WILDLAND FIRE MANAGEMENT PLAN
VOLUME I of III: THE PLANNING CONTEXT

County of Orange
Central/Coastal NCCP/HCP
Nature Reserve of Orange County
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County of Orange Central/Coastal NCCP/HCP
Wildland Fire Management Plan
Volume I of III: The Planning Context

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EXECUTIVE SUMMARY

This Wildland Fire Management Plan (WFMP) has been prepared for the Nature Reserve of Orange County (NROC) to satisfy Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP) requirements. This WFMP has evolved through three iterations, has included extensive collaboration, and includes valuable and considerable input from a diverse group of NROC stakeholders.

The purpose of this WFMP is to provide a long-term framework for fire management and planning throughout the 37,000 acre Central and Coastal Reserves (Reserve). The primary focus in the short term (roughly the next 30 to 50 years), is to reduce the number of ignitions that effect the Reserve and to limit fire spread within the Reserve so that damaged habitat can be restored. Longer term objectives are to maintain and improve habitat quality through strategic implementation of fire hazard reduction and suppression measures detailed herein. This plan is an attempt to balance fire hazard threats and resource conservation. To that end, this plan provides the following key discussions:

1. Review of the NCCP/HCP regulatory requirements that provide a nexus for WFMP creation
2. Overview of the primary focus on habitat management
3. Description of NROC landowners and stakeholders
4. Central and Coastal Reserve geographic setting and natural and cultural resources descriptions
5. Description of Reserve fire environments and fire effects on Reserve resources
6. Reserve fuel types and fire behavior
7. Fire hazard reduction and suppression planning recommendations
8. Stakeholder responsibilities

This WFMP provides an assessment of fire management units (FMU) throughout the Central and Coastal Reserves, focusing on 1) the anticipated fire risk, 2) potential hazards and 3) development of potential hazard reduction measures. To substantiate the use of specific hazard reduction measures, this WFMP includes thorough review of vegetation (fuels), terrain, weather influence, ignition sources, biological and cultural assets, off-site adjacent private assets, along with fire response capabilities. This plan includes a vetted list of potential hazard reduction measures that are ranked according to their usefulness and applicability now and over the long term. Some of these measures can be implemented immediately with no or very little cost to

landowners or land managers. Other measures may require environmental review, may be too expensive, may need testing/experimentation, or may not be needed at this time. Measures that are currently considered infeasible for one reason or another, remain in the potential hazard reduction measure “toolkit” in the event that changing conditions, over time, whether environmental, political, sociological or other, may result in the need for their specific approach to hazard reduction, may include technological advancements that reduce costs, or other factors that make them feasible solutions.

In summary, this WFMP includes analysis of the following points:

- The Reserve includes valuable biological and cultural resources and is a regionally important ecological asset;
- The Reserve represents a significant preservation of continuous blocks of native and non-native vegetation along with sensitive wildlife, plants, and historic links to the area’s past;
- The Reserve is an important recreational and psychological resource for Orange County visitors and citizens;
- Native and non-native vegetation within the Reserve becomes available fuel to wildfire, especially during drier months which occur from roughly June through November;
- There are numerous ignition sources within a sphere of influence of the Reserve, primarily roads/vehicle related, urban development, arson, and electrical transmission lines, amongst others;
- Terrain, weather, ignition sources and drying vegetation result in seasonal conditions that facilitate fire spread and large-scale, uncontrollable fires;
- The 37,000 acre Reserve has been delineated into 13 Fire Compartments encompassing 57 Fire Management Units – these FMUs were established with OCFA and NROC input, coordination and agreement;
- Many of the Reserve FMUs are experiencing fire too frequently while others have not burned in recorded history of 80 years or more;
- Fire behavior modeling conducting in support of this WFMP are consistent with results of recent large fires in illustrating that extreme weather fires present challenges where firefighting agencies have difficulties controlling fire spread and are relegated to structure protection. Therefore, the focus of the WFMP in the short term will be on preventing fire ignitions, especially during extreme weather.

- Much of the Reserve edge borders urban settings, primarily residential development, and this situation will continue to create an "island of open space amongst a sea of urbanization";
- Currently, habitat management and public protection goals are aligned with a focus on minimizing the number of Reserve fires and the number of acres burned;
- There will be periods of time where habitat management and public protection goals may conflict, such as if habitat has become senescent would otherwise represent a significant fuel source that would be susceptible to fire; in these cases, a management decision will need to be made on whether the fuels will be manipulated or left alone. –;
- FMUs vary with regard to their overall hazard potential (i.e., ignition sources, fuels, terrain, wind alignment, fire history, ease of firefighting response, etc.), but the vast majority of FMUs (51 total) are classified in the "Assertive" response category where responding firefighters are encouraged to minimize ground disturbance, but are supported fully in their actions to minimize fire spread through all means available;
- Only two FMUs are categorized as "Reserved", meaning that biological and/or cultural resources, terrain/access or other constraints render these FMUs as highly sensitive to ground disturbance (even more so than fire disturbance) and that as possible, firefighting response should use aerial attack and avoid dozers and off-road vehicle use;
- Pre-fire planning conducted herein with input from stakeholders (including OCFA, USFWS, IRC, OC Parks, TCA, CAL TRANS, LBFD, NBFD, IRWD, and others) identifies FMUs where varying hazard reduction measures are recommended for consideration by Resource Advisors, landowners, and other stakeholders;
- A total of 41 potential hazard reduction measures have been identified, assessed, and ranked within a cost benefit matrix. The measures are ranked based on overall cost vs. benefit. Costs include primarily financial and potential ecological and environmental impacts while benefits include primarily the measures' leveragability (ability to receive a greater benefit than the investment) and effectiveness;
- This WFMP includes establishment of a Resource Advisory Fire Team (RAFT). The RAFT may consist of a NROC Board selected committee of stakeholders who will be responsible for fire management issues, will represent other stakeholders, will elect a fire liaison who will work directly with fire agencies during an emergency, and who will focus a coordinated stakeholder fire reduction effort for the Central and Coastal Reserves – the RAFT concept is introduced herein and will be open to definition of its specific attributes by the NROC stakeholders; and

- Lastly, Volume III provides a brief mapbook and data table of natural and cultural resources to assist resource managers' tactical response planning. This volume provides a quick-reference for FMU resources and the types of natural resources concerns that should be considered prior to, during, and following wildfire.

This WFMP provides a comprehensive analysis of the fire environment that has been augmented with extensive stakeholder coordination and input. Through this process, it was determined that fire ignition and spread has impacted habitat quality within the Central and Coastal Reserves. The Central Reserve, in particular, includes large acreage that has burned too frequently and implementation of measures to reduce ignitions and fire impacts is considered a high priority. Native habitats are resilient and in most cases, will recover with little human intervention, assuming that human-caused fires can be minimized. Therefore, it is recommended that NROC and its stakeholders regularly review this plan, revise it with changing conditions, and begin implementation of hazard reduction measures where most needed, as soon as possible.

The extent of analysis, the size of the Reserve and the complexities that influence fire occurrence resulted in a substantial document that may be more information than required by most readers. Therefore, if specifics of the Reserve's establishment, policies, natural resources, and fire environment are not pertinent, readers are referred to Chapters 6.0 through 9.0 for focused discussion on fire hazard reduction recommendations, stakeholder responsibilities, and post-fire recommendations. Further, Appendices A-1 through A-3 detail the hazard reduction measures, fire management unit hazard assessments, and individual hazrd reduction measure cost-benefit analysis, respectively while Volume II and Volume III provide focused resource data for fire agencies and resource managers, respectively.

1.0 INTRODUCTION

This Wildland Fire Management Plan (WFMP) is customized for the Nature Reserve of Orange County's (NROC) Central-Coastal Reserve in Orange County, California. Volume I of this WFMP provides a planning context, history of the NCCP/HCP and resulting Central-Coastal Reserve, as well as brief discussions of the Reserves' natural resources, sensitive species, fire environment, hazard and risk and fire management significance. This information is vital to conducting wildfire risk analysis and from that, developing hazard reduction measures and strategic pre-fire planning actions that enable Reserve goals to be met while simultaneously providing for public safety. The customized, potential fire hazard reduction measures recommended for the Reserve are detailed and ranked in Appendices A-1 through A-3. WFMP Volume II includes detailed information regarding delineated Fire Management Units. The matrices in Volume II provide a quick-reference for responding firefighters and resource managers by defining the suppression activities recommended for each FMU as well as providing vegetation, sensitive species, and important management issues/priorities needed for making informed decisions. WFMP Volume III includes a quick-reference for resource advisors. The matrices and mapbook within Volume III provides a brief natural resources focused reference for use in pre-, during, and post-fire incident resource management.

This WFMP has been prepared with a focus on balancing fire hazard threats and resource conservation and a focus of that effort included stakeholder input gained through a variety of outreach efforts including questionnaire responses, advisory committee meetings, stakeholder meetings, and direct contact. Additionally, stakeholders have had the opportunity to review and comment on WFMP components at various stages of completion. Further, NROC stakeholders have participated in the cost-benefit analysis that was conducted to thoroughly examine each of the potential hazard reduction measures available for strategic implementation within the Reserve fire management units. Recommended measures are shown to have high likelihood of effectiveness for reducing ignitions and wildfire spread, and subsequent natural and cultural resources impacts and some are extremely leveraged measures that provide a significant benefit compared to the associated financial and ecological implementation costs.

Southern California wildland vegetation has been heavily influenced by wildfire. From an historical perspective, wildfires have occurred throughout the sage scrub and grassland vegetation communities as long as these communities have existed. Naturally caused wildfires from lightning, sparks from falling rocks, or other natural sources have occurred on local and widespread areas, although less commonly than wildfire ignitions experienced today. Vegetation communities have evolved with fire, as indicated by the fire tolerance of many plant species and the unique adaptations many plants have developed in response to fire. Further, dating back some

10,000 years to the oldest, known indigenous inhabitats, humans began influencing southern California vegetation with fire, clearing areas to produce oak germination sites (for acorns) and for creating grassland hunting grounds. Although historic wildfire has shaped southern California's vegetation composition, distribution, and density, the current fire regime, primarily human caused vegetation fires (Keeley 2006), includes much shorter intervals between fires than historically experienced, and the very real threat of vegetation type conversion and non-native vegetation dominance over large expanses of southern California.

The vast tracts of non-native and native grasslands, numerous ignition sources (roadways, recreational areas, private residences, etc.), and seasonal weather in Orange County accentuates wildfire ignition and spread, combining to form a unique and significant threat to the often competing goals of preserving wildlife habitat and providing public protection. Wildfire in Mediterranean-type ecosystems, as found in Orange County, ultimately affects the structure and function of vegetation communities. Large wildfires have had, and will continue to have a substantial and recurring role on the Reserve, in part because (1) the site's grasslands, shrubs, and other vegetation become increasingly flammable each year, (2) the climate in the region has been characterized by fire climatologists as the worst fire climate in the United States (Keeley 2004) with high winds (Santa Ana) occurring during autumn after a 6-month drought period each year, and (3) the presence of a high number of ignition sources adjacent to and within the "fire sheds" (the fire equivalent of watersheds) that encompass and portions of which, are encompassed by the Reserve.

Open space reserves provide benefits to sensitive species and society by preserving important islands of natural environment. However, as urbanization occurs in the vicinity of reserves, the potential for increased fire frequency and detrimental impacts from fire intensifies and the need to prevent wildfire from threatening these urbanized areas becomes a high priority. From a regional perspective, the Central-Coastal Reserve and connected off-site conserved open space (including the Cleveland National Forest) has become an "island" within an "ocean" of development. Fires are no longer desirable from a human impact perspective but occur at much higher rates than they did historically, resulting in establishment of non-native species and type conversion of native vegetation communities to non-natives that are often more prone to short-interval fires, and perpetuation of habitat degradation. The area where urban development abuts these vast tracts of open space is substantial and is known as the wildland urban interface (WUI). The WUI requires special attention and planning efforts to provide a buffer that not only serves a defensible space function for private structures, but also provides a buffer or setback area for the Reserve from these adjacent ignition sources.

This WFMP update specifically addresses the Central-Coastal Reserve and is based on a previously existing draft WFMP. Many of the concepts for fire hazard reduction, pre-suppression, suppression, and post-suppression activities and fire management planning remain valid and are preserved and enhanced in this plan. Other concepts in the original WFMP are no longer reasonable or implementable, and have been addressed as such, herein. The focus of this WFMP is to provide more detailed discussion of available fire management tools, refinement of fire management units, and a more balanced approach to tactical response guidelines. Further, this plan stresses that Reserve fire management actions will evolve over time, requiring an adaptive management approach supported by a robust GIS capability and relatively frequent updating of this WFMP.

1.1 NCCP/HCP

On March 25, 1993, the U.S. Department of the Interior (DOI) listed the California gnatcatcher *(Polioptila californica)* as a "Threatened" species and adopted a special rule in accordance with Section 4(d) of the Federal Endangered Species Act (FESA) that authorized landowners and local jurisdictions to voluntarily participate in the State of California Natural Community Conservation Plan (NCCP) Act of 1992 (Assembly Bill No. AB2172, September 1991).

On April 16, 1996, the Orange County Board of Supervisors approved the Central-Coastal Subregional Natural Community Conservation Plan/Habitat Conservation Plan (NCCP/HCP). The NCCP/HCP protects sensitive plant and animal species and their natural habitats in an approximately 37,000 acre Reserve System. The NCCP process is evidence of a growing trend toward natural lands management at the ecosystems level. The intent of this NCCP/HCP and its associated management activity is to accomplish the following key goals, (County of Orange 1996, pages II-2 to II-9):

"Undertake multiple-species, natural community-based planning for coastal sage scrub habitat located in Central and Coastal NCCP subregion in a manner that would further the statutory purposes of the NCCP Act, California Endangered Species Act (CESA), FESA and the Section 4(d) Rule, California Environmental Quality Act (CEQA), and National Environmental Policy Act (NEPA)

Develop a coastal sage scrub (CSS) habitat conservation strategy and management program (the NCCP/HCP) that would provide an alternative to current single species conservation efforts by formulating a subregional NCCP/HCP that provides for a multiple-species, natural community-based conservation and management program within the regional NCCP planning framework

Complete a subregional conservation plant that addresses the FESA Section 10 criteria for the federally listed coastal California gnatcatcher under the Section 4(d) Rule, thereby providing the basis for future Incidental Take of the gnatcatcher

Prepare a subregional conservation plan that provides the basis for future Incidental Take of the two candidate species that, in addition to the coastal California gnatcatcher, were designated "target species" (the coastal cactus wren and orange-throated whiptail lizard), by treating the coastal cactus wren and orange-throated whiptail lizard as if they were listed species under CESA and FESA

Complete a subregional conservation plan, that by addressing the habitat needs of the "target species" through protection and management of substantial CSShabitat, effectively mitigates future potential impacts on a broader range of species residing in CSS habitat and in other habitats included in the reserve

Formulate a conservation strategy that addresses the protection of non-CSS habitats within the overall CSS habitat mosaic"

1.2 Nature Reserve of Orange County

The Nature Reserve of Orange County (NROC) was established as a result of conservation planning at the natural community level by federal and state wildlife agencies, county and city governments, major landowners, and the environmental community (County of Orange 1996). NROC is a 501(c)(3) non-profit, public benefit corporation incorporated in 1996 to assemble the public lands and oversee and implement the Reserve's 75-year (60 remaining years) habitat management program. The NROC Board of Directors is composed of a representative group of public and private Reserve Land owners, wildlife agencies, local governments and community representatives.

NROC comprises Orange County's largest Reserve System. Approximately 37,000 acres are contained in two roughly equal blocks in the foothills north of Irvine and in coastal areas around Laguna Beach and Newport Beach. Orange County Parks comprises 16,000 acres of land managed for native plants and animals within the NCCP/HCP Reserve. At the time the NCCP/HCP was established, there were 21,000 acres of still-private lands destined to be parks in the future. The Reserve was designed to protect sensitive plant and animal species and their natural habitats for many generations into the future. Within the Reserve, compatible land uses such as low impact recreation is allowed. Incompatible uses, such as urban growth and economic development, are not allowed inside Reserve boundaries.

The mission of NROC is: *"To ensure the persistence of the reserve's natural communities, including the full spectrum of native plant and animal species, through the protection, study and restoration of native habitats and natural processes."*

Fire plays a significant role in helping plant and animal species persist in southern California native landscapes. However, human-caused fire that occurs at higher frequencies than historic natural fires represents a significant threat to NROC's mission and this WFMP provides measures to reduce that threat through methods aimed at reducing the occurrence and resulting impact of unnatural fires in the Reserve.

1.2.1 Reserve Wildlife and Habitat Monitoring Program

NROC is responsible for overseeing and conducting research and monitoring activities within the Reserve System. NROC also coordinates monitoring activities by the various land managers. The program tracks the status and population trends of "target" and "identified" species receiving regulatory coverage under the NCCP/HCP to identify and prioritize management actions that enhance long-term persistence. The monitoring can include periodic surveys to assess population levels or may involve more in-depth studies of reproduction, survival and dispersal to identify threats to sensitive species populations. In addition to monitoring individual sensitive species, a more holistic approach is also employed to assess the status of natural communities and their ecological functions in order to identify potential threats to long term sustainability of these systems and to the sensitive species they support. This can include monitoring recovery of natural communities after disturbances such as wildfire or during periods of environmental stress such as drought. It can and should also include monitoring the effectiveness of fire prevention and hazard reduction measures and fire suppression operations implemented within the Reserve.

1.2.2 Adaptive Management

Adaptive management is a flexible approach to land management, open to change based on new scientific information and the results of monitoring sensitive species and natural habitats. Reserve management activities are concentrated in four areas: recreation, habitat restoration, species recovery efforts, wildfire management.

Recreation

The key to public access is balance. Visitors can enjoy activities like hiking, horseback riding, cycling, bird watching, and other low-impact recreation at levels and in locations that do not damage the native plant communities. In return, the wilderness parks of the reserve offer opportunities for solitude and a natural experience that will be sustainable.

Habitat Restoration

The goal of habitat restoration is to return former agricultural and grazing lands to a landscape of native plant communities. Cattle grazing was historically widespread in Reserve Lands but was phased out in 2002. Natural communities in the Reserve evolved in the absence of domestic grazing animals for 10,000 years. Cattle grazing over the last two centuries has impacted and in some cases substantially altered natural communities, particularly by facilitating invasion of exotic plant species and the disappearance of many native plant species. The cycle of readily ignited non-native plants and frequent fires facilitates continued exotic plant invasion, especially exotic grasses and forbs, more fires, and degraded native habitats. The first phase of recovery is removal of cattle grazing where it has altered habitat quality and distribution. Long-term management should not dismiss the possibility that managed grazing may be a desirable fuel/hazard reduction method on the Reserve.

A restoration plan was developed for NROC (LSA 2003) to guide weed control and restoration activities in the Reserve. Restoration activities include:

- Controlling invasive plant species, such as artichoke thistle, veldt grass, garland chrysanthemum, castor bean, and tree tobacco, to minimize degradation of native habitats in the Reserve;
- Planting cactus and native shrubs and forbs to aid recovery of cactus scrub and coastal sage scrub following disturbances such as grazing and wildfire;
- Conducting restoration experiments to develop the most effective methods for passive and active restoration of lands invaded by exotic plant species;
- Restoring native grasslands invaded by exotic annual grasses and forbs;
- Controlling exotic grasses and forbs to enhance oak woodlands.

Species Recovery Efforts

“Target” or “identified” species receiving regulatory coverage under the NCCP/HCP may be actively managed to enhance their populations in the Reserve. If the monitoring program detects declining populations or threats to species’ persistence, adaptive management techniques may be undertaken for their long-term protection. Management actions may include restricting recreation activities in areas where declining species occur, enhancing habitats through restoration of native habitat and control of invasive plant populations, controlling exotic animal species posing a threat to native species (e.g., brown-headed cowbirds and feral cats), augmenting populations through translocation of individuals, and re-introducing individuals into unoccupied and suitable habitat. Recovery efforts may also include management actions that reduce the risk of predation or disease transmission in declining populations.

Fire Management

Fire management activities in the Reserve are intended to minimize the detrimental effects of fire intervals that are occurring too frequently. Accomplishing this intention provides benefits of minimizing impacts to listed species, their habitats, and natural ecological processes, and improving public safety. The overriding fire policy is to provide flexibility for responding Incident Command teams so they can determine the appropriate form of response based on a wealth of available information. Where possible, the fire policy provides guidance of suppression and control methods that are appropriate for the fire conditions (intensity, severity, weather), cause the least amount of damage to natural resources, and provide firefighting control needed to protect human life and property. The wildland-urban interface (WUI) at the intersect of developed lands and natural lands is an area where there is a need to manage wildland fires so that threats to life and property are reduced while in turn, minimizing human-caused ignitions in these areas. The NCCP was adopted with the following policy: "Fuel modification zones are not a permitted use within the habitat Reserve System, with the exception of limited and identified areas adjacent to already developed areas located in immediate proximity to the reserve boundary (e.g., Emerald Bay and the Top of the World in City of Laguna Beach). In all other cases, fuel modification zones shall be located outside and immediately adjacent to the Reserve System, separating the Reserve system from the nearest urban uses (NCCP/HCP p. II-338). It is the intent of this FMP to identify the specific locations where pre-existing developed areas abut the Reserve boundary witnhout adequate provisions for a fuel modification zone outside of the Reserve, and to recommend strategies for providing appropriate separation and/or protection of wildland and urban land uses in these locations.

1.3 Reserve Landowners

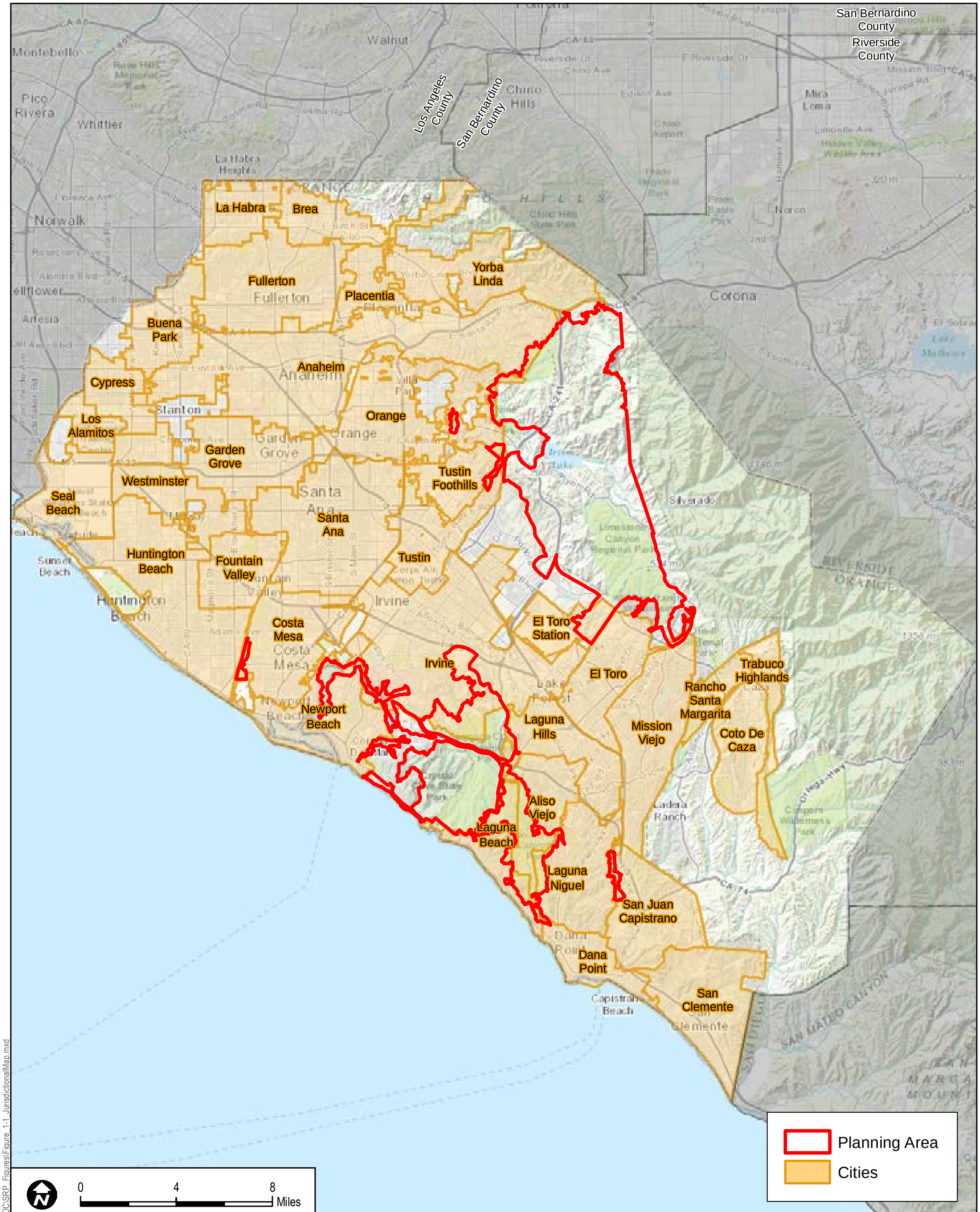
The extensive nature of the Central-Coastal NCCP/HCP required significant involvement of many public agencies and private entities. On July 17, 1996, the participating landowners, utility companies, local, county, state and federal agencies executed the NCCP/HCP Implementation Agreement (IA). NCCP/HCP participants currently include:

- California Department of Fish and Game,
- California Department of Forestry and Fire Protection,
- California Department of Parks and Recreation,
- Headlands Reserve LLC,

- Cities within the County of Orange: Irvine, Orange, Anaheim, Laguna Woods, Lake Forest, Dana Point, Mission Viejo, and Newport Beach.
- County of Orange,
- Transportation Corridor Agencies,
- Irvine Ranch Water District,
- The Irvine Company,
- Metropolitan Water District of Southern California,
- Orange County Fire Authority (although no signature has been provided),
- Orange County Flood Control District,
- Regents of the University of California,
- Santiago County Water District
- Southern California Edison,
- State of California Resources Agency, and
- United States Fish and Wildlife Service.

Each of these stakeholders include a wealth of knowledge, expertise, and experience on a wide variety of topics and related to specific areas of the Reserve that can be applied to management of the Central-Coastal Reserve. Additionally, these stakeholders understand their responsibilities with regard to the conserved resources protected by the Reserve designation. To that end, this WFMP includes extensive stakeholder review, input, coordination and approval.

Among the stakeholders are several fire agencies that would respond to fires within the Reserve, including Laguna Beach Fire Department, which is not from a jurisdiction that is a participant to the NCCP/HCP. Figure 1-1 provides a fire department jurisdictional map for the Reserve area. The primary responsibility for fire response in the Central-Coastal Reserve resides with Orange County Fire Authority (OCFA). OCFA includes significant personnel, apparatus, and expertise to respond to wildfires. Their input and cooperation with the preparation of this WFMP is significant and invaluable. The organization's fire prevention staff clearly understands and appreciates the value of the Reserve as an important natural resource while also realizing the potential of the Reserve to ignite and facilitate the spread of fire over great distances. This WFMP has been prepared with OCFA's mission as a prominent guideline and seeks to aid OCFA and other responding firefighters with their successful response to Reserve wildfires.



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SOURCE: ESRI 2012

FIGURE 1-1

Jurisdictional Map

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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2.0 POLICY ELEMENTS AND PLAN STRUCTURE

2.1 NCCP/HCP Section 5.7: Fire Management Programs and Policies

Section 5.7 of the NCCP/HCP requires that a plan be developed to address short- and long-term fire management issues related to implementing an effective subregional CSS management program. It describes two distinct plans: a short-term plan and a long-term plan. A short-term "Tactical Fire Suppression Plan" was approved by the NROC Board of Directors in 1999. Several iterations of a long-term "Strategic Fire Protection Plan" were developed, and an interim plan was approved by the board in 2003 with the understanding that it would be revised over time. Both tactical and strategic elements are incorporated into this "NCCP/HCP Wildland Fire Management Plan", as appropriate.

2.1.1 Short-Term Tactical Elements

2.1.1.1 Intent

The intent of the tactical component of this WFMP is to establish appropriate standardized fire service response guidelines that, when possible to implement during a wildfire, reduce damage to natural resources while providing flexibility to responding fire agencies so they can effectively provide fire protection and suppression and transition between tactics, as necessary, during a fire event. Standard wildland firefighting considerations, such as resource responses, strategies, and tactics commonly used in Reserve lands, will emphasize measures aimed at minimizing the impacts of fire and firefighting on sensitive wildlife and wildlife habitats. Minimizing resource impact from operations will be balanced with consideration for the potential damage that may be caused by wildfire that is not contained, given an opportunity to do so, and then burns through habitats that are sensitive and at risk from habitat loss or conversion from frequent fire damage. These fire-fighting considerations are expected to be revised, as appropriate and necessary, to address changes to the existing environmental conditions and circumstances over time.

On Reserve lands, when fire incident decision maker(s), including designated Reserve representatives, have determined that human life and property are not threatened, such as when a fire occurs within an area that is readily accessed, under favorable weather and fuels conditions, and enables fast response, a pre-determined protocol will be followed. In these cases, 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. Note that it is expected to be a rare scenario that results in a determination that a fire should be "monitored" only. The combination of too many fires occurring within large portions of the Reserve and the increasing percentage of Reserve adjacency that is urbanized, as well as the non-Reserve open space and recreation areas, require aggressive wildfire suppression in most situations. This approach is consistent with current reserve needs due to frequent fires and degraded habitats in some areas. However, it is possible that an approach that lets some fires burn as a means to reduce fuel loads and rejuvenate habitats that have not burned for extended periods could be important at some future time, especially as public education and fire prevention efforts associated with this plan and the greater efforts of fire agencies culminate and penetrate. If extreme weather conditions are present (high watershed dispatch levels, Red Flag conditions, etc.), or if fuels or topography result in aggressive fire spread, all available firefighting strategies and tactics will be employed, as deemed necessary by the IC, to ensure the highest probability of successful containment and control.

The following elements were included in the preparation of the Short-Term Tactical Fire Suppression Plan, and have been incorporated into this comprehensive plan:

- *Defining fire management "compartments" that encompass major populations of target species and the overall sub-regional reserve system for use during pre-planning and actual fire events to aid IC response plans. Fire compartments, fire management units, or portions of fire management units may become high-priorities for "point protection" where heavy firefighting resource allocation is provided to protect these areas as "refugia" in the event of a large wildfire.*
- *Preparing fire suppression strategy plans for each fire management compartment or unit.*
- *Identifying WUI FMZ criteria which achieve effective defensible space for urban development while minimizing impacts on CSS habitat.*
- *Defining natural resources management units (Volume III of this WFMP) that encompass major populations of target species, cultural resources, and other assets that require pre-suppression planning*. Natural resources management units utilize the same delineated areas as the FMU's to assist NROC's statkeholders and resource managers with resource management related to fire. These compartments are useful pre-suppression and post-suppression planning and prioritizing tools.

The entire Reserve is, by definition, a refugium for plant and animal species. Protection of the various habitats and species requires maintenance of large acreages in undisturbed conditions for decades at a time. That is the ultimate goal of this plan. Toward that goal, fourteen (14) Fire Compartments were established based upon high fire frequency and known natural resources occurrences and locations The Fire Compartments were further divided into Fire Management

Units (FMUs) based on land features and existing fire roads. Fire suppression operational modes have been established for each FMU within Volume II of this WFMP. Reserve land boundaries were established outside of all existing and future fuel management zones (FMZs), except for FMZs in the vicinity of Emerald Canyon and Top of the World in Laguna Beach. A plant palette was developed for the FMZ area that emphasizes the use of native plant species that enhance the biological integrity of the Reserve, where possible, establish an appropriate transition at the WUI, and do not represent an unacceptable fire hazard adjacent to private assets.

2.2 Short-Term Tactical Elements

2.2.1 Delineation of Compartments and Management Units (FMUs)

The original Tactical Fire Suppression Plan established the following fourteen (14) Fire Compartments, now incorporated into this plan:

1. Aliso-Wood Canyon Wilderness Park
2. Coastal San Joaquin Hills/Newport Coast
3. West San Joaquin Hills (Upper Newport Bay/UCI)
4. Inland San Joaquin Hills (City of Irvine Open Space)
5. El Toro MCAS Conservation Area
6. Limestone Canyon Wilderness Area/Whiting Ranch Wilderness Park
7. Lomas Ridge
8. Peters Canyon Regional Park
9. Shirley Grindle Open Space/Santiago Oaks Regional Park
10. Irvine Lake/Santiago Canyon
11. Weir Canyon Wilderness Park
12. Gypsum Canyon/Coal Canyon Ecological Reserve
13. Talbert Nature Reserve
14. Salt Creek Corridor

The Fire Compartments were further subdivided into smaller units called Fire Management Units (FMUs) identified with numbers 01, 02, 03, 04, etc., for each Compartmen (e.g., 5.01 indicates compartment 5, fire management unit 1).

The Fire Compartments and FMU's were established in the field by OCFA, The Nature Conservancy, a fire consulting firm, and County of Orange Resources Planning staff. Factors considered in the delineation of these planning units included topography such as ridgelines, vegetation types, including riparian areas, land cover such as lakes and streams, roads, trails and development edges. It should be noted that in some instances, the Fire Compartments and FMU's extend beyond the boundaries of the Nature Reserve to provide more logical geographic boundaries for guiding tactical response and suppression planning. The Fire Compartment and FMU boundaries were reviewed by Dudek in 2012 based on site-wide fire behavior modeling results, Fire Authority input and analysis of the site's topographical, natural resources, access, adjacent assets, and overall fire risk. There are no changes to the previously completed delineations. However, there are numerous opportunities to refine the FMU edges where development has occurred or where boundaries are not representative of open space. These same 14 compartments and multiple FMUs are also called out as Natural Resources Management Compartments and Management Units for purposes of separating resource based pre- during, and post-fire activities. Separating these activities enables clearer, cleaner, more user-friendly tactical maps and data forms. This effort was completed in acknowledgement of various constraints that may result in confusion during a wildfire in the Reserve, unfamiliar firefighters responding within the Reserve, or other issues that could lead to avoidable ecological impacts from firefighting activities. Pre-suppression and post-suppression activities are more detailed and are not typically reviewed during chaotic and potentially dangerous wildfire conditions.

2.2.2 NCCP/HCP Fire Suppression Policies

Section 5.7 of the NCCP/HCP identifies the following eight (8) fire suppression policies to be considered in the preparation of the plan. These policies are considered in this plan, but in many cases, they are listed as guidelines, enabling more flexibility for firefighting response than if they were considered policy.

Policy 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 plan, 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 target species. Further, previously used dozer lines have been mapped and are included*

within the Volume II – Tactical Response Plan as the first priority for placement of dozer lines during a wildfire fight.

Policy 2: New Fire Roads Policy

To the extent practicable, new fire roads or firebreaks will not be created by mechanical methods. Hand crews will be used to create any necessary new firebreaks wherever practicable or feasible.

Application of Policy: *TNC re-evaluated this policy and determined that although the limitation of new roads and trails is a very important issue for reserve lands management, this fire policy should be expanded to include the potential for mechanically created firebreaks. In situations where fire threatens type conversion and habitat loss, the spatial limited impacts of a bulldozer may be the preferred biological alternative to the consumption of additional Reserve lands. It should also be noted, with the exception of size, there is no clear difference in impacts between fire lines created mechanically or by hand. There will be no fire roads or firebreaks created for planning purposes as the use of firebreaks has been determined to include higher ecological costs than firefighting benefits.*

Policy 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: *TNC re-evaluated this policy and determined that the use of backfiring should be weighed against short and potential long-term loss of habitat. Backfiring should remain a possible fire management tool but should not be mandated by the plan.*

Policy 4: Ground Tactical Units Policy

To the extent practicable, ground tactical operations will use natural features such as ridgelines, as well as roads and firebreaks for containment lines.

Application of Policy: *TNC re-evaluated this policy and determined that the use of natural firebreaks should be encouraged only when the consumption of additional acres is considered to have ecological benefits or presents less of an impact than the construction of new control features.*

Policy 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.

> Application of Policy: *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 are discouraged from leaving established roads/trails to conduct fire suppression operations.*

Policy 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.

> Application of Policy: *The Tactical Fire Suppression Plan (Short-Term Fire Management Plan) establishes appropriate guidelines for pre and post-fire suppression that will identify remediation of grading and disturbed areas and implementation of erosion control measures as part of the fire agency responsibilities in consultation with the Resource Advisor(s) Fire Team (RAFT).*

Policy 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 and/or in areas potentially subject to post-fire erosion.

> Application of Policy: *TNC re-evaluated this policy and determined that the use of water saturation can result in extensive streaming damage to feeder roots 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.*

Policy 8: Fire Prevention Techniques Policy

Until such time as a specific set of fire-related is prepared by the Orange County Fire Authority/Department of Harbors, Beaches and Parks, the interim Chino Hills State Park policies (at pp. 6-9, 2-set forth in Appendix 10) 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.*

2.3 Strategic Elements

Section 5.7 of the NCCP/HCP describes management actions for the long-term strategic plan to to focus on prescribed burning to reduce fuel loads and ensure a mosaic of vegetation communities. However, conditions have changed since the mid-1990s when the NCCP/HCP was developed. Wildfire has burned much of the Reserve habitat in the past twenty years and increasing ignition sources and ignitable non-native fuels have become established in large portions of the Reserve, making too-frequent fire the most significant issue. Other fuel load reduction and management methods such as establishing strategic fuel breaks within the Reserve may play a role in overall fire management, but have considerable potential for negative ecological effects, such as promotion of exotic plant species establishment or spread, to the detriment of native habitat (Syphard et.al. 2011). In addition, the close proximity of residential communities along Reserve boundaries at the WUI make planned fire (prescribed burns) complex and socially difficult to implement.

2.4 Structure of the NCCP/HCP Wildland Fire Management Plan

The plan has been written in three sections:

- Volume I: The Planning Context is a reference manual containing the foundation for developing tactical and strategic planning measures that will implement the WFMP. It includes background information about the NCCP/HCP, NROC, the Reserve System, and various pertinent aspects of fire ecology, fire risk, natural resources, and tactical fire suppression.
- The Volume I, Appendices A-1 through A-3: Hazard Analysis can be treated as a stand-alone document that details important fire hazard reduction recommendations for each FMU based on site fire risk assessment. It includes descriptions of standard fire hazard reduction measures based on unique FMU characteristics and potential threats as well as potential fire hazard reduction measures that may be beneficial, but for which funding would need to be secured. The recommended treatments for each FMU were developed and vetted by NROC stakeholders and included an extensive cost-benefit analysis.
- Volume II: A Tactical and Strategic Fire Response Plan is designed to be useful primarily for firefighters and secondarily for resource managers/advisors. It contains both tactical and strategic maps and tables for each of the 54 Fire Management Units (FMUs). The tactical maps include necessary access and safety information including fire behavior predictions, topography, and locations of truck trails, gates, and power lines, amongst others. The tactical tables focus on, suppression related information and preferred

activities for each FMU. The strategic maps illustrate FMU classification via a color-coding and provide details pertaining to topography, vegetation type and sensitive resources for each FMU. The strategic tables include a description of the FMU, sensitive species, and management issues. Large tactical and strategic maps for each of the fourteen Fire Compartments are also available.

- Volume III: Tactical and Strategic Resource Response Plan is designed to be useful primarily by RAFT members and land owners. It contains resource maps and tables for each FMU that provide a quick reference for what resources occur within the FMUs, what pre-fire planning and projects have occurred and what post-fire actions should be considered by the RAFT in response to loss of vegetation cover, potential soil disturbance and other fire effects.

2.5 Fire Management Plan MOU

Section 5.7 of the NCCP/HCP requires the implementation of an MOU "involving the Orange County Fire Authority, CDF (CAL FIRE), USFWS, CDFG and the South Coast Air Quality Management District…" However, this requirement appears to refer to the development of an agreement for the process of controlled, prescribed fire and may not be relevant under current conditions. Should prescribed fire become an important management tool in the future, such as if global or local climate change results in conditions that negatively alter vegetation communities and limit or alter fire occurrences or severity, then this MOU will be collaboratively drafted and signed by the necessary agencies so that prescribed fire is a useable alternative.

3.0 GEOGRAPHIC AREA, ENVIRONMENTAL SETTING AND RESERVE RESOURCE BASE

3.1 Description of Reserve Areas

3.1.1 Location and Land Ownership

The Nature Reserve of Orange County's Central/Coastal Reserve System is a part of the South Coast Ecoregion of Southern California. All 37,378 acres of the Reserve are located within the boundaries of Orange County, California (Figure 3-1). Reserve lands are configured into two distinct parcels: Coastal Subregion and Central Subregion Reserves.

3.1.1.1 Central Reserve

The Central Subregion Reserve (Central Reserve) is 20,177 acres in size and extends from Interstate 5 east into the Santa Ana Mountains. It is bordered by the City of Irvine to the west, City of Mission Viejo to the south, the City of Orange and the City of Anaheim to the north, and the Cleveland National Forest to the east (Figure 3-2A). Figure 3-2B describes Reserve ownership for the Central Reserve which remains largely within private holdings. Orange County Parks within the Central Reserve include Peter's Canyon Regional Park, Irvine Regional Park, Santiago Oaks Regional Park, and Whiting Ranch Wilderness Park. Other lands within the Central Reserve include Southern California Edison Viejo Conservation Bank, California Department of Fish and Game's Coal Canyon Reserve, City of Irvine Open Space North Preserve and a small portion of Chino Hills State Park. The Irvine Company owns approximately 9,000 acres of land in the Central Reserve that will be transferred to public ownership in the future. An approximately 900-acre area of natural lands from within the former El Toro Marine Corps Air Station is targeted for conservation within the Central Subregion Reserve. This land is currently owned and managed by the Federal Bureau of Investigation (FBI). The FBI is not a participant to the NCCP/HCP so the permanent conservation status of this land remains uncertain. The FBI has indicated a willingness to cooperate with NROC regarding implementation of the adaptive management program.

3.1.1.2 Coastal Reserve

The Coastal Subregion Reserve (Coastal Reserve) is comprised of 17,200 acres encompassing natural lands from the coast inland to Interstates 405 and 5. It is bordered by the City of the Laguna Beach to the south and west, City of Laguna Niguel to the east, and the City of Irvine to the north. The San Joaquin Hills Transportation Corridor bisects the Coastal Reserve as depicted in the center of Figure 3-3A. Land ownership within the Coastal Reserve is described in Figure

3-3B. The Coastal Reserve includes Orange County Parks such as Laguna Coast Wilderness Park, Aliso and Wood Canyons Wilderness Park, Upper Newport Bay Park, and Talbert Nature Preserve. The Coastal Reserve also includes the City of Irvine Open Space South, City of Newport Beach's Buck Gully Reserve, California State Park's Crystal Cove State Park, the University of California Irvine Ecological Reserve, and California Department of Fish and Game's Upper Newport Bay and Laguna Laurel Reserves.

3.2 Climate and Weather

The Central and Coastal Subregions exhibit a Mediterranean climate with hot, dry summers and cool, wet winters (Keeley and Fotheringham 2003). A strong marine air influence is evident throughout the year and helps to lower local temperatures. The Reserve'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. A marine layer of fog is most prevalent during the summer along the coast and extending inland into the foothills.

Local Foehn winds known as "Santa Anas" develop in southern California as a result of a trough of low pressure along the Pacific Coast and a high-pressure system in the Great Basin (Keeley and Fotheringham 2003). This produces a strong pressure gradient across southern California Mountains, producing strong winds and conditions of low humidity. Santa Ana winds often have speeds greater than 60 mi/h (100 km/h) for sustained periods and usually blow from the northeast and east (Keeley and Zedler 2009). High winds and low humidity have a large impact on the potential for fire ignitions, fire spread and behavior, and fire suppression. These concepts are discussed in detail in Section 5.5.

On the coastal side of mountains, differences in the heating and cooling of valleys and slopes in relation to the land and ocean adds complexity to wind patterns. During the day, onshore flows from the ocean can blow counter to the Santa Ana winds and during the night, Santa Ana winds often regain their strength with greatest speeds around day break until about noon. Santa Ana winds tend to blow from August through April with peaks in the fall and early winter (Keeley and Fotheringham 2003, Moritz et al. 2004). Figure 3-4 A provides a depiction of extreme weather wind patterns across the Central Reserve, while Figure 3-4B provides a depiction of extreme weather wind patterns across the Coastal Reserve.

Figure 3-1 Orange County's Central and Coastal Natural Community Conservation Plan/Habitat Conservation Plan boundaries.

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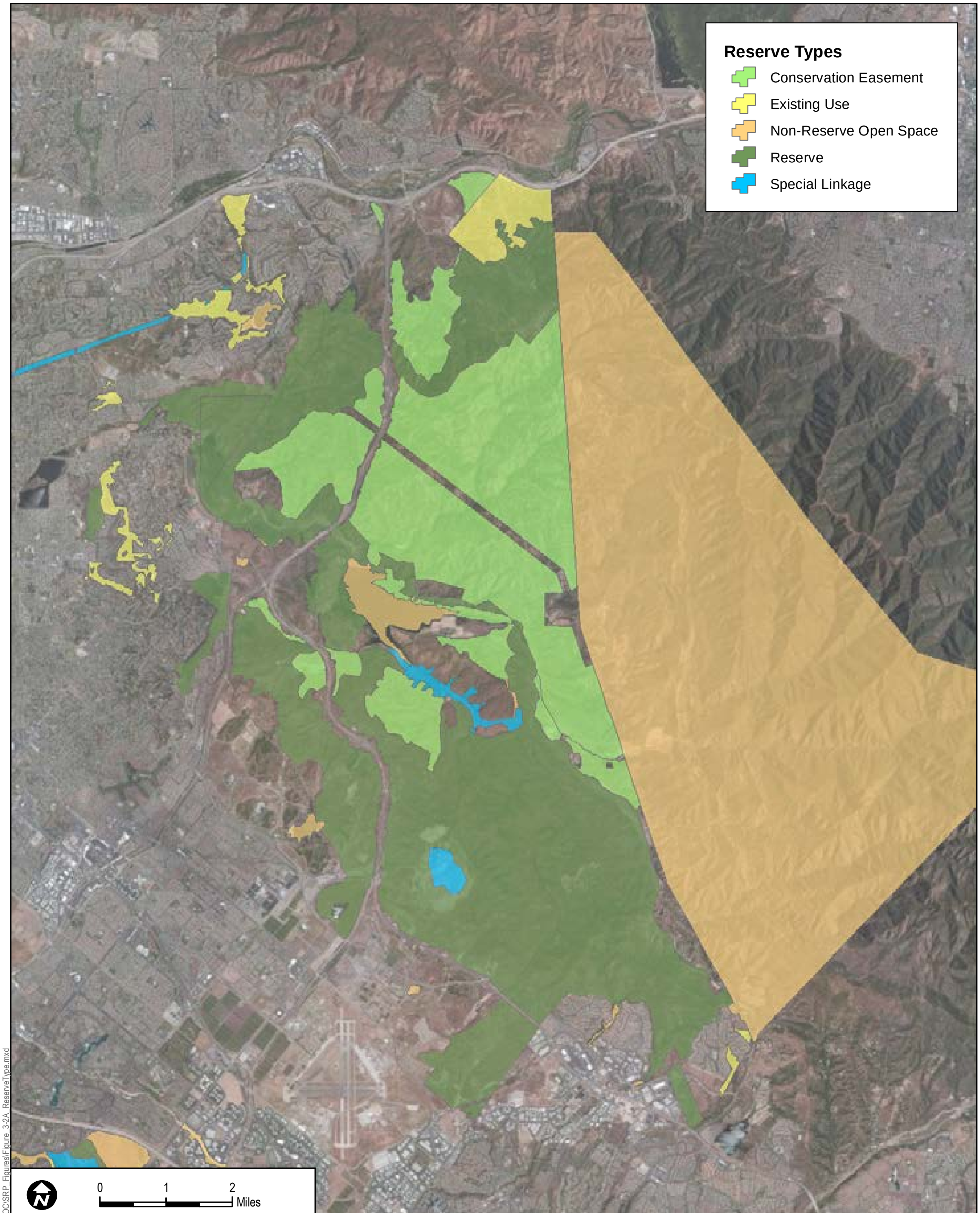

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SOURCE: Bing 2012, Orange County 2010

FIGURE 3-2A

Reserve Type - Central Subregion NCCP

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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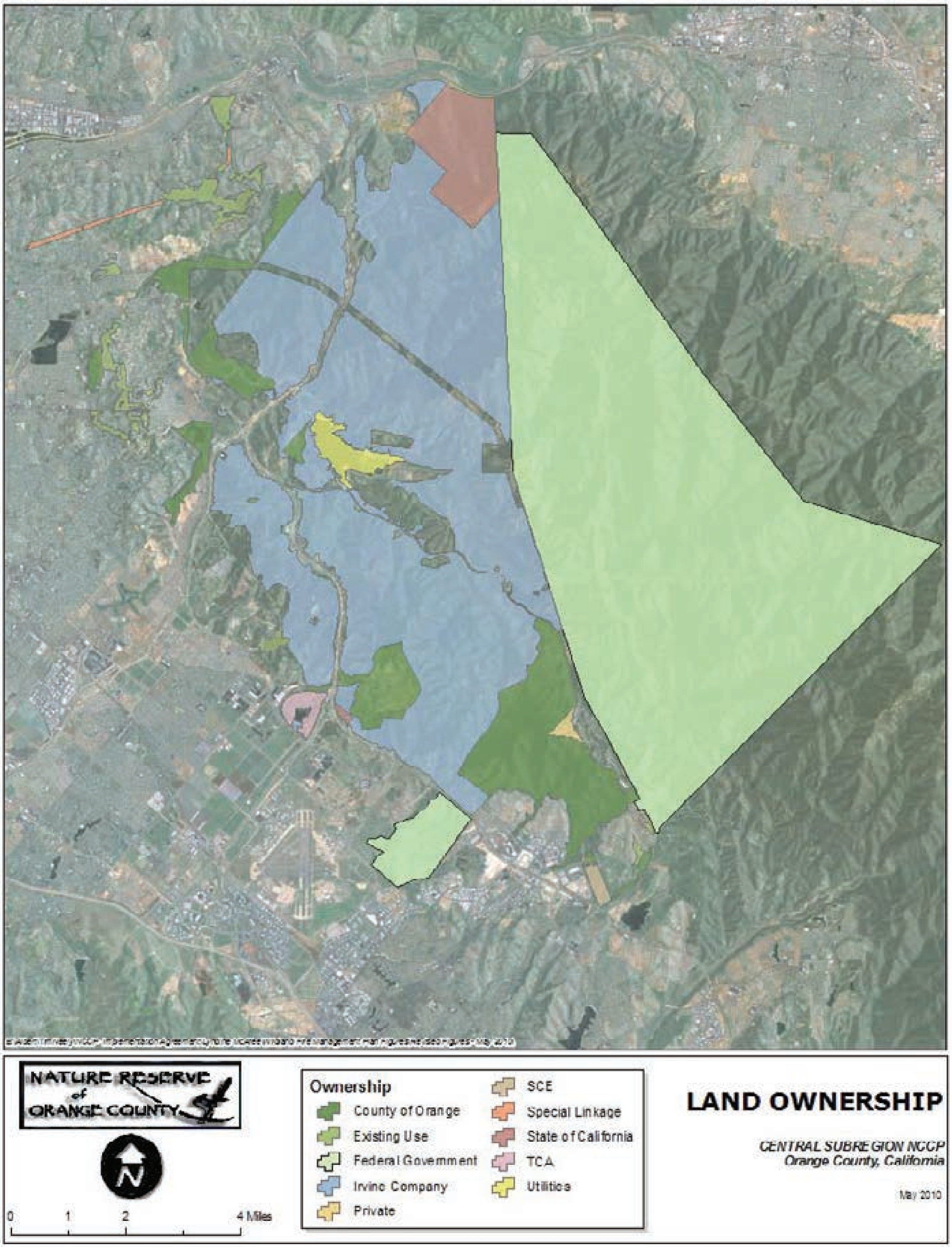

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FIGURE 3-2B
Central Reserve Land Ownership

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SOURCE: Bing 2012, Orange County 2010

FIGURE 3-3A

Reserve Type - Coastal Subregion NCCP

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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FIGURE 3-3B

Coastal Reserve Land Ownership

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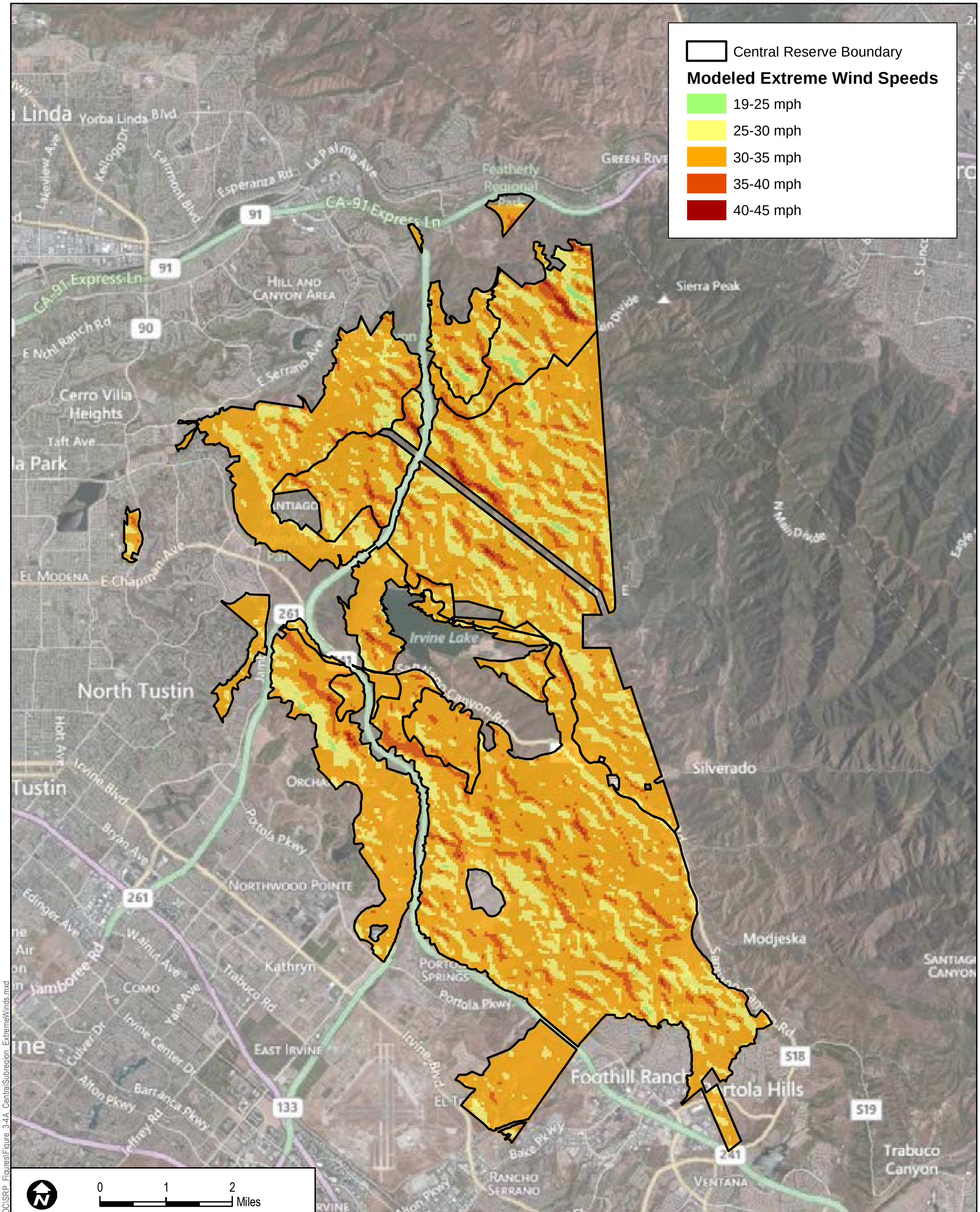

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SOURCE: USGS Topo, Orange County 2010

FIGURE 3-4A

Central Subregion Extreme Wind Patterns

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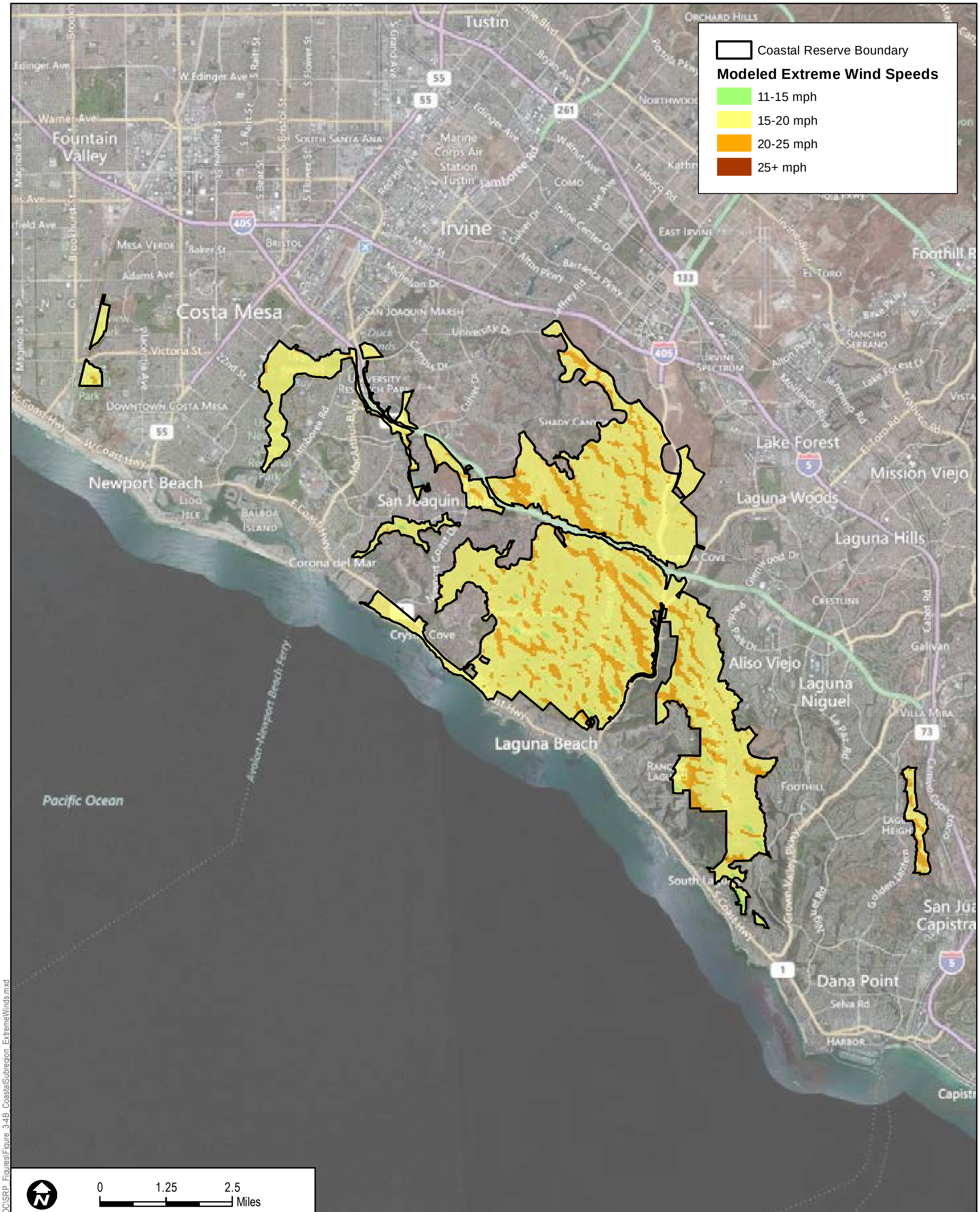

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SOURCE: USGS Topo, Orange County 2010

FIGURE 3-4B

Coastal Subregion Extreme Wind Patterns

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3.2.1 Climate in the Central and Coastal Subregions

Between 1902 and 2003 in Tustin in the Central Subregion, average annual rainfall was 12.9 inches (32.8 cm) and from 1928 to 2008 it was 12.6 inches (32.0 cm) at Laguna Beach in the Coastal Subregion (Western Regional Climate Center 2009). Approximately 90% of annual precipitation occurs from November through April (Figures 3-5A and 3-5B). There is substantial annual variation in rainfall in both the Coastal and Central Subregions (Figure 3-6). During the 81 year period of weather monitoring in the Coastal Subregion, annual rainfall varied from 3.45 inches (8.8 cm) in 1941 to 28.2 inches (71.6 cm) in 1953. For the Central Subregion during the 102 year monitoring period, minimum rainfall was 4.2 inches (10.7 cm) in 1941 and maximum rainfall was 28.6 inches (72.6 cm) in 1989. The majority of rainfall is 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. Although not typical in the Reserve area, a non-typical thunderstorm event in late August 1998 resulted in multiple fire ignitions throughout southern California.

Temperatures in both the Coastal and Central Subregions exhibit similar monthly patterns, with lowest temperatures from December through March and warmest temperatures from July through September (Figure 3-7). Compared to precipitation, average monthly temperatures range somewhat more widely in the Central Subregion than in the Coastal. Average monthly temperatures from 1928 to 2008 at Laguna Beach in the Coastal Subregion varied from 54.2 °F (12.3°C) in January to 68.9°F (20.5°C) in August. In contrast, average monthly temperatures from 1915 to 2003 in the Central Subregion ranged from 53.5°F (11.9°C) in January to 72.1°F (22.3°C) in August. There is also a greater range in average minimum and average maximum monthly temperatures in the Central Subregion.

3.2.2 Changing Climate Conditions

There is scientific research supporting climate change. Changes in the Earth’s climate, resulting in changing temperatures and precipitation patterns (IDAG 2005; IPCC 2007) will likely affect wildfire patterns globally and locally. Climate change is expected to result in vegetation distribution changes and subsequent wildfire occurrence and behavior changes. For example, some research suggests that by the end of this century, average temperature in California is expected to increase by 2.7 to 8.1°F (1.5 to 4.5°C), depending on levels of future carbon emissions (Cayan et al. 2008). Summer temperatures are predicted to increase more than during the winter, with average summer temperatures higher by 2.9 to 11.5°F (1.6 to 6.4°C) and winter temperatures increasing by 1.8 to 6.1°F (1.7 to 3.4°C). Inland regions are predicted to experience a substantially larger increase in summer temperatures than coastal regions. Warming temperatures will result in a large increase in extreme heat days (and possibly an increase in Red Flag Warning days) and a 30-80% reduction in Sierra snow packs (Hayhoe et al. 2004, Cayan et al. 2008).

There is less certainty about how California precipitation patterns might change in the future. Most projections for semi-arid southern California predict that precipitation will decrease, with more frequent and prolonged drought periods (Seager et al. 2007, Burke and Brown 2008). According to the USDA "Climate change would affect the annual area burned and the frequency and intensity of fires, with most of the scenarios resulting in increased fire, particularly in higher elevation conifer forests. However, change in fires is not expected to be significant until the latter part of the century and are not likely to be noticeable on the Central/Coastal Reserves. The drier scenarios result in more frequent fires and more area consumed by fire annually. The wetter scenarios result in larger and more intense fire than those that have occurred in the simulated historical record because under the wetter scenarios more fuel accumulates and then burns during the occasional dry year."(Lenihan et al. 2005).

Southern California has been identified as a climate change hotspot within the United States, indicating it may face great change in physical climate within the coming decades and may be vulnerable to climate change impacts (Diffenbaugh et al. 2008). Impacts resulting from climate changes such as increased or decreased precipitation and/or variations with the temperature gradient could include both vegetation and disturbance based changes. Vegetation changes could include phenological shifts, altered productivity, shifts in species distributions and composition, stress induced mortality, extirpations and extinctions, and increased plant susceptibility to pests and pathogens consistent with the large scale bark beetle outbreaks in the southern California forests. Disturbance based impacts may include longer fire seasons, changes in wildfire intensity and severity, potential increases in fire frequency and extent, and weather extremes (Loehmen 2011). The resulting potential impacts from climate change could change the way fires will impact Southern California at some point in the future, but is not anticipated to have a significant affect on the Central/Coastal Reserves and will not be a focus for fire management planning over the next 50 years.

Figure 3-5A Average, minimum and maximum monthly precipitation in the Central Subregion

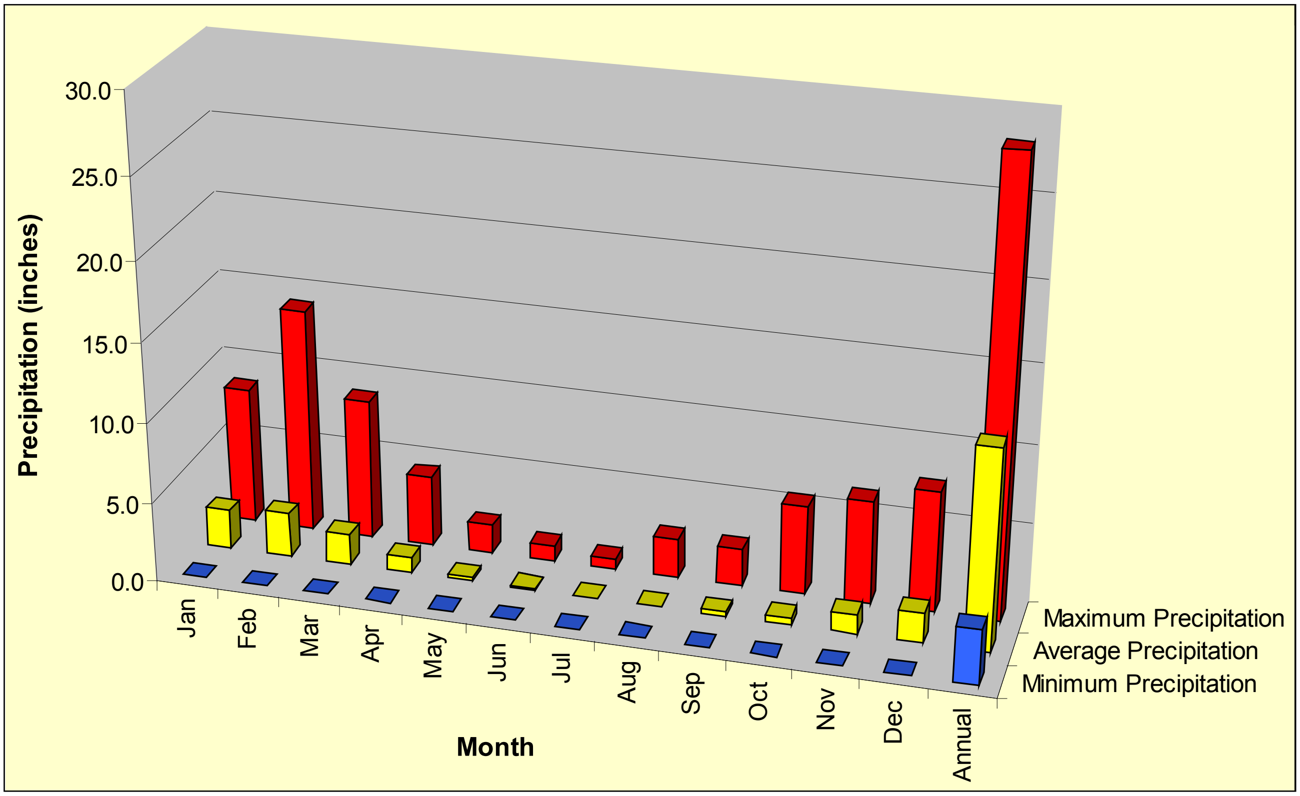


Figure 3-5B Average, minimum and maximum monthly precipitation in the Coastal Subregion

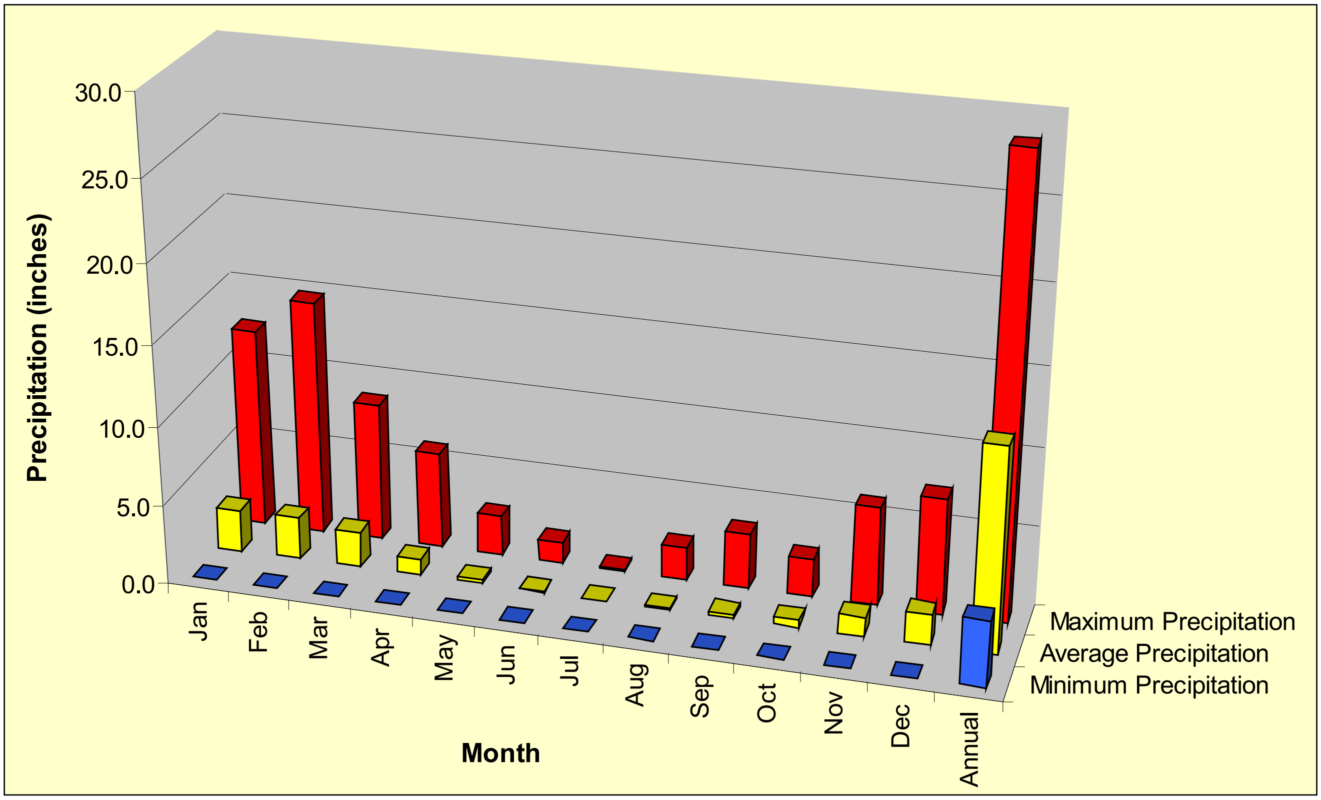


Figure 3-6 Annual precipitation in the Central and Coastal Subregions from 1929 to 2007

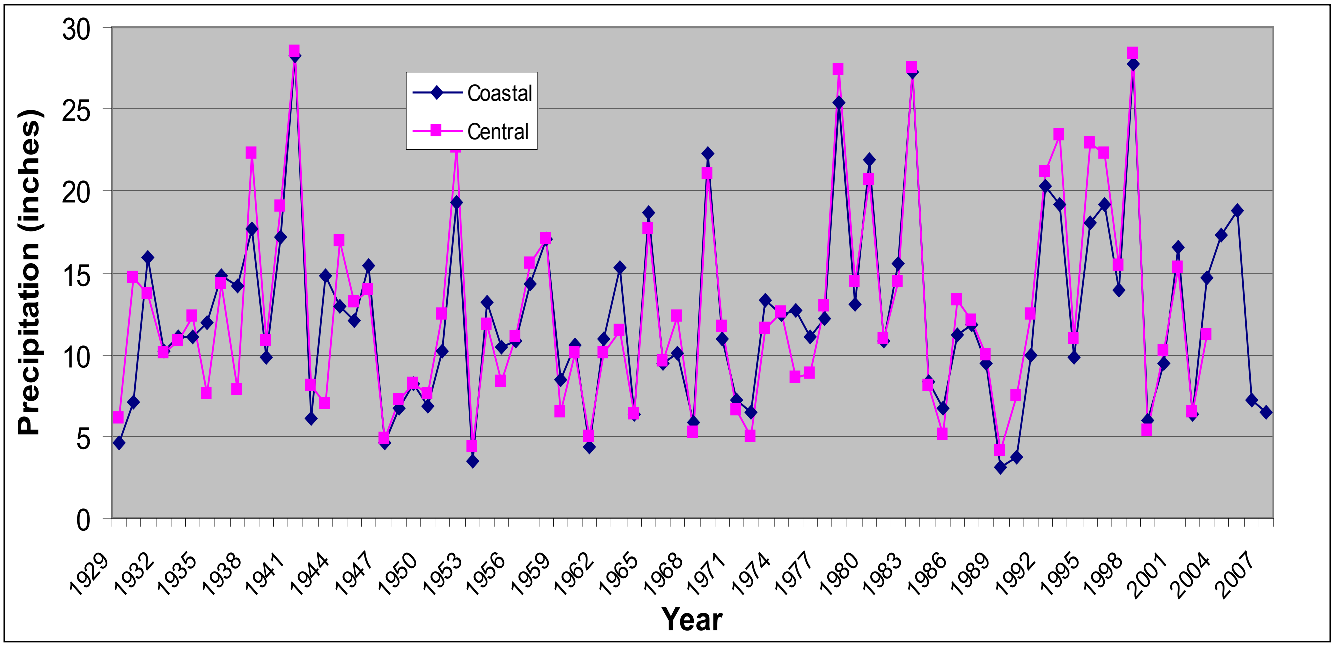
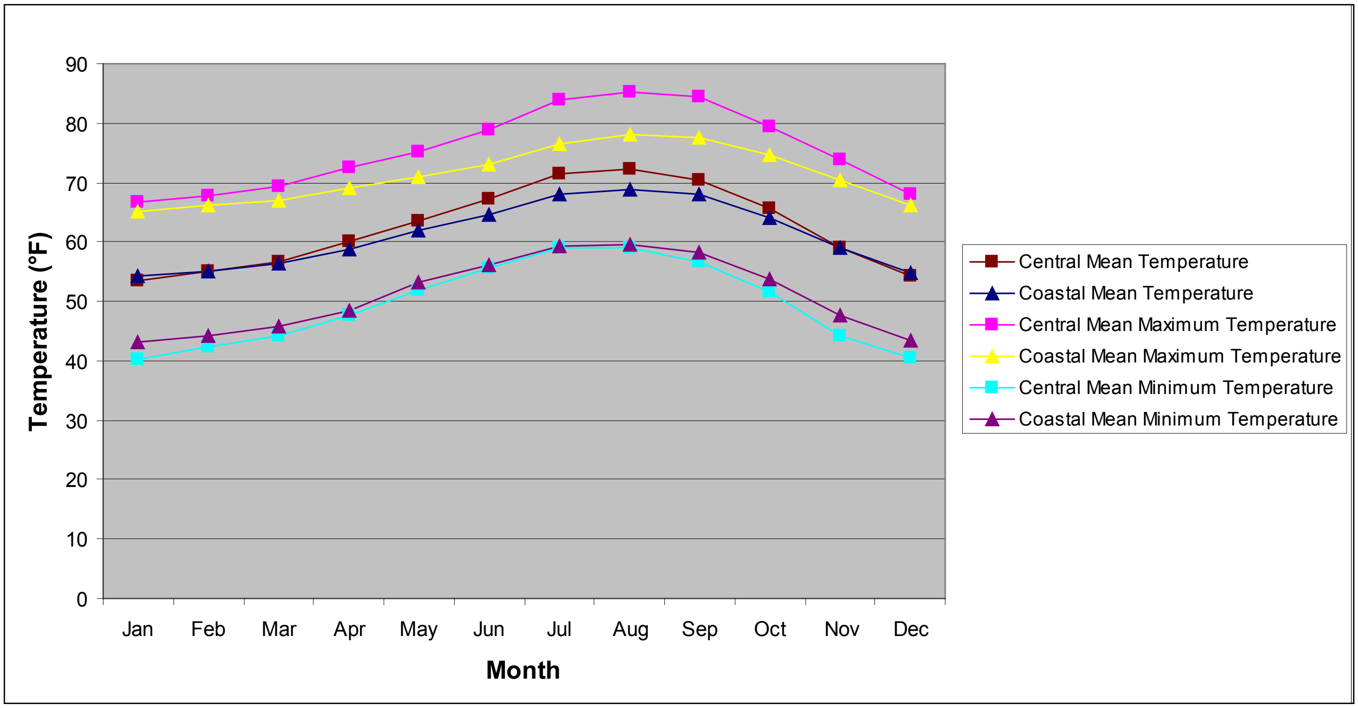


Figure 3-7 Average, minimum and maximum monthly temperatures in the Central and Coastal Subregions from 1929 to 2007



3.3 Topography and Soils

Central Reserve

Topography for the Central Reserve is varied, reflecting the wide range of elevations typical of canyon and ridge landforms (Figure 3-8A). A prominent landform feature within the Central Reserve is Limestone Canyon and its adjoining area. This portion of the Reserve is characterized by gently sloping creek beds and washes to steep hillsides along interior ridge systems. Elevations vary from 750 to 1,780 feet above sea level.

Significant features within this portion of the Reserve include:

- Santiago Canyon
- Limestone Canyon
- Elephant Peak
- The Sinks and Agua Chinon Wash
- Dripping Springs Canyon
- Borrego Wash

An additional landform within the Central Reserve is Gypsum Canyon. This large feature drains from south to north, emptying eventually into the Santa Ana River. With the exception of the canyon bottom, slopes are considered steep, often exceeding 30%. A large elevation gradient exists within this landform, with a 1,650 foot spread between the lowest canyon bottom at 400 ft above mean sea level (amsl) and 2,050 feet amsl measured at the top of Windy Ridge.

Coastal Reserve

Topography for the Coastal Reserve is characterized by a tall ridgeline running west from prominent Laguna Canyon (Figure 3-8B). Deep south- and west- facing canyons dissect the landscape with steep slopes and a representation of all aspects. An elevation gradient from 1,100 feet amsl to sea level occurs in this portion of the Reserve.

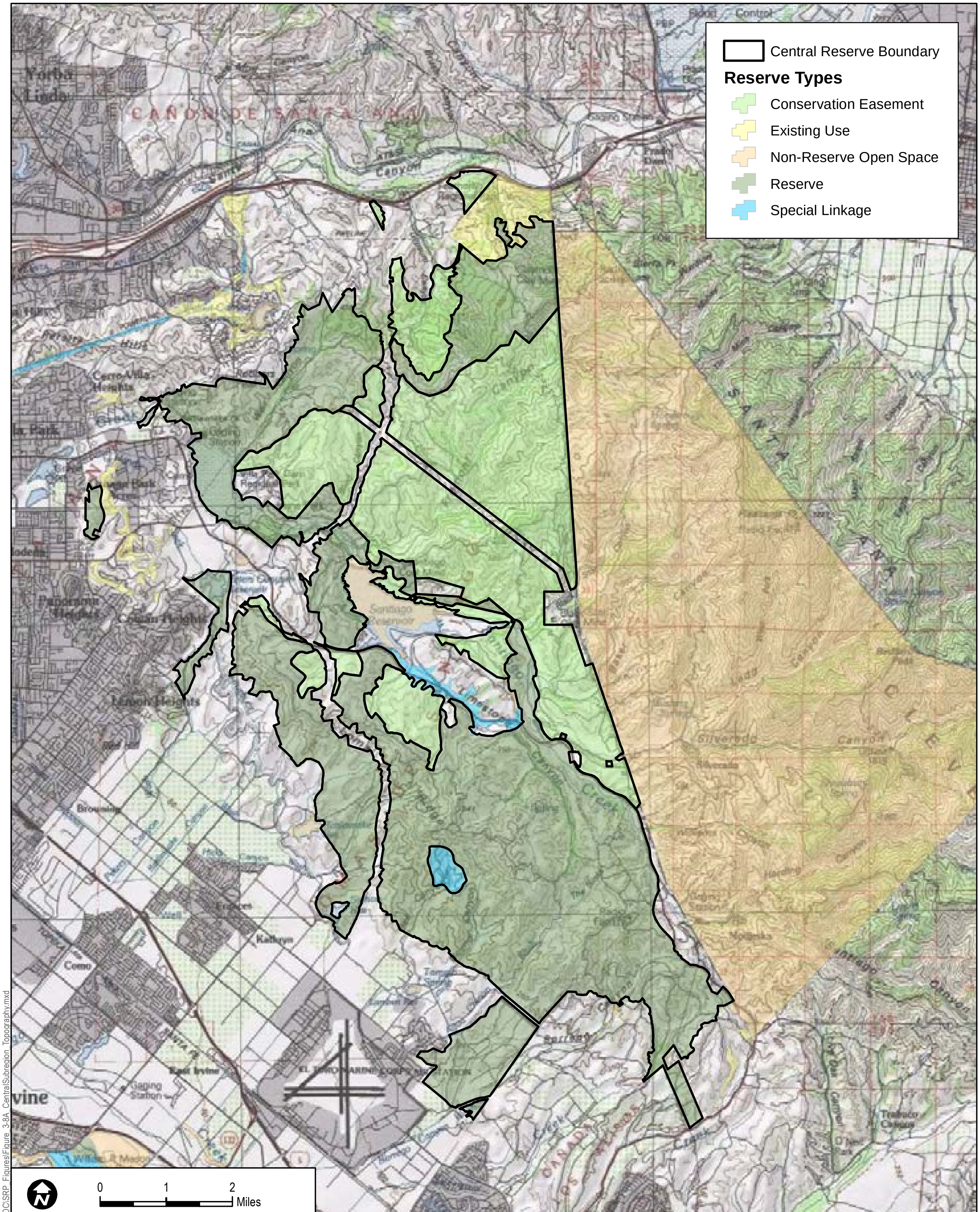
A rich mosaic of soil types exists within the Reserve System (Figures 3-9A and 3-9B). The Gabino gravelly clay loam, Soper loam, and Calleguas clay loam are found exclusively in the Central Reserve. Myford sandy loam, Capistrano sandy loam, Cieneba sandy loam, Als Clay and Anaheim clay loam occur in both portions of the Reserve. These soil types relate directly to the dominant vegetation communities and resulting fire patterns throughout the Reserve.

Additionally, these soil types indicate which areas may be more susceptible to erosion or other earth movement following wildfire.

3.3.1 Soil Erosion and Slope Instability

Large amounts of erosion and sedimentation are common in semi-arid regions with complex topography, sedimentary soils, and tectonic activity, as is characteristic of southern California. Erosion processes cause sediment from hillslopes to move into stream channels and to eventually reach the ocean. This movement occurs through several processes including soil slips and landslides, dry flows (dry ravel), hillside debris flows, and sheet and rill erosion (NPS 2004). High rainfall periods can lead to slope instability and landslides. A number of factors can affect the rate of soil movement, including the amount of precipitation, topography, soil type and vegetation.

Land use and management practices, either intentional or incidental, can contribute to problems with soil erosion and slope instability. Conversion of native shrublands to non-native annual grassland in order to increase forage for livestock or to reduce fire hazards can increase the incidence of soil slippage and shallow landslides (Terwilliger and Waldron 1991, Gabet and Dunne 2002). Deep rooted shrubs increase soil stability compared with shallow rooted exotic grasses. Non-native grasslands are documented to alter water balance by drying soils, increasing runoff and reducing infiltration (D'Antonio and Vitousek 1992, Di Tomaso et al. 2006, Jigour 2009). This can lead to severe soil erosion and flooding, and reduce recharge of aquifers. In contrast to non-native grasses, deep rooted native shrubs and perennial grasses can enhance infiltration and percolation during a rainfall event, leading to reduced runoff and sediment transport, and greater subsurface retention of water (Jigour 2009). These findings support the need for reducing the occurrence of wildfire on some portions of the Reserve to minimize the conversion of erosion preventing shrublands to erosion producing nonnative grasslands.



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SOURCE: USGS Topo, Orange County 2011

FIGURE 3-8A

Central Subregion Topography

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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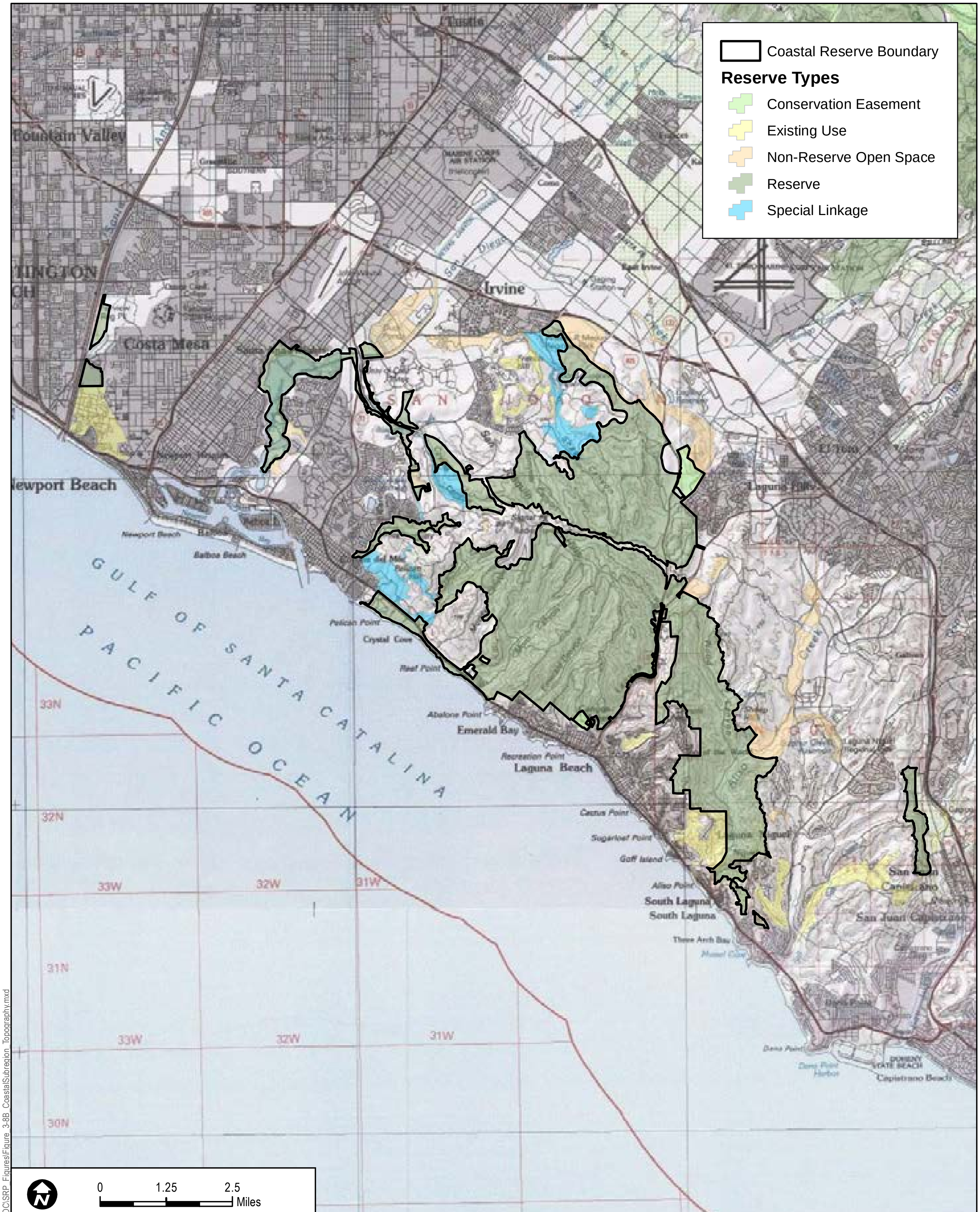

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FIGURE 3-8B

Coastal Subregion Topography

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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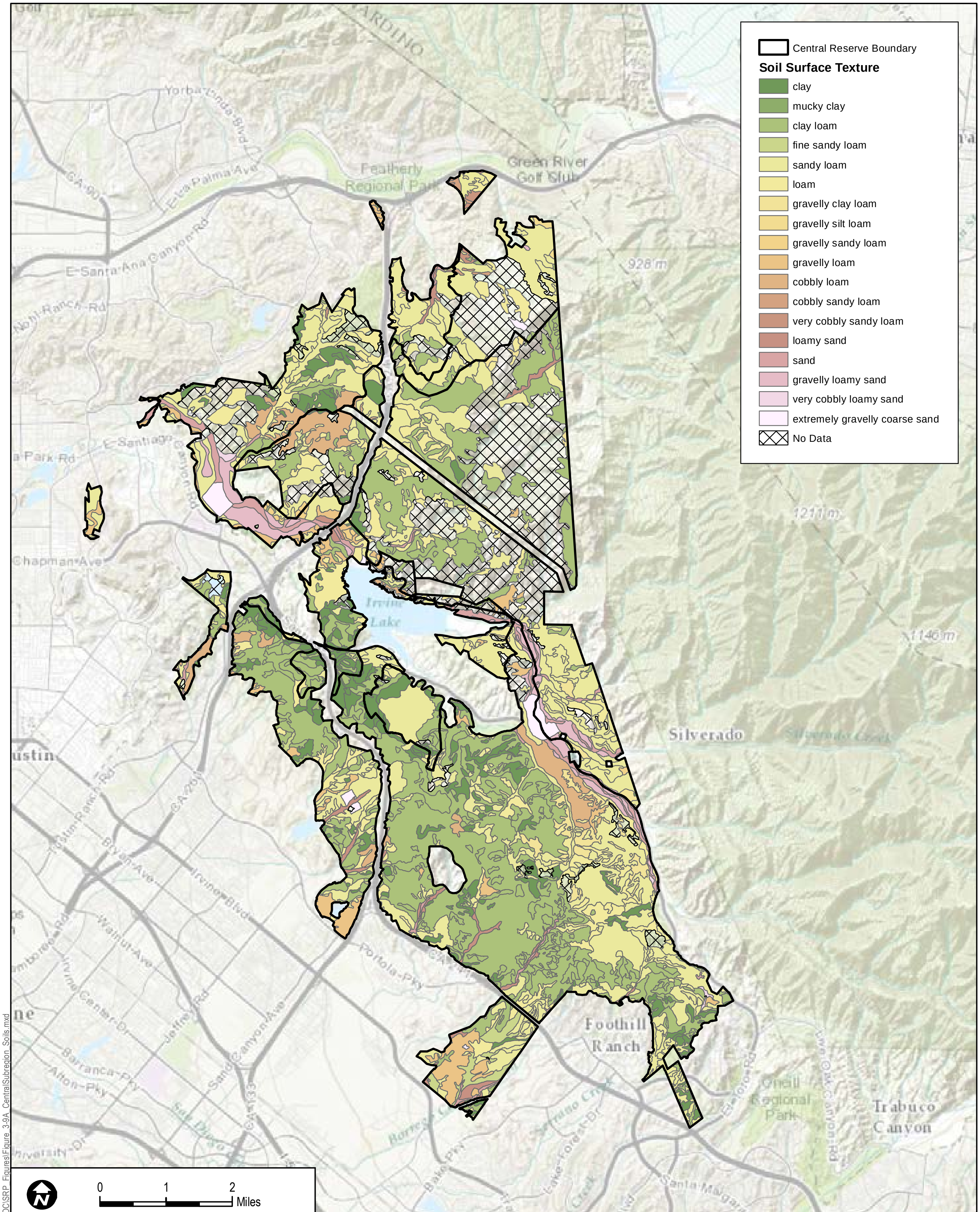

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SOURCE: USGS Topo, Orange County 2010, USDA Soils 2011

FIGURE 3-9A

Central Subregion Soils

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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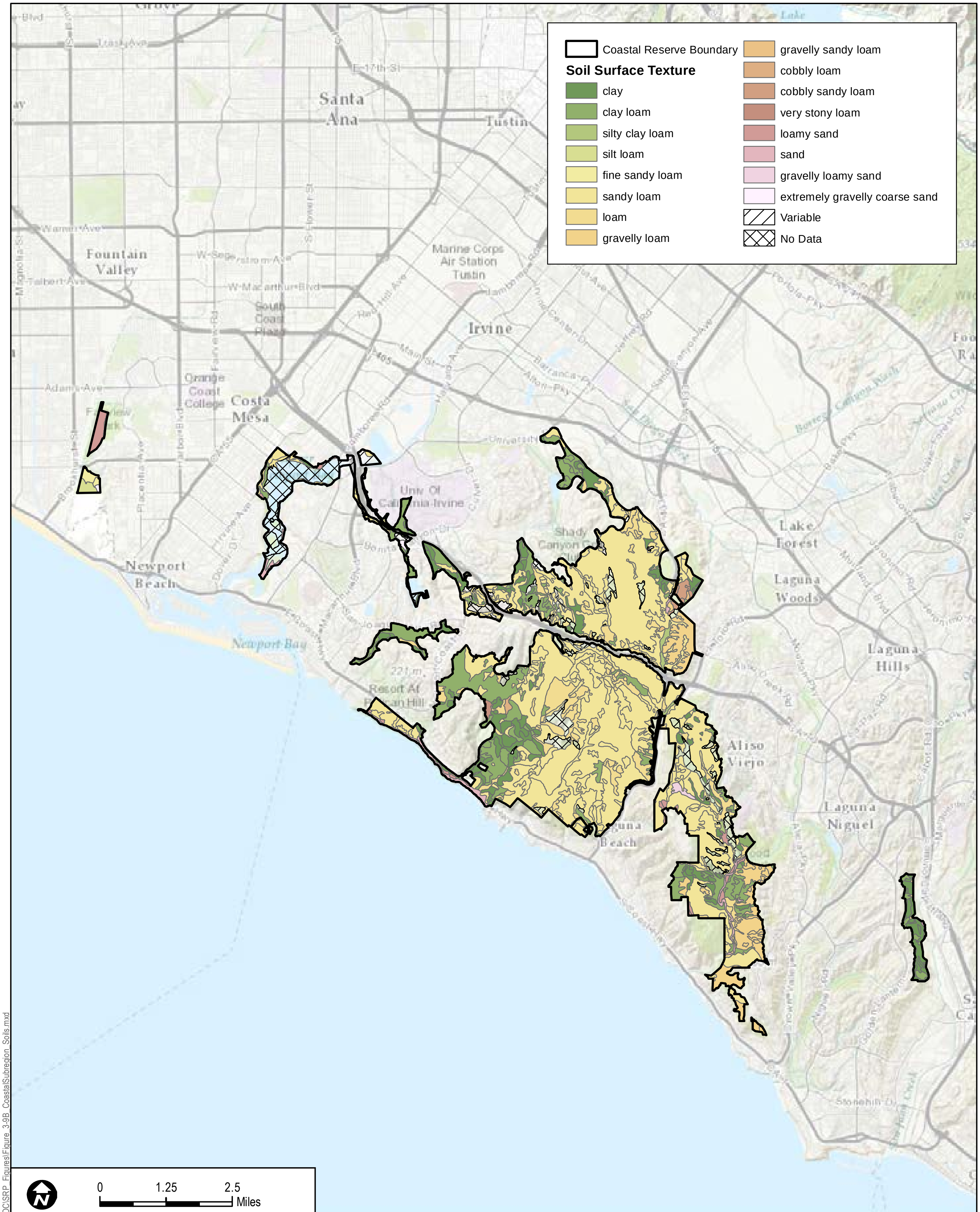

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SOURCE: USGS Topo, Orange County 2010, USDA Soils 2011

FIGURE 3-9B

Coastal Subregion Soils

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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During El Niño years of unusually high rainfall, such as the winters of 1997-1998 and 2004-2005, significant damage from landslides and erosion along creeks, trails and unpaved roads has been documented in the Reserve (Harbors, Beaches and Parks 2005). It is costly for the Reserve's landowners to repair damage to roads, trails, and utilities from flooding and erosion. Clearing of natural vegetation, such as trees and shrubs, either from anthropogenic fires or by well-intentioned landowners seeking to reduce fuel, can further contribute to this erosion and slope instability problem. The risk of slide erosion, the uniform removal of soil in layers from hill sides, is reduced when there are deep rooted shrubs that can add tensile strength and increase slope stability (Terwilliger and Waldron 1991, Booker 1998). In the interface between Reserve lands and adjacent development, there are often FMZs to reduce fire risk. In a few instances, these FMZs are within the Reserve boundaries as the development existed prior to the creation of the Reserve, as discussed in more detail in Chapter 7. In these areas, it is important that vegetation management completed to reduce fire risk is implemented in a manner that reduces soil erosion and landslide risk. This may include retaining deep rooted native shrubs and trees that are thinned and spaced adequately to reduce fire laddering, spread and intensity and removing invasive grasses and forbs that provide flashy fuels and facilitate movement of fire through the interspaces between shrubs. It may also mean the application of coarse mulch or other materials in these areas for control of weeds and soil erosion.

3.5 Vegetation Communities

Table 3-1 lists the vegetation communities and land uses within the Reserve when the NCCP/HCP was established in 1996 (County of Orange 1996). Five types of terrestrial vegetation comprised 90.7% (33,919 acres) of the Reserve and include grasslands (non-native annual and Valley needlegrass grasslands), coastal sage scrub (Diegan sage scrub and southern cactus scrub), chaparral, woodland, and riparian (Table 3-1, Figures 3-11A and B). These plant communities are representative of common upland vegetation types in southern California and occur in a mosaic pattern, across the Reserve. Topography, precipitation, slope aspect, hydrology and soil type help to determine the mosaic pattern. Non-native grasses generally occupy lowland valleys, with deep soils. Upland sites, with rocky soils, tend to support chaparral and coastal sage scrub. Oak woodlands are typically in canyons, on north-facing slopes and to a lesser extent in savannah type settings with loamy soils and relatively high water tables. Riparian vegetation occurs along streams in canyon and valley bottoms with nutrient rich soils. The five major plant communities are described in further detail below.

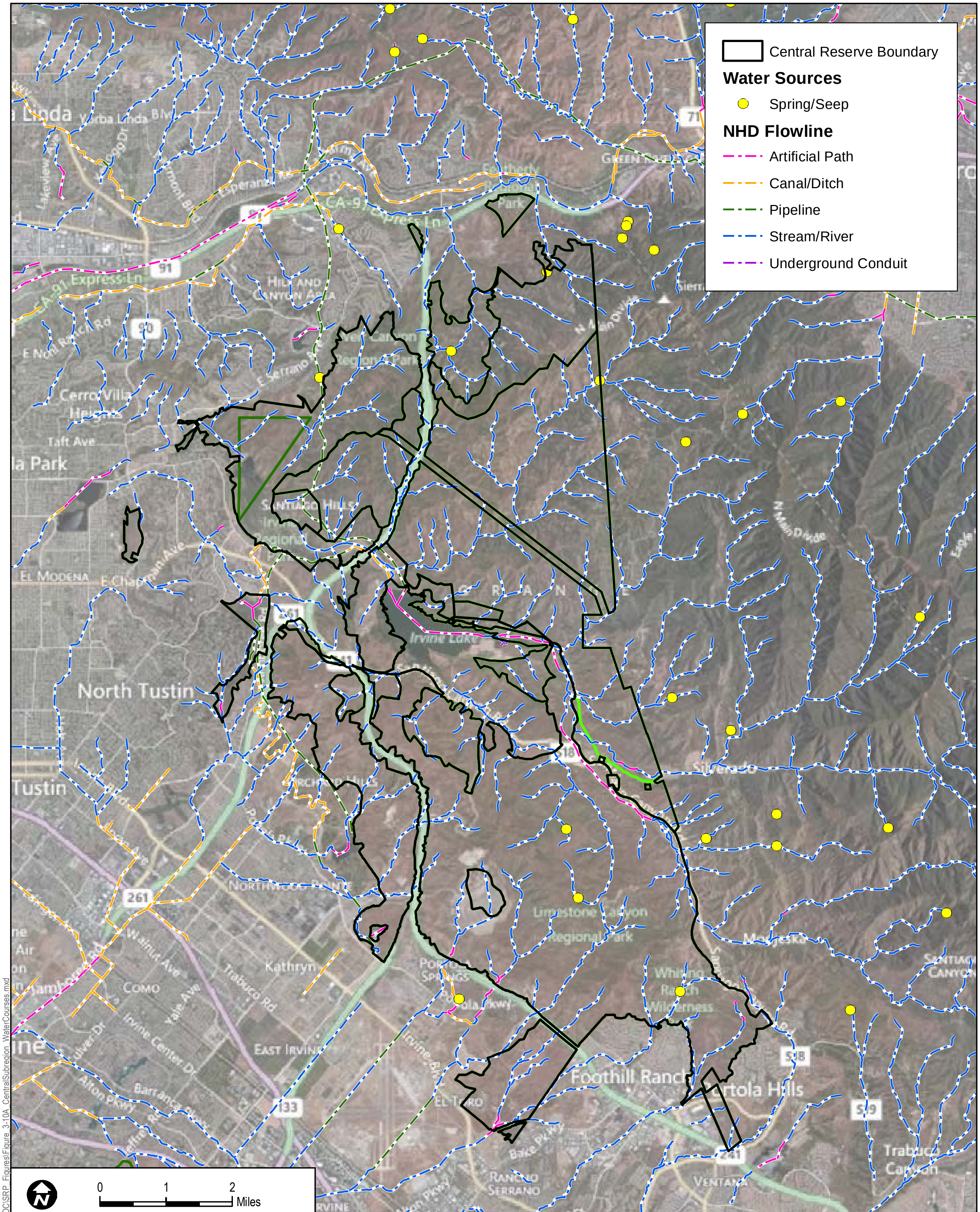
From a fire perspective, the vegetation communities that dominate fire spread and behavior are the coastal sage scrub, chaparral and grassland dominated areas, which combine to represent just under 84% of the Reserve's landscape. These fuel types, along with weather and topography, will govern fire activity throughout most of the Reserve.

Table 3-1
Vegetation communities and land uses within Orange County's Central and Coastal NCCP/HCP at the time the plan was established (vegetation types and acreages are from Table 1-ES in County of Orange 1996)

Vegetation Community	Acres	Percentage of Reserve Lands
Coastal Sage Scrub	18,527	49.6%
Chaparral	6,950	18.6%
Grassland	5,732	15.3%
Vernal Pool	9	0.002%
Marsh	343	0.9%
Riparian	1,770	4.7%
Woodland	940	2.5%
Forest	191	0.5%
Cliff and Rock	74	0.2%
Marine and Coastal	362	1.0%
Lakes, Reservoirs, Basins	99	0.3%
Water Courses	182	0.5%
Agriculture	577	1.5%
Developed	694	1.9%
Disturbed	929	2.5%
Total	37,378	100.0%

3.5.1 Diegan Sage Scrub and Southern Cactus Scrub

Diegan sage scrub is the major type of coastal sage scrub found throughout the Reserve. At the time the NCCP/HCP was established, Diegan sage scrub comprised 49.6% (18,527 acres) of the Reserve (County of Orange 2006). Coastal sage scrub species are often less than 1.5 m tall and may be widely spaced in comparison to chaparral. Diegan sage scrub includes the sub-association, southern cactus scrub, which has shrubs and more than 20% cover of cactus species. NROC mapped southern cactus scrub throughout the Reserve during 2006 through 2008. It is estimated that the Coastal Reserve supported 2,323 acres of southern cactus scrub in 2006 (Mitrovich and Hamilton 2007). Additionally, it is estimated that the Central Reserve had 1,855 acres of southern cactus scrub in 2008 and 76.5% (1,420 acres) were burned with varying degrees of severity during the 2007 Santiago Canyon fire (Leatherman 2009).



DUDEK

7108-01

SOURCE: USGS Topo, Orange County 2010, USGS NHS 2012

FIGURE 3-10A

Central Subregion Water Courses

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

Path: Z:\Projects\j710801\MAP_DOC\SRP_Figures\Figure_3-10A_CentralSubregion_WaterCourses.mxd

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Path: Z:\Projects\j710801\MAP_DOC\SRP_Figures\Figure 3-10B_CoastalSubregion_WaterCourses.mxd

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7108-01

SOURCE: USGS Topo, Orange County 2010, USGS NHS 2012

FIGURE 3-10B

Coastal Subregion Water Courses

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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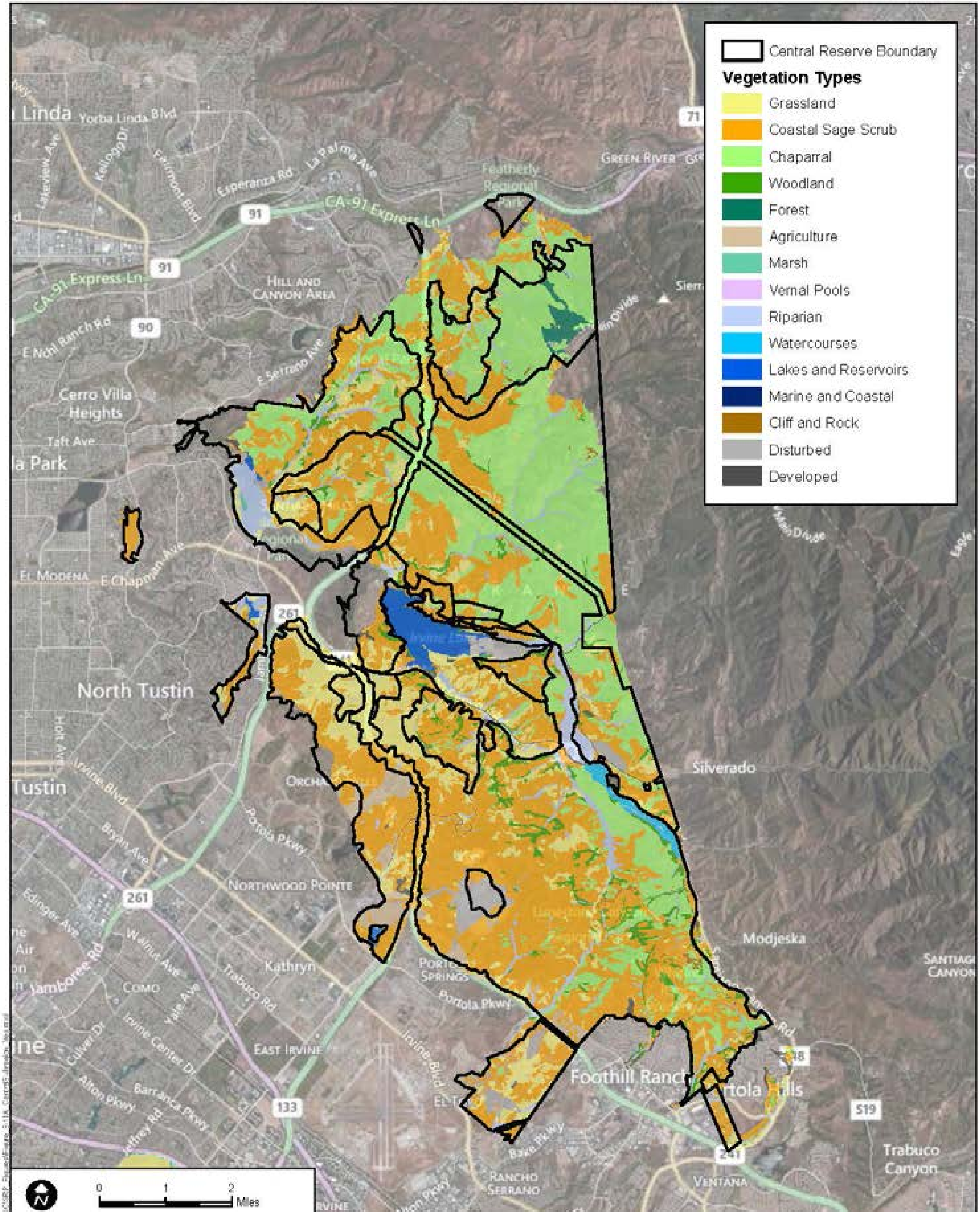

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SOURCE: USGS Topo, Orange County 2010;

FIGURE 3-11A

Central Subregion Vegetation

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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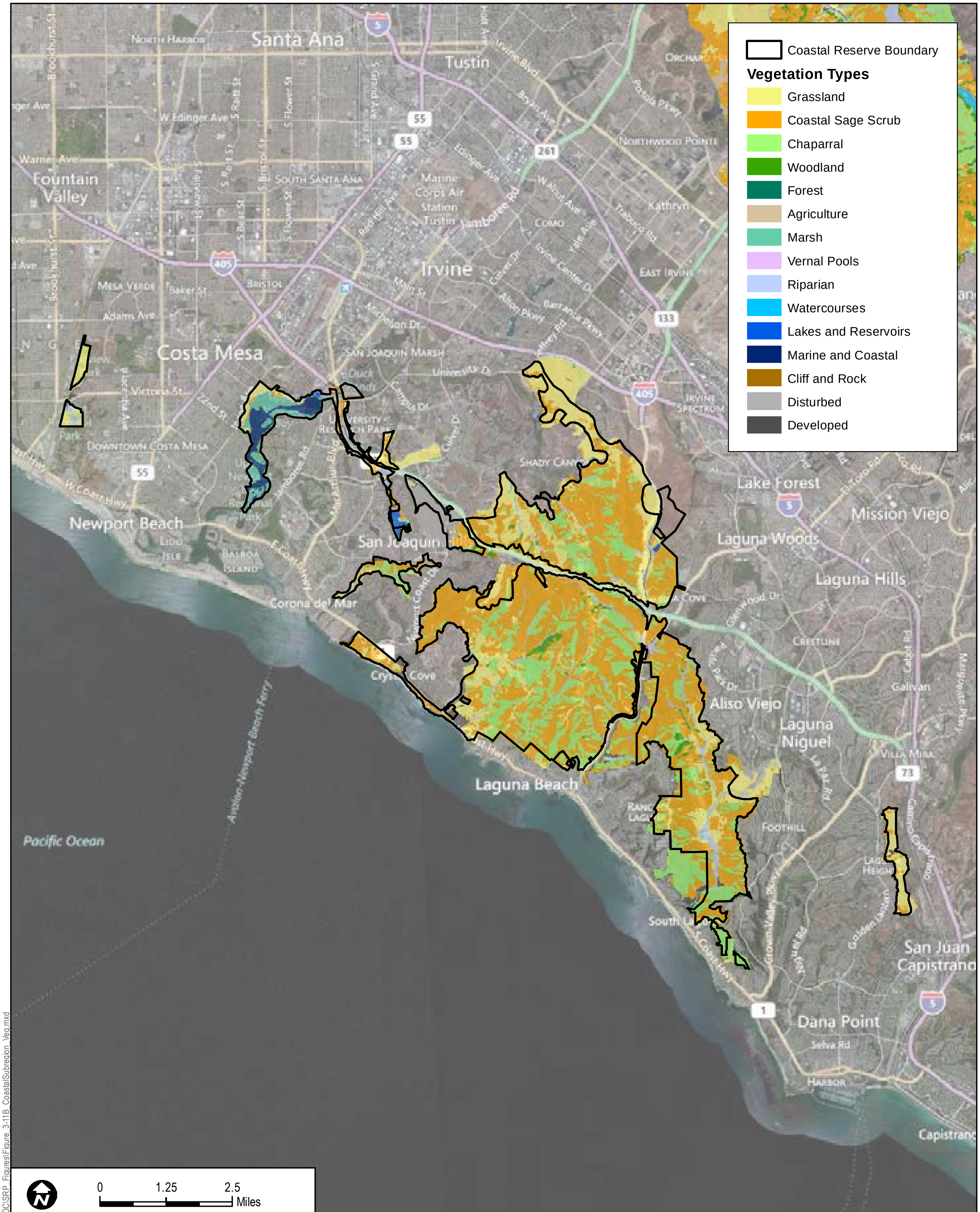

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7108-01

SOURCE: USGS Topo, Orange County 2010,

FIGURE 3-11B

Coastal Subregion Vegetation

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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Coastal sage scrub shrubs typically occur in shallow soils low in nutrients and moisture. The shrubs are important in stabilizing shallow soils by intercepting rainfall, as many species have soil-holding, fibrous shallow roots that do not penetrate into the deeper soil layers. Coastal sage scrub shrubs have evolved adaptive mechanisms to exploit soil moisture in upper soil horizons during the cool winter season (NPS 2004). Many shrub species in this community begin growing soon after the winter rains begin and slow growth as the summer drought progresses (Mooney 1977, Gray and Schlesinger 1983). Many factors influence plant species distributions including temperature, precipitation, evapotranspirative stress, substrate type, soil nitrogen, soil moisture, solar radiation, and air pollution (Westman 1981b, 1991, Meentmeyer et al. 2001). Evapotranspirative stress during the summer is an important influence in the distribution of coastal sage scrub species and mean temperature of the warmest month is the most important predictor of this stress (Westman 1981b). Unlike evergreen sclerophyllous chaparral, most sage scrub is characterized by subshrubs whose leaves shed during summer drought and are replaced by a lesser number of smaller leaves (Westman 1981a, Gray and Schlesinger 1983, Kolb and Davis 1994). The loss of leaves reduces transpiring surfaces in summer and may make these shrubs less susceptible than evergreen plants to variation in timing and amount of rainfall, and in particular to drought (Kolb and Davis 1994, DeSimone and Zedler 1999). Coastal sage scrub tends to occur in drier, lower elevation sites than chaparral shrub species (Kolb and Davis 1994).

The community composition of coastal sage scrub has been shown to consist of a small number of widespread shrub species, with the majority of species in the herbaceous understory. There is medium-scale patchiness in the distribution of dominant shrubs leading to variable community composition over a larger scale (Westman 1981b). Westman (1981c) 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. It is estimated that there were originally 247,000,000 acres (1,000,000 ha) of coastal sage scrub in California, but that by the late 1970's this was reduced to 10-15% of the original extent due to conversion of these areas to other uses, particularly, urbanization and agricultural development.

Shrub species commonly found in Diegan sage scrub in the Reserve include California buckwheat (*Eriogonum fasciculatum*), California sagebrush (*Artemisia californica*), California encelia (*Encelia californica*), chaparral mallow (*Malacothamnus fasciculatum*), laurel sumac (*Malosma laurina*), coyote bush (*Baccharis pilularis*), lemonade berry (*Rhus integrifolia*), Mexican elderberry (*Sambucus mexicanus*), black sage (*Salvia mellifera*), and Menzies's goldenbush (*Isocoma menziesii*). Cactus species found in southern cactus scrub are coastal prickly pear (*Opuntia littoralis*), oracle cactus (*Opuntia oricola*), and coastal cholla (*Cylindropuntia prolifer*a).

Coastal sage scrub shrubs are adapted to a particular fire regime that is less frequent than favored by non-native grasses which may replace sage scrub that is subject to short-cycle, repeated fires. 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). Coastal sage shrubs recover after fire as facultative seeders/sprouters or as obligate resprouters which can produce seeds in the first year following a fire and produce seedlings in the second year (Malanson and O'Leary 1982). Shrubs that comprise coastal sage scrub establish seedlings following fire or in gaps in unburned sage scrub and grassland (DeSimone and Zedler 1999). Animals are essential in establishing and maintaining the gaps that are important to seedling recruitment. Small mammals, such as gophers, provide bare dirt for seedlings to establish in grasslands while seeds are often depredated by small mammals in coastal sage scrub and grassland ecotones. Multiple successional pathways may exist following disturbance events in sage scrub. Cooper (1922) indicated that sage scrub may be successional to mixed chaparral types given longer fire intervals. More details on the response of coastal sage scrub to fire are provided in Section 4.1.7.1.

3.5.2 Chaparral

Chaparral is a shrub dominated vegetation type that occurs in Mediterranean climates and in California is typically found at 900-4,500 feet in elevation (300-1500 m; Barro and Conard 1991). Chaparral plant communities consist of evergreen, deep-rooted shrubs that often grow on steep slopes and are adapted to drought and fire (Mooney 1977). Chaparral shrubs tend to grow on coarse-textured soils with limited water holding capacity. Soil moisture, especially during drought periods, is thought to be the most limiting resource for chaparral shrubs (Meentemeyer and Moody 2002). Many chaparral shrubs have waxy, leathery or thick leaves to retain moisture. Chaparral shrubs can either be physiologically adapted to very dry conditions or they can be deep rooted to take advantage of moisture deep in the soil to avoid drought stress. Topography is an important determinant in the species that can establish in a particular spot, with some shrubs such as toyon (*Heteromeles arbutifolia*) and mountain mahogany (*Cercocarpus betuloides*) found on topographically sheltered slopes with more mesic conditions (Meetemeyer and Moody 2002). In contrast, shrubs such as chamise (*Adenostoma fasciculatum*) and hoary-leaf ceanothus (*Ceanothus crassifolius*) can grow on south facing slopes with greater solar insolation and reduced soil moisture. Most chaparral species grow more than 1.5 m tall, and often shrubs grow close together creating a dense barrier that is difficult to move through.

Chamise chaparral is found at higher elevations in the Reserve and this classification is applied to chaparral stands in which chamise comprises 80% or more of the total shrub cover (Hanes 1977). Chamise chaparral is dense, interwoven vegetation 1-2 m high at maturity without a well-developed understory. Southern mixed chaparral within the Reserve supports a variety of shrub species including chamise, Manzanita (*Arctostaphylos* species), ceanothus, toyon, mountain mahogany, and black sage (*Salvia mellifera)*. Coastal scrub oak (*Quercus dumosa*) is found in chaparral in the Coastal Reserve whereas California scrub oak (*Quercus berberidifolia*) occurs in the Central Reserve. The presence of Parry's beargrass (*Nolina cismontane)* identifies a sub-association of Nolina chaparral within the Reserve. Chaparral comprised of toyon and laurel sumac is most common in the Coastal Reserve and often intergrades with grassland and coastal sage scrub.

Fire is a natural occurrence in southern California chaparral vegetation because of the flammable properties of the shrubs and the long, hot and dry summers (Barro and Conard 1991) which lower fuel moisture levels and predispose shrubs to combustion. Following a wildfire, chaparral is typically dominated by fire-adapted and ephemeral annual and perennial herbs and shrubs, with particularly high cover and diversity of herbaceous plants (Westman 1979). Chaparral shrubs are important in stabilizing slopes following a fire because of their deep roots that can help reduce erosion and slope failures. Re-growth after fire may differ between chaparral species. Some species reproduce after fire from seeds and may be dependent on fire for their seeds to germinate. Other species may resprout and some species recover both by seeds and resprouting. Seedlings are subjected to drought stresses in the first growing season following fire and seedling mortality can vary among shrub species, depending on their tolerance to drought and their life history traits (Thomas and Davis 1989, Meetemeyer et al. 2002). Slower response may be due to poor site conditions (Horton 1960), the effects of fire intensity on response of viable seed in the remaining duff, and root crown sprouting. A rich herbaceous flora is often associated with this community type during the first wet seasons following fire events (Horton and Kraebel 1955). Responses of the chaparral plant community to fire are further detailed in Section 4.1.7.2.

*3.5.2.1Tecate Cypress**

Tecate cypress (*Cupressus forbesii*) is a rare endemic species restricted to southern California and northern Baja California and is classified as a List 1B Species by the California Native Plant Society (http://www.cnps.org/cnps/rareplants/ranking.php). The northern most population of Tecate cypress occurs in the Santa Ana Mountains within the Reserve System and receives regulatory coverage under the NCCP/HCP. Tecate cypress is adapted to a fire regime with fire return intervals of 30-40 years, a period sufficient for stands to develop cones to ensure replacement. Too-frequent fires can cause the loss of adult stands and threaten persistence of the population. Recent fires (2002 and 2006) have burned through the population putting it at risk of local exinction in future fires.

Tecate cypress is one of twelve new world cypress species that occur in California. Currently, this species is considered vulnerable because there are only a few small and poorly connected populations (IUCN 2006). Tecate cypress grows between 200-1200 meters above sea level and is distributed in four groves in southern California and several disconnected stands in northern Baja California. (Figure 2-1). The Santa Ana Mountains population grows on intermediate to steep slopes dominated by rocky outcrops, with soils predominately in the Sieneba-Anaheim association (SSURGO 2009). In the specific areas where Tecate cypress grows, soils have a pH ranging from 4.2 to 6.5, are very low in nitrogen, and are composed of 28-30% clay. These soils are more acidic and nitrogen poor than soils in other locations where Tecate cypress occurs. Within the Santa Ana Mountains, soil characteristics where Tecate cypress grows do not differ from adjacent chaparral areas (Stottlemeyer and Lathrop 1981). Tecate cypress grows in dense stands or intermixed with chamise-chaparral vegetation. Based on spring 2009 observations, the shrub community in this area is dominated by chamise (*Adenostoma fascilulatum*), Yerba Santa (*Eriodictyon crassifolium*), and at least two lilac species (*Ceanothus* sp.). Other common species include manzanita (*Arctostaphylos glandulosa*), black sage (*Salvia mellifera*), Lord's candle (*Yucca whipplei*), and chaparral beargrass (*Nolina cismontana*).

Tecate cypress has several life history traits that make it especially vulnerable to changes in fire regime. Tecate cypress is a fire dependent, obligate seeder that establishes after a fire (Vogl et al. 1977; Zedler 1981; Dunn 1986). In this species, like any other with serotinous cones, most seeds are released following a fire as the cones require long periods of time to dry out and open (Armstrong 1966), and intense heat during fire speeds up this process. After a fire, germination and recruitment are profuse, which has also been suggested as evidence of the fire dependent nature of this species (Armstrong 1966; Dunn 1986); although there is little information about recruitment between fire events. Dunn (1986) estimated that age specific survival of Tecate cypress increases with age; corresponding to a type III survival curve. Markovchick-Nicholls (2007) suggested that this species experiences an intense density dependent mortality based upon data provided by Paul Zedler. Although this dataset is not detailed enough to support the specific function she used, her equation is the best approximation we have to describe this process. Several studies have found that Tecate cypress can start reproducing at relative early ages (as soon as 6-7 years of age; Zedler 1977 and 1984), but peak cone production is only reached when trees are between 35 and 40 years old (Dunn 1986). There is little information about changes in cone production after this age, although some authors assume a post-reproductive stage (De Gouvenain and Ansary 2006). Seeds may remain viable in closed cones for many years (Spenger 1985), although there is no explicit evidence of this pattern or any explicit investigation of seed viability. Dispersal is considered minimal for this species and assumed to be mostly downhill and facilitated by wind and water currents (Armstrong 1966 and Zedler 1986). These life history characteristics make Tecate cypress particularly vulnerable to the current trend of increasing fire frequencies in Southern California. Populations are at risk of local extinction whenever fires are so frequent that new recruits are unable to reach maturity and contribute to the seedbank or whenever fires are so infrequent that most seeds are not released and dispersed. In these cases, recruitment is lower than levels that allow for population self replacement.

3.5.3 Non-native Grassland and Valley Needlegrass Grassland

Within the Reserve, there are two types of grassland; non-native annual grassland and native perennial Valley needlegrass grassland. Native grasslands are much reduced in the Reserve and remnant patches are often invaded by exotic plant species. Perennial grass species characteristic of Valley needlegrass grasslands include purple needlegrass (*Nassella pulchra*), foothill needlegrass (*Nassella lepida*), wild rye (*Leymus triticoides*), and deergrass (*Muhlenbergia rigens*). Other native plants often found in grasslands include wreath plant (*Stephanomeria virgata*), blue dicks (*Dichelostemma capitatum*), morning glory (*Calystegia mactrostegia*), California plantain (*Plantago erecta*), purple owl's clover (*Castilleja exserta*), wild onion *(Allium* sp.), and various types of lupine (*lupinus species*).

Exotic grasses invading Valley needlegrass grasslands and comprising non-native grasslands include wild oats (*Aven*a *fatua.*), ripgut brome (*Bromus diandrus*), compact brome (*Bromus madritensis*), soft chess brome (*Bromus hordeaceaus*), and foxtail fescue (*Vulpia myurus*). Non-native forbs can also be found in grasslands and in disturbed areas and include redstem filaree (*Erodium cicutarium*), short pod mustard (*Hirschfeldia incana*), black mustard (*Brassica nigra*), prickly lettuce (*Lactuca serriola*), and Russian thistle (*Salsola tragus*).

3.5.3.1 Invasion of Native Plant Communities by Exotic Annual Plants

There is a long history of non-native plant species being introduced into southern California and becoming established in native plant communities. Hendry (1931) suggested that red-stem filaree, 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 resulting decomposition rates slow. This may lead to a negative feedback loop, where excess thatch can follow a year of high production (Huenneke and Mooney 1989). This excess thatch and ground litter has significantly altered seedbed micro-environments. Native plants, such as purple needlegrass, are more likely to successfully germinate in the presence of bare soil (Dyer and Rice 1999). In a study of Valley needlegrass grassland in southern California, 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

Type conversion of coastal sage scrub to annual grassland is also increasing in prevalence throughout southern California (Minnich and Dezzani 1998, Stylinski and Allen 1999, Talluto and Suding 2008). A primary factor in the conversion of coastal sage scrub to non-native grassland is a high fire frequency, which favors competitive displacement of native shrubs by exotic grasses (Zedler et al. 1983, Keeley et al. 2005a, Talluto and Suding 2008). Since 1910 there has been a change in the frequency of fires in southern California shrublands, with the number of fires ignited positively correlated to population density (Keeley et al. 1999, Keeley and Fotheringham 2001). This increase in fire frequency facilitates expansion of non-native grassland into coastal sage scrub.

Other factors may influence the invasion of native plant communities by exotic annual plants including grazing and disturbances that open up shrubland to colonization. A long history of grazing throughout much of the Reserve has likely facilitated declines in native cover and enhanced establishment of exotic annual weeds. Anthropogenic nitrogen deposition from air pollution has also been linked to the establishment of non-native annual grasses in native grasslands and shrublands in California (Weiss 1999, Fenn et al. 2003, Talluto and Suding 2008).

Establishment of non-native species on the Reserve has a direct effect on fire ignitions, spread, intensity, and frequency. Many non-native plants, especially non-native grasses, are readily ignited during their drying phase. Fires in these communities spread quickly and are often interspersed with shrublands, resulting in shrub ignitions and potentially larger, repeated fires, establishment of more grasslands, and the potential for shorter fire intervals that favor grassland establishment and spread, directly in conflict with maintenance of Diegan sage scrub habitats throughout large portions of the Reserve.

3.5.4 Riparian

Riparian vegetation in the Reserve varies from well-developed forest types to shrub dominated series. The riparian vegetation occurring on any given site is a function of hydrology, disturbance history and/or edaphic (soil type, texture and drainage) conditions. Structural elements vary greatly between riparian series. Utilization of riparian habitat by wildlife species is often closely correlated with the structure of the vegetation.

Riparian scrub is often dominated by Arroyo willow (*Salix lasiolepis*) and mulefat *(Baccharis salicifolia).* In a shrubland form many emergent trees may also be present. Riparian woodlands may support an overstory of coast live oak (*Quercus agrifolia*) and western sycamores (*Platanus racemosa*) such as established in Wood Canyon, or can be willow dominated. Common species include black willow (*Salix gooddingii*), red willow (*Salix laevigata*), Fremont cottonwood (*Populus fremontii*), and an understory of southern California grape (*Vitis girdiana*), mulefat, and California wild rose (*Rosa californica*).

During typical fire events, riparian woodlands are less prone to ignition and fire spread due to their higher plant moisture and larger fuel sizes that are less prone to ignition, e.g., sycamore and oak trees. However, during extreme weather conditions, riparian areas will burn with high intensity, consuming all above-ground plant biomass.

3.5.5 Woodland

Woodlands in the Reserve are considered multi-layered, non-riparian communities with 20-80% canopy cover of trees (County of Orange 1996). Coast live oak occurs in canyons, on mesic north-facing slopes, along streams and in open grassland savannahs in the Reserve. Dense stands of mature trees occur on raised stream banks and terraces. Native walnut trees (*Juglans californica* var. *californica*) may be found in association with oaks on mesic, north facing slopes. A mix of tree, shrub and herbaceous species often co-occur with live oaks. Typical species include toyon, California sagebrush, poison oak (*Toxicodendron diversilobum*), wild ryegrass and miner's lettuce (*Claytonia parviflora*). In addition, a significant portion of the herbaceous layer of these stands may be composed of non-native annual grasses. In some areas, live oaks occur in open savannahs with native and non-native grasses and herbs and low shrub cover.

Native California woodlands have evolved with fire and can readily resprout after fire. However, some fires have created total tree kills due to high intensity heat that burns into the roots, preventing basal sprouting. Coast live oak trees are very fire resistant, with fire adaptations including evergreen leaves, thick bark, and post-fire sprouting from surviving tissue. Fire intensity affects individual tree survival, with the amount and extent of trunk char and canopy consumption playing a critical role in survival and response (Plumb and Gomez 1983). Following burning, coast live oaks sprout from the main trunk and upper crown even after severe burning (Plumb and McDonald 1981). Post-fire recovery of coast live oak woodlands is dependent on fire intensity, and fall fire damage is typically more severe than that occurring earlier in the year (Plumb and Gomez 1983). While the thick bark of mature coast live oak trees minimizes the effects of heat exposure from wildfire, seedlings and acorns are much more susceptible to mortality, even following low-intensity fires (Lawson, Zedler and Sieger 1997).

As with coastal sage and chaparral, decreases in fire frequency in coast live oak woodlands and forests favors woodland/forest expansion into neighboring grassland (Callaway and Davis 1993). Fire behavior in oak woodlands and forests is typically much less intense than wildfires burning in chaparral and sage scrub communities. Low, compacted leaf litter understory, canopy shading of ground fuels, and wind velocity reduction resulting from tree canopies significantly reduce the intensity and spread rates of surface fires in oak woodland and forest vegetation types. However, transition from ground to canopy fire increases fire intensity, spotting, and tree mortality potential.

3.6 Threatened, Endangered and Rare Species

Highlighting the need for a comprehensive fire management plan is the large number of wildlife species that inhabit the various vegetation communities found on the Reserve. Fire management planning seeks to preserve and enhance these habitats and the wildlife that rely on them by prevention, strategic protection, and guided suppression activities.

The California floristic province along the Pacific Coast is considered a global biodiversity hotspot with high priority for conservation due to the substantial loss of native plant communities to urban development and agricultural expansion (Myers et al. 2000). Orange County's Central-Coastal NCCP/HCP is part of this biodiversity conservation hotspot, supporting many plant and animal species in a variety of habitats from the coastal beaches to the Santa Ana Mountains. Up to 199 species of vertebrates are known to exist within the Central/Coastal Reserve System. This includes 7 amphibian, 15 reptile, 145 bird and 32 mammal species. Examples of common amphibian and reptile species in the Reserve include western toad (*Bufo boreas*), pacific treefrog (*Hyla regilla*), side-blotched lizard (*Uta stansburiana*), coastal western whiptail (*Cnemidophorus tigris*), gopher snake (*Pituophis melanoleucus*), California kingsnake (*Lampropeltis getulus*), and northern red diamond rattlesnake (*Crotalus viridis*). Bird species typically found in the Central and Coastal Subregions include red-tailed hawk (*Buteo jamaicensis*), California quail (*Callipepla californica*), Anna's hummingbird (*Calypte anna*), western scrub-jay (*Aphelocoma californica*), Bewick's wren (*Thryomanes bewickii*), wrentit (*Chamaea fasciata*), California towhee (*Pipilo crissalis*), house finch (*Carpodacus mexicanus*), and western meadowlark (*Sturnella neglecta*). Common mammal species in the Reserve include California ground squirrel (*Spermophilus beecheyi*), Botta's pocket gopher (*Thomomys bottae*), dusky-footed woodrat (*Neotoma fuscipes*), desert cottontail (*Sylvilagus audubonii*), coyote (*Canis latrans*), bobcat (*Felix rufus*) and southern mule deer (*Odocoileus hemionus)*.

The NCCP/HCP was designed to conserve threatened, endangered, rare and declining species along with the more common species that occur in the Central and Coastal Subregions. Many sensitive species are declining because of extensive habitat loss and fragmentation in southern California, particularly in the last several decades. The NCCP/HCP provides coverage for 39 "Identified Species", including three target species and ten species that are "conditionally covered" pursuant to satisfaction of certain conditions. Identified species are considered conserved as:

- their habitat closely or generally overlaps with one of the three target species
- the species is endemic to the region and the Reserve and adaptive management program adequately conserves known populations
- the species is widely distributed beyond the NCCP/HCP and the Reserve provides adequate conservation measures for this subregion
- the species distribution is limited to a very small portion of the subregion that overlaps at least one of the "target species"
- the species is a top predator that will benefit by the habitat linkages in the Reserve

As previously mentioned, the NCCP/HCP protects three target species, including one lizard and two bird species (Table 3-2; County of Orange 1996). The orange-throated whiptail (Aspidoscelis hyperythrus beldingi) is a common reptile throughout much of the Reserve, especially in the Central Subregion. The California gnatcatcher (Polioptila californica) is a federally threatened species and occurs in coastal sage scrub habitats throughout the Reserve. The coastal cactus wren (Campylorhynchus brunneicapillus) was once widespread throughout southern cactus scrub habitats in the Reserve and is currently much reduced in abundance, largely because of recent wildfires.Figures 3-12A and 3-12B illustrate mapped occurrences of coastal cactus wrens, California gnatcatchers and rare plant species. It is important to note, especially for wildlife species, that the mapped locations serve only to identify that the species has been known to occur in these mapped areas. It is likely that the various species occur on a much broader scale throughout the Reserve.

Table 3-2
Plant and animal species receiving regulatory coverage under the NCCP/HCP across the Reserve or only in the Dana Headlands Site and species that are conditionally covered

Common Name	Scientific Name
Target Species	
Reptiles	
Orange-throated Whiptail	*Aspidoscelis hyperythrus beldingi*
Birds	
Coastal Cactus Wren	*Campylorhynchus brunneicapillus*

Table 3-2
Plant and animal species receiving regulatory coverage under the NCCP/HCP across the Reserve or only in the Dana Headlands Site and species that are conditionally covered

Common Name	Scientific Name
Target Species	
Coastal California Gnatcatcher	*Polioptila californica*
Identified Species	
Plants	
Catalina Mariposa Lily	*Calochortus catalina*
Coulter's Matilija Poppy	*Romneya coulteri*
Heart-leaved Pitcher Sage	*Lepichinia cardiophylla*
Laguna Beach Dudleya	*Dudleya stolonifera*
Nuttal's Scrub Oak	*Quercus dumosa*
Santa Monica Mtns Dudleya	*Dudleya cymosa ovatifolia*
Small-flowered Mountain Mahogany	*Cercocarpus minutiflorus*
Tecate Cypress	*Cupressus forbesii*
Amphibians	
Arboreal Salamander	*Aneides lugubris*
Black-bellied Salamander	*Batrachoseps nigriventris*
Western Spadefoot	*Scaphiophis hammondii*
Reptiles	
Coastal Rosy Boa	*Lichanura trivirgata rosafusca*
Coastal Western Whiptail	*Aspidoscelis tigris multiscutatus*
Coronado Skink	*Eumeces skiltonianus interparietalis*
Northern Red Diamond Rattlesnake	*Crotalus ruber ruber*
San Bernardino Ringneck Snake	*Diadophis punctatus modestus*
San Diego Horned Lizard	*Phrynosoma coronatum blainvillii*
Birds	
Northern Harrier	*Circus cyaneus*
Peregrine Falcon	*Falco peregrinus*
Red-shouldered Hawk	*Buteo lineatus*
Rough-legged Hawk	*Buteo lagopus*
Southern California Rufous-crowned Sparrow	*Aimophila ruficeps canescens*
Mammals	
Coyote	*Canis latrans*
Gray Fox	*Urocyon cinereoargenteus*
San Diego Desert Woodrat	*Neotoma lepida intermedia*
Conditionally Covered Species	
Plants	
Foothill Mariposa Lily	*Calochortus weedii var intermedius*

Table 3-2
Plant and animal species receiving regulatory coverage under the NCCP/HCP across the Reserve or only in the Dana Headlands Site and species that are conditionally covered

Common Name	Scientific Name
Target Species	
Crustaceans	
Riverside Fairy Shrimp	*Streptocephalus woottoni*
San Diego Fairy Shrimp	*Branchinecta sandiegoensis*
Insects	
Quino Checkerspot	*Euphydryas editha quino*
Amphibians	
Southwestern Arroyo Toad	*Bufo californicus*
Birds	
Golden Eagle	*Aquila chrysaetos*
Prairie Falcon	*Falco mexicanus*
Least Bell's Vireo	*Vireo bellii pusillus*
Southwestern Willow Flycatcher	*Empidonax traillii extimus*
Mammals	
Pacific Pocket Mouse	*Perognathus longimembris pacificus*
Covered on Dana Point's Headlands Site Only	
Plants	
Blochman's Dudleya	*Dudleya blochmaniae*
Cliff Spurge	*Euphorbia misera*
Nuttall's Scrub Oak	*Quercus dumosa*
Palmer's Grappling Hook	*Harpagonella palmeri*
Western Dichondra	*Dichondra occidentalis*

3.7 Cultural Resources Description

For confidentiality purposes and to protect the resources, no cultural resources description information was provided to Dudek. General information on the presence/absence of cultural resources was provided and is documented in Volume II and Volume III of this WFMP.

The primary purpose of including cultural resources data in the WFMP is to prevent inadvertent damage or destruction of archaeological and historic sites by pre-fire, during fire, and post-fire actions.

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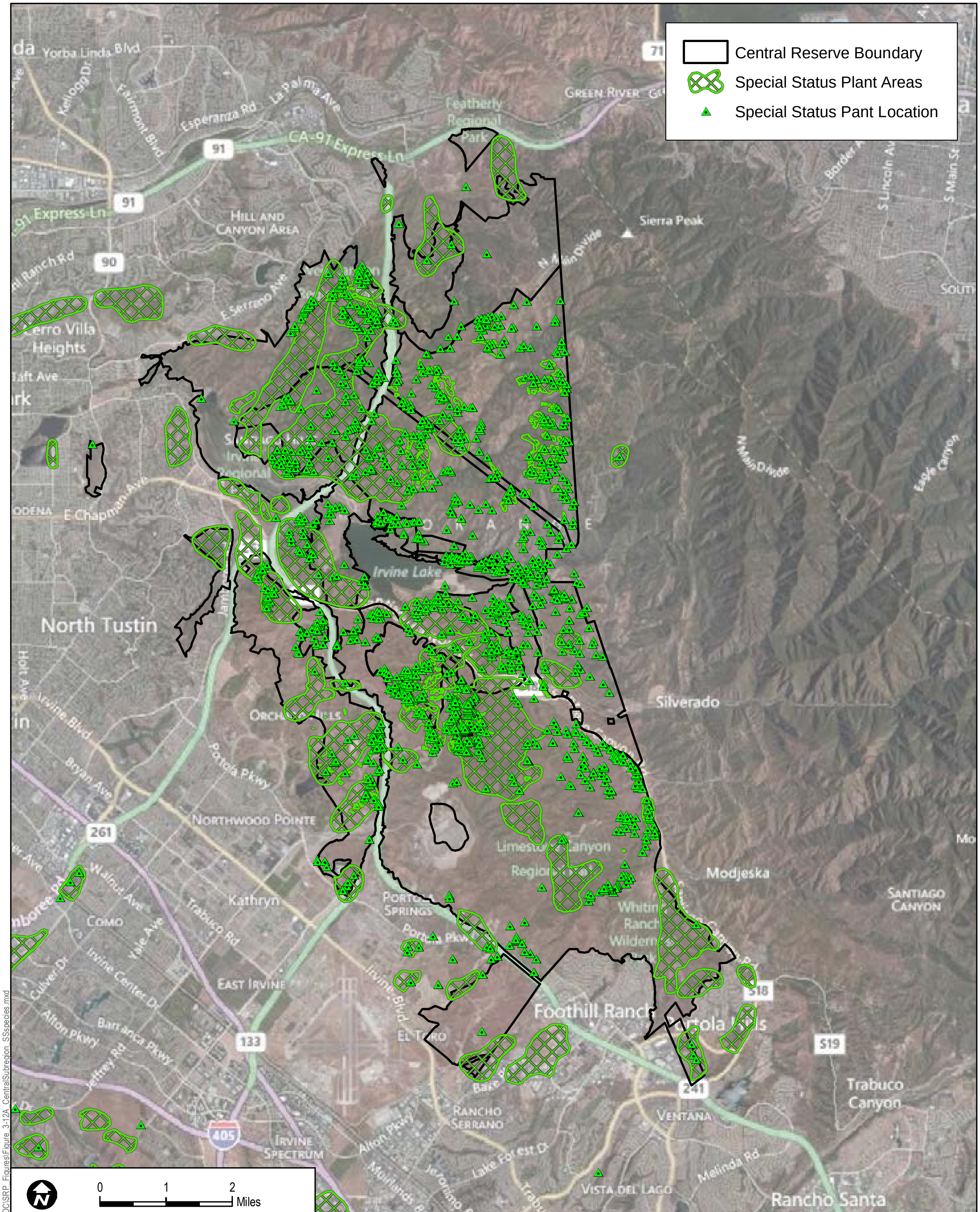

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 3-12A

Central Subregion Special-status Plant Species

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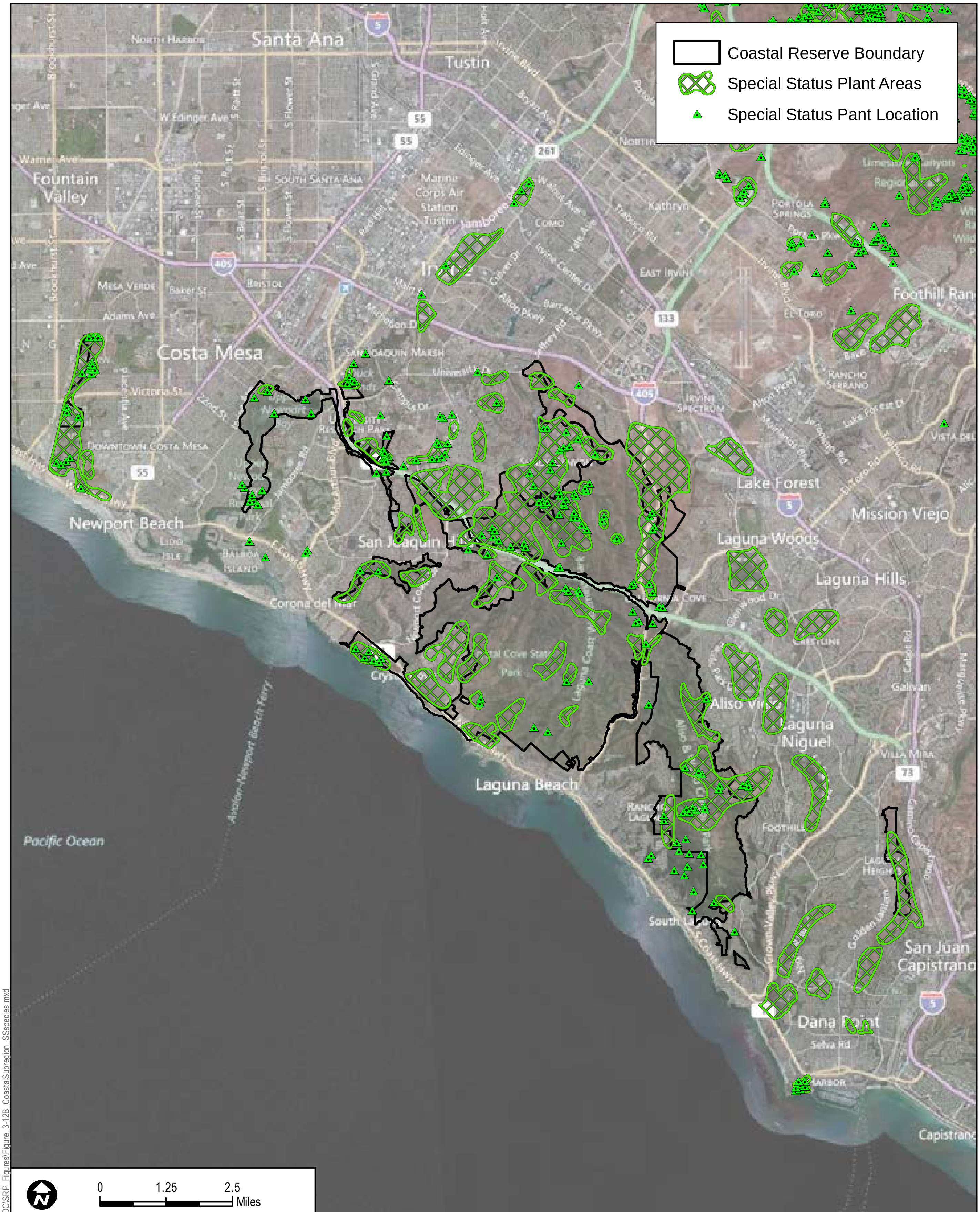

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 3-12B

Coastal Subregion Special-status Plant Species

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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4.0 FIRE: ENVIRONMENT, HISTORY, REGIME, AND EFFECTS

4.1 Fire Environment

4.1.1 Fire Weather

The unique Mediterranean climate with its long dry summer produces many days of high fire potential in southern California. An analysis of fires with known start dates recorded in Orange County from 1940 to 2008 (OCFA 2010a) illustrates that most fires occur between June and November, although fires can occur year round (Figure 4-1). Approximately 60% of fires were ignited from June through September but accounted for only 26% of the area that burned. In contrast, 17% of fires were during October and November and consumed 61% of the land burned from 1940 to 2008. Fire seasonality can be explained by southern California weather patterns. Fire potential is typically lowest during the rainy season from December through April. Fire risk increases during summer when there is little or no rain, high temperatures, and low levels of live fuel moisture (Moritz 1997, Keeley and Fotheringham 2003). This data suggests that ignition prevention and wildfire reduction on the Reserve should focus efforts during specific timing of the year when likelihood of ignition and wildfire spread are highest.

Fire risk is typically greatest in fall during periods when there is a high pressure system in the Great Basin and a low-pressure trough along the southern California coast producing Santa Ana Winds that blow from east and northeast over the western slopes of the coastal mountains (Minnich 1983, Moritz 1997, Keeley and Fotheringham 2003, Keeley and Zedler 2009). Santa Ana winds often have speeds greater than 60 mi/h (100 km/h) and 10% (or lower) relative humidities for sustained periods (Keeley and Fotheringham 2003, Keeley and Zedler 2009). On the coastal side of mountains, differences in heating and cooling of valleys and slopes in relation to the land and the ocean creates complex wind patterns. During the day, onshore flows from the ocean can blow counter to the Santa Ana winds and lead to unpredictable fire behavior. During the night, Santa Ana winds often regain their strength with greatest speeds around day break. Santa Ana wind occurrence is greatest from September through April with a peak during December. Fire danger is greatest when live fuel moisture is low, such as the fall and early winter before the rains have started (Dennison et al. 2008).

Another type of weather pattern that can produce high fire danger year-round occurs when a ridge or closed high 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).

