cecil's Pasture and Upper Chiquita north of Oso Parkway and Horseshoe Pasture have not been actively grazed since 1996 when RMV sold a conservation easement to the Transportation Corridor Agencies (TCA) as mitigation for the Oso Segment of the Foothill

Transportation Corridor-North. In accordance with the Section 7 biological opinion issued for that project by USFWS and as set forth in the TCA's management plan for that area (Upper Chiquita Canyon Conservation Easement Area Resource Management Plan), grazing is an allowed use once a grazing management plan has been reviewed and approved by USFWS and CDFG. This GMP will address grazing practices within the Upper Chiquita Canyon Conservation Easement Area.

5. Gobernadora Pastures

Three separate fenced pastures collectively called the Gobernadora pastures, occur in the Gobernadora sub-basin: Vineyard, Bull Pasture and Lower Gobernadora. The terrain types, vegetation communities and listed and other species of note for the Gobernadora pastures are depicted on *Figures 2, 3* and *4a-c* respectively. Each pasture is described separately below.

(a) The Vineyard

The Vineyard pasture is located within the valley floor of the Gobernadora sub-basin. The valley floor is characterized by deep alluvial deposits within interbedded clay lenses. Vegetation in this pasture is primarily composed of agriculture (barley), annual grasslands and the riparian habitats associated with Gobernadora Creek. The more rugged uplands west of Gobernadora Creek are dominated by coastal sage scrub and grasslands. Recorded locations for listed species include two for the California gnatcatcher. Southern willow scrub in the revegated wetland mitigation area (GERA) provides nesting habitat for least Bell's vireo, yellow-breasted chat, and red-shouldered hawk. Other species of note within this pasture include California horned lark, grasshopper sparrow, orange-throated whiptail, rufous-crowned sparrow, western whiptail and yellow warbler. Tricolored blackbirds periodically forage in the grasslands of the Vineyard pasture. Two CNPS List 1B plants occur in the Vineyard pasture, one is the listed many-stemmed dudleya and the other is southern tarplant.

The Vineyard pasture is enclosed by four-strand barbed wire fence. Internal fencing excludes cattle from GERA. Water is provided by cattle troughs and via Gobernadora Creek.

(b) Bull Pasture

Bull Pasture is located within the Gobernadora sub-basin, west of Gobernadora Creek. The flat to rolling terrain of this pasture exhibits areas of exhumed hardpan overlying sandy and silty substrates and exposed rock outcrops. Vegetation types in this pasture include agriculture (barley), coastal sage scrub, chaparral, oak woodlands, grassland, riparian and a small amount of disturbed area. Wildlife of note occurring in Bull pasture include barn owl, coastal cactus wren, grasshopper sparrow, great horned owl, orange-throated whiptail, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard and western skink. Sensitive plants occurring in the pasture include many-stemmed dudleya, Catalina mariposa lily, and Palmer's grappling hook.

Bull Pasture is enclosed by four-strand barbed wire fence. The RMV property perimeter fence is its northern boundary, its eastern boundary is fenced along Gobernadora ridge, its southern boundary shares a fence with the Lower Gobernadora pasture and its western fence is shared with the Chiquita Pasture. Water is provided by a cattle trough.

(c) Lower Gobernadora

The Lower Gobernadora pasture extends from Chiquadora ridge to Gobernadora ridge in an east-west direction, and from Bull Pasture and the Vineyard to the River Pasture in a north-south direction. This pasture includes the terrains of the valley floor (deep alluvial deposits with interbedded clays) and the ridges (exhumed hardpan overlying sandy and silty substrates).

Vegetation types on the east side of Lower Gobernadora pasture include agriculture, coastal sage scrub, chaparral and oak woodlands. The more rugged uplands west of Gobernadora Creek are dominated by coastal sage scrub and grasslands. The valley floor is characterized by agriculture, annual grasses and the riparian communities associated with Gobernadora Creek and GERA. Disturbed and developed land use covers also occur in this pasture. Listed species occurring in this pasture include least Bell's vireo, California gnatcatcher, southwestern willow flycatcher.. Sensitive plant species that occur within this pasture include; many-stemmed dudleya, Catalina mariposa lily, Palmer's grapplinghook, southern tarplant and paniculate tarplant. Other species of note include barn owl, coastal cactus wren, desert woodrat, grasshopper sparrow, orange-throated whiptail, red-shouldered hawk, red-tailed hawk, *rufous-crowned*-sparrow, western whiptail, white-tailed kite, yellow warbler and yellow-breasted chat.

Lower Gobernadora shares fences with Vineyard and Bull Pasture to the north, Horse Pasture and Nick's Pasture to the east along Gobernadora Ridge, River Pasture to the south and Lower Chiquita pasture to the west along Chiquadora Ridge. The wetland revegetation area, GERA, is fenced to exclude cattle. Water is provided by a cattle trough.

6. Horse Pasture

Horse Pasture is located within the Central San Juan sub unit of the Central San Juan and Trampas Canyon sub-basin. Terrains in this pasture generally include erodible silts and clays. Upland vegetation types include coastal sage scrub, chaparral, oak woodlands, grassland, open water, riparian, agriculture, developed and disturbed areas (Colorspot Nursery). Listed species present in this pasture include California gnatcatcher locations north of Colorspot Nursery. Sensitive plant species include many-stemmed dudleya, Catalina mariposa lily and Palmer's grapplinghook. Also present in this pasture are barn owl, coastal cactus wren, desert woodrat, grasshopper sparrow, orange-throated whiptail, red-tailed hawk, *rufous-crowned*-sparrow, southwestern pond turtle and western whiptail. The terrain types, vegetation communities and sensitive species for Horse Pasture are depicted on *Figures 2, 3* and *4a-c* respectively

Horse Pasture shares fences with Lower Gobernadora to the north-west, Nick's Pasture to the north-east and River Pasture to the south. No active grazing occurs in this pasture due to the extent of the Colorspot Nursery operation.

7. Nick's Pasture

Nick's Pasture is also located within the Central San Juan sub unit of the Central San Juan and Trampas Canyon sub-basin. Terrains in this pasture generally include erodible silts and clays. Upland vegetation types include coastal sage scrub, chaparral, oak woodlands, grassland, riparian and agriculture (citrus orchards). A small portion of this pasture is classified as developed. Listed species locations recorded in this pasture include arroyo toad, California gnatcatcher and least Bell's vireo. Sensitive plant species in this pasture include locations of many-stemmed dudleya, Catalina mariposa lily and Palmer's grapplinghook. Other species of note with locations in this pasture include barn owl, coastal cactus wren, grasshopper sparrow, orange throated whiptail, red-tailed hawk, rufous-crowned sparrow, western spadefoot toad and western whip tail. The terrain types, vegetation communities and sensitive species for Nick's Pasture are depicted on *Figures 2, 3* and *4a-c* respectively

Fencing of Nick's Pasture includes the RMV perimeter fence along the eastern edge and Bull Pasture and Lower Gobernadora to the west. Due to the lack of fencing to separate cattle from the citrus production areas, Nick's pasture has not been grazed for the last 5-6 years. Water is available through cattle troughs.

8. River Pasture

River pasture straddles San Juan Creek and is within the Central San Juan sub unit of Central San Juan and Trampas Canyon sub-basin. Terrains in this subunit generally include erodable silts and clays in the uplands north of San Juan Creek and alluvial terrace deposits in San Juan Creek itself. Vegetation types within the River Pasture include agriculture, chaparral, developed, disturbed, forest, grassland, open water, marsh, riparian, coastal sage scrub, stream and oak woodlands. Listed species locations in this pasture include the listed arroyo toad and least Bell's vireo. Other species of note include ash-throated flycatcher, barn owl, coastal cactus wren, desert woodrat, yellow-breasted chat, yellow warbler, rufous-crowned sparrow, sharp-shinned hawk, ferruginous hawk, merlin, northern red-diamond rattlesnake, orange-throated whiptail, white-tailed kite, Cooper's hawk, red-shouldered hawk, great horned owl, red-tailed hawk, great blue heron, southwestern pond turtle, two-striped garter snake, western skink, western spadefoot toad, arroyo chub and threespine stickleback. The terrain types, vegetation communities and sensitive species for River Pasture are depicted on *Figures 2, 3* and *4a-c* respectively

River Pasture shares fences with Horno, Lower Chiquita, Lower Gobernadora and Horse Pasture to the north; and Sierra, Rinconada, Cristianitos and Gabino to the south in the San Mateo watershed. Water is provided via San Juan Creek and a water trough when the creek is dry.

9. South 40

South 40 is located within the Central San Juan sub-basin, adjacent to Ortega Highway. Terrains in this pasture are erodable clays and some silts (*Figure 2*). Vegetation types in this sub-basin are disturbed (barley), annual grasses and chaparral on the steeper slopes (*Figure 3*). No sensitive plant locations occur in this pasture. Locations for barn owl, Cooper's hawk, ferruginous hawk, grasshopper sparrow, loggerhead shrike, night snake, northern red-diamond rattlesnake, orange throated whiptail, racer, red-tailed hawk, rufous-crowned sparrow, tricolored blackbird, western skink and western spadefoot toad occur in this pasture (*Figure 4b*).

South 40 is fenced along Ortega highway. Water is provided via water trough.

10. Sierra Pasture

The Sierra Pasture is located partially within the Chiquita sub-basin and partially within an un-named sub-basin that is located south of the Prima Deschecha sub-basin. Terrains in this pasture are erodable clays and less erodable clays of low to high slope (*Figure 2*). Vegetation types in this pasture are predominately grassland and coastal sage scrub, with some riparian and minor amounts of forest and oak woodland (*Figure 3*). Agriculture and developed land uses also occur in very small amounts. No sensitive plant locations occur in this pasture. However, several California gnatcatcher locations occur, as do locations for barn owl, Cooper's hawk, ferruginous hawk, grasshopper sparrow, loggerhead shrike, night snake, northern red-diamond rattlesnake, orange throated whiptail, racer, red-tailed hawk, rufous-crowned sparrow, tricolored blackbird, western skink and western spadefoot toad (*Figure 4a,b*). Both the federally-listed San Diego and Riverside fairy shrimp occur within vernal pools located along Radio Tower Road within this pasture.

Sierra pasture is fenced along Prima Deshecha Landfill, La Pata Avenue, Ortega Highway and shares fencing at the ridgeline with Rinconada pasture. Cattle are also excluded from the Ranch House by fencing. Water is provided via water trough.

11. Rinconada Pasture

Rinconada pasture is located within the Trampas and Cristianitos sub-basins. Terrains in this pasture are erodable silts and clays of low to high slope (*Figure 2*). Vegetation types in this pasture are predominately coastal sage scrub, grassland, chaparral and riparian, with oak forest and smaller amounts of oak woodland (*Figure 3*). Disturbed and developed land uses also occur in this pasture, namely the Oglebay Norton Industrial Sands (ONIS) mining operation. Trampas Canyon Dam is associated with this use. The Donna O'Neill Land Conservancy also lies within the historic boundary of this pasture, although grazing no longer occurs within the Conservancy. The state-and federally-listed thread-leaved brodiaea occurs within this pasture, as do several other sensitive plant locations including many-stemmed dudleya, Palmer's grappling hook and Catalina mariposa lily (*Figure 4a,c*). Of the other listed species, one California gnatcatcher location, one Riverside and one San Diego fairy shrimp pool occur in this pasture (*Figure 4a*). Both fairy shrimp occur within vernal pools located along Radio Tower Road within this pasture. Locations for barn owl, coastal cactus wren, great horned owl, Cooper's hawk, osprey (using open water), grasshopper sparrow, loggerhead shrike, night snake, northern red-diamond rattlesnake, orange throated whiptail, racer, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, turkey vulture, western spadefoot toad and white-tailed kite also occur in this pasture (*Figure 4b*).

Rinconada pasture is fenced along Ortega Highway, Cristiantios Road, the boundary with Prima Deshecha Landfill and Sierra Pasture. The Donna O'Neill Conservancy boundary is fenced to exclude cattle. Water is provided via water troughs and the mining pond associated with the ONIS operation. Although cattle are not specifically excluded from the ONIS operation, the lack of available forage in the active mine area acts as a deterrent to wandering cattle.

12. Cristianitos Pasture

Cristianitos Pasture is located partially within the Cristianitos sub-basin and partially within the Gabino sub-basin. Terrains in these portions of the sub-basins are erodable to less erodable clays and are subject to erosion under intensive grazing pressure (*Figure 2*). Grassland, including native grasslands and coastal sage scrub are the dominant vegetation types in this pasture (*Figure 3*). Chaparral, forest and riparian also occur in lesser amounts, as do open water, stream, woodland and rock. Developed, disturbed and agriculture also occur in this pasture. The listed thread leaved brodiaea occurs within this pasture, as do several other sensitive plant locations including many-stemmed dudleya, Palmer's grapplinghook, Coulter's saltbush, mesa brodiaea, small-flower microseris, upright burhead and western dichondra (*Figure 4a,c*).

Arroyo toad and California gnatcatcher are the two listed wildlife species with locations in this pasture (*Figure 4a,b*). Other species of note include arboreal salamander, barn owl, California horned lark, California whipsnake, coastal cactus wren, Cooper's hawk, desert woodrat, grasshopper sparrow, great horned owl, merlin, northern red-diamond rattlesnake, orange-throated whiptail, prairie falcon, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, southwestern pond turtle, coast patchnose snake, western spadefoot toad, western whiptail, white-tailed kite and yellow-breasted chat (*Figure 4a,b*).

Cristianitos pasture is fenced along Ortega Highway, Cristianitos Road, Talega pasture and the Cristianitos/Gabino ridgeline. Citrus areas in Cristianitos are also fenced to keep cattle out. Water is provided via three defunct mining ponds and water troughs.

13. Gabino

Gabino pasture is located within the Gabino and Verdugo sub-basins. Terrains in the Gabino sub-basin are divided into silty clays in the upper Gabino sub-unit and cobbly sands in the middle sub-unit. Upper Gabino is subject to erosion under intensive grazing pressure (*Figure 2*). Middle Gabino is a source of coarse sediments for Cristianitos Creek. Verdugo sub-basin terrains are cobbly sands with some silts. Verdugo Canyon is a source of coarse sediment for San Juan Creek. Coastal sage scrub and chaparral are the dominant vegetation types in this pasture. Grassland, including native grasslands, and riparian also occur in lesser amounts, as do marsh, woodland and rock (*Figure 3*). Developed and agriculture also occur in this pasture in small amounts, namely Campo Portola and citrus production. Many-stemmed dudleya, Coulter's saltbush and Fish's milkwort occur in this pasture (*Figure 4c*). Arroyo toad and California gnatcatcher are the two listed wildlife species with one location each, in this pasture (*Figure 4a*). Other species of note include: arboreal salamander, barn owl, coastal cactus wren, Cooper's hawk, grasshopper sparrow, great horned owl, long-eared owl, orange-throated whiptail, prairie falcon, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, southwestern pond turtle, two-striped garter snake, white-tailed kite and yellow-breasted chat (*Figure 4b*).

Gabino pasture is fenced along Ortega Highway, south of Gabino Creek where it shares a common fence with the Talega pasture and at the RMV boundary with Riverside County (perimeter fence). Water is provided via Jerome's Lake, water troughs and Gabino Creek (when water is available).

14. Talega

Talega pasture is located within the Talega and Blind Canyon sub-basins. Terrains in the Talega sub-basin are cobbly sands. Talega is a source of coarse sediments for Cristianitos Creek (*Figure 2*). Blind Canyon sub-basin terrains are cobbly sands. Blind Canyon is a source of coarse sediment for Cristianitos Creek. Coastal sage scrub, chaparral and grassland including native grasslands are the dominant vegetation types in this pasture (*Figure 3*). Riparian also occurs in lesser amounts, as do oak forest and woodland. Developed also occur in this pasture in small amounts. Thread leaved brodiaea, many-stemmed dudleya and chaparral beargrass occur in this pasture (*Figure 4a,c*). Arroyo toad and California gnatcatcher are the two listed species with locations in this pasture (*Figure 4a*). Other species of note include arboreal salamander, barn owl, coastal cactus wren, Cooper's hawk, grasshopper sparrow, northern red-diamond rattlesnake, orange-throated whiptail, prairie falcon, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, western whiptail, white-tailed kite and yellow-breasted chat (*Figure 4b*).

Talega pasture is fenced along the boundary with MCB Camp Pendleton, the RMV boundary, the TRW lease area and shares a common fence with Gabino and Cristianitos pastures. Water is provided via Talega Creek and water troughs.

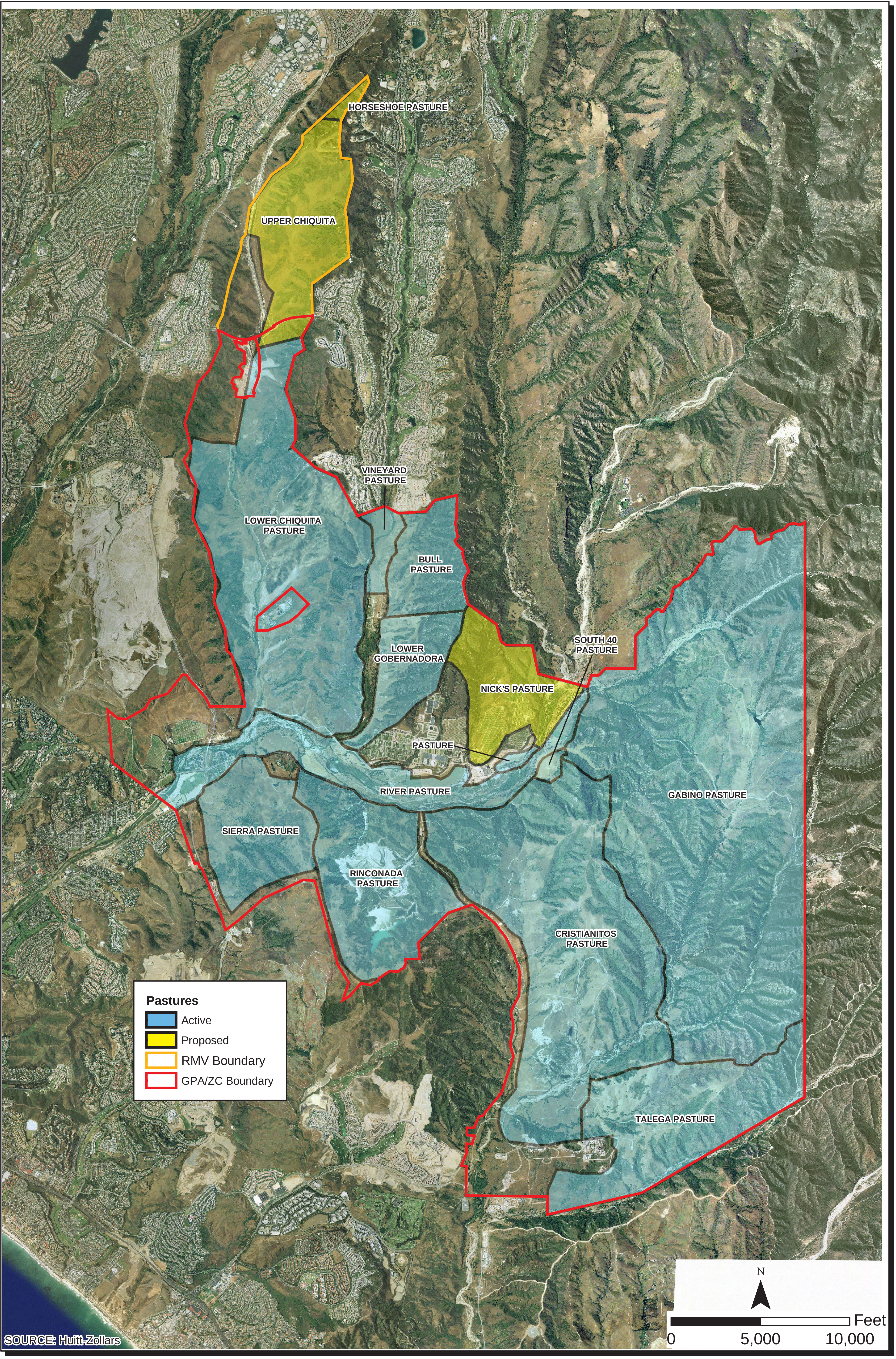
15. TRW Pasture

TRW pasture is located within the Talega and Cristianitos sub-basins. Terrains in the Talega sub-basin are cobbly sands. Talega Canyon is a source of coarse sediments for Cristianitos Creek. Cristianitos sub-basin is generally silty clays (*Figure 2*). Coastal sage scrub and grassland including native grasslands are the dominant vegetation types in this pasture (*Figure 3*). Riparian, chaparral and forest also occurs in lesser amounts, as do open water and woodland. Developed and disturbed also occur in this pasture, namely the Northrop-Grumman facility (formerly TRW) and associated ancillary uses. Many-stemmed dudleya, Palmer's grapplinghook, small-flower microseris, Coulter's saltbush and western dichondra occur in this pasture (*Figure 4c*).

Arroyo toad, California gnatcatcher and least Bell's vireo are the three listed wildlife species with locations in this pasture (*Figure 4a*). Other species of note include: barn owl, coastal cactus wren, Cooper's hawk, grasshopper sparrow, great horned owl, long-eared owl, northern red-diamond rattlesnake, orange-throated whiptail, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, sharp shinned hawk, western whiptail, yellow warbler and yellow-breasted chat (*Figure 4b*).

Although listed as a pasture, no active grazing occurs within the TRW pasture due to the ongoing lease operations of the Northrop-Grumman Capistrano Test Facility. No future use of this area as a grazed pasture is anticipated; therefore this GMP will not further address this area.

In summary, the following pastures are currently actively grazed; Lower Chiquita, Vineyard, Bull Pasture, Lower Gobernadora, River Pasture (to the Cow Camp crossing), South 40, Sierra, Rinconada, Cristianitos, Gabino and Talega. Resumption of grazing is proposed for Nicks Pasture, Chiquita Canyon above Oso Parkway (including Horseshoe Pasture, but excluding Cecil's Pasture) and River Pasture north of the Cow Camp crossing. *Figure 5* shows both actively grazed pastures and pastures proposed for future grazing.



RMV Grazing Management Plan

Active and Proposed Pastures on Aerial Base

FIGURE 5

CHAPTER 3: GRAZING MANAGEMENT

This Chapter describes the objectives of the GMP, reviews the current RMV grazing practices, including residual dry matter (RDM) goals, grazing patterns and stocking rates and makes recommendations for future grazing practices.

3.1 Objectives of Grazing Management

Chapter 1 set forth the overall purposes of this GMP, namely, to contribute an important element of the long term Adaptive Management Program goals of enhancement/restoration of native habitats and to identify grazing practices that are consistent with the Draft Southern NCCP/HCP Planning Guidelines and the Draft Watershed Planning Principles.

To achieve these overall purposes, the following specific objectives of the GMP are:

1. Establish a minimum RDM per acre for active and proposed pastures, and adjust as necessary to reflect changes developed as a result of task 2 below.
2. Identify interim and long-term changes to existing and proposed pasture configurations and stocking levels to maximize use of available forage and facilitate the restoration of perennial grasses including native grasses.
3. Identify a timed rotational grazing scheme to maximize use of available forage and facilitate the restoration and/or long term management of native grasses and coastal sage scrub.
4. Identify sensitive habitat areas where cattle grazing shall be excluded seasonally or permanently.
5. Identify additional facilities required to promote better distribution of cattle within pastures as a strategy to manage geologic and abiotic resources (e.g., water sources, shade, supplemental feed/ nutritional blocks).
6. Outline methods (i.e., cattle exclosures) for monitoring forage levels in order to assess range conditions and to provide guidance on the introduction and removal of cattle.
7. Identify pastures that may be subject to prescribed fire. Identify appropriate pasture rest periods following burns to promote habitat recovery.
8. Outline procedures for re-evaluating grazing management practices every 3 to 5 years to ensure that existing practices are achieving the desired results.

3.2 Grazing Management

This section describes the basic practice of grazing management on RMV, both in terms of general concepts and specific applications.

The production of grassland, whether annual or native, for forage purposes is dependant on four factors: precipitation, temperature, soil characteristics and residue. These four factors largely control forage productivity and seasonal species composition. These factors also change the timing and characteristics of the four distinct growth phases: break of season, winter growth, rapid spring growth and peak forage production. Break of season follows the first fall rains that exceed 1 inch during a 1-week period. Timing of the break dramatically affects forage production. Winter growth period occurs as the fall break season ends and is the result of cooling temperatures, shorter days, and lower light levels. Rapid spring growth begins with the onset of warming spring temperatures, longer days and higher light intensities. Peak forage production occurs at the end of rapid spring growth (UC Extension, Leaflet 21378).

While the precise dates of the four distinct growth phases are subject to the factors noted above, generally speaking on RMV, for annual grasses break of season occurs late October – early November, winter growth occurs mid-December through early February, rapid spring growth occurs between early February and mid-March and peak forage production occurs by late March. Although influenced by the same factors noted above, native grasses generally lag slightly behind annual grasses by about eight weeks on Rancho Mission Viejo (T. Bomkamp, personal communication).

a. Current Grazing Practices

RMV has grazed cattle on its property since 1882. Since that time RMV has practiced a rational grazing pattern that takes into account available water, forage productivity and a desire to maintain an average of 25% RDM for "natural" or "unimproved" pastures. Natural pastures are those not artificially improved through the planting of a forage crop, e.g., barley. Availability of water, forage productivity and the desired level of RDM in turn dictate the stocking levels of RMV pastures.

The following sections describe the existing pasture configurations, residue, stocking levels and grazing pattern on RMV lands.

1. Existing Pasture Configurations & Resources

The current configuration of active grazing pastures or future configuration of a proposed grazing area is shown on *Figure 5*. The vegetation types within each pasture (*Table 3*) is based on the current or proposed configuration, not the historic configuration shown in *Figure 1*.

Active Grazing Pastures

The following pastures are actively grazed: Lower Chiquita, Vineyard, Bull Pasture, Lower Gobernadora, River Pasture (south of the Cow Camp crossing), South 40, Sierra, Rinconada, Cristianitos, Gabino and Talega.

Proposed Grazing Pastures

Resumption of grazing is proposed for Nicks Pasture, Upper Chiquita, Horseshoe Pasture and River Pasture north of the Cow Camp crossing.

2. Existing Residue

Residue or dry residual matter is the dry organic matter remaining at the end of grazing. Residue, acting as mulch, influences germinating plants and soil organic matter. Residue is therefore is major manageable factor governing productivity and composition (UC Extension, Leaflet 21378). Amounts of residue dry matter per acre vary according to geography, soil conditions and livestock use. Areas with heavy rainfall, erosive soils or steep hills need more residual dry matter than do flat, stable soils in drier climates. To maintain desired forage production, therefore, it is useful to set *minimum* residue standards. Rancho Mission Viejo has historically used an average RDM of 25% (for example, 25% of produced forage. If produced forage was 1000 lbs per acre for a pasture, the RDM would be 250 lbs per acre) as the minimum standard for pastures with natural forage, i.e., annual/native grassland. RMV also plants forage (barley) in the alluvial valleys of Lower Chiquita, Vineyard, Bull Pasture, Lower Gobernadora and South 40. RDM standards are not established for planted forage areas because these areas are replanted annually. This GMP will review the 25% RDM standard for natural forage and make recommendations for revisions as necessary.

As an example of a post peak productivity assessment of the RDM conditions on the property, existing RDM was estimated in July 2003 using the visual determination method described in UC Extension Leaflet 21327. RMV staff estimated existing residue using the following levels:

- *Light* grazing leaves little or no patchy appearance. Unused plant matter averages 3 or more inches in height and small objects are masked. The residual dry matter is more than an average of 800 pounds per acre.

- *Moderate* grazing leaves an average of 2 inches of unused plant matter, a patchy appearance and little bare soil. Small objects will not show at a distance of 20 feet or more. The residual dry matter ranges from 400 to 700 pounds per acre.

TABLE 3
VEGETATION COMMUNITIES WITHIN RANCHO MISSION VIEJO PASTURES[1]

Pasture	Agriculture	Chaparral	Developed	Disturbed	Grassland	Open Water	Marsh	Riparian	Cliff & Rock	Coastal Sage Scrub	Stream-courses	Vernal Pools	Woodlands & Forest	TOTAL
Bull	126.7	103.2	0.0	0.2	5.6	0.0	0.0	6.5	0.0	235.9	0.0	0.0	57.6	535.6
Cristianitos	0.3	551.3	42.6	112.8	1,173.1	3.1	0.0	319.4	0.2	11306	6.5	0.0	118.7	3458.6
Gabino	0.9	2096.2	0.4	0.0	853.6	0.0	0.6	553.1	1.8	2841.7	0.0	0.0	70.8	6,419.0
Horseshoe	0.0	13.3	0.0	0.0	0.1	0.0	0.0	1.0	0.0	26.9	0.0	0.0	1.9	43.2
Lower Chiquita	1,363.9	129.9	78.4	13.2	274.7	0.9	2.4	117.7	0.0	1,063.1	0.0	0.0	53.7	3,098.2
Lower Gobemadora	87.5	103.1	1.5	74.5	18.1	0.0	0.0	26.7	0.0	214.0	0.0	<0.01	20.7	546.2
Nick's	13.3	206.9	16.3	0.0	75.9	0.0	0.0	88.7	0.0	246.1	0.0	0.0	5.1	652.5
Rinconada	0.0	146.6	22.8	160.7	370.1	59.3	0.0	136.9	4.1	333.9	0.0	0.0	160.4	1,394.8
River	147.8	16.8	189.6	24.7	172.2	68.8	10.8	219.3	0.0	199.5	6.6	0.0	35.6	1,091.8
Sierra	0.3	0.0	0.9	0.0	582.3	0.0	0.0	42.2	0.0	250.6	0.0	0.0	1.6	877.9
South 40	23.8	2.7	0.1	0.0	8.6	0.0	0.0	1.4	0.0	5.4	0.0	0.0	3.1	44.9
Talega		358.4	10.0	0.0	467.1	0.0	0.0	150.5	0.0	575.3	0.0	0.0	32.4	1,593.8
Upper Chiquita	445.9	67.2	33.7	2.6	6.6	0.0	0.0	21.9	0.0	458.8	0.0	0.0	12.4	1,049.3
Vineyard	90.1	0.1	0.0	48.0	2.9	0.0	0.0	7.4	0.0	4.9	0.0	0.0	0.0	153.5
TOTAL	**2,300.6**	**3,795.9**	**399.2**	**436.7**	**4,028.1**	**132.1**	**13.9**	**1,693.7**	**6.2**	**7,603.6**	**13.2**	**<0.01**	**274.3**	**20,998.5**

[1] Source: Southern NCCP/HCP Vegetation Database (1993), as revised by Dudek in 2004.

- *Heavy* grazing leaves less than 2 inches of unused plant matter. Small objects and areas of bare soil are visible at 20 feet or more. Residual dry matter is less than 400 pounds per acre.

TABLE 4
ESTIMATED DRY RESIDUAL MATTER FOR RANCHO MISSION VIEJO PASTURES IN JULY 2003

Pasture	Grazing Level	Estimated Dry Residue
Chiquita Pastures[1]	None	>800+ lbs/ac
Nick's Pasture	None	>800+ lbs/ac
River Pasture	Light – Moderate	>650-750 lbs/ac
Sierra	Light	>750 lbs/ac
Rinconada	Light	>750 lbs/ac
Cristianitos Pasture	Light	>700-800 lbs/ac
Gabino	Light - Moderate	>600 lbs/ac
Talega	Light	>800 lbs/ac

[1] Residues were estimated for Upper Chiquita. Lower Chiquita is planted with barley therefore residues are not applicable.

To verify the visual assessment, residual dry matter weights were taken in three pastures in accordance with the method described in Leaflet 21327. Results of this verification were as follows:

- Rinconada: 1,890 lbs per acre
- Sierra: 1,038 lbs per acre
- Gabino: 1,946 lbs per acre

The assessment results (*Table 4*) and the subsequent dry weight verification show that RDM on RMV typically reflects light to moderate grazing.

3. Existing Grazing Patterns

Generally cattle are grazed in the natural southern pastures (South 40, Sierra, Rinconada, Cristianitos, Gabino and Talega) from October to May to take advantage of the break of season through peak production of annual grasses. In late May or early June cattle are moved from the southern pastures to the northern pastures in the Chiquita and Gobernadora sub-basins (i.e., Lower Chiquita, Lower Gobernadora, Vineyard and Bull Pasture) and remain there until late September to take advantage of the barley stubble. From May through most of September, the southern pastures "rest". From October through most of May the natural areas of the northern pastures rest , while the alluvial valleys of Lower Chiquita, Bull Pasture, Lower Gobernadora and the Vineyard are re-planted with barley. Allowing a rest or fallow period is a well know agricultural concept, the benefits of which are documented in the literature. On Rancho Mission Viejo, these periods of rest are essential for the production of the next grazing seasons forage particularly in the natural southern pastures. During the transition from the southern pastures to the northern pastures in May or June, cattle are held temporarily in River Pasture, while adjustments to the herd size are made. On average the herd size is reduced by 20% during this transition time. In late September, cattle are returned to the southern pastures.

4. Existing Stocking Rates

Stocking rates on RMV vary according to the availability of water, the productivity of forage and the RMV 25% RDM standard. Generally speaking, in an average rainfall year, the Rancho Mission Viejo cattle herd averages approximately 500 head during the southern pasture grazing season (October – May), distributed as follows: Talega 50 head, Gabino 125 head, Cristianitos 125 head, Rinconada 60 head and Sierra 100 head. As discussed above this is reduced by 20% during the transition from the southern pastures to the northern pastures, resulting in approximately 400 head being distributed in the northern pastures between June and September as follows: Chiquita Pastures 300 head and Vineyard, Bull Pasture, Lower Gobernadora 100 head (combined).

a) Future Grazing Practices

The Draft NCCP/HCP Planning Guidelines and SAMP principles call for the GMP to address four fundamentals contained within the GMP policy statement, namely:

- address the needs of species and habitat identified for protection
- promote perennial grasses including native grasses
- allow for continued cattle grazing sufficient to support cattle operations
- where appropriate, reduce fuel loads for fire

This GMP will therefore describe adjustments to the current grazing practices necessary to implement these fundamentals and contribute to the AMP goals regarding natural habitat restoration/enhancement and comply with the Draft NCCP/HCP Planning Guidelines and the SAMP principles.

This section focuses on those portions of the policies dealing with native grasses and sufficiency of forage. Species needs are discussed in Section 3.3 of this Chapter and fire management is discussed in Section 3.4.

b) Recommended Residual Dry Matter

As noted above, recommended RDM for RMV pastures should account for rainfall, slope and soil type. Rainfall averages 12 to 16 inches per year, generally falling between the months of November and March. Sixteen (16) inches is considered "normal" for RMV. Wet and dry cycles, typically lasting 15 to 20 years, are characteristic of southern California. The region presently appears to be emerging from a wetter-than-normal cycle of years beginning in 1993. Previously, five consecutive years of sub-normal rainfall and runoff occurred in 1987 though 1991 (PCR, 2002). 2001 and 2002 were both below normal rainfall years (averaging 4 inches), while 2003 was above normal at 18 inches. Years with less than average rainfall result in lower productivity and can affect species composition. Slope and soil type are described in the Existing Setting section for each pasture and summarized below in *Table 5*.

Table 5 sets forth the recommended RDM levels for RMV pastures.

TABLE 5
RECOMMENDED RESIDUAL DRY MATTER
FOR RANCHO MISSION VIEJO PASTURES

Pasture	Slope	Soil Type	Recommended Dry Residue
Chiquita Pastures	Low – Moderate	Mixed sands/silts and hardpan	750 lbs/ac
Nick's Pasture	Low – Moderate	Clays & silts	750 lbs/ac
River Pasture	Low	Mixed silts/ clay and alluvium	725 lbs/ac
South 40	Low-Moderate	Clays	750 lbs/ac
Sierra	Moderate	Clays	750 lbs/ac
Rinconada	Low – Moderate	Silts	750 lbs/ac
Cristianitos Pasture	Low- Moderate	Clays	750 lbs/ac
Gabino	Moderate	Mixed silts/ clay and sands/silts	750 lbs/ac
Talega	Moderate	Sands	750 lbs/ac

2. Recommended Stocking Rate

To determine stocking rates for RMV pastures, two factors must be known, a) the total monthly forage requirement and b) the total annual forage per pasture. The following methodologies are taken from UC Extension Leaflet 21456. The Animal Unit (AU) is the standard measurement of livestock forage requirements. One Animal Unit Month (AUM) is the amount of feed required to support one AU for one month. This value depends on the type of feed used (i.e.,1 AUM = 1,000 lb of air dry forage (e.g., stand of annual grasses) or 800 lb of hay or 533 lb of concentrate, etc.). *Table 6* shows representative AU values for cattle at different production stages using a mature cow with calf as the Standard Unit of 1.0.

a) Total Forage Requirement

TABLE 6
ANIMAL UNIT VALUES FOR AIR DRY FORAGE

Animal Type	AU	Monthly Forage requirement/head (lb air dry forage)[1]
Mature cow with calf	1.00	1,000
Mature bull	1.25	1,250
Weaned calf	0.6	600
Yearling 12-17 mos	0.7	700
Yearling 17-22 mos	0.75	750

[1] Monthly forage = AU x 1,000 air dry forage

To determine the total monthly forage requirement, multiply the monthly forage requirement per head by the number of animals to be grazed:

Monthly Forage Requirement/ Head	x	Number of Animals	=	Total Forage Required/ Month

Using the average RMV herd of 500 head, divided as follows, 300 mature cows with calf, 20 mature bulls, 75 yearlings 12-17 mo and 75 yearlings 17-22 months, and 30 weaned calves the total forage required per month is as follows:

TABLE 7
TOTAL FORAGE REQUIRED PER MONTH

Animal Type	Number of Animals	Monthly Forage requirement/head (lb air dry forage)	Total Forage Required/Month (lbs/month)
Mature cow with calf	300	1,000	300,000
Mature bull	20	1,250	25,000
Weaned calf	30	600	18,000
Yearling 12-17 mos	75	700	52,500
Yearling 17-22 mos	75	750	56,250
		Total	**451,750**

To calculate the total forage required, multiply the total forage required per month by the grazing season:

Total Forage Required/ Month	x	Grazing Season	=	Total Forage Required

For the 500 head of cattle RMV grazes for 8 months in the southern pastures, 3,614,000 lbs of forage would be required. For the 379 head that grazes in the northern pastures for 4 months, assuming a 25% reduction in cows, yearling and weaned calves, total forage required would be 1,377,600 lbs.

b) Total Available Forage

Total available forage is calculated by subtracting the desired residue level from the estimated production value and multiplying the difference by the number of grazable acres, as follows:

(Production per Acre – Residue per Acre) Acres = Available Forage

For example, available forage on a 10 acre pasture with a recommended RDM of 750 lbs per acre with a production value of 850 lbs per acre would be (850-750) x 10 = 1,000 lbs available forage. In this example the 10 acre pasture would be capable of supporting one mature cow with calf for one month.

Because quantity and quality of available forage changes throughout the year, it is necessary to make seasonal adjustments. For example, late season or summer natural forage has limited nutrient value (a more common sense way to think of this is "green grass is better than brown grass). *Table 8* sets forth adjustment factors.

TABLE 8
SEASONAL FORAGE AVAILABILITY ADJUSTMENT

Season of Use	Seasonal Availability Adjustment
Year long	1.0
Winter	0.7
Spring	1.3
Summer	0.8
Fall	0.6

Total available forage is calculated by multiplying the available forage by the seasonal adjustment factor, as follows:

Available Forage x Seasonal Adjustment = Total Available Forage

For example, using the available forage of 1,000 lbs from the previous example and adjusting for the highest production value, i.e., Spring, the total available forage would be 1,000 lbs x 1.3 = 1,300 lbs for the ten acre pasture.

Tables 9 and 10 estimate the total available forage for each of the RMV pastures subject to this GMP. As noted above precipitation, temperature, soil characteristics and residue influence production and as such total available forage varies for year to year. For this GMP, an average production value of 1,500 lbs was used (Leaflet 21456). Recall that several pastures reviewed in Section 2 will not be grazed in the future as a result of either development or conservation of the pasture for habitat purposes (e.g., Ladera Land Conservancy). Also recall that available forage is only calculated for those pastures with RDM goals i.e.,natural or unimproved pastures. As noted above, southern pastures are grazed in the winter and spring, while northern pastures are grazed in the summer and fall. *Tables 9 and 10* reflect this rotational grazing pattern.

TABLE 9
TOTAL AVAILABLE FORAGE FOR NORTHERN PASTURES

Pasture	Summer	Fall
Chiquita Pastures	586,800	440,100
Nick's Pasture	259,200	194,400
River Pasture	397,200	297,900
Total	**1,243,200**	**932,400**

TABLE 10
TOTAL AVAILABLE FORAGE FOR SOUTHERN PASTURES

Pasture	Winter	Spring
Sierra	460,425	858,075
Rinconada	610,050	1,132,950
Cristianitos	1,498,875	2,783,625
Gabino	2,268,000	4,212,000
Talega	643,125	1,194,375
Total	**5,480,475**	**10,181,025**

Based on the Total Available Forage set forth in *Tables 9 and 10*, and the required forage discussed above (3,614,000 lbs of forage in southern pastures for 500 head and 1,377,600 lbs of forage for northern pastures for 379 head) natural or unimproved RMV pastures produce more than sufficient forage to support the average RMV herd. It should be noted that in addition to the natural northern pastures, Vineyard, Bull, and the alluvial valleys of Lower Gobernadora and Lower Chiquita are improved via barley plantings which contribute significant additional forage value.

Based on the Total Available Forage set forth in *Tables 9 and 10* recommended maximum stocking rates, based on a mature cow (1,000 lbs AUM) for all natural northern and southern pastures are set in *Tables 11 and 12*. These stocking rates for northern pastures do not include cattle grazed on barley, therefore overall herd size in summer and fall will be higher than noted here due to the availability of barley forage. It should be noted that these stocking rates are designed to be adapted to the conditions in any given year such that the recommended residue is maintained. Changes to the stocking rates should be made according to the methods reviewed above. Other factors which influence the decision of how many cattle to stock in general (i.e., what size cattle herd to maintain) are those related to expenses. Expenses include insurance, interest, utilities (e.g., cost of water), health costs (innoculations etc), transportation, materials (e.g., fencing costs) and labor. It is the combination of forage availability, expenses and market demand for beef that ultimately determine the herd size on RMV.

TABLE 11
RECOMMENDED MAXIMUM STOCKING RATES FOR NORTHERN PASTURES

Pasture	Summer	Fall
Chiquita Pastures	146	110
Nick's Pasture	65	49
River Pasture	99	74
Total	**310**	**233**

TABLE 12
RECOMMENDED MAXIMUM STOCKING RATES FOR SOUTHERN PASTURES

Pasture	Winter	Spring
Sierra	56	107
Rinconada	76	142
Cristianitos	187	348
Gabino	283	526
Talega	80	149
Total	**682**	**1,272**

3. Recommended Grazing Patterns in Relation to Adaptive Management Program Enhancement/ Restoration and Management Goals Following Transfer of Lands to RMV Open Space

a) Role of Grazing in Restoration of Native Grasses

Prior to discussing recommended grazing practices, it is useful to review the literature on grazing, particularly as it relates to native (valley and foothill) grasslands. The effects of grazing on valley and foothill grasslands however remain unclear. In spite of the fact that a long history of intensive grazing in California following European settlement has been cited as one of the primary reasons for the demise of native grasslands (Burcham 1957; Dasmann 1966 as cited; Keeley 1990; Bartolome and Gemmill 1981), most research has found that some intensity of grazing is beneficial to, or at least does not negatively affect, native grasses (Huntsinger *et al.* 1996). Several researchers have documented cases where native grasses have not increased in abundance on sites that have been excluded from grazing over 20 to 40-year periods (White

1967; Bartolome and Gemmill 1981; Goode 1981). Heady (1968, 1977) suggested that large native herbivores present prior to European colonization may have been an important factor in grassland formation and ecology. This assertion supports findings that some form of managed grazing may be useful as part of efforts to maintain or restore native grasses. Menke (*1996*) considers "Prescribed grazing to constitute the primary component of the first phase of a perennial grass restoration program." (pg. 23). Edwards (cite) notes that "bunchgrasses can benefit from grazing in a number of ways." (p.7) Grazing prevents the accumulation of dead residue within the grass bunch, increasing vigor and greater culm and seed production. Thatch reduction between bunches allows light and space for seedling recruitment. Edwards goes on to state "with proper levels of grazing at proper times, grazing can selectively reduce competition from plants lacking comparable recovery reserves such as annual grasses." The concept of timed grazing (i.e.,proper levels of grazing at proper times) is central to the grazing systems described by Allan Savory in his Holistic Resource Management (HRM).

b) Role of Grazing in Long-term Management of Coastal Sage Scrub

As described above, the RMV practices of a north-south rotational grazing pattern can be postulated is the "proper level of grazing at the proper time" for RMV pastures. The current diversity and quality of habitat types and species on RMV would appear to support this statement. As a whole, RMV lands can be characterized as high quality upland and riparian vegetation communities that support a variety of listed and unlisted species (for a detailed description of the resources present on RMV the reader is referred to the Biological Resources Section of the GPA/ZC EIR. A specific example of this occurs in the Chiquita Pastures. The highest densities of California gnatcatchers occur in the Chiquita Pastures (particularly between Oso Parkway and San Juan Creek) which have not burned since the 1950's but are actively grazed. Based on this set of factors, one could postulate that the timed grazing used by the Ranch benefits coastal sage scrub by controlling the proliferation of annual grasses and maintaining a habitat structure suitable for the California gnatcatcher. Alternatively, one could postulate that the prevalence of gnatcatchers in the Chiquita Pastures is related to the production of barley as forage for cattle in the Chiquita Pastures - the cattle concentrate in the planted areas and do not forage extensively in the coastal sage scrub (the barley has a higher nutrient value); as a consequence the light grazing in CSS may provide a thinning function that offsets or substitutes doe the absence of a major wildfire in middle Chiquita Canyon in over 50 years. In any event, it does appear that generally speaking cattle and native species have co-existed on RMV for several decades under the current grazing pattern and the current grazing practices are compatible with species persistence on the Ranch. A substantial change to the current grazing pattern, i.e.,concentration of cattle in either northern or southern pastures, would eliminate the respective rest periods for these pastures, resulting in increased pressures on both forage and possibly non-forage habitats and associated species present in the pastures. The concentration of cattle in either the northern or southern pastures would also lower cattle productivity over time. This

GMP does not, therefore, recommend a substantial change to the overall RMV rotational grazing pattern following transfer of lands to the RMV Open Space. No change to the overall north-south grazing pattern described above is recommended following transfer of lands to the RMV Open Space. The exact configuration of the RMV Open Space will influence the number of cattle grazed in the north-south pattern, as available pasture will be reduced with future development of the Ranch Plan. The following pastures would be reduced by future development: Chiquita, Gobernadora, Bull, Nick's, Rinconada, Cristianitos, Gabino, and Talega. Reduction in available grazing acres and available forage will result in a smaller cattle herd being grazed on RMV over the long-term. Development within these pastures and the associated phased dedication of areas into RMV Open Space is anticipated to be phased over 20 to 25 years. As such, the overall adjustment to the herd size will also occur over a 20 to 25 year timeframe.

c) Timed Grazing Recommendations for Specific Sub-basins

The GMP does recommend specific changes to the manner in which cattle are grazed with a view towards increasing the productivity, health and vigor of native grasslands in specific areas. Appropriately timed grazing can have several beneficial effects on the vigor of native grasslands:

- Removal of litter and thatch
- Recycling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses.

Consistent with the recommendations of the Draft NCCP/HCP Planning Guidelines and SAMP principles, timed grazing is one method to be used in the near-term for native grasslands enhancement in the following areas:

- Upper Gabino Canyon coastal sage scrub/valley needlegrass grassland (CSS/VGL) enhancement area
- Upper Cristianitos VGL enhancement area
- Blind Canyon VGL enhancement area

d) Upper Gabino Canyon CSS/VGL Enhancement Area

Section 6 of the Draft Southern NCCP/HCP Planning Guidelines describes the Upper Gabino Canyon CSS/VGL enhancement area as follows (see *Figure 6-1*of Guidelines):

Upper Gabino Canyon currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration will reduce sediment generation and promote infiltration of stormwater which will reduce downstream impacts. This area has been identified for CSS/VGL restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse CSS. Allowing a mixed community to regenerate may thus represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for revegetation and several patches of low quality VGL suitable for enhancement.

The Restoration Plan prepared to support the RMV Open Space Adaptive Management Program describes the approach to slope stabilization (i.e., repair of the gullies) in Upper Gabino. In summary, repair of the gullies to stabilize the slopes involves three steps: **(1)** re-grading of the existing ranch road to drain in the opposite direction to the prevalent slope in the canyon, **(2)** re-contouring and filling in of the existing gullies and **(3)** stabilization of the repaired areas with straw wattles and VGL seed and plugs. For further details on this effort, the reader is referred to the Restoration Plan.

Grazing patterns in the Gabino pastures, specifically Upper Gabino, need to be managed to address two goals: **(1)** facilitate recovery of the repaired areas; and **(2)** encourage proliferation of existing VGL. Two specific adjustments are proposed to accomplish these goals. To facilitate the recovery of the repaired areas, stocking rates will be temporarily decreased to a maximum of 50 head for one to three VGL growing seasons i.e., November through April which is anticipated to provide sufficient time for establishment of VGL species in the repair areas.

In order to encourage the proliferation of existing VGL, cattle will be grazed in the upper portion of Gabino pasture identified for VGL enhancement during rapid spring growth and the peak production of annual grasses i.e., early February to late March. Grazing cattle during the rapid growth period and peak production of annual grasses will reduce annual grass seed production, reduce transpiration by the annual species, remove litter and thatch and promote the recycling of nutrients. By grazing cattle during the rapid spring growth and peak production of annual grassland species and then moving the cattle off the VGL enhancement area, native species will start their rapid spring growth and peak production after the cattle have reduced the competition from annual species.

e) Upper Cristianito VGL Enhancement Area

Section 6 of the Draft Southern NCCP/HCP Planning Guidelines describes the Upper Cristianitos VGL enhancement area as follows:

Upper Cristianitos is recommended for VGL revegetation and enhancement to reduce the generation of fine sediments from clayey terrains, promote stormwater infiltration and to enhance the value of upland habitats adjacent to Cristianitos Creek. This area includes patches of annual grassland underlain by clay soils suitable for revegetation and low quality VGL suitable for enhancement. These recommended revegetation and enhancement areas also are contiguous with existing medium quality grassland, suggesting a high likelihood of successful restoration.

Similar to the grazing pattern proposed for the portion of Upper Gabino pasture identified for CSS/VGL restoration, a small adjustment to current grazing practices is recommended for the Upper Cristianitos VGL enhancement area. As noted in the description of the existing RMV grazing patterns, the southern pastures, including Cristianitos, are grazed between October and May. In order to reduce competition from annual grasses in the VGL enhancement area, the GMP recommends that grazing in the VGL enhancement area be concentrated in early February to late March during the rapid spring growth and peak production periods for annual species and ahead of the same periods for native species beginning by late March early April.

f) Blind Canyon VGL Enhancement Area

Section 6 of the Draft Southern NCCP/HCP PlanningGuidelines describes the Blind Canyon VGL enhancement area as follows:

Portions of Blind Canyon mesa are recommended for grassland revegetation and enhancement. This area has at least one patch of annual grassland suitable for revegetation and possibly two patches of low quality VGL suitable for enhancement. These areas are adjacent to existing medium quality VGL, suggesting a high likelihood of successful restoration. Additional fieldwork in the area may reveal additional restoration opportunities.

To promote native grasses in Blind Canyon which lay within the TRW pasture, the GMP recommends that grazing in the VGL enhancement area be concentrated in early February to late March during the rapid spring growth and peak production periods for annual species and ahead of the same periods for native species.

g) Upper Chiquita Canyon Conservation Easement Area

As discussed in Section 2, cattle have not been grazed in the Chiquita Pastures north of Oso Parkway since 1996. Consistent the requirements of the FTCN – Oso Section Biological Opinion and TCA's management plan for this area, the following grazing practices are recommended for Chiquita Pastures north of Oso Parkway: RDM is set at 750 lbs per acre. Based on the productivity of the Chiquita grasslands, the recommended maximum stocking rate will be 146 head in a normal rainfall year. As noted previously stocking rates are subject to change (either up or down) to maintain the recommended RDM. Chiquita is a northern pasture and as such is recommended for grazing in the summer and fall, specifically in the months of September through May.

4. Recommended Configurations & Resources

In order to implement the recommended grazing patterns described above, minimal changes to existing pasture configurations and resources are necessary. Existing fencing within the Gabino, Cristianitos & Blind pastures will allow for the movement of cattle in and out of the VGL enhancement areas.

In order to graze cattle within the Chiquita pastures north of Oso Parkway, improvement to the fencing adjacent to Oso Parkway and SR-241 will be necessary. A thorough evaluation, and improvements as necessary of all fencing in the Chiquita pastures shall conducted prior to the re-introduction of cattle into this area.

3.3 Sensitive Habitat Exclusions

Sensitive habitat exclusions (i.e., those areas where cattle should be excluded) can be broken into two categories: a) those areas from which cattle should be removed on a temporary basis (e.g., seasonally); and b) those areas where cattle should be removed permanently.

a. Seasonal Exclusions

The purpose of seasonal exclusions is to remove cattle from a specific area for a specific time period for the benefit of a specific resource or species. This GMP recommends seasonal exclusions during the breeding season of the arroyo toad that runs approximately from March to mid-June. As noted above, the current RMV grazing practice is to graze cattle in the southern pastures (Sierra, Rinconada, Cristianitos, Gabino and Talega) from October to May. In late May or early June cattle are moved from the southern pastures to the northern pastures in the Chiquita and Gobernadora sub-basins (i.e., Lower Chiquita, Lower Gobernadora, Vineyard and Bull Pasture) and remain there until late September. During the transition from the southern pastures to the northern pastures, cattle are held temporarily in River Pasture, while adjustments to the herd size are made. As noted in the description for the arroyo toad, toads occur in discrete reaches of San Juan Creek, lower Gabino Creek, lower Cristianitos Creek and Talega Creek. The potential for cattle grazing and toad breeding to overlap therefore occurs in the following pastures: Cristianitos (Gabino Creek), Talega (Talega Creek) and River (San Juan Creek) pastures (*Figure 4*). Arroyo toads do not occur in upper Gabino Creek within Gabino pasture, and Cristianitos Creek lies within the Donna O'Neill Conservancy or TRW lease area where cattle are permanently excluded. To reduce potential toad mortality resulting from trampling of either egg masses or metamorphs by cattle, the following seasonal exclusions are recommended:

1. Cattle should be seasonally excluded from active breeding pools and adjacent sand bars and benches to the extent practical within lower Gabino Creek during arroyo toad breeding season. Temporary fencing around active breeding pools and adjacent sand bars and benches should be erected to discourage cattle from entering these areas.

2. Cattle should be seasonally excluded from active breeding pools and adjacent sand bars and benches to the extent practical within San Juan Creek during arroyo toad breeding season. Temporary fencing around active breeding pools and adjacent sand bars and benches should be erected to discourage cattle from entering these areas.

No recommendations are made for Talega pasture because Talega Creek is largely located on MCB Camp Pendleton property, outside the RMV perimeter fence.

b. Permanent Exclusions

The purpose of permanent exclusions is to remove cattle from a specific area for the benefit of a specific resource or species. Cattle are currently excluded from the Gobernadora Ecological Restoration Area and the Donna O'Neill Conservancy. The GMP recommends continued exclusion of cattle from these areas, with the except for fuel modification treatment as discussed in the next section In addition to these permanent exclusions, the GMP also recommends exclusion of cattle from the slope wetlands located in the Chiquita, Rinconada and Sierra Pastures.

3.4 Fire Management

As discussed in Section 3.1, one of the objectives of this GMP is to identify pastures that may be subject to prescribed fire, and identify appropriate pasture rest periods following burns to promote habitat recovery.

An integral part of the Adaptive Management Program is the Wildland Fire Management Plan (WFMP). The WFMP is composed of five parts, **(1)** Fire Management Program, **(2)** Prescribed Fire Program, **(3)** Long-Term Strategic Fire Protection Plan, **(4)** Short-Term Tactical Fire Suppression Plan and **(5)** Research and Monitoring Criteria. Pertinent to this GMP is the relationship between grazing and fire. According to the WFMP, "because of the high numbers of wildfires that have burned through Rancho Mission Viejo since the late 1900's plus an active cattle grazing program, and the late 1980's and early 1990's Vegetative Management Program (prescribed burns) the wildland vegetation is fairly uniform thoughout RMV" (page 3-9). The predominate vegetation over most of the Ranch is scattered coastal sage scrub over cured grass (Fuel Model 2). Should the fire frequency be disrupted (ie. longer intervals between fires occurs) or cattle grazing be eliminated from RMV, the result would be an evolution of the vegetation into fuel models that have the potential for catastrophic fires i.e., FM 6 (chaparral fuels 6ft in height or less) and eventually FM 4 (chaparral fuels greater than 6ft). Grazing management therefore plays a positive role in the management of fire on RMV.

The WFMP identifies prescribed burns as a management tool in the following areas:

- Sulphur Canyon (CSS restoration site)
- Talega/La Paz Canyon (Oak woodland site)
- Cristianitos/Gabino (Oak woodland site)
- Chiquita/Narrow Canyon (Native grassland site)
- Canada Gobernadora (Native grassland site)

Grazing can also play a negative role in the recovery of burned areas. Burned areas, whether as a result of a prescribed burn or a "natural" wildfire, need time to recover. The re-introduction of cattle into a burned area too early can negatively affect the natural recovery process and may result in state-transition from one vegetation type to another (e.g., coastal sage scrub to grassland). The WFMP contains management hypotheses to be tested for three of the major habitat types on RMV (CSS, grassland and oak woodland). Results of the testing of these hypotheses will identify the optimal time that grazed can be re-introduced into a burned area.

The WFMP contains no management hypothesis for riparian systems as according to the WFMP "fire has no place in riparian area management". According to the WFMP most fires in riparian zones are accidental and of high severity, causing relatively high rates of top kill. Riparian areas should be kept fire free if all possible. According to the WFMP the fuel load in GERA is increasing and there is an abundance of ladder fuels that will carry wildfire into the crowns of the planted oaks, willows and sycamores. The WFMP recommends maintenance of a fire break between GERA and the surrounding native or non-native fuels. Plus the pruning of low hanging branches on the oaks and sycamore to reduce ground fire laddering. To facilitate reduction of fuel loads within GERA, this GMP propose the use of timed grazing within GERA. Once every three years, up to 30 head of bulls will be grazed in GERA between the months of June to October. Timed grazing within GERA will reduce the risk of a severe wildfire in GERA by reducing the both the grass fuel load and the ladder fuel load.

Similar to GERA, the Donna O'Neill Land Conservancy may require periodic fuel load reduction, up to 20 head of cattle for a period of 60-90 days in late summer/early fall (August-October) is recommended.

CHAPTER 4: MONITORING

4.1 Relationship of Grazing Management Plan to Stressor Based Adaptive Management Program

Appendix J is the proposed Adaptive Management Program for the RMV Open Space. The proposed Adaptive Management Program is stressor based. The underlying principle of this approach is that management and monitoring should be directed primarily towards environmental factors known or thought to be directly or indirectly responsible for ecosystem change. Over-grazing is identified as one of six general environmental stressors known or likely to be relevant to the habitat reserve. The Adaptive Management Program presents conceptual models that depict known and potential relationships between over-grazing and the vegetation community and individual species responses. Further, the Adaptive Management Program presents adaptive management issues, goals and objectives and monitoring in relation to these conceptual models. Hypotheses between the role of grazing and vegetation communities and individual species responses are set forth, and monitoring is proposed to response to these hypotheses.

It is not the function of this GMP to set forth and respond to adaptive management hypotheses. These need to be viewed from the vegetation community and individual species perspective as described in Adaptive Management Program. Rather, as described in Section 1, the purposes of the GMP are to: 1) contribute an important element of the long term Adaptive Management Program goals of enhancement/restoration of native habitats; and 2) demonstrate consistency with Draft NCCP/HCP Planning Guidelines and SAMP principles regarding grazing management. To achieve these purposes the GMP has identified grazing practices which seek to maintain and, where feasible, enhance long-term net habitat value within the subregion, promote perennial grasses, including native grasses, provide sufficient forage to support a cattle operation and where appropriate reduce fuel loads for fire. The monitoring portion of the GMP should therefore seek to answer whether these purposes are being achieved. In answering whether these objectives are being achieved, monitoring for the GMP will provide valuable input into the iterative feedback loop of the Adaptive Management Program.

4.2 Monitoring Objectives

To answer the question of whether the GMP is achieving its purposes the monitoring objectives are established for each of the elements addressed by the GMP, namely, forage production, restoration of native habitats and sensitive habitat exclusions:

4.3 Forage Production and Residue

Objectives

The following objectives are established for forage production and residue:

- Conduct monitoring of RDM levels to ensure consistency with recommended levels
- Conduct monitoring for sufficiency of forage production to support a cattle operation.

Monitoring

Accurate inventory and monitoring is essential to effective management of the grazed pastures. This information together with the existing conditions data described above will provide RMV managers with the data set necessary to set and adjust AUM's, determine current pasture conditions, predict future pasture conditions, and evaluate management practices.

a. Plot Location and Design

Forage production and RDM measurements should be taken in all natural or unimproved pastures. A minimum of ten permanent sample plots should be established on a stratified basis throughout the pasture in locations indicative of representative or typical conditions. All plot locations should be located using GPS and a permanent marker to provide a continuous record. Forage production measurements should be taken at peak forage production time to record the maximum available forage. RDM should be measured before the break of season.

b. Technique

According to Leaflet 21327, RDM weights can be estimated by direct clipping and weighing, double sampling (visual estimates with clipped herbage reference points) and with experience, visual estimates. The current RMV managers have over 40 years experience in running cattle on RMV lands and have traditionally used the visual estimate method. RMV managers intend to continue using this method. To provide a verification of the visual estimate, direct clipping and weighing will also be used. The normal procedure for determining the weight of residual dry matter is to use either a square foot or 1/10 square meter frame and clip the herbage as close to the ground as possible (approximately ½-inch high). All litter or shattered plant material at the ground surface which can easily be picked up should be included in the sample. Grams scales are recommended for weighing samples in the field, and air-dry weights are satisfactory under most summer and early fall conditions. Wet or green forage samples should be oven dried for dry matter determination. Grams per square foot multiplied by 96 gives the pounds per acre. Example: 12 grams per square foot x 96 = 1150 pounds per acre. All species within the square foot will be recorded, as will physical information including soils, soil moisture, slope and aspect. Weather conditions at the time of sampling will also be recorded.

c. Permanent Photo Points

In conjunction with the selection of plot locations and the location of same with GPS and permanent marker, a photo point will be established. Photos should be taken at the time of sampling using the same ASA film and approximately the same time of day. The photo point will provide a visual reference of the plot location, and further verify the visual estimate of the RMV managers.

d. Reporting

All forage production and RDM measurements will be recorded on data sheets (Exhibit A) and complied for use in the annual report discussed in Section 4.6.

4.4 Restoration of Native Habitats

Monitoring for the restoration of native habitats and their response to the application of timed grazing as a restoration technique will be accomplished as part of the Adaptive Management Program, and not as part of this GMP. The monitoring obligation of the GMP relative to restoration of native habitats is to ensure that the recommended grazing patterns are followed. In this regard monthly reports will be prepared by RMV managers documenting the location and number by pasture of cattle on the ranch. Exhibit B is a sample form that RMV managers will use to prepare the reports.

A brief summary of the Adaptive Management Program monitoring proposed for native grasslands and coastal sage scrub is provided below. The reader is referred to Adaptive Management Program (*Appendix J*) for further details.

a. Coastal Sage Scrub

Coastal sage scrub will be monitored at the landscape, habitat and species levels. The routine passive, long-term monitoring of coastal sage scrub and focal species will include two main tasks:

- Evaluation and update of the entire coastal sage scrub vegetation datebase at 5-year intervals.
- Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the heterogeneity of the

Reserve and in keys areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

b. Native Grasslands

The monitoring program for grasslands will use the same general methods described above for coastal sage scrub and the reader is directed to that section for more detail. The key points for the monitoring program are summarized here:

- Monitoring at landscape, habitat, species, and species assemblage levels.
- 5-year mapping of grassland system.
- Annual on-the-ground monitoring of selected sample plots across the physiographic gradient of grasslands in the RMV Open Space.
- Collection of regional climate, weather and air quality information

4.5 Sensitive Habitat Exclusions

Similar to Restoration of Native Habitats, the monitoring of specific habitat or species responses to cattle exclusions is a function of the Adaptive Management Program. Monitoring through the Adaptive Management Program will determine whether exclusions are a positive or negative influence through the iterative testing of hypothesis related to the conceptual models prepared for both habitat types and specific species.

The obligation of the GMP is to monitor and report on implementation of the recommended exclusions. For permanent exclusions, e.g., vernal pools, RMV managers will report quarterly on the status of the exclusion. Questions such as is the exclusionary mechanism (e.g.,fencing) in place and is the mechanism effective (e.g., is it keeping cattle out) will be asked. If the mechanism is not effective, alternatives will be proposed and reviewed with the Habitat Reserve Manager.

For seasonal exclusions, e.g., arroyo toad breeding season, reporting will occur on a weekly basis for the duration of the exclusion. Similar questions will be asked for seasonal exclusions, such as whether the exclusionary mechanism (e.g., fencing) in place and whether the mechanism is effective (i.e., is it keeping cattle out). If the mechanism is not effective, alternatives will be proposed and implemented as appropriate.

4.6 Annual Reporting

RMV managers will prepare an annual report summarizing all monitoring efforts and the results thereof, and provide same to the County of Orange.

List of Agencies and Persons Contacted

List of Preparers

Acronyms and Abbreviations

References

DRAFT – APPENDIX J-4
RMV GRAZING MANAGEMENT PLAN

CHAPTER 1

1.1 Background

This Grazing Management Plan (GMP) has been prepared to guide the management of grazing on Rancho Mission Viejo (RMV), located in southern Orange County, California. RMV has grazed cattle on its lands since 1882 and intends to continue to do so in the long term on lands which may, as part of approval of the GPA/ZC application, become dedicated as open space (RMV Open Space). As discussed later, this GMP is an integral part of the Adaptive Management Program for the proposed RMV Open Space and further implements certain key NCCP/HCP and SAMP/MSAA policies.

RMV is surrounded by the planned community of Ladera Ranch and the cities of Mission Viejo, San Juan Capistrano and San Clemente on the west. The City of Rancho Santa Margarita bounds the northern edge of RMV; the southern edge is bounded by Marine Corps Base (MCB) Camp Pendleton in San Diego County. Caspers Wilderness Park and the Cleveland National Forest bound the property on its eastern edge.

1.1.1 Relationship to Southern Subregion NCCP/HCP

As noted above, the Grazing Management Plan is a key component of the Adaptive Management Plan for the RMV Open Space and is intended to be complementary to any NCCP/HCP program completed in the future for the Southern Subregion. Implementation of an Adaptive Management Program is one of the three fundamental conservation planning principles set forth under the NCCP Conservation Guidelines. As stated in the NCCP Conservation Guidelines "…a status quo strategy of 'benign neglect' management will likely result in substantial further loss of CSS diversity…" The Guidelines concluded that habitat reserves … should be managed in ways responsive to new information as it accrues." Although the Conservation Guidelines were directed towards coastal sage scrub (CSS) in a habitat reserve context, the same adaptive management principles apply to the diversity of vegetation communities and habitat types in protected open space such as the RMV Open Space.

a. Draft Southern NCCP/HCP Planning Guidelines

Section 3.3 of the Draft EIR discusses the project history including the development of Draft Southern NCCP/HCP Planning Guidelines by the NCCP/SAMP Working Group. Using the broader NCCP Tenets as a framework and starting point, the Draft Southern NCCP/HCP Planning Guidelines provide guidance for decision-makers that are keyed to local biologic, hydrologic and geomorphic conditions. Although considered a "work in progress" the guidelines represent the most current thinking regarding protection, restoration and management priorities for the resources within the study area and for this reason are discussed here. These guidelines address resources at both the landscape (watershed) and more detailed hydrologic/geomorphic sub-basin levels. For each sub-basin planning unit, the guidelines identify the important biological resources and key hydrologic/geomorphic processes. Protection, restoration and management recommendations for each sub-basin also are included.

The Daft Southern NCCP/HCP Planning Guidelines are comprised of three primary components:

1) NCCP Tenets outlined in the 1993 NCCP Conservation Guidelines;
2) Reserve Design Principles prepared by the panel of NCCP Science Advisors convened by The Nature Conservancy; and
3) A set of draft sub-basin specific planning recommendations prepared by the NCCP/ SAMP working group.