4.1.2 Fuels

The Reserve's climate, vegetation, topography and disturbance history has created a mosaic of fuel types. Frequent fires and other disturbances have created lower volume fuel beds than what may be the case if fire intervals were longer throughout much of the Reserve. Open grasslands in the eastern Coastal Reserve are an example of this lower fuel type. In areas where fire and grazing have been excluded, fuel loads may reach moderate to high levels, such as in the southern portion of the Coastal Reserve. However, with most of the Reserve burning in recent fire events, fuels can generally be characterized as below climax volume with a high percentage of fine, herbaceous fuel.

Utilizing site vegetation maps, field evaluations were conducted to evaluate fuel loading and classify vegetation types into fuel models (Anderson 1982; Scott and Burgan 2005; Weise and Regelbrugge 1997). Fuel model assignments are presented in Table 4-1 by vegetation type and are graphically presented in Figures 4-2A and 4-2B. Certain vegetation types increase fire hazard based on plant physiology (resin content), biological function (flowering, retention of dead plant material), and/or physical structure (leaf size, branching patterns). Specifically, the following chaparral and sage scrub species found throughout the majority of the Preserve are considered to exhibit higher potential hazard based on such criteria: coastal sagebrush (*Artemisia californica*), chamise, California buckwheat, and black sage. In addition, non-native invasive plants can increase the frequency of fires by providing more continuous fuels that are more easily ignited (Brooks et al. 2004). Invasive plants also present hazards when located adjacent to neighboring structures or within fuel modification zones that are meant to provide defensible space. Non-native invasive species of the greatest concern within the Reserve include tamarisk, pampas grass, sweet fennel, and eucalyptus, amongst others.

Table 4-1
Fuel Model Assignments Central Reserve

Vegetation Community/Land Cover	Fuel Model	Canopy Cover Value
Coastal Sage Scrub	SCAL 18	0
Chaparral	SH 7	0
Woodland	9	3
Grassland	1	0
Disturbed	1	0
Riparian	9	3
Cliff and Rock	0	0
Forest	9	4
Developed	0	0

Table 4-1
Fuel Model Assignments Central Reserve

Vegetation Community/Land Cover	Fuel Model	Canopy Cover Value
Marsh	3	0
Agriculture	1	0
Watercourses	0	0
Lakes and Reservoirs	0	0
Vernal Pools	1	0
Marine and Coastal	0	0

A variety of fuel classes are represented in the Reserve. Although most fuels occur in the 1-hr and 10-hr size class, 100-hr and 1000-hr fuels do exist in the Reserve's dense brush, riparian and tree fuel models located within the interior units. Two grass fuel models occur (Fuel Model 1 and Fuel Model 3), as well as two shrub fuel models (Fuel Model SH7 and Fuel Model SCAL 18)) and one tree (hardwood) fuel model (Fuel Model 9). Each of these fuel models are described in more detail in Section 5.4.1.

Vegetation Dynamics

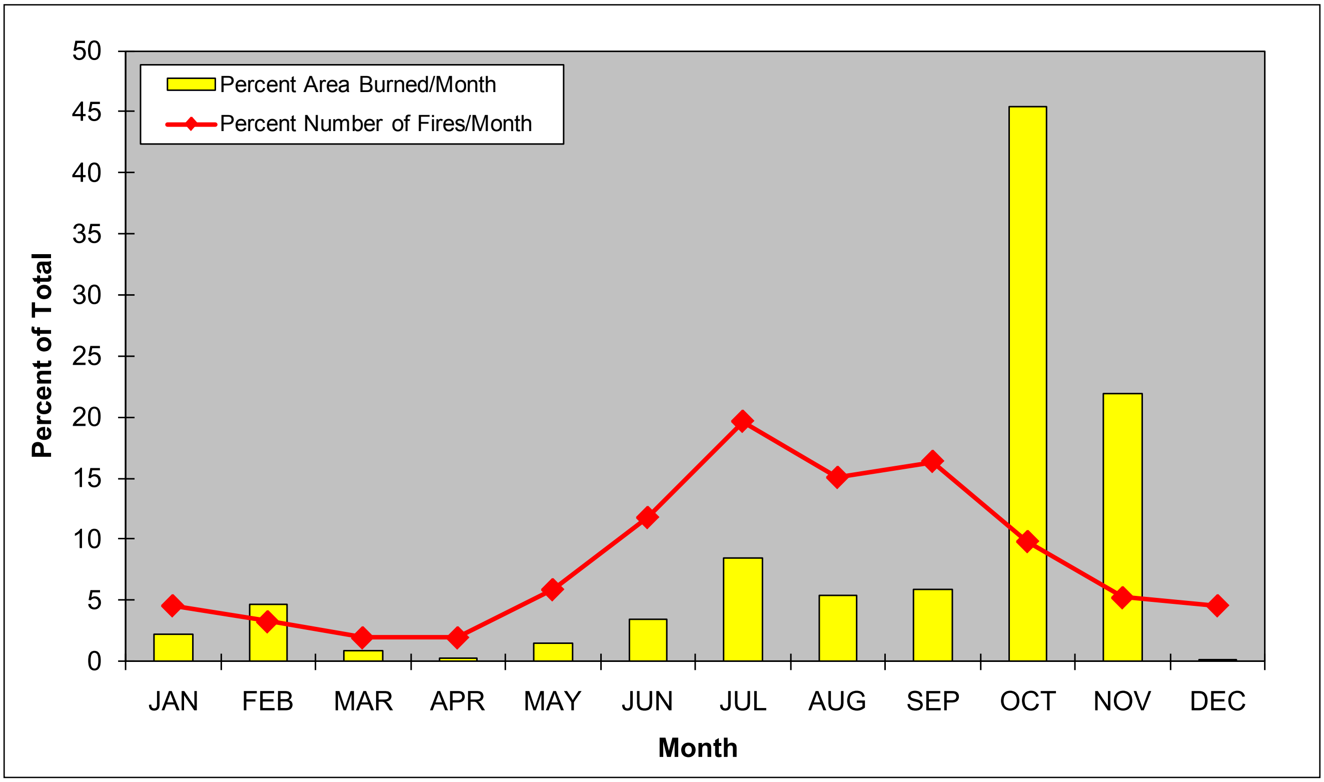
Vegetation plays a significant role in fire behavior and is an important component of the fire behavior models discussed in this report. A critical factor to consider is the dynamic nature of vegetation communities. Fire presence and absence at varying cycles or regimes affect plant community succession, or the natural sequential replacement of vegetation types over time. Succession of plant communities, most notably the gradual conversion of shrublands to grasslands in areas with high fire frequencies and short intervals between fires, and grasslands to shrublands in areas with fire exclusion or long fire-free periods, is highly dependent on fire characteristics, including intensity, duration, and return interval. Additionally, encroachment of non-native plant species from residential landscaping into wildland areas is already occurring and is expected to continue based on the proximity of ornamental landscaping to open space. Consequently, routine maintenance of the fuel reduction areas/defensible space zones, and establishment of high value resource fuel reduction zones in some areas, is needed to maintain reduced wildfire hazard conditions.

In general, biomass and associated fuel loading will increase over time, assuming that disturbance or fuel reduction efforts are not realized. Depending on factors such as fire exclusion activities, mechanical treatments, and prescribed burning, among others, the current vegetation composition and density will continue to change, either through increased volume and the potential establishment of non-native species or the continued degradation of shrublands and persistence of annual grasses.

The Reserve is dominated by southern mixed chaparral, with scattered patches of coastal sage scrub and grassland, as well as isolated oak woodland stands. It should be noted that chaparral and sage are not susceptible to annual burning, but grass cover can burn yearly (Minnich and Scott 2005). Lack of disturbance such as fire and grazing will, over time, allow shrub cover to establish in areas currently dominated by grass cover. Shrub cover, although less likely to burn in the first 20 years during typical weather conditions, will burn under extreme fire events (Moritz 2003). Once established, the shrub cover will increase in volume, and following approximately 20 years, the hazard will increase corresponding with fuel age (Keeley 2005; Moritz et al. 2004). Additionally, as previously mentioned, encroachment of non-native plants into open space areas is likely based on the proximity of ornamental landscaping to undeveloped open space land, in many cases increasing the fuel load and likelihood for higher intensity fire.

As with the changes in vegetative cover in grassland habitats over time, changes in the sage, chaparral and woodland types will also occur with extended periods free of disturbance. Chaparral stands will continue to accumulate biomass and volume, often retaining dead plant material within individual component shrubs. Oak woodland cover types tend to limit ground fuel accumulation with age. Canopy closure serves to “shade-out” understory plants, resulting in mature oak woodland characterized by a dense canopy layer and an understory consisting primarily of leaf and twig litter. Hardwood stands vary in species composition with disturbance, but maintain typically consistent shrub and tree cover with associated ladder fuels allowing the potential for canopy fire spread.

Figure 4-1 Percentage of fires and total area burned per month in Orange County from 1940 to 2008. Data are from Orange County Fire Authority (OCFA 2010a)



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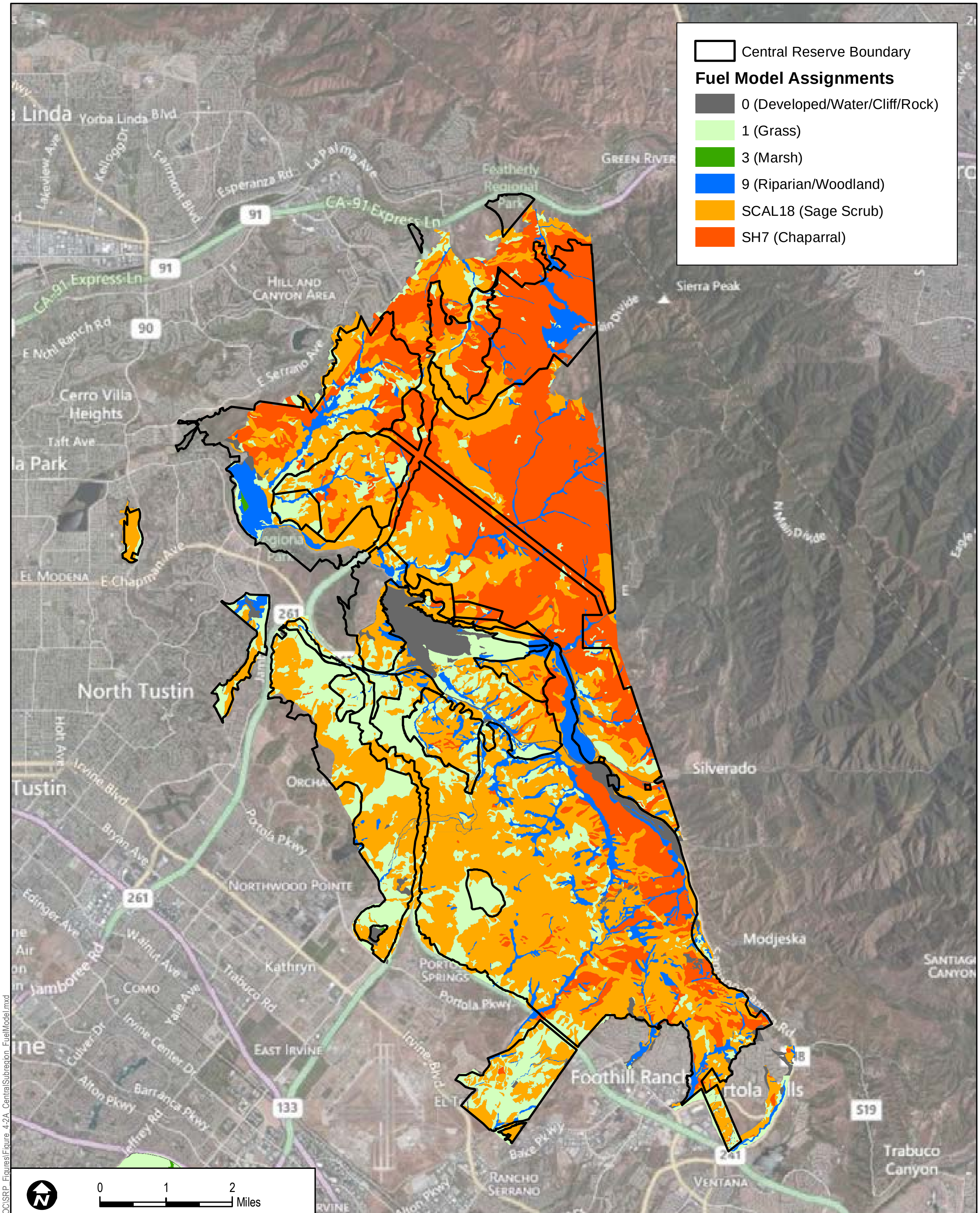

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 4-2A

Central Subregion Fuel Model Assignments

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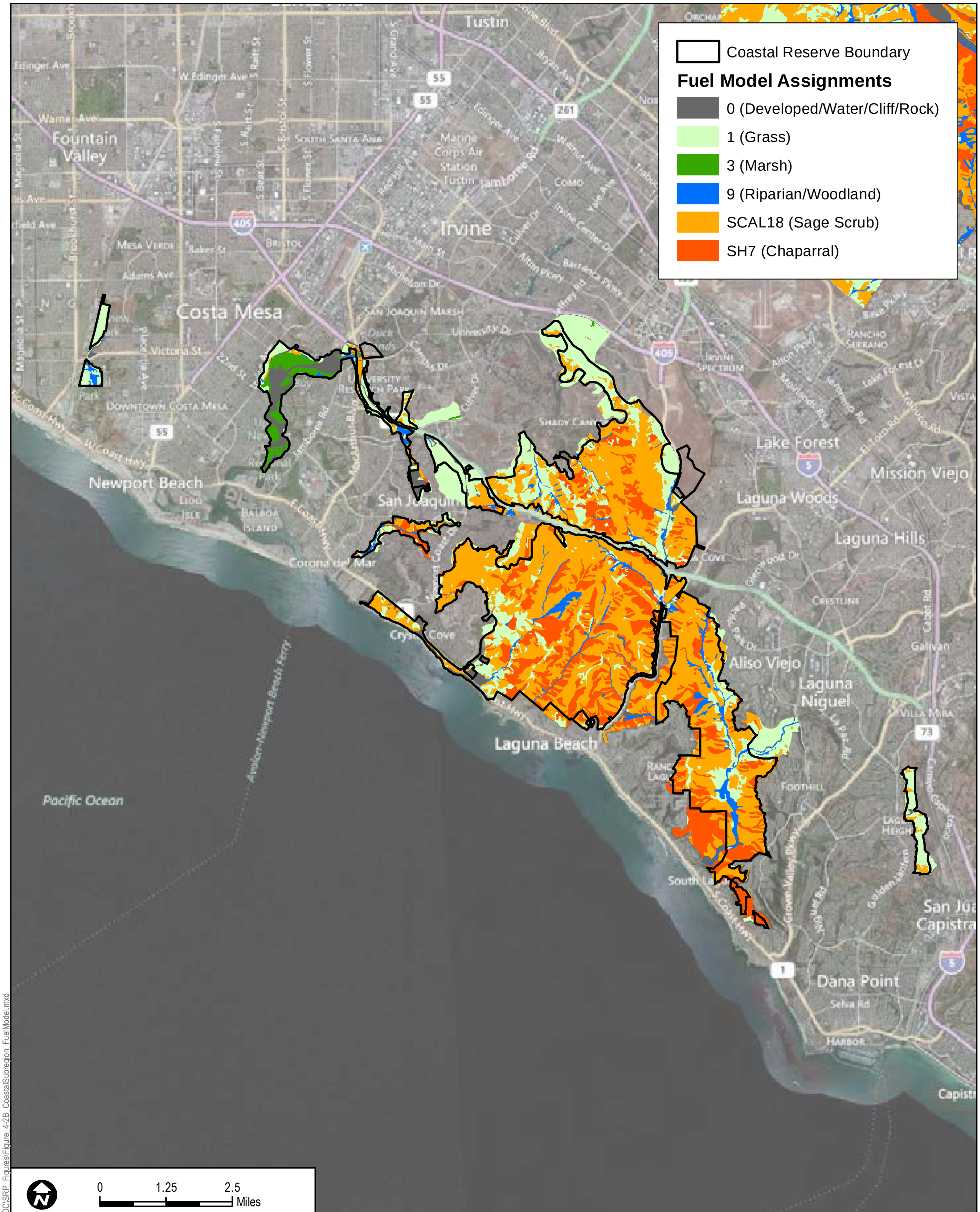

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 4-2B

Coastal Subregion Fuel Model Assignments

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4.2 Fire History

4.2.1 Historical Uses of Fire

Aboriginal use of fire is often invoked as the disturbance that maintained open grasslands and oak savannas in California. Many authors support the view that Indian burning was frequent and widespread (Cooper 1922, Jepson 1910). In southern California, lightning frequency is relatively low while the density of Native Americans was very high (Keeley 2002a). Shrublands in the region were relatively sparse in resources that native people could use. Intentional burning of the landscape was used to open up the shrublands and create a mosaic of shrublands with forbs and grasses that resulted in more resources (ungulates, for instance) for human use. Fires would be too infrequent under the natural fire regime to maintain a mosaic of shrubland and grassland across the region. However, this landscape mosaic could be achieved with intentional burning. The current pattern of vegetation within the region was altered by humans, beginning with the Native Americans and then expanded upon by early settlers. During the 19th Century, fires were repeatedly set in California shrublands to convert them to grassland for livestock grazing. Since the early 1900's fire ignitions have increased with the rise in human population, such that fire frequency now exceeds historical levels (Keeley et al. 1999, Keeley and Fotheringham 2001, Syphard et al. 2007a, b). Although Indians lived in and used the Central and Coastal Subregions, the extent and frequency of intentional burning is unknown at the time of this WFMP preparation.

4.2.2 Fire History in the Reserve

4.2.2.1 Fire Size and Frequency

Orange County has a history of large wildfires, particularly during the fall when Santa Ana winds and dry, hot conditions can result in extremely fast-spreading, uncontrollable fires (Figure 4-1). The largest Santa Ana wind-driven fires occur primarily in October and November. The largest fire in California's recorded history began in Santiago Canyon in the Central Subregion on September 24, 1889 (Keeley and Zedler 2009). Based on newspaper and historic accounts and fire records, the fire pushed by Santa Ana winds lasted several days and burned from Orange County south into San Diego and Riverside Counties. It consumed at least 308,750 acres. Orange County's fifteen largest recorded wildfires between 1914 and 2009 ranged from 10,506 to 69,444 acres (OCFA 2010a, Table 4-2). More than half a million acres burned during this period with 25% of fires accounting for 93% of burned land (Table 4-3). Despite the prevalence of large wildfires, there have also been numerous small wildfires, with the median fire equal to 199 acres.

Six of the fifteen largest fires in Orange County occurred in the Central Subregion (Table 4-2). Most recently, the 2007 Santiago Fire burned 75% of land in the Central Reserve (Leatherman 2009). Nearly 7.0% of the Central Reserve has burned as many as five to six times over the last 94 years (Figure 4-3A and Table 4-4). Over 73,000 acres (64.5%) of the Central Subregion, which includes Reserve land, towns, cities and other natural lands has burned at least once since 1914. In contrast, in the Coastal Subregion only 15,440 acres (16.1%) burned at least once since 1914 and most of this burned land was within the Coastal Reserve (Figure 4-3B and Table 4-4). The Coastal Subregion burns less frequently with most fires small in extent. An exception is the 1993 Laguna Fire which burned 75% of the Coastal Reserve and is the twelfth largest fire recorded since 1914 in Orange County (Table 4-2).

Table 4-2
Orange County wildfires greater than 10,000 acres recorded from 1914 to 2009. Data are from Orange County Fire Authority (OCFA 2010a)

Fire Name	Month	Year	Acres Burned	Subregion
Steward	December	1958	69,444	Outside Reserve (South)
Green River	No Data	1948	41,285	Central Subregion
Paseo Grande	October	1967	39,872	Central Subregion
Freeway Complex	November	2008	30,306	Outside Reserve (North)
Indian	November	1980	28,407	Outside Reserve (South)
Santiago	October	2007	28,359	Central Subregion
Ortega	October	1993	21,010	Outside Reserve (South)
Gypsum	October	1982	19,986	Central Subregion
Owl	October	1980	18,332	Outside Reserve (North)
No Name	No Data	1914	14,830	Central Subregion
Carbon Canyon	November	1980	14,613	Outside Reserve (North)
Laguna Fire	October	1993	14,337	Coastal Reserve
Mateo	October	1989	13,478	Outside Reserve (South)
No Name	No Data	1958	11,774	Outside Reserve (South)
Sierra Peak	February	2006	10,506	Central Subregion

Table 4-3
Summary statistics of Orange County fires recorded from 1914 to 2009.
Data are from Orange County Fire Authority (OCFA 2010a)

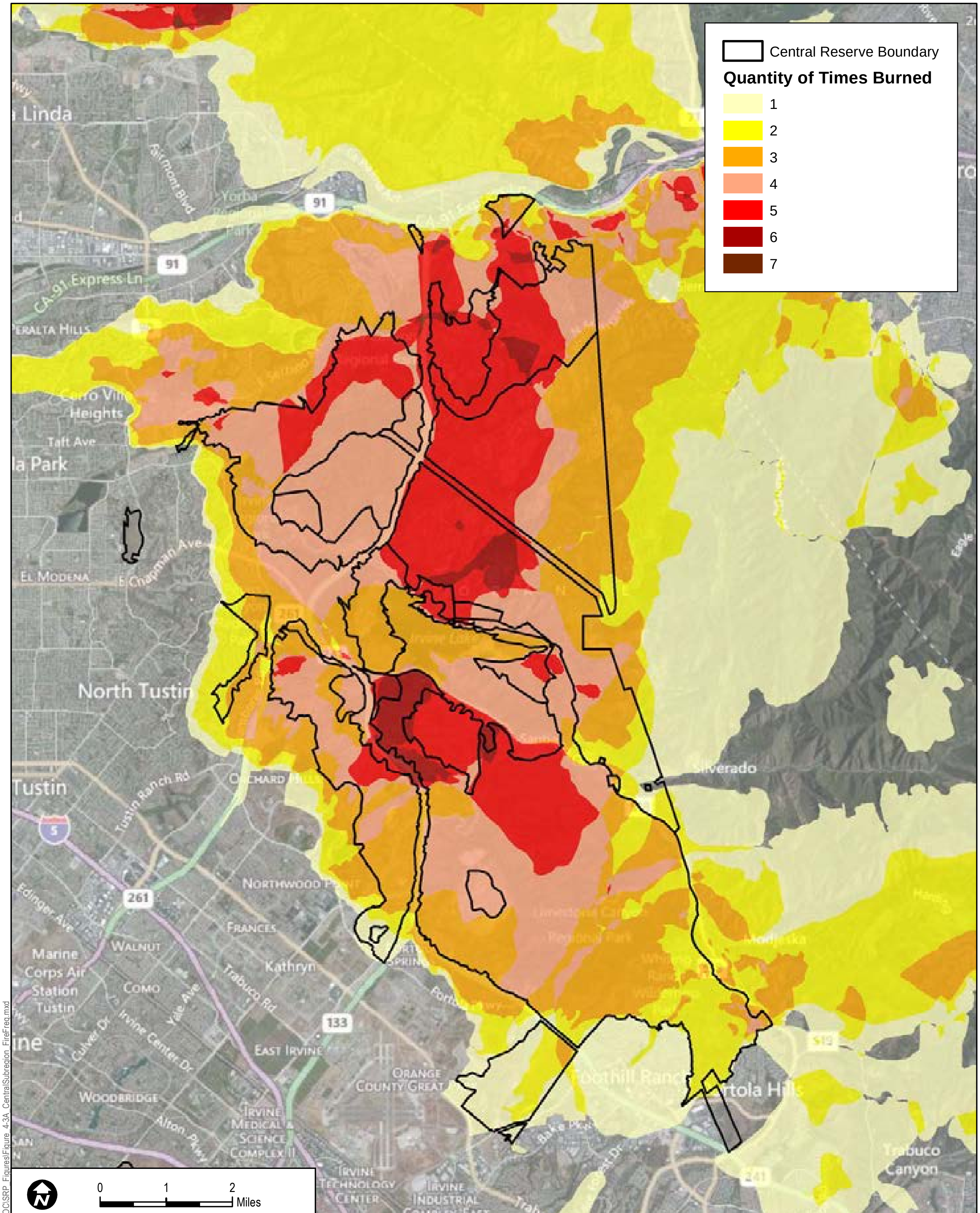
Total Number of Fires	180	
Total Area Burned (Acres)	556,708	
Mean ± Standard Deviation Fire Size (Acres)	3,093 ± 8,168	
Median Fire Size (Acres)	343	
Minimum Fire Size (Acres)	0.15	
Maximum Fire Size (Acres)	69,444	
Acres Burned in Largest 1% of Fires (n=2)	110,729	(19.9% of Total Burned)
Acres Burned in Largest 5% of Fires (n=9)	297,002	(53.3% of Total Burned)
Acres Burned in Largest 10% of Fires (n=18)	401,241	(72.1% of Total Burned)
Acres Burned in Largest 25% of Fires (n=45)	510,502	(91.7% of Total Burned)

Table 4-4
Number of times land has burned from 1914 to 2009 by acreage
and percentage of area within the Central and Coastal Subregions.
Data are from Orange County Fire Authority (OCFA 2010a)

Number of Times Burned	Central Subregion		Coastal Subregion	
	Acres	*Percent Area*	*Acres*	*Percentage Area*
0	39,597.23	35.16%	80,407.80	83.89%
1	30,121.46	26.75%	12,319.17	12.85%
2	13,733.47	12.19%	2,803.91	2.93%
3	11,544.48	10.25%	317.37	0.33%
4	10,058.33	8.93%	0.00	0.00
5	6,965.27	6.18%	0.00	0.00
6	601.24	0.53%	0.00	0.00
Total	112,621.48	100.00%	95,848.25	100.00%

An average of 23.1 ± 19.2 fires was reported each decade in Orange County from 1940 to 2009 (OCFA 2010a). Fire frequency varied between 1940 and 2009, with a trend toward increasing fires over time and a large peak from 2000 to 2009 (Figure 4-4A). The trend in increasing wildfire activity can be attributed in part to human population growth. Orange County is expected to be similar to neighboring counties that show a strong correlation between fire frequency and human population densities (Los Angeles and Riverside Counties) in southern California (Keeley et al. 1999, Keeley and Fotheringham 2001). However, the sharp increase from 2000-2008 is also due to more refined and extensive record keeping, with small fires included in the database in recent years. From 2000 to 2009 there were 29 fires that were 5.0 acres or smaller, compared to only four fires in that size class from 1914 to 1999. In the early decades of data collection, fire records may be omitted, incomplete, or less accurate.

The average number of acres burned per decade was 72,614 ± 36,272 (OCFA 2010a). There was substantial variation in the total area burned with peaks in 1950-59 and 1980-89 (Figure 4-4B). Although there was a large increase in ignitions from 2000 to 2009, the area burned was relatively small. This is the result of numerous small fires burning within the 2000-2009 time period. For example, during that time, only three fires occurred which resulted in burn perimeters exceeding 10,000 acres. Extracting these three fires, the average burn perimeter between 2000 and 2009 is approximately 150 acres. Large wildfire history (> 10,000 acres) for the Central and Coastal Subregions is depicted in Figures 4-5A and 4-5B).



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SOURCE: USGS Topo, Orange County 2011,

FIGURE 4-3A

Central Subregion Wildfire Frequency - 1914 to 2009

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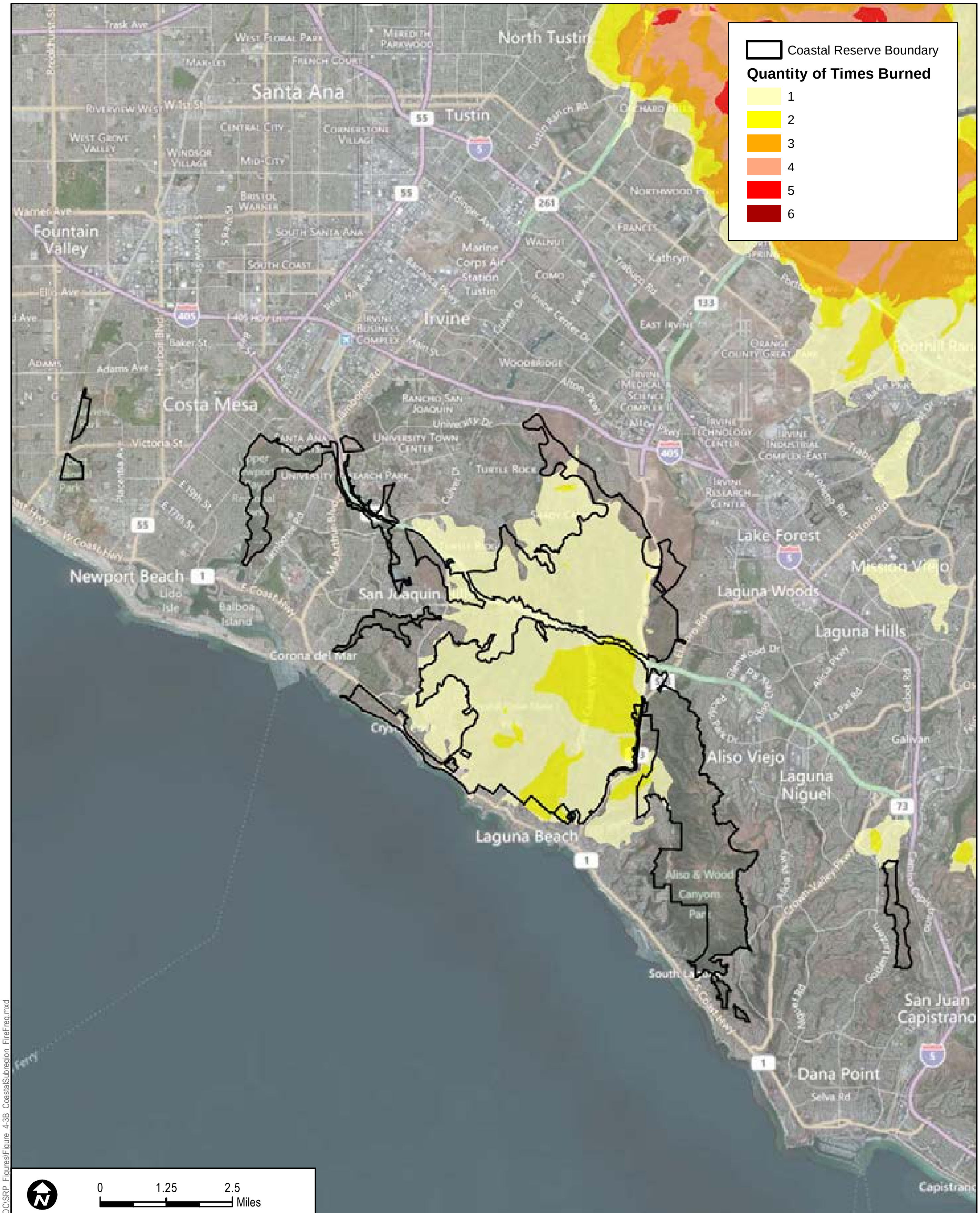

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SOURCE: USGS Topo, Orange County 2011,

FIGURE 4-3B

Coastal Subregion Wildfire Frequency - 1914 to 2009

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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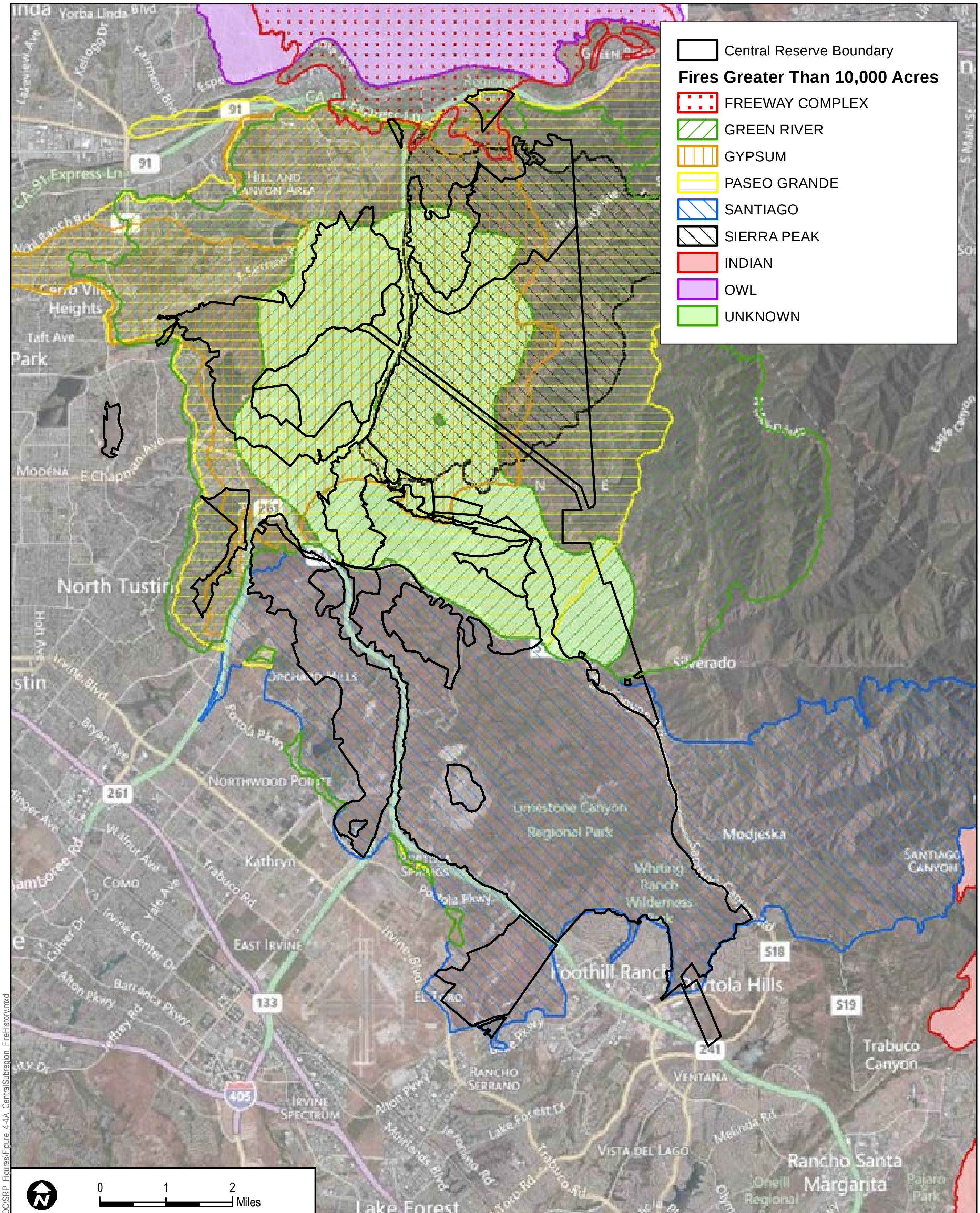

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 4-4A

Central Subregion Wildfire History

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 4-4B

Coastal Subregion Wildfire History

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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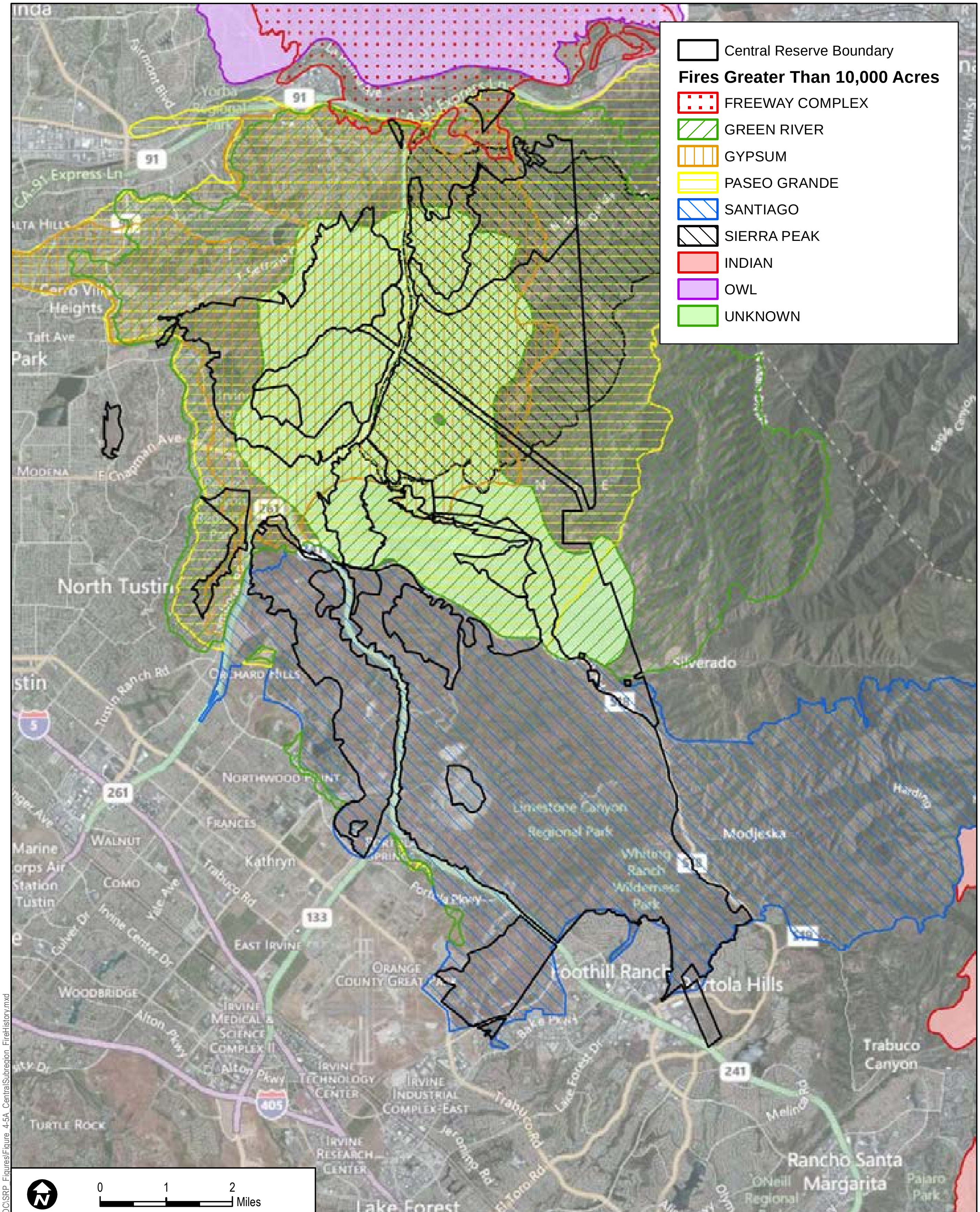

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SOURCE: USGS Topo, Orange County 2011,

FIGURE 4-5A
Central Subregion Wildfire History between 2000 and 2009 that were greater than 10,000 acres

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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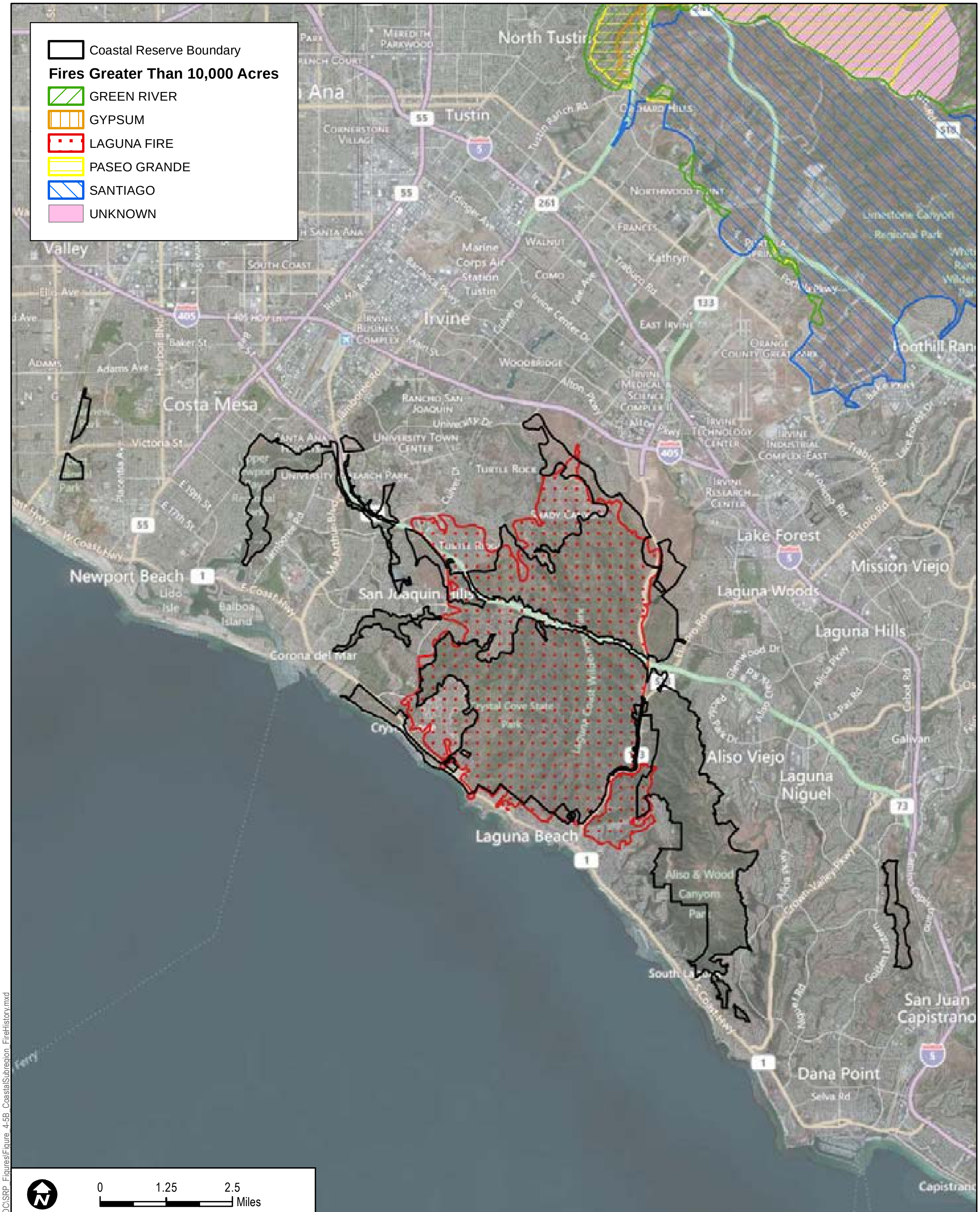

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SOURCE: USGS Topo, Orange County 2011,

FIGURE 4-5B
Coastal Subregion Wildfire History between 1950-1959 and 1980-1989 that were greater than 10,000 acres

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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There is great variability in the number of recorded fires and area burned each year in Orange County (OCFA 2010a; Figures 4-4A, B). It is important to note that most data are for larger wildland fires and do not include smaller fires in developed areas. The average number of fires recorded each year in Orange County was 3.0 ± 2.8 from 1940 to 2009, while the average area burned was 9,590.0 ± 16,602.3 acres. Annual precipitation was also highly variable (Figures 4-6A and 4-6B), although there was no correlation between fire frequency or area burned relative to annual precipitation either during the year of the fire or in previous years. It may be that spring precipitation rather than annual precipitation is more important in determining area burned (Dennison et al. 2008).

Repeated burning is the primary cause for vegetation degradation and conversion within the Reserve. The Fire History exhibits (Figures 4-3A and 4-3B) indicate that the area most significantly and repeatedly burned includes Fire Compartments 10, 11, and 12, with the most recent fires burning in ___, _____, and _____, respectively. Vegetation within these compartments is therefore at risk from future wildfires that occur before they are able to recover and reach a near-climax condition. The first step to determine the best practices to reduce the fire return interval is to determine why fires are repeatedly occurring within these particular Fire Compartments. The next section discusses ignition sources from a regional and project-specific perspective.

4.2.2.2 Causes of Ignition

California Wildfire Causes

Causes of wildfires in California can be classified as either natural (ex., lightning) or anthropogenic, including intentional (arson) and unintentional sources (railroad, escaped prescribed burn, equipment use, vehicle fires, etc.). The California Department of Forestry and Fire Protection (CAL FIRE), through its Fire and Resource Assessment Program (FRAP), maintains a GIS database of wildfire perimeters for the state of California from 1878 to 2008 which includes amongst its attributes a fire cause designation.

Fire frequency in southern California is positively correlated with human population (Keeley et al. 1999, Keeley and Fotheringham 2001, Syphard et al. 2007a, b). A study of fires started in the western United States from 1986 to 1996 found that human caused fires (60% of records) tended to occur year round and to be concentrated in regions near large population centers or in areas with intensive agriculture (Bartlein et al. 2008). In contrast, lightning caused fires tended to occur in the summer and were clumped in relation to weather conditions. Lightning is not a primary source of ignitions on the Reserve, but weather plays a significant role on the Reserve with regards to human caused ignitions that become major events. The human-caused ignitions that may occur any time have lengthened the fire season beyond the normal fire regime. Additionally, the risk of wildfire ignitions may be greatest where the landscape includes an interface or intermix of wildland fuels and closely concentrated,urban populations (Syphard et al. 2007b). Thus, highly urbanized areas with little natural vegetation may be less susceptible to fire than the outlying suburbs and semi-rural locations that are embedded within a matrix of natural lands.

Consistent with data from numerous fire agency jurisdictions, a minimum of 76% of recent fire events in Orange County were human-caused according to data compiled on fire ignitions by Orange County Fire Authority between January 2000 and March 2009 (OCFA 2010b, Table 4-5). The number of fires in this database is much greater than in the fire perimeter database, as it includes data on all fires, including non-wildland fires and fires too small to be mapped. The most common sources of ignition were incendiary ignitions, smoking, misuse of fire, equipment, outdoor fires/campfires, debris/vegetation burning, and power lines. Natural causes of fire accounted for 2.4% of all fires, with lightning causing only 1.2% of all fires. Most of the 22% of fires with an undetermined cause were potentially associated with human activities, so the actual percentage attributed to humans may be substantially higher than 76%.

A study of fire ignitions in the Santa Monica Mountains also documented most fires as human caused and found that spatial patterns of fire ignition were associated with human variables (Syphard et al. 2008). Fires were most likely to occur near roads, trails, and housing developments. Fire ignitions were negatively associated with coastal sage scrub and northern mixed chaparral and positively associated with chamise chaparral, nonnative grassland and other vegetation types.

Likely causes for wildfires in the Reserve will continue to be associated with anthropogenic sources including roadways (tossed cigarette, vehicle accidents, catalytic converter, or car fire), unattended children, arson, lower voltage electrical transmission lines, or gas powered mowers, trimmers or other equipment.

Fire Risk vs. Mitigation Measures

It has been established that the Plan area includes a higher fire danger (compared to non-vegetated areas) as an existing condition due to the terrain, fuels, ignition sources, weather, and history of wildfires. Most wildfires are the result of humans. The most significant fire threat to the Reserve would be primarily from accidents associated with incendiaries, vehicles, tossed-cigarettes, power equipment, arsonists, or intentional sources.

In order to reduce the potential for ignitions from these and other sources, this FPP provides a number of measures that directly address the potential for increased ignitions from these sources that historically have caused fires in the Reserve. The priority hazard reduction program is addressed in Appendix B.

Table 4-5
Causes of 1,605 fires recorded in Orange County from January 1, 2000 to March 15, 2009. Data from OCFA (2010b)

Type of Ignition	Number of Ignitions	Percentage of Ignitions
Natural Causes	38	2.4
Lightning	20	1.2
Other/Undetermined	18	1.2
Human Caused or Related to Human Structures	1,220	76.0
Airplane	1	0.06
Arson	65	4.0
Debris/Vegetation Burning	42	2.6
Equipment	134	8.3
Fireworks	24	1.5
Incendiary	412	25.7
Misuse of Fire	89	5.5
Open/Outdoor Fire or Campfire	51	3.2
Power Lines	39	2.4
Prescribed Fire (Escaped)	1	0.06
Smoking	247	15.4
Vehicle	16	1.0
Other	99	6.2
Undetermined	347	21.6

4.3 Historic and Current Fire Regime

4.3.1 Natural Historic Fire Regime

Coastal sage scrub and chaparral shrublands are characterized by high-intensity crown fires, while grasslands tend to support fast moving but cooler surface fires. Fire spread is a function of wind speed, topography, and fuels. There is substantial debate regarding the natural, pre-20th Century fire regime in southern California shrublands. Clarifying the natural fire regime is important in determining how best to reduce wildfire risk to natural resources in the NCCP/HCP and to reduce risk of fire to lives and property adjacent to the NCCP/HCP.

One view is that the natural fire regime in southern California shrublands is best described by a fine-grain age patch model with frequent, small or moderate sized and low to mid intensity fires ignited by lightning or by Native Americans (Minnich 1983, 1995, 2001, Minnich and Chou 1997). Under this model, lightning strikes ignited many fires that burned small areas creating a mosaic of different age fuels across the landscape. This model assumes fire hazard of chaparral increases with time since the last fire, so that the likelihood of burning varies between patches. Recently burned areas with lower fuel loads may act as barriers to keep fire from spreading, whereas fire preferentially burns in older stands with greater fuel loads. As the population increased in southern California during the early 20th Century, concerted efforts began to suppress fire and reduce threats to land use and watersheds. Fire suppression was most effective for small fires under low energy conditions. In this model, effective fire suppression led to an accumulation of high fuel loads (aging vegetation and accumulation of plant debris) across large expanses of chaparral, resulting in recent large-scale fire events in southern California. Substantiation of this model often pointed to the current pattern of fires in southern California that is in contrast to a more natural fire regime described for northern Baja California where there is no fire suppression. The northern Baja California landscape is thought to consist of a fine patch mosaic of different aged stands of chaparral and does not experience the large wildfires seen to the north in southern California. However, research (Mensing 1999, Zedler 2000, and others) suggests that a direct comparison may not be valid due to differences in fire weather and lack of Santa Ana winds in Baja California. According to the fire suppression model, returning to a natural fire regime in southern California would require fuel reduction to create different fuel age patches of chaparral. In returning to a natural chaparral fire regime in southern California, however unlikely that may be, some research predicts there would be a reduction in large-scale wildfires.

A contrasting view is that infrequent and very large, high-intensity fires are characteristic of the southern California fire regime and predate 20th Century fire suppression efforts. Under this model, large high-intensity crown fires in chaparral are driven by Santa Ana winds in the fall during hot, dry conditions when live and dead fuel moisture is typically low (Keeley and Fotheringham 2001, Moritz et al. 2004, Keane et al. 2008, Keeley and Zedler 2009). To support this view, historical newspaper accounts, unpublished reports, and U.S. Forest Service records were reviewed for southern California fires during the 1800's in order to evaluate the occurrence of large-scale fire events (Keeley and Zedler 2009). It was concluded that the natural fire regime in chaparral consisted of stand replacing fires that varied in rate of spread, intensity, and behavior. Many fires were relatively small in size, but infrequently a fire would coincide with the arrival of Santa Ana winds in the early fall and become a large landscape-scale fire. Thus, under this model, the natural southern California fire regime consisted of many small fires, although the majority of the landscape was burned in a few exceptional fire events associated with Santa Ana winds.

Figure 4-6A Annual precipitation and number of fires in Orange County from 1940 to 2007

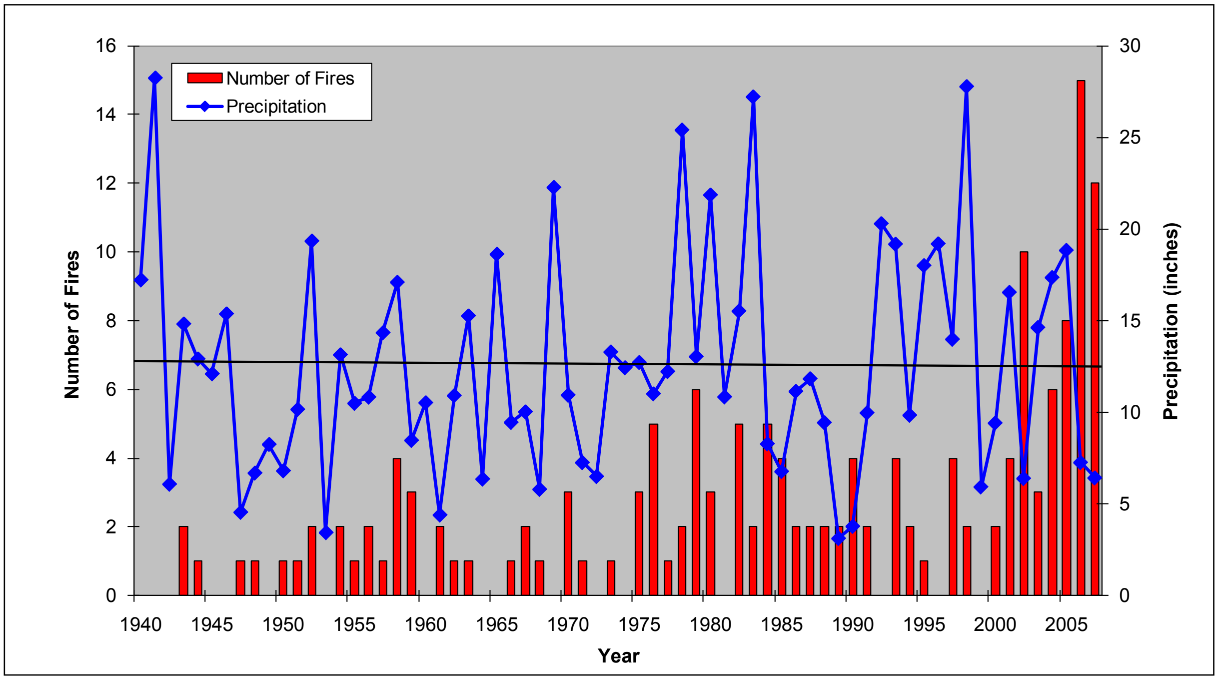

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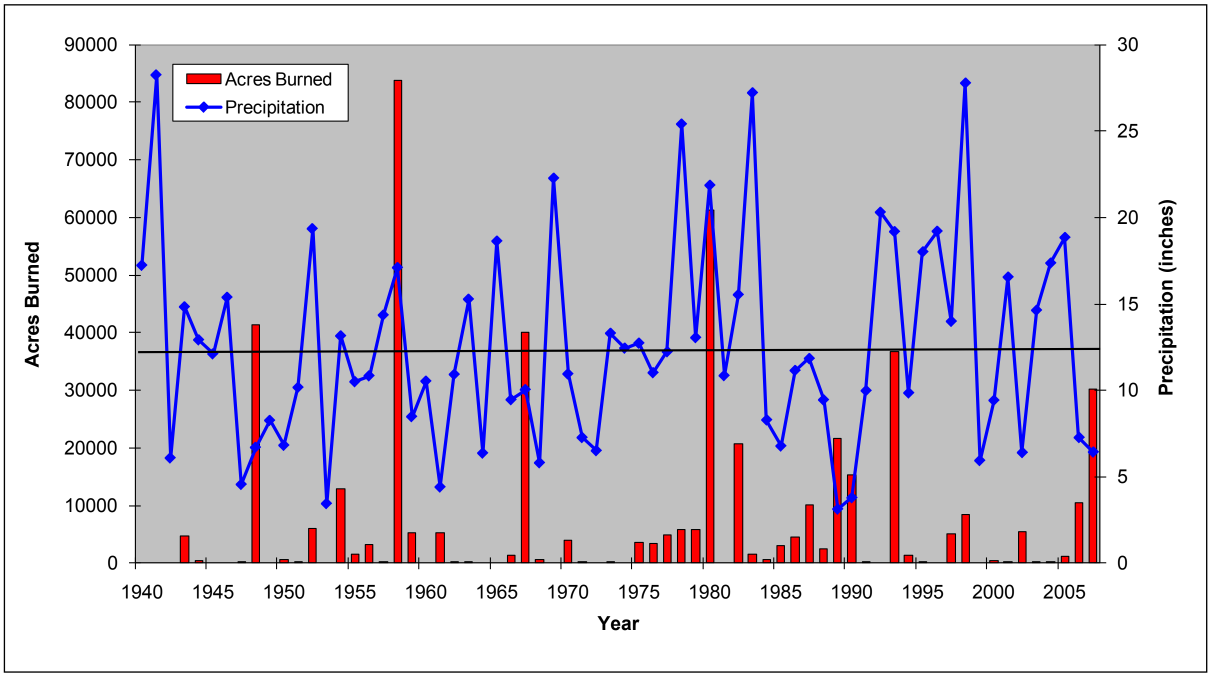
Figure 4-6B Annual precipitation and acres burned in Orange County from 1940 to 2007



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Since 1910 there has been an increase in the frequency of fires in regions of southern California, with the number of fires ignited positively correlated to population density (Keeley et al. 1999, Keeley and Fotheringham 2001). Fires are now more frequent in occurrence because of human caused ignitions and the rate of burning is greater than historically (Keeley and Zedler 2009). Despite this increase in fire frequency, over the last 130 years there has been no change detected in the frequency of large fires (>10,000 ha or 24,700 acres) in southern California (Keeley and Zedler 2009). A study of sediments in the Santa Barbara channel also confirms that over the last 560 years that the frequency of large Santa Ana fire events has not changed (Mensing et al. 1999).

Analyses of recent southern California fires find no strong relationship between fuel age and fire probability in shrublands (Moritz et al. 2004, Keane et al. 2008). Large southern California fires have burned through different age classes of chaparral and coastal sage scrub, including recently burned patches, supporting the view that fire suppression and fuel reduction are not an important factor in the size of these fires. Rather, the large-scale fires are wind driven. Drought and an increase in dead fuels increase sparks and embers that are carried by Santa Ana winds well beyond the fire boundaries to ignite new spot fires (Keeley et al. 2009, Keeley and Zedler 2009). Based on fires in Los Angeles County, it appears that the relationship between fire size and fuel age, temperature, precipitation, and fuel moisture is non-linear (Schoenberg et al. 2003). Fire risk is nearly constant if fuel age and temperature exceed a given threshold and fuel moisture and precipitation are low. In the Santa Monica Mountains, there is a fuel moisture threshold below which the likelihood of large wildfires is increased in conjunction with the arrival of Santa Ana winds (Dennison et al. 2008). An analysis of live fuel moisture and fire history data showed large fires only occurred when live fuel moisture was less than 77% and were more likely to occur at a threshold of 71%. Rainfall during the spring was found to be strongly correlated with the fuel moisture threshold.

4.3.2 Current Fire Regime

A fire regime consisting of many small fires and infrequent large Santa Ana wind driven/Red Flag Warning weather fires appears to be supported within the Coastal and Central Subregions, where there is a mixture of small and large fires dating back to the late 1800's (Tables 4-1, 4-2, Figures 4-4A, B and 4-5A, B; Keeley and Zedler 2009). The current fire regime, particularly in the Central Reserve, is characterized by too frequent fire on portions of the landscape. Some areas have burned up to six times in the last 90 years. With an expanding human population adjacent and surrounding the Reserve that is correlated with increased ignitions, there is potential for fire intervals to become shorter in the future. In addition, human caused fires can occur year round, resulting in fires burning outside the typical fire season (Bartlein et al. 2008), further compressing the fire return interval. Currently, there are few areas within the Reserve that have not recently burned, with 75% of the Coastal Reserve burned in the 1993 Laguna Fire and 75% of the Central Reserve burned in the 2007 Santiago Canyon fire.

4.3.3 Changing Climate and Potential Implications to Fire Regimes

By the end of this century, average temperature in California is expected to increase by 2.7 to 8.1°F (1.5 to 4.5°C) depending on many factors, including future carbon emissions (Cayan et al. 2008). Under projected future climate change scenarios, wildfire risk and the amount of area burned annually in California is predicted to increase (Lenihan et al. 2008; Westerling and Bryant 2008). Generally, it is presumed that if temperatures rise, vegetation communities will gradually shift elevations upward, with grasslands dominating larger areas. For example, grasslands are predicted to expand into woodlands and shrublands, which could further affect wildfire regimes (Lenihan et al. 2008), resulting in more frequent fires and perpetuation of the flashy-fuel dominated landscape. Models of fire damage in a changing climate predict an increase in wildfire-caused property damage in the WUI near major metropolitan areas, such as coastal southern California (Westerling and Bryant 2008). However, there is some uncertainty about future fire regimes in southern California as increasing aridity and higher temperatures could reduce availability of fine fuels, which could lower fire frequency and the conversion of heavier fuels to lighter fuels could result in less intense fires and a reduction in wildfire-caused property damage, especially given the ever-improving ignition resistant building codes. It is also unclear whether Santa Ana winds might be altered in a warming climate. If Santa Ana winds became less frequent or weaker, this could reduce the potential for large wind driven fires.

Wildfires, especially grassland fires, remain a frequent occurrence in portions of the Reserve; however, the average acreage burned per fire has declined since 2000, likely as a result of intentional fire suppression policies. However, fire suppression allows thatch and woody materials to build up over time, thereby increasing fuel loads beyond their natural level. Consequently, when major fire events do occur, they can burn at greater intensities, spread more quickly, and cover larger areas; i.e., they are more likely to be catastrophic. While periodic, smaller fires can benefit ecosystem health, uncontrolled, catastrophic fires (>10,000 acres) can have devastating, and sometimes irreversible, effects on ecological systems.

Wildfire size, return interval, and location within Orange County was analyzed. Derived from historic fire perimeter data (OCFA 2010a), fire size and return interval have the capacity to affect changes in vegetation community distribution and may be affected by climate change. Additionally, wildfire location is an important consideration and is affected by the availability of ignition sources. Areas prone to wildfire are concentrated primarily in the northern portion of the County.

Fire return interval for the County averages 0.5 years, based on available historic fire perimeter data between 1914 and 2009 (FRAP 2012), with intervals ranging from 0 (multiple fires in the same year) to 8 years. A total of 180 fires were recorded in the County between 1914 and 2009 with sizes ranging from 0.1 to 69,444.4 acres. However, reliance on this data set to represent total ignitions and acres burned is not prudent, since the FRAP database does not include most fires less than 100 acres. The 180 recorded fires may represent less than 10% of the actual number of wilfire ignitions in Orange County during the nearly 100 year timeframe.

The FRAP data does provide valuable insight into larger wildfires, ignition points and fire behavior and can be used as a resource for predicting where future large fires will occur. A total of 118 recorded fires burned at least 100 acres, 80 burned at least 500 acres, and 60 burned at least 1,000 acres. Fifteen fires burned in excess of 10,000 acres and are considered catastrophic fires. The trend over the past decade (2000-2009) is a higher number of smaller fires, although the capacity of vegetation in the County to support large and catastrophic fires does exist. Finally, the location of fire perimeters is strongly correlated with public roads and highways, emphasizing the importance of anthropogenic ignition sources in wildfire occurrence in the County.

Evidence that climate change may have begun to affect wildfire activity has been documented in the western United States, particularly in higher elevation forested areas. Westerling et al. (2006) documented a sudden increase in forest fires starting in the mid-1980's with more frequent and longer duration fires and an increase in the length of the wildfire season. The increase in forest fires at higher elevations was attributed to increased spring and summer temperatures and an earlier spring snowmelt.

One assessment of the impact of climate change on California wildfire occurrence (Westerling et al. 2009) indicates a median increase of 30% in large fire occurrence and burned area by 2050, but does not appear to be highly predictable and is and may only apply to high elevation forests. Additionally, based on published research, the effect of climate change on fire frequency is expected to be more pronounced near the end of the century (Lenihan et al. 2003). Consequently, limited change from historic fire return interval and fire size is expected during the NCCP permit term. Because climate change is estimated to affect high elevation areas, the Reserve is not likely to realize perceivable changes in fire regimes driven by a changing climate. Roughly 99% of wildfires in Orange County are started by humans and projections indicate a 50% increase in population this century, it is clear that the focus should be on fire prevention efforts.

4.4 Effects of Fire on Reserve Resources

4.4.1 Fire Effects on Soil Erosion and Properties

4.4.1.1 Post-Fire Erosion

Soil erosion and landslides are characteristic features of the Reserve, given the steep topography, soil characteristics, and tectonic processes. However, soil erosion and movement can be accelerated following fire events and be several orders of magnitude larger than in unburned chaparral (Wells 1987, Barro and Conard 1991). Wildfires can lead to significant hydrological and geomorphical change in burned landscapes (Shakesby and Doerr 2006). This change is through direct weathering of bedrock and soil structure and properties as well as indirect influences of vegetation and soil.

Factors affecting the type and amount of erosion include soil erodibility, steepness of slope, amount and intensity of rainfall, percentage and type of plant cover, severity of the fire and the length of time since the last burn (NPS 2004). In unburned chaparral the vegetation canopy prevents wind and rain from directly contacting the soil and shrub roots help to anchor the soil providing paths for water to penetrate (Barro and Conard 1991). Landslides and dry ravel are the two most important processes in moving soil and are common to chaparral systems in southern California. Dry ravel erosion can be even greater than erosion caused by rainfall. In the first two to three years following a fire, steep hill slopes can fail under both wet and dry conditions. Typically failure is in the form of slides and formation of gullies. Landslides are not usually initiated by fire events as shrub and tree roots below the soil help maintain stability, even if the plants are killed by the fire (Booker 1998). Slopes dominated by shallow rooted non-native grasses are more likely to fail after a fire because the roots do not help to stabilize the slope.

Fire in shrubland communities can affect soil infiltration rates with a reduction in water storage capacity. Following high-intensity fires, plants and litter can vaporize. 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). This creates a hydrophobic layer that prevents rain from permeating to the deeper soil layers and causes water to pool under the shallow soil layer. This can lead to overland flow of sediments from hillsides and cause channel scouring. Increased runoff after a fire often causes streams to flood and can also result in channel scouring. Sediments carried into the streams can cause debris flows that increase downstream sedimentation and alter stream morphology. Post-fire sediment erosion and transport within one or two years after fires in the western United States can deposit three times more sediment from channels (240 tons/ha) than sediment from hillslopes (82 tons/ha; Moody and Martin 2009).

Debris flows in burned areas often follow a fire during precipitation events and in some cases can be very destructive of life and property (Barro and Conard 1991, Cannon et al. 2008). The most destructive debris flows tend to occur in steep sloped drainages with underlying sedimentary rock and lack of a hydrophobic soil layer (NPS 2004). The volume of debris flows following fires in the western United States is best explained (R^2 = 83%) by variables quantifying basin area with slopes greater than 30%, area with moderate and high fire severity, and total storm rainfall (Gartner et al. 2008). A study of 68 recently burned areas in southern California showed that debris flows were often initiated in response to long duration low intensity storms (Cannon et al. 2008). The flows started after two to sixteen hours of low intensity rainfall and the potential for flows was greatest in the first year following a fire.

4.4.1.2 Controlling Post-Fire Erosion

Erosion can be reduced by ground surface cover that reduces the impact of rain drops on bare soil and slows transport of water to allow greater infiltration. Historically, grass seed was applied to burned slopes as an attempt to stabilize them. However, there is little evidence that grass seeding decreases erosion (Beyers 2004, Groen and Woods 2008). Other methods to decrease erosion have varying levels of success depending on site conditions (Beyers 2004). In general, post-fire seeding of steep chaparral hillsides is not effective as soil movement processes will overtake the ability of germinating grass seeds to stabilize soils (NPS 2004). A study of erosion control in a forest in Montana found that aerial grass seeding had no effect on erosion rates, whereas straw mulch reduced erosion by 87% relative to the control in the first year after fire (Groen and Woods 2008). In the second year after fire, neither aerial seeding nor straw mulch provided a reduction in erosion. If grassland becomes established at the expense of native shrubland and perennial grassland, there can be subsequent problems with increased soil slippage (Terwilliger and Waldron 1991, Booker 1998, Gabet and Dunne 2002) and greater fire frequency (Zedler et al. 1983, D'Antonio and Vitousek 1992). The introduction of nonnative grasses for slope stabilization can also detrimentally alter shrubland ecosystems. There are a variety of approaches and methods available that can minimize soil erosion, providing immediate cover while fostering growth of native plant mixes over time. These approaches may be useful, if funding allows, for use in the Reserves in strategic areas following wildfire and are discussed in more detail in Volume III.

4.4.1.3 Post-Fire Soil Properties

Fire can directly influence the physical and chemical properties of soils. Soils in chaparral and coastal sage scrub are often limited in nutrients, especially nitrogen and phosphorous, which become tied up in standing biomass as stands get older (Barro and Conard 1991). Plants often reabsorb these nutrients before dropping leaves so that nitrogen and phosphorous can be at greater concentrations in the living biomass than in the soil. Some portion of existing nitrogen will be volatilized by fire, the amount depends on fire intensity (NPS 2004). Mineral and nutrient cycling in fire type ecosystems is dominated by ashing (Zinke 1977). Although the total nitrogen pool decreases in a fire due to volatization, more nitrogen is released from existing plant biomass and becomes available to new plants (Barro and Conard 1991). Most nutrients are deposited on the soil surface where they are readily taken up by plants. Nitrogen remaining in ash is highly available in the form of ammonia nitrogen, or after nitrification, as nitrate nitrogen (DeBano et. al. 1977). The quantity of nutrients depends on how much and how thoroughly the organic matter burned and in later years post-fire, how much has been leached from the soil (Barro and Conard 1991). Herbaceous annuals may lock up some of the nutrients on the site and release them later into the leaf litter for other plants to use. There are also shrubs that can fix nitrogen, such as deer weed and some Ceanothus species, and make nitrogen available for use by other plants.

4.4.2 Plant Community Response to Fire

Each plant community responds differently to wildland fire depending upon fire intensity and frequency, environmental characteristics of the site, and the composition and abundance of plant species and seed banks prior to the fire. The following sections describe responses of plant communities in the Central and Coastal Subregions to fire.

4.4.2.1 Coastal Sage Scrub and Chaparral Responses to Fire

Coastal sage scrub shrubs have lower biomass, net primary productivity, and leaf litter, and are smaller and do not grow as densely as chaparral shrubs (Gray and Schlesinger 1981). These factors contribute to lower fuel loading and discontinuity in fuels in coastal sage scrub compared to chaparral (NPS 2004). Many coastal sage scrub and chaparral shrubs contain high levels of waxes, oils, terpenes and fats that make them flammable (Barro and Conard 1991). Since the coastal sage scrub canopy is more open, grasses and herbaceous cover can occur within interspaces between shrubs and carry fire and increase susceptibility for ignition. These characteristics lead to different fire behavior, often with reduced fire intensity in coastal sage scrub compared with chaparral. In chaparral, stand age, pre-fire shrub density, and the shortest interval between fires significantly affect fire severity (Keeley et al. 2008). While fire intensity in chaparral increases with fire interval, a decline in leaf litter in coastal sage scrub over time can decrease fire intensity at longer fire intervals in that plant community. Although the total annual litter fall in coastal sage scrub is similar to 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 accumulation (Gray and Schlesinger 1981). Fire intensity in coastal sage scrub is likely more dependent on weather conditions than on stand age (Malanson and O'Leary 1982). More intense fire suppresses crown sprouting and consequently promotes herb flora. Fires can burn in young stands of chaparral and coastal sage scrub as well as older stands with higher fuel loads (Barro and Conard 1991).

4.4.2.1.1 Functional Shrub Group and Post-Fire Establishment

Fires in coastal sage scrub and chaparral are typically crown fires that consume above ground biomass while leaving below ground roots (Barro and Conard 1991). Some adaptations of shrubs to fire include the ability to re-sprout after a fire and long-lived seeds that germinate only after exposure to fire. Shrubs can be categorized in three functional groups based on mode of recovery after fire. Many coastal sage scrub and chaparral shrubs are facultative seeders with the potential for basal resprouting as well as growing from seeds following a fire (Malanson and Westman 1985, Keeley et al. 2006). Relatively few coastal sage scrub shrub species, compared with chaparral species, are obligate seeders. These species do not re-sprout following a fire and instead rely solely on seed germination and seedling establishment. Some chaparral and coastal sage scrub shrub species are obligate resprouters as their seeds do not survive fire and they rely on resprouting during post-fire recovery. Obligate resprouters may establish seedlings during fire free periods.

Coastal sage scrub shrub species often re-sprout following a fire, grow quickly and produce multiple seedling cohorts by the second year (Keeley et al. 2006). With rapid crown sprouting and small wind dispersed seeds, sage scrub communities are often fire successional to chaparral (Cooper 1922, Wells 1962). Some obligate seeding shrubs, such as many *Ceanothus* species, are delayed in reaching reproductive maturity and rely on fire for seed germination, producing a single post-fire seedling cohort that results in same age stands (Keeley et al. 2006). These shrubs can exhibit high seedling recruitment in the first year post-fire, allowing them to persist through multiple fire cycles (Thomas and Davis 1989). Other obligate seeders have more rapid growth and can produce multiple age seedling cohorts resulting in a mixed age population structure. Post-fire obligate resprouting subshrubs mature quickly and begin seedling establishment the second year post-fire, whereas the obligate resprouting shrubs can take several years before achieving seedling recruitment (Keeley et al. 2006).

Fire frequency can influence the composition of functional groups in southern California shrublands. Model simulations at three levels of fire frequency predicted substantially different community composition in terms of species and obligate seeder, facultative seeder and obligate resprouter groups (Franklin et al. 2001). Over a 500 year period of infrequent fires (1,050 year fire cycle) southern California shrublands would likely be dominated by the most shade tolerant and long-lived species with shorter-lived, shade intolerant seeders and resprouters disappearing from the community. Under a moderate fire regime (70 year fire cycle) facultative seeders would persist along with long-lived shade tolerant species, whereas the obligate seeder would disappear. In a high frequency fire regime (35 year fire cycle), all groups would persist.

The timing and intensity of a fire, precipitation in the first year after a fire, topography, and shrub size can influence survival of individual shrubs and establishment of seedlings following a fire, thereby affecting community composition during post-fire recovery (Barro and Conard 1991). The resilience of a particular stand of coastal sage scrub largely depends on the resprouting vigor of dominant shrub species. Sites dominated by vigorous resprouters tend to be more competitive than sites with both weak and strong resprouters, although intense fires can kill even strong resprouters. Sites with both strong and weak resprouters are more likely to experience permanent alteration (Westman and O'Leary 1986). For chaparral shrubs, obligate resprouters are most versatile in conditions under which they can grow following fire (Pratt et al. 2008). Obligate seeders tend to survive best in full sun, whereas obligate and facultative seeders survive better in the shade. Obligate resprouters also do well in full sun. Chaparral plant communities often change in composition after a fire depending on shrub mortality and post-fire recruitment (Barro and Conard 1991).

4.4.2.1.2 Post-Fire Succession

Generally, annual herbs dominate during the first year after a fire in coastal sage scrub or couple of years in chaparral, but tend to decline in subsequent years as shrubs attain greater cover (Westman 1979, Keeley and Keeley 1984). Herbaceous plants can account for 84% of the total plant cover in the first year (O'Leary 1988). Typically a few species are dominant and show preferences for different slope aspects and in some cases for particular substrates.

Perennial herb understory species primarily grow from re-sprouts and show low recruitment from the soil seed bank (Keeley and Keeley 1984). Unlike herbaceous annuals, the overall diversity and abundance of perennial understory herbs remains constant the first few years following fire. New species continue to recruit into recovering coastal sage scrub, reaching a peak at 5 to 10 years after a fire. After the peak in diversity, there is a general decline in perennial understory herb species. This may be attributed to dominant shrub species increasing cover, thereby shading out understory herbs.

In coastal sage scrub shrubs, most species tend to re-sprout the year after fire and in one study 70% of the pre-fire shrubs had re-sprouted and attained 33% cover by the end of the second post-fire growing season (Keeley and Keeley 1984). Establishment of seedlings from the pre-fire soil seed bank was low, especially in comparison to chaparral. Shrub seedlings in chaparral tend to be observed primarily two years after fire, possibly as a result of seed produced from first-year sprouts (Westman 1982).

4.4.2.1.3 Environmental Factors Affecting Post-Fire Recovery

A few studies have shown that fire intensity and ash and char products can affect germination of herbaceous and shrub species following fire (O'Leary 1988, Moreno and Oechel 1991). Chamise, a facultative seeding chaparral shrub, can be sensitive to fire intensity with reduced seedling production as fire intensity increases. Cup-leaf ceanothus (*Ceanothus greggii*), an obligate seeding chaparral shrub, exhibited seed germination that was resistant and even enhanced by higher fire intensity and also showed earlier germination with increasing intensity. Annual plants associated with fire were also resistant to fire intensity, whereas more widespread and less fire dependent species were vulnerable to increasing fire intensity. In contrast, one study found fire severity had little long-term effect on vegetation recovery, community recovery or erosion (Keeley et al. 2008). However, fire severity did have opposite effects on different functional groups. Exotic plants were sensitive in the first year to high fire severity and the percentage of non-native plant species in the post-fire community declined as fire severity increased.

In addition to fire characteristics, the amount and timing of precipitation can influence post-fire recovery and shape coastal sage scrub and chaparral community composition and diversity (Keeley et al. 2005b). The age and composition of the pre-fire shrub community can also influence the post-fire shrub community (Grace and Keeley 2006). A recent study measured five years of post-fire recovery in 90 sites distributed across southern California coastal sage scrub and chaparral shrublands and developed models to identify how post-fire species diversity was related to fire characteristics and local and landscape-scale environmental attributes (Grace and Keeley 2006). Species richness was highest in the first year after a fire with a decline in richness over time and some variation explained by annual precipitation patterns. Highest species richness occurred in areas with moderate to high population abundance, high plot heterogeneity, soils with low nitrogen and high sand content, low fire severity, and young pre-fire stand age. These results indicate local site conditions influence species richness and these local conditions are in turn related to landscape level attributes.

Factors such as slope, aspect, and substrate type appear to have an effect on distribution patterns of herbs in sage scrub after fire. Variability in response may be driven by temperature and available moisture associated with insolation differences on opposing slopes (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 and cover on north-facing slopes was higher than on south-facing slopes. This was attributed to the relatively mesic conditions under which the particular sub-association develops (O'Leary 1990).

In a five year study of fire recovery in coastal sage scrub and chaparral, species present immediately after the fire were dominant early in succession but by the fifth year, half of the species were colonizers although their contribution to overall cover was less than 15% (Keeley et al. 2005c). Fire severity differentially influenced post-fire diversity depending on the plant's life form (Keeley et al. 2005b). Early post-fire diversity was influenced by species with life histories of long dormancy in soil seed banks and whose germination was triggered by the fire. Precipitation was also associated with post-fire diversity responses. Diversity by the fifth year was composed of species different from those immediately following the fire with 60% turnover in species. This turnover was attributed to the flow of other post-fire species onto the site from adjacent areas, colonization by non-native species, and loss of post-fire endemic species (Keeley et al. 2005 b, c).

Because so many factors in the environment contribute to post-fire recovery, patterns of recovery between sites can be variable and complex. There can be marked differences in recovery between interior and coastal populations of sage scrub (Keeley et al. 2005c). Inland sage scrub recovery can be slower than for coastal sites and pre-fire stand age of inland sites is positively related to fire severity and negatively to post-fire cover. In one study inland sage scrub showed greater change in post-fire composition because of reliance entirely upon seedling recruitment (Myers and Ellstrand 1986). Re-sprouting of dominant shrub species rarely occurred. Recovery of pre-fire species composition and cover on inland sites can be dependent upon the existing native seed bank or seeds brought onsite by wind or wildlife species.

4.4.2.1.4 Increasing Fire Frequency and Invasive Annual Plants in Shrublands

It has become apparent that coastal sage scrub is converting to non-native grassland across large portions of the southern California landscape (Minnich and Dezzani 1998, Stylinski and Allen 1999, Talluto and Suding 2008), including within the Central and Coastal Reserve. A primary factor in the conversion of coastal sage scrub to non-native grassland is high fire frequency, which favors competitive displacement of native shrubs by exotic grasses (Zedler et al. 1983, Keeley et al. 2005a, Talluto and Suding 2008). Similarly, in chaparral, high fire frequency opens up the shrub community to invasion by exotic annual grasses and forbs (Zedler et al. 1983, Barro and Conard 1991).

An unusually short fire return interval can cause the failure of many shrub species to re-sprout or reseed (Zedler et al. 1983). 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. In a study of shrubland post-fire recovery, non-native annual plant cover and species richness were positively correlated with the number of times a site burned and were negatively correlated with time since the last fire. Woody plants can competitively displace non-native grasses under a longer fire regime which allows shrubs the time to mature and produce seeds and to shade out grasses (Keeley et al. 2005a).

Since 1910 there has been an increase in fire frequency in southern California correlated with a growing human population (Keeley et al. 1999, Keeley and Fotheringham 2001). The introduction of nonnative annual plants into shrubland systems can alter fire behavior and the fire regime to favor establishment of annual grasses (D'Antonio and Vitousek 1992, Keeley 2006). In intact shrublands, fires typically burn as intense crown fires, whereas when grasses are introduced into the system, fires burn more on the surface with a reduced intensity (Keeley et al. 2008). Grasses are also highly flammable which increases the potential for ignition and can lead to more fires. This increase in fire frequency and reduction of fire severity provides a positive feedback facilitating conversion of shrubland to nonnative annual grassland.

4.4.2.1.5 Fire Management of Shrublands to Reduce Risk of Invasive Plants

Historically, fire suppression has been largely ineffective in reducing the area burned in coastal sage scrub and chaparral (Keeley and Zedler 2009), including Tecate cypress. Reducing fuel loads by mechanical thinning and prescribed fire facilitates invasion of exotic annual grasses and forbs, which increases the prevalence of flashy fuels and enhances wildfire ignitions (Keeley 2006, Potts and Stephens 2009). A study of fall, winter, and spring prescribed fires versus fall and spring mastication fuel reduction treatments in chaparral found that treatment type had greater effect on native and nonnative plant responses than the season in which the treatments were undertaken (Potts and Stephens 2009). Mastication resulted in 34% greater cover of nonnative annual grasses than fire treatments. Winter and spring prescribed fire treatments were most resistant to invasion by exotic plants.

Seeding of burned areas with nonnative grasses to prevent erosion has been shown to have little effect on erosion but large adverse effects to natural shrublands (Beyers 2004, Keeley 2006). Fuel breaks provide another point of entry for invasive plants into native shrublands (Keeley

2006 and 2011,Merriam et al. 2006). A study of California fuel breaks found nonnative plant abundance was 200% higher on fuel breaks than in adjacent wildland areas (Merriam et al. 2006). Fuel breaks constructed by bulldozers had the greatest relative cover of nonnative plants while canopy cover, litter cover, and duff depth were lower than for other methods.

It is becoming apparent that some native southern California shrublands are being exposed to fire frequencies that are higher than "natural" and that facilitate type conversion to nonnative annual grassland. This poses a serious threat to coastal sage scrub and chaparral communities and to sensitive species conserved by Orange County's Central and Coastal NCCP/HCP. The Nature Reserve of Orange County and individual landowners/managers spend hundreds of thousands of dollars annually to reduce invasive plant species and to restore native shrublands within the NCCP/HCP (Harmsworth Associates 2008, NROC 2008). As a result, fire management practices within the Reserve must be carefully selected and implemented to reduce the threat of invasive exotic plants and to substantively reduce the risk of fire. There are several methods for reducing the occurrence of wildfire on the Reserve. Moritz et al. (2004) and Cary et al. (2009) point to ignition reduction and strategic fuel reduction as keys to reducing threat. Recommendations for reducing fire occurrence and effects on the Reserve are discussed in more detail in Appendices A-1 through A-3.

4.4.2.2 Other Plant Community Responses to Fire

4.4.2.2.1 Valley Needlegrass and Non-Native Annual Grassland

Grasslands are characterized by lower fuel loading and a continuous fuel bed and a readily ignitable (flashy fuel) in which fire can spread rapidly (NPS 2004, Higgins et al. 2008). Grass fires are surface fires and relatively cool in contrast to the crown fires found in many shrublands and forests. Grasslands are adapted to frequent fires in the summer and fall making them a fire resilient plant community.

Native Valley needlegrass grassland is tolerant of high fire frequencies but is not dependent on fire (NPS 2004). Managed fire at the appropriate time can help restore native grassland by killing nonnative grasses and seeds in the soil bank, with a particularly strong effect in the first year (D'Antonio, et.al. No Date). To keep exotic annual grasses from re-establishing in native grassland requires active restoration of native grasses and potentially rotating prescribed burns at the appropriate time. Because fire is such an integral component of native grasslands but is undesirable in much of the Reserve's scrublands, management for the replacement of nonnative grassland with native grasslands may not be possible given the current fire return interval and the desire to minimize fire. Prescribed fire is not considered a probable fuel treatment at the time of this WFMP, but circumstances may change and allow an active prescribed fire program at some time in the future.

4.4.2.2.2 Riparian

Under typical weather conditions, fire tends to stop or spot over riparian woodlands with little impact to trees or understory (NPS 2004). In other cases, especially under extreme fire weather conditions, riparian vegetation can be heavily burned, including total top kill and consumption. Fire severity in the understory may be decoupled from fire severity in the overstory especially when soil moisture is high (Halofsky and Hibbs 2009). Recovery after a fire can be by resproutering in the first year, while seedlings may become established in subsequent years. Weedy, invasive species can increase fire risk, particularly giant reed (*Arundo donax*), which can grow very dense with an accumulation of flammable biomass. Riparian areas within areas with higher than normal fire return intervals may be in need of strategic fuel reduction. The efficacy of carrying out this type of operation is discussed in more detail in Appendix B.

4.4.2.2.3 Woodland

Coast live oak recovers fairly well after fire, largely through resproutering. Acorns are often consumed by the fire so seedlings are seldom established in the first year. Larger oaks tend to survive better, although if fires are too frequent oaks may fail to re-sprout and reestablish. A study of fire scars in post fire-oaks in Tennessee, found that larger oak trees had a lower percentage of their circumference killed or had a higher resistance to fire scarring than young trees (Guyette and Stambaugh 2004). Another study of oaks in deciduous forests in Kentucky showed that repeated prescribed fires negatively impacted growth and survival of oaks and oaks with smaller pre-burn basal diameters showed the lowest post-burn survival (Alexander et al. 2008). Fires can also lower seedling establishment and delay growth and recruitment of individuals into the population. Oak woodland observations in Southern California since 2007 wildfires indicates that many oak trees were lost completely, others were top-killed, but recovered from basal sprouting, while others have experienced varying levels of damage, but have stabilized and will persist on the landscape for extended periods. Some of the damaged trees will succumb prematurely to various insect and disease pests that are attracted to stressed trees that are unable to adequately respond to colonization (Personal observations 2007-2012).

4.4.3 Wildlife Responses to Fire

4.4.3.1 General Effects of Fire on Wildlife

Under natural conditions, fire is the most common disturbance in many plant communities, including coastal sage scrub and chaparral. Fire can directly affect wildlife by causing injury or mortality or indirectly affect wildlife by altering food availability, cover and other resources. Both direct and indirect effects can alter the diversity and abundance of wildlife species and influence ecological processes. The positive role of fire in maintaining a mosaic of habitats has often been emphasized (Quinn 1979, Fox and McKay 1981, , Pyne 1984). Management actions which are employed to minimize fire or reduce the number of ignitions and acres burned will need to be weighed against the potential impacts the actions may have on wildlife and the anticipated benefits to be realized. The following sections introduce fire effects on wildlife, including Central and Coastal sensitive species.

Direct impacts to wildlife from fires have traditionally been thought to be less important than indirect impacts. However, wildfires can result in substantial mortality. Chew et al. (1959) found 43 dead mammals and two dead birds on 1.7 acres following a chaparral fire in Malibu, southern California. Other researchers have found low mortality of birds and animals from wildfire (Howard et al. 1959, Komarek 1969, Biswell 1989). However, these studies were conducted primarily with controlled burns, which typically burn with less intensity and slower rates of spread than wildfires. As evidenced in the 2003 Cedar Wildfire in San Diego County, fast moving Santa Ana fires can result in greater mortality and injury to wildlife than smaller, slow moving fires. Kaufman et al. (1990) listed the direct causes of mortality in fire as burns, heat stress, asphyxiation, physiological stress, trampling, and predation while fleeing.

Indirect effects of wildfire may be great, as fire substantially alters wildlife habitat, changing the availability of food, cover and other resources, Lawrence (1966) found that many species in burned chaparral in the Sierra Nevada Mountains were exposed to high levels of predation in the bare ash following fire, with most small mammals and brush dwelling birds decreasing rapidly in abundance while predatory birds and mammals increased. Over time, brush-dwelling species also declined as forbs and grasses increased, whereas grass-dwelling species increased. No species were eliminated altogether. 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. The direct and indirect impacts fire has on wildlife species are important considerations when defining fire compartments and fire management units and determining the appropriate risk reduction prescriptions throughout the Reserve. Fire compartments and management units are detailed in Section 5.2.

4.4.3.2 Effects of Fire on Insects

There is not a lot known about the effects of fire on insect communities. Some studies have found a decrease in arthropod abundance and diversity, whereas others have found increases

(Komarek 1969, Hogue 1993, Niwa et al. 2001). Several factors influence survival of arthropods during fire, including fire intensity, seasonality, and amount of litter and other fuels burned (Niwa et al. 2001). Fire effects are site specific and may be reduced if litter and woody debris remain after the fire to act as refugia. There may be a change in composition of arthropod guilds following fire. A study of a butterfly community in Indonesia following large wildfires estimated 43% of butterfly species did not persist after the fire (Hirowatari et al. 2007). Komarek (1969) observed ants relocating their nests (including eggs and larvae) from burned areas to unburned vegetation within an hour after burning in Florida. Hogue (1993) found that "Fire Beetles" (genus *Melanophila*, family Buprestidae) and Smoke Flies (genus *Microsania*, family Platypezidae) were attracted to heat and smoke and may arrive on a burning plot before the flames recede.

The effects of fire on insects in chaparral and other Mediterranean-type ecosystems is not well documented, despite the strong influences insects have on plant and animal communities (Quinn 1979). 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 established more slowly in burned areas. Fourth year insect richness and diversity showed a dramatic increase after an overall three-year decreasing trend. Lawrence (1966) found insects to be particularly susceptible to predation by California quail (*Callipepla californica*), California towhees, and western meadowlarks following fire.

4.4.3.3 Effects of Fire on Amphibians

There is little information on the effects of fire on amphibians in southern California. Most studies of fire and amphibians have taken place in the southeastern United States. Komarek (1969) observed frogs in Florida seeking moist areas to avoid fire and the spring chorus of certain species resumed soon after a fire passed by their breeding pond. A recent study of the effects of prescribed burns on amphibians in temporary ponds in South Carolina found significant negative effects (Schurbon and Fauth 2003). There were immediate effects from fire leading to a decrease in abundance and species richness in burned areas relative to unburned. Species richness increased over time since the fire, although evenness decreased as salamanders disappeared by two years post-fire. Burned sites had shallow leaf litter and high variance in soil temperature, which likely increased desiccation and predation risk. Amphibians may also have migrated out of burned areas to unburned areas. A similar study in Georgia found that amphibian abundance, diversity and species richness were similar in burned and unburned hardwood stands (Moseley et al. 2003). The winter fires did not affect coarse woody debris volumes, which may have accounted for the lack of effect on amphibians.

NROC conducted a pit fall trapping study of amphibians and reptiles in the Coastal and Central Reserves from 1995 to 2000 (Fisher 2000). In 2000, trapping was conducted at the San Joaquin Hills West site in the Coastal Reserve, which had burned seven years previously in the 1993 Laguna Fire. A total of 21 trap arrays were set out for one night each in February, March, April and July. Six amphibian species were captured, equal to the number captured in Limestone Canyon in the Central Reserve and higher than for any other sites in the Reserve System. Species captured included arboreal salamander (*Aneides lugubris*), western spadefoot toad (*Scaphiophis hammondii*), black-bellied salamander (*Batrachoseps nigriventris*), pacific slender salamander (*Batrachoseps pacificus*), pacific treefrog, and western toad. These surveys suggest that the amphibian population had recovered relatively well by seven years after the fire. Walking surveys conducted in the 1993 burn perimeter during 2000 documented an additional amphibian species, the nonnative Bullfrog (*Rana catesbiana*; Harmsworth 2000).

4.4.3.4 Effects of Fire on Reptiles

Lizards often survive fire by seeking shelter in burrows or under rocks (Barro and Conard 1991). Recent surveys have shown large numbers of snakes being killed during prescribed burns in coastal California shrublands. Biologists observed numerous burned reptiles and small mammals at several project sites within the 2003 Cedar fire perimeter shortly after the fires (Dudek personal observations). Additionally, 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. A study of the effects of fire on reptiles in bottomland hardwood forests in Georgia found that reptile diversity and abundance was greater in burned stands, whereas species richness did not differ (Moseley et al. 2003). These fires were small (36-94 ha) in comparison to larger wildfires in southern California and may have had a smaller impact on direct reptile mortality.

Pit-fall trapping was conducted in 2000 at the San Joaquin Hills West site in the Coastal Reserve, within the 1993 Laguna Fire perimeter, and documented fairly high reptile diversity (Fisher 2000). This is notable since trapping was only conducted at this Coastal Reserve site for one year, rather than for a four to five year period, as for many other sites in the Reserve. Thirteen species were captured, which is more than for the two unburned Coastal Reserve sites (UC Irvine Ecological Reserve; 8 species and Aliso/Wood Canyons Wilderness Park; 11 species). There is no information on the reptile community at this site prior to the 1993 fire. However, based on the number of species captured it appears there had been substantial recovery by the seventh year post-fire. Western fence lizard (*Sceloporus occidentalis*) and western skink (*Eumeces skiltonianus*) were the most abundant lizard species while Gopher snake, southern pacific rattlesnake (*Crotalus viridis*) and northern red diamond rattlesnake were the most common snakes. Walking surveys conducted in 2000 within the 1993 Laguna Fire perimeter detected seven reptile species, all of which were captured in the pit-fall trapping study (Harmsworth Associates 2000).

4.4.3.5 Effects of Fire on Birds

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. Birds are thought to be able to flee fire so that the main impacts of fire are changes to their habitat. A study of California Gnatcatchers, Cactus Wrens and other birds in the Coastal Subregion of the NCCP/HCP following the 1993 Laguna Canyon fire found that few birds died in the fire (Bontrager et al. 1995). It is likely that bird mortality in the case of large, fast-moving Santa Ana wind-driven fires varies, depending on fire behavior and intensity, the size of the fire, availability of refugia, topography, and whether the fire burns through natural habitats during the day or at night when birds tend to roost and may not respond in time to evade the fire.

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.

Lawrence (1966) found mourning doves and western meadowlarks to be among the earliest users of burned chaparral in the Sierra Nevada Mountains and the degree of habitat recovery in the first year after 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, 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 chaparral 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, but increases were noted in the number of insect and seed-eating birds. 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 at 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, western-scrub jays (*Aphelocoma californica)*, 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 at 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.

Following the 1993 Laguna Fire in the Coastal Reserve, a portion of the burned area was surveyed immediately after the fire (Bontrager et al. 1995). It appeared that direct mortality from the fire was low in the survey area. Individuals from many species expected to occur in the burned area prior to the fire were observed, especially in lightly burned or unburned coastal sage scrub/cactus scrub refugia. This included species that might be most vulnerable in a fire due to their territoriality and tendency to seek cover in vegetation and to fly only short distances. Examples of these species include California quail, Bewick's wren, hermit thrush (*Catharus guttatus*), wrentit, California thrasher, and spotted towhee (*Pipilo erythrophthalmus*). After a week post-fire, birds were greatly reduced in the burn area, with small numbers remaining in refugia. Additional bird surveys were conducted throughout the burned area from 1996 to 2000 (Harmsworth Associates 2000). There is no pre-fire data, but it appears that by 2000, seven years post-fire there was high bird diversity within the burn perimeter. A total of 78 species were detected, including hermit thrush, wrentit, California thrasher, California gnatcatcher and other insect gleaning/fruit eating species that are most vulnerable to fire effects. NROC contracted with the Institute for Bird Populations to Monitor Avian Productivity and Survivorship from 1999 to 2003 in the Coastal and Central Reserves (DeSante et al. 2003). A total of ten sites were sampled each spring for two to six years. Three of the five Coastal Reserve sites were within the 1993 Laguna Fire perimeter. Species richness was similar in burned and unburned habitat during the five to ten year period after the fire. On average, 51.3 ± 5.2 species were detected annually at the three burned sites, whereas 54.7 ± 1.5 (n=7) were documented in unburned sites in the Coastal and Central Reserves.

4.4.3.6 Effects of Fire on Mammals

The effect of fire on mammals has focused largely on small mammals and in particular burrowing mammals. Small mammals that can retreat to burrows are more likely to survive fire than animals that remain above ground and must run from the fire to survive. In a controlled experiment, Howard et al. (1959) measured the lethal temperature for several chaparral rodents at 138-145^{o}F. Burrows a few inches deep were sufficient to insulate animals from these temperatures as fire burned on the surface. Lawrence (1966) also conducted similar measurements of burrows in Sierra Nevada foothill chaparral and found that burrows four inches deep could allow animals to survive heat of up to 1000°F and increased vapor pressure. Vapor pressure was determined to be an important predictor of survival, since animals cool by evaporating water from their lungs, and to survive vapor pressure should be below 40 mm Hg. Pocket gophers (*Thomomys* spp.) burrows were typically 9-36 inches deep allowing them to survive most fires. Animals such as rabbits and woodrats must run from fire to survive and may suffer high mortality during large and fast moving wildfires. Woodrats may be reluctant to leave their middens, nests constructed of twigs and branches, and if they do leave they may go to open areas where they can be killed by cars. In one study, 44 dead woodrats were found along 1.5 miles of road, all had been hit by cars and none were singed by the fire (Quinn 1979).

No small mammals were trapped immediately following a fire at the 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 offspring at the burned area than at 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.

Wirtz (1995) found species requiring brush for cover and/or food are most severely impacted by fire, and require the longest time to recover to pre-fire densities. Post-burn predation is probably more restrictive on small birds and mammals than the fire itself. 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. In Australia, Fox and McKay (1981) found that species in a small mammal community reached maximum densities at times as disparate as 1-8 years following fire and emphasized the importance of maintaining habitat diversity. Some Australian species are unable to reoccupy burned areas for more than four years (Fox 1982).

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. Erickson (1993) suggested fire may have been beneficial in opening up habitat for the pacific pocket mouse (*Perognathus longimembris pacificus*) in coastal Southern California sage scrub. These same sites, studied by Price and Waser (1984), suggest brush-dwelling species such as desert woodrat (*Neotoma lepid*a) declined whereas species that prefer more open habitat like agile kangaroo rat (*Dipodomys agilis*) increased.

Mule deer and other large mammals such as mountain lions (*Felis concolor*) typically escape injury and mortality during wildfires (NPS 2004). Following fire there is typically a flush of nutrient rich herbaceous cover that can provide food for grazing mammals. Mule deer can run from fire and then return to burned areas in early winter after shrubs and herbaceous cover begin growing with the onset of winter rains. Populations in recently burned areas can increase up to three to four times the pre-burn population (Tabor and Dasmann 1957). Elevated nutrients may persist in the plants for up to three years and deer feeding on these plants tend to be larger and healthier.

The effects of recent fires on mammal communities in the Reserve have not been evaluated immediately following the fire event, but there have been studies seven to eight years post-fire that indicate the mammal community has recovered well. These studies and surveys focused on larger mammals and carnivores and did not sample burrowing rodents. Walking surveys conducted in 2000 within the burn perimeter of the 1993 Laguna Fire detected five mammal species (Harmsworth Associates 2000). Species observed include black-tailed jackrabbit (*Lepus californicus*), desert cottontail, California ground squirrel, coyote, and mule deer. A mammalian carnivore study was conducted in the Reserve in 2001, eight years after the Laguna Fire (George and Crooks 2001). Cameras and tracking stations recorded coyotes, bobcats, and mule deer in unburned and previously burned habitats in the Coastal Reserve. Gray foxes (*Urocyon cinereoargenteus*) were sensitive to edge areas, but were sparsely distributed in burned and unburned interior areas of the Coastal Reserve. Spotted skunks (*Spilogale gracilis*) were found only in the Shady Canyon area, which was lightly burned in 1993. There were no mountain lions detected in burned or unburned habitats in the Coastal Reserve. The only post-fire information on mammals following the 2007 Santiago Fire is the death of a radio-collared bobcat due to injuries received in the fire (Boydston and Lyren 2008).

4.4.3.7 Effects of Fire on NCCP/HCP Covered Species

Approximately 75% of Orange County's Central Coastal NCCP/HCP Reserve burned in two large fires over the last 16 years (Table 4-2). The 1993 Laguna Fire burned 14,338 acres within and outside the Coastal Reserve whereas the 2007 Santiago Fire burned 28,430 acres. In addition, there have been a number of other fires in the Central Reserve over the last two decades. These fires have affected plant and animal communities, although our knowledge of the impacts is limited to a few species.

4.4.3.7.1 Effects of Fire on Target Species

Orange-throated Whiptail

Orange-throated whiptail was the fourth most common lizard species detected over five years (1995-2000) of pit-fall trapping in the NCCP/HCP Reserve (Fisher 2000). It was most abundant in the Central Reserve and absent from Coastal Reserve sites, except for Aliso and Wood Canyons Wilderness Park.

1993 Laguna Fire - The San Joaquin Hills West site was in the 1993 Laguna Fire perimeter and was sampled with 21 trap arrays in winter, spring and summer of 2000. Orange-throated whiptails were not captured at the site. This species was also not detected during 1992 walking surveys in this area prior to the fire or in post-fire walking surveys conducted in 2000 (Harmsworth Associates 2000). Thus, it is not known the extent to which the 1993 Laguna Fire affected orange-throated whiptail populations.

2007 Santiago Fire - The 2007 Santiago Fire burned through many areas known to support orange-throated whiptails prior to the fire and the current population status in these areas is unknown.

California Gnatcatcher

The California gnatcatcher is a federally threatened species and an NCCP/HCP Target Species (Table 3-2) with substantial amounts of its coastal sage scrub habitat burned in the Coastal and Central Reserves over the last two decades.

1993 Laguna Canyon Fire – The Laguna Fire burned 6,721 acres of coastal sage scrub in the Coastal Reserve (Bontrager et al. 1995), with 465 acres remaining as unburned or lightly burned refugia (LSA 1995). Before the fire there were an estimated 127 pairs of California gnatcatchers within the burn perimeter (Harmsworth Associates 2000). Surveys conducted within the first week after the fire indicate that direct mortality from the fire was low, 27 gnatcatchers were detected in a portion of the burn area that was surveyed (Bontrager et al. 1995). The number of birds observed in this area was higher than had been previously documented during single visit surveys. However, by one week after the fire the gnatcatcher population within this area decreased markedly. There was evidence gnatcatchers moved from burned areas into adjacent unburned areas. This assessment was based on behavioral observations and temporary increases in the numbers of birds in peripheral areas, although local production of young prior to the fire may have also contributed to these increases.

Spring 1994 surveys of the entire burned area found only twelve (9%) of an estimated 127 pre-fire California gnatcatcher pairs remaining in refugia and of these only 33% successfully produced young. Remaining gnatcatchers were found in relatively large patches of lightly burned scrub with some herbaceous cover and were not found in severely burned areas. It was concluded that there was likely to be a temporary decline in the gnatcatcher population as a result of the Laguna Fire. This assessment was based on the assumption that peripheral areas would not be able to support a large influx of birds from burned areas over the long term and that those birds remaining in refugia had substantially reduced reproductive success. It was predicted that the population would increase with the post-fire recovery of coastal sage scrub habitat and colonization of the burned area by birds from peripheral unburned habitat.

Subsequent surveys within the fire perimeter documented 8 pairs in 1996, 16 pairs in 1997 and a rapid increase to 61 pairs in 1998 and 79 pairs in 1999 (Harmsworth 2000). The number of California gnatcatcher pairs decreased to 46 in 2000 presumably due to unusually high levels of winter rain. A concurrent study of gnatcatchers from 1993 to 1999 in unburned areas of the Coastal Reserve found that the population was stable, except for the post-fire increase in 1994

(Bontrager et al. 2000). Surveys in unburned and previously lightly burned areas of the Coastal Reserve from 1999 to 2004 indicate a moderate decline in numbers of California gnatcatchers that was attributed to drought (Hamilton 2004).

2007 Santiago Fire – There have been no focused surveys to assess the effects of the 2007 Santiago Fire on California gnatcatchers. During 2008 surveys for cactus wren in the Central Reserve, California gnatcatchers were detected incidentally at 45 locations. The proportion of burned sites where gnatcatchers were incidentally detected was much lower than in unburned sites (Leatherman 2009). At two unburned sites in the Central Reserve, gnatcatchers were abundant in 2009 and successful in producing fledglings based on incidental observations during a cactus wren monitoring study. Surveys during spring 2011 resulted in observations of ____ gnatcatchers in the Central Reserve. Coastal sage scrub had sufficiently recovered by that time to support California gnatcatchers within the Santiago Fire perimeter.

Coastal Cactus Wren

The cactus wren is an NCCP/HCP Target Species. In the Central and Coastal Reserves 67.5% of 994 Cactus Wren locations documented during 1992 surveys were conserved within the Reserve (County of Orange 2003). Another 10.4% of locations were potentially conserved in special linkages and existing use areas. Although these locations have not been developed, cactus wrens have disappeared from most of these locations. This decline is attributed largely to the loss of cactus scrub habitat from wildfire compounded by other factors, such as drought and population isolation. Cactus wrens nest in mature cactus scrub. Following wildfire, it can take many years for cactus to grow back to a size sufficient for cactus wren use (Proudfoot et al. 2000, Solek and Szijj 2004, Mitrovich and Hamilton 2007).

1993 Laguna Fire - In 1993, the Laguna Fire burned 75% of the ~17,000 acre Coastal Reserve. Lightly burned and unburned patches of scrub were mapped in spring 2004 and approximately 470 acres survived, most of which was southern cactus scrub (Bontrager et al. 1995). Cactus tended to burn severely, but in larger patches some cactus survived intact. Cactus in grasslands appeared less severely burned than cactus in shrublands. In the first week after the fire a portion of the burned area was surveyed and a total of 19 cactus wren were detected. This number was low relative to the number of individuals found in single pre-fire surveys of that same area. By a week after the fire, numbers were even lower with remaining birds found in refugia. In contrast to gnatcatchers, there was no influx of cactus wrens into adjacent unburned areas. Prior to the fire there were an estimated 282 pairs of cactus wren within the burn perimeter. Spring 1994 surveys documented 79 (28%) cactus wren territories remaining in lightly burned cactus scrub. Typically, the number of wrens was positively associated with the amount of taller cactus (> 1 m). There were some observations of wrens in areas that appeared too severely burned to support them and also instances of apparently suitable habitat with no wrens. Recovery of cactus wren populations was predicted to be slower following the Laguna Fire than for California gnatcatchers, even though there were more wrens remaining in refugia within the burned area. This assessment was based on the considerably long time it takes cactus scrub to recover and become suitable for wren occupancy. In addition, there were not many peripheral populations of cactus wren in unburned habitat to provide individuals to colonize recovering habitat.

Cactus wren surveys in the burned area in 1996 show a much smaller population of 27 pairs and five single individuals compared with 79 territories in 1994 (Harmsworth Associates 2000). The population increased over time to 38 pairs and 7 single birds in 1999, with 70% of pairs detected with fledglings. This was followed by a decline to 23 pairs and nine single birds in 2000 with only five pairs (21.7%) observed with fledglings. A continuing decline has been documented within burned and unburned areas of the Coastal Reserve from 2000 to 2009. Annual surveys conducted at 40 sites within the Coastal and Central Reserves from1999 to 2004 documented larger proportional reductions in cactus wren populations in the Coastal Reserve than in the Central Reserve (Hamilton 2004). Cactus wren surveys and cactus scrub mapping conducted in 2006 found that 58% of cactus scrub that burned in 1993 remained unoccupied (Mitrovich and Hamilton 2007). Much of this unoccupied cactus appeared too small to be suitable for cactus wrens. An analysis of cactus scrub habitat and cactus wren locations indicates an 87% decline in occupied habitat in the Coastal Reserve between 1993 and 2006. While much of this decrease was due to the Laguna Fire, there has also been a decrease in cactus wren abundance in unburned patches of cactus scrub.

2007 Santiago Fire – During the first spring following the 2007 Santiago Fire, NROC mapped cactus throughout the Central Reserve and categorized burn severity as unburned, low, moderate and high (Leatherman 2009). A total of 1,855 acres of cactus were mapped and 1,420 acres (76.5%) were burned with varying degrees of severity. A total of 1,059 acres (57%) were categorized as severely burned and unsuitable for supporting nesting cactus wren. Surveys were conducted in 683 acres that appeared suitable for wrens and an estimated 67 territories were documented, a decline of 82.1% of the 374 territories estimated in the Central Reserve in 2004.

4.4.3.8 Effects of Fire on Identified Species

In 2000, seven years after the 1993 Laguna Fire, cactus wren and California gnatcatcher surveys were conducted in the burn perimeter and records were made of incidental observations of three NCCP/HCP Identified Species. These included the San Diego horned lizard, northern harrier, and southern California rufous-crowned sparrow (Harmsworth

Associates 2000). Seven other sensitive animal species and two sensitive plant species were also detected. Amphibian and reptile trapping studies in late winter, spring and early summer of 2000 documented seven NCCP/HCP Identified Species, three amphibians and four reptiles, within the Laguna Fire perimeter. These included arboreal salamander, black-bellied salamander, western spadefoot toad, San Diego horned lizard, coastal western whiptail, Coronado skink, and northern red diamond rattlesnake. Coronado skink, coastal western whiptail, and northern red diamond rattlesnake were the most commonly captured of the sensitive amphibian and reptile species in 2000. There is no comparable pre-fire sampling to indicate how well Identified Species populations have recovered after the 1993 Laguna Fire. Information is also lacking on the recovery of Identified Species populations in areas burned by the 2007 Santiago Fire in the Central Reserve.

4.4.3.9 Effects of Fire on Cultural Resources

Adverse impacts would potentially result from ground disturbing activity, such as vehicle traffic, dozer operations, hand crews creating fire line, and multiple apparatus at makeshift staging areas; from removal or dislocation of site features, such as boulders or walls; and from fire damage to certain types of materials. Fire-induced alteration of stone artifacts is a potential adverse effect, but probably would not be a significant impact for most of the known prehistoric sites on the Reserve. Fire damage is a potentially significant impact for most of the remaining known historic sites that include combustible materials (wood, plant materials).

An interview with a long-time archaeologist in southern California (personal communication with Mica Hale, Dudek Cultural Resources Practice Manager, May 2012) indicate fire effects on cultural resources may be significant. The effects of fire on archaeological sites may consist of damage to artifacts and cultural features resulting from burning or exposure to high heat. This is particularly detrimental to organic artifacts (bone, shell, wood, etc.) as well as softer inorganics, such as pottery. However, artifacts common to the Orange County area and southern California in general, such as grinding stones and flaked lithic tools also suffer the effects of high eat. Grinding stones, typically made from granite or sandstone endemic to the area become friable and degrade faster after exposure to fire. This can have the effect of reducing or eliminating evidence that a particular stone was used for grinding; it also rapidly accelerates the effects of natural erosion on these artifacts. Flaked lithics are typically sturdier, but high heat can cause fracturing and reduce the moisture in some stone. Reduced moisture in a flaked lithic artifact can make it less durable, and if the stone is obsidian, it can skew readings of the hydration rind that naturally accumulates over time after obsidian has been flaked to produce a tool. This reduces the ability to discern the relative age of the obsidian artifact. Another common problem with wildland fires is that non-cultural carbon is introduced into the sediments making chronological assessments based on radiocarbon dating more difficult.

If the cultural deposits or features are historical in age, the effects of fire can be much worse. Historic artifacts typically consist of metal and glass objects that are highly susceptible to heat destruction (i.e., glass melts and metal rapidly degrades after burning). These effects compromise the ability to conduct basic analyses of historical assemblages. The effects to structures and other such features are more obvious; fire can completely destroy wood structures but it also degrades concrete and other building materials.

In contrast to the potentially negative effects of fire on cultural resources, fire can have the positive effect of making unknown cultural resources discoverable. Fire removes vegetation and often results in discovery of new archaeological sites.

5.0 NROC FUEL TYPES AND FIRE BEHAVIOR MODELING

5.1 Nature Reserve of Orange County Fuel Types and Fire Behavior Modeling

Wildland fire suppression tactics and all fire use prescriptions are based upon the expected fire behavior within each FMU. The type of vegetation where wildfire is currently burning, or may burn based on fire spread patterns, is one of the key elements in the fire behavior calculations. This section provides an overview of the fire behavior modeling that supports the recommendations of this WFMP. The original draft of this WFMP included representative sample "point fire behavior modeling". This effort was completed using BehavePlus software and represents specific locations regarding slope, fuel, aspect, and weather conditions. This WFMP provides an update to this "point fire behavior modeling" effort and includes an updated fire behavior modeling analysis using FlamMap software, which is a GIS based program enabling a much wider and Reserve-specific view of anticipated fire behavior that includes integration of field-collected data, digital data analysis, and updated fuel models specifically for southern California fuels. The fire behavior modeling was conducted to document the type and intensity of fire that would be expected within the Reserve given characteristic site features such as topography, vegetation, and weather and to depict where fire behavior is most extreme in a GIS-based exhibit.

Dudek utilized BehavePlus for "point fire behavior modeling" in an effort to compare the effect of weather on expected firer behavior. Additionally, FlamMap software was used to graphically depict fire modeling results at a Reserve-wide scale. FlamMap utilizes the same fire spread equations built into the BehavePlus software package, but allows for a geographical presentation of fire behavior outputs as it applies the calculations to each pixel in an associated Geographic Information Systems (GIS) landscape. For FlamMap modeling, extreme fall, offshore weather conditions (97th Percentile) were modeled in order to understand worst-case fire behavior on the Reserve. For the BehavePlus analysis, 50th percentile and 97th percentile weather conditions were modeled to evaluate the effect of weather on fire behavior.

5.1.1 Fuel Model Classifications

The initial step in modeling potential fire behavior is the evaluation of vegetation and determination of appropriate fuel model assignments. In order to make reliable estimates of fire behavior, one must understand the relationship of fuels to the fire environment and be able to recognize the variations in these fuels. Natural fuels are made up of the various components of vegetation, both live and dead, that occur in a particular landscape. The type and quantity will depend upon soil, climate, geographic features, and fire history. The major fuel groups of grass, shrub, trees, and slash are defined by their constituent types and quantities of litter and duff layers, dead woody material, grasses and forbs, shrubs, regeneration, and trees. Fire behavior can be predicted largely by analyzing the characteristics of these fuels. Fire behavior is affected by seven principal fuel characteristics: fuel loading, size and shape, compactness, horizontal continuity, vertical arrangement, moisture content, and chemical properties.

The seven fuel characteristics help define the 13 standard fire behavior fuel models (Anderson 1982) and the more recent custom fuel models developed for Southern California (Weise and Regelbrugge 1997). According to the model classifications, fuel models used in BehavePlus have been classified into four groups, based upon fuel loading (tons/acre), fuel height, and surface-to-volume ratio. Observation of the fuels in the field (on site) determines which fuel models should be applied in modeling efforts. The following describes the distribution of fuel models among general vegetation types for the standard 13 fuel models and the custom Southern California fuel models:

- Grasses – Fuel Models 1 through 3
- Brush – Fuel Models 4 through 7, SCAL 14 through 18
- Timber – Fuel Models 8 through 10
- Logging slash – Fuel Models 11 through 13.

In addition, the aforementioned fuel characteristics were utilized in the recent development of 40 new fire behavior fuel models (Scott and Burgan 2005) developed for use in the BehavePlus and FlamMap modeling systems. These new models attempt to improve the accuracy of the 13 standard fuel models outside of severe fire season conditions, and to allow for the simulation of fuel treatment prescriptions. The following describes the distribution of fuel models among general vegetation types for the 40 new fuel models:

- Non-burnable – Models NB1, NB2, NB3, NB8, NB9
- Grass – Models GR1 through GR9
- Grass shrub – Models GS1 through GS4
- Shrub – Models SH1 through SH9
- Timber understory – Models TU1 through TU5
- Timber litter – Models TL1 through TL9
- Slash blowdown – Models SB1 through SB4.

Any resource or fire management decision regarding the use of prescribed fire and/or wildland fire suppression tactic must be based upon authenticated fire behavior expectations and established fuel models. Table 5-1 contains descriptions of the five burnable fuel models found on the Reserve.

Table 5-1
Fuel Model Characteristics

Fuel Model	Vegetation Type	Description	Tons/acre; Btu/lb	Fuel Bed Depth (Feet)
1	Grassland, disturbed areas, agriculture, vernal pools	Short grass	0.7 tons/acre; 8,000 Btu/lb	1.0
3	Marsh	Tall grass	3.0 tons/acre; 8,000 Btu/lb	2.5
9	Riparian, woodland, and forest	Hardwood litter	3.5 tons/acre; 8,000 Btu/lb	0.2
SCAL18	Sage scrub	Sage/buckwheat	9.7 tons/acre; 9,200 Btu/lb	3.0
SH7	Chaparral	Very high load dry climate scrub	14.4 tons/acre; 8,000 Btu/lb	6.0

5.1.2 Weather

Historical weather data for the region was utilized in determining appropriate fire behavior modeling inputs for the Reserve. Due to the geographic separation between the Central and Coastal Reserves, two separate historical weather data sets were used to more appropriately represent weather conditions in each location. For both Reserve areas, 97th percentile moisture values were derived from Remote Automated Weather Station (RAWS) and utilized in the fire behavior modeling efforts conducted in support of this WFMP. Data from the Fremont RAWS was utilized for modeling fire behavior in the Central Reserve, while data from the Bell Canyon RAWS was utilized for the Coastal Reserve.

For both areas, RAWS fuel moisture and wind speed data were processed utilizing the Fire Family Plus software package to determine atypical (97th percentile) and typical (50th percentile) weather conditions. Data from each RAWS was evaluated from August 1 through November 30 for each year between 1995 and 2011 (extent of available data record) for 97th percentile weather conditions and from June 1 through September 30 for each year between 1995 and 2011 for 50th percentile weather conditions.

Following analysis in Fire Family Plus, fuel moisture information was incorporated into the Initial Fuel Moisture file used as an input in FlamMap. Wind speed data resulting from the Fire

Family Plus analysis was also determined. Initial wind direction and wind speed values for the two FlamMap runs were manually entered during the data input phase. WindNinja software (v. 2.1.0), which is incorporated into FlamMap, allows for the generation and incorporation of gridded wind data in the FlamMap simulation. The input wind speed and direction is roughly an average surface wind at 20 feet above the vegetation over the analysis area. The WindNinja-generated wind data was included in the modeling effort and provides a more detailed data set for modeling the effect of wind speed and direction on fire behavior across the modeling area. Table 4 presents the weather and fuel moisture input variables used for fire behavior modeling efforts. Table 5-2 summarizes the wind and weather input variables used in the FlamMap and BehavePlus modeling efforts.

Table 5-2
FlamMap and BehavePlus Fire Behavior Inputs – Central Reserve

Model Variable	50th Percentile Weather	97th Percentile Weather
1 h fuel moisture	6%	2%
10 h fuel moisture	8%	3%
100 h fuel moisture	13%	7%
Live herbaceous moisture	60%	30%
Live woody moisture	90%	59%
20 ft wind speed	9 mph	32 mph
Wind direction	225 degrees	45 degrees
Wind adjustment factor (BehavePlus)	0.2	0.2
Slope (BehavePlus)	20%	20%
FlamMap and BehavePlus Fire Behavior Inputs – Coastal Reserve		
Model Variable	50th Percentile Weather	97th Percentile Weather
1 h fuel moisture	8%	2%
10 h fuel moisture	10%	4%
100 h fuel moisture	17%	9%
Live herbaceous moisture	60%	30%
Live woody moisture	90%	59%
20 ft wind speed	9 mph	19 mph
Wind direction	225 degrees	45 degrees
Wind adjustment factor (BehavePlus)	0.2	0.2
Slope (BehavePlus)	20%	20%

5.1.3 FlamMap Fire Behavior Modeling

Fire behavior modeling includes a high level of analysis and information detail to arrive at reasonably accurate representations of how wildfire would move through available fuels in high-fire hazard areas. Fire behavior calculations are based on site-specific fuel characteristics supported by fire science research that analyzes heat transfer related to specific fire behavior. Current and accepted fire research data from several programs that specialize in the study of wildland fire were utilized for the completion of this analysis for the Preserve. To objectively predict flame lengths and intensities, the FlamMap fire behavior fuel modeling system was applied using predominant fuel characteristics from representative fuel models observed on the Preserve. In addition to fuels data, topographic and weather data were utilized in developing fire behavior models for worst-case (97th Percentile) weather conditions representing a fall, off-shore weather pattern. Results of fire behavior modeling efforts for the Reserve are presented in Figures 5-1A and 5-1B.

Predicting wildland fire behavior is not an exact science. As such, the minute-by-minute movement of a fire will probably never be predictable, especially when considering the variable state of weather and the fact that weather conditions are typically estimated from forecasts made many hours before a fire. Nevertheless, field-tested and experienced judgment in assessing the fire environment, coupled with a systematic method of calculating fire behavior, yields accurate results (Rothermel 1983).

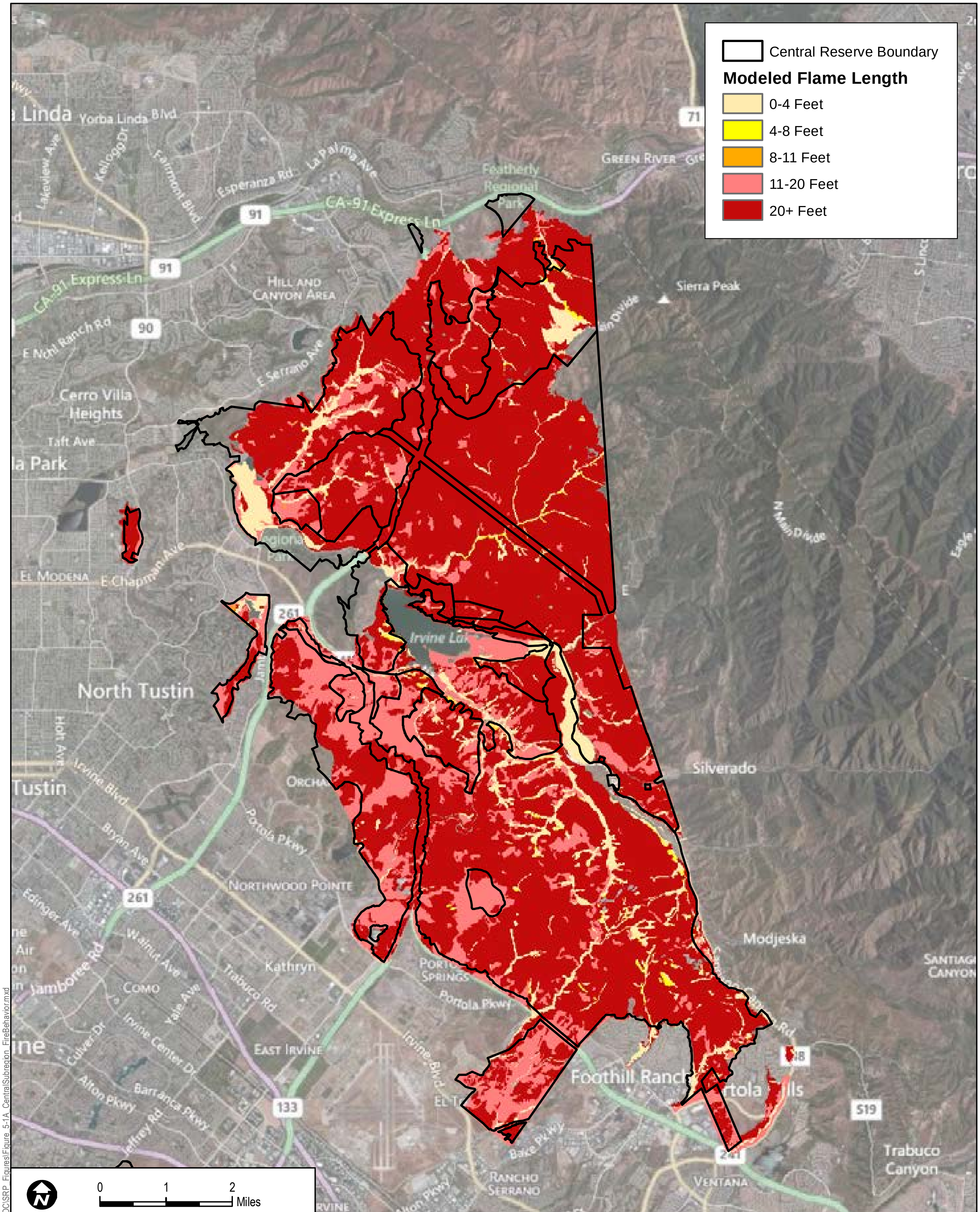
The FlamMap (version 5.0) software package (Finney 2012) is a GIS-driven computer program that incorporates fuels, weather, and topography data in generating static fire behavior outputs, including values associated with flame length, fireline intensity, and spread rate, amongst others. It is a flexible system that can be adapted to a variety of specific wildland fire planning and management needs. The calculations that come from FlamMap are based on the BehavePlus Fire Modeling System algorithms but result in geographically distinct data set based on GIS inputs. FlamMap model outputs allow wildland resource managers to evaluate expected fire behavior which provides important insight about the characteristics of wildfire spread within and adjacent to high-value areas, such as preserved sage scrub habitats. Each of the input variables used in FlamMap remain constant at each location, meaning that the input variables are applied consistently to each grid cell and the fire behavior at one grid cell does not impact that at a neighboring grid cell. Essentially, the model presents a “snapshot” in time and does not account for temporal changes in fire behavior or the movement of fire across the landscape. As such, the results of the models contained herein should be utilized as valuable information sources and tools to prioritize fuel treatment options rather than an exact representation of how a fire would behave on the Reserve.

The basic assumptions and limitations of FlamMap are:

- The fire model output describes fire behavior only in the flaming front. The primary driving forces in the predictive calculations are the dead fuels less than 0.25 inch in diameter. These are the fine fuels that carry fire. Fuels greater than 1 inch in diameter have little effect to carry fire, and fuels greater than 3 inches in diameter have no effect.
- The model bases calculations and descriptions on a wildfire spreading through surface fuels that are within 6 feet of the ground and contiguous to the ground. Surface fuels are often classified as grass, brush, litter, or slash.
- The software assumes that fuel moisture conditions are uniform. However, because wildfires almost always burn under non-uniform conditions, length of projection period and choice of fuel must be carefully considered to obtain useful predictions.
- WindNinja software (v. 2.1.0), which is incorporated into FlamMap, allows for the generation and incorporation of gridded wind data in the FlamMap simulation.
- The FlamMap fire behavior computer modeling system provides the average length of the flames, which is a key element for determining defensible space distances for minimizing structure ignition.

FlamMap software requires a minimum of five separate input files that represent field conditions on the Reserve, including elevation, slope, aspect, fuel model, and canopy cover. Each of these files was created as a raster GIS file using ArcGIS 10 software, exported as an ASCII grid file, then utilized in creating a FARSITE (Finney 1998) Landscape file that served as the base for the FlamMap runs. The resolution of each grid file and associated ASCII file that was used in the FlamMap models described herein is 10 meters (32.8 feet). In addition to the Landscape file, wind and weather data are incorporated into the model inputs. The output file chosen for the modeling run included flame length (feet). The map included in Figures 5-1A and 5-1B depicts the results of the modeling run.

The following provides a description of the input and output variables used in processing the FlamMap models. In addition, data sources are cited and any assumptions made during the modeling process are described.



Path: Z:\Projects\j710801\MAP_DOC\SRP_Figures\Figure_5-1A_CentralSubregion_FireBehavior.mxd

DUDEK

7108-01

SOURCE: USGS Topo, Orange County 2010,

FIGURE 5-1A

Central Subregion Fire Behavior Model

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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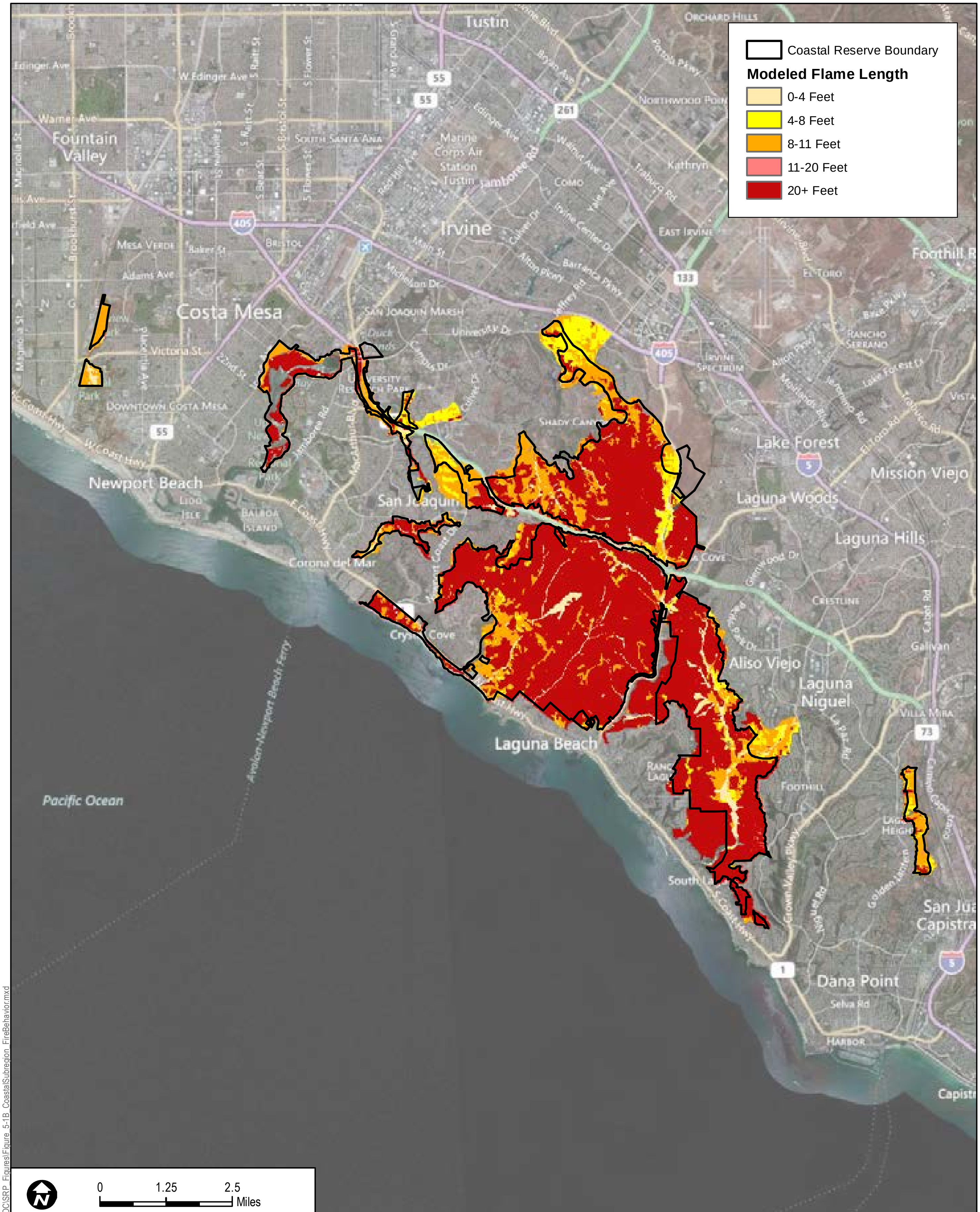

DUDEK

7108-01

SOURCE: USGS Topo, Orange County 2010,

FIGURE 5-1B

Coastal Subregion Fire Behavior Model

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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Elevation

Elevation data were derived from a U.S. Geologic Survey (USGS) Digital Elevation Model (DEM) with a resolution of 10 meters and projected in the NAD 1983, California State Plane, Zone 6 coordinate system. Elevation values throughout the FlamMap analysis area range from 0 (sea level) to 2,530 feet AMSL. These data were utilized to create an elevation grid file, using units of feet above sea level. The elevation data are a necessary input file for FlamMap runs and are necessary for adiabatic adjustment of temperature and humidity and for conversion of fire spread between horizontal and slope distances.

Slope

Using ArcGIS Spatial Analyst tools, a slope grid file was generated from the elevation grid file described above. Slope measurements utilized values in percentage of inclination from horizontal. Slope values on site range from 0% (flat) to 110% (approximately 48°). The slope input file is necessary for computing slope effects on fire spread and solar radiance.

Aspect

Using ArcGIS Spatial Analyst tools, an aspect grid file was generated from the elevation grid file described above. The aspect values utilized were azimuth degrees. Aspect values are important in determining the solar exposure of grid cells.

Fuel Model

Vegetation coverage data in the form of a GIS shapefile was used in this analysis to create a fuel model file. Based on available vegetation mapping data, coupled with field observations, vegetation and land cover types were classified into fuel models. Specifically, 6 separate fuel models were utilized for the Central Reserve and 6 fuel models for the Coastal Reserve. Included in these fuel models is one non-combustible classification (e.g., bare soil, rock outcrops, pavement). Once fuel model values were assigned to vegetation/land cover types, the vector-based vegetation data file was converted to a grid file for inclusion in FlamMap modeling. Table 5-3 outlines the fuel model values applied to the different vegetation and land cover types found on and Central and Coastal Reserves.

Canopy Cover

Canopy cover is measured as the horizontal fraction of the ground that is covered directly overhead by tree canopy. Crown closure refers to the ecological condition of relative tree crown density. Stands can be said to be “closed” to recruitment of canopy trees but still only have 40% or 50% canopy cover. Coverage units can be categories (0–4) or percentage values (0%–100%).

Table 5-3 summarizes the fuel model and canopy cover assignments utilized in the FlamMap analysis.

Table 5-3
Reserve-wide Fuel Model and Canopy Cover Assignments for FlamMap Modeling

Vegetation Community/Land Cover	Fuel Model	Canopy Cover Value
Coastal Sage Scrub	SCAL 18	0
Chaparral	SH 7	0
Woodland	9	3
Grassland	1	0
Disturbed	1	0
Riparian	9	3
Cliff and Rock	0	0
Forest	9	4
Developed	0	0
Marsh	3	0
Agriculture	1	0
Watercourses	0	0
Lakes and Reservoirs	0	0
Vernal Pools	1	0
Marine and Coastal	0	0

5.1.3.1 FlamMap Fire Behavior Modeling Results

One output grid file was generated for each FlamMap run and includes representations of flame length (feet). The graphical output from the modeling runs is presented in Figures 5-1A and 5-1B. The fire behavior analysis results for the Reserve vary depending on fuel type. As FlamMap utilizes site-specific digital terrain data (including slope, vegetation, aspect, and elevation data) slight variations in predicted flame length values can be observed based on fluctuations of these attributes across the landscape. As presented, wildfire behavior in each of the fuel types varies, based on differing weather conditions.

Given the climatic, vegetation, and topographic characteristics along with the fire behavior modeling results and fire history discussed in this WFMP, both areas of the Reserve are expected to be receptive to wildfire starting on, burning onto, or spotting onto the site. Under extreme weather conditions, fire can move rapidly through the Reserve's fuels. The most common type of fire anticipated is a fire burning onto the Reserve from one of several nearby highways or roadways and fanned by off shore Santa Ana winds. Worst-case modeled flame lengths were calculated at 75 feet in the Central Reserve and up to 51 feet in the Coastal Reserve.

It should be noted that the modeling results presented herein depict values based on inputs to the FlamMap software, which are held constant for each cell in the analysis landscape. Changes in wind, weather, or pockets of different fuel types are not accounted for in this analysis. Model results should be used as a basis for planning only, as actual fire behavior for a given location will be affected by many factors, including unique weather patterns, small-scale topographic variations, or changing vegetation patterns.

5.1.4 BehavePlus Fire Behavior Modeling

A previous draft of this WFMPA (FireWise2000 2010) included representative sample "point fire behavior modeling" which was completed using BehavePlus software. Anticipated wildland fire behavior for the Reserve was determined during this effort, by general vegetation type/fuel model. The original results are comparable to those derived during FlamMap modeling efforts. The fuel models analyzed using BehavePlus in the original WFMP include three categories: 1) Grass Group, 2) Shrub Group and 3) Tree Group. A re-evaluation of "point fire behavior modeling" was conducted for this update to evaluate the effect that weather has on fire behavior. Utilizing the vegetation type/fuel categories discussed in Section 5.5.1, BehavePlus analysis of fire behavior for 50th and 97th percentile weather conditions were conducted and are summarized in the following sections.

5.1.4.1 Fire Behavior under 50th Percentile Weather Conditions

Fire behavior during 50th percentile weather conditions was modeled with a 20-foot wind speed of 9 mph for both the Central and Coastal Reserve and slope gradient of 20%. All other weather input variables are identified in Table 5-2. BehavePlus modeling evaluated the following fire behavior variables: spread rate (mph), fireline intensity (btu/ft/s), and flame length (feet). Table 5-4 summarizes the modeling results for 50th percentile weather conditions in the Central Reserve and Table 5-5 summarizes results for the Coastal Reserve.

Table 5-4
Modeled Fire Behavior For 50th Percentile Weather Conditions – Central Reserve

Fuel Type	Fuel Model	Spread Rate (mph)	Fireline Intensity (btu/ft/s)	Flame Length (ft.)
Grass	1	0.27	36	2.4
Marsh	3	0.51	553	8.2
Sage Scrub	SCAL18	0.20	1,011	10.8
Chaparral	SH7	0.18	560	8.3
Riparian/Woodland	9	0.03	19	1.7

Table 5-5
Modeled Fire Behavior For 50th Percentile Weather Conditions – Coastal Reserve

Fuel Type	Fuel Model	Spread Rate (mph)	Fireline Intensity (btu/ft/s)	Flame Length (ft.)
Grass	1	0.24	29	2.1
Marsh	3	0.44	445	7.4
Sage Scrub	SCAL18	0.19	878	10.2
Chaparral	SH7	0.17	514	7.9
Riparian/Woodland	9	0.03	15	1.6

Fires in the grass type fuel models exhibit some the fastest rates of spread of all the fuel models when exposed to similar weather conditions. Chaparral and sage scrub fuels, while exhibiting lower spread rates, have higher fireline intensity and flame length values. Fire behavior calculations for riparian/woodland fuels result in low spread rate, fireline intensity, and flame length values.

NOTE: *Sage scrub and chaparral fuels (Fuel Model SCAL 18 and SH7, respectively) display fire behavior characteristics in the "serious control problem" category during 50th percentile weather conditions.*

5.1.4.2 Fire Behavior under 97th Percentile Weather Conditions

Fire behavior during 97th percentile weather conditions was modeled with a 20-foot wind speed of 32 mph for the Central Reserve and 19 mph for the Coastal Reserve and slope gradient of 20% as representing the typical conditions. All other weather input variables are identified in Table 5-2. BehavePlus modeling evaluated the following fire behavior variables: spread rate (mph), fireline intensity (btu/ft/s), and flame length (feet). Table 5-6 summarizes the modeling results for 97th percentile weather conditions in the Central Reserve and Table 5-7 summarizes results for the Coastal Reserve.

Table 5-6
Modeled Fire Behavior for 97th Percentile Weather Conditions – Central Reserve

Fuel Type	Fuel Model	Spread Rate (mph)	Fireline Intensity (btu/ft/s)	Flame Length (ft.)
Grass	1	2.99	508	7.9
Marsh	3	3.22	4,622	21.8
Sage Scrub	SCAL18	0.97	6,191	25.0
Chaparral	SH7	1.11	4,417	21.4
Riparian/Woodland	9	0.26	185	5.0

Table 5-7
Modeled Fire Behavior for 97th Percentile Weather Conditions – Coastal Reserve

Fuel Type	Fuel Model	Spread Rate (mph)	Fireline Intensity (btu/ft/s)	Flame Length (ft.)
Grass	1	1.15	196	5.1
Marsh	3	1.72	2,483	16.4
Sage Scrub	SCAL18	0.63	3,981	20.4
Chaparral	SH7	0.63	2,453	16.3
Riparian/Woodland	9	0.12	87	3.5

Fires in the grass type fuel models exhibit some the fastest rates of spread of all the fuel models when exposed to similar weather conditions, in some cases exceeding 3 mph. Chaparral and sage scrub fuels, while exhibiting lower spread rates, have higher fireline intensity and flame length values. Fire behavior calculations for riparian/woodland fuels result in low spread rate, fireline intensity, and flame length values.

NOTE: *All fuels display fire behavior characteristics in the "serious control problem" category during 97th percentile weather conditions, except Fuel Model 9.*

5.1.5 Fire Suppression Capability Based on Flame Characteristics

CAUTION: *The following Table 5-8 information should only be used as a guide when personnel safety is involved. Fires can be dangerous at any level of intensity and depends on individual knowledge, equipment, dress/gear, and preparedness. Studies have shown that most fatalities occur in light fuels on small fires or isolated sectors of large fires.*

Table 5-8 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.

The Incident Command System (ICS) and National Wildland Coordinating Group (NWCG) certifies wildland fire Incident Commanders and Prescribed Fire Managers. One of the educational tracts includes providing an understanding of the value of fuel models and the BehavePlus: Fire Behavior Prediction and Fuel Modeling System. BehavePlus is a fire planning tool used by IC in 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 correlation of vegetation to fuel models and fire behavior modeling's use for accurate prediction of expected wildland and/or prescribed fire behavior. This information can be a valuable natural resources planning tool that supports management decisions.

Table 5-8
General guides for estimating successful containment of a wildland fire
Recommendations in this table based upon Roussopoulos and Johnson (1975)

Flame Length (Feet)	Fireline Intensity (BTU/ft/sec.)	Interpretation
< 4	<100	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 – 8	100 – 500	Fires are too intense for direct attack on the head by persons using hand tools. 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 – 1,000	Fires may present serious control problems – torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
>11	>1,000	Crowning, spotting and major fire runs are probable. Control efforts at head of fire are ineffective. Indirect fire suppression strategies will be most effective.

Note: Fire suppression capability interpretations based on observed flame lengths and calculated fire intensity levels.

6.0 NROC FIRE HAZARD REDUCTION AND SUPPRESSION GUIDING PRINCIPLES

6.1 Introduction

Fire is an important ecological process in the natural ecosystems within the Reserve. However, the natural fire regime has been altered by anthropogenic (human-caused) ignitions, which have increased with growth of the human population over the last several decades and resulting ignition sources adjacent wildland fuels. Short fire intervals that are in contrast to the natural, longer interval fire regime can adversely impact natural plant communities and sensitive species. Large, Santa Ana wind driven fires pose a particular threat to natural resources within the Reserve and to human safety and property at the periphery of the Reserve because these fires are difficult to control and can affect very large (Reserve wide) areas. Protection of life, public and firefighters, remains the single most important element in wildland fire protection. The second priority is meeting Reserve management goals including a primary focus on minimizing impacts of fire on natural plant communities and sensitive species.

The following guiding principles are fundamental to the successful implementation of the Fire Hazard Reduction Plan (Appendices A-1 through A-3) and the Tactical Fire Suppression Plan (Volume II):

1. Firefighter and public safety is the first priority in every fire management activity.
2. Impacts to natural plant communities and sensitive plant and animal species as a result of wildfires and actions to reduce fire hazard, prevent fires, and suppress fires must be considered when developing and implementing fire management actions within the Reserve.
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 activities must be prioritized on a cost-benefit basis with stakeholder input, review, and approval.
6. Highly leveraged measures should be given a higher priority than measures that have low leverage, such as those that are very costly (ecological or financial), are unproven, or may result in adverse effects on natural resources.
7. High priority Reserve assets may require protection measures that are untraditional or include lower priority resource impacts.

8. Fire management programs and activities must be economically viable, based upon values to be protected, costs and land and resource management objectives.
9. Fire management programs and hazard reduction measures must be thoroughly vetted and ranked by stakeholders, and implementation should occur through a process that includes landowner and manager representatives (Resource Advisory Fire Team – discussed in detail in Section 7.1.3).
10. Fire management planning and activities must be based upon the best available science.

The Strategic Fire Protection Plan identifies wildland fire management issues relating to the protection of life and property located on lands adjoining the Reserve and priorities for extinguishment of fire within the Reserve to protect natural resources. This planning process also identifies those specific natural resource areas that will require enhanced fire protection in an effort to perpetuate the targeted species. One example is the Tecate cypress stands in Compartment 12 - Gypsum/Coal Canyon; FMUs 12.01 and 12.02.

6.1.1 Nature Reserve Lands of Orange County

Fire has long been a natural part of the southern California landscape. Fire is a periodic source of disturbance to which certain NROC habitat types have adapted during their evolution. NROC contains large acreages of plant communities that depend on occasional fire for rejuvenation and maintenance of natural biodiversity. Many plant species within these communities have responded to a pre-settlement fire regime which provided stimulation for germination or creation of gaps for colonization followed by extended periods of plant maturation. Vegetation is important for many reasons, with one of the most prominent being its habitat function. Many Threatened and Endangered and other State and Federally Listed animal species rely on vegetation in Nature Reserves for their habitat and cover.

Historic fire regimes have been altered due to reduction in grazing by wild ungulates, increases in fire ignitions, invasion by exotic annual grasses and forbs resulting in abundant flashy fuels, social values that include limiting fire, and increased development within or surrounding the NROC wildlands. The combination of expanding WUI, increasing human-caused fire ignitions, historic and changing fire weather patterns, and accumulation of large, continuous areas of Nature Reserve of Orange County managed open space native vegetation all lead to the potential for large wildland fires with significant property, cultural and natural resources losses, as has recently been experienced throughout southern California and Orange County.

6.1.2 The Planning Context

Concepts and principles underlying ecosystem management evolve with ongoing research and improved understanding. For example, Keeley (over the last 30 years) and others continue to expand the general understanding of wildfire, ecological impacts of wildfire, efficacy of fire hazard reduction measures, and vegetation responses. The results from these studies have implications on how large reserves should be managed and the type of planning options that should be considered no longer applicable. The framework presented in this section is a discussion of principles, concepts, processes, relationships, and methods that may be useful in implementing long-term fire management and fire hazard reduction within NROC. This framework seeks to place planning procedures within a broad, proactive process that considers the public's societal values and the biophysical components of ecosystems at the earliest stages of program design.

The management approach suggested here is guided by four broad principles. These principles are:

- Ecosystems are dynamic, evolutionary, and resilient;
- Ecosystems can be viewed spatially and temporally within organizational levels;
- Ecosystems have biophysical and social limits (may not be able to provide what society demands); and
- Ecosystem patterns and processes are not completely 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.

Management efforts are guided by an ever-increasing understanding of how large ecosystem patterns and processes relate to smaller ecosystem patterns and processes. There are limits to the 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.

Long-term ecosystem management requires completion of the following tasks:

- Goals to establish a direction and purpose;
- An assessment of resources at multiple resolutions and geographic extents;
- A strategy for implementing decisions;
- A monitoring program to evaluate the outcome of decisions; and
- Adaptive management approaches.