In addition to these components the Draft Southern NCCP/HCP Planning Guidelines also set forth general policies for resource protection, management and restorations that apply at the planning (landscape) area scale. General Policy 6 of the guidelines addresses grazing management as follows:

- Cattle grazing shall be permitted within the Rancho Mission Viejo portion of the Habitat Reserve provided that grazing activities are consistent with a "grazing management plan" approved as part of the certified NCCP/HCP

- The grazing management plan (GMP) approved as part of the NCCP/HCP shall identify suitable grazing areas and allowable grazing practices that are consistent with certified NCCP/HCP policies and the aquatic resource management program. The GMP will address grazing practices following approval of the NCCP/HCP and prior to transfer of lands to the Habitat Reserve.

- The GMP will incorporate grazing management techniques designed to address the needs of species and habitat identified for protection, promote perennial grasses including native grasses, allow for continued cattle grazing sufficient to support cattle operations and, where appropriate, reduce fuel loads for fire. (Page 3-11, Draft Southern NCCP/HCP Planning Guidelines)

The following specific grazing management recommendation is made for the Cristianitos Sub-basin and the upper and middle sub-units of the Gabino sub-basin:

- Pursuant to the GMP, implement grazing management techniques to help protect listed and other selected species and habitat, promote perennial grasses including native grasses, allow for continued cattle grazing sufficient to support cattle ranching operations, and, where appropriate reduce fuel loads for fire.

In addition, management of grazing is to be factored into the management program for sensitive plant locations in the Chiquita sub-basin, Gobernadora sub-basin, Central San Juan/Trampas sub-basin, Cristianitos sub-basin and the Gabino sub-basin as follows:

- Implement a management program for protected sensitive plant locations in the sub-basin, including control of non-native invasive species, management of grazing as part of the adaptive management program, and prevention of human disturbance

1.1.2 Relationship to San Juan Creek Watershed and Western San Mateo Creek Watershed SAMP/MSAA

The Adaptive Management Program and this Grazing Management Plan are intended to be complimentary to any SAMP/MSAA program that is completed in the future, and, as such, have been structured to comply with the goals, objectives, and Tenets and Principles of the SAMP/MSAA.

b. SAMP/MSAA Planning Principles Management Recommendations

Section 3.3 of the Draft EIR discusses the project history including the development of Draft Watershed and Sub-basin Planning Principles ("Draft Watershed Planning Principles') by the NCCP/SAMP Working Group. The Draft Watershed Planning Principles provide a link between the broader SAMP/MSAA Tenets for protecting and conserving aquatic and riparian resources and known, key physical and biological resources and processes. Although considered a "work in progress" the principles represent the most current thinking regarding protection, restoration and management priorities for the resources within the study area and for this reason are discussed here.

The planning principles provide specific grazing management recommendations for Gabino sub-basin as follows:

- Protect headwaters through restoration of existing gullies using a combination of slope stabilization, grazing management, and native grassland and/or scrub restoration. To the extent feasible, restore native grasses to reduce sediment generation and promote infiltration of stormwater.
- Modify grazing management in the upper portion of the sub-basin to support restoration and vegetation management in the headwater areas.

1.2 Purpose of the Grazing Management Plan

Grazing management policies are under review in numerous government agencies. A common thread in the review of policies and ongoing discussion about grazing management is the recognition of its importance to the ecology of our grasslands. According to Menke (1996), herbivory and fire are natural and necessary processes, which remove litter, recycle nutrients, stimulate tillering and reduce seedbanks of competitive annual plants. Recognition that grazing is important to the evolved ecology of grasslands, however, as Edwards (1992) notes, is not license to use it indiscriminately; nor is understanding that grazing is not always needed license to eliminate it in advance of analyzing site-specific needs.

The purposes of this GMP are to: **(1)** demonstrate consistency with the Draft Southern NCCP/HCP Planning Guidelines and the Draft Watershed Planning Principles regarding grazing management (see above); and **(2)** contribute an important element of the long term Adaptive Management Program (AMP) goals of enhancement/restoration of native habitats. The GMP will address grazing practices following approval of the Southern NCCP/HCP and prior to transfer of lands to the Habitat Reserve and practices following transfer of lands into the Habitat Reserve.

1.3 Participants in the Grazing Management Plan

Participants in the development of this plan included Rancho Mission Viejo, USFWS, CDFG, USACE and the County of Orange. Consultant support was provided by Rod Meade NCCP/SAMP consultant, Bill Boyd Esq., Phil Behrends of Dudek & Associates, Inc., and Huitt Zollars.

CHAPTER 2: EXISTING CONDITIONS

The following descriptions of the existing setting are provided to familiarize the reader with the climate, geomorphology and vegetation communities of RMV. An understanding of the factors which influence where, when and how grazing is conducted is vital to the development of a successful grazing management plan.

2.1 Biological Setting

RMV is located within the San Juan Creek watershed and the western portion of the San Mateo Watershed.

2.1.1 Climate

The Mediterranean Climate in Southern California is characterized by brief, intense storms between November and March. It is not unusual for a majority of the annual precipitation to fall during a few storms in close proximity to each other. Average annual rainfall on Rancho Mission Viejo resulting from this Mediterranean precipitation pattern is 12 to 16 inches. The higher elevation portion of the watershed (typically the headwater areas) typically receive significantly greater precipitation due to orographic effects. In addition, rainfall patterns are subject to extreme variations from year to year and longer term wet and dry cycles. The combination of steep, short watersheds; brief intense storms; and extreme temporal variability result in "flashy" systems where stream discharge can vary by several orders of magnitude over very short periods of time.

Wet and dry cycles, typically lasting up to 15 to 20 years, are characteristic of southern California. The region presently appears to be emerging from a wetter-than-normal cycle of years beginning in 1993. Previously, five consecutive years of sub-normal rainfall and runoff occurred in 1987 through 1991.

Prior droughts of recent note include the brief, 'hard' drought of 1976 and 1977, and 1946 to 1951. Previous notable wet periods of the recent past were observed in 1937 to 1944 and 1978 to 1983. An unusually protracted sequence of generally dry years began in 1945 and continued through 1977. During this period, rainfall was approximately 25 percent below the average for the prior 70 years (Reichard, 1979; Lang et al., 1998). Both recharge and (especially) sediment transport were diminished to even greater degrees during this period. Although wet years did occur during this period, dry conditions were sufficiently persistent to lower groundwater levels and contract the extent of riparian corridors.

2.1.2 Geomorphology

a. Regional Geology

The San Juan and San Mateo creek watersheds are located on the western slopes of the Santa Ana Mountains, which are part of the Peninsular Ranges that extend from the tip of Baja California northward to the Palos Verdes Peninsula and Santa Catalina Island. The geology of the region is complex and has been dominated by alternating periods of depression and uplift, mass wasting, and sediment deposition. Within the watersheds, the Santa Ana Mountains are composed of igneous, metavolcanic, and metasedimentary rocks of Jurassic age and younger. The exposed rocks in the mountainous areas are slightly metamorphosed volcanics, which have been intruded by granitic rocks of Cretaceous age, principally granites, gabbros, and tonalites. Overlying these rocks are several thousand stratigraphic feet of younger sandstones, siltstones, and conglomerates of upper Cretaceous age, composed largely of material eroded from the older igneous and metavolcanic rocks now underlying the Santa Ana Mountains.

Younger sedimentary rocks comprise the bedrock between the Santa Ana Mountains, their foothills, and the Pacific Ocean. Most of the study area is underlain by these marine and non-marine sandstones, limestones, siltstones, mudstones, shales, and conglomerates, many of which weather, erode, and/or hold groundwater in characteristic ways. Overlying them are Quaternary stream terrace deposits and Holocene stream channel deposits. During the past two million years or longer, at least three processes that fundamentally affect structure and process along the major stream channels have affected the two watersheds:

1. Continuing uplift, typically 400 feet or more, which has left at least four major stream terrace levels along the major streams.

2. Downcutting of the main canyons to sea levels, which have fluctuated widely during the global glaciations. The flat valley floors were deposited as sea level rose, leaving often-sharp slope breaks at the base of the existing hillsides and tributary valleys. These materials are geologically young, soft, and prone to incision under certain conditions.

3. Soils formed under climates both warmer/colder and drier/wetter than at present, which led to development of hardpans that have been eroded to form mesas. These hardpan mesas have minimal infiltration and presently channel flows into headwater streams.

b. Terrains

Terrain designations are largely based on soils, geology and topography, as these provide many of the fundamental factors that influence the hydrology and geomorphology characteristic of each terrain. Bedrock is the raw material from which soils are weathered, and, as such, it determines the size and types of particles that will comprise the soil. The resistance of different kinds of bedrock to weathering and erosion also controls the topography of the landscape within a given terrain and, therefore, influences the hydrology of the watersheds and morphology of the drainage networks. Watershed hydrology is also strongly influenced by the climatic patterns typical of Southern California.

There are three major geomorphic terrains found within the San Juan Creek and San Mateo Creek watersheds: **(1)** sandy and silty-sandy; **(2)** clayey; and **(3)** crystalline. These terrains are manifested primarily as roughly north-south oriented bands of different soil types. The soils and bedrock that comprise the western portions of the San Juan Creek watershed (*i.e.,* Oso Creek, Arroyo Trabuco, and the lower third of San Juan Creek) contain a high percentage of clays in the soils. The soils typical of the clayey terrain include the Alo and Bosanko clays on upland slopes and the Sorrento and Mocho loams in floodplain areas. In contrast, the middle portion of the San Juan basin, (*i.e.,* Cañada Chiquita, Bell Canyon, and the middle reaches of San Juan Creek) is a region characterized by silty-sandy substrate that features the Cieneba, Anaheim, and Soper loams on the hill slopes and the Metz and San Emigdio loams on the floodplains. The upstream portions the San Juan Creek watershed, which comprise the headwaters of San Juan Creek, Lucas Canyon Creek, Bell Creek, and Trabuco Creek, may be characterized as a "crystalline" terrain because the bedrock underlying this mountainous region is composed of igneous and metamorphic rocks. Here, slopes are covered by the Friant, Exchequer, and Cieneba soils, while stream valleys contain deposits of rock and cobbly sand. The upland slopes east of both Chiquita and Gobernadora canyons are unique in that they contain somewhat of a hybrid terrain. Although underlain by deep sandy substrates, these areas are locally overlain by between 2 and 6 feet of exhumed hardpan.

2.1.3 Vegetation Community Description

The following descriptions of vegetation communities are taken from the NCCP vegetation database. *Appendix A* contains a general description of the vegetation communities discussed more specifically here for RMV. The reader is also referred to the Draft EIR for a full description of the NCCP vegetation database, its sources and the history of its development.

a. Grasslands on Rancho Mission Viejo

The NCCP/HCP vegetation database for RMV does not distinguish between annual and native grasslands. However, several individual mapping efforts have been conducted in various areas of RMV, which allows for a general characterization of the annual and native grasslands.

1. Annual Grasslands

Annual grasslands on RMV are dominated by bromes (*Bromus madritensis, Bromus diandrus, Bromus hordaceous*), wild oats (*Avena barbata, Avena fatua*), rat-tail fescue, barleys (*Hordeum* spp.) and Italian ryegrass (*e.g.,* Gray and Bramlet 1992; MBA 1996; Dudek 2001). Annual forbs common to non-native grasslands in the RMV include Indian milkweed (*Asclepias eriocarpa*), tocalote, common fiddleneck (*Amsinckia menziesii*), popcornflower (*Plagiobothrys* spp.), black mustard (*Brassica nigra*), field mustard (*Brassica rapa*), common catchfly, stickwort (*Spergularia arvensis*), miniature lupine (*Lupinus bicolor*), white-whorl lupine (*Lupinus densiflorus* var. *austocollium*), burclover (*Medicago polymorpha*), bristled clover (*Trifolium hirtum*), red-stemmed filaree, white-stemmed filaree (*Erodium moschatum*), and fluellin (*Kickia spurria*) (MBA 1996). Tarweeds and doveweed become dominant in later summer and fall (MBA 1996). Cardoon also occurs in portions of the grasslands on RMV. .

Gray and Bramlet (1992) also describe a ruderal grassland that consists of early successional grassland dominated by pioneering herbaceous species of several genera such as *Centaurea, Brassica, Malva, Salsola, Eremocarpus, Amaranthus* and *Atriplex.*

2. Native Grasslands

Native grasslands on RMV are designated as Valley needlegrass grassland (called southern coastal needlegrass grassland by Gray and Bramlet). Gray and Bramlet define needlegrass grassland as a grassland with more than 10 percent cover of purple needlegrass (*Nassella pulchra*). It is associated with the annual grasses listed above, leafy bentgrass (*Agrostis pallens*), junegrass (*Koeleria macrantha*), cane bluestem (*Bothriochloa barbiodis*), coast range melic (*Melica imperfecta*) and annual forbs such as common goldenstar (*Bloomeria crocea*), blue dicks, Cleveland's goldenstar (*Dodecatheon clevelandii*), smooth cat's-ear (*Hypocharis glabra*), lilac mariposa lily (*Calochortus splendens*), many-stemmed dudleya (*Dudleya multicaulis*), blue-eyed grass (*Sisyrinchium bellum*) and rosin weed (*Calycadenia truncata*) (Gray and Bramlet 1992; Dudek 2001; MBA 1996).

3. Distribution of Grasslands on Rancho Mission Viejo

Grasslands are scattered throughout the lower elevations of the Ranch, with the largest, contiguous concentration in the south Ranch. Other areas supporting large patches of grassland include Chiquita Ridge, Ladera Open Space, Cristianitos Canyon, the TRW lease area, and upper Gabino Canyon.

Although annual and native grasslands are not differentiated in the NCCP vegetation database, some survey work was done on RMV by St. John in 1989 (St. John 1990) and later mapping in specific areas has been completed by Dudek (1997, 2001) and MBA (1996). Generally, native grasslands are patchy north of Highway 74, with patches occurring in Ladera Open Space east of Arroyo Trabuco (Dudek 2001) and Chiquita Canyon (St. John 1990; Dudek 1997; MBA 1996). Much of the native grassland on RMV is located in the southern San Juan and San Mateo watersheds in upper Gabino Canyon (St. John 1990; Dudek 2001), Verdugo Canyon (St. John 1990), and Cristianitos Canyon (St. John 1990; MBA 1996; Dudek 1990). St. John made a preliminary estimate of approximately 3,300 to 4,000 acres of native grassland on RMV property, but based on the Dudek's refined mapping of native grasslands, the total appears to be closer to 1,100 acres. Major areas of native grassland include Cristianitos Canyon (~405 acres) and upper Gabino Canyon (276 acres), with smaller areas of native grassland in Blind Canyon (102 acres) and middle and lower Chiquita Canyon (76 acres). There are likely to be several smaller patches of unmapped native grassland scattered throughout the RMV, but individual patches are unlikely to be more than a few 10s of acres in size. The cumulative total of these unmapped areas is likely to be no more than a few hundred acres.

b. Coastal Sage Scrub Communities on Rancho Mission Viejo

Coastal sage scrub is dominated by a characteristic suite of low-statured, aromatic, drought-deciduous shrubs and subshrub species. Composition varies substantially depending on physical circumstances and the successional status of the habitat. Characteristic species include California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), laurel sumac (*Malosma laurina*), California encelia (*Encelia californica*), and several species of sage (*e.g.*, *Salvia mellifera, Salvia apiana*) (Holland 1986; Sawyer and Keeler-Wolf 1995). Other common species include brittlebush (*Encelia farinosa*), lemonadeberry (*Rhus integrifolia*), sugarbush (*Rhus ovata*), yellow bush penstemon (*Keckiella antirrhinoides*), Mexican elderberry (*Sambucus mexicana*), sweetbush (*Bebbia juncea*), boxthorn (*Lycium* spp.), prickly-pear (*Opuntia littoralis*), coastal cholla (*Opuntia prolifera*), tall prickly-pear (*Opuntia oricola*), and several species of *Dudleya*. Sage scrub often is patchily distributed throughout its range (O'Leary 1990). Over a scale of several miles, it can be found in diverse habitat mosaics with other plant communities, particularly grassland and chaparral, and oak/riparian woodland in more mesic areas. Coastal sage scrub may convert to chaparral or grassland, depending on slope, aspect, climate, fire history, and other physical factors and biological phenomena. Conversely, chaparral or grassland areas may convert to coastal sage scrub (Axelrod 1978; White 1995; O'Leary 1995; Allen *et al.* 1999).

Coastal sage scrub typically is found on xeric sites, notably steep, south-facing slopes with thin and/or rocky soils. It also is found on exposed sea bluffs, coastal and river terraces composed of coarse alluvial outwash, and coastal dunes (Axelrod 1978). The more open nature of the canopy permits persistence of a diverse herbaceous component of forbs, grasses, and succulents in mature stands than usually is associated with chaparral. It often is mixed with chaparral and grassland communities and the distinct boundaries between each can sometimes be difficult to delineate.

Gray and Bramlet (1992) proposed a complex and highly detailed classification system, modified from Holland (1986), for use in mapping vegetation types in Orange County, California. Within "scrub" habitats, Gray and Bramlet (1992) identified eight major subtypes: **(1)** southern coastal bluff scrub; **(2)** maritime succulent scrub; **(3)** Venturan-Diegan transitional coastal sage scrub; **(4)** southern cactus scrub; **(5)** Riversidean coastal sage scrub; **(6)** floodplain sage scrub; **(7)** chenopod scrub; and **(8)** sage scrub-grassland ecotone. Within the Venturan-Diegan transitional coastal sage scrub subtype, 12 distinct subassociations were identified based on the dominant species. Within the sage scrub-grassland ecotone subtype, five distinct subassociations were identified based on the same criterion. For a description of these subassocations the reader is referred to the Southern NCCP/HCP.

"Scrub" as defined for RMV, roughly corresponds to Holland's (1986) descriptions of Venturan-Diegan coastal sage scrub (a transitional community containing elements of two major types described by Holland), southern coastal bluff scrub, and Riversidean coastal sage scrub. In RMV, scrub is a more or less open community composed of low, drought deciduous shrubs, with a sparse understory of annual and perennial grasses and forbs.

c. Riparian Vegetation on Rancho Mission Viejo

Eight distinct associations of riparian vegetation are included in the vegetation database for the RMV study area (*Table 2*).[1] In order of their prevalence in the study area, they are coast live oak riparian forest, willow riparian scrub (southern willow scrub), sycamore riparian woodland, southern arroyo willow riparian forest, herbaceous riparian, mule fat scrub, white alder riparian,

[1] The riparian and wetland habitat acreages are based on the 1993 NCCP vegetation database and provide a general characterization of the study area. This original mapping was based on aerial photo interpretation and field checking, but was not performed using the USACE and CDFG formal criteria for jurisdictional waters of the U.S./State, including wetlands. Formal USACE/CDFG delineations have been performed by GLA and confirmed by the USACE and CDFG [pendind?]. The location and acreage information for riparian and wetland habitats based on this refined work is used to assess impacts, make significance findings, and identify appropriate mitigation.

and cottonwood-willow riparian forest. The descriptions of these riparian communities primarily are based on Gray and Bramlet (1992) and MBA (1996).

Riparian communities typically consist of one or more deciduous tree species with an assorted understory of shrubs and herbs (Holland and Keil 1995). The transition between riparian habitats and adjacent non-riparian habitats often is abrupt (Grenfell 1988). Vegetation height can vary from three to ten feet in scrub habitats to 100 feet in riparian forest habitats (Grenfell 1988). Riparian habitats generally occur among mid- to large-order streams below about 4,000 feet above msl, primarily within the foothills and valleys (Stephenson and Calcarone 1999). Riparian communities are not restricted to specific climates or soil types, but are primarily dependent on a permanent supply of water. In southern California, most streams have very low flow during the summer, and in many cases surface flow may dry up (Stephenson and Calcarone 1999).

Riparian communities are dynamic systems. The stream channels may be swept clean of vegetation during floods as sediments are shifted during erosion flood events. Some have deep root systems that anchor them against the floodwaters and some have flexible stems that bend with floodwaters.

In addition to riparian communities, RMV supports several distinct wetland communities, including open water, freshwater marsh, water courses, and vernal pools, which support their own unique plants and wildlife and contribute additional biodiversity and ecological functions.

d. Woodlands and Forest on Rancho Mission Viejo

Oak woodlands consist of multilayered vegetation with a canopy that is 20 to 80 percent tree cover (Gray and Bramlet 1992). Oak woodlands occur throughout the lower elevations of western California, generally from sea level to 4,900 feet (Holland and Keil 1995). Oak forests are similar to oak woodlands, but have 80 percent or more canopy cover (Gray and Bramlet 1992).

Thorne (1976) distinguishes between northern, foothill, southern, and island oak communities in California. Southern and coastal woodlands, including coast live oak woodland found in the RMV, extend from eastern Mendocino County at 40° N latitude through the North Coast, Central Coast, and Transverse ranges on north-facing and coast-facing slopes and in canyons below 3,900 feet (Barbour and Minnich 2000). The range continues through the interior valleys and foothill slopes of the Peninsular ranges, mainly between 500 and 4,600 feet, and south to the Sierra San Pedro Martir at 30° N latitude in Baja California, Mexico (Barbour and Minnich 2000). According to Munz and Keck (1949), the southern oak woodlands are found in the valleys of southern California between Los Angeles and San Diego counties east to about 5,000 feet in the San Jacinto Mountains of western Riverside County. According to Holland and Keil (1995), coast live oak woodlands range from Sonoma County to Baja California, generally in mesic areas including canyon bottoms and north-facing slopes, whereas southern oak woodlands extend from Ventura County southward. This roughly corresponds with Griffin (1977) who distinguishes oak woodlands from the Santa Ynez Mountains of Santa Barbara County southward as southern oak woodland.

Generally, oak woodlands are open where moisture is limited in drier more exposed aspects, and densest in moist areas (Holland and Keil 1995). North-facing slope occurrences are also denser than south-facing slope occurrences (Holland and Keil 1995). Average annual rainfall of areas supporting oak woodlands is between 15 and 25 inches. Runoff tends to be rapid. The growing season is seven to 10 months (Munz and Keck 1949). Oak trees, in general, require 60 to 80 years to mature (Holland 1988).

Common soils that support coast live oak include sandstone and shale-derived soils (Sawyer and Keeler-Wolf 1995). Coast live oak typically occupies slopes with deep soils, alluvial terraces, and the recent alluvium of canyon bottoms (Griffin 1977; Brown 1982). Open woodlands form when soils are shallow (Holland and Keil 1995).

Canyon live oak forest is similar in composition to coast live oak forest, but is dominated by canyon live oak.

Many understory shrubs in woodlands and forest are shade tolerant and include scrub oak (*Quercus berberidifolia*), California blackberry, snowberry (*Symphoricarpos mollis*), California walnut (*Juglans californica*), California-lilac (*Ceanothus* spp.), laurel sumac, gooseberry, toyon, California laurel, manzanita (*Arctostaphylos* spp.), poison-oak, Mexican elderberry, mountain-mahogany, sugarbush (*Rhus ovata*), big-leaf maple and white alder. Herbaceous understory species include California goldenrod (*Solidago californica*), western wild rye (*Elymus glaucus*), giant ryegrass, *Melica* spp., *Stellaria* spp., *Claytonia* spp., ripgut grass, wild cucumber, nightshade, *Phacelia* spp., and common eucrypta (*Eucrypta chrysanthemifolia*) (Gray and Bramlet 1992).

Live oak forest primarily occurs on the Donna O'Neill Land Conservancy , at the head of Cristianitos Creek, on the northern slopes of Blind Canyon, and in small patches in lower Chiquita Canyon and east of Cañada Gobernadora.

e. Chaparral Communities on Rancho Mission Viejo

Gray and Bramlet (1992) identify several scrub-chaparral ecotone/sere and chaparral subassociations in the Orange County. These subassociations generally are self-descriptive by their titles. The scrub-chaparral ecotone/sere subassociations are characterized gradations between scrub and chaparral vegetation communities. Two scrub-chaparral ecotone/sere subassociations known from the RMV are chamise-sage scrub and maritime chaparral-sagebrush, the former dominated by chamise and California sagebrush and the latter dominated by lemonadeberry, laurel sumac, and toyon. Chaparral subassociations known from the RMV include southern mixed chaparral, chamise chaparral, scrub oak chaparral, toyon-sumac chaparral, snowball ceanothus chaparral, and manzanita chaparral.

TABLE 1
VEGETATION COMMUNITIES/LAND COVERS IN THE STUDY AREA

Vegetation Community/Land Cover[1]	Acres
Natural Habitats	
Grassland	5,040.9
Coastal Sage Scrub	7,682.0
Riparian[2]	1,919.7
Open Water	135.7
Freshwater Marsh	25.2
Slope Wetland	2.2
Watercourses	13.2
Vernal Pools	19.9
Woodland	275.9
Forest	311.9
Chaparral	3,792.9
Cliff and Rock	6.2
Subtotal – Natural Habitats	**1,9225.7**
Non-habitat Land Covers	
Developed	534.7
Disturbed	501.2
Agriculture	2554.8
Sub-total – Non-Habitat Land Covers	**3,590.7**
TOTAL	**22,816.4**

[1] Source: Southern NCCP/HCP Vegetation Database (1993), as revised by Dudek in 2004 (file date 3/24/04).

[2] See Table 2 for a breakdown of specific riparian vegetation communities.

TABLE 2
RIPARIAN VEGETATION COMMUNITIES IN THE STUDY AREA

Riparian Community[1]	Acres[2]
Herbaceous Riparian	17.2
Willow Riparian Scrub (Southern Willow Scrub)	357.5
Southern Arroyo Willow Riparian Forest	168.1
Coast Live Oak Riparian Forest	1,116.2
Cottonwood—Willow Riparian Forest	1.2
Sycamore Riparian Woodland	246.9
White Alder Riparian Forest	1.6
Mule Fat Scrub	11.0
TOTAL	**1,919.7**

[1] Source: Southern NCCP/HCP Vegetation Database (1993), as revised by Dudek in 2004 (file date 3/24/04).

[2] Acres not representative of USACE or CDFG jurisdiction, see Tables 4.9-5 and 4.9-6 of EIR for USACE and CDFG jurisdiction.

2.1.4 Sensitive Species

The following are summary descriptions of listed and non-listed sensitive species which may benefit from this GMP. For a complete species account for these species, the reader is referred to Biological Resources Section of the EIR.

a. Listed Species

California Gnatcatcher

The California gnatcatcher (*Polioptila californica*) is federally listed as threatened. It is a small, long-tailed member of the thrush family (Muscicapidae). The gnatcatcher typically occurs in or near coastal sage scrub, which is a broad category of vegetation that includes the following plant communities as classified by Holland (1986): Venturan coastal sage scrub, Diegan coastal sage scrub, maritime succulent scrub, Riversidean sage scrub, Riversidean alluvial fan sage scrub, southern coastal bluff scrub, and coastal sage-chaparral scrub. Coastal sage scrub is composed of relatively low-growing, dry-season deciduous, and succulent plants. As described above, characteristic plants of this community include coastal sagebrush, various species of sage (*Salvia* sp.), California buckwheat, lemonadeberry, California encelia and *Opuntia* spp. Ninety-nine percent of all gnatcatcher locality records occur at or below an elevation of 300 meters (m) (984 feet [ft]) (Atwood 1990). Gnatcatchers on RMV are concentrated in two locations, namely Chiquita and Gobernadora Canyons, and in more scattered locations in Cristianitos and Trampas Canyons.

Arroyo Toad

The arroyo toad (*Bufo californicus*) is federally-listed as endangered It is found in foothill canyons and inter-mountain valleys where rivers are bordered by low hills and the stream gradients are low (Miller and Miller 1936; Sweet 1992). The arroyo toad uses riparian environments for breeding and adjacent uplands for foraging and estivation. Arroyo toads are known to either breed, forage, and/or aestivate in aquatic habitats, riparian, coastal sage scrub, oak, and chaparral habitats. The species is restricted to medium- to large-sized, slow-moving streams. The majority of arroyo toad population studies occur within third and fourth order drainages that are characterized by decomposed granite bedrock. However, toad populations have been found in a wide range of stream orders, including lower, second order, and higher, fifth and sixth order coastal streams characterized by sedimentary rock (PCR 2002). According to USFWS, streams supporting arroyo toads range from first to sixth order in the central part of the species' range (Orange, Riverside and San Diego counties) (USFWS 1999). Within RMV, the arroyo toad is associated with riparian, streamcourses with sandy benches along streams in both the San Juan Creek and San Mateo Creek watersheds, specifically San Juan Creek from about the mouth of Chiquita Canyon upstream to the RMV boundary and beyond to about Hot Springs Creek and in lower Bell Canyon. In the San Mateo Watershed the toad occurs in Talega, lower Gabino and lower Cristianitos creeks.

Least Bell's Vireo

The least Bell's vireo (*Vireo belli pusillus*) is state and federally listed as endangered. It occupies a more restricted nesting habitat than the other subspecies of Bell's vireo, as summarized in USFWS (1986). Least Bell's vireos primarily occupy riverine riparian habitats that typically feature dense cover within one to two meters of the ground and a dense, stratified canopy. It inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically it is associated with southern willow scrub, cottonwood forest, mule fat scrub, sycamore alluvial woodland, coast live oak riparian forest, arroyo willow riparian forest, wild blackberry, or mesquite in desert localities. It uses habitat that is limited to the immediate vicinity of watercourses below about 457 m (1,500 ft) elevation in the interior (USFWS 1986; Small 1994). In the coastal portions of southern California, the least Bell's vireo occurs in willows and other low, dense valley foothill riparian habitat and lower portions of canyons and along the western edge of the deserts in desert riparian habitat. On RMV, surveys have documented nesting locations in Gobernadora Creek, middle San Juan Creek (between the Ortega Highway bridge and Casper Wilderness Park), Chiquita Creek and lower Cristianitos Creek.

Southwestern Willow Flycatcher

The southwestern willow flycatcher (*Empidonax traillii extimus*) is state and federally listed as endangered. It is restricted to riparian woodlands along streams and rivers with mature, dense stands of willows (*Salix* spp.), cottonwoods (*Populus* spp.) or smaller spring fed or boggy areas with willows or alders (*Alnus* spp.) (Sedgwick and Knopf 1992). It is an insectivore that forages within and above dense riparian vegetation, taking insects on the wing or gleaning them from foliage (USFWS 1993). This species also forages in areas adjacent to nest sites which may be more open (USFWS 1995). On RMV, the southwestern willow flycatcher is known from the Gobernadora Ecological Restoration Area (GERA) in Gobernadora Canyon.

Riverside Fairy Shrimp

The Riverside fairy shrimp (*Steptocephalus wootonii*) is federally-listed as endangered. It is restricted to deep seasonal vernal pools, vernal pool-like ephemeral ponds, and stock ponds and other human modified depressions (Eng et al. 1990; USFWS 1993, USFWS 2001). Riverside fairy shrimp prefer warm-water pools that have low to moderate dissolved solids, are less predictable, and remained filled for extended periods of time (Eriksen and Belk 1999). Basins that support Riverside fairy shrimp are typically dry a portion of the year, but usually are filled by late fall, winter or spring rains, and may persist through May (USFWS 2001). All known vernal pool habitat lies within annual grasslands, which may be interspersed through chaparral or coastal sage scrub vegetation. On RMV, the Riverside fairy shrimp in very large population in a large pool on Chiquita Ridge (this pool is within Ladera Open Space) and in two pools located along Radio Tower Road (pools 2 and 7).

San Diego Fairy Shrimp

The San Diego fairy shrimp (*Branchchinecta sandiegonensis*) is state-listed as endangered and federally-listed as threatened. It occurs in small, shallow vernal pools ranging in depth from 5.1 to 30.5 cm (2 to 12 in) and in water temperatures from 10 and 14.5 degrees C (50 to 58 degrees F). Water temperature and chemistry are important factors in the species' distribution. Adults are usually observed in January-March when pools hold water from winter rains, although the breeding season may be extended in association with early winter or mid-spring rains (USFWS 2000). Eggs are either dropped to the pool bottom or remain in the brood sac until the adult female dies and sinks. The shrimp hatch and mature in seven days to two weeks, depending on water temperature. "Resting eggs" of cysts are capable of withstanding heat, cold and prolonged drying (USFWS 2000). Because the high variability rainfall in southern California, and thus the success of any given breeding season, only a fraction of cysts may hatch in a given year and reproductive success can be spread out over several years (USFWS 2000).

The San Diego fairy shrimp occurs two locations on RMV: in the large and small vernal pools on Chiquita Ridge (vernal pools 3 and 4) and in three pools located along Radio Tower Road south of Ortega Highway (vernal pools 1, 2 and 7).

Thread-leaved Brodiaea

Thread-leaved brodiaea (*Brodiaea filifolia*) is state-listed as endangered and federally-listed as threatened. It is a perennial geophyte, that has a corm with a dark brown, fibrous tunic. The flowering stalk is 20.3-40.6 cm (8-16 in) high and the narrow leaves are generally shorter than the flowering stem. The flowers are dark blue to violet and have six perianth segments. There are three stamens and three staminodia (sterile stamens), which are narrow and thread-like in each flower. In Orange County, populations are known from Aliso-Woods Canyon Regional Park (several thousand), RMV (4,500 to 5,500 flowering stalks), Forster Ranch (approximately 5,000 flowering stalks associated with a restoration/relocation program), Prima Deshecha Landfill, and the Talega Development where one small population will be preserved in open space and a second population is slated for translocation.

b. Non-listed Species

Several non-listed species also occur on RMV which that are likely to be affected by grazing management program either directly (e.g., species such as grasshopper sparrow that nest in grasslands with high structural diversity) or indirectly (species whose prey may be affected by grazing practices such as kite, horned lizard and whiptail). These species are: cactus wren, yellow warbler, yellow-breasted chat, grasshopper sparrow, white-tailed kite, merlin, western spadefoot toad, southwestern pond turtle, San Diego horned lizard, and orange-throated whiptail. For a complete species account for these species, the reader is referred to the Biological Resources Section of the EIR.

2.2 Pastures

Figure 1 shows the general location of the historic RMV pastures within the RMV property boundary. Trabuco Pasture, Oil Well, Horno, Lower Chiquita, Middle Trabuco, Cecil's Pasture, Horseshoe Pasture, Upper Chiquita, the Vineyard, Bull Pasture, Lower Gobernadora, Horse Pasture and Nick's Pasture are located north of San Juan Creek in the San Juan Watershed. River Pasture straddles San Juan Creek. South of San Juan Creek located partially within the San Juan

Figure 1

Creek Watershed and partially within the San Mateo Watershed are Sierra, Rinconada, Cristianitos Pasture, Gabino, Talega and TRW Pasture. South 40 is located adjacent to Ortega Highway in the San Juan Creek watershed.

2.2.1 Pasture Description

The following is an overview of the location by sub-basin, soils, vegetation community, sensitive species, fencing and water resources for each of the historic pastures listed above. The current status of the pasture is also discussed, i.e., whether it is actively grazed or not. *Figures 2, 3,* and *4a-c* depict terrain types, vegetation and listed and selected sensitive species for the pastures.

a. Trabuco Pasture

Trabuco Pasture is located in the Trabuco sub-basin Terrains in this sub-basin are low to high slope less erodable clays (*Figure2*). Vegetation is this pasture is dominated by grassland and coastal sage scrub (*Figure 3*). Other vegetation types occurring in the pasture to a lesser degree include riparian and chaparral. Agriculture, distributed and developed also occur in this pasture. Thread-leaved brodiaea occurs in this pasture. No other sensitive plant species occur. Eleven California gnatcatcher locations occur in this pasture (*Figure 4a*). Other species of note include American badger, Bell's sage sparrow, coastal cactus wren, grasshopper sparrow, red-tailed hawk and white-tailed kite (*Figure 4b*).

Trabuco Canyon pasture has been set aside for conservation purposes in accordance with the terms and conditions of the USACE, UFSWS and CDFG permits for Ladera Ranch and the Arroyo Trabuco Golf Course. No active grazing occurs on this pasture. In accordance with the terms and conditions of the Ladera Open Space Conservation Easement grazing is a reserved use subject to the preparation and approval of a grazing management plan by the County of Orange. A subsequent amendment to the Ladera Open Space Easement associated with approval of the Arroyo Trabuco Golf Course revised this provision of the easement to state "No grazing shall be permitted within the Conservation Easement Area without the written consent of CDFG and the Service." It is not the intent of RMV to resume grazing in the Trabuco Pasture, therefore this pasture will not be further addressed by this GMP.

1. Narrow Canyon

Narrow Canyon pasture is located in the Narrow Canyon sub-basin. This pasture is characterized by high to low slope and less erodible clays (*Figure 2*). Vegetation types in Narrow pasture include agriculture, annual and native grasslands, coastal sage scrub and minor amounts of chaparral and riparian (*Figure 3*). No sensitive plant species occur within this pasture. Recorded locations of listed species include 11 locations for California gnatcatcher (*Figure 4a*). Other

Figure 2

Figure 3

Figure 4a

Figure 4b

Figure 4c

species of note recorded within this pasture include coastal cactus wren, grasshopper sparrow, loggerhead shrike, northern red-diamond rattlesnake, orange-throated whiptail, *rufous-crowned* sparrow, San Diego horned lizard, western spadefoot toad and western whiptail (*Figure 4b*).

Grazing is excluded from Narrow Canyon in accordance with the terms and conditions of the 404 permit issued by the USACE for Ladera Ranch and is also partially within the Ladera Open Space Conservation Easement (discussed above), therefore this pasture will not be further discussed in this GMP.

2. Horno

Horno pasture straddles the Horno and Narrow/Chiquita Sub-basins as shown on *Figure 1*. This pasture is characterized by high to low slope and less erodible clays (*Figure 2*). Vegetation types in Horno pasture include agriculture, annual grasslands, coastal sage scrub and very minor amounts of native grasslands, chaparral, lakes and riparian (*Figure 3*). No sensitive plant species occur within this pasture. Recorded locations of listed species include one location for California gnatcatcher (*Figure 4a*). Other species of note recorded within this pasture include barn owl, great horned owl and western spadefoot toad (*Figure 4b*).

Horno pasture is also part of the Ladera Open Space and is subject to the Ladera Open Space Conservation Easement and its subsequent amendment. As noted above for the Trabuco Pasture, RMV does not intend to resume grazing in the Ladera Open Space Conservation Easement, therefore this pasture will not be discussed further in this GMP.

3. Oil Well Pasture

Oil Well Pasture straddles the Horno and Narrow/Chiquita Sub-basins as shown on *Figure 1*. This pasture is characterized by high to low slope and less erodible clays (*Figure 2*). Vegetation types in Oil Well Pasture pasture include agriculture, annual grasslands, coastal sage scrub and minor amounts of native grassland, riparian and developed (*Figure 2*). No sensitive plant species occur within this pasture. Recorded locations of listed species include three locations for California gnatcatcher (*Figure 4a*). Other species of note recorded within this pasture include coastal cactus wren and western spadefoot toad (*Figure 4b*).

Oil Well Pasture is also part of the Ladera Open Space and is subject to the Ladera Open Space Conservation Easement and its subsequent amendment. As noted above for the Trabuco, Narrow Canyon and Horno pastures, RMV does not intend to resume grazing in the Ladera Open Space Conservation Easement, therefore this pasture will not be discussed further in this GMP.

4. Lower Chiquita, Middle Trabuco, Upper Chiquita and Cecil's Pasture – "Chiquita Pastures"

Lower Chiquita, Middle Trabuco, Upper Chiquita and Cecil's Pasture are all located within the Chiquita sub-basin and include the majority of Chiquadora ridge located in the Gobernadora sub-basin. Portions of Middle Trabuco, Cecil's Pasture, Upper and Lower Chiquita have been removed from active grazing for development purposes (Cecil's Pasture below Oso Parkway) or set aside for conservation purposes (Cecil's Pasture and Upper Chiquita above Oso Parkway, Horseshoe Pasture, Narrow Canyon and portions of Horno. The remaining portions of these pastures are grazed as one pasture today. For purposes of this overview this group of pastures will be called the "Chiquita Pastures". These pastures are characterized by sandy or silty terrains in the main and side canyons. Ridges on the east side of the valley are characterized by rock outrcroppings and areas of hardpan (eroded remnants of claypans formed in the geologic past that have eroded to form mesas) and locally steep slopes (*Figure 2*).

Vegetation in the Chiquita Pastures includes coastal sage scrub, agriculture (in the form of citrus and avocado orchards and barley fields), patches of annual and native grasslands and patches of chaparral (*Figure 3*). Chiquita Creek supports herbaceous riparian, southern willow scrub, arroyo willow riparian forest and coast live oak riparian forest. Slope wetlands also occur in this pasture. Several listed and other species of note occur in the Chiquita Pastures including the federally-listed California gnatcatcher, the state/federally-listed thread leaved Brodiaea, the state/federally-listed least Bell's vireo, California Native Plant Society (CNPS) List 1B plants many-stemmed dudleya, southern tarplant, Coulter's saltbush and salt spring checkerbloom (*Figures 4a,c*). Other wildlife of note includes coastal cactus wren, ferruginous hawk, prairie falcon, merlin, northern harrier, wintering burrowing owls, loggerhead shrike, grasshopper sparrow, rufous-crowned sparrow, California horned lark, tricolored blackbird, (nomadic colonies), orange-throated whiptail, coastal western whiptail, San Diego horned lizard, northern-red diamond rattlesnake, mule deer and mountain lion (*Figure 4b*).

The actively grazed portion of the Chiquita Pastures is enclosed by a four-strand barbed wire fence located below Tesoro High School for the northern boundary, along Chiquita Ridge for the western boundary and the west side of Gobernadora Creek for the eastern boundary. Internal fencing to separate cattle from other uses, such as the orchards, the Chiquita wetland mitigation sites and the reclamation plant also divides the pasture. Fencing along San Juan Creek for the River Pasture forms the southern boundary of the actively grazed portion of Chiquita Pastures. Water is provided by a cattle trough in the lower part of the pasture and via Chiquita Creek.

The portion of Cecil's Pasture and Upper Chiquita north of Oso Parkway and Horseshoe Pasture have not been actively grazed since 1996 when RMV sold a conservation easement to the Transportation Corridor Agencies (TCA) as mitigation for the Oso Segment of the Foothill

Transportation Corridor-North. In accordance with the Section 7 biological opinion issued for that project by USFWS and as set forth in the TCA's management plan for that area (Upper Chiquita Canyon Conservation Easement Area Resource Management Plan), grazing is an allowed use once a grazing management plan has been reviewed and approved by USFWS and CDFG. This GMP will address grazing practices within the Upper Chiquita Canyon Conservation Easement Area.

5. Gobernadora Pastures

Three separate fenced pastures collectively called the Gobernadora pastures, occur in the Gobernadora sub-basin: Vineyard, Bull Pasture and Lower Gobernadora. The terrain types, vegetation communities and listed and other species of note for the Gobernadora pastures are depicted on *Figures 2, 3* and *4a-c* respectively. Each pasture is described separately below.

(a) The Vineyard

The Vineyard pasture is located within the valley floor of the Gobernadora sub-basin. The valley floor is characterized by deep alluvial deposits within interbedded clay lenses. Vegetation in this pasture is primarily composed of agriculture (barley), annual grasslands and the riparian habitats associated with Gobernadora Creek. The more rugged uplands west of Gobernadora Creek are dominated by coastal sage scrub and grasslands. Recorded locations for listed species include two for the California gnatcatcher. Southern willow scrub in the revegated wetland mitigation area (GERA) provides nesting habitat for least Bell's vireo, yellow-breasted chat, and red-shouldered hawk. Other species of note within this pasture include California horned lark, grasshopper sparrow, orange-throated whiptail, rufous-crowned sparrow, western whiptail and yellow warbler. Tricolored blackbirds periodically forage in the grasslands of the Vineyard pasture. Two CNPS List 1B plants occur in the Vineyard pasture, one is the listed many-stemmed dudleya and the other is southern tarplant.

The Vineyard pasture is enclosed by four-strand barbed wire fence. Internal fencing excludes cattle from GERA. Water is provided by cattle troughs and via Gobernadora Creek.

(b) Bull Pasture

Bull Pasture is located within the Gobernadora sub-basin, west of Gobernadora Creek. The flat to rolling terrain of this pasture exhibits areas of exhumed hardpan overlying sandy and silty substrates and exposed rock outcrops. Vegetation types in this pasture include agriculture (barley), coastal sage scrub, chaparral, oak woodlands, grassland, riparian and a small amount of disturbed area. Wildlife of note occurring in Bull pasture include barn owl, coastal cactus wren, grasshopper sparrow, great horned owl, orange-throated whiptail, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard and western skink. Sensitive plants occurring in the pasture include many-stemmed dudleya, Catalina mariposa lily, and Palmer's grappling hook.

Bull Pasture is enclosed by four-strand barbed wire fence. The RMV property perimeter fence is its northern boundary, its eastern boundary is fenced along Gobernadora ridge, its southern boundary shares a fence with the Lower Gobernadora pasture and its western fence is shared with the Chiquita Pasture. Water is provided by a cattle trough.

(c) Lower Gobernadora

The Lower Gobernadora pasture extends from Chiquadora ridge to Gobernadora ridge in an east-west direction, and from Bull Pasture and the Vineyard to the River Pasture in a north-south direction. This pasture includes the terrains of the valley floor (deep alluvial deposits with interbedded clays) and the ridges (exhumed hardpan overlying sandy and silty substrates).

Vegetation types on the east side of Lower Gobernadora pasture include agriculture, coastal sage scrub, chaparral and oak woodlands. The more rugged uplands west of Gobernadora Creek are dominated by coastal sage scrub and grasslands. The valley floor is characterized by agriculture, annual grasses and the riparian communities associated with Gobernadora Creek and GERA. Disturbed and developed land use covers also occur in this pasture. Listed species occurring in this pasture include least Bell's vireo, California gnatcatcher, southwestern willow flycatcher.. Sensitive plant species that occur within this pasture include; many-stemmed dudleya, Catalina mariposa lily, Palmer's grapplinghook, southern tarplant and paniculate tarplant. Other species of note include barn owl, coastal cactus wren, desert woodrat, grasshopper sparrow, orange-throated whiptail, red-shouldered hawk, red-tailed hawk, *rufous-crowned*-sparrow, western whiptail, white-tailed kite, yellow warbler and yellow-breasted chat.

Lower Gobernadora shares fences with Vineyard and Bull Pasture to the north, Horse Pasture and Nick's Pasture to the east along Gobernadora Ridge, River Pasture to the south and Lower Chiquita pasture to the west along Chiquadora Ridge. The wetland revegetation area, GERA, is fenced to exclude cattle. Water is provided by a cattle trough.

6. Horse Pasture

Horse Pasture is located within the Central San Juan sub unit of the Central San Juan and Trampas Canyon sub-basin. Terrains in this pasture generally include erodible silts and clays. Upland vegetation types include coastal sage scrub, chaparral, oak woodlands, grassland, open water, riparian, agriculture, developed and disturbed areas (Colorspot Nursery). Listed species present in this pasture include California gnatcatcher locations north of Colorspot Nursery. Sensitive plant species include many-stemmed dudleya, Catalina mariposa lily and Palmer's grapplinghook. Also present in this pasture are barn owl, coastal cactus wren, desert woodrat, grasshopper sparrow, orange-throated whiptail, red-tailed hawk, *rufous-crowned*-sparrow, southwestern pond turtle and western whiptail. The terrain types, vegetation communities and sensitive species for Horse Pasture are depicted on *Figures 2, 3* and *4a-c* respectively

Horse Pasture shares fences with Lower Gobernadora to the north-west, Nick's Pasture to the north-east and River Pasture to the south. No active grazing occurs in this pasture due to the extent of the Colorspot Nursery operation.

7. Nick's Pasture

Nick's Pasture is also located within the Central San Juan sub unit of the Central San Juan and Trampas Canyon sub-basin. Terrains in this pasture generally include erodible silts and clays. Upland vegetation types include coastal sage scrub, chaparral, oak woodlands, grassland, riparian and agriculture (citrus orchards). A small portion of this pasture is classified as developed. Listed species locations recorded in this pasture include arroyo toad, California gnatcatcher and least Bell's vireo. Sensitive plant species in this pasture include locations of many-stemmed dudleya, Catalina mariposa lily and Palmer's grapplinghook. Other species of note with locations in this pasture include barn owl, coastal cactus wren, grasshopper sparrow, orange throated whiptail, red-tailed hawk, rufous-crowned sparrow, western spadefoot toad and western whip tail. The terrain types, vegetation communities and sensitive species for Nick's Pasture are depicted on *Figures 2, 3* and *4a-c* respectively

Fencing of Nick's Pasture includes the RMV perimeter fence along the eastern edge and Bull Pasture and Lower Gobernadora to the west. Due to the lack of fencing to separate cattle from the citrus production areas, Nick's pasture has not been grazed for the last 5-6 years. Water is available through cattle troughs.

8. River Pasture

River pasture straddles San Juan Creek and is within the Central San Juan sub unit of Central San Juan and Trampas Canyon sub-basin. Terrains in this subunit generally include erodable silts and clays in the uplands north of San Juan Creek and alluvial terrace deposits in San Juan Creek itself. Vegetation types within the River Pasture include agriculture, chaparral, developed, disturbed, forest, grassland, open water, marsh, riparian, coastal sage scrub, stream and oak woodlands. Listed species locations in this pasture include the listed arroyo toad and least Bell's vireo. Other species of note include ash-throated flycatcher, barn owl, coastal cactus wren, desert woodrat, yellow-breasted chat, yellow warbler, rufous-crowned sparrow, sharp-shinned hawk, ferruginous hawk, merlin, northern red-diamond rattlesnake, orange-throated whiptail, white-tailed kite, Cooper's hawk, red-shouldered hawk, great horned owl, red-tailed hawk, great blue heron, southwestern pond turtle, two-striped garter snake, western skink, western spadefoot toad, arroyo chub and threespine stickleback. The terrain types, vegetation communities and sensitive species for River Pasture are depicted on *Figures 2, 3* and *4a-c* respectively

River Pasture shares fences with Horno, Lower Chiquita, Lower Gobernadora and Horse Pasture to the north; and Sierra, Rinconada, Cristianitos and Gabino to the south in the San Mateo watershed. Water is provided via San Juan Creek and a water trough when the creek is dry.

9. South 40

South 40 is located within the Central San Juan sub-basin, adjacent to Ortega Highway. Terrains in this pasture are erodable clays and some silts (*Figure 2*). Vegetation types in this sub-basin are disturbed (barley), annual grasses and chaparral on the steeper slopes (*Figure 3*). No sensitive plant locations occur in this pasture. Locations for barn owl, Cooper's hawk, ferruginous hawk, grasshopper sparrow, loggerhead shrike, night snake, northern red-diamond rattlesnake, orange throated whiptail, racer, red-tailed hawk, rufous-crowned sparrow, tricolored blackbird, western skink and western spadefoot toad occur in this pasture (*Figure 4b*).

South 40 is fenced along Ortega highway. Water is provided via water trough.

10. Sierra Pasture

The Sierra Pasture is located partially within the Chiquita sub-basin and partially within an un-named sub-basin that is located south of the Prima Deschecha sub-basin. Terrains in this pasture are erodable clays and less erodable clays of low to high slope (*Figure 2*). Vegetation types in this pasture are predominately grassland and coastal sage scrub, with some riparian and minor amounts of forest and oak woodland (*Figure 3*). Agriculture and developed land uses also occur in very small amounts. No sensitive plant locations occur in this pasture. However, several California gnatcatcher locations occur, as do locations for barn owl, Cooper's hawk, ferruginous hawk, grasshopper sparrow, loggerhead shrike, night snake, northern red-diamond rattlesnake, orange throated whiptail, racer, red-tailed hawk, rufous-crowned sparrow, tricolored blackbird, western skink and western spadefoot toad (*Figure 4a,b*). Both the federally-listed San Diego and Riverside fairy shrimp occur within vernal pools located along Radio Tower Road within this pasture.

Sierra pasture is fenced along Prima Deshecha Landfill, La Pata Avenue, Ortega Highway and shares fencing at the ridgeline with Rinconada pasture. Cattle are also excluded from the Ranch House by fencing. Water is provided via water trough.

11. Rinconada Pasture

Rinconada pasture is located within the Trampas and Cristianitos sub-basins. Terrains in this pasture are erodable silts and clays of low to high slope (*Figure 2*). Vegetation types in this pasture are predominately coastal sage scrub, grassland, chaparral and riparian, with oak forest and smaller amounts of oak woodland (*Figure 3*). Disturbed and developed land uses also occur in this pasture, namely the Oglebay Norton Industrial Sands (ONIS) mining operation. Trampas Canyon Dam is associated with this use. The Donna O'Neill Land Conservancy also lies within the historic boundary of this pasture, although grazing no longer occurs within the Conservancy. The state-and federally-listed thread-leaved brodiaea occurs within this pasture, as do several other sensitive plant locations including many-stemmed dudleya, Palmer's grappling hook and Catalina mariposa lily (*Figure 4a,c*). Of the other listed species, one California gnatcatcher location, one Riverside and one San Diego fairy shrimp pool occur in this pasture (*Figure 4a*). Both fairy shrimp occur within vernal pools located along Radio Tower Road within this pasture. Locations for barn owl, coastal cactus wren, great horned owl, Cooper's hawk, osprey (using open water), grasshopper sparrow, loggerhead shrike, night snake, northern red-diamond rattlesnake, orange throated whiptail, racer, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, turkey vulture, western spadefoot toad and white-tailed kite also occur in this pasture (*Figure 4b*).

Rinconada pasture is fenced along Ortega Highway, Cristiantios Road, the boundary with Prima Deshecha Landfill and Sierra Pasture. The Donna O'Neill Conservancy boundary is fenced to exclude cattle. Water is provided via water troughs and the mining pond associated with the ONIS operation. Although cattle are not specifically excluded from the ONIS operation, the lack of available forage in the active mine area acts as a deterrent to wandering cattle.

12. Cristianitos Pasture

Cristianitos Pasture is located partially within the Cristianitos sub-basin and partially within the Gabino sub-basin. Terrains in these portions of the sub-basins are erodable to less erodable clays and are subject to erosion under intensive grazing pressure (*Figure 2*). Grassland, including native grasslands and coastal sage scrub are the dominant vegetation types in this pasture (*Figure 3*). Chaparral, forest and riparian also occur in lesser amounts, as do open water, stream, woodland and rock. Developed, disturbed and agriculture also occur in this pasture. The listed thread leaved brodiaea occurs within this pasture, as do several other sensitive plant locations including many-stemmed dudleya, Palmer's grapplinghook, Coulter's saltbush, mesa brodiaea, small-flower microseris, upright burhead and western dichondra (*Figure 4a,c*).

Arroyo toad and California gnatcatcher are the two listed wildlife species with locations in this pasture (*Figure 4a,b*). Other species of note include arboreal salamander, barn owl, California horned lark, California whipsnake, coastal cactus wren, Cooper's hawk, desert woodrat, grasshopper sparrow, great horned owl, merlin, northern red-diamond rattlesnake, orange-throated whiptail, prairie falcon, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, southwestern pond turtle, coast patchnose snake, western spadefoot toad, western whiptail, white-tailed kite and yellow-breasted chat (*Figure 4a,b*).

Cristianitos pasture is fenced along Ortega Highway, Cristianitos Road, Talega pasture and the Cristianitos/Gabino ridgeline. Citrus areas in Cristianitos are also fenced to keep cattle out. Water is provided via three defunct mining ponds and water troughs.

13. Gabino

Gabino pasture is located within the Gabino and Verdugo sub-basins. Terrains in the Gabino sub-basin are divided into silty clays in the upper Gabino sub-unit and cobbly sands in the middle sub-unit. Upper Gabino is subject to erosion under intensive grazing pressure (*Figure 2*). Middle Gabino is a source of coarse sediments for Cristianitos Creek. Verdugo sub-basin terrains are cobbly sands with some silts. Verdugo Canyon is a source of coarse sediment for San Juan Creek. Coastal sage scrub and chaparral are the dominant vegetation types in this pasture. Grassland, including native grasslands, and riparian also occur in lesser amounts, as do marsh, woodland and rock (*Figure 3*). Developed and agriculture also occur in this pasture in small amounts, namely Campo Portola and citrus production. Many-stemmed dudleya, Coulter's saltbush and Fish's milkwort occur in this pasture (*Figure 4c*). Arroyo toad and California gnatcatcher are the two listed wildlife species with one location each, in this pasture (*Figure 4a*). Other species of note include: arboreal salamander, barn owl, coastal cactus wren, Cooper's hawk, grasshopper sparrow, great horned owl, long-eared owl, orange-throated whiptail, prairie falcon, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, southwestern pond turtle, two-striped garter snake, white-tailed kite and yellow-breasted chat (*Figure 4b*).

Gabino pasture is fenced along Ortega Highway, south of Gabino Creek where it shares a common fence with the Talega pasture and at the RMV boundary with Riverside County (perimeter fence). Water is provided via Jerome's Lake, water troughs and Gabino Creek (when water is available).

14. Talega

Talega pasture is located within the Talega and Blind Canyon sub-basins. Terrains in the Talega sub-basin are cobbly sands. Talega is a source of coarse sediments for Cristianitos Creek (*Figure 2*). Blind Canyon sub-basin terrains are cobbly sands. Blind Canyon is a source of coarse sediment for Cristianitos Creek. Coastal sage scrub, chaparral and grassland including native grasslands are the dominant vegetation types in this pasture (*Figure 3*). Riparian also occurs in lesser amounts, as do oak forest and woodland. Developed also occur in this pasture in small amounts. Thread leaved brodiaea, many-stemmed dudleya and chaparral beargrass occur in this pasture (*Figure 4a,c*). Arroyo toad and California gnatcatcher are the two listed species with locations in this pasture (*Figure 4a*). Other species of note include arboreal salamander, barn owl, coastal cactus wren, Cooper's hawk, grasshopper sparrow, northern red-diamond rattlesnake, orange-throated whiptail, prairie falcon, red-tailed hawk, rufous-crowned sparrow, San Diego horned lizard, western whiptail, white-tailed kite and yellow-breasted chat (*Figure 4b*).

Talega pasture is fenced along the boundary with MCB Camp Pendleton, the RMV boundary, the TRW lease area and shares a common fence with Gabino and Cristianitos pastures. Water is provided via Talega Creek and water troughs.

15. TRW Pasture

TRW pasture is located within the Talega and Cristianitos sub-basins. Terrains in the Talega sub-basin are cobbly sands. Talega Canyon is a source of coarse sediments for Cristianitos Creek. Cristianitos sub-basin is generally silty clays (*Figure 2*). Coastal sage scrub and grassland including native grasslands are the dominant vegetation types in this pasture (*Figure 3*). Riparian, chaparral and forest also occurs in lesser amounts, as do open water and woodland. Developed and disturbed also occur in this pasture, namely the Northrop-Grumman facility (formerly TRW) and associated ancillary uses. Many-stemmed dudleya, Palmer's grapplinghook, small-flower microseris, Coulter's saltbush and western dichondra occur in this pasture (*Figure 4c*).

Arroyo toad, California gnatcatcher and least Bell's vireo are the three listed wildlife species with locations in this pasture (*Figure 4a*). Other species of note include: barn owl, coastal cactus wren, Cooper's hawk, grasshopper sparrow, great horned owl, long-eared owl, northern red-diamond rattlesnake, orange-throated whiptail, red-shouldered hawk, red-tailed hawk, rufous-crowned sparrow, sharp shinned hawk, western whiptail, yellow warbler and yellow-breasted chat (*Figure 4b*).

Although listed as a pasture, no active grazing occurs within the TRW pasture due to the ongoing lease operations of the Northrop-Grumman Capistrano Test Facility. No future use of this area as a grazed pasture is anticipated; therefore this GMP will not further address this area.

In summary, the following pastures are currently actively grazed; Lower Chiquita, Vineyard, Bull Pasture, Lower Gobernadora, River Pasture (to the Cow Camp crossing), South 40, Sierra, Rinconada, Cristianitos, Gabino and Talega. Resumption of grazing is proposed for Nicks Pasture, Chiquita Canyon above Oso Parkway (including Horseshoe Pasture, but excluding Cecil's Pasture) and River Pasture north of the Cow Camp crossing. *Figure 5* shows both actively grazed pastures and pastures proposed for future grazing.

Figure 5

CHAPTER 3: GRAZING MANAGEMENT

This Chapter describes the objectives of the GMP, reviews the current RMV grazing practices, including residual dry matter (RDM) goals, grazing patterns and stocking rates and makes recommendations for future grazing practices.

3.1 Objectives of Grazing Management

Chapter 1 set forth the overall purposes of this GMP, namely, to contribute an important element of the long term Adaptive Management Program goals of enhancement/restoration of native habitats and to identify grazing practices that are consistent with the Draft Southern NCCP/HCP Planning Guidelines and the Draft Watershed Planning Principles.

To achieve these overall purposes, the following specific objectives of the GMP are:

1. Establish a minimum RDM per acre for active and proposed pastures, and adjust as necessary to reflect changes developed as a result of task 2 below.
2. Identify interim and long-term changes to existing and proposed pasture configurations and stocking levels to maximize use of available forage and facilitate the restoration of perennial grasses including native grasses.
3. Identify a timed rotational grazing scheme to maximize use of available forage and facilitate the restoration and/or long term management of native grasses and coastal sage scrub.
4. Identify sensitive habitat areas where cattle grazing shall be excluded seasonally or permanently.
5. Identify additional facilities required to promote better distribution of cattle within pastures as a strategy to manage geologic and abiotic resources (e.g., water sources, shade, supplemental feed/ nutritional blocks).
6. Outline methods (i.e., cattle exclosures) for monitoring forage levels in order to assess range conditions and to provide guidance on the introduction and removal of cattle.
7. Identify pastures that may be subject to prescribed fire. Identify appropriate pasture rest periods following burns to promote habitat recovery.
8. Outline procedures for re-evaluating grazing management practices every 3 to 5 years to ensure that existing practices are achieving the desired results.

3.2 Grazing Management

This section describes the basic practice of grazing management on RMV, both in terms of general concepts and specific applications.

The production of grassland, whether annual or native, for forage purposes is dependant on four factors: precipitation, temperature, soil characteristics and residue. These four factors largely control forage productivity and seasonal species composition. These factors also change the timing and characteristics of the four distinct growth phases: break of season, winter growth, rapid spring growth and peak forage production. Break of season follows the first fall rains that exceed 1 inch during a 1-week period. Timing of the break dramatically affects forage production. Winter growth period occurs as the fall break season ends and is the result of cooling temperatures, shorter days, and lower light levels. Rapid spring growth begins with the onset of warming spring temperatures, longer days and higher light intensities. Peak forage production occurs at the end of rapid spring growth (UC Extension, Leaflet 21378).

While the precise dates of the four distinct growth phases are subject to the factors noted above, generally speaking on RMV, for annual grasses break of season occurs late October – early November, winter growth occurs mid-December through early February, rapid spring growth occurs between early February and mid-March and peak forage production occurs by late March. Although influenced by the same factors noted above, native grasses generally lag slightly behind annual grasses by about eight weeks on Rancho Mission Viejo (T. Bomkamp, personal communication).

a. Current Grazing Practices

RMV has grazed cattle on its property since 1882. Since that time RMV has practiced a rational grazing pattern that takes into account available water, forage productivity and a desire to maintain an average of 25% RDM for "natural" or "unimproved" pastures. Natural pastures are those not artificially improved through the planting of a forage crop, e.g., barley. Availability of water, forage productivity and the desired level of RDM in turn dictate the stocking levels of RMV pastures.

The following sections describe the existing pasture configurations, residue, stocking levels and grazing pattern on RMV lands.

1. Existing Pasture Configurations & Resources

The current configuration of active grazing pastures or future configuration of a proposed grazing area is shown on *Figure 5*. The vegetation types within each pasture (*Table 3*) is based on the current or proposed configuration, not the historic configuration shown in *Figure 1*.

Active Grazing Pastures

The following pastures are actively grazed: Lower Chiquita, Vineyard, Bull Pasture, Lower Gobernadora, River Pasture (south of the Cow Camp crossing), South 40, Sierra, Rinconada, Cristianitos, Gabino and Talega.

Proposed Grazing Pastures

Resumption of grazing is proposed for Nicks Pasture, Upper Chiquita, Horseshoe Pasture and River Pasture north of the Cow Camp crossing.

2. Existing Residue

Residue or dry residual matter is the dry organic matter remaining at the end of grazing. Residue, acting as mulch, influences germinating plants and soil organic matter. Residue is therefore is major manageable factor governing productivity and composition (UC Extension, Leaflet 21378). Amounts of residue dry matter per acre vary according to geography, soil conditions and livestock use. Areas with heavy rainfall, erosive soils or steep hills need more residual dry matter than do flat, stable soils in drier climates. To maintain desired forage production, therefore, it is useful to set *minimum* residue standards. Rancho Mission Viejo has historically used an average RDM of 25% (for example, 25% of produced forage. If produced forage was 1000 lbs per acre for a pasture, the RDM would be 250 lbs per acre) as the minimum standard for pastures with natural forage, i.e., annual/native grassland. RMV also plants forage (barley) in the alluvial valleys of Lower Chiquita, Vineyard, Bull Pasture, Lower Gobernadora and South 40. RDM standards are not established for planted forage areas because these areas are replanted annually. This GMP will review the 25% RDM standard for natural forage and make recommendations for revisions as necessary.

As an example of a post peak productivity assessment of the RDM conditions on the property, existing RDM was estimated in July 2003 using the visual determination method described in UC Extension Leaflet 21327. RMV staff estimated existing residue using the following levels:

- *Light* grazing leaves little or no patchy appearance. Unused plant matter averages 3 or more inches in height and small objects are masked. The residual dry matter is more than an average of 800 pounds per acre.

- *Moderate* grazing leaves an average of 2 inches of unused plant matter, a patchy appearance and little bare soil. Small objects will not show at a distance of 20 feet or more. The residual dry matter ranges from 400 to 700 pounds per acre.

TABLE 3
VEGETATION COMMUNITIES WITHIN RANCHO MISSION VIEJO PASTURES[1]

Pasture	Agriculture	Chaparral	Developed	Disturbed	Grassland	Open Water	Marsh	Riparian	Cliff & Rock	Coastal Sage Scrub	Stream-courses	Vernal Pools	Woodlands & Forest	TOTAL
Bull	126.7	103.2	0.0	0.2	5.6	0.0	0.0	6.5	0.0	235.9	0.0	0.0	57.6	535.6
Cristianitos	0.3	551.3	42.6	112.8	1,173.1	3.1	0.0	319.4	0.2	11306	6.5	0.0	118.7	3458.6
Gabino	0.9	2096.2	0.4	0.0	853.6	0.0	0.6	553.1	1.8	2841.7	0.0	0.0	70.8	6,419.0
Horseshoe	0.0	13.3	0.0	0.0	0.1	0.0	0.0	1.0	0.0	26.9	0.0	0.0	1.9	43.2
Lower Chiquita	1,363.9	129.9	78.4	13.2	274.7	0.9	2.4	117.7	0.0	1,063.1	0.0	0.0	53.7	3,098.2
Lower Gobernadora	87.5	103.1	1.5	74.5	18.1	0.0	0.0	26.7	0.0	214.0	0.0	<0.01	20.7	546.2
Nick's	13.3	206.9	16.3	0.0	75.9	0.0	0.0	88.7	0.0	246.1	0.0	0.0	5.1	652.5
Rinconada	0.0	146.6	22.8	160.7	370.1	59.3	0.0	136.9	4.1	333.9	0.0	0.0	160.4	1,394.8
River	147.8	16.8	189.6	24.7	172.2	68.8	10.8	219.3	0.0	199.5	6.6	0.0	35.6	1,091.8
Sierra	0.3	0.0	0.9	0.0	582.3	0.0	0.0	42.2	0.0	250.6	0.0	0.0	1.6	877.9
South 40	23.8	2.7	0.1	0.0	8.6	0.0	0.0	1.4	0.0	5.4	0.0	0.0	3.1	44.9
Talega		358.4	10.0	0.0	467.1	0.0	0.0	150.5	0.0	575.3	0.0	0.0	32.4	1,593.8
Upper Chiquita	445.9	67.2	33.7	2.6	6.6	0.0	0.0	21.9	0.0	458.8	0.0	0.0	12.4	1,049.3
Vineyard	90.1	0.1	0.0	48.0	2.9	0.0	0.0	7.4	0.0	4.9	0.0	0.0	0.0	153.5
TOTAL	**2,300.6**	**3,795.9**	**399.2**	**436.7**	**4,028.1**	**132.1**	**13.9**	**1,693.7**	**6.2**	**7,603.6**	**13.2**	**<0.01**	**274.3**	**20,998.5**

[1] Source: Southern NCCP/HCP Vegetation Database (1993), as revised by Dudek in 2004.