6.1.3 Land Management Goals

This plan is intended to support a landscape/community level focus for fire management as the scale most likely to produce success for this conservation effort. To do this, it is important to set some broad overall goals for land management. It is the intent of the Central/Coastal Subregion Reserve System ecological based fire management program to achieve the following overall goals:

- Ensure the persistence of a native-dominated vegetation mosaic and function in the Reserve.
- Restore or enhance the quality of degraded vegetation communities and other habitat types in a manner consistent with overall conservation goals for species and natural communities.
- Protect high value biological and cultural resources from too frequent or catastrophic wildfire.
- Support efforts to develop target structural characteristics for selected species habitat (i.e., natural conversion of non-native grasslands to shrublands).

In addition, this WFMP identifies the following broad level goals:

- Protecting the existing natural resources (biological, cultural, geological, ecological) from disturbance-causing fire-related activities within and adjacent to the Reserve;
- Developing fuel-load/fire hazard reducing methods that are consistent with overall Reserve management goals;
- Minimizing the possibility of catastrophic wildfires that negate the Reserve's function as habitat:
  - Minimizing loss of existing sage scrub and enhancing currently degraded shrublands
  - Maintaining native grassland and managing annual grasslands to encourage native grasses.
  - Enhancing Tecate cypress groves such that long term viability is facilitated
  - Maintaining and enhancing oak and riparian woodlands as important and unique habitats
- Providing for public safety through pre-planning, education, response plans and fire prevention activities; and
- Providing for adaptive fire management within each of the Reserve's habitat types.

Achievement of these long-term management goals will be guided by the following objectives which focus on facilitating desired levels of resource protection as well as public and firefighter safety. Some of these objectives are mandated by the NCCP/HCP while others have been formulated in this WFMP for the Reserve. Some of these objectives are currently or have previously been addressed in the Reserve while others will be on-going, requiring at least annual updates. This WFMP update has been developed to address fire management related issues identified in the NCCP/HCP, including the following long-term objectives:

- Guide pre-, during-, and post-fire activities to maintain or enhance the baseline desirable biological conditions and prevent adverse impacts to biological resources in a manner that is consistent with OCFA's fire protection mission.
    - Develop a "toolbox" of hazard reduction methods including fuel reduction for removal/control of invasive non-native plant species; such as manual removal, hand tools, power equipment, grazing, herbicide application, and if conditions become conducive, prescribed fire – all of which must be consistent with Reserve goals for habitat preservation, enhancement, and restoration, and asset and cultural resource protection;
    - Identify highest priority WUI areas and associated fuel management goals with a dual role of working with fire agencies and private property owners on ways to prevent wildfire from impacting urban areas where there is insufficient available setback from hazardous fuels, as well as protecting Reserve lands from fire originating in urban areas;
    - Prepare fire restoration management guidelines for each FMU including discussion of pre-fire prevention (Appendices A-1 through A-3), during-fire suppression (Volume II), and post-fire mitigation activities (Volume III);
- Over the next 30-50years, begin to lengthen the interval between recurring fires through pre-fire prevention measures and pre-planning and eventually (as soon as possible) restoring a fire regime that benefits the Reserve's natural plant communities.
- Familiarize and educate local firefighting personnel about sensitive resources and overall management considerations associated with the Reserve;
    - Provide updated maps of sensitive biological and cultural resources to OCFA and neighboring fire agencies to help minimize impatcs to those resources during fire-fighting response.;
    - Conduct annual outreach with OCFA and neighboring fire agencies on-site to drive Reserve roads, review response maps, and request additional input to improve fire response and resource protection based on changing site conditions;

- Update Reserve tactical response maps depicting relevant fire management data, including property boundaries, topography, vegetation and fuel types, access, and other major features, such as roads and structures on at least a 5-year cycle; and
- Provide a structured line of communication between the Reserve stakeholders and responding fire agencies to streamline and simplify the natural resources information sharing process.

6.1.4 Adjacent Property Fire Management Goals

This WFMP recommends that NROC stakeholders and land managers are familiar with neighboring open space fire policies. Understanding the focus, goals, and procedures implemented on natural areas that may affect the Reserve is critical to meeting the short-term Reserve goal of fire exclusion. The most significant open space potentially affecting the Reserve is the Cleveland National Forest.

The Cleveland National Forest's fire organization is the largest and most complex component of the national forest and is the primary management focus. It includes the following areas of responsibility:

- Management and Administration
- Fire Pre-Suppression and Preparedness
- Wildland Fire Suppression
- Hazardous Fuels Reduction

Management and administration provides for direction and oversight of all fire management activities including fighting forest fires, adhering to approved employee safety practices, community protection and forest health projects, educating the public and responding to inquiries.

Primary pre-suppression activities include fire prevention, maintaining fire suppression equipment, fire suppression training and first aid training.

Fire prevention activities focus on four primary areas: fire prevention engineering, education, community preparedness, and enforcement. Education includes Smokey Bear programs to instill a fire prevention ethic in children and the Firewise community program targets civic and homeowner groups. Engineering includes abatement of fire hazards along roadways in high-use areas. Enforcement includes county, state, and federal fire laws regarding hazard abatement around structures, for both public and private lands in the national forest. This also is enacted along all electrical transmission and distribution systems placed by public utilities across the national forest. Many of the policies implemented on the Cleveland NF are consistent with those within the Reserve.

Cleveland NF Fire Management personnel respond primarily to wildland fire incidents on the national forest. Initial attack firefighting can involve hundreds of firefighters. Extended attack operations (more than two days) involve the leadership and coordination of up to several thousand firefighters and support personnel in a complex interagency environment with substantial urban interface. OCFA and other southern California fire agencies may provide mutual aid during large fires in an attempt to prevent the fire from causing significant resource damage, protect structures, and minimize spread outside forest service boundaries.

Cleveland NF land managers conduct prescribed burns as part of a program to reintroduce fire into the ecosystem. Cleveland NF's goal with prescribed fires is to clear dead, dry plant and chaparral material and improve conditions for wildlife by encouraging new plant regeneration. The prescribed burns are thought to provide improved wildlife food sources and help protect water sources from the erosion caused by large wildland fires. Finally, prescribed fire is used as part of the program to protect national forest facilities and communities within and adjacent to the Cleveland NF boundaries.

The Clevenland NF program managers' first priority is suppression of wildland fires. All wildland fires on southern California national forests are considered to be a threat to communities. Fire staff expects to implement aggressive fire suppression and prevention strategies near communities to protect life and property from wildland fire and subsequent floods. Managers expect to maintain the suppression organization at approximately 90 percent of the most efficient level or higher (Cleveland National Forest 2012).

With regard to protecting communities that neighbor the Cleveland NF, managers focus on creating community defense zones around structures, fuelbreaks, and vegetation treatments to maintain or restore forest health within community protection areas as the second priority for the program. Over the short term, managers are focusing on strategically integrating vegetative treatments to maximize community protection efforts and to minimize wildland fire size, while considering multiple resource needs. Dead tree removal and other vegetation treatments are given priority within the community defense zones.

6.1.4.1 Recommended Coordination

The group of Reserve resource advisors recommended in this WFMP (Section 7.1.3) will be a primary resource for coordination and cooperation with neighboring land owners/managers. A goal for this program is to establish working relationships so that short-term and long-term planned actions can be shared, discussed, and tailored to avoid compromising Reserve fire management plans. For example, should the Cleveland NF determine that a prescribed burn is necessary for a given area, Reserve resource advisors should partake in the discussion and planning, as appropriate, so that potential escapes that may affect the Reserve can be adequately avoided. In this particular example, it may be determined that additional firefighting resources are positioned strategically and with a weight that may be considered overkill, to stop unplanned escapes from entering into the Reserve FMUs.

Another important coordination effort should be focused on developing consistent fire-hazard closure guidelines for Federal, State, and local open space areas and parks within the region.

Closure plans should be simple and straightforward, with guidelines that are based on easily measured thresholds (such as the National Weather Service's Red Flag Warnings).

Coordination amongst open space land owners/managers should consider the importance of these large blocks of habitat and result in fire plans that are flexible (adaptive management). For example, should a large wildfire occur in the Reserve or on other open space areas, then planned burns on the Cleveland NF should be altered or postponed due to the loss of habitat and the elevated importance of the undamaged habitat adjacent the Reserve. This type of coordination currently occurs to some degree, but should be more formally planned and should include all open space land owners/managers in the Orange County/Northern San Diego County region.

It is recommended that RAFT members develop a comprehensive list of land owners/managers whose actions may affect the Reserve through their fire management actions. Fuel reduction efforts on smaller properties has the potential to negatively affect the Reserve if misguided or inappropriate actions, such as blading to bare dirt and/or establishing invasive species that may opportunistically establish within the Reserve and directly interfere with the goal of ignition reduction, are undertaken. Influencing this type of undesirable and damaging fuel reduction approach will likely require RAFT input on public outreach and education efforts undertaken as part of the broader fire management planning by Reserve stakeholders.

Coordination efforts with off-site property owners/managers should include discussion of the Reserve fire management goals and overall approach. This WFMP provides many tools and topics to help communicate the importance of ignition reduction over the next 30 to 50 years. Further, this WFMP provides specific land delineations, known as fire management compartments and fire management units, which will aid the achievement of numerous fire management activities, including coordination with off-site, adjacent property owners/managers. The next section provides a detailed description of fire management delineations.

6.2 Fire Compartments and Fire Management Units

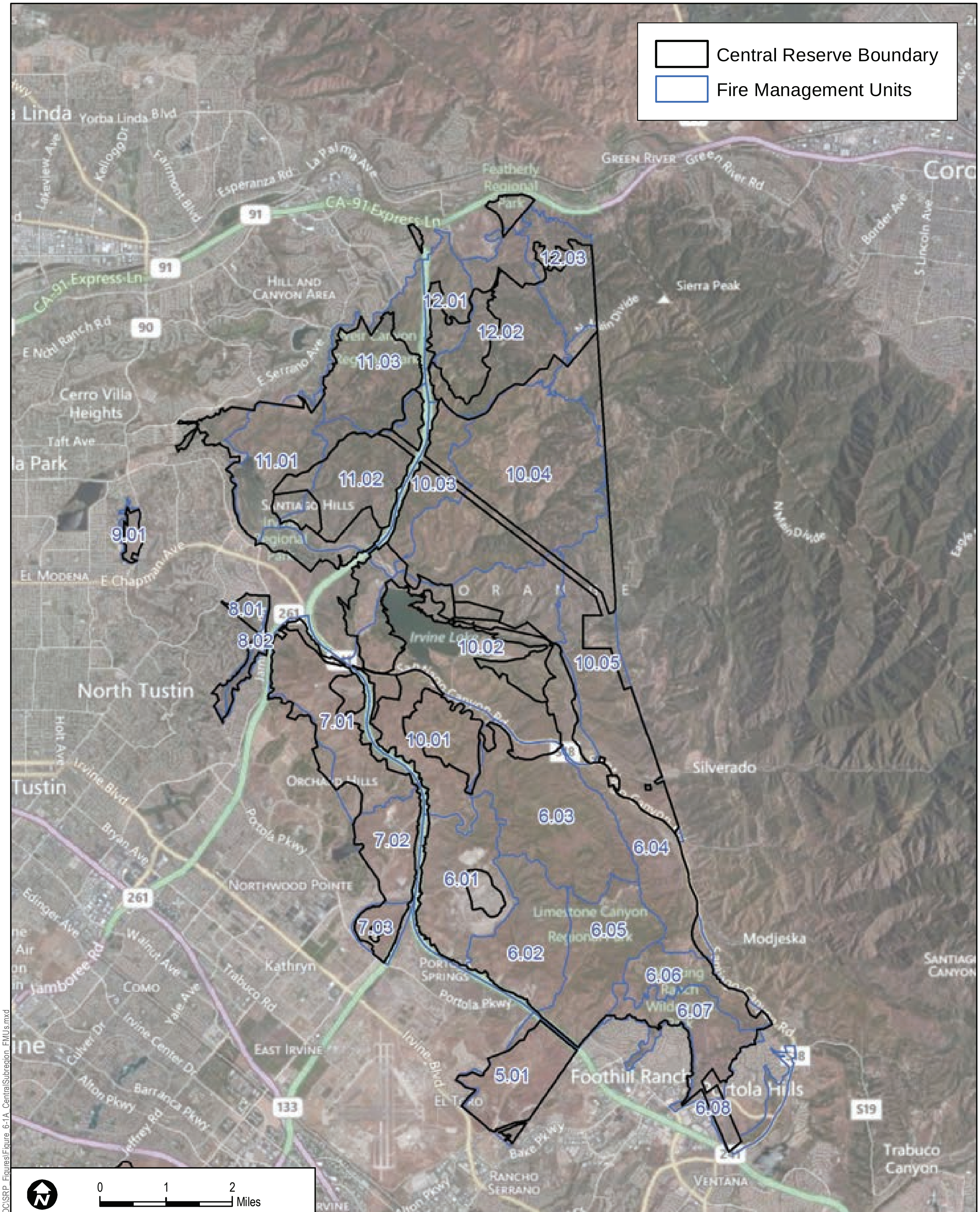
Fire protection planning for Reserve lands began with the formulation of fourteen Fire Management Compartments (FMC) by a group representing key fire and natural resources stakeholders. The compartments were delineated based upon pre-established NROC management Reserves and/or Orange County regional parks. Compartments were further subdivided into individual Fire Management Units (FMUs), depending on the size of the respective compartments (Table 6-1) and totaling 54 FMUs in all. The boundary of each FMU was determined by its potential to support containment of a wildland fire. 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 breaks in fuel continuity helped to shape these boundaries.

The current baseline fire suppression tactical strategy is to contain wildfire within an FMU before it encroaches upon another FMU, as possible. It is fully understood that under severe wildland fire weather conditions (Santa Ana winds, or other periods of hot, dry weather and strong winds),or subject to fire-facilitating fuels and/or topography which can result in aggressive fire spread, wildland fires may spread uncontained through one or more FMUs or fire compartments, including through spotting and area ignitions. However, this baseline is a reasonable fire suppression guideline for the most common wildfire scenario on the Reserve during typical fire weather conditions when the majority of fires, roughly 80%, occur. The baseline strategy may change over time, depending on changes in prevailing weather patterns, vegetation types, or other factors. It is important to consider that this WFMP and its findings, recommendations, and strategies, is applicable for the life of the Reserve. What may be overwhelmingly a clear strategy currently may be an undesirable strategy at some point in the future. Fire compartments and FMUs may need to be re-delineated at some point as field conditions change over time. Large, continuous areas that encompass FMUs with the same firefighting response strategy could be delineated into fewer, larger FMUs. This approach should be considered by the RAFT as field conditions dictate.

Fire suppression tactical strategies are planned by specific FMUs (Volume II). Figures 6-1A and 6-1B depict where the current fourteen Fire Management Compartments and their individual Fire Management Units are located for the Central and Coastal Reserve Lands, respectively. Volume II of this WFMP includes detailed FMU maps and response tables.

Table 6-1
Nature Reserve of Orange County Fire Management Compartments
(Number of FMUs and Total Acres)

FMC No.	Title	Acres	No. of FMU's
1	Aliso/Wood Canyon Wilderness Park	5,174	6
2	Coastal San Joaquin Hills/Newport Coast	8,281	8
3	West San Joaquin Hills/Upper Newport Bay/UC Irvine	3,247	6
4	Inland San Joaquin Hills (City of Irvine Open Space)	6,474	6
5	El Toro MCAS Conservation Area	1,092	1
6	Limestone Canyon Wilderness Area / Whiting Ranch Wilderness Park	10,078	8
7	Lomas Ridge	2,962	3
8	Peters Canyon Regional Park	333	2
9	Santiago Oaks Regional Park	139	1
10	Irvine Lake Santiago Canyon	11,835	5
11	Weir Canyon Regional Park	4,570	3
12	Gypsum Canyon/Coal Canyon	3,689	3
13	Talbert Nature Preserve	216	1
14	Salt Creek Corridor	332	1



DUDEK

7108-01

SOURCE: USGS Topo, Orange County 2010,

FIGURE 6-1A

Central Subregion Fire Compartments and Fire Management Units

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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SOURCE: USGS Topo, Orange County 2010,

FIGURE 6-1B

Coastal Subregion Fire Compartments and Fire Management Units

Nature Reserve of Orange County Wildland Fire Management Plan - Volume I

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6.3 Fire Hazard Reduction

Different approaches to managing wildfire risk have been proposed for shrublands in southern California, depending on one's view of the natural and current fire regime. Under the view that fire has been suppressed and there has been a build-up of fuels increasing the risk of large fires, fuel reduction treatments are proposed to reduce hazards (Minnich 1998). These fuel treatments may take the form of prescribed fire or mechanical clearing. These are the type of fire management policies that are also typically applied to coniferous forests with a surface fire regime that differs from the crown fire regime of southern California shrublands (Keeley 2002b).

Reducing fuel load throughout natural shrublands is not an effective management option under the alternative view that many small fires and infrequent large wind-driven fires are a feature of the natural fire regime (Moritz et al. 2004, Keeley 2005, Keane et al. 2008). Large-scale fuel reduction does not stop or control Santa Ana wind driven fires, which have been demonstrated to burn through all fuel classes and produce embers which cause new fires far in advance of the main fire front. These fires account for the majority of acres burned in southern California. There is also evidence that fire hazard is not well linked to the age of chaparral stands (Schoenberg et al. 2003, Mortiz 2003). When analyzed from a "leverage" standpoint, that is, how many acres are saved from each acre treated with prescribed burning, data indicates that prescribed fire does not reduce the area burned in Southern California (Price et al. 2012). This particular study indicated that there is no leverage gained from prescribed burning since wind driven fires may re-burn areas that recently burned (fuel age does not seem to matter) and the chances that a reburn occurs in the same area as a planned burn are slim.

Instead, fuel reduction is more effective if performed at strategic locations in the WUI or intermix areas as "point protection" to protect identified high value assets, lives and property. This strategy has the added benefit of helping reduce the likelihood that fire originating in the urban side of the interface spreads unchecked into wildlands. Fuel reduction in these strategic areas results in a reduction of fire intensity, slowing of fire spread, and provides fire fighters with the opportunity to implement tactical measures that help them defend important assets. .

In addition to point protection fuel modified areas, strategically placed fuel breaks or fire breaks within wildlands in the interior of the Reserve can provide fire fighters with an opportunity to implement tactical measures to contain wildfires (Keeley 2002b and 2011). In addition to providing an opportunity for containment, strategically placed fuel breaks can also be used to provide protection for specific sensitive resources. However, during Santa Ana conditions, these interior fuel breaks will not stop the wildfire from spreading and it is likely to be too dangerous to send crews in to remote areas within the Reserve interior to conduct tactical operations. Fuel breaks cause significant environmental damage and must be thoroughly analyzed against historic and predicted fire behavior and occurrences. Syphard et al. (2011) showed that fuel break location must be critically reviewed as the primary benefits from fuel breaks were related more to firefighter access and operations then to stopping fire spread. Many fire breaks in Syphard's study, and likely in many Reserve areas, have never been intersected by fire while others have intersected numerous fires.

Among the documented disadvantages of fuel breaks is that inadequate maintenance can result in invasion and establishment of exotic annual grasses and forbs, which provide flashy fuels, increasing the risk of fire ignition and initial spread (Keeley 2002b, Merriam et al. 2006). Grass and herbaceous cover (1 hour fuels) is more readily ignited than chaparral for a longer period and can lead to faster and more wide-spread fires (Rothermel 1983). Also due to the ignitable nature of exotic grasses for large parts of the year, fire frequency intervals may be compressed (D'Antonio and Vitousek 1992), in direct conflict with the current goals of this WFMP. Fuel breaks may also allow exotic plants to establish and degrade adjacent native plant communities (Keeley 2002b, Merriam et al. 2006) and could increase fire risk in these areas. Creating fuel breaks by thinning and removing native vegetation is also likely to result in impacts, possibly significant, to sensitive habitats and species in the Reserve. Recent post-wildfire assessments indicate that it is likely more cost effective to focus on reducing fuels at the WUI, rather than creating fuel breaks throughout the interior wildlands. In certain cases, interior fuel breaks may be warranted, particularly if the fuel break provides a significant tactical advantage for containing fires within a portion of the Reserve, helps meet management goals, can be implemented to take advantage of areas with naturally lighter fuels or existing roads, or allows fire fighter access to protect especially vulnerable and sensitive species.

A high priority for reducing the effects of wildfire on the Reserve is reduction of human-caused ignitions. Reducing the comparatively high ignition rates would reduce the potential for wildfire encroachment and spread throughout the Reserve. The currently elevated fire frequency is the primary cause for NROC's degraded habitats and the focus is on returning to a longer fire cycle, similar to the pre-settlement fire cycle and the historical regime under which coastal sage scrub and chaparral communities evolved. Prioritizing management of ignitions is predicted to be more effective than widespread fuel reduction efforts, especially when not directly connected to a high priority asset, in reducing the area burned by wildfire. A recent comparison of five landscape fire models in a standardized modeling experiment evaluated the importance of fuel management, ignition management, and weather on total area burned and the amount of burned edge area adjacent to a fire prone landscape (Cary et al. 2009). The researchers found weather and ignition management were more important than fuel management in determining the total area burned under each of the five landscape models. However, one model found that fuel management at the burned edge area was important. This analysis supports after fire assessments in Orange, San Diego, Los Angeles, and Riverside Counties, along with other California locations that indicate that fuel management strategies, particularly in shrublands, may not be effective at reducing risk in comparison to the effects of reducing ignitions, particularly under Red Flag Warning weather conditions. Other analyses have concluded that manipulating fuel loads in southern California shrublands is unlikely to be effective in preventing large wind driven wildfires since they burn through old and new fuels (Moritz et al. 2004, Keane et al. 2008, Keeley and Zedler 2009). A glaring example of how ineffective fuel breaks can be during extreme fire weather is the documented fire spread across major freeways (Interstates 8 and 15) in San Diego County which offer in excess of 300 feet wide modified fuels and non-combustible surfaces.

6.3.1 The NCCP/HCP and the Long-Term Fire Management Plan

Section 5.7 of the NCCP/HCP (County of Orange 1996) stresses the importance of fire in maintaining coastal sage scrub successional processes. At the time that the plan was developed, the view was that "…the ecological role of fire has been suppressed in urban areas, resulting in the build-up of thick layers of thatch and dense patches of vegetation" (County of Orange 1996 page II-329). It was recognized that fire management was an important part of the adaptive management program and that extremely large wildfires such as the 1993 Laguna Canyon fire should be prevented. Instead small, planned prescribed fires were envisioned as an appropriate strategy to reduce fuel build up and maintain the viability and diversity of the Reserve System. The NCCP/HCP includes a memo by the USFWS in 1994 that discusses the difficulty in implementing prescribed fires given air quality concerns, objections of local landowners, budget limitations, unsuitable weather conditions and effects on endangered species (County of Orange 1996). Based upon the 1993 Laguna Canyon fire, the importance of refugia for wildlife was highlighted. California gnatcatchers and other sensitive species were able to take refuge from the fire next to urban development and in small remnants of habitat embedded in the urban development. The NCCP/HCP recognizes that delineated FMZs and clarifications to fuel modification definitions and stricter building requirements could allow for less aggressive forms of fuel management in the natural areas. It was recommended that a long-term program of prescribed burns and other means of fuel load reduction be implemented to manage fire risk. The goal of this fuel reduction was to prevent another catastrophic wildfire that could destroy substantial areas of the Central and Coastal Reserves.

Since 1996, there have been several wildfires in the Central Reserve, including the 2007 Santiago Fire that burned 75% of the Reserve (Leatherman 2009). Some areas have burned up to six times since 1914. As a result, the fire frequency for portions of the Reserve is currently higher than the historic level and potentially threatens the integrity of coastal sage scrub and other native plant communities and has caused considerable impacts to species covered by the NCCP/HCP, particularly coastal cactus wren and Tecate cypress. For example, there is a growing problem with exotic plant species invading burned areas and inhibiting recovery of the native plant communities. This presents a dilemma for land managers struggling to determine how to manage fire hazard risk and protect intact native ecosystems and sensitive species covered by the NCCP/HCP. Since current conditions differ from those when the NCCP/HCP was developed, and future conditions may differ from current, the approach to fire management requires adjustment and greater flexibility. The widespread use of prescribed fire is no longer practical for the reasons outlined by the USFWS (above) and also because over 75% of the Reserve has burned within the last two decades. The use of prescribed fire has also been shown to be risky. A prescribed burn in 1998 escaped and burned 2,234 acres, including most of the Tecate cypress population in the Reserve. A more recent fire in 2006 burned through the Tecate cypress, consuming the majority of trees in a large, concentrated stand. Tecate cypress is an endemic species and is an "identified" species under the NCCP/HCP. It occurs in isolated stands only in San Diego and Orange Counties in the United States and in northern Baja California, Mexico. The NROC population in the northern Santa Ana Mountains has suffered from repeated fires since 1914 and is vulnerable to extinction from another fire burning through the stand within the next 30 years (Rodriguez-Buritica et al. 2010).

As required by the NCCP/HCP (Section 5-7), NROC developed a Wildland Fire Management Model that included a fire prescription program to create a mosaic of seral stages and incorporated fire prescription models into the fire management program. However, this fire prescription program is no longer relevant to the current conditions in the Reserve due to the high high frequency and an alternative approach is needed. If fire frequency can be reduced to the historic, natural fire regime which results in more mature vegetation communities within large portions of the Reserve, then at some future time the use of prescribed fire as a fire management tool may be warranted, at least on an experimental basis. The current focus is to reduce fire frequency and fire hazard risk within the Reserve. Prescriptive burning may still provide a useful management tool under certain circumstances to improve the ecology of natural communities within the Reserve, such as reducing the cover of exotic annual grasses in native grassland. However, developing and implementing a prescribed fire program will require extensive analysis and pre-planning as well as clear demonstration that it is necessary and would provide substantial benefits on the Reserve landscape. Currently, the evaluated leverage associated with prescribed burning does not warrant its use due to the high potential ecological and societal costs.

6.3.2 Wildfire Ignition Reduction

Because natural ignition sources (i.e., lighting) are relatively absent from the Reserve, the human-caused ignitions of all types high, and the projected population growth in Orange County over the next 50 years, preventing human-caused ignitions of wildfire is considered the most important means of limiting wildfire and protecting the Reserve and surrounding communities. Further, the fire behavior modeling results presented in this plan, which are consistent with other large, extreme fire weather wildfire events (including the Sanitago Fire), indicate that fire fighting is limited in terms of available options and overall affect. This elevates the need to focus on preventing ignition and reducing fire spread during normal weather conditions. The Irvine Ranch Conservancy (IRC), a land manager within the Reserve, prepared a plan with OCFA and others to reduce ignition of fires on lands they manage within the Central Reserve and in adjacent non-Reserve wildlands (Irvine Ranch Conservancy 2008). The core of their strategy is to "….carry out actions that will reduce the probability of wildland fire ignitions during Santa Ana wind conditions." Important components of this strategy include a Fire Watch Network, fire hardening roadways, improving powerline safety to reduce downed line ignitions, limiting authorized and unauthorized access to wildlands in the Reserve during dangerous wind conditions, and working with home-owner associations and developers of new subdivisions to establish and implement policies to reduce wildfire ignitions. The plan identifies areas at high risk of wildfire ignition, including along public roads and at fire ignition hotspots, which are areas with a history of wildfire ignitions. The IRC plan also identifies common ignition sources (see also Table 4-4 in this volume) and ignition patterns. Important fire ignition patterns include: most fires are human-caused, start near roads and development, and spread quickly into grasslands or into canyons that funnel Santa Ana winds. Further, a notable pattern supporting human-caused ignition as a primary issue is that natural plant communities with the longest periods between fires are those that are farther from human development. The IRC plan is a significant and focused assessment of the issue and of several targeted measures to reduce ignition and minimize fire spread within the Reserve. That plan and its components are encompassed within this WFMP and fire hazard reduction measures discussed in Appendices A-1 through A-3 include the IRC identified measures.

Appendices A-1 through A-3 includes fire hazard reduction recommendations based on analysis of ignition risk across the Reserve (including IRC 2008 analysis). The analysis and recommendations were developed in consultation with landowners, land managers, wildlife agencies, fire-fighting agencies and other stakeholders within the Reserve System.

In summary, Appendices A-1 through A-3 is one document but includes three components. The first component describes the collaborative approach to stakeholder input, the fire hazard, and recommended hazard reduction measures. The second component is an FMU x FMU fire hazard analysis where individual FMUs were assessed and potential hazard reduction measures were developed. The second component is a Cost Benefit Analysis that ranks each of the potential hazard reduction measures based on how highly leveraged they may be compared with other measures.

6.3.3 Strategic Fuel Reduction

The National Park Service prepared a Fire Management Plan for the Santa Monica Mountains National Recreation Area in southern California (NPS 2004). This plan was developed for an area similar to the Nature Reserve of Orange County, in that large patches of conserved coastal sage scrub, chaparral, grassland and woodlands are enveloped within an urbanized landscape. This plan evaluated impacts to natural resources and effectiveness of fire management measures and found that the environmentally preferred approach consisted of strategic fuels reduction, ecological prescribed burns, suppression of wildland fires, and mechanical fuel reduction in the WUI. This approach was analyzed and considered to reduce fire risk to life and property in the WUI and components of that plan can be used as a model for the NROC long-term Fire Management Plan assuming that the current fire frequency issue is resolved and human-caused fire exclusion is achieved.

Strategic fuels treatment is defined as:

> *"Reduction of plant biomass by either prescribed fire or mechanical fuel treatments in strategic locations that would modify fire behavior to the extent that it would limit fire spread, protect identified values at risk, or allow control of a fire perimeter. Excludes the defensible space created by mechanical fuel modification adjoining homes that is required by law…" (NPS 2004, pages 2-1 - 2-2).*

Under the National Park Service approach (NPS 2004), wildfires are suppressed to protect developed and natural lands within a complex mosaic across the landscape. Natural fire (for example, ignition started by lightning) is very infrequent and usually does not occur under acceptable Orange County weather parameters conducive to wildland fire spread. The native vegetation is either too wet during a lightning storm or too dry to successfully plan for use of natural ignited fires to play a key role in shaping the ecosystem. Instead, wildfire hazard reduction will utilize other measures, such as reducing fire ignitions and providing "active" hazard reduction measures (Appendices A-1 through A-3) to reduce the chance that fires start and subsequently spread over a large area of natural lands within the Reserve. In some instances, it may also be necessary to implement fuel treatments at strategic locations to protect high value biological resources. Typically, fuel treatment methods to protect high biological or cultural values are either by strategically placed fuel breaks and/or prescribed fire units to break up highly flammable vegetative fuels. However, prescribed burning is currently considered infeasible on the Reserve and other potential measures are considered appropriate for consideration in lieu of planned burns, at least until habitat goals are achieved.

Managed fuel breaks consist of a strip of land where fuels have been reduced. A fire break, in contrast, includes clearing fuels from a strip of land and providing modified fuel areas adjacent to the cleared area. Fuel breaks may vary from 10 feet wide to over 1,000 feet wide. Fuel breaks include trimming shrubs and removing flammable herbaceous vegetation within a pre-designated area. This is completed with a minimum of ground disturbance by either hand labor or mechanical means (e.g., blade-up dozer crushing) to widen and enhance the fuel break. To maintain the effectiveness of fuel breaks, herbaceous vegetation should be removed annually and trees and shrubs trimmed, limbed up or removed every few years. It is especially important to remove herbaceous weeds (e.g., mustards, European annual grasses) before seeding so that they do not spread into the adjacent native habitats. The fuel break provides a reduced fuel zone where fire, absent wind-born embers, is starved of fuels which causes a decrease in the flame lengths, fire intensity, and spread rates.

Using the NPS approach as a model (NPS 2004), short term impacts to sensitive biological resources are weighed against long-term reductions in fire hazard risk in the region and decisions are made as to where fuel reduction measures should be applied. These analyses take into account information on natural resources and vegetation, fuel characteristics, the results of fire spread models, and a consideration of potential risks to life, property and natural resources. An analysis of the Reserve has been conducted and the results used to develop recommendations for strategic fire hazard reduction within the Reserve (Appendices A-1 through A-3). Landowners, land managers, wildlife agencies, fire-fighting agencies and other stakeholders in the Reserve were part of this process and provided input into the development of these recommendations. As previously introduced, Appendix A-1 presents the recommendations resulting from this fire hazard reduction analysis a. All fuel reduction treatments will be conducted in a manner to protect sensitive biological resources, such as implementing the treatments outside the breeding season to avoid impacts to nesting birds and focusing fuel reduction at assets (on- and off-site) as well as with consideration for prior disturbances.

6.3.4 Fuel Treatment at the Wildland Urban Interface

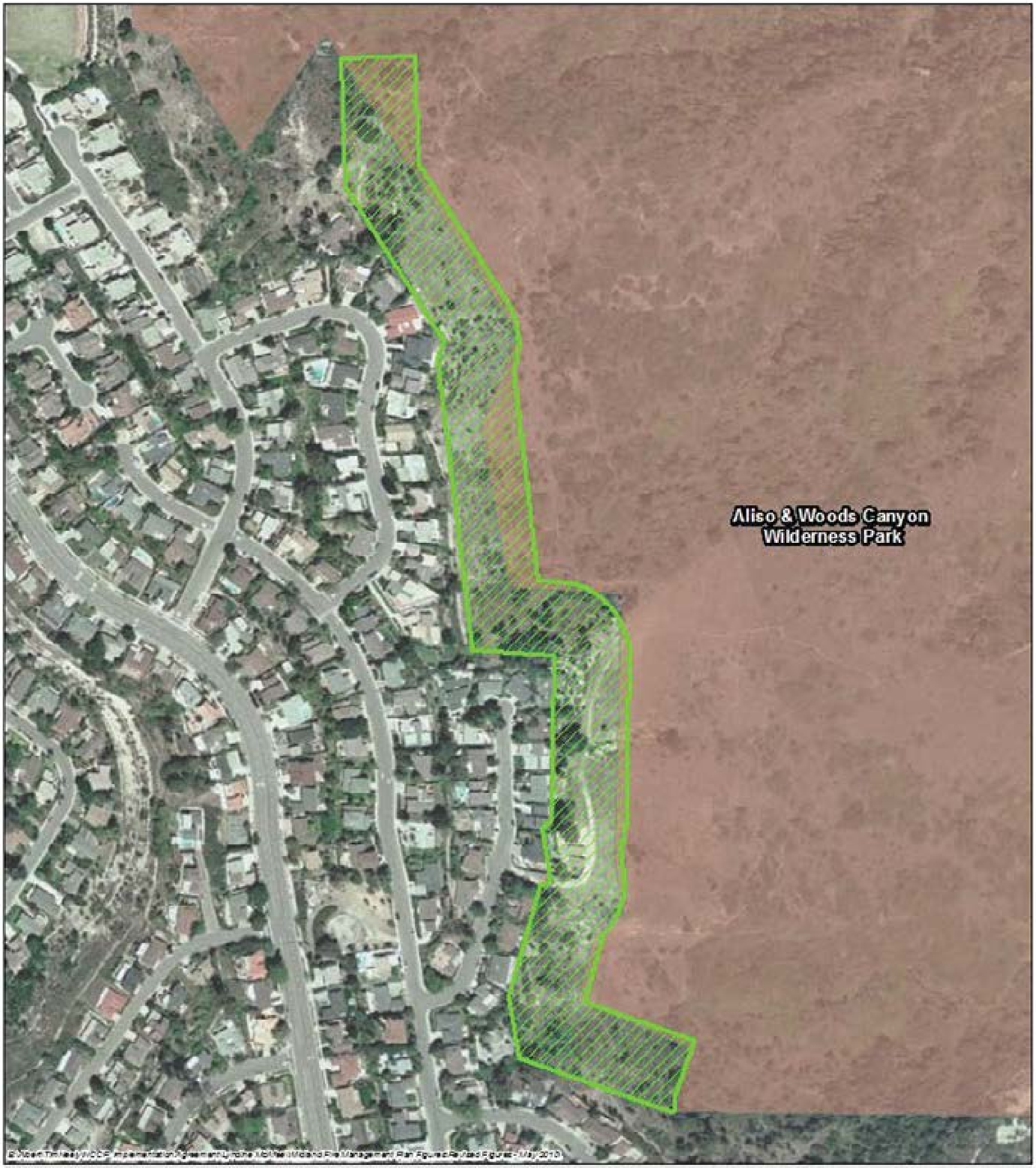
The protection of life and property is best implemented from structures (residences) outward. If a property does not include: 1) appropriate defensible space, 2) ignition resistant construction, , and 3) adequate emergency access, the fire department may determine that the property is too dangerous and does not provide a reasonable defensibility against high intensity wildland fire. These properties may be assigned the "loser" category, determined to be unsafe for firefighters and not defendable.

While this WFMP can do little to improve off-site structure ignition resistance, beyond educating interested citizens, and emergency access, it can influence defensible space areas. The NCCP/HCP was developed so that most FMZ at the Reserve WUI are outside the Reserve boundaries. However, there are a few situations consisting of older developments where a FMZ was not included in the development plan. In these cases, the homeowner meets all the other FireSafe requirements, but does not have the necessary room on their property to comply with the OCFA or local fire jurisdiction requirement of 170 to 195 feet of fuel modification treatment from their structure. In these cases, the FMZ was "grandfathered" into the Reserve based on reducing the fire risk to the adjacent structures as well as considering the buffer's positive impact on reducing structure or back-yard ignitions from having a direct fuel path into the Reserve. Fuel modification zones adjacent private property, including the areas within the Reserve boundaries must be maintained annually in order to function as planned. Maintenance must be provided by the property owner or entity assigned responsibility for annual maintenance (such as an HOA, City Fire Department, or homeowner, etc.).

6.3.5 Fuel Modification Zones in Practice

The NCCP/HCP does not allow for FMZs as a permitted use within the Reserve System, except for areas adjacent to pre-1996 development (County of Orange 1996). There are two areas that could be delineated on current maps where FMZs were explicitly allowed under the NCCP/HCP - Emerald Bay and Top of the World in Laguna Beach (Figures 6-2A and 6-2B). These FMZs are at least 170 feet wide (consistent with OCFA standards) and overlap the Reserve boundary. The Top of the World FMZ encompasses 10.9 acres and the Emerald Bay zone is 18.4 acres. The remainder of the Reserve was designed so that FMZs are outside and adjacent to the Reserve boundaries, thereby separating the Reserve from adjacent urban areas.

FMZ practices in these two areas and in all areas where urbanized landscapes border Reserve native landscapes can directly and indirectly affect native plant communities and animals within the Reserve. In some cases, FMZs properly maintained with the appropriate native plant species can provide wildlife habitat and even refugia for animals following a fire. This has been particularly important for the coastal cactus wren which has persisted in FMZs that support cactus patches and are adjacent to burned Reserve lands (Leatherman 2009). Potential management problems associated with FMZs include invasion of exotic plant species into the Reserve, particularly annual grasses and weeds in improperly maintained FMZs.



NATURE RESERVE of ORANGE COUNTY

Fuel Modification Zone

Top of the World Zone

NCCP Reserve

Boundary

0 125 250 500 Feet

FUEL MODIFICATION ZONES

COASTAL SUBREGION NCCP
Orange County, California

May 2010

DUDEK

7108-01

FIGURE 6-2A
Fuel Modification Zones

INTENTIONALLY LEFT BLANK

DUDEK

7108-01

FIGURE 6-2B

Fuel Modification Zones

Nature Reserve of Orange County Wildland Fire Management Plan – Volume I

INTENTIONALLY LEFT BLANK

For areas where deep-rooted shrubs have been removed, there can be serious problems with slope stability, leading to erosion and landslides that impact Reserve lands. The varying widths and structure of the on-site fuel modification zones may enable modifications that result in dual purpose zones, functioning as fuel modification and wildlife habitat. This measure and its potential for implementation within the Reserve is analyzed in Appendices A-1 through A-3.

6.3.6 Maintenance of Fuel Modification Zones

FMZs within the Reserve are currently inspected and maintained annually by LBFD. Property owners/managers are expected to inspect their FMZs or have them inspected to identify fuel accumulation and prescribe treatment. Unchecked, fuels accumulation results in increased fire intensity adjacent to private assets as well as increased risk of fire ignition or spread from the reserve to the urban areas or from the urban area into adjacent natural plant communities. If FMZs, at some future point, are no longer provided inspections or annual maintenance, then the RAFT will consider options available to re-engage the appropriate fire agency and reinstitute annual maintenance on hazardous lots. This is a new policy and a recommended RAFT responsibility.

OCFA utilizes detailed guidelines for FMZ maintenance that have been reviewed and sanctioned by the NCCP/HCP. Because LBFD's FMZ maintenance guidelines are very similar to OCFA's it is expected that they could receive NCCP/HCP sanction, with minor changes. Most aspects of either agency's guidelines can be implemented within these areas to reduce the potential threat of wildfire spread. Ground cover may require removal more often than annually. During especially wet winters, grass and forb growth may need to be mowed, trimmed, or grazed two or more times. Thinning and clearing of shrubs may occur less frequently, depending on their rate of growth. Thinning of shrubs in coastal sage scrub should not be implemented during the bird breeding season (February 15 to July 15) to prevent impacts to nesting birds, particularly California Gnatcatchers and Cactus Wrens. Removal of herbaceous plants, such as native and exotic grasses and forbs, in coastal sage scrub should be conducted in a manner to minimize potential impacts to nesting birds. This will require a pre-treatment survey by a qualified biologist to ensure there are no nesting California Gnatcatchers or Cactus Wren within the FMZ. If there are, then the nests will be flagged and treatment of areas within 100 feet of nests will not be allowed until after the young are fledged and capable of moving outside the disturbance area.

6.3.7 Fire Resistant Plant Material

To reduce impacts to the Reserve, and enhance the ability of FMZs to provide refugia benefits following fires, a plant palette has been developed jointly by the NROC, wildlife agencies, Orange County Fire Authority and others to provide guidelines on the species that are best suited for planting in the WUI and is provided in Appendix B.

6.3.8 Undesirable Plant Species

Certain plants are considered to be undesirable in the landscape due to characteristics that make them highly flammable and/or highly invasive when located in areas adjacent to preserved natural areas. Fire characteristics can be either physical or chemical. Physical properties that would contribute to high flammability include large amounts of dead material retained within the plant, rough or peeling bark, and the production of copious amounts of litter. Chemical properties include the presence of volatile substances such as oils, resins, wax, and pitch. Certain native plants are notorious for containing these volatile substances. Invasive plants are often able to outcompete native plants, eventually replacing them if left unchecked. Invasive plants are often more prone to ignition due to their flashy fuel tendency.

Examples of plants with these characteristics are presented in Appendix C. Should these species already exist within these areas, they shall be removed because of the potential threat they pose to fire ignition, spread, and structure threat. They are referred to as “target species” since their complete removal is a critical part of hazard reduction.

The occurrence and distribution of undesirable species will change over time and it will be the responsibility of NROC, the RAFT and land managers to monitor and develop invasive plant restoration plans as funds allow and to actively pursue funds through available avenues (grants, donations, etc.). The Habitat Restoration and Enhancement Plan, Nature Reserve of Orange County, Central Coastal Subregion (LSA 2003) identifies the current locations and recommended actions for removal and restoration, and subsequent fire hazard reduction, on NROC.

6.4 Preventing Structure Ignition in the Wildland-Urban Interface

Throughout Orange County, urban development continues to sprawl into wildland areas, increasing the WUI and introducing new ignition sources and assets needing protection. This trend is creating an expansion of wildland/urban interface areas where structures are located next to a large area of conserved open space i.e., native vegetation. These structures may be vulnerable to wildland fire based on a variety of factors. There are three ignition sources of concern to a structure located in a wildland environment:

Radiation

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. Wildland fires can cause ignition by radiating heat to a 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.

Conduction

Molecules move heat through a solid object. Heat will transfer through wood, although very slowly and this is not considered a major factor in wildland fire spread.

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 such as roofing, lawn furniture, etc.) to continue the fire spread.

Ignition of a structure by convective heat transfer requires the flame to come in direct contact (direct flame impingement) 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, "defensible space" clearing to prevent flame contact with the structure must include removal of any materials directly adjacent the structure capable of producing even small flames (for example, cured grasses, low ground cover, flammable mulch, leaves or pine needles on roofs, and combustible yard furniture) that can ignite flammable structure components.

Firebrands are pieces of burning materials that detach from a fire due to the strong convective drafts in the burning zone. Firebrands can be carried a long distance (up to 5 miles or more) by wildland fire drafts and/or strong winds. The chance of these firebrands igniting a structure will depend on the size of the firebrands and their decay rate, how long it burns after contact with a combustible fuelbed, and the ignition resistance (materials, design, and construction) of the structure. In extreme fire storms, fire brands can include intense showers of small, quick decay embers as well as large brands such as 4x8 plywood or whole palm fronds that can be carried into the air and dropped in receptive fuels.

6.3.6.1 Ignition Resistance Focused Building Codes/Ordinances

Past practices such as placing structures too close to the property line to enable adequate fuel modification (reduction) and not providing suitable Alternative Materials and Methods, installation of combustible roofing and siding, improper landscaping, and other building design features (porous vents, spaces) have contributed to wildland fire transitioning to urban, structure fire. This type of older construction can be found throughout the County of Orange and is generally associated with 1950s to 1990s building codes. Generally, it is these older, non-compliant residences that are the leading cause for the high number of structure losses during any serious wildland fire incident. For example, statistics from the 2003 and 2007 mega-fires in San Diego County clearly indicate that newer homes, subject to ignition resistant building codes, fare much better during wildfires. Of 15,000 total structures within the 2003 fire perimeters, 17 percent were damaged or destroyed. However, of the 400 structures built using the 2001 building codes, only 4 percent were damaged or destroyed. Further, and even more telling, of 8,300 structures within the 2007 fire perimeters, 13 percent were damaged or destroyed. However, of 789 structures built using the 2001 building codes, 3 percent were damaged or destroyed and of the 1,218 structures built using the 2004 building codes, only 2 percent were damaged or destroyed (Institute for Business and Home Safety 2007).

OCFA and the Cities of Anaheim, Newport Beach, Orange and Laguna Beach Fire Departments currently have ordinances and policies that have helped minimize these wildland fire threats to their new developments, including adoption of the latest state building and fire codes. The biggest wildland fire problem facing OCFA and local fire jurisdictions is that there are still many residential structures that were built prior to the implementation of the OCFA or local fire jurisdictional Wildland Urban Interface Ordinances (Chapter 7A, Ignition Resistant Construction, of the California Building Code) and it is difficult to convince home-owners to invest in upgrading their homes' ignition resistance.

6.3.6.2 Cultural Resources Fire Damage Prevention

Archaeological site location data are kept confidential from the general public, because of potential damage and destruction from illegal excavation, collection, and vandalism. Within an organization such as NROC, OCFA, or any of the Stakeholders, site location data should be restricted to persons for whom it is a requisite for project planning and avoidance of impacts.

Initial survey results indicate that the majority of the known sites would be only minimally impacted by fire and moderately to highly impacted by ground disturbance activities. Therefore, focused placement of staging areas, fuel breaks, fire lines (dozer or hand crews), and other soil disturbing activities prior to, during, or following fire can use the available cultural resource location information for planning until more focused surveys can be completed.

Within OCFA, the lack of accurate cultural resources data has reportedly resulted in the loss of sites through inadvertent impacts during fire suppression activity. Based on the recommendation of this WFMP, NROC will provide the OCFA primary contact with a map showing the locations of the Reserve archaeological sites along with this WFMP. This map is to be kept confidential by the OCFA representative and not displayed, reproduced, or released to other OCFA or fire agency personnel or to the public. However, because large fires can result in mutual aid from firefighters from outside of the county, maintaining confidentiality of cultural locations can make them vulnerable during a large fire event. Therefore, limited cultural information is provided on the tactical response maps in Volume II that will be available at the Reserve, so that the resource advisors, through the OCFA contact, can provide the cultural information to responding firefighters to the Incident Command. The latter may require digital tactical response plans as the IC may be established in a distant location.

Historic sites containing structural remains have special management requirements. The locations of foundations, walls, and rubble piles as well as boulder outcrop related sites, cannot be concealed from field personnel in the same manner as scatters of flaked stone artifacts. These historic sites are frequently close to dirt roads and are easily seen from approaching vehicles. OCFA personnel report that such structural remains are subject to bulldozing if they are viewed as obstacles to fire suppression. Impacts to boulder outcrop related sites can be prevented by avoiding dislocation of boulder outcrops; many of these outcrops overlap with sensitive habitat locations. In addition, as noted above, structural remain sites may contain some wood construction materials and other perishable artifacts that would be adversely impacted by fire. Given these considerations, historically sensitive areas where visible structural remains may occur should be indicated, along with added buffer zones, on the Fire Management Unit maps, however, cultural data was not made available to Dudek. The presence of other types of archaeological sites, both prehistoric and historic, is noted for each of the Fire Management Units, but the precise locations are not indicated on the Fire Management Unit maps. Access to these maps should be restricted to personnel who need the information in order to avoid impacting the sites. This information is not for public distribution.

6.5 Fire Management Unit Fire Hazard Reduction Prescriptions

Fire hazard reduction includes any number of activities that are focused on reducing fire ignitions, spread, intensity, and related damage to high value resources (habitats, wildlife, sensitive species, cultural assets, off-site property). An exhaustive process of analysis and stakeholder input was undertaken to arrive at the currently recommended prescriptions for each FMU. Each FMU was evaluated and compared against available GIS data regarding topography, vegetation, high value resources, accessibility, natural fuel breaks, adjacent, offsite assets, fire history, relation to potential ignition sources, and potential for beneficial treatments (Appendix A-1). Potential treatments were prioritized on a cost-benefit basis with input from fire authorities, fire planners, and stakeholders. Based on this analysis and compared with the FMU characteristics described above, a primary prescription has been developed for each FMU. Table 6-2 provides a summary of the Fire Management Units, potential ignition sources, and the corresponding hazard reduction prescription. In some instances, there is no prescription as the cost to implement any of the possible measures could not be justified based on current FMU conditions. The detailed FMU assessment, including site specific attributes and recommended fire hazard reduction toolkit measures is presented in Appendices A-1 through A-3.

Table 6-2
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
1.01	residential/accidental, electrical transmission line, power equipment, recreational users, arson, spotting	Improve fuel modification in northwest, west and south portions of FMU by increasing width and/or reducing fuel densities, educate homeowners on landscaping through consistent and frequent message
1.02	residential/accidental, vehicular/roadways, electrical transmission line, arson, recreational users, power equipment, spotting/embers	Educate homeowners of fire safety and structural protection, restrict access during Red Flag Warning (RFW) weather, monitoring patrols
1.03	residential/accidental, vehicular/roadways, arson, recreational users, power equipment, spotting/embers; electrical transmission line to CTP	Improve fuel modification at ridgetops by removing exotic species and focusing at structures outward - consider studying whether full 200 + is necessary based on type of construction, implement more pronounced fuel mod for some stretches where heavier fuel/ornamentals; in secondary canyon (M and K streets); implement minimum 100 feet wide fuel mod for mobile homes and 20 feet along any existing, paved roadways; education outreach with consistent message and frequent contact - many homeowners are violating principles of FMZ; restrict access during RFW weather; monitoring patrols

Table 6-2
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
1.04	vehicles/roadway, residential/urban accidental, arson, electrical transmission line	Invasives removal/restoration; restricted access during RFW weather, educational outreach to neighbors - consistent message and frequent contact
1.05	roadways/vehicles, electrical transmission lines, recreational users, residentiall / retail / industrial / accidental, arson, spotting/embers	Establish FMZ within FMU along interface with Laguna Canyon Road (LCR) structures/properties – currently there is a wide range of conditions with some very hazardous fuels just off-site, restrict access to Reserve on RFW days
1.06	Electrical transmission line to north and east, roadways/vehicles, recreational users, spotting, arson	Maintain and increase buffers along El Toro Road and Laguna Canyon Road to at least 20 feet wide (as possible) and inclusive of spring mowing of grasses and flashy fuels and establishment of native shrublands, where feasible
2.01	recreationists, PCH/vehicles, beach fires, residential/accidental, arson, spotting from FMU 2.05	Invasive conversion to habitat, fuel mod maintenance along PCH and on-site roads, educational signage about fire
2.02	vehicles/roadways, residential/accidental, spotting from north and east,	None identified
2.05	roadway/vehicle, electrical transmission line, residential / accidental, treatment facility, adjacent FMU (spread or spotting), remote campers, arson, spotting	Maintain fuel mod/defensible space adjacent to residential community to the southeast of this FMU; maintain suitable buffers between school, RV site and wastewater treatment facility; maintain buffer along PCH - mowing annually by June and as needed
2.06	vehicles/roadway, electrical transmission line, residential / accidental, recreation user, arson	Patrol campsites, no camping on RFW days
2.07	Electrical transmission line, WUI residential/accidental, power equipment, recreational users, arson	Re-assess FMZ's on FMU, may be wider than needed and focus should be on structures out, not reversed. Create turnarounds for fire engines at key locations along dirt roads, as possible..
2.08	Electrical transmission line, WUI residential/accidental, power equipment, recreational users, arson	Re-assess FMZ's on FMU, may be wider than needed and focus should be on structures out, not reversed. Consider creating turnarounds at key locations along dirt roads to enable engine access.
2.09	Electrical transmission line, adjacent substation, roadway/vehicle, recreational users, residential-industrial/accidental, spotting	Fuel modification along LCR and around 3 facilities (substation, Laguna College of Art and Design, and transportation facility) should be created/expanded to reduce potential threats of ignition and/or structural damage; Laguna Canyon Road fuel buffer should be expanded to at least 20 feet wide, as possible and LBFD should provide nexus and enforcement.
2.10	vehicles/roadways, electrical transmission line, recreational users, spotting	Maintain fuel mod buffers along roadways, especially 133/Laguna Canyon Road, educate hikers, signage about fire safety

Table 6-2
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
3.01	Roadways, residential / urban areas, accidental, arson, recreation	Invasive species removal, fuel modification improvements on off-site, adjacent properties
3.02	Roadways, residential/urban areas, accidental, arson	Property owner education on fuel mod safety, starting at home landscaping
3.03	Roadway/vehicles, residential related (fire, children, accidental), arson, power equipment	Maintenance of roadside fuel mod buffers for all roads that travel adjacent to and through the FMU – CAL TRANS and/or Transportation Corridor Agencies remove flashy fuels in May/June
3.04	oil wells?, electrical facility, roadways/vehicle, accidental from residential, arson, recreation, spotting	Targeted fuel mod maintenance/improvements to reduce fuel on northeast facing slopes, especially in south adjacent Arbella to Portica
3.05	Power equipment, vehicles/roadways, residential/accidental, arson	Adjacent to Poppy Lane and southward across canyon need to consider significant fuel modification for adjacent residents; possibly a full habitat restoration of the canyon in this roughly 2000 linear foot section of the Canyon to remove exotics and return the canyon to a reduced fuel, native condition; other technologies may be useable - phos-chek system with thinning of exotic fuels
3.06	Roadways, facilities, residential fire, arson, accidental, spotting	Targeted fuel modification to reduce fuels, raise tree crowns, thin tree densities at terminus of Port Carlisle PL, Port Durness PL, reservoir facility (west of reservoir)
4.01	Roadway/vehicle, residential/accidental, arson, recreational user, spotting	Maintain fuel mod along Bommer Canyon Road, implement vigorous flashy fuel removal along 73, educate park users; Web cams and/or flame/heat detectors for viewing remote areas on RFW days
4.02	roadway/vehicle, power equipment (golf course), residential/accidental, arson, recreational users, spotting/burning from neighboring FMU	Maintenance of trails, especially Little Sycamore Trail to at least 10 feet for backfiring or anchorpoint operations; educate golf course to enforce fire safety by grounds crew and golfers, especially on RFW days; maintain buffers along 73 by removing flashy fuel where it occurs in May/June annually; Web cams or flame/heat detectors for viewing remote areas on RFW days
4.03	Transmission line (east), residential/accidental, roadway/vehicle, recreational	Roadside mowing by responsible party (City, Cal Trans, HOA, County, etc.) along all paved road surfaces, particularly the higher traffic volume roads in June, trails maintenance, monitor access, close down access during extreme weather, Web cameras and/or flame/heat detectors for viewing remote areas on RFW days
4.04	Vehicle/roadways, Farming equipment/operations, Golf course equipment, recreational users, arson	Work with CAL TRANS to ensure roadside fuel mod/mowing of flashy fuels in May/June along 405 freeway

Table 6-2
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
4.05	Transmission lines along eastern edge in northeast FMU, electrical substation at eastern edge; roadways/vehicles, residential development, accidental/residence related; arson	Vegetation management under distribution lines and implementation of “Go 95” vegetation management around poles; work with CAL TRANS; NROC may provide mowing annually along interface, including 133/73, consider Webcam and/or flame/heat detectors for monitoring interior areas on RFW days, restrict access on RFW days
4.06	Transmission lines through FMU, electrical substation at eastern edge (just off site); roadways/vehicles, residential development, accidental/residence related; arson	Vegetation management under distribution lines and implementation of “Go 95” vegetation management around poles; work with CAL TRANS to provide mowing annually along interface, including 133/73
5.01	roadways/vehicles, machinery, power equipment, arson, agriculture operations, off-road vehicles, electrical transmission line, on-site law enforcement activities	Determine what activities occur on site with law enforcement, structure fire prevention requirements appropriately, implement fuel mod along 241, restoration to native communities
6.01	low voltage electrical T-line (along Bee Cnyn Rd); roadways/vehicle related, industrial, structure/operations (accidental), arson, spotting, fire encroachment; ag related	Monitor access - off-road vehicles, restrict access to undisturbed FMU areas on RFW days, restrict activities on landfill on RFW days, watch program; vegetation clearance on T-line and “Go 95 vegetation management around poles.
6.02	roadways/vehicle related, landscape/recycling center/operations (accidental), arson, spotting, fire encroachment; landfill related	Monitor access - vehicle uses, restrict access to undisturbed FMU areas on RFW days, watch program; fire detection system technology
6.03	roadways/vehicles, spotting, wildfire encroachment, adjacent T-lines (SCE) high voltage east, agriculture ops off-site, recreational users, arson	Remote fire detection systems, education of hikers/visitors, fire watch on RFW days, access restrictions on RFW, vehicle user restrictions
6.04	roadways/vehicles, rural residential/accidental, electrical transmission line, spotting, wildfire encroachment	Educate homeonwers and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams or fire detection technology in remote areas
6.05	roadways/vehicles, residential / accidental, ag operations, recreational user, spotting, wildfire encroachment	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or flame/heat detection in remote areas
6.06	roads/vehicles, arson, electrical transmission lines, spotting from neighboring FMUs	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams or flame/heat detection system in remote areas
6.07	residential/accidental, electrical transmission line, roadways/vehicle, recreational user, arson, spotting	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or flame/heat detection system in remote areas
6.08	electrical transmission lines, roadways/vehicles, recreational users, arson, substation, residential/accidental, spotting	restoration of non-native habitats, especially to cactus scrub

Table 6-2
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
7.01	low voltage electrical T-line (north); roadways/vehicle related, recreational related, ag structure/operations (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles, laborer “lunch fires”, restrict access to FMU on RFW days, watch program; fire detection technology; vegetation clearance on T-line and “GO 95” vegetation management around poles
7.02	low voltage electrical T-line (several throughout); roadways/vehicle related, recreational related, batch facility - heavy trucks; gravel, industrial, ag structure/operations (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles, laborer "lunch fires", restrict access to FMU on RFW days, fuel mod along heavy equipment parking areas (recommend 20 feet wide minimum) at facilities; watch program; fire detection technology; clearance on T-line and poles (Appendix A-3)
7.03	low voltage electrical T-line (NE corner, along 133); roadways/vehicle related, (accidental), arson, spotting, fire encroachment (from neighboring FMU)	Monitor access - off-road vehicles, restrict access to FMU on RFW days, fuel mod improvements along Bee Canyon Road – maintain a 20 foot wide “fuel management zone” where flashy fuels are managed; watch program; clearance on T-line and poles
8.01	residential/accidental, roadway/vehicle, electrical transmission line, recreational user, arson, mntnce operations, spotting	Work with OCFA and homeowners on continued landscaping/defensible space messages; fuel reduction by habitat restoration within drainage, removal of exotic trees
8.02	residential/accidental, roadway/vehicle, electrical transmission line, recreational user, arson, spotting	Work with OCFA and homeowners on continued landscaping/defensible space messages; fuel reduction by habitat restoration: removal of exotic trees (OCFA and OC Parks have removed eucalyptus trees south of the upper reservoir)
9.01	urban sources, residential/accidental, arson, electrical transmission line, substation, spotting	Homeowner education on fire safety and prevention; allow fuel mod extension for some homes that may require wider defensible space buffer
10.01	low voltage electrical T-line (N/NE); roadways/vehicle related, recreational related, ag structure/operations (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles, restrict access to trails on RFW days, watch program; fire detection technology; maintenance of vegetation clearance on T-line (away from distribution lines) and “Go 95” vegetation management around poles.
10.02	electrical transmission line; roadways/vehicle related, recreational/boating/lake related, 1 residence at dam (accidental), arson, spotting, fire encroachment;	Monitor access, restrict access to trails on RFW days, watch program, Webcams, Remote Ignition Detector Systems or similar fire detectors
10.03	freeway/vehicle (north and west), toll stop adjacent, cigarette, electrical transmission line; arson, spotting, fire encroachment	Monitor access, restrict access on RFW days, watch program, fire detectors
10.04	electrical transmission line; arson, spotting, fire encroachment; lightning	Monitor access, specific fuel reduction/point protection for Tecate Cypress grove to north (Appendix A-3); restrict access on RFW days, watch program, Webcams, RFID or similar fire detectors

Table 6-2
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
10.05	electrical transmission lines; recreational users, rural residential (accidental), roadways (vehicle related); arson, spotting, fire encroachment; lightning	Monitor access, educational outreach to home/property owners in or adjacent to FMU (rural properties) restrict access on RFW days, watch program, Webcams, RFID or similar fire detectors
11.01	full interface with residential community/ Serrano Ave to the west (vehicle related ignitions - less than freeway); electrical transmission line (northern boundary), recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, more robust fuel buffer or ignition containment devices along 241; restrict access on RFW days, watch program, Webcams, RFID or flame detectors; habitat restoration in SW with removal of exotic trees;
11.02	full interface with 241 Toll Road to east (vehicle related ignitions), electrical transmission line (northern boundary), recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, more robust fuel buffer or ignition containment devices along 241; restrict access on RFW days, watch program, Webcams, RFID or flame detectors
11.03	full interface with 241 Toll Road to east (vehicle related ignitions), full interface with residential to west (accidental, small combustion engines, etc.), electrical transmission line, recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, more robust fuel buffer or ignition containment devices along 241; restrict access on RFW days, watch program, Webcams, RFID or flame detectors
12.01	full interface with 241 Toll Road to west, full interface with 91 to the north (vehicle related ignitions), recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, more robust fuel buffer or ignition containment devices along 241; restrict access on RFW days, watch program, Webcams
12.02	freeway/vehicle (north and west), toll stop just south, cigarette, electrical transmission line; arson, spotting, fire encroachment, lightning	Monitor access, specific fuel reduction/point protection for Tecate Cypress grove (per Hazard Reduction Toolkit in Appendix A-3); restrict access on RFW days, watch program, Webcams, RFID or similar fire detectors
12.03	freeway/vehicle, cigarette, electrical transmission line; arson, spotting, fire encroachment, lightning	Monitor access, restrict access on RFW days, watch program, Webcams and/or flame/heat detectors in remote areas
13.01	Roads, residential/urban areas, accidental, arson, recreation	Invasive species removal, restoration (refer to the Restoration and Enhancement Plan (LSA 2003), Improve fuel modification width and composition where inadequate
14.01	I-5 to east, residential to west, accidental, arson, recreation	Restore native habitats; minimize exotic species;

6.6 Fire Suppression Strategy

6.6.1 Fire Suppression Tactics

This WFMP establishes three distinct Tactical Operations Modes/Fire Suppression Guidelines for application to fighting fires on all Nature Reserve of Orange County lands: “Assertive”, “Standard” and “Reserved”. Guidelines for Tactical Operation Mode activities within each FMU are detailed in Volume II: Tactical Plan. 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 which were assigned with input by The Nature Conservancy and OCFA/Fire Agency staff to each FMU as a Nature Reserve Lands Rating.

Standard wildland firefighting considerations (resources, strategies and tactics) for these three operational modes as recommended by this plan shall be used in Reserve lands and shall emphasize short-term goals of minimizing fire impacts with consideration for minimizing fire suppression related impacts on sensitive wildlife and wildlife habitats. It should be noted that the operational mode for each FMU may change based upon environmental conditions as determined by Resource Advisory Fire Team (RAFT) members, as described in more detail in Section 6. In addition, OCFA 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, assertive or normal firefighting strategies and tactics will be employed to ensure the highest probability of success.

This WFMP utilizes a color-coded response system, as presented in Table 6-3. The color code uses a “RED” Response Category to indicate Reserved Response FMUs (i.e., red = stop = careful consideration before ground disturbance due to biological or cultural issues or consistency of fire with management goals). The “GREEN” Response Category indicates Assertive Response FMUs (i.e., green = go = aggressive response). Response Category GREEN FMUs include the high-value response areas requiring assertive intervention due to frequent fires and a desire to lengthen time between burns). This Response Category indicates that, in these areas, management goals focus on reducing the fire return interval for habitat enhancement or that increased allocation of tactical resources as a rapid intervention method to minimize losses to high-value assets and resources is required. Response Category “YELLOW” FMUs include standard tactical response areas where caution is utilized. YELLOW FMUs are managed for fire containment but with consideration for the least impact possible for control. Fires in YELLOW FMUs will not typically be allowed to self-extinguish. Response Category RED includes FMUs where current management goals include fire and where fire will be allowed to burn but will be "guided" toward existing site features, such as roads, rock outcrops, and bare ground, or other control lines to encourage the fire to self-extinguish (as long as conditions allow a high probability of successful containment). Table 6-3discusses Response Categories, and Table 6-4 provides the Response Category classifications by FMU.

Table 6-3
Fire Management Unit Response Categories

Response Category	Response Level	Description	Fire Management Unit Objectives
Green	Assertive*	Fire Management Units assigned "Green" status are managed for minimal fire spread. As such, incident response is aggressive.	Rapid Fire Control/Extinguishment Fire spread minimization All available tactical firefighting resources and methods may be utilized
Yellow	Standard*	Fire Management Units assigned "Yellow" status are managed for fire containment within FMU with minimization of natural and cultural resources disturbance.	Fire Containment Natural and Cultural Resources Avoidance Minimize use of ground-disturbing tactics, as possible
Red	Reserved*	Fire Management Units assigned "Red" status are managed for minimal natural or cultural resources impacts and containment within FMU or within Compartment.	Fire Containment Natural and Cultural Resources avoidance Avoid use of ground-disturbing tactics, focus on structure protection at periphery and minimizing fire spread outside of FMU

* When conditions dictate use of equipment or techniques that may result in biological disturbances within "Yellow" or "RED" FMUs to control or extinguish a fire, priority is given to public safety and avoidance of Reserve-wide, catastrophic fire conflagration. Under such conditions, "impacting" fire suppression methods should be considered valid by responding firefighters.

Note: Under "Red Flag" conditions, severe fire weather subjects all FMUs to Response Category level elevation. Ultimately, implementation of the FMU recommendations will depend on site-specific fire environment conditions. It is anticipated that variations in the type of tactical response occurring on any given FMU during wildfire events will occur and will be addressed with post-fire remediation and monitoring.

Table 6-4
FMU Response Classifications Summary

Fire Management Unit	Response Category Classification
1.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
1.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
1.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
1.04	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
1.05	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
1.06	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

Table 6-4
FMU Response Classifications Summary

Fire Management Unit	Response Category Classification
2.05	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.06	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.07	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.08	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.09	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
2.10	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
3.01	Reserved – Minimal Biological Impact
3.02	Reserved – Minimal Biological Impact
3.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
3.04	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
3.05	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
3.06	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
4.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
4.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
4.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
4.04	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
4.05	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
4.06	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
5.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.04	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.05	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.06	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.07	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
6.08	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
7.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
7.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
7.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
8.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
8.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
9.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
10.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
10.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
10.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
10.04	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
10.05	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

Table 6-4
FMU Response Classifications Summary

Fire Management Unit	Response Category Classification
11.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
11.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
11.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
12.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
12.02	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
12.03	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread
13.01	Standard – Containment while minimizing damage from suppression
14.01	Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

6.4.2.1 Assertive Tactics (Tactical Operations Mode "Direct Attack")

FMU's that are identified as "Green" or "Aggressive" will receive immediate containment and control using all available resources (i.e., aircraft, bulldozers, engines, backfiring, hand crews, etc.) in response to resource value of the watershed which justifies an increased allocation of firefighting resources for an aggressive response and rapid intervention to contain the fire. Also, these FMU's must be protected as "Refugia" for the Reserve target species and have, in most cases, burned too frequently. Therefore, immediate containment and control are the objectives of the Incident Action Plan (IAP). Tactical operations will also identify necessary post-fire suppression activities, in consultation with the RAFT including mop-up, remediation of grading, erosion control and habitat rehabilitation to return the affected area to its natural state.

Special note on backfiring during wildfire events. This method of removing fuel in front of an advancing fire to affect its behavior and spread has merits for protecting high value assets. However, this firefighting tool should be used with caution due to the focus on reducing fire on the Reserve landscapes. An example of where backfiring likely caused more burned acres than the wildfire would have is during the Sierra Fire on the Central Reserve. This 2,000 acre wildfire was increased to 10,000 acres by a backfire. The use of backfires should be undertaken with a clear strategy for protecting high value assets and applied with understanding of the risks and potential for causing greater habitat damage than the wildfire.

6.4.2.2 Standard Tactics (Tactical Operations Mode "Combination Attack")

FMU's that are identified as "Yellow" or "Standard" will receive a standard tactical fire response with minimal disruption to natural resources. The primary objective of this operational mode is to manage the fire 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 fire suppression responses. Only one FMU has been identified as a Standard response – FMU 13.01.

Normal firefighting tactics are employed. These FMU's receive standard tactical firefighting response to the threat of fire with avoidance of disruption to the natural ecology, as possible. The use of heavy equipment and excessive firing 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. Tactical operations will also identify necessary post fire suppression activities, in consultation with the RAFT such as mop-up, erosion control, habitat rehabilitation/remediation, etc.

6.4.2.3 Reserved Tactics (Tactical Operations Mode "Indirect Attack")

FMU's that are identified as "Red" or "Reserved" fire suppression response will, under favorable weather conditions, be allowed to burn naturally up to the pre-determined natural and man-made control lines and barriers. When the IC determines that it is feasible, no extraordinary equipment such as aircraft or bulldozers will be used. There are only two FMUs identified as "Reserved" response – 3.01 and 3.02, which are both marsh dominated or include restoration areas.

The fire will be steered toward pre-existing control lines or natural barriers and allowed to burn naturally when the fire's IC determines there is a high probability of successful containment. Potentially destructive firefighting actions will be relegated to "last-resort" in an effort to reduce potential impacts to the FMU ecological resources. Among the types of firefighting activities encouraged in Reserved FMUs are: hose lines and water application at non-erosive levels, hand tool use to reduce potential flame heights with no grubbing or removal of root structure. The primary objective of the IAP is containment of fires within the FMU with minimal destruction or disturbance to the natural ecology. Tactical operations will also identify necessary post-fire suppression activities, in consultation with the RAFT including mop-up, remediation of grading, erosion control and habitat rehabilitation to return the affected area to its natural state.

7.0 STAKEHOLDER FIRE RESPONSE: RESPONSIBILITIES, PROCEDURES, TRAINING, AND RESOURCES

7.1 Stakeholder Fire Response: Responsibilities, Procedures, Training and Resources

7.1.1 NCCP/HCP Requirements

Section 5.7 of the *Natural Community Conservation Plan and Habitat Conservation Plan* (NCCP/HCP) for the Central and Coastal Subregions requires that short-term and long-term fire management programs and policies are prepared and submitted to the U.S. Fish and Wildlife Service (USFWS) and the California Department of Fish and Game (CDFG) for review and approval. This WFMP satisfies that requirement through short-term response guidance and long-term planning requirements. The responsibilities for carrying out this WFMP are widespread among the large group of stakeholders.

The various fire management responsibilities will rest with the stakeholder agencies and organizations, among which the following are the largest landowners:

- Orange County Fire Authority (OCFA)
- California Department of Forestry and Fire Protection (CAL FIRE)
- Nature Reserve of Orange County (NROC)
- California Department of Fish and Game (CDFG)
- U.S. Fish and Wildlife Service (USFWS)
- Orange County Wildland/Urban Interface Task Force
- South Coast Air Quality Management District
- The Irvine Company
- Southern California Edison
- California Department of Parks and Recreation
- Cities within the County of Orange: Irvine, Tustin, Orange, Anaheim, Laguna Woods, Lake Forest, Dana Point, Mission Viejo, and Newport Beach
- County of Orange
- Transportation Corridor Agencies

- Irvine Ranch Water District
- Metropolitan Water District of Southern California
- Orange County Flood Control District
- State of California Resources Agency

7.1.2 Fire Response Procedures

7.1.2.1 Notification

In the event of an ignition within the Reserve, the Emergency Communication Center (ECC) shall notify the initial attack units that the fire is on Nature Reserve lands and, whenever possible, identify the affected Fire Management Compartment and Fire Management Unit. It will not typically be likely that the reporting individual will have fire compartment or management unit information, as depending on who reports the fire, only a small number of individuals associated with the Reserve will understand the reporting procedure. Also, wildfires may burn erratically, crossing FMU boundaries with different ratings. The responding Battalion Chief or equivalent will utilize a mobile computer to determine the potential constraints for firefighting in the Reserve. The FMU information is contained within Volume II: Tactical Plan of the Fire Management Plan, but will also be provided to local fire agencies. If a Reserve manager or employee or someone knowledgeable about Fire Compartments and FMU reports a fire, the ECC will make an announcement including important info, such as: "All units responding to the vegetation fire be advised that this is on Nature Reserve Lands, Refer to Map page X-X and Table X for Response Guidance". As possible, NROC or stakeholder agencies may provide information to OCFA through a single contact (currently George McEwan) to be designated annually or when position turnover occurs. When detailed location information is not available, responding firefighters/Incident Command will determine which Fire Compartment(s) and FMU(s) the fire is in and the appropriate response and potential constraints.

7.1.2.2 Response

In response to this announcement, the Battalion Chief (BC) shall make one of the following determinations:

- Is the current weather considered "extreme fire weather" (Red Flag Warning or localized high winds, low humidity)
    - If yes, then fire response occurs with consideration for the Tactical Fire Suppression Plan, but a focus on conducting operations necessary for containing/controlling the fire, regardless of the Fire Compartment or FMU rating.

- If no, then the following determinations will be considered:
  - Is the wildfire's Fire Compartment and FMU location known? If so, is it confirmed? If not, determine location.
  - Once the location is determined and confirmed, the appropriate response method will need to be determined from the Tactical Fire Suppression Plan. Then, the BC will determine if:
  - The recommended tactical operations mode **can** be implemented based on current and projected weather, fuels, topography, nearby assets, or other potential "game-changers" or
  - The recommended tactical operations mode **cannot** be implemented, and the BC will 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 FMU rating form which are maintained in their command vehicles computer and will be provided at the site (remote gate-located lock-boxes containing Tactical Fire Suppression Plan).
- If the incident is expected to escalate to extended attack fires beyond the first operational period (12 hours), the Lead Resource Advisor, working on behalf of the Resource Advisory Team (defined in next Section) is requested to respond to the Incident Command Post (ICP). The Lead Resource Advisor shall be a biologist and/or resource ecologist designated by a vote of the stakeholder participants on an annual basis and will be provided training in wildland fire management. The Lead Resource Advisor will be notified of fires occurring within Nature Reserve Lands by pager, text, cell-phone, email, or other means, by the Orange County Fire Authority. The Lead Resource Advisor will serve as a Technical Advisor to OCFA providing expert knowledge of the Tactical Fire Suppression Plan which will reduce the time necessary to consult specific portions of the plan and the resulting occasions where plan content is not considered during tactical operations.

7.1.3 Resource Advisory Fire Team

NROC's Board of Directors will designate members of a Resource Advisory Fire Team (RAFT) which will include up to 10 persons representing up to 10 stakeholder organizations/agencies. The RAFT will annually designate a RAFT representative who shall be the sole point of contact with OCFA's designated point of contact. The team representative will communicate via all available methods with the RAFT during a fire event such that stakeholder interests are duly considered and integrated into the Incident Command (IC) decision making process. The team representative shall be responsible for notifying OCFA of an alternate team representative (selected by the RAFT annually) to serve in his or her absence. The RAFT representative shall coordinate with the RAFT prior to communication with the OCFA personnel. There may be occasions where the team representative is requested at the IC or within the fire perimeter. However, no one shall enter the fire line without prior authorization from the IC, through OCFA's point of contact.

7.1.3.1 Notification and Coordination of Resource Advisory Fire Team

The RAFT representative shall be notified by pager, text, cell phone, email, or other means (as determined prior to fire events by OCFA and RAFT), of all fire events affecting the Reserve and shall be responsible for contacting, consulting and coordinating with the RAFT via team designated methods and timing. The RAFT members in turn will disseminate information to land managers and other stakeholders, as appropriate. The RAFT will establish information sharing responsibilities among its members. Agencies/organizations that are not directly represented on the RAFT will receive representation and information sharing by a designated RAFT member. The team representative shall maintain a list of all RAFT members and contact information and notify OCFA of any changes to the list of team members, including a designated alternate representative.

7.1.3.2 RAFT Representative Response:

In response to the initial notification, the RAFT representative shall coordinate with RAFT members via a method that enables all to quickly and simultaneously receive information and reply to all. The RAFT representative will be in communication with OCFA's point of contact and will feed OCFA technical and Reserve resource information that will help with the successful implementation of this WFMP and its Tactical Fire Suppression Plan. Only as directed by OCFA will the RAFT representative report to the Incident Command Post.

The RAFT representative will be sufficiently familiar with the Tactical Fire Suppression Plan and the "Sensitive Resource Areas" mapping and advise OCFA appropriately. The Sensitive Resource Areas mapping is an Appendix to this WFMP and includes the following:

- NCCP/HCP Target Species locations (California gnatcatcher and coastal cactus wren);
- California Natural Diversity Database (CNDDB) - Sensitive Plant and Animal Species locations;
- Other "Identified Species" location data collected during NCCP/HCP monitoring;

- Central-Coastal NCCP/HCP Special Area Management Plan Aquatic Species
- Locations including:
  - Vernal pools/ephermal wetlands
  - Endangered fairy shrimp occurrences
  - Arroyo toad
  - Least bell's vireo and southwestern willow flycatcher
  - Exotic species
  - Native Fish
  - Rare plant boundaries
  - Riparian birds
  - Wetland plants
  - Pond turtle suitability
  - Wetland habitat quality
- Native Grasslands;
- Crystal Cove State Park;
- Archeological / Paleontological Resource Areas; and
- Streams, creeks, lakes and reservoirs

The sensitive species location information is incomplete and constantly evolving for most species. Wildlife species locations may change considerably over time and hour to hour. Plant communities may change more slowly and cultural resources locations may not change over very long periods. As such, it is recommended that the sensitive species databases be consulted on an annual basis for updated information and that the timing of this procedure be memorialized for implementation consistency.

The RAFT is responsible for understanding the limitations inherent to sensitive species location data and advising OCFA appropriately. For example, assuming a 30 to 40 year timeframe where fire has been successfully excluded from Tecate cypress forest and a wildfire that is threatening to burn into the forest; it will be RAFT's responsibility to understand each Fire Compartment's fire history and need for occasional fire. Advisement to OCFA may be to let the fire burn rather than building a dozer line and/or aggressive use of aerial fire retardant drops. Likewise, mapped locations of sensitive wildlife locations may be accurate from an observation perspective, but may not appropriately dictate fire response. A known gnatcatcher location from two years ago should not typically dictate that on-ground operations need to avoid the location due to the map symbol. Conditions at the time of the fire will ultimately dictate what actions are needed and the sensitive resource maps should help guide those actions through a well-informed RAFT and RAFT representative who will interpret and translate data to OCFA.

Annual updating of the Central and Coastal Reserve GIS data is essential to successful implementation of this WFMP. As such, County of Orange, GIS will update the Sensitive Resource Areas mapping annually or more often as required by the RAFT and as new data become available from sources including updates to the most current California Natural Diversity Database, from the Nature Reserve of Orange County monitoring studies and from land manager surveys and monitoring efforts.

7.2 Post-Fire Response

7.2.1 Post-Fire Assessment of Tactical Operations

The short-term fire management plan (NROC 1999) was created as part of a cooperative effort involving the Orange County Fire Authority (OCFA), The Nature Conservancy, Firewise 2000, NROC and the Orange County Planning and Development Services Department. The following actions identified in the plan are to be implemented after a wildfire.

Following each fire event on Nature Reserve Lands, the RAFT and OCFA will review the effectiveness of the tactical operations recommended in the plan. The RAFT and/or OCFA (in consultation with its suppression forces) may recommend changes to the WFMP or its Volume II Tactical and Strategic Plan to better achieve the goals and objectives of the plan.

Also, the RAFT with support from resources professional from stakeholder organizations/agencies, including NROC, will monitor natural resource conditions regularly, update the FMU response rating (Aggressive, Standard and Modified) for each FMU on an as-needed basis, and recommend plan revisions to address these changing conditions.

Within 48 hours of securing emergency status following a wildfire, the RAFT will attempt to convene the Wildlife Agencies and key Reserve stakeholders to determine if there were adverse effects to covered species or their habitats. This will involve site reconnaissance, sampling, or surveying, as deemed appropriate, and preparation of a disturbance assessment report. Specific issues to be addressed will include, but not be limited to:

- Damage to fences, gates, or other security equipment;
- Direct mortality of species;
- Access points resulting from the firefighting effort;
- Contamination from fire retardants; and
- The potential for damaging actions by good Samaritans (e.g., the planting of non-native and potentially invasive vegetation to reduce the potential for soil erosion).

Unforeseen Circumstances: Disturbance caused by fire can be very expensive to repair or manage and could potentially exceed the operating budget of the Reserve and/or its stakeholder land owner/manager agencies. For purposes of this WFMP, any single event or cumulative events that exceed 10% of the operations and management budget in any year is an unforeseen circumstance. If the event or cumulative events exceed 10% per year, the Implementing Entity has the option of seeking funding from other sources to properly implement the control program.

All fire events occurring on Nature Reserve lands shall be evaluated by the RAFT representative in consultation with OCFA's point of contact, as follows:

- Date and time of fire;
- Weather Conditions: Typical, Red Flag Warning, other;
- Ignition Source;
- Measures that may have avoided ignition or fire spread, if any;
- Fire behavior;
- Fire Management Compartment/Fire Management Unit (FMC/FMU) affected;
- Nature Reserve Lands Rating for the affected FMC/FMU;
- Actual fire suppression tactics used;
- Estimated size of fire (acres);
- GPS or digitize hand map of perimeter;
- 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 RAFT representative.

All fire incidents and responses occurring on Nature Reserve Lands shall be reported to the U.S. Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG) and the Nature Reserve of Orange County Board of Directors as soon as practically possible and a full reporting provided at their next regularly scheduled quarterly meeting. The report shall include the information collected by the RAFT representative.

7.3 Training, Plan Updates and Resources

7.3.1 Training Sessions

Annual RAFT training sessions provided by senior RAFT members (the RAFT should never have all members replaced simultaneously as having seasoned RAFT members to provide training and continuity is important to overall success) should be conducted by May 15th each year to review roles and responsibilities and the overall design and implementation of the Tactical and Strategic Plan components of the WFMP. Training should include an overview of the plans, along with assignments for each RAFT member to become intimately familiar with Fire Compartments and FMUs over which they are responsible or their organization/agency has connection. In addition, RAFT members who are representing organizations/agencies without an RAFT member must become familiar with those entities' FMU's.

Additionally, training sessions should be conducted at least every two (2) years at each fire station with jurisdictional coverage over Nature Reserve open space lands. The RAFT representative should be responsible for coordinating these training events. Every individual involved in fire event response, including heavy equipment operators, should be familiar with the overriding concepts of the Reserve WFMP. It is reasonable to expect the OCFA and other participating city fire agencies fire prevention officers to have more than a conceptual understanding of the types of resources occurring on the Reserve, the types of impacts that can occur from the available firefighting procedures and activities, and how the WFMP is there to help them successfully do their jobs while providing protection for the Reserves' resources.

It is recommended that the RAFT develop an on-line video or PowerPoint webinar that can be easily accessed by firefighters during "down" time at the station. Fire agency Fire Chiefs and/or Fire Marshals or equivalent should be contacted annually and reminded of the training along with instructions for accessing the webinar. Fire agencies must make it a priority for all personnel to view the webinar, which can include a short quiz throughout or at the end along with trackers that provide statistics about who viewed the information.

7.3.2 Wildland Fire Management Plan Revisions

WFMP Revisions resulting from year to year changes in field conditions or post-disturbance events will require review and approval by the NROC WFMP Advisory Committee. The committee will review all recommendations in consultation with the RAFT and approve appropriate additions and revisions to the WFMP and its Tactical Fire Suppression Plan (Short Term Fire Management Plan). It is recommended that the plan be revisited at least every five years for consistency with then-current resource, fire, economic, and socio-political conditions.

7.3.2.1 FMC/FMU Mapping Maintenance

The RAFT shall annually determine if updated GIS mapping would impact OCFA's ability to successfully carry out the WFMP's Tactical Fire Suppression Plans. If so, then the RAFT representative will ensure that OCFA has the latest GIS data for use in their master system as well as in mobile computers. It is requested that the Orange County Fire Authority (OCFA) maintain the FMC's/FMU's mapping data and train personnel on accessing the information while in route to a fire and while on a fire within the Reserve. Updates to the mapping shall be made by OCFA when data is provided by the RAFT. Maps and species data shall be in a format readily accessiblt as a contingency plan should this training and familiarity not occur. County of Orange GIS and NROC Resource Advisors and staff shall assist in this effort as required by OCFA.

Because no agency maintains a consistent record of small wildfires, NROC land managers should be required to map and provide GIS data for every fire ignition occurring within the Central and Costal Reserves. The data should include the date, ignition point, cause if known, the fire perimeter, and total acreage burned.

7.3.2.2 FMU Rating Form Maintenance

OCFA shall maintain the FMU Rating forms and all subsequent updates as required by the RAFT and its designees. County of Orange GIS and NROC Resource Advisors and staff shall assist in this effort as required by OCFA.

7.3.2.3 Resource Sensitive Areas Mapping

County of Orange GIS staff and NROC Resource Advisors and staff shall update the Resource Sensitive Areas mapping annually as new data become available, and incorporate it as approved by the RAFT.

7.3.2.4 Tactical Fire Suppression Plan Interagency Coordination and Training

OCFA, County of Orange, and NROC Resource Advisors and staff shall conduct a training session for the affected OCFA Battalion Chief, other wildland fire agencies and Nature Reserve Land managers annually during the period of December through May.

8.0 POST FIRE ACTIVITIES

8.1 Post Fire Activities

8.1.1 Post-Fire Monitoring and Management Planning

Following a wildfire in the Reserve, the RAFT and Reserve land managers will meet to evaluate the impact of the fire to natural resources within the Reserve. There will generally be two types of post-fire actions, depending on the size and severity of the fire. If the fire is small, localized, and does not include a significant footprint, then after fire actions will be determined by the RAFT and affected land managers. If the fire is large in extent or appears to have significantly impacted natural and/or cultural resources, then the Federal Burned Area Emergency Response (BAER) model should be used for post-fire activities on NROC.

PostWildfire Response

While most wildfires cause minimal damage to natural or cultural resources, some fires create situations that require special efforts to prevent further catastrophic damage after the fire. Loss of vegetation exposes soil to erosion; runoff may increase and cause flash flooding; sediments may move downstream, causing resource damage; and potentially resulting in risk to the community water supply.

The Burned Area Emergency Response (BAER) model addresses these situations only on federal lands with the goal of protecting life, property, water quality, and deteriorated ecosystems from further damage after a wildfire is controlled. Concern for possible post-fire effects on fish, wildlife, archeological sites and endangered species is often a primary consideration in the development of a BAER plan.

BAER objectives that could be adapted to NROC are to:

1. Determine if an emergency condition exists after the fire.
2. Alleviate emergency conditions to help stabilize soil; control water, sediment and debris movement; prevent impairment of ecosystems; mitigate significant threats to health, safety, life property and downstream values at risk.
3. Monitor the implementation and effectiveness of emergency treatments.

BAER is "first aid" – immediate stabilization that often begins before a fire is fully contained. BAER does not seek to replace what is damaged by fire, but to reduce further damage due to the land being temporarily exposed in a fragile condition.

When a large or damaging fire occurs, NROC will convene a meeting to plan for post-fire monitoring and management actions. The post-fire recovery will include RAFT, affected land managers, members of the Technical Advisory Committee (TAC) and Land Manager Council, fire ecologists and experts for sensitive species or natural communities affected by the fire. The purpose of this meeting will be to develop short-term and long-term post-fire monitoring and management strategies and to identify specific actions to facilitate recovery of the natural communities and sensitive species affected by the fire. Longer term management activities may also be required for recovery of ecosystem processes or to enhance populations of sensitive species adversely affected by fire. Follow-up meetings and planning will be conducted as needed to facilitate recovery of the natural plant communities and sensitive resources.

After a wildfire, there may be an immediate need to repair habitats or infrastructure impacted by fire suppression actions. Because every burn area is unique and requires specific soil erosion control practices based on terrain, resources, time of year, etc., application of soil erosion measures will need to be developed by land managers and the RAFT immediately following fire events. The following principles should be considered when developing the erosion control plan.

One of the first concerns following wildfire is stabilization of soils in the burn area, especially if sloped areas are included in a burn. A goal should be to have erosion control Best Management Practices (BMPs) in place as soon as possible and prior to the onset of the winter rainy season. There are various erosion control practices available for slowing the rate of erosion.It may be necessary to implement erosion control measures to protect facilities, sensitive resources and downstream watersheds. Land managers should identify repair and erosion control needs and identify feasible and effective management actions and present them during the post-fire recovery meeting. Examples of short-term management actions that may be required are rehabilitation of bulldozer fire breaks with native seed (for particularly hot fires in areas adjacent invasive species sources), placement of erosion controlling mats and hydroseeding in key areas, potential installation of water bars along roads and trails to reduce erosion, and repair of trails. Recent research indicates that mechanical rehabilitation treatments, including straw mulch, hay bales, flexible structure mats (Enkamat) and jute rolls are more predictable for reducing soil erosion and post-fire hydrological problems than seeding or other treatments (Robichard et al. 2000). Mulching may introduce exotics (Kruse et al. 2004), so erosion potential should be high before the decision to place these erosion mitigating features in the Reserve is finalized

Post-fire seeding with non-native plants in an attempt to stabilize soils is ineffective and leads to the invasion of alien plants into native plant communities (Keeley 2006). This practice has substantially impacted native plant communities in southern California and should not be used within the Reserve. Instead, other more effective soil erosion treatments include straw mulch, hay bales, jute rolls, and flexible matrices growing mats. Preparations and planning to ensure that adequate reserves of weed-free straw mulch, jute rolls, and native seed can be difficult, especially if large quantities are required. The RAFT should be responsible for this planning and for exploring and implementing options for the acquisition and storage of adequate reserves. The potential for damage from erosion should be great before erosion measures are implemented, as even straw mulch and hay bales can introduce exotic plant species into wildlands.

There may also be a need for longer term management activities to assist with recovery of ecosystem processes or to enhance populations of sensitive species adversely affected by the fire. These may include invasive weed control measures and active restoration of burned areas. Sensitive animal species may need active management to restore populations. This could include restoration of their habitat or in areas where there is local extinction following a fire individuals of that species may need to be reintroduced after the habitat has sufficiently recovered.

Lands in the Reserve that have burned previously will be included with unburned lands in long-term monitoring activities, such as Target and Identified Species surveys, vegetation surveys and community monitoring. These areas will also be included in management activities, such as the annual weed control program.

8.1.2 Post-Fire Research

NROC conducts research and actively supports research by others that informs management of natural resources conditions within the Reserve. Each year, NROC staff and the TAC develop a work plan that identifies and prioritizes research needs within the Reserve. NROC will conduct research into post-fire recovery of native plant communities and Target or Identified Species as the need arises.As with other projects, fire related research projects will be reviewed for approval to be implemented in the Reserve.

Because many of the management concepts provided in this WFMP are based on strategies that are commonly utilized for fire management and for habitat enhancement but are untested within the Reserve, their implementation may require additional experimentation. As such, pre- and post-fire research and monitoring are strongly recommended. The monitoring program can be conducted in conjunction with monitoring programs on nearby open space lands or as a stand-alone program. Monitoring provides a description of pre- and post- fire response of plant and animals on representative portions of the Reserve.

8.2 Ongoing Data Management

Data management is an important aspect of a fire management program, especially within the NROC with its multiple land owners and stakeholders and the variety of efforts that may be underway at any one time. Existing geospatial and resource related information exists for large portions of the Reserve. Assuming supplementing fire research and monitoring information is collected over the long-term, as recommended in this WFMP and the Reserve Resource Management Plans, it will be necessary to house that information within a secure and accessible database in a format that is compatible with common GIS software and that can be converted to statistical and trend analysis software applications.

It will be the responsibility of NROC staff and the RAFT to review the monitoring results and adapt the WFMP's implementation. Data analysis results will, over time, become the basis for WFMP adaptations to more closely match the Reserve's management goals should current recommendations prove inappropriate. Data collected prior to, during, and following disturbance events should be made available to surrounding land management agencies with similar habitat management goals so that larger data sets can be evaluated. Optimal disturbance return intervals may vary by site, and comparisons among the open space land data will be important for long-term fire and habitat management.

8.2.1 GIS Data Management

NROC includes a large number of stakeholders and interested cooperators with various agencies and entities collecting, tracking and maintaining GIS data. GIS data varies in its need for updates. For example, boundary, road, fence, gate and trail data require updates less often while species, restoration, and fire data requiring more frequent updates. The RAFT should be responsible for working with and directing the GIS hub or hubs (there many be multiple GIS databases unless a central system can be established, as discussed below) on how frequently updates should be provided and shared with stakeholder agencies.

Although there is currently a large volume of GIS data available for the Central/Coastal Reserves, it is maintained in separate databases that are not coordinated with other stakeholders. The data exists in "silos" with limited sharing. There is likely overlap, redundancy, and conflicting data. Specific GIS architecture and sharing agreements will need to be determined by the stakeholder agencies.

One option is to pursue a central GIS system that houses all Reserve geospatial information with a customized, easy to use interface that enables land managers from each of the stakeholder agencies ready access to common data sets. This system would be valuable for overall Reserve management as well as for pre-, during, and post-fire management. The database management program recommended for NROC should:

- Numerous stakeholders include GIS capabilities and will all be generating data that should then be deposited in a central database.
- Provide a shared source of information, possibly leveraging a system proposed by OCFA for greater Orange County or a stand alone system that enables secure data housing while allowing access by multiple users
- Decision support tool that supports multiple platforms thru web browser interface
- Developed as a web-accessible, service-oriented layer that complements existing baseline architectures rather than replacing an organization's GIS investment
- Core technology designed in coordination with ESRI and other GIS and database industry solution providers allowing the system to provide data to and interact with multiple database architectures.
- Provide a framework for all stakeholder organizations to leverage information through enterprise GIS
- Provide an easy-to-use, flexible graphical interface with mobile capabilities
- Integrate internal or external "plug-ins" and service-oriented-architecture capabilities
- Combine decision support tools with an intuitive map display
- Enable users to download and display information from internal and external sources
- Share a common view, or a "limited" view of a situation quickly with stakeholders, cooperators or the public, as appropriate.
- Enable Reserve wide (through enterprise GIS) collaboration through shared mapping and geoprocessing.

The software management system should provide a "top-level" view of the Reserve and its natural and cultural resources, across land owner and FMU boundaries, allowing key decision makers' necessary perspective before delving into resource management actions on a FMU or land ownership scale. The software should quickly and easily provide land and resource managers:

- Uncluttered views of the region's open space to give a simple, highly intuitive representation of the area's open space reserves, forests, and natural resources and connections between them;
- "Quick-look", Reserve-wide level information for top-level decision-making. For example, the data available in the "quick look" window may provide habitat acreage information, sensitive species information, current survey and monitoring program information, fire history data, pre-fire prevention programs, FMU response tactics, and change in status of any of these items for a particular reporting period;
- Ability to 'drill into' any NROC areas with as much land, resource, or management planning detail or functionality as required;
- Tailored operational and maintenance views to address resource specific needs, enabling managers to leverage the power of spatial data through simple navigation tools and icons, design interfaces, and workflows that were developed from field experience with stakeholder input;
- Full utilization of existing GIS data in easy-to-use field format (from planning and mitigation information to historical data to base maps). The interface should rely on single button clicks allowing easy access from a mobile unit with an internet connection.
- Preconfigured to display real-time data feeds from federal/state/local sources, as available;
- Multiple seamless base map choices (Aerial Photos, Street Maps, and Topographic Maps);
- Include tools for understanding what is happening as a result of management actions and decisions;
- Spatial queries and geoprocessing configurable to point to any source of data (natural or cultural resources, roads, gates, dozer lines, staging areas, structures, critical infrastructure, etc.);
- Capability to develop and 'plug-in' new analysis functions using base data from within a geodatabase or any data loaded into the framework;
- Access and use data from all potential data sources – including internal databases and external sources:
  - OGC compliant web services.
  - Web Mapping Services (WMS).
  - Shapefiles (zipped or uncompressed).
  - KML/KMZ layers from Google Earth.

- Create and share information and intelligence across an organization
    - Export any layer from within to Google Earth with the touch of a button.
    - Configurable to work within Microsoft SharePoint as a web part.
    - Creation and management of specific 'view states' that can be saved and shared.
- Store and save user preferences to include open layers, tools, and map settings. This feature allows operations personnel to 'begin where they left off' when they return to the system.
- Share a view state as an email or URL allowing partners to 'see what you see'.
- Create custom views including layers, tools, and content based on user name, group, or role.
- Print any map with ability to add custom title and sharing options.
- Collaboratively map and share information – The ability to generate and edit spatial data within the common operational picture
- Allow operators in the field (resource managers, field staff, consultants, fire fighters) to directly add field information such as habitat mapping, species observations, transect locations, habitat restoration sites, or fire perimeters into an evolving, real-time display.
- Spatial data editing with the capability to populate NROC-specific geodatabases, temporary user databases, or enterprise geodatabases.
- Editing functions configurable by user name, group, or role.
- Mobile editing supportable within the viewer or on mobile devices such as the iPad, iPhone, or Windows7 phones.
- Process remote sensing and imagery data as an active decision support tool

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9.0 SUMMARY OF RECOMMENDATIONS

9.1 Summary of Recommendations

This section provides a summary of the various recommendations made within this WFMP. Recommended actions include both specific measures recommended for implementation within NROC FMUs and general measures that will improve NROC and its stakeholder's ability to function as land owners/managers/monitors, as detailed in this WFMP.

9.1.1 Specific Recommended Hazard Reduction Measures

9.1.1.1 Highest Ranked Potential Hazard Reduction Measures

- Restrict access during RFW – Closing access to the Reserve during extreme fire weather events and enforcing closure through a variety of means (patrols, fire watch network, etc.) would directly affect the potential for ignition sources within the reserve. Therefore, this measure is highly recommended.
- Remote, solar powered Web-accessible cameras although more costly than other short-term measures, will positively affect early detection and reporting, especially when monitored by fire watch network volunteers. This measure is highly recommended for some remote locations.
- Construction related work, involving open flame or operations producing heat or sparks (e.g., hot works), restrictions during elevated fire conditions adjacent to vegetation on roadways. This measure would address a potential ignition source that was identified as currently not having any specific oversight, especially for OC Public Works. This measure is recommended.
- Coordination with Cleveland National Forest or other Adjacent Stakeholders and Fire Agencies – the RAFT committee that is to be established with implementation of this WFMP will include an outreach component so that land owners adjacent to the Reserve undertaking activities that could affect the Reserve (prescribed burning, fuel reduction, non-native plant removal, etc.) are "in the loop" and goals and concerns are shared among each of the landowners, raising overall awareness. This measure should be implemented immediately and maintained over the long-term.
- Expand FireSafe Council program and/or provide funding for hazard reduction projects – this measure would result in increased overall risk reduction adjacent the Reserve on private and public properties through the Community Wildfire Protection Planning process. Further, stakeholders may agree to contribute fire hazard reduction funding to

implement CWPP priority projects with a reduction in off-site fires spreading to the Reserve and an increase in the regional fire awareness level. Projects focusing on providing defensible space buffers between private property and the Reserve lands, brush removal, exotic plant removal and similar would be beneficial to the Reserve from a fire and habitat perspective. This measure is highly recommended as a potential stakeholder funding source (SCE) has been identified.

- Expanded volunteer watch coverage supporting/expanding IRC program – this program is a relatively inexpensive program that currently has a solid baseline of volunteers, but that should be expanded following an outline already being implemented by the Irvine Ranch Conservancy. This program can be augmented by other measures (Web cams, fire detectors) to provide better Reserve coverage (area and nighttime hours) and arsonist deterrence. This is a high-leverage measure that is endorsed by numerous stakeholders.
- Enterprise GIS interactive, user-friendly Data Access – this measure would improve the overall Reserve fire management planning, but would also improve all other aspects of Reserve management. GIS data is an important component of understanding the Reserve's various ecosystem components, and is currently housed in several databases on stakeholder servers. These data have no or very little interconnection/data sharing. Enterprise GIS would enable a broader sharing of data, organized data storage, and easy interfaces so non-GIS savvy users can access needed data. This measure is recommended and has good leverage based on the number of potential users and the shared costs.
- Providing fewer restrictions on fire agency response to FMUs – Fewer restrictions on fire suppression response activities within high frequency fire areas is estimated to be important for reducing habitat impacts. Streamlining the process for relaying high value resource information to firefighters (such as through the Volume II mapbook and RAFT member involvement with the Incident Command) is part of this measure's focus on letting firefighters perform their job with few constraints, except where absolutely necessary (very high value resource areas). This measure is recommended.
- Place educational Fire Safety/Awareness Signage at key trail entries – this measure is a relatively low cost measure that augments existing signage, adds signs where there currently are none, and could consider adding strong language indicating that the Reserve is monitored by video, watch network, ranger patrol and neighborhood watch/We Tip (and any other means). This measure is recommended as a low-cost educational outreach program.
- Work with utilities to reduce power line-ignited fires – this measure prioritizes, replaces and retrofits old technology, explores areas where distribution lines can be placed underground, especially where vegetation results in high ignition possibilities, replaces

wood poles with steel, and increases maintenance schedule frequency in particularly vulnerable locations. This measure is recommended for implementation and will need to include a significant coordination effort with SCE. SCE will drive the process with input and guidance from this WFMP, land managers, and stakeholders familiar with the fire issue and the location of distribution lines in their FMUs.

- Continue current practice offuel modification adjacent major roadways and potentialignition sources (91, 241, 133, 73, etc.) and increase to 20 feet where possible – fuel modification encompasses a variety of measures that remove, thin, trim, and reduce the amount of fuel in a specified area. Roadways have been identified as the primary ignition source near the Reserve. Although the cost-benefit score for this measure did not automatically move it into the highest ranked hazard reduction measure group, it has been placed here because the benefits for reducing roadway related fire ignitions are considered to outweigh the financial and habitat costs. This measure is currently completed by transportation agencies on an annual basis and should be continued with a goal of establishing a minimum of 20 feet of treated roadside (removal of flashy fuels) as the first line of defense against vegetation ignitions. Treatment does not suggest complete removal of vegetation. Removal of flashy fuels and debris that may ignite readily from sparks, cigarettes, or burning vehicles is the focus of this practice.

9.1.1.2 Moderately Ranked Potential Hazard Reduction Measures

- Hidden Pull-out closure along major roadways – roadside pull-outs were identified by stakeholders as a source for arson related fires. The pull-outs, particularly along the 241 and 133 Toll Roads, provide concealed access to wildland fuel areas and closure would minimize the ability of an arsonist to use these convenient areas. This measure is recommended in lieu of or in combination with other mitigation measures, such as cameras, that would deter would-be arsonists. This measure will need to be thoroughly vetted by the transportation agencies as the pull-outs are often necessary for maintenance activities. An interim approach would be to position fire watch volunteers at these pull-outs during RFW conditions, which would reduce the likelihood of ignitions during these critical periods.
- Prescribed burning – this measure is commonly used for managing landscapes with a goal of creating a mosaic of fuel ages. However, prescribed burning as a fuel reduction tool has been increasingly more difficult to implement, especially in open space islands like NROC. Further, recent research suggests that younger aged fuels may only function to slow the spread of fire during typical fire events as wind-driven fires often burn through younger fuels, suggesting prescribed burns are not an effective fuel reduction

too. Regardless of the effectiveness, much of the Reserve has burned too frequently and the remainder occurs in areas where prescribed burning is infeasible, therefore, the measure remains in the toolkit in case changing conditions occur, but is not recommended at this time.

- Increase capability for fire response (better access, better road maintenance, wider roads; turnarounds on some dirt roads) – fire agency access within the Reserve would tend to increase the likelihood that firefighters would be sent into the Reserve during a fire and should reduce the amount of time required to get them to remote locations. However, under extreme conditions, it is not likely that firefighters would be sent into the Reserve where they could be in harm's way. Therefore, although access roads within the Reserve could use rehabilitation and maintenance, this measure is considered a second tier recommendation.
- Private Fire Company to provide point protection (gel applications, fuel reduction) when fire approaches – this measure includes contracting with a private fire company who will be responsible for pre-applying fire retardant to high value assets when wildfire threatens to encroach. Examples may include cultural resources that could burn, sensitive biological resources, or other combustible assets. This measure is recommended for high value assets but can be expensive, provides little leverage, and relies on considerable pre-fire timelines in order to safely make fire retardant applications. Therefore, it is not considered a high-priority recommendation, but is a potential tool for any high-value, highly sensitive resources that are determined to require protection.
- Herbicide application at locations along roadways, within Fuel Modification Zones; or for particularly aggressive invasive species – this measure is recommended as part of an ongoing program to reduce flashy fuels along roads, where most ignitions occur. This measure can be utilized at other locations, as needed and in combination with other fuel reduction measures for particularly difficult to eradicate species. This measure is recommended where mowing or manual treatment is not facilitated. Convert outer portions of wide fuel modification zones to Cactus Wren Habitat – this measure focuses on existing fuel modification zones in Laguna Beach that occur within the Reserve boundary. Some of these fuel modification zones are 200 feet wide and based on adjacent ignition resistant residences, could be considered for partial conversion to cactus scrub. The cactus scrub habitat would need to be maintained with at least 70% cactus, provided irrigation during establishment and extended drought, and maintained to function as fuel modification, but would reduce the amount of typical fuel modification within Reserve boundaries while providing habitat. This measure is recommended for further exploration with reserve land owners and managers and Laguna Beach Fire.

- Mastication – mastication is a general term for vegetation treatments with the use of machinery that cuts, chops, and grinds vegetation, including woody materials associated with shrubs and small trees. Mastication is faster and less expensive than removing vegetation with hand tools. Impacts associated with mastication may be fewer and less significant with skid-steer mounted masticators as ground disturbance is minimal. This measure is recommended for use within the Reserve, wherever woody, non-native plants require treatment, within fuel modification zones, where diseased or infested woody materials require removal.
- Targeted non-native plant removal – non-native plant removal is an important component of any fuel reduction program. The Reserve includes large areas with non-native, invasive species, some of which are in areas that are prone to frequent ignitions, others in areas that will facilitate fire spread and delay natural succession back to a native, shrub dominated landscape. This measure focuses on the areas that are prone to ignitions, such as along roadways and the wildland-urban interface. Minimizing ignitions in these areas will effect internal non-native dominated landscapes by minimizing fire frequency. This measure would be implemented in conjunction with other fuel reduction measures, and generally describes a process of identifying key areas dominated by non-natives and then instituting targeted fuel reduction.
- Roadside "hardening" – hardening roadsides refers to deployment of safe, effective methods to reduce the occurrence of ignitions along roadways, which has been identified as the primary ignition source throughout portions of the Reserve. This WFMP does not place limits on what could be employed, but focuses on currently used measures that are assumed to meet the safety and other requirements of CAL TRANS. K-rail, which is a linear, concrete barrier, is very effective at keeping sparks, heated metal, and cigarettes on the non-combustible roadways. Further, weed control mats, which are flexible, several feet wide, and are placed alongside roadways helps keep weed growth to a minimum, removing flammable fuels from the fire equation. Further, these mats are non-combustible and help detain debris from reaching flammable fuels. These measures are relatively expensive to implement, require transportation agency review and study, and may not be possible in some areas. However, this measure is considered a high priority given that it could have a major impact on fire ignition reduction and achievement of habitat protection goals.
- Early wildfire Detection Systems – fire detection systems vary in their size, complexity, accuracy, and cost. There are systems that are being used now and that are under development, as well as heat detectors that have been used in industry settings for many years. The application considered most useful on the Reserve would be the Fire Scout x3

wildfire sensor (http://www.fire-scout.com/). These systems are not expensive by themselves, but must be connected via radio or other means so that alerts can be sent and received. San Diego Gas & Electric is in the process of deploying these detectors in the SD County backcountry.

- Restore areas of non-native grasslands to shrubbier, less flashy fuels, especially cacti habitat – this measure fits in well with NROC and IRC plans for habitat restoration and can include any native plant community; however, focusing this type of fuel conversion with cactus scrub, in areas near important assets, whether biological, cultural, or off-site private (such as at outer edges of fuel mod zones in Laguna Beach), would have the highest overall benefit.
- Extending fuel mod areas (on Reserve) near vulnerable construction – as areas with vulnerable construction (older structures, wood-shake roofs, vulnerable vents, ridgetop locations with minimal fuel modification) are identified, they should be considered for additional fuel modification (possibly including outreach with the fire authority having jurisdiction, private HOA, homeowner(s), reduced fuels within the Reserve, placement of walls, or other means) to provide an appropriate, and scientifically justified buffer between the Reserve and the structure. This measure would have benefits for the off-site private property and may also benefit the Reserve from the additional buffer area. Although feasible, this measure could be costly in terms of dollars and environmental imapacts as well as potentially including difficulty with landowners and/or fire agencies to implement the action. It could als result in additional Reserve vegetation impacts (in addition to areas in Laguna Beach).
- Annual Phos-Chek application at highest ignition points (e.g., along roadways) – this measure includes contracting with a private fire company (or OCFA) to apply Phos-Check on the ground and vegetation at the highest ignition points. This measure differs from measure 5 in Section 2.3 in that this is a one-time application annually that would have a positive effect on vegetation ignition reduction, but a negative impact on the vegetation itself (concentrated fertilizers cause plant decline and can facilitiate non-native plant establishment). This measure is considered to have potential use on the Reserve, especially if focused on areas where non-native plants are dominant and adjacent to known ignition sources, particularly roadways. Before implementation, this measure would require additional research to determine the likelihood of facilitating non-native plant establishment. A pilot project could be conducted in a manageable area with high ignition rates to determine if the benefits outweigh the potential costs.

- Fire Adapted Communities Education campaign – this measure would include broader outreach amongst citizens in Reserve-adjacent communities. This measure seeks to increase the overall fire awareness of the average citizen, as their actions along roads, in parks, and in the Reserve have the potential to result in ignitions. Fire adapted communities would be one component of public outreach and is expected to have positive impacts, but not at the same level as the other public education/collaboration efforts identified in Section 2.1. Therefore, it receives a slightly lower ranking and is not recommended for short-term implementation.

9.1.1.3 Currently Infeasible Potential Hazard Reduction Measures

- Fuel Break(s) – fuel breaks are utilized within the Reserve within which fuel modification zones have been grandfathered. Fuel break maintenance in these areas is expected to continue, or be altered if other measures (extending, converting to cacti scrub, reducing) are implemented. Additional fuel break locations were not identified as they are considered to be best used near the asset(s) being protected.
- Shaded Fuel Break(s) – shaded fuel breaks are appropriate primarily for wooded areas. There were no wooded areas identified that would be appropriate for a shaded fuel break.
- Strategically placed area treatments - fuel mod - cultural asset(s) – cultural asset data was not made available to Dudek during the preparation of this plan. Therefore, it could not be determined with any accuracy whether this treatment would be appropriate for specifically high value, vulnerable cultural resources.
- Fire Break(s) – this measure is considered currently infeasible as there were no definitive locations identified where fuel breaks could be assured of stopping wildfires from spreading, especially under extreme conditions. The potential ecological impacts were also considered too great.
- Phos-Check systems at highest ignition points – phos-chek application systems are expensive, un-tested for this type of use, and would likely be vandalized or stolen without considerable protections. There are several other measures that are focusing on the highest ignition points (roadways) and until it is determined whether those measures are successful, this measure will not be considered a high priority. Should other measures (road side fuel mod, k-rail, weed matt) prove to have little effect on ignitions, then other measures, including phos-chek systems, may be considered.
- Construct walls, strategically place boulders – noncombustible landscape walls have successfully reduced heat intensity and fire spread, protecting structural assets from

adjacent wildland fuels. Similarly, rock outcroppings and boulders naturally produce "fuel or fire breaks" that starve encroaching fire of fuels and result in modified fire behavior. Walls could be used as part of an effort to reduce fuel modification zone widths within the Reserve, providing compensation for the converted fuel modification is to the fire agency(ies) satisfaction. Boulders can be used as part of a more natural appearing use of noncombustible features to create separation between high value resources and fuels, to extend existing fire breaks (roads) in key areas, etc. Currently this measure is not considered a high priority, but may become so as site conditions change.

- Tree Crown Raising (oak woodland, riparian, tecate cypress) – tree crown raising is a preventative measure that can be utilized in native tree stands that are vulnerable to fire transition from ground fuels to crown, as a treatment within fuel modification zones, or as a temporary treatment for non-native tree populations when cost of removal is too great to implement in the short-term.
- Silvicultural Treatment in Site Woodlands/Forest (Oak Woodlands, Riparian, Tecate Cypress) - silvicultural treatments include a wide variety of measures typically used in merchantable timber operations. These treatments have valid uses for reducing fire hazard within woodlands, protecting woodlands against crown fire, woodland habitat quality enhancement, and others. Currently, there are no woodlands identified for this type of treatment. However, any of the Reserve's woodlands could be considered for treatment, depending on overall health, fuel loading, stand density, or other conditions, such as elevated levels of Goldspotted Oak Borer (*Agrilus auroguttatus*)-induced mortality or new pests or diseases that become established in southern California.
- Vegetation Crushing and Mechanical Reduction – This measure would be used in combination with other fuel reduction measures. It is typically used as a preparation for prescribed burning. Crushing and mechanical fuel reduction lowers the fuel, changes the air to fuel mixture, and generally reduces flame lengths and fire spread. However, this type of fuel reduction is not recommended in the absence of burning or chipping as it results in dead fuel accumulations.
- Grazing at key locations to reduce fuels – grazing within the Reserve is considered a negative fuel reduction process by many stakeholders. It is currently used in Laguna Beach and results in an effective fuel modification treatment, but the ecological sensitivity of the treatment requires additional research. It may not be consistent with Reserve goals, but grazing can be a good way to manage fuels and habitat and is considered potentially useable on the Reserve, but not recommended at this time until

additional research regarding methods to reduce impacts to habitat while reducing the fire hazard can be accomplished in a cost-effective manner.

- Strategically placed area treatments/fuel modification - biological asset(s) – although there are numerous biological resources within the Reserve, there was no feedback provided by stakeholders on priority assets that should be considered for "above and beyond" protection. Further, additional study would be needed to determine the type of fuel modification (fuel break) needed, what impacts would be realized, and how effective it would be on a situation by situation basis. Therefore, this measure is considered useable, but not recommended at this time.
- Phos-Check system near Tecate Cypress Concentrations – This measure was considered based on the loss/significant damage to the largest concentration of Tecate cypress on the Reserve during a wildfire in 2007. Noting that these systems have been successfully implemented within Laguna Beach, they could be effective for protecting Tecate cypress groves, but are expensive and untested for this type of point protection.
- Dip tank(s) in remote locations – analysis of providing additional opportunities in remote locations for helicopter bucket filling resulted in the identification of numerous water bodies located on various adjacencies that were considered to provide good coverage. Additionally, the addition of tanks would require plumbing and a reliable water supply. Should OCFA indicate that dip tanks would be useful, then they should be re-considered.
- Fire Max Pro - Pre-installed pipe lines and reservoir(s) for defense of high value resources – this measure was recommended as having potential for the Reserve by the OCFA. Further research indicates that the technology has not been thoroughly tested, there are no examples of it in use in similar situations, and therefore its effectiveness cannot be confirmed. It is a potential solution to high ignition point areas or for protecting priority resources, but is considered infeasible at this time.
- NROC Property Fuel Modification Areas transferred to Laguna Beach – although this measure would provide a cleaner, less confusing situation by removing existing Reserve fuel modification areas (Emerald Bay and Top of the World) from the Reserve and transferring them to the City, there was no apparent stakeholder enthusiasm (based on feedback that wasn't received). Therefore, this measure was not considered a high priority. However, this concept should be explored further by OC Parks and the City of Laguna Beach to determine whether there is interest and if desired benefits would be worth pursuing.

9.1.2 General Recommended Measures

The following general recommendations are the primary recommendations not directly associated with hazard reduction, but that will affect the efficiency with which this WFMP is implemented, maintained, and monitored.

- Establish a Resource Advisor Fire Team (RAFT) to manage fire pre-planning, coordination with neighboring land owners/managers, hazard reduction measure consideration and implementation, and act as liaison with fire agencies during fire and post-fire natural resources planning and operations. Specific duties of the RAFT should be further defined by NROC and its Stakeholder agencies. Among the RAFT responsibilities should be:
    - Designate a RAFT Reprsentative who will be the sole point of contact for and with OCFA during fire events
    - Review, familiarize, and understand the components of this WFMP so that the RAFT members become the experts who can respond to all inquiries
    - Establish training program where senior RAFT member(s) provide annual training to newer members on procedures and responsibilities
    - Develop or coordinate the creation of a Web-accessible training video or PowerPoint slide show that summarizes the WFMP and familiarizes firefighters with the Reserve
    - Formulate a hazard reduction implementation plan
    - Coordinate hazard reduction efforts Reserve wide
    - Identify funding sources and pursue funding for hazard reduction projects
    - Determine which priority areas an measures will be implemented and when
    - Provide ongoing communication and outreach with:
        - OCFA and participating fire agencies
        - Fire agencies that may respond into Reserve
        - Cleveland National Forest District Forester and Fuels Officer
        - Stakeholders, land managers
        - Private citizens at Reserve interface

- Provide liaison role with OCFA at Incident Command during wildfire events
  - Provide resource information
  - Interpret response and resource information presented in Volume II
  - Disseminate pertinent information to RAST members and stakeholders during fire events
- Develop and maintain a list of all land managers whose actions may affect fire management on the Reserve. Coordinate and help guide any fire hazard reduction actions for consistency with this WFMP
- Review and approve suggested updates/edits to the WFMP
- Re-evaluate FMUs to consolidate where feasible based on similar terrain and fuels
- Monitor condition of FMZ's (both on-site and adjacent the Reserve) and coordinate with fire agencies for enforcement of fuel modification, as necessary
- Monitor condition of on-site fuel beds/habitats and update the FMU response categories as field conditions changed.
- Identifiy necessary post-fire activities and coordinate with land owners and applicable agencies to determine next steps
  - Explore and implement a plan to ensure that adequate soil erosion control capabilities for use after fires are available (e.g., procure and store weed-free straw, fiber rolls, and native seed).
- Work with OCFA and other fire agencies post-fire to determine what WFMP concepts were recommended for re-visit and possible update/revision/adaptive management
- Convene wildlife agencies within 48 hours of securing emergency status, following wildfire
- Work with OCFA to collect wildfire occurrence details for inclusion in the GIS database
- Coordinate GIS Data management and updates including:
  - GIS framework
  - Data update timelines for various types of GIS data
  - Fire data, including all fire occurences
  - Data update transfers to OCFA

- On a regular basis, estimated to be every 5 to 10 years, or as deemed necessary by the RAFT, review, revise and re-analyze the recommended hazard reduction measures as conditions on the Reserve and in the region change over time. New potential measures should be added as identified and existing measures should be re-ranked based on the changing conditions.
- Update Volume II and Volume III as necessary to account for changing conditions within and in the sphere of influence of the Reserve
- Share Volume II with responding fire agencies as a resource for efficient response and interfacing with the RAFT, including digital map information
- RAFT formulate a hazard reduction implementation plan based on available funding and stakeholder and landowner input. The RAFT should be responsible for coordinating efforts, identifying funding sources, and pursuing funding for implementation of the identified hazard reduction measures.
- Revise the FMU boundaries to exclude areas that have converted from open space to development (examples: 2.05, 2.02, 3.06, 4.07, and others).

9.1.3 Environmental Compliance/Regulatory Considerations

Several of the recommendations listed in Section 9.1.1 and 9.1.2 may result in environmental impacts. Biological resources, cultural resources, transportation systems/functions, water quality and recreational resources may be affected should some of these recommendations be implemented. Prior to proceeding with such activities, it is recommended that NROC ensure compliance with the California Environmental Quality Act (CEQA) and possibly the National Environmental Policy Act (NEPA), Federal and State Clean Water Acts, Federal and State Endangered Species Acts and the Federal National Historic Preservation Act. Dudek's recommendations for compliance with each are outlined below.

California Environmental Quality Act. Because NROC is a non-profit organization and does not have land use authority, adoption/approval of the proposed program would not be a discretionary action and therefore approval would not trigger the need to comply with CEQA. However, many of the recommendations contained in the program would have the potential to affect the environment so compliance with CEQA must occur prior to implementation. The question of which agency would be tasked with CEQA compliance for this program should be further explored. The NCCP/HCP includes a specific requirement that a fire management plan be developed and adopted. Thus, CEQA compliance for the fire management plan has already been addressed to some degree by the programmatic EIR/EIS for the NCCP/HCP. The need for additional CEQA analysis and review is prompted by measures that are inconsistent with the policies of the NCCP/HCP or otherwise unaddressed by the NCCP/HCP (e.g., implementation of fuel mod zones in the Reserve, and possibly implementation of fire breaks in the Reserve). Options may include, but are not limited to the California Department of Fish and Wildlife, in particular if an amendment to the existing NCCP/HCP permit is necessary (see discussion below) or the County of Orange if additional "incidental take" is necessary to compensate for impacts to the reserve from fire management activities and the County agrees to allow use of their incidental take allotment.

Depending on the discretionary action and CEQA lead agency, several types of environmental documents may be appropriate to fully disclose the environmental impacts of the program in compliance with CEQA. If an amendment must be made to the existing Central and Coastal NCCP/HCP, an amendment or subsequent CEQA document that tiers off the original NCCP/HCP EIR would be appropriate. The type of CEQA document must be discussed with the California Department of Fish and Wildlife.

If the County of Orange or another local jurisdiction serves as the CEQA lead agency, a program EIR may be the most appropriate document for the following reasons: First, because the recommendations originate from a program, the "whole of the action" (ie, the entire program) must be evaluated prior to action taken on any single element. This ensures that the public is made aware of the full extent of the environmental impacts of the entire program. Second, because the exact extent and timing of implementation of each recommendation is not precisely known at this time, a full, project-level, site-specific evaluation of every on-the-ground effect of each recommendation is not possible. A program EIR allows the lead agency (in this case, potentially the County of Orange) to consider broad policy alternatives and programmatic mitigation measures at an early time when the agency has greater flexibility to deal with basic problems or cumulative impacts (CEQA Section 15168).

Preparation of the CEQA document would include development of avoidance and mitigation measures to help reduce the potential impacts to resources (ie, biological, cultural, recreational, etc.) in an effort to create a "self-mitigating" program. These measures would be outlined and a process for implementing them, based on the specific impacts anticipated by each program element, would be laid out in the project description of the CEQA document. The recommendations outlined in Section 9.1.1 and 9.1.2 and the avoidance and minimization measures would constitute the project evaluated in the CEQA document. In addition to development of an avoidance and minimization program, it is recommended that NROC develop a list of "projects" that they wish to implement in the near term. This WFMP provides a thorough analysis of the FMU's, their potential hazards, recommended hazard reduction measures, and a toolkit of prioritized actions for implementing hazard reduction measures. This WFMP recommends that the RAFT is established and determines, based on the analysis presented in this plan, what priority hazard reduction projects (by FMU and by area within FMU, as detailed herein) will be pursued based on identified importance, availalble funding and cost effectiveness. When enough information about these "projects" can be generated, they can be evaluated at a "project" level in the CEQA document. Evaluation at a project level will allow for full CEQA compliance allowing NROC to move forward with implementation. All remaining plan recommendations that aren't fully developed or where timing of implementation is uncertain, would be evaluated for consistency with the CEQA document at the time they are proposed. In some cases further environmental review, in the form of a Negative Declaration, Mitigated Negative Declaration or an EIR, may be necessary.

State and Federal Endangered Species Acts. Compliance with the federal and state Endangered Species Acts would entail ensuring consistency with the policies and guidance provided through the Central and Coastal NCCP/HCP for most listed species potentially affected by the activities. The Central and Coastal NCCP/HCP includes provisions for fire management and fire management planning and covers impacts to most listed and highly sensitive species, such as California gnatcatcher (Central and Coastal NCCP/HCP, pg. II-323). However, a full evaluation of the consistency of each recommendation with the provisions outlined in the Plan should be conducted to determine whether all aspects of the program would be considered covered activities in the NCCP/HCP. If some of the elements of the program aren't considered covered activities, then an amendment to the NCCP/HCP may be necessary. Preparation and processing of an amendment with the US Fish and Wildlife Service and California Department of Fish and Wildlife may trigger the need for compliance with CEQA (see above) and NEPA. If listed species that are not covered by the Central and Coastal NCCP/HCP are affected, separate compliance with state and/or federal Endangered Species Acts may be required.

State Fish and Game Code, Porter-Cologne Act, and Federal Clean Water Act.Some of the recommendations may involve impacts to state and federally regulated water resources such that compliance with Sections 401 and 404 of the Federal Clean Water Act, Section 1600 of the State Fish and Game Code, and/or the state Porter-Cologne Act would be necessary. Once NROC further evaluates the recommendations contained herein, an evaluation of potential impacts to water resources could be conducted to determine what types of permits, if any, should be pursued to ensure compliance with the state and federal wetlands regulations.

National Historic Preservation Act - Some of the recommendations may involve impacts to cultural resources such that compliance with Sections 106 and 110 of the Federal National Historic Preservation Act would be necessary. Once NROC further evaluates the recommendations contained herein, an evaluation of potential impacts to cultural resources could be conducted to determine what types of permits/consultations, if any, should be pursued to ensure compliance with this federal legislation.

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APPENDIX A-1

Focused Hazard Reduction Plan

Appendix A-1
Focused Hazard Reduction Plan

1.0 INTRODUCTION

As described in Volume I, NROC Wildland Fire Management Plan, wildfires are occurring much more frequently on portions of the Nature Reserve of Orange County (NROC) than are conceived to have occurred historically. The natural plant communities are adapted to a fire cycle of between 25 and 100+ years (Keeler-Wolfe, et. al. 2010), depending on the plant community type. This changing fire regime has compressed the recurrence intervals to roughly 6 to 10 years in some portions of NROC and has become the primary driver of native plant community/habitat loss and degradation. The fire frequency increases are directly related to the increased presence of humans and ignition source producing machines within an NROC sphere of influence. In the absence of proactive, focused fire prevention planning and implementation of ignition and fire spread reducing measures, NROC natural areas are and will continue to convert to non-native habitats, which in turn facilitate higher fire frequency and loss of the very habitat for which the Reserve was created to protect.

Studies conducted by IRC (2008) and confirmed through analysis of OCFA and CAL FIRE data for this WFMP, indicate that the vast majority of burned acres in Orange County, and on NROC, occur during extreme weather associated with the region's Santa Ana wind patterns. This weather condition has the potential to produce uncontrollable fire storms that consume vegetative fuels that have been "prepared" for burning through seasonal dry periods and low humidity levels. History indicates that wildland fires occurring on non-Red Flag Warning days have a very high likelihood of being contained to 10 acres or less. These fires may have immediate fire area impacts, but they have little overall impact on the landscape ecology of the nearly 40,000 acre Reserve system. Historical fire history data indicate that 90% of the acreage burned coincides with high-wind conditions. Therefore, the focus of any fire management planning must be on preventing ignitions, especially coinciding with these periods of extreme weather. A secondary priority should be focused on minimizing fire spread potential when an ignition does occur. Targeted hazard reduction measures will reduce vegetation ignitions and can help reduce fire spread. This WFMP appendix provides a summary of the analysis conducted within each Fire Management Unit (FMU) as well as introducing a prioritized list of stakeholder reviewed fire hazard reduction measures as well as recommendations for consideration by NROC stakeholders.

The following sections provide background on the NROC FMU assessments and potential hazard reduction measures, summarize the results of a hazard reduction measure cost-benefit analysis and priority ranking, and address the resulting recommendations for stakeholder implementation.

1.1 Wildland Fire Management Plan Hazard Analysis and Hazard Reduction Measures

1.1.1 Research

The initial preparation phase of this WFMP included researching relevant studies, statistical data, and fire management planning documents available from the various Stakeholder agencies, committees, technical advisors, neighboring open space land agencies, and fire prevention/protection planning industry. Various wildland fire management concepts, measures, and findings were incorporated into the WFMP, as appropriate. In addition, this phase included integration of authors' experience and application of significant fire protection planning and vegetation management throughout Southern California. The WFMP includes a list of references indicating the extent of the document review supporting the WFMP's recommendations.

1.1.2 Stakeholder Meetings

The second WFMP phase was a series of stakeholder agency meetings that brought together similar stakeholders, for example, infrastructure stakeholders attended one meeting while fire agencies attended a separate meeting. The stakeholder meetings were critical for presenting the WFMP concepts and proposed structure to the respective groups and discussing stakeholder priorities, concerns, and "hot buttons". In all, several stakeholder meetings were held so that a wide-range of involvement and input could be integrated into the plan. Among the stakeholder meetings completed are:

1. Open stakeholder meeting – all stakeholder agencies/entities were invited to attend a project update/stakeholder input meeting held at IRWD. A cross-section of stakeholders participated including USFWS, NBFD, TCA, NROC, IRC, City of Irvine, NROC technical advisory committee, IRWD, LBFD, OC Parks, and Cal State Parks.
2. Fire Agency Meeting – the stakeholder fire agencies were invited to attend a project update/fire agency input meeting held at OCFA's headquarters. All invited fire agencies attended the meeting and provided input: OCFA, LBFD, NBFD, Anaheim Fire Department, and Orange Fire Department.
3. Infrastructure stakeholder meeting – the infrastructure related stakeholders were invited to attend a project update/input meeting held at IRWD. All invited stakeholders attended the meeting and provided input: CalTrans, County of Orange, SCE, TCA, IRWD, and NROC.
4. Data acquisition meetings – meetings were held with stakeholders who control GIS data for their respective lands including with IRC, City of Irvine, Nature Conservancy, OCFA, Orange County, TCA, and LBFD.

5. NROC meetings – multiple meetings, telephone communications, and emails between NROC staff and Dudek occurred throughout the data acquisition, analysis, and WFMP preparation phases of this project. NROC provided oversight, coordination, and direction.
6. Internal meetings – Dudek conducted several in-house meetings with biologists, GIS operators, and fire protection planners during the course of this project, particularly during the hazard assessment and recommendation analysis phases.

Stakeholder input from these meetings has been incorporated into the WFMP, fire management unit hazard analysis, and formulation of potential hazard reduction measures. The WFMP is truly reflective of the stakeholder values and concerns, while maintaining a focus on Reserve habitat goals and methods to maintain or improve habitats.

1.1.3 Fire Management Unit Hazard Analysis

The third phase of this project included analysis of the 56 fire management units (FMUs) delineated by OCFA, Resource Agencies, and Private Fire Protection Planners. The 56 FMUs were evaluated in the field via a driving tour of the Coastal and Central Reserves. OCFA accompanied Dudek during the Central Reserve reconnaissance and provided valuable input on tactical response, risk evaluations, and overall fire agency strategies. The Coastal Reserve reconnaissance occurred without presence of OCFA during a one-day windshield survey. Augmenting the limited field evaluations is the authors' experience with the Reserve through years of experience working within and nearby the Reserve on various projects, including Central Reserve oak tree count/evaluations, fire protection planning throughout portions of the Coastal Reserve, natural resources planning within and adjacent the Reserve.

Once field data was evaluated and fine-tuned, Dudek fire protection planners conducted an intensive GIS-aided review of each FMU. Appendix A-1 includes the results of the FMU x FMU hazard evaluations. Each FMU was evaluated for:

- Potential ignition sources
- Fuel types represented in FMU
- Likely fire spread pattern
- Terrain
- Wind alignment
- Anticipated Fire Behavior
- Adjacent Land Uses
- Off-site Resources/Assets

- On-site Resources/Assets
- Presence of Fuel Modification (and therefore assets) Adjacent
- FMU overall visibility
- Site Access
- Overall Fire Hazard Priority
- Potential Hazard Reduction Measures

Combining field reconnaissance information with staff-specific NROC experience and GIS/aerial image review, each FMU received a thorough examination with regard to describing the current fire environment and area attributes. The information collected from each FMU was centered on determining where fires are most likely to start, how they are anticipated to behave, what special challenges exist for containment, what assets need to be considered both on- and off-site adjacent, and ultimately, what hazard priority level each FMU represents. The hazard priority level is based primarily on: 1) the potential for vegetative ignitions, 2) the potential affect wildfire burning in the FMU would present a threat to off-site urbanized areas, and 3) the fire frequency and habitat conditions. The hazard priority level differs from the tactical response categories in that the latter are categorized based on: 1) the existence of high priority assets (off-site structures, on-site sensitive resources), 2) the FMU's sensitivity to ground impacts from fire suppression activities, and 3) the FMUs fire history and importance for suppressing fire in degraded habitats. Using this assessment as a baseline, potential hazard reduction measures were formulated. Potential hazard reduction measures are FMU-specific and based on the type of ignitions and fire spread currently identified. These measures are not considered requirements, but are provided as tools that would help reduce the likelihood of ignitions and/or fire spread. The combined set of potential hazard reduction measures from the FMUs, along with additional potential measures are provided as a "tool kit" of measures that may be useful for reducing fire occurrence.

1.1.4 Potential Hazard Reduction Measure Cost-Benefit Ranking

Determining which of the measures are considered currently appropriate and feasible included three levels of evaluation:

1. Fire protection planner evaluation
2. Cost-Benefit Analysis
3. NROC Stakeholder evaluation

Three fire protection planners/foresters with experience analyzing fire hazards, prescribing treatments, and writing fire and vegetation management plans for open space preserves in Southern California, formulated and evaluated potential hazard reduction measures based on real-world examples. Many of the identified measures are standard practices, including thinning, mastication, exotic/non-native plant removal, and habitat restoration. Other measures are less well-known, but have proven effective for protecting important assets, including automatic landscape Phos-Chek systems, mechanical vegetation crushing, or pre-plumbed emergency landscape irrigation. Further, some measures are considered important to retain within the overall "tool kit", even though they would currently not be advised, including prescribed burning, silvicultural treatments in Tecate cypress groves/oak woodlands, and private fire company for point protection. Each of the potential hazard reduction measures was provided an analysis of benefits (hazard reduction, ecological, and other) provided vs. costs (financial, ecological, and other). The overall benefits and costs were given a ranking of High, Moderate, or Low. Basing the benefits on broad categories was more reasonable than providing specific ranking, such as on a scale of 1 to 10 as less subjectivity is included in the former process. Benefits considered included known or anticipated effect on ignition reduction, fire spread reduction, and protection of natural resources. Costs considered centered largely on financial and ecological. Once each measure had been appropriately categorized, rankings were calculated based on a simple cost to benefit ratio. The cost-benefit analysis matrix (Appendix A-2) was utilized to summarize the potential hazard reduction measures, their potential costs, their potential benefits and the overall benefit rank. In addition, the cost-benefit matrix provides a column indicating where each of the potential hazard reduction measures could be applicable.

Once complete, the cost benefit analysis was provided to each stakeholder agency for review and comment. Only two stakeholders provided comments with USFWS providing the most detailed and comprehensive review and recommendations (note that in addition to the two stakeholder entities comment, the Technical Advisory Committee provided comments, primarily through Jon Keeley's comment letter). Following receipt of these comments, the cost-benefit matrix was revised to include suggested edits regarding potential ecological impacts from some measures, further explanation of several measures, and implementation of a less-subjective ranking system. Because individual stakeholder agencies responsible for land ownership or management of the NROC FMUs did not provide FMU-specific input on where the potential measures could be implemented, Dudek performed additional analysis of each FMU and determined potential applicability. The result is a ranked list of potential hazard reduction measures that can be considered for application on NROC. This ranking, the costs and benefits, and even the measures themselves may change over time as conditions on NROC change. Changes in technology, understanding of fire ecology, climate, or other components of the fire environment may require updating this cost-benefit matrix to more accurately reflect future conditions.

The following sections provide brief discussions of the NROC potential fire hazard, the potential fire hazard reduction measures, and recommended application on NROC FMUs.

1.2 Potential Fire Hazard

This section presents a brief discussion of the fire hazard situation at NROC. Volume I – WFMP includes a more detailed discussion of the site's fire environment, fire history, ignition sources, and fire behavior. NROC's hazard analysis included a merging of data collected during initial site analysis, from interviews with fire officials and resource managers, reviews of project data, fire behavior modeling results, and high-resolution aerial imagery and was integrated into the preparation of this document and associated recommendations.

Based on topography, vegetation, fire weather, and fire history of the region, large wildfire conflagration has occurred on the Reserve and is likely to repeat due to the presence of wildland fuels adjacent numerous potential ignition sources. A large variety of ignition sources exist on the periphery of the Reserve including major transportation corridors, urban communities, and electrical transmission corridors. Fires originating from these sources, driven by high winds and occurring when plant moisture is low will result in a high intensity fire that spreads generally from northeast to southwest, but that may include erratic behavior and spread patterns due to the steep terrain and deep canyons. This type of wildfire occurred in 2007 when 28,000 acres of the Central Reserve were burned by the Santiago Fire. Fires occurring during typical on-shore wind patterns are also likely to spread into NROC from adjacent roadways or from adjacent WUI areas.

The following general observations summarize typical NROC FMU fire environment and likely scenarios:

4. A WUI threat exists along the north, south, and west of the Central Reserve. Additionally, the entire periphery of the Coastal Reserve includes WUI except for FMU 2.01 which abuts the Pacific Ocean. Ultimately, the entire NROC can be considered to occur within a wildland urban interface. NROC is an island amongst a growing sea of development that continues to place more ignition sources and assets to protect within NROC's sphere of influence. A fire originating in a structure in the sphere of influence of the Reserve could burn onto the Preserve.
5. The Central Reserve includes a significant area of shared boundary with the adjacent Cleveland National Forest to the east. This interface can be described as a wildland interface that is absent the "urban", but nonetheless represents a potential source for ignitions in the form of fire brands or direct flame impingement from wildfires that originate on the Forest.

6. Potential urban ignition sources not associated with the residential development include roadways (major freeways, primary streets, secondary roads, etc.), power lines, arson, accidental related to use of power equipment, and other anthropogenic sources.
7. Assets within NROC FMUs vary by location, but may include habitats, sensitive wildlife or plant species, cultural resources, recreation opportunities, electrical transmission lines, and communication facilities, amongst others.
8. Portions of NROC are experiencing fire at a level that is considered too frequent for continued persistence of quality native habitats. These areas are subject to non-native plant establishment and eventual conversion to a non-native plant community. Other portions of NROC have not experienced fire in several decades or longer, indicating that these areas are not particularly prone to ignitions, but also suggesting that should an ignition occur under weather that facilitates spread, the potential for significant habitat loss is possible and the potential for the non-native plant establishment, more frequent fire cycle is likely.
9. Wildfires fueled by Santa Ana winds may move rapidly across NROC. Grassland, sage scrub, and chaparral fuels will be the predominant carriers of fire across the open space. Steep slopes with even steeper walled drainages typify the topography throughout NROC. Fires in grassland fuels will be fast-moving ground fires while those in chaparral or sage scrub fuels will move more slowly, but produce greater flame lengths and associated heat output and significant spotting.
10. Firefighting may be difficult on NROC due to limited access and steep terrain. Air attack will be an important component but may not be available or usable, depending on the extent of the fire event and/or the time of day and weather conditions.
11. The catastrophic wildfire threat for NROC is extreme when severe fire weather occurs, which will typically coincide with Red Flag Warnings periods. Red Flag Warnings are declared by the National Weather Service. The Reserve is located in Fire Weather Zone 242, Orange County. Accordingly, Red Flag Warnings are issued when humidity is 15% or lower and sustained winds are 25 mph (with gusts greater than or equal to 35 mph) OR humidity is less than or equal to 10% regardless of wind (National Interagency Fire Center 2008).

1.3 Recommended Potential Hazard Reduction Measures

This section is provided as an overview to help guide prioritization and implementation of potential hazard reduction measures on the Reserve. This WFMP provides information to NROC decision makers along with recommendations based on current conditions, but appropriately leaves hazard reduction measure application to the more than capable NROC land and resource managers and advisors. This WFMP lays out a framework for addressing the highest priority goals which are, 1) reducing the number of ignitions, especially those coinciding with Red Flag Warning conditions and 2) limiting fire spread within NROC. Accomplishing these two goals will require implementation of several hazard reduction measures, such as hardening roadways, facilitating firefighting response, augmenting the current network of fire watch volunteers, and raising citizen fire awareness. Attainment of these goals will have the secondary benefit of achieving additional NROC fire planning goals of protecting sensitive species, cultural resources, and off-site adjacent private assets by minimizing damaging wildfires. Appendix A-2 provides brief FMU x FMU descriptions of potential fire hazard reduction measure application.

1.3.1 Long-Term Fire Prevention/Fuel Reduction

Successful long-term fire management requires pre-planning, consistent application of principles known to reduce fire hazard, and utilization of fire prevention techniques and strategies. Ignition sources and fire spread patterns are important components of understanding wildfire behavior and implementing practices aimed at preventing wildfires. In addition, high-value resource areas must be identified and then appropriate wildfire ignition/wildfire spread reduction practices must be implemented and maintained. With those concepts in mind, Table A-1 provides a summary of the potential ignition sources and potential hazard reduction measures for achieving long-term management goals, by FMU.

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
1.01	residential/accidental, electrical transmission line, power equipment, recreational users, arson, spotting	Improve fuel modification in northwest (Ceanothus Drive area), west (neighborhood areas near Scenic Drive and Sunset Avenue) and south portions of FMU, educate homeowners on landscaping through consistent and frequent message; fuel mod may need to encroach on NROC – at least 100 feet of fuel modification is recommended
1.02	residential/accidental, vehicular/roadways, electrical transmission line, arson, recreational users, power equipment, spotting/embers	Educate homeowners of fire safety and structural protection, restrict access during RFW weather, monitoring patrols
1.03	residential/accidental, vehicular/roadways, arson, recreational users, power equipment, spotting/embers; electrical transmission line to Coastal Treatment Plant	Maintain existing fuel mod zones, focus on private property owner landscape fuel/ornamentals; in secondary canyon (M and K streets); implement minimum 100 feet wide fuel mod for mobile homes and 20 feet along roadway; education outreach with consistent message and frequent contact - many homeowners are violating principles of FMZ; restrict access during RFW weather; monitoring patrols

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
1.04	vehicles/roadway, residential/urban accidental, arson, electrical transmission line	Invasives removal/restoration, especially in Aliso Creek; restricted access during RFW weather, educational outreach to neighbors - consistent message and frequent contact
1.05	roadways/vehicles, electrical transmission lines, recreational users, residential/retail/industrial/accidental, arson, spotting/embers	Establish FMZ within FMU along interface with LCR structures/properties, restrict access on RFW days, consider a minimum 10 foot thinning zone on either side of ridge-top road on eastern FMU boundary
1.06	Electrical transmission line to north and east, roadways/vehicles, recreational users, spotting, arson	Maintain and increase buffers along El Toro Road and Laguna Canyon Road to a 10 foot wide swath, as possible
2.01	recreationists, PCH/vehicles, residential/accidental, arson, spotting from FMU 2.05 or 2.02	Habitat restoration/invasive removal, fuel mod maintenance along PCH and on-site roads, educational signage about fire
2.02	vehicles/roadways, residential/accidental, spotting from north and east, arson,	Fire awareness signage at key trail points
2.05	roadway/vehicle, electrical transmission line, residential/accidental, treatment facility, adjacent FMU (spread or spotting), remote campers, arson, spotting	Maintain fuel mod/defensible space adjacent to residential community to the southeast of this FMU; maintain existing modified fuel buffers between school, RV site and wastewater treatment facility
2.06	vehicles/roadway, electrical transmission line, residential/accidental, recreation user, arson	Patrol campsites, no camping on RFW days, no open flames, fire awareness signage and ranger outreach
2.07	Electrical transmission line, WUI residential/accidental, homeowner power equipment, recreational users, arson	Re-assess FMZ's on FMU, may be wider than needed and focus should be on structures out, not reversed. Possibly utilize the outer 50 to 100 feet of FMZ for cactus wren habitat (Opuntia) habitat that functions as fuel mod.
2.08	Electrical transmission line, WUI residential/accidental, power equipment, recreational users, arson	Off-site fuel mod - private properties need to focus on ornamental vegetation; Allview Terrace area especially dense ornamentals and vulnerable exposures to wind driven wildfire
2.09	Electrical transmission line, adjacent substation, roadway/vehicle, recreational users, residential-industrial/accidental, spotting	Fuel modification along Laguna Canyon Road and around 3 facilities (substation, LCAD, and transportation facility) should be created/expanded to reduce potential threats of ignition and/or structural damage - may need to encroach within NROC up to 100 feet; Laguna Canyon Road fuel buffer should be expanded to at least 10 feet on each side, as possible, stress fire safety at Nix Nature Center; restricted access on Red Flag Warning days; early fire detection system, web cams or similar automated system, focused volunteer watch expansion, as needed on RFW days; monitor 133 corridor ignitions and as necessary, consider walls and/or weed management mats to mitigate

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
2.10	vehicles/roadways, electrical transmission line, recreational users, spotting	Maintain fuel mod buffers along roadways, especially 133/Laguna Canyon Road, educate hikers, signage about fire safety; manage pull out areas with regulation-consistent gates or other access restrictions that may limit possibility of vehicle fire spread into vegetation or arson access; monitor 133 corridor ignitions and as necessary, consider walls and/or weed management mats to mitigate
3.01	Roadways, residential / urban areas, accidental, arson, recreation	Invasive species removal, restoration, fuel modification improvements off-site
3.02	Roadways, residential/urban areas, accidental, arson	Cooperate with NBFD toward hazard reduction efforts within the canyon, continued fuel mod program
3.03	Roadway/vehicles, residential related (fire, children, accidental), arson, power equipment	Maintenance of roadside fuel mod buffers to a minimum of 20 feet of treated area - remove flashy fuels in May/June
3.04	former land fuel, vents, electrical facility, roadways/vehicle, accidental from residential, arson, recreation, spotting	Targeted fuel mod maintenance to continue maintainance in compliance with NBFD requirements (which are currently 100 feet of fuel modification zone but should be extended to 170 feet in width)
3.05	Vehicles/roadways, residential/accidental, arson, power lines, trail - recreational user	Adjacent to Poppy Avenue and southward across canyon need to consider drastic fuel modification for adjacent residents; possibly a full habitat restoration of the canyon in this roughly 2000 linear foot section of the Canyon; other technologies may be useable - phos-chek system with thinning/removal of exotic fuels
3.06	Roadways, facilities, residential fire, arson, accidental, spotting, power lines	Targeted fuel modification at terminus of Port Carlisle PL, Port Durness PL, reservoir facility (west of reservoir), IRWD maintain roadside vegetation on access road
4.01	Roadway/vehicle, residential/accidental, arson, recreational user, spotting	Maintain fuel mod along Bommer Canyon Road at 10 feet on either side of road, implement annual flashy fuel removal along 73, educate park users
4.02	roadway/vehicle, power equipment (golf course), residential/accidental, arson, recreational users, spotting/burning from neighboring FMU	Educate golf course to enforce fire safety by grounds crew and golfers, especially on RFW days, no greenwaste deposit over side; maintain buffers along 73 by removing flashy fuels in May/June annually
4.03	Transmission line (east), residential/accidental, roadway/vehicle, recreational	Roadside mowing in June to 20 feet on either side, trails maintenance (remove flashy fuels alongside trails, as possible, monitor access, restrict access during extreme weather
4.04	Vehicle/roadways, Farming equipment/operations, Golf course equipment, recreational users, arson	No recommendations

Appendix A-1 (Continued)

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
4.05	Transmission lines along eastern edge in northeast FMU, electrical substation at eastern edge; roadways/vehicles, residential development, accidental/residence related; arson	Transportation corridors may need a minimum of 20 foot fuel modification areas along road easement, as possible, maintain flashy fuels, create low fuel areas with native species along interface; may require NROC encroachment including 133/73, restrict access on RFW days
4.06	Transmission lines through FMU, electrical substation at eastern edge (just off site); roadways/vehicles, residential development, accidental/residence related; arson	Ignitions off 133 and 73 are primary concern, fuel mod along these corridors of 20 feet wide is recommended, may require encroachment into NROC
5.01	roadways/vehicles, machinery, power equipment, arson, agriculture operations, recreational users, off-road vehicles, electrical transmission line, on-site law enforcement activities; shooting range at law enforcement facility	Coordinate with law enforcement and OCFA on proper fire protection/prevention measures at law enforcement facility interior to the site; establish a fuel modification zone to comply with OCFA for the type of structure and use; restrict any type of law enforcement training activities on RFW days, e.g., shooting or other ignition producing activities; extend invitation to become stakeholders or at least active participants in NROC meetings.
6.01	low voltage electrical T-line (along Bee Canyon Rd); roadways/vehicle related, industrial, structure/operations (accidental), arson, spotting, fire encroachment; ag related	Monitor access - off-road vehicles, restrict access to undisturbed FMU areas on RFW days, restrict activities on landfill on RFW days, expand watch program in this area; clearance on T-line and poles/replace wood poles with non-combustible
6.02	Roadways/vehicle related, landscape/recycling center/operations (accidental), arson, spotting, fire encroachment; landfill related	Monitor access - vehicle uses, restrict access to undisturbed FMU areas on RFW days, expand fire watch program; fire detection system technology up on ridge
6.03	Roadways/vehicles, spotting, wildfire encroachment, adjacent T-lines (Santiago Canyon Road) high voltage east, agriculture operations off-site, recreational users, arson	Consider early warning fire detection systems, education of hikers/visitors on fire prevention and safety, expansion of fire watch program on RFW days/Web cam monitoring, access restrictions on Red Flag Warning, vehicle user restrictions; key road maintenance (Limestone, Shady Oaks, Dripping Springs)
6.04	roadways/vehicles, rural residential/accidental, electrical transmission line, spotting, wildfire encroachment	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams or fire detection technology in remote areas; knox padlock on gate for access - confirm
6.05	roadways/vehicles, residential / accidental, ag operations, recreational user, spotting, wildfire encroachment	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or early warning fire detection in remote areas; maintain fuel mod at community in southeast
6.06	roads/vehicles, arson, electrical transmission lines, spotting from neighboring FMUs	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or early warning flame/heat detection system in remote areas; consider working with equestrian facility owner to expand/create fuel modification under oak trees and within 100 feet of exposed structures

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
6.07	residential/accidental, electrical transmission line, roadways/vehicle, recreational user, arson, spotting	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or early warning fire detection system in remote areas; existing fuel mod areas functioned well in Santiago Fire but will re-populate with plants that may form ladder fuels and continuous fuel areas – reducing the effectiveness; focus on ladder fuel removal under oak woodlands (shaded fuel break), educate homeowners on appropriate ornamental landscape
6.08	electrical transmission lines, roadways/vehicles, recreational users, arson, substation, residential/accidental, spotting	restoration of non-native habitats, especially to cactus scrub; Aliso Creek restoration to natives removal of invasives;
7.01	low voltage electrical T-line (north); roadways/vehicle related, recreational related, ag structure/operations (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles, laborer "lunch fires", restrict access to FMU on RFW days, expand fire watch program; early warning fire detection technology; maintain clearance on T-line (vegetative clearance under lines and GO 95 vegetation clearnance around poles and along roadway (20 feet either side) to Emergency Operations Center
7.02	low voltage electrical T-line (several throughout); roadways/vehicle related, recreational related, batch facility - heavy trucks; gravel, industrial, ag structure/operations (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles, laborer "lunch fires", restrict access to FMU on RFW days, fuel mod along heavy equipment parking areas at facilities; fire watch program; early warning fire detection technology; clearance on T-line and poles
7.03	low voltage electrical T-line (NE corner, along 133); roadways/vehicle related, (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles, restrict access to FMU on RFW days, clearance on T-line and poles
8.01	residential/accidental, roadway/vehicle, electrical transmission line, recreational user, arson, mntnce operations, spotting	Work with OCFA and homeowners on continued landscaping/defensible space messages and implementation of OCFA approved Fuel Mod Zones; fuel reduction by habitat restoration within drainage, removal of exotic trees
8.02	residential/accidental, roadway/vehicle, electrical transmission line, recreational user, arson, spotting	Work with OCFA and homeowners on continued landscaping/defensible space messages; fuel reduction by habitat restoration: removal of exotic trees (OCFA and OC Parks have removed eucalyptus trees south of the upper reservoir)

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
9.01	Urban sources, residential/accidental, arson, electrical transmission line, substation, spotting, school - student smoking	Focus education and coordination at school to prevent student ignitions (include education, cameras, signage indicating no trespassing/no smoking, school is responsible for ignitions from students - possibly fire suppression costs); Homeowner education on fuel mod is necessary based apparent understanding of fuel mod zones (some with bare dirt, some with no FMZ; recommend that consistent fuel mod is provided for structures on periphery and done to fuel mod standards – work with City of Orange Fire Department, OCFA and private property owners to annually implement fuel modification; City of Orange Fire Department continue enforcement of maintenance of FMZ to the east of school; fuel mod between water tank road and private property under ornamental trees to augment protection
10.01	low voltage electrical T-line (N/NE); roadways/vehicle related, recreational related, ag structure/operations (accidental), arson, spotting, fire encroachment	Monitor access - off-road vehicles (maintain gates), restrict access to trails on RFW days, watch program; early warning fire detection technology; maintain clearance on T-line and poles
10.02	electrical transmission line; roadways/vehicle related, recreational/boating/lake related, 1 residence at dam (accidental), arson, spotting, fire encroachment; lightning	Monitor access, restrict access to trails on RFW days, expand fire watch program
10.03	freeway/vehicle (north and west), toll stop adjacent, cigarette, electrical transmission line; arson, spotting, fire encroachment, natural (lightning, rocks, etc.)	Roadway is significant ignition source so recommend: concrete barriers, weed barrier mats for critical stretches on both north and south bound perimeters, especially where long- up hill grades exist; north-bound there are at least two opportunities for pulling off roadway - these should be gated and monitored; coordinate with TCA for camera monitoring of corridor, especially during RFW weather;
10.04	electrical transmission line; arson, spotting, fire encroachment from neighboring FMU; lightning	Monitor access and restrict on RFW days, specific fuel reduction/point protection for Tecate Cypress grove on northern boundary (may need experimentation on methods (fuel break vs. thinning, etc.) as current grove matures), expand fire watch program, Webcams, early warning fire detectors; Windy Ridge Road improvements for fire apparatus and fire watch access
10.05	electrical transmission lines; recreational users, rural residential (accidental), roadways (vehicle related); arson, spotting, fire encroachment; lightning; unknown, fenced facility off Black Starr Canyon Road	Monitor access, educational outreach to home/property owners in or adjacent to FMU (rural properties) restrict access on RFW days, expand volunteer fire watch program, Webcams, early warning fire detectors; confirm land use off Black Starr Canyon Road and whether specific fire prevention/protection is warranted – no stakeholder input provided on this area.

Table A-1
Fire Prevention/Fuel Reduction Prescriptions

Fire Management Unit	Potential Ignition Sources	Potential Hazard Reduction Measures
11.01	full interface with residential community/ Serrano Ave to the west (vehicle related - less than freeway); electrical transmission line (northern boundary), recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, restrict access on RFW days, expand fire watch program, Webcams, early warning fire detectors; habitat restoration in SW with removal of exotic trees; public education at education center to focus on wildfire prevention, safety, ecology
11.02	full interface with 241 Toll Road to east (vehicle related ignitions), electrical transmission line (northern boundary), recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, more robust fuel buffer or ignition containment devices such as walls or weed control mats at key locations such as long uphill grades along 241; restrict access on RFW days, expand fire watch program, early fire warning detectors
11.03	full interface with 241 Toll Road to east (vehicle related ignitions), full interface with residential to west (accidental, small combustion engines, etc.), electrical transmission line, recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, more robust fuel buffer or ignition containment devices such as walls or weed control mats at key locations such as long uphill grades along 241; restrict access on RFW days, expand fire watch program, early fire warning detectors
12.01	full interface with 241 Toll Road to west, full interface with 91 to the north (vehicle related ignitions), recreational, arson, encroachment or spotting from neighboring FMUs	Monitor access, restrict access on RFW days, expand fire watch program at least until the FMU is developed, NOTE: the FMU is planned for urban residential development as part of Mountain Park project so fuels will be converted and overall ignition potential reduced - will provide fuel buffer between 91/241 and adjacent FMUs.
12.02	freeway/vehicle (north and west), toll stop just south, cigarette, electrical transmission line; arson, spotting, fire encroachment, lightning	Monitor access, specific fuel reduction/point protection for Tecate cypress grove; restrict access on RFW days, expand fire watch program, Webcams strategically located to monitor remote portions of FMU, early fire warning detectors placed to help response to cypress area; road improvements for fire access facilitation (ex - grade shoulders down, widen, provide fuel mod zones of 10 feet or more on either side); potential experimentation on cypress protection measures - thinning, fuel mod/point protection and if funding or donated system available, then Phos-chek landscape protection system or pre-plumbed fire deluge system could be considered
12.03	freeway/vehicle, cigarette, electrical transmission line; arson, spotting, fire encroachment, lightning	Monitor access, restrict access on RFW days, expand fire watch program, Webcams and/or early warning fire detectors in remote areas of FMU; concrete walls or mats to help prevent ignitions along 91 freeway;
13.01	Roads, residential/urban areas, accidental, arson, recreation, power lines	Invasive species removal, restoration, Improve fuel modification where structure setbacks do not meet current local fire code standards
14.01	I-5 to west, residential to east, accidental, arson, recreation	Invasive species removal/restoration to native scrub throughout the site, promote fuel mod at the residential structures and stress proper ornamental placement and maintenance

In summary, each of the FMUs include high-value habitat and cultural resources that may be considered a priority for protection from wildfire. Additionally, each FMU has an associated fire hazard and ignition sources. Various options are available for reducing ignitions and fire spread as well as for protecting identified assets. However, the key to protecting the NROC natural resources is on minimizing the occurrence of wildfire rather than focusing funding on point protection, such as providing fuel reduction near high priority assets.

1.3.2 Leverage Based Prioritization

Potential hazard reduction measures that focus on fuels manipulation, including annual mowing, mastication, exotic plant removal, grazing, herbicides, and potentially, prescribed burning, among others are practices that are considered to support the overall goal of reducing the occurrence of vegetation ignitions. A focus of this analysis has been on determining which of the available, feasible measures provide the most *leverage*. Leverage can be defined as the ability to influence a system, or an environment, in a way that multiplies the outcome of applied efforts without a corresponding, proportional increase in the consumption of resources. In other words, leverage is the advantageous condition of having a relatively small amount of cost yield a relatively high level of returns. With regard to NROC's fire hazard condition, the objective is to maximize return (minimizing fire occurrence and spread) on investment (funding of hazard reduction measures) by prioritizing the measures and the FMU areas where they will provide the most leverage. The following sections provide a discussion of the identified potential hazard reduction measures, their priority level, estimated leverage and where these treatments may be best applied.

1.3.3 Prioritization of Potential Hazard Reduction Measures

Refer to Appendix A-2 for details on the rated benefits and costs for each potential hazard reduction measure. The measures are provided more detail below and are listed in order or calculated rank for implementation on NROC. Note that some of the measures have an NROC-wide potential impact (citizen education, enterprise GIS) while others affect targeted areas within small portions of NROC (Tecate cypress point protection, conversion of outer fuel modification areas to cactus wren habitat). As such, it is possible that individual potential hazard reduction measure rankings provided herein will vary by FMU, stakeholder, and available funding, as well as potentially changing over time as field (ecological), political, and financial conditions change. As previously mentioned, the cost to benefit categories are purposely broad vs. precise in order to minimize subjectivity. Therefore, there are several measures that resulted in the same ranking scores and further prioritization was provided considering the overall leverage that would be achieved with each measure. Measures considered to include more leverage were ranked higher than those with the same overall score, but less identifiable leverage.

1.3.3.1 Restrict Access during Red Flag Warning Weather

The highest ranked potential hazard reduction measure is restricting access during Red Flag Warning Weather. This measure is perceived to have a very low financial cost (keep gates locked, patrols monitor trail heads, erect signs indicating no use and potential for fines if unauthorized use occurs) and low cost in terms of lost recreational opportunities, especially considering it is unlikely to realize more than approximately 20 Red Flag Warning days per year. Due to the low cost and significant potential for removing potential ignition sources and potential emergency rescues from NROC on days when fire ignition and spread is most likely, this measure is considered to include at least a moderate and likely a high leverage level. Removing normal recreational users during this period also makes it easier to identify and deter potential arsonists who may shy from the area due to patrols (in combination with fire watch programs discussed in 1.3.3.5). This measure is currently enforced within the reserve and should be reinforced with additional efforts, including on off-site, adjacent open space lands. This measure is considered applicable to all NROC FMUs. Funding for this measure should be provided by each FMU landowner/management entity based on required patrols necessary to restrict access during these high fire hazard periods.

1.3.3.2 Roadway Maintenance/Construction Related Restrictions during Red Flag Warning Periods

This potential hazard reduction measure was ranked second highest due to an estimated low financial cost and only minimal costs associated with short delays for road and right-of-way maintenance activities. During Red Flag Warning days, fire ignition potential dramatically increases and the probability of a vegetation fire associated with any type of road or road ROW project including heat or spark sources (guard rail maintenance, road fuel modification maintenance, sign installations, paving, etc.) is enhanced. Research indicates that CAL TRANS and the Transportation Corridor Agency (TCA) currently include protocols for suspending potential fire producing activities during Red Flag Warning conditions. However, there are other agencies who are responsible for roads, trails, and green spaces adjacent to NROC that do not include RFW weather protocols. One such identified agency in Orange County Public Works. It is recommended that a study to identify the entities responsible for maintenance is completed so that educational outreach can be conducted. The outreach would focus on the importance of fire weather restrictions during RFW weather, the potential liabilities associated with fire ignitions, and sample restriction language that can be adopted by the entities/agencies. Funding necessary for coordination with roadway/greenspace/facility maintenance restrictions is considered minimal and should be borne by affected stakeholder agencies as part of ongoing operating costs. Developing standard RFW restriction language that can be shared with, for example, OC Public Works, would be minimal effort as much of that language can be readily found on the Internet.

1.3.3.3 Coordination with Neighboring Open Space Land Owners/Managers for Fire Reduction and Response Planning

Coordination with NROC adjacent open space neighbors is an important consideration for fire management and response planning. These open space areas have the potential to influence and to be influenced by NROC. Wildfires originating on these properties may quickly move into NROC and circumvent any hazard reduction measures. Coordination with these entities must include ongoing communication and cooperation such that similar fire hazard reduction measures (e.g., RFW access restrictions) are practiced and fire prevention measures are implemented in a holistic process. Coordination should occur between stakeholders and the CNF on a regular basis. To ensure that coordination and communication is occurring, it is recommended that the Resource Advisor Fire Team (RAFT) include at least annual, and more often as needed, communication outreach with the CNF District Forester and Forest Fuels Officer. The outreach efforts should focus on sharing management planning and vegetation management activities, particularly prescribed burns on the CNF, to enable each agency/entity to properly prepare for the possibility of escaped fires that could affect NROC.

1.3.3.4 Enterprise Geographic Information System (GIS)

The existing NROC framework includes a variety of land owners, land managers and related stakeholder agencies/entities within the area encompassed by this WFMP. Coordination and communication amongst the various entities is functioning at a level considered poor. NROC resources data should be readily available for a variety of purposes, including preparing management plans such as this WFMP. They system overall is considered disjointed, with separate stakeholder entities owning and harboring data in silos. The silos are not connected and therefore, resource management occurs with little consideration of what may have occurred on neighboring FMUs. Geographic Information Systems (GIS) are powerful tools for geospatial data management, record keeping, and resource planning. Not every stakeholder entity currently has the technology, budget or expertise to manage a GIS program and this situation would be far from cost-efficient and cooperative. There are potential solutions to the identified data issue that are affordable and relatively easy to use. Data sharing programs can be set up in a variety of formats using a variety of software programs. GIS is a natural fit and enterprise GIS typically centers around a central database that is inclusive of all data and customized user interfaces that enable accessing the data. Safeguards can be programmed into these systems so that, for example, sensitive data can be restricted to authorized users. Our evaluation indicates that Irvine Ranch Conservancy includes a strong GIS group and manager that could be leveraged to provide a more robust data management and sharing system available to participating NROC stakeholders.

Efficiencies gained from a large number of stakeholders participating are anticipated to bring the per share costs down to reasonable levels. There may be an opportunity to piggy-back on an

Orange County Fire Authority system if that system is deployed, but if not, there are other options that can and should be explored. Data sharing and cooperation is necessary at NROC for short- and long-range planning efforts, restoration planning, fire hazard reduction planning, post-fire restoration planning, fire response planning, and overall successful management of this vast resource. Data management and sharing is expected to provide a large number of benefits for a modest investment, thus it is considered to include a high leverage advantage. This potential hazard reduction measure would be applicable to all FMUs and would transcend fire hazard reduction as it could be used for many land management purposes. Funding for GIS data management expansion to include all NROC stakeholders (with restrictions based on role of each) should be fair-share amongst stakeholders based on size of land area, data creation, manipulation, and use frequency, or as otherwise agreed upon by participating stakeholders.

1.3.3.5 Expanded Volunteer Watch Coverage Program

One of the most leveraged investments that can be made for reducing ignitions leading to catastrophic fires is a highly collaborative, community-based Fire Watch Network. The current network includes Irvine Ranch Conservancy, Greater Laguna Coast Fire Safe Council, Inter-Canyon League Fire Safe Council, Trabuco Canyon Defense Against Wildfires, OC Parks, Crystal Cove State Park and Modjeska Canyon Fire Watch programs. These Fire Watch programs form a well-organized framework for eyes on the ground that when coupled with a public outreach program, is a significant deterrent for would-be arsonists. It can also result in early fire detection and reporting, enabling the well-organized and equipped Orange County Fire Authority (OCFA) the advantage of a fast response and potential for containing fires in their incipient stages. This network of human-resources in the field results in protection of the nearly 40,000 acre NROC reserve, but additional benefits are realized for the billions of dollars of privately and publicly owned assets and human-lives that would be potentially threatened by large, uncontrollable Reserve wildfires.

Currently, the Community Fire Watch Network has an estimated 150 trained volunteers who monitor and maintain high visibility to deter and report ignitions during periods of extreme risk such as high winds. The Community Fire Watch Network is credited by local officials and fire departments with contributing to fire reduction in wildlands even though it has been deployed a relatively short period (less than 5 years). However, OCFA and NROC stakeholders have identified that the program includes inherent vulnerabilities due to gaps in coverage, both on the landscape level and during nighttime hours. Mitigating these gaps will require more volunteers and possibly the implementation of technological solutions that enable remote area monitoring at any hour.

Supplementing the existing Community Fire Watch Network requires a higher level of coordination, management and funding than one would initially consider for a volunteer program. Costs associated with recruiting, training, coordination and deployment accumulates and ideally, this type of program is managed by a committed, paid and knowledgeable person that can maintain consistency from year to year. The current program includes volunteer training and deployment by OCFA or the local fire agency along with the organizations originating the various watch groups. The expansion of the existing program will likely be best managed by IRC since they are already in the process of expanding the Community Fire Watch Network.

Each year, the volunteer fire watchers are sent to pre-identified areas around NROC's perimeter during Red Flag Warning periods, when weather conditions would facilitate ignition and fire spread. History indicates that RFW's tend to increase arsonist activity. Previous focus areas have been high ignition rate sites. With additional volunteers and remote Web cameras, volunteers may be able to cover a larger area, including the target ignition points, but also areas where ignitions have not occurred on a regular basis, but for which there is potential. Each Fire Watch volunteer will act as a visual deterrent to potential arsonists, will be an early fire detector, and will serve as a community liaison, educating the public on the extreme fire risks. It is important to note that Fire Watch volunteers are trained to not become involved in fire suppression, their role is only deterrence and reporting.

Details of the Community Fire Watch Program are in development and will solidify as funding is available and a fire watch coordinator is in place. Conceptually, as IRC's program indicates, volunteer training between all Fire Watch Program cooperators would be performed cooperatively with each other and OCFA, with technological advancements used such as online training being available to volunteers. The training program should also include classroom and field elements that examine fire behavior, public contact, radio communications, and remote Web camera monitoring basics. Furthermore, all Fire Watch volunteers need to be thoroughly background checked and deployed in pairs.

The following provides IRC's outline for program expansion (Wildland Fire Ignition Reduction Strategy 2008) and this WFMP recommends that its implementation continue and be expanded to include coverage for the greater NROC. Italic font below describes recommended revisions to the IRC plan to expand its use beyond IRC managed lands.

Phase 1: Staffing and Program Management

To initiate growth of the Fire Watch Program, IRC will hire a Wildland Fire Program Manager and a Fire Watch volunteer coordinator. These staff will work with partner agencies on managing and reducing all aspects of fire ignition within the historic boundaries of the Irvine Ranch (*recommend NROC wide*). The Program Manager will implement, administer and manage IRC's overall Fire Prevention Program.

IRC will be responsible for recruitment, training and deployment of all Fire Watch volunteers. This includes the ramp up phase of the first two years and maintaining the appropriate level of volunteerism over the next 10 years. The manager will also be responsible for equipment identification, procurement and dissemination to the Fire Watch volunteers. The equipment is based on an existing list of recommended items agreed upon by IRC and OCFA. All training materials and public outreach information will also be updated and disseminated by the manger.

IRC will monitor weather conditions for red flag alerts *and warnings* and/or Santa Ana wind conditions and deploy Fire Watch volunteers to predetermined "high risk" *and overall NROC coverage* locations. The manager will notify the Fire Watch volunteers of pending or existing deployments through a phone tree system and deployment location schedules will be managed through a password protected web page. The manager will also be tasked with expanding the deployment locations based on the analysis of the Wildland Fire Ignition Reduction Strategy.

IRC will maintain current *and cooperating* relationships with agencies, fire safe councils, *and NROC stakeholders* throughout the region and build and maintain new relationships that will enhance the program's effectiveness. Opportunities exist to increase the network of volunteers through local law enforcement, the Community Emergency Response Teams (CERT) and the American Red Cross.

Phase II: Recruitment, Training and Deployment

IRC with OCFA, will plan and implement a volunteer recruitment strategy for the first 200 Fire Watch volunteers. Necessary equipment will be procured, training manuals and public hand out information will be updated and printed and training sessions will be scheduled.

Recruitment information will be created and publicly disseminated to generate the needed volunteer interest. Simultaneously an on-line Fire Watch training module will be created through E-Learning Solutions and hosted on-line. The deployment phone notification system will be upgraded and the web based scheduling system will be improved.

A minimum of four training sessions will be scheduled and implemented with IRC and OCFA. Trainings will be held at the OCFA headquarters in Irvine. By the completion of fiscal year *2015, up to 350* new Fire Watch volunteers will participate in classroom trainings supplemented by the on-line course, be outfitted with necessary equipment and communication materials, complete background checks, and be prepared for regular deployment. *The goal is to gain better fire watch coverage of NROC wildlands as soon as possible, but no later than 2015.*

Due to the fact that the fire season is heaviest between October and February, training sessions may be concentrated during this time of the year. This will help to ensure that Fire Watch coverage exists when it is most needed.

Phase III: Maintenance and Continued Deployment

After 2015, when the number of fire watch volunteers of 500 has been achieved, IRC will manage and deploy Fire Watch volunteers during red flag alerts and/or Santa Ana wind conditions. The volunteer recruitments will be reduced *as necessary each year* to help maintain the volunteer force at 500 individuals.

The phone tree deployment system and web based scheduling will be maintained and updated regularly. Public outreach information will be replenished each year to ensure that the correct messages regarding hazardous fire conditions are disseminated to the public. A minimum amount of replacement equipment will be kept on hand to cover any damaged or loss during deployment.

Funding for this program should be contributed by each participating FMU land owner/management entity, as needed to maintain a robust 500 person volunteer program with paid positions to manage and coordinate. The total cost of this program is estimated by IRC to be $200,000 per year. FMUs identified as being good candidates for fire watch coverage are: all of Central Reserve to provide an overlapping umbrella of coverage. Coastal Preserve, especially: 2.06, 2.07, 2.09, 4.02, 4.05; possibly 1.02 and 1.03

1.3.3.6 Remote Solar Powered Web Cameras

Remote Web-Accessible Cameras have become more frequently used to monitor areas that are not easily accessed due to terrain, remoteness, lack of roads, or associated danger during fires. These units can be solar powered to avoid the need for an electricity source. Web cameras are a good tool to augment a Community Fire Watch Program as they can enable dedicated volunteers access to live views of difficult to monitor NROC locations. Depending on the type of Web camera, it is possible to include thermal nighttime viewing from the comfort of home or a central monitoring location, thus expanding the capabilities of the Fire Watch Program. Additionally, one person can monitor several cameras, leveraging the required resources to cover large areas.

Funding for purchase and deployment of Web Cameras should be on a fair-share basis, with landowners/management entities of the FMUs where they are deployed paying the largest share of the cost. FMUs identified as potentially being good candidates for remote solar powered Web cameras are: 6.03, 6.04, 10.01, 10.02, 10.03, 10.04, 10.05, 12.02, 12.03, 11.02

1.3.3.7 Fewer Restrictions on Fire Agency Response to FMUs

Analysis of the draft WFMP created by NROC and never fully released for review indicates that there were many restrictions placed on the responding fire agencies for the NROC FMUs. Restrictions included what type of firefighting tactics were permitted in each FMU and which were not. Were these restrictions to have been applied and fire agencies expected to stay within the pre-determined acceptable tactics, it is likely that many more acres of NROC habitat would have unnecessarily burned. For example, a vegetation ignition off of a roadway that is spreading into an NROC FMU under typical weather conditions could easily escape initial containment efforts due to the vegetation and terrain, even absent high winds if the tactical response plan indicates that certain tactics are not allowed. Likewise, during RFW weather, it is easy to imagine a vegetation fire that may have been contained to 20 acres with a fast, aggressive response that instead grows to 2,000 acres or more because the response plan removed bulldozer activities from the available firefighting arsenal. This hazard reduction measure focuses on removing the tactical response/firefighting method restrictions for FMUs at least until fire frequency on the majority of NROC returns to a more healthy frequency. It has been identified in the Volume I WFMP and by numerous stakeholders that the current frequent fire interval has caused significant habitat damage and establishment of a high-fire frequency, non-native plant community. Therefore, the Volume I WFMP focuses on letting the fire agencies conduct operations necessary to contain fires, but not doing so in a vacuum. Rather, tactical response plans indicating the important natural and cultural resources that would be affected by ground-disturbing activities are provided to fire agencies and a second, active layer of education is provided by resource advisors who are tasked with providing important resource information so that informed decisions can be made and important decisions can be made when there's potential to minimize fire damage on a large scale by accepting resource damage from firefighting activities on a smaller scale.

This measure applies to all NROC FMUs and is proposed within the Volume I WFMP. Funding above and beyond the existing staffing is not anticipated.

1.3.3.8 Trail Head/Entry Fire Safety Signage Program

A consistent message at all NROC trailheads should be provided regarding fire prevention, fire safety, and the importance of avoiding activities that can lead to vegetation fires. There has not been a high incidence of wildland fires originating from NROC recreational users, but there is a correlation with outdoor users and wildfires. For example, a lost hiker may start a fire to keep warm in the dark or to signal for help. A visiting hiker not familiar with the potential for vegetation ignitions in dry grass may decide to smoke a cigarette in a vulnerable area that can lead to a wildfire. There are many other examples of humans causing fires in wildland areas, and these potential ignition sources can be positively affected with clear, consistent messages. It is recommended that language indicating the potential for firefighting cost recovery from the individual may occur for fire started by NROC users.

Signage funding should be on a fair-share basis based on the number of trail heads within each land owner/management entities responsibility area, or based on some other formula acceptable to participating stakeholders. FMUs identified where signs would be placed include all NROC

Public access entrances (trail heads) including: 2.01, 2.02, 3.01, 3.02, 3.03, 3.05, 2.05, 2.06, 2.07, 2.08, 2.09, 2.10, 4.01, 4.02, 4.03, 4.04, 4.05, 4.06, 6.02, 6.05, 6.03, 6.04, 7.01, 7.03, 10.01, 10.02, 10.03, 10.04, 10.05, 11.01, 11.02, 11.03, 12.01.

1.3.3.9 Electrical Transmission Line Fire Prevention Measures

This potential hazard reduction measure focuses on reducing the potential ignition of vegetative fuels from electrical transmission lines.

Electrical transmission lines and associated structures can start fires in a number of ways, including the following:

- Uncleared vegetation, especially trees, coming into contact with conductors
- Sparks (from exploding hardware such as transformers and capacitors) coming into contact with vegetation
- Wind-blown debris coming into contact with hardware such as transformers and conductors
- Conductor-to-conductor contact
- Wood transmission poles blown down by high winds
- Dust or dirt buildup on power line hardware
- Aircraft or helicopter, or attached features such as fire-fighting water buckets, coming into contact with power line hardware and support structures
- Wildlife coming into contact with power line hardware or transmission line.

Power lines of different voltages may cause fires in different ways. For example, according to the Final EIR/EIS for the Sunrise Powerlink Project, between 2004 and 2007 the majority (89 of 104) of SDG&E power line ignitions were low-voltage system ignitions while the remaining events were medium- and high-voltage (69 kilovolt (kV), 113 kV, 230 kV) system ignitions (CPUC and BLM 2008a). SDG&E's extra-high-voltage (500 kV) system (consisting of the Southwest Powerlink (SWPL) transmission line) has never been the cause of a fire (CPUC and BLM 2008a). In other words, the higher energy transmission systems produced substantially fewer fires than the lower rated distribution systems. Reasons for this trend are likely related to the structural components, materials, line heights, locations, and adjacent vegetation, among others. Over the 2004 to 2007 time period, the 15 high-voltage line ignitions were caused by a variety of factors including Mylar balloon contact with conductors, conductor-to-conductor contact, dust on insulators, static line failure, kite tail contact with conductors, crashing plane contact with transmission line towers, and wildlife contact with conductors (CPUC and BLM

2008a). These statistics are assumed to be similar for Southern California Edison given the similar territories and customers.

Due to system components, low-voltage and high-voltage lines are susceptible to different wildfire-causing events. For example, some low-voltage lines are mounted with devices (transformers and capacitors) that can explode and ignite nearby vegetation. Also, fallen or wind-blown tree limbs and debris is more likely to come into contact with low-voltage transmission lines because these lines are spaced much closer together than higher voltage lines and are typically closer to the ground. Arcing (which occurs when electrons are able to jump a gap in a circuit) from a single conductor to ground through vegetation contact can occur on power lines of all voltages, but generally the distance to the ground of conductors on all facilities limits the potential for this event to occur (arcing between conductor phases is more likely to occur) (CPUC and BLM 2008a). Of the various voltage lines, 69 kV transmission lines can be subject to conductor-to-conductor contact when high winds force two conductors on a single pole to oscillate so excessively that they come in contact with one another (also known as “mid-line” slap) (CPUC and BLM 2008a). Nearby vegetation can catch fire from sparks resulting from conductor-to-conductor contact. Maintenance activities can also inadvertently result in fires on transmission lines of any voltage, depending on the specific components of the system in question.

Although power line structures (including wood and steel poles and steel lattice structures) are designed to retain their structural integrity in high-wind environments, high winds can (in rare cases) blow over these structures. When such an event occurs, the protection and control systems of transmission lines systems are designed to safeguard against the threat of wildland fire by shutting off power immediately, thereby disrupting electrical flow along the line (CPUC and BLM 2008a). This approach, however, does not always work as designed and sparks generated prior to power shut down can ignite nearby vegetation, although the occurrence of this type of wildfire is very rare.

Small- and medium-voltage power line ignitions caused by high winds were responsible for four of the largest fires recorded in California between 1923 and 2007: the Witch Fire (which eventually merged with the Guejito Fire) (2007), the Campbell Complex (1990), the Laguna Fire (1970), and the Clampitt Fire (1970).

In addition to high winds and vegetation maintenance violations, contact between large birds and power lines and gunshots fired at power line hardware can also result in wildfires. Fire can result from birds coming into contact with two closely spaced conductors, resulting in an unintended electrical arc or “flashover” (CPUC and BLM 2008a). Bird-related flashovers, which are more common on lines where conductors are positioned close together and can hence be contacted by outstretched wings, can result in fires if the feathers of an electrocuted bird catch fire and come into contact with ground vegetation. Wider spacing of conductors minimizes the possibility of this type of flashover; therefore, the risk of flashover decreases with increasing voltage as higher-voltage lines are required to be spaced at greater intervals. Regarding gun shots, it is common in remote areas for vandals to shoot at power line components, including ceramic insulators. Lower-voltage lines are more susceptible to damage from gun shots and possess a greater wildfire potential when compared to higher-voltage lines. The support structures associated with higher-voltage lines are taller than those associated with lower-voltage lines, making insulators and conductors placed on lower-voltage lines easier targets for vandals. Similarly, the structural integrity of steel conductors associated with higher-voltage lines is greater than the integrity afforded to similar hardware located on lower-voltage lines, resulting in a less dramatic response to being hit by bullets and resulting in lower occurrences of vandalism.

As previously discussed, inadequate maintenance practices around power lines and associated structures can also result in wildfires, such as when the structural integrity of the power lines or structures is degraded and trees or vegetation are allowed to grow to the point of contacting hardware, including conductors. California Public Resources Codes 4292 and 4293 establishes the minimum clearance requirements for overhead power lines.

This measure focuses on working with SCE, who is responsible for electrical transmission lines on and adjacent NROC, on coordinated and planned maintenance and upgrades/retrofits of NROC vicinity equipment. Among the types of activities that should be considered high priority are replacement of wood poles with steel, replacing and/or repairing aging equipment on a more frequent timeline, providing raptor/bird protection retrofits, and increasing the number of patrols along the right-of-way to increase the probability that a potential issue is detected early. SCE indicated in a stakeholder meeting that they have been working on a Fire Management MOU that would facilitate additional fire safety procedures. No details were provided.

SCE currently follows RFW restrictions, suspending all non-essential work in wildland areas during high fire hazard conditions. They also require construction related fire prevention activities including water truck on site, educational training, no smoking outside vehicle, etc., that is mandated by contractors.

Vegetation line clearance occurs on an as-needed basis that is driven by species growth characteristics and size of distribution line. This primarily occurs outside of NROC, but vegetation ignitions could easily result in spread onto NROC.

Coordination should focus initially on identifying all FMUs potentially affected by electrical infrastructure and then identifying where the highest priority maintenance needs are and implementing a program to mitigate these issues. Funding for this potential hazard reduction measure would be provided by SCE as part of their operating budget. FMUs where these measures are applicable are all FMUs including presence of or adjacency of electrical transmission lines, substations, and related electrical infrastructure.

1.3.3.10 Expand Orange County FireSafe Council Program/Provide Funding for Hazard Reduction Projects

The FireSafe Council is an established, non-profit organization devoted to facilitating citizen involvement in identification and mitigation of fire hazards in and around their communities. The Orange County FireSafe Council is not as established as other counties', for example, San Diego County includes numerous individual FireSafe Councils, each coordinated by a County FireSafe Council. Typically, FSCs prepare Community Wildfire Protection Plans (CWPPs) in which the fire hazard is identified and individual hazard reduction projects are formulated. Once this step is complete, FSCs can apply for federal fire hazard reduction grants that can enable them to purchase equipment and fund hazard reduction projects. FSCs can also accept funding from other entities, including utility companies, private developers, and others. Formulation of two FSCs (one for the Central and one for the Coastal Reserve) that included stakeholder representatives (including fire agencies) as well as citizens would be another proactive, highly leveraged way to address potential fire hazards in and around the Reserve. There is no monetary cost to establish a FireSafe Council, but there is a time and participation requirement. SCE has expressed interest in funding a local FSC and that money could be used to prepare the CWPP, which can be easily adapted using analysis conducted as part of this WFMP, and expanded to focus on the private assets needing protection from wildfire. This measure would have a positive effect on all NROC FMUs and funding would be initially from SCE with potential funding from other stakeholders as donations and from FEMA as grant applications are approved.

1.3.3.11 Roadway Fuel Modification

Studies (IRC 2008) indicate, and this report's analysis confirms, that roadways are one of the most significant sources of ignitions on NROC, especially the Central Reserve. The cost-benefit analysis of this measure indicates a "moderate" importance because the benefit is high, but the associated costs are moderately expensive. However, this plan suggests that the importance of roadside fuel modification efforts outweigh the costs and therefore, this measure is considered one of the most important on-going efforts. As such, roadside vegetation management and maintenance is critical to reducing wildfires. Roadway fuel modification efforts occur on most of the public roadways throughout the County. This maintenance must continue to be performed through mowing operations that remove dry, non-native fuels during the spring annually. Sparks generated by dragged chains, overheated/failed brakes, exploding catalytic converters, tossed cigarette, or other roadway/vehicle related sources may be contained in the road shoulder area or first few feet off the road that usually includes no vegetation (on primary roadways) or they may bounce into the extended area adjacent roadways where vegetation occurs. Depending on the fuel bed that hot material lands, it may ignite a vegetation fire which could spread under the right conditions. Non-native fuels, primarily grasses, cure during the spring and early summer and are receptive to ignitions. Native fuels generally take longer to dry out and reach a point where they readily ignite. Removing the flashy grass fuels and other non-native species from the areas adjacent roadways provides significant reduction in ignitions. The existing maintenance area along roadways is roughly 10 to 20 feet wide with 14 feet the standard. The area mowed should be as wide as 20 feet, where possible and at high ignition points along the Toll roads (241, 133, 73) and along Santiago Canyon Road and Pacific Coast Highway. Where 20 feet cannot be provided, due to terrain or existence of native, lower flammability shrub species, roadside fuel modification should be as wide as possible without impacting native vegetation unless it is dead, then it should be removed.

Funding for roadway fuel modification will be provided by existing road managing agencies including Cal Trans, Transportation Corridor Agency, Orange County, City of Irvine, and others. Most of the agencies responsible for road maintenance are NROC stakeholders, so cooperation is expected to be facilitated. FMUs identified as including roadways with existing or recommended roadside fuel modification include: 1.05, 1.06, 2.09, 2.10, 3.02, 3.03, 3.04, 4.01, 4.02, 4.05, 4.06, 5.01, 6.08, 6.01, 6.02, 6.05, 7.01, 7.02, 7.03, 10.01, 10.03, 11.02, 12.01, 12.02, 11.03, 6.03, 6.04, 10.05. Annual inspections of these roadsides should be performed by stakeholder fire agencies to ensure that mowing is completed by June each year. Maintenance should be completed by June each year. Note that the bird breeding season (February 15 through August) may require agency approval and/or bird nesting surveys to avoid impacts to breeding birds.

1.3.3.12 Roadway Hidden Pullout Closure/Monitoring

Stakeholder input provided during the infrastructure stakeholder and the fire agency stakeholder meetings indicated that there are specific roads that include pull-outs that provide good “cover” for an arsonist to gain access into NROC. The last primary potential ignition source, intentional fires/arson, has historically been an issue in southern California and in Orange County. The trend has been toward increasing area burned in wildfires, resulting from the high number of arson-related ignitions associated with Santa Ana winds, such as in the Malibu area (ForEverGreen Forestry 2010). When weather conditions are favorable for wildfire ignition and spread, arsonists have made their presence known. The importance of the Santa Ana winds to overall wildfire severity and risk cannot be understated. Statistics reveal that wildfires ignite with approximately equal occurrences in summer and fall, but almost 90% of the total area burned occurs in late fall, when Santa Ana winds are blowing (National Park Service 2005).

These pullouts exist for various reasons from roadway maintenance parking, access to bridge overpass areas, debris basin access, and others. It was suggested by the fire agencies that closing these pull-outs or making them inaccessible would result in a reduced occurrence of arson and for wildfires ignited from the burning and discarding of stolen cars over the edge of roads or down these pull-outs. Closure or impeding access will need to comply with transportation safety standards and it may not be entirely possible to eliminate opportunities for pulling off the roadway. Where possible, efforts to gate or chain access should be implemented and complete closure through the use of soil berms or other means should be conducted where access is no longer needed by the responsible agencies.

Stakeholders will need to identify the locations where work can be completed and the precise type of restrictions that will be applied. It is assumed that funding would be provided by the transportation or other agency responsible for roadway maintenance. Closing these pull-outs can include a combination of measures including remote monitoring, gating, and fire watch patrols during RFW weather, amongst others. FMUs identified as having pull-outs along roadways that should be further explored include: 12.01, 11.03, 10.03, 11.02, (south of 11.02 and north of 7.01), 10.01, 10.02, 7.01, 7.02, 8.02.

1.3.3.13 Prescribed Burning

Intentionally managed fires are planned ignitions for purposes of reducing fuels primarily for public safety or habitat improvement, are regulated by all applicable laws, and are managed by OCFA using CAL FIRE's Vegetation Management Program. If prescribed burning becomes a desirable and feasible measure, it shall be conducted under permit from OCFA or under contract with CAL FIRE under the statewide Vegetation Management Program. Utilization of fire to perform fuel modification can be an inexpensive means of fuel reduction, but overall is becoming the least feasible. The advantages of prescribed fire must be weighed against difficulties in getting burns implemented, potential for escape, air quality conflicts, public opposition, and propensity to result in non-native grass and weed reestablishment if implemented too frequently. Prescribed fire occurs in two forms: (1) natural fire, occurring primarily through lightning strikes that are then allowed to burn, and (2) intentional, managed fires. Naturally caused wildfires are rare in this portion of Orange County due to a general lack of lightning. However, natural fires may occur, and if allowed to burn as part of a fire plan, would then be considered a prescribed fire. Although considered unlikely, if natural fire occurs NROC and the fire is determined to pose no threat to life or high-value resources, the fire may be allowed to burn if it meets fire authority and Plan Area vegetation management objectives. If unsafe conditions exist (e.g., high winds, low humidity, high temperature) and, without suppression, it has a high likelihood of burning into areas of fire exclusion or is threatening valuable resources on or off site, then assertive suppression would be pursued. Currently, there is no identified need for prescribed burning within NROC. Off-site prescribed burning is likely to occur in the Cleveland National Forest with the potential to spread into NROC if not properly planned and executed. RAFT coordination with CNF is considered essential and a hazard reduction measure, as described previously (1.3.3.3).

Prescribed fire is a useful tool that is cost effective and, in some landscapes, is the favored form of disturbance for maintenance of habitat. Prescribed fire is analyzed and detailed within Volume 1 - WFMP. In brief, prescribed fire is not currently considered a high priority for fuel management on NROC given the other more readily implementable treatment options described in this WFMP. However, future environmental conditions may warrant and socio-political conditions may enable the use of prescribed fire as a fire hazard reduction or habitat modification technique. Prescribed fire can only be implemented by OCFA or CAL FIRE. A prescribed burn plan is required to conduct burns within the County.Burning objectives shall be devised with RAFT input and coordination with the fire agency. Prescribed burns will generally be utilized in strategic locations when the surrounding land has few residences or a fire can be easily controlled because of topographic or other features. Again, the use of fire as a management tool will be considered specific to ecosystem management objectives.

Funding for prescribed burning would be provided by resource agencies, fire agencies, federal government and potentially private sources, depending on the purpose of the prescribed burn (Wildland fire training, habitat management, wildland fire hazard reduction, etc.). Funding for prescribed fire could be obtained through a Community Wildfire Protection Plan (CWPP) prepared by a FireSafe Council, or by the federal or state fire agency conducting the burn in cooperation with NROC. No FMUs have been identified as appropriate for prescribed burning at this time.

1.3.3.14 Increased Fire Response Capability within Key FMUs

This potential hazard reduction measure focuses on physical access within NROC as it relates to firefighting response capabilities. The road system within NROC provides access primarily along electrical transmission line right-of-way roads. OCFA is under contract with SCE to provide ongoing maintenance of the roads. Maintenance to date appears to include blading the roads as needed, which has resulted in an accumulation of soil berms or banks along the roadways, especially within the Central Reserve. Some roads are along very steep slopes, presenting challenges to fire engines, others occur in precarious positions at ridge-tops, canyon bottoms, or even mid-slope. The roads vary in overall condition, with some roads 10 feet wide and others up to 12 feet wide or more in isolated locations. Access within NROC FMUs should be maintained at a level that will ensure that responding fire agencies can safely respond to typical weather condition fires. Fires during RFW conditions will likely not result in fire engine access into NROC as there is too much potential vulnerability in doing so. Access roads need to be maintained without ruts and deep, loose sand. The berms that have been created on the road shoulders should be re-graded into the roadway, which will raise the current road bed in some locations, remove the banks and potentially reduce funneling of water and erosion in some areas. Roadways should include properly designed and engineered water bars to prevent erosion and rutting that currently occurs following heavy rains. Particularly steep sections should be upgraded to a less vulnerable surface of decomposed granite or even short sections of concrete to help reduce serious road rutting, reduce annual impacts associated with grading, and further facilitate fire engine access. Additionally, access roads should be provided at least 10 feet of modified fuel along both sides, more in particularly hazardous situations.

Maintain local fire agency gate locks and report any notice of removed or missing locks to the appropriate fire agency. Signs should be installed indicating access limitations and extents (map form) and provide road quality to local fire responders. This information will be included in their wildland pre-response plans, resulting in more efficient responses. Information readily accessible by responders not familiar with the area, such as out of County or out of state responders, will improve firefighter safety. As such, it is advised that tactical fire response maps be provided in Knox boxes at major site access routes. Digital site information may be provided to OCFA, LBFD, Anaheim FD, Orange FD, and NBFD, for use in their mobile computer systems.

Funding for access improvements would be provided by SCE and potentially by federal sources as part of a CWPP if access is identified as a hazard reduction project. OCFA's maintenance of the roads may need to be modified to avoid the continued buildup of berms on both shoulders. OCFA would be the primary source of direction regarding priority enhancement locations and what level of enhancement is most appropriate. It is recommended that a study of the roads, annual damage from winter rains, current level of repair needs, steep areas for road improvements, and overall fuel modification be documented so the level of effort needed to meet the intent of this measure can be determined. Currently, this potential hazard reduction measure applies to every FMU within the Central Reserve. Access within Coastal Reserve FMUs is considered adequate.

1.3.3.15 Private Fire Company Point Protection of High Priority Resources

Private insurance companies offer high value properties individual fire protection through a private fire company. The private fire company provides customized apparatus and equipment as well as trained firefighters for focused structure protection during wildfires. The goal of these companies is to access insured properties prior to a fire's approach so that measures can be taken to reduce the likelihood of structure loss. Measures typically enacted include removal of dangerous vegetation, removal of flammable landscape features, closing up structure vulnerabilities and in some cases, applying a flame retardant gel to the structures. These private fire companies would be available for similar services for certain high priority natural or cultural resources. Among the identified resources within NROC that may be considered worthy of point protection are: Tecate cypress, above-ground, flammable cultural resources, sensitive, and smaller plant occurrences (small polygons of rare species) in accessible locations.

Fire company tasks could vary, but may focus on creation of a fuel break or modified fuel area adjacent to the resource being protected and/or application of Phos-Chek or similar fire retardant.

Funding for these services would need to come from the land owner/management company for individual areas to be protected. Cost is estimated at $2,500/day per engine and strike team. Although there are resources that may benefit from this intensive type of protection, there is currently no recommendation for use on NROC at this time. This measure should be retained as an available hazard reduction measure option.

1.3.3.16 Targeted Herbicide Use for Fuel Reduction

Chemical means to control fuels/non-native plants is an effective method, but one that has a negative connotation, potential toxicity for humans and wildlife, and can affect water quality and environmental conditions. Focused chemical selection and application minimizes the detrimental effects and makes the use of chemicals, such as glyphosate and other selective chemicals, a feasible alternative. The application of herbicides to control target invasive species may be used on its own or as a secondary treatment following manual or mechanical removal for controlling sprout growth and regeneration. Herbicide application is recommended following removal of invasive tree species and other perennial species with the ability to regenerate from root fragments when removal of all plant material is not feasible. Herbicide use should be limited to localized applications rather than foliar applications to eliminate the possibility of drift and impacts to neighboring desirable species. A wide range of herbicides are available for such types of treatment. Herbicide labels and material safety data sheets (MSDS) list susceptible target plant species and provide proper direction in the use and handling of the products. Herbicides should be applied by state licensed applicators.

Combination - Cut and Daub

Cut and daub treatment is recommended for larger invasive plants to control regrowth and kill the portion of the plant remaining belowground. Cut and daub involves the cutting of invasive plant stalks and then the direct application of an appropriate herbicide directly to the freshly cut stump. Other related methods include “drill and fill” where holes are drilled into the trunk of a tree and herbicide is injected; or the glove method, where an herbicide-soaked glove is used to apply directly to plant foliage or freshly cut stumps. It is critical that the herbicide treatment occur immediately after the plants are severed so that the herbicide is carried into the plant tissue. If enough time elapses to allow the cut surface of the severed plant to dry out, a fresh cut should be made prior to herbicide application.

Herbicide application is relatively low cost, roughly equivalent to goat grazing, however it is a more focused treatment method. Herbicide application within NROC is not currently recommended or needed on a landscape basis. Rather, herbicides may be an effective treatment within roadway adjacent FMUs and along FMU access roads where undesirable plants are establishing and preferably as a pre-emergent or shortly after emergence so the accumulation of ignitable, dead fuel does not occur. Other areas where this potential hazard reduction measure may be utilized within NROC is for any disturbed area that is being colonized by undesirable species. In these cases, treatments may be part of a restoration program. Without establishment of desired species, the site(s) will tend to establish with non-natives/undesirables on an annual basis, requiring on-going herbicide treatments. Steep slope applications may require appropriate erosion control measures as above ground biomass and below ground root systems are typically killed and lose any soil stabilization function.

1.3.3.17 Convert Outer Zones of Existing Fuel Modification to Cacti Scrub

Conversion of outer fuel modification zones to Cacti Scrub is a potential hazard reduction measure that includes benefits of providing wildlife habitat and reducing maintenance over time while continuing to provide fuel modification function. Most of the fuel modification zones that are within the NROC boundary are 200 feet or wider and include fuel removal to roughly 6 inches height. Converting the outer 50 to 100 feet to a cacti-dominated landscape would enable that portion of the FMZ to better mesh with NROC's habitat goals and could be done in a manner that does not compromise fire protection. Cacti scrub dominated by 70% or more cacti clumps forms a modified fuel bed that is ignition resistant.

In order for this hazard reduction/habitat quality measure to be possible, analysis including determining predicted flame length, fire intensity (BTUs) site topography and vegetation, extreme weather, position of structures on pads, position of roadways, adjacent fuels, landscape retaining walls, neighboring communities relative to the proposed project, and type of construction would be necessary to determine where this measure is implementable without compromising safety.

Reduced FMZ's would be planted predominantly with succulent cacti, which will be native plants grown in the region and salvaged from development sites. Open space between patches of cacti could be provided a significant mulch layer (utilizing the largest commonly available chip size) to minimize weed/exotic species establishment and growth and reduce habitat enhancement activities.

Contrary to the standard OCFA fuel modification zone system that includes two irrigated zones and two non-irrigated thinning zones, the entire fuel modification area would remain semi-irrigated. Permanent irrigation (below grade) would be provided for establishment and long-term fuel modification zone fuel moisture management, although irrigation application is expected to be minimal based on cacti's ability to efficiently utilize available water. Fuel modification zone widths can range down to 100 feet wide with cactus beyond. This type of dual-role fuel modification zone would be consistent with the standard thinning zone with regard to plant densities, but would include irrigation that would be used to maintain the succulents in a hydrated state.

Based on preliminary analysis, areas that this measure could potentially be implemented are focused in Laguna Beach jurisdiction, but other exist wherever current fuel modification exceeds 100 feet, assuming extraordinary natural fire hazards are not present. Costs to implement this measure are high, estimated at $50,000 to $85,000/acre, depending on the extent of the restoration program (design, biddable specifications, contractor labor, and monitoring).

1.3.3.18 Targeted Non-Native Plant Removal

Targeted non-native plant removal focuses on high value habitats including waterways as well as areas adjacent fuel modification zones. Targeted non-native plant removal may include species such as arundo (*Arundo donax*), salt cedar (*Tamarix tamarix*), eucalyptus (*Eucalyptus* sp.), artichoke thistle (*Cynara cardunculus*), castor bean (*Ricinus communis),* amongst many others. The selection of the appropriate fuel reduction methodology should be determined with consideration of many variables, including the particular species, time of year, severity of fuel loading/exotic infestation, the presence of sensitive resources, the degree of intermixing of invasive species with sensitive native habitats, access, and proximity to surface water. The U.S. Army Corps of Engineers and USFWS should be consulted regarding potential permitting requirements if invasive removal will occur in waterways or wetlands under their jurisdiction. General recommendations for NROC are summarized below A summary of potential fuel management methods for use in the Plan Area are provided within the NROC Restoration and Enhancement Plan.

Targeted undesirable species removal is recommended to be focused within the Coastal Reserve in FMU's including Aliso Creek (1.02, 1.03, 1.04) and adjacent fuel mod areas and at wildland urban interfaces throughout both the Central and Coastal Reserves.

1.3.3.19 Roadside Hardening

Roadside hardening is a process of reducing the potential for ignition along vehicle travel ways by providing physical barriers that stop or deflect sparks, heated metal, cigarette butts, etc. Barriers along roads are commonly provided by k-rails, which are concrete barriers roughly three feet tall. Another roadside hardening method identified by the Transportation Corridor Authority is the use of weed mats. These mats have been used alongside roads to prevent weed growth and have been shown to be ignition resistant, reduce the incidence of vegetation ignition, and have the added benefit of absorbing oils and other fluids that are washed from the roads during rains. Roadside hardening is a critical hazard reduction measure on some NROC adjacent roads.

Specifically, roads adjacent to FMUs 2.09, 2.10, 10.03, 11.02, 11.03, and 12.03 have been identified as including characteristics that could facilitate fire ignitions (long uphill grades) and that also have historically included vehicle related ignitions. These areas are not to be considered the only potential areas where roadside hardening may be useful. The cost of roadside hardening is roughly the same for these two options, roughly \$30/lineal foot. It is recommended that NROC, TCA, and CAL TRANS coordinate to seek funding for roadside hardening.

1.3.3.20 Early Fire Detection System

Early fire detection systems have been used in industrial setting for a long time, but for wildland fire detection, the technology is newer, but there are systems that are specifically designed for wildland settings. For this application, NROC would work with OCFA on testing and using Remote Ignition Detection Systems (RIDS) in key areas of the reserve. RIDS would provide early detection of wildfires through visible range optical cameras that detect smoke. Smoke is the first visible indication of a wildfire. Trees and other topographical features, such as ridgelines, may obscure the flames until the fire has grown and on the verge of being out of control. The RIDS monitoring system includes video cameras installed on towers with the video stream from each camera sent to OCFA's Fire Communication Center. The RIDS system analyses and evaluates successive images to provide for identification of wildfire smoke. Once wildfire smoke detection is confirmed by RIDS, an audible and visual alarm is issued to OCFA's Fire Communication Center. The fire dispatch operator is able to examine the alert area by manual control, decide the appropriate response, issue notifications and/or dispatch suppression resources.

A recommended product that is not dependent camera dependent is the Fire Scout x3 (wildfire detector) http://www.fire-scout.com/. This type of system is not expensive for the detectors, which range from \$500 to \$1,000 each, depending on the type of system desired and the communications connections most appropriate for the application. The X3 detects both flames and power line arcing by the ultraviolet light they give off. This type of ultraviolet light is absent in sunlight, so the X3 works just as well by day as it does at night.

It has a hemispherical field of view, so does not need to face the flame or arc, which results in 24-hour coverage.

Solar-powered units can operate for years without maintenance, and are not affected by power outages. X3s can be provided with wireless phone dialers that call authorities when a fire is detected or fitted with a radio transmitter, and placed in a fire-prone area. While this dialer system can be used independently, a network of these units across an entire fire district or, in this case, the Reserve, is the most cost-effective way to avoid losing homes to catastrophic fires in high winds.

Although potentially costly, depending on the system ultimately deployed, fire detectors would be appropriate for those FMUs that require a rapid detection (within 15 minutes) system that will allow a fire to be extinguished quickly and with moderate equipment, and thereby, reducing fire suppression impacts, including in FMUs: 6.03, 6.04, 10.01, 10.02, 10.03, 10.04, 10.05, 12.02, 12.03, and 11.02.

1.3.3.21 Restore Areas of Non-Native Grassland to Shrub Cover

One of the most notable impacts from repeated fire on portions of NROC is the establishment of non-native grasses throughout numerous portions of the reserve. Non-native grasses are perpetuated by frequent fires as the fires remove the recovering shrub cover that develops over time. In the absence of fire, grassland will proceed along successional pathways toward a climax condition of shrub cover in Southern California landscapes like those found on large parts of NROC. However, the existence of non-native grasses, which readily populate a burned site, facilitate repeated fires due to their early season drying and flashy nature, that is, they are much easier to ignite than native shrubs. Because they are receptive to ignition for a longer period and are more readily ignited, the tendency for these areas to burn repeatedly is enhanced and the successional path remains disrupted and in an early successional period. Hence, the primary goal of the WFMP is to prevent ignitions so the natural process can occur and return habitats to their climax conditions. Active restoring of non-native landscapes to shrub cover may be necessary in some areas and may need to be accomplished in conjunction with additional hazard reduction measures that help reduce the likelihood of ignition. Habitat restoration can be costly and success depends highly on the level of maintenance and monitoring provided. IRC has identified several areas where restoration is needed. It is anticipated that other stakeholder entities also have identified areas where restoration should occur, but that information was not provided to Dudek. Regardless, the areas identified by IRC are recommended for priority for any active restoration projects. However, it may be prudent to consider implementation of other hazard reduction measures identified in this assessment and if successful, restoration will occur naturally over time. Where areas do not return to shrub cover would then be the focus of active restoration efforts. FMUs identified as having the potential for active restoration include both Coastal and Central Reserve areas with high fire frequency, including: FMUs 3.03, 4.03, 6.03, 7.01, 10.01, 10.02. The NROC Restoration and Enhancement Plan includes delineations of areas determined to be candidates for this type of restoration.

1.3.3.22 Mastication

Mastication is a term used to generally describe the process of using mechanical means, usually a skid-steer mounted drum, to cut and grind vegetation for fuel reduction purposes. Mastication is a relatively fast method of fuel reduction with roughly one treated acre per hour possible. The process leaves behind biomass as mulch on the ground and mastication can include selective removal of above ground components to bare earth or to any other desired height. This method of fuel reduction is best used where non-native shrubs and small trees require removal. Operation of this type of machinery on steep slopes is an advantage with up to 45% slopes possible. Cost of mastication is good compared to hand methods of removal at $500 to $1,000/acre.

Currently, areas where this method of fuel reduction is recommended is along roadways where woody invasive plants require removal and mowing is not appropriate. In these situations, an extended arm masticator would be appropriate. Other areas where mastication may be appropriate on NROC are where fuel modification zones are considered in need of significant maintenance updates and removal of shrub and small trees would be most cost effectively completed with a skid-mounted masticator. The NROC Restoration and Enhancement Plan provides discussion of the types of restoration needed throughout NROC. Detailed locations where mastication would be appropriate is beyond the scope of this study, but would be determined on a case by case basis where woody plant material is best removed with this method.

1.3.3.23 Extending Fuel Modification Areas near Vulnerable Construction

The majority of structures in urban areas adjacent to NROC's central and coastal reserves is considered to be reasonably ignition resistant. However, there are some areas of older construction that would benefit from additional fuel modification width, such as within the Santiago Canyon area, Cowan Heights, and portions of Laguna Beach and Newport Beach, amongst others. Because NROC's boundary occurs as a hard line in these areas, it requires significant environmental documentation before justification for extending the modified zone into the reserve. Fuel modification areas are intended to starve approaching fire by removing/reducing the fuels available for consumption. This process reduces the fire spread rate and the resulting heat intensity, thereby increasing the ability of nearby structures to withstand the threat and avoid ignition. One good example of a high priority area identified where extension of the fuel modification zones would have a significant benefit for adjacent structures is in Newport Beach's Buck Gully. This area includes structures that can be argued are vulnerable to wildfire, even though 100 feet of fuel modification is provided. Extending the fuel modification area to 150 or 170 feet would substantially reduce the likelihood of structure fires, but would require habitat impacts within NROC.

The Hazard Assessment Matrix in Appendix A-1 discusses FMUs where extension of existing fuel modification zones may be considered. A focused assessment should be conducted in combination with OCFA and the affected fire agencies to determine a priority list of areas that should be considered for fuel modification extensions. This WFMP includes analysis of each FMU and where adjacent structures exist, has incorporated the relative risk based on structure vulnerability with treatment option prioritation. It is the RAFT's responsibility to prioritize where the available funding is focused. Cost can be a factor in the decision to extend fuel modification as fuel reduction would need to occur and ongoing maintenance would be required in perpetuity. If the only option is to extend the fuel modification area into the Reserve, there may be environmental permitting documents that need to be prepared, which complicates the issue and adds cost and time delays.

1.3.3.24 Annual Phos-Chek Application at Highest Ignition Points

The benefits of fire retardant for slowing fire spread are well-documented. Agencies responsible for wildland firefighting utilize fire retardants via aerial attack as well as for application to structures in some situations. Fire retardant, for example, Phos-Chek, prevents wildland fuel sources, such as grass, woody materials, and foliage from igniting. The chemical reaction that occurs as a fire approaches plants coated with Phos-Chek is that as heat increases, Phos-Chek decomposes, releasing water vapor which cools the flames and leaves behind a non-flammable, carbon coating. This coating insulates and restricts air flow, virtually "starving" the fire of fuel. Phos-Chek remains effective until it is removed by strong hosing or significant rainfall. The active ingredients are ammonium phosphate and diammonium sulfate; the same active ingredients in many agricultural fertilizers. Once applied, fire retardants will remain on the plants and can cause foliage burns. Rain or washing of vegetation can avoid this type of foliage damage. The material then is washed into the soil, and can result in plant growth, if large quantities of the fertilizers were applied. This measure includes procuring a contract with a private fire company who would be responsible for applying Phos-Chek, or similar fire retardant, to key ignition areas prior to fire season. This would have a positive effect in minimizing fire spread, but would likely cause plant damage over time as the retardant would remain on the plants for 3 or 4 months before winter rains washed it off. It may also facilitate non-naitve species establishment and growth from the pulse of available nutrients that are washed into the soil. Because this measure could result in loss of native vegetation, it would be appropriate to only use this method where a high ignition source area corresponds with highly flammable, non-native plant cover (such as along a roadway) that would not result in a habitat impact. Currently this measure is not recommended but could be considered for specific ignition reduction efforts in the future where persistent ignitions cause habitat damage and threaten vegetation conversion.

1.3.3.25 Fuel Breaks

Fuel breaks provide areas of reduced fuels that can play an important role in helping fire agencies contain fire during typical fire conditions. Fire agencies attempt to minimize impacts to sensitive resources when fighting fires in wildland areas, when possible; and where feasible, fires are allowed to run to natural breaks including trails and roads. These locations then serve as a defensive position for fighting the fire. Fuel breaks on NROC are best typified by the limited on-site and adjacent off-site fuel modification zones. There are currently no planned fuel breaks within the Reserve. Fuel breaks, it can be argued, occur where native fuels have been converted to a less intense fuel, such as annual grasses. These areas will burn more readily, but burn with a lower intensity than native fuels. However, there is no intention to maintain non-native vegetation within NROC and based on analysis conducted during the preparation of this WFMP, there is no specified need for formalized fuel breaks within the reserve at this time. Potential uses for fuel breaks could include their use as part of a point protection for biological or cultural assets, extensions of existing fuel modification zones, or along roadways as an extension to a roadside clearance zone in particularly ignition prone locations.

1.3.3.26 Shaded Fuel Breaks

A shaded fuelbreak is a strip of land where fuel has been modified or reduced to limit fire's ability to spread rapidly. Shaded fuelbreaks under normal weather conditions can slow an advancing fire and reduce fire intensity. Under moderate weather conditions, shaded fuelbreaks can also provide easy access and a good line of defense for firefighters. For example, fire lines can be anchored or tied into the shaded fuelbreak. Within the shaded fuelbreak, overstory trees are thinned to reduce crown-to-crown overlap. In addition, within the shaded fuelbreak, understory trees and combustible shrubs (e.g., ladder fuels), heavy ground fuels, and snags should be reduced or removed. Shaded fuelbreak width depends on the type of woodlands, fuel loading, and terrain steepness. To improve their effectiveness, shaded fuelbreaks should be placed above and below existing NROC roads or in other strategic areas, such as adjacent to rocky outcroppings. To be effective, shaded fuelbreaks need to be wider than typical firebreaks since vegetation is retained in a shaded fuel break whereas in a firebreak, all vegetation is removed. The minimum recommended width is approximately 200 feet. Shaded fuelbreaks must be maintained periodically, depending on woodlands site productivity and fuels re-accumulation. Maintenance may include cutting, piling, burning, grazing, or herbicide treatments to reduce fuel accumulation. Shaded fuel breaks are not currently recommended on NROC as a prescription for any of the FMUs. However, over time, should conditions exist where shaded fuel breaks would provide necessary fuel reduction and fire spread rate reductions, FMUs such as 6.07, and others where oak canopy exists, would be potential implementation areas.

1.3.3.27 Strategically Placed Area Treatments – Cultural Asset Protection

Strategically placed area treatments include focused and targeted measures at culturally significant asset locations intended to reduce the damage caused by wildfire. Cultural assets considered vulnerable to fire may include wood-based structures, flammable materials, or any other material that may be damaged, discolored, or otherwise compromised by wildfire. Fuel treatments can include ongoing maintenance (removal of dead, dying vegetation, non-native species), restoration with fire resistive species (e.g., cacti), thinning, mowing, disking, grazing, or other methods to reduce heat generation and fire spread rates near protected assets by reducing fuels and/or creating areas with younger fuel ages, which are less prone to burning under normal fire conditions.

Although no specific locations have been identified for strategically placed area treatments at this time, this tool may become valuable with changing conditions over time or with better cultural resources data. Lack of cultural resources data during this analysis has resulted in a low capability to provide specific recommendations. Funding would be provided by land owners/land managers and potentially through grants.

1.3.3.28 Firebreaks and Dozer Lines

A firebreak is an area where all vegetation and organic material is removed down to mineral soil, thereby removing all fuels. Firebreaks can be used to prevent advancing surface flames from coming in direct contact with important resources on NROC, such as historical buildings. A rule-of-thumb for firebreak construction is three times as wide as the nearest surface vegetation (e.g., fuel) heights, such as grasses or shrubs. Firebreaks may require costly annual maintenance on a per area basis for removal of invading vegetation. Because mineral soil is exposed, there is a high probability of creating conditions for invasive weeds to establish. There are currently no areas where a permanent firebreak is recommended on the Reserve. Should future conditions change enough that a permanent firebreak is considered necessary by fire agencies, locations should be based on historical ignition data and previous fire spread studies. The goals of minimizing the total bare soil area and focusing on the areas where most fires occur and could be more easily contained if a strategic no-fuel area was present should guide placement.

Dozer lines are often cut during fire events in an effort to provide fire containment boundaries and to provide access for backfiring. Dozer lines function similarly to firebreaks except that they are not maintained in a vegetation free condition. In fact, dozer lines are typically revegetated following fires. Any new dozer lines considered necessary during a fire event should be located where they have been cut during previous fires, if possible. Focusing on previously used dozer lines will help avoid disturbance to new areas and are likely to be located in desirable locations as determined during the fire event in which they were first cut.

When an existing dozer line (as depicted in Volume II of this WFMP) does not occur in a particular area that is determined by responding fire agencies to require one during a fire, they should not be located near areas that are to be managed for restoration of sage scrub or native grassland habitats because newly cut fuel breaks can support non-native plants, providing a safe site with reduced temperatures and proliferation in disturbed areas following fire. In effect, they become major sources of non-native seed on very receptive burn areas after fires (Keeley 2005). However, the need for dozer lines is dependent on the specific conditions of a fire. If new dozer lines are required, the location should be coordinated with the Incident Command team by the RAFT as early as possible during the firefight, whenever possible. The Incident Command team would be provided access to location information of sensitive biological and cultural resources that should be avoided, as possible. Post fire rehabilitation will need to be prioritized on these areas where soil is turned over/bladed including short-term erosion control and longer term revegetation.

1.3.3.29 Phos-Chek Systems at Highest Ignition Points

Phos-Chek-based emergency landscape irrigation systems have gained popularity as a means of protecting structures and landscapes in Southern California. The systems include either customized big gun nozzle and plumbing systems that face into adjacent wildland or a self-contained system that includes a water tank, plumbing, nitrogen bottles, timers, and heat/flame detectors. These systems are able to operate virtually independent of human manipulation, and therefore are considered potentially appropriate for wildland situations, such as those found on NROC. Analysis of ignitions indicates that there are documented areas where ignitions occur more frequently and therefore, have a higher potential of igniting wildfires that affect NROC. An example of a high ignition point is along the 241 freeway. The areas that include historic ignition occurrences and/or that meet criteria as having the potential for higher ignitions could be considered for placement of these systems. The recommended use of these systems is that if implementation of passive approaches, such as roadside k-rail, weed mats, or other hardening does not significantly decrease the number of ignitions over time, then placement of an emergency landscape system could be considered as an additional suppression feature. These systems are expensive to purchase and would require on-going maintenance to ensure operability. However, it may be possible to receive a discounted price or offer one or two key locations as beta test sites to the manufacturer, Firebreak Protection Systems, (http://firebreakpro.com/wildfire-protection-systems. Since roads are associated with ignitions, FMUs including adjacency with major roadways would be the highest priority for consideration of these systems. This would potentially include FMUs 5.01, 6.01, 6.02, 6.03, 6.04, 6.05, 6.06, 7.01, 7.02, 7.03, 10.01, and 10.05. Other ignition source priority areas would need to be identified before consideration of this measure in other FMUs.

1.3.3.30 Non-Combustible Walls and or Landscape Boulders

This fire protection measure is intended to place fire and heat deflection barriers where they will provide point protection for important assets. Walls are commonly used when a full width fuel modification zone is not possible on a WUI located structure. Walls must be located at the top of slope so it can take advantage of the natural flame position somewhat parallel to the slope. Boulders can provide a similar barrier and are a more natural appearing feature in wildlands. Rock outcrops naturally form the equivalent of a fuel modification area and placed boulders can mimic this type of point protection.

Currently there are no specific recommendations for use of this hazard reduction measure. However, should fuel modification zones within NROC be reduced, converted to cactus scrub, or similar, walls and/or boulders may be a good alternative means/method for meeting the intentions of the full fuel modification zone. Likewise, very sensitive biological or cultural resources may, at some point, be considered to require additional protection from wildfire. One such example could be the replanted Tecate cypress grove. Placement of boulders downslope from the grove could help prevent the type of full-consumption crown fire that occurred during the Windy Ridge Fire.

1.3.3.31 Tree Crown Raising

Crown raising is simply removing branches from the bottom of the crown of a tree to provide clearance for any of a variety of reasons including hikers (trailside trees), vehicles (maintenance or fire engines), or for increasing the distance between ground fire and the tree crown. Crown raising is commonly used within fuel modification areas as a means to protect the trees from fire laddering into the tree crown and producing intense heat, tall flames, and large quantities of embers. As an NROC valuable resource strategy, oaks, sycamores, and potentially Tecate cypress could be individually treated as part of an overall “point protection” measure aimed at reducing the likelihood that a typical fire (non wind-driven fire) would cause mortality. Note that the use of this method on Tecate Cypress would be site-dependent. Ideally, where the tree is already separated from adjacent shrub fuels, raising the crown could provide additional separation from ground fuels and prevent a crown fire. Although, this is a speculative benefit for Tecate cypress because this a species with thin bark and shrub-like growth form that characteristically burns in crown fires. This method could be particularly useful for very high value trees/stands where wildfire is not desirable for stand health and maturation purposes. In these cases, such as the dense Tecate cypress stand that was densely stocked and consumed during the Windy Ridge Fire, it may be determined that benefits from this type of crown trimming outweigh the costs, both financial and environmental.

This asset protection method is not currently recommended for NROC due to the lack of a Tecate cypress stand that would need this treatment. However, this treatment could be used wherever there are large trees that have low-branches and are susceptible to fire laddering into the crown, or need clearance for other practical purposes. FMUs where individual Tecate cypress are located include 10.04 and 12.02. Oak woodland occur in many of the FMUs, primarily those in the Central Reserve and vulnerable oaks should be considered for this relatively low impact treatment if it is determined that the treatment would provide significant likelihood of protection from fire.

1.3.3.32 Silvicultural Treatment in NROC Woodland Areas

Silviculture is the practice of controlling the establishment, growth, composition, health, and quality of forests to meet needs and values. Silviculture can include a variety of different prescriptions within a particular woodland or forest area. NROC includes primarily oak woodland and riparian woodland, and to a lesser extent Tecate cypress stands and ornamental/non-native groves/concentrations. There are a variety of methods that may be useful for reducing ignition potential, ladder fuels, and generally for reducing the likelihood that a particular woodland is significantly impacted by wildfire. Among the silvicultural methods that could be considered for use on NROC:

1. Single-tree selection - The single-tree selection method is an uneven-aged regeneration method most suitable when shade tolerant species regeneration is desired. It is typical for older and diseased trees to be removed, thus thinning the stand and allowing for younger, healthy trees to grow. Single-tree selection can be very difficult to implement in dense or sensitive stands and residual stand damage can occur. Also, wildlife habitat values of standing dead trees would need to be considered before trees were removed. However, if trees become hazardous to recreational users (located near a parking area, roadway, high use trail, etc.), the use of this method could be considered.
2. Group selection – This method could be considered for thinning projects in overstocked/dense stands, such as the former Tecate cypress stand that was consumed in the Windy Ridge Fire. The group selection method is an uneven-aged regeneration method that can be used shade-intolerant species regeneration is desired. The group selection method can still result in residual stand damage in dense stands, however directional falling can minimize the damage. Additionally, foresters can select across the range of diameter classes in the stand and maintain a mosaic of age and diameter classes.
3. Clearcutting - An even-aged regeneration method that can employ either natural or artificial regeneration. Clearcutting can be biologically appropriate with species that typically regenerate from stand replacing fires. Alternatively, clearcutting can result in the introduction of non-native and invasive species as was shown at the Blodgett Experimental Forest near Georgetown California. Additionally, clearcutting can prolong slash decomposition, expose soil to erosion, impact visual appeal of a landscape and remove essential wildlife habitat. However, despite the numerous negative associations with clear-cutting, its use could be desired at some future time should a disease or insect occur that results in mass-mortality of woodland trees and significant fire hazard or need to remove trees to lessen the likelihood of spread.
4. Shelterwood – this prescription is a regeneration method that removes trees in a series of three harvests: 1) Preparatory cut; 2) Establishment cut; and 3) Removal cut. The method's objective is to establish new tree reproduction under the shelter of the retained trees. Residual trees alter understory environmental conditions (i.e., sunlight,

temperature, and moisture) that influence tree seedling growth. This method could be useful for restoring woodland where exotics have invaded and established. For example, eucalyptus forest restoration to oak woodland or riparian woodland could be best achieved by leaving some overstory eucalyptus trees to provide shading that helps oak seedlings establish.

5. Coppicing is a regeneration method which depends on the sprouting of cut trees. Most hardwoods (oaks, willows, sycamore) naturally sprout from stumps and can be managed through coppicing. Coppicing is generally used to produce fuelwood, pulpwood, and other products dependent on small trees, but on NROC, it is possible that coppicing could be used to remove diseased or infested trees and relying on the resprouting from the stump and retained root system to quickly provide replacement trees with minimal replanting costs.
6. Thinning can reduce fuel continuity and loading by selective removal of dead and dying, overly dense, horizontal and vertical bunches and non-native plants. This type of fuel reduction is most useful in the areas around high-value resources, such as structures or biological or cultural resources. Thinning is recommended to occur on an annual basis prior to June for fuel modification areas associated with high value assets (structures biological or cultural resources, or other Plan Area identified assets to be protected). Within NROC, removal of dead and/or dying plants along with non-native species would be the typical thinning application.

1.3.3.33 Fire Adapted Communities Education Campaign

Private property owners in the interface or intermix (located adjacent to NROC or adjacent open space should be encouraged to play an active role in reducing the potential fire hazard in the region. As such, this WFMP recommends a concerted effort to reach property owners who are situated in locations that may be affected by wildfire within open space areas or whose properties and actions may serve as ignition sources. The Fire Adapted Communities Educational material can be customized for these homeowners to include discussion of the importance of managing fire in the Plan Area. Public Service Announcement information can be obtained free of charge at http://psacentral.adcouncil.org/psacentral/signon.do. Additional information is available from OCFA, the Firewise organization, / CAL FIRE (http://www.fire.ca.gov), FireSafe Councils (http://www.fire safecouncil.org) and other Web sources.

The educational campaign should include involvement in the “We Tip” program with signage indicating telephone numbers where citizens can report criminal activity, including arson. Neighborhood Watch programs also can help provide additional eyes and ears on the ground in neighborhoods surrounding NROC, potentially leading to a reduction in ignitions and associated burned acreages.

1.3.3.34 Vegetation Crushing and Mechanical Reduction

Mechanical removal includes fuel reduction with the use of equipment such as mowing, masticating, crushing, and grinding. Mechanical fuels removal is an efficient process but can be higher cost then other forms of fuel reduction. Mechanical removal may also include fellers or chainsaws, which may be necessary for control of some larger target invasive species that are currently, or may establish within the Plan Area, including, but not limited to: eucalyptus, pines, cypress, fan palms, other flammable non-native trees, pampas grass, and tamarisk. Mechanical removal may also be used to implement silvicultural treatments within native woodlands.

Mechanical removal of trees and woody plants is recommended to be combined with herbicide application. Cutting and removal of the aboveground plant material can be conducted with chainsaws and/or hand saws. The resulting material should be chipped and hauled off site. Subsequent application of herbicides should follow product guidelines for safe transport, storage, and application. Stumps remaining on site after cutting and herbicide application are not recommended for removal or grinding, but should be left to decompose in place. Certain species sprout back from the stump, so follow-uptreatments would be needed. Mowing, masticating, crushing and grinding all occur with the use of ride-on machines. They remove vegetation with cutting and/or grinding wheels or blades and may exert considerable pressure on soils and resulting need for careful timing of use.

There is no identified specific need for this fuel reduction method outside where it is already being implemented. Vegetation crushing could be used as a fuel preparation treatment for prescribed burning, where the crushing compacts the woody material into a continuous fuel bed that is readily burned with shorter flame lengths.

1.3.3.35 Grazing at Key Locations

Sheep, goats and/or cattle can be a low-impact alternative to fire and mowing. Grazing is an effective fuel reduction method that performs a dual function of reducing cover in heavily thatched grasslands. Unmanaged or improperly managed grazing can result in habitat impacts, erosion, and exotic plant establishment. Managed grazing for habitat quality improvement and fuel reduction will require the preparation of a range plan considering timing, pre-grazing preparations, grazing units, and optimal grazing, intensity, duration, and rotation. Currently, there is limited goat grazing in Laguna Beach fuel modification zones that has been approved by the California Coastal Commission, but that is not considered an appropriate means of fuel maintenance within NROC. Areas where grazing currently occurs include FMUs 1.01, 1.02, 1.03, 1.05, 2.05, 2.07, and 2.08. There is no current recommendation to expand the grazing operations within NROC. However, properly managed grazing has been shown to improve certain habitat types, augment restoration by removing competing plants, and resulting in significantly reduced fire hazard. Therefore, this hazard reduction measure remains in the toolkit should it be needed within NROC to meet habitat and fire hazard reduction objectives.

1.3.3.36 Strategically Placed Area Treatments – Biological Asset Protection

Strategically placed area treatments is the applicaton of focused and targeted measures at biological asset locations intended to reduce the damage caused by wildfire.

Although no specific locations have been identified for strategically placed area treatments currently, this tool may become valuable with changing conditions over time. Funding would be provided by land owners/land managers and through grants.

1.3.3.37 Phos-Chek System for Tecate Cypress/Sensitive Resource Concentrations

Point protection with an automated landscape system that is capable of applying Phos-Chek fire retardant to a targeted area has become more prominent in Southern California over the last several years. Initially, these systems required site-specific engineering and access to a significant water supply. A newer system is fully self-contained, uses far less water, and mixes in a fire retardant so that less water is needed to result in a fire resistant landscape. For NROC, the landscape may be a particularly sensitive biological or cultural resource. Or, the landscape may be a crucial fire spread pathway adjacent to a common ignition source (e.g., roadway). These systems include flame/heat detectors that can trigger the system automatically or they can be triggered via a cell-phone or manually. The advantage of these systems is that they do not apply Phos-Chek until it is needed. The disadvantage is that they require maintenance and are expensive. Further, there reliability over the long-term has not been tested so remains unknown. Similarly, high winds found within portions of NROC during RFW weather periods may affect overall efficiency/effectiveness of the system.

Although not currently recommended as a high priority, these systems could be used anywhere stationary sensitive, high priority resources are located. For example, FMUs 10.04 and 12.02, which include Tecate cypress are potential sites where a system could be installed in order to reduce the likelihood of fire damage and lengthen the time between burns. Funding for these systems would likely need to be targeted from private donors, FEMA grants coupled with discounts or testing models provided by the manufacturer.

1.3.3.38 Dip Tanks in Remote Locations

Dip tanks are a potential hazard reduction measure that aims to provide a reliable water source for helicopter water drops. The goal is to reduce the turn-around time between each bucket drop. Dip tanks for this type of application would typically be located at strategic locations, provided open tops, and automatic refill valves. This would require plumbing to a reliable water source, which would not be feasible on large portions of NROC. During the analysis of this measure, it was determined that there is not currently a need for dip tanks due to available water sources near both the Central and Coastal Reserves, including: (Irvine Lake, Rattlesnake Reservoir, Upper Oso Reservoir, Peter's Canyon Reservoir, Walnut Canyon Reservoir, Pacific Ocean, Back Bay, San Joaquin Reservoir, and Barbara Lake.

Should the use of strategically located dip tanks become feasible or desirable in the future (such as if an existing water source dries up or is no longer inclusive of accessible open water), then funding would need to be provided by the appropriate land owner/land manager, OCFA or other fire agency, or via grant money acquired via a FireSafe Council.

1.3.3.39 Expand Orange County FireSafe Council Program/Provide Funding for Fire Hazard Reduction Projects

The FireSafe Council is an organization that focuses on mobilizing Californians to protect their homes, communities and environments from wildfire. The organization's vision is working together, eliminating the impact of catastrophic wildfires on persons and communities. The organization was formed in 1993 and has focused on a consistent fire safety message. The Council has distributed fire prevention education materials to industry leaders and their constituents, evaluated legislation pertaining to fire safety and empowered grassroots organizations to spearhead fire safety programs. FireSafe Councils can be formed by organizations and citizens who volunteer their time to work with local fire agencies on identifying fire hazards within their communities and then organizing, funding, and carrying out hazard reduction projects. Each community that is adjacent to NROC FMUs should be represented in a FireSafe Council. The Councils provide a conduit for FEMA grants to reduce fire hazards. The typical process includes preparation of a Community Wildfire Protection Plan that identifies the highest hazard areas, as defined by the fire agency and fire experts that are members of the FireSafe Council, and priorities for reducing hazards. Once complete, the CWPP enables submittal of grant funding applications, which can fund considerable amounts of money, with in-kind matches, for hazard reduction projects. This WFMP will be used as a base for these plans and many of the recommendations herein can be tied to the CWPPs which then can be used to provide funding.

Funding the startup of FireSafe Councils is minimal. Volunteers are the backbone of these organizations. SCE indicated that they would be interested in funding FireSafe Council establishment and/or hazard reduction projects. As such, it is expected that a few to several FireSafe Councils may be needed and could be formalized with public outreach by NROC stakeholders, who should all be members of established FireSafe Councils. This measure is applicable NROC wide. It is a highly leveraged measure in that little money is needed to establish FSCs and the potential grant funding is significant. Further, citizens get involved and become more acutely aware of the fire hazard and are part of the process for determining when and how they are going to be mitigated.

1.3.3.40 Pre-Installed or Mobile Water Reservoirs

This potential fire hazard reduction measure was brought up for consideration by OCFA. Review of the technology reveals that large shipping containers are being converted to water proof reservoirs that can be fitted with an internal dry zone that houses a high volume pump. The containers are offered in two configurations and can provide up to 17,000 gallons of water for fire protection. The system would include the pre-plumbing of underground irrigation pipe (sized appropriately) and big gun nozzles. The container can be permanent below ground or can be mobile. Mobile containers are shipped to the site at the start of fire season or prior to fire. Site access would limit where these large containers could be provided. Permanent containers have roughly a 20 year lifespan. The system can be designed for remote start and is capable of thoroughly wetting a concentrated, pre-plumbed area and reducing the potential for fire spread and ember ignitions.

Although not currently recommended as a high priority, the systems could be utilized in FMUs 10.04 and 12.02 for Tecate cypress point protection. However, there are many aspects of this measure that would need to be designed, engineered, installed and maintained and there are currently no working models in the field. It is expected that working samples will be available in the coming years, and this measure can be considered for applications within NROC, as feasible.

1.3.3.41 NROC Property Fuel Modification Transferred to Laguna Beach

This measure is a result of stakeholder input that identified the ongoing situation within Laguna Beach where fuel modification area maintained by the City occurs within the current boundary of NROC. The goal of this measure would be to remove the fuel modification area from NROC so that there are no situations where annual maintenance and removal of fuels occurs within NROC borders. There would not be an advantage for reducing fire hazard. However, the result of the analysis conducted in preparation of this WFMP is that there may be areas where fuel modification extends within NROC in areas other than those where it already occurs. If so, this would tend to reduce the overall priority of this measure as it would not resolve the perceived conflict if others are created. Furthermore, if restoration of outer zones to cactus wren habitat were implemented, as discussed previously (1.3.3.17),their inclusion in NROC would be considered to be advantageous and consistent with the Reserve habitat protection goals.

If this measure were implemented, funding for the removal of the area from NROC's boundary (environmental assessments, permitting, contracts, etc.) would need to be provided. It is unclear who would be responsible for the funding, but would likely be NROC or FMU land owners/managers. FMUs where this condition may apply are:, 1.01, 1.02, 1.03,1.05, 2.05, 2.07, 2.08, and 2.09.

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2.0 HAZARD REDUCTION MEASURE RECOMMENDATIONS

The assessment results include recommended implementation of several potential hazard reduction measures in the short-term. The following lists summarize which of the previously described measures may be considered for implementation in the near term and which would be considered longer-term or not likely feasible measures.

2.1 Highest Ranked Potential Hazard Reduction Measures (2.0 – 3.0 rating)

As depicted in Appendix A-2, the Potential Hazard Reduction Measure Cost-Benefit Matrix, measures rated in the 2.0 or higher category (on a 3.0 scale) would provide considerable leverage, i.e., they tend to include lower "costs" but can provide higher benefits by directly affecting the number of fire ignitions, the elapsed time from an ignition to fire response, and ultimately, the number of acres burned. Further, these measures are deemed to be easily implemented, and/or have no or relatively low cost.

1. Restrict access during RFW – Closing access to the Reserve during extreme fire weather events and enforcing closure through a variety of means (patrols, fire watch network, etc.) would directly affect the potential for ignition sources within the reserve. Therefore, this measure is highly recommended.
2. Remote, solar powered Web Cams – although more costly than other short-term measures, positioning Web-accessible cameras with night-vision capabilities in strategic areas will positively affect early detection and reporting, especially when monitored by fire watch network volunteers and is highly recommended.
3. Construction related work (e.g., hot works) restrictions adjacent vegetation on Roadways – this measure would address a potential ignition source that was identified as currently not having any specific oversight, especially for OC Public Works. This measure is recommended.
4. Coordination with Cleveland National Forest or other Adjacent Stakeholders & Fire Agencies – the RAFT committee that would be established with implementation of this WFMP would include an outreach component so that land owners adjacent the Reserve that may undertake activities that could affect the Reserve (prescribed burning, fuel reduction, non-native plant removal, etc.) are "in the loop" and goals and concerns are shared among each of the landowners, raising overall awareness. This measure should be implemented immediately and maintained over the long-term.
5. Expand FireSafe Council program and/or provide funding for hazard reduction projects – this measure would result in increased overall risk reduction adjacent the Reserve on

private and public properties through the Community Wildfire Protection Planning process. Further, stakeholders may agree to contribute fire hazard reduction funding to implement CWPP priority projects with a reduction in off-site fires spreading to the Reserve and an increase in the regional fire awareness level. This measure is highly recommended as a potential stakeholder funding source (SCE) has been identified.

6. Expanded volunteer watch coverage supporting/expanding IRC program – this program is a relatively inexpensive program that currently has a solid baseline of volunteers, but that should be expanded following an outline already being implemented by the Irvine Ranch Conservancy. This program can be augmented by other measures (Web cams, fire detectors) to provide better Reserve coverage (area and nighttime hours) and arsonist deterrence. This is a high-leverage measure that is endorsed by numerous stakeholders.

7. Enterprise GIS interactive, user-friendly Data Access – this measure would improve the overall Reserve fire management planning, but would also improve all other aspects of Reserve management. GIS data is an important component of understanding the Reserve's various ecosystem components, and is currently housed in several databases on stakeholder servers. These data have no or very little interconnection/data sharing. Enterprise GIS would enable a broader sharing of data, organized data storage, and easy interfaces so non-GIS savvy users can access needed data. This measure is recommended and has good leverage based on the number of potential users and the shared costs.

8. Fewer restrictions on fire agency response to FMUs – as laid out in Volume I of this WFMP, providing fewer restrictions on how firefighters respond in Reserve areas where fire has occurred too frequently and the resulting damage from additional fires is considered worse than strategically placed ground disturbance associated with firefighting, is expected to result in fewer acres burned. Streamlining the process for relaying high value resource information to firefighters (such as through the Volume II mapbook and RAFT member involvement with the Incident Command) is part of this measure's focus on letting firefighters perform their job with few constraints, except where absolutely necessary (very high value resource areas). This measure is recommended.

9. Educational Fire Safety/Awareness Signage at key trail entries – this measure is a relatively low cost measure that augments existing signage, adds signs where there currently are none, and could consider adding strong language indicating that the Reserve is monitored by video, watch network, ranger patrol and neighborhood watch/We Tip (and any other means). This measure is recommended as a low-cost educational outreach program.

10. Work with utilities to reduce power line-ignited fires – this measure prioritizes, replaces and retrofits old technology, explores areas where distribution lines can be placed underground, especially where vegetation results in high ignition possibilities, replaces wood poles with steel, and increases maintenance schedule frequency in particularly

vulnerable locations. This measure is recommended for implementation and will need to include a significant coordination effort with SCE. SCE will drive the process with input and guidance from this WFMP, land managers, and stakeholders familiar with the fire issue and the location of distribution lines in their FMUs.

2.2 Moderately Ranked Potential Hazard Reduction Measures (1.0 to 1.5 rating)

As depicted in Appendix A-2, the Potential Hazard Reduction Measure Cost-Benefit Matrix, measures rated in the 1.0 to 1.5 category (on a 3.0 scale) include leverage, but also include higher costs, unproven technology, difficult implementation, reliance on stakeholder financing, may require environmental review, or are subject to other constraints that make implementation probable, but not in the immediate or short-term.

1. Fuel modification adjacent major roadways/ignition sources (91, 241, 133, 73, etc.) – fuel modification encompasses a variety of measures that remove, thin, trim, and reduce the amount of fuel in a specified area. Roadways have been identified as the primary ignition source near the Reserve. This measure is currently completed by transportation agencies on an annual basis. Its continued use is recommended as the first line of defense against vegetation ignitions.
2. Hidden Pull-out closure along major roadways – roadside pull-outs were identified by stakeholders as a source for arson related fires. The pull-outs provide concealed access to wildland fuel areas and closure would minimize the ability of an arsonist to use these convenient areas. This measure is recommended in lieu of or in combination with other mitigation measures, such as cameras, that would deter would-be arsonists. This measure will need to be thoroughly vetted by the transportation agencies as the pull-outs are often necessary for maintenance activities.
3. Prescribed burning – this measure is commonly used for managing landscapes with a goal of creating a mosaic of fuel ages. However, prescribed burning as a fuel reduction tool has been increasingly more difficult to implement, especially in open space islands like NROC. Further, recent research suggests that younger aged fuels may only function to slow the spread of fire during typical fire events as wind-driven fires often burn through younger fuels, suggesting prescribed burns are not an effective fuel reduction too. Regardless of the effectiveness, much of the Reserve has burned too frequently and the remainder occurs in areas where prescribed burning is virtually infeasible, therefore, the measure remains in the toolkit in case changing conditions occur, but is not recommended at this time.

4. Increase capability for fire response (better access, better road maintenance, wider roads; turnarounds on some dirt roads) – fire agency access within the Reserve would tend to increase the likelihood that firefighters would be sent into the Reserve during a fire and should reduce the amount of time required to get them to remote locations. However, under extreme conditions, it is not likely that firefighters would be sent into the Reserve where they could be in harm's way. Therefore, although access roads within the Reserve could use rehabilitation and maintenance, this measure is considered a second tier recommendation.
5. Private Fire Company to provide point protection (gel applications, fuel reduction) when fire approaches – this measure includes contracting with a private fire company who will be responsible for pre-applying fire retardant to high value assets when wildfire threatens to encroach. Examples may include cultural resources that could burn, sensitive biological resources, or other combustible assets. This measure is recommended for high value assets but can be expensive, provides little leverage, and relies on considerable pre-fire timelines in order to safely make fire retardant applications. Therefore, it is not considered a high-priority recommendation, but is a potential tool for any high-value, highly sensitive resources that are determined to require protection.
6. Herbicide application at locations along roadways, within Fuel Modification Zones; or for particularly aggressive invasive species – this measure is recommended as part of an ongoing program to reduce flashy fuels along roads, where most ignitions occur. This measure can be utilized at other locations, as needed and in combination with other fuel reduction measures for particularly difficult to eradicate species. This measure will be
7. Convert outer portions of wide fuel modification zones to Cactus Wren Habitat – this measure focuses on existing fuel modification zones in Laguna Beach that occur within the Reserve boundary. Some of these fuel modification zones are 200 feet wide and based on adjacent ignition resistant residences, could be considered for partial conversion to cactus scrub. The cactus scrub habitat would need to be maintained with at least 70% cactus, provided irrigation during establishment and extended drought, and maintained to function as fuel modification, but would reduce the amount of typical fuel modification within Reserve boundaries while providing habitat. This measure is recommended for further exploration with reserve land owners and managers and Laguna Beach Fire.
8. Mastication – mastication is a general term for vegetation treatments with the use of machinery that cuts, chops, and grinds vegetation, including woody materials associated with shrubs and small trees. Mastication is faster and less expensive than removing vegetation with hand tools. Impacts associated with mastication may be fewer and less significant with skid-steer mounted masticators as ground disturbance is minimal. This measure is recommended for use within the Reserve, wherever woody, non-native plants

require treatment, within fuel modification zones, where diseased or infested woody materials require removal.

9. Targeted non-native plant removal – non-native plant removal is an important component of any fuel reduction program. The Reserve includes large areas with non-native, invasive species, some of which are in areas that are prone to frequent ignitions, others in areas that will facilitate fire spread and delay natural succession back to a native, shrub dominated landscape. This measure focuses on the areas that are prone to ignitions, such as along roadways and the wildland-urban interface. Minimizing ignitions in these areas will effect internal non-native dominated landscapes by minimizing fire frequency. This measure would be implemented in conjunction with other fuel reduction measures, and generally describes a process of identifying key areas dominated by non-natives and then instituting targeted fuel reduction.

10. Roadside "hardening" – hardening roadsides refers to deployment of safe, effective methods to reduce the occurrence of ignitions along roadways, which has been identified as the primary ignition source throughout portions of the Reserve. This WFMP does not place limits on what could be employed, but focuses on currently used measures that are assumed to meet the safety and other requirements of CAL TRANS. K-rail, which is a linear, concrete barrier, is very effective at keeping sparks, heated metal, and cigarettes on the non-combustible roadways. Further, weed control mats, which are flexible, several feet wide, and are placed alongside roadways helps keep weed growth to a minimum, removing flammable fuels from the fire equation. Further, these mats are non-combustible and help detain debris from reaching flammable fuels. These measures are relatively expensive to implement, require transportation agency review and study, and may not be possible in some areas. However, this measure is considered a high priority given that it could have a major impact on fire ignition reduction and achievement of habitat protection goals.

11. Early wildfire Detection Systems – fire detection systems vary in their size, complexity, accuracy, and cost. There are systems that are being used now and that are under development, as well as heat detectors that have been used in industry settings for many years. The application considered most useful on the Reserve would be the Fire Scout x3 wildfire sensor (http://www.fire-scout.com/). These systems are not expensive by themselves, but must be connected via radio or other means so that alerts can be sent and received. San Diego Gas & Electric is in the process of deploying these detectors in the SD County backcountry.

12. Restore areas of non-native grasslands to shrubbier, less flashy fuels, especially cacti habitat – this measure fits in well with NROC and IRC plans for habitat restoration and can include any native plant community; however, focusing this type of fuel conversion

with cactus scrub, in areas near important assets, whether biological, cultural, or off-site private (such as at outer edges of fuel mod zones in Laguna Beach), would have the highest overall benefit.

13. Extending fuel mod areas (on Reserve) near vulnerable construction – As areas with vulnerable construction (older structures, wood-shake roofs, vulnerable vents, ridgetop locations with minimal fuel modification) are identified, they should be considered for additional fuel modification (possibly including reduced fuels within the Reserve, placement of walls, or other means) to provide an appropriate, and scientifically justified buffer between the Reserve and the structure. This measure would have benefits for the off-site private property and may also benefit from the additional fuel modification. Although feasible, this measure could be costly in terms of dollars and environmental impacts and would result in additional on-site fuel mod (in addition to areas in Laguna Beach).
14. Annual Phos-Chek application at highest ignition points (e.g., along roadways) – this measure includes contracting with a private fire company (or OCFA) to apply Phos-Check on the ground and vegetation at the highest ignition points. This measure differs from measure 5 in Section 2.3 in that this is a one-time application annually that would have a positive effect on vegetation ignition reduction, but a negative impact on the vegetation itself (concentrated fertilizers cause plant decline). This measure is considered to have potential use on the Reserve, especially if focused on areas where non-native plants are dominant and adjacent to known ignition sources, particularly roadways.
15. Fire Adapted Communities Education campaign – this measure would include broader outreach amongst citizens in Reserve-adjacent communities. This measure seeks to increase the overall fire awareness of the average citizen, as their actions along roads, in parks, and in the Reserve have the potential to result in ignitions. Fire adapted communities would be one component of public outreach and is expected to have positive impacts, but not at the same level as the other public education/collaboration efforts identified in Section 2.1. Therefore, it receives a slightly lower ranking and is not recommended for short-term implementation.

2.3 Currently Infeasible Potential Hazard Reduction Measures (less than 1.0)

As depicted in Appendix A-2, the Potential Hazard Reduction Measure Cost-Benefit Matrix, measures rated in the less than 1.0 category (on a 3.0 scale) were considered to provide no or very little leverage, could result in considerable resource damage, were financially infeasible, and/or were not considered vetted for Reserve application and therefore, would require testing. These measures are not considered to be unusable on the Reserve, but they are currently not recommended.

1. Fuel Break(s) – fuel breaks are utilized within the Reserve within which fuel modification zones have been grandfathered. Fuel break maintenance in these areas is expected to continue, or be altered if other measures (extending, converting to cacti scrub, reducing) are implemented. Additional fuel break locations were not identified as they are considered to be best used near the asset(s) being protected.
2. Shaded Fuel Break(s) – shaded fuel breaks are appropriate primarily for wooded areas. There were no wooded areas identified that would be appropriate for a shaded fuel break.
3. Strategically placed area treatments - fuel mod - cultural asset(s) – cultural asset data was not made available to Dudek during the preparation of this plan. Therefore, it could not be determined with any accuracy whether this treatment would be appropriate for specifically high value, vulnerable cultural resources.
4. Fire Break(s) – this measure is considered currently infeasible as there were no definitive locations identified where firebreaks could be assured of stopping wildfires from spreading, especially under extreme conditions. The potential ecological impacts were also considered too great.
5. Phos-Check systems at highest ignition points – phos-chek application systems are expensive, un-tested for this type of use, and would likely be vandalized or stolen without considerable protections. There are several other measures that are focusing on the highest ignition points (roadways) and until it is determined whether those measures are successful, this measure will not be considered a high priority. Should other measures (road side fuel mod, k-rail, weed matt) prove to have little effect on ignitions, then other measures, including phos-chek systems, may be considered.
6. Construct walls, strategically place boulders – noncombustible landscape walls have successfully affected heat intensity and fire spread, protecting structural assets from adjacent wildland fuels. Similarly, rock outcroppings and boulders naturally produce "fuel or fire breaks" that starve encroaching fire of fuels and result in modified fire behavior. Walls could be used as part of an effort to reduce fuel modification zone widths within the Reserve, providing compensation for the converted fuel modification to the fire agency(ies) satisfaction. Boulders can be used as part of a more natural appearing use of noncombustible features to create separation between high value resources and fuels, to extend existing fire breaks (roads) in key areas, etc. Currently this measure is not considered a high priority, but may become so as site conditions change.
7. Tree Crown Raising (oak woodland, riparian, tecate cypress) – tree crown raising is a preventative measure that can be utilized in native tree stands that are vulnerable to fire transition from ground fuels to crown, as a treatment within fuel modification zones, or as a temporary treatment for non-native tree populations when cost of removal is too great to implement in the short-term.

8. Silvicultural Treatment in Site Woodlands/Forest (Oak Woodlands, Riparian, Tecate Cypress) - silvicultural treatments include a wide variety of measures typically used in merchantable timber operations. These treatments have valid uses for reducing fire hazard within woodlands, protecting woodlands against crown fire, woodland habitat quality enhancement, and others. Currently, there are no woodlands identified for this type of treatment. However, any of the Reserve's woodlands could be considered for treatment, depending on overall health, fuel loading, stand density, or other conditions.
9. Vegetation Crushing and Mechanical Reduction – This measure would be used in combination with other fuel reduction measures. It is typically used as a preparation for prescribed burning. Crushing and mechanical fuel reduction lowers the fuel, changes the air to fuel mixture, and generally reduces flame lengths and fire spread. However, this type of fuel reduction is not recommended in the absence of burning or chipping as it results in dead fuel accumulations.
10. Grazing at key locations to reduce fuels – grazing within the Reserve is considered a negative fuel reduction process by many stakeholders. It is used in Laguna Beach and results in a very capable fuel modification area. It may not be consistent with Reserve goals, but grazing can be a good way to manage fuels and habitat and is considered potentially useable on the Reserve, but not recommended at this time.
11. Strategically placed area treatments/fuel modification - biological asset(s) – although there are numerous biological resources within the Reserve, there was no feedback provided by stakeholders on priority assets that should be considered for "above and beyond" protection. Further, additional study would be needed to determine the type of fuel modification (fuel break) needed, what impacts would be realized, and how effective it would be on a situation by situation basis. Therefore, this measure is considered useable, but not recommended at this time.
12. Phos-Check system near Tecate Cypress Concentrations – This measure was considered based on the loss/significant damage to the largest concentration of Tecate cypress on the Reserve during a wildfire in 2007. Noting that these systems have been successfully implemented within Laguna Beach, they could be effective for protecting Tecate cypress groves, but are expensive and untested for this type of point protection.
13. Dip tank(s) in remote locations – analysis of providing additional opportunities in remote locations for helicopter bucket filling resulted in the identification of numerous water bodies located on various adjacencies that were considered to provide good coverage. Additionally, the addition of tanks would require plumbing and a reliable water supply. Should OCFA indicate that dip tanks would be useful, then they should be re-considered.
14. Fire Max Pro - Pre-installed pipe lines and reservoir(s) for defense of high value resources – this measure was recommended as having potential for the Reserve by the

OCFA. Further research indicates that the technology has not been thoroughly tested, there are no examples of it in use in similar situations, and therefore its effectiveness cannot be confirmed. It is a potential solution to high ignition point areas or for protecting priority resources, but is considered infeasible at this time.

15. NROC Property Fuel Modification Areas transferred to Laguna Beach – although this measure would provide a cleaner, less confusing situation by removing existing Reserve fuel modification areas from the Reserve and transferring them to the City, there was no apparent stakeholder enthusiasm (based on feedback that wasn’t received). Therefore, this measure was not considered a high priority.

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APPENDIX A-2

Fire Management Unit Hazard Assessment Analysis

Appendix A-2
Fire Management Unit Hazard Assessment Analysis

Table 1.01

Type	Description
Ignition Sources	residential/accidental, electrical transmission line, power equipment, recreational users, arson, spotting
Fuel type	chaparral, sage scrub, developed, grassland
Likely fire spread pattern	following FMU terrain, fire spread is expected to spread from lower elevations up toward ridgetop homes; backing fire from upslope down is possible, but not considered as severe, windy conditions could result in erratic spread
Terrain	FMU includes steep west facing slopes and secondary drainages with steep north-south facing slopes; the FMU is an island among development
Wind alignment	on-shore flow would be more aligned with the canyons than a north wind; northeast wind could influence the FMU, but less severely than FMUs to the north
Fire Behavior	fire is expected to be aggressive in the FMU's fuels, flame lengths of 45 feet would be expected in heavier fuels, flashy fuels in disturbed areas would spread fire quickly, possible spotting into open space to east not associated with NROC
Adjacent Land Use	residential, Mission Hospital, water storage/tanks, FMU open space,
Off-site Resources	structures, infrastructure, roads, private and public property
On-site Resources	habitat, wildlife, electrical transmission line, trails, water storage reservoirs/tanks
Fuel Mod Adjacent	Fuel mod varies with some structures in northwest, west, and south considered possibly inadequate
Visibility	FMU is highly visible from multiple vantage points; ignitions would likely be spotted and reported quickly
Site Access	Access is somewhat limited to paved roadway in northern FMU (water reservoir road) and various perimeter roadways; trails within FMU are not adequate for fire engine response, roads are steep
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Improve fuel modification in northwest (Ceanothus Drive area), west (neighborhood areas near Scenic Drive and Sunset Avenue) and south portions of FMU, educate homeowners on landscaping through consistent and frequent message; fuel mod may need to encroach on NROC; at least 100 feet of fuel mod from structures is recommended

Table 1.02

Type	Description
Ignition Sources	residential/accidental, vehicular/roadways, electrical transmission line, arson, recreational users, power equipment, spotting/embers
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian
Likely fire spread pattern	Fire has not burned this FMU, spread would be up the canyon slopes, into secondary drainages toward ridgetop homes; spread during SA winds would be generally to the south, consuming all available fuels; on-shore flows could also result in fire spread into canyon from south and into adjacent FMUs
Terrain	The FMU includes its western boundary at the bottom of Wood Canyon and steep slopes to the east comprise the FMU; At the southern end of FMU, north-facing slope is extremely steep and could be location of area ignitions; small finger at northeastern portion of FMU along Alicia Pkwy is manufactured slope
Wind alignment	Canyon aligns with north/NE and on-shore winds; wind will have a significant effect on fire in Aliso and Wood Canyon
Fire Behavior	Fire behavior is expected to be extreme; wind driven fires will be fast moving and intense with flame lengths approaching 100 feet tall, intense heat, spot ignitions, and potential for "area ignitions"; multiple heads and impossible to contain
Adjacent Land Use	Laguna Niguel residential, roads, infrastructure, FMU open space, wastewater treatment plant
Off-site Resources	structures, infrastructure, habitats, trails, rec ops, treatment facility
On-site Resources	Habitats, trails, wildlife, sensitive species, cultural resources, rec ops
Fuel Mod Adjacent	Fuel modification at the interface to the east is typically less than 120 feet, long stretches it is less than 75 feet; slope percentage may accommodate this due to structure setback from top of slope; extreme southern tip of FMU includes several structures with no FMZ or defensible space
Visibility	The FMU is visible from a variety of viewpoints and fire ignition is expected to be quickly spotted and reported, reducing amount of time for response
Site Access	The western portion of the FMU is accessible off AWMA road, a paved roadway in the bottom of the canyon at the western FMU boundary; trails occur in various portions of the FMU,; trails/roadways at the top of slope in Laguna Niguel would offers access to eastern edge of FMU
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Educate homeowners of fire safety and structural protection, restrict access during RFW weather, monitoring patrols

Table 1.03

Type	Description
Ignition Sources	residential/accidental, vehicular/roadways, arson, recreational users, power equipment, spotting/embers; electrical transmission line to Coastal Treatment Plant
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian, woodland
Likely fire spread pattern	Fire has not burned this FMU except for a small portion in 1961 in the extreme northwest corner, spread would be up the canyon slopes, into secondary drainages toward ridgetop homes; spread during SA winds would be generally to the south, consuming all available fuels; on-shore flows could also result in fire spread into canyon from south and into adjacent FMUs
Terrain	The FMU includes its eastern boundary at the bottom of Wood Canyon and steep slopes to the west comprise the FMU; At the southern end of FMU, secondary canyon occurs to the west of the top of slope and before Nyes Place
Wind alignment	Canyon aligns with north/NE and on-shore winds; wind will have a significant effect on fire in Aliso & Wood Canyon
Fire Behavior	Fire behavior is expected to be extreme; wind driven fires will be fast moving and intense with flame lengths approaching 100 feet tall, intense heat, spot ignitions, and potential for "area ignitions"; multiple heads and impossible to contain
Adjacent Land Use	Laguna Beach residential, school, FMU open space, wastewater treatment plant
Off-site Resources	structures, infrastructure, habitats, trails, rec ops, treatment facility
On-site Resources	Habitats, trails, wildlife, sensitive species, cultural resources, recreation opportunities
Fuel Mod Adjacent	Fuel modification at the interface to the west varies from over 220 feet wide to significantly less and less well-defined; fuel mod at mobile home park is considered inadequate
Visibility	The FMU is visible from a variety of viewpoints and fire ignition is expected to be quickly spotted and reported, reducing amount of time for response
Site Access	The eastern portion of the FMU is accessible off AWMA road, a paved roadway in the bottom of the canyon at the eastern FMU boundary; trails occur in various portions of the FMU, but would not be suitable for fire response; paved roadway (M street and K street) enable access into secondary canyon in south
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Maintain existing fuel mod zones, focus on private property owner landscape fuel/ornamentals; in secondary canyon (M and K streets); implement minimum 100 feet wide fuel mod for mobile homes and 20 feet along roadway; education outreach with consistent message and frequent contact - many homeowners are violating principles of FMZ; restrict access during RFW weather; monitoring patrols

Table 1.04

Type	Description
Ignition Sources	vehicles/roadway, residential/urban accidental, arson, electrical transmission line
Fuel type	chaparral, sage scrub, disturbed, grassland, riparian, woodland
Likely fire spread pattern	fire spread to the south would occur rather quickly, modeling indicates ignition at 73 could reach Aliso Canyon coastal treatment plant within hours or faster with spotting; onshore winds could result in spread northward toward ridgetop communities to the east
Terrain	FMU dominated by Wood Canyon - north-south trending canyon with steep side slopes; a secondary canyon, with a more gently sloping side walls and wider bottom occurs at the southeastern portion of the FMU
Wind alignment	The FMU includes 2 canyons aligned with north, and northeast winds, respectively. Onshore winds would be funneled through Aliso Canyon into FMU from the south; erratic winds are common during SA events
Fire Behavior	Fire would be aggressive under extreme weather, no fire history has resulted in accumulated chaparral fuels that are 15 feet tall or taller, flame lengths would approach 75 feet tall, intense heat and spotting would be expected
Adjacent Land Use	FMU to the south and west; Aliso Viejo communities to the east and north
Off-site Resources	Structures, infrastructure, schools (SOKA), habitats, wildlife trails, recreational opps
On-site Resources	Habitat, wildlife, trails, rec ops, electrical transmission lines and towers, roadway (AWMA), water tanks/reservoirs
Fuel Mod Adjacent	Fuel mod present at interface with urban areas, varies in width, but generally over 85 feet to 160 feet; education on planting at structure is needed most as many homeowners are compromising FMZ function
Visibility	The FMU is visible from multiple vantage points and ridge-top homes; staff at coastal treatment plant there 5 to 7 days per week
Site Access	Access in FMU is available via AWMA/Aliso Canyon Road and on-site trails (10 feet wide), dirt and transmission line roads; most trails are not considered useable during fire event
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Invasives removal/restoration, especially in Aliso Creek; restricted access during RFW weather, educational outreach to neighbors - consistent message and frequent contact

Appendix A-2 (Continued)

Table 1.05

Type	Description
Ignition Sources	roadways/vehicles, electrical transmission lines, recreational users, residential/retail/industrial/accidental, arson, spotting/embers
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, marsh, riparian, vernal pool, woodland
Likely fire spread pattern	This FMU would include ignitions that burn up-slope toward FMU's eastern boundary and along the slope when pushed by north-winds and toward Laguna Beach; fire burning in Woods Canyon would spot into FMU and cause fire spread that depends on weather conditions
Terrain	Entire FMU is Laguna Canyon eastern sloped wall, with multiple drainages and a reverse L curve near its southern boundary; terrain is steep and rugged
Wind alignment	Laguna Canyon aligns with north winds and winds from the south/on-shore; the area includes potential for erratic wind behavior due to the many canyons in the area
Fire Behavior	Fires are expected to behave erratically, aggressively, and difficult to contain, especially with high winds; RFW conditions could result in a mega-fire
Adjacent Land Use	Immediately west of this FMU are a variety of structures including residences, schools, industrial, commercial, retail, and others; transportation corridor and FMUs along with Laguna Beach residential communities to the south; Canyon Acres residences - one way in and one way out, open space to the east
Off-site Resources	Structures, infrastructure, electrical transmission lines (LCR), habitats, trails, wildlife, recreational opps, private and public property
On-site Resources	Habitats, wildlife, trails, recreational opps, 2 water reservoirs/tanks, electrical ignition lines
Fuel Mod Adjacent	Fuel mod to the west, along urban areas is not adequate for most of the stretch of this FMU. Structure fires, hot works, children with matches, power equipment, etc. could create an ignition that would make an aggressive run up the slope toward Woods Canyon.
Visibility	The FMU is visible from within Laguna Canyon and from various vantage points; ignitions would be relatively quickly spotted and reported
Site Access	access is limited in the FMU; the only feasible access is off Alta Laguna Blvd and then via dirt W. Ridge dirt road (15 feet) wide
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Establish FMZ within FMU along interface with Laguna Canyon Road structures/properties, restrict access on RFW days, consider a minimum 10 foot and ideally a 20 foot thinning zone on either side of ridge-top road on eastern FMU boundary

Table 1.06

Type	Description
Ignition Sources	Electrical transmission line to north and east, roadways/vehicles, recreational users, spotting, arson
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	ignitions from roadways would burn upslope to top of hill, mid FMU ignitions would burn in any direction based on wind
Terrain	FMU is a hill with moderately steep slopes on all sides down to FMU boundaries
Wind alignment	On-shore winds funneled up Laguna Canyon would affect the FMU likely more than off-shore winds
Fire Behavior	Lighter fuels in FMU would result in moderate intensity fire; spread may be erratic, may burn fast through flashy fuels
Adjacent Land Use	FMU open space on 3 sides, 73 transportation corridor to north, open space (non-FMU) to east, school directly south; retail and residential north across 73
Off-site Resources	FMU habitats, infrastructure, trails, recreational opportunities
On-site Resources	Habitats, cactus scrub, wildlife, rock outcrops
Fuel Mod Adjacent	Roads have minimal buffers, Laguna Canyon Road with minimal; El Toro Road has minimal buffer
Visibility	Site is highly visible from multiple vantage points; ignitions are likely to be spotted and reported quickly
Site Access	Access is extremely limited within the FMU with no drivable roads or trails; access on the periphery of the FMU is good with major, paved roadways on all sides
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Maintain and increase buffers along El Toro Road and Laguna Canyon Road to a 20 foot wide swath, as possible; terrain limits where this is achievable; do not remove native plants, mow/treat flashy fuels

Table 2.01

Type	Description
Ignition Sources	recreationists, PCH/vehicles, residential/accidental, arson, spotting from FMU 2.05 or 2.02
Fuel type	sage scrub, developed, grassland, marine/coastal, woodland
Likely fire spread pattern	Vehicle caused fire off PCH may spread toward ocean with winds, on-shore winds typical and could push ignitions northward toward PCH but with low likelihood of ignition due to moist air off ocean
Terrain	Terrain slopes from PCH down toward ocean, steep cliffs in some areas, drainages interspersed with steeper slopes throughout, especially in northwest of FMU
Wind alignment	on-shore aligns with FMU's slopes and small drainages with heavier fuels, off-shore winds from coastal drainages could disperse across the FMU, but with lower intensity
Fire Behavior	moderately intense fire in the site's sage scrub and ornamental fuels is possible, but only when extreme Santa Ana present for a 2 to 3 day period, intense fire if residential structures involved
Adjacent Land Use	Ocean to the southwest, PCH/golf course to the northeast, residential to the northwest and urban/community to northwest in southern part of FMU
Off-site Resources	structures, private property, infrastructure, beach, golf course, habitats, schools, camping/RV
On-site Resources	parking areas, structures, trails, habitat, restoration sites
Fuel Mod Adjacent	Fuel mod is adequate throughout except some structures on Crystal Cove
Visibility	FMU is highly visible and used, ignitions would be spotted and reported quickly
Site Access	Site access is good throughout with PCH and internal roadway, parking, turnarounds throughout much of the FMU.
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Encourage transportation agencies to continue fuel mod maintenance along PCH and increase to 20 feet width, as possible; Provide on-site roads with at least 5 feet of fuel modification (narrower than major roadways), educational signage about fire safety positioned at key trail areas

Table 2.02

Type	Description
Ignition Sources	vehicles/roadways, residential/accidental, spotting from north and east, arson,
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian
Likely fire spread pattern	Extreme weather would result in rapid fire spread with moderately intense to intense fire pushed by SA winds. Onshore events could funnel fire up-canyon and into adjacent FMUs to the east.
Terrain	Three NE/SW trending canyons, steep walled, ridgetop development on portions. Very steep in northwestern portion and western portion of FMU. Wider valley in east.
Wind alignment	Directly aligned to on-shore and off-shore winds
Fire Behavior	Moderate to intense, especially with Red Flag conditions. Fire would be fast moving, erratic, and include spotting downwind
Adjacent Land Use	Residential communities, open space (FMUs), transportation corridors
Off-site Resources	Private property, structures, infrastructure, habitats, communication tower
On-site Resources	Habitat
Fuel Mod Adjacent	Fuel mod varies from 120 feet to 200+ feet and is adequate to good.
Visibility	Visibility of the western portion of the site is good; eastern areas are less visible but smoke could be seen from 73 and PCH as well as neighboring communities to the north and south.
Site Access	Access on the periphery of the FMU is good. Access throughout the FMU is limited. Seawatch Road is potential connection between midpoint of FMU. Other firebreaks/dirt roads occur in limited quality including the Pacific Ridge Trail at the FMU's eastern boundary, access points through development to wildland areas are provided and dispersed; Seawatch road is potentially good FMU tactical operation area within FMU - i.e., firing out operation
Overall Fire Hazard Priority	Moderate - substantial fuels and potential for intense fire, but homes are generally newer construction and include defensible space
Potential Hazard Reduction Measures	Fire awareness signage at key trail points

Table 2.05

Type	Description
Ignition Sources	roadway/vehicle, electrical transmission line, residential/accidental, treatment facility, adjacent FMU (spread or spotting), remote campers, arson, spotting
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	fire igniting along PCH could move into canyons and burn northward toward adjacent FMUs; fires from other FMUs to the north could be driven by terrain, fuels, and wind into this FMU
Terrain	Two primary canyons/valleys in the FMU - Moro and Muddy are primary canyons, all are northeast/north to southwest trending; steep slopes, flat bottoms
Wind alignment	Canyons are directly aligned to NE wind or off-shore wind
Fire Behavior	Fire would behave erratically and would burn with high flame lengths and intense heat through the sage scrub areas, typically upslope with potential to threaten ridgetop homes
Adjacent Land Use	Open space FMUs, residential, school, treatment facility (water/wastewater), RV site
Off-site Resources	Structures, facilities, infrastructure, habitats, trails
On-site Resources	mixed sage scrub habitats, grassland habitats, trails, wildlife, campsites, State Park Facilities
Fuel Mod Adjacent	Fuel mod to the west edge is more than adequate, fuel mod for the residences to the southeast is good
Visibility	The FMU is visible from various adjacent communities, but portions are remote and could require a large smoke column before seen; spotting and reporting of ignitions is expected to be reasonably fast
Site Access	Access is considered limited in this FMU and includes paved road into wastewater facility in southwest corner, dirt trails throughout ridges and canyon bottoms
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Maintain fuel mod/defensible space adjacent to residential community to the southeast of this FMU; maintain existing modified fuel buffers between school, RV site and wastewater treatment facility

Table 2.06

Type	Description
Ignition Sources	vehicles/roadway, electrical transmission line, residential/accidental, recreation user, arson
Fuel type	chaparral, sage scrub, grassland, riparian, woodland
Likely fire spread pattern	ignitions from the north would spread to the southwest, west along defined canyon slopes; ignitions from the south may spread northeast/north/northwest
Terrain	three prominent canyons trending northeast - southwest with narrow bottoms and steep slopes on canyon walls
Wind alignment	Canyons are directly aligned to NE off-shore or on-shore winds
Fire Behavior	fire may behave erratically and be difficult to contain in this FMU, especially with off-shore winds which will result in spotting, fast moving and intense fire
Adjacent Land Use	FMU open space occurs on 3 sides of this FMU with residential development adjacent in the extreme northwest corner and the 73 transportation corridor adjacent a small portion in the extreme north
Off-site Resources	Habitat, trails, wildlife, infrastructure, structures, infrastructure
On-site Resources	Habitat, trails, wildlife, camp sites
Fuel Mod Adjacent	Roughly 150 feet of FMZ for development west of Pacific Ridge Trail
Visibility	Much of the site is visible from adjacent community high points, smoke columns would be visible from distant communities, ignition would take several minutes to tens of minutes before spotted and reported
Site Access	Access is limited to a 10 foot wide trail on the western FMU boundary (Pacific Ridge Trail) and Bommer Ridge Road for a short segment in the north, canyon bottom road (Moro) extends through the FMU
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Patrol campsites, no camping on RFW days, no open flames, fire awareness signage and ranger outreach

Table 2.07

Type	Description
Ignition Sources	Electrical transmission line, WUI residential/accidental, homeowner power equipment, recreational users, arson
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	on-shore winds would drive ignitions northward through canyon on slopes into adjacent FMUs, off-shore, SA winds would push fire through FMU toward Laguna Beach along slopes, over ridges with multiple heads, spot fires
Terrain	one large north-south trending canyon with steep slopes dominate the FMU; smaller secondary and tertiary drainages along slopes create a series of north-facing slopes with denser vegetation
Wind alignment	Canyons are aligned to on and off shore winds; erratic wind behavior in the area may result in on-shore flows during Santa Ana wind events
Fire Behavior	Fire is expected to behave aggressively, as indicated in the 1993 Laguna Fire, fast-moving, intense, multiple heads, and high flame lengths would be expected, especially under RFW conditions
Adjacent Land Use	north- FMUs, east - FMU, West, FMU, south - Laguna Beach residential and City core beyond that
Off-site Resources	Structures, infrastructure, private and public property, habitat, trails, recreational opportunities, electrical transmission lines
On-site Resources	habitats, wildlife, trails, recreational opps, transmission lines
Fuel Mod Adjacent	Wide fuel mod (190 to 220+ feet provided on FMU, some residences with heavy ornamental vegetation (palms and others) may compromise FMZ function
Visibility	Portions of the FMU are remote and would require several to tens of minutes before fire/smoke spotted and recorded
Site Access	access is limited throughout canyon bottoms, ridge-tops include dirt road/trails including Moro Ridge Rd, Bommer Ridge Road, Emerald Bay Rd, and other transmission line roads; roads would likely not be used during fire, no turnarounds
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Re-assess FMZ's on FMU, may be wider than needed and focus should be on structures out, not reversed. Possibly utilize the outer 50 to 100 feet of FMZ for cactus wren habitat (Opuntia) habitat that functions as fuel mod.

Table 2.08

Type	Description
Ignition Sources	Electrical transmission line, WUI residential/accidental, power equipment, recreational users, arson
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	on-shore winds would drive ignitions northward through canyon on slopes into adjacent FMUs, off-shore, SA winds would push fire through FMU toward Laguna Beach along slopes, over ridges with multiple heads, spot fires
Terrain	two large north-south trending canyons with steep slopes dominate the FMU; smaller secondary and tertiary drainages along slopes create a series of north-facing slopes with denser vegetation
Wind alignment	Canyons are aligned to on and off shore winds; erratic wind behavior in the area may result in on-shore flows during Santa Ana wind events
Fire Behavior	Fire is expected to behave aggressively, as indicated in the 1993 Laguna Fire, fast-moving, intense, multiple heads, and high flame lengths would be expected, especially under RFW conditions
Adjacent Land Use	north- FMUs, east - FMU, West, FMU, south - Laguna Beach residential and City core beyond that
Off-site Resources	Structures, infrastructure, private and public property, habitat, trails, recreational opportunities, electrical transmission lines
On-site Resources	habitats, wildlife, trails, recreational opps, water reservoir/tank, transmission lines
Fuel Mod Adjacent	Wide fuel mod (190 to 220+ feet provided on FMU, some residences with heavy ornamental vegetation that may compromise FMZ function
Visibility	Portions of the FMU are remote and would requires several to tens of minutes before fire/smoke spotted and recorded
Site Access	access is limited throughout canyon bottoms, ridge-tops include dirt road/trails including Spur Ridge Rd, Water Tank Rd, Laguna Bowl Rd and other transmission line roads; roads would likely not be used during fire, no turnarounds, unsafe topography for ground attack
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Off-site fuel mod - private properties need to focus on ornamental vegetation; Allview Terrace area especially dense ornamentals and vulnerable exposures to wind driven wildfire

Table 2.09

Type	Description
Ignition Sources	Electrical transmission line, adjacent substation, roadway/vehicle, recreational users, residential-industrial/accidental, spotting
Fuel type	chaparral, sage scrub, developed, grassland, riparian
Likely fire spread pattern	fire spread would likely burn along canyon slopes creating significant embers and spotting; fire would be erratic and patchy, especially under SA winds; high on shore flows may produce similar fire spread
Terrain	Several northwest/southeast trending canyons paralleling each other with secondary drainages on each north and south facing slope. Terrain is rugged and steep throughout the FMU
Wind alignment	The northeast facing slopes throughout the FMU align with SA winds and southwest facing with on-shore flows; erratic and unpredictable winds are common in this area
Fire Behavior	fire behavior is likely to be aggressive, intense, have 45 to 70 foot flame lengths, and be significant under any conditions, but especially during SA wind fires
Adjacent Land Use	FMU open space to north and west, constrained transportation corridor to east with varying structures, residential, schools, industrial, retail, commercial, south is Laguna Beach core; Laguna Canyon Road is a critical evacuation route and is highly traveled/congested
Off-site Resources	Electrical substation, private property, structures, public property, transmission lines, infrastructure, FMU habitats, rec opportunities; high density populations including Sawdust Festival, Laguna College of Art and Design; older wood-framed structures with vulnerabilities, built under less ignition resistant fire and building codes
On-site Resources	Habitats, wildlife, trails, cultural resources; Willow Canyon visitors center
Fuel Mod Adjacent	Along Laguna Canyon road, fuel mod is minimal, but some buffer, 3 facilities on east side of LCR, all have minimal fuel mod
Visibility	Portions of the FMU are remote and could result in delayed recognition of ignition and resulting several to tens of minutes before fire spotted and reported
Site Access	access is limited within FMU - Bommer Ridge Trail forms western boundary, dirt road, narrow; other trails are not drivable; access along 133 precarious during fire
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Fuel modification along Laguna Canyon Road and around 3 facilities (substation, Laguna College of Art and Design, and transportation facility) should be created/expanded to reduce potential threats of ignition and/or structural damage - may need to encroach within NROC up to 100 feet; Laguna Canyon Road fuel buffer should be expanded to at least 20 feet on each side, as possible, stress fire safety at Nix Nature Center; restricted access on Red Flag Warning days; early fire detection system, web cams or similar automated system, focused volunteer watch expansion, as needed on RFW days; monitor 133 corridor ignitions and as necessary, consider walls and/or weed management mats to mitigate

Table 2.10

Type	Description
Ignition Sources	vehicles/roadways, electrical transmission line, recreational users, spotting
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	ignitions from the north will spread via terrain, fuels, and wind to the south, over ridge; fire may back down into the canyon from the south with on-shore flow; erratic spread may push fire along slopes either direction
Terrain	FMU consists of a steep walled canyon tending northwest - southeast; steep walled with narrow canyon bottom
Wind alignment	The FMU canyon is not directly aligned with on-shore or off-shore winds, affects would be to push fire up south slope in SA wind and into adjacent FMU
Fire Behavior	Fire may be slow moving as it creeps down the canyon slopes, or may move quickly with multiple or a wide head; during extreme weather, fire may crown in the oaks and spread linearly, creating fire brands
Adjacent Land Use	FMU is surrounded by FMU's and transportation corridors; there is no direct interface with residential
Off-site Resources	Habitat, trails, wildlife, infrastructure, electrical transmission line; toll plaza; possible wildlife corridor to north under 73
On-site Resources	Habitat, trails, wildlife, infrastructure, electrical transmission line
Fuel Mod Adjacent	73 includes 6 feet of buffer, 133 has limited roadside buffer
Visibility	FMU is visible from 73 and 133 as well as from distant communities, although ignitions could take several to tens of minutes to be spotted and reported
Site Access	Bommer Ridge Road (10 foot wide) forms the southern boundary of the FMU; Laguna Canyon Road to the east; 73 to the north; various trails within FMU
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Maintain fuel mod buffers along roadways, especially 133/Laguna Canyon Road, educate hikers, signage about fire safety; manage pull out areas with regulation-consistent gates or other access restrictions that may limit possibility of vehicle fire spread into vegetation or arson access; monitor 133 corridor ignitions and as necessary, consider walls and/or weed management mats to mitigate

Table 3.01

Type	Description
Ignition Sources	Roadways, residential / urban areas, accidental, arson, recreation
Fuel type	sage scrub, developed, disturbed, grassland, lakes/reservoirs, marine/coastal, marsh, riparian, watercourses
Likely fire spread pattern	Along slopes to south under extreme fire weather conditions
Terrain	Flat bottom canyon with moderately steep sides, short run canyon slopes
Wind alignment	Aligned with on-shore and off-shore winds
Fire Behavior	Under extreme conditions fire would move through dry brush on canyon slopes
Adjacent Land Use	Heavily urbanized with multiple urban land uses
Off-site Resources	Structures, private property, various hard assets and infrastructure
On-site Resources	Newport Bay, habitats
Fuel Mod Adjacent	Defensible space / fuel mod varies in quality and maintenance, adequate in most cases, improvements needed in others
Visibility	Very visible from adjacent communities
Site Access	Access is good at Jamboree Road and Back Bay Drive, Irvine Avenue, interior access is poor with no roads.
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	work with OCFA to encourange Off-site fuel modification improvements adjacent the eastern portion of the FMU

Table 3.02

Type	Description
Ignition Sources	Roadways, residential/urban areas, accidental, arson
Fuel type	sage scrub, developed, disturbed, grassland, lakes/reservoirs, marine/coastal, marsh, riparian, watercourses
Likely fire spread pattern	Depends on wind conditions, burn to the south away from freeway, uphill to structures
Terrain	Slopes to the south along 73 Toll Road, short run, steeper slopes up from Toll Road to residential areas
Wind alignment	No direct alignment with off-shore or on-shore winds, winds may funnel along FMU length
Fire Behavior	Disturbed site would result in patchy fire spread, moderate intensity
Adjacent Land Use	Heavily urbanized with multiple urban land uses
Off-site Resources	Structures, private property, infrastructure
On-site Resources	Habitats, reservoir
Fuel Mod Adjacent	Defensible space / fuel mod varies in quality and maintenance, adequate in most cases, improvements needed in others
Visibility	Highly visible from adjacent urban areas
Site Access	Access is limited to trails and perimeter streets including: Anteater Dr, Peltason Dr and California Ave and office parking lots and 73 transportation corridor to the East, Bonita Canyon to the south, various residential and reservoir access to the west, Bison Ave and University Dr in the mid-FMU and Jamboree Rd to the north
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Work with NBFD on their fuel reduction improvement efforts within this FMU, currently 100 feet of modified fuel area should be expanded to 170 feet from private lot top of slope, continue NBFD fuel mod annual program and inspections

Table 3.03

Type	Description
Ignition Sources	Roadway/vehicles, residential related (fire, children, accidental), arson, power equipment
Fuel type	sage scrub, developed, disturbed, grassland, marsh
Likely fire spread pattern	Fire spread would be rapid through grasslands and secondarily, scrub. Ignitions during SA conditions could move rapidly from the northern reaches of FMU to the 73 in a short time frame. On-shore winds could result in ignitions from the 73 spreading toward homes/office buildings
Terrain	Terrain is generally gently sloping. A hill in the western boundary slopes gently while a broad, gently sloped hill with a southern aspect in the southeastern FMU slopes from north to south
Wind alignment	The FMU does not include a canyon and is highly urbanized to the north, so wind would influence fire during on-shore or off-shore events and may be influence fire behavior
Fire Behavior	Fire would move rapidly through the FMU's grasslands. Scrub areas would carry rapid fire due to spacing and invasive grasses throughout. Scrub appears to be sparse and patchy in this FMU
Adjacent Land Use	Office complex, residential, retail, UC Irvine
Off-site Resources	Structures, infrastructure, private property, public property, Bonita Reservoir (south)
On-site Resources	Microwave tower (northeast), cactus scrub habitat, grassland habitat,
Fuel Mod Adjacent	Fuel mod appears adequate, especially considering the fuel types
Visibility	The site is highly visible from numerous angles; ignitions would be quickly spotted and reported.
Site Access	Access is limited to dirt roads in the central/eastern portion and only 1 dirt road through the eastern edge of the western portion of the FMU
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Maintenance of roadside fuel mod buffers - remove flashy fuels in May/June

Table 3.04

Type	Description
Ignition Sources	former land fuel, vents, electrical facility, roadways/vehicle, accidental from residential, arson, recreation, spotting
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian, watercourses, woodland
Likely fire spread pattern	Ignition off of 73 toll road or Newport Coast Drive or in adjacent FMU burning east to west driven by SA wind, up slope in south toward residential, on-shore flow may result in fire spread under 73 into adjacent FMU.
Terrain	Slopes are moderate from low in the north to high in the south; slopes down from 73 into canyon then up toward residential in south, flatter in the north near school.
Wind alignment	Open space is wide enough that winds may funnel in from the east or north, slope in the south directly aligned with NE wind,
Fire Behavior	fast moving fire in the northern half of FMU in flashy fuels, fire may gain intensity in south with scrub fuels and may become intense on slope below residential, but fuel mod is in place
Adjacent Land Use	Residential, school, transportation, urbanized
Off-site Resources	Roadways, open space/habitats, residential, urbanized areas, school (on/or off site?)
On-site Resources	School, electrical facility, transmission towers, habitats
Fuel Mod Adjacent	Fuel mod is present adjacent all residential and urban areas
Visibility	Site is visible from multiple off-site and on-site vantages, ignitions would be reported relatively quickly
Site Access	Access is good throughout FMU with paved and gravel roadways throughout and on the periphery
Overall Fire Hazard Priority	Moderate due to southern portion of FMU (fuels, terrain, off-site assets)
Potential Hazard Reduction Measures	Targeted fuel mod maintenance to continue to maintain in compliance with NBFD requirements

Table 3.05

Type	Description
Ignition Sources	Vehicles/roadways, residential/accidental, arson, power lines, trail - recreational user
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian
Likely fire spread pattern	Extreme weather may include spotting into the canyon with fire spread along slopes making runs toward ridgetop homes, typical weather may result in on-shore flows and ignition that is primarily terrain/fuel driven
Terrain	deep canyon with steep slopes; north includes steep slope toward San Joaquin Hills Rd, west includes narrow canyon, southwest; south = steep slopes ridge top homes
Wind alignment	west and east wind may funnel through the canyon
Fire Behavior	Intense wildland fire behavior would be expected in the fuels and terrain in this FMU
Adjacent Land Use	Residential, urban, recreation (golf)
Off-site Resources	structures, golf course, infrastructure
On-site Resources	Habitat, waterway/riparian
Fuel Mod Adjacent	Off-site fuel mod is to fire code for northern portion, along western slopes. Remaining structures include 100 feet of defensible space, some of which is within the Reserve.
Visibility	Canyon is highly visible, ignitions would be spotted and reported quickly
Site Access	Site access is poor, very little of the FMU includes drivable roadways, and access through dense residential in southwest is constraining
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Adjacent to Poppy Avenue and southward across canyon need to consider drastic fuel modification for adjacent residents; address possible encroachments into Reserve lands by private homeowners, possibly a full habitat restoration of the canyon in this roughly 2000 linear foot section of the Canyon; other technologies may be useable - phos-chek system with thinning/removal of exotic fuels

Table 3.06

Type	Description
Ignition Sources	Roadways, facilities, residential fire, arson, accidental, spotting, power lines
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, lakes/reservoirs, riparian
Likely fire spread pattern	ignition off Bonita Canyon Road southward, driven by SA winds / less likely - coastal wind driving fire from the south from a residential fire
Terrain	north to south, moderately steep in some areas
Wind alignment	north/south wind alignment, somewhat sheltered from direct on-shore or off-shore wind
Fire Behavior	consistent fuels in the north would create moderately intense fire while southern portion would be patchy on flanks of reservoir
Adjacent Land Use	residential, secondary and tertiary roadways, open space to north
Off-site Resources	structures, infrastructure, open space, urban areas
On-site Resources	San Joaquin Reservoir
Fuel Mod Adjacent	Defensible space/fuel mod present, questionable in a couple locations along the western portion of the FMU where no Fuel Mod Zones exist, reservoir is large fire break, eastern side of FMU includes fuel modification zones
Visibility	Highly visible, ignition would be reported quickly
Site Access	Access is good to the site and throughout the site with paved roads leading to and around reservoir and on edges of FMU, gate off of Ford Road managed by IRWD - confirm fire access capability
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Targeted fuel modification at terminus of Port Carlisle PL, Port Durness PL, reservoir facility (west of reservoir), IRWD maintain roadside vegetation on access road

Table 4.01

Type	Description
Ignition Sources	Roadway/vehicle, residential/accidental, arson, recreational user, spotting
Fuel type	chaparral, sage scrub, developed, grassland, marsh, riparian, watercourses, woodland
Likely fire spread pattern	Fire spread may be erratic, following flashy fuels along ridgetops and burning in sage scrub along slopes, especially in RFW conditions, ridges not defined enough to contain fire; FMU's eastern boundary seems arbitrary
Terrain	terrain varies from gently sloping to steep and includes a wide variety of drainages, slope aspects, and a central drainage/valley in the western portion of the FMU
Wind alignment	The primary drainages are not aligned with SA or on-shore winds, but many of the smaller drainages and canyons are in alignment; winds of any sort will impact fire behavior in the FMU as they are funneled through the terrain
Fire Behavior	Fire behavior will be erratic, fast moving through flashy fuels, moderately to highly intense in the site's denser scrub habitats, and difficult to contain under extreme weather
Adjacent Land Use	Residential, estate residential, transportation corridor, open space/fmu
Off-site Resources	Structures/private property, infrastructure, school (south)
On-site Resources	Grassland, scrub, cacti scrub, and minimal woodland/riparian habitats; park; trails
Fuel Mod Adjacent	Fuel mod is adequate for the adjacent residences and structures
Visibility	The FMU is visible from the 73 and adjacent communities, but includes some remote areas; ignition would likely be spotted fairly early and response would be facilitated
Site Access	Access is provided by Bommer Canyon Road - paved from the north, dirt to the south, other trails exist on the FMU but are limited and not useable by all engines
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Maintain fuel mod along Bommer Canyon Road at 20 feet on either side of road, as possible without impacting native species, work with Transportation agencies to implement annual flashy fuel removal along 73, educate park users

Table 4.02

Type	Description
Ignition Sources	roadway/vehicle, power equipment (golf course), residential/accidental, arson, recreational users, spotting/burning from neighboring FMU
Fuel type	chaparral, sage scrub, grassland, riparian, vernal pool
Likely fire spread pattern	Fire may spread on the vegetated slopes throughout the FMU, including erratic and unpredictable behavior fueled by grasses and shrubs and aided by terrain and wind
Terrain	Large north-south trending canyon with steep slopes in central portion of FMU, east-west trending canyons in northeastern portion of FMU, steep and rugged terrain on slopes and flat, gentler terrain in bottoms of valleys/drainages
Wind alignment	Although not directly aligned with on-shore or off-shore winds, wind alignment will affect fire behavior in this FMU; winds may be funneled through the various drainages/valleys and create eddies, unpredictable patterns
Fire Behavior	Fire behavior will be moderate to intense, depending on weather conditions and fuels burning. The sites scrub dominated areas will burn intensely while grasslands will burn less intensely but quickly
Adjacent Land Use	residential, estate residential, golf course, transportation corridor, FMU open space
Off-site Resources	Structures, infrastructure, private and public property, recreation facility
On-site Resources	Unbroken or minimally broken expanses of several habitat types, trails,
Fuel Mod Adjacent	Minimal urbanized area adjacent to the FMU and all have adequate fuel mod zones per OCFA; 73 corridor fuel mod is non-existent, if possible, provide 20 feet on north exposure
Visibility	Portions of the FMU are remote and not visible, however smoke columns would be visible by a large percentage of the surrounding area; ignitions are expected to be spotted and reported relatively quickly
Site Access	Access is limited throughout most of the FMU; dirt road trails (roughly 10 feet wide) occur along the eastern FMU boundary and along canyon bottoms
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Educate golf course to enforce fire safety by grounds crew and golfers, especially on RFW days, no greenwaste deposit over side; maintain buffers along 73 by removing flashy fuels in May/June annually

Table 4.03

Type	Description
Ignition Sources	Transmission line (east), residential/accidental, roadway/vehicle, recreational
Fuel type	agriculture, chaparral, sage scrub, developed, grassland, riparian, watercourses
Likely fire spread pattern	Fire could spread in multiple directions in this FMU, northeast winds would affect fire spread upslope in the western portion of the FMU, while the eastern portion could have the same affect from both on-shore and off-shore winds
Terrain	Terrain rises from Laguna Canyon Road to the west and from Shady Canyon Road to the east toward the mid-FMU peaks, steep but gentle slopes, incised drainages, and flatter areas throughout
Wind alignment	Wind aligns with north/east facing slopes, incides drainages; Laguna Canyon may have unpredictable winds that affect this FMU
Fire Behavior	Fire behavior will be erratic and fast moving, with spotting and jackpot flare ups.
Adjacent Land Use	residential, estate residential, open space (FMUs), transportation corridor
Off-site Resources	structures, infrastructure, private property, urbanization
On-site Resources	water tanks/reservoirs, scrub habitats, cacti habitat, grassland habitat, trails
Fuel Mod Adjacent	adequate fuel mod for all as they are newer developments
Visibility	The area is visible, but not as visible as some FMUs, ignitions would likely be spotted early, but response may be delayed
Site Access	Access is limited in this FMU to paved roads associated with two water tanks and a hiking trail that is not useable by engines, periphery areas are accessible
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Outreach to private land owners for roadside mowing no later than June to 20 feet on either side of off-site private roads to be implemented by home-owners/HOA, trails maintenance, monitor access, restrict access during extreme weather

Table 4.04

Type	Description
Ignition Sources	Vehicle/roadways, Farming equipment/operations, Golf course equipment, recreational users, arson
Fuel type	agriculture, sage scrub, developed, disturbed, grassland, lakes/reservoirs, marsh, riparian, watercourses
Likely fire spread pattern	Fire may spread in any direction on this site, terrain and winds will affect spread
Terrain	The site includes a hill in the central portion of the FMU, the hill drops off in all directions out to Shady Canyon, 405, Sand Canyon Wash and the reservoir
Wind alignment	The site is aligned such that ignitions could be affected by wind from the NE or on-shore.
Fire Behavior	Fire behavior will be a fast moving fire in flashy fuels throughout most of the FMU. Scrub patches are very light, patchy and may be threatened if severe fire occurs,
Adjacent Land Use	agriculture, golf course, and reservoir to the southwest, residential to the southeast and northeast, urbanized in all directions but directly east (FMU 4.03)
Off-site Resources	structures, private property, public property/open space, infrastructure
On-site Resources	grassland and scrub habitats, concrete reservoir/tank, trails
Fuel Mod Adjacent	Adequate fuel mod/defensible space for adjacent structures
Visibility	The site is visible from a wide viewing area and ignitions would be spotted and reported quickly
Site Access	Site vehicular access is limited to a paved road to the reservoir at the top of Quail Hill, peripheral roads provide good access on all sides
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	No significant assets identified on or adjacent, based on grassland fuels would have a manageable fire, as funding allows, restoration of non-native grassland should be considered as the FMU includes large expanses of NNG that is susceptible to fire. Restoration in this FMU will be a large undertaking and unless large areas can be converted at a time, restoration areas may be susceptible to fire from the existing non-native grasslands.