6/1/2004

- *Heavy* grazing leaves less than 2 inches of unused plant matter. Small objects and areas of bare soil are visible at 20 feet or more. Residual dry matter is less than 400 pounds per acre.

TABLE 4
ESTIMATED DRY RESIDUAL MATTER FOR RANCHO MISSION VIEJO PASTURES IN JULY 2003

Pasture	Grazing Level	Estimated Dry Residue
Chiquita Pastures[1]	None	>800+ lbs/ac
Nick's Pasture	None	>800+ lbs/ac
River Pasture	Light – Moderate	>650-750 lbs/ac
Sierra	Light	>750 lbs/ac
Rinconada	Light	>750 lbs/ac
Cristianitos Pasture	Light	>700-800 lbs/ac
Gabino	Light - Moderate	>600 lbs/ac
Talega	Light	>800 lbs/ac

[1] Residues were estimated for Upper Chiquita. Lower Chiquita is planted with barley therefore residues are not applicable.

To verify the visual assessment, residual dry matter weights were taken in three pastures in accordance with the method described in Leaflet 21327. Results of this verification were as follows:

- Rinconada: 1,890 lbs per acre
- Sierra: 1,038 lbs per acre
- Gabino: 1,946 lbs per acre

The assessment results (*Table 4*) and the subsequent dry weight verification show that RDM on RMV typically reflects light to moderate grazing.

3. Existing Grazing Patterns

Generally cattle are grazed in the natural southern pastures (South 40, Sierra, Rinconada, Cristianitos, Gabino and Talega) from October to May to take advantage of the break of season through peak production of annual grasses. In late May or early June cattle are moved from the southern pastures to the northern pastures in the Chiquita and Gobernadora sub-basins (i.e., Lower Chiquita, Lower Gobernadora, Vineyard and Bull Pasture) and remain there until late September to take advantage of the barley stubble. From May through most of September, the southern pastures "rest". From October through most of May the natural areas of the northern pastures rest , while the alluvial valleys of Lower Chiquita, Bull Pasture, Lower Gobernadora and the Vineyard are re-planted with barley. Allowing a rest or fallow period is a well know agricultural concept, the benefits of which are documented in the literature. On Rancho Mission Viejo, these periods of rest are essential for the production of the next grazing seasons forage particularly in the natural southern pastures. During the transition from the southern pastures to the northern pastures in May or June, cattle are held temporarily in River Pasture, while adjustments to the herd size are made. On average the herd size is reduced by 20% during this transition time. In late September, cattle are returned to the southern pastures.

4. Existing Stocking Rates

Stocking rates on RMV vary according to the availability of water, the productivity of forage and the RMV 25% RDM standard. Generally speaking, in an average rainfall year, the Rancho Mission Viejo cattle herd averages approximately 500 head during the southern pasture grazing season (October – May), distributed as follows: Talega 50 head, Gabino 125 head, Cristianitos 125 head, Rinconada 60 head and Sierra 100 head. As discussed above this is reduced by 20% during the transition from the southern pastures to the northern pastures, resulting in approximately 400 head being distributed in the northern pastures between June and September as follows: Chiquita Pastures 300 head and Vineyard, Bull Pasture, Lower Gobernadora 100 head (combined).

a) Future Grazing Practices

The Draft NCCP/HCP Planning Guidelines and SAMP principles call for the GMP to address four fundamentals contained within the GMP policy statement, namely:

- address the needs of species and habitat identified for protection
- promote perennial grasses including native grasses
- allow for continued cattle grazing sufficient to support cattle operations
- where appropriate, reduce fuel loads for fire

This GMP will therefore describe adjustments to the current grazing practices necessary to implement these fundamentals and contribute to the AMP goals regarding natural habitat restoration/enhancement and comply with the Draft NCCP/HCP Planning Guidelines and the SAMP principles.

This section focuses on those portions of the policies dealing with native grasses and sufficiency of forage. Species needs are discussed in Section 3.3 of this Chapter and fire management is discussed in Section 3.4.

b) Recommended Residual Dry Matter

As noted above, recommended RDM for RMV pastures should account for rainfall, slope and soil type. Rainfall averages 12 to 16 inches per year, generally falling between the months of November and March. Sixteen (16) inches is considered "normal" for RMV. Wet and dry cycles, typically lasting 15 to 20 years, are characteristic of southern California. The region presently appears to be emerging from a wetter-than-normal cycle of years beginning in 1993. Previously, five consecutive years of sub-normal rainfall and runoff occurred in 1987 though 1991 (PCR, 2002). 2001 and 2002 were both below normal rainfall years (averaging 4 inches), while 2003 was above normal at 18 inches. Years with less than average rainfall result in lower productivity and can affect species composition. Slope and soil type are described in the Existing Setting section for each pasture and summarized below in *Table 5*.

Table 5 sets forth the recommended RDM levels for RMV pastures.

TABLE 5
RECOMMENDED RESIDUAL DRY MATTER
FOR RANCHO MISSION VIEJO PASTURES

Pasture	Slope	Soil Type	Recommended Dry Residue
Chiquita Pastures	Low – Moderate	Mixed sands/silts and hardpan	750 lbs/ac
Nick's Pasture	Low – Moderate	Clays & silts	750 lbs/ac
River Pasture	Low	Mixed silts/ clay and alluvium	725 lbs/ac
South 40	Low-Moderate	Clays	750 lbs/ac
Sierra	Moderate	Clays	750 lbs/ac
Rinconada	Low – Moderate	Silts	750 lbs/ac
Cristianitos Pasture	Low- Moderate	Clays	750 lbs/ac
Gabino	Moderate	Mixed silts/ clay and sands/silts	750 lbs/ac
Talega	Moderate	Sands	750 lbs/ac

2. Recommended Stocking Rate

To determine stocking rates for RMV pastures, two factors must be known, a) the total monthly forage requirement and b) the total annual forage per pasture. The following methodologies are taken from UC Extension Leaflet 21456. The Animal Unit (AU) is the standard measurement of livestock forage requirements. One Animal Unit Month (AUM) is the amount of feed required to support one AU for one month. This value depends on the type of feed used (i.e.,1 AUM = 1,000 lb of air dry forage (e.g., stand of annual grasses) or 800 lb of hay or 533 lb of concentrate, etc.). *Table 6* shows representative AU values for cattle at different production stages using a mature cow with calf as the Standard Unit of 1.0.

a) Total Forage Requirement

TABLE 6
ANIMAL UNIT VALUES FOR AIR DRY FORAGE

Animal Type	AU	Monthly Forage requirement/head (lb air dry forage)[1]
Mature cow with calf	1.00	1,000
Mature bull	1.25	1,250
Weaned calf	0.6	600
Yearling 12-17 mos	0.7	700
Yearling 17-22 mos	0.75	750

[1] Monthly forage = AU x 1,000 air dry forage

To determine the total monthly forage requirement, multiply the monthly forage requirement per head by the number of animals to be grazed:

Monthly Forage Requirement/ Head	x	Number of Animals	=	Total Forage Required/ Month

Using the average RMV herd of 500 head, divided as follows, 300 mature cows with calf, 20 mature bulls, 75 yearlings 12-17 mo and 75 yearlings 17-22 months, and 30 weaned calves the total forage required per month is as follows:

TABLE 7
TOTAL FORAGE REQUIRED PER MONTH

Animal Type	Number of Animals	Monthly Forage requirement/head (lb air dry forage)	Total Forage Required/Month (lbs/month)
Mature cow with calf	300	1,000	300,000
Mature bull	20	1,250	25,000
Weaned calf	30	600	18,000
Yearling 12-17 mos	75	700	52,500
Yearling 17-22 mos	75	750	56,250
		Total	**451,750**

To calculate the total forage required, multiply the total forage required per month by the grazing season:

Total Forage Required/ Month	x	Grazing Season	=	Total Forage Required

For the 500 head of cattle RMV grazes for 8 months in the southern pastures, 3,614,000 lbs of forage would be required. For the 379 head that grazes in the northern pastures for 4 months, assuming a 25% reduction in cows, yearling and weaned calves, total forage required would be 1,377,600 lbs.

b) Total Available Forage

Total available forage is calculated by subtracting the desired residue level from the estimated production value and multiplying the difference by the number of grazable acres, as follows:

(Production per Acre – Residue per Acre) Acres = Available Forage

For example, available forage on a 10 acre pasture with a recommended RDM of 750 lbs per acre with a production value of 850 lbs per acre would be (850-750) x 10 = 1,000 lbs available forage. In this example the 10 acre pasture would be capable of supporting one mature cow with calf for one month.

Because quantity and quality of available forage changes throughout the year, it is necessary to make seasonal adjustments. For example, late season or summer natural forage has limited nutrient value (a more common sense way to think of this is "green grass is better than brown grass). *Table 8* sets forth adjustment factors.

TABLE 8
SEASONAL FORAGE AVAILABILITY ADJUSTMENT

Season of Use	Seasonal Availability Adjustment
Year long	1.0
Winter	0.7
Spring	1.3
Summer	0.8
Fall	0.6

Total available forage is calculated by multiplying the available forage by the seasonal adjustment factor, as follows:

Available Forage x Seasonal Adjustment = Total Available Forage

For example, using the available forage of 1,000 lbs from the previous example and adjusting for the highest production value, i.e., Spring, the total available forage would be 1,000 lbs x 1.3 = 1,300 lbs for the ten acre pasture.

Tables 9 and 10 estimate the total available forage for each of the RMV pastures subject to this GMP. As noted above precipitation, temperature, soil characteristics and residue influence production and as such total available forage varies for year to year. For this GMP, an average production value of 1,500 lbs was used (Leaflet 21456). Recall that several pastures reviewed in Section 2 will not be grazed in the future as a result of either development or conservation of the pasture for habitat purposes (e.g., Ladera Land Conservancy). Also recall that available forage is only calculated for those pastures with RDM goals i.e.,natural or unimproved pastures. As noted above, southern pastures are grazed in the winter and spring, while northern pastures are grazed in the summer and fall. *Tables 9 and 10* reflect this rotational grazing pattern.

TABLE 9
TOTAL AVAILABLE FORAGE FOR NORTHERN PASTURES

Pasture	Summer	Fall
Chiquita Pastures	586,800	440,100
Nick's Pasture	259,200	194,400
River Pasture	397,200	297,900
Total	**1,243,200**	**932,400**

TABLE 10
TOTAL AVAILABLE FORAGE FOR SOUTHERN PASTURES

Pasture	Winter	Spring
Sierra	460,425	858,075
Rinconada	610,050	1,132,950
Cristianitos	1,498,875	2,783,625
Gabino	2,268,000	4,212,000
Talega	643,125	1,194,375
Total	**5,480,475**	**10,181,025**

Based on the Total Available Forage set forth in *Tables 9 and 10*, and the required forage discussed above (3,614,000 lbs of forage in southern pastures for 500 head and 1,377,600 lbs of forage for northern pastures for 379 head) natural or unimproved RMV pastures produce more than sufficient forage to support the average RMV herd. It should be noted that in addition to the natural northern pastures, Vineyard, Bull, and the alluvial valleys of Lower Gobernadora and Lower Chiquita are improved via barley plantings which contribute significant additional forage value.

Based on the Total Available Forage set forth in *Tables 9 and 10* recommended maximum stocking rates, based on a mature cow (1,000 lbs AUM) for all natural northern and southern pastures are set in *Tables 11 and 12*. These stocking rates for northern pastures do not include cattle grazed on barley, therefore overall herd size in summer and fall will be higher than noted here due to the availability of barley forage. It should be noted that these stocking rates are designed to be adapted to the conditions in any given year such that the recommended residue is maintained. Changes to the stocking rates should be made according to the methods reviewed above. Other factors which influence the decision of how many cattle to stock in general (i.e., what size cattle herd to maintain) are those related to expenses. Expenses include insurance, interest, utilities (e.g., cost of water), health costs (innoculations etc), transportation, materials (e.g., fencing costs) and labor. It is the combination of forage availability, expenses and market demand for beef that ultimately determine the herd size on RMV.

TABLE 11
RECOMMENDED MAXIMUM STOCKING RATES FOR NORTHERN PASTURES

Pasture	Summer	Fall
Chiquita Pastures	146	110
Nick's Pasture	65	49
River Pasture	99	74
Total	**310**	**233**

TABLE 12
RECOMMENDED MAXIMUM STOCKING RATES FOR SOUTHERN PASTURES

Pasture	Winter	Spring
Sierra	56	107
Rinconada	76	142
Cristianitos	187	348
Gabino	283	526
Talega	80	149
Total	**682**	**1,272**

3. Recommended Grazing Patterns in Relation to Adaptive Management Program Enhancement/ Restoration and Management Goals Following Transfer of Lands to RMV Open Space

a) Role of Grazing in Restoration of Native Grasses

Prior to discussing recommended grazing practices, it is useful to review the literature on grazing, particularly as it relates to native (valley and foothill) grasslands. The effects of grazing on valley and foothill grasslands however remain unclear. In spite of the fact that a long history of intensive grazing in California following European settlement has been cited as one of the primary reasons for the demise of native grasslands (Burcham 1957; Dasmann 1966 as cited; Keeley 1990; Bartolome and Gemmill 1981), most research has found that some intensity of grazing is beneficial to, or at least does not negatively affect, native grasses (Huntsinger *et al.* 1996). Several researchers have documented cases where native grasses have not increased in abundance on sites that have been excluded from grazing over 20 to 40-year periods (White

1967; Bartolome and Gemmill 1981; Goode 1981). Heady (1968, 1977) suggested that large native herbivores present prior to European colonization may have been an important factor in grassland formation and ecology. This assertion supports findings that some form of managed grazing may be useful as part of efforts to maintain or restore native grasses. Menke (*1996*) considers "Prescribed grazing to constitute the primary component of the first phase of a perennial grass restoration program." (pg. 23). Edwards (cite) notes that "bunchgrasses can benefit from grazing in a number of ways." (p.7) Grazing prevents the accumulation of dead residue within the grass bunch, increasing vigor and greater culm and seed production. Thatch reduction between bunches allows light and space for seedling recruitment. Edwards goes on to state "with proper levels of grazing at proper times, grazing can selectively reduce competition from plants lacking comparable recovery reserves such as annual grasses." The concept of timed grazing (i.e.,proper levels of grazing at proper times) is central to the grazing systems described by Allan Savory in his Holistic Resource Management (HRM).

b) Role of Grazing in Long-term Management of Coastal Sage Scrub

As described above, the RMV practices of a north-south rotational grazing pattern can be postulated is the "proper level of grazing at the proper time" for RMV pastures. The current diversity and quality of habitat types and species on RMV would appear to support this statement. As a whole, RMV lands can be characterized as high quality upland and riparian vegetation communities that support a variety of listed and unlisted species (for a detailed description of the resources present on RMV the reader is referred to the Biological Resources Section of the GPA/ZC EIR. A specific example of this occurs in the Chiquita Pastures. The highest densities of California gnatcatchers occur in the Chiquita Pastures (particularly between Oso Parkway and San Juan Creek) which have not burned since the 1950's but are actively grazed. Based on this set of factors, one could postulate that the timed grazing used by the Ranch benefits coastal sage scrub by controlling the proliferation of annual grasses and maintaining a habitat structure suitable for the California gnatcatcher. Alternatively, one could postulate that the prevalence of gnatcatchers in the Chiquita Pastures is related to the production of barley as forage for cattle in the Chiquita Pastures - the cattle concentrate in the planted areas and do not forage extensively in the coastal sage scrub (the barley has a higher nutrient value); as a consequence the light grazing in CSS may provide a thinning function that offsets or substitutes doe the absence of a major wildfire in middle Chiquita Canyon in over 50 years. In any event, it does appear that generally speaking cattle and native species have co-existed on RMV for several decades under the current grazing pattern and the current grazing practices are compatible with species persistence on the Ranch. A substantial change to the current grazing pattern, i.e.,concentration of cattle in either northern or southern pastures, would eliminate the respective rest periods for these pastures, resulting in increased pressures on both forage and possibly non-forage habitats and associated species present in the pastures. The concentration of cattle in either the northern or southern pastures would also lower cattle productivity over time. This

GMP does not, therefore, recommend a substantial change to the overall RMV rotational grazing pattern following transfer of lands to the RMV Open Space. No change to the overall north-south grazing pattern described above is recommended following transfer of lands to the RMV Open Space. The exact configuration of the RMV Open Space will influence the number of cattle grazed in the north-south pattern, as available pasture will be reduced with future development of the Ranch Plan. The following pastures would be reduced by future development: Chiquita, Gobernadora, Bull, Nick's, Rinconada, Cristianitos, Gabino, and Talega. Reduction in available grazing acres and available forage will result in a smaller cattle herd being grazed on RMV over the long-term. Development within these pastures and the associated phased dedication of areas into RMV Open Space is anticipated to be phased over 20 to 25 years. As such, the overall adjustment to the herd size will also occur over a 20 to 25 year timeframe.

c) Timed Grazing Recommendations for Specific Sub-basins

The GMP does recommend specific changes to the manner in which cattle are grazed with a view towards increasing the productivity, health and vigor of native grasslands in specific areas. Appropriately timed grazing can have several beneficial effects on the vigor of native grasslands:

- Removal of litter and thatch
- Recycling of nutrients
- Stimulation of tillering (sprouting of new stalks)
- Removal and control of alien species
- Reduced transpiration (loss of water) by alien species making more water available for native grasses.

Consistent with the recommendations of the Draft NCCP/HCP Planning Guidelines and SAMP principles, timed grazing is one method to be used in the near-term for native grasslands enhancement in the following areas:

- Upper Gabino Canyon coastal sage scrub/valley needlegrass grassland (CSS/VGL) enhancement area
- Upper Cristianitos VGL enhancement area
- Blind Canyon VGL enhancement area

d) Upper Gabino Canyon CSS/VGL Enhancement Area

Section 6 of the Draft Southern NCCP/HCP Planning Guidelines describes the Upper Gabino Canyon CSS/VGL enhancement area as follows (see *Figure 6-1*of Guidelines):

Upper Gabino Canyon currently generates fine sediment due to extensive gully formation in the headwaters area. A combination of slope stabilization, grazing management and CSS/VGL restoration will reduce sediment generation and promote infiltration of stormwater which will reduce downstream impacts. This area has been identified for CSS/VGL restoration because some areas mapped as grassland in 1990 have since naturally revegetated with sparse CSS. Allowing a mixed community to regenerate may thus represent a more natural climax situation. This area has at least one area of annual grassland adjacent to the creek suitable for revegetation and several patches of low quality VGL suitable for enhancement.

The Restoration Plan prepared to support the RMV Open Space Adaptive Management Program describes the approach to slope stabilization (i.e., repair of the gullies) in Upper Gabino. In summary, repair of the gullies to stabilize the slopes involves three steps: **(1)** re-grading of the existing ranch road to drain in the opposite direction to the prevalent slope in the canyon, **(2)** re-contouring and filling in of the existing gullies and **(3)** stabilization of the repaired areas with straw wattles and VGL seed and plugs. For further details on this effort, the reader is referred to the Restoration Plan.

Grazing patterns in the Gabino pastures, specifically Upper Gabino, need to be managed to address two goals: **(1)** facilitate recovery of the repaired areas; and **(2)** encourage proliferation of existing VGL. Two specific adjustments are proposed to accomplish these goals. To facilitate the recovery of the repaired areas, stocking rates will be temporarily decreased to a maximum of 50 head for one to three VGL growing seasons i.e., November through April which is anticipated to provide sufficient time for establishment of VGL species in the repair areas.

In order to encourage the proliferation of existing VGL, cattle will be grazed in the upper portion of Gabino pasture identified for VGL enhancement during rapid spring growth and the peak production of annual grasses i.e., early February to late March. Grazing cattle during the rapid growth period and peak production of annual grasses will reduce annual grass seed production, reduce transpiration by the annual species, remove litter and thatch and promote the recycling of nutrients. By grazing cattle during the rapid spring growth and peak production of annual grassland species and then moving the cattle off the VGL enhancement area, native species will start their rapid spring growth and peak production after the cattle have reduced the competition from annual species.

e) Upper Cristianito VGL Enhancement Area

Section 6 of the Draft Southern NCCP/HCP Planning Guidelines describes the Upper Cristianitos VGL enhancement area as follows:

Upper Cristianitos is recommended for VGL revegetation and enhancement to reduce the generation of fine sediments from clayey terrains, promote stormwater infiltration and to enhance the value of upland habitats adjacent to Cristianitos Creek. This area includes patches of annual grassland underlain by clay soils suitable for revegetation and low quality VGL suitable for enhancement. These recommended revegetation and enhancement areas also are contiguous with existing medium quality grassland, suggesting a high likelihood of successful restoration.

Similar to the grazing pattern proposed for the portion of Upper Gabino pasture identified for CSS/VGL restoration, a small adjustment to current grazing practices is recommended for the Upper Cristianitos VGL enhancement area. As noted in the description of the existing RMV grazing patterns, the southern pastures, including Cristianitos, are grazed between October and May. In order to reduce competition from annual grasses in the VGL enhancement area, the GMP recommends that grazing in the VGL enhancement area be concentrated in early February to late March during the rapid spring growth and peak production periods for annual species and ahead of the same periods for native species beginning by late March early April.

f) Blind Canyon VGL Enhancement Area

Section 6 of the Draft Southern NCCP/HCP PlanningGuidelines describes the Blind Canyon VGL enhancement area as follows:

Portions of Blind Canyon mesa are recommended for grassland revegetation and enhancement. This area has at least one patch of annual grassland suitable for revegetation and possibly two patches of low quality VGL suitable for enhancement. These areas are adjacent to existing medium quality VGL, suggesting a high likelihood of successful restoration. Additional fieldwork in the area may reveal additional restoration opportunities.

To promote native grasses in Blind Canyon which lay within the TRW pasture, the GMP recommends that grazing in the VGL enhancement area be concentrated in early February to late March during the rapid spring growth and peak production periods for annual species and ahead of the same periods for native species.

g) Upper Chiquita Canyon Conservation Easement Area

As discussed in Section 2, cattle have not been grazed in the Chiquita Pastures north of Oso Parkway since 1996. Consistent the requirements of the FTCN – Oso Section Biological Opinion and TCA's management plan for this area, the following grazing practices are recommended for Chiquita Pastures north of Oso Parkway: RDM is set at 750 lbs per acre. Based on the productivity of the Chiquita grasslands, the recommended maximum stocking rate will be 146 head in a normal rainfall year. As noted previously stocking rates are subject to change (either up or down) to maintain the recommended RDM. Chiquita is a northern pasture and as such is recommended for grazing in the summer and fall, specifically in the months of September through May.

4. Recommended Configurations & Resources

In order to implement the recommended grazing patterns described above, minimal changes to existing pasture configurations and resources are necessary. Existing fencing within the Gabino, Cristianitos & Blind pastures will allow for the movement of cattle in and out of the VGL enhancement areas.

In order to graze cattle within the Chiquita pastures north of Oso Parkway, improvement to the fencing adjacent to Oso Parkway and SR-241 will be necessary. A thorough evaluation, and improvements as necessary of all fencing in the Chiquita pastures shall conducted prior to the re-introduction of cattle into this area.

3.3 Sensitive Habitat Exclusions

Sensitive habitat exclusions (i.e., those areas where cattle should be excluded) can be broken into two categories: a) those areas from which cattle should be removed on a temporary basis (e.g., seasonally); and b) those areas where cattle should be removed permanently.

a. Seasonal Exclusions

The purpose of seasonal exclusions is to remove cattle from a specific area for a specific time period for the benefit of a specific resource or species. This GMP recommends seasonal exclusions during the breeding season of the arroyo toad that runs approximately from March to mid-June. As noted above, the current RMV grazing practice is to graze cattle in the southern pastures (Sierra, Rinconada, Cristianitos, Gabino and Talega) from October to May. In late May or early June cattle are moved from the southern pastures to the northern pastures in the Chiquita and Gobernadora sub-basins (i.e., Lower Chiquita, Lower Gobernadora, Vineyard and Bull Pasture) and remain there until late September. During the transition from the southern pastures to the northern pastures, cattle are held temporarily in River Pasture, while adjustments to the herd size are made. As noted in the description for the arroyo toad, toads occur in discrete reaches of San Juan Creek, lower Gabino Creek, lower Cristianitos Creek and Talega Creek. The potential for cattle grazing and toad breeding to overlap therefore occurs in the following pastures: Cristianitos (Gabino Creek), Talega (Talega Creek) and River (San Juan Creek) pastures (*Figure 4*). Arroyo toads do not occur in upper Gabino Creek within Gabino pasture, and Cristianitos Creek lies within the Donna O'Neill Conservancy or TRW lease area where cattle are permanently excluded. To reduce potential toad mortality resulting from trampling of either egg masses or metamorphs by cattle, the following seasonal exclusions are recommended:

1. Cattle should be seasonally excluded from active breeding pools and adjacent sand bars and benches to the extent practical within lower Gabino Creek during arroyo toad breeding season. Temporary fencing around active breeding pools and adjacent sand bars and benches should be erected to discourage cattle from entering these areas.

2. Cattle should be seasonally excluded from active breeding pools and adjacent sand bars and benches to the extent practical within San Juan Creek during arroyo toad breeding season. Temporary fencing around active breeding pools and adjacent sand bars and benches should be erected to discourage cattle from entering these areas.

No recommendations are made for Talega pasture because Talega Creek is largely located on MCB Camp Pendleton property, outside the RMV perimeter fence.

b. Permanent Exclusions

The purpose of permanent exclusions is to remove cattle from a specific area for the benefit of a specific resource or species. Cattle are currently excluded from the Gobernadora Ecological Restoration Area and the Donna O'Neill Conservancy. The GMP recommends continued exclusion of cattle from these areas, with the except for fuel modification treatment as discussed in the next section In addition to these permanent exclusions, the GMP also recommends exclusion of cattle from the slope wetlands located in the Chiquita, Rinconada and Sierra Pastures.

3.4 Fire Management

As discussed in Section 3.1, one of the objectives of this GMP is to identify pastures that may be subject to prescribed fire, and identify appropriate pasture rest periods following burns to promote habitat recovery.

An integral part of the Adaptive Management Program is the Wildland Fire Management Plan (WFMP). The WFMP is composed of five parts, **(1)** Fire Management Program, **(2)** Prescribed Fire Program, **(3)** Long-Term Strategic Fire Protection Plan, **(4)** Short-Term Tactical Fire Suppression Plan and **(5)** Research and Monitoring Criteria. Pertinent to this GMP is the relationship between grazing and fire. According to the WFMP, "because of the high numbers of wildfires that have burned through Rancho Mission Viejo since the late 1900's plus an active cattle grazing program, and the late 1980's and early 1990's Vegetative Management Program (prescribed burns) the wildland vegetation is fairly uniform thoughout RMV" (page 3-9). The predominate vegetation over most of the Ranch is scattered coastal sage scrub over cured grass (Fuel Model 2). Should the fire frequency be disrupted (ie. longer intervals between fires occurs) or cattle grazing be eliminated from RMV, the result would be an evolution of the vegetation into fuel models that have the potential for catastrophic fires i.e., FM 6 (chaparral fuels 6ft in height or less) and eventually FM 4 (chaparral fuels greater than 6ft). Grazing management therefore plays a positive role in the management of fire on RMV.

The WFMP identifies prescribed burns as a management tool in the following areas:

- Sulphur Canyon (CSS restoration site)
- Talega/La Paz Canyon (Oak woodland site)
- Cristianitos/Gabino (Oak woodland site)
- Chiquita/Narrow Canyon (Native grassland site)
- Canada Gobernadora (Native grassland site)

Grazing can also play a negative role in the recovery of burned areas. Burned areas, whether as a result of a prescribed burn or a "natural" wildfire, need time to recover. The re-introduction of cattle into a burned area too early can negatively affect the natural recovery process and may result in state-transition from one vegetation type to another (e.g., coastal sage scrub to grassland). The WFMP contains management hypotheses to be tested for three of the major habitat types on RMV (CSS, grassland and oak woodland). Results of the testing of these hypotheses will identify the optimal time that grazed can be re-introduced into a burned area.

The WFMP contains no management hypothesis for riparian systems as according to the WFMP "fire has no place in riparian area management". According to the WFMP most fires in riparian zones are accidental and of high severity, causing relatively high rates of top kill. Riparian areas should be kept fire free if all possible. According to the WFMP the fuel load in GERA is increasing and there is an abundance of ladder fuels that will carry wildfire into the crowns of the planted oaks, willows and sycamores. The WFMP recommends maintenance of a fire break between GERA and the surrounding native or non-native fuels. Plus the pruning of low hanging branches on the oaks and sycamore to reduce ground fire laddering. To facilitate reduction of fuel loads within GERA, this GMP propose the use of timed grazing within GERA. Once every three years, up to 30 head of bulls will be grazed in GERA between the months of June to October. Timed grazing within GERA will reduce the risk of a severe wildfire in GERA by reducing the both the grass fuel load and the ladder fuel load.

Similar to GERA, the Donna O'Neill Land Conservancy may require periodic fuel load reduction, up to 20 head of cattle for a period of 60-90 days in late summer/early fall (August-October) is recommended.

CHAPTER 4: MONITORING

4.1 Relationship of Grazing Management Plan to Stressor Based Adaptive Management Program

Appendix J is the proposed Adaptive Management Program for the RMV Open Space. The proposed Adaptive Management Program is stressor based. The underlying principle of this approach is that management and monitoring should be directed primarily towards environmental factors known or thought to be directly or indirectly responsible for ecosystem change. Over-grazing is identified as one of six general environmental stressors known or likely to be relevant to the habitat reserve. The Adaptive Management Program presents conceptual models that depict known and potential relationships between over-grazing and the vegetation community and individual species responses. Further, the Adaptive Management Program presents adaptive management issues, goals and objectives and monitoring in relation to these conceptual models. Hypotheses between the role of grazing and vegetation communities and individual species responses are set forth, and monitoring is proposed to response to these hypotheses.

It is not the function of this GMP to set forth and respond to adaptive management hypotheses. These need to be viewed from the vegetation community and individual species perspective as described in Adaptive Management Program. Rather, as described in Section 1, the purposes of the GMP are to: 1) contribute an important element of the long term Adaptive Management Program goals of enhancement/restoration of native habitats; and 2) demonstrate consistency with Draft NCCP/HCP Planning Guidelines and SAMP principles regarding grazing management. To achieve these purposes the GMP has identified grazing practices which seek to maintain and, where feasible, enhance long-term net habitat value within the subregion, promote perennial grasses, including native grasses, provide sufficient forage to support a cattle operation and where appropriate reduce fuel loads for fire. The monitoring portion of the GMP should therefore seek to answer whether these purposes are being achieved. In answering whether these objectives are being achieved, monitoring for the GMP will provide valuable input into the iterative feedback loop of the Adaptive Management Program.

4.2 Monitoring Objectives

To answer the question of whether the GMP is achieving its purposes the monitoring objectives are established for each of the elements addressed by the GMP, namely, forage production, restoration of native habitats and sensitive habitat exclusions:

4.3 Forage Production and Residue

Objectives

The following objectives are established for forage production and residue:

- Conduct monitoring of RDM levels to ensure consistency with recommended levels
- Conduct monitoring for sufficiency of forage production to support a cattle operation.

Monitoring

Accurate inventory and monitoring is essential to effective management of the grazed pastures. This information together with the existing conditions data described above will provide RMV managers with the data set necessary to set and adjust AUM's, determine current pasture conditions, predict future pasture conditions, and evaluate management practices.

a. Plot Location and Design

Forage production and RDM measurements should be taken in all natural or unimproved pastures. A minimum of ten permanent sample plots should be established on a stratified basis throughout the pasture in locations indicative of representative or typical conditions. All plot locations should be located using GPS and a permanent marker to provide a continuous record. Forage production measurements should be taken at peak forage production time to record the maximum available forage. RDM should be measured before the break of season.

b. Technique

According to Leaflet 21327, RDM weights can be estimated by direct clipping and weighing, double sampling (visual estimates with clipped herbage reference points) and with experience, visual estimates. The current RMV managers have over 40 years experience in running cattle on RMV lands and have traditionally used the visual estimate method. RMV managers intend to continue using this method. To provide a verification of the visual estimate, direct clipping and weighing will also be used. The normal procedure for determining the weight of residual dry matter is to use either a square foot or 1/10 square meter frame and clip the herbage as close to the ground as possible (approximately ½-inch high). All litter or shattered plant material at the ground surface which can easily be picked up should be included in the sample. Grams scales are recommended for weighing samples in the field, and air-dry weights are satisfactory under most summer and early fall conditions. Wet or green forage samples should be oven dried for dry matter determination. Grams per square foot multiplied by 96 gives the pounds per acre. Example: 12 grams per square foot x 96 = 1150 pounds per acre. All species within the square foot will be recorded, as will physical information including soils, soil moisture, slope and aspect. Weather conditions at the time of sampling will also be recorded.

c. Permanent Photo Points

In conjunction with the selection of plot locations and the location of same with GPS and permanent marker, a photo point will be established. Photos should be taken at the time of sampling using the same ASA film and approximately the same time of day. The photo point will provide a visual reference of the plot location, and further verify the visual estimate of the RMV managers.

d. Reporting

All forage production and RDM measurements will be recorded on data sheets (Exhibit A) and complied for use in the annual report discussed in Section 4.6.

4.4 Restoration of Native Habitats

Monitoring for the restoration of native habitats and their response to the application of timed grazing as a restoration technique will be accomplished as part of the Adaptive Management Program, and not as part of this GMP. The monitoring obligation of the GMP relative to restoration of native habitats is to ensure that the recommended grazing patterns are followed. In this regard monthly reports will be prepared by RMV managers documenting the location and number by pasture of cattle on the ranch. Exhibit B is a sample form that RMV managers will use to prepare the reports.

A brief summary of the Adaptive Management Program monitoring proposed for native grasslands and coastal sage scrub is provided below. The reader is referred to Adaptive Management Program (*Appendix J*) for further details.

a. Coastal Sage Scrub

Coastal sage scrub will be monitored at the landscape, habitat and species levels. The routine passive, long-term monitoring of coastal sage scrub and focal species will include two main tasks:

- Evaluation and update of the entire coastal sage scrub vegetation datebase at 5-year intervals.
- Annual on-the-ground monitoring of selected sample plots distributed across the RMV Open Space in a spatial distribution that represents the heterogeneity of the

Reserve and in keys areas where environmental stressors are most likely to operate (e.g., along the Open Space-development edge).

b. Native Grasslands

The monitoring program for grasslands will use the same general methods described above for coastal sage scrub and the reader is directed to that section for more detail. The key points for the monitoring program are summarized here:

- Monitoring at landscape, habitat, species, and species assemblage levels.
- 5-year mapping of grassland system.
- Annual on-the-ground monitoring of selected sample plots across the physiographic gradient of grasslands in the RMV Open Space.
- Collection of regional climate, weather and air quality information

4.5 Sensitive Habitat Exclusions

Similar to Restoration of Native Habitats, the monitoring of specific habitat or species responses to cattle exclusions is a function of the Adaptive Management Program. Monitoring through the Adaptive Management Program will determine whether exclusions are a positive or negative influence through the iterative testing of hypothesis related to the conceptual models prepared for both habitat types and specific species.

The obligation of the GMP is to monitor and report on implementation of the recommended exclusions. For permanent exclusions, e.g., vernal pools, RMV managers will report quarterly on the status of the exclusion. Questions such as is the exclusionary mechanism (e.g.,fencing) in place and is the mechanism effective (e.g., is it keeping cattle out) will be asked. If the mechanism is not effective, alternatives will be proposed and reviewed with the Habitat Reserve Manager.

For seasonal exclusions, e.g., arroyo toad breeding season, reporting will occur on a weekly basis for the duration of the exclusion. Similar questions will be asked for seasonal exclusions, such as whether the exclusionary mechanism (e.g., fencing) in place and whether the mechanism is effective (i.e., is it keeping cattle out). If the mechanism is not effective, alternatives will be proposed and implemented as appropriate.

4.6 Annual Reporting

RMV managers will prepare an annual report summarizing all monitoring efforts and the results thereof, and provide same to the County of Orange.

Appendix J-5

RANCHO MISSION VIEJO
WILDLAND FIRE MANAGEMENT PLAN

INTRODUCTION

APPENDIX J-5
WILDLAND FIRE MANAGEMENT PLAN

0.0 INTRODUCTION

This Wildland Fire Management Plan (WFMP) has been prepared to guide the management of fire on lands belonging to Rancho Mission Viejo (RMV), located in Southern Orange County, California. Portions of these RMV lands may be dedicated as open space (RMV Open Space) as part of the approval of the RMV GPA/ZC application by the Orange County Board of Supervisors. As discussed later, this WFMP is an integral part of the Adaptive Management Program for the proposed RMV Open Space and further implements certain key NCCP/HCP and SAMP/MSAA policies.

As noted above, the WFMP is a key component of the Adaptive Management Program (see *Appendix J*) for the RMV Open Space and is intended to be complementary to any NCCP/HCP program completed in the future for the Southern Subregion. Because of this desire for future coordination, and the fact that fire is a landscape process which does not recognize artificial boundaries (i.e., property boundaries), this WFMP addresses the entirety of the Southern Subregion, but places particular emphasis on RMV lands.

Implementation of an Adaptive Management Program is one of the three fundamental conservation planning principles set forth under the 1993 NCCP Conservation Guidelines. As stated in the NCCP Conservation Guidelines, "a status quo strategy of 'benign neglect' management will likely result in substantial further loss of CSS diversity..." The Guidelines concluded that habitat reserves...should be managed in ways responsive to new information as it accrues." Although the Conservation Guidelines were directed toward coastal sage scrub (CSS) in a habitat reserve context, the same adaptive management principles apply to the diversity of vegetation communities and habitat types in protected open space such as the proposed RMV Open Space.

The intent of this program and its associated management activity is to assist in accomplishing the following key goals on RMV Open Space:

- *Ensure the persistence of currently extant native-dominated vegetation communities and habitat types,*

- *Restore or enhance the quality and extent of degraded vegetation communities and other habitat types, and*

- *Maintain and restore biotic and abiotic processes.*

Draft Southern NCCP/HCP Planning Guidelines

Section 3.3 of the Draft EIR discusses the project history, including the development of Draft Southern NCCP/HCP Planning Guidelines (Draft NCCP/HCP Planning Guidelines) by the NCCP/SAMP Working Group. Using the broader NCCP Tenets as a framework and starting point, the Draft NCCP/HCP Planning Guidelines provide guidance for decision-makers that are keyed to local biologic, hydrologic and geomorphic conditions. Although considered a "work in progress" the guidelines represent the most current thinking regarding protection, restoration, and management priorities for the resources within the study area and, for this reason, are discussed here. These guidelines address resources at both the landscape level (watershed) and more detailed hydrologic/geomorphic sub-basin levels. For each sub-basin planning unit, the guidelines identify the important biological resources and key hydrologic/geomorphic processes. Protection, restoration, and management recommendations for each sub-basin also are included.

The Draft NCCP/HCP Planning Guidelines are comprised of three primary components: **(1)** NCCP Tenets outlined in the 1993 NCCP Conservation Guidelines; **(2)** Reserve Design Principles prepared by the panel of NCCP Science Advisors convened by The Nature Conservancy; and **(3)** A set of draft sub-basin specific planning recommendations prepared by the NCCP/SAMP Working Group.

In addition to these components, the Draft NCCP/HCP Planning Guidelines also set forth general policies for resource protection, management and restoration that apply at the planning (landscape) area scale. Sub-policies to General Policy 5 of the Guidelines (regarding management of indirect impacts through creation of an urban/wildlands interface zone) addresses fire management as follows:

- Create fuel management zones combining irrigated and non-irrigated native plantings separating the Habitat Reserve from adjacent urban uses.
- To the extent that fuel management zones are composed of native habitats and can support Identified Species and other species, or be enhanced or managed to support Identified Species and other species this should be encouraged.
- Fuel management zones and practices will be set forth in a fuel management plan as part of the NCCP/HCP and aquatic resources protection program.
- Prohibit plants identified by the California Exotic Pest Council as an invasive risk in Southern California from development and fuel management zones adjoining the Habitat Reserve.

Relationship to the San Juan Creek Watershed and Western San Mateo Creek Watershed SAMP/MSAA

The Adaptive Management Program and this WFMP are intended to be complementary to any SAMP/MSAA program that is completed in the future and, as such, have been structured to comply with the goals, objectives, tenets and principles of the SAMP/MSAA.

Draft Watershed and Sub-basin Planning Principles

Section 3.3 of the Draft EIR discusses the project history, including the development of Draft Watershed and Sub-basin Planning Principles (Draft Watershed Planning Principles) by the NCCP/SAMP Working Group. The Draft Watershed Planning Principles provide a link between the broader SAMP/MSAA Tenets for protecting and conserving aquatic and riparian resources and known, key physical and biological resources and processes. Although considered a "work in progress" the principles represent the most current thinking regarding protection, restoration, and management priorities for the resources within the study area and, for this reason, are discussed here. In particular the WFMP is directed towards complying with SAMP Tenet 8, which states, "Protect riparian areas and associated habitats of listed and sensitive species."

Overview and Structure of the Wildland Fire Management Plan

The Orange County Fire Authority worked with Firewise 2000, Inc. on the Short-Term Fire Management Plan, now referred to as **Part IV – Short-Term Tactical Fire Suppression Plan** of this Wildland Fire Protection Plan document. The Short-Term Tactical Fire Suppression plan focuses on minimizing the impacts of unplanned fire events and the associated suppression activities. The goals of the Short-term Tactical Fire Suppression Plan are met though detailed descriptions of the landscape and standardized fire response guidelines based on contemporary resource needs. All prescriptions provided in the tactical plan are directed at increasing fire-fighting efficiency with the protection of life and property and natural resources as its highest priorities.

Following completion of the Short-Term Tactical Fire Suppression Plan, a Long-Term Fire Management Plan was prepared. This plan, now referred to as **Part III – Long-Term Strategic Fire Protection Plan** of this Wildland Fire Protection Plan document, focuses on the appropriate application of fire to reduce the costs and losses of unplanned fire events while enhancing or maintaining habitat quality, vegetative structure and composition as well as landscape patterns. For these reasons, the plan is now referred to as "The Long-Term Strategic Fire Protection Plan".

The Long-Term Strategic Fire Protection plan provides details for implementation of managed fire as well as a structure for measuring success. These two plans are combined in this Wildland Fire Protection Plan document with the intent to work synergistically towards the minimizing of wildfire threats in the short term while utilizing fire as an ecological management tool in the long term. However, each part, when combined makes up the Wildland Fire Management Plan. Each part is designed to be used as a "Stand Alone" document.

Part IV – Short-Term Tactical Fire Suppression Plan will be used primarily by the wildland fire fighting agencies, while Part III – Long-Term Strategic Fire Protection Plan and Part V - Research and Monitoring Plan will be used by Rancho Mission Viejo in overall management of the RMV Open Space.

0.1 Fire Management Program

The Fire Management Program brings together all of the critical issues impacted both positively and negatively by fire emphasizing that wildland ecosystems are dynamic, evolutionary, and resilient, all at the same time. Coastal sage scrub received very little attention from researchers until the late 1970's. Consequently knowledge gaps exist. Managers must learn as they go which requires an adaptive management approach. With the fate of listed species in the balance there is little room for error.

0.2 Prescribed Fire Program

The basis for the prescribed fire program is developed throughout Parts I, II, III and Part V of this document. The fire history maps by 10 year decade in Part I clearly demonstrate that wildfire is a frequent visitor to the Southern Subregion. Wildfires do not necessarily burn in the way we would like them to and there is absolutely no control of the outcome. Prescribed fire results in a new paradigm, allowing the land manager to be in control of the outcome. The Orange County Fire Authority encourages the use of well-planned use of prescribed fire and will assist in the development and execution of burn plans.

0.3 Long-Term Strategic Fire Protection Plan

Fire is a natural part of the southern California landscape. Wildland fire can be a serious threat to life, property and natural resource values. The Strategic Fire Protection Plan was written to determine the role of fire, both negative and positive, on the Southern Subregion and to address the various management options to minimize the threat from wildland fire. The Strategic Fire Protection Plan is described in Part III of this document.

0.4 Short-Term Tactical Fire Suppression Plan

The Short-Term Tactical Fire Suppression Plan in Part IV has been prepared as a stand alone document to function as the fire management portion of the Adaptive Management Program. The Fire Management Compartments and Fire Management Units are the result of a joint planning effort with the Orange County Fire Authority (OCFA), who contracts with the California Department of Forestry and Fire Protection (CDF) for protection of State Responsibility Area (SRA) Lands within Orange County and by virtue of the authority given by this contract, OCFA has both wildland and structural fire suppression responsibilities within the Southern Subregion.

0.5 Research and Monitoring Criteria

Future research and monitoring of the fire and fuel treatment activities, both proposed and status quo, will be evaluated by routine long-term observations and management experiments to test the hypotheses proposed in Part V. Research and Monitoring Criteria is described in Part V of this document.

PART I – FIRE MANAGEMENT PROGRAM

PART I – FIRE MANAGEMENT PROGRAM

1.0 THE PLANNING CONTEXT

This Section discusses a framework of principles, concepts, processes, relationships, and methods that may be useful in implementing long-term fire management within the Southern Subregion. This framework places planning procedures within a broad, proactive management approach that considers societal values and the protection of biophysical components of ecosystems at the earliest stages of fire management program design.

The management approach suggested here is guided by four broad principles:

- Ecosystems are dynamic, evolutionary, and resilient;
- Ecosystems should be viewed spatially and temporally within organizational levels;
- Ecosystems have biophysical tolerances and social limits (societies willingness to financially support corrective actions); and
- Ecosystem processes are not completely understood and, therefore are not fully predictable.

Clearly, ecosystems are dynamic and change with or without human influence. Existing conditions are a product of natural and human history. Although ecosystems are dynamic, there are limits to their ability to withstand change and still maintain their integrity, diversity, and productivity. Our efforts are guided by an ever-increasing understanding of how large ecosystem patterns and processes relate to smaller ecosystem patterns and processes, however, there are limits to our ability to predict how ecosystems may change. These principles suggest the need for an adaptive approach to fire management, one that can be adjusted in response to new information and changing conditions.

Long-term ecosystem management requires completion of the following tasks:

- *Establishing measurable goals and objectives;*
- *Assessing resources at multiple resolutions and geographic scales;*
- *Defining a strategy for implementing decisions;*

- *Formulating and carrying out a monitoring program to evaluate the outcome of decisions; and*

- *Formulating and implementing adaptive management approaches*

1.1 Land Management Goals

The Orange County Southern Subregion NCCP Science Advisors acknowledged and supported a landscape/natural community focus for fire management as the scale most likely to produce success for this conservation effort. To implement fire management at this scale, it is important to set broad overall goals for land management. It is the intent of the Adaptive Management Program the RMV Open Space lands be managed in accordance with a fire management program that is ecologically based and designed to achieve the following overall goals:

- Ensure the persistence of a native-dominated vegetation mosaic in the RMV Open Space.

- Restore and enhance the quality of degraded vegetation communities and other habitat types in a manner consistent with the overall Conservation Strategy for Identified Species and associated natural communities.

- Maintain landscape functions at all identified scales within the RMV Open Space.

- Protect and manage identified target structural characteristics for selected species and their associated habitats.

Overall goals are needed to point the program in the right direction, but they may not provide sufficient guidance in defining target conditions for specific habitats and management activities on individual parcels. The following sections discuss development of a program designed to achieve the above goals by addressing species and community-specific objectives and conditions.

1.2 Keys to Fire Management

Ecosystem management presumes a working knowledge of system function and structure. Unfortunately, the timeline of management actions typically precedes the development of requisite management knowledge. Many habitats are represented in the Southern Subregion with little history of consumptive-resource value. Vegetation types, like coastal sage scrub, received very little attention from researchers until the late 1970's (see O'Leary et al. 1994). As a result, existing knowledge relies on experimentation as part of an Adaptive Management Program to manage the system, particularly in southern California, where habitat fragmentation and continuing urbanization compound already complex management issues. In this situation, land managers must learn through carefully designed adaptive management actions as a means of compensating for uncertainty.

A structured model for this learning process directs management and monitoring actions to increase the rate of information acquisitions and improve management in iterative steps (Lee 1993:9).

The fundamental elements of the Fire Management Program are as follows:

1.3 Management Objectives

- Identify appropriate spatial scales and patterns for the long-term management of fire;
- Develop active fire management prescriptions consisting of 1) Management Objectives, 2) Preparing Management Plans and Models for shrublands (coastal sage scrub and chaparral) and 3) identifying uncertainties for valley grasslands, focused on increasing diversity of native plants and promoting community structure and composition favored by target wildlife species;
- Quantify effects of varying fire regimes on selected wildlife species;
- Utilize prescribed fire to reduce unplanned fire events from known ignition corridors;
- Define fire prescriptions that aid in restoring degraded shrublands and riparian areas;
- Quantify active restoration techniques for application following fire treatments; and
- Develop public understanding and support for active fire management.

1.4 Preparing Management Plans and Models

Based on the best available information and the objectives described above, the second step in the fire management program is to prepare management plans for designated Southern Subregion sub-units. To do this successfully, some concept of how the natural system works is necessary.

Researchers at the Riverside Forest Fire Laboratory have brought together University and Agency scientists and managers to collect information on the functioning of natural systems and develop working models of those systems.

Because of the complexity of natural systems, even the best models must provide for flexibility as part of an adaptive management approach. Natural community models represent a set of assumptions or hypotheses, based on current knowledge, that are tested through the application of management techniques. Using a combination of the desired future conditions and natural community models, a working fire management plan is developed.

The current stated goals for the RMV Open Space indicate a desire to protect natural ecosystems, including those that support CSS, native grasslands, riparian and oak woodlands. It is also the desire of RMV enhance the currently degraded coastal sage scrub. In addition, existing valley needlegrass grasslands will be maintained and enhanced with the active use of prescribed fire if grazing is not an option as will oak woodland habitats. Fire is not a viable option in riparian zones except in some very specific situations. These management goals define a four-part fire management approach:

1. The reduction of unplanned fire events through the use of maintained firebreaks and strategic prescribed burns (VMP projects);

2. Implementation of a seasonally and frequency-focused fire regime as part of a management/restoration strategy for valley needlegrass grassland;

3. Careful experimentation using fire as part of restoration and management in currently degraded coastal sage scrub stands; and

4. Implementation of low to moderate intensity ground fires in the oak woodland habitats where undergrowth is too thick and dense for cattle. If a wildfire occurs there is a great chance of a stand replacement fire where the entire ecosystem is set back to zero. Goats could be used as an alternative to prescribed fire to reduce understory vegetation beneath the oaks.

Although the four described fire activities will be distributed throughout the Southern Subregion, areas of focus are clearly defined for the landscape. Much of the grassland burning is likely to take place within the eastern half of the Southern Subregion. Prescriptions targeted at CSS Restoration & Management will occur throughout the Southern Subregion. Chaparral/shrubland restoration will most commonly be directed toward the western half of the Southern Subregion. Oak woodland maintenance will be concentrated throughout the Southern Subregion while fire protection strategies will be deployed in both the southern portion and western half of the Southern Subregion.

These four described fire activities will not be implemented on currently undeveloped lands within the Southern Subregion without the concurrence and participation by the landowner or the agency with jurisdiction for the property within the Subregion.

1.4.1 Identifying Uncertainties and Knowledge Gaps in Management Plans

To create an effective fire management program, it is important to identify the gaps in knowledge about the natural system that may lead to uncertainties about the role of fire's effectiveness in meeting the management plan's desired objectives at an early stage.

Scrutiny of management actions, or in actions, during the implementation of the proposed fire plan model may determine the need for more basic research. For example, we may not know what happens to a natural community if prescribed fire is applied too frequently or the fuels are allowed to accumulate due to a no-action decision and a wildland wildfire occurs.

The purpose of identifying gaps in models and knowledge is to translate them into a set of questions (hypotheses) that can be addressed through experimentation, monitoring and research. This experimental approach to management recognizes the limitations of current knowledge about natural communities and encourages and provides opportunities to improve management efforts. As knowledge gaps are identified and hypotheses tested, our models and management decisions will improve, new gaps in knowledge will emerge, and additional questions and hypotheses will be developed and tested.

1.5 Site Description

1.5.1 Location

The 132,000-acre Southern Subregion is located in the south coast ecoregion of southern California. The Southern Subregion lies entirely within the boundaries of the County of Orange. Thirty (30) percent of the entire Southern subregion (about 40,000 acres, see *Figure 1-2*) is located within the Cleveland National Forest (CNF) while about 92,000 acres are located outside the CNF.

As shown in *Figure 1-1*, the Southern Subregion includes the southern portion of Orange County from the coast inland to the boundary with the counties of Riverside and San

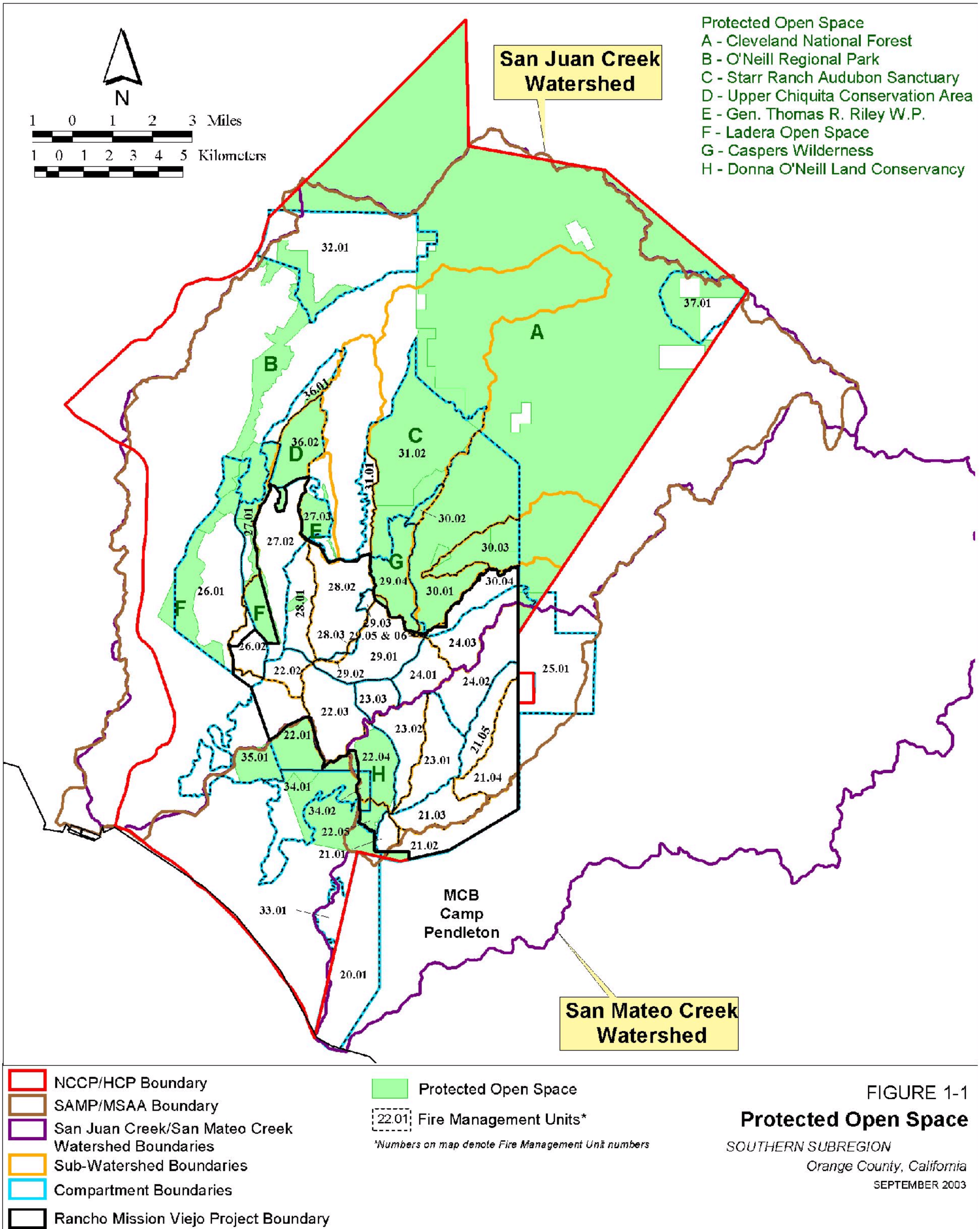


FIGURE 1-1
Protected Open Space
SOUTHERN SUBREGION
Orange County, California
SEPTEMBER 2003

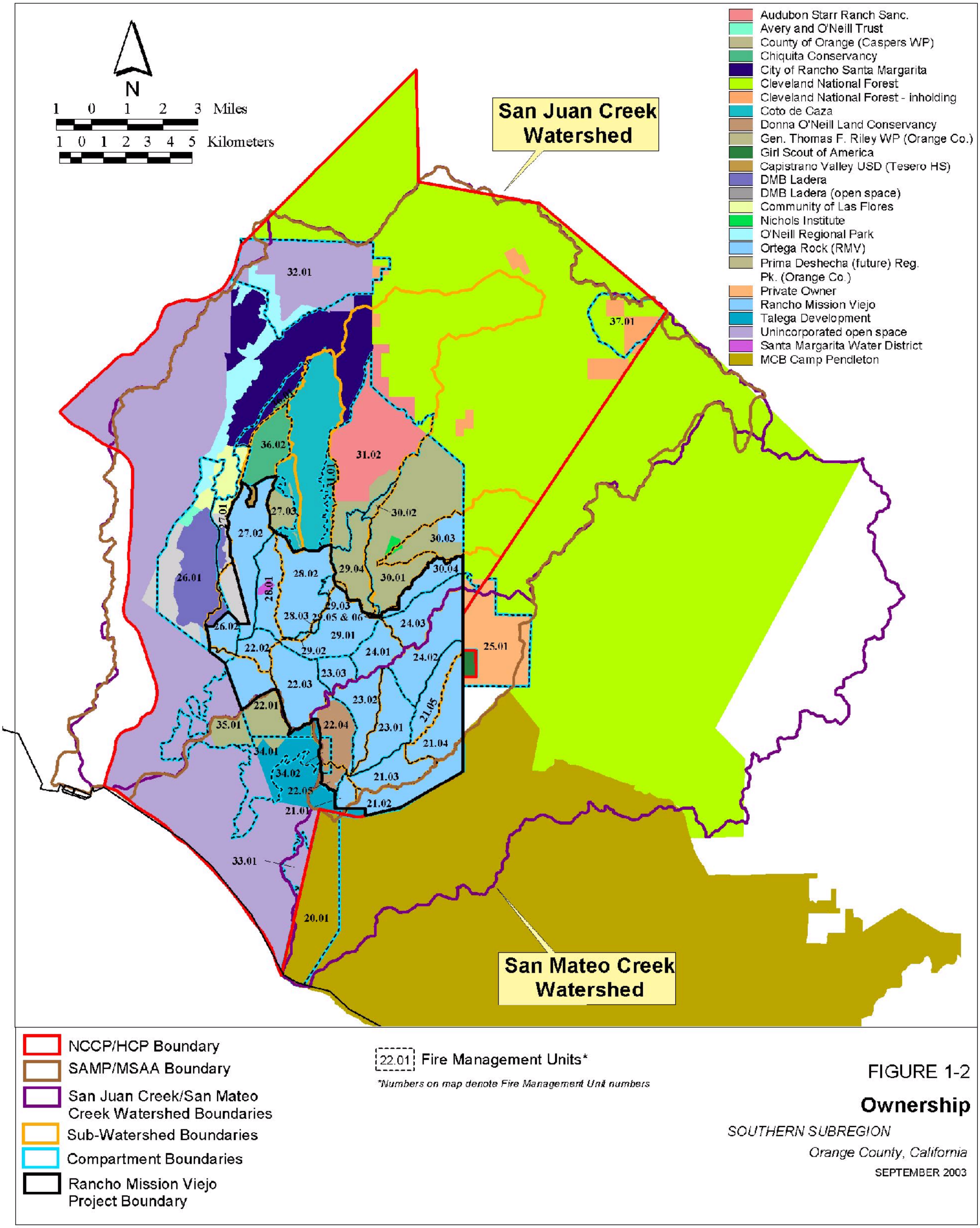


FIGURE 1-2

Ownership

SOUTHERN SUBREGION

Orange County, California

SEPTEMBER 2003

Diego. Along the coast, the Subregion extends from the mouth of San Juan Creek in the City of Dana Point to the San Diego County boundary, in the City of San Clemente. The Subregion is bounded on the west and southwest by the Central and Coastal NCCP Subregion, where a separate NCCP/HCP was prepared by the County and approved by USF&WS and CDFG in 1996.

Starting at its southwest corner, the boundary of the Southern Subregion (*Figure 1-1*):

- extends from the mouth of San Juan Creek along the Creek inland to Interstate 5;
- northwest along Interstate 5 to El Toro Road;
- north along El Toro Road to the intersection of Live Oak Canyon Road;
- northeasterly on a straight line from the El Toro/Live Oak Canyon intersection to the northern apex of the boundary with Riverside County; and
- along the San Diego and Riverside county boundaries, southerly to the Pacific Ocean.

1.5.2 Maps of Land Use Classifications

1.5.2.1 Land Uses

Within the 92,000-acre portion of the Subregion located outside of the CNF, 36 percent (about 33,000 acres) has already been urbanized. Another 6 percent (about 5,800 acres) has been used for agricultural purposes for decades or has been significantly disturbed by other uses. Natural habitats comprise 58 percent (about 52,400 acres) of the remaining non-CNF area. The natural communities that are subject to potential development pressure include, but are not limited to, coastal sage and other sage scrub communities, chaparral, oak woodland and forest, riparian, wetlands, and native and annual grasslands.

1.5.2.2 Land Ownership

Figure 1-1 is a graphic of the current landownership within the Southern Subregion. Land owners include the Audubon Starr Ranch Sanctuary, the City of Rancho Santa Margarita, the Cleveland National Forest, the community of Coto de Caza, the Donna O'Neill Land Conservancy, County of Orange (Caspers Wilderness Park, General Thomas F. Riley Wilderness Park, O'Neill Regional Park, the future Prima Deshecha Regional Park and unincorporated open space lands), the Girl Scouts of America, Capistrano Valley Unified School District (Tesoro High School), DMB Ladera, the community of Las Flores, Nichols Institute, individual landowners, Rancho Mission Viejo, Talega Development, and the Santa Margarita Water District (Chiquita Wastewater Treatment Plant). MCB Camp Pendleton is the southerly landowner and is mentioned throughout this document because of the relationship of MCB Camp Pendleton to the fire history of the Southern Subregion.

1.5.3 Maps of Various Natural Resources

1.5.3.1 Topography and Soils

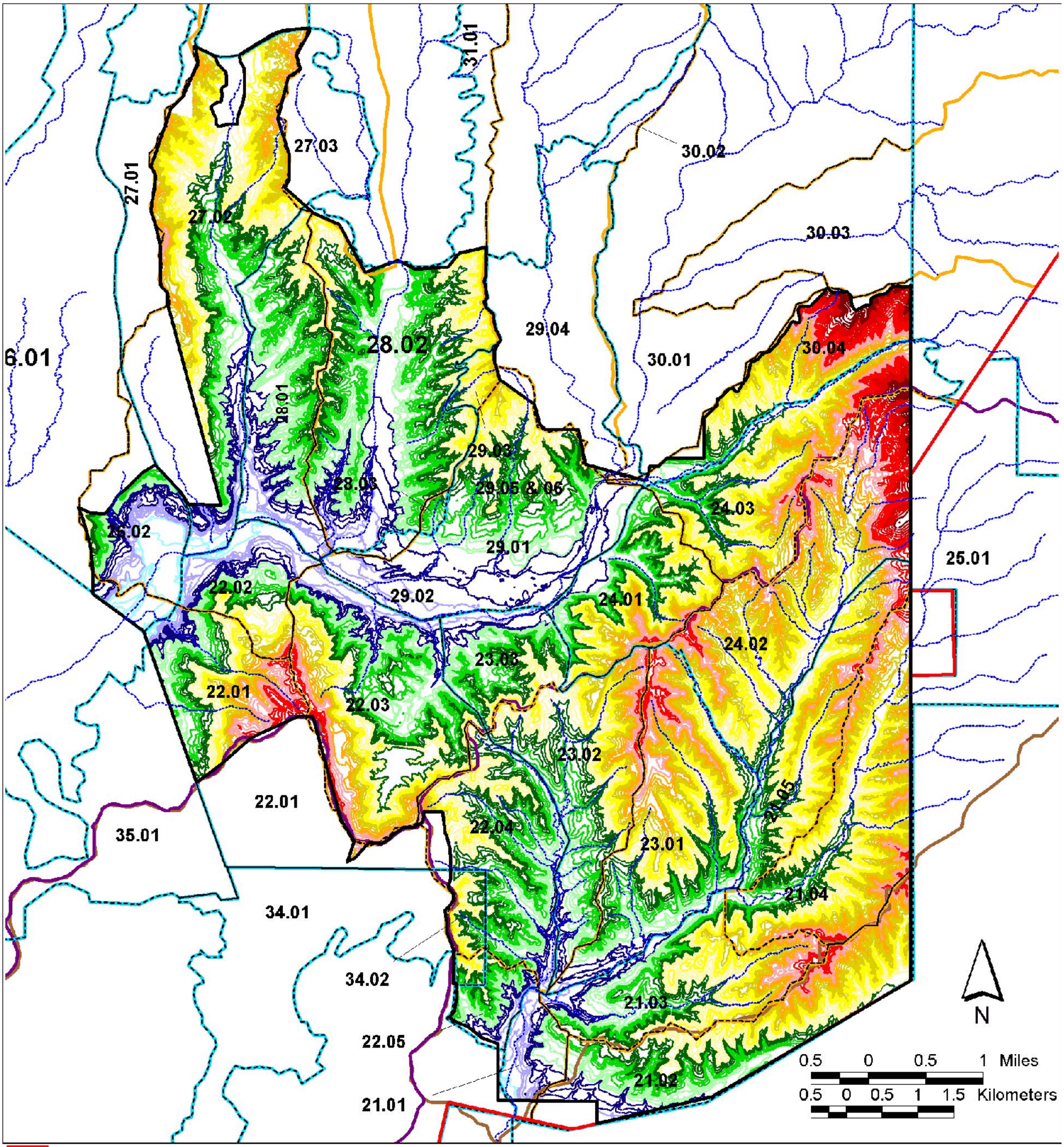
Elevations in the Southern Subregion run from 5,500 feet in the CNF to sea level. The highest elevation outside the CNF is approximately 1,758 feet on the Starr Ranch property. Topography for the Southern Subregion is characterized by rolling hills and a number of ridge systems that run from north to south from the slopes of the Santa Ana Mountains to the Pacific Ocean. Deep south and west facing canyons dissect the landscape with steep slopes and a representation of all aspects.

A rich mosaic of soil types exists within the Southern Subregion system (*Figure 1-3*). The Gabino gravelly clay loam, Soper loam, and Calleguas clay loam are found within the Southern Subregion at the higher elevations. Myford sandy loam, Capistrano sandy loam, Cieneba sandy loam, Also Clay and Anaheim clay loam occur in the lower portion of the Southern Subregion. The Cieneba Series is the most well represented soil series within the Southern Subregion.

1.5.3.2 Hydrology

Trabuco Creek, a major tributary of San Juan Creek, San Juan Creek and San Mateo Creek comprise the major drainages in the Southern Subregion. With the exception of a few man-made reservoirs, ephemeral drainages and stream courses characterize the landscape described in this plan. Rainfall and the resulting stream flow tend to be highly episodic in nature. For most Subregion streams, active flow occurs between the months of January and May. The upper reaches of San Juan Creek and San Mateo Creek have year round water. *Figure 1-4A* identifies the Southern Subregion's stream systems.