Table 4.05

Type	Description
Ignition Sources	Transmission lines along eastern edge in northeast FMU, electrical substation at eastern edge; roadways/vehicles, residential development, accidental/residence related; arson
Fuel type	chaparral, sage scrub, developed, grassland, riparian, watercourses, woodland
Likely fire spread pattern	Ignitions from the 73 could burn northward, especially with on-shore flow; ignitions along 133 could burn quickly in the flashy fuels and into the heavier fuel types up slope and to the west; fire in the steep, rugged areas would be erratic with spotting well-ahead of the fire front, which could have multiple heads
Terrain	Rugged, steep slope walled canyons/drainages in the western portion of the FMU and gentler sloping hills in the northeast; flatter in southeast
Wind alignment	Many of the drainages/valleys align with on-and off-shore wind patterns, potentially exasperating the issue
Fire Behavior	Fire behavior in the grassland dominated areas to the northeast will be fast, moderately intense fires that are easier to control; fires in the south or western portion of the FMU will be more intense, spotting
Adjacent Land Use	transportation corridor; FMU open space
Off-site Resources	FMU open space, habitat, wildlife, trails, recreation ops, transportation corridor infrastructure
On-site Resources	Valuable habitat part of large, continuous expanse; electrical transmission lines, Nix nature center (structure), reservoir/ponds, trails,
Fuel Mod Adjacent	No interface with residential development
Visibility	Most of this FMU is visible from surrounding communities, but portions are remote and would require a good smoke column before spotted and reported; as such, delays in response may be realized
Site Access	Access is limited throughout much of the FMU to dirt trails not adequate for heavy engine use; 133 provides access on the eastern FMU boundary and 73 along the south
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Transportation corridors fuel modification areas should be increased to 20 feet, where possible, for consistency with latest fire codes, as possible, along interface and may require NROC encroachment including 133/73, consider, restrict access on RFW days;

Table 4.06

Type	Description
Ignition Sources	Transmission lines through FMU, electrical substation at eastern edge (just off site); roadways/vehicles, residential development, accidental/residence related; arson
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, lakes/reservoirs, marsh, riparian, watercourses, woodland
Likely fire spread pattern	Ignitions from the 73 could burn northward, especially with on-shore flow; ignitions along 133 could burn quickly in the flashy fuels and into the heavier fuel types up slope and to the east; fire in the steep, rugged areas would be erratic with spotting well-ahead of the fire front, which could have multiple heads
Terrain	southeast near substation includes north-south trending valley with steep slopes
Wind alignment	align with on-and off-shore wind patterns, potentially exasperating the issue during fire event
Fire Behavior	Fire behavior in the grassland dominated areas to the northeast will be fast, moderately intense fires that are easier to control; fires in the south or western portion of the FMU will be more intense, spotting, and difficult to contain
Adjacent Land Use	Residential, transportation corridor, commercial
Off-site Resources	Substation, transmission lines, private property/structures, infrastructure,
On-site Resources	Valuable habitat part of large, continuous expanse; electrical transmission lines, reservoir/ponds, trails,
Fuel Mod Adjacent	Fuel mod appears adequate
Visibility	Most of this FMU is visible from surrounding communities, as such, it is expected that quick reporting would be experienced
Site Access	Access is limited throughout much of the FMU to dirt trails not adequate for heavy engine use; 133 provides access on the western FMU edge, 73 access on the southern FMU edge, and dirt trails in some areas
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Ignitions off 133 and 73 are primary concern, fuel mod along these corridors of 20 feet wide is recommended, may require encroachment into NROC

Table 5.01

Type	Description
Ignition Sources	roadways/vehicles, machinery, power equipment, arson, agriculture operations, recreational users, off-road vehicles, electrical transmission line, on-site law enforcement activities; shooting range at law enforcement facility
Fuel type	agriculture, chaparral, sage scrub, developed, disturbed, grassland, riparian, watercourses, woodland
Likely fire spread pattern	ignitions to the north in central Preserve or off SR 241 would be driven toward Irvine by north/northeast wind; ignitions in the south would tend to move toward 241 in site's fuels
Terrain	The site trends from lower elevations in the southwest to higher in the northeast; three hills occur in the middle of the FMU, terrain is moderate to gentle
Wind alignment	Site aligns with on and off shore winds, facilitating fire spread along the hill slopes and in the open, flatter areas
Fire Behavior	fire behavior would be low to moderately aggressive fire through grasses and sparse sage, spotting is possible with multiple fires on the FMU
Adjacent Land Use	Former base housing - to be residential development; retail/commercial, industrial
Off-site Resources	Structures, infrastructure, transportation corridor, water reservoir, agriculture
On-site Resources	habitats, wildlife, pond, 10 structures, roads, electrical transmission line/poles; structures
Fuel Mod Adjacent	Adequate fuel mod occurs on all sides of the FMU, future development will be required to implement appropriate fuel mod zones
Visibility	The site is visible from multiple vantage points; ignitions would be spotted quickly and reported
Site Access	The site has good access; multiple roadways, some paved, occur throughout the FMU; most limited access occurs in the northeast/east portion of FMU and in northwest.
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Coordinate with law enforcement and OCFA on proper fire protection/prevention measures at law enforcement facility interior to the site; establish a fuel modification zone to comply with OCFA for the type of structure and use; restrict any type of law enforcement training activities on RFW days, e.g., shooting

Table 6.01

Type	Description
Ignition Sources	low voltage electrical T-line (along Bee Canyon Rd); roadways/vehicle related, industrial, structure/operations (accidental), arson, spotting, fire encroachment; ag related
Fuel type	agriculture, chaparral, sage scrub, developed, disturbed, grassland, riparian, woodland
Likely fire spread pattern	Fire spread will be limited over much of the landfill, although during final reclamation native scrub will be re-established; steep slopes in the northern and western portion of the FMU will influence spread; fire spread from the landfill to the west will be slow down the steep slopes; wind and spotting would hasten spread; ignitions to the west could move rapidly up slope toward the landfill
Terrain	Terrain is rugged and steep in the north, east and west of this FMU; southern portion of FMU is steep, but includes shorter run slopes; canyons in all directional aspects are included in FMU
Wind alignment	The FMU is susceptible to fire spread influence by on-shore or off-shore winds; adjacency to large area of fuels to the east/NE and predominance of fire weather winds from that area can result in unpredictable wind patterns that affect fire spread
Fire Behavior	Fire behavior would be aggressive within the canyons and on the slopes in this FMU; current landfill areas do not represent a significant fire threat, but will upon completion of the landfill and revegetation
Adjacent Land Use	FMUs to the north, southeast, east and west; transportation corridor to the west, urban areas west of that; SW is planned development; agriculture to west
Off-site Resources	Habitats, wildlife, cultural, T-line corridor, transportation corridor, various natural resources, ag fields, reservoirs
On-site Resources	Habitats, wildlife, cultural, structures (industrial, offices), landfill, low voltage T-line; roads/trails; ag fields
Fuel Mod Adjacent	Fuel mod generally adequate for structures on the site; adjacent ag fields fuel mod adjacent windrows could be improved; roadways have minimal buffer
Visibility	FMU is visible from roadways, neighboring communities ag areas and landfill; delayed detection may occur after hours in most remote portions of FMU
Site Access	Access limited by terrain in north, available on perimeter of FMU provided along 241 to the west; Bee Canyon Access Rd to landfill in the mid FMU; landfill roads to east and north; Old Bee Canyon Rd and ag roads in south
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access - off-road vehicles, restrict access to undisturbed FMU areas on RFW days, restrict activities on landfill on RFW days, expand watch program in this area; clearance on T-line and poles/replace wood poles with non-combustible materials.

Table 6.02

Type	Description
Ignition Sources	Roadways/vehicle related, landscape/recycling center/operations (accidental), arson, spotting, fire encroachment; landfill related
Fuel type	agriculture, chaparral, sage scrub, grassland, riparian, woodland
Likely fire spread pattern	fire spread in this FMU will be strongly terrain influenced; wind will also impact fire spread with strong uphill runs possible with onshore flow and sideslope runs down canyon toward 241 transportation corridor to the south
Terrain	terrain is steep and rugged throughout most of the FMU; dominated by a large, wide canyon bottom adjacent the western boundary extending from 241 in the south to the northern FMU boundary; 2 primary ridgelines above a canyon also occur in the southwest corner below Bowerman landfill; from the large canyon, slopes rise steeply to the northeast with numerous secondary drainages on the west-facing slopes; the terrain levels somewhat on the ridgeline near the FMU boundary
Wind alignment	FMU canyons and slopes align with direct SA winds that are pushed over and down the slopes and into the canyons; onshore flows may push fire upslope toward easterly FMUs; wind affects fire spread in this region and in this FMU
Fire Behavior	Fire behavior would be aggressive within the canyons and on the slopes in this FMU; small fires can get out of control quickly
Adjacent Land Use	FMUs to the north, east and west; agricultural areas (planned development long-term) occur to the south across 241; transportation corridor to the south, landfill to the north
Off-site Resources	Habitats, wildlife, cultural, T-line landfill, agricultural, transportation corridor, various natural resources, residential (southwest), rec opps
On-site Resources	Habitats, wildlife, natural resources, cultural, roads/trails, rec opps, structures, water tanks (facility/storage yard at south boundary)
Fuel Mod Adjacent	Fuel mod generally adequate for facility to the south; no other structures; roadside fuel mod minimal
Visibility	FMU is visible from roadways to south and landfill to northwest; some portions of FMU are remote and delayed detection may occur if after hours ignition occurs
Site Access	Access is limited in the FMU; Loma Ridge Rd provides access on the northern/NE boundary, landfill roads to the west; trails on south; eastern boundary is not on a roadway
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access - vehicle uses, restrict access to undisturbed FMU areas on RFW days, expand fire watch program; fire detection system technology up on ridge

Appendix A-2 (Continued)

Table 6.03

Type	Description
Ignition Sources	Roadways/vehicles, spotting, wildfire encroachment, adjacent T-lines (Santiago Canyon Road) high voltage east, agriculture operations off-site, recreational users, arson
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	Fire spread would likely occur from east to west or north to south pushed by Santa Ana off-shore winds; terrain on site would influence spread, funneling winds through canyons and up perpendicular slopes, spotting and creating fast moving fire
Terrain	Major topographical feature within this FMU is Limestone Canyon which extends from north to south, a branching canyon from east to nearly the western border in the central portion of the FMU; ridgelines associated with these canyons are steep sloped and well-defined, canyon bottoms are wide; secondary drainages occur east-west along main ridge slopes; terrain is rugged, but less so than FMUs and National Forest lands to the east
Wind alignment	northeast winds can be funneled into the north-south and east-west canyons; north winds can blow through adjacent Santiago Canyon with great force; onshore flows would be milder; Santa Ana type winds have significant effects on fire in this FMU
Fire Behavior	Fire behavior can be intense, aggressive, and unpredictable with 50+ foot flame lengths, spotting fires ahead of the main front, intense heat
Adjacent Land Use	FMUs on all sides; Santiago Canyon Road to the north; Santiago Creek to the east; landfill (Bowerman) to the west
Off-site Resources	habitats, wildlife, natural resources, cultural, recreational opps, road/infrastructure, transmission lines, agriculture areas, FMUs, landfill, reservoirs, electrical Transmission-lines; communities
On-site Resources	wildlife, natural resources, cultural, road, agriculture areas, reservoirs, electrical T-lines, recreational opps
Fuel Mod Adjacent	No structures adjacent; fuel buffer along Santiago Canyon Roads is minimal
Visibility	Portions of FMU are visible from roadways, while most of the FMU is remote and would have potential to cause delayed observation and reporting of ignitions
Site Access	Access is limited in portions of the FMU, especially the central and western; Santiago Canyon Road to the north boundary, Limestone Canyon Road on the eastern portion and northern portion of FMU (not boundary), Loma Ridge Road and Jeep trail on southern boundary,
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Consider early warning fire detection systems, education of hikers/visitors on fire prevention and safety, expansion of fire watch program on RFW days/Web cam monitoring, access restrictions on Red Flag Warning, vehicle user restrictions; provide annual key road maintenance (Limestone, Shady Oaks, Dripping Springs) to include light grading/repair of ruts without grading the road down and creating berms on either side.

Table 6.04

Type	Description
Ignition Sources	roadways/vehicles, rural residential/accidental, electrical transmission line, spotting, wildfire encroachment
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian, watercourses, woodland
Likely fire spread pattern	ignitions off of Santiago Canyon Road would likely spread into east-west canyons into interior of FMU where they could burn into interior of Central Preserve; ignitions interior would burn erratically due to varied terrain and likely unpredictable wind patterns
Terrain	The northern portion of the FMU is the eastern slope of north-south ridgeline and widened wash channel along Santiago Canyon Rd; several east-west trending canyons comprise the central and southern portion of the FMU with steep slopes, sparsely vegetated south-facing slopes, rugged terrain characterizes this FMU
Wind alignment	northeast winds can be funneled into the east-west canyons; north winds can blow through Santiago Canyon with great force; onshore flows would be milder; SA type winds have significant effects on fire in this FMU
Fire Behavior	Fire behavior is intense, aggressive, and unpredictable with 50+ foot flame lengths, and intense heat
Adjacent Land Use	transportation corridor, FMUs, School, rural residential
Off-site Resources	few structures, road/infrastructure, transmission lines, agriculture areas, FMUs
On-site Resources	electrical transmission lines, habitats, wildlife, rocky wash, ponds
Fuel Mod Adjacent	Fuel mod varies for structures, but generally seems adequate
Visibility	Portions of FMU are visible while portions are remote and would cause delayed observation and reporting of ignitions
Site Access	Access is limited to perimeter roads with Loma Ridge Rd to the northwest; Limestone Canyon Rd to the southwest; 241 and agricultural roads to the south/SW; residential roads and trails to the southeast
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams or fire detection technology in remote areas; knox padlocks are provided on gates for fire access

Table 6.05

Type	Description
Ignition Sources	roadways/vehicles, residential / accidental, ag operations, recreational user, spotting, wildfire encroachment
Fuel type	agriculture, chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	fire spread is likely within and on the slopes of Limestone Canyon; fire spread may be erratic, patchy, or consuming all vegetation, depending on weather and wind; on-shore flows can push fire up the canyon while SA winds can push fire down the canyon
Terrain	The dominant topological feature in this FMU is Limestone Canyon which extends from the southern boundary to the northern boundary; the canyon includes steep, unvegetated limestone walls in its upper reaches and scrub and grass covered slopes for the majority; terrain is moderately steep to steep with a pronounced canyon bottom/wash
Wind alignment	northeast winds can be funneled into the northeast-southwest canyons; north winds can blow through Santiago Canyon with great force and feed into the side canyons; onshore flows would be milder; SA type winds have significant effects on fire in this FMU
Fire Behavior	Fire behavior is likely to be intense, aggressive, and unpredictable with 50+ foot flame lengths, and intense heat along with ember/fire brands for downwind communities
Adjacent Land Use	FMUs surround this FMU except in the southeast and extreme southwest corners; transportation corridor
Off-site Resources	Structures and infrastructure, habitats, wildlife, cultural and natural resources, transportation corridor
On-site Resources	natural and cultural resources: habitats, wildlife, recreational opps, limestone canyons, orchard
Fuel Mod Adjacent	Fuel mod varies for structures, but generally seems adequate
Visibility	Portions of FMU are visible while portions are remote and would cause delayed observation and reporting of ignitions
Site Access	Access is limited to transmission line roads including Adkins Rd, Spur Rds, Hangman's Tree Rd, Limestone Ridge, Rd, Bolero Lookout Rd, Pr Rd; Santiago Canyon Road along eastern FMU boundary
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or early warning fire detection in remote areas; maintain fuel mod at community in southeast

Table 6.06

Type	Description
Ignition Sources	roads/vehicles, arson, electrical transmission lines, spotting from neighboring FMUs
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, lakes/reservoirs, riparian, woodland
Likely fire spread pattern	Fire spread would follow terrain with slopes resulting in faster spread, spotting would result in multiple fires; spread could be southward along canyon slopes or northward, depending on wind
Terrain	Terrain is rugged, steep, and is comprised of a ridge that forms the northern boundary and three north-south trending canyons with steep side walls and narrow bottoms, the southeastern portion of the FMU is a large canyon also with steep side walls that peaks to the east before downward slope to Santiago Canyon Road
Wind alignment	winds from the northeast and north would fan fires southward toward residential developments, winds from the south or on-shore would push fire with terrain northward toward adjacent FMUs
Fire Behavior	Fire behavior is expected to be aggressive, primarily following drainages and slopes, depending on wind conditions; flame lengths may reach 50 feet or higher and heat would be intense in heavier scrub fuels
Adjacent Land Use	rural residential, minor track residential interface, transportation corridor, FMUs
Off-site Resources	structures (limited), roads, electrical transmission lines, infrastructure, adjacent FMUs
On-site Resources	Habitats, trails, wildlife, ponds, reservoir/tanks, equestrian facility, electrical transmission line,
Fuel Mod Adjacent	Fuel modification varies from apparently inadequate (equestrian facility), to good, single residential off Bolera Lookout Rd (north FMU) boundary.
Visibility	Portions of the FMU are remote and ignitions may take several to tens of minutes to be observed and reported; potential response delays
Site Access	Access is provided by dirt road along FMU boundary and trails within large canyon bottoms, access is limited in some areas and fuels grow up to dirt roadways
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or early warning flame/heat detection system in remote areas; consider working with equestrian facility owner to expand/create fuel modification under oak trees and within 100 feet of exposed structures

Table 6.07

Type	Description
Ignition Sources	residential/accidental, electrical transmission line, roadways/vehicle, recreational user, arson, spotting
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian, woodland
Likely fire spread pattern	Fire spread would likely burn erratically throughout the FMU, dependent on weather conditions; ignition in the north would burn southward in the FMU canyons and along slopes toward Glenn Ranch Rd; ignitions in the south may burn northward into the FMU driven by terrain and on-shore wind; Santiago Fire burned into this FMU and behaved erratically
Terrain	Terrain is rugged, steep, and includes one large canyon that extends from the northeast to the south west of the FMU; eastern slopes of this canyon are northwest facing and lead up to residential development; west slopes lead up to a large hill that dominates the central portion of the FMU; portions of 3 additional canyons occur to the west of the hill, all with steep side slopes
Wind alignment	The largest canyon aligns with northeast winds, the remaining canyons align with north winds
Fire Behavior	fire behavior is expected to be aggressive with 50 + foot flame lengths , spotting, multiple fires, and unpredictable spread under windy conditions
Adjacent Land Use	residential (existing and future), park, commercial/industrial, transportation corridor, FMUs
Off-site Resources	structures, infrastructure, FMU habitats
On-site Resources	Habitats, wildlife, ponds, trails, transmission lines, water tank/reservoir(s)
Fuel Mod Adjacent	Fuel mod adjacent the FMU appears adequate with a couple exceptions along southeast
Visibility	This FMU is visible from several vantage points, but includes areas that are semi-remote and ignition observation may be delayed several to tens of minutes
Site Access	Access is limited to trails (hiking on Whiting Ranch) and dirt roads, although there are several ridgetop roads that may provide access for firefighting purposes
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Educate homeowners and recreational users on fire safety and reporting, restrict access on RFW days, consider webcams and/or early warning fire detection system in remote areas; existing fuel mod areas functioned well in Santiago Fire; focus on ladder fuel removal under oak woodlands (shaded fuel break), educate homeowners on appropriate ornamental landscape

Table 6.08

Type	Description
Ignition Sources	electrical transmission lines, roadways/vehicles, recreational users, arson, substation, residential/accidental, spotting
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian, woodland
Likely fire spread pattern	ignitions in the northeast would burn upslope and along slope to the south, especially with north/northeast winds; on-shore winds would have less impact, but would push ignitions upslope in the southern portion of the FMU and along the slope in the south and east
Terrain	The FMU includes Aliso Creek in its low point (south and east) with slopes rising toward the northern portion of the FMU; two prominent canyons extend from north to south in the FMU with a broad hill between; terrain is gentle to moderately sloped on the western 2/3 and more rugged in the eastern 1/3
Wind alignment	The FMU slopes and Aliso Creek are aligned with on and off shore winds while the canyons are not directly aligned.
Fire Behavior	Fire behavior modeling indicates that fuels in this FMU will produce 40+ foot flame lengths in the scrub fuels, less than 20 in the grasses, depending on winds
Adjacent Land Use	Residential, transportation corridors, industrial, electrical substation, schools, rural, adjacent FMU, open space associated with southern NCCP
Off-site Resources	Structures, roads and infrastructure, substation, habitat
On-site Resources	Habitat, electrical transmission line, trails, wildlife
Fuel Mod Adjacent	Fuel mod is adequate on current adjacency; future development next to this FMU will include 100 to 150 feet of fuel mod
Visibility	The site is visible in a populated area and ignitions would be spotted quickly and reported
Site Access	Access is limited to transmission line road/trail, Edison Trail, Aliso Creek Bikeway, El Toro Rd to east/south and 241 to south, Glenn Ranch Road to north
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	restoration of non-native habitats, especially to cactus scrub to augment development related cactus scrub creation (proposed); Aliso Creek restoration to natives, removal of invasives;

Table 7.01

Type	Description
Ignition Sources	low voltage electrical T-line (north); roadways/vehicle related, recreational related, ag structure/operations (accidental), arson, spotting, fire encroachment
Fuel type	agriculture, chaparral, sage scrub, developed, disturbed, grassland, riparian, woodland
Likely fire spread pattern	Fire spread could occur throughout the FMU in the flashy fuels which dominate agricultural related fires from the south/west may burn upslope toward the 241; ignitions off the 241 may burn toward Orchard Hills/agriculture areas with SA wind conditions
Terrain	Terrain is considered moderately steep in the western portion of the FMU; the eastern portion and northern portions are gentle sloping; steep fill slopes below 241
Wind alignment	The FMU is susceptible to fire spread influence by on-shore or off-shore winds; canyons are generally aligned with on-shore and off-shore or true SA winds
Fire Behavior	Fire behavior would be predominantly flashy fuel driven on moderate to gentle slopes in the north; more rugged terrain in the western and southern portions of the FMU could result in more erratic fire and encroachment into the agricultural areas
Adjacent Land Use	Roadways eastern and northwestern boundaries; agriculture and residential development to west, FMUs south and east, schools to west beyond ag areas and housing
Off-site Resources	Habitats, wildlife, cultural, T-line corridor, various natural resources, ag fields, schools (west)
On-site Resources	Habitats, wildlife, cultural, recreational opps, structures (agricultural and "other" - emergency operations center), low voltage T-line (N/NE); roads/trails; ag fields
Fuel Mod Adjacent	Fuel mod generally adequate for structures on the site; adjacent ag fields fuel mod adjacent windrows could be improved; roadways have minimal buffer
Visibility	FMU is visible from roadways and neighboring communities; delayed detection may occur after hours
Site Access	Access on perimeter of FMU provided along 261 toll road (north/west), 241 (east); gated access up Loma Ridge Jeep Trail to structure; agricultural roads provide access to western boundary
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access - off-road vehicles, laborer "lunch fires", restrict access to FMU on RFW days, expand fire watch program; early warning fire detection technology; maintain clearance on T-line and poles and along roadway (20 feet either side) to Emergency Operations Center

Table 7.02

Type	Description
Ignition Sources	low voltage electrical T-line (several throughout); roadways/vehicle related, recreational related, batch facility - heavy trucks; gravel, industrial, ag structure/operations (accidental), arson, spotting, fire encroachment
Fuel type	agriculture, sage scrub, developed, disturbed, grassland, lakes/reservoirs, riparian, vernal pool
Likely fire spread pattern	Fire spread in the flashy fuels in the southern portion of the FMU on gentle slopes would burn quickly and could go in all directions; fire in the scrub areas would be associated with Rattlesnake Canyon slopes which are steeper; fire spread toward urban areas to the southwest would occur with SA winds; ag areas would not spread fire as readily
Terrain	Terrain varies from semi-rugged in the north to gentle in the south of this FMU; 2 primary canyons run through this FMU and trend northeast - southwest
Wind alignment	The FMU is susceptible to fire spread influence by on-shore or off-shore winds; canyons are generally aligned with on-shore and off-shore or true SA winds
Fire Behavior	Fire behavior would be predominantly flashy fuel driven on moderate to gentle slopes in the south; more rugged terrain in the northern portions of the FMU could result in more erratic fire and encroachment into the agricultural areas in the central portion and to the west
Adjacent Land Use	Ag, reservoir and roadway to west; FMU to south; transportation corridor and FMU to east; ag and FMU to north
Off-site Resources	Habitats, wildlife, cultural, T-line corridor, transportation corridor, various natural resources, ag fields, reservoirs
On-site Resources	Habitats, wildlife, cultural, structures (industrial, offices), low voltage T-line (throughout); roads/trails; ag fields
Fuel Mod Adjacent	Fuel mod generally adequate for structures on the site; adjacent ag fields fuel mod adjacent windrows could be improved; roadways have minimal buffer
Visibility	FMU is visible from roadways, neighboring communities and ag areas; delayed detection may occur after hours
Site Access	Access on perimeter of FMU provided along ag roads to north; 241 to the east; Bee Canyon Access Rd to south; ag roads to west; Rattlesnake Rd and Jeffrey Rd in interior canyons
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access - off-road vehicles, laborer "lunch fires", restrict access to FMU on RFW days, fuel mod along heavy equipment parking areas at facilities; fire watch program; early warning fire detection technology; clearance on T-line and poles

Table 7.03

Type	Description
Ignition Sources	low voltage electrical T-line (NE corner, along 133); roadways/vehicle related, (accidental), arson, spotting, fire encroachment
Fuel type	agriculture, sage scrub, developed, disturbed, grassland, lakes/reservoirs, marsh
Likely fire spread pattern	Fire spread may occur in any direction throughout FMU with no strong terrain or fuel differences to heavily influence spread; ignitions off of adjacent roadways or from spotting may burn throughout the FMU depending largely on wind
Terrain	Terrain is gently sloped to moderately sloped with one central, northeast - southwest drainage (including the reservoir); slopes to the southeast and northwest are gentle toward adjacent roadways
Wind alignment	The FMU is susceptible to fire spread influence by on-shore or off-shore winds; canyons are generally aligned with on-shore and off-shore or true SA winds
Fire Behavior	Fire behavior would be predominantly flashy fuel driven on moderate to gentle slopes throughout the FMU.
Adjacent Land Use	FMUs to the northeast and east; residential development to the west, east/SE, ag to south (planned development area), industrial and ag to the north/NW; entire FMU is bounded by transportation corridors/roadways
Off-site Resources	structures, infrastructure, agricultural resources, natural resources, industrial facilities, transportation corridors
On-site Resources	Reservoir, habitats, wildlife, low voltage T-line; roads/trails
Fuel Mod Adjacent	Fuel mod generally adequate for structures adjacent the site; roadway buffers are minimal but considered standard
Visibility	FMU is visible from roadways, neighboring communities and ag areas; delayed detection may occur after hours
Site Access	Access on perimeter of FMU provided along Bee Canyon Access Rd and Portola Parkway to south/SW; 133 Transp Corridor on SE/East, Bee Canyon Access Rd to north; dirt roads throughout the FMU related to reservoir maintenance
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Monitor access - off-road vehicles, restrict access to FMU on RFW days, clearance on T-line and poles

Table 8.01

Type	Description
Ignition Sources	residential/accidental, roadway/vehicle, electrical transmission line, recreational user, arson, mntnce operations, spotting
Fuel type	sage scrub, developed, disturbed, grassland, lakes/reservoirs, riparian
Likely fire spread pattern	Fire spread would be highly dependent on wind since the terrain is relatively flat in the north; ignition off Jamboree Rd may spread into the FMU, especially with wind; similar for ignitions from adjacent residential; ignitions in the southern portion of this FMU could crown and spread linearly along the FMU
Terrain	relatively flat terrain with small slope down to Jamboree Rd, small valleys and central low spot with reservoir; terrain slopes up, away from adjacent residential in the southern linear portion of the FMU
Wind alignment	Northeast wind aligns with the southern hillside and drainage, wind would affect the FMU, especially in the drainage
Fire Behavior	fire behavior varies by location within FMU; denser fuels could produce very tall flame lengths and intense heat; grasses in northern and western FMU locations would produce fast moving, but lower intensity fires; fire in eucalyptus/palm drainage area could crown and produce 100+ foot flame lengths and ember showers
Adjacent Land Use	Residential, FMU, non-FMU open space, transportation corridor
Off-site Resources	structures, urban development, open space habitats, trails
On-site Resources	Reservoir, electrical transmission line, structure, trails, access road, habitat
Fuel Mod Adjacent	Fuel mod generally is ok, private property landscaping to the south and west in Cowan Heights is an issue, but is being addressed by OCFA
Visibility	Site is highly visible, ignitions would be observed and reported quickly
Site Access	Access is limited to a dirt access road to viewing point, trails occur on periphery of reservoir; dirt roadway along southern stretch and around lower Peter's canyons
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Work with OCFA and homeowners on continued landscaping/defensible space messages and implementation of OCFA approved Fuel Mod Zones; fuel reduction by habitat restoration within drainage, removal of exotic trees

Table 8.02

Type	Description
Ignition Sources	residential/accidental, roadway/vehicle, electrical transmission line, recreational user, arson, spotting
Fuel type	sage scrub, developed, disturbed, grassland
Likely fire spread pattern	Fire spread would be highly dependent on wind; most of the ignition sources are on the upslope portion so backing fire down slope may occur, with wind, spotting and faster fire spread; crown fire in the eucalyptus forest would result in erratic fire spread with spotting
Terrain	FMU is a west-facing slope that runs parallel to FMU 8.01; terrain includes various small drainages/canyons that trend east west along the main slope
Wind alignment	Northeast wind aligns with the hillside and drainage, wind would affect the FMU, especially in the drainage
Fire Behavior	fire behavior varies by location within FMU; denser fuels could produce very tall flame lengths and intense heat; grasses in northern FMU locations would produce fast moving, but lower intensity fires; fire in eucalyptus woodland area could crown and produce 100+ foot flame lengths and ember showers
Adjacent Land Use	Residential, FMU, non-FMU open space, transportation corridor
Off-site Resources	structures, urban development, open space habitats, trails
On-site Resources	electrical transmission line, structure, trails, access road, habitat
Fuel Mod Adjacent	Fuel mod generally is ok, private property landscaping to the east is good
Visibility	Site is highly visible, ignitions would be observed and reported quickly
Site Access	Access is good and provided via dirt access roads at top of ridge and near bottom of slope around Lower Peter's Canyon Reservoir
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Work with OCFA and homeowners on continued landscaping/defensible space messages; fuel reduction by habitat restoration: removal of exotic trees (OCFA and OC Parks have removed eucalyptus trees south of the upper reservoir)

Table 9.01

Type	Description
Ignition Sources	Urban sources, residential/accidental, arson, electrical transmission line, substation, spotting, school - student smoking
Fuel type	sage scrub, developed, disturbed, grassland
Likely fire spread pattern	fire would spread up the slopes with terrain as primary fire spread driver, winds could facilitate faster spread, either on or off shore
Terrain	The FMU is comprised of two prominent hills with steep slopes to the east west, north and south, the terrain is not rugged, but is steep
Wind alignment	SA winds could facilitate spread up slope from the east side of the FMU which would blow embers into adjacent community
Fire Behavior	fire behavior would be moderately aggressive with flame lengths 25 feet and taller in scrub fuels, relatively fast moving, and moderate heat intensity
Adjacent Land Use	urban, school, residential, roads/infrastructure, non-FMU open space
Off-site Resources	structures, roads/infrastructure, water reservoir/tank, urban forest
On-site Resources	habitats, wildlife, substation electrical transmission line, trails
Fuel Mod Adjacent	Fuel mod is generally acceptable with some areas that could use more significant fuel mod
Visibility	The FMU is highly visible and ignitions would be observed and reported in a fast timeframe
Site Access	Access is limited to trails that are not drivable. A paved road provides access to a substation in the northwestern portion of the FMU, N. Cannon St provides access along the eastern FMU boundary, residential roads provide limited access to western, southern, and northern boundaries
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Focus education and coordination at school to prevent student ignitions (include education, cameras, signage indicating no trespassing/no smoking, school is responsible for ignitions from students - possibly fire suppression costs); Homeowner education on fuel mod is necessary based apparent understanding of fuel mod zones (some with bare dirt, some with no FMZ; recommend that consistent fuel mod is provided for structures on periphery and done to fuel mod standards; continue maintenance of FMZ to the east of school; fuel mod between water tank road and private property under ornamental trees to augment protection – adjacent to NROC property

Table 10.01

Type	Description
Ignition Sources	low voltage electrical T-line (N/NE); roadways/vehicle related, recreational related, ag structure/operations (accidental), arson, spotting, fire encroachment
Fuel type	agriculture, chaparral, sage scrub, developed, grassland, riparian, vernal pool, watercourses, woodland
Likely fire spread pattern	Fire spread could occur throughout the FMU in the flashy fuels which dominate the western 1/2 and the southern 1/2; scrub fuels in the northeast may burn within the many shallow canyons
Terrain	Terrain is considered gentle to moderately sloping with the most rugged terrain in the northeast portion of FMU; The FMU slopes steeply up from the 241
Wind alignment	The FMU is susceptible to fire spread influence by on-shore or off-shore winds; primary canyon that extends through this FMU is aligned to SA winds; adjacent FMUs with rugged terrain can create unpredictable wind patterns in this FMU
Fire Behavior	Fire behavior would be predominantly flashy fuel driven on moderate to gentle slopes; more rugged terrain in the northeastern portion of the FMU could result in more erratic fire
Adjacent Land Use	Roadways all sides, marina/reservoir to north; FMUs on all sides; landfill south
Off-site Resources	Habitats, wildlife, cultural, T-line corridor, various natural resources, school (south)
On-site Resources	Habitats, wildlife, cultural, recreational opps, structures (barn and ag bldg), low voltage T-line (N/NE); roads/trails
Fuel Mod Adjacent	One structure with adequate fuel mod, no other structures; roadways have minimal buffer
Visibility	FMU is visible from roadways and distant western communities; delayed detection may occur after hours
Site Access	Access on perimeter of FMU provided along E. Santiago Canyon Rd (north/east), E. Trans Corridor - 241 (south/west), Jeffrey Rd (south/east), and Loma Ridge Jeep Trail (central FMU)
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access - off-road vehicles (maintain gates), restrict access to trails on RFW days, watch program; early warning fire detection technology; maintain clearance on T-line and poles

Table 10.02

Type	Description
Ignition Sources	electrical transmission line; roadways/vehicle related, recreational/boating/lake related, 1 residence at dam (accidental), arson, spotting, fire encroachment; lightning
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, lakes/reservoirs, riparian, watercourses, woodland
Likely fire spread pattern	Fire spread woud likely occur within from the east to the west in front of SA winds; fire in the southern and western portion of the FMU would spread quickly in the flashy fuels; fire in the canyons to the north of the FMU would move erratically with spotting likely
Terrain	Terrain is rugged and steep in the north; canyons trend northeast - southwest; Santiago Creek in the south is a dominant feature of low fuel volume; less rugged terrain in southern FMU includes less topo relief
Wind alignment	The primary canyon that extends through this FMU is aligned to SA winds; rugged terrain and steep canyons will affect wind patterns and fire spread in this FMU
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible in the north and possibly the south; around the reservoir, fire would be fast moving grass fires
Adjacent Land Use	Santiago Canyon Road to south/west, non-reserve open space north/west, FMU's to N, E, S
Off-site Resources	Habitats, wildlife, cultural, T-line corridor, various natural resources, school (south)
On-site Resources	Habitats, wildlife, cultural, T-line (extreme northeast), marina/reservoir, recreational opps, Coulter pines (north of lake), structures (home and rec bldgs), roads/trails, agriculture
Fuel Mod Adjacent	Fuel mod appears adequate for adjacent uses
Visibility	FMU is visible from roadways and distant western communities; portions of FMUs are remote and may result in delayed ignition detection
Site Access	Access on perimeter of FMU along Lake View SCE Rd (north); State Spur Rd and Black Star Canyon Rd and Red Rock Ridge Road (east); dam facility rd (west); east Santiago Canyon Rd (south); some access internally in FMU on Red Spur, Haul Rds; and other trails/roads
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access, restrict access to trails on RFW days, expand fire watch program

Table 10.03

Type	Description
Ignition Sources	freeway/vehicle (north and west), toll stop adjacent, cigarette, electrical transmission line; arson, spotting, fire encroachment, natural (lightning, rocks, etc.)
Fuel type	chaparral, sage scrub, grassland, riparian, woodland
Likely fire spread pattern	Fire ignited along freeway (241) would have a tendency to move upslope into the FMU; wind driven fires from the east would burn through the FMU's fuels and canyons toward 241
Terrain	Terrain is characterized by a ridgetop along the eastern boundary and west/southwest facing slopes to the FMU's western boundary at the 241; terrain steep but not as rugged as other FMUs to the east
Wind alignment	Erratic winds through the 91 and 241 corridor and area canyons will affect fire spread in this FMU
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving
Adjacent Land Use	transportation corridor - major to west; FMU to N, E, and SE; Irvine Lake, non-NROC open space and other FMUs to the south
Off-site Resources	Reservoir, habitats, trails, roads/transportation corridor, water facilities; toll plaza
On-site Resources	Habitats, wildlife, cultural, roads/trails, electrical T-line/towers, abandoned coal mine
Fuel Mod Adjacent	No structures requiring fuel mod; minimal fuel buffers between 241 freeway exist
Visibility	The FMU is visible from the 241; but is remote beyond this transportation corridor; after hours ignitions could go undetected for a long period
Site Access	Access to FMU is moderate considering its narrow shape; MWD road to the south boundary, 241 along the west boundary, Coal Road along the east boundary and Upper Blind Canyon Rd along the northern boundary.
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Roadway is significant ignition source so recommend: concrete barriers, weed barrier mats for critical stretches on both north and south bound perimeters, especially where long- up hill grades exist; north-bound there are at least two opportunities for pulling off roadway - these should be gated and monitored; coordinate with TCA for camera monitoring of corridor, especially during RFW weather;

Table 10.04

Type	Description
Ignition Sources	electrical transmission line; arson, spotting, fire encroachment from neighboring FMU; lightning
Fuel type	chaparral, sage scrub, disturbed, forest, grassland, riparian, woodland
Likely fire spread pattern	Fire spread woud likely occur within the large canyons that transect this FMU; fire spread could occur within the canyons that spread onto adjacent FMUs from wildfire encroachment or originate in the FMU and spread via terrain and wind
Terrain	Terrain is extremely rugged and steep; canyons trend northeast - southwest through most of the FMU; steep slopes, small canyon bottoms
Wind alignment	The primary canyon that extends through this FMU is aligned to SA winds; rugged terrain and steep canyons will affect wind patterns and fire spread in this FMU
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	FMU's to N, S, W; Cleveland NF to East; T-Line corridor to east and on-site
Off-site Resources	Habitats, NF, wildlife, cultural, T-line corridor, significant Tecate cypress stand to north; natural resources
On-site Resources	Habitats, scattered tecate cypress, wildlife, cultural, roads/trails
Fuel Mod Adjacent	No structures requiring fuel mod
Visibility	Large portions of FMU are remote and could result in delayed observation and reporting of fire
Site Access	Access is limited to perimeter on Lake View SCE Rd (south/east); N. Windy Ridge Rd (north/NW); S Windy Ridge Rd (west); Mine SCE Rd and other T-line maintenance roads.
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access and restrict on RFW days, specific fuel reduction/point protection for Tecate Cypress grove on northern boundary (may need experimentation on methods (fuel break vs. thinning, etc.) as current grove matures), expand fire watch program, Webcams, early warning fire detectors; Windy Ridge Road improvements for fire apparatus and fire watch access

Table 10.05

Type	Description
Ignition Sources	electrical transmission lines; recreational users, rural residential (accidental), roadways (vehicle related); arson, spotting, fire encroachment; lightning; unknown, fenced facility off Black Starr Canyon Road
Fuel type	agriculture, chaparral, sage scrub, developed, disturbed, forest, grassland, riparian, watercourses, woodland
Likely fire spread pattern	Fire spread woud likely occur from the east or north and burn down or across the FMU driven by terrain and wind; slopes leading from USFS land into the FMU along with east winds, large canyon (n - s alignment) and ridgetop align with SA wind from north spread southward toward Santiago Canyon
Terrain	Terrain is extremely rugged and steep; the primary canyon is north-south; steep slopes, small canyon bottoms, easterly slope is east-facing, climbs to ridge on east side of large canyon; Black Star Canyon is major drainage in middle section of FMU and includes steep, rugged terrain; Baker and Silverago Canyons occur within FMU in southern section; FMU includes broad, flatter wash floodplain along Santiago Creek/Santiago Canyon Rd
Wind alignment	The FMU is aligned to various wind patterns and terrain in the area creates its own patterns with SA winds; fire spread is heavily influenced by wind in these canyons
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	FMU's to N, S, W; Cleveland NF to East; T-Line corridor to east and on-site
Off-site Resources	Habitats, National Forest, wildlife, cultural, T-line corridor, natural resources
On-site Resources	Habitats, wildlife, cultural, roads/trails, T-line/towers (high and low kV), structures
Fuel Mod Adjacent	Rural structures on and adjacent the site require more substantial fuel mod and at least annual maintenance, roadside fuel buffers are minimal but unlikely to get more clearance
Visibility	Large portions of FMU are remote and could result in delayed observation and reporting of fire
Site Access	Access is limited to perimeter roads including: Santiago Canyon Rd (SW); Black Star Canyon Rd (southwest); State Spur Rd (west); Lake View SCE RD (northwest); T-line maintenance roads eastern portion along T-line corridor
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access, educational outreach to home/property owners in or adjacent to FMU (rural properties) restrict access on RFW days, expand volunteer fire watch program, Webcams, early warning fire detectors; confirm land use off Black Starr Canyon Road and whether specific fire prevention/protection is warranted.

Table 11.01

Type	Description
Ignition Sources	full interface with residential community/ Serrano Ave to the west (vehicle related - less than freeway); electrical transmission line (northern boundary), recreational, arson, encroachment or spotting from neighboring FMUs
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, lakes/reservoirs, marsh, riparian, woodland
Likely fire spread pattern	Fire may spread throughout the FMU unpredictably during windy and RFW conditions, grasses will fuel fast moving fire while oak woodlands generally will burn slower and less intensely in understory, but hot and aggressive if crowning occurs; ignitions from residential may burn controllably or if fueled by winds, can spread rapidly out of control with spotting and multiple fire fronts
Terrain	The FMU is characterized by a central, prominent valley with steep slopes and a wide bottom that extends from north to south; secondary drainages that trend northwest-southeast occur along the main valley/canyon and include steeper slopes and narrower bottoms; terrain is steep but less rugged than neighboring FMUs; SW portion of FMU includes 2 prominent drainages - n-s alignment with steep, but smaller slopes to ridgetops
Wind alignment	The primary canyons align with north/northeast SA winds, internal canyons vary with alignment and would result in erratic wind patterns with most facilitating wind driven fire
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	Anaheim Hills residential/urban interface - west/north; FMU's - east; Irvine Regional Park and city of Orange residential - south;
Off-site Resources	Habitats, structures/private property, school, wildlife, cultural, transportation corridor, electrical transmission line
On-site Resources	Habitats, wildlife, cultural, roads/trails, electrical transmission towers/line; Irvine Ranch Outdoor Education Center
Fuel Mod Adjacent	Fuel mod is generally good at the WUI to the west, fuel buffer along park is good; fuels in/adjacent to Santiago Creek in SW corner of FMU include exotics, pines, eucalyptus
Visibility	FMU is visible from adjacent urban areas, but many of the canyons create remote areas within the FMU; fire ignition may not be detected for several to tens of minutes, resulting in delayed reporting
Site Access	Access to FMU is better than most FMUs with Edition Ridge on the West boundary; Serrano Ave SW boundary; MWD access road - eastern boundary, trails within FMU and Edison T-line road to north
Overall Fire Hazard Priority	Moderate
Potential Hazard Reduction Measures	Monitor access, restrict access on RFW days, expand fire watch program, Webcams, early warning fire detectors; habitat restoration in SW with removal of exotic trees; public education at education center to focus on wildfire prevention, safety, ecology

Table 11.02

Type	Description
Ignition Sources	full interface with 241 Toll Road to east (vehicle related ignitions), electrical transmission line (northern boundary), recreational, arson, encroachment or spotting from neighboring FMUs
Fuel type	chaparral, sage scrub, developed, grassland, riparian, woodland
Likely fire spread pattern	Fire may spread throughout the FMU unpredictably during windy and RFW conditions, grasses will fuel fast moving fire while oak woodlands generally will burn slower and less intensely in understory, but hot and aggressive if crowning occurs; ignitions off 241 would burn rapidly west/southwest with spotting and multiple fire fronts
Terrain	terrain rises from Santiago creek/Irvine lake spillway to the north with incised drainages (north-south trending) and ridgelines rising above steep slopes, terrain is steep and rugged throughout FMU
Wind alignment	The primary canyons align with north/northeast SA winds, internal canyons vary with alignment and would result in erratic wind patterns with most facilitating wind driven fire
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	Transportation corridor - east (FMUs beyond that); Anaheim Hills residential/urban interface - west; FMU's - south
Off-site Resources	Habitats, structures/private property, wildlife, cultural, transportation corridor, electrical transmission line
On-site Resources	Habitats, wildlife, cultural, roads/trails, electrical transmission towers/line; Irvine Ranch Outdoor Education Center
Fuel Mod Adjacent	Fuel mod is generally good at the WUI to the west, fuel buffer along 241 varies from minimal to adequate; fuel buffer along park is good; remnant fire break at northeast boundary
Visibility	FMU is visible from 241 and adjacent urban areas, but many of the canyons create remote areas within the FMU; fire ignition may not be detected for several to tens of minutes, resulting in delayed reporting
Site Access	Access to FMU is provided by Edison transmission line road in the north, MWD access road on the west, 241 on the east, and Regional Park roads/MWD access on the south; access to the middle portion of the FMU is very restricted with no roads
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Monitor access, more robust fuel buffer or ignition containment devices such as walls or weed control mats at key locations such as long uphill grades along 241; restrict access on RFW days, expand fire watch program, early fire warning detectors

Table 11.03

Type	Description
Ignition Sources	full interface with 241 Toll Road to east (vehicle related ignitions), full interface with residential to west (accidental, small combustion engines, etc.), electrical transmission line, recreational, arson, encroachment or spotting from neighboring FMUs
Fuel type	chaparral, sage scrub, developed, disturbed, grassland, riparian, woodland
Likely fire spread pattern	Fire may spread throughout the FMU unpredictably during windy and RFW conditions, grasses will fuel fast moving fire while oak woodlands generally will burn slower and less intensely in understory, but hot and aggressive if crowning occurs; ignitions off 241 would burn rapidly west/southwest with spotting and multiple fire fronts
Terrain	north-south main drainage in western portion of FMU; prominent ridge line with north/south canyon and steep slopes in northern portion of FMU; east-west trending canyon in mid and southern portion of FMU; terrain is rugged and steep, canyon bottoms are wider and flatter
Wind alignment	The primary canyons align with north/northeast SA winds, internal canyons vary with alignment and would result in erratic wind patterns with most facilitating wind driven fire
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	Transportation corridor - east (FMUs beyond that); Anaheim Hills residential/urban interface - north and west; FMU's - south
Off-site Resources	Habitats, structures/private property, wildlife, cultural, transportation corridor
On-site Resources	Habitats, wildlife, cultural, roads/trails, electrical transmission towers/line
Fuel Mod Adjacent	Fuel mod is generally good at the WUI to the west, fuel buffer along 241 varies from minimal to adequate; remnant fire break at SE boundary
Visibility	FMU is visible from 241 and adjacent urban areas fire ignition is likely to be observed quickly and reported - nighttime hours may cause delayed observation
Site Access	Access to FMU is better than most FMUs; occurs along boundary lines at MWD access road (southwest), Windy Ridge Road, through the middle of the FMU, Jeep trail in the northern 1/2 of the FMU; 241 - eastern edge, horse trail and Blude Sky Way, western edge; gates - confirm knox padlock for fire access
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Monitor access, more robust fuel buffer or ignition containment devices such as walls or weed control mats at key locations such as long uphill grades along 241; restrict access on RFW days, expand fire watch program, early fire warning detectors

Table 12.01

Type	Description
Ignition Sources	full interface with 241 Toll Road to west, full interface with 91 to the north (vehicle related ignitions), recreational, arson, encroachment or spotting from neighboring FMUs
Fuel type	chaparral, sage scrub, disturbed, grassland, riparian, woodland
Likely fire spread pattern	Fire ignited along freeway could burn throughout the FMU with windy conditions; fire encroaching from outside the FMU also could burn throughout the FMU based on terrain, wind alignment and fuels
Terrain	Terrain is extremely rugged and steep; primary canyon is on eastern boundary with 2ndry canyon to the northwest; smaller canyons occur throughout FMU with 3 prominent ridgelines
Wind alignment	The primary and secondary canyons align with north/northeast SA winds, internal canyons vary with alignment and would result in erratic wind patterns
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	Transportation corridor - north, west; FMU's on all other interfaces to the northeast, east and southeast, south
Off-site Resources	Habitats, planned structures (minimal to north/northeast) wildlife, cultural, transportation corridor
On-site Resources	Habitats, wildlife, cultural, roads/trails
Fuel Mod Adjacent	No structures requiring fuel mod; minimal fuel buffers between 241 freeway exist, burned in 09 fire; generally have a downslope adjacent 241, ignitions may be slowed as back downhill into FMU
Visibility	FMU is visible from 241; portions of FMU are remote and could result in delayed observation and reporting of fire
Site Access	Access to FMU occurs along a jeep trail on the eastern boundary; 241 forms boundary on western side - neither have access to interior of FMU; constrained access to interior of FMU
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Monitor access, restrict access on RFW days, expand fire watch program at least until the FMU is developed, NOTE: the FMU is planned for urban residential development as part of Mountain Park project so fuels will be converted and overall ignition potential reduced - will provide fuel buffer between 91/241 and adjacent FMUs.

Table 12.02

Type	Description
Ignition Sources	freeway/vehicle (north and west), toll stop just south, cigarette, electrical transmission line; arson, spotting, fire encroachment, lightning
Fuel type	chaparral, sage scrub, disturbed, forest, grassland, riparian, woodland
Likely fire spread pattern	Fire ignited along freeway (91) and driven by funneled winds will move westerly and southerly up the FMUs canyons; fire may also burn from the south/east with an easterly wind; ignitions off the 241 could burn into the FMU canyons and move easterly/northerly with on-shore flow
Terrain	Terrain is extremely rugged and steep; canyons trend northwest - southeast through most of the FMU; steep slopes, small canyon bottoms all rising from the north to the south to Windy Ridge
Wind alignment	Erratic winds through the 91 corridor and across the rugged terrain and steep canyons will affect fire spread in this FMU; the canyon slopes are aligned with on- and off-shore wind patters
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	reclaimed rock quarry, planned residential, FMU to south, east, and west; transportation corridor - major to north and west
Off-site Resources	Habitats, planned structures (minimal to north) wildlife, cultural, transportation corridor
On-site Resources	Habitats, significant tecate cypress stand, wildlife, cultural, roads/trails
Fuel Mod Adjacent	No structures requiring fuel mod; minimal fuel buffers between 241 freeway exist, burned in 09 fire; generally have a downslope adjacent 241, ignitions may be slowed as it backs downhill into FMU
Visibility	Portions of FMU are remote and could result in delayed observation and reporting of fire
Site Access	Access to FMU occurs along N. Windy Ridge Road on eastern and southern FMU boundary and along a jeep trail on the western boundary; north accessible on dirt roads on old Quarry site; off-road = no access - overall access is constrained on much of the FMU
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Monitor access, specific fuel reduction/point protection for Tecate cypress groupings and single trees; restrict access on RFW days, expand fire watch program, Webcams strategically located to monitor remote portions of FMU, early fire warning detectors placed to help response to cypress area; road improvements for fire access facilitation (e.g., - grade shoulders down, widen, provide fuel mod zones of 10 feet or more on either side); potential experimentation on cypress protection measures - thinning, fuel mod/point protection and if funding or donated system available, then Phos-chek landscape protection system or pre-plumbed fire deluge system could be considered

Table 12.03

Type	Description
Ignition Sources	freeway/vehicle, cigarette, electrical transmission line; arson, spotting, fire encroachment, lightning
Fuel type	chaparral, sage scrub, forest, grassland, riparian, woodland
Likely fire spread pattern	Major canyon (coal canyon) in middle of FMU is north-south trending, slopes would carry ignition off 91 as Sierra fire spread; nw - se trending side canyons could spread fire into Cleveland NF
Terrain	Terrain is extremely rugged and steep
Wind alignment	Coal Canyon is aligned with SA/NE winds; winds funneled into the canyon pick up speed and become erratic
Fire Behavior	Fire behavior would be extreme, erratic, and fast moving with multiple heads possible
Adjacent Land Use	Private rural residential and Cleveland NF to east; FMU to south; transportation corridor - major to north, FMU to west
Off-site Resources	Habitats, tecate cypress, structures (minimal to east), wildlife, cultural, transmission line, roads
On-site Resources	Habitats, wildlife, cultural, transmission line, roads;
Fuel Mod Adjacent	No structures requiring fuel mod; fuels between 91 freeway exist, burned in 09 fire; will continue to present fire risk from 91; fire history indicates high frequency of ignitions in this area, presumably 91 related
Visibility	Portions of FMU are remote and could result in delayed observation and reporting of fire
Site Access	Access to FMU occurs along N. Windy Ridge Road; no access off-road
Overall Fire Hazard Priority	High
Potential Hazard Reduction Measures	Monitor access, restrict access on RFW days, expand fire watch program, Webcams and/or early warning fire detectors in remote areas of FMU; concrete walls or mats to help prevent ignitions along 91 freeway where there are currently no impediments between natural fuels and travel lanes

Table 13.01

Type	Description
Ignition Sources	Roads, residential/urban areas, accidental, arson, recreation, power lines
Fuel type	sage scrub, developed, disturbed, grassland, lakes/reservoirs, riparian, watercourses
Likely fire spread pattern	on-shore wind driven toward upslope homes
Terrain	Flat bottom with west facing slope up to structures
Wind alignment	Aligned with on-shore and off-shore winds
Fire Behavior	low hazard during on-shore, Santa Ana may result in ignitions that produce embers ignitions not likely based on high moisture content/marsh
Adjacent Land Use	Santa Ana River directly west, urbanized, residential or planned residential all other sides, park, school, golf course east
Off-site Resources	Structures, school private property, infrastructure
On-site Resources	Habitat, managed park, trails, reservoir, power lines
Fuel Mod Adjacent	Defensible space/fuel mod varies in width and condition, Victoria Road bisects the north and south ends of the park
Visibility	Very visible from roads and surrounding communities
Site Access	Good access throughout, roads, trails
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Invasive species removal, restoration, Improve fuel modification where structure setbacks do not meet current local fire code standards such as adjacent the FMU in the southeastern portion

Table 14.01

Type	Description
Ignition Sources	I-5 to west, residential to east, accidental, arson, recreation
Fuel type	agriculture, sage scrub, developed, grassland, riparian, watercourses
Likely fire spread pattern	east to west, up slope, wind driven
Terrain	Moderate to steep sloping
Wind alignment	Slope intersects north/northeast wind, Arroyo Trabuco upwind, open space downwind/on-shore flow includes fuels upwind (westerly)
Fire Behavior	fast moving flashy fuel fire with jackpots, burn quickly upslope, especially in extreme fire weather
Adjacent Land Use	Urban residential, freeway, agricultural area (east)
Off-site Resources	Residential tract community, open space, school (north), infrastructure
On-site Resources	Cultural present, habitat, grove
Fuel Mod Adjacent	offsite resources include defensible space areas/fuel modification
Visibility	Very visible from freeway and adjacent communities
Site Access	Access is poor to fair - dirt road along western edge, roads within southern edge, steep terrain to the west
Overall Fire Hazard Priority	Low
Potential Hazard Reduction Measures	Invasive species removal/restoration to native scrub throughout the site, promote fuel mod at the residential structures and stress proper ornamental placement and maintenance

APPENDIX A-3

Hazard Reduction Measure Cost-Benefit Analysis

Appendix A-3
Hazard Reduction Measure Cost-Benefit Analysis

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Restrict access during RFW	Low impact, removes potential ignition sources during worst fire spread periods, reduces risk to persons and Reserve, limited to less than 20 days per year	3	$0 (already patrolling, close gates, volunteer watches	Costs associated with patrol, recreation user dissatisfaction, notification of closures	1	3.00	Reserve Wide - all public access areas
Remote, solar powered Web Cams	Web cams = Low to moderate cost, boosts ability to monitor remote areas and detect fire early, especially during RFW, community and volunteer involvement, can be automated to provide remote warning	3	$1,000 to $5,000 each	low to moderate financial commitment, need dedicated monitors to conduct watches, ongoing maintenance, potential impacts with positioning of the solar powered systems	1	3.00	6.03, 6.04, 10.01, 10.02, 10.03, 10.04, 10.05, 12.02, 12.03, 11.02
Construction related work (e.g., hot works) restrictions adjacent vegetation on Roadways	Removes high fire hazard activities (welding, grinding, brazing, sparking, etc.) from adjacent vegetated landscapes during period when fires are most likely to ignite and spread, reduces ignition potential	3	$0 (potential delays in required work/repairs)	Road and roadside repairs may be delayed 1 to several days; plan would need to be developed by agencies/stakeholders responsible for any kind of roadway or infrastructure maintenance	1	3.00	Reserve wide - and adjacent land uses and agencies
Coordination with CNF or other Adjacent Stakeholders and Fire Agencies	Advanced knowledge can allow preplanning resulting in quicker response to escaped burns, tactical responses on wildfires	3	$0 (coordination time assumed to occur as part of normal duties)	No costs identified	1	3.00	Recommended regionally with all open space reserve/vacant land owners/managers
Expand FireSafe Council program and/or provide funding for hazard reduction projects	Provides a conduit for Federal Funding or utility/project funding for fuel and hazard reduction projects; involves community members in fire prevention planning, is a well-established non-profit that furthers coordination with fire agencies and the public, would have low overall costs, with potential for large grant funding opportunities	3		Requires coordination with existing Firesafe Councils and promotion of expanded program, meeting attendance and program championing, costs to SCE or other agencies/entities	1	3.00	Applicable to all FMUs

Appendix A-3 (Continued)

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Expanded volunteer watch coverage supporting/expanding IRC program	Low cost on a per acre basis as the entire reserve would benefit, quicker ignition ID and fire department notification, quicker fire response and fire containment/control, smaller impact on NROC resources	3	up to $265,000annually ($7.36/acre protected)	Training requires time and funding, program must be managed, coordinated and scheduled: assumes training and equipment as well as coordinator and support	1	3.00	All of Central Reserve to provide an overlapping umbrella of coverage. Coastal Preserve, especially: 2.06, 2.07, 2.09, 4.02, 4.05; possibly 1.02 and 1.03
Enterprise GIS interactive, user-friendly Data Access	Provides a common access to Reserve Wide data; very important for managing a system of resources that should not be considered on a compartmentalized basis; relatively inexpensive, could co-habitate with OCFA; can restrict data availability by user, greatly assists fire planning, resource management and fire response	3	up to $4,000 per stakeholder initially + $2,500 per year (assumes OCFA may take lead on system that can be adapted) - $4/acre affected + $2.43/acre affected annually	Financial up-front costs for user-interface customization, ongoing monthly fees, costs to get data migrated into system, ongoing data management costs	1	3.00	Recommended for all NROC stakeholder agencies
Fewer restrictions on fire agency response to FMUs	Enables faster response, enables quicker decision making in the field "what's needed now"; potentially quicker fire control, potentially less confusion for firefighters	2	$0 (no dollar cost identified; results from WFMP recommendations)	Potentially higher soil and resources impacts, collateral damage, potentially higher restoration costs/activities related to surface impacts; road rehabilitation will require new bio impacts and considerable grading costs and maintenance	1	2.00	Reserve Wide

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Educational Fire Safety/Awareness Signage at key trail entries	Constant reminder to users of their responsibilities with regard to fire safety, revives or creates new "smoky" fire safety figure, reduces likelihood of accidental ignitions and provides a contact for anyone seeing any potentially risky activities on or near FMUs	2	$2,000/initially; $200 annually	Design, material and placement costs, maintenance costs, visual/aesthetic/program development costs	1	2.00	Public access entrances (trail heads) including: 2.01, 2.02, 3.01, 3.02, 3.03, 3.05, 2.05, 2.06, 2.07, 2.08, 2.09, 2.10, 4.01, 4.02, 4.03, 4.04, 4.05, 4.06, 6.02, 6.05, 6.03, 6.04, 7.01, 7.03, 10.01, 10.02, 10.03, 10.04, 10.05, 11.01, 11.02, 11.03, 12.01
Work with utilities to reduce powerline ignited fires- prioritize and replace and retrofit old technology, underground where possible, replace wood poles with steel, maintenance schedules	Reduces potential for failure of electrical equipment, reduces potential for vegetation related ignitions	3	$0 (assumed SCE includes in operations budget)	Costs to SCE, potential interim resource impacts (undergrounding), potentially higher incidence of maintenance related ignitions due to hot works, vehicles, etc, primarily related to lower voltage lines, NROC includes primarily higher voltage lines	1	2.00	All FMUs including low-voltage lines, wood poles, and older transformers and related equipment
Fuel mod adjacent major roadways/ignition sources (91, 241, 133, 73, etc.)	Reduces roadside vehicular ignitions; major impact on reducing wildland fire ignitions; habitat impacts are reduced and concentrated along already impacted areas	3	$1.00/linear foot for mowing to 10 to 14 feet wide area	Native habitat impacts; cost obligation for annual or more often maintenance; potential for ignitions from maintenance; financial costs are relatively high considering the areas to be treated but benefits outweigh costs	2	1.50	1.05, 1.06, 2.09, 2.10, 3.02, 3.03, 3.04, 4.01, 4.02, 4.05, 4.06, 5.01, 6.08, 6.01, 6.02, 6.05, 7.01, 7.02, 7.03, 10.01, 10.03, 11.02, 12.01, 12.02, 11.03, 6.03, 6.04, 10.05

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank *1 to 3 (Low, Medium, High)*	$ Cost Calculations	Potential Costs	Combined Costs Rank *1 to 3 (Low, Medium, High)*	Ratio *Benefit Rank*	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
Hidden Pull-out closure along major roadways	Reduces the incidence of legal or illegal access of pull-outs adjacent wildland fuels, makes arson more difficult, keeps vehicles on roadways, minimizes unauthorized access, potentially reduces vegetation ignitions coinciding with RFW events	3	up to $20,000 or more, depending on whether bermed, chained or K-Rail for the areas along the 241, 133, and 91 that could be considered	Financial cost is one time up front with minimal maintenance costs annually, potential safety issues, delays access by maintenance staff and firefighters, may still need to maintain enough room for vehicle to park before gate/barrier	2	1.50	12.01, 11.03, 10.03, 11.02, (south of 11.02 and north of 7.01), 10.01, 10.02, 7.01, 7.02, 8.02
Prescribed burning	Can mimic natural burning process, some vegetation requires occasional fire for reproduction, can be healthy part of native vegetation communities, inexpensive, training opportunities for firefighters; over long-term, prescribed fire may be important to natural ecosystems but current fire regime will not benefit from prescribed fire - need to return to a longer fire interval	3	up to $1,200/acre	Not likely possible due to air quality and political issues (currently), not likely needed due to occurrence of too many fires on Reserve, smoke issues, escape issues, would require significant pre-fire measures, in the event of unplanned fire results in shorter fire return intervals possibly facilitating habitat type conversion; burn permit, resources environmental documentation result in high cost; potential for escape and damage offsite	2	1.50	Currently not recommended

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Increase capability for fire response (better access, better road maintenance, wider roads; turnarounds on some dirt roads)	Potentially faster response, may result in decision to send engines in vs. not, enable firing operation, allows access for firefighting tactics, anchor points, etc.; anticipated to equate to higher probability of faster control and fewer impacts	3	$20,000 to $50,000 (estimated additional cost above existing road maintenance contract)	Financial commitment may be significant, SCE and/or OCFA buy in and commitment of resources, biological impacts associated with access improvements; potential for increased unauthorized use, may require more intensive patrol levels	2	1.50	Central Reserve - all FMUs
Private Fire Company to provide point protection (gel applications, fuel reduction when fire approaches	Reduces impacts to those associated with protection activities just prior to fire, may be as little as temporary gel or retardant application, provides a back-up measure for protecting the highest value resources on the Reserve	3	$2,500 per day	Cost may be as high as $2,500 per use or more; likely need an ongoing maintenance contract, access may be not possible or denied by IC, may include vegetation impacts if they need to construct hand lines; high value resources would need to be identified, prioritized, and put on a plan for protection	2	1.50	Currently not recommended
Herbicide application at Locations along Roadways, within Fuel Modification Zones; or for particularly aggressive invasive species	Effective plant killer, retains biomass on site/in place, financially cost effective for small areas, less so for large areas, can be targeted to specific plants, can be used as preventative or post-emergence	3	$600/acre	Not a natural component of the ecosystem, potential for drift and/or accumulation in waterways, loss of unintended native plants due to overspray, indirect effects on wildlife (birds, amphibians, aquatic animals	2	1.50	Roadway adjacent FMUs and along FMU access roads, as possible

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Convert outer portions of wide fuel modification zones to Cactus Wren Habitat	Improves habitat value of fuel modification zones, provides habitat for sensitive species, creates aesthetic benefits, functions as extended fuel mod zone, consistent with NROC directives	3	$50,000 to $85,000/acre depending on site (lower level planning could include significant cost savings, such as collecting pads and planting them)	financial cost can be high and success can vary, requires maintenance during establishment period and beyond	2	1.50	Fuel modification areas exceeding 100 feet in width (outer areas of zone), primarily in Laguna Beach jurisdiction.
Mastication	Selective vegetation removal, roots stay intact, fast and agile, good for selective high value areas; low ground impact with skid steer with rubber track, mulches woody biomass for erosion control	3	$500 - $1,000/acre	negative connotation, cost makes widespread use limited, slope limitations (less than 45%), will require ongoing, occasional follow-up treatments; shows a higher number of non-native invasives following treatment,	2	1.50	Currently recommended along roadways (extended arm masticator)
Targeted Non-native plant removal	Low impact, targeted methods, consistent with Reserve goals, may be all that is needed to reduce hazard in some areas, fewer ignitions, slower or less fire spread	3	$2,500/acre for grasses; up to $40,000/acre for tree removal; costs may go down over time	May not be enough to sufficiently reduce fire hazard, can be costly if large trees or large areas are involved, may need ongoing follow up treatments	3	1.00	Coastal Reserve in FMU's including Aliso Creek (1.02, 1.03, 1.04), adjacent fuel mod areas and at wildland urban interfaces throughout Central and Coastal Preserves.

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank *1 to 3 (Low, Medium, High)*	$ Cost Calculations	Potential Costs	Combined Costs Rank *1 to 3 (Low, Medium, High)*	Ratio *Benefit Rank*	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
Roadside "hardening"	Concrete walls (K-Rail) and/or ignition resistant weed control "mats" can minimize habitat impacts; very effective at keeping cigarettes, sparks, and other vehicle related ignition sources on roadway; walls reduce stolen vehicle disposal and burning on Reserve lands	3	$30 linear foot for K-Rail $33 linear foot for weed control mat	Expensive to implement and maintain; only useable in specific areas; CalTrans or transportation agency rules and regulations; Cal Trans would need to fund and install, or other funding sources would need to be identified and funds obtained, limited to 6 foot wide mats, may need wider in some areas	3	1.00	2.09, 2.10, 10.03, 11.02, 11.03, 12.03
Early Fire Detection Systems	System is automated and can detect fire early, technology evolving with reliability and effectiveness increasing	3	up to $35,000 each	High cost to implement and maintain, need infrastructure and monitors.	3	1.00	6.03, 6.04, 10.01, 10.02, 10.03, 10.04, 10.05, 12.02, 12.03, 11.02
Restore areas of non-native grasslands to shrubbier, less flashy fuels, especially cacti habitat.	Focused in key areas would reduce ignition and fire spread potential, provides native wildlife benefits; in line with NROC goals and objectives	3	$5,000/acre for large scale to $85,000/acre or more for concentrated efforts, depending on site and species	Cost of restoration can be high, may impact small mammals and raptors, management and maintenance period high cost, then reduced over time	3	1.00	Coastal and Central Reserve on high fire frequency areas - 3.03, 4.03, 6.03, 7.01, 10.01, 10.02

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Extending fuel mod areas (on Reserve) near vulnerable construction	As applicable; provides additional defensible space and separation of fuels/heat from structures AND provides extended buffer to help prevent structural or other human caused ignitions from escaping into wildland fuels; may remove exotic vegetation	3	$2,500/acre	May not be necessary or only in specific locations; native habitat and potentially cultural impacts; initial and ongoing costs; may involve coordination with adjoining landowners/homeowner associations. challenge may be identifying the responsible party who will bear the expense and maintain the expanded fuel mod zone, need study to determine which properties this would apply to adjacent the Reserve	3	1.00	See Haz Assessment Matrix
Annual Phos-Chek application at highest ignition points (e.g., along roadways)	Potential to reduce ignitions and fire spread, annual application by private company, directly mitigates the highest hazard areas	3	$10,000 to $20,000 /year based on high ignition areas along 91 freeway and 241/133 toll roads, depending on extent of area covered (not including potential environmental review/permits	Moderate cost annually, potential plant impacts, waterway impacts, potential for EIR/permitting issues, habitat impacts through facilitation of non-native plant species	3	1.00	Currently not recommended

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank *1 to 3 (Low, Medium, High)*	$ Cost Calculations	Potential Costs	Combined Costs Rank *1 to 3 (Low, Medium, High)*	Ratio *Benefit Rank*	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
Fuel Break(s)	Slow advancing fire under typical conditions; potential "point (bio or cultural or private asset) protection"; useful as tactical firefighting operations like back-firing/firing out	2	$2,000/acre	Potential invasive species establishment, erosion potential; financial expense that will be ongoing; native habitat impacts; effectiveness is subject to weather conditions - winds may allow spotting;	3	0.67	No Fuel or Fire Breaks currently recommended
Shaded Fuel Break(s)	Provides reduced fuel with few invasive species issues; may help slow fire under typical conditions; overstory remains mostly intact; aesthetics are retained, helps reduce crown fire	2	$2,000/acre	incremental native plant impacts; less effective due to higher fuel loads; implementable in specific conditions (oak woodlands, riparian woodland, exotic/ornamental; maintenance costs are ongoing to retain function	3	0.67	6.07 and other where oak canopy exists
Strategically placed area treatments - fuel mod - cultural asset(s)	Reduces fuels strategically around cultural assets, focuses fuel reduction where will provide point protection; focused on above ground cultural resources, wood structures and other artifacts	2	$2,500/acre	Habitat impact realized, may not be effective in extreme weather conditions, labor cost, ongoing - maintenance	3	0.67	Where above-ground, wood or flammable artifacts exist, need comprehensive data set to evaluate
Fire Break(s)	Potential anchor point or control line to stop advancing fire (non-extreme conditions); may slow fire spread in non-windy conditions; strategic implementation with GIS analysis may reduce extent of necessary breaks by focusing on fire ignitions and spread patterns	2	$2,500/acre initially and $1,500/acre in perpetuity	Invasive species may increase and create a more flammable landscape; financial expense that will be ongoing; native habitat impacts, should be correlated with high fire areas - not indiscriminately placed, erosion potential on slopes, public access issues	3	0.67	Currently not recommended

Appendix A-3 (Continued)

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Phos-Check systems at highest ignition points	Automated system provides eyes at the scene day and night, can stop fire from spreading at its source, effectively minimizes vegetation combustibility, minimizes vegetation/biological impacts	2	$75,000 or more per isolated area, depending on extent	Systems are costly, have not been tested over long periods for reliability, may not perform well in extreme weather (wind) conditions ,require ongoing maintenance and testing, require post-use vegetation washing, may be susceptible to vandalism	3	0.67	Currently not recommended unless a system is offered at a drastic discount or as a beta test; potentially FMUs 5.01, 6.01, 6.02, 6.03, 6.04, 6.05, 6.06, 7.01, 7.02, 7.03, 10.01, 10.05
Construct walls, strategically place boulders	Non-combustible landscape features can enable reduction of necessary fuel modification zones, reduces natural resources impacts, consistent with Reserve goals, can be used at high value asset sites (walls) and in natural areas to protect natural resources (boulders); one time cost for placement/construction, may not function during extreme weather	2	up to $200/linear foot - wall, $300-$5000/site for boulder placement, dependent on site	Costly and labor intensive, negative reaction from adjacent property owners, permits may be required, environmental documentation possibly needed, would require study to determine where this would be most appropriate	3	0.67	No walls or boulder placement recommended currently
Tree Crown Raising (oak woodland, riparian, tecate cypress)	Provides a perimeter buffer of limbed up trees to help prevent wildland fires from laddering into tree crowns in areas with very high tree densities	2	$2,000/acre - $20,000/acre	Minor to moderate individual tree impacts; Financial costs initial and ongoing; increased potential for weed invasion; cost effectiveness would need affirmation, useful primarily on mature trees with understory	3	0.67	10.04, 12.02 - no limbing up recommended currently

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Silvicultural Treatment in Site Woodlands/Forest (Oak Woodlands, Riparian, Tecate Cypress)	May provide healthier spacing in over-stocked stands; reduces laddering and continuous fuels; reduces likelihood of stand replacing fire; reduces competition for healthier retained trees; removes dead and dying; based on standard silvicultural practices; materials can be chipped or left whole on site for nutrient cycling	2	$5,000/acre to $75,000/acre	Costs can be high, especially if material removed from site, would require additional study to confirm if benefits would be realized in Tecate cypress, potential impacts to existing rare resources; tree marking and hand labor for removal costs; Increased potential for weed invasion	3	0.67	10.04, 12.02 - not currently recommended
Fire Adapted Communities Education campaign	Provides public outreach and education, raising awareness and potentially reducing fire starts, aims to create vesting of citizens and Reserve neighbors on reducing fire, aims to increase structural ignition resistance, which helps reduce need for extended fuel modification in the Reserve, significant info already available	2	up to $60,000/year, depending on level of outreach ($1.66/acre affected)	Financial commitment for campaign is proportional to success, requires manpower to orchestrate and lead meetings, Website info, and mailers; success of similar programs has varied from good to poor	2	1.00	Regional - not associated with individual FMU's, place at outdoor education centers (NIX and similar), and at trailhead kiosks
Vegetation crushing and Mechanical Reduction	Relatively inexpensive, low to moderate impact, can be somewhat selective; used as pretreatment prior to prescribed burning; would be a very rare treatment since prescribed fire is not anticipated for the foreseeable future	1	$1,500/acre	Cost of machinery, planning, implementation; can be costly, wide-spread use is limited; environmental review and permitting, habitat impacts, need cultural coordination, limited overall usage throughout NROC	2	0.50	No identified need currently. Would be used pre-prescribed burn or to crush fuels and reduce fuel/air mix and reduce potential flame lengths

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank *1 to 3 (Low, Medium, High)*	$ Cost Calculations	Potential Costs	Combined Costs Rank *1 to 3 (Low, Medium, High)*	Ratio *Benefit Rank*	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
Grazing at key locations to reduce fuels	Effective reduction of fuels, in use in Laguna Beach and elsewhere - precedence, marketing opportunity, potential research project on goat grazing impacts/benefits, cost ($500/acre)	1	$500/acre (various sources) Cost of enviro review is high ($300,000 or more for EIR); costs relatively constant over time	Non-discriminatory fuel removal, higher land impact, cost, ($500/ acre), potential for exotic plant establishment, may conflict with reserve goals and/or guidelines, erosion potential, disease transmission to native species, accretion of impacts, requires vigilant oversite; areas of goat grazing in coastal zone, costs of enviro review and permitting high	3	0.33	Although currently being used to reduce fuels in Laguna Beach areas within the Reserve, it is not currently recommended in other areas until detailed study indicate it would be beneficially used on other areas of the Reserve,
Strategically placed area treatments/fuel mod - bio asset(s)	Reduces fuels strategically around biological assets (sensitive species, tecate cypress, known wildlife locations, etc.), focuses fuel reduction where will provide point protection; can be used to modify fuel ages adjacent important assets; potentially provides extended period for response	1	$2,500/acre	Habitat impact realized, may not be effective in extreme weather conditions, labor cost, ongoing - maintenance	3	0.33	No Strategically placed area treatments currently recommended
Phos-Check system near Tecate Cypress Concentrations	System has proven effective for detecting heat source and applying phos-chek, protecting vegetation, Low impact, phos-check can be washed off after threat, possibility of getting system at reduced cost or as demo	1	up to $150,000 or more (depends on extent of system needed)	System needs to be installed, water tank, compressed air cylinders, and hard-line distribution pvc system with high flow spray guns, maintenance annually or more often, very expensive; pulse of nutrients if ever used - may lead to weed establishment and spread	3	0.33	10.04, 12.02, not currently recommended unless system is offered at significant discount or as a beta test

Action / Mitigation Measure	Potential Benefits	Combined Benefits Rank	$ Cost Calculations	Potential Costs	Combined Costs Rank	Ratio	Where Could This be Implemented in FMU(s): (Provide FMU # and Location - refer to provided FMU map)
		1 to 3 (Low, Medium, High)			*1 to 3 (Low, Medium, High)*	*Benefit Rank*	
Dip tank(s) in remote locations	Water source for remote fires, reduces time necessary for helicopter drops, potential to stop fires sooner; potential to limit fire spread and habitat loss, aesthetic impacts potential	1	up to $10,000 or more per tank, depending on location and plumbing required	Need water piped to these tanks, or access for water tender filling and maintenance, potential impacts, may be no realistic locations for them, other sources (lakes) close enough, OCFA needs to identify spots that would provide advantage	3	0.33	Currently no need for dip tanks due to available water sources (Irvine Lake, Rattlesnake Reservoir, Upper Oso Reservoir, Peter's Canyon Reservoir, Walnut Canyon Reservoir, Pacific Ocean, Back Bay, San Joaquin Reservoir, Barbara Lake
Fire Max Pro - Pre-installed pipe lines and reservoir(s) for defense of high value resources	Provides a pre-planned way to reduce the ignitability of vegetation near high value resources; reduces impacts with the use of water, no chemicals, only needed during wildfire	1	$15,000 to $40,000 per area	Some impact during installation of pipes, aesthetic impacts, Initial cost is high, maintenance over time, relies on company moving water containers (high volume) in at right time before fires, or activating a permanent tank/pump; reliability is unknown	3	0.33	10.04, 12.02 - not currently recommended
NROC Property Fuel Modification Areas transferred to Laguna Beach	Removes fuel modification that was grandfathered into Reserve from the Reserve (virtual benefit), eliminates disturbance that occurs with fuel removal; eliminates use of goats within Reserve; could be linked with an equal transfer of land to Reserve (OC Parks);	1	$30,000 or more, depending on enviro permitting, coastal commission and other issues	Requires research and planning; time and costs, unprecedented; environmental review and permitting may be necessary potential loss of reserve acreage and area over which adaptive management of ecosystem is practiced	3	0.33	2.05, 2.07, 2.08, 2.09, 1.03, 1.01, 1.05, 1.02

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APPENDIX B

Orange County Fuel Modification Zone Plant Palette

Appendix B
Orange County Fuel Modification Zone Plant Palette

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Abelia grandiflora	Glossy Abelia Shrub	Shrub	W
Acacia redolens	Desert Carpet	Shrub	n
Acer macrophyllum	Big Leaf Maple	Tree	o
Achillea millefolium	Common Yarrow	Low Shrub	X
Achillea tomentosa	Woolly Yarrow Low	Shrub	W
Aeonium decorum	Aeonium	Ground cover	X
Aeonium simsii	no common name	Ground cover	X
Agave attenuata	Century Plant	Succulent	W
Agave shawii	Shaw's Century Plant	Succulent	W
Agave victoriae-reginae	no common name	Ground Cover	N
Ajuga reptans	Carpet Bugle	Ground Cover	X
Alnus cordata	Italian Alder	Tree	W
Alnus rhombifolia	White Alder	Tree	o
Aloe arborescens	Tree Aloe	Shrub	N
Aloe aristata	no common name	Ground Cover	N
Aloe brevifoli	no common name	Ground Cover	N
Aloe vera	Medicinal Aloe	Succulent	W
Alogyne huegeii	Blue Hibiscus	Shrub	W
Ambrosia chammissonis	Beach Bur-Sage	Perennial	o
Amorpha fruticosa	Western False Indigobush	Shrub	o
Anigozanthus flavidus	Kangaroo Paw	Perennial/accent	W
Antirrhinum nuttalianum ssp.	no common name	Subshrub	o
Aptenia cordifolia x 'Red Apple'	Red Apple	Ground cover	X
Arbutus unedo	Strawberry Tree	Tree	W
Arctostaphylos 'Pacific Mist'	Pacific Mist	Ground Cover	W
Arctostaphylos edmundsii	Little Sur Manzanita	Ground Cover	W
Arctostaphylos glandulosa ssp.	Eastwood Manzanita	Shrub	o
Arctostaphylos hookeri 'Monterey Carpet'	Monterey Carpet Manzanita	Low Shrub	W
Arctostaphylos pungens	no common name	Shrub	N
Arctostaphylos refugioensis	Refugio Manzanita	Shrub	N
Arctostaphylos uva-ursi	Bearberry	Ground Cover	W
Arctostaphylos x 'Greensphere'	Greensphere Manzanita	Shrub	W
Artemisia caucasica	Caucasian Artesmisia	Ground Cover	N
Artemisia pycnocephala	Beach Sagewort	Perennial	X
Atriplex canescens	Four-Wing Saltbush	Shrub	X
Atriplex lentiformis ssp. *breweri*	Brewer Saltbush	Shrub	X
Baccharis emoyi	Emory Baccharis	Shrub	o
Bacharis pilularis ssp. *consanguinea*	Chaparral Bloom	Shrub	W
Baccharis pilularis var. *pilularis 'Twin Peaks #2'*	Twin Peaks	Ground Cover	X
Baccharis salicifolia	Mulefat	Shrub	o

Appendix B (Continued)

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Baileya multiradiata	Desert Marigold	Ground Cover	N
Beaucarnea recurvata	Bottle Palm	Shrub/Small Tree	W
Bougainvillea spectabilis	Bougainvillea	Shrub	N n
Brahea armata	Mexican Blue Palm/Blue Hesper Palm	Palm	N n
Brahea brandegeei	San Jose Hesper Palm	Palm	N n
Brahea edulis	Guadalupe Palm	Palm	N n
Brickellia californica	no common name	Subshrub	o
Bromus carinatus	California Brome Grass	Grass	W o
Camissonia cheiranthifiloa	Beach Evening Primrose	Shrub	o
Carissa macrocarpa	Green Carpet Natal Plum	Ground Cover/Shrub	N
Carpobrotus chilensis	Sea Fig Ice Plant	Ground Cover	X
Ceanothus gloriosus 'Point Reyes'	Point Reyes Ceanothus	Shrub	W
Ceanothus griseus 'Louis Edmunds'	Louis Edmunds Ceanothus	Shrub	W
Ceanothus griseus horizontalis	Yankee Point	Ground Cover	W
Ceanothus griseus var. *horizontalis*	Carmel Creeper Ceanothus	Shrub	W
Ceanothus griseus var. *horizontalis 'Yankee Point'*	Yankee Point Ceanothus	Shrub	W
Ceanothus megarcarpus	Big Pod Ceanothus	Shrub	o
Ceanothus prostratus	Squaw Carpet Ceanothus	Shrub	W
Ceanothus spinosus	Green Bark Ceanothus	Shrub	o
Ceanothus verrucosus	Wart-Stem Ceanothus	Shrub	W
Cerastium tomentosum	Snow-in-Summer	Ground cover/Shrub	W
Ceratonia siliqua	Carob	Tree	W
Cercis occidentalis	Western Redbud	Shrub/Tree	W
Chrysanthemum leucanthemum	Oxeye Daisy	Ground Cover	X
Cistus Crispus	no common name	Ground Cover	W
Cistus hybridus	White Rockrose	Shrub	W
Cistus incanus	no common name	Shrub	W
Cistus incanus ssp.	no common name	Shrub	W
Cistus salviifolius	Sageleaf Rockrose	Shrub	W
Cistus x purpureus	Orchid Rockrose	Shrub	W
Citrus species	Citrus	Tree	W
Clarkia bottae	Showy Fairwell to Spring	Annual	o
Cneoridium dumosum	Bushrue	Shrub	o
Collinsia heterophyllia	Chinese Houses	Annual	o
Comarostaphylis diversifolia	Summer Holly	Shrub	W o
Convolvulus cneorumrub	Bush Morning Glory	Shrub	N
Coprosma kirkii	Creeping Coprosma	Ground Cover/Shrub	W
Coprosma pumila	Prostrate Coprosma	Low shrub	W
Coreopsis californica	Califiornia Coreopsis	Annual	o
Coreopsis lanceolata	Coreopsis	Ground Cover	W

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Corea pulchella	Australian Fuscia	Ground Cover	N
Cotoneaster buxifolius	no common name	Shrub	W
Cotoneaster congestus 'Likiang'	Likiang Cotoneaster	Ground Cover/Vine	W
Cotoneaster aprneyi	no common name	Shrub	W
Crassula lactea	no common name	Ground Cover	X
Crassula multicava	no common name	Ground Cover	X
Crassula ovata	Jade Tree	Shrub	X
Crassula tetragona	no common name	Ground Cover	X
Croton californicus	California Croton	Ground Cover	W o
Delosperma 'alba'	White trailing Ice Plant	Ground Cover	X
Dendromecon rigida	Bush Poppy	Shrub	o
Dichelostemma capitatum	Blue Dicks	Herb	o
Distinctis buccinatoria	Blood-Red Trumpet Vine	Vine/Climbing vine	N
Dodonaea viscosa	Hopseed Bush	Shrub	N
Drosanthemum floribundum	Rosea Ice Plant	Ground Cover	X
Drosanthemum hispidum	no common name	Ground Cover	X
Drosanthemum speciosus	Dewflower	Ground Cover	X
Dudleya lanceolata	Lance-leaved Dudleya	Succulent	o
Dudleya pulverulenta	Chalk Dudleya	Succulent	o
Elaeagnus pungens	Silverberry	Shrub	W
Encelia californica	California Encelia	Small Shrub	o
Epilobium canum (Zauschneria californica)	Hoary California Fuschia	Shrub	o *
Eriastrum sapphirinum	Mojave Woolly Star	Annual	o
Eriobotrya japonica	Loquat	Tree	N
Eriodictycon crassifolium	Thick Leaf Yerba Santa	Shrub	o
Eriodictycon trichocalyx	Yerba Santa	Shrub	o
Eriophyllum confertiflorum	no common name	Shrub	W o
Erythrina species	Coral Tree	Tree	W
Escallonia species	Several varieties	Shrub	N
Eschscholzia californica	California Poppy	Flower	W o
Eschscholzia mexicana	Mexican Poppy	Herb	X
Euonymus fortunei	Winter Creeper Euonymus	Ground Cover	N
Feijoa sellowiana	Pineapple Guava	Shrub/Tree	N
Fragaria chiloensis	Wild Strawberry/Sand Strawberry	Ground Cover	N
Frankenia salina	Alkali Heath	Ground Cover	o
Fremontondendron californicum	California Flannelbush	Shrub	W
Gaillardia grandiflora	Blanketflower	Ground Cover	X
Galvezia speciosa bush	Bush Snapdragon	Shrub	W
Garrya ellipta	Silktassel	Shrub	W
Gazania hybrids	South African Daisy	Ground Cover	X

Appendix B (Continued)

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Gazania rigens leucolaena	Training Gazania	Ground Cover	X
Gillia capitata	Globe Gilia	Perrenial	o
Gilia leptantha	Showy Gilia	Perrenial	W
Gilia tricolor	Bird's Eyes	Perrenial	W
Ginkgo biloba	Maidenhair Tree	Tree	W
Gnaphalium californicum	California Everlasting	Annual	o
Grewia occidentalis	Starflower	Shrub	W
Grindelia stricta	Gum Plant	Ground Cover	o
Hakea suaveolens	Sweet Hakea	Shrub	N n
Hardenbergia comptoniana	Lilac Vine	Shrub	W
Heliathemum muutabile	Sunrose	Ground Cover/Shrub	N
Helianthemum scoparium	Rush Rose	Shrub	o
Heliotropium curassavicum	Salt Heliotrope	Ground Cover	o
Helix canariensis	English Ivy	Ground Cover	X
Hesperaloe parviflora	Red Yucca	Perennial	W
Heteromeles arbutifolia	Toyon	Shrub	o n
Hypericum calycimum	Aaron's Beard	Shrub	X
Iberis sempervirens	Edging Candytuft	Ground Cover	N
Iberis umbellatum	Globe Candytuft	Ground Cover	N
Isocoma menziesii	Coastal Goldenbush	Small Shrub	o
Isomeris arborea	Bladderpod Shrub	Shrub	o
Iva hayesiana	Poverty Weed	Ground Cover	W
Juglans californica	California Black Walnut	Tree	N
Juncus acutus	Spiny Rush	Perrenial	o
Keckiella antirrhinoides	Yellow Bush Penstemon	Subshrub	o
Keckiella cordifolia	Heart Leaved Penstemon	Subshrub	o
Keckiella ternata	Blue Stemmed Bush Penstemon	Subshrub	o
Kniphofia uvaria	Red Hot Poker	Perennial	W
Lagerstroemia indica	Crape Myrtle	Tree	W
Lagunaria patersonii	Primrose Tree	Tree	W
Lamprathus aurantiacus	Bush Ice Plant	Ground Cover	X
Lampranthus filicaulis	Redondo Creeper	Ground Cover	X
Lampranthus spectabilis	Trailing Ice Plant	Ground Cover	X
Lantana camara cultivars	Yellow Sage	Shrub	W
Lantana montevidensis	Trailing Lantana	Shrub	W
Lasthenia californica	Dwarf Goldfields	Annual	o
Lavandula dentata	French Lavender	Shrub	W
Leptospermum laevigatum	Australian Tea Tree	Shrub	W
Leucophyllum frutescens	Texas Ranger	Shrub	W
Leymus condensatus	Giant Wild Rye	Large Grass	o
Ligustrum japonicum	Texas privet	Shrub	N

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Limonium pectinatum	no common name	Ground Cover	X
Limonium perezii	Sea Lavender	Shrub	X
Liquidambar styraciflua	American Sweet Gum	Tree	W n
Liriodendron tulipfera	Tulip Tree	Tree	W
Lonicera japonica 'Halliana'	Hall's Japanese Honeysuckle	Vining Shrub	X
Lonicera subspicata	Wild Honeysuckle	Vining Shrub	o
Lotus corniculatus	Bird's Foot Trefoil	Ground Cover	X
Lotus hermannii	Northern Woolly Lotus	Perennial	o
Lotus scoparius	Deerweed	Shrub	o
Lupinus arizonicus	Desert Lupine	Annual	W
Lupinus benthamii	Spider Lupine	Annual	W
Lupinus bicolor	Sky Lupine Flowering	annual	o
Lupinus sparsiflorus	Annual Lupine/Coulter's Lupine	Annual	o
Lyonothamnus floribundus ssp.	Fernleaf Ironwood	Tree	W
Macadamia integrifolia	Macadamia Nut	Tree	W
Mahonia aquifolium 'Golden Abundance'	Golden Abundance Oregon Grape	Shrub	W
Mahonia nevenii	Nevin Mahonia	Shrub	W
Malacothamnus fasciculatus	Chapparal Mallow	Shrub	o
Malephora luteola	Training Ice Plant	Ground Cover	X
Maytenus boaria	Mayten Tree	Tree	W
Melaleuca nesophila	Pink Melaleuca	Shrub	W
Metrosideros excelsus	New Zealand Christmas Tree	Tree	N
Mimulus species	Monkeyflower	Flower	o *
Mirabilis californica	Wishbone Bush	Perennial	o
Myoporum debile	no common name	Shrub	N
Myoporum insulare	Boobyalla	Shrub	W
Myoporum parvilfolium	no common name	Ground Cover	W
Myoporum pacificum	no common name	Ground Cover	W
Nassella (stipa) lepidra	Foothill Needlegrass	Ground Cover	o
Nassella (stipa) pulchra	Purple Needlegrass	Ground Cover	o
Nemophilia menziesii	Baby Blue Eyes	Annual	o
Nerium oleander	Oleander	Shrub	X
Nolina cismontana	Chapparal Nolina	Shrub	o
Nolina species	Mexican Grasstree	Shrub	N
Oenothera belandieri	Mexican Evening Primrose	Ground Cover	W
Oenothera hookeri	California Evening Primrose	Flower	N
Oenothera speciosa	Show Evening Primrose	Perennial	W
Ophiopogon japonicus	Mondo Grass	Ground Cover	X
Opuntia littoralis	Prickly Pear	Cactus	o *

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Opuntia oricola	Oracle Cactus	Cactus	o *
Opuntia prolifera	Coast Cholla	Cactus	o *
Osmanthus fragrans	Sweet Olive	Shrub	W
Osteospermum fruticosum	Training African Daisy	Ground Cover	X
Parkinsonia aculeata	Mexican Palo Verde	Tree	X
Pelargonium peltatum	Ivy Geranium	Ground Cover	W
Penstemon species	Beard Tongue	Shrub	X
Photinia fraseria	no common name	Shrub	W
Pistacia chinesis	Chinese Pistache	Tree	W
Pittosporum undulatum	Victorian Box	Tree	X
Plantago erecta	California Plantain	Annual	o
Plantago insularis	Woolly Plantain	Annual	**
Plantago sempervirens	Evergreen Plantain	Ground Cover	X
Plantanus racemosa	California Sycamore	Tree	W
Plumbago auritulata	Plumbago Cape	Shrub	W
Popolus fremontii	Western Cottonwood	Tree	o
Portulacaria afra	Elephant's Food	Shrub	X
Potentilla glandulosa	Sticky Cinquefoil	Subshrub	o
Potentilla tabernaemontanii	Spring Cinquefoil	Ground Cover	X
Prunus caroliniana	Carolina Cherry Laurel	Shrub/Tree	X
Prunus ilicifolia ssp. *Ilicifolia*	Holly Leafed Cherry	Shrub	o
Prunus lyonii	Catalina Cherry	Shrub/Tree	X
Punica granatum	Pomegranate	Shrur/Tree	N
Puya species	Puya	Succulent/Shrub	W
Pyracantha species	Firethorn	Shrub	W
Quercus agrifolia	Coast Live Oak	Tree	o
Quercus berberdifolia	California Scrub Oak	Shrub	o n *
Quercus dumosa	Coastal Scrub Oak	Shrub	o n *
Quercus engelmannii	Engelmann Oak	Tree	X
Quercus suber	Cork Oak	Tree	X
Rhamnus alaternus	Italian Buckthorn	Shrub	X
Rhamnus californica	California Coffee Berry	Shrub	o
Rhamnus crocea	Redberry	Shrub	o
Rhamnus crocea ssp. *ilicifolia*	Hollyleaf Redberry	Shrub	o
Rhaphiolepis species	Indian Hawthorne	Shrub	N
Rhus integrifolia	Lemonade Berry	Shrub	o
Rhus lancea	African Sumac	Tree	N
Rhus ovata	Sugarbush	Shrub	o n
Ribes aureum	Golden Currant	Shrub	o
Ribes indecorum	White Flowering Currant	Shrub	o

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Ribes speciosum	Fuschia Flowering Goosebberry	Shrub	o
Ribes viburnifolium	Evergreen currant	Shrub	W
Romneya coulteri	Matilija Poppy	Shrub	o *
Romneya coulteri 'White Cloud'	White Cloud Matilija Poppy	Shrub	X
Rosmarinus officinalis	Rosemary	Shrub	W n
Salvia greggii	Autums Sage	Shrub	W n
Salvia sonomensis	Creeping Sage	Ground Cover	W n
Sambucus mexicana	Mexican Elderberry	Tree	o
Santolina chamaecyparissus	Lavender Cotton	Ground Cover	W
Santolina virens	Green Lavender Cotton	Shrub	W
Satureja chandleri	San Miguel Savory	Perennial	o
Scirpis scutus	Hard Stem Bulrush	Perennial	o
Scirpus californicus	California Bulrush	Perennial	o
Sedum acre	Goldmoss Sedum	Ground Cover	X
Sedum album	Green Stonecrop	Ground Cover	X
Sedum confusum	no common name	Ground Cover	X
Sedum lineare	no common name	Ground Cover	X
Sedum x rubrotinctum	Pork and Beans	Ground Cover	X
Senecio serpens	no common name	Ground Cover	X
Sisyrinchium bellum	Blue Eyed Grass	Ground Cover	o
Solanum douglasii	Douglas Nightshade	Shrub	o
Solanum xantii	Purple nightshade	Perennial	o
Stenicarpus sinuatus	Firewheel Tree	Tree	W
Strelitzia nicolai	Giant Bird of Paradise	Perennial	W
Strelitzia reginae	Bird of Paradise	Perennial	W
Symphoricarpos mollis	Creeping Snowberry	Shrub	o
Tecoma stans (Stenolobium stans)	Yellow Bells	Shrub/Small Tree	W
Tecomaria capensis	Cape Honeysuckle	Ground Cover	X
Teucarium chamedrys	Germander	Ground Cover	N
Thymus serpyllum	Lemon Thyme	Ground Cover	N
Trachelospermum jasminoides	Star Jasmine	Shrub	N
Trichosstems lanatum	Woolly Blue Curls	Shrub	o
Trifolium hirtum 'Hyron'	Hyron Rose Clover	Ground Cover	X
Trifolium fragerum 'O'Connor's'	O'Connor's Legume	Ground Cover	X
Umbellularia californica	California Laurel	Tree	o
Verbena lasiostachys	Western Vervain	Perennial	o
Verbena peruviana	no common name	Ground Cover	N
Verbena species	Verbena	Ground Cover	X
Vinca minor	Dwarf Periwinkle Ground	Ground Cover	X
Vitis girdiana	Desert Wild Grape	Vine	o

Orange County Fuel Modification Zone Plant Palette

Botanical Name	Common Name	Plant Form	Code
Vulpia myuros 'Zorro'	Zorro Annual Fescue	Grass	X
Westringia fruticosa	no common name	Shrub	W
Xannithorrhoea species	Grass Tree	Shrub	W
Xylosma congestum	Shiny Xylosma	Shrub	W
Yucca species	Yucca	Shrub	X
Yucca whipplei	Yucca	Shrub	o

Code Legend:
X = Plant species prohibited in wet and dry fuel modification zones adjacent to Reserve lands. Acceptable on all other fuel modification locations and zones.
W = Plant species appropriate for use in wet fuel modification zones adjacent to Reserve lands. Acceptable in all other wet and irrigated dry (manufactured slopes) fuel modification locations and zones.
o = Plant species native to Orange County. Acceptable in all fuel modification wet and dry zones in all locations.
N = Plant species acceptable on a limited basis (maximum 30% of the area at the time of planting) in wet fuel modification zones adjacent to Reserve lands. Acceptable on all other fuel modification zones.

* = If locally collected.
** = Not native but can be used in all zones.
n = Plant species acceptable on a limited use basis. Refer to qualification requirements following plant palette.

APPENDIX C

Conceptual Prohibited Plant List

Appendix C
Conceptual Prohibited Plant List

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Abies species	Fir
Acacia baileyana	Bailey Acacia, Cootamundra Wattle
Acacia cyclopis	Acacia
Acacia dealbata	Acacia
Acacia decurrens	Green Wattle
Acacia latifolia	Sydney golden wattle
Acacia longifolia	Sidney Golden Wattle
Acacia melanoxylon	Blackwood Acacia
Acacia redolens	A. Ongerup
Acacia sp. (all species)	Acacia
Acacia species	Acacia
Achillea millefolium var. *millefolium*	Common Yarrow
Adenostoma fasciculatum	Chamise
Adenostoma sparsifolium	Red Shanks
Aegilops triuncialis	Barbed goatgrass
Aeschynomene rudis	Rough jointvetch
Agave americana	Century plant
Ageratina adenophora	Eupatory
Agonis juniperina	Juniper Myrtle
Agropyron repens	Quackgrass
Agrostis avenacea	Pacific bentgrass
Ailanthus altissima	Tree of Heaven
Albizia lophantha	Plume acacia
Alhagi pseudalhagi	Camel thorn
Ammophila arenaria	European beach grass
Anthemis cotula	Mayweed
Anthoxanthum odoratum	Sweet vernal grass
Aptenia cordifolia	Red Apple
Aptenia cordifolia	Red apple, Baby Sunrose
Araucaria species *(A. heterophylla, A. araucana, A. bidwillii)*	Araucaria (Norfolk Island Pine, Monkey Puzzle Tree, Bunya Bunya)
Arbutus menziesii	Madrone
Arctostaphylos species	Manzanita
Arctotheca calendula	Cape Weed
Arctotheca calendula	Capeweed
Arctotis sp. (all species and hybrids)	African daisy
Artemesia species *(A. abrotanium, A. absinthium, A. californica, A. caucasia, A. dracunulus, A. tridentate, A. pynocephala)*	Sagebrush (Southernwood, Wormwood, California, Silver, True tarrangon, Big, Sandhill)
Arundo donax	Giant Reed or Arundo Grass

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Asparagus asparagoides	Florist's-smilax, Bridal Creeper, Smilax
Asparagus denssiflorus	Asparagus Fern, Meyers Asparagus
Asparagus setaceus (A. plumosus)	Asparagus Fern
Asphodelus fistulosus	Asphodel
Atriplex glauca	White Saltbush
Atriplex semibaccata	Australian saltbush
Atriplex species (numerous)	Saltbush
Auena fatua	Wild Oat
Avena barbata	Slender oats
Avena fatua	Wild Oats
Baccharis pilularis	Coyote Bush
Bambusa species	Bamboo
Bassia hyssopifolia	Bassia
Bellardia trixago	Bellardia
Bougainvillea species	Bougainvillea
Brachypodium distachyon	False brome
Brassica nigra	Black mustard
Brassica rapa	Field Mustard
Brassica species *(B. campestris, B. nigra, B. rapa)*	Mustard (Field, Black, Yellow)
Brassica tournefortii	Moroccan or African mustard
Bromus diandrus	Ripgut grass
Bromus hordeaceus [B. mollis]	Brome grass, Softchess
Bromus madritensis ssp. *rubens*	Red brome
Bromus molfis	Brome Grass, Soft Chess
Bromus rubens	Foxtail Chess
Bromus tectorum	Cheat grass, downy brome
Callistemon species *(C. citrinus, C. rosea, C. viminalis)*	Bottlebrush (Lemon, Rose, Weeiping)
Calocedrus decurrens	Incense Cedar
Cardaria chalepensis	lens-podded, white-top
Cardaria draba	White-top, hoary cress
Carduus acanthoides	Giant plumeless thistle
Carduus pycnocephalus	Italian thistle
Carex spp. (all species)	Sedge
Carpobrotus chilensis	Ice Plant
Carpobrotus edulis	Iceplant, sea fig
Carpobrotus species	Ice Plant, Hottentot Fig
Castanopsis chrysophylla	Giant Chinkapin
Casuarina cunninghamiana	River She-Oak

Appendix C (Continued)

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Catalpa bignoniodes	Common catal
Cedrus species *(C. atlantica, C. deodara)*	Cedar (Atlas, Deodar)
Centaurea calcitrapa	Purple starthistle
Centaurea maculosa	Spotted knapweed
Centaurea melitensis	Yellow star thistle
Centaurea solstitialis	Bamaby's thistle
Centranthus ruber	Red Valerian
Chamaecyparis species (numerous)	False Cypress
Chasmanthe floribunda	African Cornflag Chasmanthe
Chenopodium album	Pigweed, lamb's quarters
Chenopodium murale	Goosefoot
Chrysanthemum coranarium	Annual chrysanthemum
Cinnamomum camphora	Camphor
Cirsium arvense	Canada thistle
Cirsium vulgare	Bull thistle
Cistus ladanifer	Gum cistus
Cistus sp. (all species)	Rockrose
Conicosia pugioniformis	Narrow-leaved iceplant, roundleaf iceplant
Conium maculatum	Poison hemlock
Convolvulus arvensis	Field bindweed
Conyza bonariensis	Horseweed
Coprosma pumila	Prostrate Coprosma
Coprosma repens	Mirror plant
Cordyline australis	New Zealand cabbage
Cortaderia atacamensis	Pampas Grass
Cortaderia didica [C. sellowana]	Selloa Pampas Grass
Cortaderia jubata	Andean pampas grass
Cortaderia selloana	Pampas grass
Cotoneaster lacteus	Cotoneaster
Cotoneaster pannosus	Cotoneaster
Cotoneaster sp. (all species)	Cotoneaster
Crassula ovata (C. argentea)	Jade plant
Crataegus monogyna	Hawthorn
Crocosmia x crocosmiiflora	Montbretia Crocosmia
Crupina vulgaris	Bearded creeper, common crupina
Cryptomeria japonica	Japanese Cryptomeria
Cupaniopsis anacardioides	Carrot wood
Cupressocyparis leylandii	Leyland Cypress
Cupressus macrocarpa	Monterey cypress

Appendix C (Continued)

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Cupressus species *(C. fobesii, C. glabra, C. sempervirens,)*	Cypress (Tecate, Arizona, Italian, others)
Cynara cardunculus	Artichoke thistle
Cynodon dactylon	Bermuda Grass
Cyperus spp. (all species)	Nutsedge, umbrella plant
Cytisus scoparius	Scotch broom
Cytisus sp. (all species)	Broom
Cytisus striatus	Striated broom
Delairea odorata	Cape ivy, German ivy
Delosperma 'Alba'	White Trailing Ice Plant
Descurainia sophia	Flixweed
Digitalis purpurea	Foxglove
Dimoiphotheca sp. (all species)	African daisy, Cape marigold, Freeway daisy
Dipsacus fullonum	Wild teasel, Fuller's teasel
Dipsacus sativus	Wild teasel, Fuller's teasel
Dodonea viscose	Hopseed Bush
Drosanthemum floribundum	Rosea Ice Plant
Drosanthemum hispidum	Purple ice plant
Drosanthemum hispidum	Purple Ice Plant Eucalyptus (all species) Eucalyptus Eupatofium
Echium candicans	Pride of Madeira, pride of Teneriffe
Echium pininana	Pride of Madeira, pride of Teneriffe
Egeria densa	Brazilian waterweed
Ehrharta calycina	Veldt grass
Ehrharta erecta	Veldt grass
Ehrharta longiflora	Veldt grass
Eichhornia crassipes	water hyacinth
Elaeagnus angustifolia	Russian olive
Emdiurn circutanum	Filaree
Erechtites glomerata	Australian fireweed
Erechtites minima	Australian fireweed
Erica lusitanica	Heath
Eriodyctyon californicum	Yerba Santa
Eriogonum species *(E. fasciculatum)*	Buckwheat (California)
Erodium cicutarium	Filaree
Eucalyptus camaldulensis	Red Gum, River Red Gum
Eucalyptus globulus	Tasmanian blue gum
Eucalyptus species *(numerous)*	Eucalyptus
Eupatorium (Ageratina) adenophorum	Eupatory
Euphorbia esula	Leafy spurge
Euphorbia lathyris	Caper spurge, gopher plant

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Festuca arundinacea	Tall fescue
Festuca rubra	Creeping red fescue
Ficus carica	Edible fig
Foeniculum vulgare	Wild fennel
Fraxinus uhdei	Evergreen ash, shamel ash
Fremontodendron species	Flannel Bush
Fumaria officinalis	Fumitory
Fumaria parviflora	Fumitory
Gaura (spp.) (all species)	Gaura
Gazania linearis	Gazania
Gazania sp. (all species and hybrids)	
Genista monspessulana	French broom
Genista spp. (all species)	Broom
Glyceria declinata	Waxy mannagrass
Halogeton glomeratus	Halogeton
Hedera canariensis	Algerian ivy
Hedera helix	English ivy
Hedera species *(H. canariensis, H. helix)*	Ivy (Algerian, English)
Helichrysum petiolare	Licorice plant
Heterotheca grandiflora	Telegraph Plant
Hirschfeldia incana	Mediterranean or short pod mustard
Holcus lanatus	Velvet grass
Hordeum leporinurn	Foxtail Barley, Mouse Barley
Hydrilla verticillata	Hydrilla
Hypericum canariense	Canary Island hypericum
Hypericum perforatum	Klamathweed, St. John's wort
Hypericum spp. (all species)	St. John's Wort
Hypochaeris radicata	Rough cat's-ear
Ilex aquifolium	English holly
Ipomoea acuminata	Blue dawn flower,Mexican morning glory
Ipomoea purpurea	Common Morning-glory
Iris pseudacorus	Yellow water iris, yellow flag
Isatis tinctoria	Dyers' woad
Juniperus species	Juniper
Lactuca serriola	Prickly lettuce
Lampranthus spectabilis	Trailing Ice Plant
Lantana camara	Common garden lantana
Larix species *(L. decidua, L. occidentalis, L. kaempferi)*	Larch (European, Japanese, Western)
Larrea tridentata	Creosote bush

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Lepidium latifolium	Perennial pepperweed
Leptospermum species *(L. laevigatum, L. petersonii)*	Tea Tree (Austrailian, Tea)
Leucanthemum vulgare	Ox-eye daisy
Ligustrum lucidum	Glossy privet
Limonium perezii	Sea Lavender
Limonium sinuatum	Notch-oleaf Marsh-rosemary Statice
Linaria bipartita	Toadflax
Lithocarpus densiflorus	Tan Oak
Lobularia maritima	Sweet Allysum
Lolium multiflorum	Ryegrass
Lollium perenne	Perennial ryegrass
Lonicera japonica	Japanese Honeysuckle
Lotus comiculatus	Birdsfoot trefoil
Ludwigia hexapetala	Water primrose
Ludwigia uruguayensis	Water primrose
Lupinus arboreus	Bush lupine
Lupinus sp. (all non-native species)	Lupine
Lupinus texanus	Texas blue bonnets
Lythrum salicaria	Purple loosestrife
Mahonia species	Mahonia
Malephora crocea	Ice plant
Malephora crocea	Red-flowered Iceplant, Croceum Iceplant
Malephora luteola	Ice Plant
Malva parviflora	Cheeseweed
Marrubium vulgare	Horehound
Maytenus boaria	Mayten
Medicago polymorpha	California bur clover
Melaleuca species *(M. linariifolia, M. nesophylla, M. quinqenervia)*	Melaleuca (Flaxleaf, Pink, Cajeput Tree)
Melilotus officinalis	Yellow sweet clover
Melinus repens	Natal Grass, Natal Ruby Grass, Red Top
Mentha pulegium	Pennyroyal
Mesembryanthemum crystallinum	Crystalline iceplant
Mesembryanthemum nodiflorum	Little Ice Plant
Mimulus aurantiacus	Sticky Monkeyflower
Mirabilis jalapa	Four O'Clock, Marvel of Peru
Miscanthus species	Eulalie Grass
Mosembryanthemum crystallinum	Common Ice Plant
Muehlenbergia species	Deer Grass

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Myoporum laetum	Myosporum
Myriophyllum aquaticum	Parrot's feather
Myriophyllum spicatum	Eurasian watermilfoil
Nerium oleander	Oleander
Nicotania species *(N. bigelevil, N. glauca)*	Tobacco (Indian, Tree)
Nicotiana glauca	Tree Tobacco
Oenothera berlandieri	Mexican Evening Primrose
Olea europaea	Olive
Ononis alopecuroides	Foxtail restharrow
Opuntia ficus-indica	Indian fig
Oryzopsis miliacea	Smilo Grass
Osteospermum sp. (all species)	Trailing African daisy, African daisy, Cape marigold, Freeway daisy
Oxalis pes-caprae	Bermuda buttercup
Palm species (numerous)	Palm
Parentucellia viscosa	Yellow Bartsia
Parkinsonia aculeata	Mexican Palo Verde, Jerulalem Thorn
Passiflora caerulea	Blue passionflower
Pelargonium x. hortorum	Common Geranium, Garden Geranium, Zonal Geranium
Pennisetum cilliare	Buffelgrass
Pennisetum clandestinum	Kikuyu Grass
Penniseturn setaceum	Fountain Grass
Perronskia Atriplicifloria	Russian Sage
Phalaris aquatica	Harding grass
Phalaris aquatica	Harding Grass
Phoenix canadensis	Canary Island date palm
Phoenix dactylifera	Date palm
Phoradendrom species	Mistletoe
Phyla nodiflora	Mat lippia
Picea (numerous)	Spruce
Pickeringia montana	Chaparral Pea
Picris echioides	Bristly ox-tongue
Pinus radiata cultivars	Monterey pine Cultivars
Pinus species *(P. brutia, P. canariensis, P. eldarica, P. halopensis, P. pinea, P. radiate,* numerous others*)*	Pine (Calabrian, Canary Island, Mondell, Aleppo, Italian Stone, Monterey)
Piptatherum [Oryzopsis] miliacea	Rice grass, smilo grass
Pistacia chinensis	Chinese pistache
Pittosporum unulatum	Victorian Box
Platycladus orientalis	Oriental arborvitae
Plumbago auriculata	Cape leadwort

Appendix C (Continued)

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Podocarpus species (*P. gracilior, P. macrophyllus, P. latifolius)*	Fern Pine (Fern, Yew, Podocarpus)
Polygonum spp. (all species)	Knotweed
Populus nigra 'italica'	Lombardy poplar
Potamogeton crispus	curlyleaf pondweed
Prosopis spp. (all species)	Mesquite
Prunus cerasifera	Cherry plum
Prunus lyonii	Catalina Cherry
Pseudotsuga menziesii	Douglas Fir
Pyracantha angustifolia	Pyracantha
Raphanus sativus	Wild Radish
Retama monosperma	Bridal broom
Rhus Lentii	Pink Flowering Sumac
Rhus species (*R. diversiloba, R. laurina, R. lentii)*	Sumac (Poison oak, Laurel, Pink Flowering)
Ricinus communis	Castor bean
Robinia pseudoacacia	Black locust
Robinia pseudoacacia	Black Locust
Rosmarinus species	Rosemary
Rubus discolor	Himalayan blackberry
Rubus procerus	Himalayan blackberry
Rumex conglomeratus	Creek Dock
Rumex crispus	Curly Dock
Sacsola austails	Russian Thistle
Salsola australis	Russian Thistle
Salsola soda	Glasswort
Salsola tragus	Russian thistle, tumbleweed
Salvia aethiopis	Mediterranean sage
Salvia species (numerous)	Sage
Salvinia molesta	Giant waterfern
Sapium sebiferum	Chinese tallow tree
Saponaria officinalis	Bouncing bet
Schinus molle	California Pepper Tree
Schinus species (*S. molle, S. terebenthifolius)*	Pepper (California and Brazilian)
Schinus terebinthifolius	Brazilian pepper
Schismus arabicus	Mediterranean grass
Schismus barbatus	Mediterranean grass
Senecio jacobaea	Tansy ragwort
Senecio mikantoides	German Ivy
Senna didymobotrya	Popcorn Senna, Popcorn Cassia,African Senna
Sesbania punicea	Scarlet wisteria

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Shinus terebinthifolius	Brazilian pepper
Silybum marianum	Milk thistle
Sisymbrium irio	London rocket
Sisymbrium officinale	Hedge mustard
Sisymbrium orientale	Eastern Rocket
Solanium Xantii	Purple Nightshade (toxic)
Sonchus asper	Prickly sow thistle
Sonchus oleraceus	Sow Thistle
Sorgum halepense	Johnson grass
Spartina alterniflora	Atlantic or smooth cordgrass
Spartina anglica	cord grass
Spartina densiflora	dense-flowered cord grass
Spartina patens	salt-meadow cord grass
Spartium junceum	Spanish broom
Stipa capensis	Cape ricegrass
Sylibum marianum	Milk Thistle
Taeniatherum caput-medusae	Medusa-head
Tamarix aphylla	Athel
Tamarix chinensis	Tamarisk, salt cedar
Tamarix gallica	Tamarisk, salt cedar
Tamarix parviflora	Tamarisk, salt cedar
Tamarix ramosissima	Tamarisk, salt cedar
Tamarix species *(T. Africana, T. apylla, T. chinensis, T. parviflora)*	Tamarix (Tamarisk, Athel Tree, Salt Cedar, Tamarisk)
Tanacetum vulgare	Common tansy
Taraxacum officinale	Dandelion
Taxodium species *(T. ascendens, T. distichum, T. mucronatum)*	Cypress (Pond, Bald, Monarch, Montezuma)
Taxus species *(T. baccata, T. brevifolia, T. cuspidata)*	Yew (English, Western, Japanese)
Thuja species	Arborvitae
Tribulus terrestris	Puncture vine
Trifolium tragiferum	Strawberry clover
Tropaelolum majus	Nasturtium
Tsuga species *(T. heterophylla, T. mertensiana)*	Hemlock (Western, Mountain)
Ulex europaeus	Gorse
Ulmus parvafolia	Chinese Elm Tree
Urtica urens	Burning Nettle
Verbascum thapsus	Woolly or common mullein
Verbena bonariensis	Tall vervain
Verbena litoralis	Tall vervian

Conceptual Prohibited Plant List

Botanical Name	Common Name
Invasive Species	
Vinca major	Periwnkle
Washingtonia robusta	Mexican Fan Palm
Xanthium spinosus	Cocklebur
Yucca gloriosa	Spanish dagger
Zantedeschia aethiopica	Calla lily
Zoysia cultivars	Amazoy and others

Notes:

1. Plants included on this list are those that are prohibited due to high flammability or their undesirable biological characteristics, such as invasiveness.
2. For the purpose of using this list as a guide in selecting plant material, it is stipulated that all plant material will burn under various conditions.
3. The absence of a particular plant, shrub, groundcover, or tree, from this list does not necessarily mean it is fire resistive.
4. All vegetation used in Vegetation Management Zones and elsewhere in this development shall be subject to approval of the Fire Marshal.
5. Additional plants that are considered undesirable due to their invasiveness nature are detailed on the California Invasive Plant Council's Web site at www.cal-ipc.org/ip/inventory/index.php.
6. Landscape architects may submit proposals for use of certain vegetation on a project specific basis. They shall also submit justifications as to the fire resistivity of the proposed vegetation.

WILDLAND FIRE MANAGEMENT PLAN
VOLUME II: FIRE AGENCY TACTICAL RESPONSE PLAN

County of Orange
Central/Coastal NCCP/HCP
Nature Reserve of Orange County
www.NatureReserveOC.org

AUGUST 2013

FIRE MANAGEMENT UNIT 1.01

FIREFIGHTING PROTOCOL: Assertive – Minimize Fire Losses, aggressive suppression	
Size: 290 acres Special Considerations: Area supports sensitive plant resources, including maritime chaparral, a large number of rare/endangered plants. Area also contains three known archeological sites.	Access Route: Access to perimeter of FMU is from Crown Valley Parkway from the North or South to Pacific Island Drive on the east side or Coast Highway from North or South on the west side of FMU. Both arterial roads provide access to collector roads in various neighborhoods that abut FMU.

Vegetation (fuel) types

Chaparral	165 ac.	57%
Coastal Sage Scrub	87 ac.	30%
Developed	25 ac.	9%
Grassland	13 ac.	5%

Sensitive Environmental Resources

Known sensitive species: Big-leaved crown-beard (*Verbesina dissita*), Coastal cactus wren (*Campylorhynchus brunneicapillus*), Laguna Beach dudleya (*Dudleya stolonifera*), Many-stemmed dudleya(*Dudleya multicaulis*), Palmer's grappling hook (*Harpagonella palmeri)*, Small-flowered microseris (*Microseris douglasii*), Small flowered petunia (*Petunia parviflora*), Small-flowered morning glory(*Convolvulus simulans*), Thread-leaved brodiaea (*Brodiaea filifolia*), Vernal barley (*Hordeum intercedens)*

Last Fire Activity (Year and Percentage of Unit Burned)

No date available (1.6%)

Cultural Resources

Three sites documented,.

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Pacific Ocean
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures meet or intermingle with undeveloped wildland or vegetative fuels. Older residential communities on west side and ridge top homes on east side of FMU.

SAFETY PRECAUTIONS: No Recorded Fires – heavy fuels, No Access Roads into FMU, WUI area with ridge top residences

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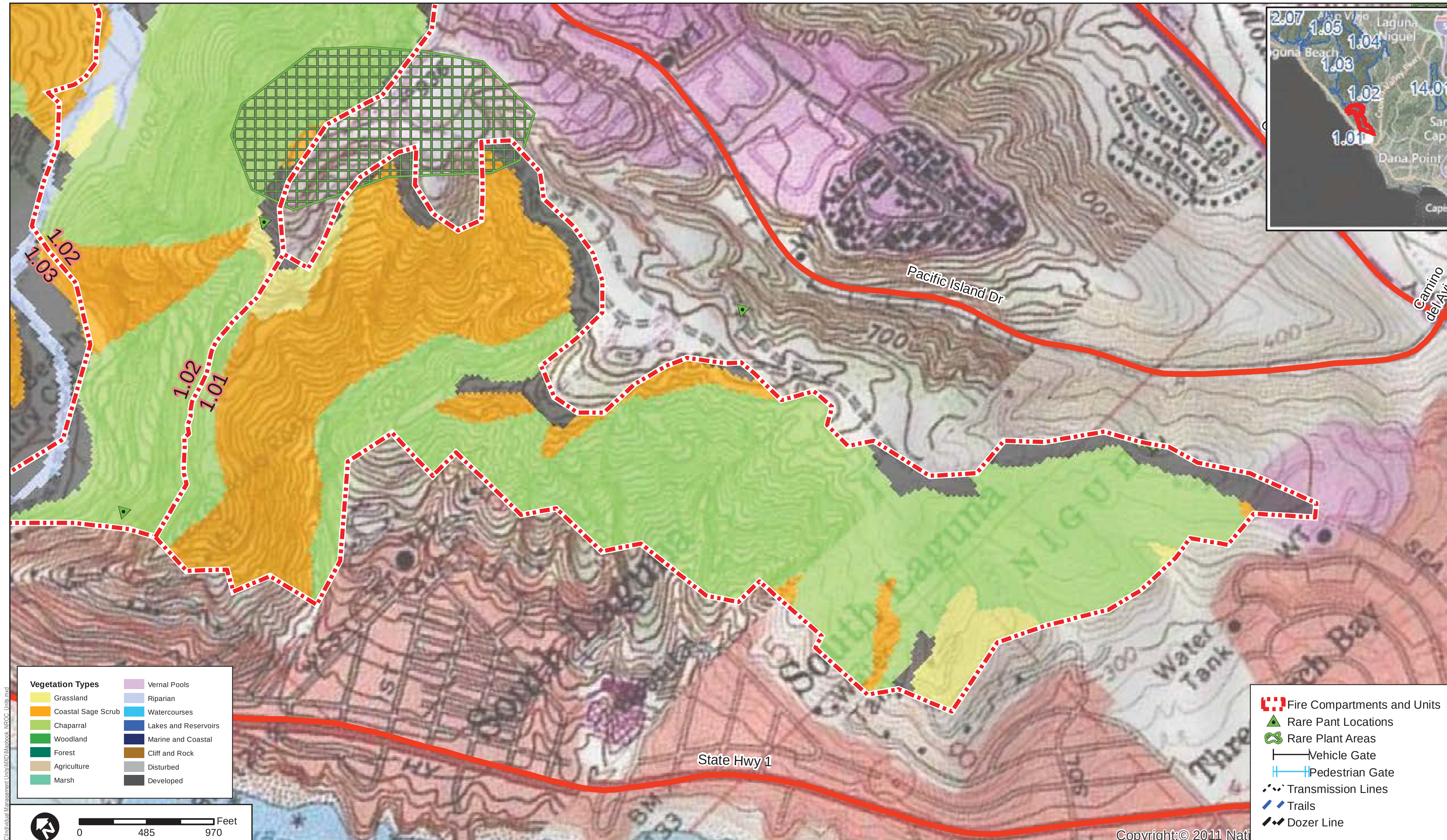

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 1.01 / Acres - 289

Fire Management Unit 1.01

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 1.02

FIREFIGHTING PROTOCOL: Assertive – Minimize Fire Losses, aggressive suppression

Size: 1,100 acres; Special Considerations: Riparian habitat, sensitive species include gnatcatcher, cactus wren, least Bell's vireo, two striped garter snake and pond turtle.	Access Route: The western portion of the FMU is accessible off Country Club Road through Aliso Creek Inn & Golf Course and a paved, private roadway in the bottom of the canyon at the western FMU boundary; trails occur in various portions of the FMU, but would not all be suitable for fire response; trails/roadways at the top of slope in Laguna Niguel would offer access to eastern edge of FMU via Awma Road and Alicia Parkway.

Vegetation (fuel) types

Chaparral	263 ac.	24%
Coastal Sage Scrub	440 ac.	40%
Developed	34 ac.	3%
Disturbed	4 ac.	0.3%
Grassland	249 ac.	23%
Riparian	110 ac.	10%

Cultural Resources

Known sensitive species: Thread-leaved brodiaea, Coastal California gnatcatcher (*Polioptila californica californica*), Coastal cactus wren, Southwestern pond turtle (*Actinemys marmorata pallida*), Western spadefoot toad (*Spea hammondii*), Two-striped Gartersnake (*Thamnophis hammondii*), Grasshopper sparrow (*Ammodramus savannarum*), Least bell's vireo (*Vireo bellii pusillus*), Yellow breasted chat (*Icteria virens*), Yellow warbler (*Setophaga petechia*), Big-leaved crownbeard

Last Fire Activity (Year and Percentage of Unit Burned)

No recorded fire activity

Cultural Resources

None documented.

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Pacific Ocean
Sulphur Creek Reservoir
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures include a wastewater treatment facility inside the FMU perimeter boundary and residential homes which border the FMU on ridgetops.

SAFETY PRECAUTIONS: No Recorded Fire History – heavy fuels, Aliso Creek may flood during heavy storm events

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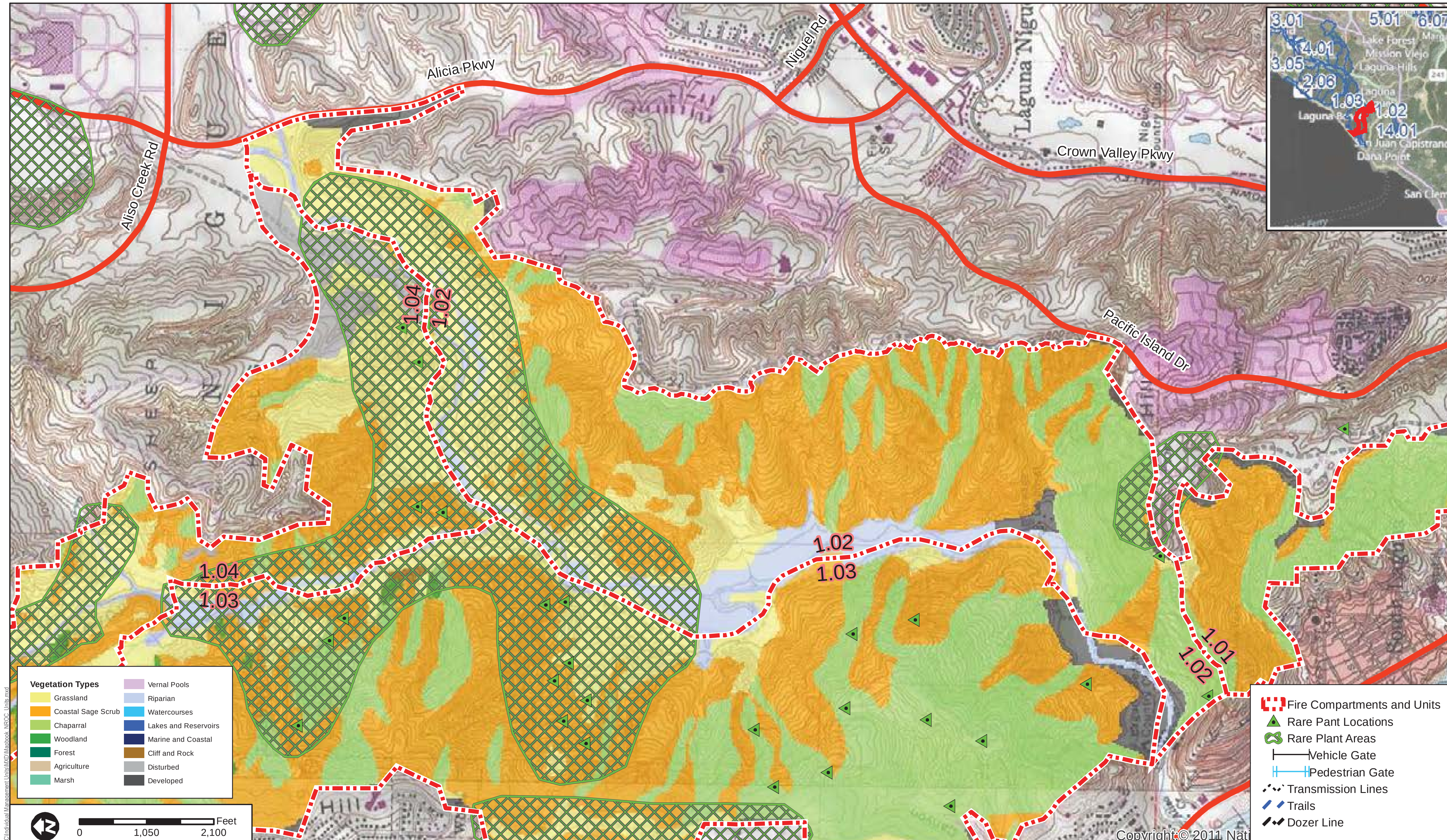

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 1.02 / Acres - 1099

Fire Management Unit 1.02

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FIRE MANAGEMENT UNIT 1.03

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 1768 acres; Special Considerations: Numerous archeological sites, oak/riparian and coastal sage scrub habitats. Sensitive species include gnatcatcher, least Bell's vireo, pond turtle	Access Route: The eastern portion of the FMU is accessible off Country Club Road through Aliso Creek Inn & Golf Course and a paved, private roadway in the bottom of the canyon.The northeastern portion of the FMU is also accessible from Aliso Canyon Road via Awma road and Knollwood Road; trails occur in various portions of the FMU, but would not be suitable for fire response; paved roadway (M street & K street) enable access into secondary canyon in south.

Vegetation (fuel) types

Chaparral	628 ac.	36%
Cliff and Rock	2 ac.	0.1%
Coastal Sage Scrub	836 ac.	47%
Developed	39 ac	2%
Disturbed	1 ac.	0.1%
Grassland	172 ac.	10%
Riparian	43 ac.	2%
Woodland	47 ac.	3%

Sensitive Environmental Resources

Sensitive plants and wildlife species that have been documented within the unit include: Big-leaved crown-beard, Thread-leaved brodiaea, Coastal California gnatcatcher, Coastal cactus wren, Southwestern pond turtle, Western spadefoot toad, Two-striped Gartersnake, Grasshopper sparrow, Least Bell's vireo, Yellow breasted chat

Last Fire Activity (Year and Percentage of Unit Burned)

1983 (.006%), 1961 (6.5%), No date given (4.5%)

Cultural Resources

Several archeological sites

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Pacific Ocean
Sulphur Creek Reservoir
Municipal water system (fire hydrants)
Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels. Older residential communities on west side of FMU.

SAFETY PRECAUTIONS: Steep terrain, flashy fuels, potential for park users to be in area

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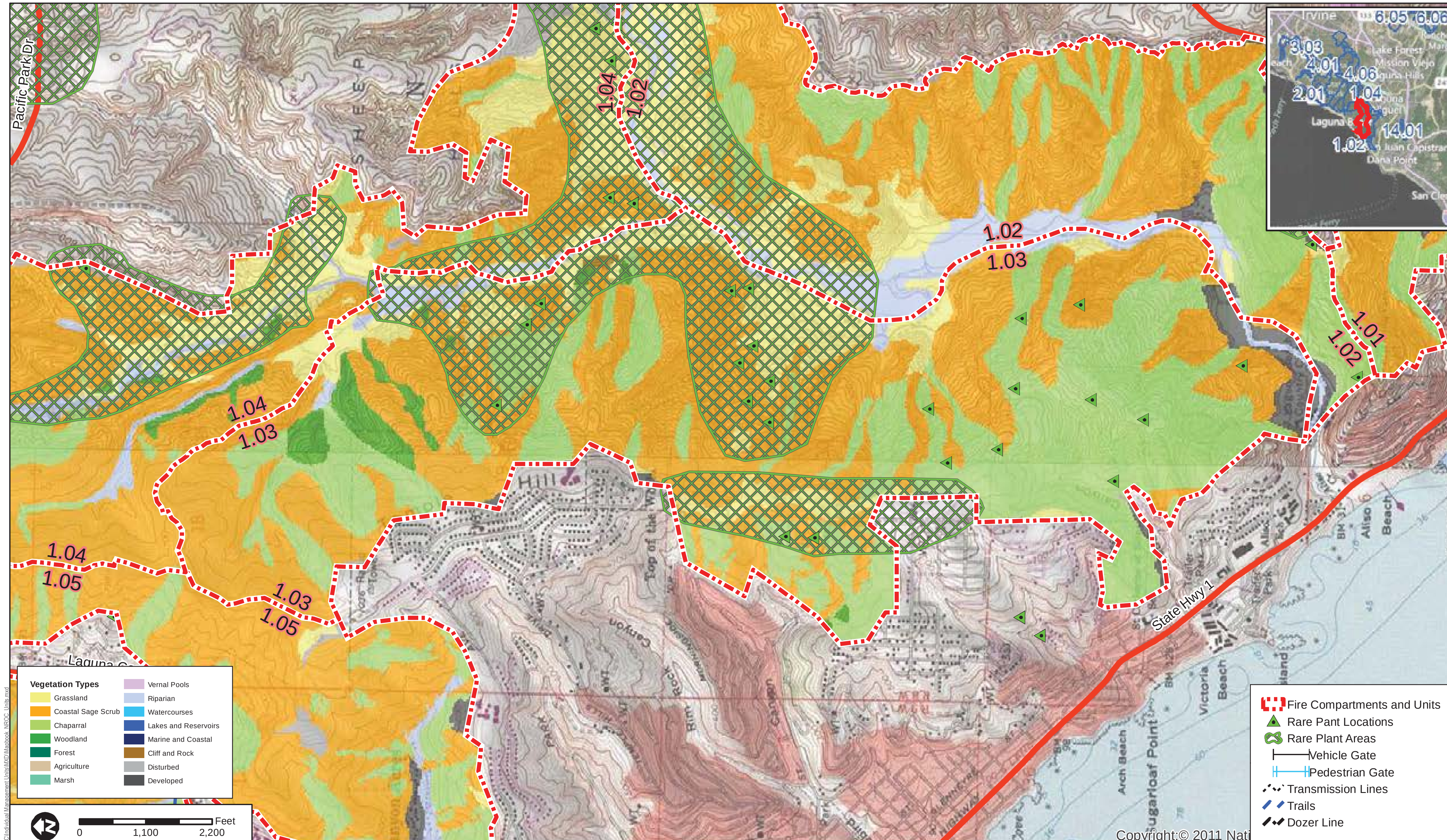

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 1.03 / Acres - 1769

Fire Management Unit 1.03

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 1.04

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 1182 acres; Special Considerations: Adjacent urban development, riparian habitats, pond turtle , garter snake	Access Route: Access in FMU is available via Awma Road and Aliso Canyon Road and from Woods Canyon Drive or Pacific Park Drive. Trails, such as Coyote Trail, Rock it Trail, and Lynx Trail, occur in various portions of the FMU, but would not be suitable for fire response. The only feasible access to the western portion of FMU is off Alta Laguna Blvd and then via W. Ridge Road which is a 15 feet wide dirt road.

Vegetation(fuel) types

Chaparral	95 ac.	8%
Coastal Sage Scrub	676 ac.	57%
Disturbed	100 ac.	9%
Grassland	229 ac.	19%
Riparian	64 ac.	5%
Woodland	18 ac.	2%

Sensitive Environmental Resources

Known sensitive species: big-leaved crown-beard , thread-leaved brodiaea , coastal California gnatcatcher, coastal cactus wren, southwestern pond turtle, grasshopper sparrow, least Bell's vireo

Last Fire Activity (Year and Percentage of Unit Burned)

1961 (1.2%)

Cultural Resources

Two sites on border of 1.03 FMU

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Pacific Ocean
Sulphur Creek Reservoir
Municipal water system (fire hydrants)
Fire Protection:
Residential homes occur along the eastern border the FMU on ridgetops.

SAFETY PRECAUTIONS: Steep terrain, flashy fuels, potential for park users to be in area

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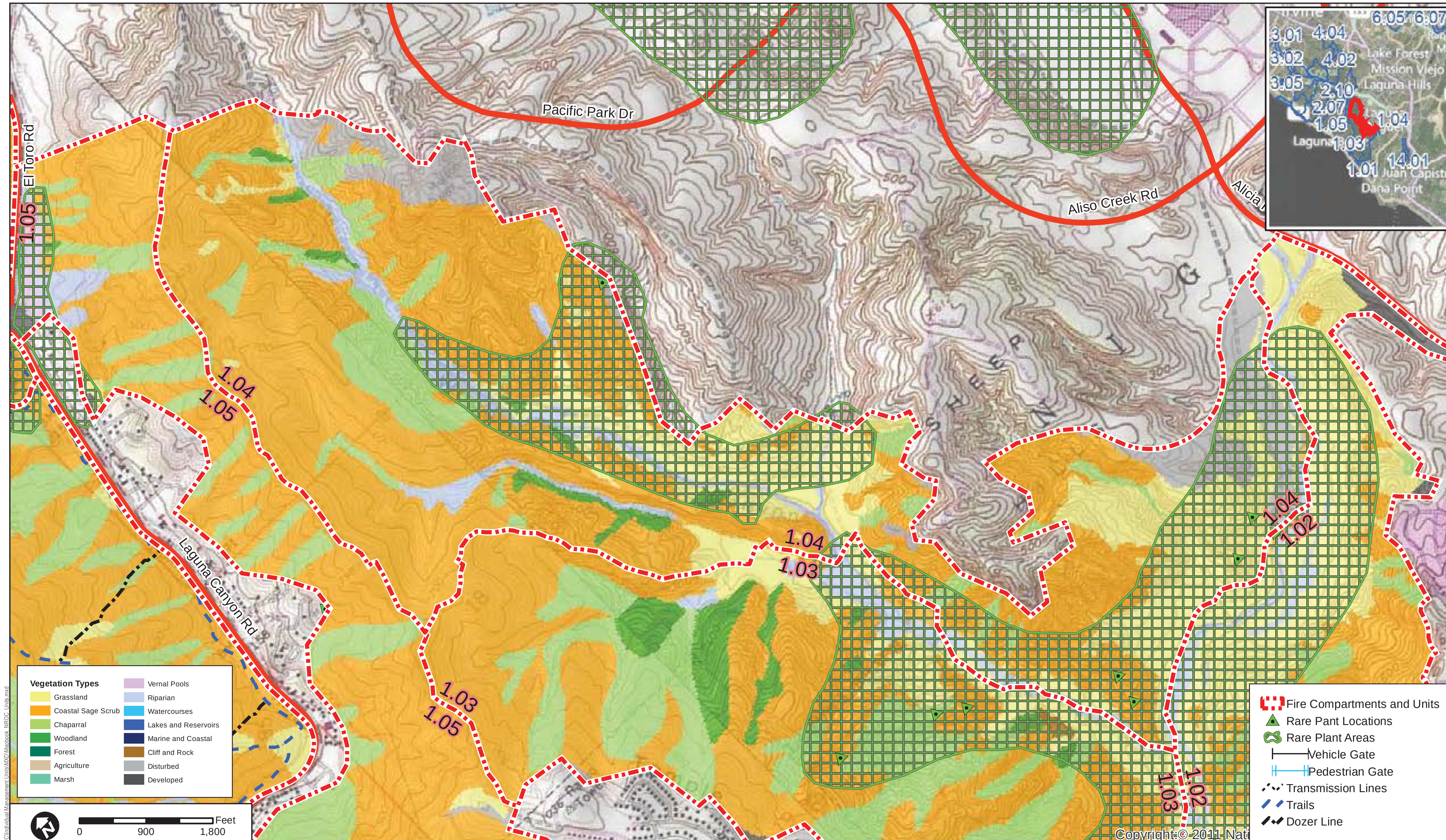

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 1.04 / Acres - 1182

Fire Management Unit 1.04

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FIRE MANAGEMENT UNIT 1.05

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression			
Size: 751 acres; Special Considerations: Area supports Laguna Beach dudleya		Access Route: Access is limited in the FMU to connector streets off Highway 133 and El Toro Road along the western and northern FMU boundaries or off Alta Laguna Blvd. and then via W. Ridge road (15 feet wide dirt road) along the eastern boundary.	
Vegetation (fuel) types			
Chaparral	186 ac.	25%	
Coastal Sage Scrub	471 ac.	63%	
Developed	36 ac.	5%	
Disturbed	8 ac.	1%	
Grassland	8 ac.	1%	
Marsh	1 ac.	0.2%	
Riparian	30 ac.	4%	
Vernal Pools	9 ac.	1%	
Woodland	2 ac.	0.2%	
Sensitive Environmental Resources			
Known sensitive species: Laguna Beach dudleya, Many-stemmed dudleya, Coastal cactus wren, Coast horned lizard (*Phrynosoma coronatum*)			
Last Fire Activity (Year and Percentage of Unit Burned)			
1993 (61%), 1983 (21%), 1982 (4%), 1961 (27%), No date given (.04%)			
Cultural Resources			
None documented			
Suppression Activities			
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Pacific Ocean Municipal water system (fire hydrants) <u>Fire Protection:</u> Residential homes occur along the southern border on ridgetops and businesses and residences occur in a box canyon along Laguna Canyon Road.			
SAFETY PRECAUTIONS: Steep terrain and limited access.			

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 1.05 / Acres - 750

Fire Management Unit 1.05

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FIRE MANAGEMENT UNIT 1.06

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 86 acres Special Considerations: Area supports abundance of rare species and cultural sites; Site largely inaccessible	Access Route: Access is extremely limited within the FMU with no drivable roads or trails; FMU is a triangle- shaped property bordered by El Toro Road and SR 73 and SR 133.

Vegetation (fuel) types

Chaparral	9 ac.	11%
Coastal Sage Scrub	68 ac.	79%
Developed	0.3 ac.	0.4%
Grassland	6 ac.	7%
Riparian	2 ac.	2%
Woodland	1 ac.	1%

Sensitive Environmental Resources

Known sensitive species: California gnatcatcher, Cactus wren, Yellow breasted chat, Many-stemmed dudleya

Last Fire Activity (Year and Percentage of Unit Burned)

No recorded fire activity

Cultural Resources

Two sites documented,.

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Pacific Ocean
Municipal water system (fire hydrants)
Fire Protection:
No structures to protect

SAFETY PRECAUTIONS: No fire history – heavy fuels, largely inaccessible by road

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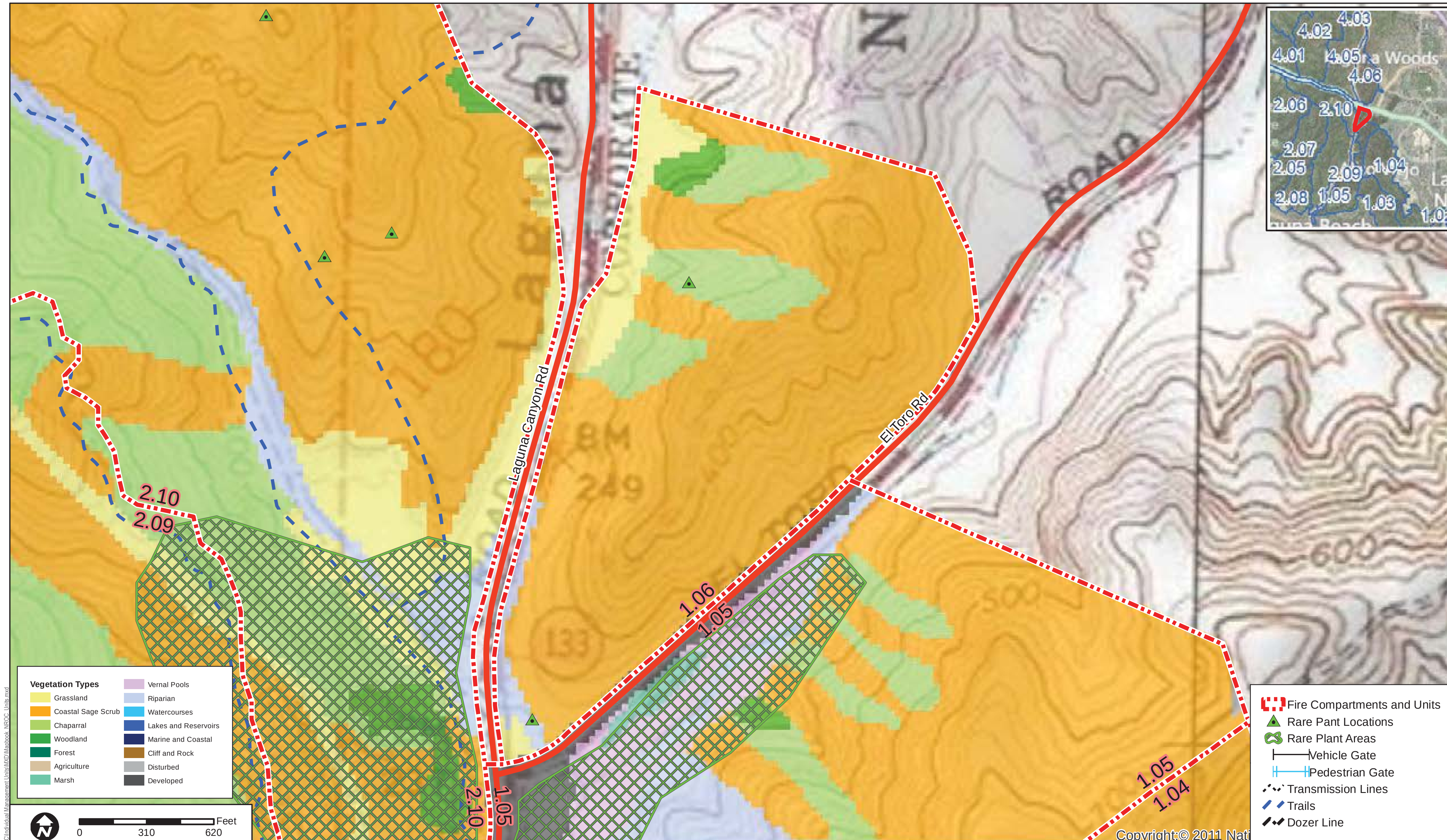

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 1.06 / Acres - 86

Fire Management Unit 1.06

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FIRE MANAGEMENT UNIT 2.01		
FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread		
Size: 310 acres Special Considerations: No Bulldozers Allowed. Site supports sensitive archeological sites and important refugia for California gnatcatcher.		Access Route: Site access is good throughout with the main access off Pacific Coast Highway that connects to State Park roadways, parking lots, and turnarounds throughout much of the FMU.
Vegetation (fuel) types		
Cliff and Rock	10 ac.	3%
Coastal Sage Scrub	161 ac.	52%
Developed	47 ac.	15%
Grassland	52 ac.	17%
Marine and Coastal	39 ac.	13%
Woodland	0.8 ac.	0.3%
Sensitive Environmental Resources		
Known sensitive species: Many-stemmed dudleya, South coast saltscale (*Atriplex pacifica*), Turkish rugging (*Chorizanthe staticoides*), Coastal California gnatcatcher, Northern harrier (*Circus cyaneus*)		
Last Fire Activity (Year and Percentage of Unit Burned)		
1993 (2%)		
Cultural Resources		
Several sites documented		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Fire containment and control Minimize destruction of biological and cultural resources Utilize lowest impacting fire suppression equipment and methods possible <u>Water Supply:</u> Pacific Ocean Municipal water system (fire hydrants) <u>Fire Protection:</u> Structures meet with undeveloped wildland or vegetative fuels along northern and southern portions of FMU.		
SAFETY PRECAUTIONS: Watch for steep ravines and erodible, coastal bluffs within unit		

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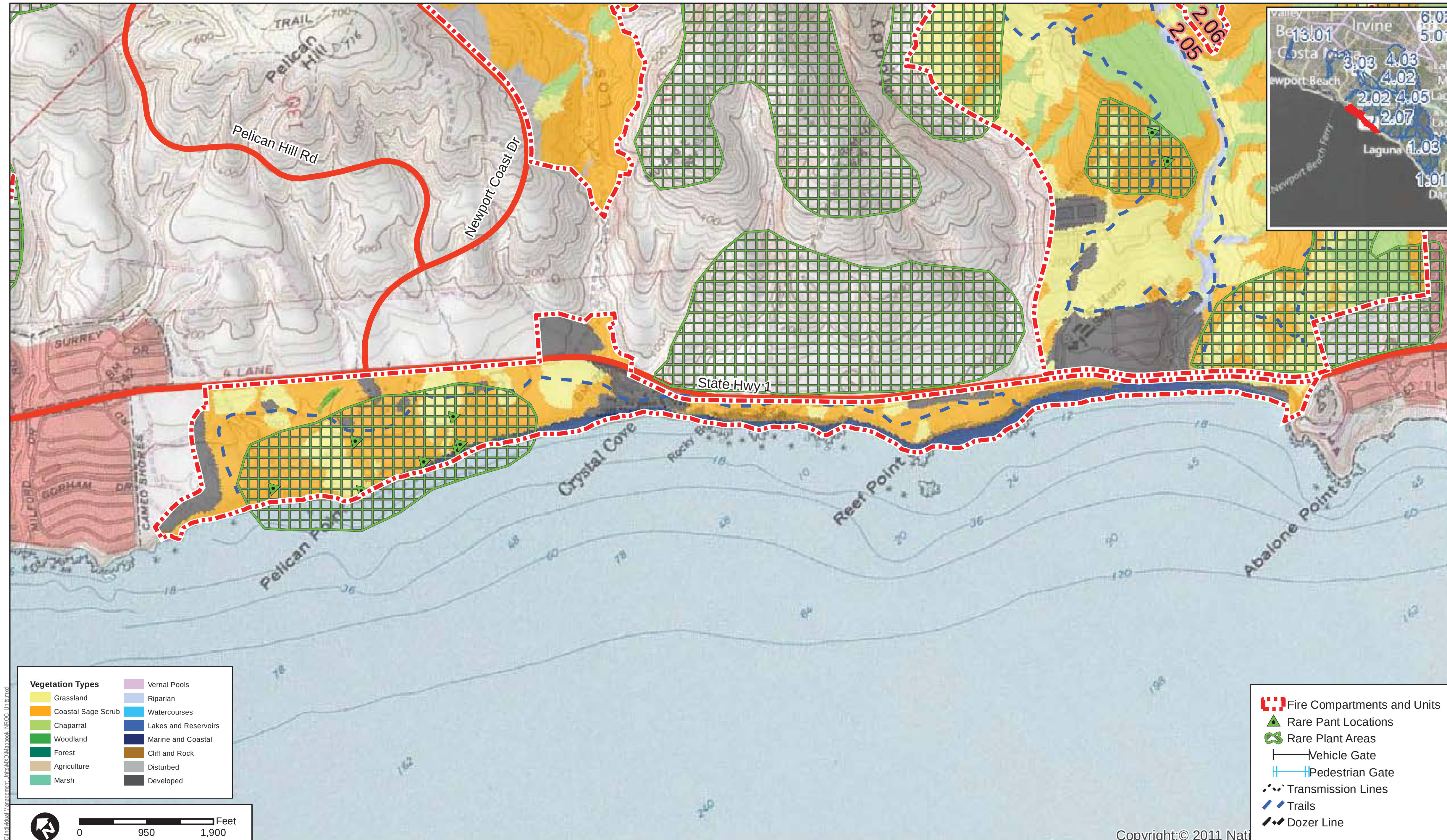

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.01 / Acres - 310

Fire Management Unit 2.01

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FIRE MANAGEMENT UNIT 2.02

<table>
<tr><th colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</th></tr>
<tr><td colspan="3">Size: 1057 acres; Special Considerations: Site supports sensitive archeological sites and important refugia for California gnatcatcher.</td><td>Access Route: Access on the periphery of the FMU is good via Newport Coast Drive (west); Vista Ridge Road (north) and Pacific Mist (northeast). Access throughout the FMU is limited. Seawatch Road is potential connection between mid-point of FMU. Other firebreaks/dirt roads occur in limited quality including the Pacific Ridge Trail at the FMU's eastern boundary, access points through development to wildland areas are provided and dispersed; Seawatch road is potentially good FMU tactical operation area within FMU - i.e., firing out operation.</td></tr>
<tr><td colspan="4">Vegetation (fuel) types</td></tr>
<tr><td>Chaparral
Coastal Sage Scrub
Disturbed
Grassland
Riparian</td><td>114 ac.
743 ac.
35 ac.
163 ac.
2 ac.</td><td colspan="2">11%
70%
3%
15%
0.2%</td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species: Many-stemmed dudleya, South coast saltscale, Turkish rugging, coastal California gnatcatcher, Northern harrier</td></tr>
<tr><td colspan="4">Last Fire Activity (Year and Percentage of Unit Burned)</td></tr>
<tr><td colspan="4">1993 (98%)</td></tr>
<tr><td colspan="4">Cultural Resources</td></tr>
<tr><td colspan="4">Several sites documented</td></tr>
<tr><td colspan="4">Suppression Activities</td></tr>
<tr><td colspan="4"><u>Fire Management Unit objectives:</u>
Fire containment and control
Minimize destruction of biological and cultural resources
Utilize lowest impacting fire suppression equipment and methods possible
<u>Water Supply:</u>
Pacific Ocean
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures meet undeveloped wildland or vegetative fuels along the northern, western, and southern boundaries of FMU.</td></tr>
<tr><td colspan="4">SAFETY PRECAUTIONS: Watch for steep ravines within unit</td></tr>
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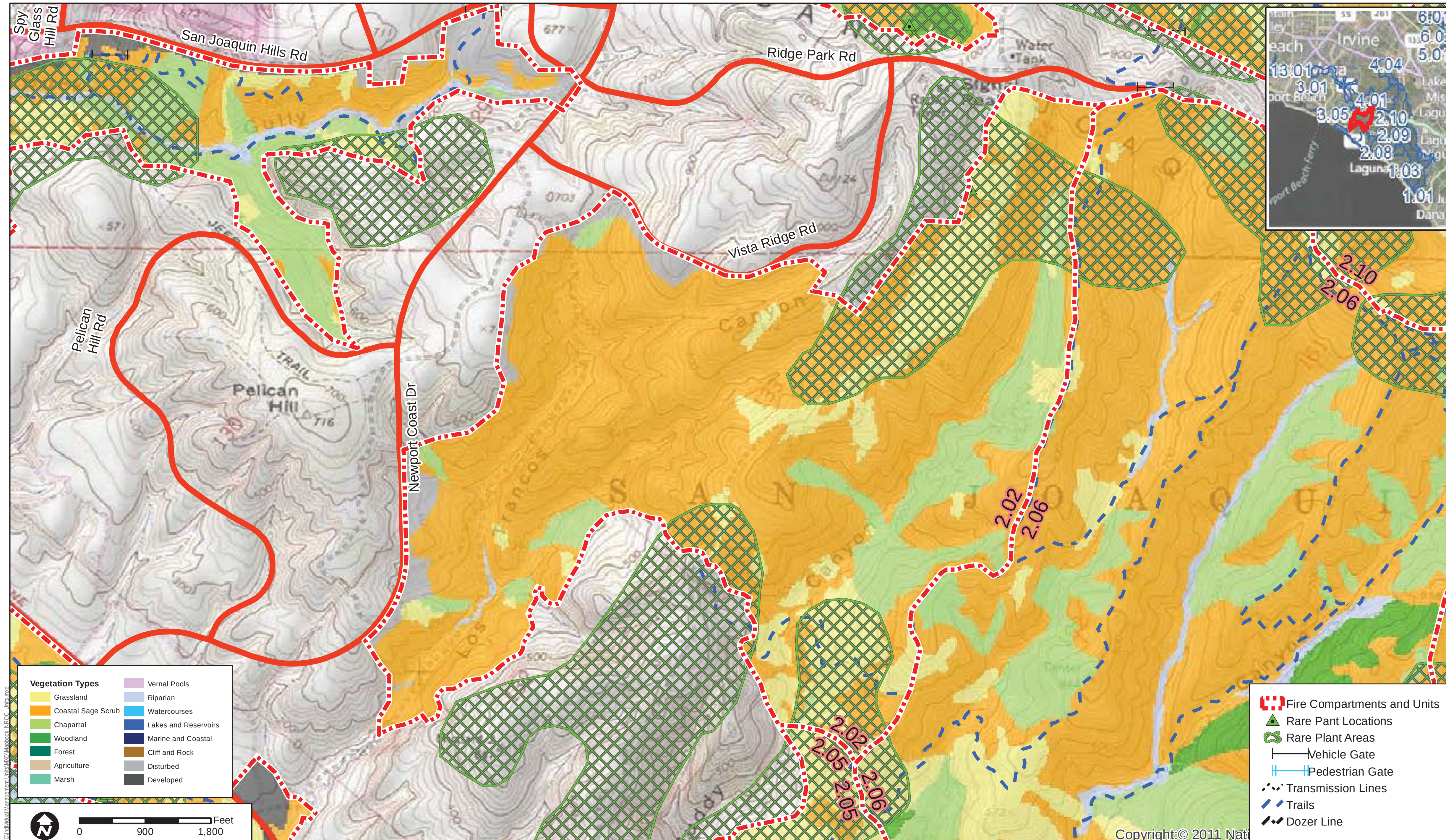

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.02 / Acres - 1058

Fire Management Unit 2.02

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FIRE MANAGEMENT UNIT 2.05

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 818 acres Special Considerations: No bulldozers allowed on State Park lands; Unit supports several archeological sites.	Access Route: Access is considered limited in this FMU and includes paved road off of Pacific Coast Highway into wastewater facility in southwest corner; Moro Ridge Road runs along the eastern portion of FMU. Various unknown dirt trails run throughout the ridges and canyon bottoms.

Vegetation (fuel) types

Chaparral	178 ac.	22%
Coastal Sage Scrub	276 ac.	34%
Developed	54 ac.	7%
Grassland	296 ac.	36%
Riparian	14 ac.	2%

Sensitive Environmental Resources

Known sensitive species: South coast saltscale, Coastal California gnatcatcher, Coastal cactus wren, Western spadefoot toad, Coast horned lizard, Least Bell's vireo, Yellow-breasted chat

Last Fire Activity (Year and Percentage of Unit Burned)

1997 (5%), 1993 (95%), 1990 (.48%), No date given (.26%)

Cultural Resources

Suppression Activities

Fire Management Unit objectives:
Fire containment and control
Minimize destruction of biological and cultural resources
Utilize lowest impacting fire suppression equipment and methods possible
Water Supply:
Pacific Ocean
Municipal water system (fire hydrants)
Fire Protection:
A school, wastewater treatment facility, and campground occur within the FMU boundary.

SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit

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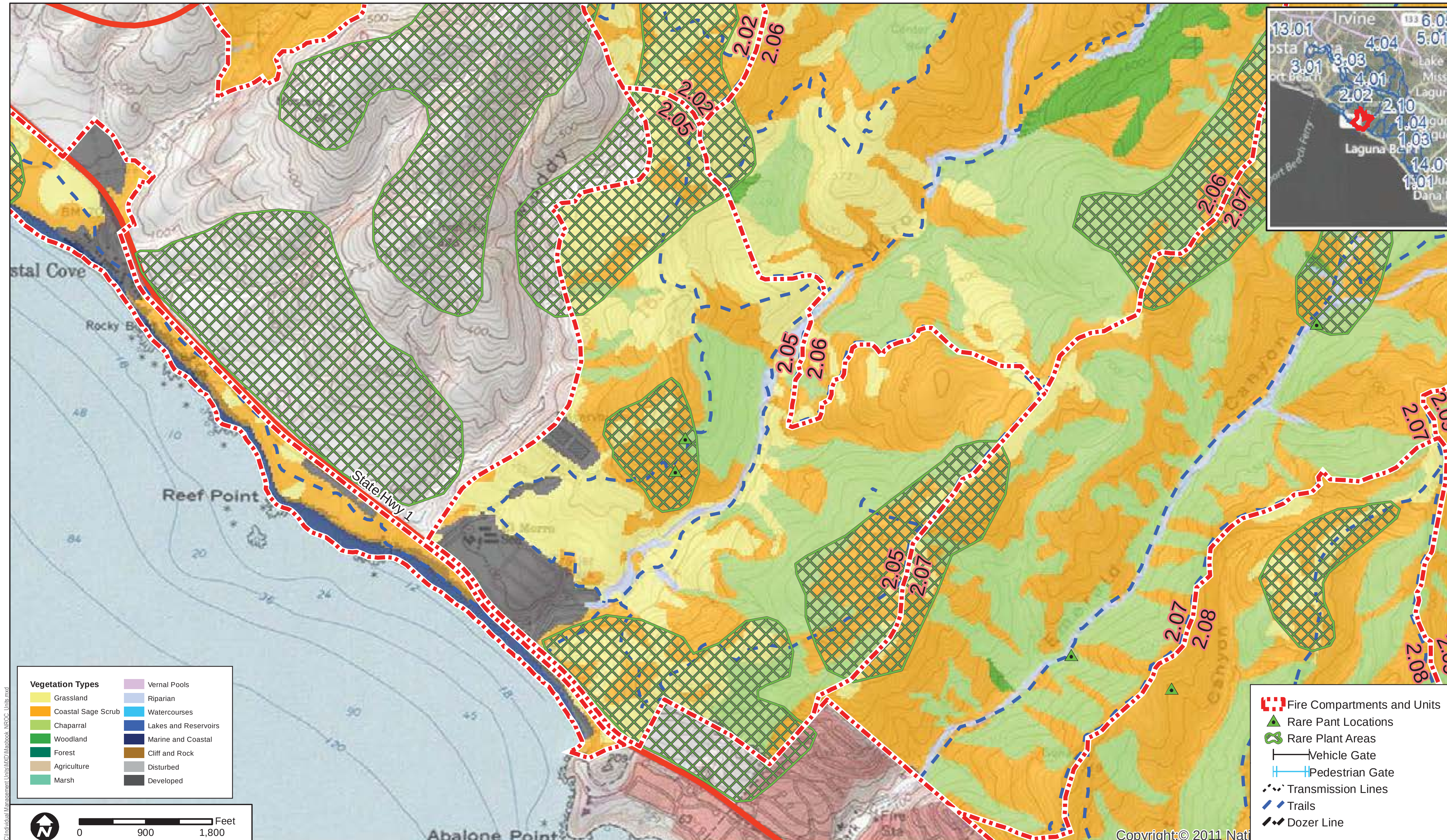

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.05 / Acres - 818

Fire Management Unit 2.05

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FIRE MANAGEMENT UNIT 2.06

FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

Size: 1618 acres Special Considerations: No bulldozers allowed on State Park lands; Unit supports several archeological sites	Access Route: Access is limited to a 10-foot wide trail on the western FMU boundary (Pacific Ridge Trail) and Ridge Park Road via gate #4837 in the north; a canyon bottom road (Moro Ridge Road) extends through the FMU and is accessed from either Pacific Coast Highway from the dirt road that connects to Ridge Park Road in the north.

Vegetation (fuel) types

Chaparral	404 ac.	25%
Coastal Sage Scrub	964 ac.	60%
Grassland	154 ac.	10%
Riparian	36 ac.	2%
Woodland	60 ac.	4%

Sensitive Environmental Resources

Known sensitive species: south coast saltscale, coastal California gnatcatcher, Coastal cactus wren, Western spadefoot toad, Coast horned lizard , Palmer's grappling hook

Last Fire Activity (Year and Percentage of Unit Burned)

2004 (.29%), 2001 (.40%), 1997 (3%), 1993 (100%), 1990 (.05%), 1955 (17%),

Cultural Resources

Many sites documented throughout FMU

Suppression Activities

Fire Management Unit objectives:
Fire containment and control
Minimize destruction of biological and cultural resources
Utilize lowest impacting fire suppression equipment and methods possible
Water Supply:
Pacific Ocean
Municipal water system (fire hydrants)
Fire Protection:
Structures meet undeveloped wildland or vegetative fuels along northwest side of FMU.

SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit

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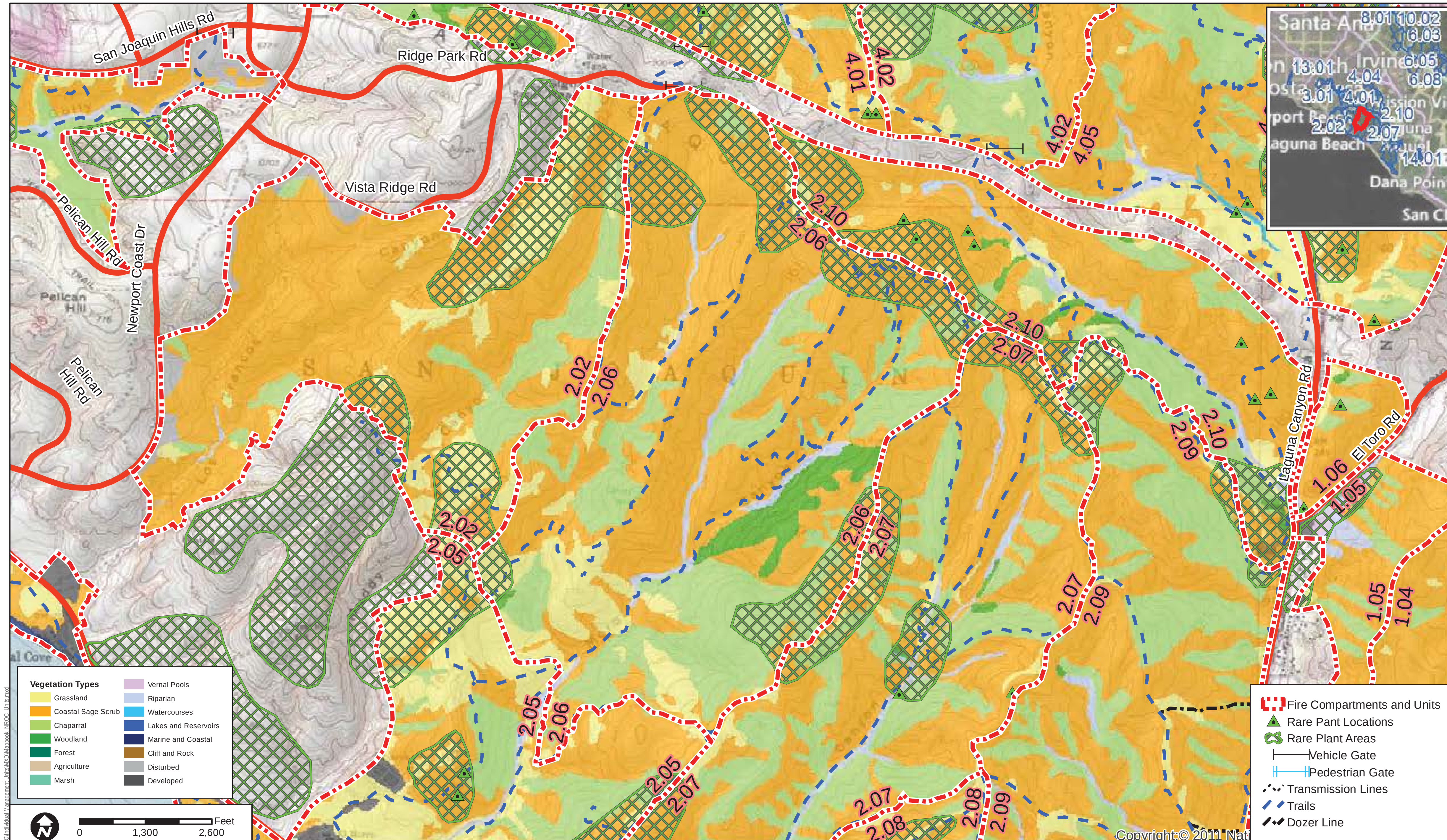

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.06 / Acres - 1618

Fire Management Unit 2.06

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FIRE MANAGEMENT UNIT 2.07

FIREFIGHTING PROTOCOL: Assertive - Rapid Fire Control/Extinguishment, minimal fire spread

Size: 1290 acres Special Considerations: Unit borders state parks; no bulldozers allowed on state parks lands. Unit supports high quality riparian and coastal sage scrub habitat. Southern California Edison Powerlines cross unit.	Access Route: Access is limited throughout canyon bottoms, ridge-tops include dirt road/trails including Moro Ridge Road and Emerald Bay Road which intersect with Pacific Coast Highway via connector roads, and Bommer Ridge Road and other transmission line roads; roads would likely not be used during fire, no turnarounds.

Vegetation (fuel) types

Chaparral	443 ac.	34%
Coastal Sage Scrub	751 ac.	58%
Grassland	54 ac.	4%
Riparian	36 ac.	3%
Woodland	6 ac.	0.5%

Sensitive Environmental Resources

Known sensitive species: coastal cactus wren, coastal California gnatcatcher, coast horned lizard, western spadefoot toad, red-diamond rattlesnake (*Crotalus ruber*), red-tailed hawk (*Buteo jamaicensis*), red-shouldered hawk (*Buteo lineatus*), yellow breasted chat, western dichondra (*Dichondra occidentalis*).

Last Fire Activity (Year and Percentage of Unit Burned)

1993 (100%), 1979 (14%), 1955 (33%), No date given (.60%) (Emerald Canyon Prescribed Burn in 1990 occurred in 55% of FMU)

Cultural Resources

Many sites documented

Suppression Activities

<u>Fire Management Unit objectives::</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized, except bulldozers may be restricted due to cultural resource sites are in adjoining FMUs.
<u>Water Supply:</u>
Pacific Ocean
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures meet undeveloped wildland or vegetative fuels along southwest side of FMU.

SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit; steep topography; nettles and poison oak in canyon bottom.

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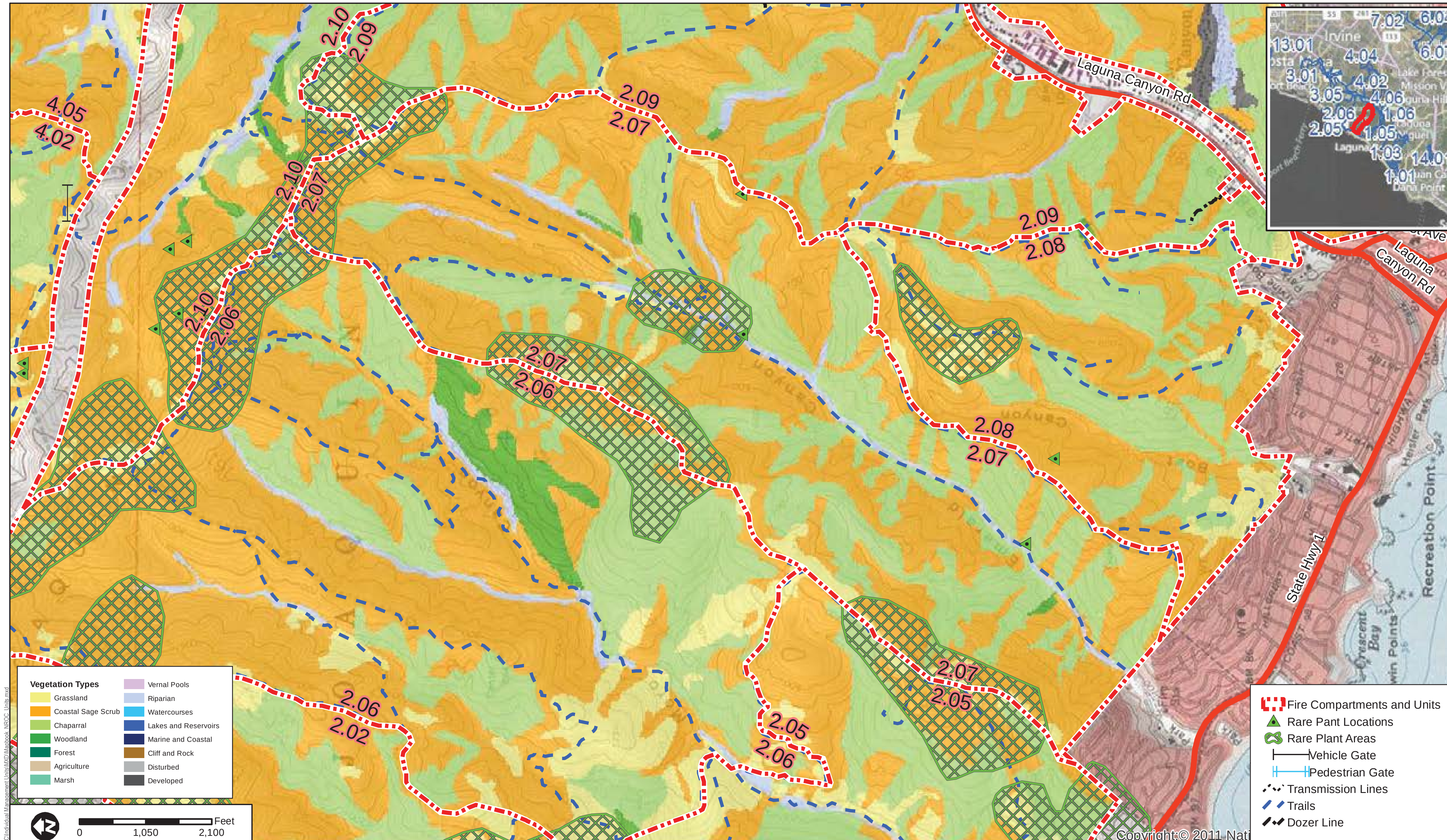

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.07 / Acres - 1291

Fire Management Unit 2.07

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FIRE MANAGEMENT UNIT 2.08

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 576 acres Special Considerations: Unit supports high quality coastal sage scrub habitat. Southern California Edison Powerlines cross unit.	Access Route: Access is limited throughout canyon bottoms and ridgetops. Main access points to FMU are Spur Ridge Road and Water Tank Road which intersect with Pacific Coast Highway via various connector streets and Laguna Bowl Road accessed from Laguna Canyon Road; roads would likely not be used during fire, no turnarounds, unsafe topography for ground attack.

Vegetation (fuel) types

Chaparral	202 ac.	35%
Coastal Sage Scrub	311 ac.	54%
Developed	3 ac.	0.6%
Grassland	59 ac.	10%
Woodland	0.6 ac.	0.1%

Sensitive Environmental Resources

Known sensitive species: coastal cactus wren, coastal California gnatcatcher, coast horned lizard, western spadefoot toad

Last Fire Activity (Year and Percentage of Unit Burned)

1993 (99%), 1990 (.18%), 1979 (59%), No date given (6%)

Cultural Resources

Several sites documented

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Pacific Ocean
Municipal water system (fire hydrants)
Fire Protection:
Structures meet with undeveloped wildland or vegetative fuels along southern boundary.

SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit; steep topography

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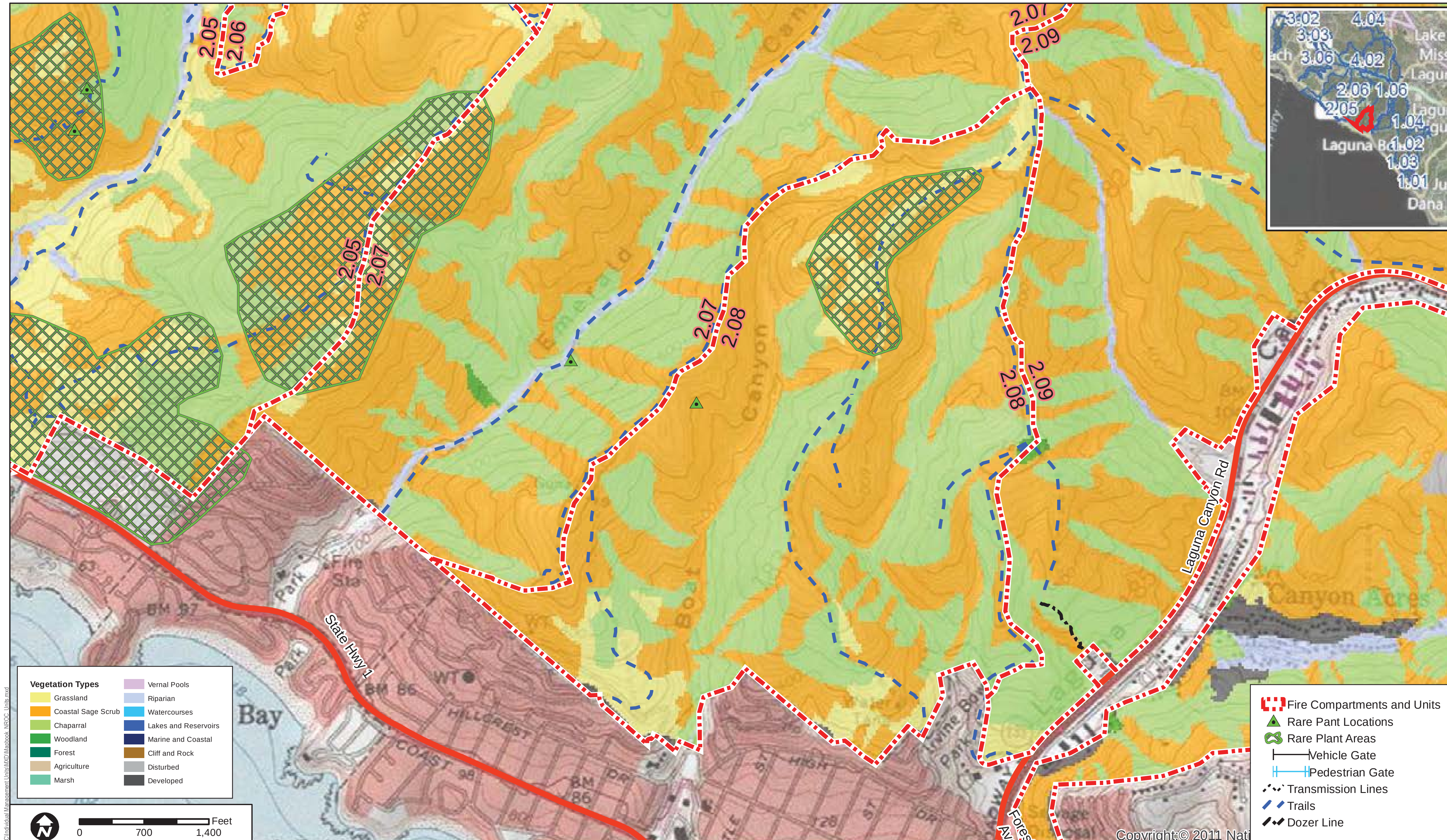

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.08 / Acres - 576

Fire Management Unit 2.08

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FIRE MANAGEMENT UNIT 2.09

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 1144 acres Special Considerations: Telecommunication lines along Laguna Canyon Road; Unit supports high quality coastal sage scrub; FMU forms the west side of steep, box canyon.	Access Route: Access is limited within FMU – Laguna Bowl Road and Bommer Ridge Road (both dirt roads) form western boundary and can be accessed from Laguna Canyon Road (Highway 133); Big Bend Trail and other trails in FMU are not drivable.

Vegetation (fuel) types

Chaparral	396 ac.	35%
Coastal Sage Scrub	676 ac.	59%
Developed	0.9 ac.	0.1%
Grassland	53 ac.	5%
Riparian	16 ac.	1%
Woodland	2 ac.	0.2%

Sensitive Environmental Resources

Known sensitive species: coastal cactus wren, coastal California gnatcatcher, coast horned lizard, Least Bell's vireo

Last Fire Activity (Year and Percentage of Unit Burned)

1993 (1%), 1990 (17%), 1979 (.30%), 1955 (39%), No date given (.5%)

Cultural Resources

Three sites documented

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Pacific Ocean
Municipal water system (fire hydrants)
Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels in steep, box canyon along Laguna Canyon Road (Highway 133).

SAFETY PRECAUTIONS: Flashy fuels, steep topography

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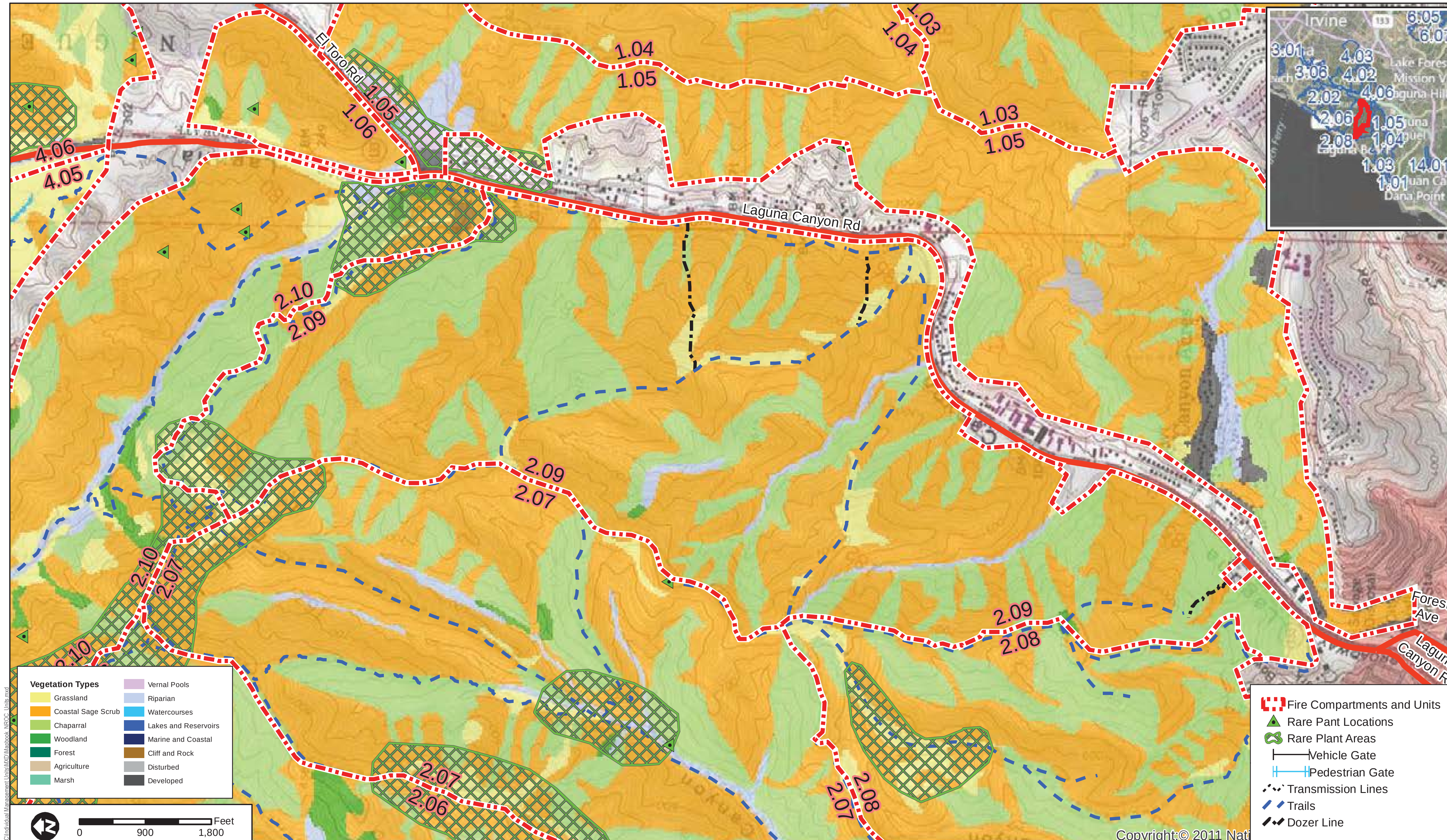

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.09 / Acres - 1145

Fire Management Unit 2.09

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FIRE MANAGEMENT UNIT 2.10

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 640 acres Special Considerations: Unit supports Laguna Beach dudleya and high quality rock outcrop, Coastal sage scrub, chaparral, and riparian woodlands.	Access Route: Main access is from Ridge Park Road gate #4837 to Bommer Ridge Road or from Laguna Canyon Road (Highway 133) to Willow Canyon Road which intersects with Bommer Ridge Road. Laurel Canyon Trail and other trails in FMU are not drivable.

Vegetation (fuel) types

Chaparral	107 ac.	17%
Cliff and Rock	3 ac.	0.5%
Coastal Sage Scrub	427 ac.	67%
Grassland	52 ac.	8%
Riparian	31 ac.	5%
Woodland	20 ac.	3%

Sensitive Environmental Resources

Known sensitive species: Laguna Beach dudleya , coastal cactus wren, coastal California gnatcatcher, red-shouldered hawk, Vernal barley, Many stemmed dudleya

Last Fire Activity (Year and Percentage of Unit Burned)

1993 (100%), 1955 (59%)

Cultural Resources

Several sites documented, likely more present

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Pacific Ocean
Municipal water system (fire hydrants)
Fire Protection:
FMU is bordered by Interstate 73 to the north and Highway 133 to the south with no structures.

SAFETY PRECAUTIONS: Steep topography; limited access to interior of unit

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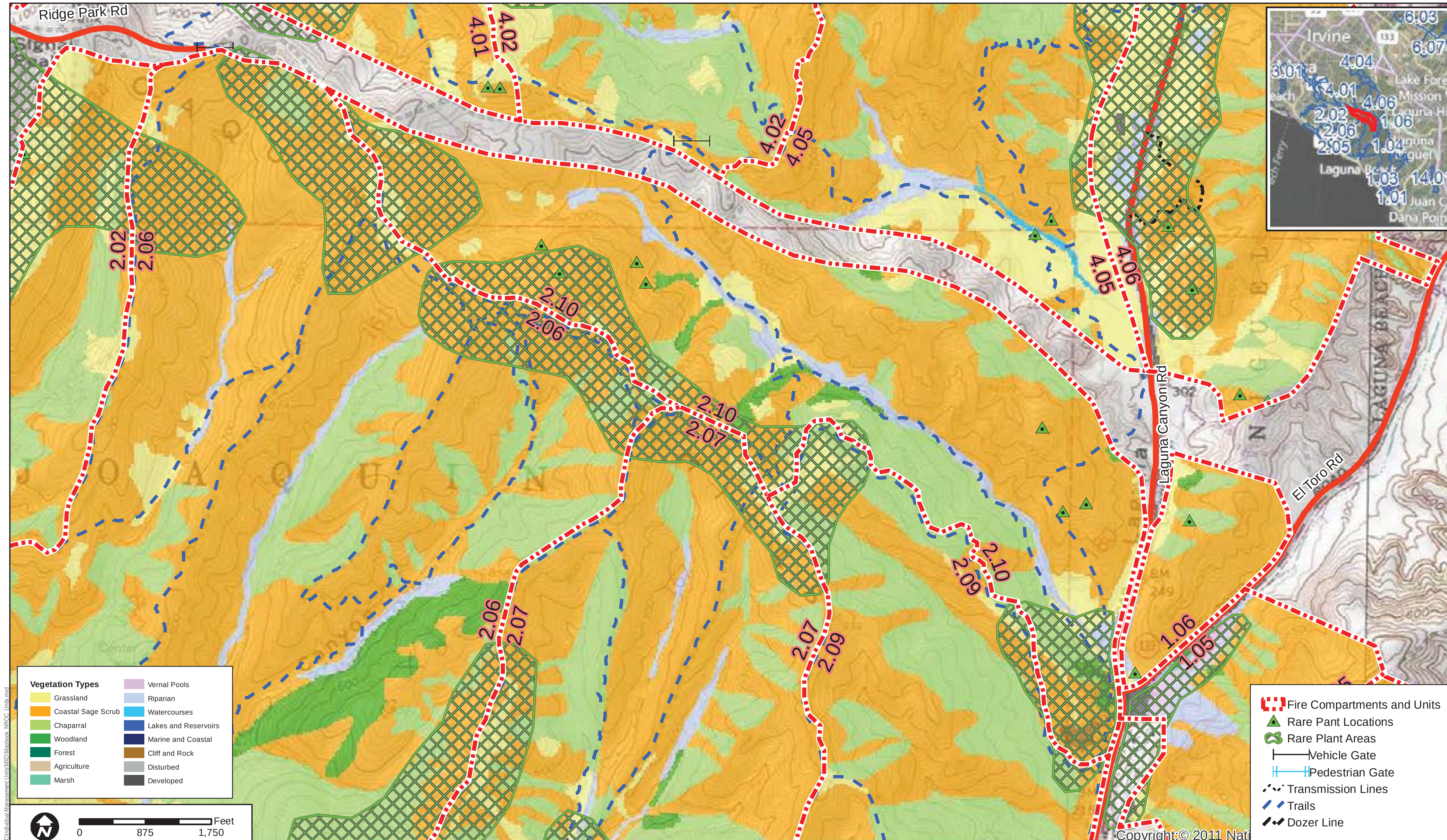

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 2.10 / Acres - 641

Fire Management Unit 2.10

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FIRE MANAGEMENT UNIT 3.01		
FIREFIGHTING PROTOCOL: Reserved – Minimal Biological Impact		
Size: 810 acres; Special Considerations: Site contains sensitive wetland habitat and several known cultural resource sites		Access Route: Access is Irvine Avenue on west side of FMU and Jamboree Road to Back Bay Drive on the east side. Interior access is poor with no roads.
Vegetation (fuel) types		
Coastal Sage Scrub	20 ac.	3%
Developed	8 ac.	1%
Disturbed	3 ac.	0.4%
Grassland	93 ac.	12%
Lakes and reservoirs	6 ac.	1%
Marine and Coastal	323 ac.	40%
Marsh	328 ac.	41%
Riparian	24 ac.	3%
Watercourses	5 ac.	1%
Sensitive Environmental Resources		
Known sensitive species: California gnatcatcher, Clapper rail (*Rallus longirostris*), Least tern (*Sterna antillarum browni*), Osprey (*Pandion haliaetus*), Davidson's saltscale (*Atriplex serenana var. davidonsii*), Southern Tarplant (*Hemizonia parryi ssp. australis*), many stemmed dudleya, salt marsh bird's beak (*Chloropyron maritimum ssp. maritimum*)		
Last Fire Activity (Year and Percentage of Unit Burned)		
No recorded fire activity		
Cultural Resources		
None documented.		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Fire containment and control Minimize destruction of biological and cultural resources Utilize lowest impacting fire suppression equipment and methods possible <u>Water Supply:</u> Pacific Ocean Newport Bay Municipal water system (fire hydrants) <u>Fire Protection:</u> Structures meet or intermingle with undeveloped wildland or vegetative fuels.		
SAFETY PRECAUTIONS: WUI area with homes on top of coastal bluffs. No good access to fight fires in marsh or riparian areas.		

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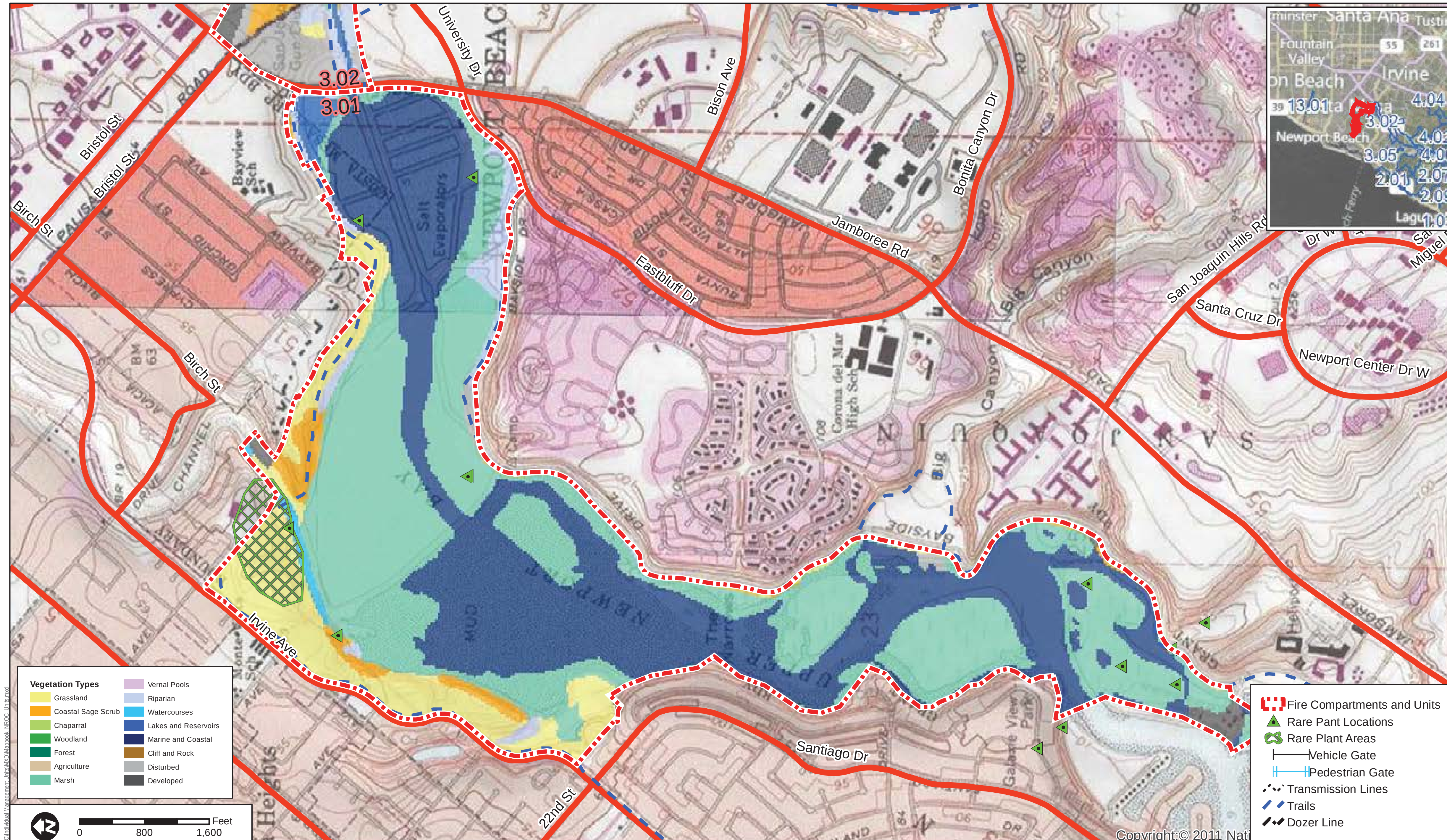

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 3.01 / Acres - 809

Fire Management Unit 3.01

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FIRE MANAGEMENT UNIT 3.02

FIREFIGHTING PROTOCOL: Reserved – Minimal Biological Impact

Size: 325 acres; Special Considerations: TCA mitigation site. Several California gnatcatcher sites documented	Access Route: Access is limited to trails and perimeter streets including: Office parking lots and 73 transportation corridor to the East; Bonita Canyon to the south; MacArthur Boulevard and various residential and reservoir access to the west; Bison Avenue and University Drive in the mid-FMU and Jamboree Road to the north.

Vegetation (fuel) types

Coastal Sage Scrub	75 ac.	23%
Developed	40 ac.	12%
Disturbed	129 ac.	40%
Grassland	38 ac.	12%
Lakes and reservoirs	3 ac.	1%
Marine and Coastal	0.1 ac.	0.1%
Marsh	4 ac.	1%
Riparian	35 ac.	11%
Watercourses	0.1 ac.	0.1%

Sensitive Environmental Resources

Known sensitive species: Coastal cactus wren , California gnatcatcher, Least bell's vireo, IntermediateFoothill Mariposa Lily (*Calochortus weedii var. intermedius*), Many stemmed dudleya, Woolly sea-blite (*Suaeda californica*).

Last Fire Activity (Year and Percentage of Unit Burned)

No recorded fire activity

Cultural Resources

None documented

Suppression Activities

<u>Fire Management Unit objectives:</u>
Fire containment within FMU
Minimal destruction or disturbance of habitat
Utilize only non-impacting fire suppression methods
<u>Water Supply:</u>
Municipal water system (fire hydrants)
Upper Newport Bay
San Joaquin Reservoir
<u>Fire Protection:</u>
Structures meet or intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: none

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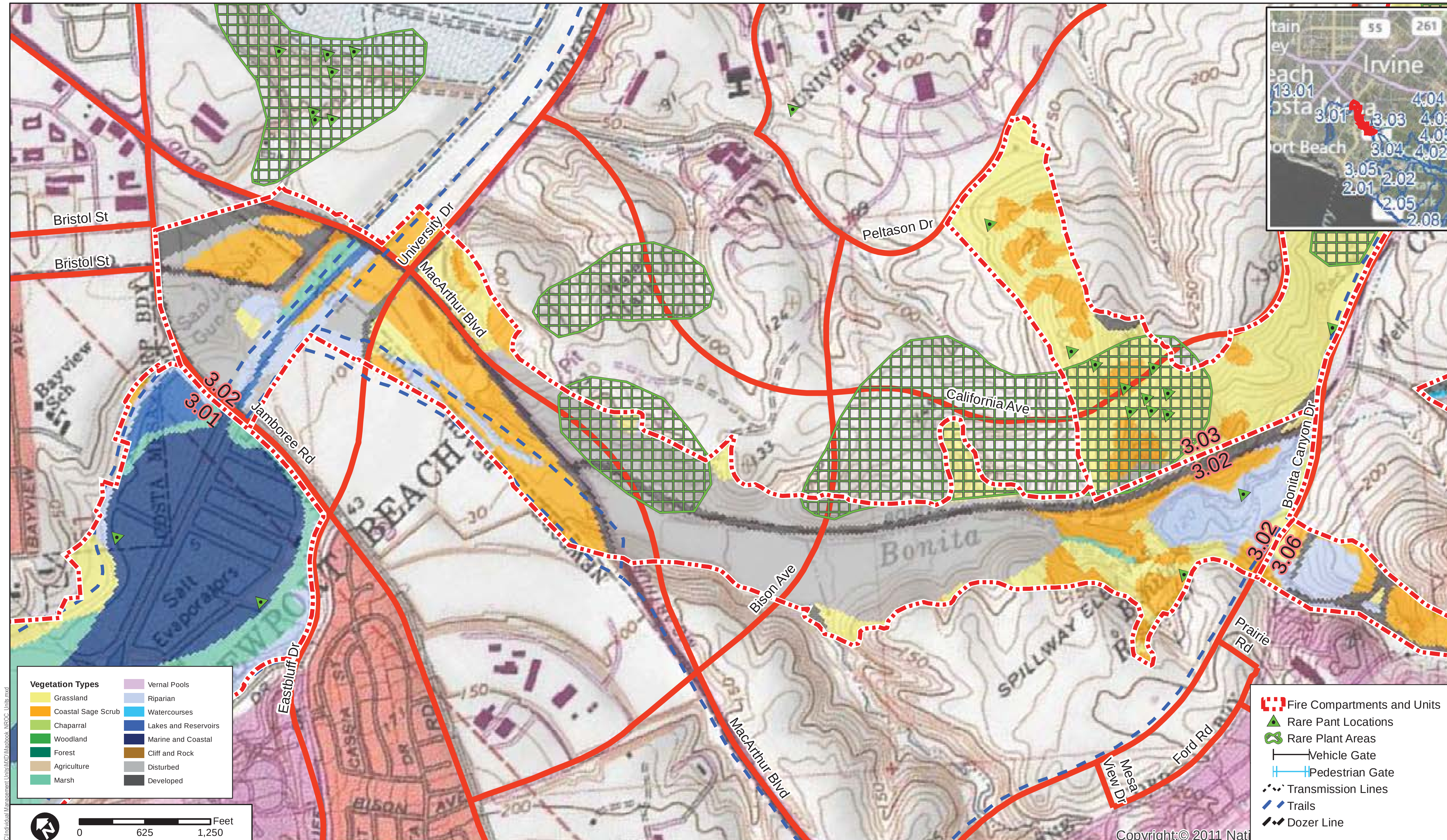

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 3.02 / Acres - 325

Fire Management Unit 3.02

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FIRE MANAGEMENT UNIT 3.03

FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

Size: 207 acres Special Considerations: Unit supports sensitive Coastal sage scrub, California gnatcatcher and cactus wren	Access Route: Access is limited to trails and perimeter streets including: Anteater Drive, Peltason Drive and California Avenue and office parking lots and 73 transportation corridor to the East; Bonita Canyon to the south; various residential and reservoir access to the west; Bison Avenue and University Drive in the mid-FMU and Jamboree Road to the north.

Vegetation (fuel) types

Coastal Sage Scrub	21 ac.	10%
Developed	2 ac.	1%
Disturbed	2 ac.	1%
Grassland	177 ac.	86%
Marsh	5 ac.	3%

Sensitive Environmental Resources

Known sensitive species: California gnatcatcher, Cactus wren, Coulter's goldfields (*Lasthenia glabrata ssp. coulteri*), Many stemmed dudleya, Small flowered microseris, Vernal barley

Last Fire Activity (Year and Percentage of Unit Burned)

No recorded fire activity

Cultural Resources

Unknown

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
1. Fire containment and control
2. Minimize destruction of biological resources
3. Utilize lowest impacting fire suppression equipment and methods possible

Water Supply:
Municipal water system (fire hydrants)
San Joaquin Reservoir

Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: none

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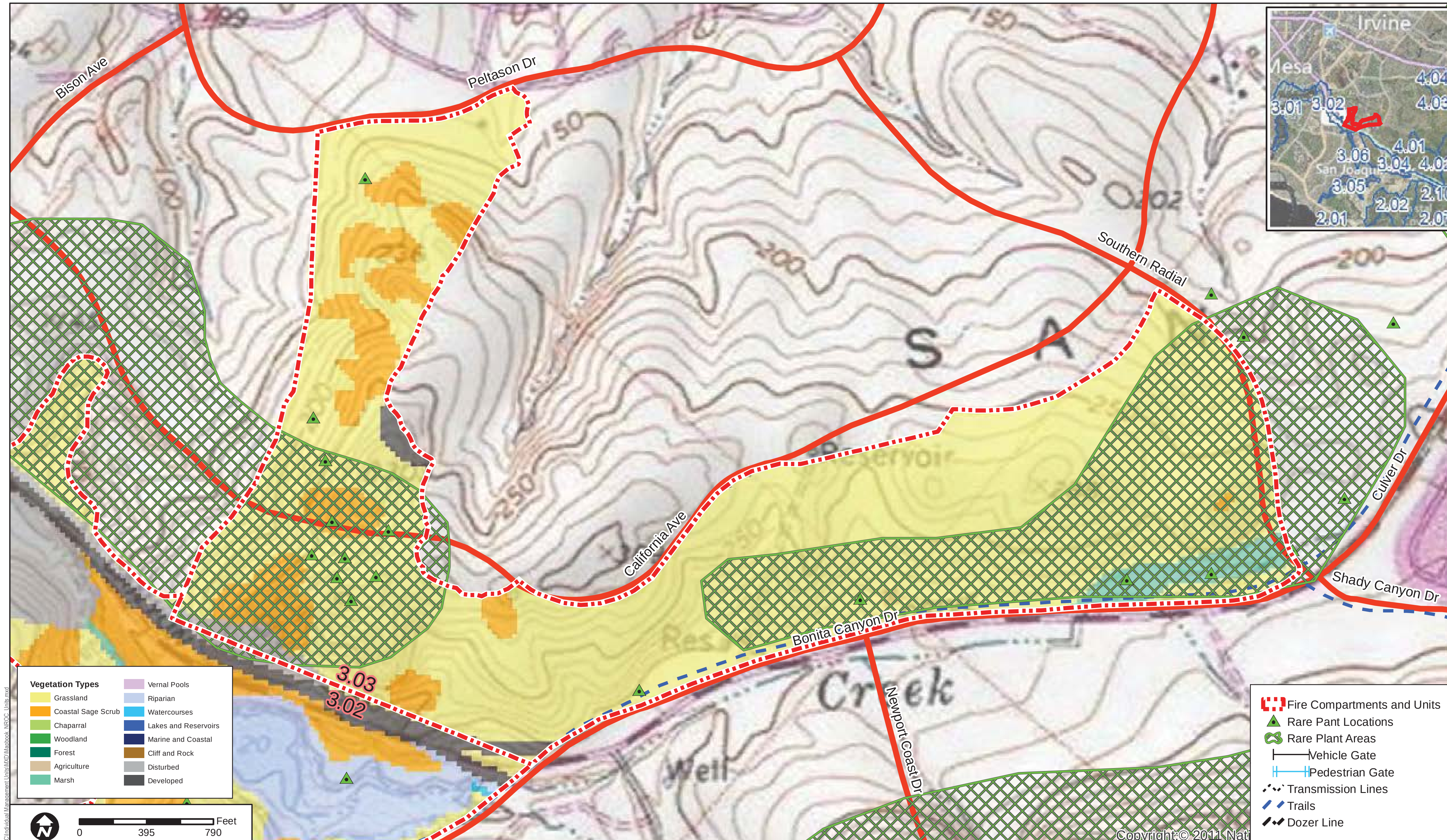

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 3.03 / Acres - 207

Fire Management Unit 3.03

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FIRE MANAGEMENT UNIT 3.04		
FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 575 acres; Special Considerations: Methane gas recovery facility; TCA Mitigation area supports re-vegetated Coastal sage scrub and California gnatcatcher	Access Route: Newport Coast Drive bisects FMU into two sections. The western section is accessed from Coyote Canyon Drive and I-73. The eastern portion can be accessed from Ridge Park Road to the south, I-73 in the north and east, and Newport Coast Drive from the west.	
Vegetation (fuel) types		
Chaparral	14 ac.	3%
Cliff and Rock	1 ac.	0.2%
Coastal Sage Scrub	96 ac.	17%
Developed	27 ac.	5%
Disturbed	389 ac.	68%
Grassland	24 ac.	4%
Riparian	5 ac.	1%
Watercourses	0.5 ac.	0.1%
Woodland	18 ac.	3%
Sensitive Environmental Resources		
Known sensitive species: California gnatcatcher, San Diego black-tailed jackrabbit (*Lepus californicus bennettii*), Engelmann oak (*Quercus engelmannii*)		
Last Fire Activity (Year and Percentage of Unit Burned)		
1993 (39%)		
Cultural Resources		
Five sites documented		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Municipal water system (fire hydrants) San Joaquin Reservoir <u>Fire Protection:</u> Structures meet or intermingle with undeveloped wildland or vegetative fuels. High School and wastewater treatment facility within FMU boundaries.		
SAFETY PRECAUTIONS: Methane gas recovery facility; wastewater treatment facility		

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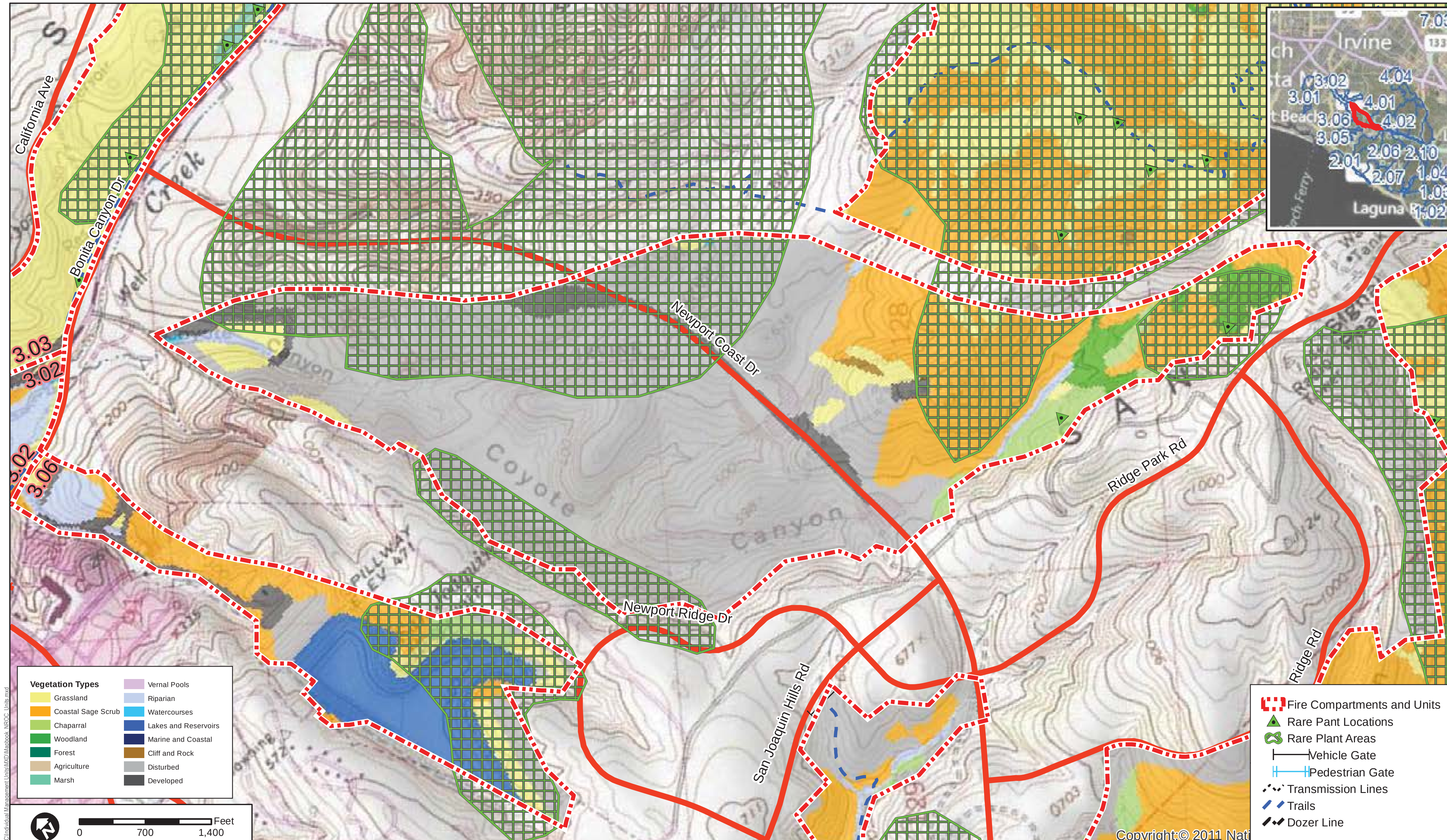

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 3.04 / Acres - 576

Fire Management Unit 3.04

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 3.05</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 332 acres; Special Considerations: Unit supports sensitive coastal sage scrub and Quercus dumosa</td><td>Access Route: Main access is from San Joaquin Hills Road in the north, Newport Coast Drive from east, and Pacific Coast Highway from the west. Site access is poor, very little of the FMU includes drivable roadways, and access through dense residential in southwest is constraining. Locked gates are 4930X at Poppy Avenue, 4832W and 4734Y at San Joaquin Hills Road.</td></tr>
<tr><td colspan="4">Vegetation (fuel) types</td></tr>
<tr><td>Chaparral</td><td>91 ac.</td><td>38%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>82 ac.</td><td>34%</td><td></td></tr>
<tr><td>Developed</td><td>25 ac.</td><td>10%</td><td></td></tr>
<tr><td>Disturbed</td><td>41 ac.</td><td>17%</td><td></td></tr>
<tr><td>Grassland</td><td>59 ac.</td><td>25%</td><td></td></tr>
<tr><td>Riparian</td><td>34 ac.</td><td>14%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Sensitive plant and wildlife species that have been documented in Buck Gully include: Nuttall’s scrub oak (Quercus dumosa), coastal California gnatcatcher, coastal cactus wren</td></tr>
<tr><td colspan="4">Last Fire Activity (Year and Percentage of Unit Burned)</td></tr>
<tr><td colspan="4">1993 (.01%)</td></tr>
<tr><td colspan="4">Cultural Resources</td></tr>
<tr><td colspan="4">Three sites documented</td></tr>
<tr><td colspan="4">Suppression Activities</td></tr>
<tr><td colspan="4"><u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Pacific Ocean
San Joaquin Reservoir
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures meet with undeveloped wildland or vegetative fuels. Older residential communities on both sides of Bick Canyon.</td></tr>
<tr><td colspan="4">SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit. Truck trail in bottom of canyon is washed out/un-passable.</td></tr>
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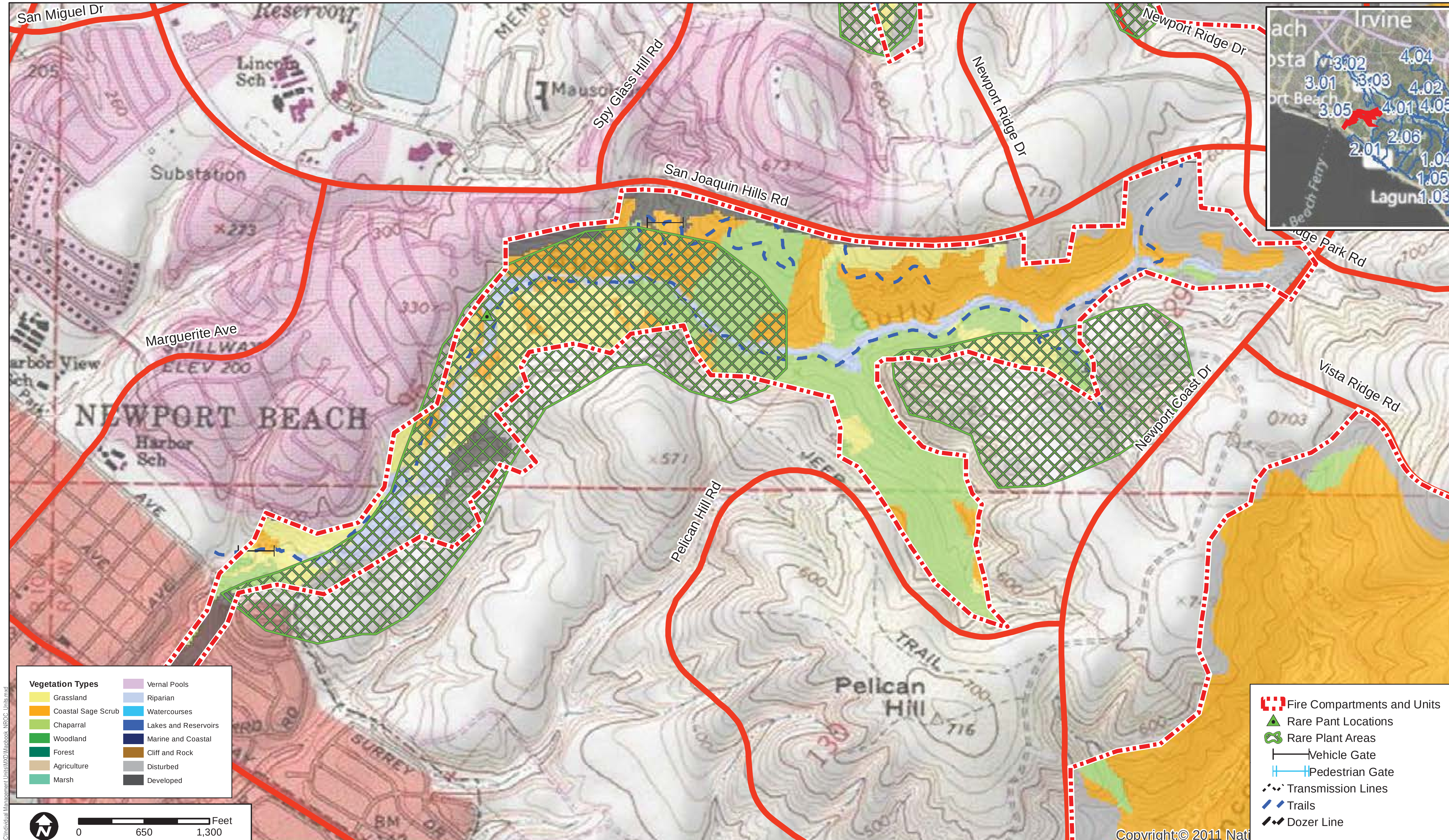

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 3.05 / Acres - 332

Fire Management Unit 3.05

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FIRE MANAGEMENT UNIT 3.06

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 139 acres Special Considerations: Reservoir, WUI on all sides, Bonita Canyon Road to north, fuel modification in place for adjacent structures	Access Route: Access is good to the site from Bonita Drive to Ford Road. Gates off of Ford Road and Chambord Road managed by Irvine Ranch Water District. Paved road continues throughout the site leading to and around reservoir. Southern portion of FMU is accessible from Spyglass Hills Drive, El Capitan Drive, and Newport Ridge Drive.

Vegetation (fuel) types

Chaparral	5 ac.	4%
Coastal Sage Scrub	32 ac.	23%
Developed	10 ac.	7%
Disturbed	18 ac.	13%
Grassland	13 ac.	9%
Lakes and reservoirs	53 ac.	38%
Riparian	8 ac.	6%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented in FMU:

Last Fire Activity (Year and Percentage of Unit Burned)

No recorded fire activity

Cultural Resources

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
San Joaquin Reservoir
Municipal water system (fire hydrants)
Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Gated access at north (Ford Road), Second gated access off Chambord Road (adjacent neighborhood) narrow canyon

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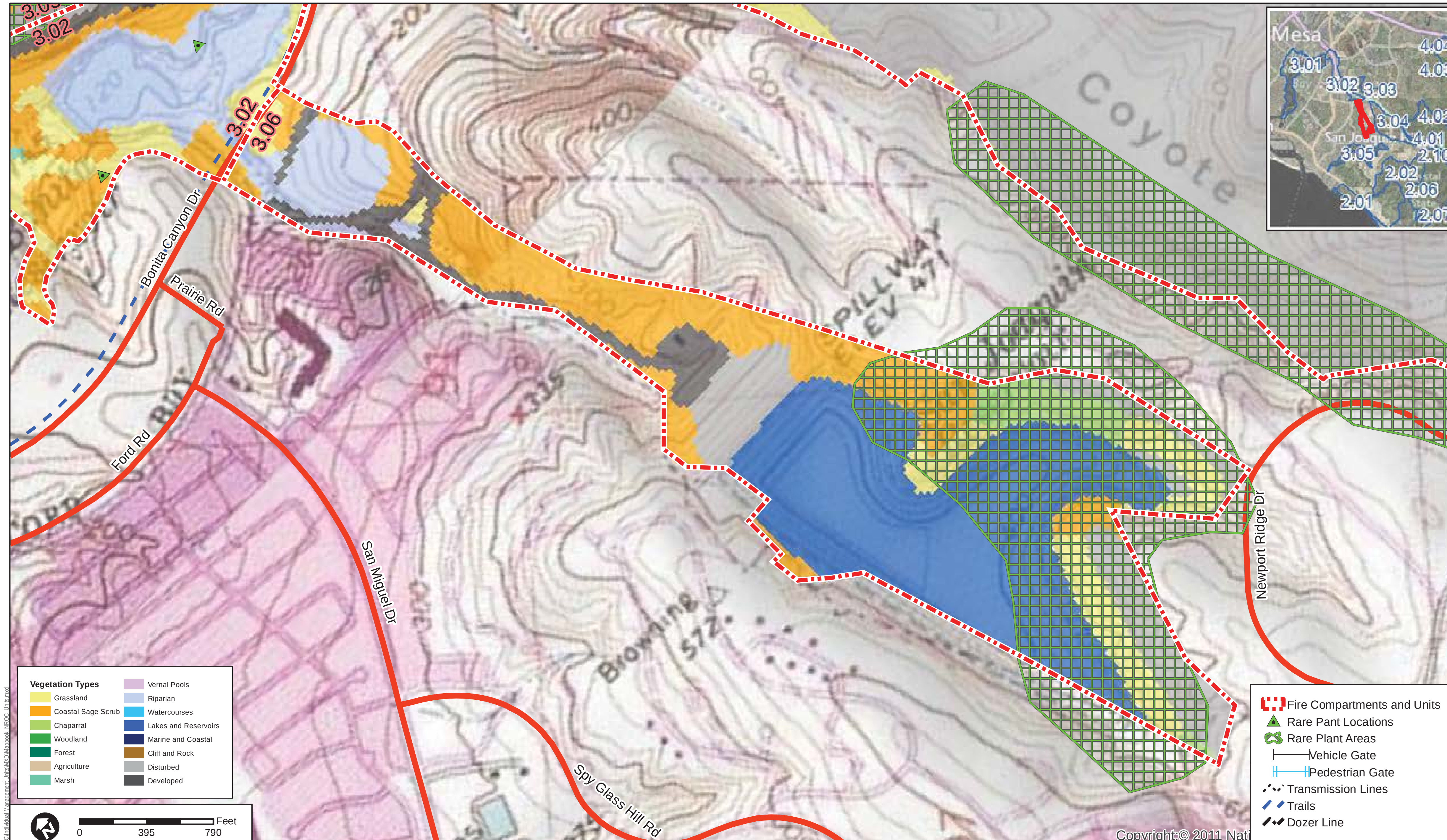

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 3.06 / Acres - 139

Fire Management Unit 3.06

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FIRE MANAGEMENT UNIT 4.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 1009 acres; Special Considerations: Sensitive habitat/refugia for the cactus wren; sensitive rock outcrops and extensive native grasslands. Area contained within San Diego Creek Special Management Area		Access Route: Access is provided to Bommer Canyon Road via Shady Canyon Road. Road is paved locked in northern portion (gates 4436X,4437Y, & 4537W), dirt to the south and exits underneath I-73 through gate 4737Z; other trails exist on the FMU but are limited and not useable by fire apparatus; trail heads have gates (4537Y,4637X, & 4637Z) located at entrances.
Vegetation (fuel) types		
Chaparral	52 ac.	5%
Cliff and Rock	1 ac.	0.1%
Coastal Sage Scrub	428 ac.	42%
Developed	0.002 ac.	0.1%
Grassland	481 ac.	48%
Marsh	0.18 ac.	0.1%
Riparian	26 ac.	23%
Watercourses	4 ac.	0.4%
Woodland	17 ac.	2%
Sensitive Environmental Resources		
Sensitive plant and animal species documented in Bommer Canyon include: Many-stemmed dudleya , Coastal California gnatcatcher, Coastal cactus wren, Chocolate lily (*Fritillaria biflora*), Small flowered microseris, Intermediate foothill mariposa lily		
Last Fire Activity (Year and Percentage of Unit Burned)		
1993 (88%)		
Cultural Resources		
Several sites documented, primarily in rock outcrops		
Suppression Activities		
Fire Management Unit objectives: Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized Water Supply: Municipal water system (fire hydrants) off Shady Canyon Road Sandy Canyon Reservoir Fire Protection: Structures meet with undeveloped wildland or vegetative fuels at top of slopes.		
SAFETY PRECAUTIONS: Steep terrain, flashy fuels		

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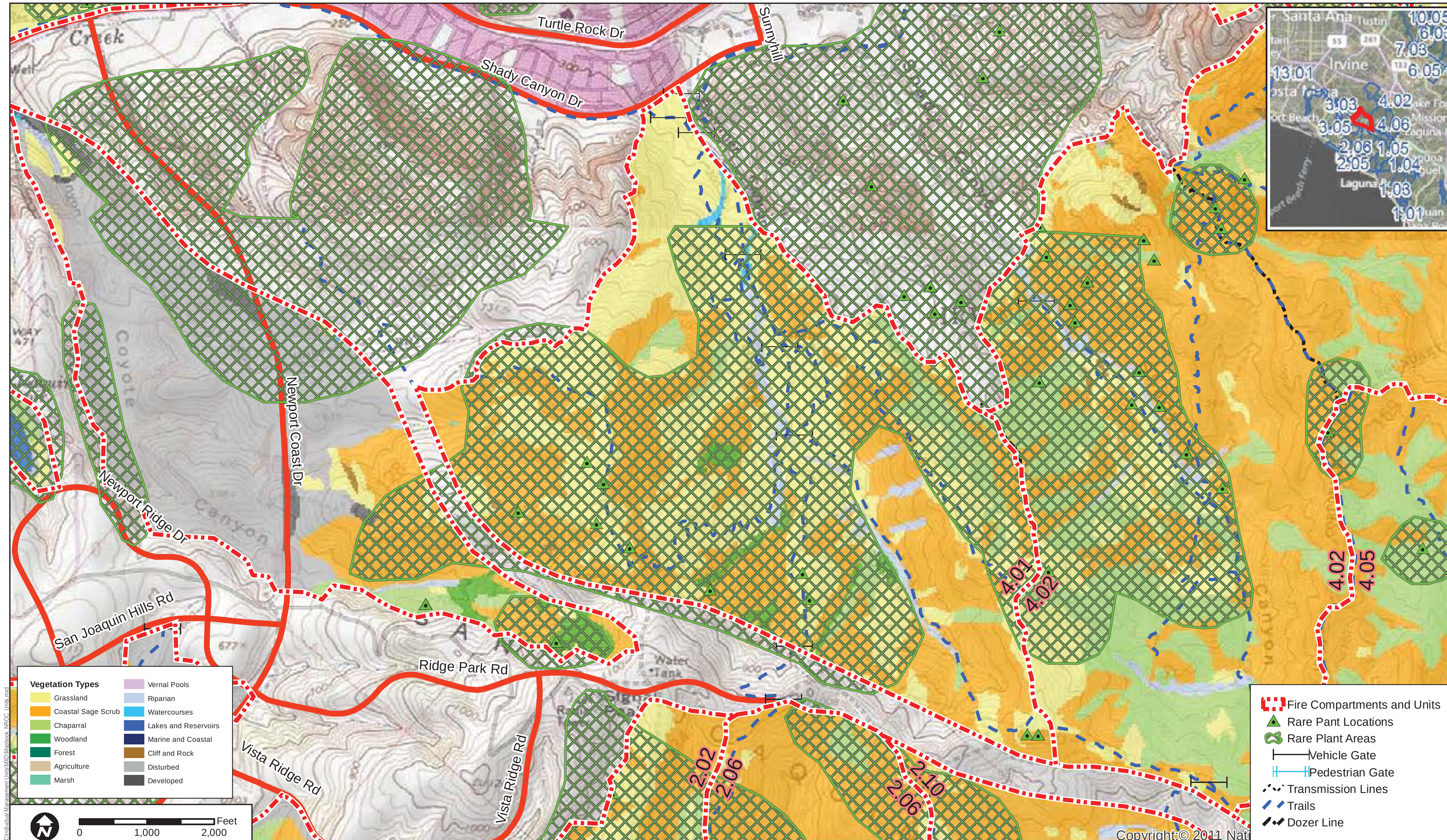

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 4.01 / Acres - 1010

Fire Management Unit 4.01

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FIRE MANAGEMENT UNIT 4.02

<table>
<tr><td colspan="4" align="center">FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression</td></tr>
<tr><td colspan="2">Size: 1328 acres
Special Considerations: SCE powerlines, sensitive cactus wren habitat/refugia, southwestern pond turtle. Area contained within San Diego Creek Special Management Area</td><td colspan="2">Access Route:
Access is limited throughout most of the FMU; dirt road trails (roughly 10 feet wide) occur along the eastern FMU boundary and along canyon bottoms. Closet paved access is Shady Canyon through neighborhood streets. Gate 4539Y for powerline maintenance is located off golf course.</td></tr>
<tr><td colspan="4" align="center">Vegetation (fuel) types</td></tr>
<tr><td>Chaparral
Cliff and Rock
Coastal Sage Scrub
Grassland
Riparian
Vernal Pools</td><td>331 ac.
4 ac.
776 ac.
194 ac.
23 ac.
0.34 ac.</td><td colspan="2">25%
0.3%
58%
15%
2%
0.1%</td></tr>
<tr><td colspan="4" align="center">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Sensitive plant and wildlife species that have been documented in FMU include: Many-stemmed dudleya, Ashy spike moss (Selaginella cinerescens), Intermediate foothill mariposa lily, California gnatcatcher, coastal cactus wren, red-diamond rattlesnake, western spadefoot toad, southwestern pond turtle.</td></tr>
<tr><td colspan="4" align="center">Last Fire Activity (Year and Percentage of Unit Burned)</td></tr>
<tr><td colspan="4">2002 (.23%), 1993 (100%)</td></tr>
<tr><td colspan="4" align="center">Cultural Resources</td></tr>
<tr><td colspan="4">One site documented</td></tr>
<tr><td colspan="4" align="center">Suppression Activities</td></tr>
<tr><td colspan="4"><u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Municipal water system (fire hydrants)
Sand Canyon Reservoir
<u>Fire Protection:</u>
Structures meet or intermingle with undeveloped wildland or vegetative fuels. Older residential communities on west side and ridge top homes on east side of FMU.</td></tr>
<tr><td colspan="4">SAFETY PRECAUTIONS: SCE powerlines cross unit</td></tr>
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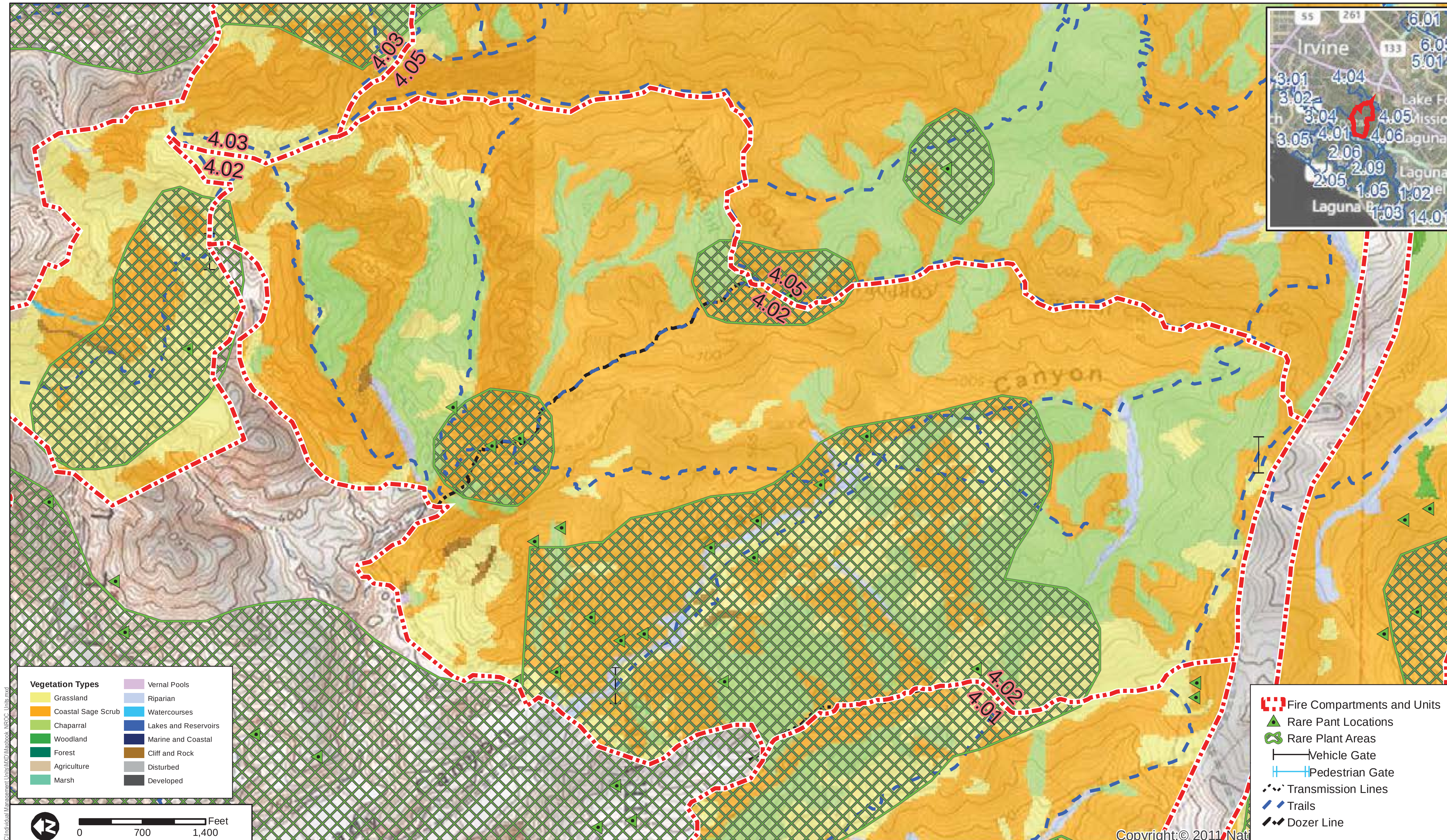

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 4.02 / Acres - 1330

Fire Management Unit 4.02

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<table>
<tr><th colspan="3">FIRE MANAGEMENT UNIT 4.03</th></tr>
<tr><td colspan="3">FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression</td></tr>
<tr><td colspan="2">Size: 470 acres; Special Considerations: Sensitive coastal sage scrub, California gnatcatcher and cactus wren habitat. Area contained within San Diego Creek Special Management Area</td><td>Access Route: Access is limited in this FMU to neighborhood paved streets (Canyon Creek and Momento) associated with two water tanks and a hiking trail that is not useable by fire apparatus; periphery areas are accessible from Shady Canyon to the north and connector streets in the west and east.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td></tr>
<tr><td>Agriculture</td><td>8 ac.</td><td>2%</td></tr>
<tr><td>Chaparral</td><td>6 ac.</td><td>1%</td></tr>
<tr><td>Cliff and Rock</td><td>1 ac.</td><td>0.3%</td></tr>
<tr><td>Coastal Sage Scrub</td><td>119 ac.</td><td>25%</td></tr>
<tr><td>Developed</td><td>0.006</td><td>0.1%</td></tr>
<tr><td>Grassland</td><td>332 ac.</td><td>71%</td></tr>
<tr><td>Riparian</td><td>3 ac.</td><td>0.6%</td></tr>
<tr><td>Watercourses</td><td>0.74 ac.</td><td>0.2%</td></tr>
<tr><td colspan="3">Sensitive Environmental Resources</td></tr>
<tr><td colspan="3">Sensitive wildlife species that have been documented in the FMU include: Coastal California gnatcatcher, Coastal cactus wren, Grasshopper sparrow, Western spadefoot toad, red-diamondback rattlesnake, Small flowered microseris</td></tr>
<tr><td colspan="3">Last Fire Activity (Year and Percentage of Unit Burned)</td></tr>
<tr><td colspan="3">2001 (26%), 1993 (36%)</td></tr>
<tr><td colspan="3">Cultural Resources</td></tr>
<tr><td colspan="3">None documented</td></tr>
<tr><td colspan="3">Suppression Activities</td></tr>
<tr><td colspan="3"><u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Sand Canyon Reservoir
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures meet or intermingle with undeveloped wildland or vegetative fuels.</td></tr>
<tr><td colspan="3">SAFETY PRECAUTIONS: Limited access for firefighting equipment</td></tr>
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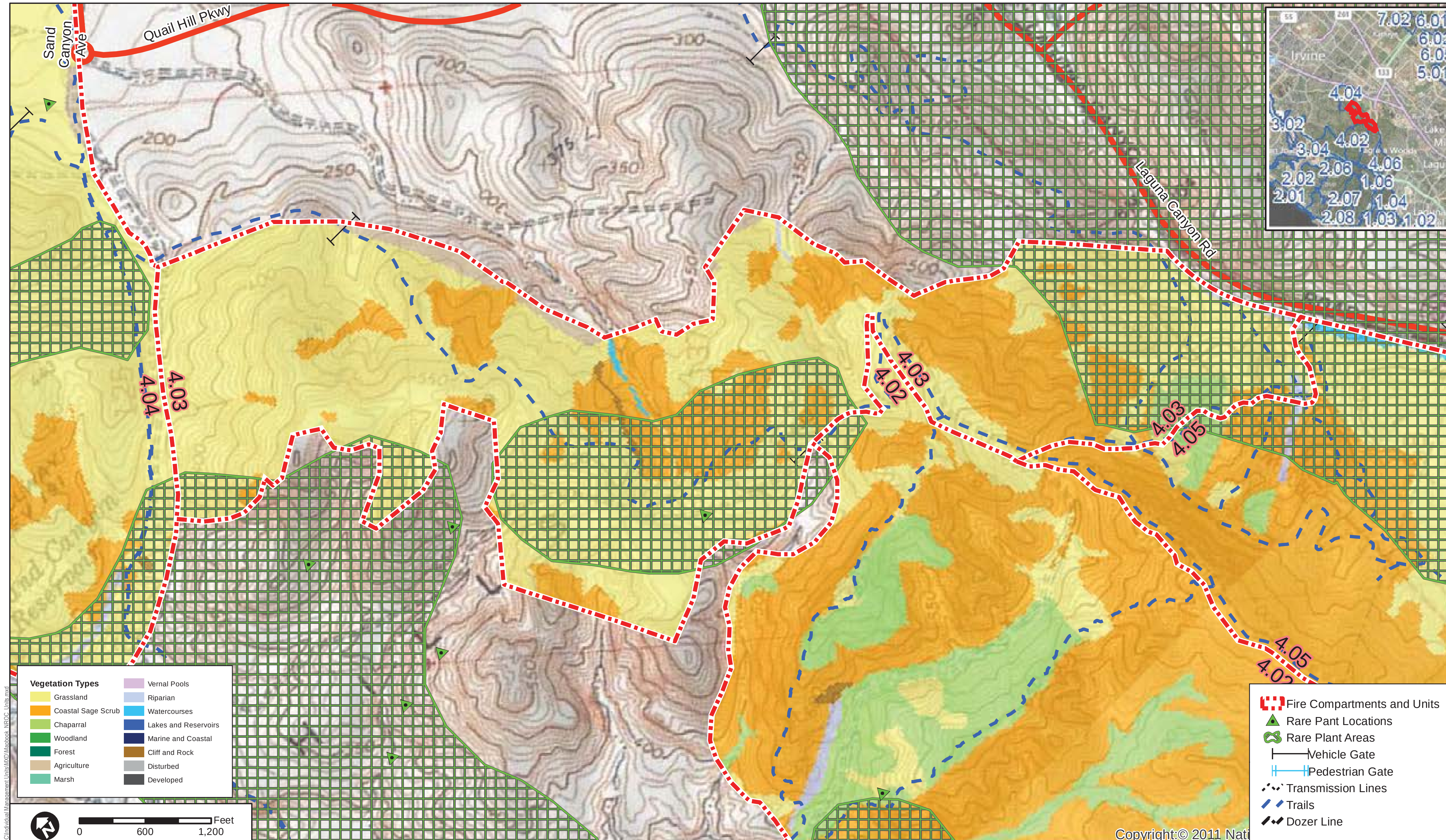

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 4.03 / Acres - 470

Fire Management Unit 4.03

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FIRE MANAGEMENT UNIT 4.04

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 689 acres; Special Considerations: Sensitive coastal sage scrub, California gnatcatcher and cactus wren habitat	Access Route: FMU is accessible from University Drive and Strawberry Farm Road in the north, Shady Canyon in the south and Quail Trail in the north. Site vehicular access to interior of FMU is limited to a paved road to the reservoir at the top of Quail Hill. Trails are gated (4139Z & 4139X) and accessible form Quail Hills parking lot.

Vegetation (fuel) types

Agriculture	39 ac.	6%
Cliff and Rock	2 ac.	0.2%
Coastal Sage Scrub	69 ac.	10%
Developed	0.82 ac.	0.1%
Disturbed	0.96 ac.	0.1%
Grassland	561 ac.	81%
Lakes and reservoirs	4 ac.	0.6%
Marsh	3 ac.	0.5%
Riparian	2 ac.	0.3%
Watercourses	7 ac.	1%

Sensitive Environmental Resources

Sensitive wildlife species that have been documented in these locations include: Coastal California gnatcatcher, Coastal cactus wren, Grasshopper sparrow, Western spadefoot toad, Red-diamondback rattlesnake

Last Fire Activity (Year and Percentage of Unit Burned)

1993 (4%)

Cultural Resources

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Sand Canyon Reservoir
Municipal water system (fire hydrants)
Fire Protection:
Structures (farming, Fire Station) meet with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Defunct surface water line crosses unit

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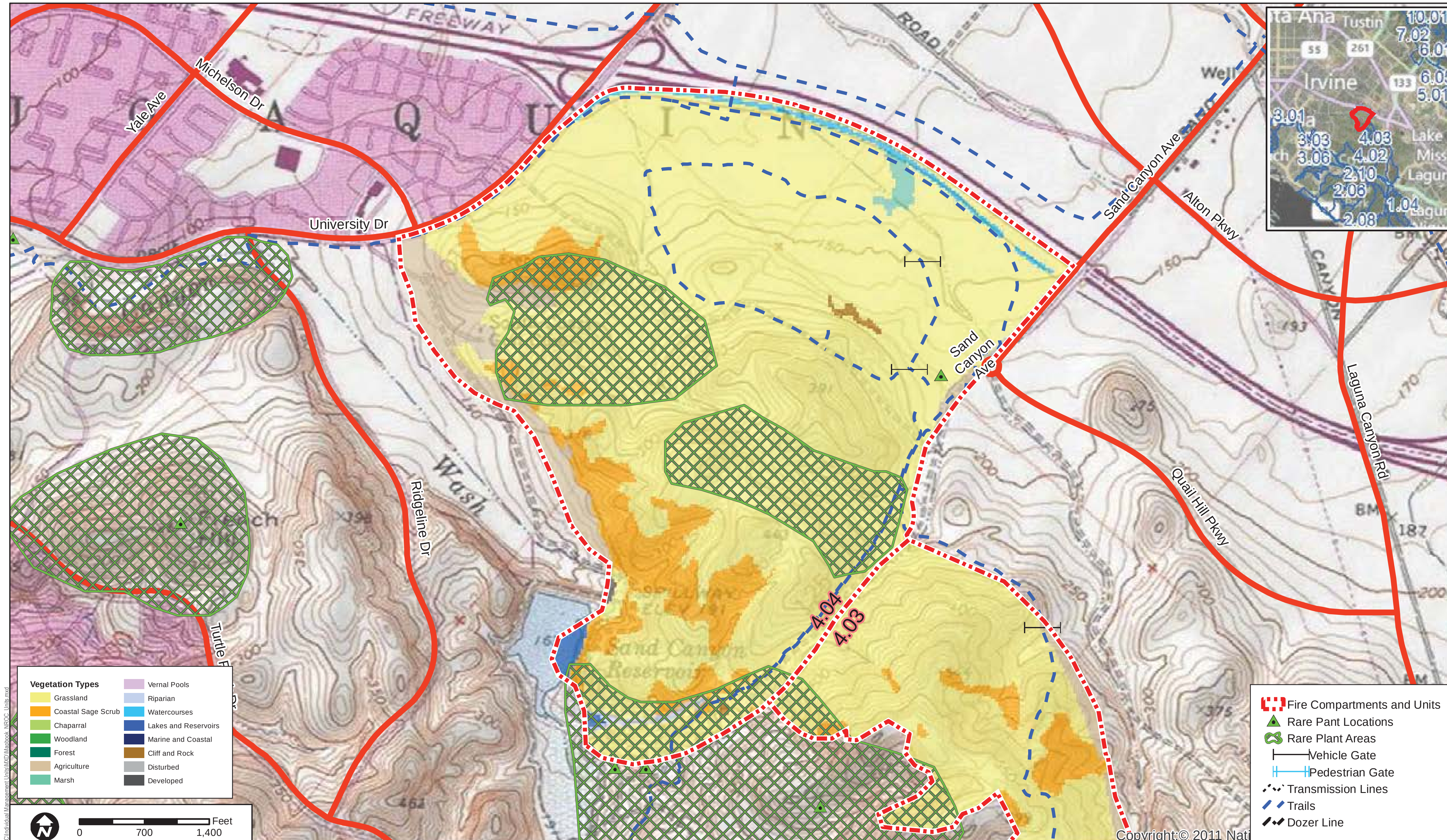

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 4.04 / Acres - 688

Fire Management Unit 4.04

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 4.05</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 991 acres
Special Considerations: Sensitive cactus wren, coastal sage scrub and native grassland habitats. Area contained within the San Diego Creek Special Management Area. Nix Nature Center</td><td>Access Route:
Access is limited throughout much of the FMU to dirt trails and roads not adequate for heavy engine use; 133 provides access on the eastern FMU boundary and 73 along the south.</td></tr>
<tr><td colspan="4">Vegetation (fuel) types</td></tr>
<tr><td>Chaparral</td><td>164 ac.</td><td>17%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>581 ac.</td><td>59%</td><td></td></tr>
<tr><td>Developed</td><td>0.039 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Grassland</td><td>222 ac.</td><td>22%</td><td></td></tr>
<tr><td>Riparian</td><td>18 ac.</td><td>2%</td><td></td></tr>
<tr><td>Watercourses</td><td>6 ac.</td><td>0.6%</td><td></td></tr>
<tr><td>Woodland</td><td>0.28 ac.</td><td>0.1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Sensitive wildlife species that have been documented in these locations include: Coastal California gnatcatcher, Coastal cactus wren, Grasshopper sparrow, Western spadefoot toad, and red-diamondback rattlesnake</td></tr>
<tr><td colspan="4">Last Fire Activity (Year and Percentage of Unit Burned)</td></tr>
<tr><td colspan="4">2007 (28%), 1993 (97%), 1955 (2%)</td></tr>
<tr><td colspan="4">Cultural Resources</td></tr>
<tr><td colspan="4">None documented</td></tr>
<tr><td colspan="4">Suppression Activities</td></tr>
<tr><td colspan="4"><u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Water tenders will be required
Barbara's Lake and Bubbles Pond in FMU 4.06
<u>Fire Protection:</u>
Nix Nature Center in unit</td></tr>
<tr><td colspan="4">SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit</td></tr>
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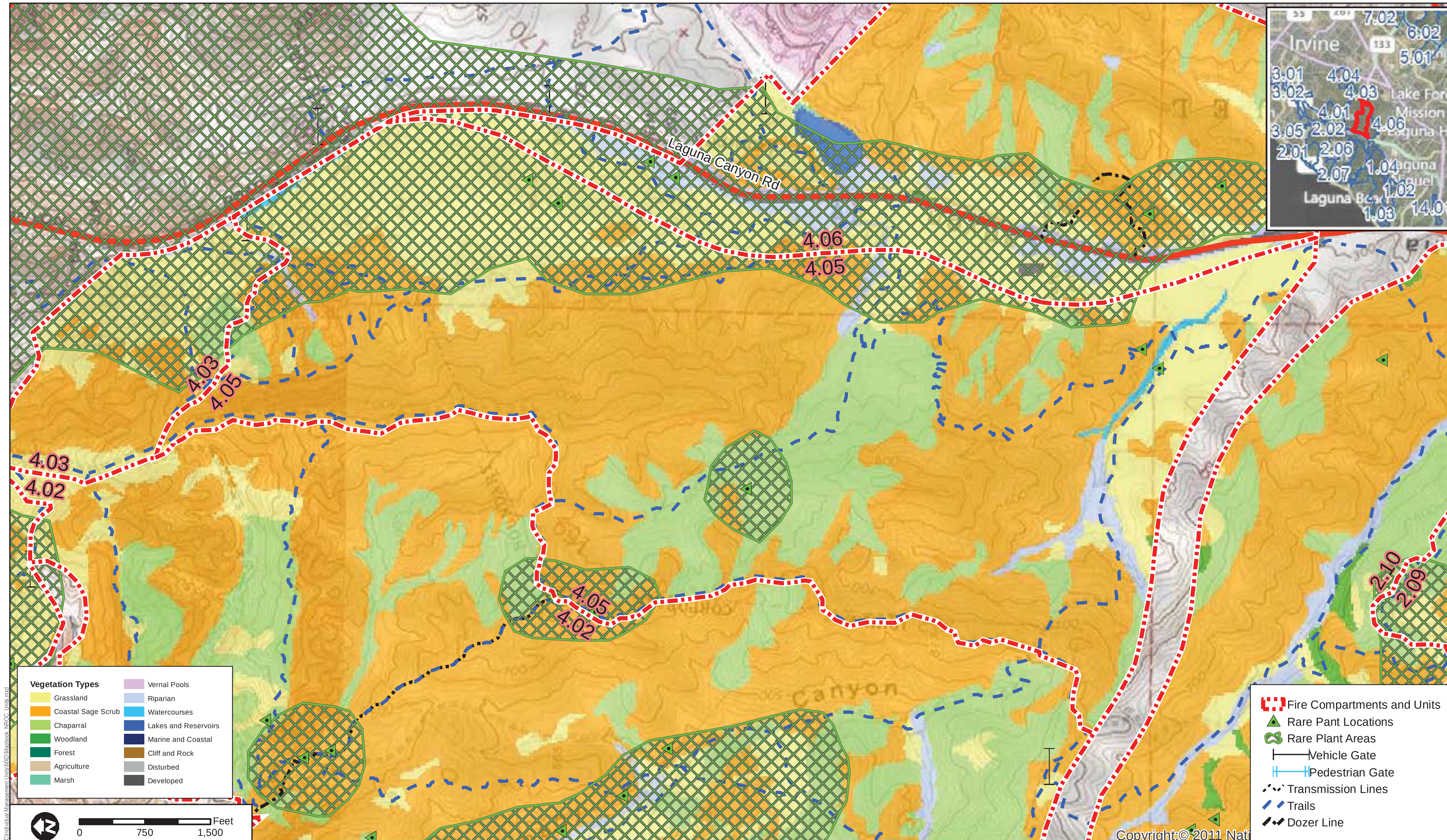

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 4.05 / Acres - 992

Fire Management Unit 4.05

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FIRE MANAGEMENT UNIT 4.06

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 529 acres; Special Considerations: Southern California Edison powerlines, Wildland Urban Interface to east, high quality native grasslands and coastal sage scrub, Barbara's Lake and Bubbles Pond	Access Route: Access is limited throughout much of the FMU to dirt trails not adequate for heavy engine use; 133 provides access on the western FMU edge, 73 access on the southern FMU edge, and dirt trails in some areas.

Vegetation (fuel) types

Chaparral	58 ac.	11%
Coastal Sage Scrub	255 ac.	48%
Developed	15 ac.	3%
Disturbed	2 ac.	0.5%
Grassland	151 ac.	28%
Lakes and reservoirs	8 ac.	2%
Marsh	0.34 ac.	0.1%
Riparian	39 ac.	7%
Watercourses	1 ac.	0.3%
Woodland	0.35 ac.	0.1%

Sensitive Environmental Resources

Sensitive plant and animal species that have been documented in this unit include: Coastal cactus wren, Coastal California gnatcatcher, Grasshopper sparrow, Coast horned lizard, Western spadefoot toad, red-diamondback rattlesnake, red-tailed hawk, Intermediate foothill mariposa lily

Last Fire Activity (Year and Percentage of Unit Burned)

2001 (1%), 1993 (14%)

Cultural Resources

Several documented along SR 133

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Water tenders will be required
Barbara's Lake and Bubbles Pond in FMU
<u>Fire Protection:</u>
Structures meet with undeveloped wildland or vegetative fuels on east side of FMU.

SAFETY PRECAUTIONS: Southern California Edison powerlines cross unit; flashy fuels

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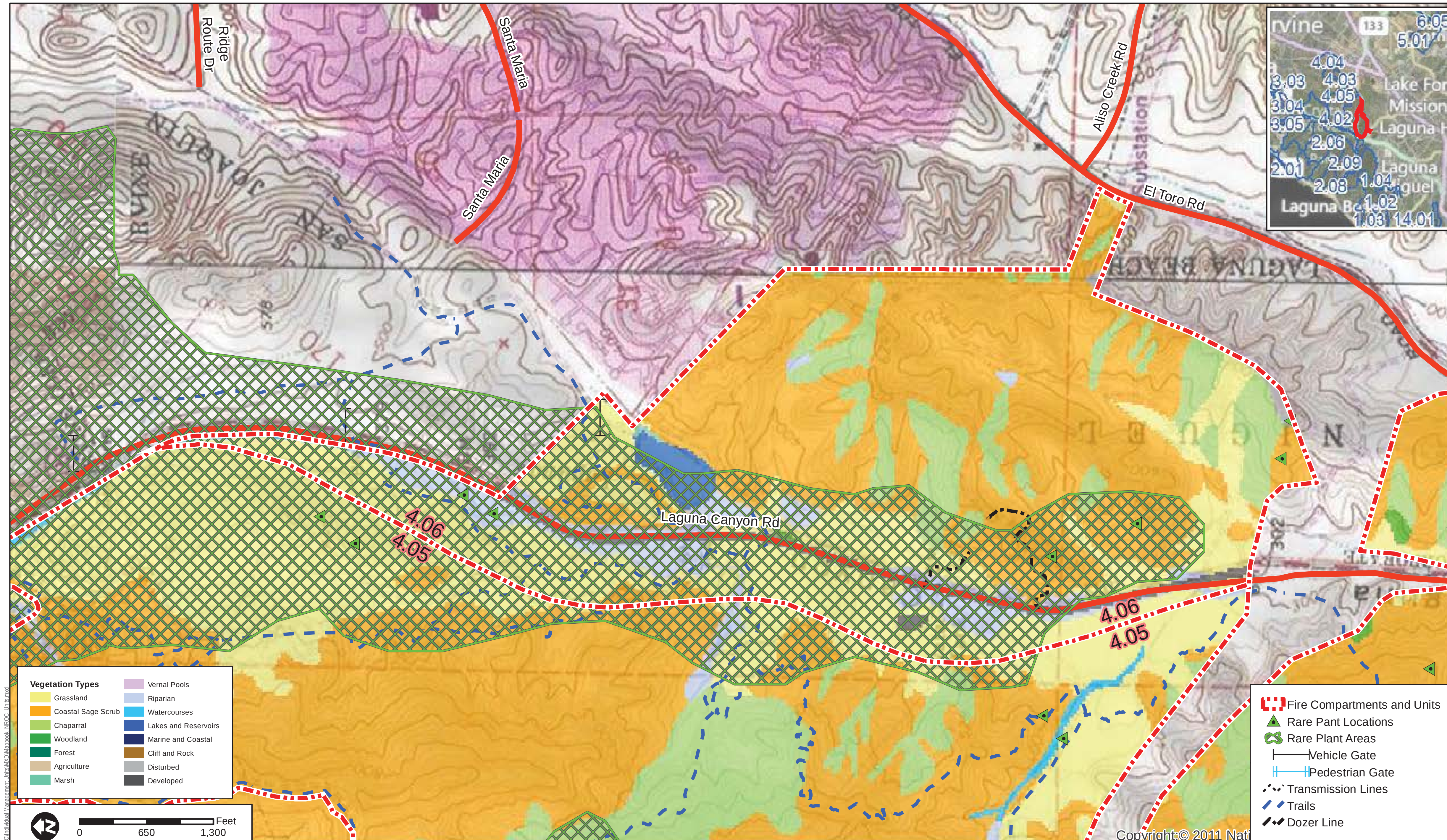

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 4.06 / Acres - 532

Fire Management Unit 4.06

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FIRE MANAGEMENT UNIT 5.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 1091 acres; Special Considerations: transportation corridor to north, WUI on three sides, FBI law enforcement training, contains two capped landfills, several shooting ranges, explosive ordinance disposal area, and underground storage bunkers		Access Route: The site has good access into interior from Irvine Blvd. via a private asphalt road; most limited access occurs in the northeast/east portion of FMU and in northwest. Eastern boundary is bordered by SR 241.
Vegetation (fuel) types		
Agriculture	12 ac.	1%
Chaparral	9 ac.	1%
Coastal Sage Scrub	445 ac.	41%
Developed	13 ac.	1%
Disturbed	217 ac.	20%
Grassland	348 ac.	32%
Riparian	42 ac.	4%
Watercourses	0.36 ac.	0.1%
Woodland	5 ac.	0.4%

Sensitive Environmental Resources

Sensitive plant and animal species that have been documented in this unit include: Coastal California gnatcatcher, Vernal barley, Cooper's hawk (*Accipiter cooperii*), Red diamond rattlesnake, Red-tailed hawk, Yellow breasted chat, Yerba mansa (*Anemopsis* sp.), Ashy spike moss, Cactus wren, Least Bell's vireo, and Riverside fairy shrimp (*Streptocephalus woottoni*)..

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (98%), 1998 (.33%), 1926 (.33%)

Cultural Resources

Three documented along unit periphery

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Municipal water system (fire hydrants)
Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: alignment with Santa Ana winds, ignitions from SR 241 possible

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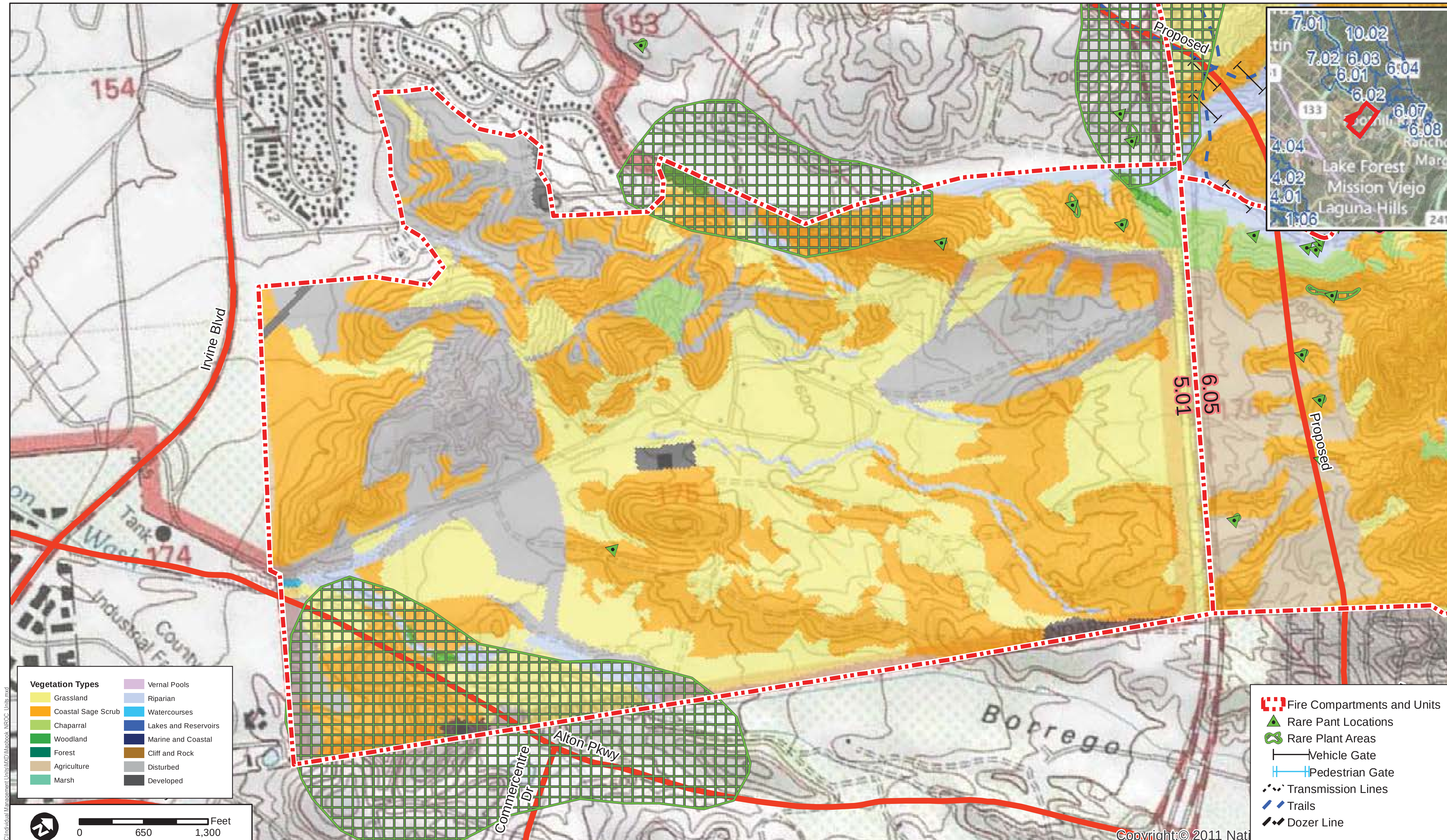

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 5.01 / Acres - 1092

Fire Management Unit 5.01

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FIRE MANAGEMENT UNIT 6.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 1683 acres; Special Considerations: Remote/difficult access, unstable geology, grading for Bowerman Landfill. Area contained within San Diego Creek Special Management Area; landfill restoration and life cycle unknown.	Access Route: Access limited by terrain in north; Main access is off Portola Parkway to either Bee Canyon Access Road to landfill in mid- FMU or to the north from Jeffreys Road to Hicks Haul Road via gate #3046Z. SR 241 borders west and southern perimeter of FMU. Landfill dirt roads to east and north; Old Bee Canyon Road and agriculture roads in south.

Vegetation (fuel) types

Agriculture	84 ac.	5%
Chaparral	2 ac.	0.1%
Coastal Sage Scrub	1151 ac.	68%
Developed	4 ac.	0.3%
Disturbed	342 ac.	20%
Grassland	91 ac.	5%
Riparian	5 ac.	0.3%
Woodland	4 ac.	0.3%

Sensitive Environmental Resources

Sensitive plants and wildlife documented in Hicks Canyon include: Catalina mariposa lily (*Calochortus catalinae*), Coastal California gnatcatcher, Many-stemmed dudleya, Intermediate foothill mariposa lily, Coast horned lizard, Cactus wren, Nesting locations for red tailed hawk, red shouldered hawk

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (100%), 1998 (65%)

Cultural Resources

Six sites documented on perimeter of landfill

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Syphon Reservoir
Municipal water system (fire hydrants)
Portable construction water tanks or water tenders
Fire Protection:
Landfill Structures and infrastructure to protect.

SAFETY PRECAUTIONS: Unstable geology in the southern side of Loma Ridge; landfill is good fuel break,

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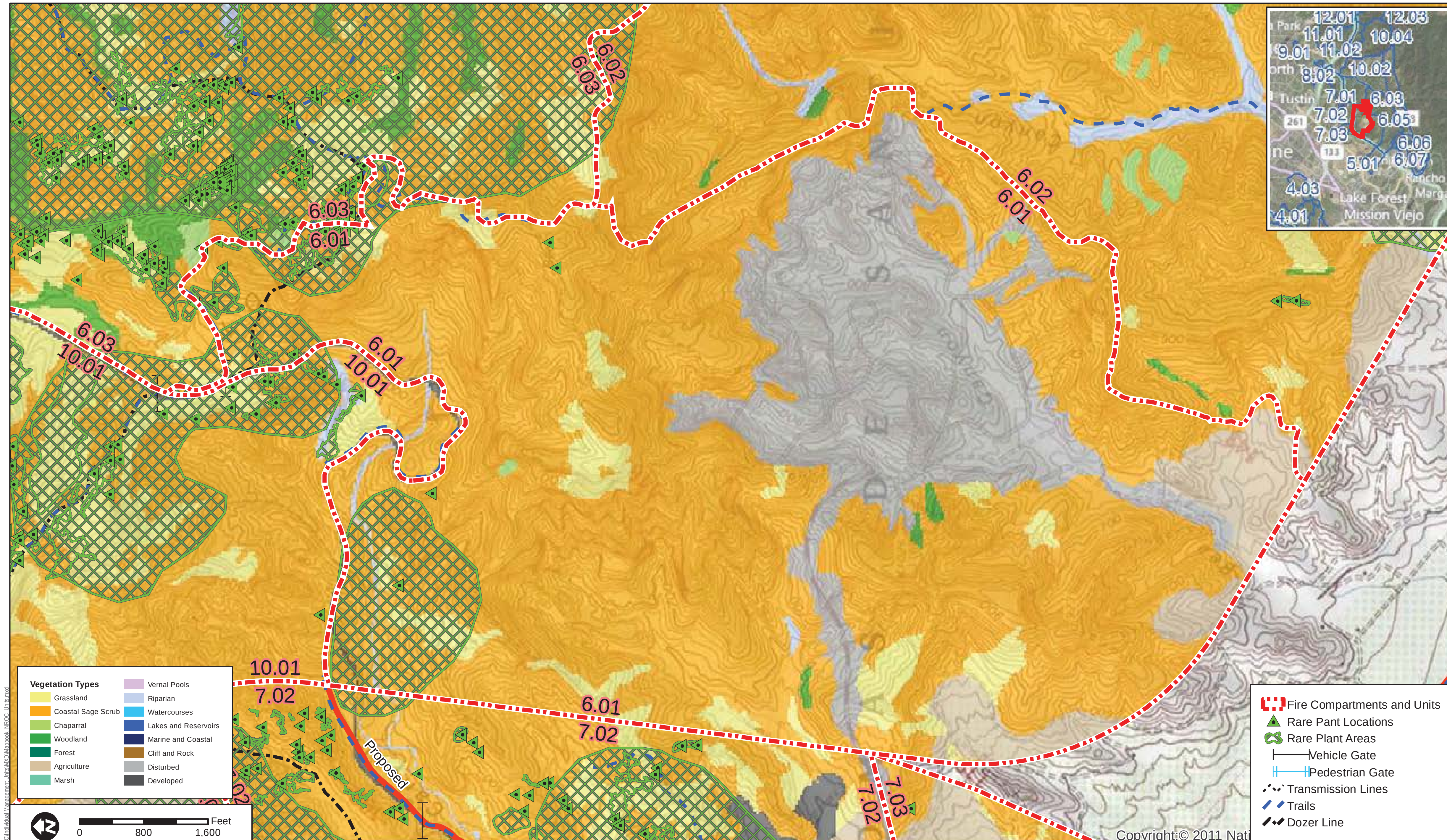

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.01 / Acres - 1684

Fire Management Unit 6.01

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FIRE MANAGEMENT UNIT 6.02

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 1474 acres Special Considerations: oak woodlands, riparian scrub/woodlands, remote/difficult access to interior of FMU, WUI to the south opposite side of Toll Road	Access Route: Access is limited in the FMU; Loma Ridge Road provides access on the northern/northeastern boundary, Portola Parkway (old road) provides access to water storage tanks via gate #3550X and into canyon drainages through gates # 3449Z and # 3549X; trails on south; eastern boundary is not on a roadway.

Vegetation (fuel) types

Agriculture	31 ac.	2%
Chaparral	36 ac.	3%
Coastal Sage Scrub	1241 ac.	84%
Grassland	93 ac.	6%
Riparian	60 ac.	4%
Woodland	13 ac.	1%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented in the FMU include: Catalina mariposa lily, Intermediate foothill mariposa lily, Coastal cactus wren, Red shouldered hawk, White-tailed kite (*Elanus leucurus*), Grasshopper sparrow, Coast horned lizard, Orange throated whiptail lizard (*Aspidoscelis hyperythra beldingi*)

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (99%), 1999 (76%)

Cultural Resources

Three sites documented

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Water storage tank onsite
Municipal water system (fire hydrants) near Portola Parkway
<u>Fire Protection:</u>
No structures to protect; water tank onsite

SAFETY PRECAUTIONS: Unstable geology throughout unit; SR 241 is firebreak and also potential ignition source.

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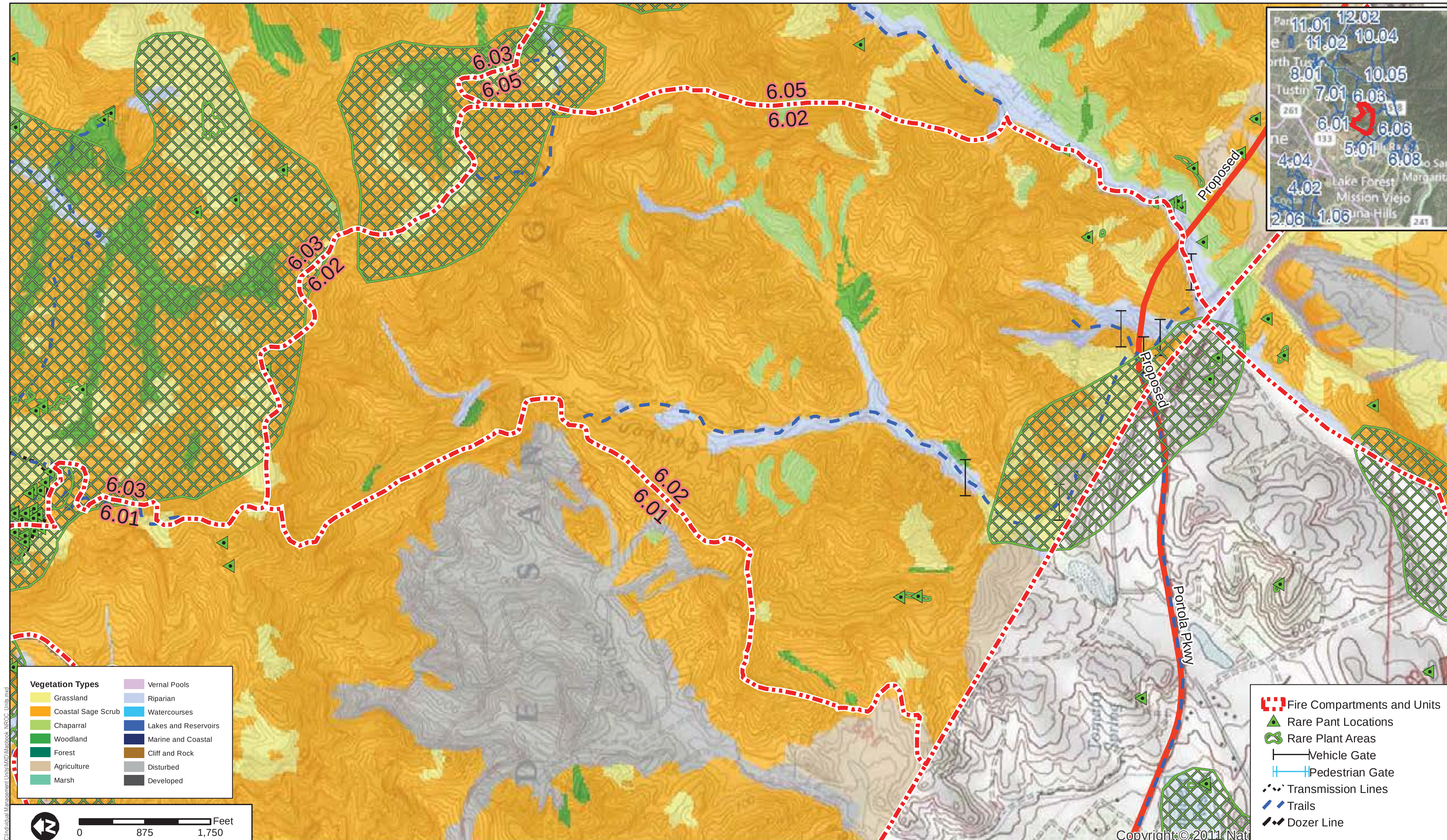

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.02 / Acres - 1475

Fire Management Unit 6.02

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FIRE MANAGEMENT UNIT 6.03

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 2367 acres; Special Considerations: Access throughout site is limited	Access Route: Access is limited in portions of the FMU, especially the central and western areas; Access to FMU is from either East Santiago Canyon Road to Limestone Spur to Limestone Canyon Road via gates #2751W and 2751Y or E. Santiago Canyon Road to Hicks Haul Road through gates #2749W and 2749X at north boundary; Loma Ridge Road and Jeep trail on southern boundary.

Vegetation (fuel) types

Chaparral	196 ac.	8%
Coastal Sage Scrub	1281 ac.	54%
Developed	5 ac.	0.2%
Grassland	444 ac.	19%
Riparian	181 ac.	8%
Woodland	260 ac.	11%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented in Limestone Canyon include: Catalina mariposa lily and Intermediate foothill mariposa lily found in Coastal sage scrub and native grasslands, Coastal cactus wren, red shouldered hawk nesting locations in oak woodlands, White-tailed kite nesting locations in oak woodlands, Grasshopper sparrows in native grasslands, Coast horned lizard documented throughout FMU

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (100%), 1998 (100%), 1997 (.08%), 1967 (.17%), 1948 (.17%), No date given (.17%)

Cultural Resources

No information on cultural resources available.

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Irvine Lake
Water tenders
Water storage systems in local nurseries, communities of Modjeska Canyon and Silverado
Municipal water system (fire hydrants) near Foothill Ranch
Fire Protection:
No structures to protect within FMU

SAFETY PRECAUTIONS: Limestone Ridge Road is not driveable, power lines to the east, Santiago Canyon Road at North end ;Wildland Urban Intermix with Modjeska Canyon and Silverado

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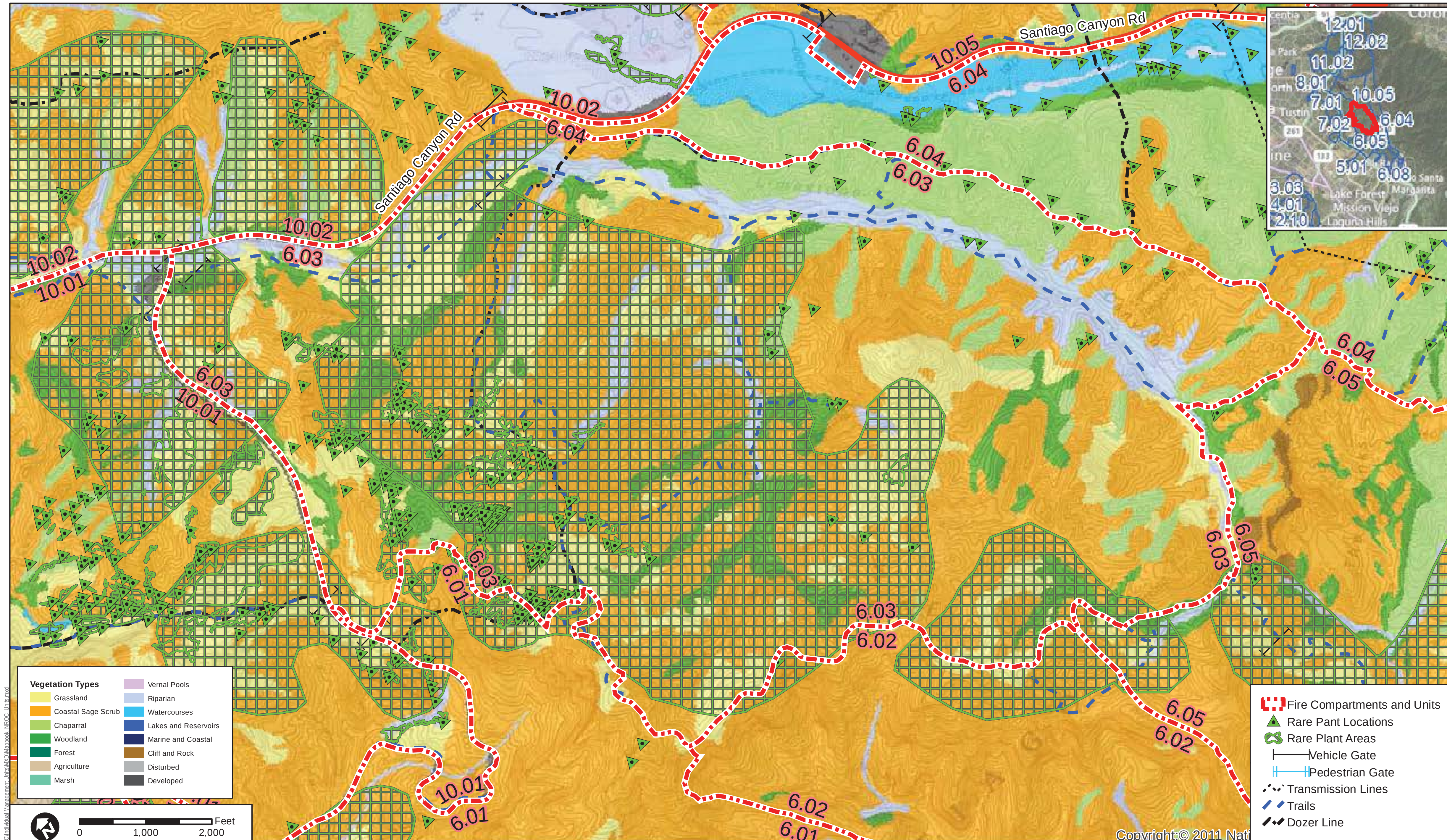

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.03 / Acres - 2368

Fire Management Unit 6.03

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FIRE MANAGEMENT UNIT 6.04

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 1199 acres; Special Considerations: Sensitive aquatic resources, TCA riparian mitigation area, SCE transmission line		Access Route: East Santiago Canyon Road forms northern and eastern boundary. Access to FMU is from East Santiago Canyon Road to Hangmans Tree Road via gate # 3255W , Bolero Lookout Road and #2 Spur Road in south. Limited access in northern portion of FMU.
Vegetation (fuel) types		
Chaparral	597 ac.	50%
Coastal Sage Scrub	263 ac.	22%
Developed	6 ac.	0.5%
Disturbed	8 ac.	0.7%
Grassland	22 ac.	2%
Riparian	25 ac.	2%
Watercourses	173 ac.	14%
Woodland	105 ac.	9%
Sensitive Environmental Resources		
Sensitive plant and wildlife species that have been documented in the FMU include: Catalina mariposa lily, Intermediate foothill mariposa lily, Chocolate lily, Chaparral beargrass (*Nolina micrantha*), Coastal cactus wren, Santa Ana speckled dace (*Rhinichthys osculus*), Coast horned lizard		
Last Fire Activity (Year and Percentage of Unit Burned)		
2007 (100%), 1998 (81%,) 1967 (.01%), 1948 (1%), No date given (1%)		
Cultural Resources		
Four sites documented, likely many more		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Irvine Lake Water tenders Water storage systems in local nurseries, communities of Modjeska Canyon and Silverado Municipal water system (fire hydrants) near Foothill Ranch <u>Fire Protection:</u> Structures (residential home and commercial nursery) meet or intermingle with undeveloped wildland or vegetative fuels.		
SAFETY PRECAUTIONS: Southern California Edison transmission line crosses unit, Wildland Urban Intermix with Modjeska Canyon, seasonal pond in southeast corner		

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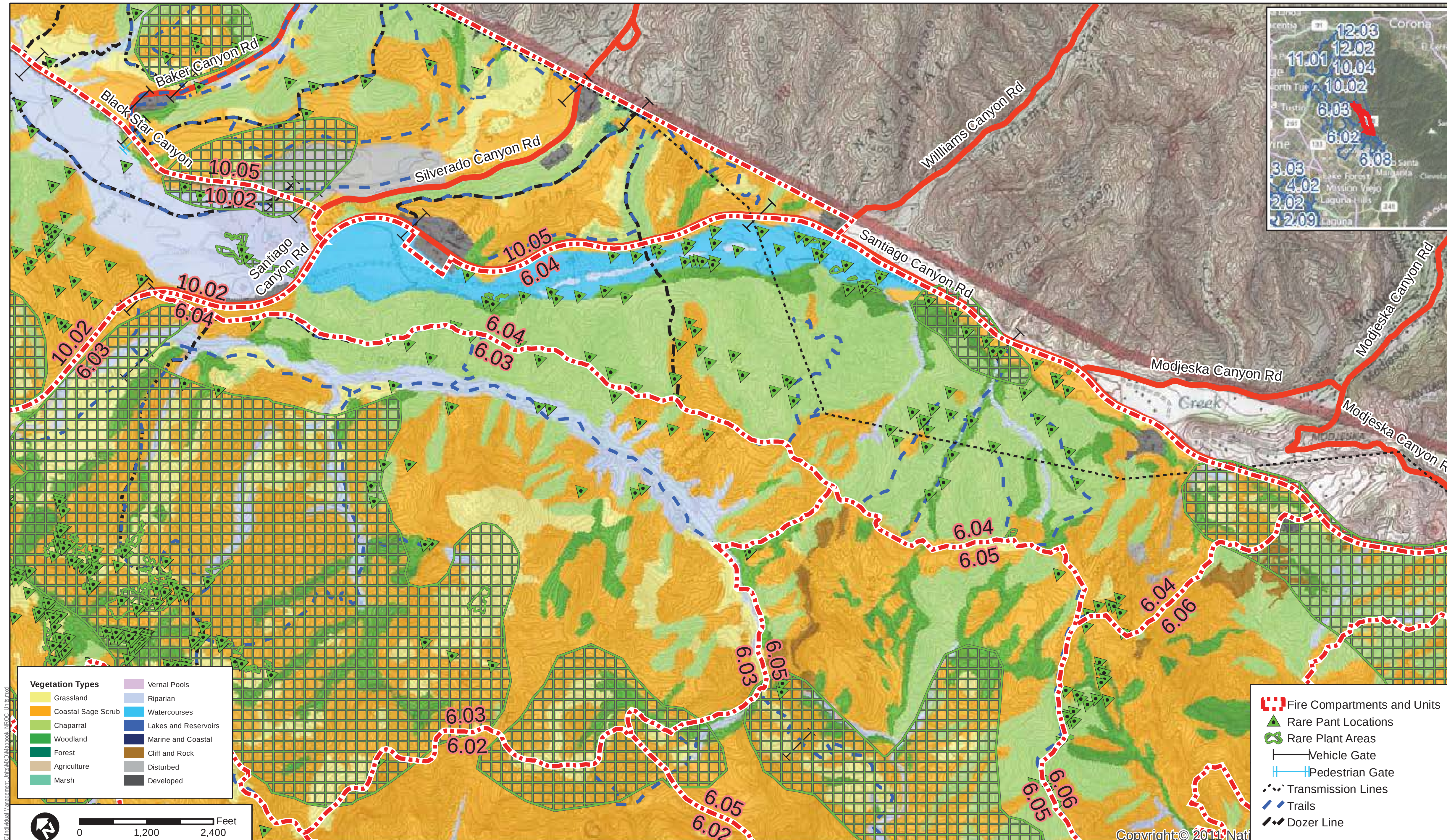

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.04 / Acres - 1199

Fire Management Unit 6.04

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FIRE MANAGEMENT UNIT 6.05

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 1506 acres; Special Considerations: Riparian habitat, sensitive species including Gnatcatcher, Cactus Wren, coast horned lizard, orange throated whiptail lizard, intermediate and Catalina mariposa lily, no known archaeological sites in the FMU.	Access Route: Access is limited to transmission line roads including Adkins Road, #2 Spur Road, Hangmans Tree Road, Limestone Ridge Road, Bolero Lookout Road, Pr Road; FMU can also be accessed from Portola Highway up Limestone Canyon Road through Gate #3550Z.

Vegetation (fuel) types

Agriculture	80 ac.	5%
Chaparral	296 ac.	20%
Cliff and Rock	19 ac.	1%
Coastal Sage Scrub	829 ac.	55%
Developed	0.34 ac.	0.01%
Grassland	96 ac.	6%
Riparian	69 ac.	5%
Woodland	117 ac.	8%

Sensitive Environmental Resources

Sensitive species documented in FMU include: Coast horned lizard, Orange-throated whiptail lizard, Intermediatefoothill mariposa lily, California gnatcatcher (particularly on southern edge of unit – within Coastal sage scrub patches amongst orchards)

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (8%), 1998 (90%,) 1926 (2%)

Cultural Resources

No information available on cultural resources

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Oso Reservoir
Water tenders
Water storage systems in local nurseries, communities of Modjeska Canyon and Silverado
Municipal water system (fire hydrants) near Foothill Ranch
Fire Protection:
Structures meet with undeveloped wildland or vegetative fuels in southeastern portion of FMU.

SAFETY PRECAUTIONS: Steep topography, unstable geology and flashy fuels

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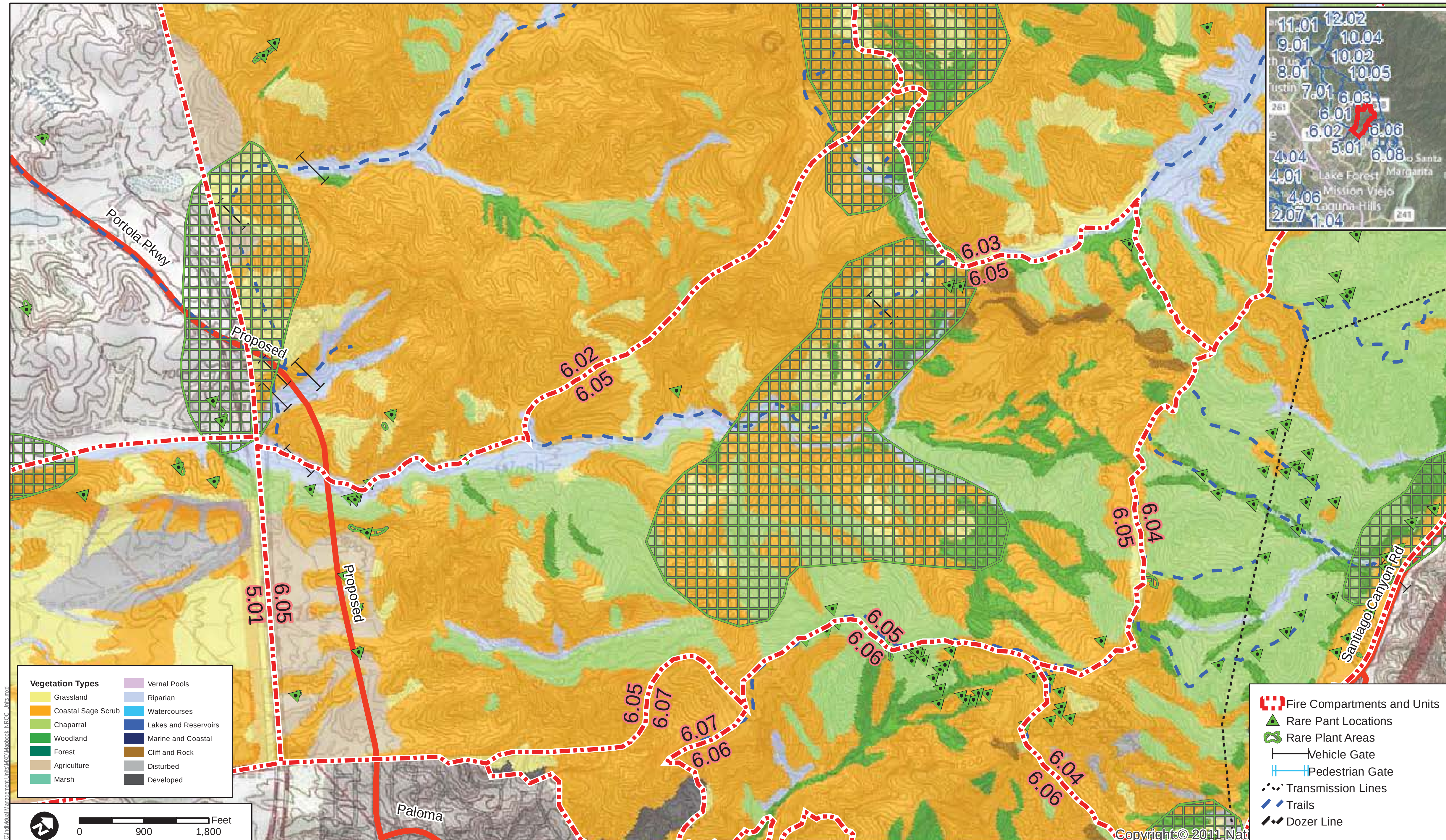

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.05 / Acres - 1507

Fire Management Unit 6.05

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FIRE MANAGEMENT UNIT 6.06

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 738 acres; Special Considerations: Truck trail off of Santiago Canyon Rd is closed due to landslide. Southern California Edison transmissions lines cross FMU.	Access Route: Access is provided by dirt road along FMU boundary and trails within large canyon bottoms, access is limited in some areas and fuels grow up to dirt roadways. Eastern boundary formed by East Santiago Canyon Road and Bolero Lookout forms the northern perimeter boundary.	
Vegetation (fuel) types		
Chaparral	210 ac.	29%
Cliff and Rock	20 ac.	3%
Coastal Sage Scrub	394 ac.	54%
Developed	12 ac.	2%
Disturbed	1 ac.	0.1%
Grassland	5 ac.	0.6%
Lakes and reservoirs	0.5 ac.	0.1%
Riparian	28 ac.	4%
Woodland	67 ac.	9%
Sensitive Environmental Resources		
Sensitive wildlife species documented at this site include: Chaparral beargrass, Coastal California gnatcatcher, Coastal cactus wren, Western spadefoot toad, Red diamondback rattlesnake, Coast horned lizard, Orange-throated whiptail lizard		
Last Fire Activity (Year and Percentage of Unit Burned)		
2007 (100%), 1998 (41%)		
Cultural Resources		
Four sites documented		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Oso Reservoir Water tenders Water storage systems in local equestrian stables and community of Modjeska Canyon; water storage tank is located in southern portion of FMU Municipal water system (fire hydrants) near Foothill Ranch <u>Fire Protection:</u> Structures meet or intermingle with undeveloped wildland or vegetative fuels		
SAFETY PRECAUTIONS: Truck trail access off of Santiago Canyon Rd closed due to landslide; Southern California Edison Transmission line crosses unit		

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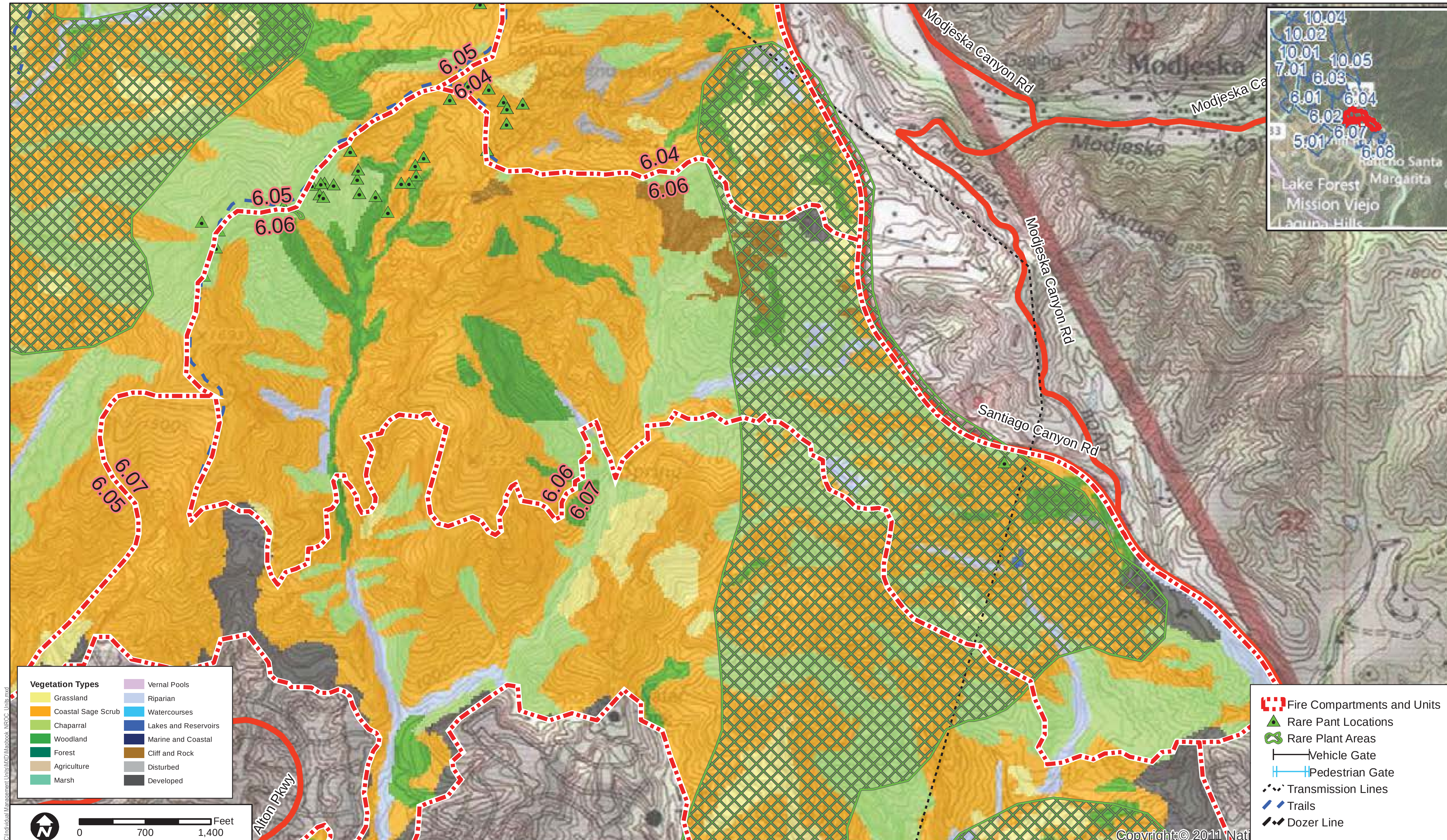

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.06 / Acres - 737

Fire Management Unit 6.06

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FIRE MANAGEMENT UNIT 6.07

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 1091 acres Special Considerations: Riparian habitat, sensitive species including Gnatcatcher and Cactus Wren, sensitive habitat and plant species, several known archeological sites in the FMU.	Access Route: Access is limited to trails (hiking on Whiting Ranch) and dirt roads, although there are several ridgetop roads that may provide access for firefighting purposes and are accessible from Foothill Ranch.