The soils in the Southern Subregion run from non-erosive to highly erosive (see *Figure 8* in the Draft Watershed and Sub-basin Planning Principles Report). Soil erosion can be accelerated following fire events. Factors effecting the type and amount of erosion include the erodibility of soil, steepness of slope, amount and intensity of rainfall, percentage of plant cover, severity of the fire and the length of time since the last burn. With much overland flow, erosion potential is



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Subwatershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
22.01 Fire Management Units*

*Numbers on map denote Fire Management Unit numbers

Elevation Contours (feet)

125 - 200	575 - 650	1075 - 1200
200 - 275	650 - 725	1200 - 1350
275 - 350	725 - 800	1350 - 1525
350 - 425	800 - 875	
425 - 500	875 - 950	
500 - 575	950 - 1075	

Streams and drainages

FIGURE 1-3A

Elevation Contours

Rancho Mission Viejo

Orange County, California

SEPTEMBER 2003

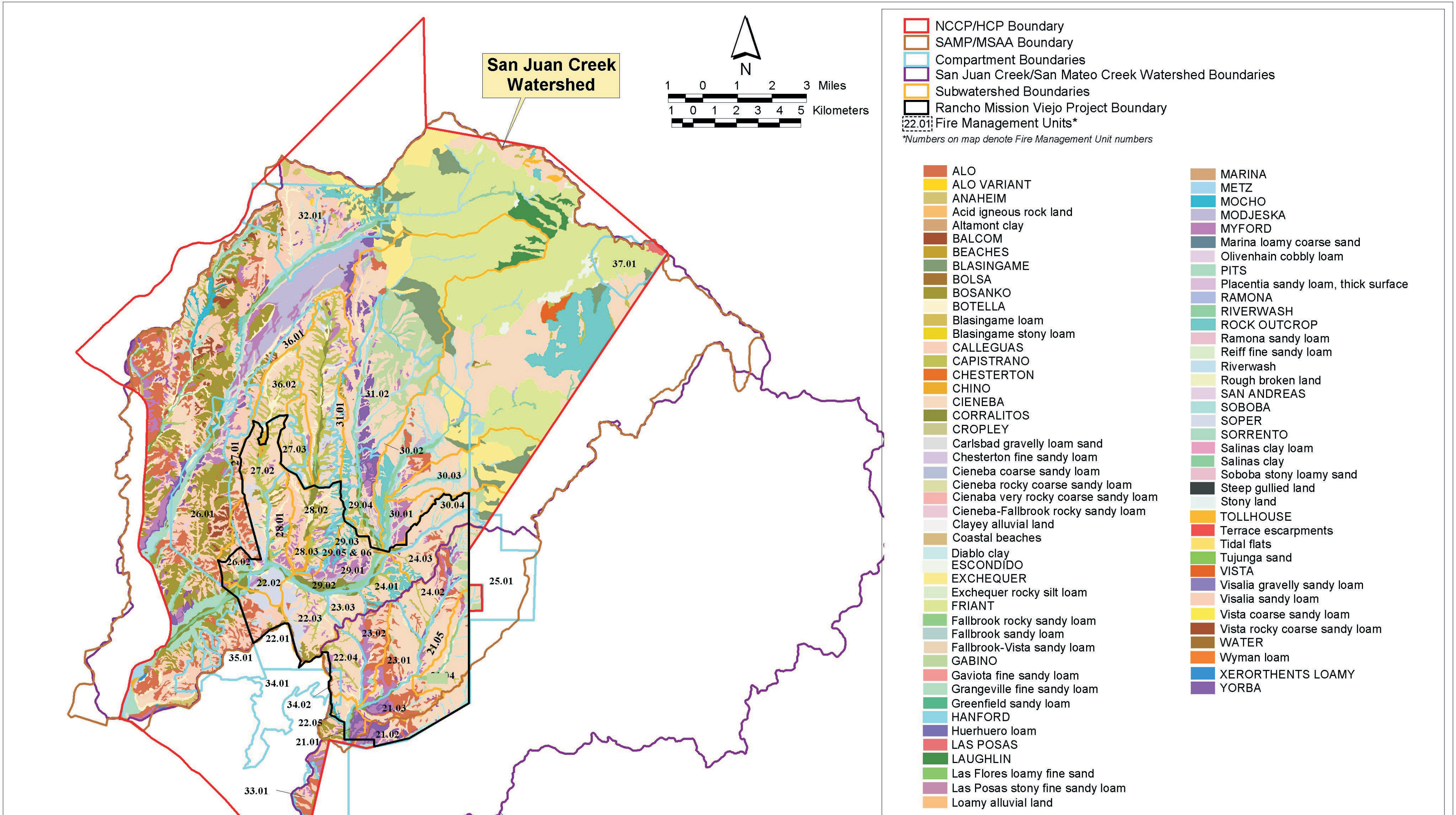
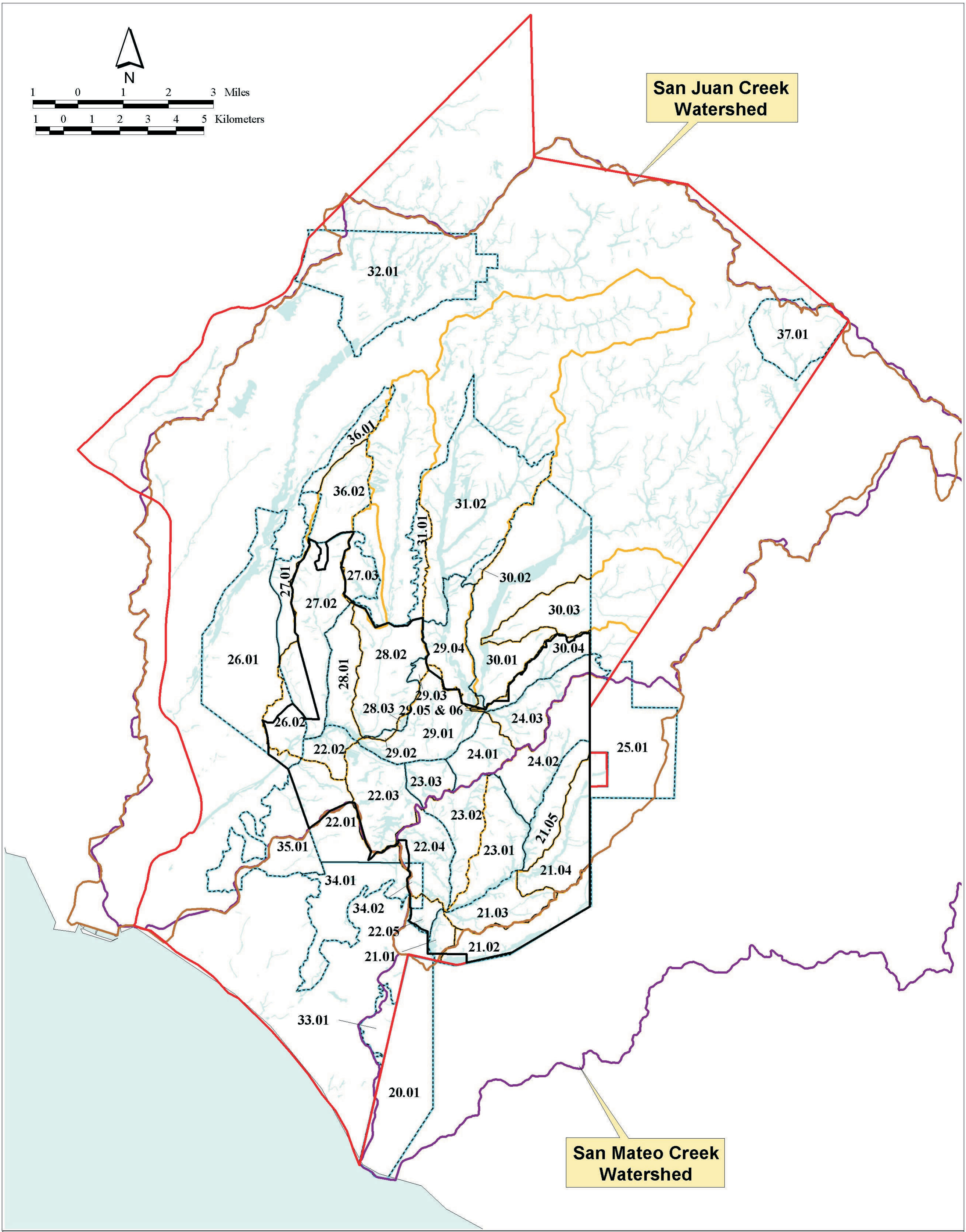


Figure 1-3B
SOILS

SOUTHERN SUBREGION
Orange County, California
SEPTEMBER 2003



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
22.01 Fire Management Units*
Natural Watercourses, Lakes, & Ponds

*Numbers on map denote Fire Management Unit numbers

FIGURE 1-4A
WATER COURSES
SOUTHERN SUBREGION
Orange County, California
SEPTEMBER 2003

a significant planning variable to be considered prior to prescribed fire events. There are numerous examples of moderate gully erosion in the existing grasslands throughout the Southern Subregion.

A simple erosion index will be included within unit prescriptions (see *Figure 1-4B*). Within units with high erosion potential, pre and post fire management practices will be recommended.

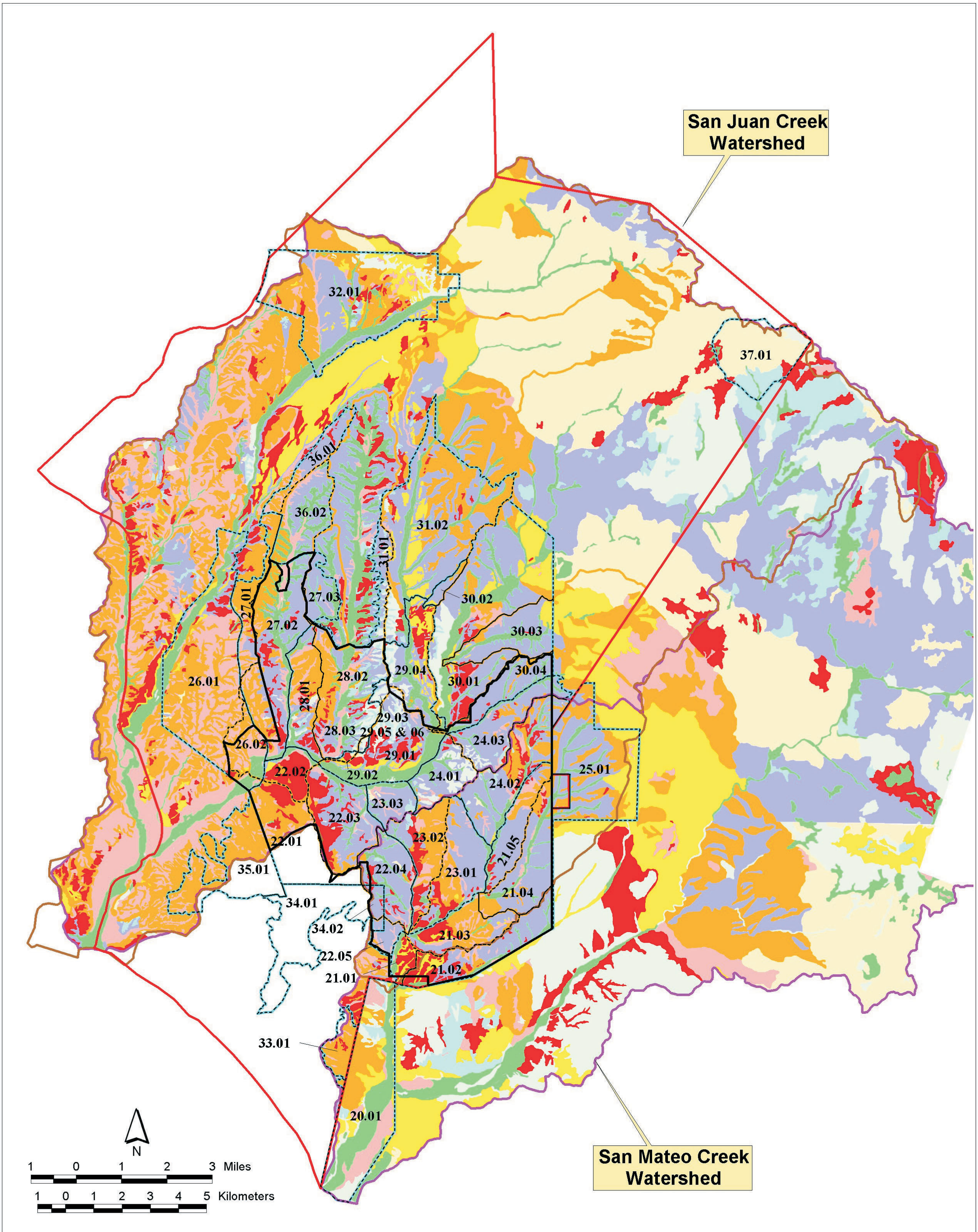
1.5.3.3 Climate

The Southern Subregion exhibits a characteristic Mediterranean climate with warm to hot summers and mild winters. Rainfall is concentrated in the winter. Summer seasons are characterized by extended periods of sunny weather. A strong marine air influence is experienced throughout the year and helps to lower local temperatures. The Southern Subregion's location, in relation to other significant topographic features such as the Santa Ana Mountains, may intensify the effect that these air masses have on local temperatures.

Local conditions may strongly affect fire behavior. The unique Mediterranean climate with its long dry summer produces many days of great fire potential (McCutchan 1977). Local Foehn winds know as "Santa Ana's" develop in conjunction with high-pressure systems in the Great Basin. When a low-pressure trough is located along the southern California coast, a strong pressure gradient is found across the southern California Mountains (Schroeder and Buck 1970). The resulting strong winds, along with warm temperatures and humidity sometimes lower than 5 percent, produce very serious fire weather.

Average annual rainfall on lands outside the CNF is 12 to 14 inches. The higher Elevation portion of the watershed (typically the headwater areas) typically receive Significantly greater precipitation due to orographic effects. In addition, rainfall patterns are subject to extreme variations from year to year and longer term wet and dry cycles.

In nearby Laguna Beach, a 74-year average computes annual rainfall to be 30.20 Centimeters (12.08 inches) between 1928 and 2002. *Figure 1-6* shows the seasonal distribution of precipitation for the period of record. Mean annual rainfall from an inland site (Santa Ana) appears slightly higher (*Figure 1-5*). A 54-year mean computes annual precipitation at 32.85 centimeters (13.14 inches). Figure 1-6 also displays the seasonal distribution of precipitation at the Laguna Beach Fire Station between 1948 and 2002.



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/ San Mateo Creek Watershed Boundaries
Compartment Boundaries
Sub-Watershed Boundaries
Rancho Mission Viejo Project Boundary
22.01 Fire Management Units*

Numbers on map denote Fire Management Unit numbers

Roads

Rocky or unclassified
Erodable sand
Alluvial
Less erodable upland sand
Erodable clay
Less erodable clay, mid to low slope
Less erodable clay, high slope
Erodable silt, low slope
Erodable silt, high slope

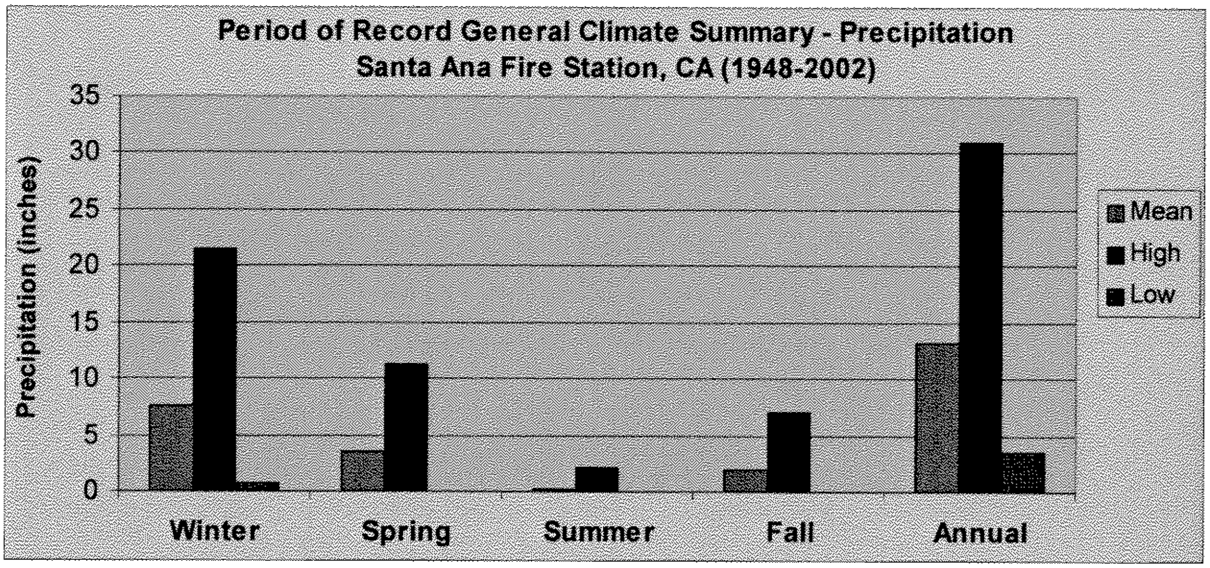
FIGURE 1-4B

ERODABILITY

SOUTHERN SUBREGION

Orange County, California

SEPTEMBER 2003



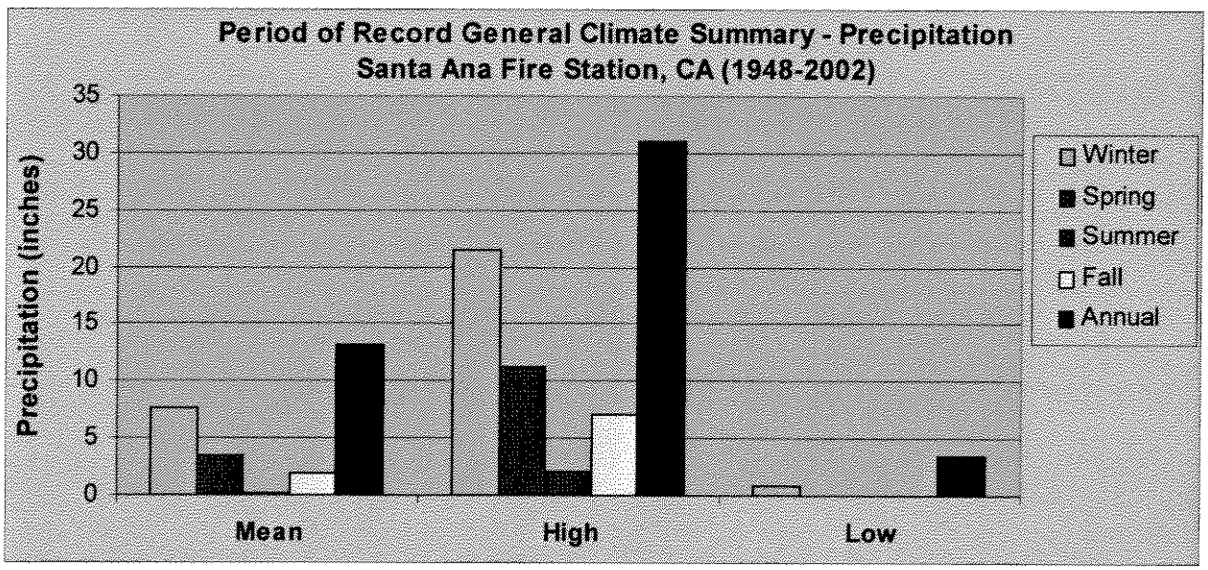
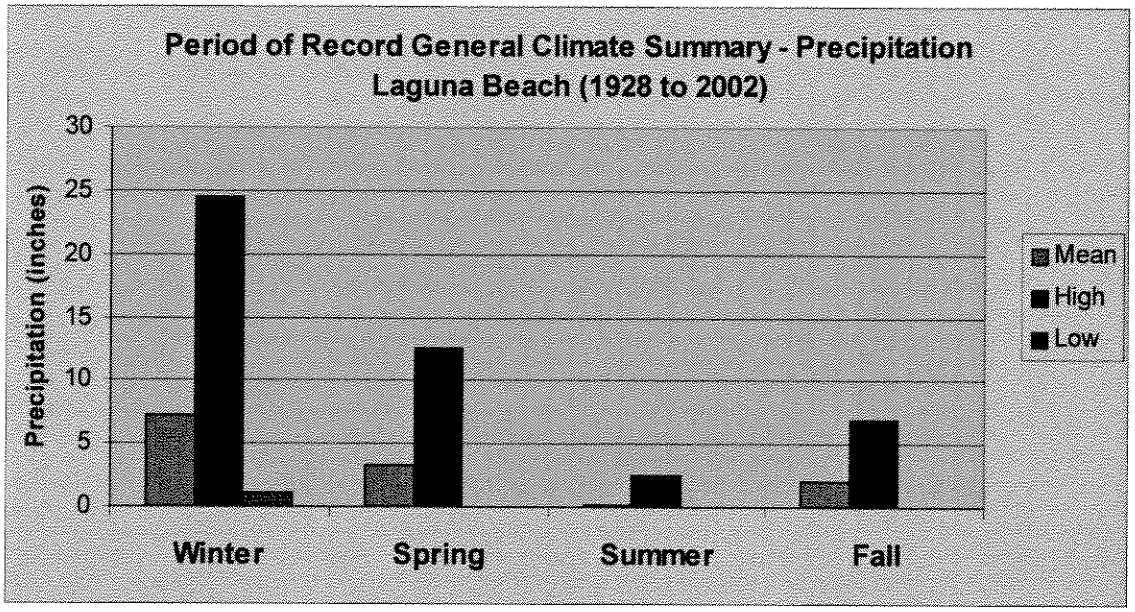


Figure 1-5: Rainfall data for a single site in Santa Ana, Ca. Rainfall records are partitioned here to reflect seasonal distributions.



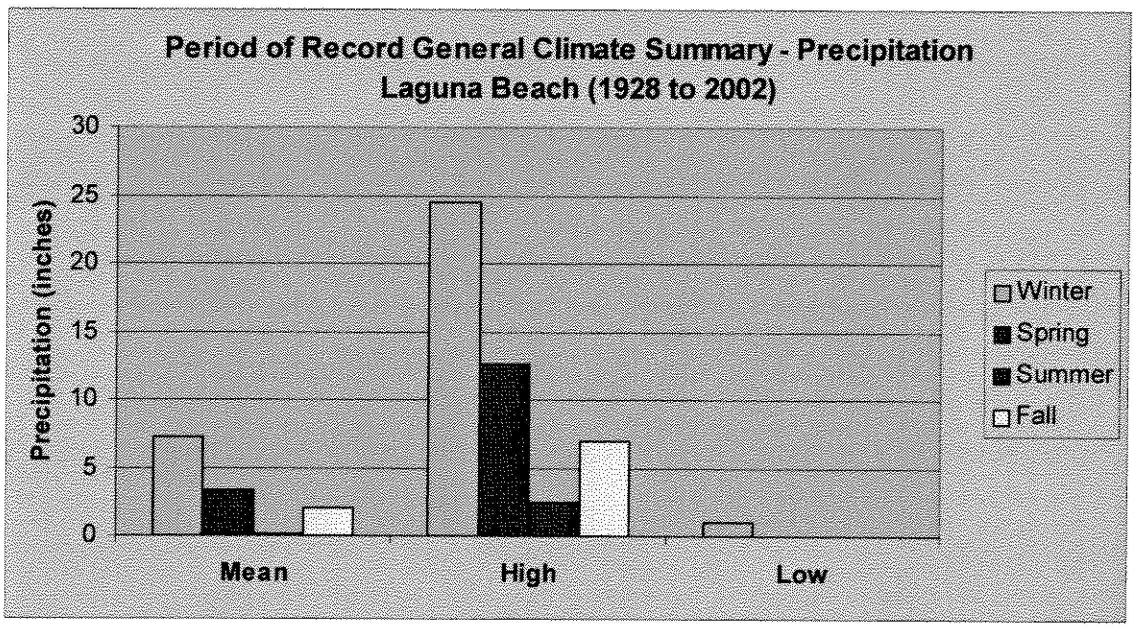


Figure 1-6: Rainfall data for a single site in Laguna Beach, Ca. Rainfall records are partitioned here to reflect seasonal distributions.

The majority of this rainfall is winter storm generated from cold frontal systems originating in the Gulf of Alaska. Although infrequent, thunderstorms derived from warm, wet southern air masses do develop in late summer or early fall. A typical thunderstorm event, resulting in multiple ignitions throughout southern California, occurred in the last days of August 1998.

1.5.3.4 Vegetation

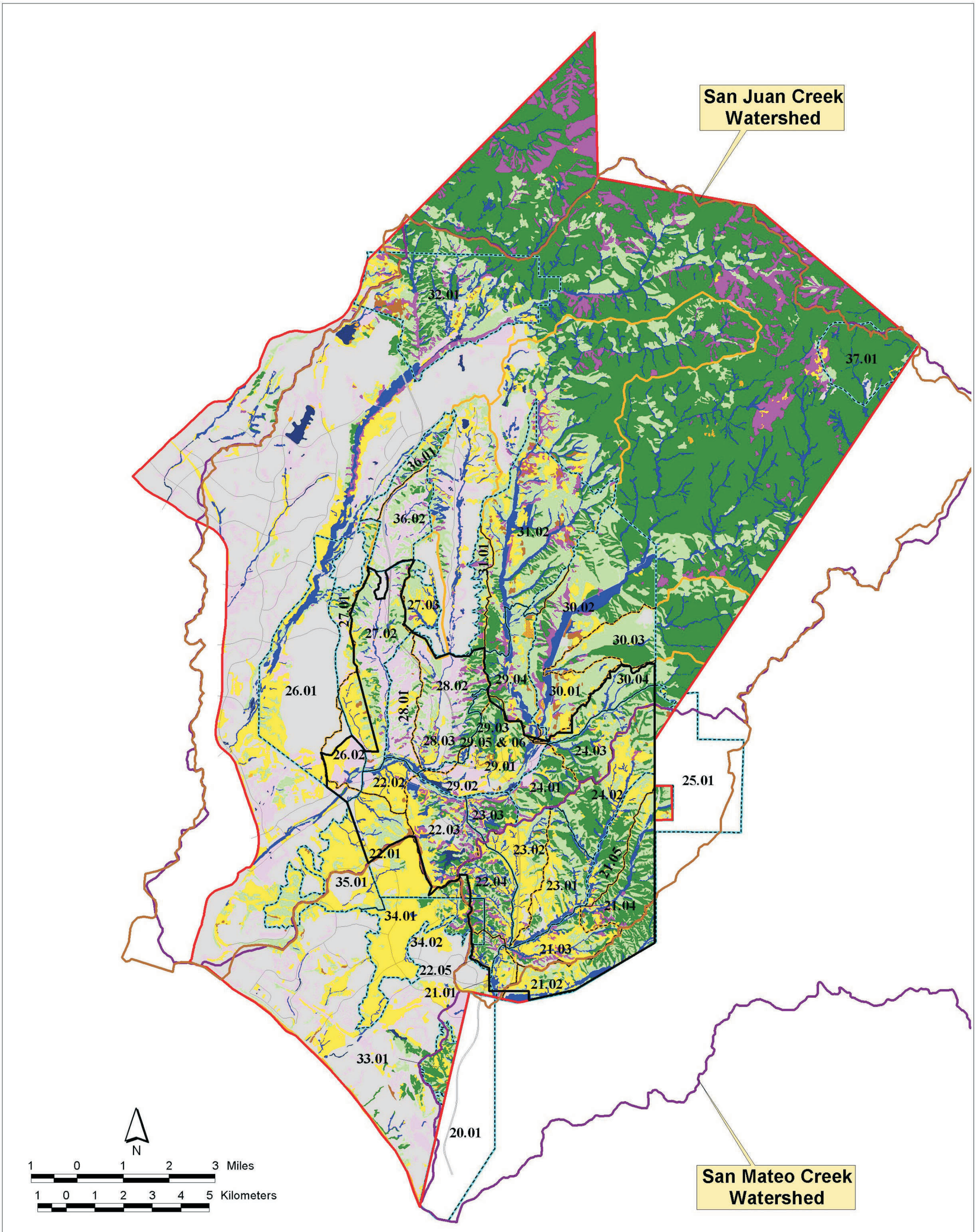
Five types of upland vegetation are dominant within the Southern Subregion: grasslands (predominately non-native), coastal sage scrub, oak woodland, mixed chaparral, and riparian (*Figure 1-7*). These communities also represent most of the major upland vegetation types in southern California. These plant assemblages occur in a mosaic pattern across the Southern Subregion. Topography and soils likely drive this vegetation pattern. Non-native grasses generally occupy lowland valleys, with deep soils. Upland areas, with rocky soils, tend to be dominated by chaparral and sage scrub, with significant cover taken up by non-native grasses.

Due to limited spatial extent or lack of relevance to fire planning, additional vegetation types represented within the Southern Subregion's boundary have not been addressed in this plan. Rare assemblages that may be impacted by fire events will be identified at the unit plan level. Appropriate protection strategies will also be identified at that time.

1.5.3.4.1 Non-native grasslands

Non-native grassland types occurring within the boundary occupy a significant spatial extent of the vegetation. Many of the acres currently identified as non-native grasslands are likely to have been type converted from southern California bunchgrass prairie, native flower fields or coastal sage scrub. It should be noted that conversion of native plant communities to non-native grasslands dates back to before the arrival of the Spaniards in the 1500's.

Hendry (1931) suggested that red-stemmed filaree (*Erodium cicutarium)*, curly dock (*Rumex crispus)*, and prickly-sow thistle (*Sonchus asper)* may have preceded Europeans to California. Burcham (1956, 1957) and Robbins (1940) present evidence that suggest major replacement of native herbaceous plants with introduced annuals occurred in stages beginning in the 1850's and ending by the 1870's. In a Mediterranean climate, hot and moist conditions are scarce and decomposition rates are slow. This may lead to a negative feedback loop, where excess thatch can follow a year of high production (Huenke and Mooney 1989). This excess thatch and ground litter has significantly altered seedbed micro-environments. Native plants, such as purple needlegrass (*Stipa or Nassella pulchra)*, are more likely to successfully germinate in the presence of bare soil (Dyer and Rice 1999). Annual grass conversion has also taken place in coastal sage scrub. The conversion of native shrublands to annual grasslands is a more



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/ San Mateo Creek Watershed Boundaries
Compartment Boundaries
Sub-Watershed Boundaries
Rancho Mission Viejo Project Boundary
22.01 Fire Management Units*
*Numbers on map denote Fire Management Unit numbers
Roads

Grassland
Savannah woodland
Sparse scrub
Scrub
Chaparral
Forest
Riparian
Misc
Agricultural or landscaped
Developed/Disturbed
Water/Wetlands

FIGURE 1-7
VEGETATION
SOUTHERN SUBREGION NCCP/HCP
Orange County
SEPTEMBER 2003

contemporary phenomenon, likely caused by elevated fire frequencies (Keeley and Keeley 1984).

In an extensive study of grasslands in Orange County, native perennial grasslands were found to occupy less rocky soils, with higher clay contents (Keeley 1993). Research indicates that shrublands may have been displaced on rocky sites, while native bunch grass prairies may have been lost on heavier clay soils. In a study of plant succession of central California transition rates between grassland and more woody vegetation was found to be similar on moderately drained sandy clay to clay soils. Still, burned areas experienced significantly lower shrub invasion on silty clay to clay soils (Callaway and Davis 1993). These results substantiate findings by Wells (1962) that fire in combination with soil types seems to influence the distribution of vegetation types in the Mediterranean climate areas of California.

Grassland composition within the Southern Subregion boundaries closely resembles sites throughout the state. Dominant species include wild oats (*Avena barbata*), red brome (*Bromus madritensis* ssp. *rubens*), soft chess grass (*Bromus mollis*), foxtail fescue (*Vulpia myuros*), and red-stemmed filaree (*Erodium cicutarium & E. botrys*). Additional common broad-leaf weeds include prickly lettuce (*Lactuca serriola*), tumbleweed (*Amaranthus albus)* and black mustard (*Brassica nigra*). Though these communities tend to have low species richness and a high proportion of their composition made up of alien species, with proper management they still provide important habitat for target species. As a result, these sites will be focused targets for fire management.

1.5.3.4.2 Diegan Sage Scrub

This series is often referred to as coastal sage scrub, which is better thought of as a collection of series. This approach allows stands of comparable composition to be described across a large geographic range. Much effort has gone into detailed mapping of Diegan Sage Scrub sub-associations within the Southern Subregion boundary. For the purpose of this plan Diegan Sage Scrub will be used to describe sage scrub types throughout the Southern Subregion. Dominant shrub species include; black sage (*Salvia mellifera*) California buckwheat (*Eriogonum fasciculatum*), California sagebrush (*Artemisia californica*), California encelia (*Encelia californica*), chaparral mallow (*Malacothamnus fasciculatum*), coast prickly-pear (*Opuntia littoralis*), laurel sumac (*Malosma laurina*) and coyote brush (*Baccharis pilularis*).

The shrubs, dominant in this vegetation type, have evolved adaptive mechanisms to exploit soil moisture in upper soil horizons during cool winter seasons. Most dominant shrubs in this community are winter-active and avoid the summer drought by shedding their leaves (Mooney 1977). Unlike evergreen sclerophyllous chaparral, sage scrub is characterized by malacophyllous subshrubs whose leaves abscise or shed during summer drought and are replaced by a lesser number of smaller leaves (Westman, 1981, Gray and Schlesinger, 1983)

Major factors influencing plant species distribution and composition include evapotranspirative stress, substrate type, soil nitrogen, and air pollution (Westman 1981c). The community composition of coastal sage scrub has been shown to consist of relatively few dominant shrub species, with the majority of species occurring in the herbaceous understory. Westman (1981b) found that of the 375 species encountered during his study, over 50 percent were herbaceous understory species with rare occurrence throughout the community's geographic range.

Studies of post-fire recovery of coastal sage scrub indicate that community response varies with differences in geographic location, species composition, disturbance history, aspect, fire intensity and fire interval (Wells 1962). Multiple successional pathways may exist following disturbance events in sage scrub. Cooper (1922) indicated that sage scrub might be successional to mixed chaparral types.

1.5.3.4.3 Chaparral

Several mixed chaparral types are represented in the Southern Subregion. The most common of these types may be described as chamisal. The term chamisal is applied to chaparral stands in which common chamise (*Adenostoma fasciculatum)* comprises 80% or more of the total shrub cover (Hanes 1977). Chamise chaparral is a dense, interwoven vegetation 1-2m high at maturity without a well-developed understory (Hotrod 1960, Hanes 1971). Stands within the Southern Subregion often have the additional, low frequency occurrence of the following shrubs: eastwood manzanita (*Arctostaphylos grandulosa),* flat-leaved lilac *(Ceanothus crassifolius),* toyon *(Heteromeles arbutifolia)* and black sage (*Salvia mellifera).*

Re-growth after fire may be slower between different chaparral types. Slower response may be due to poor site conditions such as soil depth, soil moisture, nutrient availability (Horton 1960), and the effects of fire intensity on root crown sprouting and response of viable seed in the remaining duff layer. A rich herbaceous flora is often associated with this community type during the first wet seasons following fire events (Horton and Kraebel 1955). Due to the compressed fire return intervals experienced on this site, the Southern Subregion chaparral tends to be more open and of lower stature then other mature stands of this type.

1.5.3.4.4 Riparian

Riparian vegetation in the Southern Subregion varies from well-developed forest types to shrub dominated series. The riparian vegetation occurring on any given site may be a function of disturbance history and/or edaphic (soil type, texture and drainage) conditions. Structural elements vary greatly between riparian series. Utilization of these sites as habitat is often closely correlated with structural change.

Arroyo willow (*Salix lasiolepis*), black cottonwood (*Populus balsamifera*), mulefat (*Baccharis salicifolia*) and additional willows (*Salix spp*) often dominate riparian scrub. In a shrubland form many emergent trees may be present.

These stands may or may not be dominated by a single species. The response of these stands to fire events is not well documented. Little is known of prescribed fire effects and although many stands have burned under wildfire conditions few efforts have been made to quantify response. There is some antidotal evidence that young stands respond more vigorously than sites with a dominance of mature vegetation.

1.5.3.4.5 Oak Woodland

Additional vegetation types of management concern are those sites dominated by coast live oak (*Quercus agrifolia*). Dense stands of mature trees occur on raised stream banks and terraces. Soils are generally sandstone or shale-derived. A mix of tree, shrub and herbaceous species characterize these types. California coffee berry (*Rhamnus californica*), California sagebrush (*Artemisia californica*), poison oak (*Toxicodendron diversilobum*), beardless wild ryegrass (*Elymus triticoides*) and Miners lettuce (*Claytonia parviflora*) may all be common in the understory of these stands. In addition, a significant portion of the herbaceous layer of these stands may be composed of non-native annual grasses. As with other riparian types little appears in the literature regarding fire effects. Many mature trees, within the Southern Subregion, have survived even high intensity fire events. With well-defined adaptations, it seems likely that fire has played a historic role in the development of these stands. Still, ecologically based fire regimes remain undefined. The relationship between tree and shrub recruitment and other stand development issues needs to be examined as burning efforts take place in these vegetation types.

1.5.3.5 Wildlife

199 species of vertebrates are known to exist within the Southern Subregion. This list includes 7 species of amphibians, 15 reptiles, 145 birds and 32 mammals. The Southern Subregion's fauna remains important, in a regional context, for several reasons. Though many of the species occurring within the Southern Subregion are typical of coastal Southern California, several clines of species (members of population) typical of inland sites, are also present. In addition, connectivity between remaining populations of some of the region's wildlife species can still be achieved with the Southern Subregion as an important node in a landscape network. Lastly, populations of selected wildlife species within the Southern Subregion are considered rare and declining. Rare species are distributed throughout the Southern Subregion. *Figures 1-8A*

through *1-8G* represent the distributions of the following federally listed species: California gnatcatchers, least Bell's vireo, southwestern willow flycatcher, arroyo toad Riverside fairy shrimp, San Diego Fairy shrimp and Thread-leaved brodiaea (these Figures are not shown in this appendices to the Draft NCCP/HCP Planning Guidelines but can be found in Chapter 4, *Figures 4-1* through *4-7* of the Draft NCCP/HCP Planning Guidelines).

Some of the Southern Subregion's other notable amphibian and reptile species include the western spadefoot toad (*Scaphiopus hammondii*), the western toad (*Bufo boreas*), Pacific treefrog (*Hyla regilla*), granite spiny lizard (*Sceloporus orcuttii*), side-blotched lizard (*Uta stansburiana*), western whiptail (*Cnemidophorus tigris*), gopher snake (*Pituophis melanoleucus*), California kingsnake (*Lampropeltis getulus*), and the red diamond rattlesnake (*Crotalus viridis*). Selected avian species likely affected by this plan include the northern harrier (*Circus cyaneus*), the red-tailed hawk (*Buteo jamaicensis*), the California quail (*Callipepla californica*), the California gnatcatcher (*Polioptila californica californica*), the southwestern willow flycatcher (*Empidonax traillii*), the least Bell's vireo (*Vireo bellii*), the San Diego cactus wren (*Campylorhynchus brunneicapillus*) the horned lark (*Eremophila alpestris*), the California towhee (*Pipilo crissalis*), the grasshopper sparrow (*Ammodramus savannarum*) and the western meadowlark (*Sturnella neglecta*).

Significant mammals, which the fire program could conceivably impact, include California ground squirrel (*Spermophilus beecheyi*), valley pocket gopher (*Thomomys bottae*), desert woodrat (*Neotoma lepida*), and dusky-footed woodrat (*N. fuscipes).*

With the exception of the dusky-footed Woodrat, which occupies extremely decadent chaparral stands with very high dead to live fuel ratios and is essentially the only species utilizing these stands, the other mammal species respond favorably to fire due to the abundance of new sprouts and seed bearing annual and perennial fire followers.

1.5.3.6 Cultural Environment

1.5.3.6.1 Pre-Settlement

Prior to European contact (ca. mid to late 1500's), the valleys surrounding the Southern Subregion were inhabited by layers of Native Americans of several ethno-historical traditions (McKenna and Hatheway 1988). The earliest known occupants of coastal Southern California are referred to as the San Dieguito Tradition. This first group of coastal residents date from man's arrival until the establishment of post-glacial environments. The Encinitas Tradition follows with occupations of the Southern Subregion between 6000 to 3000 BC. Sites in the city of Irvine document an emphasis on grass seed procurement, with abundant milling equipment. A high likelihood exists that these people actively used fire to maintain a grass seed resource. The

Campbell tradition then occupied these sites from 3000 BC to 700 AD. It is during this period that acorn-processing technology was developed.

The Shoshonean Tradition begins around 500 AD and continues until the Spanish colonization of California. Following the development of the mission system, the term "Gabrielino" was applied to these people and their ancestors. They lived an intensive hunter-gather existences with permanent or semi-permanent villages along coastal estuaries. According to Bean and Shipek (1978), fauna comprised between fifteen and twenty percent of the subsistence resources.

Though the use of managed fire is not specifically documented for the Shoshonean Indians, much evidence exists for tribes throughout California. Several researchers maintain that there is evidence for almost every tribe in the western United States having used fire to modify their respective environments (Lewis 1993, Steward 1955).

Reynolds (1959) demonstrates the use of frequent fire by California tribes to increase the yield of desired seeds, drive game, stimulate the growth of wild tobacco, improve visibility and facilitate the collection of seeds. The combination of anthropogenic burning and natural fire likely created a pre-settlement fire regime characterized by frequent fire of variable intensity.

1.5.3.6.2 Settlement

The area currently within the Southern Subregion boundaries was originally settled during the late 1760's and was primarily used for grazing of cattle and sheep (Hudson 1981). Much of the Southern Subregion is contained within the historic boundaries of Rancho Mission Viejo which extended from Camp Pendleton to Cooks Corner. Cattle grazing and water use are documented from the early 1800's. It is believed the area experienced light to moderate seasonal grazing and infrequent fire. No evidence of managed fire has been documented for this period (1760 – 1800's).

Starting in 1860 additional land uses developed in and surrounding the Southern Subregion. Orchards were established, sheep grazing was initiated, while limited limestone and coal mining occurred.

1.5.3.6.3 Recent Land Use

Recent history has seen extensive residential and agricultural development throughout the landscape within and surrounding the Southern Subregion. With the exception of the eastern border of the Southern Subregion, the other three edges of the open space landscape within the Subregion have experienced some level of urban-wildland interface. Much of the contemporary development benefits from thoughtful fire planning. Defensible space and appropriate building materials characterize structures built during the last ten years. Still, the high density of human occupation has resulted in a highly altered fire environment. In addition, managed fire has been used successfully and was most recently used in a series of Vegetative Management Projects (VMP's) in 1985, 1986, 1987 and 1994 (see 1981-1990 Fire History Map, *Figure 1-9C* and 1991-2000 Fire History Map, *Figure 1-9B*).

1.6 Natural and Historic Role of Fire

1.6.1 Natural Fire

Little is known of pre-settlement fire events in the Southern Subregion. Many of the assemblages of plants known to occur in the Southern Subregion have documented fire adaptations. With an atmosphere full of oxygen, a surface stuffed with organic fuels and an endless source of ignition, it seems unlikely that these communities would experience significant fire free intervals (Pyne 1995).

The structural and compositional nature of the pre-settlement fuels also indicates frequent fire. Though grasslands may have their origins rooted in soils and climate, the selective forces of fire (Vogl 1974) likely maintained these communities. The widespread appearance of shrublands would also indicate repeated fire events. The spread of chaparral seems to be based chiefly in the Pliocene. The rapid rise of steep slopes, increasingly dry climates strengthened by Santa Ana winds have created extreme fire conditions. Fires from lightning and volcanism effectively eliminated trees and favored seral shrublands.

Contemporary research supports the concept of pre-settlement fire regimes. Comparing the size and pattern of fire events on either side of the Alta and Baja California borders, Minnich (1990) describes a regime of frequent, low to mid intensity fire events in the absence of fire suppression activities. In contrast Keeley (1999) describes contemporary fire regimes in Southern California shrublands as characterized by too frequent fire. These compressed fire return intervals are thought to be the source of type conversion and the reduction in shrub densities. Modern day fire ecologists most likely considered both theories to be acceptable; however, type conversion and reduction in shrub densities are more directly related to high intensity wildfires. Frequent, large sized low to moderate intensity wildland fire events (prior to the fall Santa Ana winds) of the past likely reduced the probability of high intensity wildland fires from occurring on the same landscape.

At the turn of the century citizens began petitioning the Federal and State Governments to do something about managing the remaining public lands that were the source for devastating wildfires that burned out settlements, or the denuded landscapes resulted in severe flooding of down stream towns and cities. A 10:00 AM policy was put into effect by the US Forest Service. This policy required that all wildfires be vigorously attacked and extinguished by 10:00 AM the following day. This policy resulted in most wildfires being extinguished with the lone exception of the unsuccessful suppression of wind driven wildfires that accounted for all of the acreage burned. Prior to the 1900's many of the early season fires burned large areas over several months with low to moderate intensity fires. Since the 1900's these low to moderate intensity wildfires occurring prior to the Santa Ana winds were quickly and easily suppressed allowing both living and dead vegetative fuels to build up.

In the early 1970's land managers began to realize that there were not as many wildfires, but when they did occur they were causing much more soil damage and chaparral stands were being type converted to very flammable stands of non-native grasses. It took about 70 years for managers to realize that well-meaning fire suppression policies were only postponing the inevitable and were causing unnatural ecosystem changes. Fire suppression policies were allowing wildland fuels to accumulate to unnatural levels so that when wildfires did occur they were of very high intensities and were very destructive. These realizations have brought us to the present day prescribed fire policy where fire is viewed as natural part of the ecological balance of wildland ecosystems.

1.6.2 Historical Uses of Fire

Aboriginal use of fire is often invoked as the disturbance maintaining open grasslands and oak savannas. Many authors support the view that Indian burning was frequent and widespread (Cooper 1922, Jepson 1910). Although Indians lived and utilized the area within the Southern Subregion, the extent and frequency of Indian burning is unknown, however, it is very likely that Indians did use fire. Although evidence is not clear, it is quite likely that countless fires were set during the settlement period. Early California newspapers document grassland and chaparral fires which burned for weeks and months.

During contemporary land management, in addition to the wildfire history, a small number of vegetative management burns have occurred within the Southern Subregion (see *Figure 1-9C*). The Orange County Fire Authority, California State Parks, the Cleveland National Forest and the Marine Corps Base at Camp Pendleton have all implemented successful prescribed burns in grassland and shrubland vegetation. These efforts were intended to both reduce fire hazards and improve habitat quality.

1.7 The Fire Environment

1.7.1 Fire Weather

The fire season in Orange County usually starts in May and ends in November, although critical fire weather can occur year round (Orange County Historical Records). Significant fires have been recorded in December and January (California Department of Forestry and Fire Protection).

Several synoptic weather conditions produce high fire danger. One is a cold front passage followed by winds from the northeast quadrant. Another is produced by high pressure systems in the Great Basin. This Great Basin high produces the foehn-type wind along the west slope of the Coast Ranges, known as "Santa Ana Winds". Peak "Santa Ana" wind occurrence is in November with a secondary peak in March, however, over time Santa Ana winds have been recorded in every month of the calendar year with the exception of August.

A third high fire danger situation occurs when a ridge or closed high aloft persists over the western portion of the United States. At the surface, this pattern produces very high temperatures, low humidity, and air-mass instability (Schroeder and Buck 1970).

1.7.2 Fire History

Historic fire data indicates that large wildland fires have been a frequent visitor to the Southern Subregion lands. Most of the Southern Subregion lands have experienced a wildfire one or more times in the past 50 years. Since the 1940s, the California Department of Forestry and Fire Protection (CDF) and later the Orange County Fire Authority (OCFA) have documented all wildland fire events for the entire county. *Figures 1-9A* through *1-9J* depict wildland fires by decade for the Southern Subregion. Most of these fire events were of human origin. The majority of ignitions have been associated with roadways, arson and person-related activities. Exceptions include the Santiago Canyon Fire of 1998, where multiple lighting strikes caused this fire.

1.8 Fuels

The Southern Subregion's vegetation, topography and disturbance history has created a mosaic of fuel types. Frequent disturbance has created low volume fuel beds throughout portions of the Southern Subregion. Open grasslands in the eastern portion of the Southern Subregion are an example of this respective fire type. In areas where fire and grazing has been excluded, fuel loads have reached moderate to high levels. Where fuels have burned within the last 10 years fuels can be generally characterized as low volume with a high percentage of fine, herbaceous fuels.

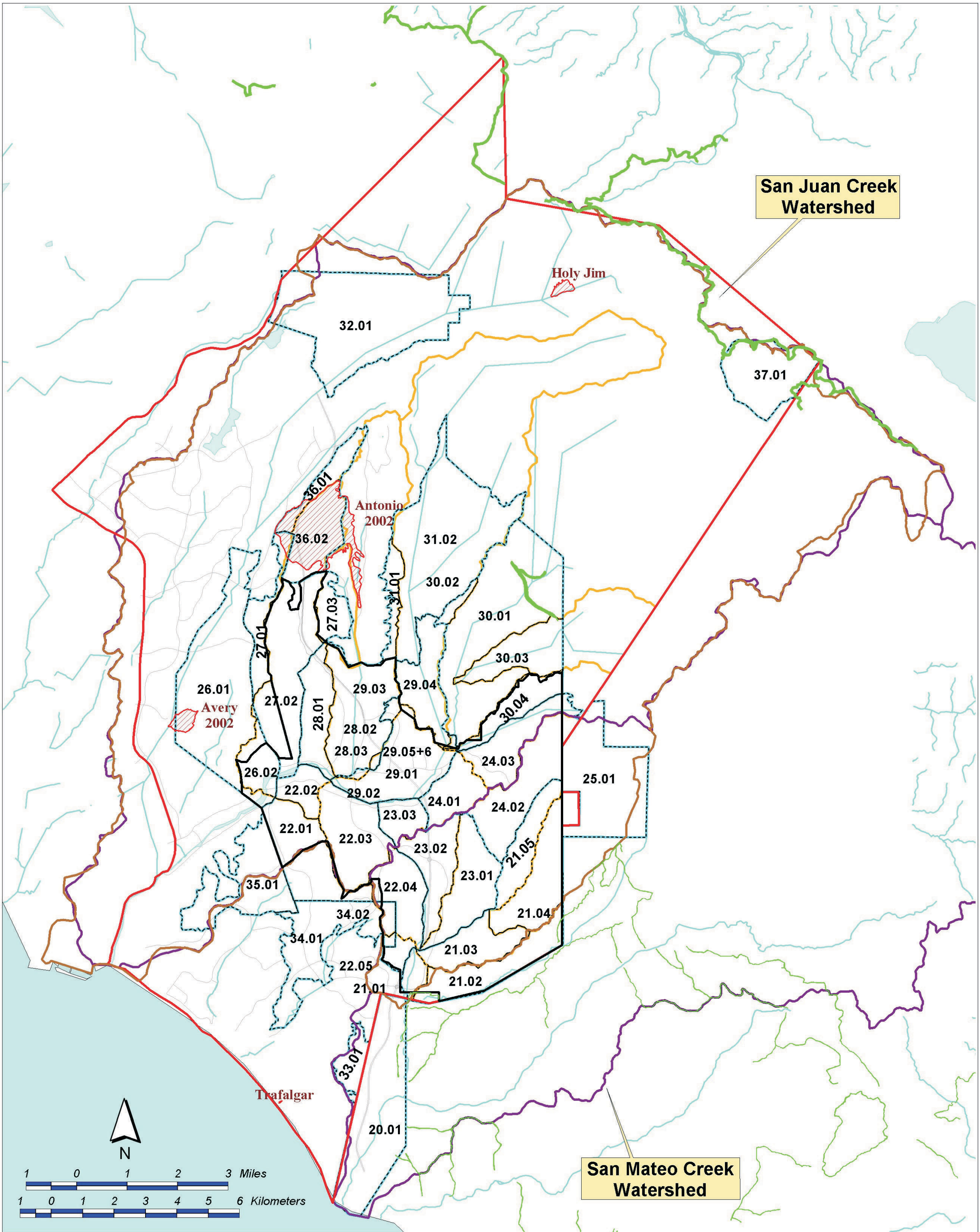


Figure 1-9A

Wildfire History 2001-2002

Southern Subregion
Orange County, California

SEPTEMBER 2003

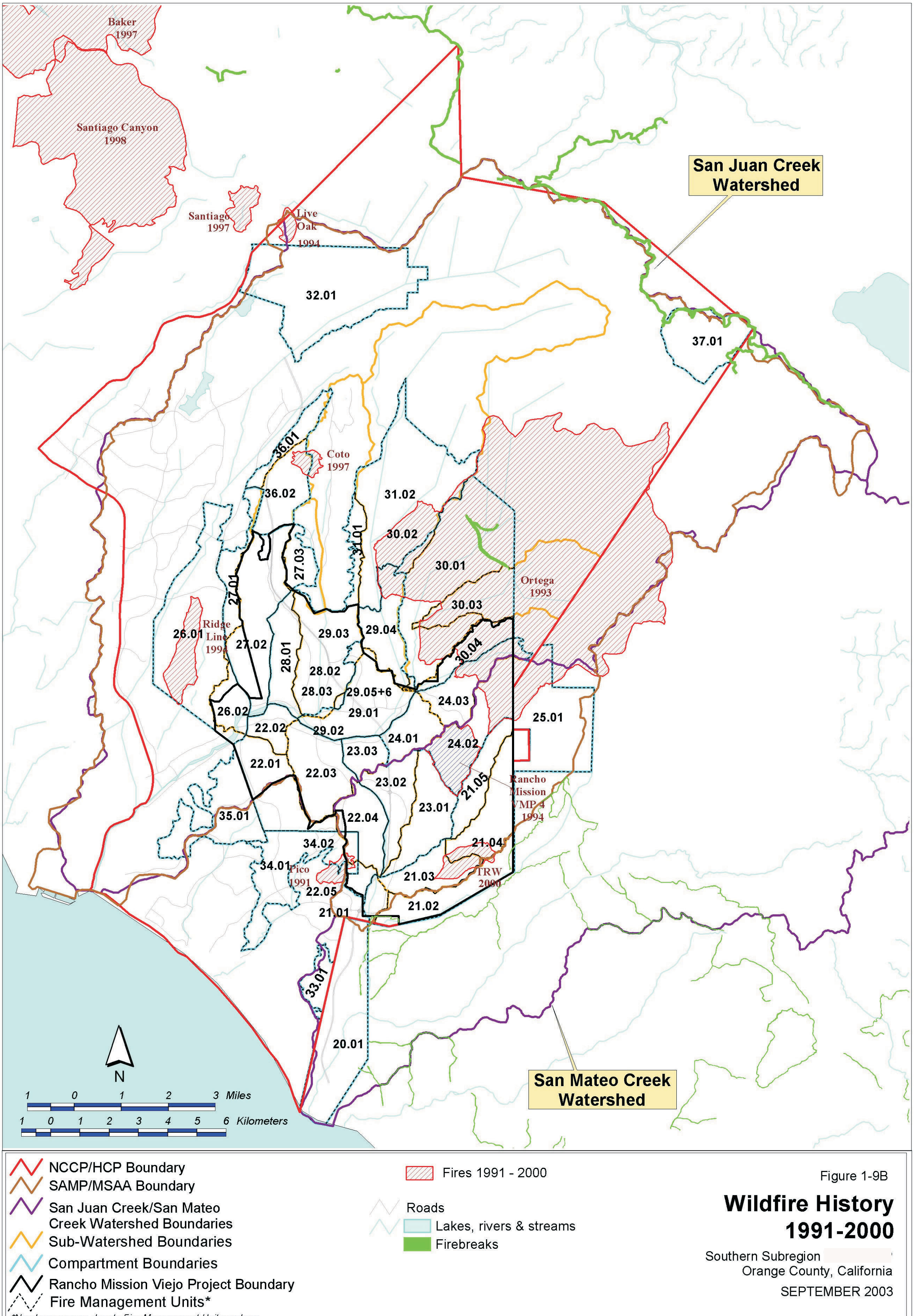
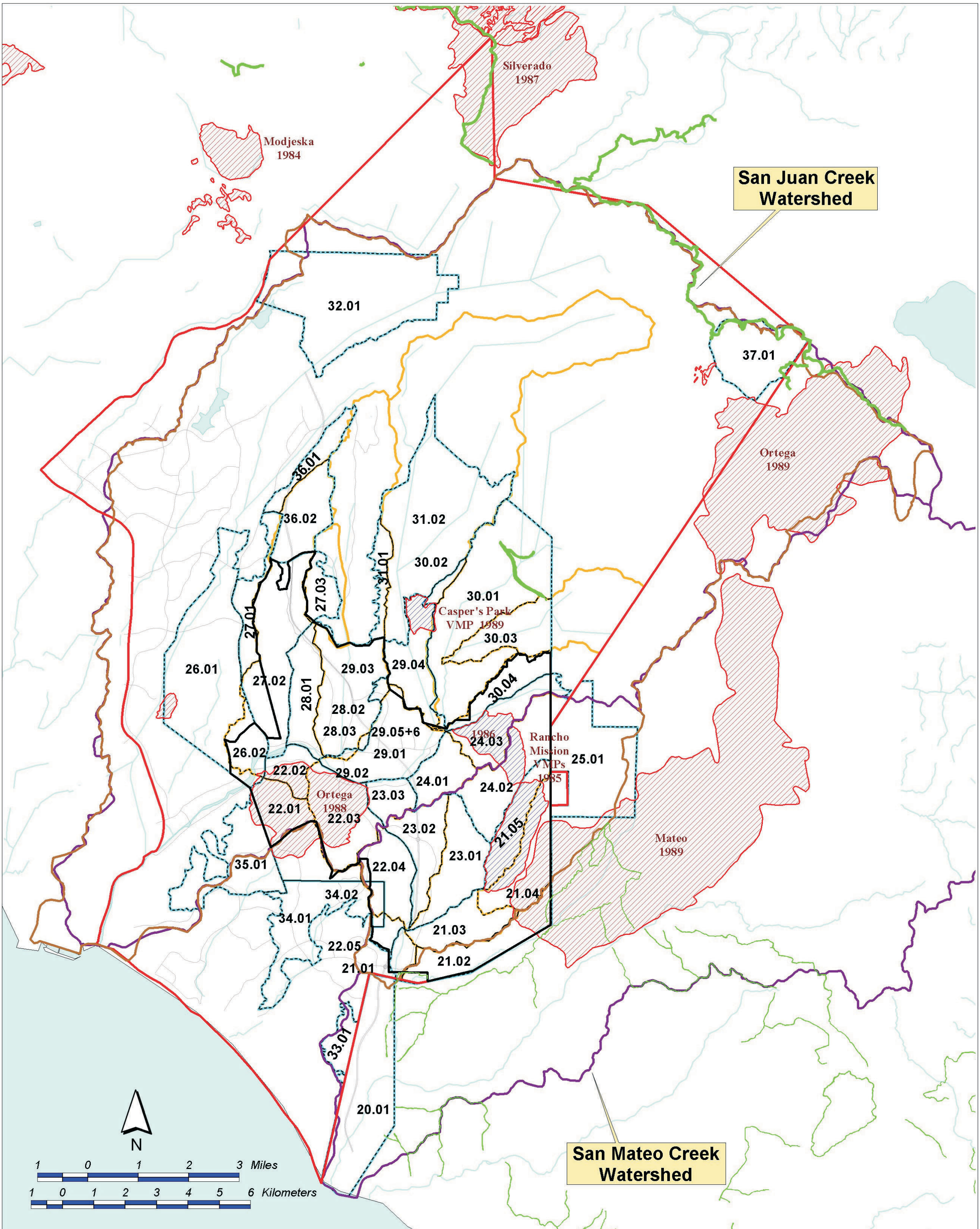


Figure 1-9B

Wildfire History 1991-2000

Southern Subregion
Orange County, California
SEPTEMBER 2003



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
Fire Management Units*
*Numbers on map denote Fire Management Unit numbers

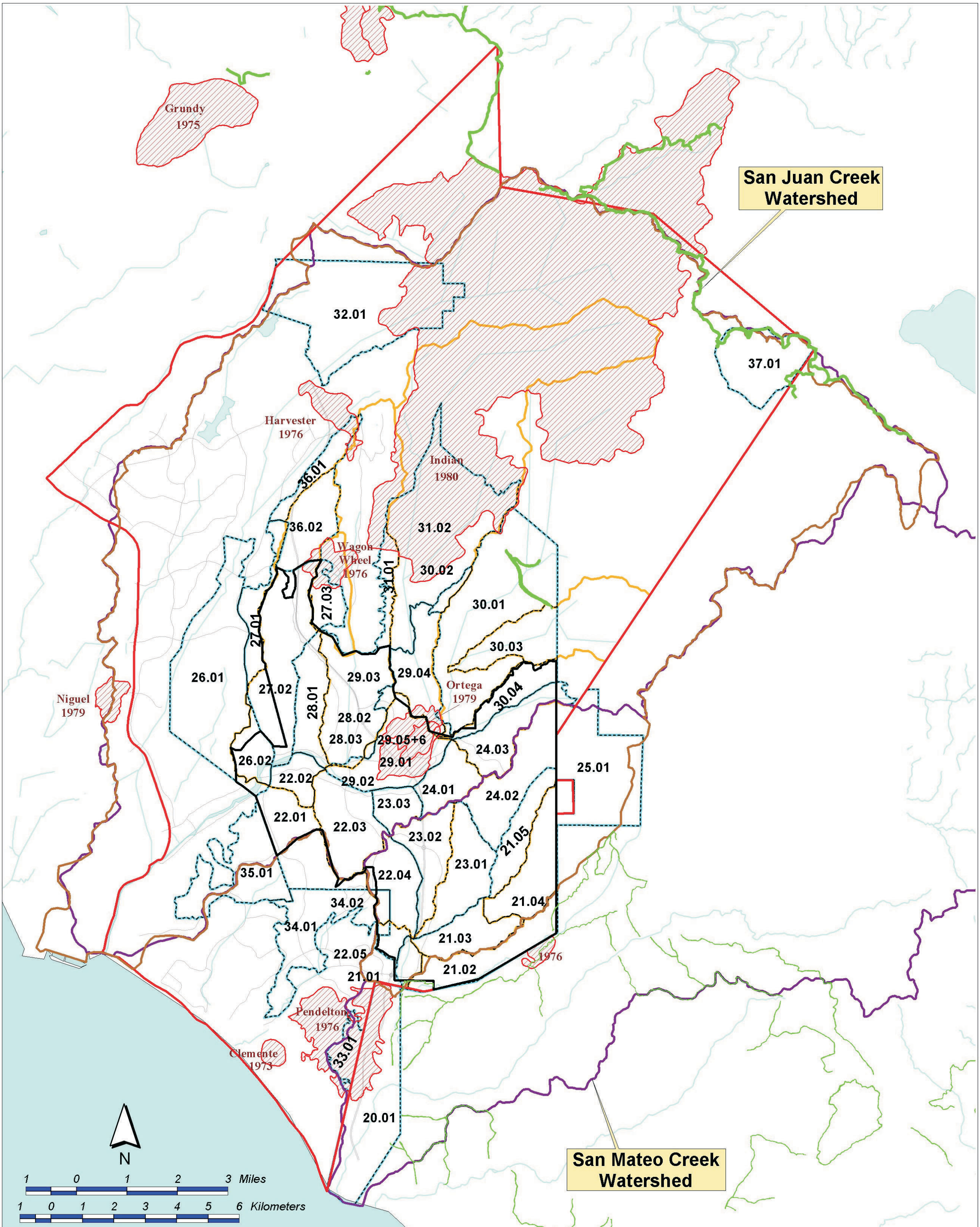
Fires 1981 - 1990

Roads
Lakes, rivers & streams
Firebreaks

Figure 1-9C

Wildfire History 1981-1990

Southern Subregion
Orange County, California
SEPTEMBER 2003



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
Fire Management Units*

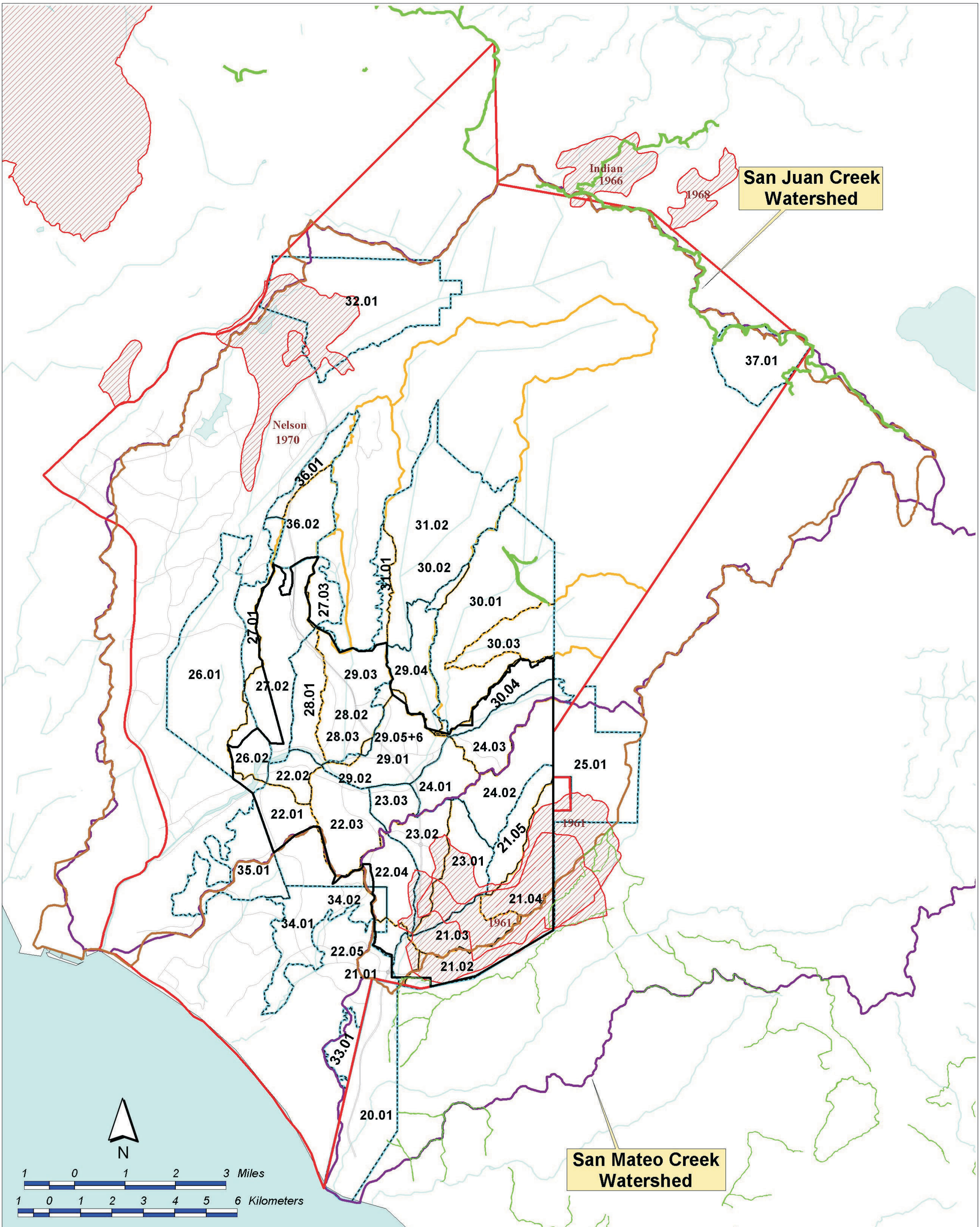
*Numbers on map denote Fire Management Unit numbers

Fires 1971 - 1980
Roads
Lakes, rivers & streams
Firebreaks

Figure 1-9D

Wildfire History 1971-1980

Southern Subregion
Orange County, California
SEPTEMBER 2003



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
Fire Management Units*
*Numbers on map denote Fire Management Unit numbers