Vegetation (fuel) types

Chaparral	154 ac.	14%
Coastal Sage Scrub	619 ac.	57%
Developed	78 ac.	7%
Disturbed	42 ac.	4%
Grassland	76 ac.	7%
Riparian	59 ac.	5%
Woodland	63 ac.	6%

Sensitive Environmental Resources

Sensitive wildlife species documented at this site include: Coastal California gnatcatcher, Coastal cactus wren, Western spadefoot toad, Red diamondback rattlesnake, Coast horned lizard, Orange-throated whiptail lizard

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (89%), 1998 (11%), 1984 (.04%), 1926 (8%), 1919 (1%)

Cultural Resources

More than ten cultural sites within unit

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Oso Reservoir
Municipal water system (fire hydrants) in Foothill Ranch
<u>Fire Protection:</u>
Structures meet with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Steep topography and flashy fuels and Strong winds aligned down canyon to residential communities.

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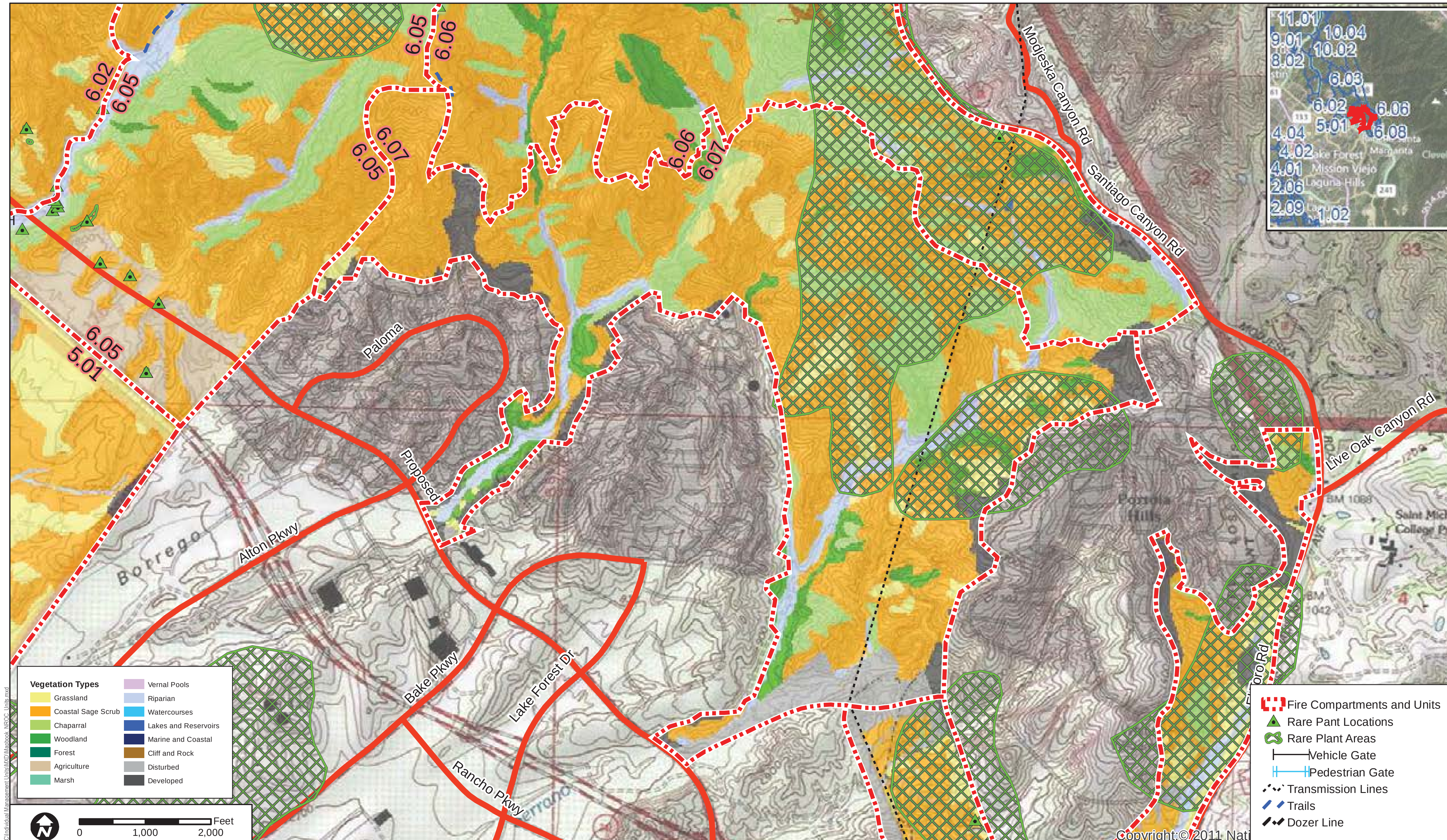

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.07 / Acres - 1090

Fire Management Unit 6.07

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FIRE MANAGEMENT UNIT 6.08

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 355 acres Special Considerations: Southern California Edison easement contains vernal pools supporting endangered Riverside Fairy Shrimp, cactus wren	Access Route: Access is limited to transmission line road/trail, Edison Trail, Aliso Creek Bikeway, El Toro Rd to east/south and SR 241 to south, Glenn Ranch Road to north.

Vegetation (fuel) types

Chaparral	14 ac.	4%
Coastal Sage Scrub	147 ac.	41%
Developed	39 ac.	11%
Disturbed	33 ac.	9%
Grassland	89 ac.	25%
Riparian	30 ac.	9%
Woodland	3 ac.	1%

Sensitive Environmental Resources

Sensitive wildlife species documented at this site include: Riverside fairy shrimp, Coastal California gnatcatcher, Coastal cactus wren, Western spadefoot toad, Red diamondback rattlesnake, Coast horned lizard, Orange-throated whiptail lizard

Last Fire Activity (Year and Percentage of Unit Burned)

1970 (19%,) 1919 (11%)

Cultural Resources

More than ten cultural sites identified

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Oso Reservoir
Municipal water system (fire hydrants) in Foothill Ranch
Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels

SAFETY PRECAUTIONS: Southern California Edison transmission lines cross unit

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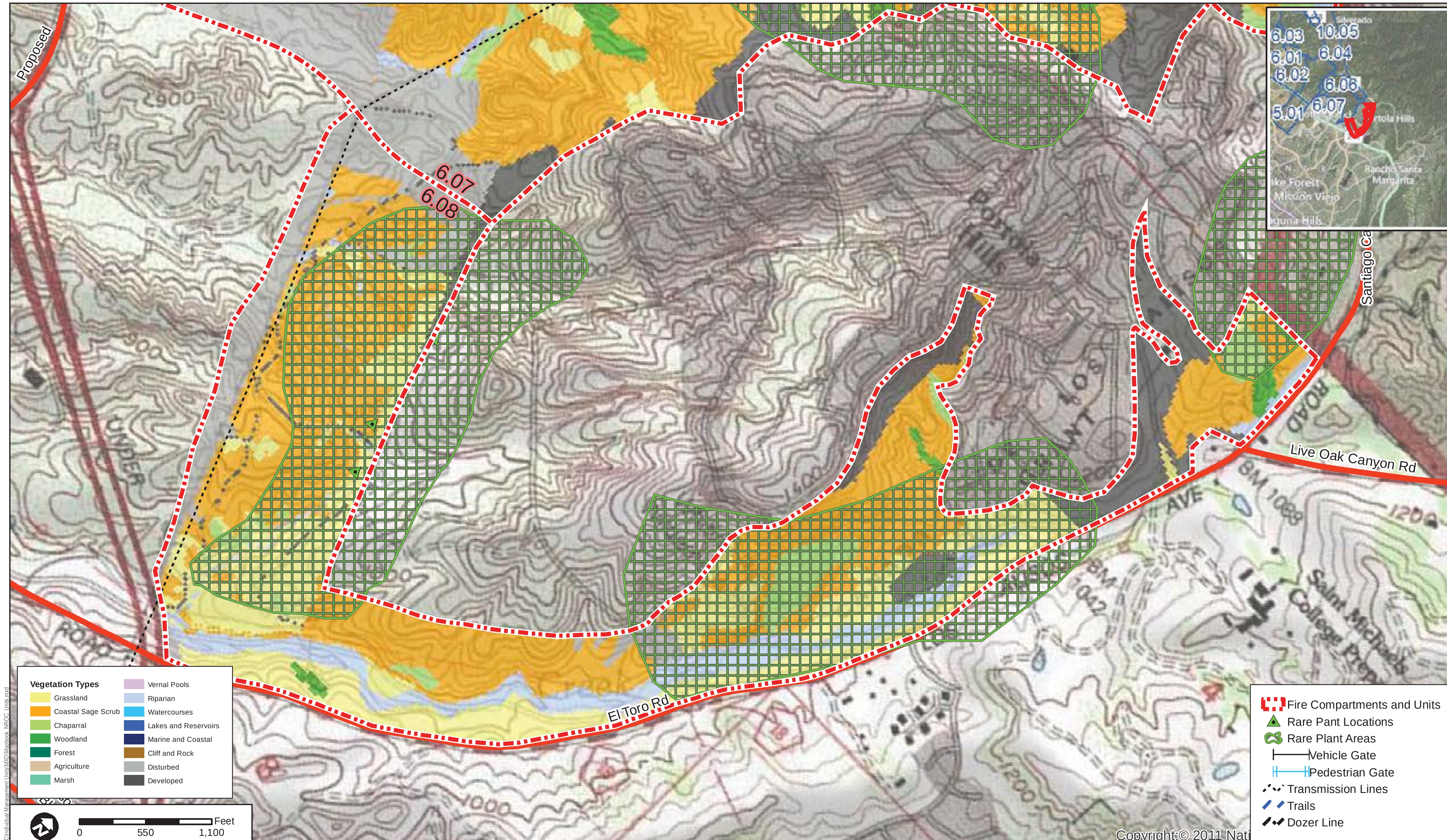

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 6.08 / Acres - 356

Fire Management Unit 6.08

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FIRE MANAGEMENT UNIT 7.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 1811.37 acres; Special Considerations: Site contains Orange County Emergency Communications Center HQ; Coastal sage scrub, native grasslands, California gnatcatcher, many-stemmed dudleya.		Access Route: Access on perimeter of FMU provided along SR 261 toll road (north/west), SR 241 (east); gated access up Loma Ridge Jeep Trail to structure; agricultural roads provide access to western boundary. Orange Count y EOC accessed from Santiago Canyon Road via gate #2544X.
Vegetation (fuel) types		
Agriculture	237 ac.	13%
Chaparral	2 ac.	0.1%
Coastal Sage Scrub	782 ac.	43%
Developed	11 ac.	0.6%
Disturbed	2 ac.	0.1%
Grassland	770 ac.	43%
Riparian	7 ac.	0.4%
Woodland	0.06 ac.	0.01%
Sensitive Environmental Resources		
Sensitive plant and wildlife species that have been documented in this area includes: Catalina mariposa lily, Intermediate foothill mariposa lily, Many-stemmed dudleya, Coastal California gnatcatcher, Coastal cactus wren, American badger (*Taxidea taxus*), Western spadefoot toad, Red diamondback rattlesnake		
Last Fire Activity (Year and Percentage of Unit Burned)		
2007 (88%), 2006 (.21%), 1984 (2%), 1982 (10%), 1967 (12%), 1948 (12%)		
Cultural Resources		
None documented		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Municipal water system (fire hydrants) at Orange County EOC Water Tenders Rattlesnake Reservoir <u>Fire Protection:</u> Structures (Orange County EOC) meet or intermingle with undeveloped wildland or vegetative fuels.		
SAFETY PRECAUTIONS: Steep slopes, unstable geology, flashy fuels		

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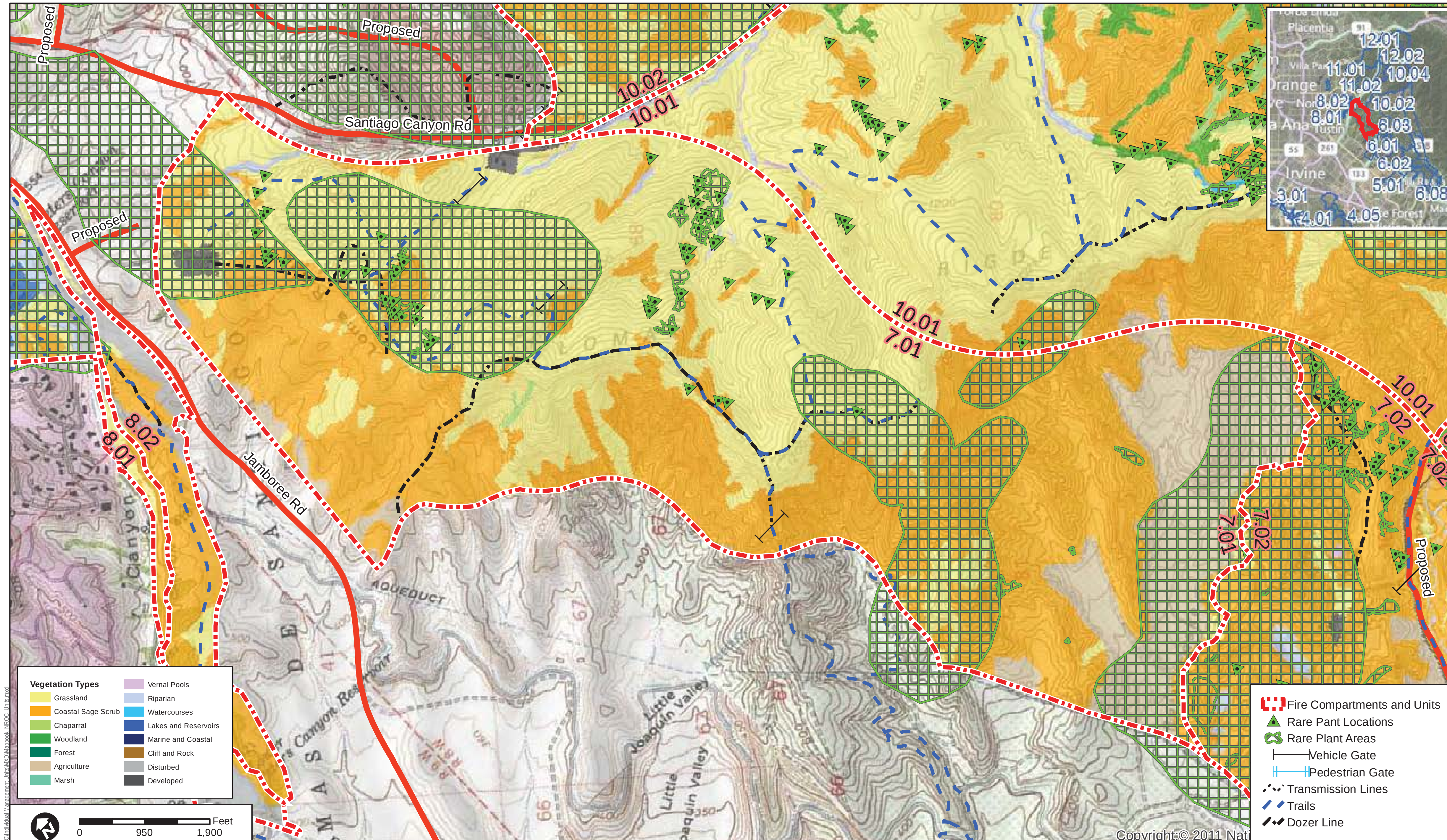

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 7.01 / Acres - 1811

Fire Management Unit 7.01

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FIRE MANAGEMENT UNIT 7.02

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 803 acres Special Considerations: Large population of California gnatcatcher, cactus wren, and intermediate mariposa lily; orchards	Access Route: Access on perimeter of FMU provided along agriculture roads to north; SR 241 to the east; Bee Canyon Access Rd to south; agriculture roads to west; Rattlesnake Road and Jeffrey Road in interior canyons.

Vegetation (fuel) types

Agriculture	82 ac.	10%
Coastal Sage Scrub	550 ac.	69%
Developed	25 ac.	3%
Disturbed	7 ac.	1%
Grassland	115 ac.	14%
Lakes and reservoirs	1 ac.	0.2%
Riparian	22 ac.	3%
Vernal Pools	0.67 ac.	0.1%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented in this area includes: Catalina mariposa lily, Intermediate foothill mariposa lily, Many-stemmed dudleya, Coastal California gnatcatcher, Cactus wren

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (100%)

Cultural Resources

Three sites documented

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Rattlesnake Reservoir
Municipal water system (fire hydrants)
<u>Fire Protection:</u>
Structures meet or intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Roads within orchards inaccessible by large equipment; many fencelines cross unit

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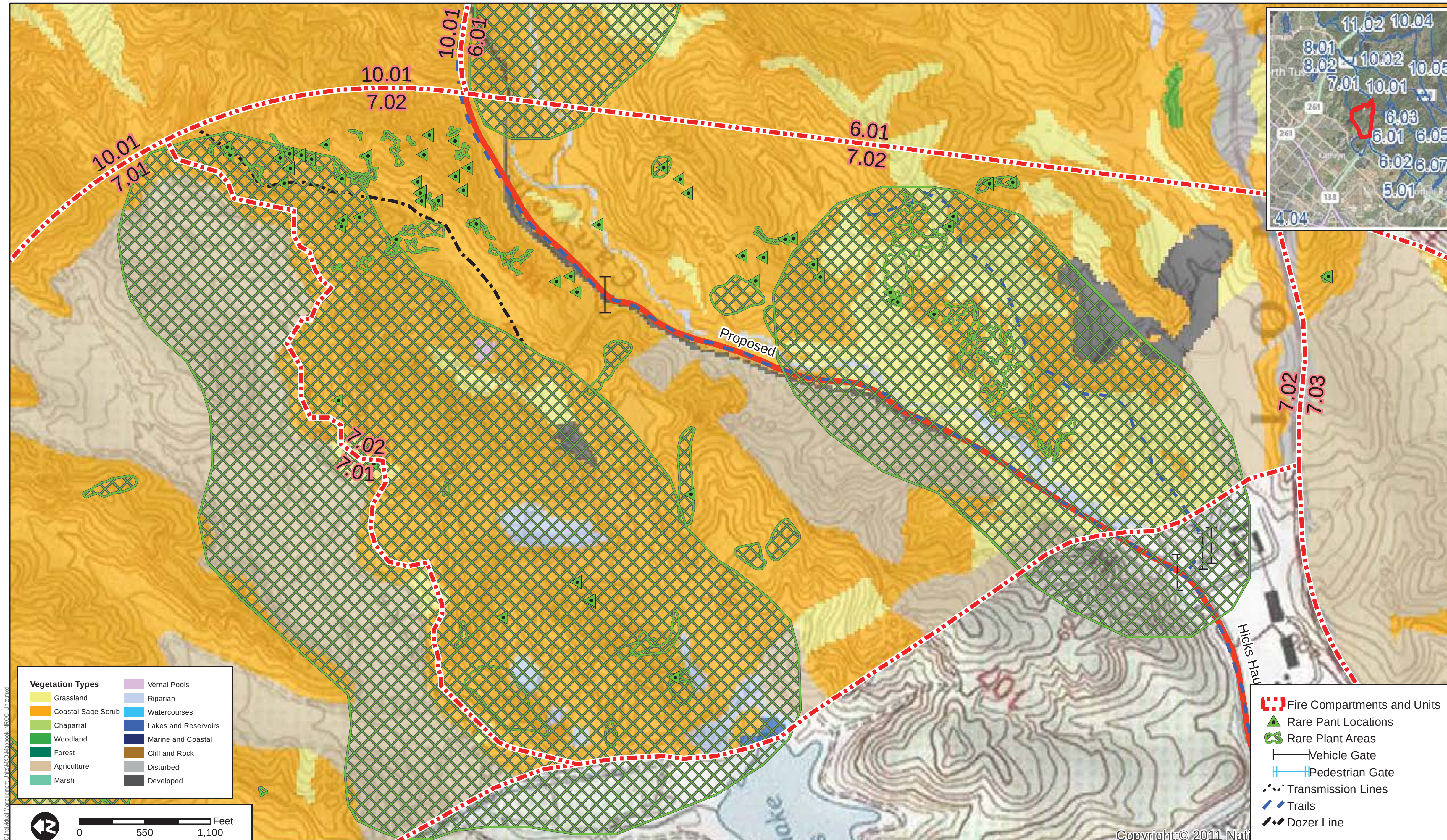

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 7.02 / Acres - 804

Fire Management Unit 7.02

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FIRE MANAGEMENT UNIT 7.03

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 346 acres Special Considerations: TCA Habitat Mitigation Area; coastal sage scrub, California gnatcatcher, cactus wren, area contained within San Diego Creek Special Management Area	Access Route: Access on perimeter of FMU provided along Bee Canyon Access Rd and Portola Parkway to south and southwest; SR 133 Transportation Corridor on southeast and east, Bee Canyon Access Road to north; dirt roads throughout the FMU related to reservoir maintenance.

Vegetation (fuel) types

Agriculture	147 ac.	42%
Coastal Sage Scrub	139 ac.	40%
Developed	1 ac.	0.4%
Disturbed	9 ac.	3%
Grassland	24 ac.	7%
Lakes and reservoirs	24 ac.	7%
Marsh	2 ac.	0.5%

Sensitive Environmental Resources

Sensitive plant and wildlife species found at this site include: Coastal California gnatcatcher, Cactus wren

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (97%), 1948 (.56%)

Cultural Resources

One site documented

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Syphon Reservoir
Municipal water system (fire hydrants) nearby
Fire Protection:
No Structures to protect

SAFETY PRECAUTIONS: Area includes TCA habitat mitigation area

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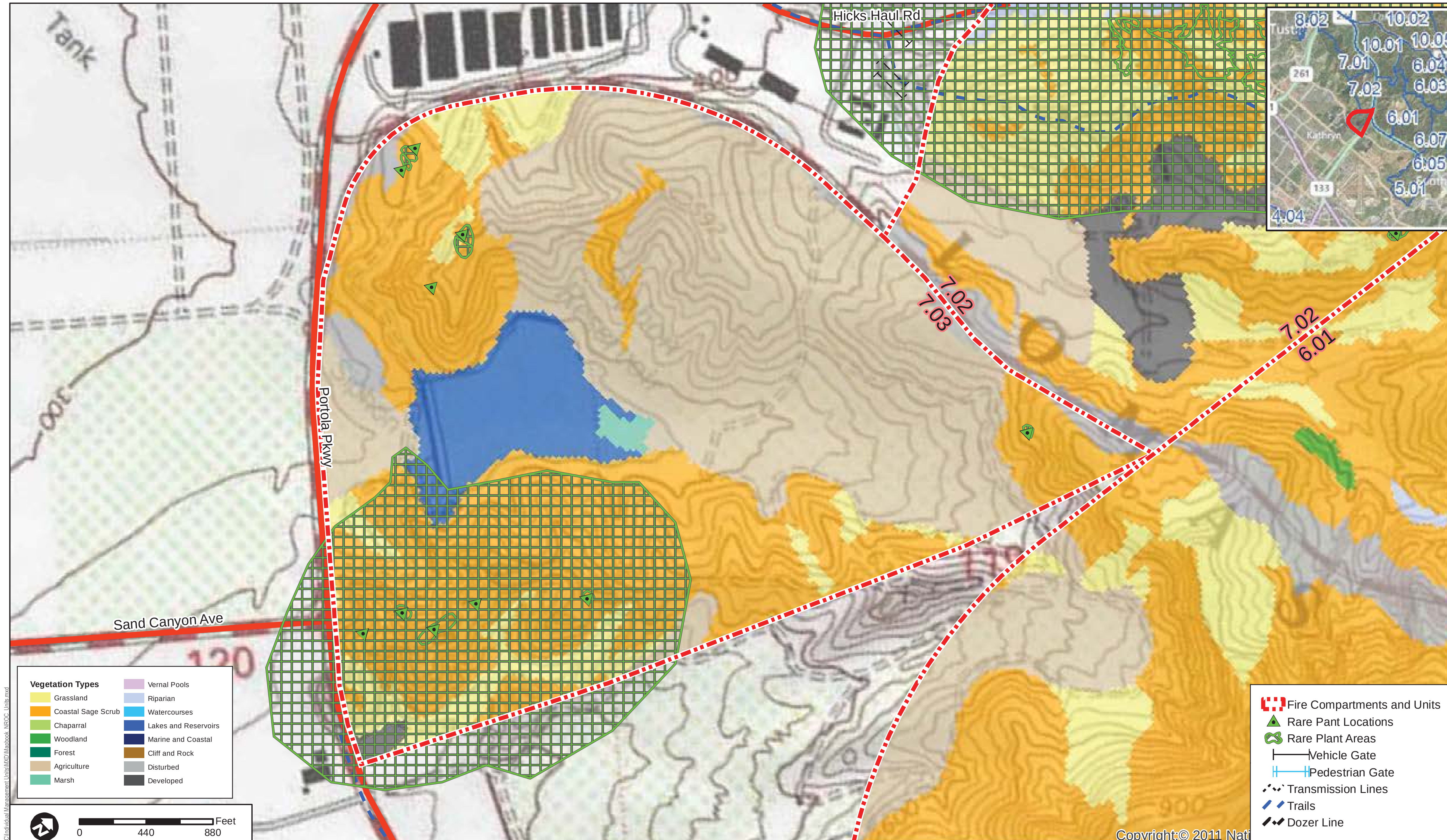

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 7.03 / Acres - 347

Fire Management Unit 7.03

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FIRE MANAGEMENT UNIT 8.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 211.343 acres Special Considerations: Sensitive riparian and native grassland habitats, California gnatcatcher	Access Route: FMU is accessible from Canyon View Avenue (north) from Jamboree Road; Skylark Place in the northwest and along east side of reservoir from Peters Canyon Road off Jamboree Road.

Vegetation (fuel) types

Coastal Sage Scrub	39 ac.	18%
Developed	2 ac.	1%
Disturbed	29 ac.	14%
Grassland	72 ac.	34%
Lakes and reservoirs	20 ac.	9%
Riparian	49 ac.	23%

Sensitive Environmental Resources

Sensitive wildlife species documented at this park include: Coastal California gnatcatcher, Coastal cactus wren, Orange-throated whiptail lizard, Grasshopper sparrow

Last Fire Activity (Year and Percentage of Unit Burned)

2003 (3%), 1982 (51%), 1967 (100%), 1948 (100%), No date given (21%)

Cultural Resources

Unknown

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Peters Canyon Reservoir
Municipal water system (fire hydrants) nearby
<u>Fire Protection:</u>
Structures meet with undeveloped wildland or vegetative fuels along southern boundary of FMU

SAFETY PRECAUTIONS: Eucalyptus trees, heavy public use, Wildland Urban Interface along southern perimeter

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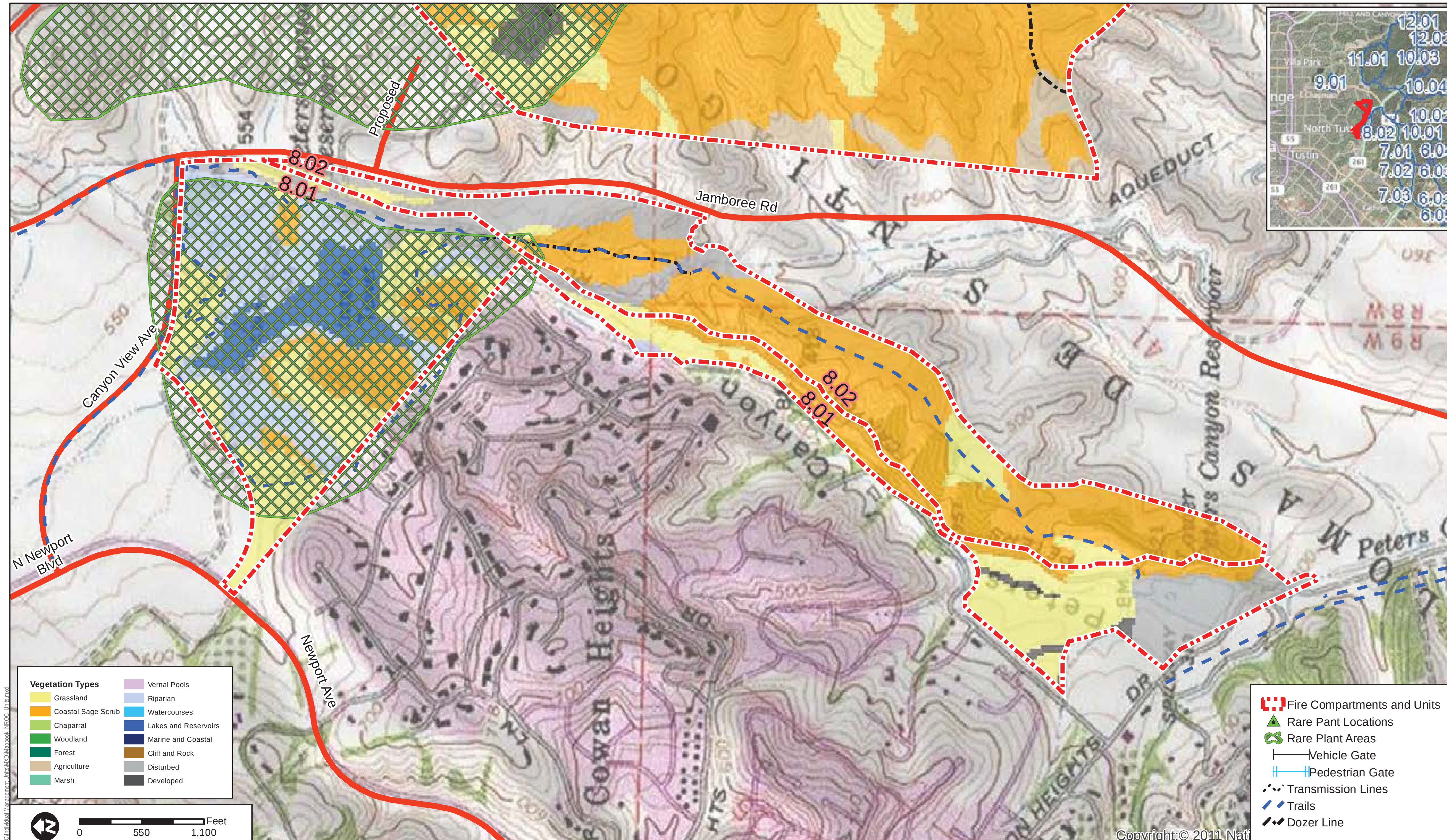

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 8.01 / Acres - 211

Fire Management Unit 8.01

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 8.02

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 121 acres Special Considerations: Sensitive riparian and native grassland habitats, California gnatcatcher, riparian habitat, WUI on eastern and western edge, Lower Peter's Canyon Reservoir	Access Route: Access is good and provided via dirt access roads at top of ridge and near bottom of slope around Lower Peter's Canyon Reservoir through gated access off Peters Canyon Road.

Vegetation (fuel) types

Coastal Sage Scrub	87 ac.	72%
Developed	0.01 ac.	0.01%
Disturbed	23 ac.	19%
Grassland	11 ac.	9%

Sensitive Environmental Resources

Sensitive wildlife species documented at this park include: Coastal California gnatcatcher, Coastal cactus wren, Orange-throated whiptail lizard, Grasshopper sparrow

Last Fire Activity (Year and Percentage of Unit Burned)

2003 (15%), 1984 (14%), 1982 (71%), 1967 (100%), 1948 (100%), No date given (35%)

Cultural Resources

Unknown

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Peters Canyon Reservoir
Municipal water system (fire hydrants) nearby
Fire Protection:
Structures meet with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Eucalyptus trees, heavy public use, older construction in some neighboring communities

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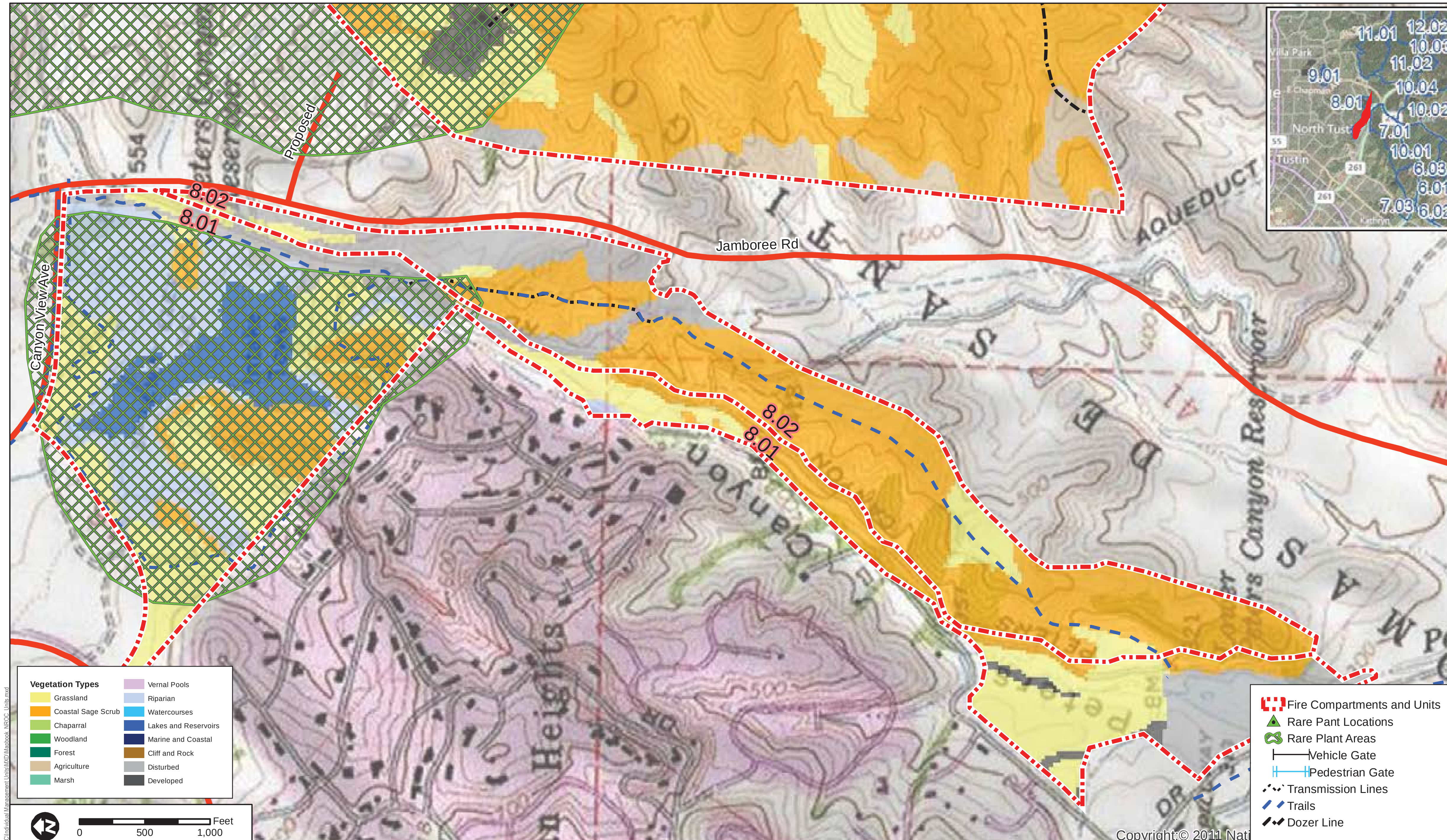

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 8.02 / Acres - 122

Fire Management Unit 8.02

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FIRE MANAGEMENT UNIT 9.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 140 acres Special Considerations: Southern cactus scrub/cactus wren habitat dominate site	Access Route: Access is limited to trails that are not drivable. A paved road (E. Glen Albyn Lane)provides access to a substation in the northwestern portion of the FMU, North Cannon Street provides access along the eastern FMU boundary, residential paved roads provide limited access to western, southern, and northern boundaries.

Vegetation (fuel) types

Coastal Sage Scrub	112 ac.	80%
Developed	5 ac.	3%
Disturbed	17 ac.	12%
Grassland	6 ac.	4%

Sensitive Environmental Resources

Sensitive plant and wildlife species documented at this site include: Coastal California gnatcatcher, Coastal cactus wren, Orange-throated whiptail lizard, Many stemmed dudleya (1 site)

Last Fire Activity (Year and Percentage of Unit Burned)

1974 (74%)

Cultural Resources

none documented

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Municipal water system (fire hydrants)
Unknown lake to the west and adjacent to Villa Park Road and North Hewes Street
Fire Protection:
Structures meet with undeveloped wildland or vegetative fuels on all sides of FMU.

SAFETY PRECAUTIONS: Cactus scrub dominates entire unit

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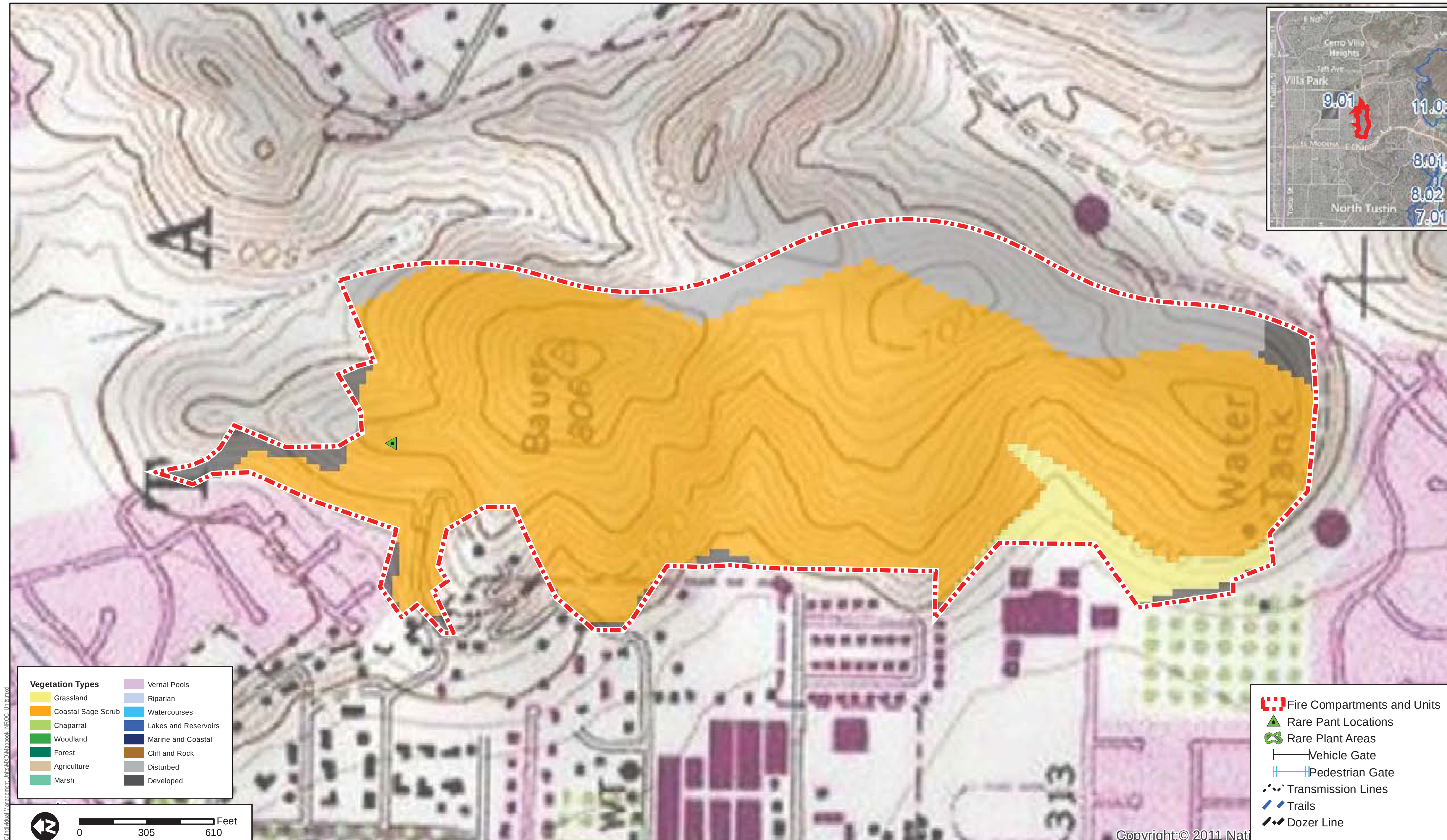

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 9.01 / Acres - 139

Fire Management Unit 9.01

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 10.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 1756 acres; Special Considerations: Area supports high quality coastal sage scrub and oak woodlands	Access Route: Access on perimeter of FMU provided along East Santiago Canyon Road (north/east), East Trans Corridor - SR 241 (south/west), Jeffrey Road to Hicks Haul Road (south/east), East end of Hicks Haul Road is gated (#2749W) and Loma Ridge Jeep Trail (central FMU)

Vegetation (fuel) types

Agriculture	4 ac.	0.2%
Chaparral	18 ac.	1%
Coastal Sage Scrub	837 ac.	48%
Developed	27 ac.	2%
Grassland	741 ac.	42%
Riparian	41 ac.	2%
Vernal Pools	2 ac.	0.1%
Watercourses	2 ac.	0.1%
Woodland	84 ac.	5%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented within this unit include: Catalina mariposa lily, Intermediate foothill mariposa lily, Coastal California gnatcatcher, Coastal cactus wren, American badger, Western spadefoot toad mitigation pools in, Shoestring Canyon

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (100%), 1998 (3%), 1997 (.27%), 1967 (.27%), 1948 (.27%), 1914 (.27%)

Cultural Resources

Unknown

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Irvine Lake
water tenders
Fire Protection:
No structure protection

SAFETY PRECAUTIONS: Unstable geology within entire unit

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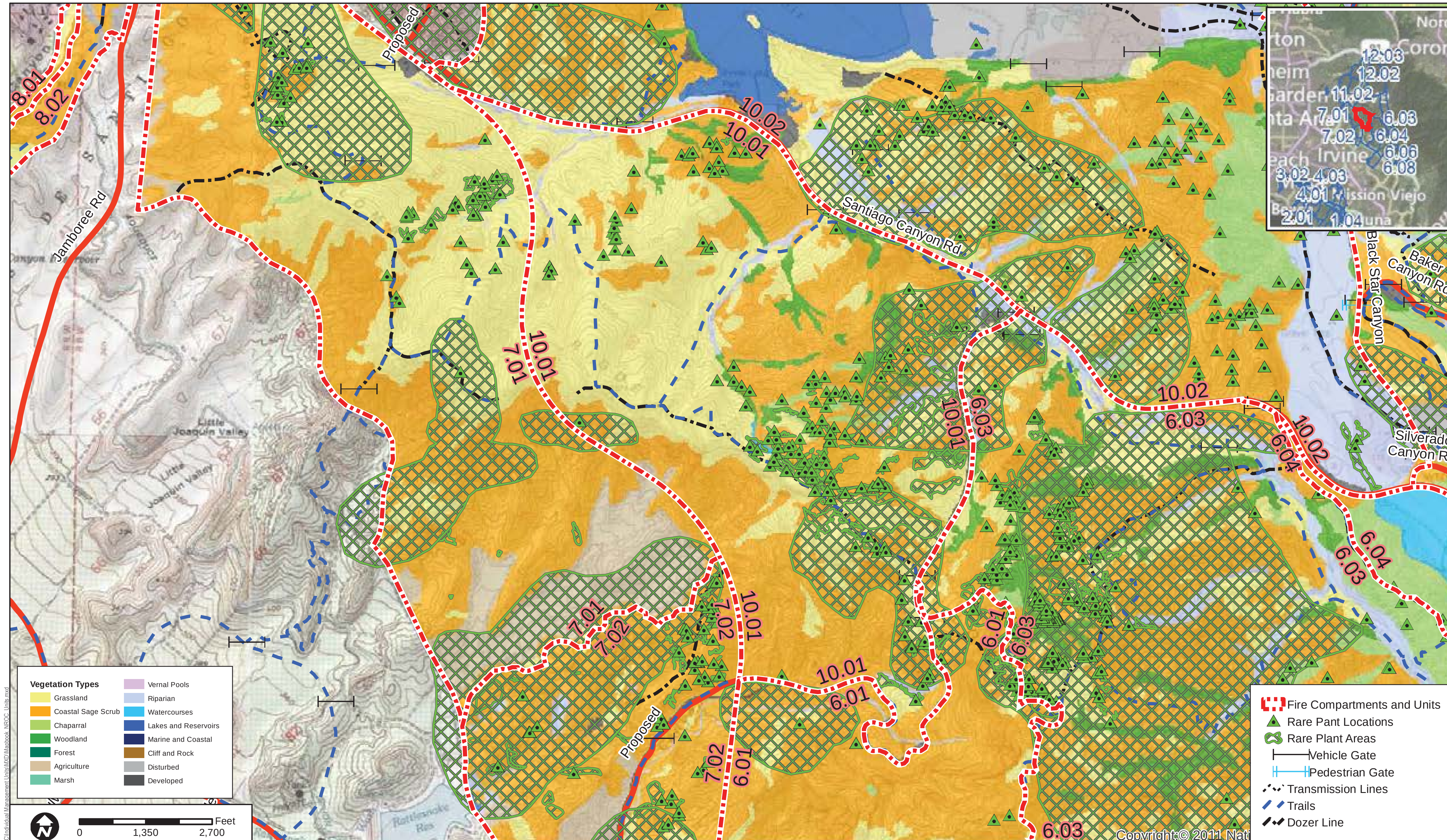

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 10.01 / Acres - 1755

Fire Management Unit 10.01

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 10.02

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 4031 acres; Special Considerations: Area supports many rare plants and unique/rare wildlife associated with riparian habitats including Arroyo toad pond turtle and speckled dace	Access Route: Access on perimeter of FMU along Lake View SCE Road (north); State Spur Road and Black Star Canyon Road and Red Rock Ridge Road (east); dam facility road (west); east Santiago Canyon Rd (south); some access internally in FMU on Red Spur, Haul Roads; and other trails/roads. Numerous gates in and around FMU perimeter.

Vegetation (fuel) types

Chaparral	866 ac.	22%
Cliff and Rock	3 ac.	0.1%
Coastal Sage Scrub	1441 ac.	36%
Developed	77 ac.	2%
Disturbed	178 ac.	4%
Grassland	469 ac.	12%
Lakes and reservoirs	514 ac.	13%
Riparian	376 ac.	9%
Watercourses	0.01	0.01%
Woodland	107 ac.	3%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented within this unit include: Catalina mariposa lily, Intermediate foothill mariposa lily, Coastal California gnatcatcher, Coastal cactus wren, Chaparral beargrass, Santa Ana speckled dace, Southwestern pond turtle, Arroyo toad (*Anaxyrus californicus*)

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (1%), 2004 (4%), 2003(.01%), 1998 (.03%), 1997 (62%), 1991 (.5%), 1982 (15%), 1967 (96%), 1956 (3%), 1948 (99%), 1914 (94%)

Cultural Resources

Two sites documented

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Irvine Lake
Water Tenders
<u>Fire Protection:</u>
Structures intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Unstable geology, cliffs, few access roads, steep topography

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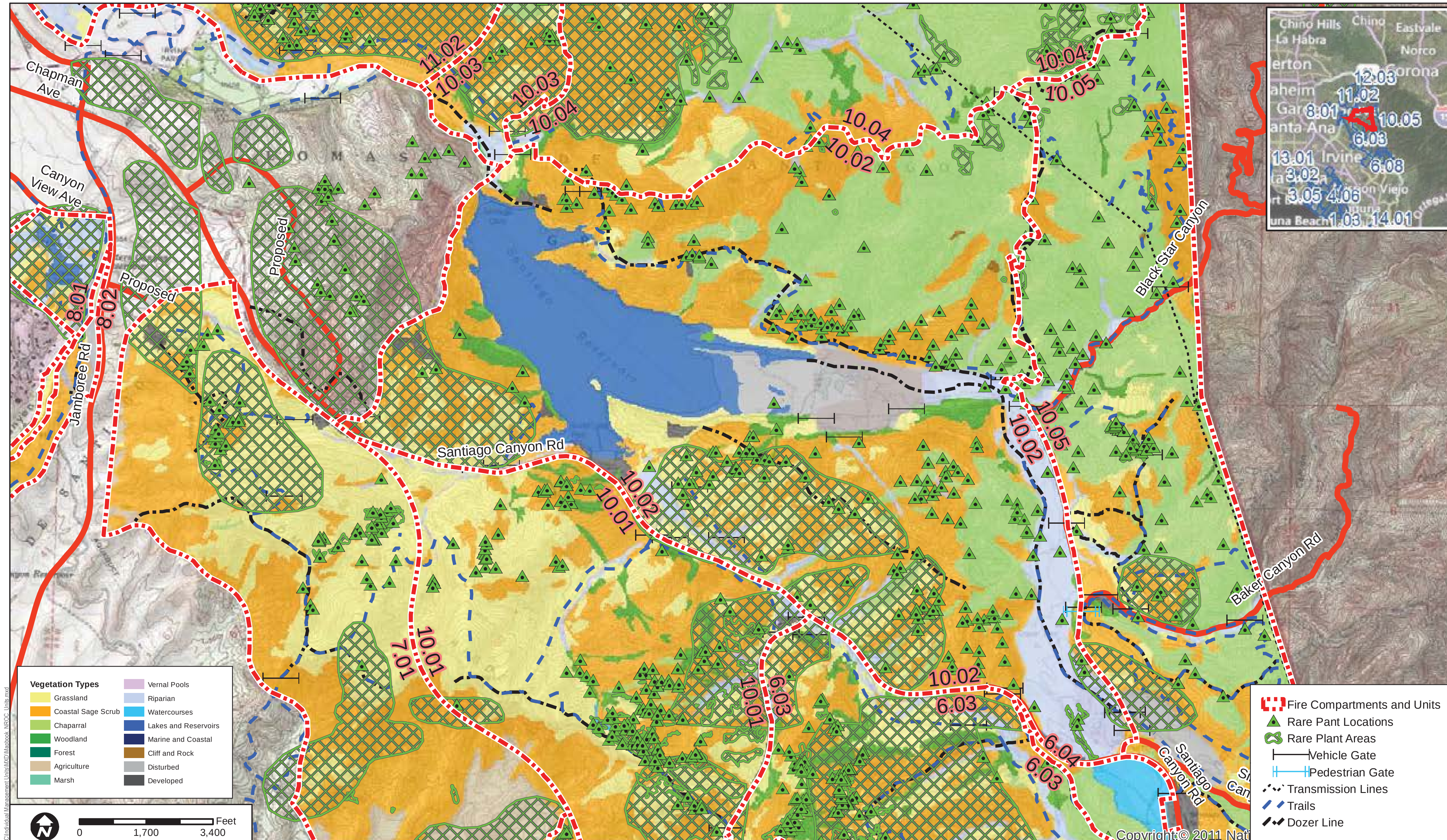

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 10.02 / Acres - 4031

Fire Management Unit 10.02

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 10.03

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 912 acres Special Considerations: Southern California Edison powerlines cross unit, area supports many rare/unique plant species	Access Route: Access to FMU is moderate considering its narrow shape; MWD road through gate #2146Y to Coal Road intersection (gate # 2246X) in the south boundary, SR-241 along the west boundary, Coal Road along the east boundary and Upper Blind Canyon Rd through interior of FMU. The northern boundary follows North and south Windy Ridge Roads.

Vegetation (fuel) types

Chaparral	470 ac.	52%
Coastal Sage Scrub	350 ac.	38%
Grassland	63 ac.	7%
Riparian	16 ac.	2%
Woodland	12 ac.	1%

Sensitive Environmental Resources

Sensitive plant and wildlife species that have been documented within this unit include: Many-stemmed dudleya, Catalina mariposa lily, Intermediate foothill mariposa lily, Coastal cactus wren, Chaparral beargrass, Western spadefoot toad, likely numerous rare plant/animal spp, Tecate cypress (*Hesperocyparis forbesii*) small stand

Last Fire Activity (Year and Percentage of Unit Burned)

2006 (91%), 1982 (100%), 1967(100%), 1948 (100%), 1914 (100%)

Cultural Resources

No Information

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Irvine Lake
Water Tenders
<u>Fire Protection:</u>
No structures to protect

SAFETY PRECAUTIONS: Cliffs, rock outcrops, Southern California Edison utility lines cross overhead

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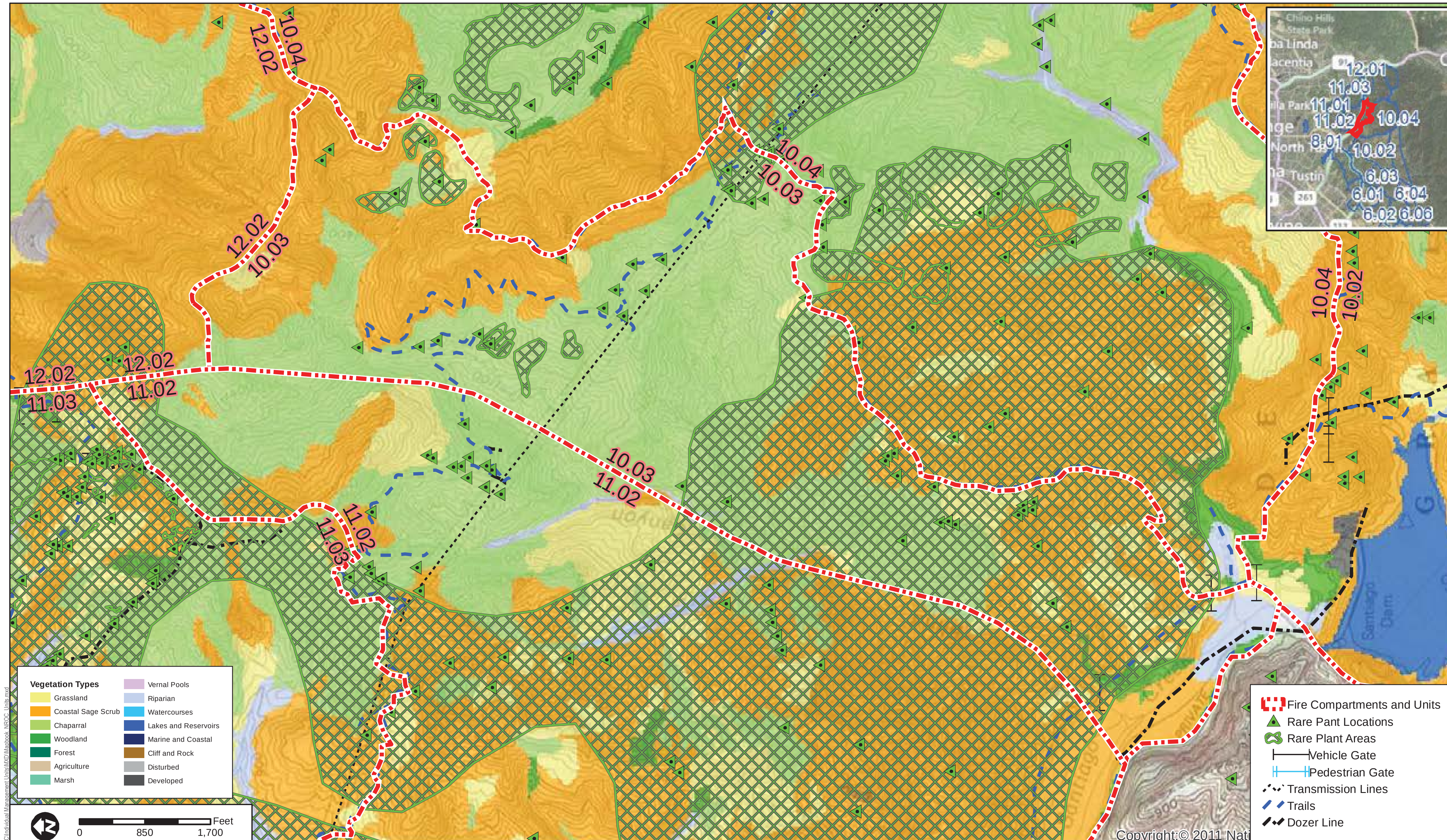

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 10.03 / Acres - 912

Fire Management Unit 10.03

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 10.04</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 3832 acres; Special Considerations: Southern California Edison powerlines overhead, Steep topography, several spur/dead end roads; few access roads</td><td>Access Route: Access is limited to perimeter on Lake View SCE Road (south/east); N. Windy Ridge Road (north/NW); South Windy Ridge Rd (west); Mine SCE Rd and other transmission line maintenance roads.</td></tr>
<tr><td colspan="4">Vegetation (fuel) types</td></tr>
<tr><td>Chaparral
Cliff and Rock
Coastal Sage Scrub
Disturbed
Forest
Grassland
Riparian
Woodland</td><td>2560 ac.
9 ac.
920 ac.
0.17 ac.
2 ac.
139 ac.
130 ac.
72 ac.</td><td colspan="2">67%
0.2%
24%
0.01%
0.1%
4%
3%
2%</td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Sensitive plant and wildlife species that have been documented within this unit include: Catalina mariposa lily, Intermediate foothill mariposa lily, Coastal cactus wren, Chaparral beargrass, Western spadefoot toad, Golden eagle (Aquila chrysaetos) and other nesting raptors, several species of bats in rock outcrops, and canyon woodlands</td></tr>
<tr><td colspan="4">Last Fire Activity (Year and Percentage of Unit Burned)</td></tr>
<tr><td colspan="4">2006 (100%), 2002 (.03%), 1997 (10%), 1982 (73%), 1967 (100%), 1948 (100%), 1914 (61%)</td></tr>
<tr><td colspan="4">Cultural Resources</td></tr>
<tr><td colspan="4">No information</td></tr>
<tr><td colspan="4">Suppression Activities</td></tr>
<tr><td colspan="4"><u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Irvine Lake
water tenders
<u>Fire Protection:</u>
No structures to protect</td></tr>
<tr><td colspan="4">SAFETY PRECAUTIONS: Southern California Edison powerlines, large boulders, steep topography, limited two-way traffic on existing truck trails</td></tr>
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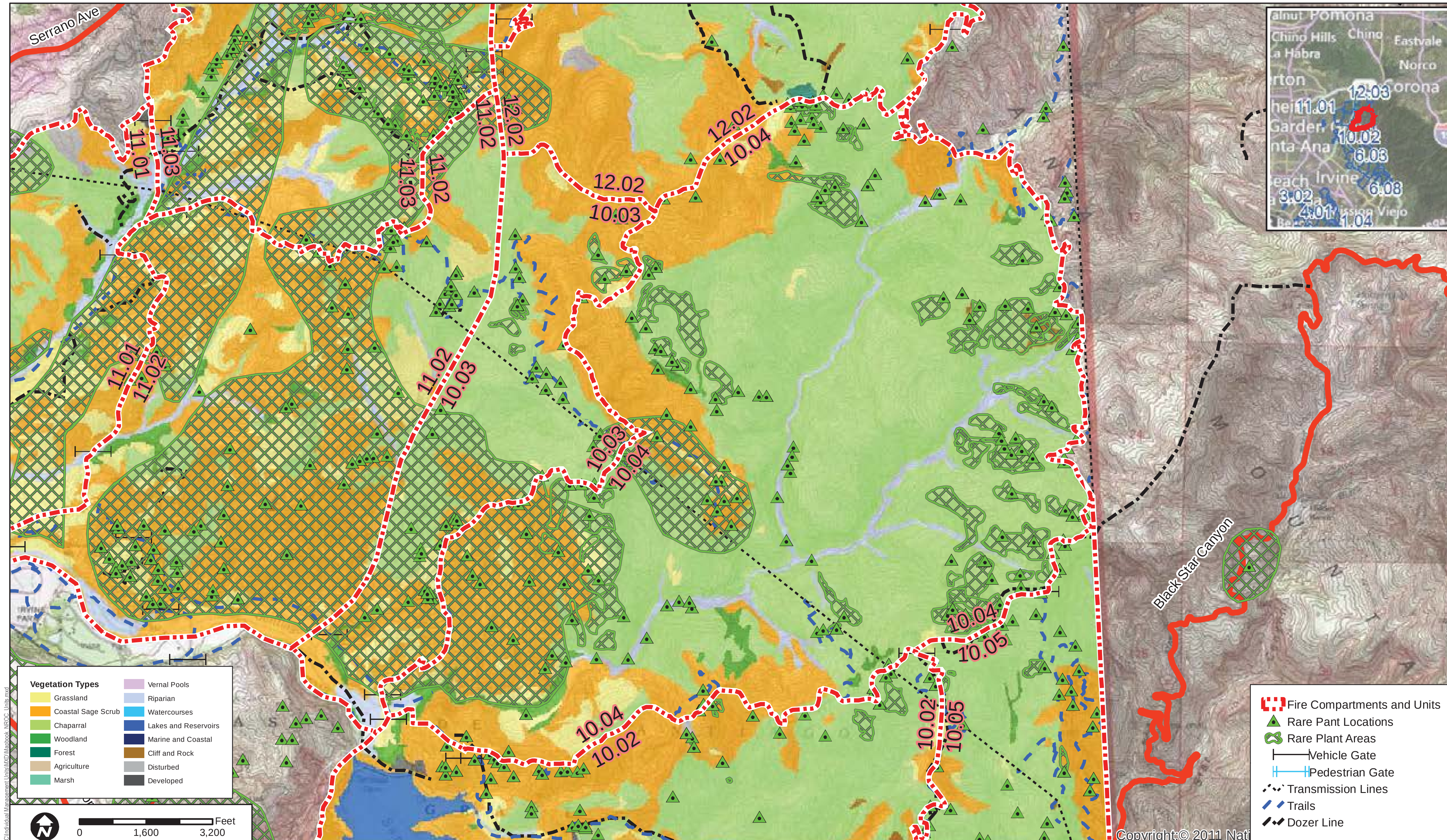

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 10.04 / Acres - 3832

Fire Management Unit 10.04

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FIRE MANAGEMENT UNIT 10.05

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 2249 acres; Special Considerations: Streams/creeks and adjacent lands support Arroyo toad and potentially Santa Ana speckled dace and pond turtle; SCE powerlines cross unit along CNF/Irvine Ranch Boundary	Access Route: Access is limited to perimeter roads including: Santiago Canyon Road (southwest); Black Star Canyon Road (southwest); State Spur Road (west); Lake View SCE Road (northwest); transmission line maintenance roads eastern portion along transmission line corridor

Vegetation (fuel) types

Agriculture	1 ac.	0.1%
Chaparral	1235 ac.	55%
Cliff and Rock	0.6 ac.	0.01%
Coastal Sage Scrub	629 ac.	28%
Developed	67 ac.	3%
Disturbed	66 ac.	3%
Forest	2 ac.	0.1%
Grassland	149 ac.	7%
Riparian	52 ac.	2%
Watercourses	2 ac.	0.1%
Woodland	45 ac.	2%

Sensitive Environmental Resources

Sensitive Plants Include: Chocolate lily, Chaparral beargrass, Intermediatefoothill mariposa lily
Sensitive Wildlife Include: Santa Ana speckled dace, California gnatcatcher, Several species of bats, Nesting raptors, Pond turtle, Arroyo toad

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (12%), 2006 (.38%), 2004 (2%), 1998 (.36%), 1997 (68%), 1975 (.15%), 1967(55%), 1948 (87%), 1914 (42%)

Cultural Resources

Unknown

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Irvine Lake
water tenders
Municipal water system (fire hydrants) in nearby Silverado
<u>Fire Protection:</u>
Structures meet or intermingle with undeveloped wildland or vegetative fuels in southern portion of FMU.

SAFETY PRECAUTIONS: Southern California Edisontransmission lines

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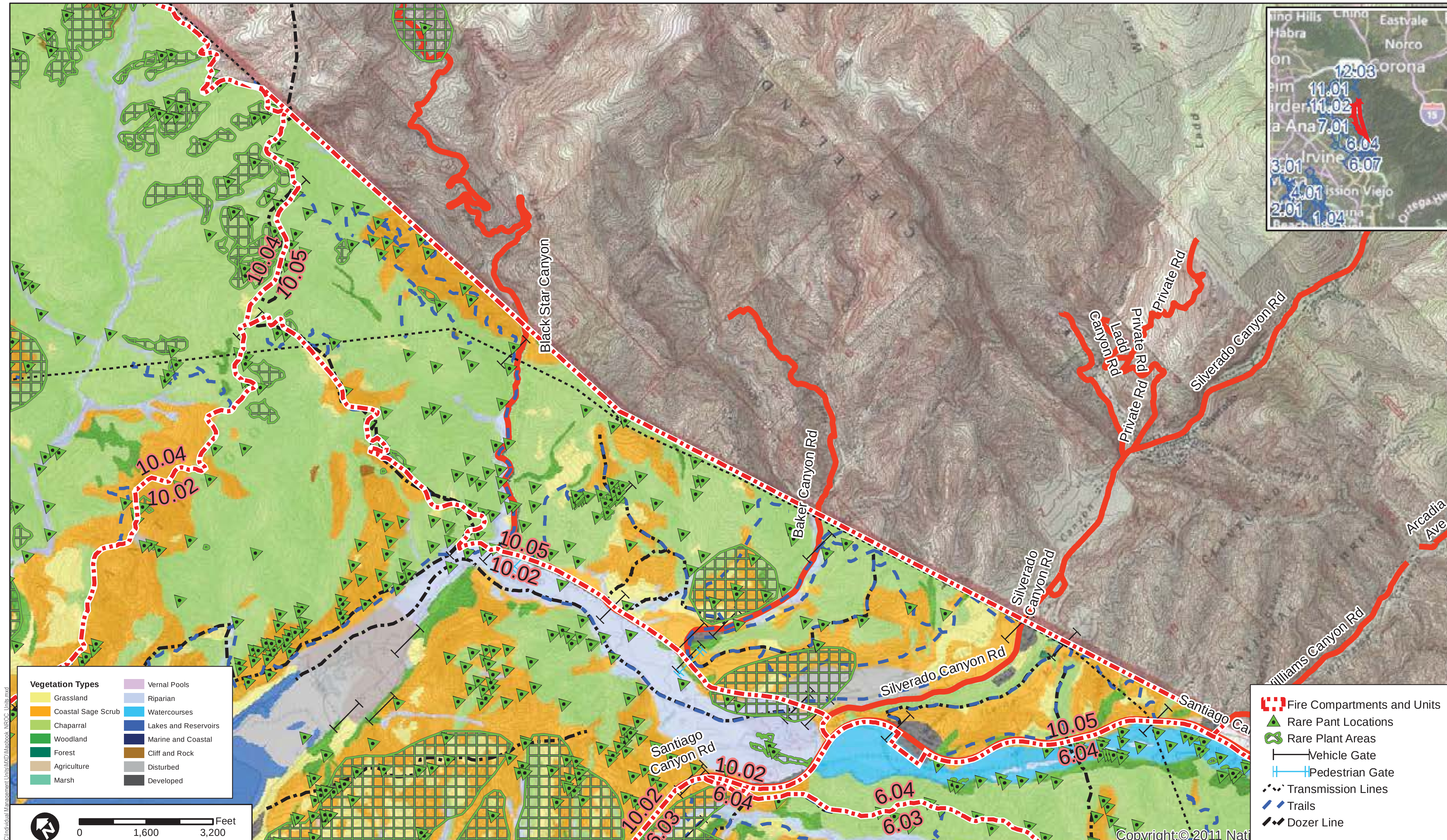

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 10.05 / Acres - 2248

Fire Management Unit 10.05

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FIRE MANAGEMENT UNIT 11.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 1420 acres; Special Considerations: Area consists of NCCP/NROC lands and lands protected through conservation easements that are considered to have high resource value. Unit contains large area of habitat for cactus wren. Outdoor Education Center	Access Route: Access to FMU is better than most FMUs with Edition Ridge on the West boundary; Serrano Avenue Southwest boundary; MWD access road via gate 2143W to outdoor education center, MWD road continues as eastern boundary of FMU which is also accessible form the north from S. Hidden Canyon Road via gate 1744X.

Vegetation (fuel) types

Chaparral	336 ac.	24%
Cliff and Rock	3 ac.	0.2%
Coastal Sage Scrub	422 ac.	30%
Developed	19 ac.	1%
Disturbed	40 ac.	3%
Grassland	243 ac.	17.1%
Lakes and reservoirs	17 ac.	1%
Marsh	11 ac.	0.7%
Riparian	293 ac.	21%
Woodland	36 ac.	3%

Sensitive Environmental Resources

Sensitive plant and wildlife species documented at this site include: Coastal California gnatcatcher, Cactus wren, Red diamondback rattlesnake, Red-shouldered hawk, Many-stemmed dudleya, Intermediate foothill mariposa lily

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (50%), 2004 (4%), 1982 (100%), 1967 (100%), 1948 (100%), 1914 (52%), No date given (3%)

Cultural Resources

Six recorded sites: CA-ORA-585, CA-ORA-586, CA-ORA-588, CA-ORA-589, CA-ORA-590, 30-176704

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Municipal water system (fire hydrants)
Reservoir in FMU near Santiago Canyon Road
Walnut Canyon Reservoir
Misc. ponds
Fire Protection:
Structures meet or intermingle with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Southern California Edison transmission lines overhead; Outdoor Education Center

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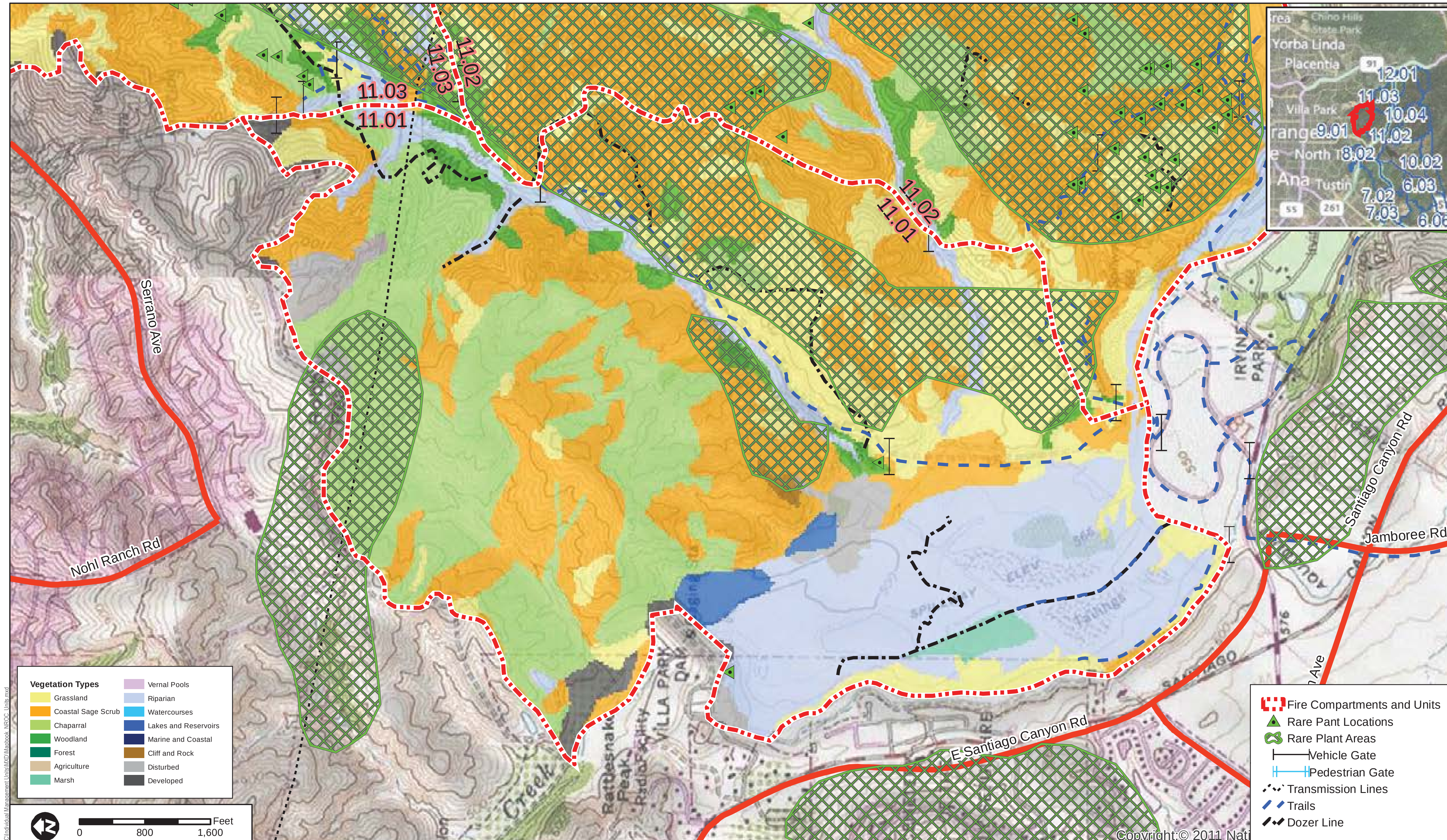

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 11.01 / Acres - 1420

Fire Management Unit 11.01

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FIRE MANAGEMENT UNIT 11.02

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression	
Size: 1849 acres; Special Considerations: Area consists of lands protected through conservation easements that are considered to have high resource value. Southern California Edison power lines border unit on the north	Access Route: Access to FMU is provided by Edison transmission line road (Upper Blind Canyon Road) via gate 1844X in the north, MWD access road along ridgeline on the west, SR 241 on the east, and Regional Park roads/MWD access on the south; access to the middle portion of the FMU is very restricted with no roads. Numerous locked gates in southern portion of FMU.

Vegetation (fuel) types

Chaparral	362 ac.	20%
Cliff and Rock	1 ac.	0.1%
Coastal Sage Scrub	1086 ac.	59%
Developed	0.0001 ac.	0.001%
Grassland	311 ac.	17%
Riparian	54 ac.	3%
Woodland	35 ac.	2%

Sensitive Environmental Resources

Sensitive plant and wildlife species documented at this site include: San Diego fairy shrimp (*Branchinecta sandiegonensis*), Coastal California gnatcatcher, San Diego cactus wren (*Campylorhynchus brunneicapillus couesi*), Rosy boa (*Lichanura trivirgata*), Red diamondback rattlesnake, Red-shouldered hawk, Several sensitive species of bats, Many-stemmed dudleya, Intermediate foothill mariposa lily, Chaparral bear-grass, Many-stemmed dudleya

Last Fire Activity (Year and Percentage of Unit Burned)

2007 (02%), 2006 (.19%), 1982 (100%), 1967 (100%), 1948 (100%), 1914 (100%), No date given (.26%)

Cultural Resources

Six recorded sites: CA-ORA-585, CA-ORA-586, CA-ORA-590, 30-176704, 30-162283, CA-ORA-1280

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Municipal water system (fire hydrants)
Reservoir in FMU 11.01 near Santiago Canyon Road
Walnut Canyon Reservoir
Peters Canyon Reservoir
<u>Fire Protection:</u>
Structures in Irvine Park meet with undeveloped wildland or vegetative fuels at southern portion of FMU.

SAFETY PRECAUTIONS: Southern California Edison transmission lines cross unit

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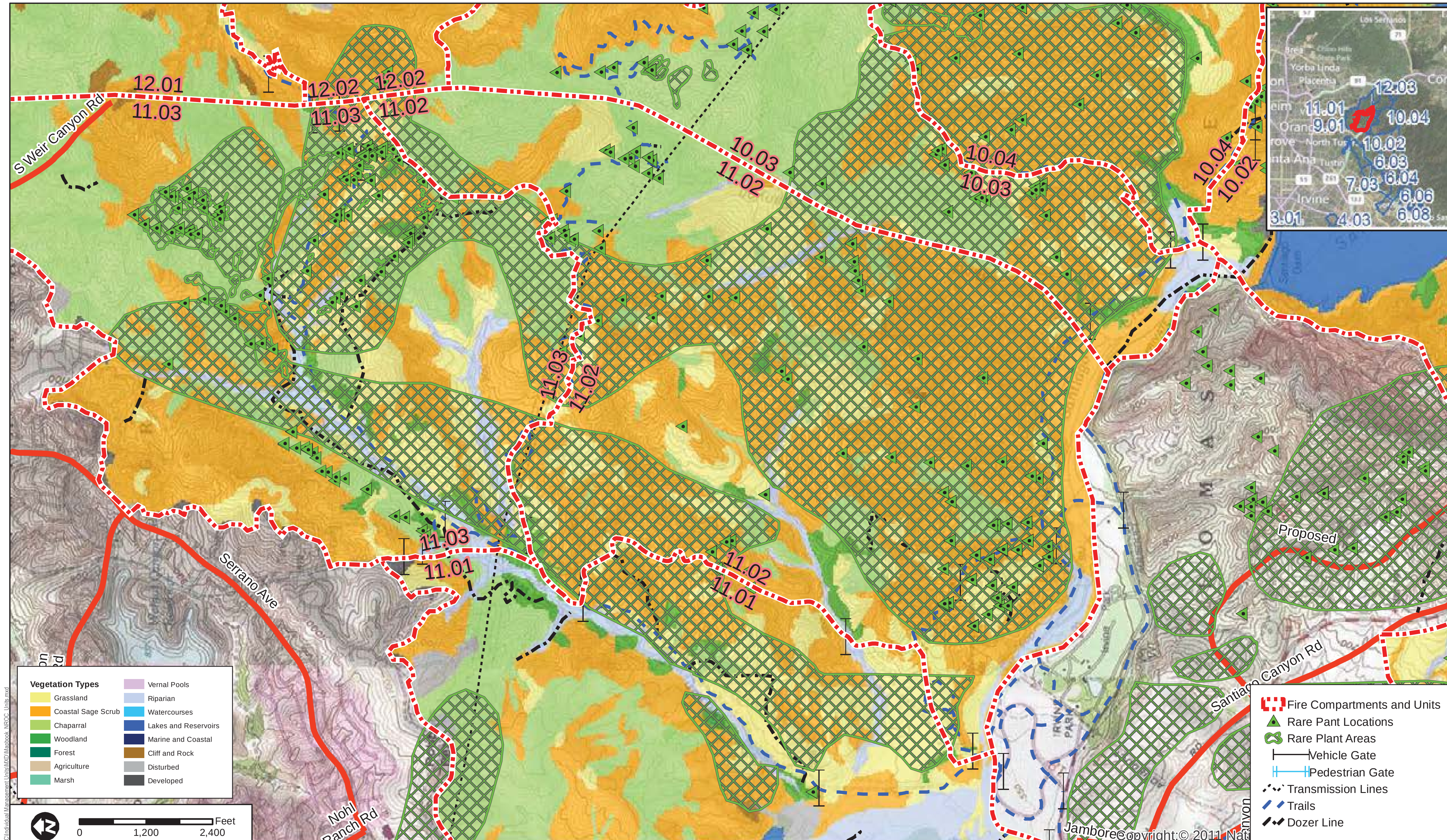

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 11.02 / Acres - 1850

Fire Management Unit 11.02

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 11.03

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 1616 acres; Special Considerations: Area consists of NCCP/NROC lands and lands protected through conservation easements that are considered to have high resource value. Southern California Edison power lines cross southern edge of unit	Access Route: Access to FMU is better than most FMUs; occurs along boundary lines at MWD access road (southwest), Windy Ridge Road, through the middle of the FMU, Jeep trail in the northern half of the FMU; SR 241 on eastern edge, horse trail and Blue Sky Way along western edge.	
Vegetation (fuel) types		
Chaparral	654 ac.	40%
Cliff and Rock	1 ac.	0.1%
Coastal Sage Scrub	581 ac.	36%
Developed	14 ac.	1%
Disturbed	27 ac.	2%
Grassland	212 ac.	13%
Riparian	84 ac.	5%
Woodland	43 ac.	3%
Sensitive Environmental Resources		
Sensitive plant and wildlife species documented at this site include: Coastal California gnatcatcher, San Diego cactus wren, Rosy boa, Red diamondback rattlesnake, Red-shouldered hawk, Several sensitive species of bats, Many-stemmed dudleya, Intermediatefoothill mariposa lily, Chaparral beargrass, Many- stemmed dudleya		
Last Fire Activity (Year and Percentage of Unit Burned)		
2007 (42%), 2006 (.33%), 1982 (100%), 1967 (100%), 1948 (100%), 1929 (13%), 1914 (84%), No date given (3%)		
Cultural Resources		
Ten recorded sites: CA-ORA-588, CA-ORA-589, CA-ORA-590, CA-ORA-591H, CA-ORA-592, CA-ORA-1197H, CA-ORA-793, CA-ORA-795, CA-ORA-794, CA-ORA-1196H		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Municipal water system (fire hydrants) Walnut Canyon Reservoir Reservoir in FMU 11.01 near Santiago Canyon Road <u>Fire Protection:</u> Structures meet with undeveloped wildland or vegetative fuels.		
SAFETY PRECAUTIONS: Southern California Edison transmission lines		

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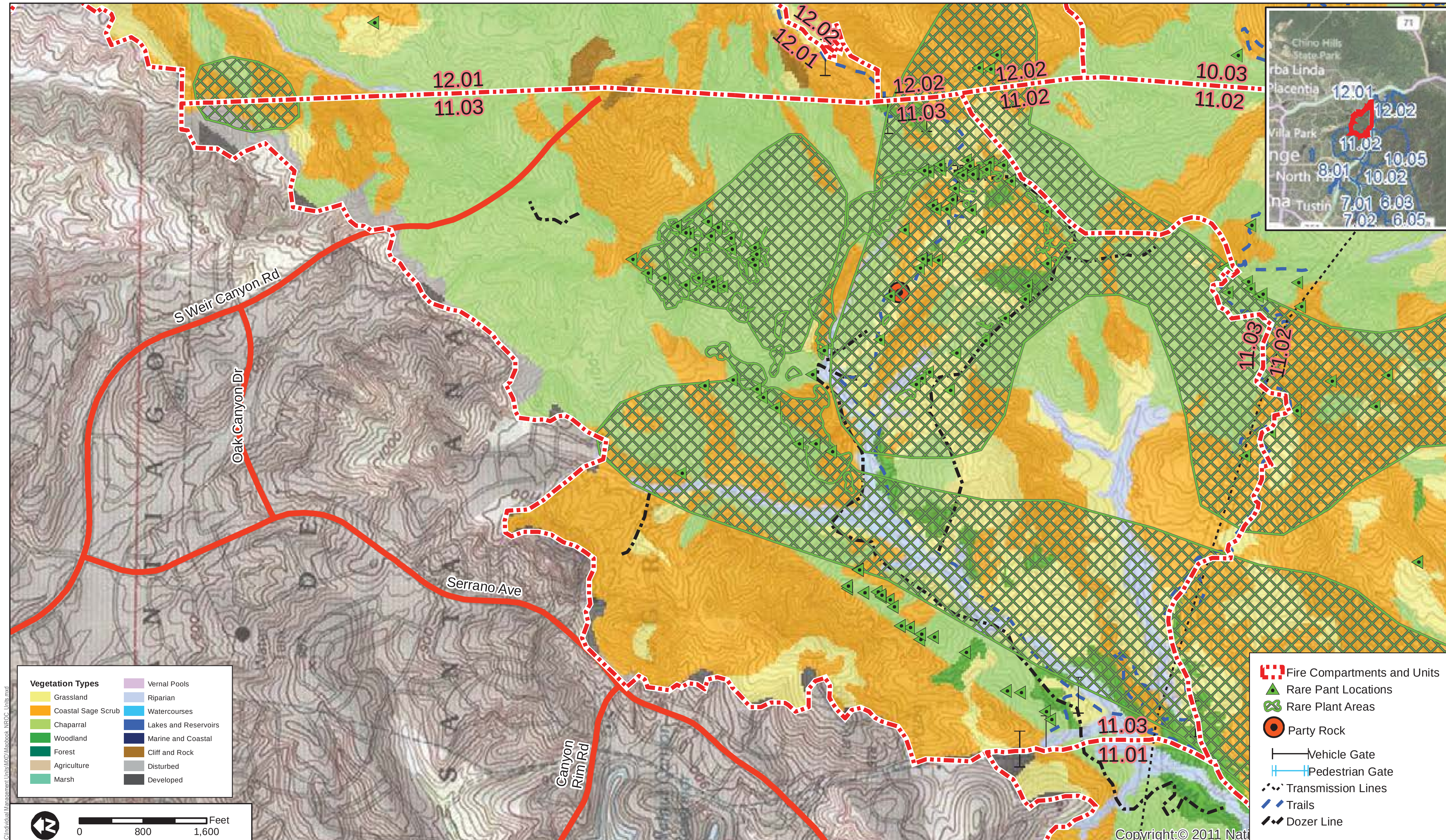

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 11.03 / Acres - 1617

Fire Management Unit 11.03

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 12.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 675 acres Special Considerations: western boundary is SR 241 Eastern Transportation Corridor, will have WUI and fuel mod in northern portion, Tecate Cypress, old firebreak not maintained.	Access Route: Access to FMU occurs along a jeep trail on the eastern boundary; Jeep trail is accessed from the north on Gypsum Canyon Road and SR 91; SR 241 forms boundary on western side - neither have access to interior of FMU; constrained access to interior of FMU.

Vegetation (fuel) types

Chaparral	234 ac.	35%
Cliff and Rock	12 ac.	2%
Coastal Sage Scrub	340 ac.	50%
Disturbed	0.14 ac.	0.001%
Grassland	71 ac.	11%
Riparian	18 ac.	3%
Woodland	0.25 ac.	0.01%

Sensitive Environmental Resources

Tecate Cypress – No Fire

Last Fire Activity (Year and Percentage of Unit Burned)

2009 (.03%), 2008 (3%), 2006 (95%), 1982 (100%), 1967 (100%), 1948 (99%), 1929 (54%), 1914 (38%), No date given (2%)

Cultural Resources

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Walnut Canyon Reservoir
Municipal water system (fire hydrants) north of unit accessible from Gypsum Canyon Road
Water tenders
Fire Protection:
No structures to protect

SAFETY PRECAUTIONS: Access is poor throughout, extreme and erratic winds through SR 91 Corridor and side canyons

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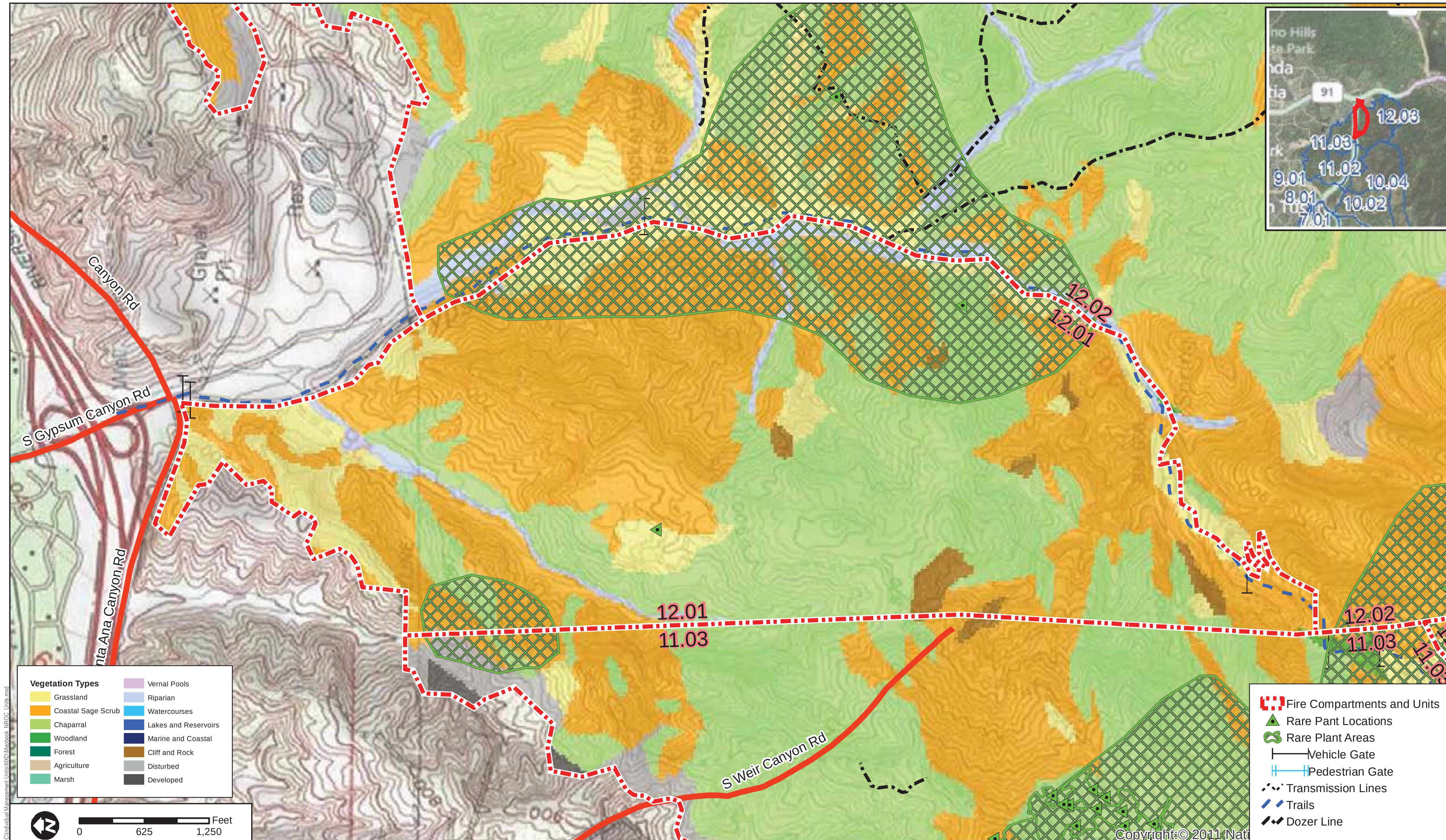

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 12.01 / Acres - 675

Fire Management Unit 12.01

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FIRE MANAGEMENT UNIT 12.02

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 2048 acres Special Considerations: Eastern edge, rock quarry to north of FMU is being reclaimed, OCFA maintains roads for Southern California Edison, Tecate Cypress	Access Route: Access to FMU occurs along North Windy Ridge Road on eastern and southern FMU boundary and along a jeep trail on the western boundary; north accessible on dirt roads on old Quarry site; overall access is constrained on much of the FMU.

Vegetation (fuel) types

Chaparral	1282 ac.	61%
Cliff and Rock	6 ac.	0.3%
Coastal Sage Scrub	570 ac.	27%
Disturbed	26 ac.	1%
Forest	65 ac.	3%
Grassland	110 ac.	5%
Riparian	54 ac.	3%
Woodland	0.25 ac.	0.01%

Sensitive Environmental Resources

Riparian vegetation in southern half of FMU, Tecate Cypress

Last Fire Activity (Year and Percentage of Unit Burned)

2008 (6%), 2006 (95%), 2002 (50%), 1982 (99%), 1967 (100%), 1962 (.02%), 1948 (100%), 1914 (47%), No date given (2%)

Cultural Resources

Need updated data

Suppression Activities

Fire Management Unit objectives:
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
Water Supply:
Walnut Canyon Reservoir
Municipal water system (fire hydrants) north of unit accessible from Gypsum Canyon Road
Water tenders
Fire Protection:
No structure protection

SAFETY PRECAUTIONS: Remote and rugged terrain, limited access; north main divide road at eastern boundary, gated access onto SR 91 freeway from north main divide road.

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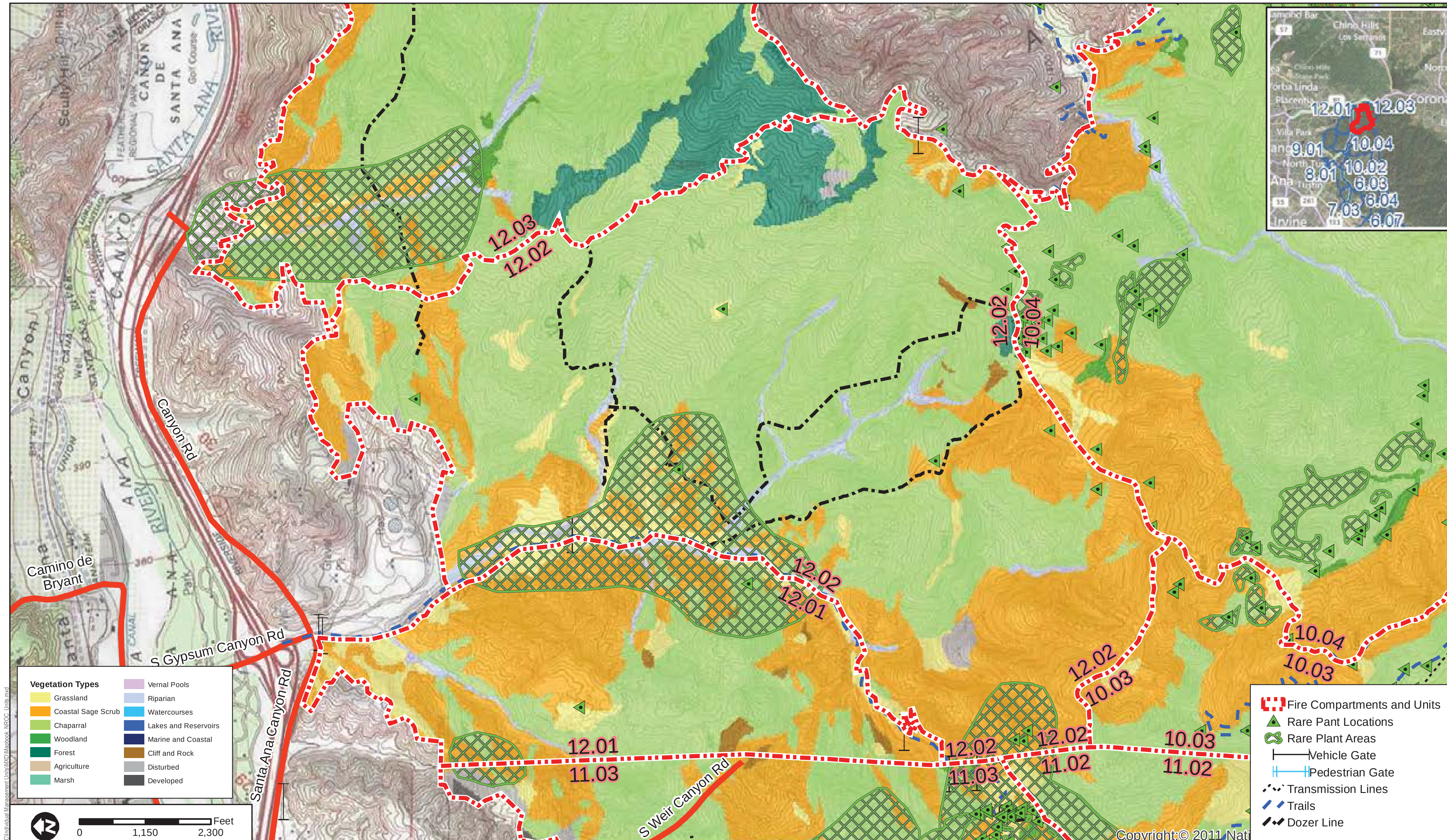

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 12.02 / Acres - 2113

Fire Management Unit 12.02

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FIRE MANAGEMENT UNIT 12.03

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression		
Size: 902 acres Special Considerations: north main divide road, OCFA maintains roads for Southern California Edison		Access Route: Access to FMU occurs along North Windy Ridge Road or gated access under SR 91 from freeway ramps; no access off-road.
Vegetation (fuel) types		
Chaparral	610 ac.	68%
Coastal Sage Scrub	110 ac.	12%
Forest	126 ac.	14%
Grassland	15 ac.	2%
Riparian	30 ac.	3%
Woodland	11 ac.	1%
Sensitive Environmental Resources		
Last Fire Activity (Year and Percentage of Unit Burned)		
2008 (1%), 2006 (55%), 2002(95%), 1985 (6%), 1984 (20%), 1982 (23%), 1967 (100%), 1948 (94%)		
Cultural Resources		
Suppression Activities		
<u>Fire Management Unit objectives:</u> Rapid fire containment Fire spread minimization All available tactical firefighting resources and methods may be utilized <u>Water Supply:</u> Walnut Canyon Reservoir Municipal water system (fire hydrants) north of unit accessible from Gypsum Canyon Road Water tenders <u>Fire Protection:</u> No structures to protect		
SAFETY PRECAUTIONS: SCE power lines; remote, rugged terrain; north main divide road on western boundary, gated access under SR 91 to freeway ramps		

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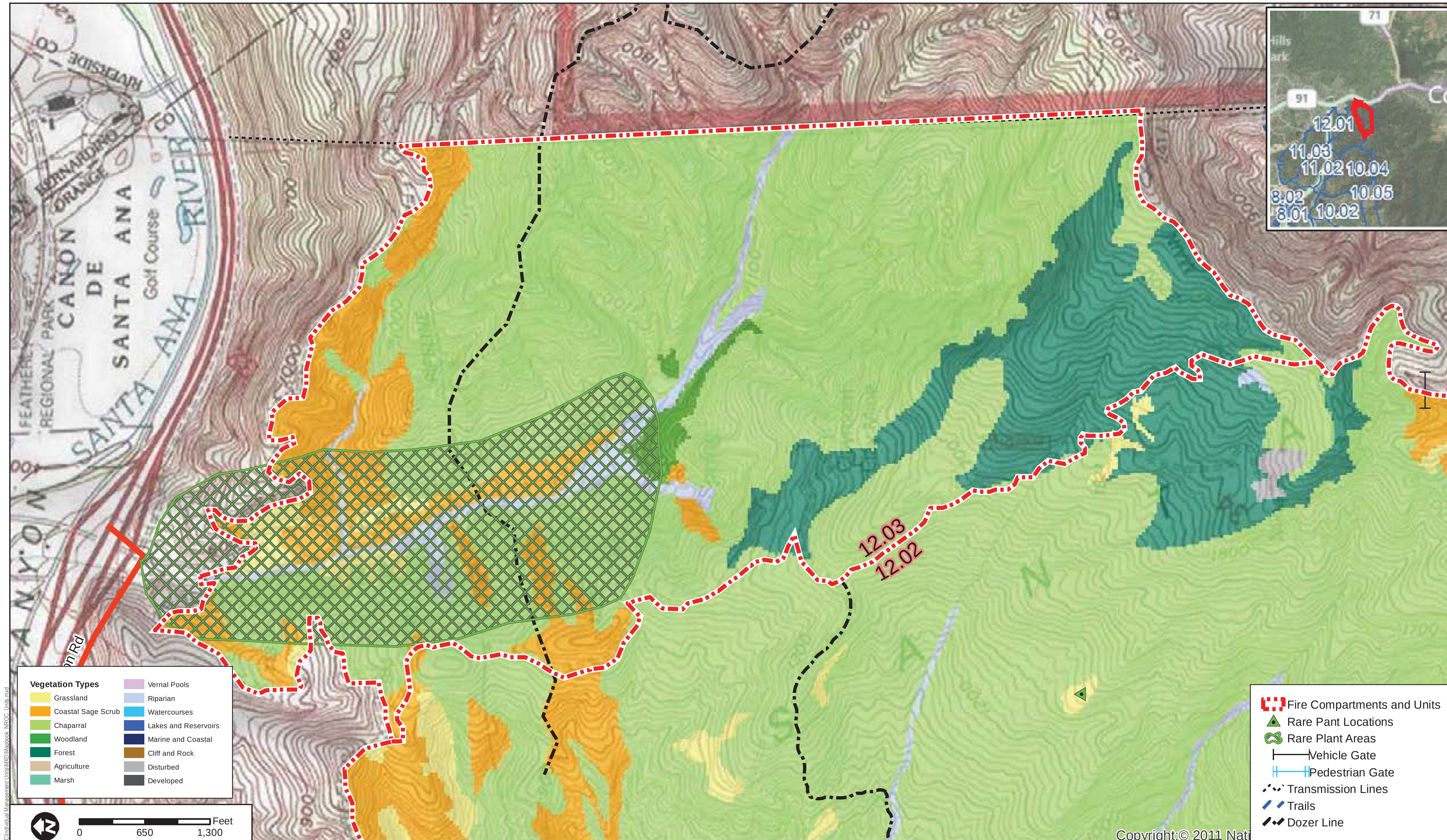

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 12.03 / Acres - 902

Fire Management Unit 12.03

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FIRE MANAGEMENT UNIT 13.01

FIREFIGHTING PROTOCOL: Standard - Containment while minimizing damage from suppression

Size: 217 acres Special Considerations: Atypical for NROC FMU's, urban park - heavily urbanized, channelized Santa Ana river to west, old oil production area, WUI areas, access along Victoria, road network throughout, pond/marsh	Access Route: FMU is bordered by Santa Ana River on west side with no access points. East side can be accessed from Placentia Avenue and Victoria Street or 19th Street along southern boundary.

Vegetation (fuel) types

Coastal Sage Scrub	1 ac.	1%
Developed	13 ac.	6%
Disturbed	13 ac.	6%
Grassland	153 ac.	71%
Lakes and reservoirs	2 ac.	1%
Riparian	34 ac.	16%
Watercourses	0.8 ac.	0.3%

Sensitive Environmental Resources

Riparian, marsh area

Last Fire Activity (Year and Percentage of Unit Burned)

None recorded

Cultural Resources

Need updated data

Suppression Activities

Fire Management Unit objective:
Fire Containment and control
Minimize destruction of habitat
Utilize lowest biologically impacting fire suppression equipment and methods possible.
Water Supply:
Pacific Ocean
Santa Ana River
Municipal water system (fire hydrants)
Fire Protection:
Structures meet undeveloped wildland or vegetative fuels along southeast side of FMU.

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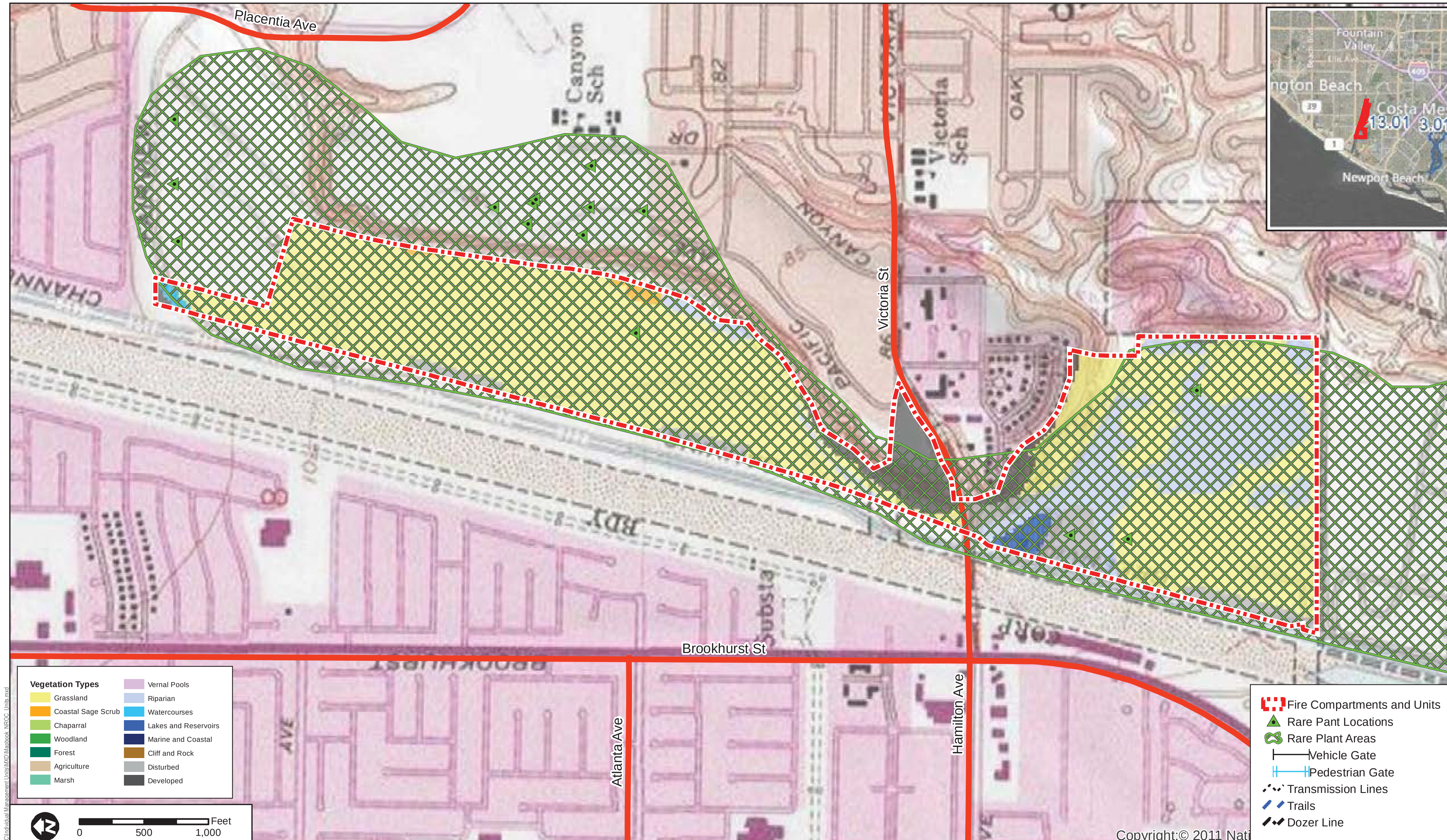

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 13.01 / Acres - 216

Fire Management Unit 13.01

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FIRE MANAGEMENT UNIT 14.01

FIREFIGHTING PROTOCOL: Assertive - High Risk, aggressive suppression

Size: 334 acres Special Considerations: WUI to west and south, outlying FMU, agricultural lands to eastern edge,	Access Route: Access is off Golden Lantern via connector streets. Oso Rancho Capistrano Trail is at the east side of FMU.

Vegetation (fuel) types

Agriculture	5 ac.	1%
Coastal Sage Scrub	55 ac.	17%
Developed	10 ac.	3%
Grassland	258 ac.	78%
Riparian	4 ac.	1%
Watercourses	2 ac.	0.5%

Sensitive Environmental Resources

Last Fire Activity (Year and Percentage of Unit Burned)

Cultural Resources

Need updated data

Suppression Activities

<u>Fire Management Unit objectives:</u>
Rapid fire containment
Fire spread minimization
All available tactical firefighting resources and methods may be utilized
<u>Water Supply:</u>
Municipal water system (fire hydrants)
Sulphur Creek Reservoir
<u>Fire Protection:</u>
Structures meet with undeveloped wildland or vegetative fuels.

SAFETY PRECAUTIONS: Poor and limited roads, flashy fuels, slopes with ridgetop homes

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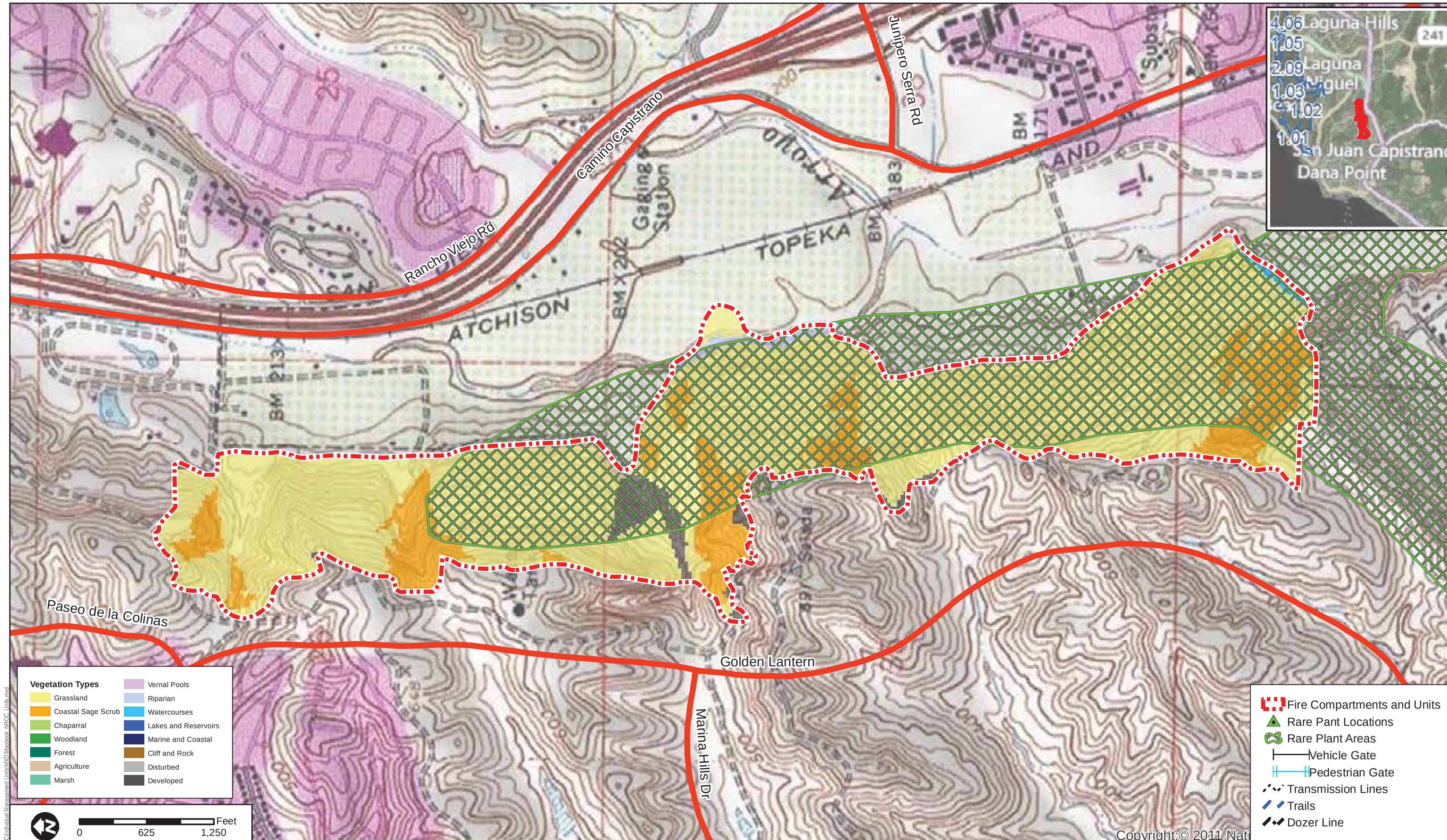

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SOURCE: USGS topo 2012; Orange County 2012

Fire Management Unit Site Statistics:
FMU - 14.01 / Acres - 332

Fire Management Unit 14.01

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WILDLAND FIRE MANAGEMENT PLAN
VOLUME III OF III: RESOURCE TACTICAL RESPONSE PLAN

Nature Reserve of Orange County
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AUGUST 2013

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1.0 INTRODUCTION

Wildfires have occurred with increasing frequency in southern California over recent history (Zedler et al. 1983). A higher fire frequency, which results in shorter intervals between fires, may permanently alter the vegetation community of the area and may result in the type conversion of habitats. Fires at 5–10 year intervals may result in type conversion from chaparral to coastal sage scrub (Keeley 1987; O'Leary et al.1992). The type conversion from coastal sage scrub or chaparral to grassland may result from repeated burning in successive or alternate years (Zedler et al. 1983).

In designing landscape-level fuel treatment projects, there are often conflicts between reducing potential fire behavior and protecting/conserving other resources (Collins et al. 2010). One common conflict is protecting habitat for special status wildlife or plant species, especially federally or state listed species, fully protected species, or narrow endemic species. Narrow endemics are species that are often of very limited distribution, potentially restricted to one county, or are species that have very specific or narrow habitat requirements. Such species may include cactus wren (*Campylorhynchus brunneicapillus*) and intermediate mariposa lily (*Calochortus weedii* var. *intermedius*) or very rarely observed species such as burrowing owl (*Athene cunicularia*).

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2.0 METHODS

Sensitive biological resources present or potentially present on site were identified through a literature search using the following sources: U.S. Fish and Wildlife Service (USFWS) (2012), California Department of Fish and Wildlife (CDFW) (2011a–c; 2012), and California Native Plant Society's (CNPS's) Inventory of Rare and Endangered Vascular Plants (2001, 2012). Information on special status species was also obtained from the various survey studies conducted by multiple agencies and jurisdictions and provided by the stakeholders. The data were sorted and only those species that are federal or state listed, fully protected, or narrow endemics were analyzed. The species include a number of plant and wildlife species (Table 1). The results of the GIS analysis of data records are shown in the maps in the following section for each Fire Management Unit (FMU). The species recorded in the database for each FMU are arranged in the Vegetation section of the table by the vegetation type within which it was recorded. For some species, there are records within multiple vegetation types and thus the species is listed in that section of the table more than once.

The individual FMU tables also provide a general description of Sensitive Environmental Resources, which include other species besides the listed/fully protected/narrow endemic species. The information for this section of each table was derived from various stakeholder surveys and documents and may provide species present within the FMU that are of special status, but not within the listed/fully protected/narrow endemic category, and also may be species that have not been documented but for which habitat is suitable within the FMU. The species in this section cannot be confirmed as present within the GIS database.

Table 1
Special Status Plant and Animal Species Analyzed for Volume III

Common Name	Scientific Name	Status Federal/State/CNPS[1]
Plants		
Braunton's milk-vetch	*Astragalus brauntonii*	FE/-/1B.1
thread-leaved brodiaea	*Brodiaea filifolia*	FT/ST/1B.1
Intermediate Foothill Mariposa Lily	*Calochortus weedii* var. *intermedius*	-/- /1B.2*
salt marsh bird's-beak	*Chloropyron maritimum* ssp. *maritimum*	FE/SE/1B.2
Blochman's Dudleya	*Dudleya blochmaniae blochmaniae*	-/- /1B.1*
Santa Monica Mtns Dudleya	*Dudleya cymosa ovatifolia*	FT/-/ 1B.2
Laguna Beach Dudleya	*Dudleya stolonifera*	FT/ST/1B.1
Tecate Cypress	*Hesperocyparis (Cupressus) forbesii*	-/- /1B.1*
chaparral nolina	*Nolina cismontana*	-/-/1B.2*
big-leaved crownbeard	*Verbesina dissita*	FT/ST/1B.1

Table 1
Special Status Plant and Animal Species Analyzed for Volume III

Common Name	Scientific Name	Status Federal/State/CNPS[1]
Invertebrates		
San Diego Fairy Shrimp	*Branchinecta sandiegonensis*	FE/ -/ -
Quino Checkerspot	*Euphydryas editha quino*	FE/ -/ -
Riverside Fairy Shrimp	*Streptocephalus woottoni*	FE/ -/ -
Amphibians		
Arroyo Toad	*Anaxyrus californicus*	FE/ -/ -
Birds		
Golden Eagle	*Aquila chrysaetos*	-/Fully Protected
burrowing owl	*Athene cunicularia*	-/-*
Cactus Wren	*Campylorhynchus brunneicapillus*	-/-*
white-tailed kite	*Elanus leucurus*	-/Fully Protected
Southwestern Willow Flycatcher	*Empidonax trailli extimus*	FE/FE
Peregrine Falcon	*Falco peregrinus*	-/Fully Protected
Coastal California Gnatcatcher	*Polioptila californica californica*	FT/-
California least tern	*Sternula antillarum browni*	FE/SE, Fully Protected
Least Bell's Vireo	*Vireo bellii pusillus*	FE/FE
Mammals		
Pacific Pocket Mouse	*Perognathus longimembris pacificus*	FE/-

1 FT = Federal Threatened
FE= Federal Endangered
ST = State Threatened
SE = State Endangered
CNPS=California Native Plant Society rankings
* = narrow endemic, species that has special habitat requirements, or species that is rarely documented in Orange County

3.0 RESULTS

A number of special status plant species are documented as occurring within the FMUs. Most of them are federal and state listed as threatened or endangered. A few are considered to be narrow endemics or at the extreme portions of their range and thus are considered as species warranting analysis. Plant species that occur in chaparral and sage scrub vegetation communities tend to be fire adapted. Braunton's milk-vetch (*Astragalus brauntonii*) and Tecate cypress (*Hesperocyparis [Cupressus] forbesii*) are fire-adapted and fire-dependent species (Esser 1994, Sclafani 2006). The thick seed coat of milk-vetch requires scarification by fire or mechanical disturbance to germinate; thus, fire may be a beneficial management tool. However, further research is needed on its adaptations to fire. For Tecate cypress, a particular fire frequency is important and more frequent fires may be detrimental. Although fire is important for releasing seed and preparing seedbeds for Tecate cypress establishment, fires occurring too frequently in Tecate cypress groves may destroy them by eliminating reproduction. Fire frequency of greater than 40 years is necessary for reproduction of the species (Esser 1994). Less is known about the optimal frequency for other species. Frequent wildfires may threaten some population of special status plants such as intermediate mariposa lily (CNPS 2012). Chaparral nolina (*Nolina cismontane*), in addition to being fire-adapted, is considered a fire follower with prolific blooming and reproduction after fires (Bryant 2013). Construction of fuel breaks and firelines by heavy equipment should be avoided because it may disturb the soil seed bank of Braunton's milk-vetch, and may otherwise impact other special status plant species such as intermediate mariposa lily, Laguna beach dudleya (*Dudleya stolonifera*), Santa Monica Mountains dudleya (*Dudleya cymosa ovatifolia*), and thread-leaved brodiaea (*Brodiaea filifolia*), as well as encourage the spread of nonnative species (CNPS 2013, Sclafani 2006, USFWS 2009a, USFWS 2010a, USFWS 2009b).

Plant species that appear to benefit from clearing and fire include big-leaved crownbeard (*Verbesina dissita*). This species is known to respond favorably to fire and some level of clearing, likely as a result of its ability to persist through underground rhizomes for extended periods of time (USFWS 2010b).

In general, wildlife species are of less concern for Pre-, During, and Post Fire activities. Wildlife are able to move to avoid fuel management activities, can flee from an area during an active fire, and often take advantage of the results of fire if trees are killed and result in cavities for nesting or if competition is lessened for other resources.

Use of fire on a planned basis can even benefit raptors as the amount of protective vegetative cover is reduced, improving the raptors' ability to forage for prey. Fire may also benefit seed and insect eating species such as quail, horned larks, towhees, the various sparrow species, and the western meadowlark. It is anticipated that fire will either be kept out of riparian ecosystems or that the overall moist condition will naturally preclude fire. Hence, southwestern willow flycatcher (*Empidonax trailli extimus*) and least Bell's vireo (*Vireo bellii pusillus*) will not be adversely affected by fire. Temporary disturbance of the coastal sage scrub may adversely impact California gnatcatchers (*Polioptila californica californica*); however, the effect is temporary and preserve systems are designed to have refugia for upland species. The species must temporarily increase their population density within the refuge area, but as the burned area recovers, the wildlife will be able to reoccupy the area.

Although non-burrowing mammals may be killed during fires, many mammal species respond favorably to fire due to the abundance of new sprouts and germinating seed during fire recovery. An increase in the population of small mammals following fire can actually be a benefit for raptor populations and other predators. The degree to which mammals are successful at surviving wildfire depends both on their mobility and the uniformity, severity, size, and duration of the fire (Wright and Baley 1982). Small mammals may be able to escape wildfire by using their burrows. Those with surface nests, such as the dusky-footed woodrat (*Neotoma fuscipes*), may be more affected by fire.

Two special status species included in the analysis of the FMUs that follows that may be affected and that are often the focus of conservation efforts include the cactus wren and coastal California gnatcatcher. These species occur within coastal sage scrub and show some negative correlation to fire. In coastal California, cactus wrens are restricted to coastal sage scrub with large cactus clumps. On Camp Pendleton in San Diego County, Tutton et al. (1991) found that 80% of known coastal California gnatcatcher locations were in areas that had not burned in at least 16 years. In coastal sage scrub areas unburned in many years with a poor representation of California sagebrush, fire may actually increase habitat suitability for gnatcatchers, provided California sagebrush becomes the dominant plant in the coastal sage scrub post fire recovery.

The cactus wren has a narrow habitat requirement of nesting within cactus patches. If nesting sites of tall (4 feet to 5 feet) groupings of prickly pear (*Opuntia littoralis* and *O. oricola*) and coastal cholla (*O. prolifera*) cactus are eliminated by a fire, the cactus wren may be adversely affected. Hence the FMU tables include a discussion of Post-fire action for areas occupied by cactus wren.

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USFWS, 2010b. *Verbesina dissita* (Big-leaved crownbeard) 5-year Review: summary and Evaluation.

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FIRE MANAGEMENT UNIT 1.01

FIREFIGHTING PROTOCOL: Assertive – Minimize Fire Losses, aggressive suppression			
Size: 290 acres Special Considerations: Area supports sensitive plant resources, including maritime chaparral, a large number of rare/endangered plants. Area also contains three known archeological sites.			Access Route: Access to perimeter of FMU is from Crown Valley Parkway from the North or South to Pacific Island Drive on the east side or Coast Highway from North or South on the west side of FMU. Both arterial roads provide access to collector roads in various neighborhoods that abut FMU.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	165 ac.	57%	
Coastal Sage Scrub	87 ac.	30%	
Developed	25 ac.	9%	
Grassland	13 ac.	5%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: big-leaved crown-beard, coastal cactus wren, Laguna Beach dudleya, Many-stemmed dudleya, Palmer's grappling hook, Small-flowered microseris, Small flowered petunia, Small-flowered morning glory, Thread-leaved brodiaea, Vernal barley			
Pre-Fire Activity			
Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 1.01 and implement as feasible			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to thread-leaved brodiaea			
Post-Fire Activity			
Protect locations of thread-leaved brodiaea from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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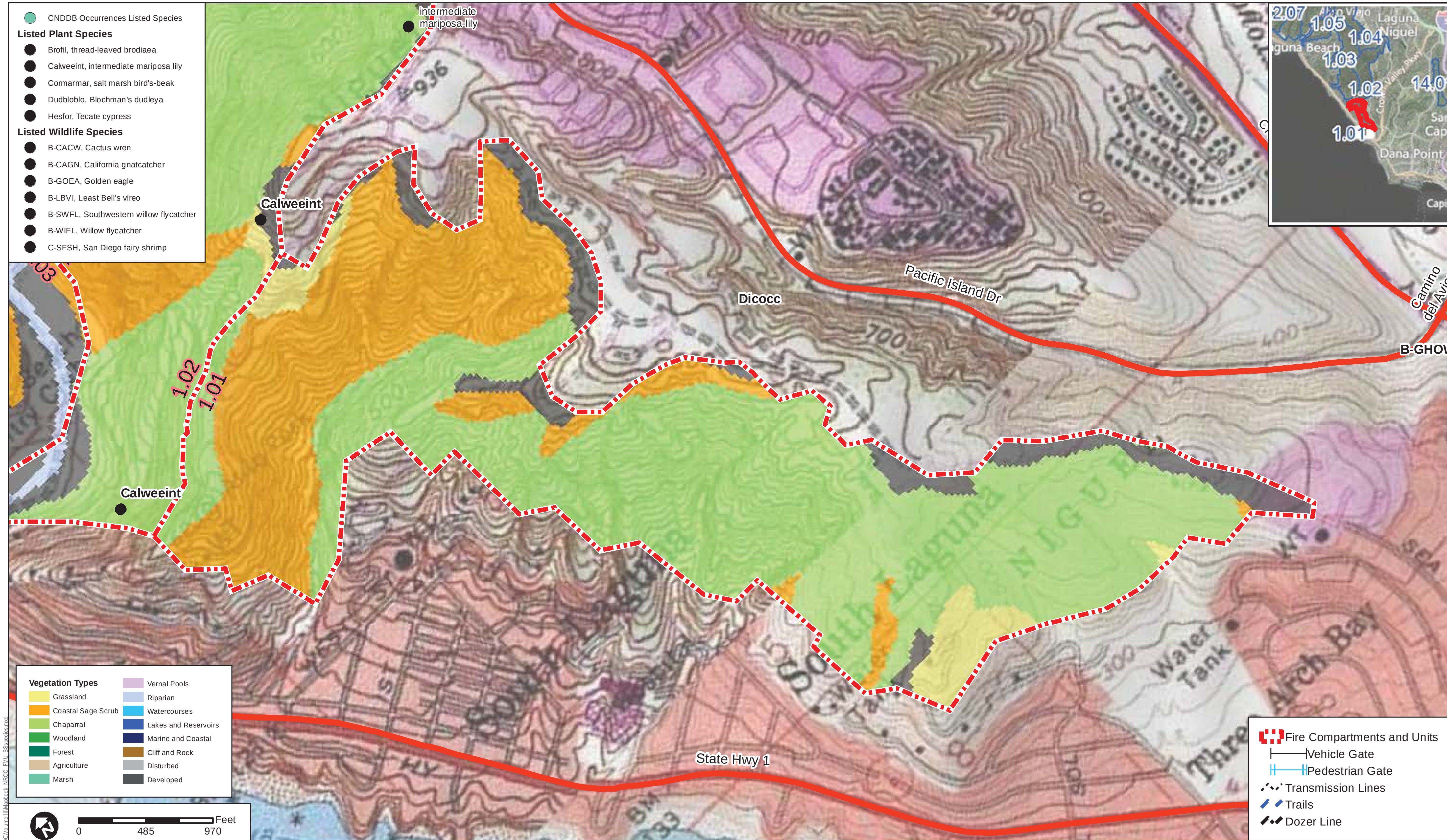

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 1.01

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FIRE MANAGEMENT UNIT 1.02

FIREFIGHTING PROTOCOL: Assertive – Minimize Fire Losses, aggressive suppression

Size: 1,100 acres Special Considerations: Riparian habitat, sensitive species include gnatcatcher, cactus wren, least Bell's vireo, two striped garter snake and southwestern pond turtle.			Access Route: The western portion of the FMU is accessible off Country Club Road through Aliso Creek Inn & Golf Course and a paved, private roadway in the bottom of the canyon at the western FMU boundary; trails occur in various portions of the FMU, but would not all be suitable for fire response; trails/roadways at the top of slope in Laguna Niguel would offer access to eastern edge of FMU via Awma Road and Alicia Parkway.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	263 ac.	24%	Big-leaved crownbeard, intermediate mariposa lily
Coastal Sage Scrub	440 ac.	40%	
Developed	34 ac.	3%	
Disturbed	4 ac.	0.3%	
Grassland	249 ac.	23%	Thread-leaved brodiaea, intermediate mariposa lily
Riparian	110 ac.	10%	Least Bell's vireo, southwestern willow flycatcher

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: thread-leaved brodiaea, coastal California gnatcatcher, coastal cactus wren, southwestern pond turtle, western spadefoot, two-striped garter snake, grasshopper sparrow, least Bell's vireo, yellow breasted chat, yellow warbler, big-leaved crownbeard

Pre-Fire Activity

Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 1.02 and implement as feasible. Control frequent fires where intermediate mariposa lily is located as intermediate mariposa lily is threatened by frequent fires.

During Fire Actions

Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to thread-leaved brodiaea;

Post-Fire Activity

Protect locations of big-leaved crownbeard responds favorably to fire and spreads by rhizomes. Protect locations of thread-leaved brodiaea from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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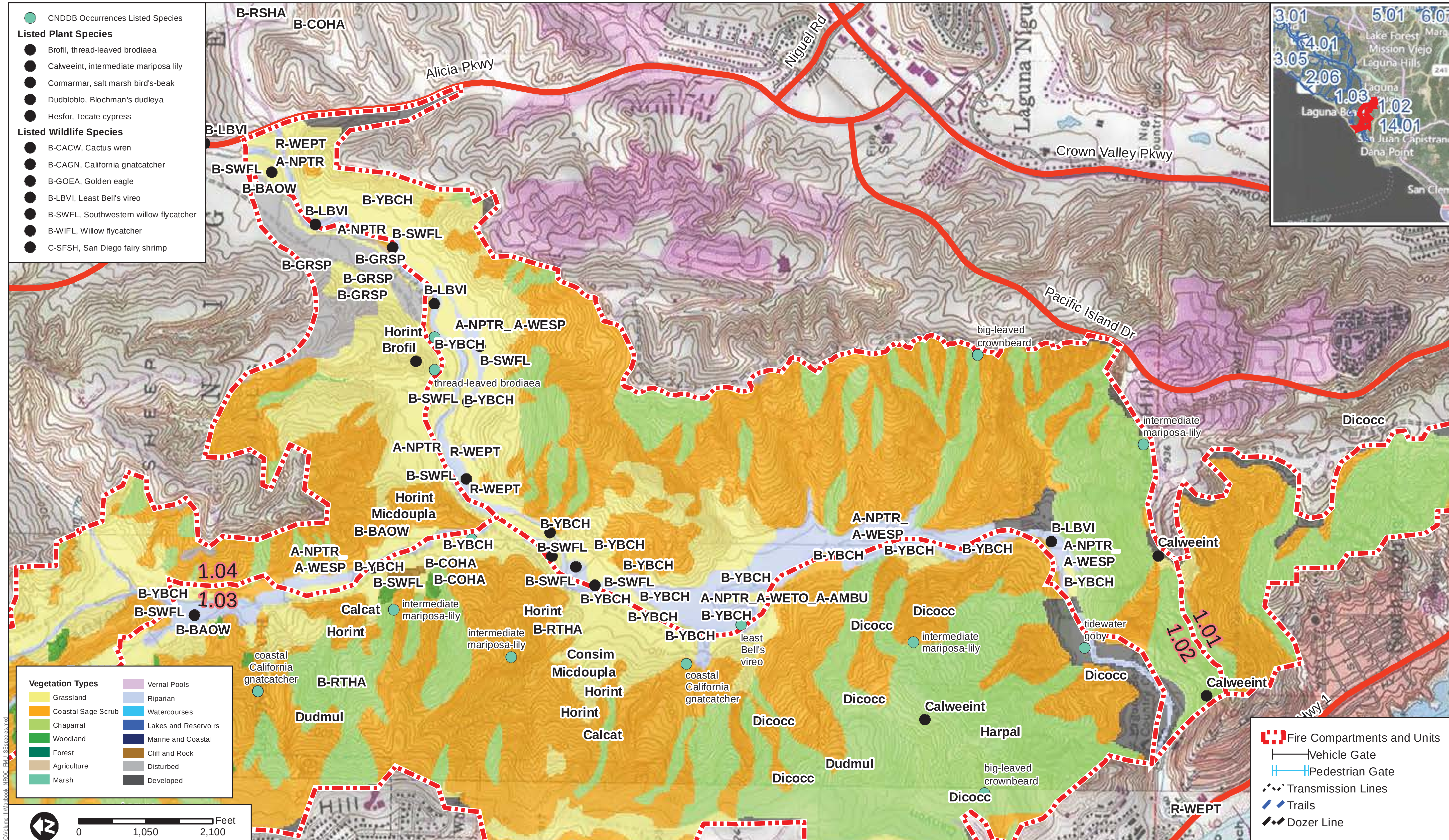

SOURCE: USGS topo 2012; Orange County 2012

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Listed Species - Fire Management Unit 1.02

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FIRE MANAGEMENT UNIT 1.03

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 1768 acres

Special Considerations: Numerous archeological sites, oak/riparian and coastal sage scrub habitats. Sensitive species include gnatcatcher, least Bell's vireo, pond turtle.

Access Route:

The eastern portion of the FMU is accessible off Country Club Road through Aliso Creek Inn & Golf Course and a paved, private roadway in the bottom of the canyon. The northeastern portion of the FMU is also accessible from Aliso Canyon Road via Awma road and Knollwood Road; trails occur in various portions of the FMU, but would not be suitable for fire response; paved roadway (M street & K street) enable access into secondary canyon in south.

Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	628 ac.	36%	Big-leaved crownbeard, intermediate mariposa lily
Cliff and Rock	2 ac.	0.1%	Laguna Beach dudleya
Coastal Sage Scrub	836 ac.	47%	California gnatcatcher, intermediate mariposa lily
Developed	39 ac	2%	
Disturbed	1 ac.	0.1%	
Grassland	172 ac.	10%	
Riparian	43 ac.	2%	southwestern willow flycatcher
Woodland	47 ac.	3%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: big-leaved crown-beard, thread-leaved brodiaea, coastal California gnatcatcher, coastal cactus wren, southwestern pond turtle, western spadefoot toad, garter snake, grasshopper sparrow, least Bell's vireo, yellow breasted chat

Pre-Fire Activity

Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 1.03 and implement as feasible. Control frequent fires where intermediate mariposa lily is located as intermediate mariposa lily is threatened by frequent fires. Fuels modification activities should avoid Laguna Beach dudleya to the maximum extent practicable.

During Fire Actions

Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to thread-leaved brodiaea; Proactive measures should be taken to avoid adverse effects to Laguna Beach dudleya while fighting active fires

Post-Fire Activity

Protect locations of big-leaved crownbeard responds favorably to fire and spreads by rhizomes. Protect locations of thread-leaved brodiaea from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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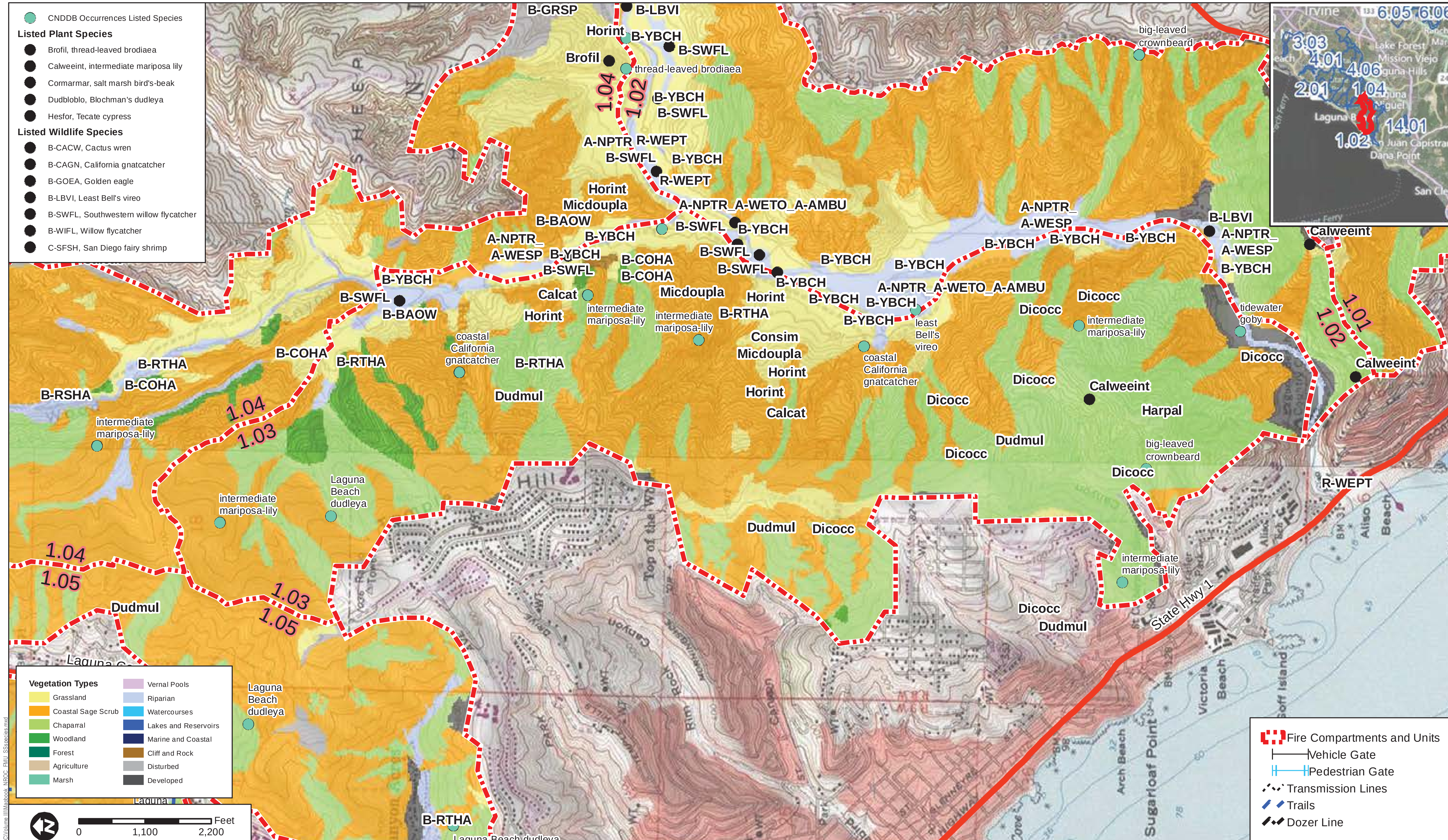

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 1.03

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 1.04</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1182 acres
Special Considerations: Adjacent urban development, riparian habitats, pond turtle , garter snake</td><td>Access Route:
Access in FMU is available via Awma Road and Aliso Canyon Road and from Woods Canyon Drive or Pacific Park Drive. Trails, such as Coyote Trail, Rock it Trail, and Lynx Trail, occur in various portions of the FMU, but would not be suitable for fire response. The only feasible access to the western portion of FMU is off Alta Laguna Blvd and then via W. Ridge Road which is a 15 feet wide dirt road.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>95 ac.</td><td>8%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>676 ac.</td><td>57%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Disturbed</td><td>100 ac.</td><td>9%</td><td></td></tr>
<tr><td>Grassland</td><td>229 ac.</td><td>19%</td><td>Thread-leaved brodiaea</td></tr>
<tr><td>Riparian</td><td>64 ac.</td><td>5%</td><td>southwestern willow flycatcher</td></tr>
<tr><td>Woodland</td><td>18 ac.</td><td>2%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: big-leaved crown-beard, thread-leaved brodiaea, coastal California gnatcatcher, coastal cactus wren, southwestern pond turtle, grasshopper sparrow, least Bell’s vireo</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 1.04 and implement as feasible. Control frequent fires where intermediate mariposa lily is located as intermediate mariposa lily is threatened by frequent fires. Avoid fire suppression activities which can be harmful to thread-leaved brodiaea and intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to thread-leaved brodiaea; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of thread-leaved brodiaea from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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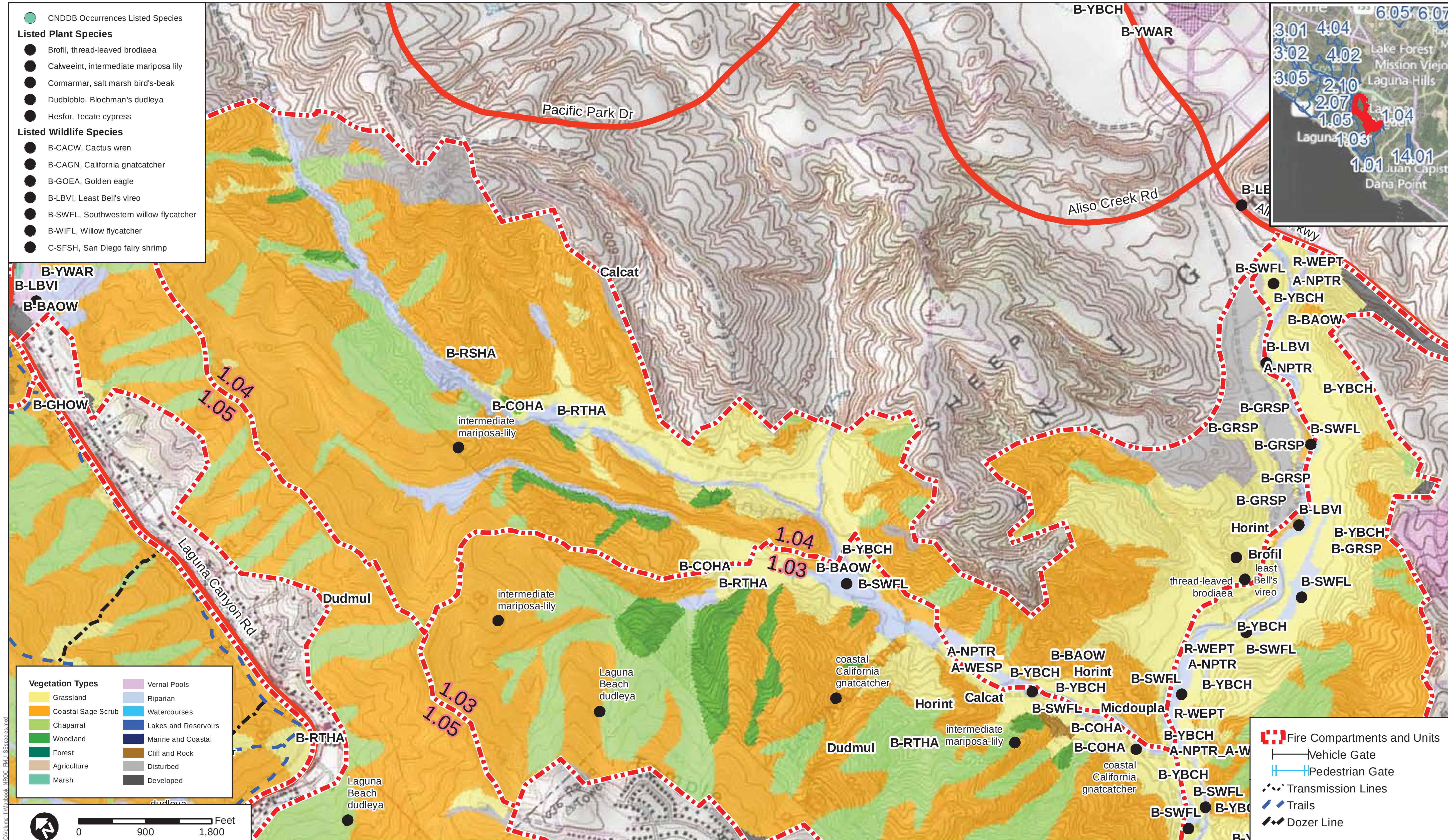

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 1.04

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FIRE MANAGEMENT UNIT 1.05

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 751 acres Special Considerations: Area supports Laguna Beach dudleya			Access Route: Access is limited in the FMU to connector streets off Highway 133 and El Toro Road along the western and northern FMU boundaries or off Alta Laguna Blvd. and then via W. Ridge road (15 feet wide dirt road) along the eastern boundary.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	186 ac.	25%	Laguna Beach dudleya
Coastal Sage Scrub	471 ac.	63%	Laguna Beach dudleya
Developed	36 ac.	5%	
Disturbed	8 ac.	1%	
Grassland	8 ac.	1%	
Marsh	1 ac.	0.2%	
Riparian	30 ac.	4%	Least Bell's vireo
Vernal Pools	9 ac.	1%	
Woodland	2 ac.	0.2%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: Laguna Beach dudleya , Many-stemmed dudleya, coastal cactus wren, coast horned lizard

Pre-Fire Activity

Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 1.05 and implement as feasible. Fuels modification activities should avoid Laguna Beach dudleya to the maximum extent practicable.

During Fire Actions

Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Proactive measures should be taken to avoid adverse effects to Laguna Beach dudleya while fighting active fires.