Fires 1961 - 1970

Roads
Lakes, rivers & streams
Firebreaks

Figure 1-9E

Wildfire History 1961-1970

Southern Subregion
Orange County, California
SEPTEMBER 2003

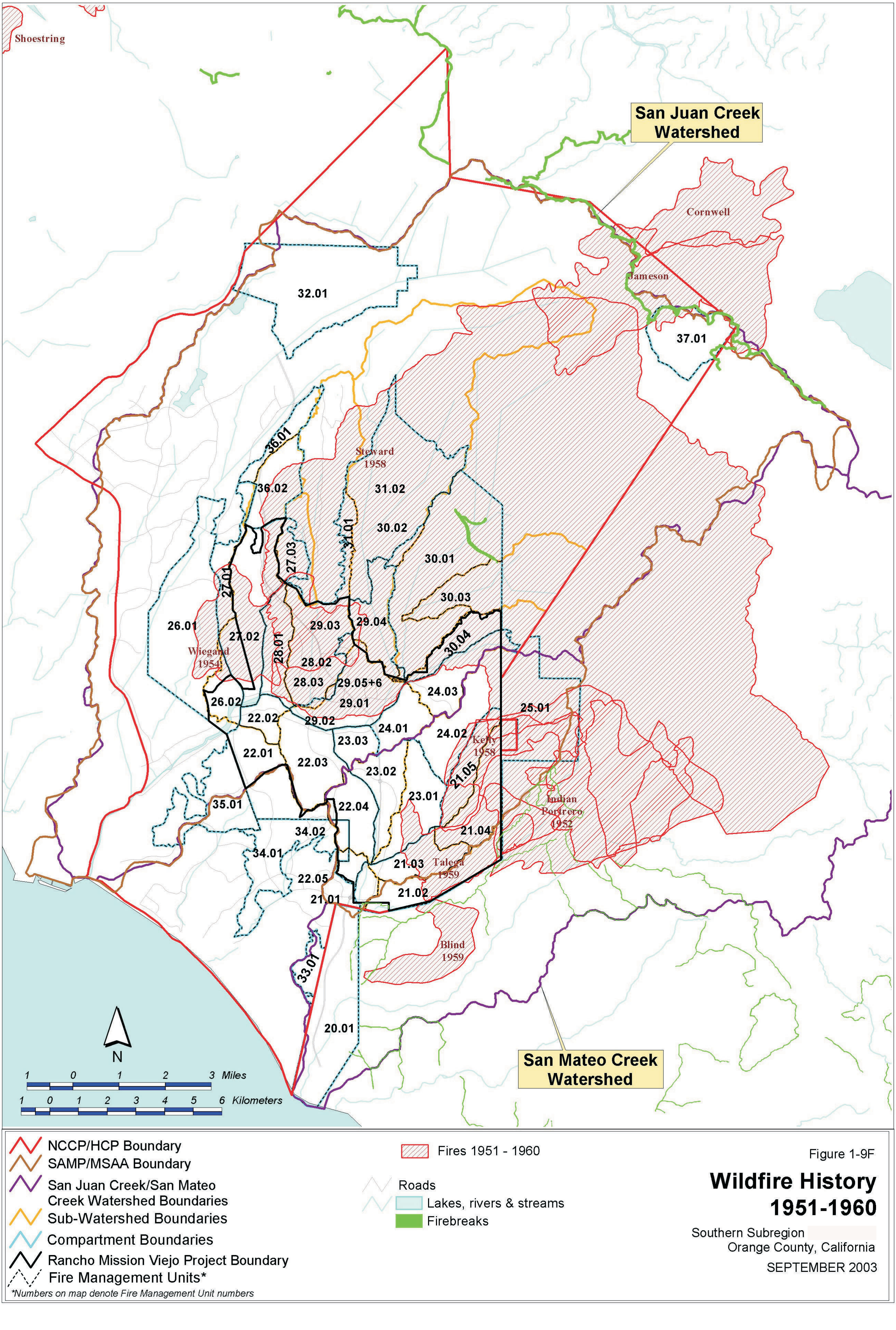


Figure 1-9F

Wildfire History 1951-1960

Southern Subregion
Orange County, California

SEPTEMBER 2003

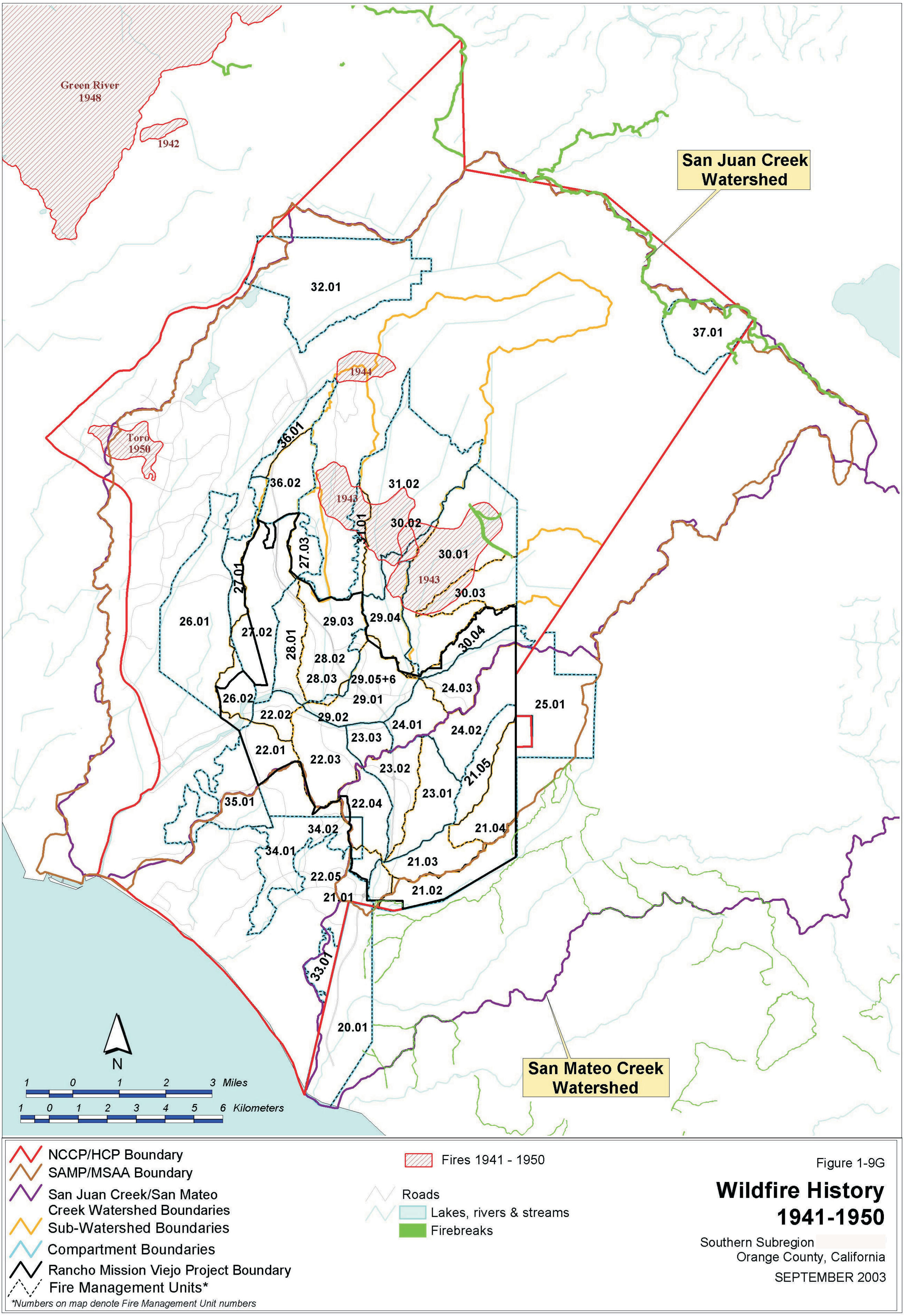


Figure 1-9G

Wildfire History
1941-1950

Southern Subregion
Orange County, California

SEPTEMBER 2003

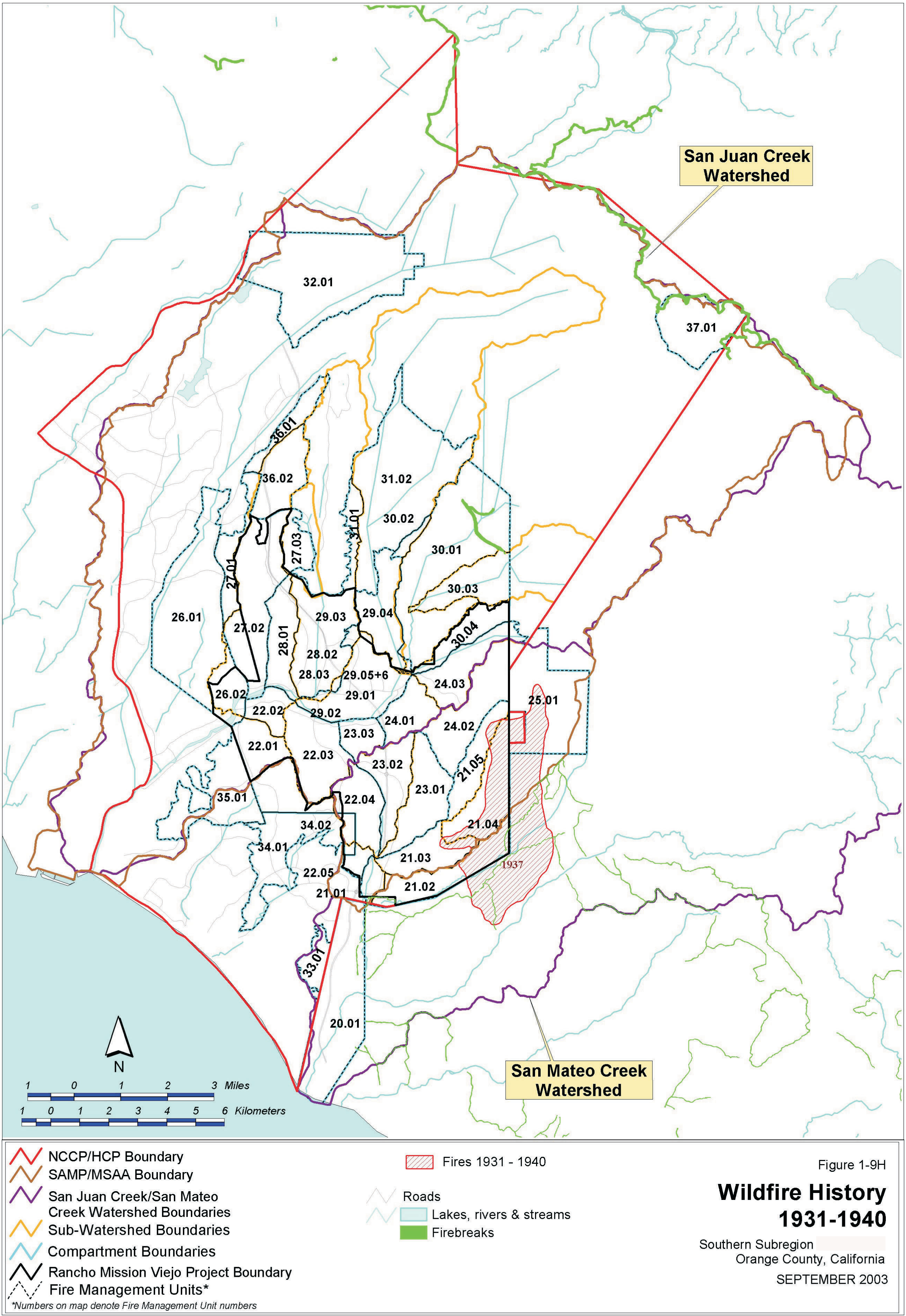
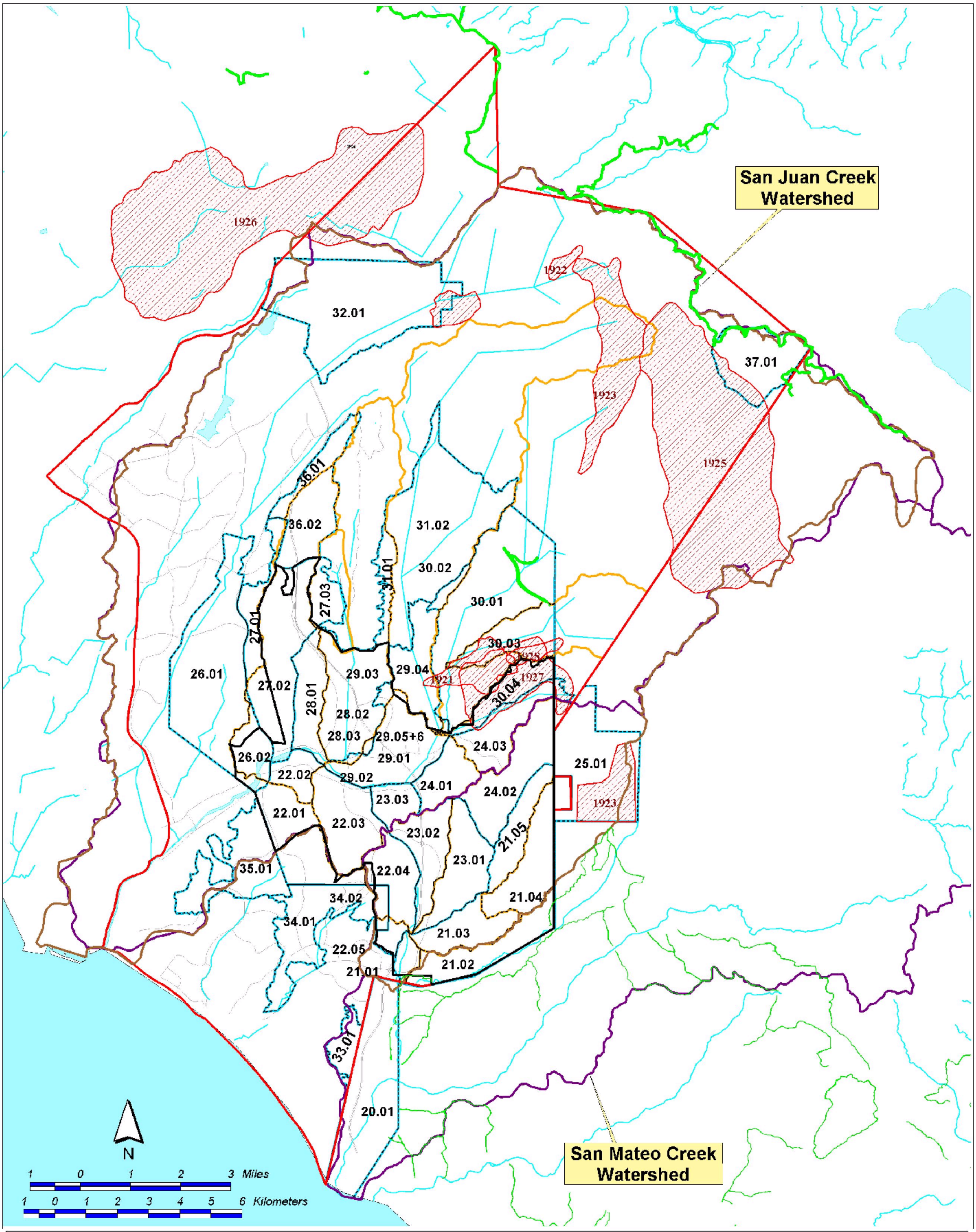


Figure 1-9H

Wildfire History 1931-1940

Southern Subregion
Orange County, California
SEPTEMBER 2003



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
Fire Management Units*

*Numbers on map denote Fire Management Unit numbers

Fires 1921 - 1930

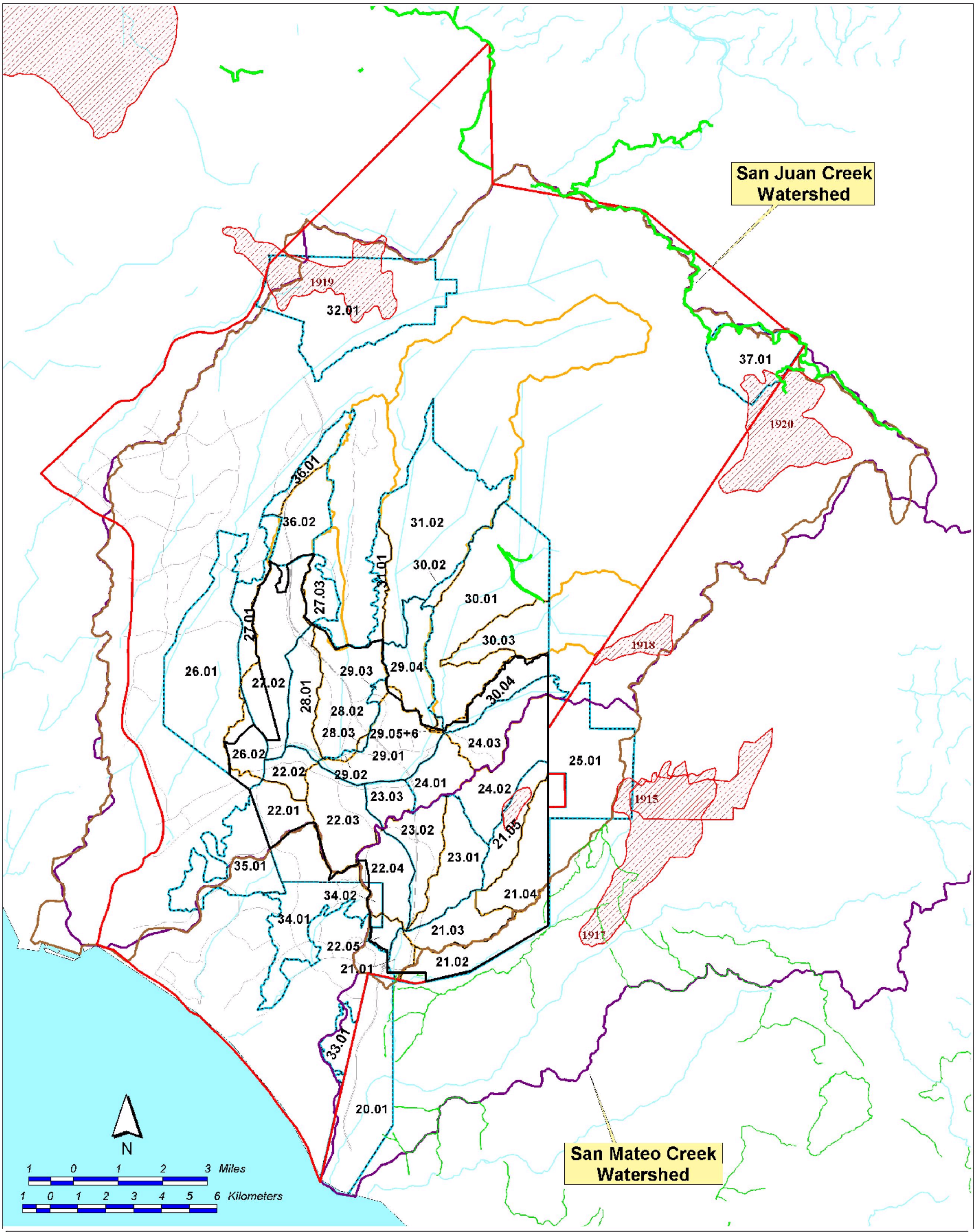
Roads
Lakes, rivers & streams
Firebreaks

Figure 1-9l

Wildfire History 1921-1930

Southern Subregion
Orange County, California

SEPTEMBER 2003



NCCP/HCP Boundary

SAMP/MSAA Boundary

San Juan Creek/San Mateo Creek Watershed Boundaries

Sub-Watershed Boundaries

Compartment Boundaries

Rancho Mission Viejo Project Boundary

Fire Management Units*

*Numbers on map denote Fire Management Unit numbers

Fires 1911 - 1920

Roads

Lakes, rivers & streams

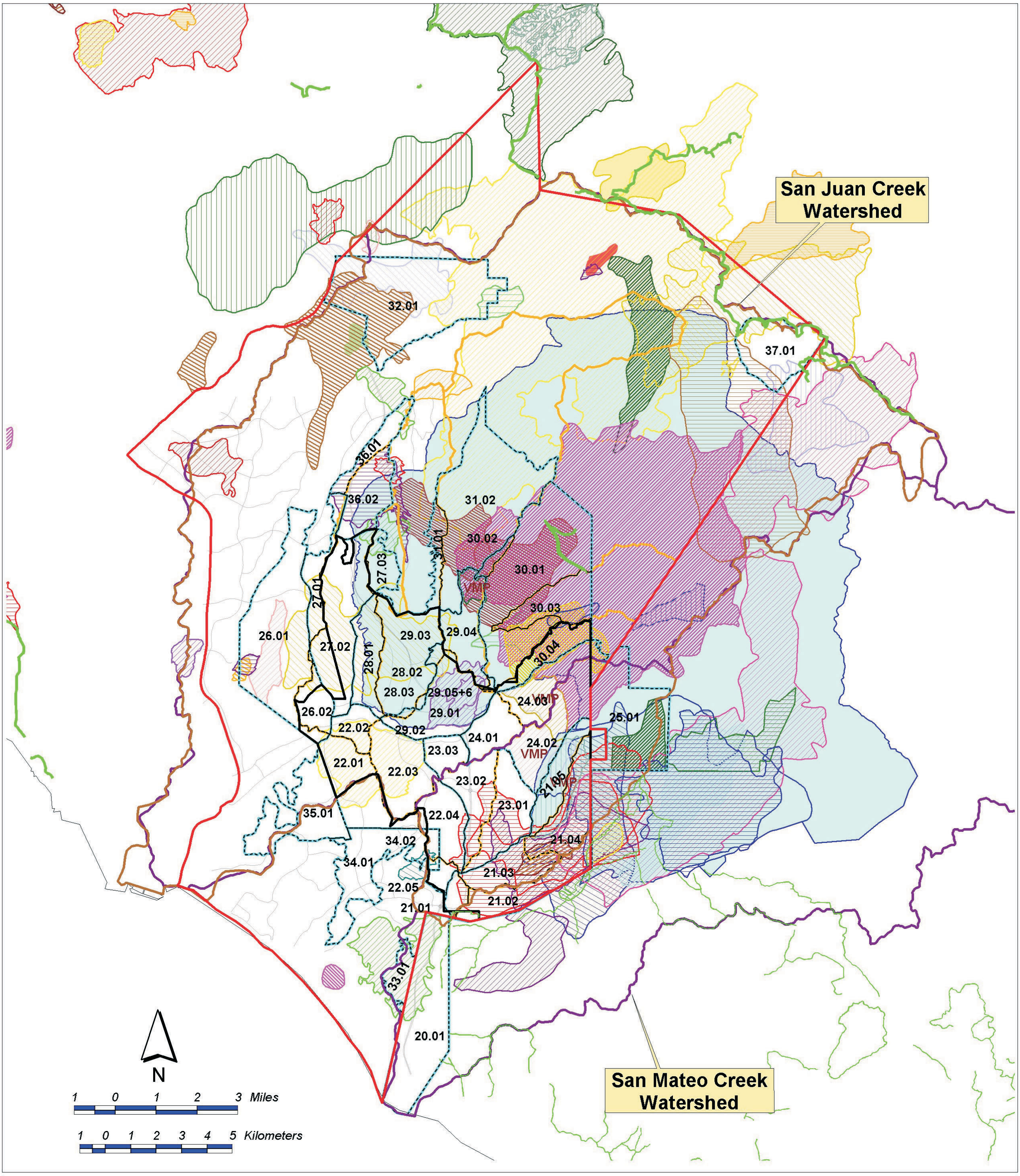
Firebreaks

Figure 1-9J

Wildfire History 1911-1920

Southern Subregion
Orange County, California

SEPTEMBER 2003



NCCP/HCP Boundary
SAMP/MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Compartment Boundaries
Rancho Mission Viejo Project Boundary
Fire Management Units*

*Numbers on map denote Fire Management Unit numbers. Refer to Part II.

Firebreaks

Wildfires by Years

1915	1928	1961	1987
1917	1937	1963	1988
1918	1943	1966	1989
1919	1944	1970	1990
1921	1950	1973	1991
1920	1952	1976	1993
1922	1954	1979	1994
1923	1956	1980	1997
1925	1957	1985	2000
1926	1958	1986	2002
1927	1959		

Figure 1-9K

Recorded Wildfire History Composite 1911-2002

Southern Subregion
Orange County, California

SEPTEMBER 2003

A variety of fuel classes are represented in the Southern Subregion. Although most fuels occur in the 1-hr and 10-hr size class, 100-hr and 1000-hr fuels do exist in the Southern Subregion's dense brush, riparian and tree fuel models located within the interior units. Two grass fuel models occur (Fuel Model 1 and Fuel Model 2), as well as three shrub fuel models (Fuel Model 4, Fuel Model 5 and Fuel Model 6) and one tree (hardwood) fuel model (Fuel Model 9). Part III of this Fire Management Plan discusses fuel models in detail.

1.9 Fire Effects

Fire is recognized as directly influencing the physical and chemical properties of soils. Many of the soils on the Southern Subregion are poor in some plant nutrients. Large portions of these nutrients are contained in actively growing plant stems. Mineral and nutrient cycling in fire type ecosystems is dominated by periodic ashing (Zinke 1977). Most nutrients are deposited on the soil surface where they are readily taken up by plants. Some portion of existing nitrogen will be volatilized. That remaining in ash is highly available in the form of ammonia nitrogen, or after nitrification, as nitrate nitrogen (DeBano et al. 1977).

Fire in shrubland communities may affect the soil infiltration rates. Large temperature gradients in the upper few centimeters of soil layer may cause vapor and gases containing hydrophobic substances to move downward in the soil profile where they condense on soil particles (DeBano 1966). Hydrophobicity may facilitate dry ravel and wet hillslope erosion processes.

Fire is effective in reducing on-site fuel loading including foliage, stems and woody portions of plants. Consumption rates may be high for litter and humus layers of soil. In addition, fire may create large amounts of dead organic matter by killing but not consuming vegetation (Wright and Heinselman 1973). This may be true within the Southern Subregion's riparian areas but is not the case on dry hillside slopes covered with dense chaparral.

Fire impacts on individual plant species and communities are often significant. Heat shock, presence of charite and change in photoperiods may all stimulate seed germination (Keeley and Keeley 1987). Post-fire response can include both vegetative reproduction and stimulation of flowering and fruiting (Malcolm 1977). Combustion of above ground biomass will alter seedbeds and temporarily eliminate competition for moisture, nutrients, heat, and light (Wright and Heinselman 1973).

On a community level, fire may also influence successional pathways through varying frequency and/or intensity.

Wildlife populations and their distribution are often regulated by fire. Fire can increase food resources for both grazers and browsers. Mass production of species, such as oaks, is also affected by fire. Insect populations, an important food source for birds and some mammals, may also be regulated by fire. Of particular consequence to wildlife is the mosaic of vegetation on the landscape. Vegetation type, structure and age class distributions are generally controlled by fire (Wright and Heinselman 1973).

Populations of insects, fungi and pathogens are also influenced by fire. Regulating stand age, sanitizing of plants and production of charcoal, which can stimulate ectomycorrhizae, can all impact the above-mentioned variables (Wright and Heinselman 1973).

1.9.1 Plant Community Response to Fire

Each plant community responds differently to wildland fire depending upon fire intensity and frequency. The key plant communities of concern in this document with regard to fire response are coastal sage scrub, grassland, oak woodlands and riparian.

1.9.1.1 Coastal Sage Scrub

Three floristic associations of coastal sage scrub are recognized in southern California: Venturan, Diegan, and Riversidian. Venturan coastal sage scrub occupies coastal sites in Santa Barbara, Ventura, and Los Angeles counties, while the Diegan association occupies coastal sites in Orange and San Diego counties. The Riversidian association occupies more inland sites in Los Angeles, Riverside, San Bernardino, and San Diego counties (Axelrod 1979; Kirkpatrick and Hutchenson 1977; Westman 1981c). Plant species common to these associations include California sagebrush (*Artemisia californica*), black sage (*Salvia mellifera*), white sage (*S. apiana*), purple sage (*S. Leucophylla*), California buckwheat (*Eriogonum fasciculatum*), brittlebush (*Encelia farinosa*) and California encelia (*E. californica*).

A complex composite of factors, particularly fire, was found to be significant in the maintenance of these habitat types (Wells 1962). With rapid crown sprouting and small wind dispersed seeds, sage scrub communities are often fire successional to chaparral at lower elevations (Cooper 1922; Wells 1962). Traditionally fires were likely to have burned hot, consuming most of the above ground biomass. Stand development periods seem to be short, with some longer period during which insufficient fuel is available to carry fire. Undisturbed stands may begin to open up their canopy in 20-25 years following periods of drought or competition for available nutrients and moisture. As canopy gaps begin to form, potential arises for invasion of annual grasses. It should be noted that major factors influencing sage scrub species distribution and composition include evapotranspirative stress, substrate type, soil nitrogen, and air pollution (Westman 1981c).

It appears that re-sprouting of dominant shrub species, particularly on coastal sites, enhances community succession in coastal sage scrub following fire (Mooney 1977). Keeley and Keeley (1982) studies within the Santa Monica Mountains estimated that 70 percent of pre-fire shrub populations re-sprouted the first year following fire, covering one-third of the ground surface by the end of the second season. The first year after a fire, herbaceous annuals dominate, with very little recruitment of perennial herbs from seed. Sprouts of dominant shrubs grow rapidly in height and dominate the site within several years. Shrub seedlings tend to be observed primarily two years after fire, possibly as a result of seed produced from first-year sprouts (Hanes 1971; Westman 1982).

Compared to coastal stands, inland stands of sage scrub recovered more slowly from fire and show greater change in post-fire composition because of reliance entirely upon seedling recruitment. Re-sprouting of dominant shrub species rarely occurs. Recovery of pre-fire species composition and cover on inland sites is therefore completely dependent upon an existing native seed bank or seeds brought onsite by wind or wildlife species (Myers and Ellstrand 1984). Generally, annual herbs dominate during the first year after a fire, but tend to decline in subsequent years as shrubs attain greater cover. Perennial herb understory species, which may grow from re-sprouts, show low recruitment for the soil seed bank. Unlike herbaceous annuals, the overall diversity of perennial understory herbs remains constant the first few years following fire. New species continue to recruit into recovering sage scrub, reaching a peak at 5 to 10 years after a fire. After the 5 to 10-year peaks in species diversity, there is a general decline in perennial understory herb species. This may be attributed to dominate shrub species increasing in cover, thereby shading out the understory herbs (Keeley and Keeley, 1984).

On coastal sites, Malanson and O'Leary (1985) suggested that early post-fire recovery on sites dominated by suffrutescent shrubs such as deer weed *(Lotus scoparius)* may suppress seedling establishment, thereby favoring re-sprouting as the dominant recovery strategy. Because suffrutescent shrubs are more abundant during shorter fire intervals, seedling establishment may be favored during less frequent fires or during fires of greater intensity.

The resilience of a particular stand of sage scrub largely depends on the re-sprouting vigor of dominant shrub species. Sites dominated by vigorous re-sprouters tend to be more competitive than sites with both weak and strong re-sprouters, although intense fires can kill even strong re-sprouters. Sites with both strong and weak re-sprouters are more likely to experience permanent alteration (Westman and O'Leary 1986). Malanson and O'Leary (1982) noted the variable nature of re-sprouting within species and suggested that it may be attributed to differences in rooting depth, carbohydrate storage, location of adventitious buds, size of plant, soil moisture conditions at the time of fire, and fire intensity.

O'Leary and Westman (1988a) compared post-fire herbaceous growth between sites with different disturbance regimes. It was found that herb species richness was similar for all sites immediately after the fire. The sites on the coast that were not affected by air pollution or close proximity to grazing rapidly returned to pre-fire levels of herb diversity in conjunction with rapid recovery of shrub re-sprouts. However, a coastal site adjacent to grazing tended to become dominated by introduced annual grasses with poor recovery of dominant shrubs. The introduction of competitive annuals on sites in proximity to grazed areas occurs due to the condition of the adjacent grazed area and the presence of annual grasses, seeds caught in the hair of cattle transported to the site from other areas and seed material in waste deposited on the ground.

Factors such as slope, aspect, and substrate type appear to have an effect on distribution patterns of herbs in sage scrub after fire. These variations in response may be driven by temperature and available moisture associated with insulation differences on opposing slopes. In addition, differences in soil temperature on opposing slopes may affect seed survival and also act as a factor in determining species distributions (O'Leary 1988).

Comparative analyses of fire response of two different sub-associations of Venturan sage scrub characterized by different soils and aspect revealed that species richness, cover, and equitability on north-facing slopes were higher than on south-facing slopes. This was attributed with relatively mesic conditions under which the particular sub-association develops (O'Leary 1990). Malanson's (1984) simulations of shrub response to fire interval and intensity indicate that long-term fire trends are unlikely to have caused the sharp boundary between these two sub-associations of coastal sage scrub.

Because of the close association of sage scrub and chaparral throughout their geographic range (Gray and Schlesinger 1980), fire management strategies for these two plant communities have largely been the same. Studies have indicated, however, that the successional processes, and therefore, fire intervals for these two plant communities may be different. Unlike chaparral, coastal sage scrub shrubs are able to establish by seed and re-sprout on a continual basis in the absence of fire. Thus, a stand of coastal sage scrub may be typically mixed aged. This indicates that the optimum fire interval for coastal sage scrub may be different than chaparral, which may also explain the need for longer fire-free intervals in chaparral plant communities (Malanson and Westman 1984; Malanson 1985).

While it may be true that fire intensity in chaparral increases with longer fire intervals, a decline in leaf litter in coastal sage scrub over time can decrease fire intensity at longer fire intervals. Although the total annual litter fall in coastal sage scrub is similar with that of chaparral the low productivity, soft wood, green tissue, and open vegetation structure of coastal sage scrub may favor more rapid decomposition and prevent large fuel accumulations beneath the plants (Grey and Schlesinger 1981). Fire intensity in coastal sage scrub is likely more dependant on weather conditions than on stand age (Malanson and O'Leary 1985). More intense fire suppresses crown sprouting and consequently promotes herb flora.

Malanson (1985) utilized a fire behavior computer model to analyze demographic competition of five coastal sage scrub species under different fire intervals. Short fire intervals of 10-20 years may greatly reduce or eliminate some species, while longer fire intervals allow for the maintenance of species diversity. Unusually short fire intervals produce anomalous vegetation responses in coastal sage scrub (Zedler, 1983). After 2 years, many shrub species failed to re-sprout or re-seed.

The Point Loma Ecological Reserve, which is managed by the Department of Defense, United States Navy and the National Park Service, Cabrillo National Monument has not had fire in this coastal sage scrub/chaparral ecosystem since 1871. Many of the coastal sage scrub and chaparral species are dropping out, specifically ceanothus (*Ceanothus verrucosus*). Yet soil samples taken throughout the Reserve contain viable seed from plants no longer observable on the Reserve. When short duration intense heat is applied to these samples species germinate that were once represented within the Reserve. A high intensity fire disturbance is needed to restore the Point Loma Reserve back to its pre-settlement vegetative condition (Zedler 1995).

1.9.1.2 Grasslands

After fire, cover, density, and seedling establishment of purple needlegrass (*Nassella pulchra*) often increases as a result of increased soil temperature, light intensity, and nutrient release, and decreased standing litter (Ahmed 1983, Brown 1982, Dyer 1993, Dyer 1996, and Langstroth 1991). Regeneration occurs from tillers at the soil surface, fragmentation of bunches, and/or by seedling establishment. Needlegrass stands that experience severe fire have larger decreases in individuals' basal area and foliage height in the 1st postfire year but are more likely to increase by fragmentation. These patterns are more pronounced with short-duration grazing, particularly in early spring (Dyer 1993 and Langstroth 1991).

Annual grasses have larger seeds than purple needlegrass and are better adapted to establishing in litter layers. For this reason, fire can increase purple needlegrass seedling establishment, particularly in old stands where litter accumulation is highest (Ahmed 1983, Dyer 1993 and Langstroth 1991). Adult individuals are also benefited by reduction of competition from annual grasses. Even though fire during periods of rapid growth can be detrimental to purple needlegrass, it is generally more damaging to nonnative annuals (Ahmed 1983 and Bartolome 1981). Some studies, however, have found fire and/or grazing effects on cover, density, or seedling establishment of purple needlegrass were highly variable or insignificant, suggesting a large influence of climate on purple needlegrass' response to fire (Dyer 1996 and Hatch 1999).

Fire regimes: There is little direct physical evidence of the historical extent of purple needlegrass and less about historic fire frequencies in the communities where it occurs. Most agree, however, that purple needle grass' abundance was historically greater, and fire exclusion has been a factor in its decline (Bartolome 1981, Brown 1982 and Langstroth 1991). In the coastal scrub, chaparral, and oak woodland, fire frequency declined in the early 1900s with restrictions against burning; in grasslands fire frequency declined in the 1840s when heavy grazing and intermittent drought reduced fuels (Brown 1982 and Greenlee 1990).

Before Spanish settlement, California prairie was used by tule elk, pronghorn antelope, and mule deer, but grazing was intermittent enough to allow dominant grasses to regrow and support fire (Brown 1982). In many areas where purple needlegrass and nonnative annuals now coexist, purple needlegrass and native annuals were historically mixed. Here, the interaction of fire and grazing likely reduced competition from annual grasses, reduced woody species encroachment, and improved purple needlegrass regeneration (Dyer 1997 and Langstroth 1991).

One study of vegetation dynamics in coastal sage scrub, chaparral, and coast live oak woodland near Santa Barbara found that without fire or livestock grazing, coastal sage scrub was replaced by oak woodland at a rate of 0.3% annually. Grassland to coastal sage scrub transition occurred at a rate of 0.69% per year, and oak woodland reverted to grassland at a rate of 0.08% per year. On burned areas without livestock grazing or on unburned sites with livestock grazing, rates of transition of grassland to coastal scrub and coastal scrub to oak woodland were lower. On areas burned without grazing or grazed without burning the rate of oak woodland reversion to grassland was higher than on areas with neither burning nor grazing (Callaway 1993).

In chaparral and coastal scrub, early postfire vegetation is dominated by native and nonnative annuals. Herbaceous vegetation is greatest in areas where fire eliminates nonsprouting shrubs (Keeley 1990 and Mensing 1998).

Purple needlegrass and other perennial grasses are more abundant after fire in coastal sage scrub than in chaparral. Fire repeated in less than approximately 3-year intervals often causes the herbaceous sere to persist (Keeley 1990). Conversion of purple needlegrass grassland to coyote bush/ripgut brome communities has been observed with 24 years of fire exclusion (Langstroth 1991).

Purple needlegrass is present in oak and pine woodlands and in the early seral stages of mixed evergreen forests, redwood and coast Douglas fir forests. Generally, purple needlegrass and other herbaceous species are present in later successional oak woodlands only in intercanopy areas. Closed stands have up to 5 inches (12.7 cm) of oak litter that essentially eliminates grass growth (Plumb 1983).

1.9.1.3 Oak woodland

Coast live oak (*Quercus agrifolia*) is exceptionally fire resistant, more so than other California oak species. Evergreens are often better able to conserve nutrients than deciduous species and are favored in fire prone environments (McDonald 1981). Low intensity surface fires have little effect on mature coast live oak. Saplings and seedlings generally recover quickly from low to moderate intensity fire (Dagit 2002, Plumb and McDonald 1981). Because of mortality among small diameter oak trees, frequent fire limits coast live oak invasion of grasslands (Mensing 1998). Mature oaks are more likely to be damaged by fall fires than early season fires. Severely burned oaks are vigorous sprouters (Plumb and Gomez 1983).

Acorns on the soil surface are killed by low intensity fire, where animal-buried acorns usually survive moderate intensity fire, sometimes resulting in high rates of post fire establishment (Davis, Keller, Parikh, and Florsheim 1989; Lawson, Zedler, and Seiger 1977).

Fire frequency largely defines the extent of coastal sage scrub, chaparral, and oak woodland; in these habitats decreasing fire frequency tends to favor the development of coast live oak. One study of vegetation dynamics in coastal sage scrub, chaparral and oak woodland near Santa Barbara, California found that without fire or livestock grazing, coastal sage scrub was replaced by coast live oak woodland at a rate of 0.3% annually. Again without fire, grassland to coastal sage scrub transition occurred at a rate of 0.69% per year, and oak woodland reverted back to grassland at a rate of 0.08% per year. On burned areas without livestock grazing, rates of transition of grasslands to coastal sage scrub and coastal sage scrub to oak woodland were much lower and the rate of oak woodland reversion to grassland was higher (Callaway and Davis1993). Sites without shrub increase are generally south facing and/or on shallow soils (Griffin 1977). Generally, grass is present in open stands while closed canopy stands have up to 5 inches of oak litter which prohibits the presence of grass (Plumb and Gomez 1983).

Fire exclusion in coastal sage scrub and mesic chaparral communities allows coast live oak to increase in density and reduce understory diversity and abundance (Mensing 1998; Van Dyke, Holl and Griffin 2001). Van Dyke and Holl recommend prescribed burning in coastal sage scrub to maintain scrub species and associated herbaceous species and to slow coast live oak expansion.

Flammability of coast live oak, coastal sage scrub and chaparral communities with a coast live oak component is of particular concern because of their high fuel loadings and proximity to developments in interface areas. Some fire-excluded chaparral habitats have fuel accumulations of 30 to 40 tons per acre (Hecht-Poinar, Costello and Parmeter 1987).

Fuel modification zones in the immediate areas of development provide the best measure of protection for structures encroaching into wildland areas. Recommendations for property protection include: planting trees away from the structures so at maturity the tree crowns are no closer than ten (10) feet to the structure, trimming up low branches up to six (6) feet from the ground, eliminating all shrubbery from beneath the canopy of the planted trees, selecting less flammable native plants for landscaping (see the Orange County Approved Plant List in Appendix A) and using non flammable construction materials (East Bay Municipal Utility District 1992; Franklin 1997).

Domestic goat grazing (at a rate of 240 goats per acre for 1 day) in conjunction with prescribed fire, has been used successfully to reduce fuel loadings and fuel continuity in dense coast live oak, coastal sage scrub scrub/chaparral near housing developments (Tsiouvaras, Havlik, and Bartolome 1989).

1.9.1.4 Riparian

Coast live oak associates in riparian areas include white alder (*Alnus rhombifolia*), California sycamore (*Platanus racemosa*) and Fremont cottonwood (*Populus fremontii*) all of which sprout vigorously after fire. Severe high intensity fires were apparently historically rare in riparian habitats. Currently most fire in riparian zones is accidental and of high severity, causing relatively high rates of top-kill and basal sprouting of all these species (Barro 1989; Davis, Keller, Parikh, and Florsheim 1989). Riparian zones comprise the least number of acres by vegetation type representing between 2 and 5% of the total acres in the Southern Subregion, yet they contain the greatest mix of biodiversity richness. Fires in riparian zones should be suppressed at the smallest size possible.

Fire managers in southern California utilize fire control lines in coast live oak riparian woodlands when planning broadcast burns of adjacent grassland, chaparral and coastal sage scrub. The control lines are burned out to create a fuelbreak between the riparian zone and the adjacent fuels targeted for treatment with prescribed fire (Dougherty and Riggan 1982).

1.9.2 Wildlife Response To Fire

Because so little has been published on the response of wildlife to fire in coastal sage scrub, this summary relies heavily on the fire ecology literature as it relates to other habitats, especially chaparral. Of the papers cited here, only Price and Waser (1984), Moriarty et al. (1985), and Stanton (1986) pertain specifically to coastal sage scrub. Writing in 1969, Udvardy stated that the literature on special adaptations toward fire resistance in animals is scarce, and the effect of recurring fires on their distribution has not yet been assessed. This account will address several general topics before discussing selected taxonomic groups in more detail.

The role of disturbance in creating early successional habitats, and how it relates to the overall health of wildlands, is receiving increasing attention in the conservation biology community (e.g., Litvaitis 1993). Under natural conditions, fire is the most common disturbance in many plant communities, including coastal sage scrub. The positive role of fire in maintaining a mosaic of habitats has often been emphasized (Fox and McKay 1981, Quinn 1982, Willan and Bigalke 1982, Pyne 1984). The latter author noted that the variable intensities of fire ensure that a variety of biotic ensembles, a mosaic, persists. The following summary was also provided:

"Free burning fire, it is argued, is a primary mechanism for ensuring complexity, variety, and ultimately stability in natural systems."

The indirect influence of fire (primarily the temporary loss of habitat) has long been recognized as being far more important than direct impacts (Leopold 1933). Still, considerable attention has been given to the fate of wildlife during fires. The negative observations of Chew et al. (1959) are the exception. They found 43 dead mammals and two dead birds in 1.7 acres following a Malibu, California chaparral fire and suggested that the fire's toll on wildlife was enormous. Howard et al. (1959), Stoddard (1903), Komarek (1969) and Biswell (1989) especially downplay the loss of life (birds and animals) due to wildfire, based largely on their experiences with controlled burns, which typically burn with less intensity and slower rates of spread than wildfires. Leopold (1933), Lawrence (1966), Catling et al. (1982), and Pyne (1984) took more moderate positions, suggesting that few birds and mammals die in wildfires, but acknowledging that under certain conditions, many animals may die.

Kaufman et al. (1990) listed direct causes of mortality in fire: burns, heat stress, asphyxiation, physiological stress, trampling, and predation while fleeing. Most insects are not believed capable of escaping wildfire (Komarek 1969, Hogue 1993).

Komarek (1969) provides considerable information concerning animal responses to fire, and included a lengthy appendix detailing specific species' reactions. Most of his observations were in the southeastern Untied States, in the general vicinity of the Tall Timbers Research Station in Tallahassee, Florida. He observed ants relocating their nests (including eggs and larvae) from burned areas to unburned vegetation within an hour after burning.

Komarek (1969) found frogs seeking moist areas to avoid fire and heard the spring chorus of certain species resume soon after a fire passed by a breeding pond. Similarly, he found little evidence of lizards or snakes killed by fire. He watched hispid cotton rats (*Sigmodon hispidus*) herding and carrying young to safety ahead of fires, and never found dead young in burned nests.

Recent surveys have shown large numbers of snakes being killed during coastal prescribed burns. Thirty-five dead snakes were collected in a 25-acre burn (Fisher, unpublished data). The majority of animals collected were western rattlesnakes (*Crotalus viridis*). Fisher has proposed that fire directly affects the heat sensors of these animals and increases the chance of individuals being killed. Still a large number of live snakes were observed in the same units, following fires. This can be attributed to those individuals that survived in rocky out crops or took refuge in ground squirrel, fox and rabbit burrows.

In a controlled experiment, Howard et al. (1959) measured the lethal temperature for several chaparral rodents at 138-145°F. Burrows a few inches deep were sufficient to insulate animals from these temperatures as fire burned on the surface. Lawrence (1900) examined this issue further, finding that three (3) inches of depth was probably enough to survive heat and increased vapor pressure in burrows. He suggested that post-burn predation is probably a more restrictive factor on small birds and mammals than the fire itself. Still, Wirtz (1995) found species requiring brush for cover and/or food, like the California gnatcatcher, are most severely impacted by fire, and require the longest time to recover to pre-fire densities.

Some animals are drawn to active fires. Biswell (1989) reported that birds have been observed to fly in back of a fire and begin feeding almost immediately. Raptorial birds and predatory mammals exploit birds and small mammals fleeing fires, while flycatchers, swallows and others aerial feeders prey on displaced insects (Stoddard 1963, Komarek, 1969). Other species, especially ground feeders, such as mourning doves (*Zenaida macroura*), northern flickers (*Colaptes auratus*), American robins (*Turdus migratorius*), bluebirds (*Sialia sp.*), sparrows, and finches may forage on burned areas immediately following fire (Stoddard 1963). Komarek (1969) noted many instances of birds and mammals consuming ash following fire, presumably as a dietary supplement.

Quinn (1982) lamented the fact that the study of insects in chaparral and other Mediterranean-type ecosystems has been largely ignored, especially in view of the strong influences insects have over plant communities.

Force (1982) conducted a four-year post-fire study in chaparral of the San Gabriel Mountains and found that pollen-nectar feeders and predatory insects can be very abundant beginning in the first spring after a burn. Phytophagous insects (other than flower feeders) and parasitic insects more slowly establish in the burn. Fourth year insect richness and diversity showed a dramatic increase after an overall three-year decreasing trend.

Hogue (1993; page 46) discussed "fire beetles" (genus *Melanophila*, family Buprestidae) and smoke flies (genus *Microsania*, family Platypezidae), noting that both are attracted to heat and smoke and may arrive on a burning plot before the flames recede. Lawrence (1966) found insects to be particularly susceptible to predation by California quail (*Callipepla californica*), California towhees (*Pipilo crissalis*), and western meadowlarks (*Sturnella neglecta*) following fire.

Birds, as a group, have received the most attention in wildlife fire studies. The benefits of fire in game management have been especially well covered. In attempting to summarize the effects of wildland fire on wildlife, Pyne (1984) stated that, in general, there tends to be a slight increase in avifauna and relatively constant number of mammal species following fire. The size of individuals tends to increase in both birds and mammals due to the abundance of both seeds and insects on burned over areas for the first several years following a fire.

Studying chaparral in the Sierra Nevada, Lawrence (1966) found that many species were severely exposed to predation in the bare ash following fire, and most small mammals and brush dwelling birds decreased rapidly; predatory birds and mammals were found to increase. Further, with time, brush-dwelling species declined as forbs and grasses increased, while grass-dwelling species increased. No species were eliminated altogether. This finding points out that nothing is static. Many species benefit with disturbance and then slowly decline in numbers as the species they replaced begin to increase as the site returns to pre-fire disturbance conditions.

Komarek (1969) pointed out that birds and mammals are often attracted to a "greening" burn site, where they feed on tender shoots unavailable elsewhere.

Without specifying habitats, Biswell (1989) claimed that one could expect an increase in bird numbers the first year after fire, especially seed-eating birds.

Lawrence (1966) and Wirtz (1982) present the results of two relatively long-term studies of bird response to fire in chaparral. Lawrence found mourning doves and western meadowlarks to be among the earliest users of burned areas at his Sierra Nevada study site, and the degree of habitat recovery in the first year following fire was sufficient to allow accelerated reproductive rates in these species. He documented an overall increase in nesting bird density following fire, especially among seed-eating birds. Increased numbers of predators following the fire included sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk (*Accipiter cooperii*) red-tailed hawk (*Buteo jamaicensis*), American kestrel (*Falco sparverius*), great horned owl (*Bubo virginianus*), and common raven (*Corvus corax*).

Wirtz (1982) found both species richness and species diversity to increase in the 42 months following fire at his study site in the foothills of the San Gabriel Mountains. No increase was noted in the number of omnivorous birds or birds that take insects from the air (flycatchers), but increases were noted in the number of insect and seed-eating birds (towhees, quail and meadow larks). These differences were most pronounced in the first year following the fire. Species that glean insects from vegetation and insect and fruit-eating species exhibited a decrease in the use of burned areas.

Moriarty et al. (1985) and Stanton (1986) compared bird communities on a burned coastal sage scrub site and control site in Pomona, California. The initial study showed greater species richness on the control site, but similar numbers of individuals on both sites, due in large part to the presence of ground-feeding finches. Substantial similarity between the two sites was evident within one year of the fire. Wrentits (*Chamaea fasciata*), California thrashers (*Toxostoma redivivum*), and California towhees were more common on the control site, while mourning doves, scrub jays (*Aphelocoma coerulescens*), house finches (*Carpodacus mexicanus*), lesser goldfinches (*Carduelis psaltria*), and American goldfinches (*C. tristis*) were more common on the burned site.

The follow-up study by Stanton (1986) was completed less than three years following the fire. Reduced species richness was again found on the burned site, with similar numbers of individuals on the two sites. Most species preferred the control, with the following species among the exceptions: American kestrel, Say's phoebe (*Sayornis saya*), western kingbird (*Tyrannus verticalis*), yellow-rumped warbler (*Dendroica coronata*), lazuli bunting (*Passerina amoena*), house finch, and lesser goldfinch. Greater heterogeneity of habitat was offered as the explanation for greater bird use of the control site, and it was suggested that coastal sage scrub might not fit the general pattern of increased bird use following fire in chaparral.

Two sensitive birds that utilize coastal sage scrub polant communities, the coastal population of cactus wren (*Campylorhynchus burnneicapillus*) and coastal California gnatcatcher (*Polioptila californica californica*) show some negative correlation to fire. Rea and Weaver (1990) point out that fire is apparently the primary limiting factor in the distribution of cactus in southern California. In coastal California, cactus wrens are restricted to coastal sage scrub with tall cactus. On Camp Pendleton, in San Diego County, Tutton et al. (1991) found that 80 percent of known coastal California gnatcatcher locations were in areas that had not burned in at least 16 years. However, in other coastal sage scrub areas unburned in many years, fire may actually increase habitat suitability for gnatcatchers.

In the case of the 1993 Laguna Fire approximately 13,000 acres of natural vegetation in the San Joaquin Hills burned including 6,800 acres of coastal sage scrub. Only 470 acres of coastal sage scrub within the burned area was left unburned or only lightly burned. Prior to the fire an estimated 127 pairs of California gnatcatchers and 282 pairs of cactus wrens occupied this area. The fire resulted in the loss or displacement of many of the resident California gnatcatchers and cactus wrens. However, the coastal sage scrub plant community reestablished itself quickly and within two years the numbers of gnatcatchers and cactus wrens began to increase over post fire populations. In 2003, almost 10 years after the Laguna Fire, the numbers of California gnatcatchers were almost back to pre-fire population levels and could easily surpass those pre-fire population levels next year. The cactus wrens have also increased, but at a much slower rate.

The slower response is attributed to a lack of suitable cactus plants which were hit hard by the fire and recover at a much slower rate than the coastal sage scrub species.

Similar findings are being observed in the 1996 and 1997 burned areas in the Upper Chiquita Canyon Conservation Easement. A new wildfire occurred in May 2002 in the southern portion of the Conservation Easement. In spite of the recent droughts, the 1996 burned area is coming back to a mixed sage plant community and the 1997 burn is coming back to a coastal sage scrub plant community. Gnatcatchers nested in the 1997 burned area for the first time in the spring of 2003. In the May 2002 fire, population numbers declined as follows: before the fire gnatcatchers were estimated at 104 locations and after the fire were detected at 42 locations. Cactus wrens dropped from being detected at 65 locations to being detected at 30 locations. Population numbers are adequate to permit the re-colonization of the burned area as soon as the habitat recovers (Harmsworth Associates 2003).

The results of a number of studies, primarily on rodents, are hereby summarized.
Crowner and Barrett (1979) identified three major factors influencing reduced rodent numbers following fire: 1) reduced cover, 2) increased predation, and 3) reduced food availability. Kaufman et al. (1990) noted two additional behavioral factors: forced emigration and direct reduction in reproductive output.

In brush habitat in the east San Francisco Bay region, Cook (1959) found that rodents were apparently limited in the first year following a fall fire by a lack of cover, as seed was abundant by early spring. After initial "annihilation," brush-dwelling mice showed a population increase, exceeding that of a control site throughout the second year following the fire.

No small mammals were trapped immediately following a fire on a Sierra Nevada chaparral site studied by Lawrence (1966), and no marked animals from the burned area were captured in adjacent habitat. Three months following the fire, marked animals were again trapped on the burned site, confirming the survival of a resident population. The loss of adults and the degree of habitat recovery in the first year following the fire apparently stimulated the reproductive rate of brush mice, producing more young than the control site. The average ratio of body weight to body length of brush mice (*Peromyscus truei*) was reduced in the first year following the fire, but was nearly equal to control animals in the second and third years following the fire.

Blankenship (1982) found no significant difference in rodent weights between burned and unburned sites in montane chaparral in San Diego County.

Rodent species richness, biomass per hectare, and species diversity reached levels equal to, or exceeding, those in 16 to 20 year old chaparral within 15 to 24 months post-fire on Wirtz's (1982) study site in the San Gabriel Mountains. Heteromyids (Kangaroo rats and pocket mice) and California meadow mice (*Microtus californicus*) contributed significantly to early post-fire seres; woodrats (*Neotoma spp.*) and white-footed mice (*Peromyscus sp.*) contributed significantly in older stands. Because of above ground nesting, woodrats are particularly susceptible to fire, and may not recolonize burned areas for 1-2 years following fires. It is assumed that some refugia always remain, due to the normally patchy nature of burns.

A study in coastal southern California coastal sage scrub by Price and Waser (1984), suggests brush-dwelling species declined following disturbance by fire while Erickson (1993) suggested fire may have been beneficial in opening up habitat for the pacific pocket mouse (*Perognathus longimembris* pacificus) in coastal southern California coastal sage scrub.

In conclusion, our wildland ecosystems are not static, nor are the wildlife populations that inhabit these systems. Withholding fire benefits some plant and animal species and denies others and conversely, fire benefits many plant and animal species while adversely impacting others. Many species that have adapted to southern California over thousands of years need and, in fact, require fire to perpetuate themselves.

PART II – PRESCRIBED FIRE PROGRAM

PART II - PRESCRIBED FIRE PROGRAM

2.0 PRESCRIBED FIRE PROGRAM

The Southern Subregion ecosystem has been shaped by fire for thousands of years. The plants that thrive in this ecosystem are all fire adapted to the point that many of them require fire for their continued presence in this fire adapted ecosystem. The wildlife that inhabit these ecosystems are indirectly dependent upon fire to provide the habitats that these species require for continued survival.

Therefore, any strategy for the management of the vegetation in the Southern Subregion must include the use of fire on a planned and controlled basis.

2.1 Justification

Adaptive management planning must recognize the role of fire within a Mediterranean ecosystem. As previously stated, past fire events have played a decisive role in the origin and maintenance of the Southern Subregion 's current plant and animal communities. This alone does not justify the use of prescribed fire, but it does imply a need to consider fire use as a tool in an overall effort to manage the Southern Subregion ecosystem. Current literature, contemporary knowledge and the Southern Subregion's fire history further justify the active use of fire in the purposeful management of the Subregion's vegetation communities.

Although some alternatives are available, substituting the natural ecological role of fire with mechanical, chemical, or grazing treatments is not feasible over the long run. The synergistic effects of fire on any given ecosystem are complex. Charring of duff, increased insulation, heating of soils, smoke moving through vegetation layers, injuring and top killing individual plants, immediately available nutrient release and many other impacts occur during a fire event. The complexity of fire regimes is increased by the variability of fire events. Fire intensities, burn severity and fire size will vary with weather, fuel conditions, and ignition patterns. Though there will be many situations in which the use of fire is not the best management practice, it is impossible to duplicate all of the beneficial influences of a long-term pattern of fire on the wildland landscape.

With the terrain and fuel features that exist within the Southern Subregion's boundaries, fire is also considered the cheapest of all fuel management alternatives. Though cost per acre will vary between units, an average cost range of $150 to $1,500 acre, depending on the complexity of the burn, can be expected for grassland and chaparral prescribed burns.

2.2 Prescribed Fire Program Structure

All prescribed burning will be conducted with the aid of California's Vegetation Management Program (VMP). OCFA will provide resources and an overhead team for each planned burn. The Rancho Mission Viejo (RMV) staff will aid with individual plan completion and fire related monitoring for RMV Open Space. It will be the responsibility of the RMV staff to review monitoring results and adapt fire implementation. For other non-RMV lands within the Southern Subregion landowners and jurisdictions, as applicable, will aid in plan completion and fire related monitoring.

The lands within the Southern Subregion are currently classified into one of five (5) prescribed fire management categories: 1) CSS Management Sites, 2) Native Grassland Management Sites, 3) Chaparral/shrub Restoration Sites, oak woodland sites, and 5) Protection of Life and Property Sites. Each of the prescribed fire management categories has objectives and prescriptions specific to that category.

2.2.1 CSS Management (A) Sites

These sites are identified as areas in which low-density shrubs exist with a significant component of non-native grass cover. These sites would be burned selectively in an effort to reduce the cover of non-native grasses and increase the density of native shrubs.

CSS Management sites are to be burned selectively within an experimental design aimed at defining seasonal and frequency effects. Post fire grazing must be excluded from these sites in order to accurately monitor plant response to fire.

Initially, CSS units would be burned as part of an experimental design addressing specific hypothesis. This effort would be aimed at determining if fire could be used to improve composition and structure of this community. These experimental treatments would focus on fire variables within the control of management. Selected units would be burned in different seasons, varied fire intensities and varied return intervals.

2.2.2 Native Grassland Management (B) Sites

These sites are proposed to be managed by moderate intensity, high frequency fire events. Native Grassland sites will focus on maintenance of open grassland communities, providing habitat for grassland-dependent species.

Fall burning will be favored for most grassland within Southern Subregion areas. The initial fire intervals will be annually for three (3) years or less. The initial period of burning may be thought of as a restoration phase. As the site is treated with fire and species composition targets are neared, a fire regime more closely resembling the historic pattern of fire may be implemented. During this period of burning both the season and frequency of fire events will be variable. Though weighted towards the fall, spring and winter burns may also occur. After the initial 3 year burn cycle a mean fire rotation of 10 years is recommended during which units may burn multiple times or not at all during any 10 year period.

2.2.3 Chaparral/Shrub Management (C) Sites

Due to the wildland wildfire frequency, the VMP burns executed in the late 1980's and the early 1990's and the Ranch's cattle grazing program it is doubtful that any Chaparral/Shrub Management sites exist on the Rancho Mission Viejo property. However, other portions of the Southern Subregion may very well support Chaparral/Shrub sites. The objective would be to target chaparral and scrub habitats, while avoiding oak woodlands and riparian habitats. The goal would be a patchy burn (50-70% fuel volume consumption) with varying low to moderate fire intensities on a thirty (30) year rotation.

Another objective for use of prescribed fire in this vegetative type is to develop a low fuel profile zone around future planned developments located to the west of this vegetation type to minimize the probability of a high intensity wildfire entering the development under Santa Ana wind conditions.

2.2.4 Oak Woodland Management (D) Sites

Historically low to moderate intensity wildfires burned beneath oak woodland stands, reducing the amount of shrub like vegetation that could lead to crown fires and encouraging the propagation of native grassland species. Prescribed fire would be utilized to continue the presence of fire beneath these oak woodland stands on a controlled basis.

2.2.5 Protection of Life and Property (E) Sites

These sites are a mix of vegetation types in which prescribed burning may provide both fire protection for life and property and natural resource values. Some units close to residences may require additional pre-fire modifications to the vegetation (e.g. crushing, thinning, and limited mowing).Fire may also be used in combination with herbicides to increase the effectiveness of both fire and herbicides as management tools.

Burn treatments, described below, will be coordinated with activities defined in the Southern Subregion's CSS, native grassland, oak woodland and chaparral/shrub restoration and enhancement planning.

2.3 Prescribed Fire

Prescribed fire is defined as: *"the skillful application of fire to natural fuels under conditions of weather, fuel moisture, soil moisture, etc., that will allow confinement of the fire to a predetermined area and at the same time will produce the intensity of heat and rate of spread required to accomplish certain planned benefits to one or more objectives of silviculture, wildlife management, grazing, hazard reduction, etc." (Chandler et al. 1983).*

Prescribed fires fall into two categories, natural (unplanned) fires and managed (planned) ignitions as defined below:

2.3.1 Natural (Unplanned) Fire

Lightning-caused fires are an uncommon but a very possible event in the Southern Subregion. These unplanned types of fires usually do not occur under acceptable Orange County fire weather parameters conducive to wildland wildfire containment. The native vegetation is either too wet during a lighting storm or too dry to successfully plan for use of naturally ignited fires as a viable factor in shaping the ecosystem. Therefore, ignitions caused by lightning will not be utilized in the Southern Subregion.

Furthermore, any objective that could possibly be met by letting natural fires burn under a prescribed set of conditions can also be more safely accomplished in a controlled environment using prescribed fire as natural fires do not allow for the assemblage of monitoring and holding forces in a pre-planned manner.

2.3.2 Managed (Planned) Ignitions

Fires started by managed or planned ignition would be the primary source of prescribed fire in the Southern Subregion. OCFA and CDF, in order to meet the legal requirements of the State of California, have established the following guidelines. All prescribed burns must have written prescriptions and burn plans covering each specific burn unit.

2.4 Prescribed Fire Prescription Matrix

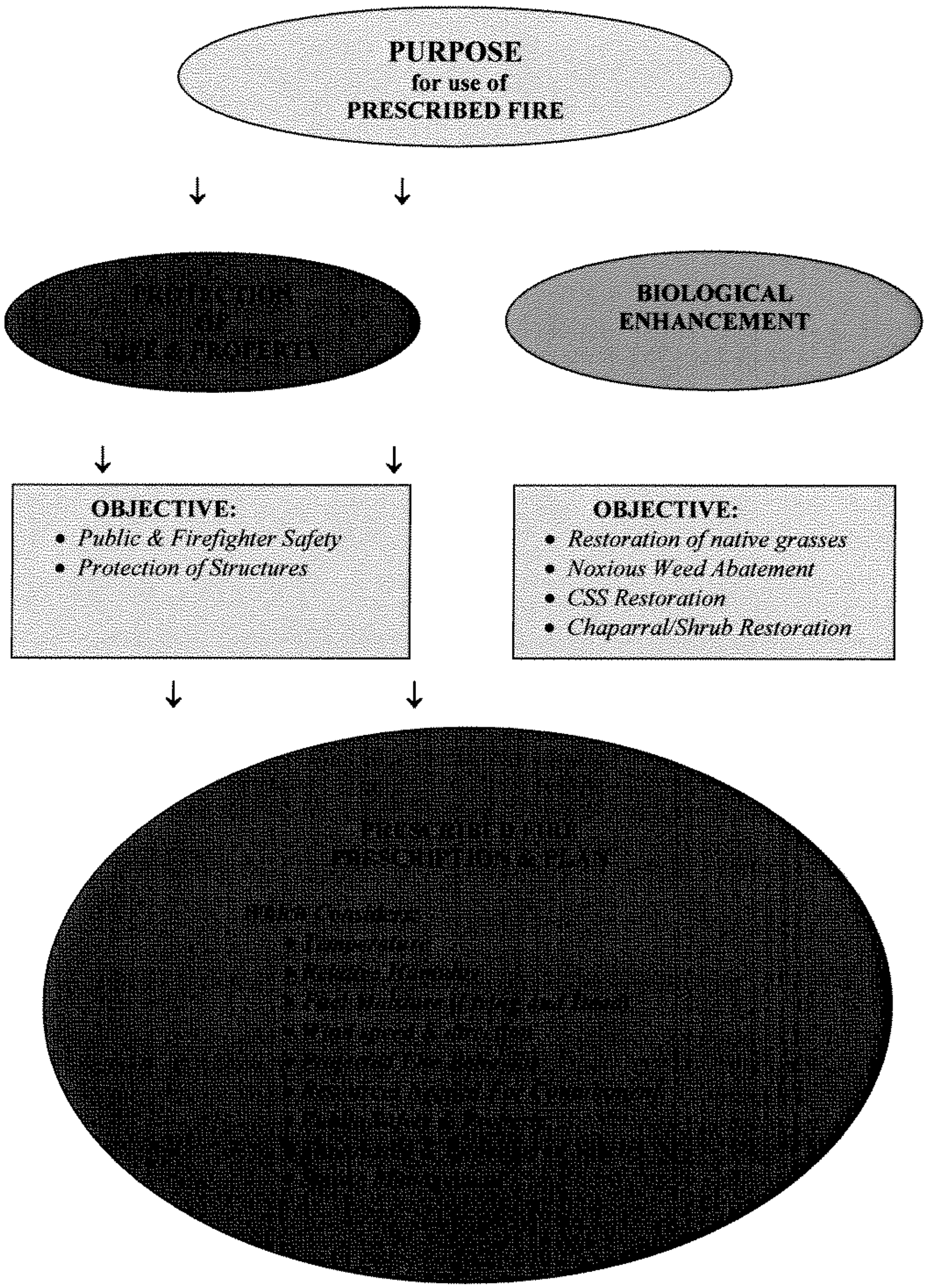
Table 2-1: This Prescribed Fire Prescription Matrix is presented to assist fire agencies and land managers in their planning of prescribed fire use within the various fuel models and fire weather parameters. *Table 2-1* depicts a range of weather parameters, which will allow for both low and moderate wildland fire behavior intensities.

Table 2-1

Prescribe Fire Prescription Matrix For Native Grassland Restoration & Maintenance, and CSS Restoration & Maintenance			
Fuel Model	1	1	2, 6 & 4
Vegetation	Grasslands	Restoration	CSS
Air Temperature (F)	**60-90**	**60-90**	**40-95**
Relative Humidity (%)	60-30	70-20	30-60
Wind Speed (mph @ 20ft)	4-8	4-8	5-8
Wind Speed (mph @ mid-fl)	1-4	2-4	2-5
1 hr Fuel Moisture (%)	**5-9**	**5-9**	**6-16**
10 hr Fuel Moisture (%)	**N/A**	**N/A**	**10-17**
Live Herbaceous			
Fuel Moisture (%)	---	---	100-300
Live Woody			
Fuel Moisture (%)	---	---	100-200
Head Fire:			
Rate of Spread (ft/min)	10-42	8-33	7-30
Flame Length (in feet)	3-8	3-8	6-22
Backing Fire			
Rate of Spread (ft/min)	3-5	3-5	3-5
Flame Length (in feet)	1-3	1-5	8-11

2.5 Prescribed Fire Planning Model

The following depicts the various elements within the Prescribed Fire Planning Model:



2.6 Pre-burn Planning Process and Checklist

2.6.1 Action Items 9 to 12 Months In Advance of Project

	Date Completed
Select burn site that meets Adaptive Management Objectives	
If VMP, sign up landowners	
Environmental review, wildlife, archaeology	
Confer with U.S. Fish & Wildlife Service	
Confer with California Fish & Game	

2.6.2 Action Items 6 to 9 Months in Advance of Project

	Date Completed
Develop burn plan and obtain burn permit	
Develop contingency plans	
Get burn plan approved by CDF if VMP burn	
Construct hand lines or dozer lines around perimeters	
Designate secondary control lines and safety zones	
Contact Southern California Edison or your utility company	

2.6.3 Action Items 3 to 6 Months in Advance of Project

	Date Completed
Develop list of required resources and volunteer help	
Involve Information Officer	
Develop Smoke Management Plan	
Approval from Air Quality Management District	
Develop contact list for prescribe burn opportunities	
Training opportunities identified with OCFA for OCFA personnel	

2.6.4 Action Items 1 to 3 Months in Advance of Project

	Date Completed
Set up portable weather station (Micro RAWS)	
Set up fuel stick at a representative site	
Take fuel moisture samples every 10 days (live and dead)	
Set up photo points and photograph before and after burn	
Develop Incident Action Plan	
Develop large briefing map	
Do fire predictions calculations	

Organize staff duties: phones, weather, biological, rovers	
Designate Landing Zone for medical emergency	
Complete handlines and interior edge preparation	
Develop test burn site	
Entry permits and gate keys issued	
Access closures for the public	
Identify radio and cell phone blind spots	
Do fire behavior predictions	
Do pre-burn vegetation transects	
Survey for nesting birds within the unit	

2.6.5 Action Items for the Last Week Prior to Project

	Date Completed
Send notifications to neighbors	
Send Press Release to local media	
Order radios from communication section	
Complete ICS forms and briefing package (Incident Action Plan)	
Put Drop Point signs in place	
Drip torches and extra parts and fuel are ready	
Have Prescribe Burn signs ready	
Move porta-potties in place	
Burn cache inventory	
Weather personnel placement	
Lookout placement	
Plan for fluids, food and coffee	
Phone list of neighbors day before and day of burn	
Call AQMD day before and day of	
Fax copy of Incident Action Plan to ECC	
Set up Check-in	
Contact Local Fire Agencies (done by dispatch center)	
Post Prescribe Burn Signs	
Conduct Operational Briefing	
Staging area organization	
Do Go-No Go Check List	
Do Test Burn	

2.6.6 "Go/No Go" check list (All items must be checked yes before the burn project can proceed)

Item	YES	NO
Prescribed burn plan (Incident Action Plan) completed and approved by appropriate jurisdictional authority(s)		
On site weather observations from preceding days indicate project will be in prescription		
Agreements with cooperating authorities are signed		
Public has been notified through Newspaper and postings on roads near the site		
OCFA and Orange County Sheriffs 911 Dispatchers notified		
Site specific current and long range weather forecasts received		
Medical Plan completed and nearest burn center location noted		
Med Evac notified about the location of the project and nearest heliport, all transmission and telephone lines are clearly marked on the map that OCFA and the Med Evac personnel have received		
Sufficient funding is on hand to execute the burning and mop up of the project		
A qualified Fire Behavior Officer is on site to take on going weather observations		
An organization chart indicating assignments is available for the pre fire briefing		
Radio communication is available for all personnel assigned to the project		
Air to ground radio frequencies are established		
All holding forces are available for initiation of the project and have been briefed		
All required equipment is in position and working properly		
The back up plan (fire suppression plan in the event of an escape) has been explained at the pre fire briefing		
A specific person is assigned on site to brief visitors and the press		
A safety briefing has been given to all personnel assigned to the project		

IF ALL ITEMS ARE MARKED "YES" THE TEST BURN CAN BE INITIATED

Location of test fire:____

Time of test fire:____

Results of test fire (Note flame length and rate of spread):

____

Item	YES	NO
Are the fuels and weather conditions representative of the burn unit?		
Is the fire behavior within the prescription parameters?		
With the existing holding forces, is fire behavior within means of control?		
Do test burn results indicate the burn objectives will be met?		
THE TEST BURN WAS SUCCESSFUL?		

IF TEST BURN WAS SUCCESSFUL, PROCEED WITH THE BURN

RX BURN BOSS:________________________________ DATE:_________

IGNITION SPECIALIST:____________________________________

HOLDING OPERATIONS SUPERVISOR:_______________________________

2.7 Post Burn Evaluation

	Date Completed
Do Post Burn Analysis and survey for dead species	
Do short Post Burn Report	
1. What we did	
2. What we burned	
3. How many acres	
4. Where the Management Objectives Obtained	
5. What didn't burn and why	
Operational debriefing conducted as a learning tool	

PART III - STRATEGIC FIRE PROTECTION PLAN

PART III – THE LONG-TERM STRATEGIC FIRE PROTECTION PLAN

3.0 THE LONG-TERM STRATEGIC WILDLAND FIRE PROTECTION PLAN

Part III, The Long-Term Strategic Wildland Fire Protection Plan, is a sub part of the overall Wildland Fire Management Plan and is written as a stand-alone document. This plan identifies those specific natural resource areas that will require enhanced fire protection through fuel management and treatment using a combination of techniques including the planned use of prescribed fire to manage habitat for Identified Species in the RMV Open Space.

3.1 Introduction

For many years protection of life and property (homes, businesses and other buildings) have been identified as the highest priority for wildland fire protection. Protection of life, public and firefighter, remains the single most important element in wildland fire protection. Resources and property now have equal weight as set out in the revised National Fire Plan (see Reducing Wildland Fire Risks to Communities and the Environment: A 10-year Comprehensive Strategy, June 2002) and comprise the second highest priority after protection of life.

The following Guiding Principles are fundamental to the successful implementation of the Strategic Fire Protection Plan and the Tactical Fire Suppression Plan discussed here:

1. Firefighter and public safety is the first priority in every fire management activity.

2. The role of wildland fire as an essential ecological process and natural change agent will be incorporated into the overall land use planning process.

3. Fire management planning, projects and activities should support land and natural resource management plans and their implementation.

4. Sound risk management is the foundation for all fire management activities.

5. Fire management programs and activities must be economically viable, based upon values to be protected, costs and land and resource management objectives.

6. Fire management planning and activities must be based upon the best available science.

Natural resource values will be evaluated on an equal basis with property values and will not automatically be relegated to a lower priority.

The Strategic Fire Protection Plan identifies wildland fire management issues relating to the protection of life and property located on lands adjoining large areas of presently existing open space lands.

3.2 The Role of Fire in the Lands of Orange County

Fire is a natural part of the southern California landscape. Fire is a periodic source of disturbance to which certain habitat types have adapted during their evolution. The Southern Subregion contains large acreages of plant communities that depend on fire for rejuvenation and maintenance of natural biodiversity. Many plant species within these communities relied on a pre-settlement natural fire regime for germination or creation of gaps for colonization. Many Threatened and Endangered and other sensitive species rely on the vegetation in the Southern Subregion to support them.

The fuel loadings in the Southern Subregion have changed due to a reduction in grazing, successful fire prevention and suppression, social values that do not embrace or understand natural systems and increased urban encroachment within or surrounding the Southern Subregion wildlands. The combination of expanding wildland/urban interface, historic fire weather patterns, and aging native vegetation within the Southern Subregion all lead to the potential for large wildland fires with significant property, cultural and natural losses.

The role of fire, both negative and positive, has been thoroughly addressed in this plan.

3.3 The Threat of Wildfire to the Wildland Urban Interface (WUI) or Intermix

Throughout Orange County, it is common to see homes, businesses, and industries being built further into wildland environments. This trend is creating an expansion of wildland/urban interface areas where structures are located next to large areas of native vegetation. Because of their location, these structures have become highly vulnerable to wildland fire.

Unsafe past practices, such as placing structures too close to the property line which led to inadequate fuel modification (reduction) between structures and undisturbed native vegetation, installation *of* combustible roofing and siding, improper landscaping, and other building design features have all contributed to wildland fire spread. These unsafe conditions can be found throughout the County of Orange, including the southern portion of the Southern Subregion.

Due to the large numbers of homes lost to wildfires over the past 10 years building codes have been revised as have fuel modification requirements. The newer construction in the Southern Subregion has been designed and built to survive the periodic onslaught of wind driven wildfires provided the homeowner continues to maintain their fire resistant landscaping. Future developments will also meet these revised building and fuel modification standards.

Generally, it is older, non-compliant residences that are the leading cause for the high number of structure losses during any serious wildland fire incident. There are three ignition sources of concern regarding structures located in a wildland environment:

3.3.1 Structure Ignition Sources

Structures ignite and burn during wildfires from these three sources of ignition.

Radiation: where heat radiates from a heat source. The air is not heated, but solid objects close to the heat source will increase in temperature. Heat can radiate through a closed window or other glazed opening and ignite curtains, drapes or other combustible materials. It can also cause wood siding to char. If the radiant heat is sustained long enough the siding will ignite.

Convection: as super heated air rises it spreads ground fire up into the brush or tree canopy or up a slope by convection. Super heated air can carry firebrands for long distances. Firebrands need a receptive fuel bed [leaves, twigs, or other combustible materials (roofing, lawn furniture, etc.) to continue the spread of the wildfire.

Conduction: molecules move heat through a solid object. Heat will transfer through wood, although very slowly. Conduction is not considered a major factor in wildland fire spread and will not be discussed any further.

3.3.1.1 Radiation

Wildland fires can cause ignition of structures by radiating heat to the structure. Radiation exposure depends on the intensity and the duration of the flame front. The radiant heat exposure to a structure (and chance of ignition) will increase due to: 1) an increase in the size of the flames, 2) an increase in the amount of surface area exposed to the flames, 3) an increase in the duration of the exposure, and 4) a decrease in the distance between the flames and the structure.

3.3.1.2 Convection

Ignition of a structure by convective heat transfer requires the flame to come in direct contact with a combustible element of that structure. Direct contact with the convection column also can cause ignition but the temperature of the column is generally not hot enough to ignite a structure.

In the convective heat process, the duration of the exposure to the flame is more critical than the size of the flames. Therefore, "survivable space " clearing to prevent flame contact with structures must include any materials capable of producing even small flames (for example, cured grasses, low ground cover, leaves or pine needles on roofs and combustible yard furniture). Sufficient set backs from edge of slope also prevents the loss of structures due to convection.

Firebrands are pieces of burning materials that detach during a fire due to the strong convective drafts in the burning zone. Firebrands can be carried a long distance (one mile or more is not uncommon) by wildland fire drafts and/or strong fire generated winds or during strong Santa Ana winds. The chance of these firebrands igniting a structure will depend on the size of the firebrands, how long the fire brand burns after contact with a combustible fuelbed, and the design, materials used and construction of the structure.

Again, Orange County Fire Authority (OCFA) currently has ordinances and policies that have helped minimize these wildland fire threats on new developments built within the County. The biggest wildland fire problem presently facing OCFA and local fire jurisdictions is that there are still many residential structures that were built prior to the implementation of OCFA Wildland Urban Interface Ordinances. In the Southern Subregion there are numerous subdivisions and individual structures in the southern portion of the Southern Subregion that predate the revised building and fuel modification requirements.

3.4 Fire Management Compartments (FMC's) and Fire Management Units (FMU's)

Fire protection planning for the Southern Subregion Planning Area begins with the formulation of individual Fire Management Compartments (FMC's). Each compartment is further subdivided into one to six individual Fire Management Units (FMU's) depending on the size of the compartment.

3.4.1 Fire Management Compartments (FMC's)

The Southern Subregion Fire Management Compartment (FMC) boundaries are based upon the most likely locations to make a stand against an approaching wildfire and/or current regional park status. The boundary of each FMC was determined by its potential to contain a wildland wildfire. Roads, ridge tops, water courses (lakes, creeks or stream bottoms), key vegetation changes (brush to grass or grass to riparian) and other natural or physical barriers to wildland fire or key changes in fuel continuity helped to shape these boundaries. Two compartments, 20 and 25 are actually outside the County of Orange and outside the Southern Subregion. OCFA includes these two units as they, by agreement, provide fire protection to these two compartments. Additionally fires starting in these compartments typically burn into the Southern Subregion during periods of high intensity Santa Ana winds. The titles and acreages of the 18 compartments are displayed in *Table 3 -1.*

Table 3 -1 Fire Management Compartment Data

FMC No.	Title	Acres	No. of FMU's
20	San Onofre State Park	2,996	One
21	Talega/La Paz	5,150	Five
22	Central San Juan/Trampas/Cristianitos	5,102	Five
23	Lower Gabino/Blind	3,110	Three
24	Upper Gabino/Blind	3,869	Three
25	San Diego County	2,626	One
26	Ladera	4495	Two
27	Wagon Wheel/Chiquita Ridge	3,762	Three
28	Chiquadora/West Gobernadora	3190	Three
29	East Gobernadora/Bell Canyon	3178	Six
30	Caspers	6364	Four
31	Starr Ranch	4689	Two
32	Foothill/Trabuco Special Planning Area	4570	One
33	Presidential Heights	455	One
34	Donna O' Neill Land Conservancy	1957	Two

35	Prima Deshecha Regional Park	1845	One
36	Upper Chiquita	1750	Two
37	El Cariso Village	1594	One

3.4.2 Fire Management Units (FMU's)

Each compartment was divided into subunits called Fire Management Units (FMU's). A traditional FMU is any land management area definable by objectives, land features, access, values to be protected, political boundaries, fuel types or major fire regimes. In the case of the Southern Subregion, watershed boundaries were used to define the FMU's.

The fire suppression tactical strategy is that all wildland fires occurring within a FMU should be contained to that specific FMU and not be allowed to encroach upon another FMU if at all possible. It is fully understood that under severe wildland fire weather conditions (Santa Ana Winds, or other periods of extreme hot, dry weather and strong winds) wildland fires may not be able to be contained to the FMU or even within the compartment of origin. However, this is a reasonable fire suppression guideline for all other average or above average fire weather conditions.

Fire protection treatments (fuel modification by mechanical means, hand-labor means or prescribed fire or a combination of all three) have been planned by specific FMU's. The role that fire will play in maintaining or enhancing key target habitats will also be planned by individual FMU's.

Figure 3-1 depicts where the 18 Fire Management Compartments and their individual Fire Management Units are located within the Southern Subregion (note that the two areas to the east of the Southern Subregion, CNF and MCB Camp Pendleton have their own Wildland Fire Management Plans).

3.5 Fuel Treatment to Protect Life and Property

The protection of Life and Property begins at each individual residence. If the homeowner does not have: 1) the appropriate "survivable space", 2) a non-combustible roof, and the other California Firesafe requirements implemented, then the fire department does not stand a reasonable chance of protecting that home from a high intensity wildland fire. However, there are many situations where a homeowner does meet most of the Firesafe requirements, but does not have the necessary room on their property to comply with the OCFA or local fire jurisdiction requirement of 170 feet of low volume fuel modification treatment from their structure. Often this means that a homeowner must either encroach upon adjoining lands or not meet the 170-foot requirement.

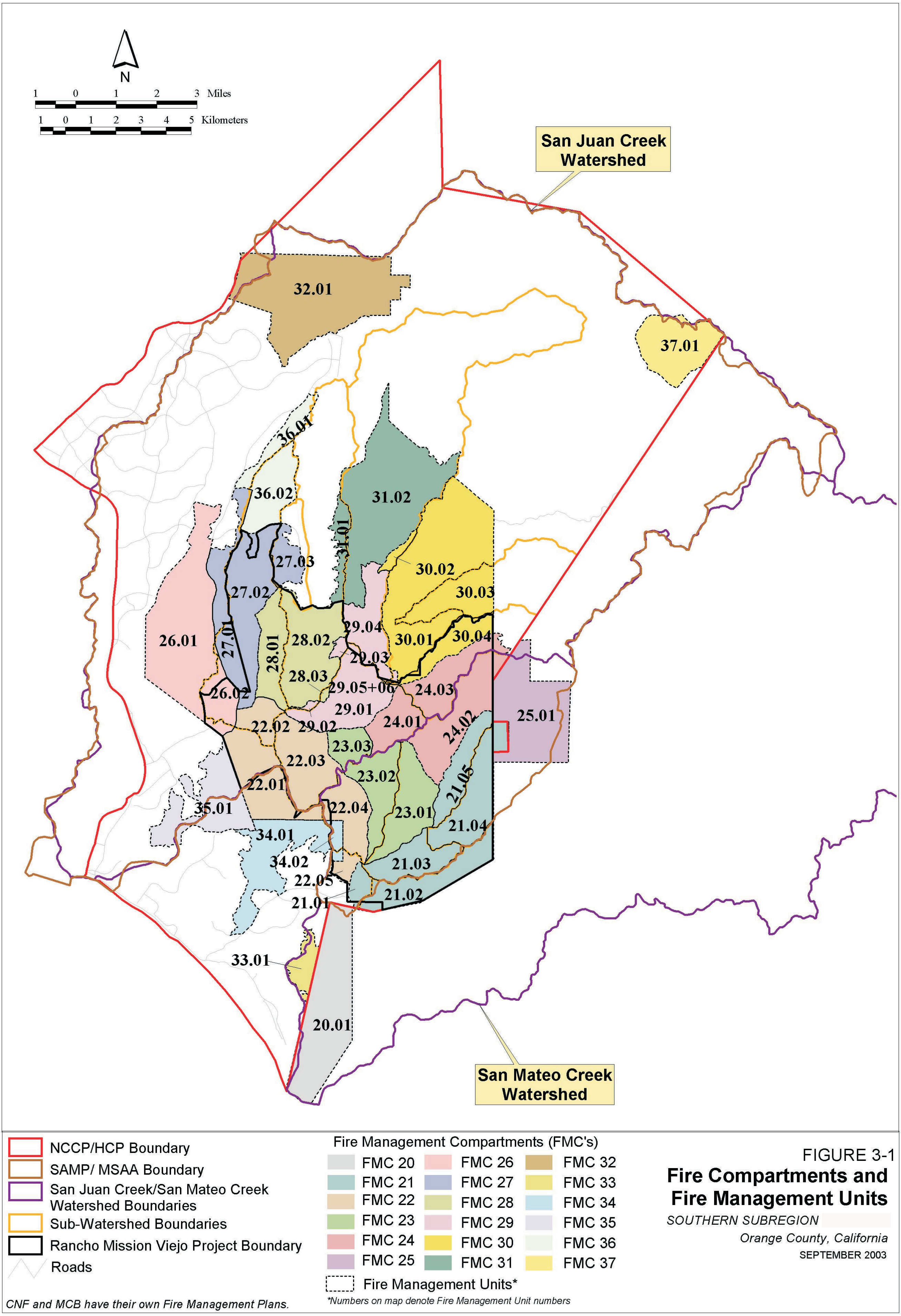


FIGURE 3-1

Fire Compartments and Fire Management Units

SOUTHERN SUBREGION

Orange County, California

SEPTEMBER 2003

In the case of proposed future RMV residential and business center development all proposed project areas will include all the necessary fuel modification treatments within the project boundaries. Fuel modification calculations are discussed in Section 3.5.1.2 that show the distance needed to safely protect future structures under the worst possible conditions is 110 feet and not 170 feet.

3.5.1 Recommended FMU's In Need of Fuel Treatment to Protect Life and Property in New Proposed Developments

This section is divided into those FMU's that occur within Rancho Mission Viejo boundaries and those that occur outside these boundaries and within the boundaries of other local jurisdictions which also may have pre-existing FMU's or a similar mechanism for prescribing required fuel treatment.

3.5.1.1 Rancho Mission Viejo

At the present time there are no FMU's that pose a threat to the protection of life and property on lands adjoining the RMV project boundary. Nor are there any threats to existing facilities within the project boundary. However, this will change as the RMV Open Space is established and residential communities adjacent to the RMV Open Space are built out over the next thirty (30) years.

3.5.1.2 Fuel Treatment Options to Protect Life and Property

Because of the high numbers of wildfires that have burned through Rancho Mission Viejo since the early 1900's, (see *Figures 3-10a-k*) plus an active cattle grazing program, and the late1980's and early 1990's Vegetative Management Program (prescribed burns) the wildland vegetation is fairly uniform throughout RMV. Most of the wildfires that have burned through the RMV property have originated on the Cleveland National Forest or the Marine Corps Base Camp Pendleton and were driven through the Ranch property by very strong Northeast/East Santa Ana winds, usually in October or November. Because of the generally light fuel loadings (scattered sagebrush over cured grass) these wildfires burned through the Ranch property very rapidly with low to moderate intensity.

The predominate vegetation over most of the Ranch is scattered coastal sage scrub over cured grass. This is a Fuel Model (FM) 2 as described in Section 3.7.2. The vegetation on the Ranch has stayed in a FM 2 because of the high frequency of wildfires burning over the Ranch property. Fortunately, this particular Fuel Model supports the high numbers of sensitive, threatened and endangered species found on the Ranch property. An FM 2 will require 100 feet of fuel modification/treatment between planned structures and the undisturbed native coastal sage scrub vegetation but there is no assurance that this area would stay in an FM 2. If the fire frequency is disrupted, i.e. longer intervals between fires occurs, the vegetation could easily densify, species composition would change and the Fuel Model would evolve into a FM 6 (chaparral fuels 6 ft. in height or less) and eventually a FM 4 (chaparral fuels greater than 6 feet in height).

This evolution from a FM 2 to a FM 4 has serious implications for the Ranch. Wildlife populations of obligate coastal sage scrub species, such as the California gnatcatcher, would decline, forage available for grazing would decline and wildfires, when they did occur, would burn with much more intensity and would be more destructive. The amount of firewise fuel treatment around the north and east sides of planned developments would need to increase from 100 feet to 110 feet. (OCFA currently requires 170 feet of fuel modification between structures and undisturbed native vegetation. However, OCFA will approve fuel treatments less than 170 feet where it can be demonstrated with fire modeling that less than 170 feet will protect the home from loss provided the home owner maintains the fuel treatment zones to the standard and maintains the structure in a fire resistant condition).

Because of the long term nature of future development within RMV lands and the rest of the Southern Subregion, and not knowing the frequency of future wildfires or the planned use of prescribed fire ***FIREWISE* 2000, Inc.** recommends fuel treatment measures based on a FM 4 configuration or 110 feet of fuel modification/treatment between planned structures and undisturbed coastal sage scrub vegetation.

3.5.1.3 Fuel Modification Zones by FMU

All future residential areas within RMV will need the same clearance requirements regardless of what FMU they will be in due to the fact that the vegetation throughout the Ranch is a fairly uniform FM 2. Fire Modeling and clearance requirements are based on a FM 4 vegetation configuration. An FM 4 provides a prudent safety factor and anticipates foreseeable changes in wildfire frequency and vegetation that may occur if fires decrease in frequency or increase in intensity. This clearance requirement applies equally to all planning areas for residential communities within the Southern Subregion.

Rancho Mission Viejo is within the Orange County Fire Authority's 5-minute initial action response time with Engine Companies stationed in the new Ladera development and in San Juan Capistrano. However, the reality is that when a wildfire occurs on southern California wildlands there are usually multiple fires occuring and fire fighting resources can be quickly drawn down and unavailable for extensive periods of time as additional new fires occur. Although there are several Orange County Fire Authority Stations several minutes away, there is no assurance that these Engine Companies will be in their stations the day a wildfire threatens development within Rancho Mission Viejo from an ignition outside or inside the development. On high/extreme fire danger days there are often multiple starts and engine companies are often already deployed on other incidents.

This is why "Firewise Communities"[1] use *"Survivable Space Strategies"* that enable their communities to survive a wildfire on their own without the loss of any lives or structures and with no intervention of the Fire Department.

The goal is for all future homes in RMV to be able to survive a wildland fire on their own, with no lives or structures lost and without any intervention from fire fighting personnel who may already be stretched to the maximum.

[1] See firewise.org for Firewise Community criteria

The following sections describe "Survivable Space Strategies."

3.5.1.4 Fuel Modification Zone A.

Zone A consists of the first 20 feet measured horizontally from the structure. No combustible structures are permitted in this zone. If a deck or patio cover is added to the house the structure must be non-combustible or the required distance is measured from the outside edge of the deck or patio cover.

3.5.1.5 Fuel Modification Zone B.

Zone B typically comprises the first 70 feet around a structure and is commonly called the "Survivable Space Zone". The 70 feet is measured horizontally from the edge of the structure.This firewise landscaped zone is usually irrigated and consists of fire resistant, maintained native or ornamental plantings usually less than 18 inches in height. This zone may contain occasional fire resistant trees and single well spaced native or ornamental shrubs up to 24 inches in height, intermixed with ground covers and lawn. Plants in this zone must be fire resistant and shall not include any pyrophytes that are high in oils and resins such as pines, eucalyptus, cypress, cedar and juniper species.

If trees are planted, they must be planted so that when they reach maturity their branches are at least 10 feet away from any structure. Refer to APPENDIX "A" *"FIREWISE"* Planting Considerations; Lists for Recommended Plants and Not-Recommended Plants. (Although the Recommended Plant List displays a large number of plants, the code next to each species must be reviewed to determine if that particular plant is suitable for all environments or is limited/prohibited in certain areas).

Thick, succulent or leathery leaf species are the most "fire resistant."

Regular maintenance and continued irrigation is most important in Zone B. Plants with high moisture content are less likely to burn. Non-flammable concrete patios, drive ways, swimming pools, walkways, boulders, rock, and gravel can be used to break up fuel continuity within Zone B provided the lot is large enough. Wooden privacy fencing must not be directly attached to any homes. Zone B can extend beyond the lot property line provided an easement can be obtained from the adjacent land owner for any required Fuel Modification that extends beyond the lot boundary. Lots should be laid out to accommodate all required Fuel Modification treatments within the lot property line.

3.5.1.6 Fuel Modification Zone C.

Zone C is the area beyond Zone B that typically extends an additional 40 feet or more out to 110 feet. In the case of this project, this zone will include native perennial grasses or the re-establishment of native coastal sage scrub species with the following exceptions: no chamise (*Adenostoma fasciculatum*), California sagebrush (*Artemisia californica*), pampas grass (*Cortaderia selloana*), common buckwheat (*Eriogonum fasciculatum*) or black sage (*Salvia mellifera*) will be permitted in Zone C. Native shrub species must be spaced at a minimum of 2 times the height of the shrub (a 12 inch shrub would need 24 inches between it and its neighbor, however, shrubs can be planted in clusters where the circumference is no more than 20 feet and all cured grasses must be removed from beneath the circumference of the shrub to eliminate a vertical fuel ladder). All dead material must be pruned out on an as needed basis, but at least annually each July. Trimmed material can be cut and scattered as mulch. "*Firewise*" landscaping criteria are important in this zone. Irrigation, partial irrigation or non-irrigation can be used in this zone depending upon the plant species selected. In the case where Open Space areas border residential structures the pruning of dead material and weed whipping or mowing will occur annually after August 31, which is after the nesting season and before the intense part of the annual wildfire season.

Mulches, chips and other small multi-cuttings (cut to less than 2 inches in diameter and 4-inches in length) should be evenly spread over the area (not to exceed 4 inches in depth) to prevent unwanted grass and weed encroachment within the treated areas. This mulching concept helps to maintain the soil moisture for the designated plants and minimizes any soil erosion on slopes. All native grasses or weeds should be mowed or weed-whipped to a 4 inch stubble height after heading out. In those cases where Zone C areas will lie outside the lot property lines but will still be within the planned development boundary the Project Home Owners Association will be responsible for the maintenance.

Lot owners will be responsible for maintaining all fuel modification Zones within their lots. Home Owner Associations will be responsible for all fuel modification required between the lot boundaries and the project boundary where these boundaries are not one and the same. Weed abatement regulations will be followed if the lot is not landscaped. In the event a lot is repossessed, the unit/agency holding title to the lot will be responsible for the maintenance.

All Fuel Modification Zones will be contained within the project boundary and in no case will these zones be permitted to encroach on RMV Open Space.

3.5.1.7 Required Building Setbacks from Edge of Slopes.

Residential development within non-RMV Open Space should capitalize on home setbacks from the edges of slopes (15 foot set back from edge of slope for 1 story homes, 30 feet set back from edge of slope for two story homes), where slopes will be below the home and building pad. In addition, the utilization of irrigated front, side and back yards, road widths and trails placed between homes and open space must be used to protect homes and to prevent adverse impacts to native coastal sage scrub species and to maximize the amount of area that can be unrestrictedly restored back to native coastal sage scrub species.

3.5.1.8 Fire Resistant Structure Requirements For Specific Perimeter Structures.

The following fire construction and design features are required for residential lots:

1) All exterior walls should be protected with 2-inch nominal solid blocking between rafters at all roof overhangs, under the exterior wall covering.

2) No attic ventilation openings or ventilation louvers shall be permitted in soffits, in eave overhangs, between rafters at eaves, or in other overhanging areas on those exposures facing hazardous vegetation.

3) All eaves of roof overhangs shall be enclosed with non-combustible materials.

4) Attic or foundation ventilation louvers or ventilation openings in vertical walls shall not exceed 144 square inches per opening and shall be covered with ¼-inch mesh corrosion-resistant metal screen or other approved material that offers equivalent protection. Attic ventilation shall also comply with the requirements of the Uniform Building Code (U.B.C.). Ventilation louvers and openings may be incorporated as part of access assemblies.

5) All projections (exterior balconies, carports, decks, patio covers, unenclosed roofs and floors, and similar architectual appendages and projections shall be of non-combustible construction, one-hour fire resistive construction on the underside, or heavy timber construction. When such appendages and projections are attached to exterior fire-resistive walls, they shall be constructed to maintain the fire-resistive integrity of the wall.

6) All glass or other transparent, translucent or opaque glazing materials, including skylights, shall be constructed of tempered glass or multi-layered (dual paned) glazed glass. No skylights will be allowed on the roof assembly facing hazardous vegetation.

7) Any chimney, flue or stovepipe will have an approved spark arrester. An approved spark arrester is defined as a device constructed of nonflammable materials, 12 gauge minimum thickness, or other material found satisfactory by the OCFA, and having 1/2 inch perforations for arresting burning carbon or sparks and installed to be visible for the purposes of inspection and maintenance.

8) Interior sprinkler systems will be installed in all homes when required by the OCFA. The Interior Sprinkler System shall meet National Fire Protection Standard (NFPA) 13d.

3.5.2 Jurisdictions outside the Rancho Mission Viejo property boundaries in the Southern Subregion

There are a number of owners and managers of large tracts of open space that surround Rancho Mission Viejo (see *Figure 1-2* in Section I). Most of these ownerships will remain in "open space". Those ownerships other than RMV that plan to include development on their properties will also need to comply with sections 3.5.1.2 through 3.5.1.8. which apply to the entire Southern Subregion.

According to the OCFA, "other than the Cleveland National Forest and Marine Corps Base, Camp Pendleton, which have Wildland Fire Management Plans, none of the other entities that directly impact Rancho Mission Viejo have Fire Management Plans". The caveat here is that the OCFA Fire Management Plan identified all open space areas by Subregion and developed Fire

Management Compartments based on defensible FMU's without consideration of ownership. OCFA took this approach since regardless of the level of planning by the various ownerships OCFA has the ultimate responsibility for the suppression of all wildland fires within the County of Orange.

The Cleveland National Forest and the Marine Corps, Camp Pendleton have addressed the NCCP/HCP guidelines. Both agencies utilize a combination of using prescribed fire and an Aggressive "**A**" Wildfire Suppression Operations Mode. The Cleveland National Forest and Camp Pendleton are the only entities in the Southern Subregion, or adjacent to the Southern Subregion, that have completed Fire Management Plans that consider the rich biodiversity found on the lands they manage.

Currently, the only non-federal Fire Plan that OCFA considers complete is the OCFA Wildland Fire Management Plan (WFMP). The OCFA WFMP does not presently address the Southern Subregion NCCP/HCP management guidelines, as the OCFA WFMP was written prior to the Southern Subregion NCCP/HCP. OCFA presently implements an aggressive "**A**" wildfire suppression strategy on all undeveloped lands without an approved Fire Management Plan (see 4.4.3. – 4.4.3.3 in Section IV). The OCFA WFMP was put together in a way that it can incorporate and recognize Fire Management Plans from other Agencies and land ownerships.

The OCFA's policy on wildfire suppression is sensible and weather driven. OCFA has a pre-planned "watershed dispatch" that determines what is initially sent to a reported wildland wildfire. That initial response can be held, increased or decreased based on a variety of conditions (weather, topography, time of year, proximity of structures, etc.). This watershed dispatch has ranged from the occasions where dozers have been turned around before arriving on an incident, to the all out effort during Santa Ana wind events.

An "Aggressive Initial Attack" on each and every wildfire is not etched in stone; good judgment and an appropriate wildfire suppression response based on the values involved while minimizing adverse environmental impacts is usually utilized. Please refer to Figure 1-2 in Section I for a display of all of the "Open Space" areas currently subject to the OCFA WFMP. Until adoption of the Southern Subregion NCCP/HCP WFMP, the OCFA WFMP will remain in effect.

Following suppression of any wildland wildfire in the Southern Subregion the wildfire response and actions taken will be reviewed with the appropriate landowner by the appropriate OCFA Officer.

3.6 Fuel Treatment to Protect Biological, Cultural and Historic Resource Values

Fuel treatment methods to protect high biological values is accomplished either by strategically placed fuelbreaks and/or prescribed fire units to breakup the highly flammable vegetative fuels so that key biological resources can be safely protected from high intensity wildland fire.

Fuelbreaks will usually consist of a minimum of ground disturbance by either hand labor or mechanical means (*e.g.* blade-up dozer crushing) followed by prescribed fire (strip burning) to widen and enhance the fuel break.

Well-planned use of prescribed fire applications, rather than unplanned random high-risk wildfire events, will become the principal as well as preferred method of using fire in these wildland ecosystems. The use of natural fire or wildland fire as a fuel management tool has limited opportunity within Southern Subregion lands. Natural fire (ignition started by lightning) is very infrequent and usually does not occur under acceptable Orange County weather parameters that permit containment. The native vegetation is either too wet during a lighting storm, or in the case of a dry lightning storm, too dry to successfully plan for use of naturally ignited fires as a viable factor in shaping the Southern Subregion ecosystem.

Any objective that could possibly be met by letting natural fires burn under a prescribed set of conditions can also be more safely accomplished in a controlled environment using prescribed fire. The use of prescribed fire can and will play a major role in meeting long-term management goals and objectives.

Accidental fires and deliberately set arson fires often occur under the very worst burning conditions. If possible, OCFA will use the suppression strategy listed in the Southern Subregion Rating Form (see Table 2-1). Weather conditions and resource shortages may result in OCFA using an "**A**" (aggressive) strategy to contain the unplanned wildfire event at the smallest size possible.

3.6.1 Recommended FMU's In Need of Fuel Treatment to Protect Biological Values

This section is divided into those FMU's that occur within RMV boundaries and those that occur outside these boundaries and within the boundaries of other local jurisdictions which also may have pre-existing FMU's or a similar mechanism for prescribing fuel treatment to protect biological values.

***FIREWISE* 2000, Inc.** has delineated units recommended for prescribed burning to protect biological values in the next decade. The concept is to use prescribed fire as an effort to restore fire back into the ecosystem on a planned basis. Prescribed fire will be one of the key tools used in coastal sage scrub management, rejuvenation and restoration, oak woodland maintenance, native grassland restoration and maintenance of chaparral/shrub sites. With the single exception of grasslands, from a control stand point, prescribed fire is best utilized as a vegetation management tool in the spring and early summer periods of the year.

Spring and early summer burning conflicts with the nesting season, however, if the vegetation is not managed on a rotational basis the plants will become senescent and of very low value to Identified Species. The tradeoff is risking a few members of the Identified population in a spring/early summer prescribed burn versus risking the loss of the entire habitat in a Santa Ana wind driven wildfire. Prescribed fire can also be utilized in the fall, however, this is also the infamous Santa Ana season. Prescribed fires ignited several days prior to an unforecasted Santa Ana wind event can be rekindled with disastrous results.

With grasslands, because of the very fine nature of the fuels, there is little danger of a hold over fire. Grasslands are more effectively burned in the fall prior to the rainy season. Newly released nutrients will be immediately available to the germinating seedlings.

3.6.1.1 Rancho Mission Viejo

FMU's requiring treatment to protect biological values within RMV are divided into four (4) categories: CSS Restoration Sites, Oak Woodland Sites, Native Grassland Management Sites and Riparian Restoration Sites as discussed below.

<u>CSS Restoration Sites:</u> The concept is to use both spring or fall prescribed fire in existing areas of degraded grassland habitat as part of an active coastal sage scrub restoration program for that particular site. This treatment would require intensive follow-up in terms of weed abatement (chemical or mechanical). The supposition is that these grassland areas at one time supported coastal sage scrub species. Viable seed may still remain on site in the soil. The radiant heat from a good hot prescribed fire would scarify the seed coat of numerous fire followers and coastal sage scrub obligate seeders. Plots large enough to produce a hot fire can be used to test for the availability of a viable seed bank. FMU's where prescribed fire is planned within restoration units are:

FMU 28.02: Sulphur Canyon: Coastal sage scrub restoration is planned in the grassland area in the bottom of Sulphur Canyon. This site would be restored back to a coastal sage scrub habitat. The approximate size of the proposed restoration unit is 100 acres. If the plots mentioned above do not produce desirable coastal sage scrub species all fire should be aggressively contained and confined to permit voluntary recruitment from the coastal sage scrub plant community surrounding the bottom of Sulphur Canyon.

<u>Oak Woodland (raptor) Sites:</u> The southeast quadrant of Rancho Mission Viejo, and especially the canyon bottoms, consists of an Oak Woodland over dense undergrowth. The Wildfire History Maps indicate that wildfires frequently come through this area. The last large wildfire occurred in 1961 which indicates a fire free interval of 32 years. The ground fuels are building up to the point that a wildfire would cause serious damage and possibly demise of the existing Oak Woodland. This vegetation type is utilized by raptors. In fact the raptor population for the Southern Subregion appears to be concentrated in this area. The health of this system is dependent upon frequent prescribed low intensity ground fires burning through and eliminating the undergrowth.

Burning releases nutrients that are immediately available to surviving vegetation, eliminates the vertical fuel ladder that will lead to the demise of the oaks and improves foraging opportunities for the raptor population. This condition exists in the following FMU's:

FMU's 21.01-21.05: Talega/La Paz

FMU's 23.01-23.03: Cristianitos/Gabino, Native Grassland Management Sites: The use of prescribed fire is proposed to restore, maintain and enhance existing and potential native grasslands within the system, especially if grazing is no longer an option on some sites. Fall prescribed burns would be used to promote existing native grass species. Again plots would be utilized to determine if desired effects can be achieved. Plots should be large (one quarter of an acre in size) and fenced to exclude the impacts of cattle grazing. Needlegrass (*Nasella spp.*), among others, responds well to fire and is a preferred perennial. FMU's where prescribed fire is planned for use within native grassland management sites are: **FMU's 22.04, 23.01-23.03:** Upper Cristianitos/Gabino valley grassland restoration areas. Following artichoke thistle control, prescribed fire will be used in the native valley grasslands of Upper Cristianitos and Gabino Sub-basins to remove dead biomass, including the seeds of annual grasses, and to promote the growth of native needlegrass species (see Section I, page 1-50). Prescribed fire would exclude existing patches of CSS.

There is a concern about using prescribed fire in watersheds located north of San Juan Creek because of the number of developments that surround the remaining RMV open space lands. It is a given that these open space areas will burn one way or the other. However, in the prescribed fire scenario there is control of the fire event where as in the case of a wildfire there is no control. In addition, the new homes surrounding RMV lands were all built to new fire safety standards and are further protected from wildfire due to the fuel modification zones required by the County of Orange that separate homes from undisturbed native fuels.

FMU 27.02: Chiquita and Narrow Canyons (see write up under FMU's 22.04, 23.01-23.03).

FMU's 28.01-28.03: Canada Gobernadora (see write up under FMU's 22.04, 23.01-23.03).

All burn units would require baseline monitoring for birds, reptiles and vegetation prior to initiation of the prescribed burn. Post burn monitoring would occur for at least two years following treatment with prescribed fire to capture positive and negative ecosystem responses to the burn.

Riparian Restoration Sites: It is recommended that the riparian areas be protected from fire encroachment by annually creating a mowed or disked firebreak between the outer edges of the riparian zones and native vegetation. Riparian areas should be kept fire free if at all possible.

FMU's where firebreaks/fuelbreaks are planned:

FMU 28.02: Canada Gobernadora Sub-basin: A large investment has been made in restoring the riparian area in the bottom of Canada Gobernadora. This investment has paid off in that least Bell's vireos and southwestern willow flycatchers increasingly utilize this zone. The fuel loading in this riparian area is increasing. There is an abundance of ladder fuels that will carry wildfire into the crowns of the planted oaks, willows and sycamores. The best strategy for protecting this critical riparian area is to keep wildfire out of it by annually mowing, plowing or disking a firebreak/fuelbreak between the outer edges of the riparian zone and the surrounding native or non-native fuels. In addition, low hanging branches on the oaks and sycamores can be pruned up to eliminate any ground fires from getting up into the crowns of the planted trees.

This condition also exists in the following FMU's. In addition, non-native rapidly spreading highly invasive exotics such as tamarisk, arundo and pampas grass, are increasing the flammability of the following riparian areas. These exotic species also have excessive evapotranspiration rates, drying up portions of riparian areas that a variety of wildlife species depend upon and should be removed. Native riparian communities with no intrusion of exotic species are reasonably fire resistant and in most cases will not burn because of the higher moisture contents of the vegetation and higher humidity within the riparian zone.

FMU's 22.01-22.05: San Juan Creek, and Trabuco Creek.

FMU's 23.01-23.03: San Mateo Creek (Cristianitos/Gabino Creeks).

3.6.1.2 Sensitive Species

In addition to the federally listed species there are a number of sensitive fauna and flora in the Southern Subregion. These additional sensitive species can be found in Draft NCCP/HCP Planning Guidelines prepared by the NCCP/SAMP Working Group. Several of these non-listed sensitive species also occur on RMV that are likely to be affected by the grazing management program either directly (e.g. species such as grasshopper sparrow that nest in grasslands with high structural diversity) or indirectly (species whose prey may be affected by grazing practices such as kite, horned lizard and whiptail). These species are: intermediate mariposa lily, cactus wren, yellow warbler, yellow-breasted chat, grasshopper sparrow, white-tailed kite, merlin, western spadefoot toad, southwestern pond turtle, San Diego horned lizard, and orange-throated whiptail. For a complete account for these species, the reader is referred to the Draft NCCP/HCP Planning Guidelines.

3.6.1.3 Historically Sensitive Areas

There are a number of historically significant Rancho Mission Viejo facilities in the Southern Subregion that must be protected. They are as follows: the O'Neill Ranch House, Cow Camp, Amantes Camp located just south of Ortega Highway (State Route 74), Campo Portola in Gabino Canyon, and the Rancho Mission Viejo Headquarters buildings located on both sides of Highway 74 and just west of Antonio Parkway. All known historic sites shall be mapped and an inventory of locations provided to OCFA as critical information for "first responders". All historic buildings that could be consumed by wildfire shall have 110 feet of fuel modification completed by May 15 of each year. Consideration should be given to removing the eucalyptus trees and replacing them with native fire resistant trees.

3.6.1.4 Culturally Sensitive Areas

In addition to the historical sites all known cultural site locations shall be mapped and an inventory of locations provided to OCFA as critical information for "first responders". If time permits cultural site locations should be flagged to avoid surface disturbance by vehicles, hand crews and dozers. Following both planned prescribed fires and wildfires all burned over areas should be surveyed to locate unknown sites obscured by vegetation.

3.6.2 Fuel Treatment to Protect Biological, Cultural and Historic Resource Values in the Southern Subregion Outside of the RMV Lands

In the non-RMV areas of the Southern Subregion it will be up to each jurisdiction or landowner to develop specific management objectives for the protection of the biological, cultural and historic values of each property. In the absence of a specific wildland fire management plan for a specific property OCFA will attack all wildfires utilizing an aggressive "**A**" strategy.

3.7 Fuel Models

Wildland fire suppression tactics and all fire use prescriptions are based upon expected fire behavior. The type of vegetation (fuels) where wildfire is currently burning, or where burning is planned, is one of the key elements in computing fire behavior calculations. The other two elements are fire weather and topography. Vegetative fuel types are normally described as a fuel model. A fuel model is a simulated fuel complex for which all the fuel descriptors required by the mathematical fire spread model have been specified. Different fuel models exhibit different fire behavior characteristics under the same fire weather and topographic parameters.

Fuel models are an approximate, not a precise representation of the fuel/vegetation complex. Consequently, some fuel/vegetation complexes exhibit fire behavior characteristics that may be in between two different specific fuel models. Also, many areas are not homogenous and do not react as a single fuel model. Usually in this case, a combined fuel model can be designated [i.e. Fuel Model 1 (60%) and Fuel Model 6 (40%)] will more closely represent the expected fire behavior.

Since it is impractical and of limited value to break down a planning unit into very small areas, a unit identified as a specific fuel model may in fact be an assortment of fuel models. The fire/resource, planner/manager must use judgment as to when it is necessary to map a change in the fuel model. On the other hand, during project planning smaller areas/units are commonly broken out for specific analysis and treatment.

3.7.1 Fuel Model Classifications

The Intermountain Forest & Range Experiment Station, USDA-Forest Service has been categorizing fuel complexes into fuel models since 1964.

Currently they have two (2) different classifications, which are:

- *The National Fire Danger Rating System (NFDRS)*
- *The National Forest Fire Laboratory System (NFFL)*

3.7.1.1 The National Fire-Danger Rating System (NFDRS) Fuel Models, USDA-Forest Service: General Technical Report INT- 39, 1978.

Fuel models under this system were developed to predict seasonal and daily fire danger over large areas. There are twenty (20) NFDRS fuel (A though U, except for M) models in this classification system. This fuel modeling system cannot be used for obtaining site specific fire behavior predictions.

3.7.2 Aids to Determining Fuel Models for Estimating Fire Behavior (NFFL or FBO Fuel Models), USDA- Forest Service General Technical Report INT- 122, April 1982 (A Publication of the National Wildfire Coordinating Group, NFES 1574).

Fuel models in this system were developed to predict site specific fire behavior. There are 13 FBO fuel models (1-13) which are divided into four (4) groups - grass, shrub, timber (tree), and slash.

The NFFL fuel models are used in the "BEHAVE" fire behavior modeling computer program to provide fire behavior outputs such as intensity, rate of spread, flame length, fire size and perimeter estimates under varying weather conditions such as dead fine fuel moisture, live fuel moisture, mid-flame wind speed, % slope and direction of fire spread based on a single, specific ignition.

Both systems have their place and can be valuable tools in classifying fuels. The fuel models are correlated between these two modeling systems in the "Aids to Determining Fuel Models for Estimating Fire Behavior" publication. Since this
section of this Report applies specifically to wildland wildfire and prescribed fire behavior, only the NFFL Fuel Models will be referenced in this report.

Any resource management or fire management decision regarding the use of prescribed fire and/or wildland wildfire suppression tactics must be based upon authenticated fire behavior expectations using actual onsite weather observations and onsite fuel models. Wildfire suppression tactics are based upon fire behavior calculations using the BEHAVE program which calculates rate of spread and fireline intensity based upon the onsite and predicted weather conditions and the fuel model the wildfire is burning in.
Under extreme burning conditions (Santa Ana winds) the recommended rating for each FMU as shown in *Table 2- 1* may not always be possible to implement because of the intensities and rates of spread. OCFA will have little choice but to adopt an aggressive "**A**" strategy even though the rating may call for a standard "**S**" or a modified "**M**" suppression strategy.

In the case of prescribed fires once the objective for the burn is determined and a prescription is developed and formally approved, the on site weather factors must be monitored for several days prior to the burn to insure that the desired weather factors will be present on the day of the burn. In addition to onsite weather, forecasted weather is also factored in to determine if the burn will continue to stay in prescription and if it will take place as scheduled before personnel and equipment are diverted from other assignments to assist in the execution of the burn.

The following 6 pages are descriptions, with pictures, of the six most representative fuel models found on Southern Subregion lands.

Grass Group - Fuel Model 1

Fire Behavior Fuel Model 1 – Short Grass (<2 feet tall)

The fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured govern fire spread. Fires are surface fires that move rapidly through the cured grass and associated material. Very little shrub is present, generally less than one-third of the area.

Grasslands, open Engelmann oak or Coast live oak savanna are representatives of this Fuel Model 1. Non-native annual grasslands, purple and Valley needlegrass are other excellent examples of this fuel model.

Refer to Photographs 1, 2 and 3 for visual illustrations of Fuel Model 1.

Fuel Model Values for Estimating Fuel Model 1 Fire Behavior

Total Fuel Load of <3-inch in diameter dead and live fuel (expressed in tons/acre)	**0.74**
Dead fuel load, ¼-inch and less (tons/acre)	**0.74**
Live fuel load, foliage (tons/acre)	**0.00**
Fuel bed depth, (expressed in feet)	**1.0**

Photo 1. Non-native Annual grasslands intermixed with islands of brush.

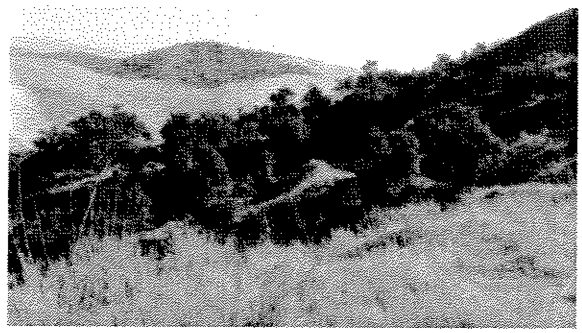


Photo 2. Native grasses/Oak woodland

Photo 3. Oak woodland

Grass Group - Fuel Model 2

Fire Behavior Fuel Model 2 – Scattered sage (<3feet tall) over cured grass

Fire spread is primarily through curing or dead herbaceous fuels. These are surface fires where the herbaceous material, in addition to litter and dead-down stem wood from the open shrub overstory, contribute to the fire intensity. Open sage shrub lands and shrub oak stands that cover one-third to two-thirds of the area may generally fit this fuel model; such stands may include clumps of fuels that generate higher fire intensities and that may produce firebrands.

Refer to Photographs 4 and 5 for visual illustrations of Fuel Model 2.

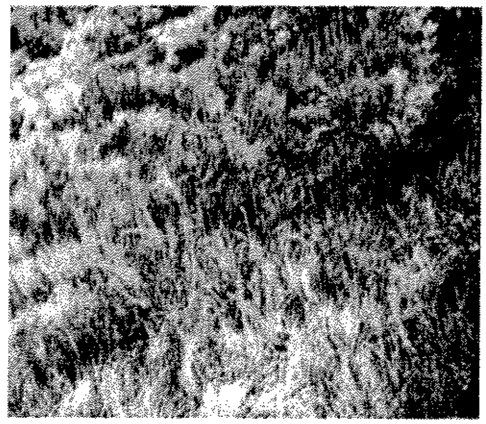


Photo 4. Scattered sage/grassland

Fuel Model Values for Estimating Fuel Model 2 Fire Behavior

Total Fuel Load of <3-inch in diameter dead and live fuel (expressed in tons/acre)	**4.0**
Dead fuel load, 1/4 inch, tons/acre	**2.0**
Live fuel load, foliage, tons/acre	**0.5**
Fuel bed depth, feet	**1.0**

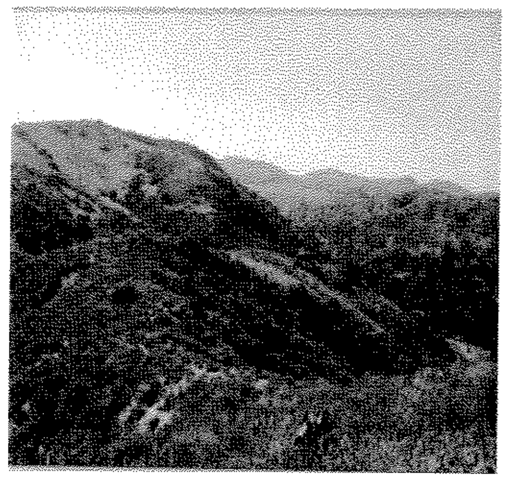


Photo 5. Young coastal sage scrub and grassland

Shrub Group - Fuel Model 4

Fire Behavior **Fuel Model 4 – Tall, dense, mature chaparral (>6 feet tall)**

Fire intensity and fast-spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary overstory. Stands of mature shrubs, 6 or more feet tall, such as dense southern mixed chaparral, chamise chaparral and *Ceanothus crassifolius* chaparral are representative of this Fuel Model.

Besides flammable foliage, dead woody material in the stands significantly contributes to the fire intensity. A deep chaparral litter layer may also hamper fire suppression efforts.

Refer to Photographs 6, 7 and 8 depict examples of Fuel Model 4.

Photo 6. Ceanothus crassifolius Chaparral

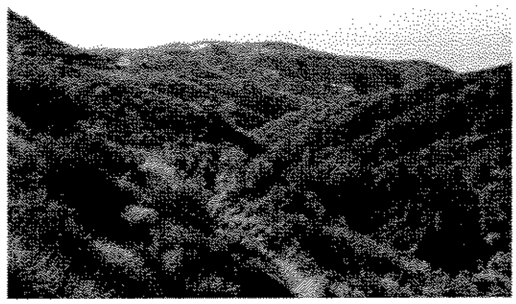


Photo 7. Southern mixed Chaparral

Photo 8. Dense Chaparral

Fuel Model Values for Estimating Fuel Model 4 Fire Behavior

Total Fuel Load of <3-inch in diameter dead and live fuel (expressed in tons/acre)	**13.0**
Dead fuel load, ¼-inch and less (tons/acre)	**5.0**
Live fuel load, foliage (tons/acre)	**5.0**
Fuel bed depth, (expressed in feet)	**6.0**

Shrub Group - Fuel Model 5

Fire Behavior Fuel Model 5 – Young, Mixed Shrub / Woodlands (<6 feet tall)

Fire is generally carried in the surface fuels that are made up of litter cast by the shrubs, grasses, and forbs in the understory. The fires are generally not very intense because surface fuel loads are light, the shrubs are young with little dead materials, and the foliage contains little volatile material. Usually shrubs are short and almost totally cover the area.
Young green stands with no dead wood would qualify; laurel, vine maple, alder, or even young chaparral, manzanita or chamise. Shrub lands after a fire or other land disturbance which have a large component of green fuel qualify as this Fuel Model.

Young green stands may be up to 6 feet high but retain poor burning properties because of the large amount of live vegetation.

Photographs 9 & 10 depicts are examples of Fuel Model 5.

Fuel Model Values for Estimating Fuel Model 5 Fire Behavior

Total Fuel Load of <3-inch in diameter dead and live fuel (expressed in tons/acre)	**3.5**
Dead fuel load, ¼-inch and less (tons/acre)	**1.0**
Live fuel load, foliage (tons/acre)	**2.0**
Fuel bed depth, (expressed in feet)	**2.0**

Photo 9. Dense young Coastal sage scrub

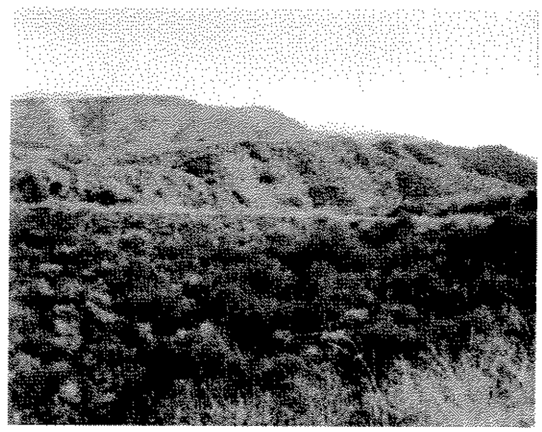


Photo 10. Young Coastal sage scrub and grasslands

Shrub Group - Fuel Model 6

Fire Behavior Fuel Model 6 – Intermediate, Dense, mature Shrubs (<6 feet tall)

Fires carry through the shrub layer of Fuel Model 6 where the foliage is more flammable than fuel model 5, but this requires moderate winds, greater than 8 mph at mid-flame height. Fire will drop to the ground at low wind speed or at openings in the stand. The shrubs are older, but not as tall as shrub types of fuel model 4. This fuel model covers a broad range of shrub conditions. Fuel situations to be considered include intermediate chamise, chaparral, oak brush and mature California sagebrush scrub.

Photos 11 and 12 are examples of Fuel Model 6.

Fuel Model Values for Estimating Fuel Model 6 Fire Behavior

Total Fuel Load of <3-inch in diameter dead and live fuel (expressed in tons/acre)	**6.0**
Dead fuel load, ¼-inch and less (tons/acre)	**1.5**
Live fuel load, foliage (tons/acre)	**0**
Fuel bed depth, (expressed in feet)	**2.5**

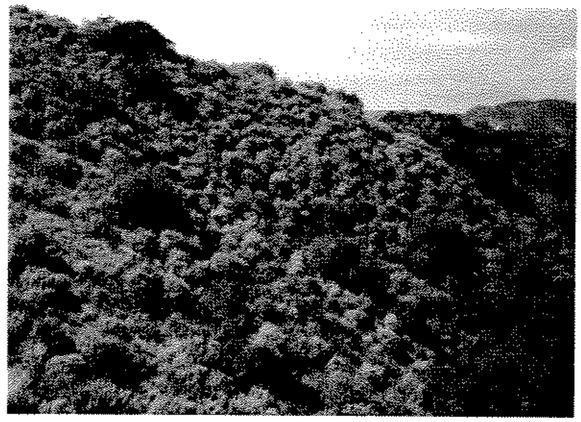


Photo 11. California sagebrush scrub

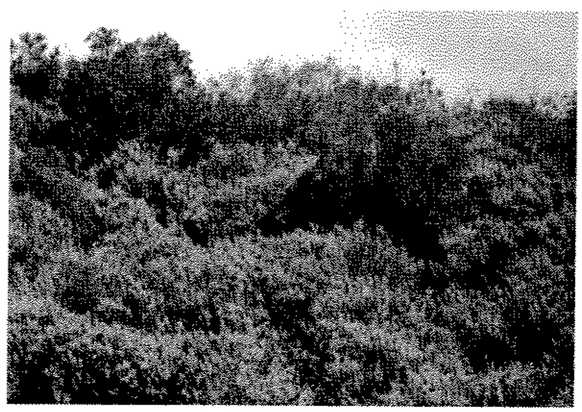


Photo 12. Mature Coastal sage scrub

Tree Group - Fuel Model 9

Fire Behavior Fuel Model 9 – Tall Riparian Shrub/Hardwoods

Fires run through the surface litter faster than other Shrub/Hardwood tree group fuel models and have longer flame height. Hardwood trees and hardwood shrub stands, especially the dense oak-willow scrub are typical Fuel Model 9 species. Fall fires produce the most intense fire behavior and strong winds are required for moderate rates of spread. High resistance to control and intense smoke can be expected due to the large amount of dead and down material intermixed with soil and duff material.

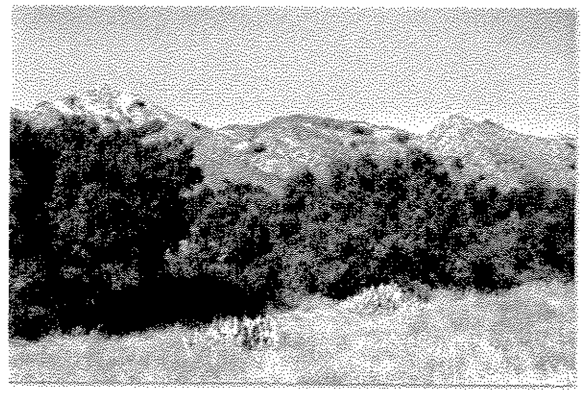


Photo 13. Woodland Oak Riparian Zone

Photos 13 and 14 are examples of Fuel Model 9.

Fuel Model Values for Estimating Fuel Model 9 Fire Behavior

Total Fuel Load of <3-inch in diameter Dead and live fuel (expressed in tons/acre)	**3.5**
Dead fuel load, ¼-inch and less (tons/acre)	**2.9**
Live fuel load, foliage (tons/acre)	**0**
Fuel bed depth, (expressed in feet)	**0.2**

Photo 14. Southern willow scrub (Mulefat) Riparian Zone

3.7.3 Expected Fire Behavior Projections By Various Fuel Models

Expected wildland fire behavior for Southern Subregion fuel models are depicted in three categories: 1) Grass Group, 2) Shrub Group and 3) Tree Group:

3.7.3.1 Grass Group Fuel Models

Fires in the grass group fuel models exhibit some the fastest rates of spread of all the Fuel Models when exposed to similar weather conditions. With a wind speed of 10-mph and a1-hr fuel moisture content of 5 percent on a 30% slope, representative rates of spread (ROS), Heat per Unit Area and Flame Length are as follows:

Fuel Model	**Rate of Spread**		**Heat/Unit Area**	**Flame Length**
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
1	81	89	92	4
2	31	34	491	6

3.7.3.2 Shrub Group Fuel Models

The fuel models of shrub groups exhibit a wide range of fire intensities and rates of spread. Using the same criteria of a 10-mph wind speed, 1-hr fuel moisture content of 5 percent and a live fuel moisture content of 100 percent on a 30% slope, the shrub fuel models have the following values:

Fuel Model	**Rate of Spread**		**Heat/Unit Area**	**Flame Length**
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
4	112	123	2712	24
5	42	46	659	6
6	33	36	499	6

3.7.3.3 Tree Group Fuel Models

The fire behavior calculations of a hardwood tree/litter fuel model (riparian) are indicated by the following values when the weather characteristics are the same as the above Shrub Group but on a 5% slope:

Fuel Model	**Rate of Spread**		**Heat/Unit Area**	**Flame Length**
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
9	7	8	390	3

NOTE: *Only Fuel Model 4 (Tall, dense brush) displays fire behavior characteristics (Heat/Unit Area and Flame Lengths) in the "serious control problem" category during wind speeds of 10 mph and lower.*

3.7.3.4 Additional Fire Behavior Influence of a 20-mph Wind Speed

With the wind speed increased to 20 mph and a 1-hr fuel moisture content of 5 percent on a 30% slope, the representative rates of spread (ROS), Heat per Unit Area and Flame Length increases are as follows:

3.7.3.5 Grass Group Fuel Model Fire Behavior with a 20-mph Wind Speed.

Grass Group fuel models are greatly influenced by increased wind speeds. Since grass fuel models consist almost entirely of fine fuels, increased wind speed causes a much faster fire spread (a 20 mph wind driven fire burns almost 2 times that of 10 mph), while the fire intensity does not substantially increase.

Fuel Model	**Rate of Spread**		**Heat/Unit Area**	**Flame Length**
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
1	272	299	92	8
2	90	99	491	10

3.7.3.6 Shrub Group Fuel Model Fire Behavior with a 20-mph Wind Speed.

The shrub group fuel models exhibit a wide range of fire intensities and rates of spread. Using the same criteria of 20-mph wind speed, 1-hr fuel moisture content of 5 percent, a live fuel moisture content of 100 percent on a 30% slope, the shrub group models have the following values:

Fuel Model	**Rate of Spread**		**Heat/Unit Area**	**Flame Length**
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
4	274	301	2712	36
5	50	55	659	9
6	73	80	499	9

3.7.3.7 Tree Group Fuel Model Fire Behavior with a 20-mph Wind Speed.

The fire behavior calculations of a hardwood tree/litter fuel model (riparian) are indicated by the following values when the weather characteristics are the same as the above Shrub Group but with a 5% slope:

Fuel Model	Rate of Spread		Heat/Unit Area	Flame Length
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
9	20	22	390	5

NOTE: *All Fuel Models exceed the "serious fire control" problem criteria (flame lengths 8-feet in length), except for Fuel Model 9 (Riparian) and this fuel model almost (at 5-feet) reaches the lower end of the range. Refer to Table 3 -2 in Section 3.7.4.*

3.7.3.8 Additional Fire Behavior Influence of a 60-mph Wind Speed

With the wind speed increased to 60 mph and a 1-hr fuel moisture content of 2 percent (a Santa Ana wind event) on a 30% slope, the representative rates of spread (ROS), Heat per Unit Area and Flame Length increases are as follows:

3.7.3.9 Grass Group Fuel Model Fire Behavior with a 60-mph Wind Speed.

Grass Group fuel models are greatly influenced by increased wind speeds. Since grass fuel models consist almost entirely of fine fuels, increased wind speeds fail to increase the rate of spread and flame lengths.

Fuel Model	Rate of Spread		Heat/Unit Area	Flame Length
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
1	666	732.6	1,415	12.7
2	968	1,065	10,808	32.3

3.7.3.10 Shrub Group Fuel Model Fire Behavior with a 60-mph Wind Speed.

The shrub group fuel models exhibit a wide range of fire intensities and rates of spread. Using the same criteria of 60-mph wind speed, 1-hr fuel moisture content of 2 percent, a live fuel moisture content of 60 percent on a 30% slope, the shrub group models have the following values:

Fuel Model	Rate of Spread		Heat/Unit Area	Flame Length
	Chains/Hour	***Feet/Minute***	***BTU/ft2***	***Feet***
4	2,104	22,154	130,077	101.3
5	367	403.7	5,437	23.5
6	398	438	4,493	21.5

3.7.3.11 Tree Group Fuel Model Fire Behavior with a 60-mph Wind Speed.

The fire behavior calculations of a hardwood tree/litter fuel model (riparian) are indicated by the following values when the weather characteristics are the same as the above Shrub Group but with a 5% slope:

Fuel Model	Rate of Spread		Heat/Unit Area	Flame Length
	Chains/Hour	*Feet/Minute*	*BTU/ft2*	*Feet*
9	180	198	1,615	13.5

3.7.4 Fire Suppression Capability Interpretations Based on Flame Lengths and Fire Intensity

CAUTION*: The following Table 3-2 information should only be used as a guide when personnel safety is involved. Fires can be dangerous at any level of intensity. Studies have shown that with most fatalities burns occur in very light fuels on small fires or isolated sectors of large fires.*

Table 3-2 depicts some general guides for estimating successful containment of a wildland fire based by visual observation of flame lengths and/or calculated fire intensity levels.

Table 3-2

Fire Suppression Capability Interpretations Based on Observed Flame Lengths and Calculated Fire Intensity Levels

Flame Length (Feet)	Fireline Intensity (BTU/ft/sec.)	Interpretation
< 4	<100	Persons using handtools can generally attack fires at the head or flanks. Handline should hold the fire.
4 – 8	100 – 500	Fires are too intense for direct attack on the head by persons using handtools. Hand line cannot be relied on to hold fire. Equipment such as dozers, engines, and aircraft with fire chemicals can be effective.
8 – 11	500 – 1000	Fires may present serious control problems – torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.

>11	**> 1000**	**Crowning, spotting and major fire runs are probable.** **Control efforts at head of fire are ineffective. Indirect fire suppression strategies will be most effective.**

Table 3.2 information was based on research by: Roussopoulos, Peter J., Johnson, Von. *Help in Making Fuel Management Decisions, Research Paper NC-112, USDA-Forest Service. 1975.*

The Incident Command System (ICS) and National Wildland Coordinating Group (NWCG) certified wildland fire Incident Commanders and Prescribed Fire Managers understand the value of fuel models and the BEHAVE: Fire Behavior Prediction and Fuel Modeling System and use these tools in all their fire management and protection decision making processes. Orange County Fire Authority is a leader in the State of California's use of ICS for wildland fire incidents.

It is also very important that all Natural Resource Managers understand the value of fuel models and their use for accurate prediction of expected wildfire and/or prescribed fire behavior in all their natural resource planning and management decision making.

PART IV - TACTICAL FIRE SUPPRESSION PLAN

PART IV – SHORT-TERM TACTICAL FIRE SUPPRESSION PLAN

4.0 BACKGROUND

This short-term Tactical Fire Suppression Plan has been prepared to function as the fire management portion of the Southern Subregion NCCP/HCP Adaptive Management Program. General Policy 5 of the Draft NCCP/HCP Planning Guidelines states:

> Long-term indirect impacts to the Habitat Reserve and other areas being preserved for species protection shall be managed through creation of an urban/wildlands interface zone separating the Habitat Reserve system from the non-reserve/urban areas.

General Policy 5 further states regarding management of the interface zone would:

- Create fuel management zones combining irrigated and non-irrigated native plantings separating the Habitat Reserve system from adjacent urban uses.
- To the extent that fuel management zones are composed of native habitats and can support Identified Species and other species, or be enhanced or managed to support Identified Species and other species, this should be encouraged. For example, using prickly-pear in the fuel management zone may provide habitat for the cactus wren, as well as enhance the buffering effect between the Habitat Reserve and developed areas.
- Fuel management zones and practices will be set forth in a "fuel management plan" as part of the NCCP/HCP and aquatic resources protection program.
- Prohibit plants identified by the California Exotic Pest Plant Council as an invasive risk in Southern California from development and fuel management zones adjoining the Habitat Reserve;

This Tactical Fire Suppression Plan has been prepared to establish appropriate fire response tactics for all wildfires in the Fire Management Compartments (FMC's), Fire Management Units (FMU's), and Fuel Management Zones (FMZ's) discussed in Section III-Strategic Fire Protection Plan (see pages 3-4 through 3-12). All wildfires will be suppressed as quickly as possible. Unplanned wildfires will not be used in the Southern Subregion as a management strategy.

4.1 Preparation of the Fire Management Plan

This short-term Tactical Fire Suppression Plan was prepared by ***FIREWISE* 2000, Inc.** in cooperation with the Orange County Fire Authority (OCFA).

4.2 Structure of the Plan

The following elements must be included in the preparation of the Short-Term Tactical Fire Suppression Plan:

- *Defining fire management "compartments" that encompass major populations of Identified Species and the overall sub-regional reserve system, and preparing specific fire attack measures that would protect these areas as "refugia" in the event of a wild fire with the least impact on sensitive habitat in or near the refugia.*

***FIREWISE* 2000, Inc.** and the Orange County Fire Authority have established eighteen (18) Fire Management Compartments (FMC's) that were further subdivided into Fire Management Units (FMU's). In addition, specific fire suppression measures were identified for each FMU.

- *Preparation of suppression plans for each fire management compartment or unit.*

As noted above, the Tactical Fire Suppression Plan prescribes a specific fire suppression operational mode for each unit (*see page 4-11 and 4-12*).

- *Identify urban fuel modification zone criteria which achieve effective protection for urban development while minimizing impacts on sensitive habitat types.*

As a result of the frequency of wildfires burning through Rancho Mission Viejo and cattle grazing there is very little dense natural vegetation on the Ranch. The young age of the existing vegetation and low to moderate shrub density intermixed with annual and perennial grasses helps account for the high species populations and excellent biodiversity found on Rancho Mission Viejo. The Fire Behavior and Fuel Modeling System – BURN Subsystem, Parts 1 & 2, known as BEHAVE, were used to assess the flammability characteristics of the vegetation on Rancho Mission Viejo. BEHAVE calculations were run for the various fuel models that could conceivably interface with future urban interface areas within Rancho Mission Viejo. The vegetation on the Ranch falls into one of the following Fuel Models (FM's) FM 1, cured grass, one foot tall; FM 2, sagebrush over cured grass; FM 4, coastal sage scrub/chaparral at or greater than six feet in height and FM 6, coastal sage scrub/chaparral at or less than six feet in height. FM 4 exhibits the highest intensity and flame lengths; however, there is very little FM 4 on Rancho Mission Viejo. FM 2 exhibits the second highest intensity and flame lengths and is the most abundant Fuel Model found on Rancho Mission Viejo. Structures built with fire resistant materials and features (*see pages 3-10 through 3-11*) coupled with seventy (70) feet of Zone A irrigated "firewise landscaping" plus an additional forty (40) feet of thinned native fuels with no chamise (*Adenostoma fasciculatum*), California sagebrush (*Artemisia californica*), pampas grass (*Cortaderia selloana*), common buckwheat (*Eriogonum fasciculatum*) or black sage (*Salvia mellifera*) will provide adequate protection from wildfire without the intervention of Fire Department Equipment and Personnel.

The Orange County Fire Authority Fire Management Plant Palette was revised as part of an earlier effort in cooperation with the California Department of Fish and Game, U.S. Fish and Wildlife Service, State Parks, Planning and Development Services Department/Resources Planning, Public Facilities and Resources Department/Harbors, Beaches and Parks, private landowners, and landscape architecture firms. The plant palette (see Appendix A for all plants coded with an **X** plus the list of undesirable plants and weeds) identifies non-native invasive plant species that may escape into the RMV Open Space and displace native habitats, impact sensitive wildlife species and overall diversity, and increase the cost of management. The revised plant palette now emphasizes the use of native plant species that enhance the biological integrity of the RMV Open Space, establishes an appropriate transition at the urban/wildland interface, and provides an acceptable level of wildland fire protection.

- *Defining fire suppression compartments that encompass major populations of Identified Species.*

As noted above, the eighteen (18) FMC's were established based upon fire history and those "open space" areas that are subject to frequent wildfires.

4.2.1 How Part IV is Developed

Part IV is designed in such a way that it can be pulled out of the overall plan and be used as a stand alone plan by OCFA line officers as their wildland fire protection direction by specific FMU's.

4.3 Fire Suppression Policies For Biologically Sensitive Areas

The following eight (8) fire suppression policies are taken from the Coastal/Central NCCP/HCP Subregion Plan and are evaluated here for their applicability in the preparation of Fire Management Plans for Biologically Sensitive Areas in the RMV Open Space:

4.3.1 Bulldozer Policy

- *To the extent practicable, the use of bulldozers or other mechanical land altering equipment will be restricted to the widening and improving of existing fire roads.*

Application of Policy: During the preparation of the NCCP/HCP for the Central/Coastal Subregion, The Nature Conservancy (TNC) re-evaluated this policy and determined that it was far too limiting and effectively eliminates the value of bulldozers as a tool for minimizing fire size. TNC further stated that the use of bulldozers should be an option for any location in which the short term loss or long term conversion of habitat presents a high risk for Identified Species.

Summary Policy Statement: ***FIREWISE 2000, Inc.*** *recommends adoption of the above Application of Policy for the RMV Open Space. During periods of extreme fire behavior OCFA must use an Aggressive Suppression Strategy, including the use of bulldozers, to limit wildfire size and wildfire spread into urban areas. The immediate confined damage often is less costly than a large temporary loss (zero to fifteen years for certain targeted species) of suitable habitat.*

4.3.2 New Fire Roads Policy

- *To the extent practicable, new fire roads or firebreaks/fuelbreaks will not be created by mechanical methods. Hand crews will be used to create any necessary new firebreaks/fuelbreaks wherever practicable or feasible.*

Application of Policy: ***FIREWISE 2000, Inc.*** *evaluated this policy and determined that although the limitation of new roads and trails is a very important issue for the RMV Open Space, this fire policy should be expanded to include the potential for mechanically-created firebreaks/fuelbreaks. In situations where wildfire threats would result in type conversion and habitat loss, the spatial limited impacts of a bulldozer may be the preferred biological alternative to the consumption of additional RMV Open Space lands. Fuelbreaks can be mechanically created on main and lateral ridgelines in a low impact manner in areas with a repeated very high wildfire frequency by crushing the standing vegetation with a bulldozer with the blade up. The crushed brush is later burned using prescribed (Rx) fire under suitable conditions.*

Summary Policy Statement: Utilize bulldozers for "blade up" fuelbreak construction by crushing standing vegetation and later burning the dried crushed vegetation.

4.3.3 Backfiring Policy

- *When conditions are suitable, backfiring from existing roads, natural barriers or trails will be considered preferable to constructing new fire control lines and other methods.*

<u>Application of Policy</u>: ***FIREWISE 2000, Inc.*** *evaluated this policy and determined that the use of backfiring in coastal sage scrub and other habitats should be weighed against short and potential long-term loss of RMV Open Space lands and particularly the loss of riparian habitat. Backfiring should remain a possible fire management tool but should not be mandated by the Plan. Backfiring is very different than firing out. Backfiring is a last ditch effort to cut off the forward rate of spread of a rapidly advancing wildfire front by falling back to a ridge line or road a considerable distance ahead of the fire front. Necessary holding lines are constructed and the vegetative fuels between the newly constructed backfiring line and the advancing wildfire front are ignited. Ignition is timed to suck the backfire into the advancing fire front, thereby incinerating all vegetative fuels in the wildfires path, including riparian areas, which halts the wildfires advance.*

Firing out utilizes elements of the backfiring technique, however, it is mostly used where it is necessary to construct indirect fireline because the flanks, or edges of the wildfire, are too hot to construct direct line on the active edge of the wildfire. As the indirect line is constructed the unburned vegetation between the wildfire edge and the indirect line is fired out. Often existing roads are also used to fire out standing vegetation between the wildfire edge and the road that is serving as the containment line or fireline. Backfiring and firing out are two very distinct kinds of operations. Firing out is a minimal impact means of containment and is readily utilized by all wildland fire suppression agencies.

<u>Summary Policy Statement:</u> *Firing out should be included as an acceptable containment technique where the edge or flank of the wildfire is too hot to permit direct fireline construction. Backfiring should not be mandated by the Fire Management Plan.*

4.3.4 Ground Tactical Units Policy

- *To the extent practicable, ground tactical operations will use natural features such a ridgelines, as well as roads and pre-fire constructed firebreaks/fuelbreaks for containment lines.*

<u>Application of Policy</u>: ***FIREWISE 2000, Inc.*** *evaluated this policy and determined that the use of natural firebreaks/fuelbreaks should be encouraged only when the consumption of additional acres is considered to have ecological benefits, i.e. letting the wildfire burn up to the ridgeline instead of a direct attack because the vegetation really needs renewing, or if the use of natural*

firebreaks/fuelbreaks presents less of an impact than the construction of new wildfire suppression control lines at the time of and out ahead of the wildfire.

Summary Policy Statement: *Use of natural firebreaks/fuelbreaks should be encouraged under two conditions. 1) When the consumption of additional acres is considered to have ecological benefits, i.e. letting the wildfire burn up to the ridgeline instead of a direct attack because the vegetation really needs renewing. 2) If the use of indirect natural firebreaks/fuelbreaks presents less of an impact than the construction of new wildfire suppression control lines to directly contain the wildfire.*

4.3.5 Off-Road Policy

- *The minimum number of fire suppression vehicles considered necessary for effective fire control by the command fire agency or ground tactical units will be allowed to drive off roads and firebreaks/fuelbreaks.*

Summary Policy Statement: *The Tactical Fire Suppression Plan (Short-Term Fire Management Plan) establishes appropriate standardized fire service response guidelines that describe conditions under which fire suppression vehicles will be allowed to conduct wildfire suppression operations off-road (see Section 2.4.3 and Table 2-1).*

4.3.6 Grading Techniques and Erosion Control Policy

- *To the extent practicable, proper grading techniques and erosion control methods will be used to minimize soil erosion on fire roads.*

Summary Policy Statement: *The Tactical Fire Suppression Plan (Short-Term Fire Management Plan) establishes appropriate guidelines for pre and post-fire suppression that will identify regrading of disturbed areas and implementation of erosion control measures as part of OCFA's wildfire suppression responsibilities in consultation with the RMV Open Space Resource Advisor(s).*

4.3.7 Water Saturation as Mop-Up Technique Policy

- *To the extent practicable, ground tactical units will use water saturation as a mop-up technique rather than digging out and stirring hot spots in locations with significant CSS or other natural resources such as the biologically rich riparian areas and/or in areas potentially subject to post-fire erosion.*

Application of Policy: *In the Central/Coastal Sub Region TNC evaluated this policy and determined that the use of water saturation can result in extensive steam damage to feeder roots,* *seeds and other plant materials, and that mop-up of any kind should be completed to a minimum level of safety and control. Also, felling and bucking of mature trees should be discouraged.* ***FIREWISE* 2000, Inc.** *recommends adoption of this Application of Policy for the Southern Subregion NCCP/HCP.*

<u>Summary Policy Statement</u>: *Dry mopping techniques will be utilized to extinguish "hot spots" and smoldering plant materials as opposed to water saturation techniques. Fire killed trees will be left standing and will not be felled and bucked.*

4.3.8 Fire Prevention Techniques Policy

- *Until such time as a specific set of fire-related recreational use policies is prepared by the County of Orange Fire Department/Department of Harbors, Beaches and Parks, the interim Chino Hills State Park policies (set forth in Appendix F) shall serve as the policies for "fire prevention techniques", "pre-suppression activities" and the fire season "step-up plan".*

<u>Application of Policy</u>: *The current fire program shall be implemented in compliance with this policy.*

<u>Summary Policy Statement</u>: *See Appendix F, pages 2-3.*

4.4 Elements Of The Tactical Fire Suppression Plan

The Tactical Fire Suppression Plan contains the following elements:

- Intent.
- Delineation of Fire Compartments and Fire Management Units.
- RMV Open Space Ratings/Tactical Operation Modes/Fire Suppression Guidelines.
- Procedures for implementing the plan.
- Post-Fire Evaluation.
- Plan Maintenance and Update

4.4.1 Intent

The intent of the Tactical Fire Suppression Plan (Short-Term Fire Management Plan) is to establish appropriate standardized fire service response guidelines for use by the Orange County Fire Authority and other fire agencies responsible for managing wildland fire events within the RMV Open Space that causes the least amount of damage to natural resources while providing the effective fire-fighting controls needed to protect human life and property. Standard wildland fire fighting considerations, such as resource responses, strategies, and tactics used in the RMV Open Space will emphasize measures aimed at minimizing the impacts of wildfire on sensitive wildlife and wildlife habitats. These wildfire-fighting considerations may be revised as appropriate to address changes to the existing environmental conditions and circumstances as determined by the designated RMV Open Space Resource Advisor(s). In the RMV Open Space, when human life and property are not threatened the Fire Authority and/or appropriate fire agency will initiate the implementation of pre-determined specific fire suppression tactics that will support environmental preservation criteria. If extreme weather conditions are present (high watershed dispatch levels, Red Flag conditions, etc.), normal fire fighting strategies and tactics will be employed to ensure the highest probability of success.

4.4.2 Delineation Of Fire Management Compartments (FMC's) and Fire Management Units (FMU's)

The Strategic Fire Protection Plan established eighteen (18) Southern Subregion Fire Management Compartments (FMC's) (see page 3-5 of Section III). For the purpose of this short-term Tactical Fire Suppression Plan the FMC's are divided into those FMC's within the RMV boundaries and those outside RMV boundaries.

FMC's within Rancho Mission Viejo

21. Talega/La Paz FMC
22. Central San Juan/Trampas/Cristianitos FMC
23. Lower Gabino/Blind Canyon FMC
24. Upper Gabino/Blind Canyon FMC
26. Ladera FMC
27. Wagon Wheel/Chiquita Ridge FMC
28. Chiquadora/West Gobernadora FMC
29. East Gobernadora/Bell Canyon FMC
34. Donna O' Neill Land Conservancy FMC
36. Upper Chiquita FMC

FMC's Outside of Rancho Mission Viejo

20. San Onofre State Park FMC (this is land leased to State Parks by MCB Camp Pendleton, but is outside the Subregion, OCFA provides wildfire protection, as discussed in Section III FMC is an ignition source)
25. Riverside County FMC (outside the Subregion, but as discussed in Section III is an ignition source.
30. Caspers FMC
31. Starr Ranch FMC

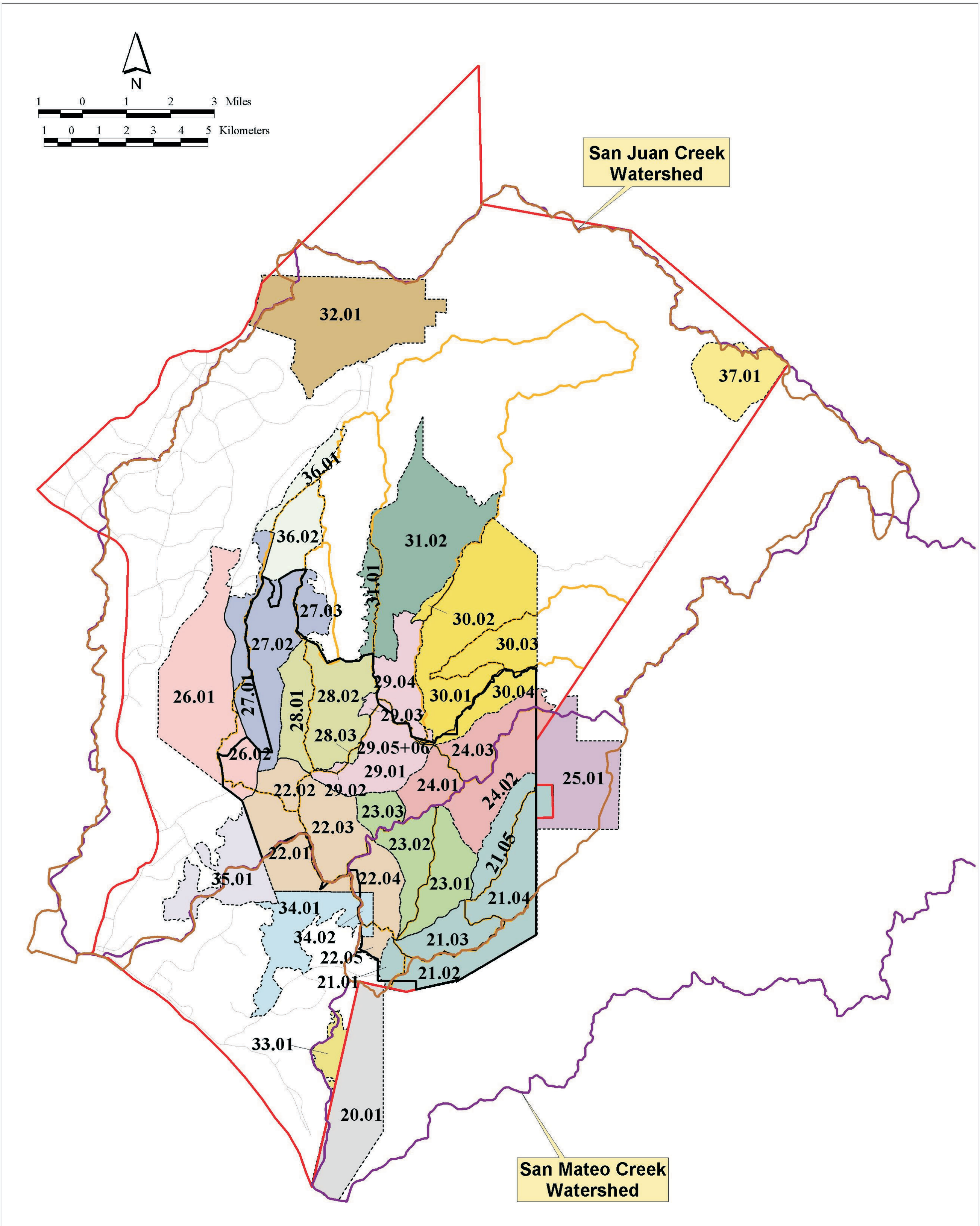
32. Foothill/Trabuco Specific Planning Area
33. Presidential Heights FMC
35. Prima Deshecha Regional Park FMC (currently a landfill)
37. El Cariso Village FMC

All of the FMC's were further subdivided into smaller units called Fire Management Units (FMU's) identified with numbers 01, 02, 03, 04, etc. The FMC's and FMU's were established in the field by OCFA and ***FIREWISE* 2000, Inc.** by utilizing natural ridgelines, riparian areas, lakes and streams, roads, trails and development edges. It should be noted that in many instances, the FMC's and FMU's extend beyond the boundaries of the Southern Subregion to achieve acceptable defensible spaces.

Figure 4 -1 is a map depicting the Southern Subregion FMC and FMU locations.

4.4.3 Southern Subregion Open Space Lands Ratings/Tactical Operation Modes/Fire Suppression Guidelines

The Plan establishes three (3) distinct Tactical Operations Modes/Fire Suppression Guidelines for application to all Southern Subregion Open Space lands, "Aggressive", "Standard" and "Modified". Tactical Operations Modes are dynamic and may change periodically based upon fuels, weather, topography and other environmental, natural resource and habitat conditions. Tactical Operations Modes may also change based upon conditions within contiguous FMU's. These guidelines correspond to "Direct Attack", "Combination Attack" and "Indirect Attack" operational modes and were assigned by The ***FIREWISE* 2000, Inc** and Orange County Fire Authority staffs to each FMU as follows:



NCCP/HCP Boundary
SAMP/ MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Rancho Mission Viejo Project Boundary
Roads

Fire Management Compartments (FMC's)

FMC 20, FMC 21, FMC 22, FMC 23, FMC 24, FMC 25, FMC 26, FMC 27, FMC 28, FMC 29, FMC 30, FMC 31, FMC 32, FMC 33, FMC 34, FMC 35, FMC 36, FMC 37

Fire Management Units*

*Numbers on map denote Fire Management Unit numbers

CNF and MCB have their own Fire Management Plans.

FIGURE 4-1

Fire Compartments and Fire Management Units

SOUTHERN SUBREGION

Orange County, California

SEPTEMBER 2003

4.4.3.1 Aggressive (Tactical Operations Mode "Direct Attack")

FMU's that are identified as "**A**" will receive immediate containment and control using all available resources (i.e., aircraft, bulldozers, engines, hand crews, etc.) in response to the resource values of the watershed which justifies an increased allocation of resources for an aggressive response and rapid intervention to contain the wildfire. Also, these FMU's must be protected as "Refugia" for the Habitat Reserve Identified Species. Therefore, immediate containment and control are the objectives of the Incident Action Plan (IAP). In many FMU's there is no separation between the ground fuels and the existing tree cover, raptor perches. Because there is a vertical fuel ladder into the crowns of most of the trees on RMV and other portions of the Habitat Reserve, any ground fire burning into these areas will kill or severely damage existing trees. The aggressive **"A"** strategy will apply to the following FMU's because of key habitat values and/or preservation strategies: FMU's 20.01–25.01, 27.01-27.03, 30.01-35.01 and 37.01.

Control objectives will also identify necessary post fire suppression activities such as mop-up, erosion control, habitat rehabilitation/remediation, etc.

4.4.3.2 Standard (Tactical Operations Mode "Combination Attack")

FMU's that are identified as "**S**" will receive a standard tactical wildfire response with minimal disruption to natural resources. The primary objective of this operational mode is to manage the wildfire in a manner that will not allow the fire to escape or spread to an adjacent FMU. This may involve a combination of all of the wildfire suppression responses.

Normal fire fighting tactics are employed. These FMU's receive standard tactical fire fighting response to the threat of wildfire with minimal disruption to the natural ecology. The use of heavy equipment and excessive backfiring operations are discouraged.

Engine Companies are encouraged to stay on roads and use operations and techniques that minimize negative impacts on the environment. Also, the primary tactical objective is to contain and control the fire with the least amount of impact to the FMU's natural habitat and overall ecology. Suppression strategies will not include extraordinary efforts to control the wildfire but will include water or retardent dropping aircraft.

The standard **"S"** strategy will apply to the following FMU's because of key habitat values that could be temporarily lost with aggressive line building with bulldozers and large scale backfiring: FMU's 26.01, 26.02, 28.01-28.03, 29.01–29.06 and 36.01, 36.02.

Tactical operations will also identify necessary post fire suppression activities such as mop-up, erosion control, habitat rehabilitation/remediation, in full consultation with the RMV Resource Advisor(s).

4.4.3.3 Modified (Tactical Operations Mode "Indirect Attack")

FMU's that are identified as "**M**" for "Modified" fire suppression response will be allowed to burn naturally up to the pre-determined natural and man-made control lines and barriers. No extraordinary equipment such as aircraft or bulldozers will be used. At this time, none of the FMU's in the Southern Subregion have an "M" modified rating.

The wildfire will be steered toward pre-existing control lines or natural barriers and allowed to burn naturally when there is a high probability of successful containment. No destructive fire fighting actions will be taken that may impact the ecology of the FMU. Bulldozers, aircraft and off-road driving should be discouraged except at pre-planned and agreed to containment lines. Hose lines and water application are permitted at non-erosive levels. Hand tools are allowed to reduce flame heights potential with no grubbing or removal of root structure. The primary objective of the IAP is containment of hostile wildfires within the FMU with no destruction or disturbance to the natural ecology. Any FMU's to be identified as an "**M**" will need to be verified on the ground with the appropriate Resource Advisor(s) and OCFA personnel. At this point we are not able to determine where free running fire that can be herded to a viable control point to meet resource management objectives other than in the grasslands. None of the FMU's are 100% Fuel Model 1, i.e. annual or perennial grasses

Standard wildland fire fighting considerations (resources, strategies and tactics) for these three (3) operational modes as prescribed by this plan shall be used in the Open Space and shall emphasize minimizing impacts of fire suppression tactics on sensitive wildlife and wildlife habitats. It should be noted that the operational mode for each FMU might change based upon environmental conditions as determined by the appropriate Resource Advisor(s). In addition, the Orange County Fire Authority and affected wildland fire agencies will attempt to implement the pre-determined fire suppression tactics unless human life and property are threatened. Should human life and property become threatened or if "**extreme**" weather conditions exist, normal fire fighting strategies and tactics will be employed, strategy "**A**", to ensure the highest probability of success and control of the wildfire at the smallest size possible.

4.4.4 Southern Subregion Open Space Lands Rating Form

The Southern Subregion Open Space Lands (SSR) ratings that form the basis for the resource response, strategies and tactics to be used by the Orange County Fire Authority Wildland Fire Defense Planner (WFDP) will be updated as needed by the appropriate Resource Advisor(s), using the SSR Rating Form (Please refer to the following suggested SSR Rating Form shown in

Table 2-1. The WFDP forwards the SSR Rating classification to the Emergency Communication Center (ECC), all Field Battalions, and Divisions in the Fire Authority, and other cooperating agencies. SSR Ratings, shown on SSR Rating Forms, correspond to existing tactical operations, or fire fighting modes.

Table 4-1 on the following page is a suggested SSR Rating Form. ***FIREWISE* 2000, Inc.** coordinated with OCFA in the development of the recommended suppression strategy ratings shown on *Table 4-1.*

Table 4-1

(*Note that these ratings are based on present conditions today and not future build out*)

Southern Subregion Open Space Lands (SSR) Rating Form			
Compartment	**Rating**	**Compartment**	**Rating**
20. San Onofre State Park		**29. East Gobernadora/Bell Canyon**	
FMU 20.01	**A**	FMU 29.01	**S**
		FMU 29.02	**S**
		FMU 29.03	**S**
(*very high habitat value, undisturbed Coastal Sage Scrub since the time of the last wildfire plus a pocket mouse that lives in loose sand*)		FMU 29.04	**S**
		FMU 29.05	**S**
		FMU 29.06	**S**
21. Talega/La Paz Canyons		**30. Caspers**	
FMU 21.01	**A**	FMU 30.01	**A**
FMU 21.02	**A**	FMU 30.02	**A**
FMU 21.03	**A**	FMU 30.03	**A**
FMU 21.04	**A**	FMU 30.04	**A**
FMU 21.05	**A**		
(*these canyons are important for raptor habitat*)		(*this FMU is managed for preservation of existing values*)	
22. Central San Juan/Trampas/Cristianitos Canyons		**31. Starr Ranch**	
FMU 22.01	**A**	FMU 31.01	**A**
FMU 22.02	**A**	FMU 31.02	**A**
FMU 22.03	**A**		
FMU 22.04	**A**		
FMU 22.05	**A**		
(*very high fuel loadings, hasn't burned since 1911, this FMC has important grassland areas, riparian areas and raptor habitat*)		(*very dense vegetation, FM 4*)	
23. Lower Gabino/Blind Canyons		**32. Foothill/Trabuco Specific Planning Area** (*State Responsibility Area*)	
FMU 23.01	**A**	FMU 32.01	**A**
FMU 23.02	**A**		
FMU 23.03	**A**		
(*this FMC has important grassland areas, riparian areas and raptor habitat*)		(*Open Space Lands above Lake Forest and Rancho Santa Margarita –disturbed land, good habitat values*)	
24. Upper Gabino/Blind Canyons		**33. Presidential Heights**	
FMU 24.01	**A**	FMU 33.01	**A**
FMU 24.02	**A**		
FMU 24.03	**A**		
25. Riverside County		**34. Donna O' Neill Land Conservancy**	
FMU 25.01	**A**	FMU 34.01	**A**
		FMU 34.02	**A**

26. Ladera FMU 26.01 **S** FMU 26.02 **S**	**35. Prima Deshecha Regional Park** FMU 35.01 **A** *(currently an active landfill)*
27. Wagon Wheel/Chiquita Ridge FMU 27.01 **A** FMU 27.02 **A** FMU 27.03 **A**	**36. Upper Chiquita** FMU 36.01 **S** FMU 36.02 **S** *(this FMC has important Coastal Sage Scrub areas)*
28. Chiquadora/West Gobernadora FMU 28.01 **S** FMU 28.02 **S** FMU 28.03 **S** *(this FMC has important grassland and riparian areas)*	**37. El Cariso Village** FMU 37.01 **A** *(this FMC has very little habitat value)*

SRL Ratings

Aggressive (**A**): Direct Attack
Standard (**S**): Combination Attack
Modified (**M**): Indirect Attack

Revision Date: ____________________

By: ______________________________

When responding to vegetation fires in the Southern Subregion Open Space lands the Emergency Communication Center notifies the initial attack Battalion Chief that the fire is in the Southern Subregion, provides the compartment and FMU number, and announces the SSR Rating. Based on this information, Battalion Chiefs determine if the recommended tactical operations mode can be implemented, based on current weather conditions. Battalion Chiefs will announce, or may request ECC to announce, what mode of operation will be used. Division Chief and field Battalion Chief Command vehicles are equipped with a folder containing maps of the Southern Subregion Compartments and the most current SSR Rating Form. These reference materials are used to assist in the managing of the incident.

4.4.5 Fire Response Procedures

4.4.5.1 Notification

The Emergency Communication Center (ECC) shall notify the initial attack units that the fire is in Southern Subregion Open Space lands and identify the affected FMC and FMU and the rating (i.e., Aggressive, Standard or Modified). For example, the ECC will make the following announcement: ***"All units responding to the vegetation fire be advised that this is on Southern Subregion Open Space lands, Compartment 21.02, Aggressive".*** The ECC will also page the OCFA Wildland Fire Defense Planner any time that a wildfire is reported in Southern Subregion Open Space lands. The Wildland Defense Planner will respond to the wildfire to work as a liaison with the Incident Commander (IC) to insure that the (IC) is aware of the rating form and Tactical Operations Modes called for by Fire Management Compartment and Fire Management Unit and to coordinate with the appropriate Resource Advisor.

4.4.5.2 Initial Attack Response:

The Battalion Chief (BC) shall make one of the following determinations:

The recommended tactical operations mode **can** be implemented based on current weather conditions and other considerations, or

The recommended tactical operations mode **cannot** be implemented, and the BC will announce, or may request that the ECC announce, the appropriate mode of operation or tactical plan to be implemented.

If the recommended tactical operations mode **can** be implemented, the Division and Battalion Chief refer to the Tactical Fire Suppression Plan and associated SSR Rating Forms which are maintained in a binder in their command vehicles.

If the incidents are expected to escalate to extended attack fires beyond the first operational period (12 hours), the appropriate Resource Advisor(s) is requested to respond to the Incident Command Post (ICP). The Resource Advisor(s) shall be a biologist and/or resource ecologist with training in wildland fire management. The appropriate Resource Advisor(s) will be notified of fires occurring within Southern Subregion Open Space lands by pager provided by the Orange County Fire Authority. The Resource Advisor will serve as a Technical Advisor ("Tech Ads") within the Plans Section.

4.5 Resource Advisor (Lead Resource Advisor Role)

Each landowner or jurisdiction with open space within the Southern Subregion shall designate a Lead Resource Advisor. This individual shall be the sole point of contact with the Incident Commander (IC). The Lead Resource Advisor shall also be responsible for notifying OCFA of an alternate Lead Resource Advisor to serve in his/her absence. The Resource Advisor shall coordinate with the affected land manager prior to communication with the IC or any OCFA personnel. No one shall enter the fire line without prior authorization from the IC, in consultation with the Lead Resource Advisor.

Table 4-2

Fire Management Compartments	Landowner/Jurisdiction With Decision Making Authority	Contact Name	Phone Number
20. San Onofre State Park	State Park Superintendent		
21. Talega/La Paz	RMV		
22. Central San Juan/Trampas/Cristianitos	RMV		
23. Lower Gabino/Blind Canyon	RMV		
24. Upper Gabino/Blind Canyon	RMV		
25. Riverside County	OCFA		
26. Ladera	RMV		
27. Wagon Wheel/Chiquita Ridge	RMV		
28. Chiquadora/West Gobernadora	RMV		
29. East Gobernadora/Bell Canyon	RMV		
30 Caspers	OC Parks & Rec		
31. Starr Ranch	Audubon Society		
32. Foothill/Trabuco Specific Planning Area	OCFA		
33. Presidential Heights	OC Parks & Rec		
34. Donna O' Neill Land Conservancy	RMV		
35. Prima Dechecha Regional Park (now a landfill)	OC Parks & Rec		
36. Upper Chiquita	RMV		
37. El Cariso Village	OCFA		

4.5.1 Notification and Coordination of Other Designated Resource Advisors

The Lead Resource Advisor shall be notified by pager of all fire events affecting their open space lands and shall be responsible for contacting, consulting and coordinating with all other Resource Advisors and land managers as necessary. The Lead Resource Advisor shall also maintain a list of all Resource Advisors and notify OCFA of any changes to the list of Resource Advisors including a designated alternate Lead Resource Advisor.

4.5.2 Lead Resource Advisor Response

In response to the initial pager notification, the Lead Resource Advisor shall report to the Incident Command Post if requested to do so by the IC and be available to provide technical advice as necessary to the IC.

The Lead Resource Advisor(s) will review the Tactical Fire Suppression Plan and the "Environmentally Sensitive Areas" (ESA) mapping and advise the BC. For the RMV Open Space, the ESA mapping has been prepared by Dudek and Associates, Inc. and Archeological Resource Management Corporation and includes the following data:

- Vernal pool locations
- Archeological sites
- Paleontological Resource Areas

The ESA mapping will be updated as required by the Resource Advisor(s) and as new locations are discovered.

4.6 Post-Fire Evaluation

The Tactical Fire Suppression Plan was created as part of a cooperative effort involving the Orange County Fire Authority, ***FIREWISE* 2000, Inc.** and the NCCP/SAMP Working Group. The plan is intended to be a "dynamic, living document" that remains effective as a management tool throughout the life of the RMV Open Space and other Southern Subregion Open Space lands.

Following each fire event on Southern Subregion Open Space lands, fire suppression forces will review the effectiveness of the tactical operations recommended in the plan. The suppression forces may recommend changes to the WFDP to better achieve the goals and objectives of the plan.

Also, the Lead Resource Advisor will monitor natural resource conditions regularly, update the SSR Ratings (Aggressive, Standard and Modified) for each FMU on an as-needed basis, and recommend plan revisions to address these changing conditions.

The Lead Resource Advisor in consultation with an OCFA representative shall evaluate all fire events occurring in the Southern Subregion as follows:

- Date & Time of Fire;
- Fire Management Compartment/Fire Management Unit (FMC/FMU) affected;

- SSR Rating for the affected FMC/FMU;
- Actual Fire Suppression Tactics used;
- Estimated Size of Fire (Acres);
- Affected Habitat(s)
- Types of Disturbances (i.e., new fire roads, hand clearing, erosion, etc.);
- Measures Undertaken to Correct Disturbances; and
- Other as determined by the Lead Resource Advisor.

4.7 Training Sessions

Annual Resource Advisor training sessions should be conducted by May 15th to review these roles and responsibilities and the overall design of the program.

4.8 Review and Approval

The WFDP will review all recommendations in consultation with the Resource Advisor(s) and approve appropriate additions and revisions to the Tactical Fire Suppression Plan (Short Term Fire Management Plan).

4.9 Post Fire Reporting

All fire incidents and responses occurring on Southern Subregion Open Space lands, and specifically RMV Open Space, shall be reported to the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG) the US Army Corps of Engineers and the County of Orange. The report shall include the cause of the incident, number of acres of habitat by type burned, types of resources effected, and post fire evaluation.

4.10 Tactical Fire Suppression Plan Maintenance

4.10.1 FMC/FMU Mapping Maintenance

The Orange County Fire Authority (OCFA) shall maintain the FMC's/FMU's mapping and SSR Rating Forms. Updates to the mapping shall be made on an on-going basis. The mapping shall be comprehensively reviewed and revised as needed on an annual basis.

4.10.2 Southern Subregion Open Space Lands (SSR) Rating Form Maintenance

OCFA shall maintain the SSR Rating forms and all subsequent updates as required by the Resource Advisor(s).

4.10.3 Resource Sensitive Areas Mapping

Name (entity to be determined) shall update the Resource Sensitive Areas mapping, as new data become available and incorporate as approved by the Resource Advisor(s)

4.11 Tactical Fire Suppression Plan Interagency Coordination and Training

OCFA, Resources Planning and appropriate Habitat Reserve Resource Advisor(s) shall conduct a training session for the affected OCFA Battalion Chief and other wildland fire agencies.

4.11.1 OCFA Battalion Chief Training Sessions

Battalion Chief training sessions will be conducted on an annual basis prior to the wildfire season.

4.11.2 Coordination with Other Wildland Fire Agencies

Annual training sessions with these agencies shall be conducted on an annual basis prior to the wildfire season.

4.11.3 Open Space Land Managers

Open Space Land Manager training will occur prior to the wildfire season. The Open Space Land Managers generally possess the greatest knowledge concerning the location of sensitive natural and scientific resources within their properties and will assist in the completion of Resource Sensitive Areas mapping.

PART IV - TACTICAL FIRE SUPPRESSION PLAN

PART IV – SHORT-TERM TACTICAL FIRE SUPPRESSION PLAN

4.0 BACKGROUND

This short-term Tactical Fire Suppression Plan has been prepared to function as the fire management portion of the Southern Subregion NCCP/HCP Adaptive Management Program. General Policy 5 of the Draft NCCP/HCP Planning Guidelines states:

> Long-term indirect impacts to the Habitat Reserve and other areas being preserved for species protection shall be managed through creation of an urban/wildlands interface zone separating the Habitat Reserve system from the non-reserve/urban areas.

General Policy 5 further states regarding management of the interface zone would:

- Create fuel management zones combining irrigated and non-irrigated native plantings separating the Habitat Reserve system from adjacent urban uses.

- To the extent that fuel management zones are composed of native habitats and can support Identified Species and other species, or be enhanced or managed to support Identified Species and other species, this should be encouraged. For example, using prickly-pear in the fuel management zone may provide habitat for the cactus wren, as well as enhance the buffering effect between the Habitat Reserve and developed areas.

- Fuel management zones and practices will be set forth in a "fuel management plan" as part of the NCCP/HCP and aquatic resources protection program.

- Prohibit plants identified by the California Exotic Pest Plant Council as an invasive risk in Southern California from development and fuel management zones adjoining the Habitat Reserve;

This Tactical Fire Suppression Plan has been prepared to establish appropriate fire response tactics for all wildfires in the Fire Management Compartments (FMC's), Fire Management Units (FMU's), and Fuel Management Zones (FMZ's) discussed in Section III-Strategic Fire Protection Plan (see pages 3-4 through 3-12). All wildfires will be suppressed as quickly as possible. Unplanned wildfires will not be used in the Southern Subregion as a management strategy.

4.1 Preparation of the Fire Management Plan

This short-term Tactical Fire Suppression Plan was prepared by ***FIREWISE* 2000, Inc.** in cooperation with the Orange County Fire Authority (OCFA).

4.2 Structure of the Plan

The following elements must be included in the preparation of the Short-Term Tactical Fire Suppression Plan:

- *Defining fire management "compartments" that encompass major populations of Identified Species and the overall sub-regional reserve system, and preparing specific fire attack measures that would protect these areas as "refugia" in the event of a wild fire with the least impact on sensitive habitat in or near the refugia.*

***FIREWISE* 2000, Inc.** and the Orange County Fire Authority have established eighteen (18) Fire Management Compartments (FMC's) that were further subdivided into Fire Management Units (FMU's). In addition, specific fire suppression measures were identified for each FMU.

- *Preparation of suppression plans for each fire management compartment or unit.*

As noted above, the Tactical Fire Suppression Plan prescribes a specific fire suppression operational mode for each unit (*see page 4-11 and 4-12*).

- *Identify urban fuel modification zone criteria which achieve effective protection for urban development while minimizing impacts on sensitive habitat types.*

As a result of the frequency of wildfires burning through Rancho Mission Viejo and cattle grazing there is very little dense natural vegetation on the Ranch. The young age of the existing vegetation and low to moderate shrub density intermixed with annual and perennial grasses helps account for the high species populations and excellent biodiversity found on Rancho Mission Viejo. The Fire Behavior and Fuel Modeling System – BURN Subsystem, Parts 1 & 2, known as BEHAVE, were used to assess the flammability characteristics of the vegetation on Rancho Mission Viejo. BEHAVE calculations were run for the various fuel models that could conceivably interface with future urban interface areas within Rancho Mission Viejo. The vegetation on the Ranch falls into one of the following Fuel Models (FM's) FM 1, cured grass, one foot tall; FM 2, sagebrush over cured grass; FM 4, coastal sage scrub/chaparral at or greater than six feet in height and FM 6, coastal sage scrub/chaparral at or less than six feet in height. FM 4 exhibits the highest intensity and flame lengths; however, there is very little FM 4 on Rancho Mission Viejo. FM 2 exhibits the second highest intensity and flame lengths and is the most abundant Fuel Model found on Rancho Mission Viejo. Structures built with fire resistant materials and features (*see pages 3-10 through 3-11*) coupled with seventy (70) feet of Zone A irrigated "firewise landscaping" plus an additional forty (40) feet of thinned native fuels with no chamise (*Adenostoma fasciculatum*), California sagebrush (*Artemisia californica*), pampas grass (*Cortaderia selloana*), common buckwheat (*Eriogonum fasciculatum*) or black sage (*Salvia mellifera*) will provide adequate protection from wildfire without the intervention of Fire Department Equipment and Personnel.

The Orange County Fire Authority Fire Management Plant Palette was revised as part of an earlier effort in cooperation with the California Department of Fish and Game, U.S. Fish and Wildlife Service, State Parks, Planning and Development Services Department/Resources Planning, Public Facilities and Resources Department/Harbors, Beaches and Parks, private landowners, and landscape architecture firms. The plant palette (see Appendix A for all plants coded with an **X** plus the list of undesirable plants and weeds) identifies non-native invasive plant species that may escape into the RMV Open Space and displace native habitats, impact sensitive wildlife species and overall diversity, and increase the cost of management. The revised plant palette now emphasizes the use of native plant species that enhance the biological integrity of the RMV Open Space, establishes an appropriate transition at the urban/wildland interface, and provides an acceptable level of wildland fire protection.

- *Defining fire suppression compartments that encompass major populations of Identified Species.*

As noted above, the eighteen (18) FMC's were established based upon fire history and those "open space" areas that are subject to frequent wildfires.

4.2.1 How Part IV is Developed

Part IV is designed in such a way that it can be pulled out of the overall plan and be used as a stand alone plan by OCFA line officers as their wildland fire protection direction by specific FMU's.

4.3 Fire Suppression Policies For Biologically Sensitive Areas

The following eight (8) fire suppression policies are taken from the Coastal/Central NCCP/HCP Subregion Plan and are evaluated here for their applicability in the preparation of Fire Management Plans for Biologically Sensitive Areas in the RMV Open Space:

4.3.1 Bulldozer Policy

- *To the extent practicable, the use of bulldozers or other mechanical land altering equipment will be restricted to the widening and improving of existing fire roads.*

Application of Policy: During the preparation of the NCCP/HCP for the Central/Coastal Subregion, The Nature Conservancy (TNC) re-evaluated this policy and determined that it was far too limiting and effectively eliminates the value of bulldozers as a tool for minimizing fire size. TNC further stated that the use of bulldozers should be an option for any location in which the short term loss or long term conversion of habitat presents a high risk for Identified Species.

Summary Policy Statement: ***FIREWISE 2000, Inc.*** *recommends adoption of the above Application of Policy for the RMV Open Space. During periods of extreme fire behavior OCFA must use an Aggressive Suppression Strategy, including the use of bulldozers, to limit wildfire size and wildfire spread into urban areas. The immediate confined damage often is less costly than a large temporary loss (zero to fifteen years for certain targeted species) of suitable habitat.*

4.3.2 New Fire Roads Policy

- *To the extent practicable, new fire roads or firebreaks/fuelbreaks will not be created by mechanical methods. Hand crews will be used to create any necessary new firebreaks/fuelbreaks wherever practicable or feasible.*

Application of Policy: ***FIREWISE 2000, Inc.*** *evaluated this policy and determined that although the limitation of new roads and trails is a very important issue for the RMV Open Space, this fire policy should be expanded to include the potential for mechanically-created firebreaks/fuelbreaks. In situations where wildfire threats would result in type conversion and habitat loss, the spatial limited impacts of a bulldozer may be the preferred biological alternative to the consumption of additional RMV Open Space lands. Fuelbreaks can be mechanically created on main and lateral ridgelines in a low impact manner in areas with a repeated very high wildfire frequency by crushing the standing vegetation with a bulldozer with the blade up. The crushed brush is later burned using prescribed (Rx) fire under suitable conditions.*

Summary Policy Statement: Utilize bulldozers for "blade up" fuelbreak construction by crushing standing vegetation and later burning the dried crushed vegetation.

4.3.3 Backfiring Policy

- *When conditions are suitable, backfiring from existing roads, natural barriers or trails will be considered preferable to constructing new fire control lines and other methods.*

Application of Policy: ***FIREWISE 2000, Inc.*** *evaluated this policy and determined that the use of backfiring in coastal sage scrub and other habitats should be weighed against short and potential long-term loss of RMV Open Space lands and particularly the loss of riparian habitat. Backfiring should remain a possible fire management tool but should not be mandated by the Plan. Backfiring is very different than firing out. Backfiring is a last ditch effort to cut off the forward rate of spread of a rapidly advancing wildfire front by falling back to a ridge line or road a considerable distance ahead of the fire front. Necessary holding lines are constructed and the vegetative fuels between the newly constructed backfiring line and the advancing wildfire front are ignited. Ignition is timed to suck the backfire into the advancing fire front, thereby incinerating all vegetative fuels in the wildfires path, including riparian areas, which halts the wildfires advance.*

Firing out utilizes elements of the backfiring technique, however, it is mostly used where it is necessary to construct indirect fireline because the flanks, or edges of the wildfire, are too hot to construct direct line on the active edge of the wildfire. As the indirect line is constructed the unburned vegetation between the wildfire edge and the indirect line is fired out. Often existing roads are also used to fire out standing vegetation between the wildfire edge and the road that is serving as the containment line or fireline. Backfiring and firing out are two very distinct kinds of operations. Firing out is a minimal impact means of containment and is readily utilized by all wildland fire suppression agencies.

Summary Policy Statement: *Firing out should be included as an acceptable containment technique where the edge or flank of the wildfire is too hot to permit direct fireline construction. Backfiring should not be mandated by the Fire Management Plan.*

4.3.4 Ground Tactical Units Policy

- *To the extent practicable, ground tactical operations will use natural features such a ridgelines, as well as roads and pre-fire constructed firebreaks/fuelbreaks for containment lines.*

Application of Policy: ***FIREWISE 2000, Inc.*** *evaluated this policy and determined that the use of natural firebreaks/fuelbreaks should be encouraged only when the consumption of additional acres is considered to have ecological benefits, i.e. letting the wildfire burn up to the ridgeline instead of a direct attack because the vegetation really needs renewing, or if the use of natural* *firebreaks/fuelbreaks presents less of an impact than the construction of new wildfire suppression control lines at the time of and out ahead of the wildfire.*

Summary Policy Statement: *Use of natural firebreaks/fuelbreaks should be encouraged under two conditions. 1) When the consumption of additional acres is considered to have ecological benefits, i.e. letting the wildfire burn up to the ridgeline instead of a direct attack because the vegetation really needs renewing. 2) If the use of indirect natural firebreaks/fuelbreaks presents less of an impact than the construction of new wildfire suppression control lines to directly contain the wildfire.*

4.3.5 Off-Road Policy

- *The minimum number of fire suppression vehicles considered necessary for effective fire control by the command fire agency or ground tactical units will be allowed to drive off roads and firebreaks/fuelbreaks.*

Summary Policy Statement: *The Tactical Fire Suppression Plan (Short-Term Fire Management Plan) establishes appropriate standardized fire service response guidelines that describe conditions under which fire suppression vehicles will be allowed to conduct wildfire suppression operations off-road (see Section 2.4.3 and Table 2-1).*

4.3.6 Grading Techniques and Erosion Control Policy

- *To the extent practicable, proper grading techniques and erosion control methods will be used to minimize soil erosion on fire roads.*

Summary Policy Statement: *The Tactical Fire Suppression Plan (Short-Term Fire Management Plan) establishes appropriate guidelines for pre and post-fire suppression that will identify regrading of disturbed areas and implementation of erosion control measures as part of OCFA's wildfire suppression responsibilities in consultation with the RMV Open Space Resource Advisor(s).*

4.3.7 Water Saturation as Mop-Up Technique Policy

- *To the extent practicable, ground tactical units will use water saturation as a mop-up technique rather than digging out and stirring hot spots in locations with significant CSS or other natural resources such as the biologically rich riparian areas and/or in areas potentially subject to post-fire erosion.*

Application of Policy: *In the Central/Coastal Sub Region TNC evaluated this policy and determined that the use of water saturation can result in extensive steam damage to feeder roots,* *seeds and other plant materials, and that mop-up of any kind should be completed to a minimum level of safety and control. Also, felling and bucking of mature trees should be discouraged.* ***FIREWISE* 2000, Inc.** *recommends adoption of this Application of Policy for the Southern Subregion NCCP/HCP.*

Summary Policy Statement: Dry mopping techniques will be utilized to extinguish "hot spots" and smoldering plant materials as opposed to water saturation techniques. Fire killed trees will be left standing and will not be felled and bucked.

4.3.8 Fire Prevention Techniques Policy

- *Until such time as a specific set of fire-related recreational use policies is prepared by the County of Orange Fire Department/Department of Harbors, Beaches and Parks, the interim Chino Hills State Park policies (set forth in Appendix F) shall serve as the policies for "fire prevention techniques", "pre-suppression activities" and the fire season "step-up plan".*

Application of Policy: The current fire program shall be implemented in compliance with this policy.

Summary Policy Statement: See Appendix F, pages 2-3.

4.4 Elements Of The Tactical Fire Suppression Plan

The Tactical Fire Suppression Plan contains the following elements:

- Intent.
- Delineation of Fire Compartments and Fire Management Units.
- RMV Open Space Ratings/Tactical Operation Modes/Fire Suppression Guidelines.
- Procedures for implementing the plan.
- Post-Fire Evaluation.
- Plan Maintenance and Update

4.4.1 Intent

The intent of the Tactical Fire Suppression Plan (Short-Term Fire Management Plan) is to establish appropriate standardized fire service response guidelines for use by the Orange County Fire Authority and other fire agencies responsible for managing wildland fire events within the RMV Open Space that causes the least amount of damage to natural resources while providing the effective fire-fighting controls needed to protect human life and property. Standard wildland fire fighting considerations, such as resource responses, strategies, and tactics used in the RMV Open Space will emphasize measures aimed at minimizing the impacts of wildfire on sensitive wildlife and wildlife habitats. These wildfire-fighting considerations may be revised as appropriate to address changes to the existing environmental conditions and circumstances as determined by the designated RMV Open Space Resource Advisor(s). In the RMV Open Space, when human life and property are not threatened the Fire Authority and/or appropriate fire agency will initiate the implementation of pre-determined specific fire suppression tactics that will support environmental preservation criteria. If extreme weather conditions are present (high watershed dispatch levels, Red Flag conditions, etc.), normal fire fighting strategies and tactics will be employed to ensure the highest probability of success.

4.4.2 Delineation Of Fire Management Compartments (FMC's) and Fire Management Units (FMU's)

The Strategic Fire Protection Plan established eighteen (18) Southern Subregion Fire Management Compartments (FMC's) (see page 3-5 of Section III). For the purpose of this short-term Tactical Fire Suppression Plan the FMC's are divided into those FMC's within the RMV boundaries and those outside RMV boundaries.

FMC's within Rancho Mission Viejo

21. Talega/La Paz FMC
22. Central San Juan/Trampas/Cristianitos FMC
23. Lower Gabino/Blind Canyon FMC
24. Upper Gabino/Blind Canyon FMC
26. Ladera FMC
27. Wagon Wheel/Chiquita Ridge FMC
28. Chiquadora/West Gobernadora FMC
29. East Gobernadora/Bell Canyon FMC
34. Donna O' Neill Land Conservancy FMC
36. Upper Chiquita FMC

FMC's Outside of Rancho Mission Viejo

20. San Onofre State Park FMC (this is land leased to State Parks by MCB Camp Pendleton, but is outside the Subregion, OCFA provides wildfire protection, as discussed in Section III FMC is an ignition source)
25. Riverside County FMC (outside the Subregion, but as discussed in Section III is an ignition source.
30. Caspers FMC
31. Starr Ranch FMC

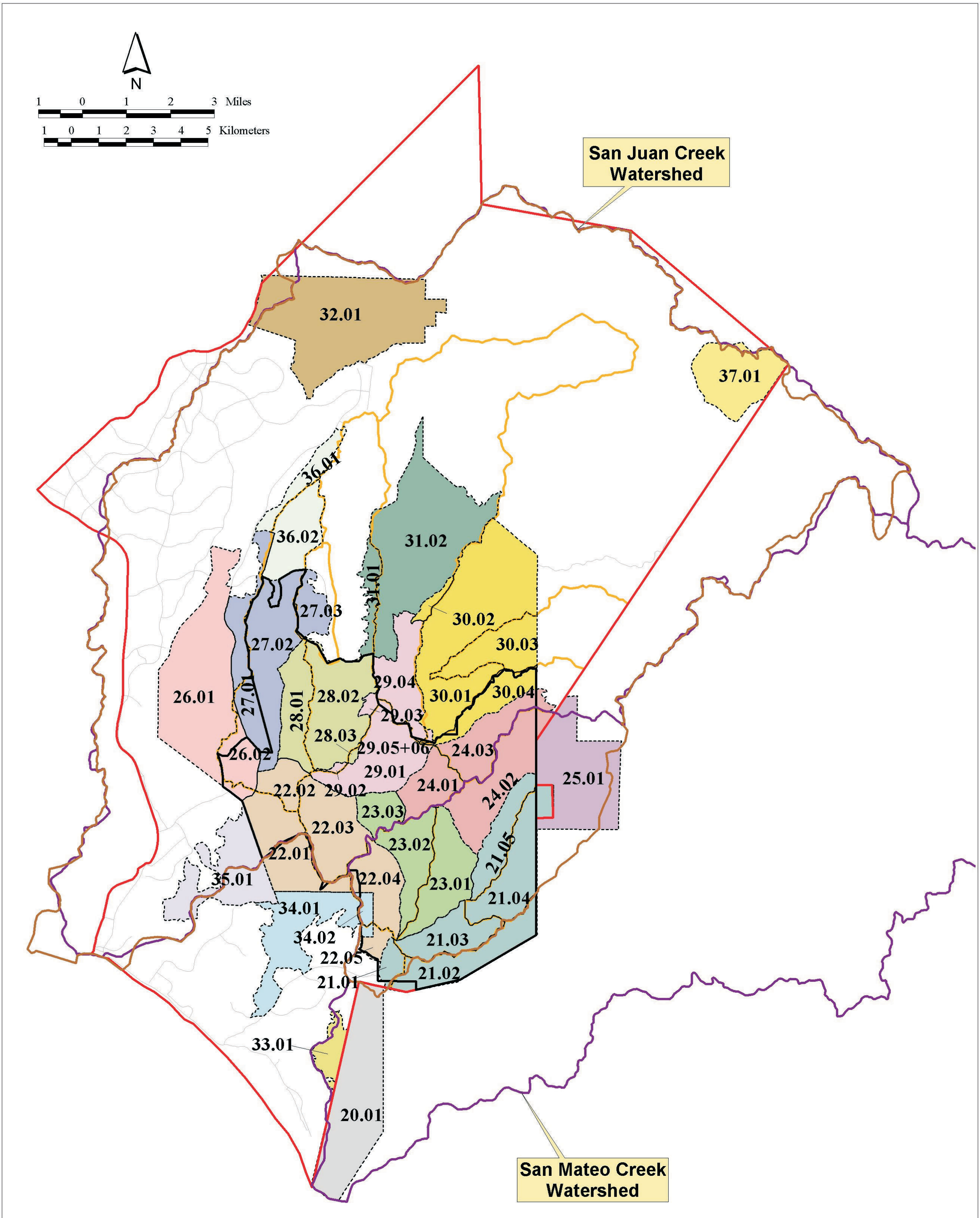
32. Foothill/Trabuco Specific Planning Area
33. Presidential Heights FMC
35. Prima Deshecha Regional Park FMC (currently a landfill)
37. El Cariso Village FMC

All of the FMC's were further subdivided into smaller units called Fire Management Units (FMU's) identified with numbers 01, 02, 03, 04, etc. The FMC's and FMU's were established in the field by OCFA and ***FIREWISE* 2000, Inc.** by utilizing natural ridgelines, riparian areas, lakes and streams, roads, trails and development edges. It should be noted that in many instances, the FMC's and FMU's extend beyond the boundaries of the Southern Subregion to achieve acceptable defensible spaces.

Figure 4 -1 is a map depicting the Southern Subregion FMC and FMU locations.

4.4.3 Southern Subregion Open Space Lands Ratings/Tactical Operation Modes/Fire Suppression Guidelines

The Plan establishes three (3) distinct Tactical Operations Modes/Fire Suppression Guidelines for application to all Southern Subregion Open Space lands, "Aggressive", "Standard" and "Modified". Tactical Operations Modes are dynamic and may change periodically based upon fuels, weather, topography and other environmental, natural resource and habitat conditions. Tactical Operations Modes may also change based upon conditions within contiguous FMU's. These guidelines correspond to "Direct Attack", "Combination Attack" and "Indirect Attack" operational modes and were assigned by The ***FIREWISE* 2000, Inc** and Orange County Fire Authority staffs to each FMU as follows:



NCCP/HCP Boundary
SAMP/ MSAA Boundary
San Juan Creek/San Mateo Creek Watershed Boundaries
Sub-Watershed Boundaries
Rancho Mission Viejo Project Boundary
Roads

Fire Management Compartments (FMC's)

FMC 20, FMC 21, FMC 22, FMC 23, FMC 24, FMC 25, FMC 26, FMC 27, FMC 28, FMC 29, FMC 30, FMC 31, FMC 32, FMC 33, FMC 34, FMC 35, FMC 36, FMC 37

Fire Management Units*

*Numbers on map denote Fire Management Unit numbers

CNF and MCB have their own Fire Management Plans.

FIGURE 4-1
Fire Compartments and Fire Management Units
SOUTHERN SUBREGION
Orange County, California
SEPTEMBER 2003

4.4.3.1 Aggressive (Tactical Operations Mode "Direct Attack")

FMU's that are identified as "**A**" will receive immediate containment and control using all available resources (i.e., aircraft, bulldozers, engines, hand crews, etc.) in response to the resource values of the watershed which justifies an increased allocation of resources for an aggressive response and rapid intervention to contain the wildfire. Also, these FMU's must be protected as "Refugia" for the Habitat Reserve Identified Species. Therefore, immediate containment and control are the objectives of the Incident Action Plan (IAP). In many FMU's there is no separation between the ground fuels and the existing tree cover, raptor perches. Because there is a vertical fuel ladder into the crowns of most of the trees on RMV and other portions of the Habitat Reserve, any ground fire burning into these areas will kill or severely damage existing trees. The aggressive **"A"** strategy will apply to the following FMU's because of key habitat values and/or preservation strategies: FMU's 20.01–25.01, 27.01-27.03, 30.01-35.01 and 37.01.

Control objectives will also identify necessary post fire suppression activities such as mop-up, erosion control, habitat rehabilitation/remediation, etc.

4.4.3.2 Standard (Tactical Operations Mode "Combination Attack")

FMU's that are identified as "**S**" will receive a standard tactical wildfire response with minimal disruption to natural resources. The primary objective of this operational mode is to manage the wildfire in a manner that will not allow the fire to escape or spread to an adjacent FMU. This may involve a combination of all of the wildfire suppression responses.

Normal fire fighting tactics are employed. These FMU's receive standard tactical fire fighting response to the threat of wildfire with minimal disruption to the natural ecology. The use of heavy equipment and excessive backfiring operations are discouraged.

Engine Companies are encouraged to stay on roads and use operations and techniques that minimize negative impacts on the environment. Also, the primary tactical objective is to contain and control the fire with the least amount of impact to the FMU's natural habitat and overall ecology. Suppression strategies will not include extraordinary efforts to control the wildfire but will include water or retardent dropping aircraft.

The standard **"S"** strategy will apply to the following FMU's because of key habitat values that could be temporarily lost with aggressive line building with bulldozers and large scale backfiring: FMU's 26.01, 26.02, 28.01-28.03, 29.01–29.06 and 36.01, 36.02.

Tactical operations will also identify necessary post fire suppression activities such as mop-up, erosion control, habitat rehabilitation/remediation, in full consultation with the RMV Resource Advisor(s).

4.4.3.3 Modified (Tactical Operations Mode "Indirect Attack")

FMU's that are identified as "**M**" for "Modified" fire suppression response will be allowed to burn naturally up to the pre-determined natural and man-made control lines and barriers. No extraordinary equipment such as aircraft or bulldozers will be used. At this time, none of the FMU's in the Southern Subregion have an "M" modified rating.

The wildfire will be steered toward pre-existing control lines or natural barriers and allowed to burn naturally when there is a high probability of successful containment. No destructive fire fighting actions will be taken that may impact the ecology of the FMU. Bulldozers, aircraft and off-road driving should be discouraged except at pre-planned and agreed to containment lines. Hose lines and water application are permitted at non-erosive levels. Hand tools are allowed to reduce flame heights potential with no grubbing or removal of root structure. The primary objective of the IAP is containment of hostile wildfires within the FMU with no destruction or disturbance to the natural ecology. Any FMU's to be identified as an "**M**" will need to be verified on the ground with the appropriate Resource Advisor(s) and OCFA personnel. At this point we are not able to determine where free running fire that can be herded to a viable control point to meet resource management objectives other than in the grasslands. None of the FMU's are 100% Fuel Model 1, i.e. annual or perennial grasses

Standard wildland fire fighting considerations (resources, strategies and tactics) for these three (3) operational modes as prescribed by this plan shall be used in the Open Space and shall emphasize minimizing impacts of fire suppression tactics on sensitive wildlife and wildlife habitats. It should be noted that the operational mode for each FMU might change based upon environmental conditions as determined by the appropriate Resource Advisor(s). In addition, the Orange County Fire Authority and affected wildland fire agencies will attempt to implement the pre-determined fire suppression tactics unless human life and property are threatened. Should human life and property become threatened or if "**extreme**" weather conditions exist, normal fire fighting strategies and tactics will be employed, strategy "**A**", to ensure the highest probability of success and control of the wildfire at the smallest size possible.

4.4.4 Southern Subregion Open Space Lands Rating Form

The Southern Subregion Open Space Lands (SSR) ratings that form the basis for the resource response, strategies and tactics to be used by the Orange County Fire Authority Wildland Fire Defense Planner (WFDP) will be updated as needed by the appropriate Resource Advisor(s), using the SSR Rating Form (Please refer to the following suggested SSR Rating Form shown in

Table 2-1. The WFDP forwards the SSR Rating classification to the Emergency Communication Center (ECC), all Field Battalions, and Divisions in the Fire Authority, and other cooperating agencies. SSR Ratings, shown on SSR Rating Forms, correspond to existing tactical operations, or fire fighting modes.

Table 4-1 on the following page is a suggested SSR Rating Form. ***FIREWISE* 2000, Inc.** coordinated with OCFA in the development of the recommended suppression strategy ratings shown on *Table 4-1.*

Table 4-1

(*Note that these ratings are based on present conditions today and not future build out*)

Southern Subregion Open Space Lands (SSR) Rating Form			
Compartment	**Rating**	**Compartment**	**Rating**
20. San Onofre State Park		**29. East Gobernadora/Bell Canyon**	
FMU 20.01	**A**	FMU 29.01	**S**
		FMU 29.02	**S**
		FMU 29.03	**S**
(*very high habitat value, undisturbed Coastal Sage Scrub since the time of the last wildfire plus a pocket mouse that lives in loose sand*)		FMU 29.04	**S**
		FMU 29.05	**S**
		FMU 29.06	**S**
21. Talega/La Paz Canyons		**30. Caspers**	
FMU 21.01	**A**	FMU 30.01	**A**
FMU 21.02	**A**	FMU 30.02	**A**
FMU 21.03	**A**	FMU 30.03	**A**
FMU 21.04	**A**	FMU 30.04	**A**
FMU 21.05	**A**		
(*these canyons are important for raptor habitat*)		(*this FMU is managed for preservation of existing values*)	
22. Central San Juan/Trampas/Cristianitos Canyons		**31. Starr Ranch**	
FMU 22.01	**A**	FMU 31.01	**A**
FMU 22.02	**A**	FMU 31.02	**A**
FMU 22.03	**A**		
FMU 22.04	**A**		
FMU 22.05	**A**		
(*very high fuel loadings, hasn't burned since 1911, this FMC has important grassland areas, riparian areas and raptor habitat*)		(*very dense vegetation, FM 4*)	
23. Lower Gabino/Blind Canyons		**32. Foothill/Trabuco Specific Planning Area** (*State Responsibility Area*)	
FMU 23.01	**A**	FMU 32.01	**A**
FMU 23.02	**A**		
FMU 23.03	**A**		
(*this FMC has important grassland areas, riparian areas and raptor habitat*)		(*Open Space Lands above Lake Forest and Rancho Santa Margarita –disturbed land, good habitat values*)	
24. Upper Gabino/Blind Canyons		**33. Presidential Heights**	
FMU 24.01	**A**	FMU 33.01	**A**
FMU 24.02	**A**		
FMU 24.03	**A**		
25. Riverside County		**34. Donna O' Neill Land Conservancy**	
FMU 25.01	**A**	FMU 34.01	**A**
		FMU 34.02	**A**

26. Ladera FMU 26.01 **S** FMU 26.02 **S**	**35. Prima Deshecha Regional Park** FMU 35.01 **A** (*currently an active landfill*)
27. Wagon Wheel/Chiquita Ridge FMU 27.01 **A** FMU 27.02 **A** FMU 27.03 **A**	**36. Upper Chiquita** FMU 36.01 **S** FMU 36.02 **S** (*this FMC has important Coastal Sage Scrub areas*)
28. Chiquadora/West Gobernadora FMU 28.01 **S** FMU 28.02 **S** FMU 28.03 **S** (*this FMC has important grassland and riparian areas*)	**37. El Cariso Village** FMU 37.01 **A** (*this FMC has very little habitat value*)

<u>SRL Ratings</u>

Aggressive (**A**): Direct Attack
Standard (**S**): Combination Attack
Modified (**M**): Indirect Attack

Revision Date: ____________________

By: ______________________________

When responding to vegetation fires in the Southern Subregion Open Space lands the Emergency Communication Center notifies the initial attack Battalion Chief that the fire is in the Southern Subregion, provides the compartment and FMU number, and announces the SSR Rating. Based on this information, Battalion Chiefs determine if the recommended tactical operations mode can be implemented, based on current weather conditions. Battalion Chiefs will announce, or may request ECC to announce, what mode of operation will be used. Division Chief and field Battalion Chief Command vehicles are equipped with a folder containing maps of the Southern Subregion Compartments and the most current SSR Rating Form. These reference materials are used to assist in the managing of the incident.

4.4.5 Fire Response Procedures

4.4.5.1 Notification

The Emergency Communication Center (ECC) shall notify the initial attack units that the fire is in Southern Subregion Open Space lands and identify the affected FMC and FMU and the rating (i.e., Aggressive, Standard or Modified). For example, the ECC will make the following announcement: ***"All units responding to the vegetation fire be advised that this is on Southern Subregion Open Space lands, Compartment 21.02, Aggressive".*** The ECC will also page the OCFA Wildland Fire Defense Planner any time that a wildfire is reported in Southern Subregion Open Space lands. The Wildland Defense Planner will respond to the wildfire to work as a liaison with the Incident Commander (IC) to insure that the (IC) is aware of the rating form and Tactical Operations Modes called for by Fire Management Compartment and Fire Management Unit and to coordinate with the appropriate Resource Advisor.

4.4.5.2 Initial Attack Response:

The Battalion Chief (BC) shall make one of the following determinations:

The recommended tactical operations mode **can** be implemented based on current weather conditions and other considerations, or

The recommended tactical operations mode **cannot** be implemented, and the BC will announce, or may request that the ECC announce, the appropriate mode of operation or tactical plan to be implemented.

If the recommended tactical operations mode **can** be implemented, the Division and Battalion Chief refer to the Tactical Fire Suppression Plan and associated SSR Rating Forms which are maintained in a binder in their command vehicles.

If the incidents are expected to escalate to extended attack fires beyond the first operational period (12 hours), the appropriate Resource Advisor(s) is requested to respond to the Incident Command Post (ICP). The Resource Advisor(s) shall be a biologist and/or resource ecologist with training in wildland fire management. The appropriate Resource Advisor(s) will be notified of fires occurring within Southern Subregion Open Space lands by pager provided by the Orange County Fire Authority. The Resource Advisor will serve as a Technical Advisor ("Tech Ads") within the Plans Section.

4.5 Resource Advisor (Lead Resource Advisor Role)

Each landowner or jurisdiction with open space within the Southern Subregion shall designate a Lead Resource Advisor. This individual shall be the sole point of contact with the Incident Commander (IC). The Lead Resource Advisor shall also be responsible for notifying OCFA of an alternate Lead Resource Advisor to serve in his/her absence. The Resource Advisor shall coordinate with the affected land manager prior to communication with the IC or any OCFA personnel. No one shall enter the fire line without prior authorization from the IC, in consultation with the Lead Resource Advisor.

Table 4-2

Fire Management Compartments	Landowner/Jurisdiction With Decision Making Authority	Contact Name	Phone Number
20. San Onofre State Park	State Park Superintendent		
21. Talega/La Paz	RMV		
22. Central San Juan/Trampas/Cristianitos	RMV		
23. Lower Gabino/Blind Canyon	RMV		
24. Upper Gabino/Blind Canyon	RMV		
25. Riverside County	OCFA		
26. Ladera	RMV		
27. Wagon Wheel/Chiquita Ridge	RMV		
28. Chiquadora/West Gobernadora	RMV		
29. East Gobernadora/Bell Canyon	RMV		
30 Caspers	OC Parks & Rec		
31. Starr Ranch	Audubon Society		
32. Foothill/Trabuco Specific Planning Area	OCFA		
33. Presidential Heights	OC Parks & Rec		
34. Donna O' Neill Land Conservancy	RMV		
35. Prima Dechecha Regional Park (now a landfill)	OC Parks & Rec		
36. Upper Chiquita	RMV		
37. El Cariso Village	OCFA		

4.5.1 Notification and Coordination of Other Designated Resource Advisors

The Lead Resource Advisor shall be notified by pager of all fire events affecting their open space lands and shall be responsible for contacting, consulting and coordinating with all other Resource Advisors and land managers as necessary. The Lead Resource Advisor shall also maintain a list of all Resource Advisors and notify OCFA of any changes to the list of Resource Advisors including a designated alternate Lead Resource Advisor.

4.5.2 Lead Resource Advisor Response

In response to the initial pager notification, the Lead Resource Advisor shall report to the Incident Command Post if requested to do so by the IC and be available to provide technical advice as necessary to the IC.

The Lead Resource Advisor(s) will review the Tactical Fire Suppression Plan and the "Environmentally Sensitive Areas" (ESA) mapping and advise the BC. For the RMV Open Space, the ESA mapping has been prepared by Dudek and Associates, Inc. and Archeological Resource Management Corporation and includes the following data:

- Vernal pool locations
- Archeological sites
- Paleontological Resource Areas

The ESA mapping will be updated as required by the Resource Advisor(s) and as new locations are discovered.

4.6 Post-Fire Evaluation

The Tactical Fire Suppression Plan was created as part of a cooperative effort involving the Orange County Fire Authority, ***FIREWISE* 2000, Inc.** and the NCCP/SAMP Working Group. The plan is intended to be a "dynamic, living document" that remains effective as a management tool throughout the life of the RMV Open Space and other Southern Subregion Open Space lands.

Following each fire event on Southern Subregion Open Space lands, fire suppression forces will review the effectiveness of the tactical operations recommended in the plan. The suppression forces may recommend changes to the WFDP to better achieve the goals and objectives of the plan.

Also, the Lead Resource Advisor will monitor natural resource conditions regularly, update the SSR Ratings (Aggressive, Standard and Modified) for each FMU on an as-needed basis, and recommend plan revisions to address these changing conditions.

The Lead Resource Advisor in consultation with an OCFA representative shall evaluate all fire events occurring in the Southern Subregion as follows:

- Date & Time of Fire;
- Fire Management Compartment/Fire Management Unit (FMC/FMU) affected;

- SSR Rating for the affected FMC/FMU;
- Actual Fire Suppression Tactics used;
- Estimated Size of Fire (Acres);
- Affected Habitat(s)
- Types of Disturbances (i.e., new fire roads, hand clearing, erosion, etc.);
- Measures Undertaken to Correct Disturbances; and
- Other as determined by the Lead Resource Advisor.

4.7 Training Sessions

Annual Resource Advisor training sessions should be conducted by May 15th to review these roles and responsibilities and the overall design of the program.

4.8 Review and Approval

The WFDP will review all recommendations in consultation with the Resource Advisor(s) and approve appropriate additions and revisions to the Tactical Fire Suppression Plan (Short Term Fire Management Plan).

4.9 Post Fire Reporting

All fire incidents and responses occurring on Southern Subregion Open Space lands, and specifically RMV Open Space, shall be reported to the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG) the US Army Corps of Engineers and the County of Orange. The report shall include the cause of the incident, number of acres of habitat by type burned, types of resources effected, and post fire evaluation.

4.10 Tactical Fire Suppression Plan Maintenance

4.10.1 FMC/FMU Mapping Maintenance

The Orange County Fire Authority (OCFA) shall maintain the FMC's/FMU's mapping and SSR Rating Forms. Updates to the mapping shall be made on an on-going basis. The mapping shall be comprehensively reviewed and revised as needed on an annual basis.

4.10.2 Southern Subregion Open Space Lands (SSR) Rating Form Maintenance

OCFA shall maintain the SSR Rating forms and all subsequent updates as required by the Resource Advisor(s).

4.10.3 Resource Sensitive Areas Mapping

Name (entity to be determined) shall update the Resource Sensitive Areas mapping, as new data become available and incorporate as approved by the Resource Advisor(s)

4.11 Tactical Fire Suppression Plan Interagency Coordination and Training

OCFA, Resources Planning and appropriate Habitat Reserve Resource Advisor(s) shall conduct a training session for the affected OCFA Battalion Chief and other wildland fire agencies.

4.11.1 OCFA Battalion Chief Training Sessions

Battalion Chief training sessions will be conducted on an annual basis prior to the wildfire season.

4.11.2 Coordination with Other Wildland Fire Agencies

Annual training sessions with these agencies shall be conducted on an annual basis prior to the wildfire season.

4.11.3 Open Space Land Managers

Open Space Land Manager training will occur prior to the wildfire season. The Open Space Land Managers generally possess the greatest knowledge concerning the location of sensitive natural and scientific resources within their properties and will assist in the completion of Resource Sensitive Areas mapping.

PART V – RESEARCH AND MONITORING

PART V - FIRE ECOLOGY RESEARCH AND MONITORING CRITERIA

5.0 GENERAL

This section addresses the need for further fire ecology research and monitoring procedures for the proposed and/or status quo management decisions addressed in the overall Wildland Fire Management Plan. Part I – Fire Management Program, Part II – Prescribed Fire Program, Part III - Strategic Fire Protection Plan, Part IV – Short Term Tactical Fire Suppression Plan, and Part V - Research and Monitoring have each been designed and written to be an integral part of the Wildland Fire Management Plan or used as "Stand Alone" documents to guide the OCFA and various Land Owners and Managers in the overall management of their lands.

5.1 Relationship of the Wildland Fire Management Plan to a Stressor Based Adaptive Management Program

The Wildland Fire Management Plan is based on the stressor-based Adaptive Management Program described in *Appendix J.* The underlying principle of the stressor-based Adaptive Management Program is that management and monitoring should be directed primarily towards environmental factors known or thought to be directly or indirectly responsible for ecosystem changes. Because fire is one of the more obvious major stressors on the southern California ecosystem, fire management is the key factor in the Adaptive Management Program (prolonged drought, disease, air pollution and very competitive invasive species are also stressors but are not as easily modeled and are a lessor impact than the positive and negative impacts of fire). *Appendix J* presents conceptual stressor models that depict known and potential relationships between fire and the vegetation community and individual species responses. These conceptual models provide the framework for the Wildland Fire Management Plan with regard to maintaining healthy ecosystems within the RMV Open Space and potentially other protected open space in the Southern Subregion. For example, as described in detail in Section 3.9.1 Plant Community Responses to Fire, each vegetation community responds differently to fire depending upon the frequency and intensity. In order to maintain healthy vegetation communities, these differential responses need to be considered in both the tactical and strategic aspects of managing fire, including controlling wildfires and conducting purposeful prescribed burns.

5.2 Monitoring to Test Hypotheses

Through the iterative process of adaptive management, evaluating basic assumptions about how natural systems operate will continually test the "stressor-based model' of ecosystem function with regard to fire. This will require adequate "baseline data" and a process for monitoring the effects of the management plan and comparing it to the stated assumptions in the conceptual model.

The monitoring program should accommodate both routine long-term observations and on-going management experiments, since some crucial hypotheses may not be easily tested in a simple management/observation context. Some questions may be better explored in more traditional scientific studies and the answers to these questions may be critical for success of the Adaptive Management Program. What is clear is that a successful fire management program must include both routine monitoring and experimentation, or observation beyond what is possible solely on the basis of observing management actions. A combination of long-term monitoring and hypothesis testing experiments are further outlined in this section. It should be noted that many additional research questions remain to be addressed. Through the Adaptive Management process the non-profit management corporation and reserve managers, possibly in collaboration with outside scientists, or other suitable group, will need to prioritize and implement management actions.

With the significant number of studies underway on similar landscapes, efforts should be made to learn from the work of others and apply findings to lands in the Southern Subregion. There already is a large amount of inventory work underway in the Southern Subregion. In addition, The Nature Conservancy (TNC) is carrying out a number of research projects on the Habitat Reserve that TNC manages in the Central and Coastal NCCP/HCP Subregion.

5.3 Plant and Animal Community Responses

5.3.1 Plant Community Response

Successful land management requires an understanding of the degree of species interdependence within communities, how the distribution of communities depends upon past and present environmental factors, and what the role is of various plant communities in the system processes such as succession and landscape pattern. Before we can address these complex questions, plant communities must first be measured and summarized. Monitoring of vegetation change and correlating the impact of those changes on selected taxa will provide relevant management information as well as a measure of RMV Open Space effectiveness. The overall Adaptive Management Program provides for periodic RMV Open Space-wide vegetation communities updates using remote imagery and selected sampling of vegetation transects within each of the five major vegetation communities.

The Southern Subregion NCCP/HCP database contains a detailed description and quantification of the vegetation types present within the entire Subregion and, therefore, of the vegetation types present within the RMV Open Space.

5.3.2 Animal Community Response

As with vegetation Monitoring, focal species monitoring will be conducted in the same plots that are selected for vegetation monitoring. The Adaptive Management Program provides a detailed description of the selection of focal species for the purpose of management and monitoring. Focal species taxa include birds, reptiles, amphibians, large mammals and invertebrates.

Prior to initiating all prescribed burns and after each wildfire, focal species sampling should be carried out. In the case of the prescribed burns the purpose of sampling is to compare before and after occupation of the burn site by focal species, and in the case of unplanned wildfires, the purpose of sampling is to measure occupation of the site by focal species as the burn site recovers from the fire.

Independent pre- and post-fire sampling by an outside scientific group for additional non-focal species (e.g., small mammals) also may be conducted. These independent studies must be authorized by RMV and coordinated for consistency with the ongoing adaptive management of the RMV Open Space.

5.4 Plant Sampling Techniques

Consistent with the methodology applied to the RMV Open Space in general, botanists will conduct annual floral surveys along belt-transects in selected burn sites, typically within the March-May timeframe, or at a time that maximizes the detection of perennial and especially annual plants in any given year. While many floral sampling regimes are possible (e.g. Elzinga et al. 1998) based on the sample plots and belt-transects established for wildlife monitoring, the following method is suggested:

> Semi-permanent 25-m segments along the center of the belt transect will be established in a pseudo-random fashion. Based on the baseline data for the belt-transects, these segments will cover the diversity/gradient along the transect. Data will be collected by recording each species that intersects an imaginary vertical plane at each 0.5-m mark along the 25-m segment of the sample transect. All species present within a 5-m band centered on the transect line will be recorded. Relative species cover and species diversity will be derived from these data. Each sample transect will be photographed to document the status of the vegetation at the site on an annual basis.

5.5 Data-Management

To reduce errors, the researcher who takes measurements will be responsible for reviewing the datasheets to eliminate recording errors at the completion of each segment. In addition, the researcher should review all data sheets for errors at the end of each field day. Reviewed data shall be submitted directly to RMV or their designated data administrator and will be entered directly into the Southern Subregion database. All entered data should be compared against data sheets for data-entry errors/quality control.

The database must have complete information on the geographic position of each transect, as well as all relevant biological and identification/attribute information.

5.6 Management Hypotheses

5.6.1 Management Hypotheses for Valley Grasslands

Based on the model depicted in Figure 5-1, the following initial adaptive management hypotheses can be postulated. Some of these hypotheses may be better addressed through independent research studies, but others may easily be tested as part of the management and monitoring program of the RMV Open Space.

The following initial hypotheses are proposed:

1. Fire intervals of 6 to 12 years will result in an increase in the diversity of native plant and animal species and a decrease in the frequency of non-native grasses, native grasses and forbs.

2. A non-deterministic, weighted-random application of fire will result in an increase in native plant and animal diversity for the target landscape.

3. Spring burning with return intervals of less than 6 years will result in a decrease in diversity and abundance of native perennial grasses.

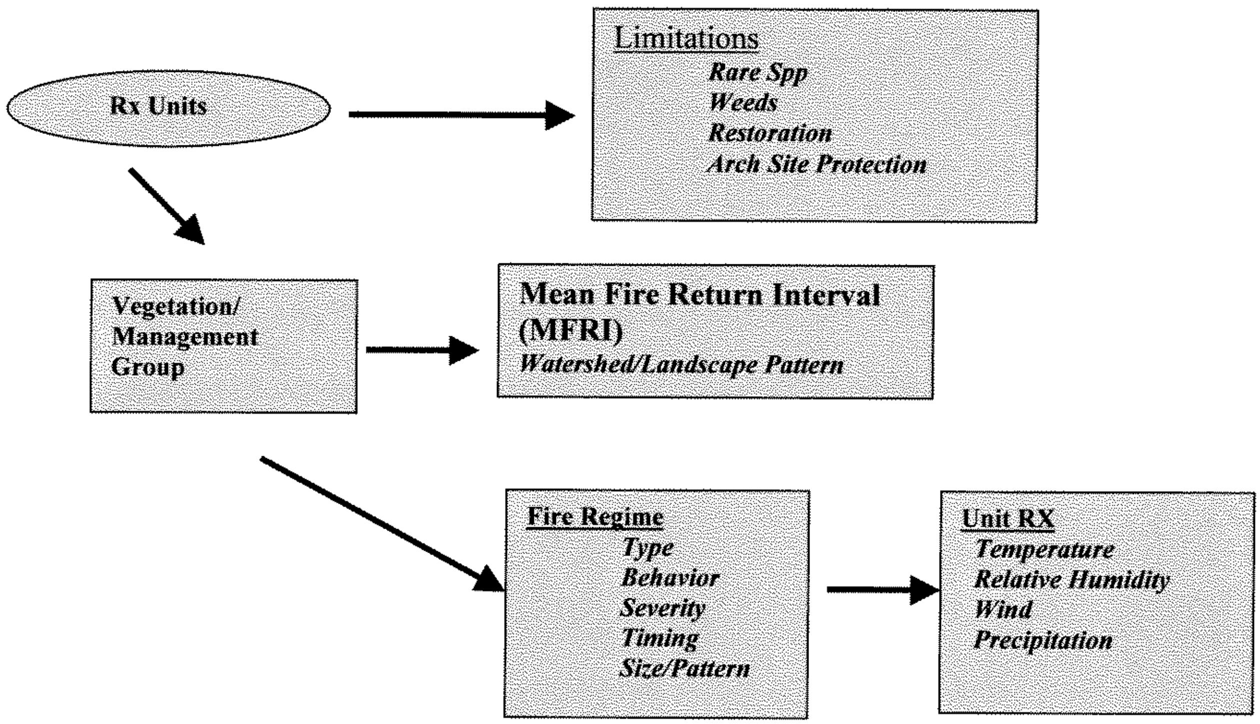
4. Fall burning with return intervals of less than 6 years will result in an increase in diversity and abundance of native perennial grasses.

5. An established grassland community that has not been subject to grazing will have a higher overall post-burn native species diversity than a same-aged stand that has been grazed (will need to establish enclosures to exclude grazers).

6. Structural and compositional components of required habitat, for selected species, will decline in quality with fires occurring at intervals greater then every 12 years.

7. Grassland communities with urban/developed edges will experience higher rates of exotic species establishment and lower representations of associated species then other vegetation types with developed edges.

Figure 5-1: Research Study Model.



5.6.2 Continued Fire Management for Grassland and Restoration Sites

Following the 6-year initial round of prescribed fires described above, continued fire management will be structured to identify those areas in particular need for re-burning, and to experimentally determine optimal fire frequency. There is a total of 4 initial FMU's (FMU's 22.04, 23.01, 23.02, and 24.02) where multiple native grassland management sites are suitable and recommended for prescribed fire. Since it is desired to provide native bunch grasses with the best hope of survival, once non-native grasses and forbs have been controlled, the frequency of prescribed fire on these sites needs to be established based upon the monitoring data.

Following the initial prescribed fires a determination should be made as to which units, if any, are high priorities for future or repeat burning. This evaluation will be based upon the visual inspection of the units, a qualitative measure of non-native grass/forb coverage, and the need to protect existing growths of native grasses and small forbs. Fenced large plots (100 meters x 100 meters) should be utilized to sample post fire recovery and protect the site from grazing impacts. Often where grazing has been utilized for a number of years, a hot fall fire will still cause native seed banks to germinate. Without test plot enclosures many plants that have not been observed for years will be immediately browsed. Fenced test plots will also allow for an ungrazed fuel loading that will provide for a different fire dynamic than the planned burning of a grazed plot. Fenced test plots will not disrupt normal grazing practices on the remainder of the grasslands while studies are underway.

Santa Catalina Island serves as an excellent example of the impacts of over-grazing, and now wildfire, on the islands grassland, oak woodland, coastal sage scrub, and chaparral vegetation. The island has had a history of 150 years of heavy over-grazing, first by sheep and then by goats and feral pigs with an out of control and rapidly expanding herd of mule deer thrown into the mix. The sheep and goats were gone by 1990 with the mule deer rapidly filling the void. With the goats gone the vegetation has dramatically responded. In 1999 a high intensity wildfire started at Goat Harbor and burned over 300 hundred acres before being brought under control. During post fire monitoring the Conservancy staff noticed that all of the new plants were immediately consumed. As a result they fenced off large areas to exclude all grazers and browsers. They began to observe plants that had not been seen on Catalina Island in the last 100 years and recorded one species that had never been seen before. One such plant, aptly named fire poppy (*Papaver californicum*), was recorded for the first time. In addition the following rare plants were found within the burned area: large-flowered phacelia (*Phacelia grandiflora*) and white mallow (*Eremalche exilis*). These two plants had not been seen on Santa Catalina Island for about a century (Knapp 2002).

Since wildland fire is a frequent visitor to the Southern Subregions native grassland and CSS management sites, the need to test high intensity fire effects on native grassland and/or CSS may be accomplished without the use of prescribed fire. In areas not already selected for monitoring, monitoring plots should be established on all wildland fire areas where high fire intensity fires have impacted native grassland or CSS vegetation. Prescribed fire can thus be used to determine the fire effects on low and moderate fire intensity burn plots with a high probability of fire containment. (Low intensity fire is often detrimental on many landscapes, including grasslands, as insufficient heat is generated to crack the seed coat of desirable species that may be present in the soil.) In contrast, high intensity wildfires can be used to determine their differential effects on both native grassland and coastal sage scrub communities.

These units should be followed through time until enough data are gathered to make a definitive judgment on fire frequency and intensity. This monitoring study is expected to be ongoing for quite some time, (e.g., several decades to determine appropriate fire return intervals) and represents continued fire management efforts for the grassland habitat of the RMV Open Space.

5.7 Management Hypotheses for Oak Woodland

The study design discussed for grasslands applies directly to-non riparian oak woodlands. The oak woodland stands can be thought of as two stories or levels; the grassland ground fuels and the crowns or canopies of mature oak trees. The key to successful oak woodland management is eliminating any fuel ladders that will carry ground fires into the canopies of the mature oaks.

Without periodic ground fires shade-tolerant shrub species will invade, out compete and shade out the native grasses. If the shade tolerant shrub species can be eliminated with fire the success of native grasses will than be dependent upon the density of the oak woodland canopy. A closed canopy will be detrimental to grasses as most species require direct sunlight. The more open the canopy the greater the success of native grasses. High intensity fires have no place in oak woodland management.

The following initial hypotheses are proposed:

1. Summer/fall burning using low intensity fire with return intervals of less than 6 years will result in a decrease in diversity and abundance of annual grasses and herbaceous understory. The more open the canopy the greater the success of perennial grasses.

2. Fall burning with low intensity fire prior to acorn drop will encourage recruitment of oak seedlings

5.8.1 Management Hypotheses for Riparian Areas

Fire has no place in Riparian area management. Therefore, no hypotheses are put forward for the benefits of fire in this ecosystem.

5.9 Management Hypotheses for CSS

Based on the general research study model depicted in Figure 5-1, the following initial adaptive management hypotheses for CSS can be postulated. As with native grassland discussed above, some of these hypotheses may be better addressed through independent research studies, but others can be readily tested as part of the management and monitoring program for the RMV Open Space.

The following initial hypotheses are proposed:

1. Spring fire intervals of less than 10 years will result in a decrease in diversity of native CSS species and an increase in the frequency of non-native grasses and forbs.

2. Fall fire intervals of less than 10 years will result in a decrease in diversity of native CSS species and an increase in the frequency on native perennial grasses.

3. Winter and spring fire events will result in a decrease in the density and diversity of native CSS shrub species.

4. Grazing in post-fire, early and mid-successional coastal sage scrub will result in decreased species diversity over time.

5. An established (late successional) stand of coastal sage scrub that has not been subject to grazing will have a higher overall post-burn native species diversity than a same-aged stand that has been grazed.

6. Structural and compositional components of required habitat, for selected species, will decline in quality with fires occurring at least every 10 years.

7. Habitat quality, for associated species, will decline with grazing or grazing/fire events during early seral stages of succession.

8. Fire treatments will increase survivorship of shrub and herbaceous species planted in post-treatment restoration efforts

5.9.1 CSS Season and Frequency Pilot Experiment

A long-term monitoring program is critical to the successful use of fire as a management tool. Measuring response through two (2) or three (3) fire cycles is the only way to objectively evaluate fire effects. Still, some applied questions are best addressed in directed studies designed to test specific hypotheses. The questions relating to appropriate fire regimes in CSS are appropriate for this approach. It is this plan's recommendation to identify a minimum of nine (9) CSS units in the RMV Open Space as a pilot test to determine the long-term effect of varying the season, frequency and intensity of burn treatments.

The recommended factorial design should include: Fall and Spring seasonal treatments, 10, 15 and 20-year return intervals, as well as low and high intensity fire behavior. Initial treatments should begin once this plan is approved and the sites have been identified.

Of the nine plots three (3) units should be prescribed burned between May and June, three (3) should be burned between September and November, while three (3) units will be left as unburned controls.

Each unit will be partitioned by a fire intensity treatment. One portion of the unit will be burned under the lowest intensity as can be safely generated given fuels and holding considerations. The remaining portion of the unit will be burned under the highest intensity possible. This partitioning of the units may or may not be of equal size, though plots will be equally distributed with three (3) in each intensity treatment. The location of intensity treatments should be driven by factors effecting fire behavior and holding considerations. Firing patterns will be determined prior to plot placement. Plots will be randomly located within these broadly defined areas. All plots should be fenced to eliminate any grazing and browsing impacts.

Following the initial seasonal and intensity treatments, return intervals should be randomly assigned to each unit. One unit from each of the spring and fall treatments should be burned on 10, 15 and 20-year return intervals. Within these return interval treatments, intensity patterns should be repeated.

Figure 5-2: Sampling design for CSS Season, Frequency and Intensity Experiment.

Each Plot will be 100 Meters Square

Plots will consider Plant:

Structure
- Density
- Height

Composition
- Cover
- Diversity

Planned Prescribed Fire Treatments For:

Fall Burning	= 3 units
Spring Burning	= 3 units
Control	= 3 units

Burn Every:

10 years	= 6 plots **1/**
15 years	= 6 plots **1/**
20 years	= 6 plots **1/**

1/; **3 Plots** High Intensity & 3 plots Low Intensity

In an effort to maintain consistency between plots and the ability to compare data from different sites, the same methods outlined above are recommended for this study. Fire intensity should be included. Fire Intensity can be quantified through observation (Flame Length and Rate of Spread), as well as through specific measures of temperature. A combination of both methods is recommended for this study. Observation points should be recorded for each plot. In addition, each plot should have an associated data-logger with thermo-couples. Thermo-couples should measure temperature within the shrub canopy, the herbaceous layer, the duff layer and two (2) places within the soil profile.

Sample size analyses will be conducted after one-year's data have been collected. If data sets are analyzed via ANOVA, sample-size analyses will follow Cohen (1988). Simulations will be conducted similar to those described above, with the differences that: 1) means (or medians) will be calculated across years for each segment rather than linear contrasts and 2) simulations will include pulsed disturbance following prescribed fire events. A relative difference of 15% in relative cover of native species between parcel types will be used as the minimal detectable difference for the sample-size analysis for Hypotheses 5 and 6. Sample-size analyses will be performed again after five (5) years of data have been collected.

The sample size may need to be expanded over the size of this initial pilot study. With any interaction effects, simple main effects could be masked by the existing variance; e.g. low intensity fires at a set season of the year could be more beneficial with short return intervals and higher intensity fires could be more beneficial with longer fire return intervals, so the optimum fire intensity may vary depending on the return interval. Without a larger sample size the optimum intensity and return interval may not be readily apparent under the proposed pilot study for CSS.

APPENDIX "J-5A"

"*FIREWISE*" Landscape Planting Considerations, Recommended & Not-Recommended Plant Lists

APPENDIX J-5A

FIREWISE 2000 Recommended Plant List

For Fuel Modification Projects in San Diego, Riverside, and Orange Counties

	Code	Botanical Name	Common Name	Plant Form
1.	W	*Abelia x grandiflora*	Glossy Abelia	Shrub
2.	□	*Acacia redolens desert carpet*	Desert Carpet	Shrub
3.	□	*Acer macrophyllum*	Big Leaf Maple	Tree
4.	X	*Achillea millefolium*	Common Yarrow	Low shrub
5.	W	*Achillea tomentosa*	Wooly Yarrow	Low shrub
6.	X	*Aeonium decorum*	Aeonium	Ground cover
7.	X	*Aeonium simsii*	ncn	Ground cover
8.	W	*Agave attenuata*	Century Plant	Succulent
9.	W	*Agave shawii*	Shaw's Century Plant	Succulent
10.	N	*Agave victoriae-reginae*	ncn	Ground cover
11.	X	*Ajuga reptans*	Carpet Bugle	Ground cover
12.	W	*Alnus cordata*	Italian Alder	Tree
13.	□	*Alnus rhombifolia*	White Alder	Tree
14.	N	*Aloe aborescens*	Tree Aloe	Shrub
15.	N	*Aloe aristata*	ncn	Ground cover
16.	N	*Aloe brevifolia*	ncn	Ground cover
17.	W	*Aloe vera*	Medicinal Aloe	Succulent
18.	W	*Alyogyne huegelii*	Blue Hibiscus	Shrub
19.	□	*Ambrosia chamissonis*	Beach Bur-Sage	Perennial
20.	□	*Amorpha fruticosa*	Western False Indigobush	Shrub
21.	W	*Anigozanthus flavidus*	Kangaroo Paw	Perennial accent
22.	□	*Antirrhinum nuttalianum ssp. nuttalianum*	ncn	Subshrub
23.	X	*Aptenia cordifolia x 'Red Apple'*	Red Apple Aptenia	Ground cover
24.	W	*Arbutus unedo*	Strawberry Tree	Tree
25.	W	*Arctostaphylos 'Pacific Mist'*	Pacific Mist Manzanita	Ground cover
26.	W	*Arctostaphylos edmundsii*	Little Sur Manzanita	Ground cover
27.	□	*Arctostaphylos glandulosa ssp.glandulosa*	Eastwood Manzanita	Shrub
28.	W	*Arctostaphylos hookeri 'Monterey Carpet'*	Monterey Carpet Manzanita	Low shrub

	Code	Botanical Name	Common Name	Plant Form
29.	**N**	*Arctostaphylos pungens*	ncn	Shrub
30.	**N**	*Arctostaphylos refugioensis*	Refugio Manzanita	Shrub
31.	**W**	*Arctostaphylos uva-ursi*	Bearberry	Ground cover
32.	**W**	*Arctostaphylos x 'Greensphere'*	Greensphere Manzanita	Shrub
33.	**N**	*Artemisia caucasica*	Caucasian Artemisia	Ground cover
34.	**X**	*Artemisia pycnocephaia*	Beach Sagewort	Perennial
35.	**X**	*Atriplex canescens*	Four-Wing Saltbush	Shrub
36.	**X**	*Atriplex lentiformis ssp. Breweri*	Brewer Saltbush	Shrub
37.	□	*Baccharis emoryi*	Emory Baccharis	Shrub
38.	**W** □	*Baccharis pilularis ssp. Consanguinea*	Chaparral Bloom	Shrub
39.	**X**	*Baccharis pilularis var. pilularis "Twin Peaks #2'*	Twin Peaks	Ground cover
40.	□	*Baccharis salicifolia*	Mulefat	Shrub
41.	**N**	*Baileya multiradiata*	Desert Marigold	Ground cover
42.	**W**	*Beaucarnea recurvata*	Bottle Palm	Shrub/Small tree
43.	**N** □	*Bougainvillea spectabilis*	Bougainvillea	Shrub
44.	**N** □	*Brahea armata*	Mexican Blue Palm, Blue Hesper Palm	Palm
45.	**N** □	*Brahea brandegeei*	San Jose Hesper Palm	Palm
46.	**N** □	*Brahea edulis*	Guadalupe Palm	Palm
47.	□	*Brickellia californica*	ncn	Subshrub
48.	**W** □	*Bromus carinatus*	California Brome	Grass
49.	□	*Camissonia cheiranthifolia*	Beach Evening Primrose	Perennial subshrub
50.	**N**	*Carissa macrocarpa*	Green Carpet Natal Plum	Ground cover/Shrub
51.	**X**	*Carpobrotus chilensis*	Sea Fig Ice Plant	Ground cover
52.	**W**	*Ceanothus gloriosus 'Point Reyes'*	Point Reyes Ceanothus	Shrub

	Code	Botanical Name	Common Name	Plant Form
53.	W	*Ceanothus griseus "Louis Edmunds'*	Louis Edmunds Ceanothus	Shrub
54.	W	*Ceanothus griseus horizontalis*	Yankee Point	Ground Cover
55.	W	*Ceanothus griseus var. horizontalis*	Carmel Creeper Ceanothus	Shrub
56.	W	*Ceanothus griseus var. horizontalis "Yankee Point"*	Yankee Point Ceanothus	Shrub
57.	□	*Ceanothus megacarpus*	Big Pod Ceanothus	Shrub
58.	W	*Ceanothus prostratus*	Squaw carpet ceanothus	Shrub
59.	□	*Ceanothus spinosus*	Green bark ceanothus	Shrub
60.	W	*Ceanothus verrucosus*	Wart-Stem Ceanothus	Shrub
61.	W	*Cerastium tomentosum*	Snow-in-summer	Ground cover/shrub
62.	W	*Ceratonia siliqua*	Carob	Tree
63.	W	*Cercis occidentalis*	Western Redbud	Tree/shrub
64.	X	*Chrysanthemum leucanthemum*	Oxeye Daisy	Groundcover
65.	W	*Cistus crispus*	ncn	Shrub
66.	W	*Cistus hybridus*	White Rockrose	Shrub
67.	W	*Cistus incanus*	ncn	Shrub
68.	W	*Cistus incanus ssp. corsicus*	ncn	Shrub
69.	W	*Cistus salviifolis*	Sageleaf Rockrose	Shrub
70.	W	*Cistus x purpureus*	Orchid Rockrose	Shrub
71.	W	*Citrus species*	Citrus	Tree
72.	□	*Clarkia bottae*	Showy Fairwell to Spring	Annual
73.	□	*Cneoridium dumosum*	Bushrue	Shrub
74.	□	*Collinsia heterophylla*	Chinese Houses	Annual
75.	W □	*Comarostaphylis diversifolia*	Summer Holly	Shrub
76.	N	*Convolvulus cneorum*	Bush Morning Glory	Shrub

	Code	Botanical Name	Common Name	Plant Form
77.	**W**	*Coprosma kirkii*	Creeping Coprosma	Ground cover/Shrub
78.	**W**	*Coprosma pumila*	Prostrate Coprosma	Low Shrub
79.	□	*Coreopsis californica*	California Coreopsis	Annual
80.	**W**	*Coreopsis lanceolata*	Coreopsis	Ground cover
81.	**N**	*Correa pulchella*	Australian Fuchsia	Ground cover
82.	**W**	*Cotoneaster buxifolius*	ncn	Shrub
83.	**W**	*Cotoneaster congestus 'Likiang'*	Likiang Cotoneaster	Ground cover/Vine
84.	**W**	*Cotoneaster parneyi*	ncn	Shrub
85.	**X**	*Crassula lactea*	ncn	Ground cover
86.	**X**	*Crassula multicava*	ncn	Ground cover
87.	**X**	*Crassula ovata*	Jade Tree	Shrub
88.	**X**	*Crassula tetragona*	ncn	Ground cover
89.	**W** □	*Croton californicus*	California Croton	Ground cover
90.	**X**	*Delosperma 'alba'*	White Trailing Ice Plant	Ground cover
91.	□	*Dendromecon rigida*	Bush Poppy	Shrub
92.	□	*Dichelostemma capitatum*	Blue Dicks	Herb
93.	**N**	*Distictis buccinatoria*	Blood-Red Trumpet Vine	Vine/Climbing vine
94.	**N**	*Dodonaea viscosa*	Hopseed Bush	Shrub
95.	**X**	*Drosanthemum floribundum*	Rosea Ice Plant	Ground cover
96.	**X**	*Drosanthemum hispidum*	ncn	Ground cover
97.	**X**	*Drosanthemum speciosum*	Dewflower	Ground cover
98.	□	*Dudleya lanceolata*	Lance-leaved Dudleya	Succulent
99.	□	*Dudleya pulverulenta*	Chalk Dudleya	Succulent
100.	**W**	*Elaeagnus pungens*	Silverberry	Shrub
101	□	*Encelia californica*	California Encelia	Small shrub

	Code	Botanical Name	Common Name	Plant Form
102.	□ •	*Epilobium canum [Zauschneria californica]*	Hoary California Fuchsia	Shrub
103.	□	*Eriastrum sapphirinum*	Mojave Wooly Star	Annual
104.	**N**	*Eriobotrya japonica*	Loquat	Tree
105.	□	*Eriodictycon crassifolium*	Thick-Leaf Yerba Santa	Shrub
106.	□	*Eriodictycon trichocalyx*	Yerba Santa	Shrub
107.	**W** □	*Eriophyllum confertiflorum*	ncn	Shrub
108.	**W**	*Erythrina species*	Coral Tree	Tree
109.	**N**	*Escallonia species*	Several varieties	Shrub
110.	**W** □	*Eschscholzia californica*	California Poppy	Flower
111.	**X**	*Eschscholzia mexicana*	Mexican Poppy	Herb
112.	**N**	*Euonymus fortunei*	Winter Creeper Euonymus	Ground cover
113.	**N**	*Feijoa sellowiana*	Pineapple Guava	Shrub/Tree
114.	**N**	*Fragaria chiloensis*	Wild Strawberry/ Sand Strawberry	Ground cover
115.	□	*Frankenia salina*	Alkali Heath	Ground cover
116.	**W**	*Fremontodendron californicum*	California Flannelbush	Shrub
117.	**X**	*Gaillardia x grandiflora*	Blanketflower	Ground cover
118.	**W**	*Galvezia speciosa*	Bush Snapdragon	Shrub
119	**W**	*Garrya ellipta*	Silktassel	Shrub
120.	**X**	*Gazania hybrids*	South African Daisy	Ground cover
121.	**X**	*Gazania rigens leucolaena*	Trailing Gazania	Ground cover
122.	□	*Gilia capitata*	Globe Gilia	Perennial
123.	**W**	*Gilia lepthantha*	Showy Gilia	Perennial
124.	**W**	*Gilia tricolor*	Bird's Eyes	Perennial
125.	**W**	*Ginkgo biloba*	Maidenhair Tree	Tree
126.	□	*Gnaphalium californicum*	California Everlasting	Annual
127.	**W**	*Grewia occidentalis*	Starflower	Shrub
128.	□	*Grindelia stricta*	Gum Plant	Ground cover

	Code	Botanical Name	Common Name	Plant Form
129.	N □	*Hakea suaveolens*	Sweet Hakea	Shrub
130.	W	*Hardenbergia comptoniana*	Lilac Vine	Shrub
131.	N	*Helianthemum mutabile*	Sunrose	Ground cover/Shrub
132.	□	*Helianthemum scoparium*	Rush Rose	Shrub
133.	□	*Heliotropium curassavicum*	Salt Heliotrope	Ground cover
134.	X	*Helix canariensis*	English Ivy	Ground cover
135.	W	*Hesperaloe parviflora*	Red Yucca	Perennial
136.	□ □	*Heteromeles arbutifolia*	Toyon	Shrub
137.	X	*Hypericum calycinum*	Aaron's-Beard	Shrub
138.	N	*Iberis sempervirens*	Edging Caandytuft	Ground cover
139.	N	*Iberis umbellatum*	Globe Candytuft	Ground cover
140.	□	*Isocoma menziesii*	Coastal Goldenbush	Small shrub
141.	□	*Isomeris arborea*	Bladderpod	Shrub
142.	W	*Iva hayesiana*	Poverty Weed	Ground cover
143.	N	*Juglans californica*	California Black Walnut	Tree
144.	□	*Juncus acutus*	Spiny Rush	Perennial
145.	□	*Keckiella antirrhinoides*	Yellow Bush Penstemon	Subshrub
146.	□	*Keckiella cordifolia*	Heart Leaved Penstemon	Subshrub
147.	□	*Keckiella ternata*	Blue Stemmed Bush Penstemon	Subshrub
148.	W	*Kniphofia uvaria*	Red Hot Poker	Perennial
149.	W	*Lagerstroemia indica*	Crape Myrtel	Tree
150.	W	*Lagunaria patersonii*	Primrose Tree	Tree
151.	X	*Lampranthus aurantiacus*	Bush Ice Plant	Ground cover
152.	X	*Lampranthus filicaulis*	Redondo Creeper	Ground cover
153.	X	*Lampranthus spectabilis*	Trailing Ice Plant	Ground cover
154.	W	*Lantana camara cultivars*	Yellow Sage	Shrub
155.	W	*Lantana montevidensis*	Trailing Lantana	Shrub
156.	□	*Lasthenia californica*	Dwarf Goldfields	Annual

	Code	Botanical Name	Common Name	Plant Form
157.	**W**	*Lavandula dentata*	French Lavendar	Shrub
158.	**W**	*Leptospermum laevigatum*	Australian Tea Tree	Shrub
159.	**W**	*Leucophyllum frutescens*	Texas Ranger	Shrub
160.	□	*Leymus condensatus*	Giant Wild Rye	Large grass
161.	**N**	*Ligustrum japonicum*	Texas Privet	Shrub
162.	**X**	*Limonium pectinatum*	ncn	Ground cover
163.	**X**	*Limonium perezii*	Sea Lavender	Shrub
164.	**W** □	*Liquidambar styraciflua*	American Sweet Gum	Tree
165.	**W**	*Liriodendron tulipifera*	Tulip Tree	Tree
166.	**X**	*Lonicera japonica 'Halliana'*	Hall's Japanese Honeysuckle	Vining shrub
167.	□	*Lonicera subspicata*	Wild Honeysuckle	Vining shrub
168.	**X**	*Lotus corniculatus*	Bird's Foot Trefoil	Ground cover
169.	□	*Lotus heermannii*	Northern Woolly Lotus	Perennial
170.	□	*Lotus scoparius*	Deerweed	Shrub
171.	**W**	*Lupinus arizonicus*	Desert Lupine	Annual
172.	**W**	*Lupinus benthamii*	Spider Lupine	Annual
173.	□	*Lupinus bicolor*	Sky Lupine	Flowering annual
174.	□	*Lupinus sparsiflorus*	Loosely Flowered Annual Lupini/Coulter's Lupine	Annual
175.	**W**	*Lyonothamnus floribundus ssp. asplenifolius*	Fernleaf Ironwood	Tree
176.	**W**	*Macadamia Integrifolia*	Macadamia Nut	Tree
177.	**W**	*Mahonia aquifolium 'Golden Abundance'*	Golden Abundance Oregon Grape	Shrub

	Code	Botanical Name	Common Name	Plant Form
178.	W	*Mahonia nevinii*	Nevin Mahonia	Shrub
179.	□	*Malacothamnus fasciculatus*	Chaparral Mallow	Shrub
180.	X	*Malephora luteola*	Trailing Ice Plant	Ground cover
181.	W	*Maytenus boaria*	Mayten Tree	Tree
182.	W	*Melaleuca nesophila*	Pink Melaleuca	Shrub
183.	N	*Metrosideros excelsus*	New Zealand Christmas Tree	Tree
184.	□ •	*Mimulus species*	Monkeyflower	Flower
185.	□	*Mirabilis californica*	Wishbone Bush	Perennial
186.	N	*Myoporum debile*	ncn	Shrub
187.	N	*Myoporum insulare*	Boobyalla	Shrub
188.	W	*Myoporum parvifolium*	ncn	Ground cover
189.	W	*Myoporum 'Pacificum'*	ncn	Shrub
190.	□	*Nassella [stipa] lepida*	Foothill needlegrass	Ground cover
191.	□	*Nassella [stipa] pulchra*	Purple needlegrass	Ground cover
192.	□	*Nemophila menziesii*	Baby Blue Eyes	Annual
193.	X	*Nerium oleander*	Oleander	Shrub
197.	□	*Oenothera hookeri*	California Evening Primrose	Flower
198.	W	*Oenothera speciosa*	Showy Evening Primrose	Perennial
199.	X	*Ophiopogon japonicus*	Mondo Grass	Ground cover
200.	□ •	*Opuntia littoralis*	Prickly Pear	Cactus
201.	□ •	*Opuntia oricola*	Oracle Cactus	Cactus
202.	□ •	*Opuntia prolifera*	Coast Cholla	Cactus
203.	W	*Osmanthus fragrans*	Sweet Olive	Shrub
204.	X	*Osteospermum fruticosum*	Trailing African Daisy	Ground cover
205.	X	*Parkinsonia aculeata*	Mexican Palo Verde	Tree
206.	W	*Pelargonium peltatum*	Ivy Geranium	Ground cover

	Code	Botanical Name	Common Name	Plant Form
207.	**X**	*Penstemon species*	Beard Tongue	Shrub
208.	**W**	*Photinia fraseri*	ncn	Shrub
209.	**W**	*Pistacia chinensis*	Chinese Pistache	Tree
210.	**X**	*Pittosporum undulatum*	Victorian Box	Tree
211.	□	*Plantago erecta*	California Plantain	Annual
212.	••	*Plantago insularis*	Woolly Plantain	Annual
213.	**X**	*Plantago sempervirens*	Evergreen Plaintain	Ground cover
214.	**W**	*Platanus racemosa*	California Sycamore	Tree
215.	**W**	*Plumbago auriculata*	Plumbago Cape	Shrub
216.	□	*Populus fremontii*	Western Cottonwood	Tree
217.	**X**	*Portulacaria afra*	Elephant's Food	Shrub
218.	□	*Potentilla glandulosa*	Sticky Cinquefoil	Subshrub
219.	**X**	*Potentilla tabernaemontanii*	Spring Cinquefoil	Ground cover
220.	**X**	*Prunus caroliniana*	Carolina Cherry Laurel	Shrub/Tree
221.	□	*Prunus ilicifolia ssp. ilicifolia*	Holly Leaved Cherry	Shrub
222.	**X**	*Prunus lyonii*	Catalina Cherry	Shrub/Tree
223.	**N**	*Punica granatum*	Pomegranate	Shrub/Tree
224.	**W**	*Puya species*	Puya	Succulent/shrub
225.	**W**	*Pyracantha species*	Firethorn	Shrub
226.	□	*Quercus agrifolia*	Coast Live Oak	Shrub
227.	□□•	*Quercus berberdifolia*	California Scrub Oak	Shrub
228.	□□•	*Quercus dumosa*	Coastal Scrub Oak	Shrub
229.	**X**	*Quercus engelmannii*	Engelmann Oak	Tree

	Code	Botanical Name	Common Name	Plant Form
230.	X	*Quercus suber*	Cork Oak	Tree
231.	X	*Rhamnus alaternus*	Italian Buckthorn	Shrub
232.	□	*Rhamnus californica*	California Coffee Berry	Shrub
233.	□	*Rhamnus crocea*	Redberry	Shrub
234.	□	*Rhamnus crocea ssp. ilicifolia*	Hollyleaf Redberry	Shrub
235.	N	*Rhaphiolepis species*	Indian Hawthorn	Shrub
236.	□	*Rhus integrifolia*	Lemonade Berry	Shrub
237.	N	*Rhus lancea*	African Sumac	Tree
238.	□ □	*Rhus ovata*	Sugarbush	Shrub
239.	□	*Ribes aureum*	Golden Currant	Shrub
240.	□	*Ribes indecorum*	White Flowering Currant	Shrub
241.	□	*Ribes speciosum*	Fuchsia Flowering Gooseberry	Shrub
242.	W	*Ribes viburnifolium*	Evergreen Currant	Shrub
243.	□ •	*Romneya coulteri*	Matilija Poppy	Shrub
244.	X	*Romneya coulteri 'White Cloud'*	White Cloud Matilija Poppy	Shrub
245.	W □	*Rosmarinus officinalis*	Rosemary	Shrub
246.	W □	*Salvia greggii*	Autumn Sage	Shrub
247.	W □	*Salvia sonomensis*	Creeping Sage	Ground cover
248.	□	*Sambucus mexicana*	Mexican Elderberry	Tree
249.	W	*Santolina chamaecyparissus*	Lavender Cotton	Ground cover
250.	W	*Santolina virens*	Green Lavender Cotton	Shrub
251.	□	*Satureja chandleri*	San Miguel Savory	Perennial
252.	□	*Scirpus acutus*	Hard-Stem Bulrush	Perennial
253.	□	*Scirpus californicus*	California Bulrush	Perennial

	Code	Botanical Name	Common Name	Plant Form
254.	X	*Sedum acre*	Goldmoss Sedum	Ground cover
255.	X	*Sedum album*	Green Stonecrop	Ground cover
256.	X	*Sedum confusum*	ncn	Ground cover
257.	X	*Sedum llineare*	ncn	Ground cover
258.	X	*Sedum x rubrotinctum*	Pork and Beans	Ground cover
259.	X	*Senecio serpens*	ncn	Ground cover
260.	□	*Sisyrinchium bellum*	Blue-Eyed Grass	Ground cover
261.	□	*Solanum douglasii*	Douglas Nightshade	Shrub
262.	□	*Solanum xantii*	Purple Nightshade	Perennial
263.	W	*Stenocarpus sinuatus*	Firewheel Tree	Tree
264.	W	*Strelitzia nicolai*	Giant Bird of Paradise	Perennial
265.	W	*Strelitzia reginae*	Bird of Paradise	Perennial
266.	□	*Symphoricarpos mollis*	Creeping Snowberry	Shrub
267.	W	*Tecoma stans [Stenolobium stans]*	Yellow Bells	Shrub/Small tree
268.	X	*Tecomaria capensis*	Cape Honeysuckle	Ground cover
269.	N	*Teucrium chamaedrys*	Germander	Ground cover
270.	N	*Thymus serpyllum*	Lemon Thyme	Ground cover
271.	N	*Trachelospermum jasminoides*	Star Jasmine	Shrub
272.	□	*Trichostema lanatum*	Woolly Blue-Curls	Shrub
273.	X	*Trifolium hirtum 'Hyron'*	Hyron Rose Clover	Ground cover
274.	X	*Trifolium fragiferum 'O'Connor's'*	O'Connor's Legume	Ground cover
275.	□	*Umbellularia californica*	California Laurel	Tree
276.	□	*Verbena lasiostachys*	Western Vervain	Perennial

	Code	Botanical Name	Common Name	Plant Form
277.	N	*Verbena peruviana*	ncn	Ground cover
278.	X	*Verbena species*	Verbena	Ground cover
279.	X	*Vinca minor*	Dwarf Periwinkle	Ground cover
280.	□	*Vitis girdiana*	Desert Wild Grape	Vine
281.	X	*Vulpia myuros 'Zorro'*	Zorro Annual Fescue	Grass
282.	W	*Westringia fruticosa*	ncn	Shrub
283.	W	*Xanthorrhoea species*	Grass Tree	Perennial accent/ Shrub
284.	W	*Xylosma congestum*	Shiny Xylosma	Shrub
285.	X	*Yucca species*	Yucca	Shrub
286.	□	*Yucca whipplei*	Yucca	Shrub

X = Plant species prohibited in wet and dry fuel modification zones adjacent to native open space lands. Acceptable on all other fuel modification locations and zones.

W = Plant species appropriate for use in wet fuel modification zones adjacent to native open space lands. Acceptable in all other wet and irrigated dry (manufactured slopes) fuel modification locations and zones.

□ = Plant species native to Riverside, Orange and San Diego Counties. Acceptable in all fuel modification (wet or dry zones) in all locations.

N = Plant species acceptable on a limited basis (maximum 30% of the area at time of planting) in wet fuel modification zones adjacent to native open space reserve lands. Acceptable in all other fuel modification locations and zones.

• If seed collected from local seed source.

•• Not native plant species but can be used in all fuel modification zones.

□ = Plant species acceptable on a limited use basis. Refer to qualification requirements starting on page 14.

QUALIFICATION STATEMENTS FOR SELECT PLANT SPECIES

□ = **Plant species acceptable on a limited use basis:**

2. **Acacia redolens desert carpet**
May be used in the upper 1/2 of fuel modification zone 2 (30 to 70 feet). The plants may Be planted at 8 feet on center minimum spacing in meandering zones not to exceed a Mature width of 24 feet or a mature height of 24 feet.

43. **Bougainvillea spectabilis [procumbent varities]**
Procumbent to mounding varieties may be used in the mid fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters at 6 feet once center spacing not to exceed

8 plants per cluster. Mature spacing between individual plants or clusters shall be 30 feet minimum.

44. **Brahea armata**
45. **Brahea brandegeei**
46. **Brahea edulis**

    May be used in the upper and mid fuel modification zone 2 (30 to 70 feet). The plants shall be used as single specimens with mature spacing between palms of 30 feet minimum.

129. **Hakea suaveolens**

    May be used in the mid fuel modification zone 2 (30-70 feet). The plants shall be used as single specimens with mature spacing between plants of 30 feet minimum.

136. **Heteromeles arbutifolia**

    May be used in the mid to lower fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or cluster shall be 30 feet minimum.

164. **Liquidambar styraciflua**

    May be used in the mid to lower fuel modification zone 2 (30 to 70 feet). The plant shall be used as a single specimens with mature spacing between trees at 30 feet minimum.

227. **Quercus berberdifolia**

228. **Quercus dumosa**

    May be used in the mid to lower fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or clusters shall be 30 feet minimum.

238. **Rhus ovata**

    May be used in the mid to lower fuel modification zone 3 (30 to 70 feet) within inland areas only. The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or clusters shall be 30 feet minimum.

245. **Romarinus officinalis**
246. **Salvia greggii**
247. **Salvia sonomensis**

May be used in the mid to upper fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or clusters hall be 15 feet minimum.

FIREWISE 2000 Not-Recommended Plant List

For Fuel Modification Projects in San Diego, Riverside, and Orange Counties

	Botanical Name	Common Name	Plant Form
1.	*Acacia species •*	Acacia	Shrub/Tree
2.	*Adenostoma fasciculatum*	Chamise	Shrub
3.	*Adenostoma sparsifolium*	Red Shank	Shrub/Tree
4.	*Artemisia californica*	California Sagebrush	Shrub
5.	*Bamboos*	Bamboo	Shrub
6.	*Cedrus species*	Cedar	Tree
7.	*Cupressus species*	Cypress	Tree
8.	*Eriogonum fasciculatum*	Common Buckwheat	Shrub
9.	*Eucalyptus species*	Eucalyptus	Shrub/Tree
10.	*Juniperus species*	Junipers	Succulent
11.	*Pennisetum*	Fountain Grass	Ground cover
12.	*Pinus species*	Pines	Tree
13.	*Rosmarinus species*	Rosemary	Shrub
14.	*Salvia species • •*	Sage	Shrub

• Except:
Acacia redolens desert carpet (Desert Carpet ground cover)

• • Except:
Salvia colubariae (chia)
Salvia sonomensis (Creeping Sage)

APPENDIX J-5B

INVASIVE PLANT & WEED LIST

APPENDIX J-5B

FIREWISE 2000 Undesirable Plants and Weeds

For Fuel Modification Projects in San Diego, Riverside, and Orange Counties
(Very Invasive Plant List)

	Botanical Name	Common Name	Plant Form
1.	*Anthemix cotula*	Mayweed	Weed
2.	*Arundo donax*	Giant Reed	Bamboo
3.	*Brassica nigra*	Black Mustard	Weed
4.	*Brassica rapa*	Yellow Mustard	Weed
5.	*Cardaria draba*	Perennial Peppergrass	Weed
6.	*Centaurea solstitialis*	Star Thistle	Weed
7.	*Cirsium vulgare*	Wild Artichoke	Weed
8.	*Conyza canadensis*	Horseweed	Weed
9.	*Cortaderia selloana*	Pampas Grass	Weed
10.	*Foeniculum vulgare*	Sweet Fennel	Weed
11.	*Heterotheca grandiflora*	Telepraphplant	Shrub
12.	*Lactuca serriola*	Prickly Lettuce	Weed
13.	*Nicotiana bigelovii*	Indian Tobacco	Weed
14.	*Nicotiana glauca*	Tree Tobacco	Weed
15.	*Ricinus communis*	Castor Bean	Shrub
16.	*Salsola australis*	Russian-Thistle	Weed
17.	*Silybum marianum*	Milk Thistle	Weed
18.	*Urtica urens*	Burning Nettle	Weed

APPENDIX J5-C

FIRE BEHAVIOR CALCULATIONS

APPENDIX J-5C

WILDLAND FIRE BEHAVIOR CALCULATIONS FOR THE OFF-SITE HAZARDOUS VEGETATIVE FUELS.

Wildland fire behavior calculations have been projected for the hazardous vegetative fuels on the undeveloped sites adjacent to and bordering the Rancho Mission Viejo proposed development. These projections were based on the following "Worst Case" (extreme) Orange County area fire weather condition assumptions:

South, Southwest and West Wind Condition Fuel Moisture Assumptions:
a typical Prevailing (normal summer) Afternoon Wind Pattern.

* 1-Hour Fine Fuel Moisture of.............4%
* 10-Hour Fuel Moisture of..................6%
* 100-Hour Fuel Moisture of 8%
* Live Woody Fuel Moisture of.............60%

South, Southwest and West Wind Condition Fuel Moisture Assumptions:
Late fire season above-average southwest wind pattern. ***A rare even Under the following fuel moisture conditions which sometimes occur with the breakdown of an intense Santa Ana condition.***

* 1-Hour Fine Fuel Moisture of 2%
* 10-Hour Fuel Moisture of..................3%
* 100-Hour Fuel Moisture of 5%
* Live Woody Fuel Moisture of.............50%

North, Northeast and East Wind Condition Fuel Moisture Assumptions:
(Santa ana Wind Conditions). ***An annual event often occuring two or three times a year.***

* 1-Hour Fine Fuel Moisture of 2%
* 10-Hour Fuel Moisture of..................3%
* 100-Hour Fuel Moisture of 5%
* Live Woody Fuel Moisture of.............50%

*Tables 6.3.*1 through *6.3.3* display the expected Rate of Fire Spread (expressed in feet per minute), Fireline Intensity (expressed in British Thermal Units per foot per second) and Flame Length (expressed in feet) for three separate BEHAVE–Fire Behavior Prediction and Fuel Modeling System Computer Calculations. We used a Fuel Model (FM) 2 for these calculations.

Fuel Models 1, 2, 4, and 6 apply directly to the native vegetation that occupies southern California landscapes. FM-1 is one foot tall grass. FM-2 is one foot tall grass and scattered sage brush. FM-4 is chaparral vegetation over 6-feet in height. FM-6 is chaparral vegetation less than 6-feet in height. We chose FM-4 to represent the Rancho Mission Viejo site in its most volatile worst case condition.

As the dedicated open space is restored back to a healthy coastal sage scrub plant community the maximum projected flame lengths will actually diminish (see the following tables 6.3.5 - 6.3.6 displaying rates of spread under "Santa Ana wind conditions for FM-1 and FM-6).

Table 6.3.1 **Expected fire behavior for a prevailing summer season Southwest Wind Pattern for a Fuel Model 2 - Scattered Sage Brush with Tall Grass**	
Rate of Spread	**75.9 feet/minute**
Fireline Intensity	**656 BTU's/foot/second**
Flame Length	**8.9 feet in length**
Additional Fire Behavior Calculation Input: **• 30 percent slope** **• 15 mph 20-foot wind speed (6.0 mph mid-flame wind speed)** **• 30° direction of wind vector to uphill slope**	

This equates to 1.4 acres in 6 minutes, 5.4 acres in 12 minutes, and 12.0 acres in 18 minutes, assuming no initial attack.

Table 6.3.2 **Expected fire behavior for an above average Southwest afternoon wind for a Fuel Model 2 – Scattered Sage Brush with Tall grass**	
Rate of Spread	**312.4 feet/minute**
Fireline Intensity	**3173 BTU's/foot/second**
Flame Length	**18.4 feet in length**
Additional Fire Behavior Calculation Input: **• 30 percent slope** **• 30 mph 20-foot wind speed (12.0 mph mid-flame wind speed)** **• 30° direction of wind vector to uphill slope**	

This equates to 16 acres in 6 minutes, 65 acres in 12 minutes and 146 acres in 18 minutes, assuming no initial attack.

Table 6.3.3 Expected fire behavior for a late season Santa Ana wind condition for a Fuel Model 2 – Scattered Sage Brush with Tall Grass	
Rate of Spread	1,065 feet/minute
Fireline Intensity	10,808 BTU's/foot/second
Flame Length	32.3 feet in length
Additional Fire Behavior Calculation Input: • 30 percent slope • 60 mph 20-foot wind speed (24.0 mph mid-flame wind speed) • 210° direction of wind vector to uphill slope	

This equates to 107 acres in 6 minutes, 427 acres in 12 minutes and 960 acres in 18 minutes, assuming no initial attack.

Table 6.3.4 Expected Fire Behavior for an above average Southwest wind condition for a Fuel Model 1 – Native Grass Stubble 4-inches in height	
Rate of Spread	732.6 feet/minute
Fireline Intensity	1415 BTU's/foot/second
Flame Length	12.7 feet in length
Additional Fire Behavior Calculation Input: • 30 percent slope • 30 mph 20-foot wind speed (12.0 mph mid-flame wind speed) • 30° direction of wind vector to uphill slope	
COMMENTS: The above fire behavior projections are based on grass fuels one-foot tall. Therefore, Rates of Spread, Fireline Intensity and Flame Lengths should be reduced one-third for 4-inch stubble grass fuels, i.e. Rate of Spread = 224 feet/minute Fireline Intensity = 471 BTU's/ft/sec Flame Length = 4.21 feet in length	

Table 6.3.5 Expected fire behavior for a late season Santa Ana Wind Condition For a Fuel Model 1 – one-foot tall cured grass	
Rate of Spread	732.6 feet/minute
Fireline Intensity	1415 BTU's/foot/second
Flame Length	12.7 feet in length
Additional Fire Behavior Calculation Input: • 30 percent slope • 60 mph 20-foot wind speed (24.0 mph mid-flame wind speed) • 210° direction of wind vector to uphill slope	

Table 6.3.6 Expected fire behavior for a late season Santa Ana Wind Condition for a Fuel Model 6 – Chaparral Brush less than 6-feet in height	
Rate of Spread	438 feet/minute
Fireline Intensity	4493 BTU's/foot/second
Flame Length	21.5 feet in length
Additional Fire Behavior Calculation Input: • 30 percent slope • 60 mph 20-foot wind speed (24.0 mph mid-flame wind speed) • 210° direction of wind vector to uphill slope	

Table 6.3.7 Expected fire behavior for a late season Santa Ana Wind Condition for a Fuel Model 4 – Chaparral Brush greater than 6-feet in height	
Rate of Spread	2591.6 feet/minute
Fireline Intensity	149,053 BTU's/foot/second
Flame Length	107.9 feet in length
Additional Fire Behavior Calculation Input: • 30 percent slope • 60 mph 20-foot wind speed (36.0 mph mid-flame wind speed) • 210° direction of wind vector to uphill slope	

APPENDIX J-5D

GLOSSARY

APPENDIX J-5D

GLOSSARY

DEFINITIONS:

Appropriate Management Response – Specific actions taken in response to a wildland fire to implement protection and fire use objectives.

Appropriate Management Strategy – A plan or direction taken by an agency administrator to guide wildland fire management actions and meet protection and fire use objectives.

Contain – To surround a fire, and any spot fires therefrom, with control line down to mineral soil as needed, which can reasonably be expected to check a fire's spread under prevailing and predicted weather conditions.

Confine – To limit fire spread within a predetermined area principally by use of natural and pre-constructed barriers or environmental conditions. Suppression action may be minimal and limited to surveillance or monitoring under appropriate conditions.

Control – To complete a control line around a fire down to mineral soil, any spot fires therefrom, and any interior islands to be saved and cool down all hot spots that are immediate threats to the control line.

Energy Release Component – A number that expresses the rate of heat release (in BTU's/sec) per unit area (in square feet) within the flaming zone of the fire.

Expected Weather Conditions – Weather conditions indicated as common, likely, or highly probable based on current and expected trends and their comparison to historical weather records. These are the most probable weather conditions for this location and time.

Experienced Severe Weather Conditions – Weather conditions that occur infrequently, but have been experienced during the period of weather record keeping. For example, rare weather conditions that significantly influence fires may have occurred only once, but their record can be used to establish a baseline for worst case scenario.

Fire Frequency – The historic return interval of fire in a defined environment.

Fire Management Unit (FMU) – Any land management area definable by objectives, topographic features, access, values to be protected, political boundaries, fuel types, major fire regimes, etc., that sets it apart from the management characteristics of an adjacent unit. FMU's are delineated in Fire Management Plans.

Firebreaks – A fireline constructed with a bulldozer on or down a ridgeline to mineral soil, two to three blade widths wide for, use in containing an eventual wildfire.

Fuelbreaks – Usually a ridge top where the fuels have been modified to provide a break in the fuel continuity. Fuelbreaks continue to support vegetation as opposed to a completely cleared firebreak, except for a cleared fireline about the width of a vehicle. Fuelbreaks are most functional when they incorporate an access road down the middle of the fuelbreak. Fuelbreaks can easily be maintained with prescribed fire.

Fuel - Fuel is comprised of living and dead vegetation that can be ignited. It is often classified as dead or alive and as natural fuels or activity fuels (resulting from human actions, usually from logging operations). Fuel components refer to such items as downed dead woody material by various size classes, litter, duff, herbaceous vegetation, live foliage etc.

Fuel Continuity - A qualitative description of the distribution of fuel both horizontally and vertically. Continuous fuels readily support fire spread. The larger the fuel discontinuity, the greater the fire intensity required for fire spread (Brown 2000).

Fuel Loading - The weight per unit area of fuel, often expressed in tons per acre or tones per hectare. Dead woody fuel loadings are commonly described for small material in diameter classes of 0 to 1/4-, 1/4 to 1-, and 1 to 3-inches and for large material in one class greater than 3 inches (Brown 2000).

Fuel Moisture - Percent or fraction of oven dry weight of fuel. It is the most important fuel property controlling flammability. In living plants it is physiologically bound. Its daily fluctuations vary considerably by species but are usually above 80 to 100%. As plants mature, moisture content decreases. When herbaceous plants cure, their moisture content responds as dead fuel moisture content, which fluctuates according to changes in temperature, humidity, and precipitation (Brown 2000).

Ground Fire - Fire that burns in the organic material below the litter layer, mostly by smoldering combustion. Fires in duff, peat, dead moss and lichens, and punky wood are typically ground fires (Brown 2000).

Head Fire - A fire spreading or set to spread with the wind (National Wildfire Coordinating Group 1995).

Holding Actions – Planned actions required to achieve wildland and prescribed fire management objectives.

Initial Attack – An aggressive suppression action consistent with firefighter, public safety and values to be protected.

Invasive Species - Species that can move into an area and become dominant numerically or in terms of cover, resource use, or other ecological impacts (Randall 1987).

Ladder Fuels - Shrubs and young trees that provide continuous fine material from the forest floor into the crowns of dominant trees (Smith 2000).

Layering - A form of vegetative reproduction in which an intact branch develops roots as the result of contact with soil or other media (Helms 1998).

Lignotuber - A woody storage structure forming a swelling, more or less at ground level, from which dormant buds can develop (Helms 1998).

Litter - The top layer of the forest floor (01 soil horizon); includes freshly fallen leaves, needles, fine twigs, bark flakes, fruits, matted dead grass and other vegetative parts that are little altered by decomposition. Litter also accumulates beneath rangeland shrubs. Some surface feather moss and lichens are considered to be litter because their moisture response is similar to that of dead fine fuel.

Management Action Points – (also called "Trigger Points") – Either geographic points on the ground or specific points in time when escalation or alteration of management actions is necessitated. These points are defined and the management actions taken are clearly described in an approved Wildland Fire Plan or Prescribed Fire Plan. Timely implementation of plans when the fire reaches the action point is generally critical to successful accomplishment of the objectives.

Mesic - Pertaining to conditions of moderate moisture or water supply (Smith 2000).

Mitigation Actions – On the ground actions that check, direct or delay the spread of fire, and minimize threats to life, property and resources. This can include mechanical and physical non-fire tasks, specific fire applications and limited suppression actions. These actions will be used to construct firelines, reduce excessive fuel concentrations, reduce vertical fuel continuity, create fuelbreaks or barriers around critical or sensitive sites or resources, create "blacklines" through controlled burnouts, and to limit fire spread and behavior.

Non-native Species - An introduced species evolved elsewhere that has been transported and purposefully or accidentally disseminated by humans (for our purposes, in North America) (Li 1995).

Prescribed Fire – Any fire ignited by management actions to met specific objectives. A written, approved prescribed fire plan must exist and NEPA requirements must be met prior to ignition.

Prescribed Fire Plan – A plan required for each fire ignited by managers. It must be prepared by qualified personnel and approved by the appropriate agency Administrator prior to implementation.

Prescription – Measurable criteria, which guide the selection of, appropriate management responses and actions. Prescription criteria may include safety, economic, public health, and environmental, geographic, administrative, social or legal considerations.

Presettlement Fire Regime - The time from about 1500 to the mid- to late-1800s, a period when Native American populations had already been heavily impacted by European presence and before extensive settlement by European Americans in most parts of North America, before extensive conversion of wildlands for agricultural and other purposes, and before fires were effectively suppressed in many areas (Smith 2000).

Sere - A succession of plant communities leading to a particular plant association (Smith 2000).

Smoke Management – Any situation which creates a significant public response, such as smoke in a metropolitan area or visual pollution in high-use scenic areas.

Stand-Replacement Fire Regime - Fire regime in which fires kill or top-kill aboveground parts of the dominant vegetation, changing the aboveground structure substantially. Approximately 80% or more of the aboveground, dominant vegetation is either consumed or dies as a result of fires. Applies to forests, shrublands, and grasslands (Smith 2000).

Succession - The gradual, somewhat predictable process of community change and replacement leading toward a climax community; the process of continuous colonization and extinction of populations at a particular site (Smith 2000).

Surface Fire - Fire that burns in litter and other live and dead fuels at or near the surface of the ground, mostly by flaming combustion (Brown 2000).

Threatened and Endangered Species – Threat to habitat of such species, or in the case of flora, a threat to the species itself.

Tiller - An erect or ascending stem that branches from the base of another at or below the ground surface; especially in Poaceae and other monocotyledons (Hunt Institute for Botanical Documentation).

Top-Kill - Kills aboveground tissues of plant without killing underground parts from which the plant can produce new stems and leaves (Smith 2000).

Total Heat Release - The heat released by combustion during burnout of all fuels, expressed in BTU per square foot or kilocalories per square meter (Brown 2000).

Underburn - Understory fire.

Understory Fire Regime - Fire regime in which fires are generally not lethal to the dominant vegetation and do not substantially change the structure of the dominant vegetation. Approximately 80% or more of the aboveground dominant vegetation survives fires. Applies to forest and woodland vegetation types (Smith 2000).

Wildfire – An unwanted wildland fire.

Xeric - Having very little moisture; tolerating or adapted to dry conditions (Smith 2000).

Appendix J5-E

CHINO HILLS STATE PARK
PREVENTION & WILDFIRE MANAGEMENT

6.0

CHINO HILLS STATE PARK

PREVENTION & WILDFIRE MANAGEMENT PLAN

APPENDIX J-5F

LITERATURE CITED

APPENDIX J-5F

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