Post-Fire Activity

Protect locations of Laguna Beach dudleya from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 1.05

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 1.06</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 86 acres
Special Considerations: Area supports abundance of rare species and cultural sites; Site largely inaccessible</td><td>Access Route:
Access is extremely limited within the FMU with no drivable roads or trails; FMU is a triangle- shaped property bordered by El Toro Road and SR 73 and SR 133.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>9 ac.</td><td>11%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>68 ac.</td><td>79%</td><td></td></tr>
<tr><td>Developed</td><td>0.3 ac.</td><td>0.4%</td><td></td></tr>
<tr><td>Grassland</td><td>6 ac.</td><td>7%</td><td></td></tr>
<tr><td>Riparian</td><td>2 ac.</td><td>2%</td><td></td></tr>
<tr><td>Woodland</td><td>1 ac.</td><td>1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: California gnatcatcher, Cactus wren, Yellow breasted chat, Many-stemmed dudleya</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 1.06 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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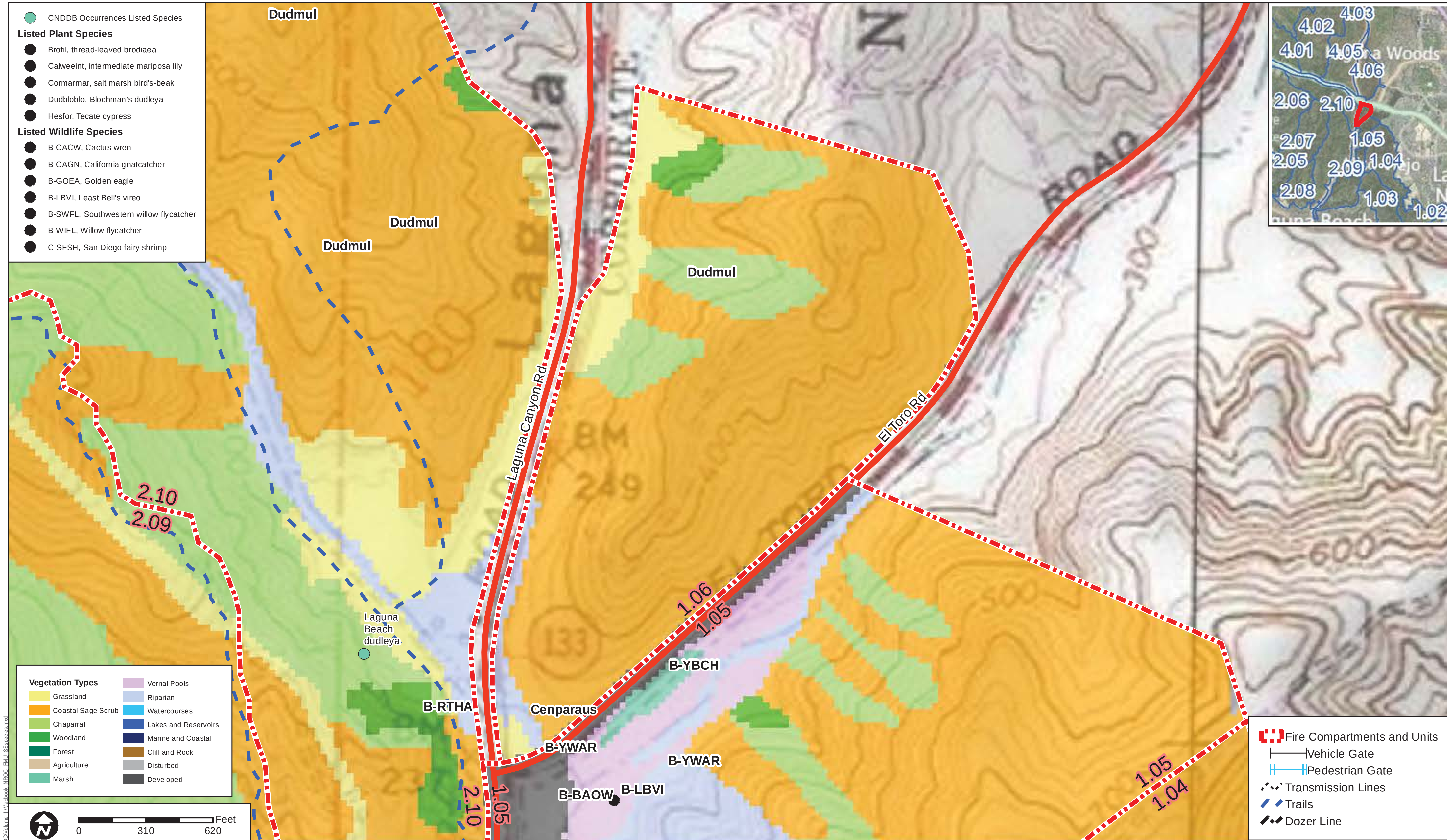

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 1.06

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 2.01</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread</td></tr>
<tr><td colspan="3">Size: 310 acres
Special Considerations: No Bulldozers Allowed. Site supports sensitive archeological sites and important refugia for California gnatcatcher.</td><td>Access Route:
Site access is good throughout with the main access off Pacific Coast Highway that connects to State Park roadways, parking lots, and turnarounds throughout much of the FMU.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Cliff and Rock</td><td>10 ac.</td><td>3%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>161 ac.</td><td>52%</td><td>California gnatcatcher</td></tr>
<tr><td>Developed</td><td>47 ac.</td><td>15%</td><td></td></tr>
<tr><td>Grassland</td><td>52 ac.</td><td>17%</td><td></td></tr>
<tr><td>Marine and Coastal</td><td>39 ac.</td><td>13%</td><td></td></tr>
<tr><td>Woodland</td><td>0.8 ac.</td><td>0.3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: many-stemmed dudleya, south coast saltscale, Turkish rugging, coastal California gnatcatcher, northern harrier</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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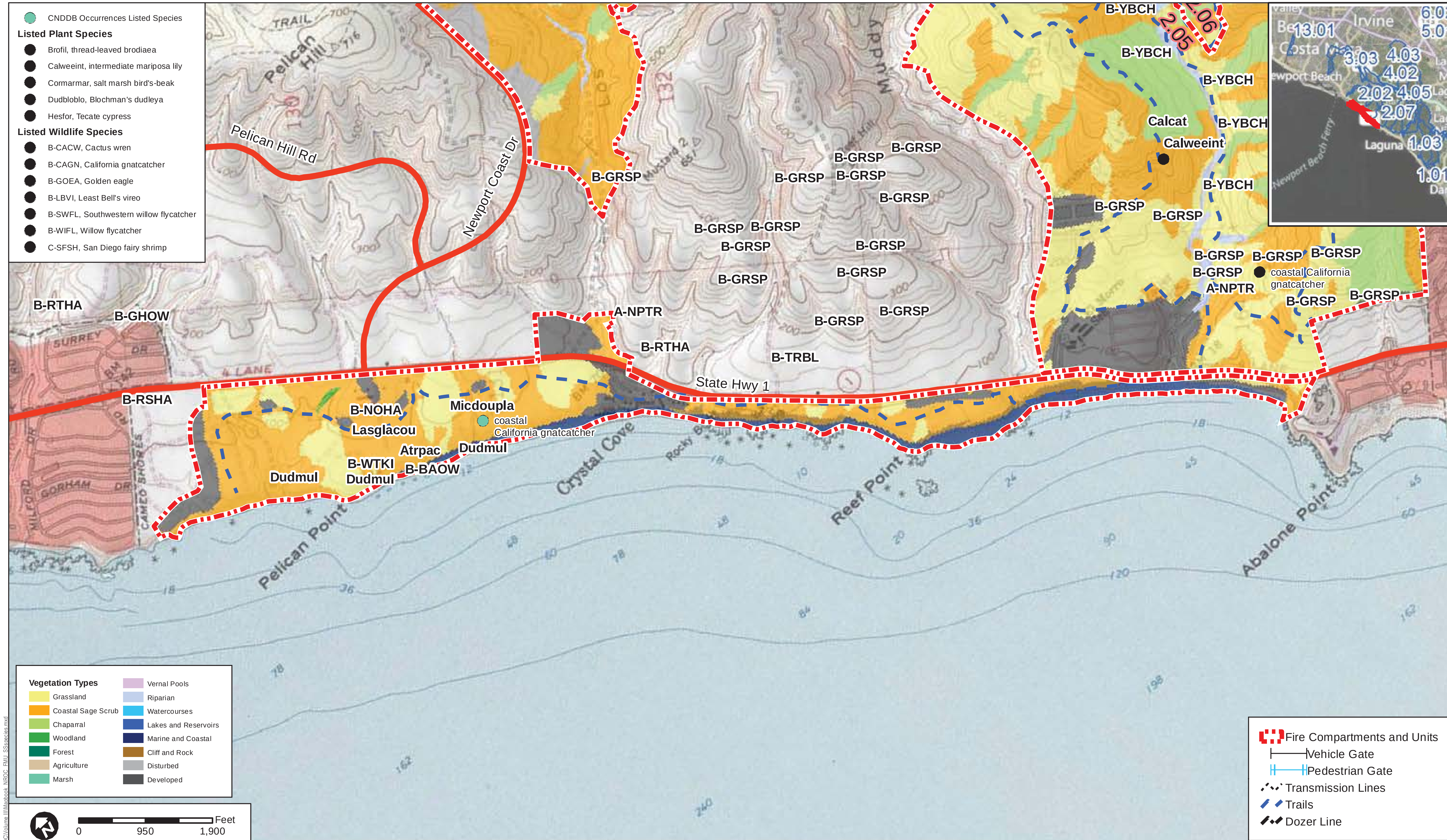

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.01

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FIRE MANAGEMENT UNIT 2.02			
FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 1057 acres Special Considerations: Site supports sensitive archeological sites and important refugia for California gnatcatcher.			Access Route: Access on the periphery of the FMU is good via Newport Coast Drive (west); Vista Ridge Road (north) and Pacific Mist (northeast). Access throughout the FMU is limited. Seawatch Road is potential connection between mid-point of FMU. Other firebreaks/dirt roads occur in limited quality including the Pacific Ridge Trail at the FMU's eastern boundary, access points through development to wildland areas are provided and dispersed; Seawatch road is potentially good FMU tactical operation area within FMU - i.e., firing out operation.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	114 ac.	11%	
Coastal Sage Scrub	743 ac.	70%	California gnatcatcher, cactus wren
Disturbed	35 ac.	3%	
Grassland	163 ac.	15%	
Riparian	2 ac	0.2%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: many-stemmed dudleya, south coast saltscale, Turkish rugging, coastal California gnatcatcher, northern harrier			
Pre-Fire Activity			
Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.02 and implement as feasible.			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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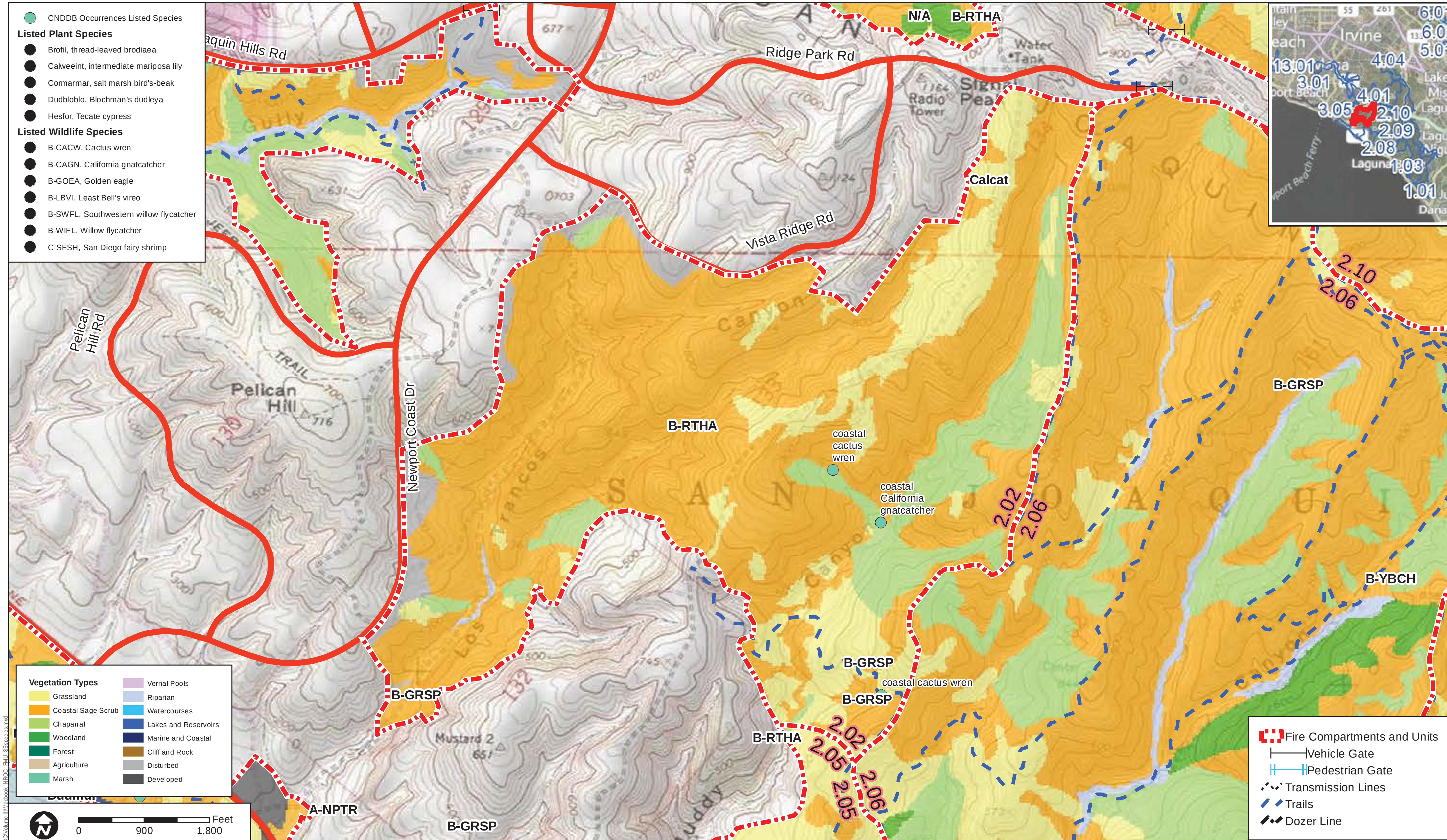

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.02

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FIRE MANAGEMENT UNIT 2.05

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 818 acres
Special Considerations: No bulldozers allowed on State Park lands; Unit supports several archeological sites.</td><td>Access Route:
Access is considered limited in this FMU and includes paved road off of Pacific Coast Highway into wastewater facility in southwest corner; Moro Ridge Road runs along the eastern portion of FMU. Various unknown dirt trails run throughout the ridges and canyon bottoms.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>178 ac.</td><td>22%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>276 ac.</td><td>34%</td><td>California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>54 ac.</td><td>7%</td><td></td></tr>
<tr><td>Grassland</td><td>296 ac.</td><td>36%</td><td></td></tr>
<tr><td>Riparian</td><td>14 ac.</td><td>2%</td><td>Least Bell’s vireo</td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: south coast saltscale, coastal California gnatcatcher, coastal cactus wren, western spadefoot toad, coast horned lizard, least Bell’s vireo, yellow-breasted chat</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.05 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of intermediate mariposa lily from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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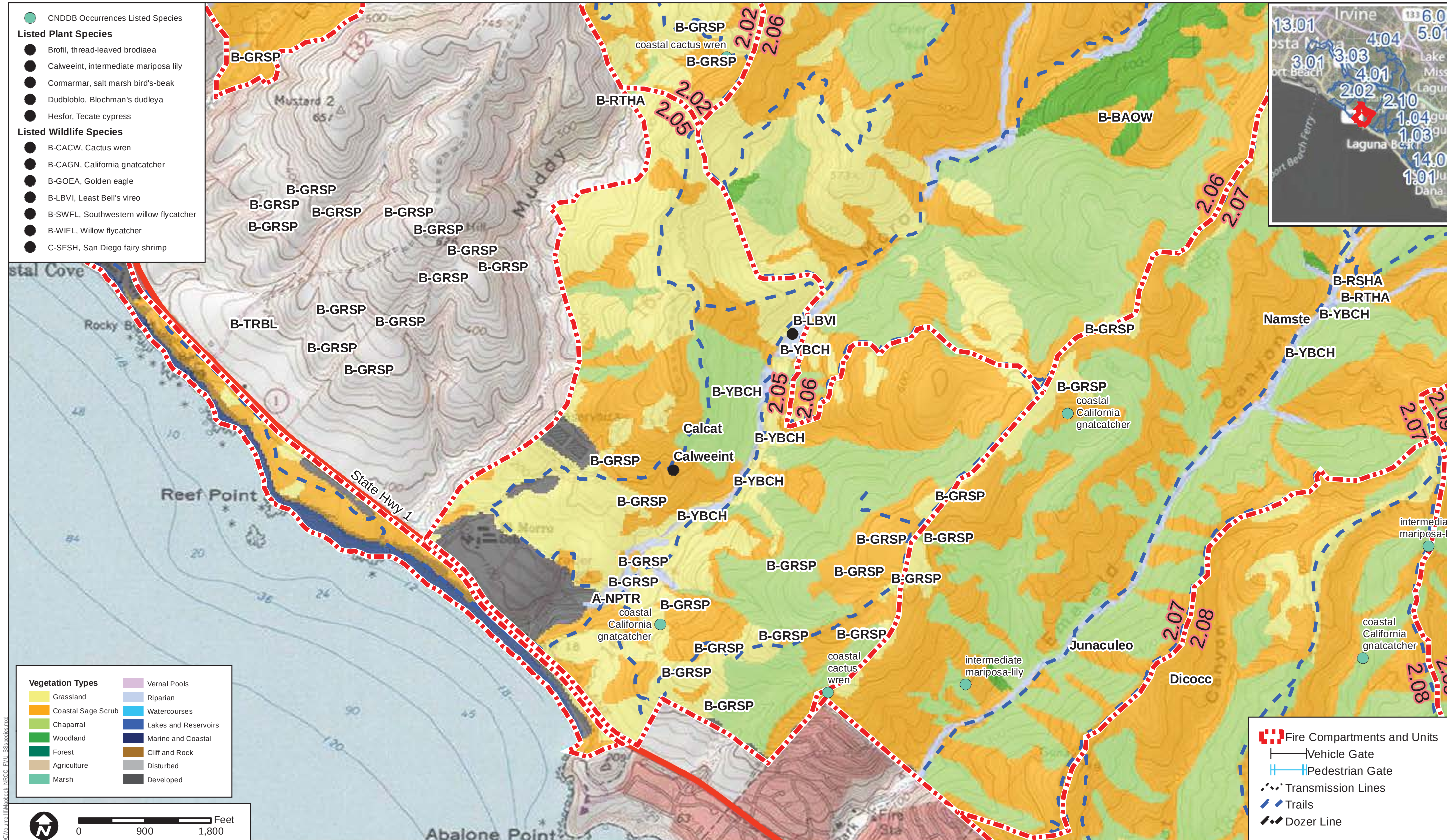

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.05

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 2.06</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread</td></tr>
<tr><td colspan="3">Size: 1618 acres
Special Considerations: No bulldozers allowed on State Park lands; Unit supports several archeological sites</td><td>Access Route:
Access is limited to a 10-foot wide trail on the western FMU boundary (Pacific Ridge Trail) and Ridge Park Road via gate #4837 in the north; a canyon bottom road (Moro Ridge Road) extends through the FMU and is accessed from either Pacific Coast Highway from the dirt road that connects to Ridge Park Road in the north.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>404 ac.</td><td>25%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>964 ac.</td><td>60%</td><td></td></tr>
<tr><td>Grassland</td><td>154 ac.</td><td>10%</td><td></td></tr>
<tr><td>Riparian</td><td>36 ac.</td><td>2%</td><td></td></tr>
<tr><td>Woodland</td><td>60 ac.</td><td>4%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: south coast saltscale, coastal California gnatcatcher, coastal cactus wren, western spadefoot toad, coast horned lizard , Palmer’s grappling hook</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.06 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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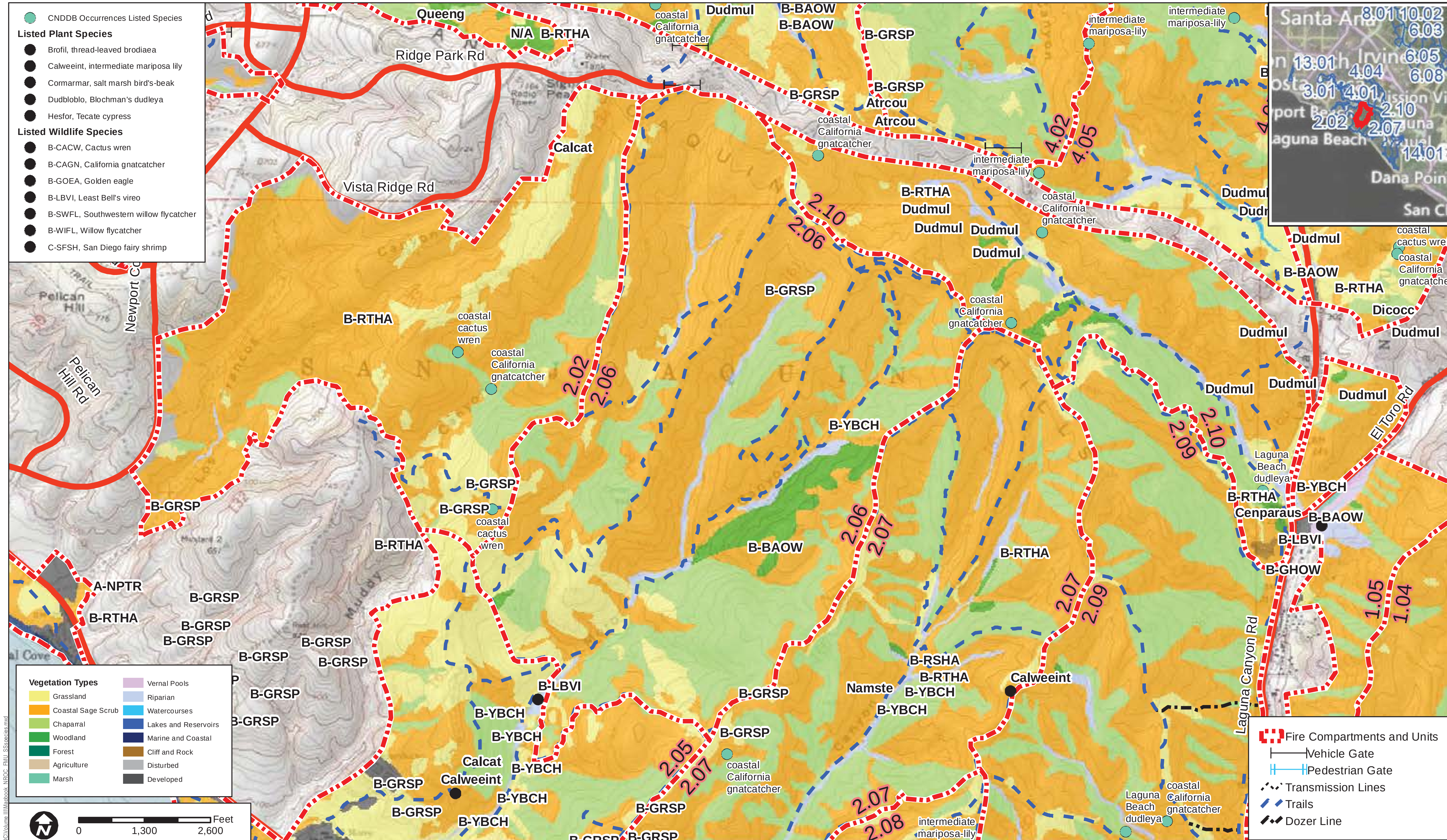

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.06

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FIRE MANAGEMENT UNIT 2.07

FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

Size: 1290 acres Special Considerations: Unit borders state parks; no bulldozers allowed on state parks lands. Unit supports high quality riparian and coastal sage scrub habitat. Southern California Edison Powerlines cross unit.			Access Route: Access is limited throughout canyon bottoms, ridge-tops include dirt road/trails including Moro Ridge Road and Emerald Bay Road which intersect with Pacific Coast Highway via connector roads, and Bommer Ridge Road and other transmission line roads; roads would likely not be used during fire, no turnarounds.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	443 ac.	34%	
Coastal Sage Scrub	751 ac.	58%	Cactus wren, California gnatcatcher, intermediate mariposa lily
Grassland	54 ac.	4%	
Riparian	36 ac.	3%	
Woodland	6 ac.	0.5%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: coastal cactus wren, coastal California gnatcatcher, coast horned lizard, western spadefoot toad, northern red-diamondback rattlesnake, red-tailed hawk, red shouldered hawk, yellow breasted chat, western dichondra

Pre-Fire Activity

Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.07 and implement as feasible.

During Fire Actions

Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.

Post-Fire Activity

Protect locations of intermediate mariposa lily from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.07

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FIRE MANAGEMENT UNIT 2.08

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 576 acres
Special Considerations: Unit supports high quality coastal sage scrub habitat. Southern California Edison Powerlines cross unit.</td><td>Access Route:
Access is limited throughout canyon bottoms and ridgetops. Main access points to FMU are Spur Ridge Road and Water Tank Road which intersect with Pacific Coast Highway via various connector streets and Laguna Bowl Road accessed from Laguna Canyon Road; roads would likely not be used during fire, no turnarounds, unsafe topography for ground attack.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>202 ac.</td><td>35%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>311 ac.</td><td>54%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>3 ac.</td><td>0.6%</td><td></td></tr>
<tr><td>Grassland</td><td>59 ac.</td><td>10%</td><td></td></tr>
<tr><td>Woodland</td><td>0.6 ac.</td><td>0.1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal cactus wren, coastal California gnatcatcher, coast horned lizard, western spadefoot toad</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.08 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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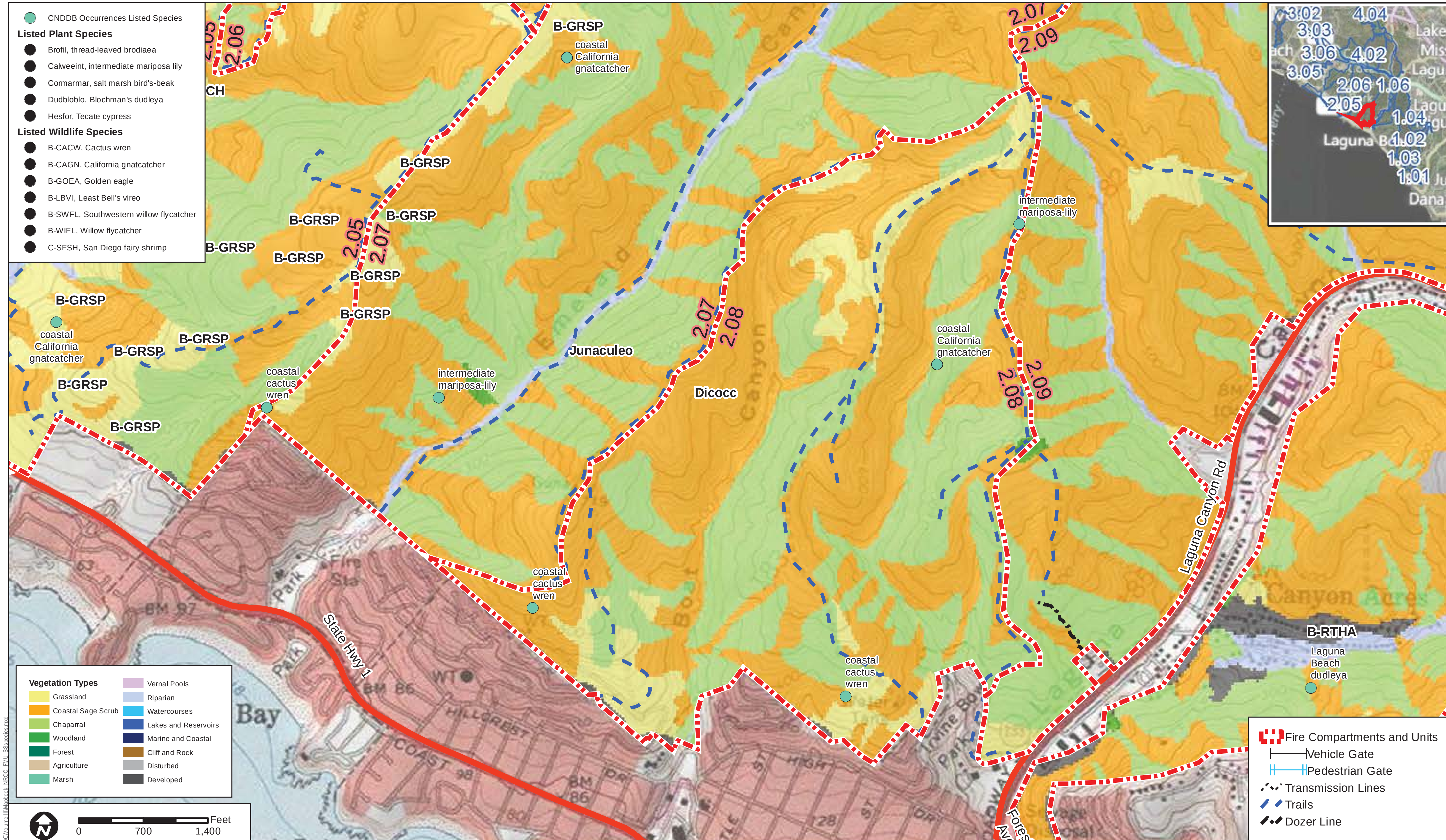

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.08

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 2.09</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1144 acres
Special Considerations: Telecommunication lines along Laguna Canyon Road; Unit supports high quality coastal sage scrub; FMU forms the west side of steep, box canyon.</td><td>Access Route:
Access is limited within FMU – Laguna Bowl Road and Bommer Ridge Road (both dirt roads) form western boundary and can be accessed from Laguna Canyon Road (Highway 133); Big Bend Trail and other trails in FMU are not drivable.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>396 ac.</td><td>35%</td><td>Laguna Beach dudleya</td></tr>
<tr><td>Coastal Sage Scrub</td><td>676 ac.</td><td>59%</td><td>California gnatcatcher</td></tr>
<tr><td>Developed</td><td>0.9 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Grassland</td><td>53 ac.</td><td>5%</td><td></td></tr>
<tr><td>Riparian</td><td>16 ac.</td><td>1%</td><td></td></tr>
<tr><td>Woodland</td><td>2 ac.</td><td>0.2%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal cactus wren, coastal California gnatcatcher, coast horned lizard, Least Bell’s vireo</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.09 and implement as feasible. Fuels modification activities should avoid Laguna Beach dudleya to the maximum extent practicable.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Proactive measures should be taken to avoid adverse effects to Laguna Beach dudleya while fighting active fires.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of Laguna Beach dudleya from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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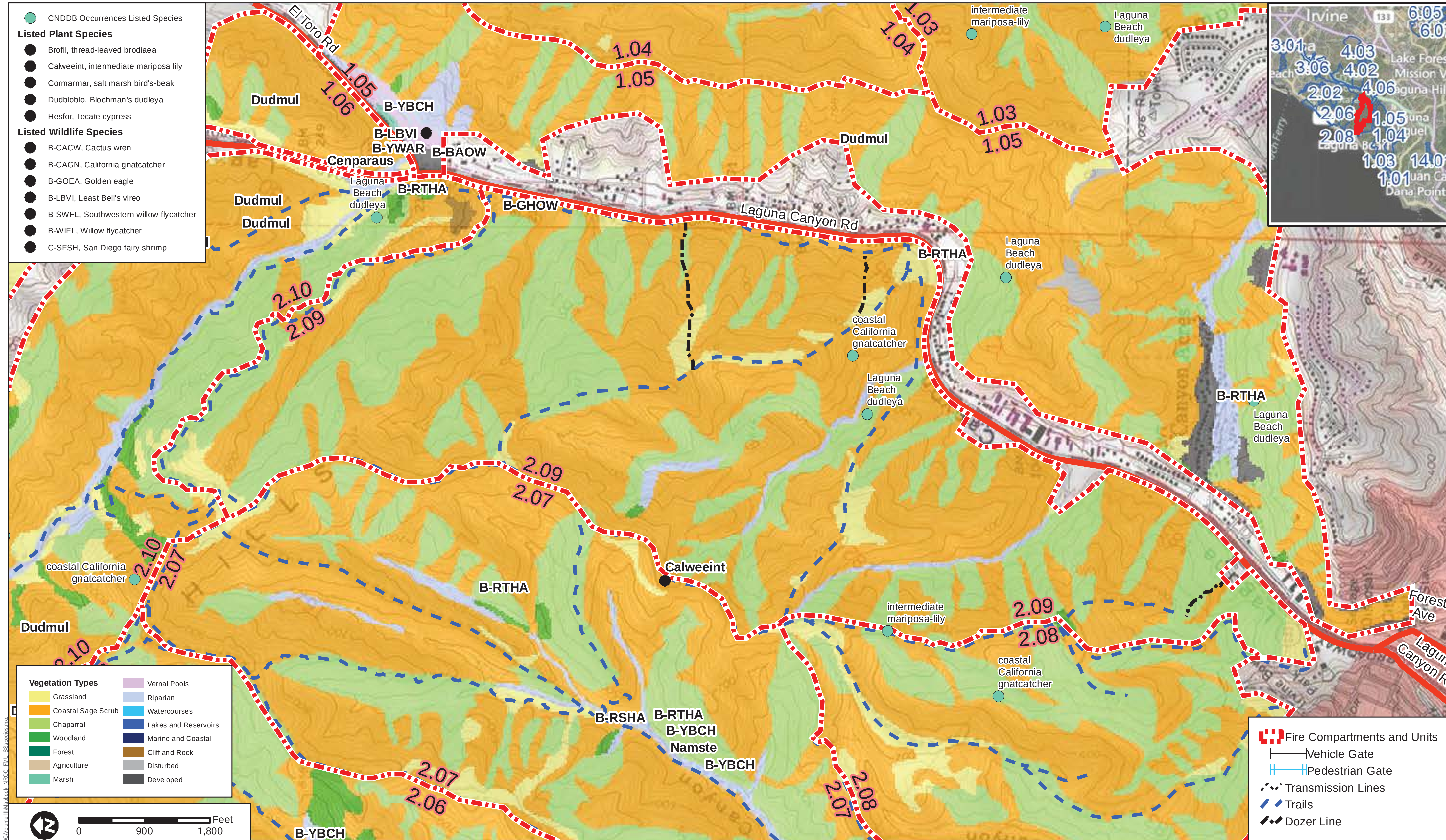

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.09

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FIRE MANAGEMENT UNIT 2.10

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 640 acres
Special Considerations: Unit supports Laguna Beach dudleya and high quality rock outcrop, Coastal sage scrub, chaparral, and riparian woodlands.</td><td>Access Route:
Main access is from Ridge Park Road gate #4837 to Bommer Ridge Road or from Laguna Canyon Road (Highway 133) to Willow Canyon Road which intersects with Bommer Ridge Road. Laurel Canyon Trail and other trails in FMU are not drivable.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>107 ac.</td><td>17%</td><td></td></tr>
<tr><td>Cliff and Rock</td><td>3 ac.</td><td>0.5%</td><td>Laguna Beach dudleya</td></tr>
<tr><td>Coastal Sage Scrub</td><td>427 ac.</td><td>67%</td><td>California gnatcatcher</td></tr>
<tr><td>Grassland</td><td>52 ac.</td><td>8%</td><td></td></tr>
<tr><td>Riparian</td><td>31 ac.</td><td>5%</td><td></td></tr>
<tr><td>Woodland</td><td>20 ac.</td><td>3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: Laguna Beach dudleya, coastal cactus wren, coastal California gnatcatcher, red-shouldered hawk, Vernal barley, Many stemmed dudleya</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 2.10 and implement as feasible. Fuels modification activities should avoid Laguna Beach dudleya to the maximum extent practicable.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Proactive measures should be taken to avoid adverse effects to Laguna Beach dudleya while fighting active fires.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of Laguna Beach dudleya from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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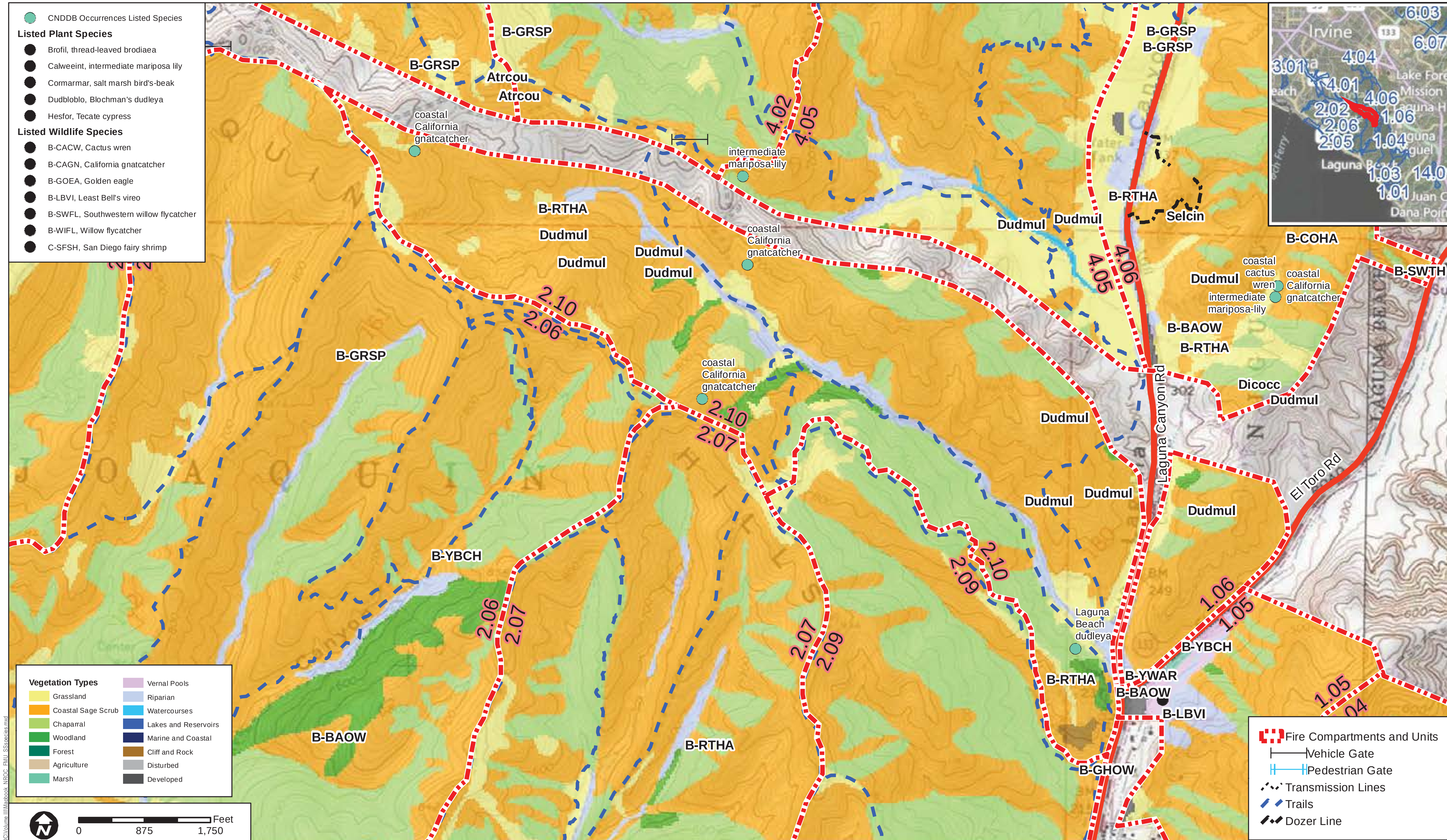

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 2.10

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FIRE MANAGEMENT UNIT 3.01

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Reserved – Minimal Biological Impact</td></tr>
<tr><td colspan="3">Size: 810 acres
Special Considerations: Site contains sensitive wetland habitat and several known cultural resource sites</td><td>Access Route:
Access is Irvine Avenue on west side of FMU and Jamboree Road to Back Bay Drive on the east side. Interior access is poor with no roads.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Coastal Sage Scrub</td><td>20 ac.</td><td>3%</td><td>California gnatcatcher; Laguna Beach dudleya</td></tr>
<tr><td>Developed</td><td>8 ac.</td><td>1%</td><td></td></tr>
<tr><td>Disturbed</td><td>3 ac.</td><td>0.4%</td><td></td></tr>
<tr><td>Grassland</td><td>93 ac.</td><td>12%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>6 ac.</td><td>1%</td><td>California least tern, Burrowing owl</td></tr>
<tr><td>Marine and Coastal</td><td>323 ac.</td><td>40%</td><td></td></tr>
<tr><td>Marsh</td><td>328 ac.</td><td>41%</td><td>Salt marsh bird’s-beak</td></tr>
<tr><td>Riparian</td><td>24 ac.</td><td>3%</td><td></td></tr>
<tr><td>Watercourses</td><td>5 ac.</td><td>1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: California gnatcatcher, Clapper rail, Least tern, Osprey, Davidson’s saltscale, Southern tarplant, many stemmed dudleya, salt marsh bird’s beak</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 3.01 and implement as feasible. Fuels modification activities should avoid Laguna Beach dudleya to the maximum extent practicable.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Proactive measures should be taken to avoid adverse effects to Laguna Beach dudleya while fighting active fires.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of Laguna Beach dudleya from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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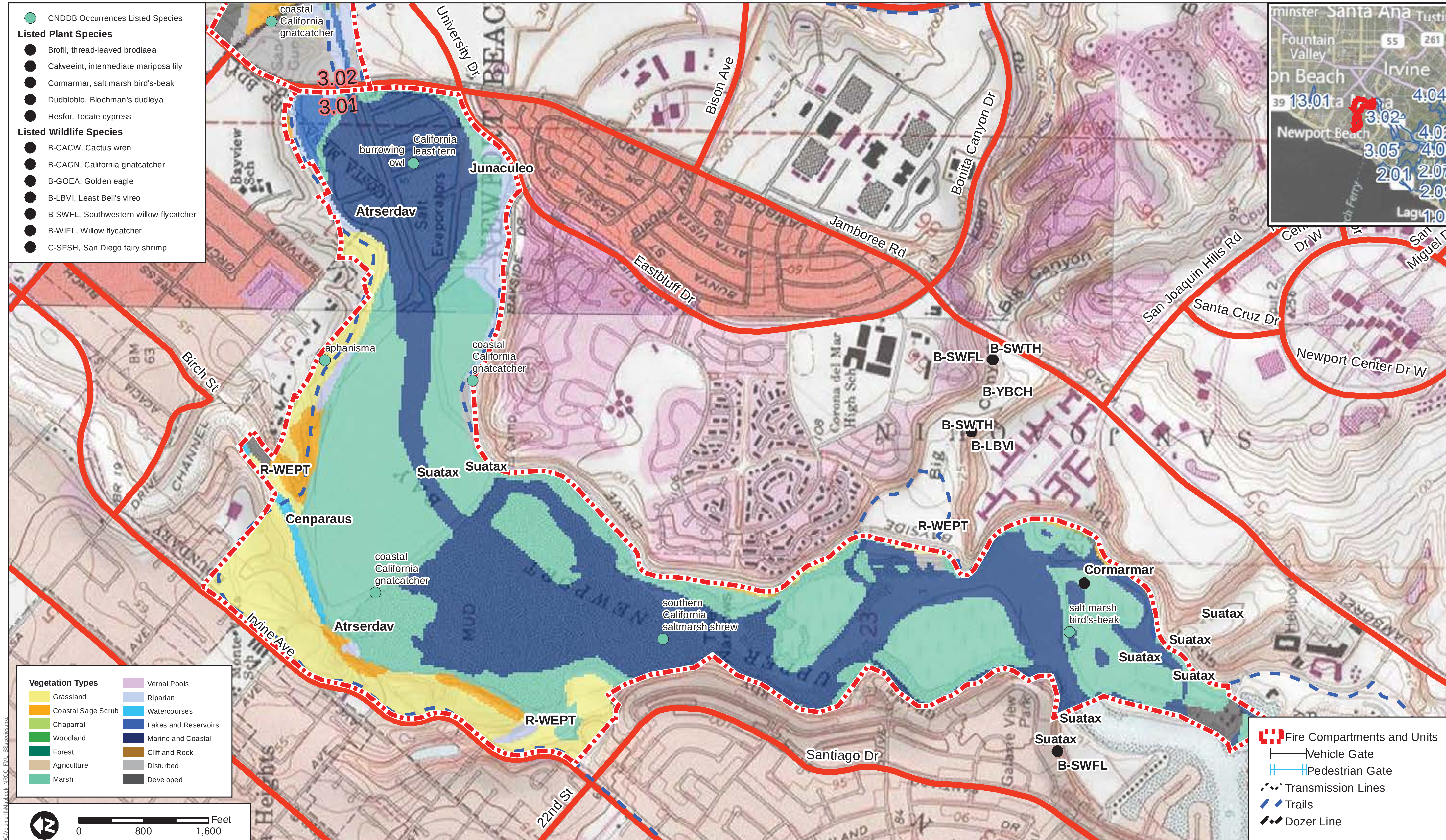

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 3.01

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FIRE MANAGEMENT UNIT 3.02

FIREFIGHTING PROTOCOL: Reserved – Minimal Biological Impact			
Size: 325 acres Special Considerations: TCA mitigation site. Several California gnatcatcher sites documented			Access Route: Access is limited to trails and perimeter streets including: Office parking lots and 73 transportation corridor to the East; Bonita Canyon to the south; MacArthur Boulevard and various residential and reservoir access to the west; Bison Avenue and University Drive in the mid-FMU and Jamboree Road to the north.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Coastal Sage Scrub	75 ac.	23%	California gnatcatcher
Developed	40 ac.	12%	
Disturbed	129 ac.	40%	
Grassland	38 ac.	12%	
Lakes and reservoirs	3 ac.	1%	
Marine and Coastal	0.1 ac.	0.1%	
Marsh	4 ac.	1%	
Riparian	35 ac.	11%	Least Bell's vireo,
Watercourses	0.1 ac.	0.1%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: Coastal cactus wren , California gnatcatcher, Least Bell's vireo, Intermediate mariposa lily, Many stemmed dudleya, Woolly sea blite			
Pre-Fire Activity			
Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 3.02 and implement as feasible.			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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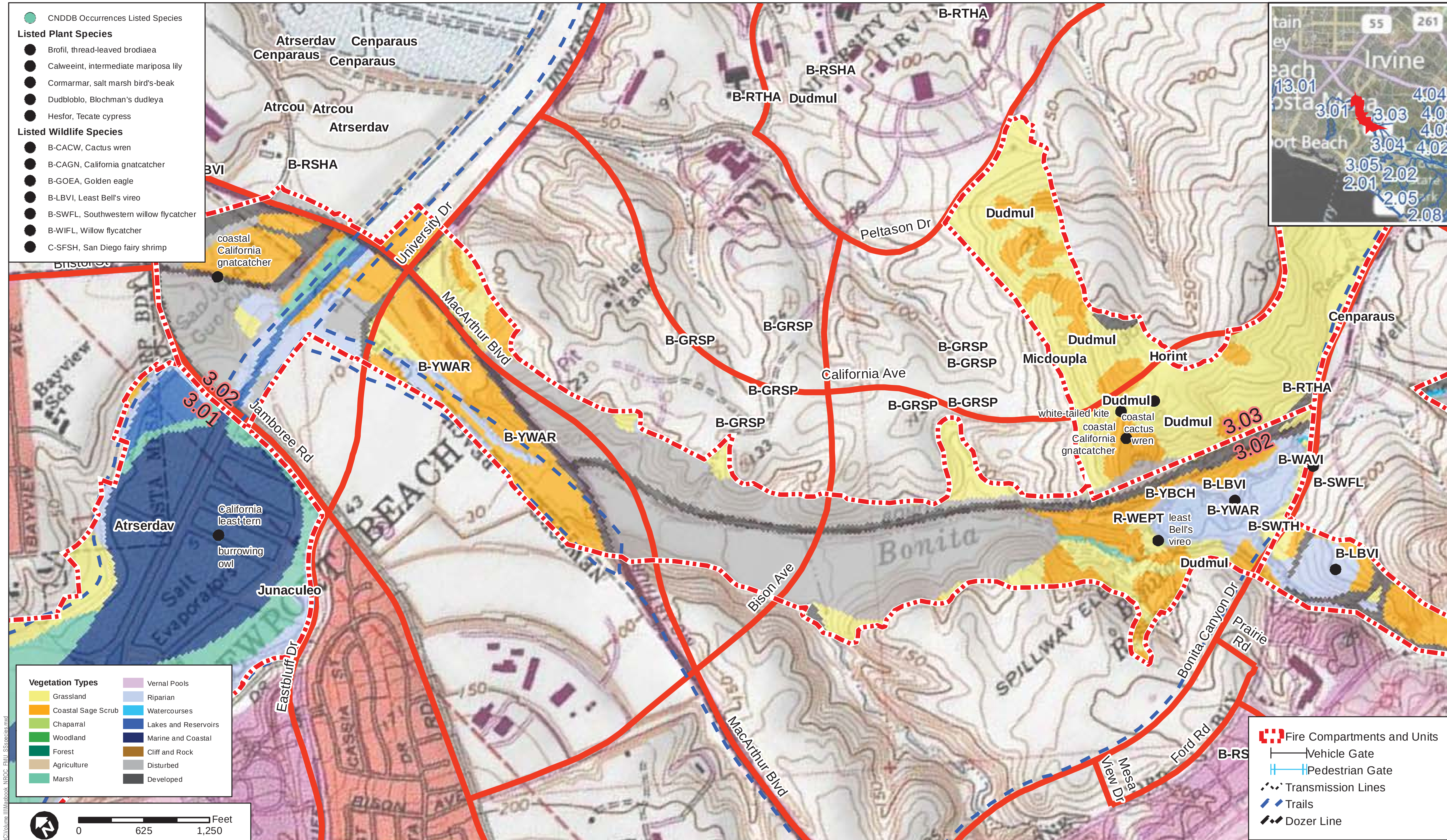

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 3.02

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 3.03</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread</td></tr>
<tr><td colspan="3">Size: 207 acres
Special Considerations: Unit supports sensitive Coastal sage scrub, California gnatcatcher and cactus wren</td><td>Access Route:
Access is limited to trails and perimeter streets including: Anteater Drive, Peltason Drive and California Avenue and office parking lots and 73 transportation corridor to the East; Bonita Canyon to the south; various residential and reservoir access to the west; Bison Avenue and University Drive in the mid-FMU and Jamboree Road to the north.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Coastal Sage Scrub</td><td>21 ac.</td><td>10%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Developed</td><td>2 ac.</td><td>1%</td><td></td></tr>
<tr><td>Disturbed</td><td>2 ac.</td><td>1%</td><td></td></tr>
<tr><td>Grassland</td><td>177 ac.</td><td>86%</td><td>White-tailed kite</td></tr>
<tr><td>Marsh</td><td>5 ac.</td><td>3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: California gnatcatcher, Cactus wren, Coulter's goldfields, Many stemmed dudleya, Small flowered microseris, Vernal barley</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 3.03 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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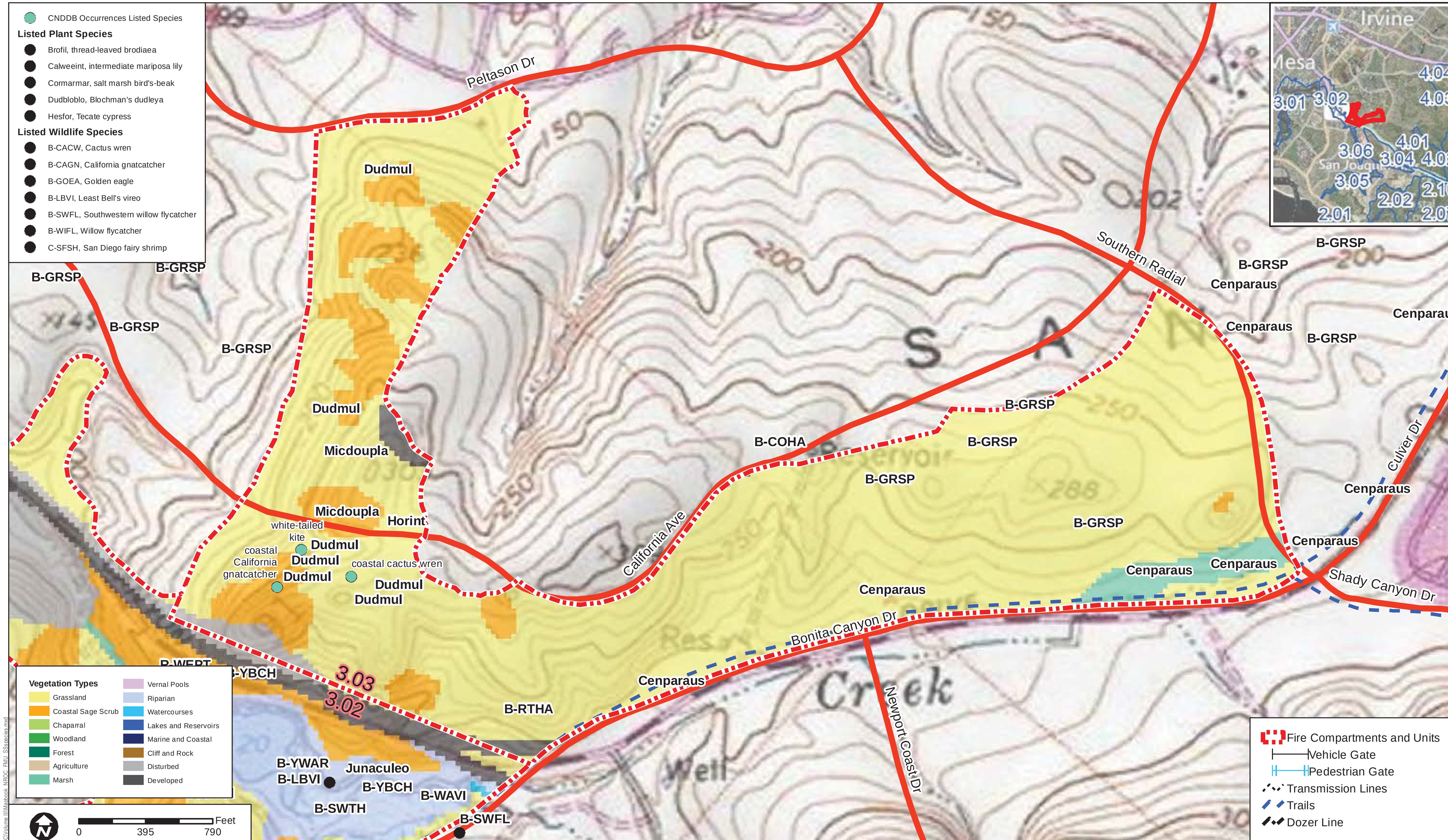

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 3.03

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FIRE MANAGEMENT UNIT 3.04

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 575 acres Special Considerations: Methane gas recovery facility; TCA Mitigation area supports re-vegetated Coastal sage scrub and California gnatcatcher			Access Route: Newport Coast Drive bisects FMU into two sections. The western section is accessed from Coyote Canyon Drive and I-73. The eastern portion can be accessed from Ridge Park Road to the south, I-73 in the north and east, and Newport Coast Drive from the west.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	14 ac.	3%	
Cliff and Rock	1 ac.	0.2%	
Coastal Sage Scrub	96 ac.	17%	California gnatcatcher
Developed	27 ac.	5%	
Disturbed	389 ac.	68%	
Grassland	24 ac.	4%	
Riparian	5 ac.	1%	
Watercourses	0.5 ac.	0.1%	
Woodland	18 ac.	3%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: California gnatcatcher, San Diego black tailed jackrabbit, Engelmann oak (?)			
Pre-Fire Activity			
Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 3.04 and implement as feasible.			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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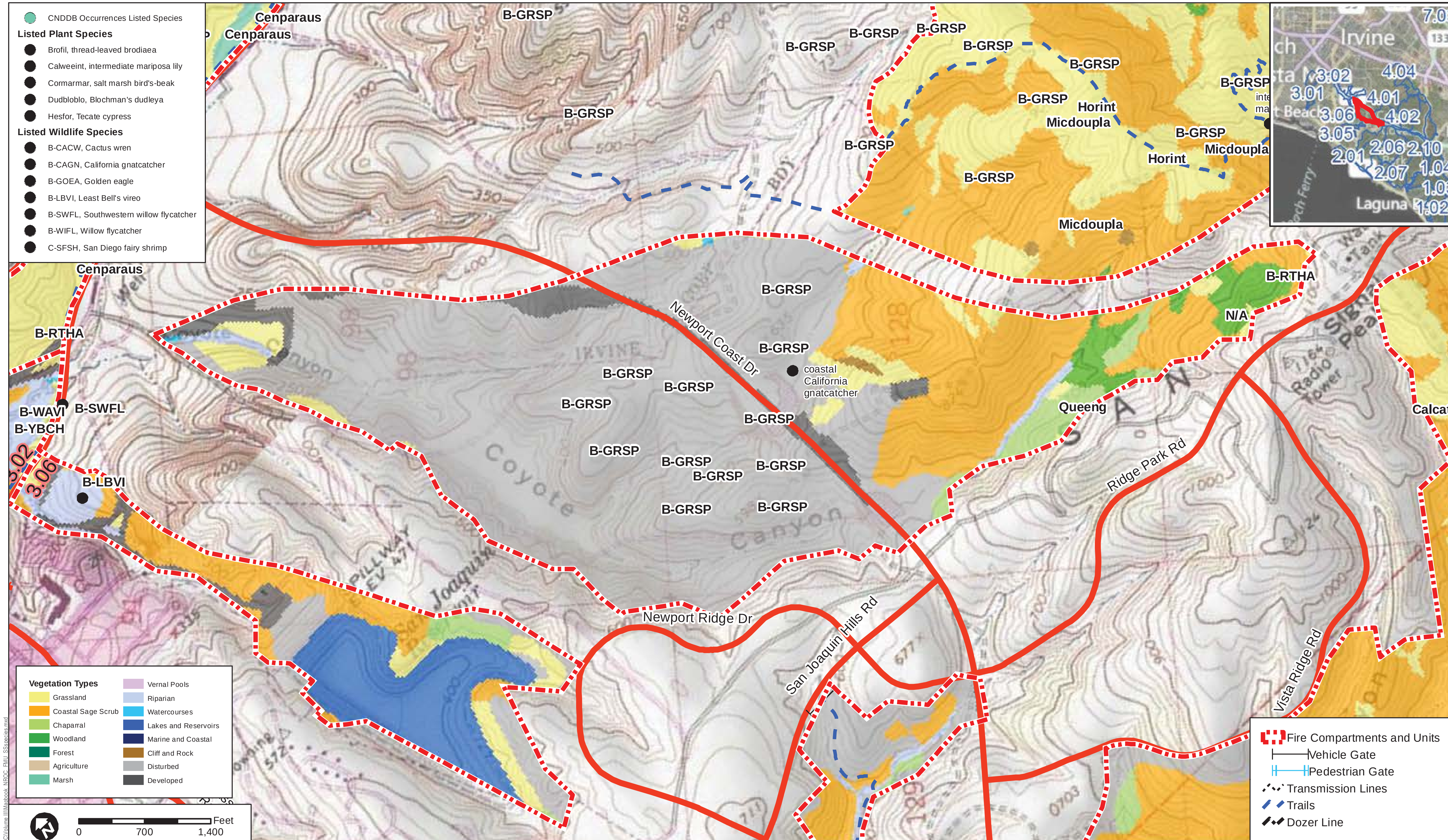

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 3.04

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 3.05</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 332 acres
Special Considerations: Unit supports sensitive coastal sage scrub and Nuttall’s scrub oak (Quercus dumosa)</td><td>Access Route:
Main access is from San Joaquin Hills Road in the north, Newport Coast Drive from east, and Pacific Coast Highway from the west. Site access is poor, very little of the FMU includes drivable roadways, and access through dense residential in southwest is constraining. Locked gates are 4930X at Poppy Avenue, 4832W and 4734Y at San Joaquin Hills Road.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>91 ac.</td><td>38%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>82 ac.</td><td>34%</td><td></td></tr>
<tr><td>Developed</td><td>25 ac.</td><td>10%</td><td></td></tr>
<tr><td>Disturbed</td><td>41 ac.</td><td>17%</td><td></td></tr>
<tr><td>Grassland</td><td>59 ac.</td><td>25%</td><td></td></tr>
<tr><td>Riparian</td><td>34 ac.</td><td>14%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: Nuttall’s scrub oak, coastal California gnatcatcher, coastal cactus wren</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 3.05 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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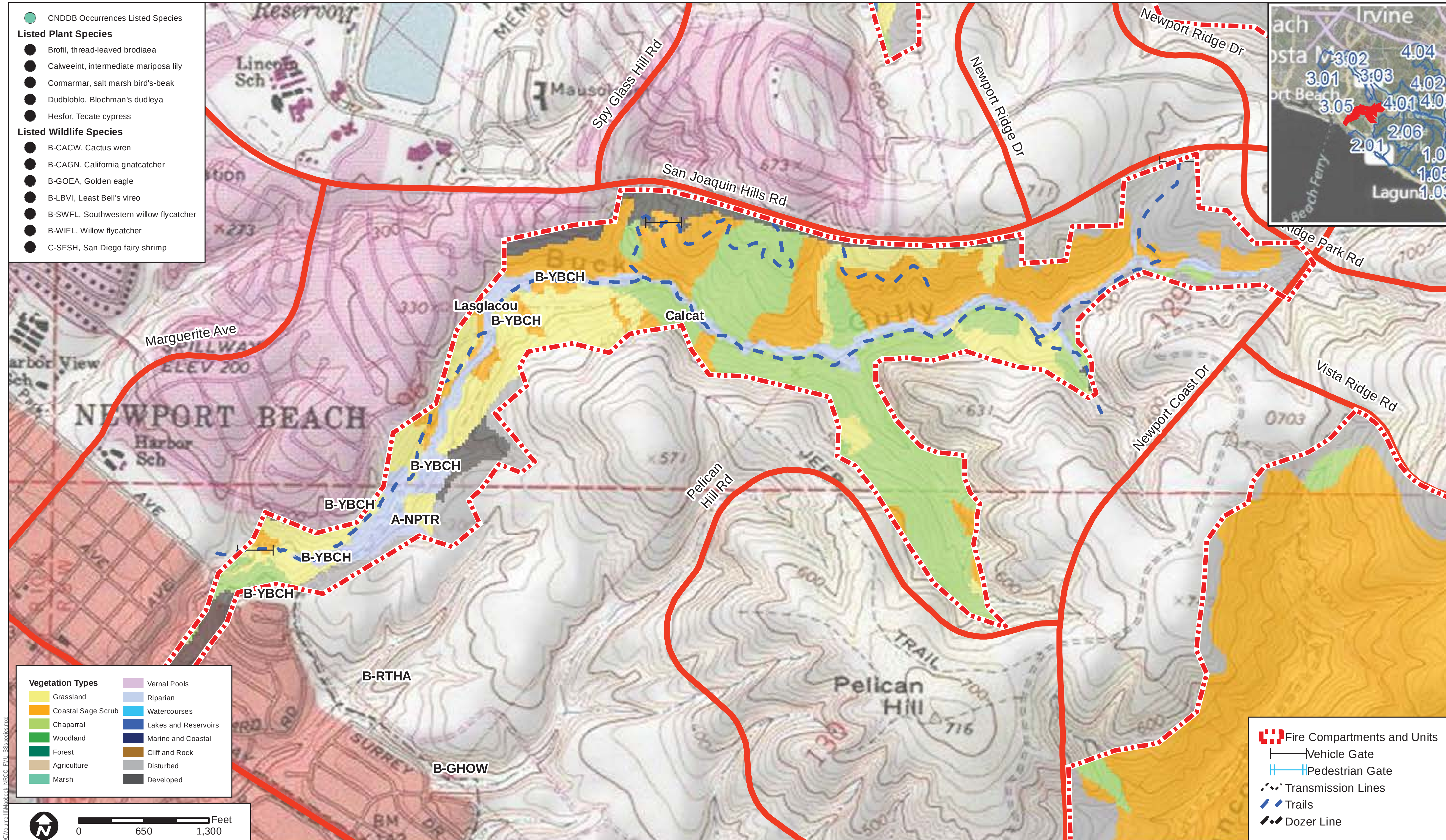

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 3.05

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 3.06</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 139 acres
Special Considerations: Reservoir, WUI on all sides, Bonita Canyon Road to north, fuel modification in place for adjacent structures</td><td>Access Route:
Access is good to the site from Bonita Drive to Ford Road. Gates off of Ford Road and Chambord Road managed by Irvine Ranch Water District. Paved road continues throughout the site leading to and around reservoir. Southern portion of FMU is accessible from Spyglass Hills Drive, El Capitan Drive, and Newport Ridge Drive.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>5 ac.</td><td>4%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>32 ac.</td><td>23%</td><td></td></tr>
<tr><td>Developed</td><td>10 ac.</td><td>7%</td><td></td></tr>
<tr><td>Disturbed</td><td>18 ac.</td><td>13%</td><td></td></tr>
<tr><td>Grassland</td><td>13 ac.</td><td>9%</td><td></td></tr>
<tr><td>Lakes and Reservoirs</td><td>53 ac.</td><td>38%</td><td></td></tr>
<tr><td>Riparian</td><td>8 ac.</td><td>6%</td><td>Least Bell's vireo,</td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 3.06 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 3.06

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 4.01

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 1009 acres Special Considerations: Sensitive habitat/refugia for the cactus wren; sensitive rock outcrops and extensive native grasslands. Area contained within San Diego Creek Special Management Area	Access Route: Access is provided to Bommer Canyon Road via Shady Canyon Road. Road is paved locked in northern portion (gates 4436X,4437Y, & 4537W), dirt to the south and exits underneath I-73 through gate 4737Z; other trails exist on the FMU but are limited and not useable by fire apparatus; trail heads have gates (4537Y,4637X, & 4637Z) located at entrances.

Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	52 ac.	5%	
Cliff and Rock	1 ac.	0.1%	Cactus wren, California gnatcatcher
Coastal Sage Scrub	428 ac.	42%	
Developed	0.002 ac.	0.1%	
Grassland	481 ac.	48%	intermediate mariposa lily
Marsh	0.18 ac.	0.1%	
Riparian	26 ac.	23%	
Watercourses	4 ac.	0.4%	
Woodland	17 ac.	2%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: many-stemmed dudleya, coastal California gnatcatcher, coastal cactus wren, Chocolate lily, Small flowered microseris, Intermediate mariposa lily

Pre-Fire Activity

Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 4.01 and implement as feasible.

During Fire Actions

Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities. Control frequent fires where intermediate mariposa lily is located.

Post-Fire Activity

Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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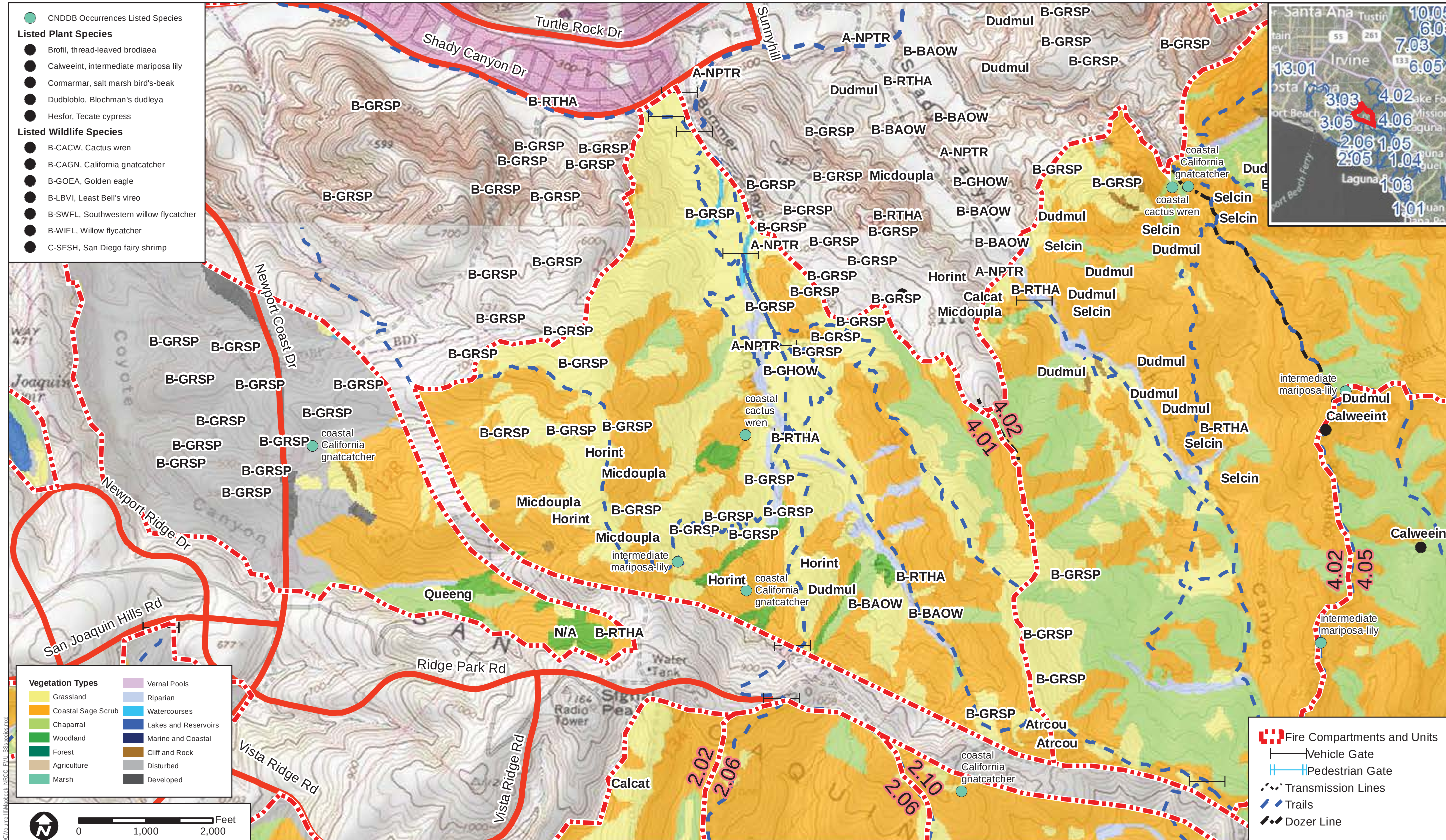

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 4.01

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FIRE MANAGEMENT UNIT 4.02

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1328 acres
Special Considerations: SCE powerlines, sensitive cactus wren habitat/refugia, southwestern pond turtle. Area contained within San Diego Creek Special Management Area</td><td>Access Route:
Access is limited throughout most of the FMU; dirt road trails (roughly 10 feet wide) occur along the eastern FMU boundary and along canyon bottoms. Closet paved access is Shady Canyon through neighborhood streets. Gate 4539Y for powerline maintenance is located off golf course.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>331 ac.</td><td>25%</td><td></td></tr>
<tr><td>Cliff and Rock</td><td>4 ac.</td><td>0.3%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>776 ac.</td><td>58%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Grassland</td><td>194 ac.</td><td>15%</td><td></td></tr>
<tr><td>Riparian</td><td>23 ac.</td><td>2%</td><td></td></tr>
<tr><td>Vernal Pools</td><td>0.34 ac.</td><td>0.1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: many-stemmed dudleya, intermediate mariposa lily, California gnatcatcher, coastal cactus wren, northern red-diamond rattlesnake, western spadefoot toad, southwestern pond turtle.</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 4.02 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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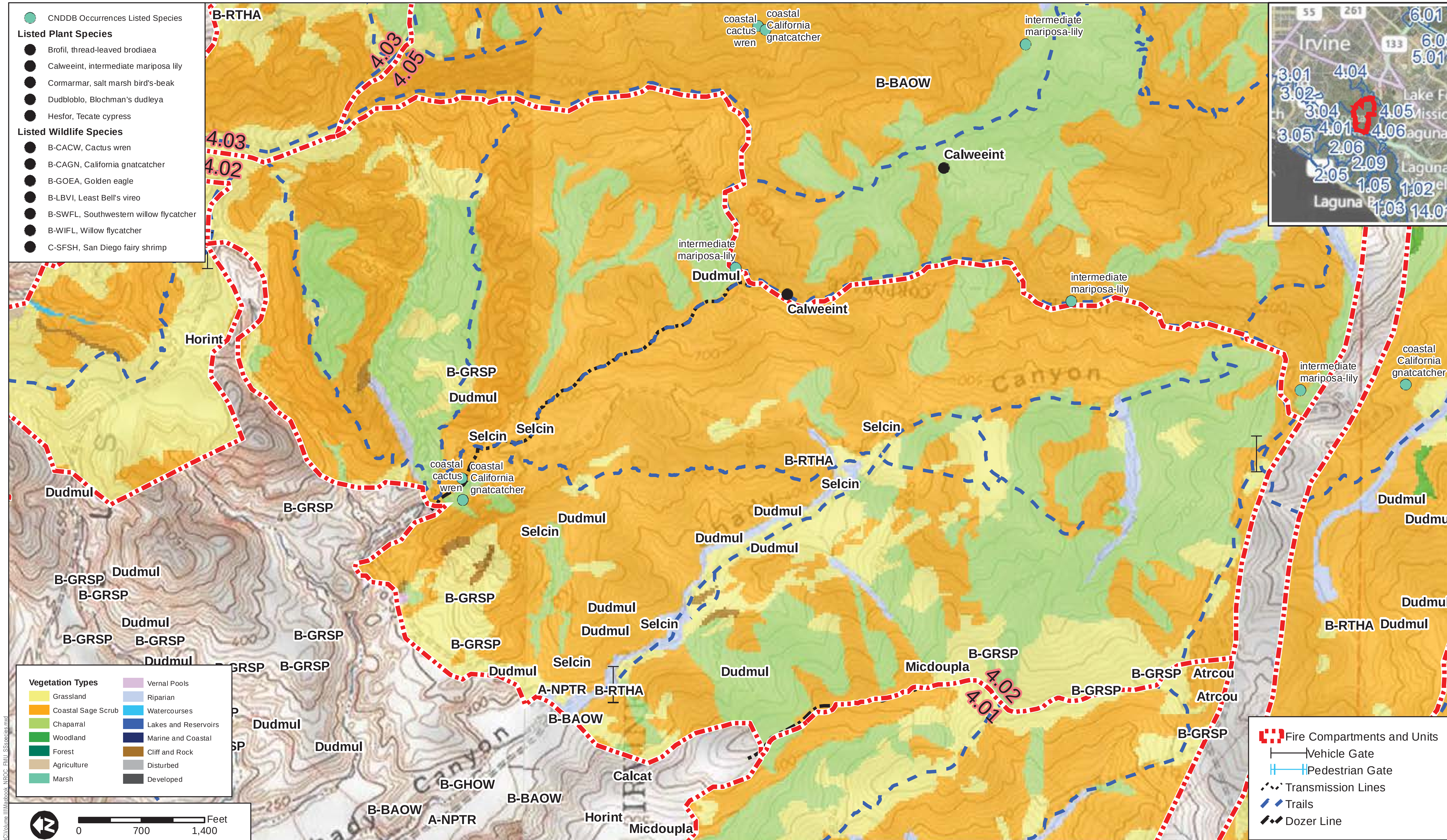

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 4.02

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FIRE MANAGEMENT UNIT 4.03

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 470 acres
Special Considerations: Sensitive coastal sage scrub, California gnatcatcher and cactus wren habitat. Area contained within San Diego Creek Special Management Area</td><td>Access Route:
Access is limited in this FMU to neighborhood paved streets (Canyon Creek and Momento) associated with two water tanks and a hiking trail that is not useable by fire apparatus; periphery areas are accessible from Shady Canyon to the north and connector streets in the west and east.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>8 ac.</td><td>2%</td><td></td></tr>
<tr><td>Chaparral</td><td>6 ac.</td><td>1%</td><td></td></tr>
<tr><td>Cliff and Rock</td><td>1 ac.</td><td>0.3%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>119 ac.</td><td>25%</td><td></td></tr>
<tr><td>Developed</td><td>0.006</td><td>0.1%</td><td></td></tr>
<tr><td>Grassland</td><td>332 ac.</td><td>71%</td><td></td></tr>
<tr><td>Riparian</td><td>3 ac.</td><td>0.6%</td><td></td></tr>
<tr><td>Watercourses</td><td>0.74 ac.</td><td>0.2%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: coastal California gnatcatcher, coastal cactus wren, grasshopper sparrow, western spadefoot toad, northern red-diamondback rattlesnake, small flowered microseris</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 4.03 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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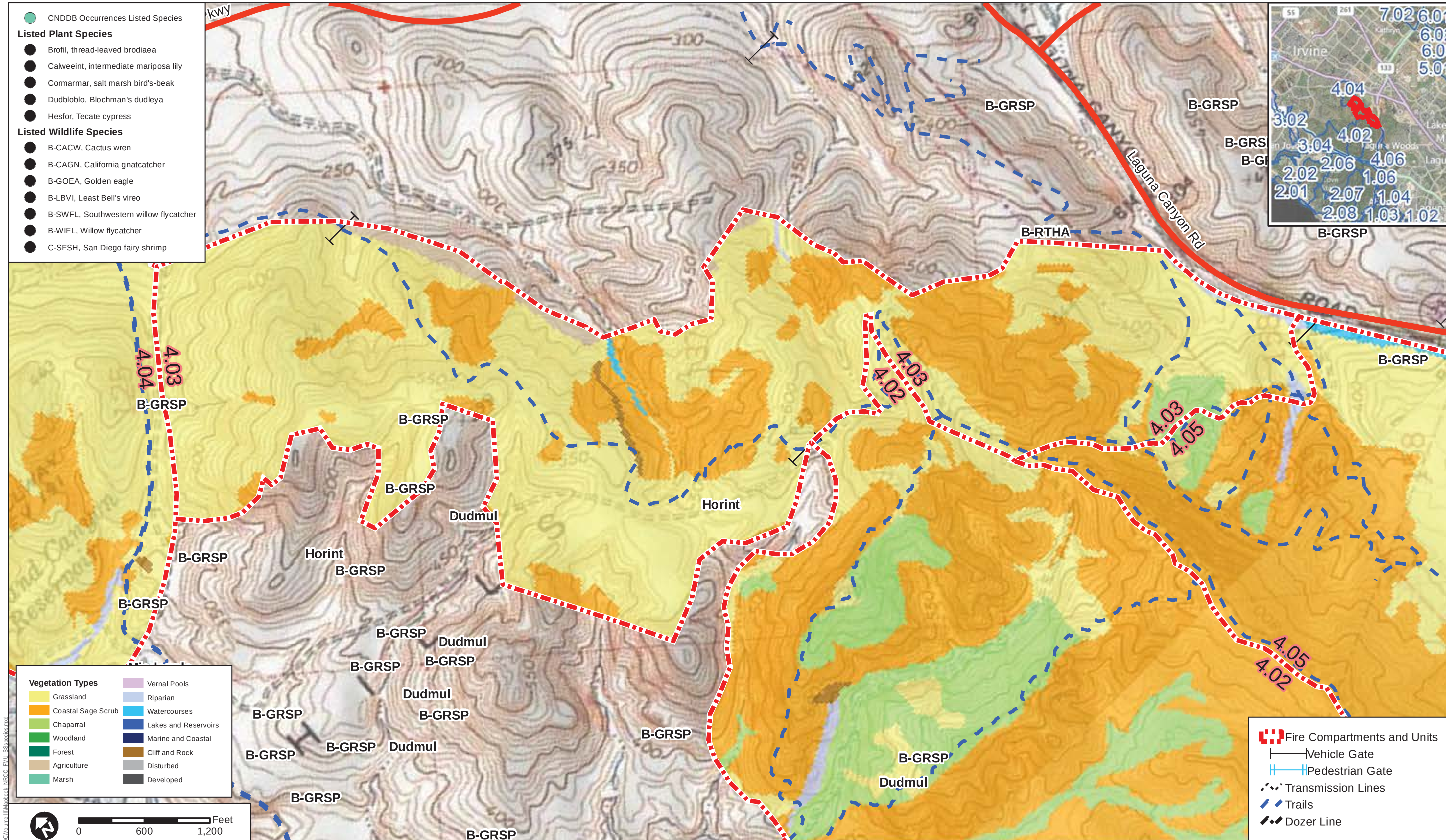

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 4.03

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 4.04

FIREFIGHTING PROTOCOL: Assertive – - High Risk, aggressive suppression			
Size: 689 acres Special Considerations: Sensitive coastal sage scrub, California gnatcatcher and cactus wren habitat			Access Route: FMU is accessible from University Drive and Strawberry Farm Road in the north, Shady Canyon in the south and Quail Trail in the north. Site vehicular access to interior of FMU is limited to a paved road to the reservoir at the top of Quail Hill. Trails are gated (4139Z & 4139X) and accessible form Quail Hills parking lot.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Agriculture	39 ac.	6%	
Cliff and Rock	2 ac.	0.2%	
Coastal Sage Scrub	69 ac.	10%	Cactus wren
Developed	0.82 ac.	0.1%	
Disturbed	0.96 ac.	0.1%	
Grassland	561 ac.	81%	
Lakes and reservoirs	4 ac.	0.6%	
Marsh	3 ac.	0.5%	
Riparian	2 ac.	0.3%	
Watercourses	7 ac.	1%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: coastal California gnatcatcher, coastal cactus wren, grasshopper sparrow, western spadefoot toad, northern red-diamondback rattlesnake			
Pre-Fire Activity			
Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 4.04 and implement as feasible.			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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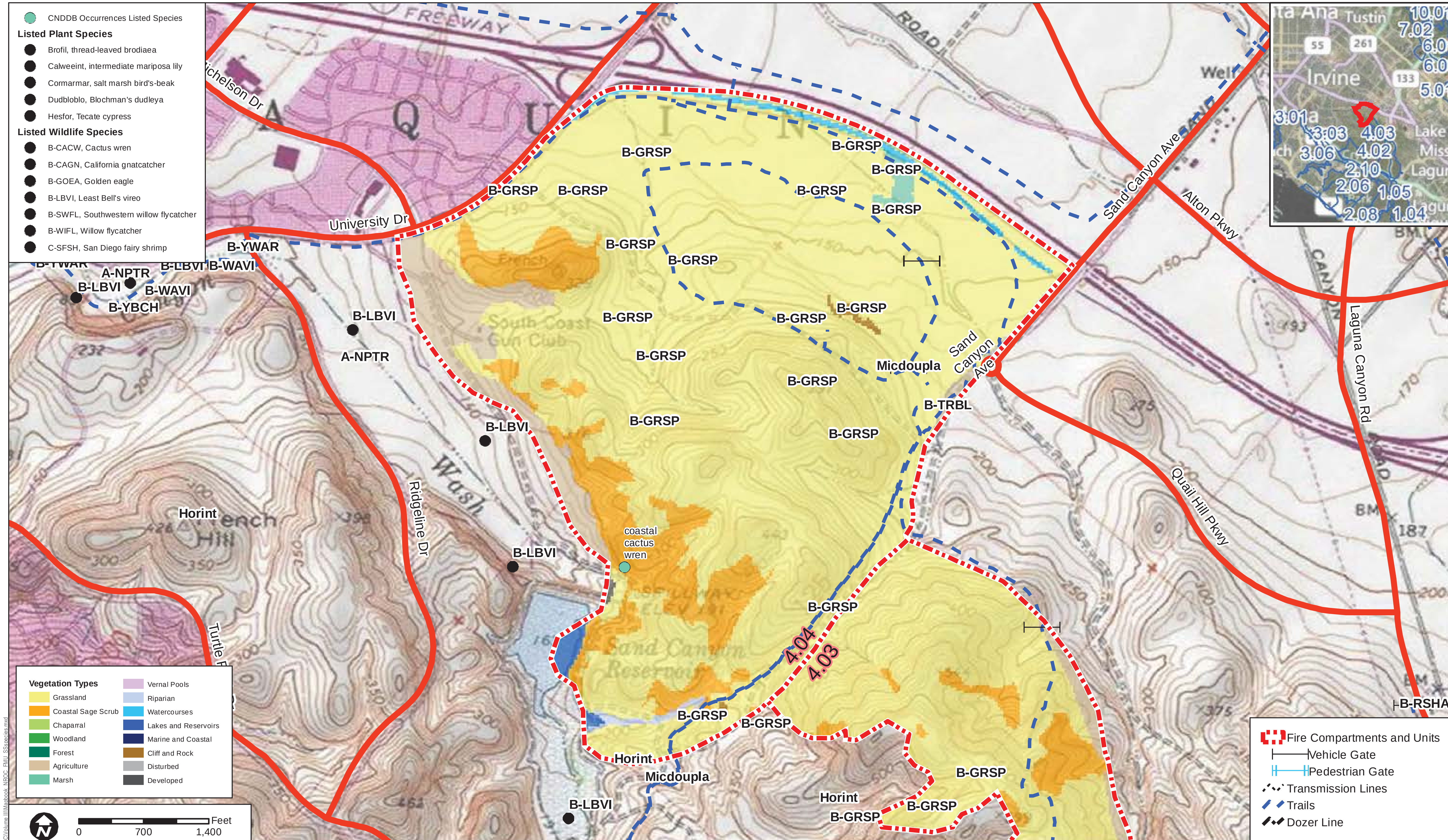

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 4.04

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 4.05

FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread

Size: 991 acres Special Considerations: Sensitive cactus wren, coastal sage scrub and native grassland habitats. Area contained within the San Diego Creek Special Management Area. Nix Nature Center	Access Route: Access is limited throughout much of the FMU to dirt trails and roads not adequate for heavy engine use; 133 provides access on the eastern FMU boundary and 73 along the south.

Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	164 ac.	17%	intermediate mariposa lily
Coastal Sage Scrub	581 ac.	59%	Cactus wren, California gnatcatcher, intermediate mariposa lily
Developed	0.039 ac.	0.1%	
Grassland	222 ac.	22%	
Riparian	18 ac.	2%	
Watercourses	6 ac.	0.6%	
Woodland	0.28 ac.	0.1%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: Coastal California gnatcatcher, coastal cactus wren, grasshopper sparrow, western spadefoot toad, and northern red-diamondback rattlesnake

Pre-Fire Activity

Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 4.05 and implement as feasible.

During Fire Actions

Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.

Post-Fire Activity

Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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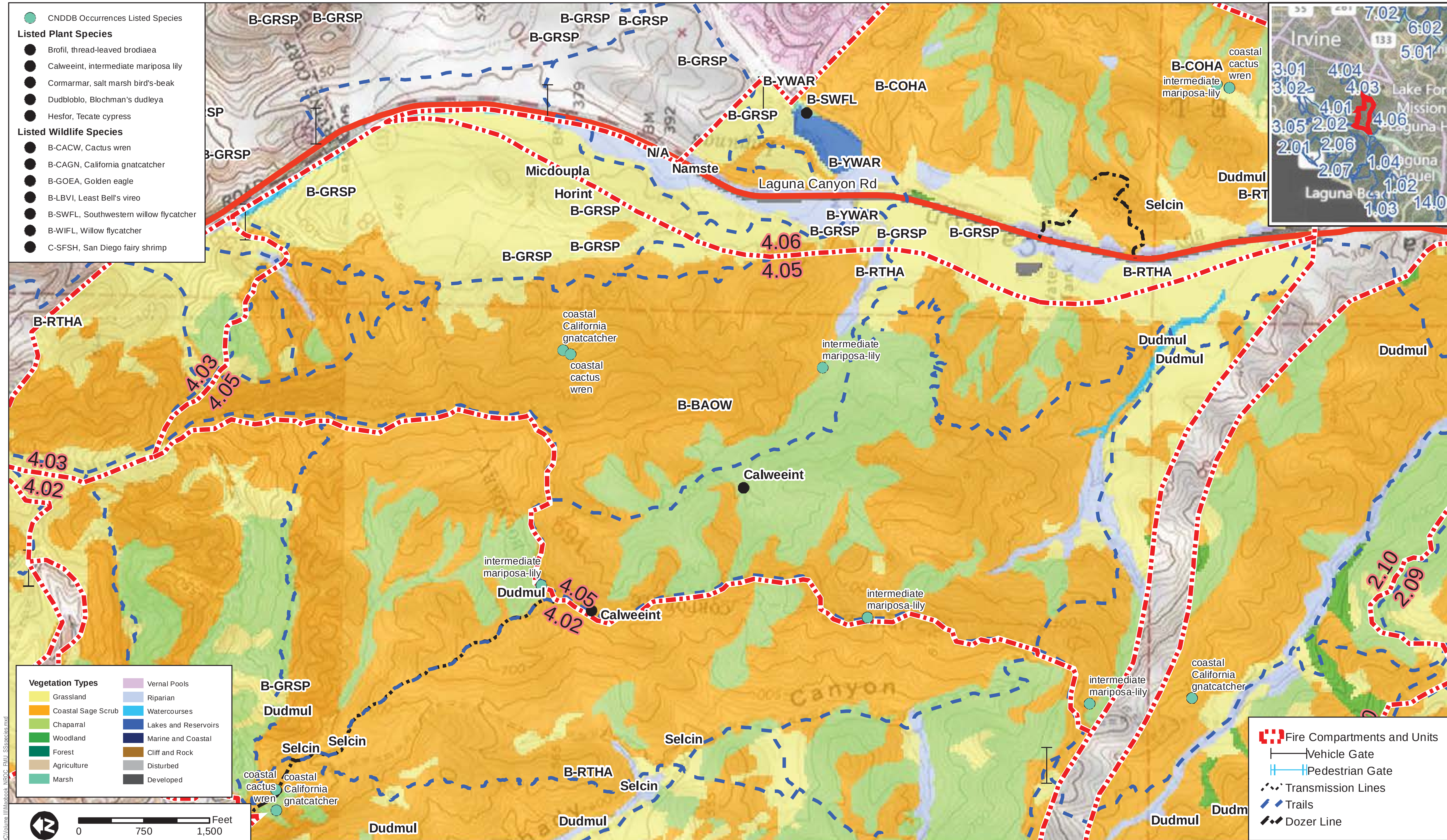

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 4.05

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 4.06</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – Rapid Fire Control/Extinguishment, minimal fire spread</td></tr>
<tr><td colspan="3">Size: 529 acres
Special Considerations: Southern California Edison powerlines, Wildland Urban Interface to east, high quality native grasslands and coastal sage scrub, Barbara's Lake and Bubbles Pond</td><td>Access Route:
Access is limited throughout much of the FMU to dirt trails not adequate for heavy engine use; 133 provides access on the western FMU edge, 73 access on the southern FMU edge, and dirt trails in some areas.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>58 ac.</td><td>11%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>255 ac.</td><td>48%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Developed</td><td>15 ac.</td><td>3%</td><td></td></tr>
<tr><td>Disturbed</td><td>2 ac.</td><td>0.5%</td><td></td></tr>
<tr><td>Grassland</td><td>151 ac.</td><td>28%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Lakes and reservoirs</td><td>8 ac.</td><td>2%</td><td></td></tr>
<tr><td>Marsh</td><td>0.34 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Riparian</td><td>39 ac.</td><td>7%</td><td>Southwestern willow flycatcher</td></tr>
<tr><td>Watercourses</td><td>1 ac.</td><td>0.3%</td><td></td></tr>
<tr><td>Woodland</td><td>0.35 ac.</td><td>0.1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: coastal cactus wren, coastal California gnatcatcher, grasshopper sparrow coast horned lizard, western spadefoot toad, northern red-diamondback rattlesnake, red-tailed hawk, intermediate mariposa lily</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 4.06 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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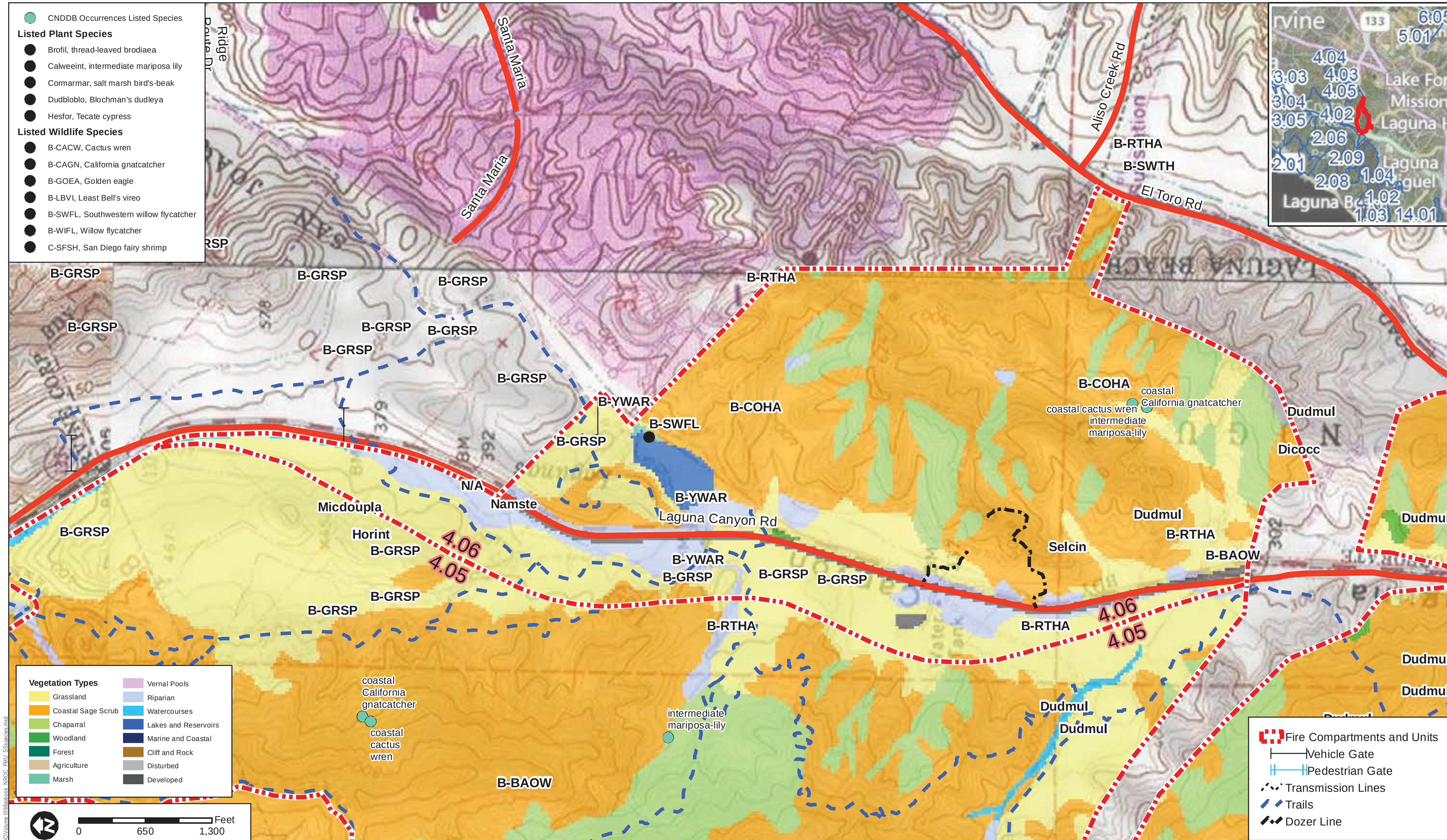

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 4.06

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FIRE MANAGEMENT UNIT 5.01

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1091 acres
Special Considerations: transportation corridor to north, WUI on three sides, dirt road system available throughout portions of FMU; fuel modification adjacent to developments (to be built).</td><td>Access Route:
The site has good access into interior from Irvine Blvd. via a private asphalt road; most limited access occurs in the northeast/east portion of FMU and in northwest. Eastern boundary is bordered by SR 241.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>12 ac.</td><td>1%</td><td></td></tr>
<tr><td>Chaparral</td><td>9 ac.</td><td>1%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>445 ac.</td><td>41%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>13 ac.</td><td>1%</td><td></td></tr>
<tr><td>Disturbed</td><td>217 ac.</td><td>20%</td><td></td></tr>
<tr><td>Grassland</td><td>348 ac.</td><td>32%</td><td></td></tr>
<tr><td>Riparian</td><td>42 ac.</td><td>4%</td><td></td></tr>
<tr><td>Watercourses</td><td>0.36 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Woodland</td><td>5 ac.</td><td>0.4%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal California gnatcatcher, Vernal barley, Cooper’s hawk, Red diamond rattlesnake, Red-tailed hawk, Yellow breasted chat, Yerba mansa, Mesa spike moss</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 5.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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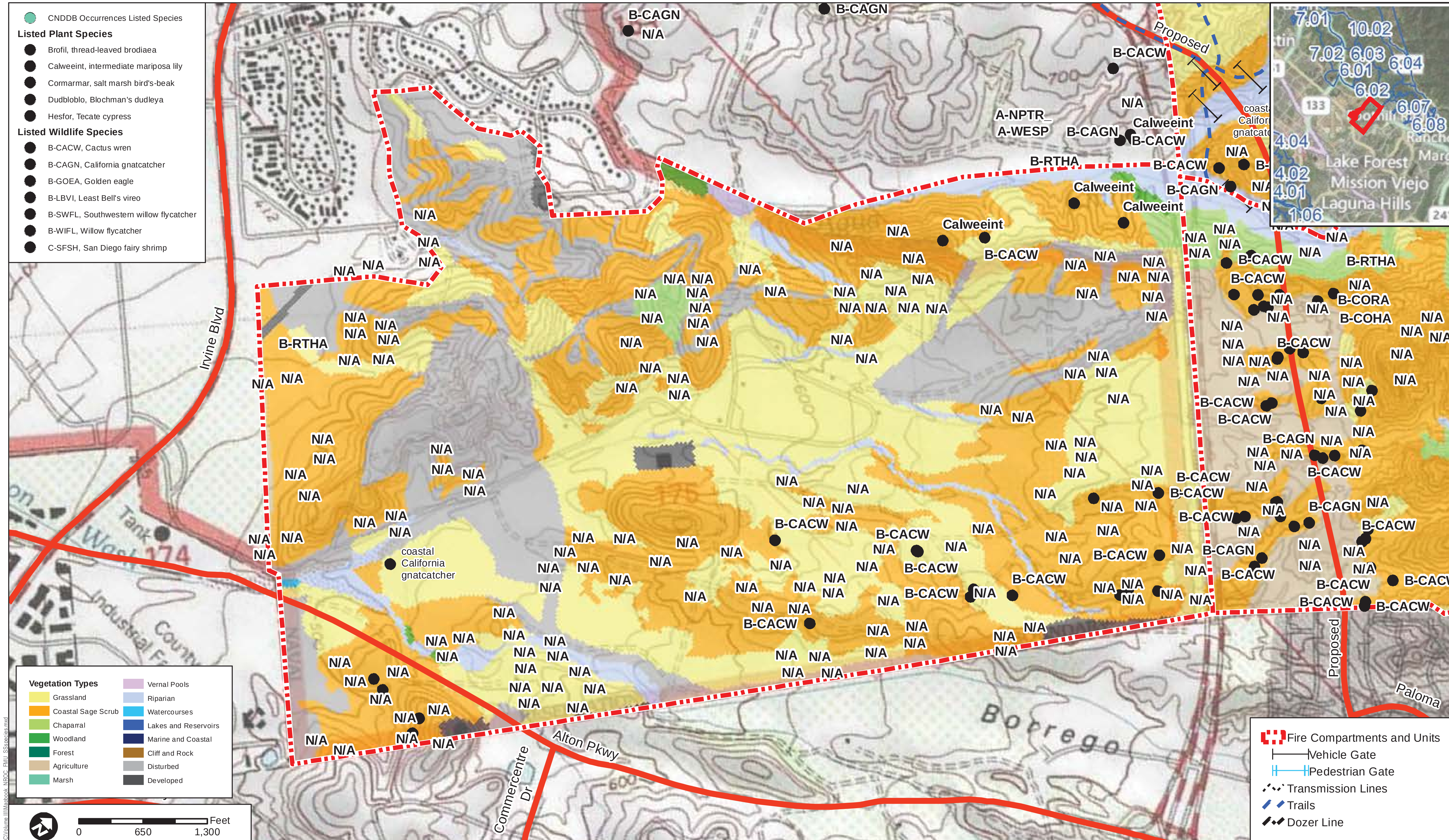

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 5.01

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 6.01</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1683 acres
Special Considerations: Remote/difficult access, unstable geology, grading for Bowerman Landfill. Area contained within San Diego Creek Special Management Area; landfill restoration and life cycle unknown; landfill may revert to sage scrub, chaparral</td><td>Access Route:
Access limited by terrain in north; Main access is off Portola Parkway to either Bee Canyon Access Road to landfill in mid- FMU or to the north from Jeffreys Road to Hicks Haul Road via gate #3046Z. SR 241 borders west and southern perimeter of FMU. Landfill dirt roads to east and north; Old Bee Canyon Road and agriculture roads in south.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>84 ac.</td><td>5%</td><td></td></tr>
<tr><td>Chaparral</td><td>2 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>1151 ac.</td><td>68%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>4 ac.</td><td>0.3%</td><td></td></tr>
<tr><td>Disturbed</td><td>342 ac.</td><td>20%</td><td></td></tr>
<tr><td>Grassland</td><td>91 ac.</td><td>5%</td><td></td></tr>
<tr><td>Riparian</td><td>5 ac.</td><td>0.3%</td><td></td></tr>
<tr><td>Woodland</td><td>4 ac.</td><td>0.3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Catalina mariposa lily, coastal California gnatcatcher, many-stemmed dudleya, intermediate mariposa lily, coast horned lizard, cactus wren, Nesting locations for red tailed hawk, red shouldered hawk</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of intermediate mariposa lily from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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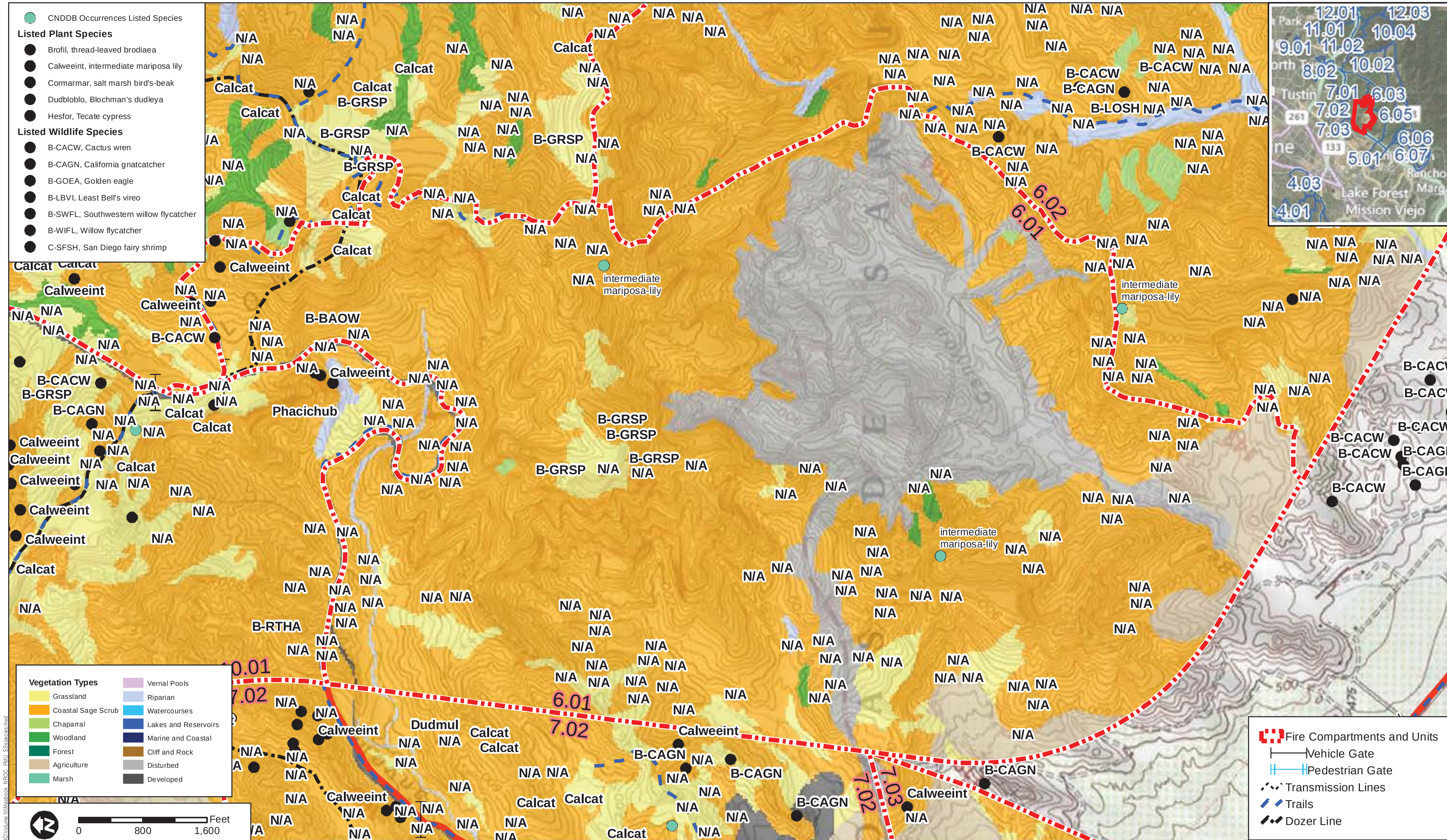

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.01

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 6.02</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1474 acres
Special Considerations: oak woodlands, riparian scrub/woodlands, remote/difficult access to interior of FMU, area is contained within San Diego Creek Watershed/Special Area Management Plan; WUI to the south opposite side of Toll Road</td><td>Access Route:
Access is limited in the FMU; Loma Ridge Road provides access on the northern/northeastern boundary, Portola Parkway (old road) provides access to water storage tanks via gate #3550X and into canyon drainages through gates # 3449Z and # 3549X; trails on south; eastern boundary is not on a roadway.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>31 ac.</td><td>2%</td><td></td></tr>
<tr><td>Chaparral</td><td>36 ac.</td><td>3%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>1241 ac.</td><td>84%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Grassland</td><td>93 ac.</td><td>6%</td><td></td></tr>
<tr><td>Riparian</td><td>60 ac.</td><td>4%</td><td></td></tr>
<tr><td>Woodland</td><td>13 ac.</td><td>1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Catalina mariposa lily, intermediate mariposa lily, coastal cactus wren, red shouldered hawk, white tailed kite, grasshopper sparrow, coast horned lizard, orange throated whiptail lizard</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.02 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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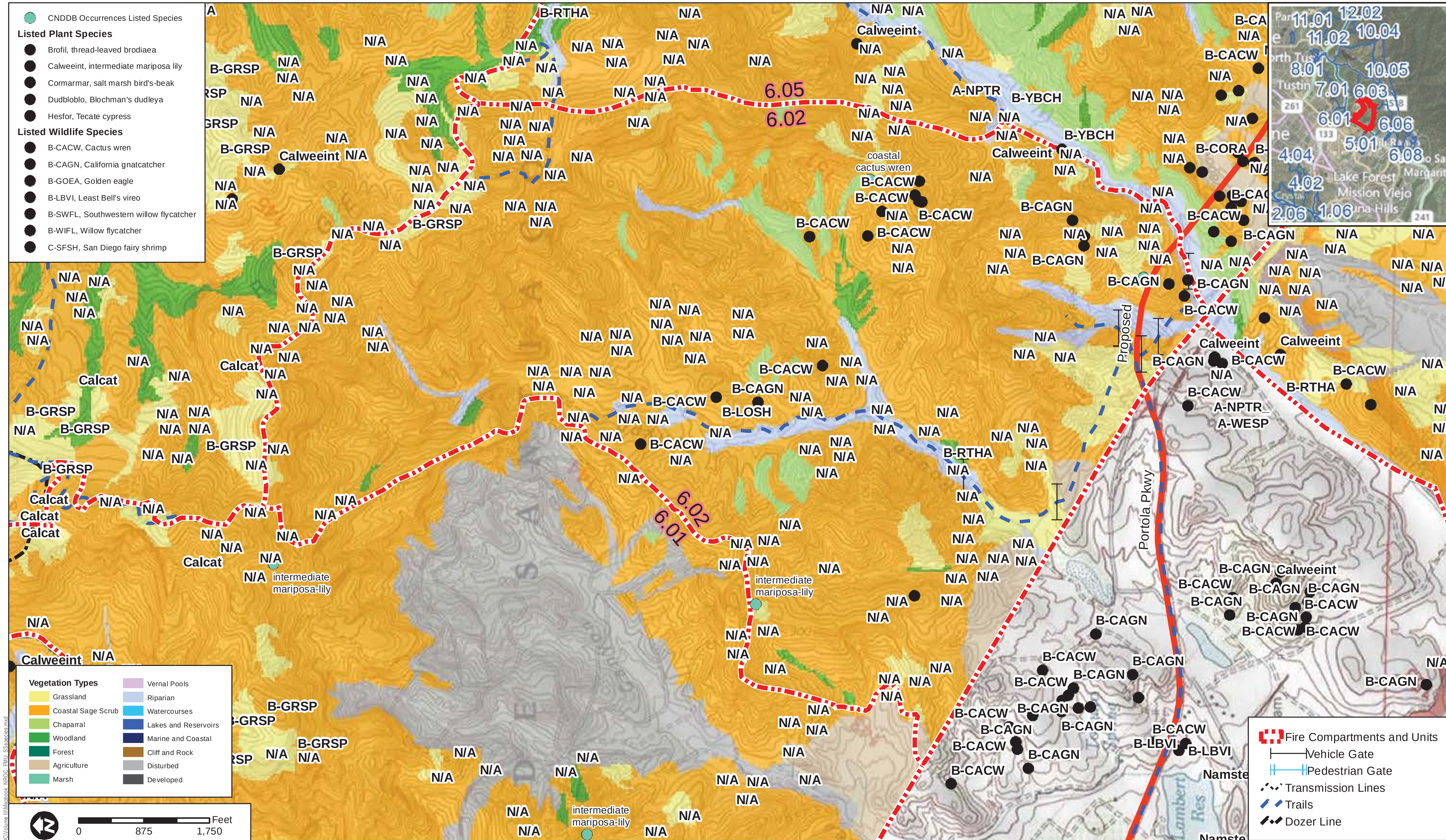

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.02

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FIRE MANAGEMENT UNIT 6.03

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 2367 acres
Special Considerations: Access throughout site is limited</td><td>Access Route:
Access is limited in portions of the FMU, especially the central and western areas; Access to FMU is from either East Santiago Canyon Road to Limestone Spur to Limestone Canyon Road via gates #2751W and 2751Y or E. Santiago Canyon Road to Hicks Haul Road through gates #2749W and 2749X at north boundary; Loma Ridge Road and Jeep trail on southern boundary.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>196 ac.</td><td>8%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Coastal Sage Scrub</td><td>1281 ac.</td><td>54%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>5 ac.</td><td>0.2%</td><td></td></tr>
<tr><td>Grassland</td><td>444 ac.</td><td>19%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Riparian</td><td>181 ac.</td><td>8%</td><td></td></tr>
<tr><td>Woodland</td><td>260 ac.</td><td>11%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: Catalina mariposa lily and intermediate mariposa lily found in Coastal sage scrub and native grasslands, coastal cactus wren, red shouldered hawk nesting locations in oak woodlands, white tailed kite nesting locations in oak woodlands, grasshopper sparrows in native grasslands, coast horned lizard documented throughout FMU</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.03 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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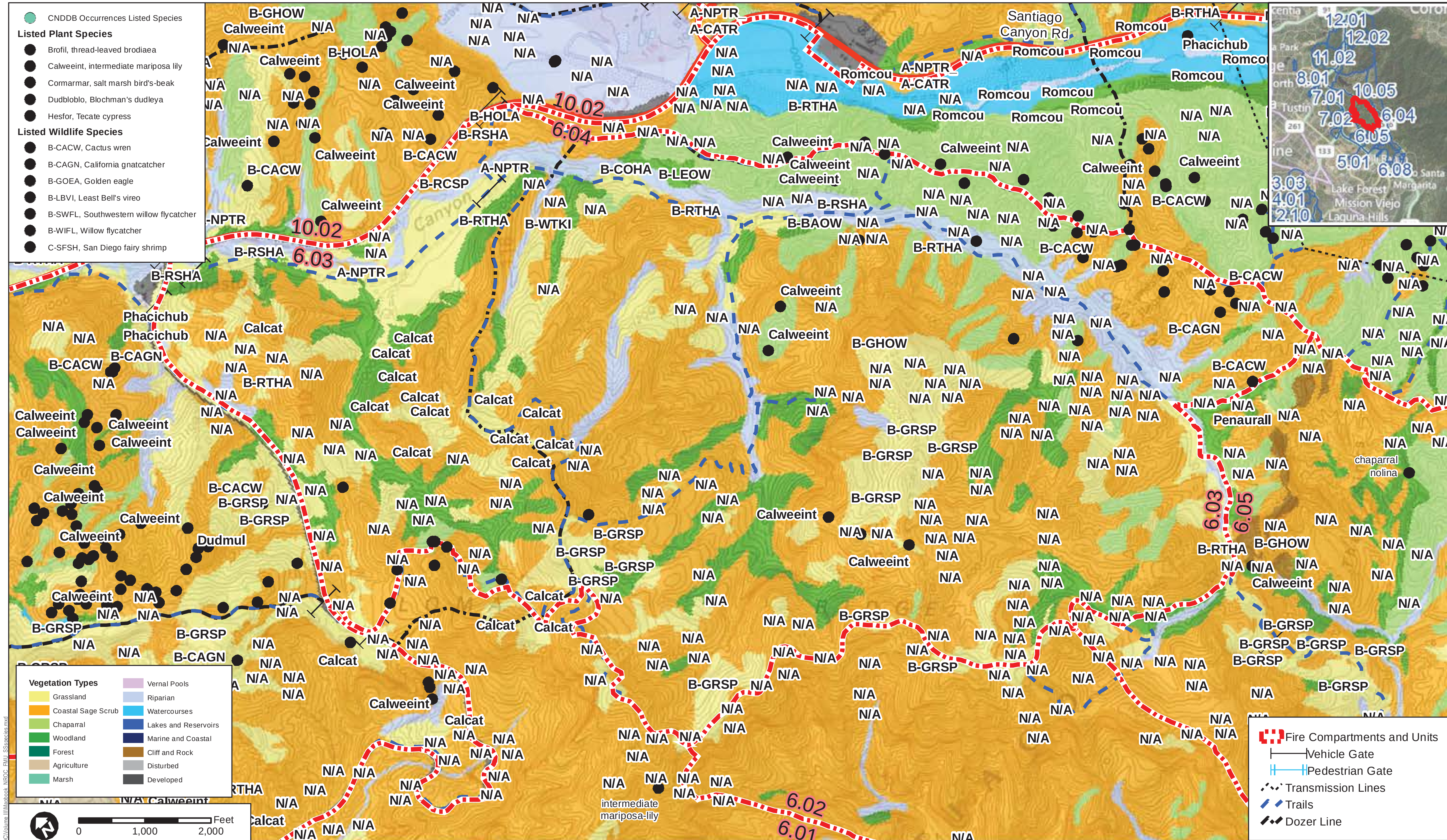

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.03

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 6.04</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1199 acres
Special Considerations: Sensitive aquatic resources, TCA riparian mitigation area, SCE transmission line</td><td>Access Route:
East Santiago Canyon Road forms northern and eastern boundary. Access to FMU is from East Santiago Canyon Road to Hangmans Tree Road via gate # 3255W , Bolero Lookout Road and #2 Spur Road in south. Limited access in northern portion of FMU.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>597 ac.</td><td>50%</td><td>Intermediate mariposa lily</td></tr>
<tr><td>Coastal Sage Scrub</td><td>263 ac.</td><td>22%</td><td>Cactus wren, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>6 ac.</td><td>0.5%</td><td></td></tr>
<tr><td>Disturbed</td><td>8 ac.</td><td>0.7%</td><td></td></tr>
<tr><td>Grassland</td><td>22 ac.</td><td>2%</td><td></td></tr>
<tr><td>Riparian</td><td>25 ac.</td><td>2%</td><td></td></tr>
<tr><td>Watercourses</td><td>173 ac.</td><td>14%</td><td>Arroyo toad</td></tr>
<tr><td>Woodland</td><td>105 ac.</td><td>9%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: Catalina mariposa lily, intermediate mariposa lily, chocolate lily, chaparral bear grass, coastal cactus wren, Santa Ana speckled dace, coast horned lizard</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.04 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect from erosion into drainage occupied by arroyo toad using fiber rolls or other BMPs. Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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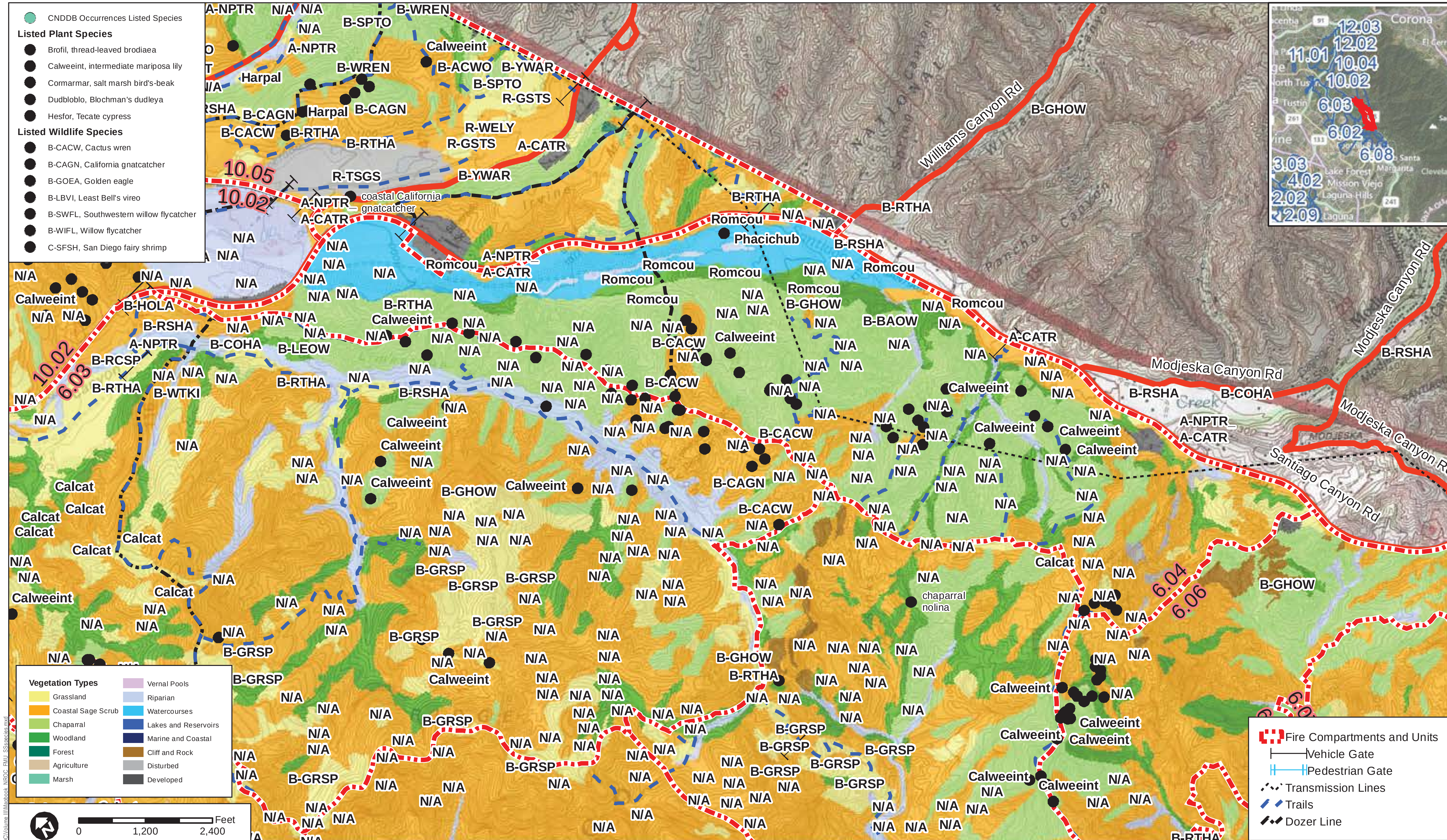

DUDEK

7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.04

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FIRE MANAGEMENT UNIT 6.05

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1506 acres
Special Considerations: Riparian habitat, sensitive species including Gnatcatcher, Cactus Wren, coast horned lizard, orange throated whiptail lizard, intermediate and Catalina mariposa lily, no known archaeological sites in the FMU.</td><td>Access Route:
Access is limited to transmission line roads including Adkins Road, #2 Spur Road, Hangmans Tree Road, Limestone Ridge Road, Bolero Lookout Road, Pr Road; FMU can also be accessed from Portola Highway up Limestone Canyon Road through Gate #3550Z.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>80 ac.</td><td>5%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Chaparral</td><td>296 ac.</td><td>20%</td><td>Chaparral nolina</td></tr>
<tr><td>Cliff and Rock</td><td>19 ac.</td><td>1%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>829 ac.</td><td>55%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>0.34 ac.</td><td>0.01%</td><td></td></tr>
<tr><td>Grassland</td><td>96 ac.</td><td>6%</td><td></td></tr>
<tr><td>Riparian</td><td>69 ac.</td><td>5%</td><td></td></tr>
<tr><td>Woodland</td><td>117 ac.</td><td>8%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: coast horned lizard, orange throated whiptail lizard, intermediate mariposa lily, California gnatcatcher (particularly on southern edge of unit – within Coastal sage scrub patches amongst orchards)</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.05 and implement as feasible. Chaparral nolina is a prolific fire follower; no action needed for this species.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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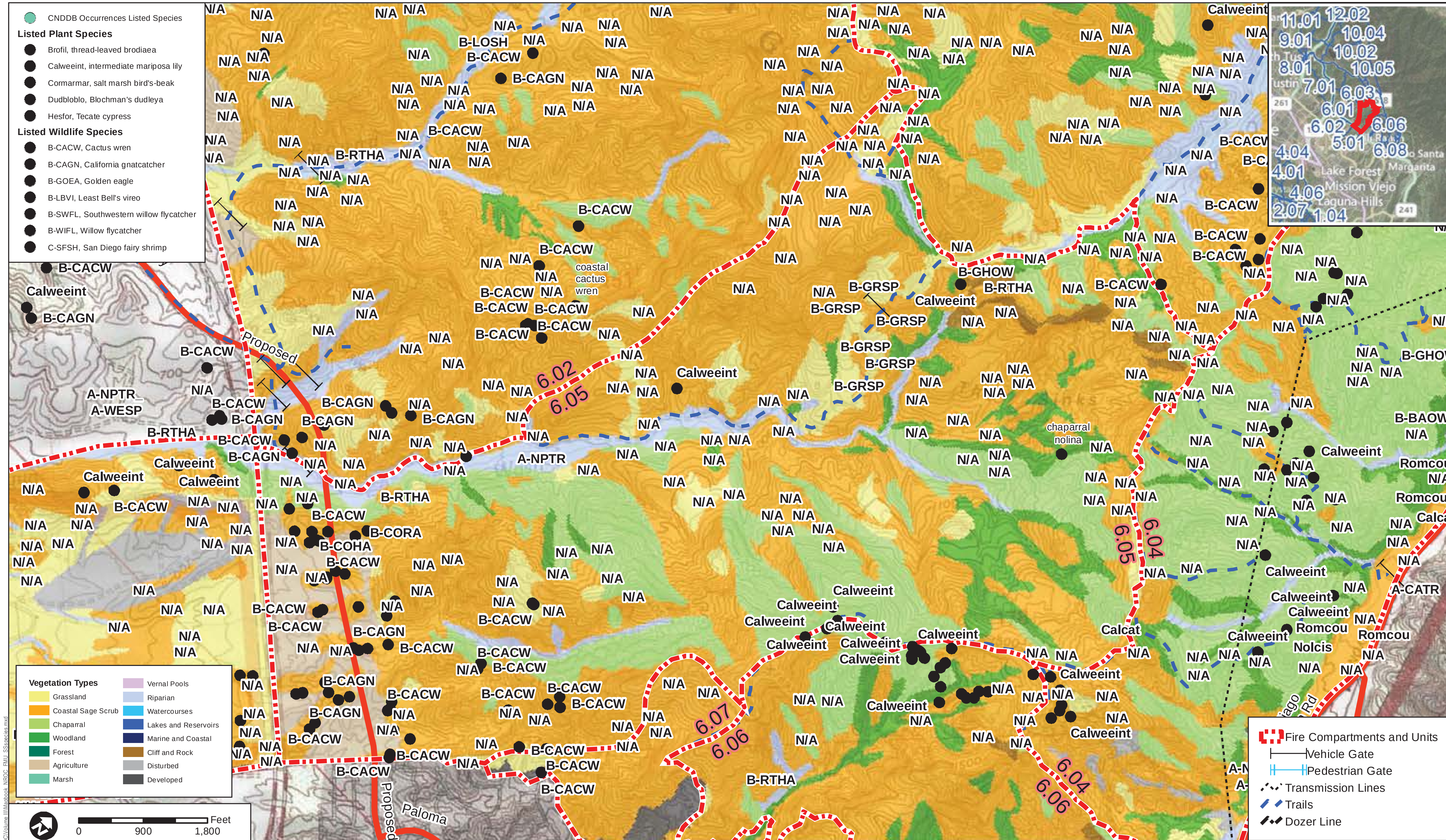

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.05

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 6.06</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 738 acres
Special Considerations: Truck trail off of Santiago Canyon Rd is closed due to landslide. Southern California Edison transmissions lines cross FMU.</td><td>Access Route:
Access is provided by dirt road along FMU boundary and trails within large canyon bottoms, access is limited in some areas and fuels grow up to dirt roadways. Eastern boundary formed by East Santiago Canyon Road and Bolero Lookout forms the northern perimeter boundary.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>210 ac.</td><td>29%</td><td>Intermediate mariposa lily</td></tr>
<tr><td>Cliff and Rock</td><td>20 ac.</td><td>3%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>394 ac.</td><td>54%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>12 ac.</td><td>2%</td><td></td></tr>
<tr><td>Disturbed</td><td>1 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Grassland</td><td>5 ac.</td><td>0.6%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>0.5 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Riparian</td><td>28 ac.</td><td>4%</td><td></td></tr>
<tr><td>Woodland</td><td>67 ac.</td><td>9%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Chaparral bear grass, coastal California gnatcatcher, coastal cactus wren, western spadefoot toad, northern red diamondback rattlesnake, coast horned lizard, orange throated whiptail lizard</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.06 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities; Avoid fire suppression activities which can be harmful to intermediate mariposa lily; Control frequent fires where intermediate mariposa lily is located.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of intermediate mariposa lily from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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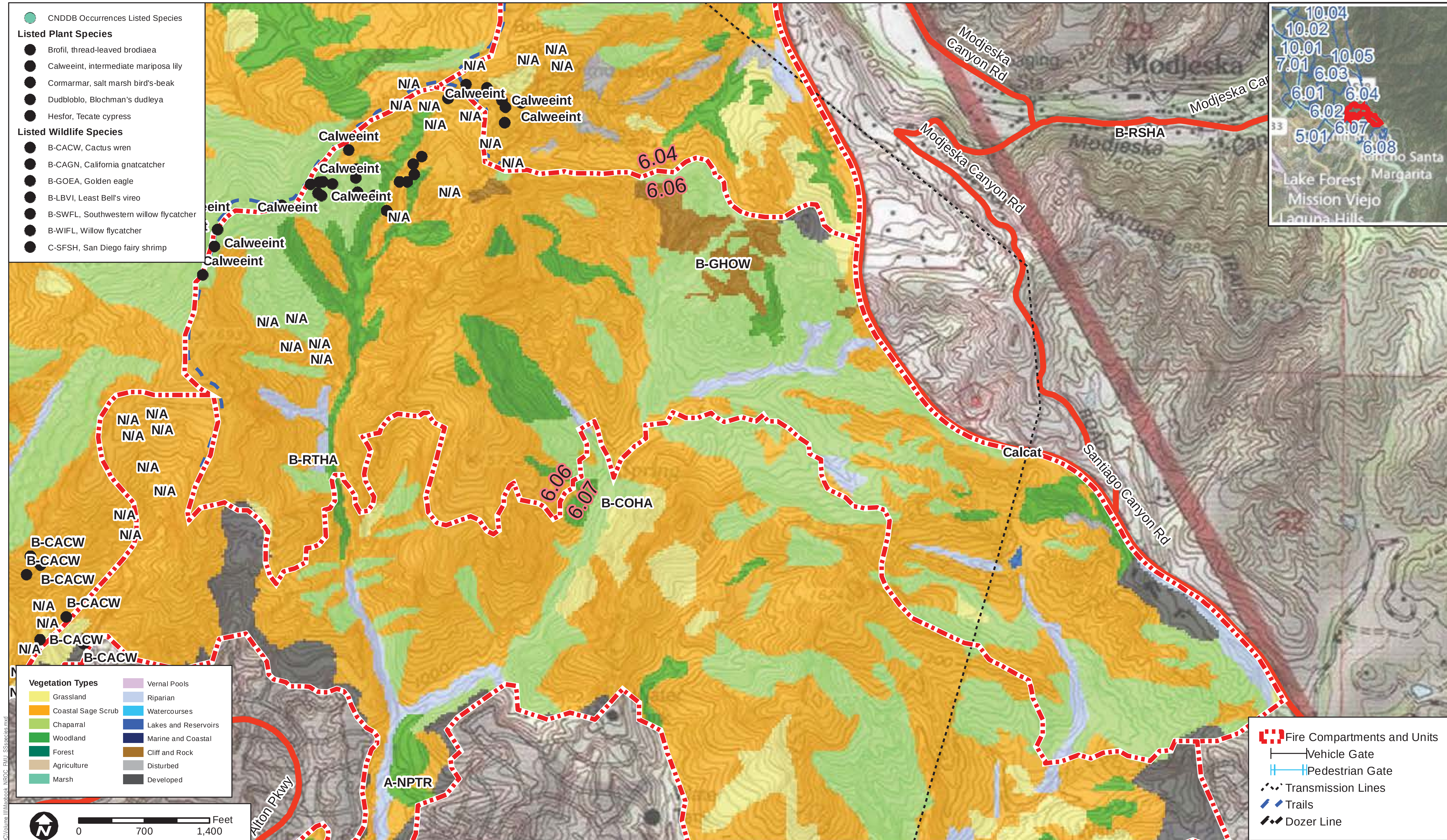

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.06

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 6.07</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1091 acres
Special Considerations: Riparian habitat, sensitive species including Gnatcatcher and Cactus Wren, sensitive habitat and plant species, several known archeological sites in the FMU.</td><td>Access Route:
Access is limited to trails (hiking on Whiting Ranch) and dirt roads, although there are several ridgetop roads that may provide access for firefighting purposes and are accessible from Foothill Ranch.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>154 ac.</td><td>14%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>619 ac.</td><td>57%</td><td>Cactus wren</td></tr>
<tr><td>Developed</td><td>78 ac.</td><td>7%</td><td></td></tr>
<tr><td>Disturbed</td><td>42 ac.</td><td>4%</td><td></td></tr>
<tr><td>Grassland</td><td>76 ac.</td><td>7%</td><td></td></tr>
<tr><td>Riparian</td><td>59 ac.</td><td>5%</td><td></td></tr>
<tr><td>Woodland</td><td>63 ac.</td><td>6%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal California gnatcatcher, coastal cactus wren, western spadefoot toad, northern red diamondback rattlesnake, coast horned lizard, orange throated whiptail lizard</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.07 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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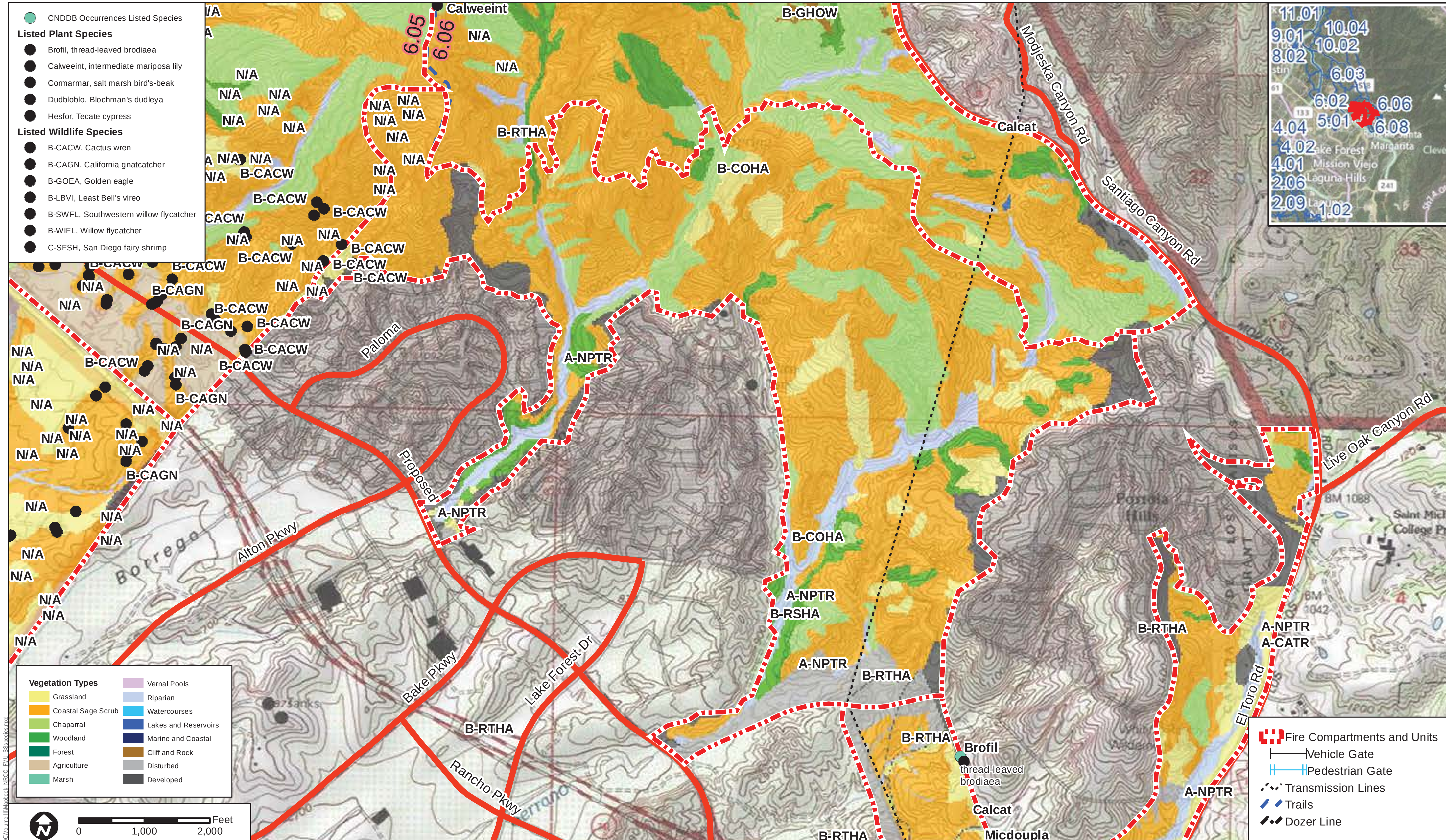

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.07

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FIRE MANAGEMENT UNIT 6.08			
FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 355 acres Special Considerations: Southern California Edison easement contains vernal pools supporting endangered Riverside Fairy Shrimp, cactus wren			Access Route: Access is limited to transmission line road/trail, Edison Trail, Aliso Creek Bikeway, El Toro Rd to east/south and SR 241 to south, Glenn Ranch Road to north.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	14 ac.	4%	
Coastal Sage Scrub	147 ac.	41%	
Developed	39 ac.	11%	
Disturbed	33 ac.	9%	
Grassland	89 ac.	25%	Riverside fairy shrimp
Riparian	30 ac.	9%	Thread-leaved brodiaea
Woodland	3 ac.	1%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: Riverside fairy shrimp, coastal California gnatcatcher, coastal cactus wren, western spadefoot toad, northern red diamondback rattlesnake, coast horned lizard, orange throated whiptail lizard			
Pre-Fire Activity			
Avoid fire suppression activities which can be harmful to thread-leaved brodiaea. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 6.08 and implement as feasible.			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect locations of thread-leaved brodiaea and Riverside fairy shrimp from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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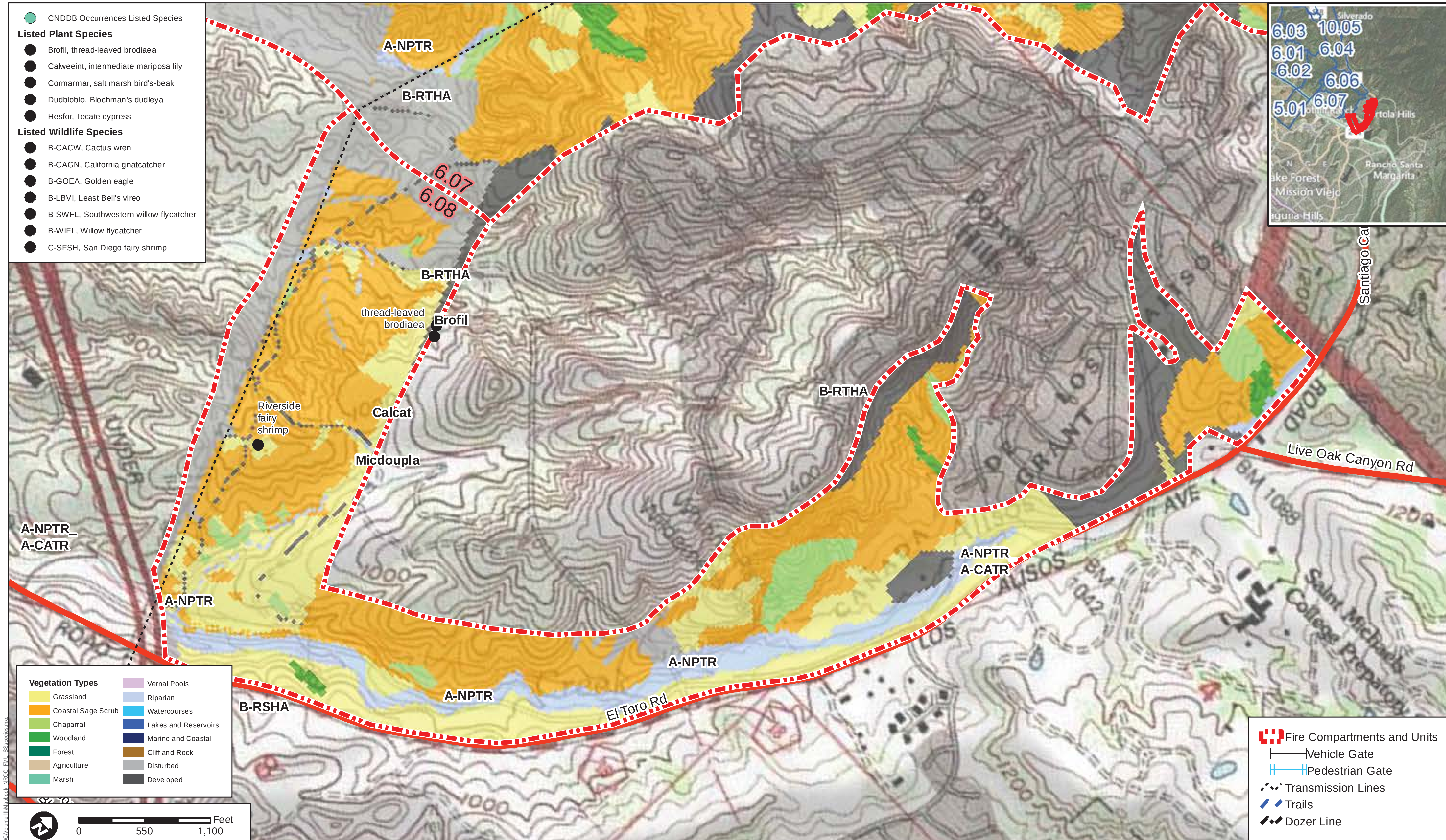

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 6.08

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 7.01

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1811.37 acres
Special Considerations: Site contains Orange County Emergency Communications Center HQ; Coastal sage scrub, native grasslands, California gnatcatcher, many-stemmed dudleya; Unit contained within San Diego Creek Special Management Area</td><td>Access Route:
Access on perimeter of FMU provided along SR 261 toll road (north/west), SR 241 (east); gated access up Loma Ridge Jeep Trail to structure; agricultural roads provide access to western boundary. Orange Count y EOC accessed from Santiago Canyon Road via gate #2544X.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>237 ac.</td><td>13%</td><td></td></tr>
<tr><td>Chaparral</td><td>2 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>782 ac.</td><td>43%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>11 ac.</td><td>0.6%</td><td></td></tr>
<tr><td>Disturbed</td><td>2 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Grassland</td><td>770 ac.</td><td>43%</td><td></td></tr>
<tr><td>Riparian</td><td>7 ac.</td><td>0.4%</td><td></td></tr>
<tr><td>Woodland</td><td>0.06 ac.</td><td>0.01%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: Catalina mariposa lily, intermediate mariposa lily, many-stemmed dudleya, coastal California gnatcatcher, coastal cactus wren, American badger, western spadefoot toad, red diamond rattlesnake</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 7.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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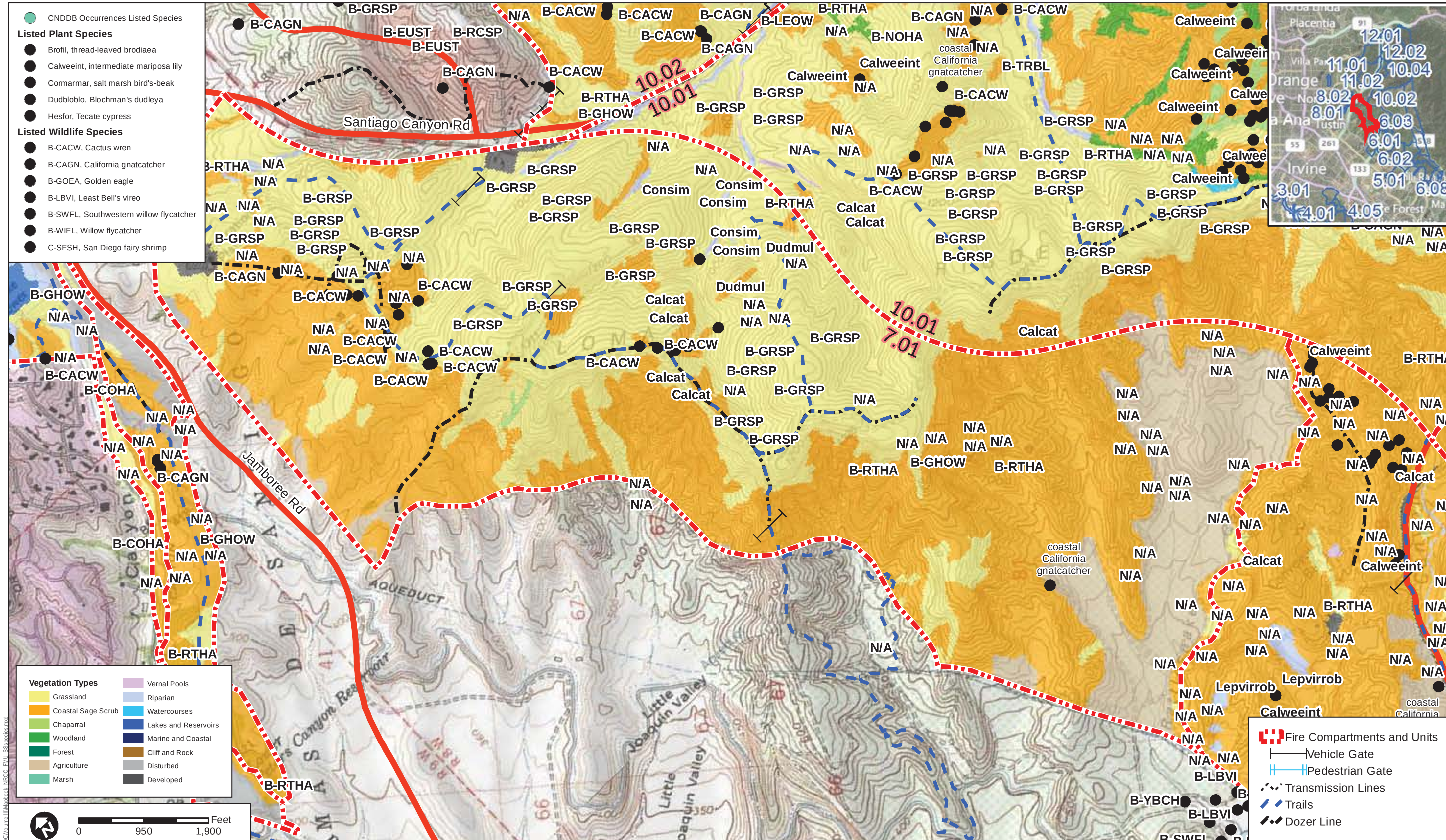

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 7.01

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FIRE MANAGEMENT UNIT 7.02

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 803 acres
Special Considerations: Large population of California gnatcatcher, cactus wren, and intermediate mariposa lily; orchards</td><td>Access Route:
Access on perimeter of FMU provided along agriculture roads to north; SR 241 to the east; Bee Canyon Access Rd to south; agriculture roads to west; Rattlesnake Road and Jeffrey Road in interior canyons.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>82 ac.</td><td>10%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>550 ac.</td><td>69%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>25 ac.</td><td>3%</td><td></td></tr>
<tr><td>Disturbed</td><td>7 ac.</td><td>1%</td><td></td></tr>
<tr><td>Grassland</td><td>115 ac.</td><td>14%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>1 ac.</td><td>0.2%</td><td></td></tr>
<tr><td>Riparian</td><td>22 ac.</td><td>3%</td><td>Least Bell's Vireo, southwestern willow flycatcher</td></tr>
<tr><td>Vernal Pools</td><td>0.67 ac.</td><td>0.1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Catalina mariposa lily, intermediate mariposa lily, many-stemmed dudleya, coastal California gnatcatcher, cactus wren</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 7.02 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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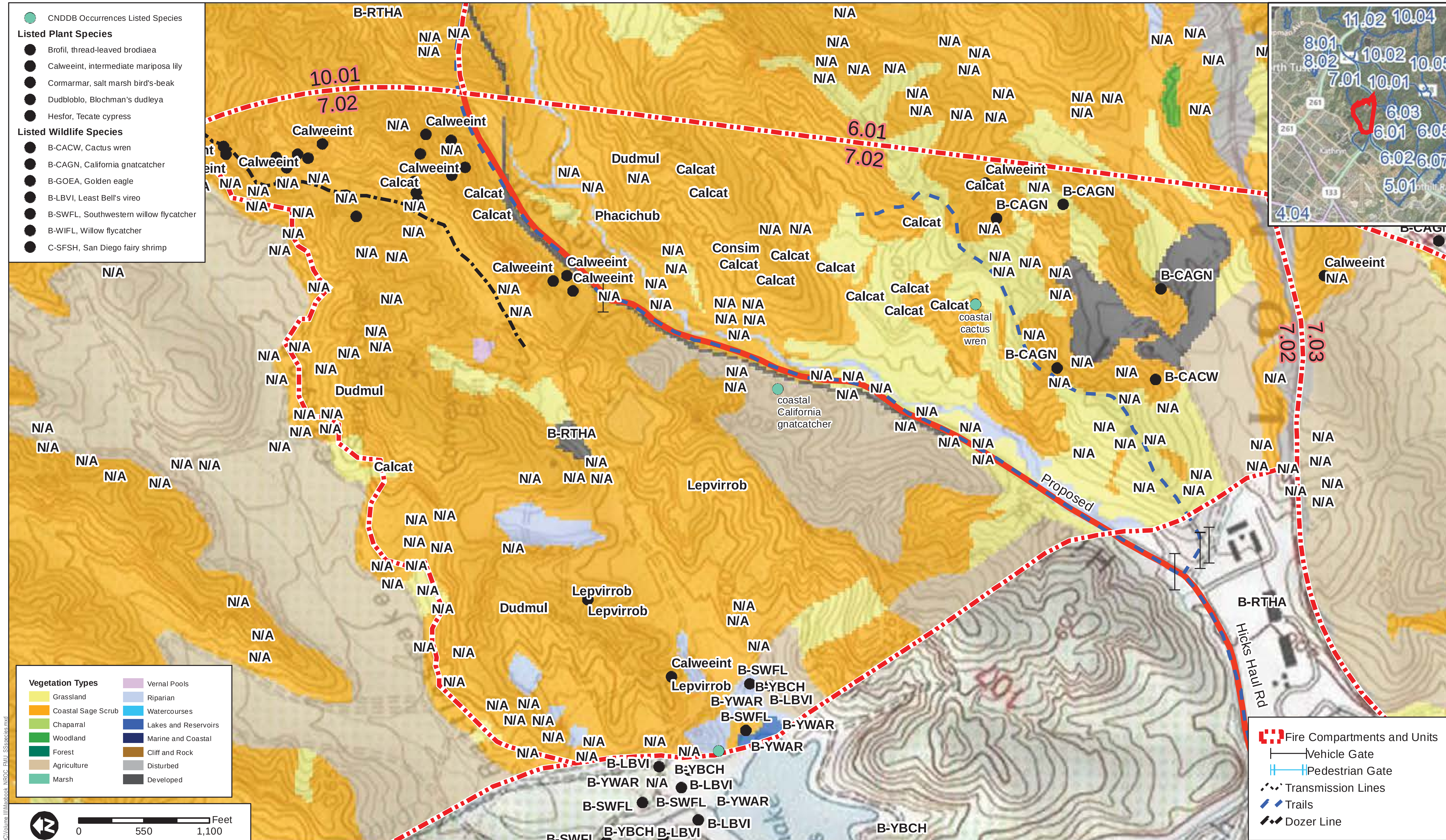

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 7.02

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 7.03</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 346 acres
Special Considerations: TCA Habitat Mitigation Area; coastal sage scrub, California gnatcatcher, cactus wren, area contained within San
Diego Creek Special Management Area</td><td>Access Route:
Access on perimeter of FMU provided along Bee Canyon Access Rd and Portola Parkway to south and southwest; SR 133 Transportation Corridor on southeast and east, Bee Canyon Access Road to north; dirt roads throughout the FMU related to reservoir maintenance.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Agriculture</td><td>147 ac.</td><td>42%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>139 ac.</td><td>40%</td><td>Cactus wren, California gnatcatcher, intermediate mariposa lily</td></tr>
<tr><td>Developed</td><td>1 ac.</td><td>0.4%</td><td></td></tr>
<tr><td>Disturbed</td><td>9 ac.</td><td>3%</td><td></td></tr>
<tr><td>Grassland</td><td>24 ac.</td><td>7%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>24 ac.</td><td>7%</td><td></td></tr>
<tr><td>Marsh</td><td>2 ac.</td><td>0.5%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal California gnatcatcher, Cactus wren</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 7.03 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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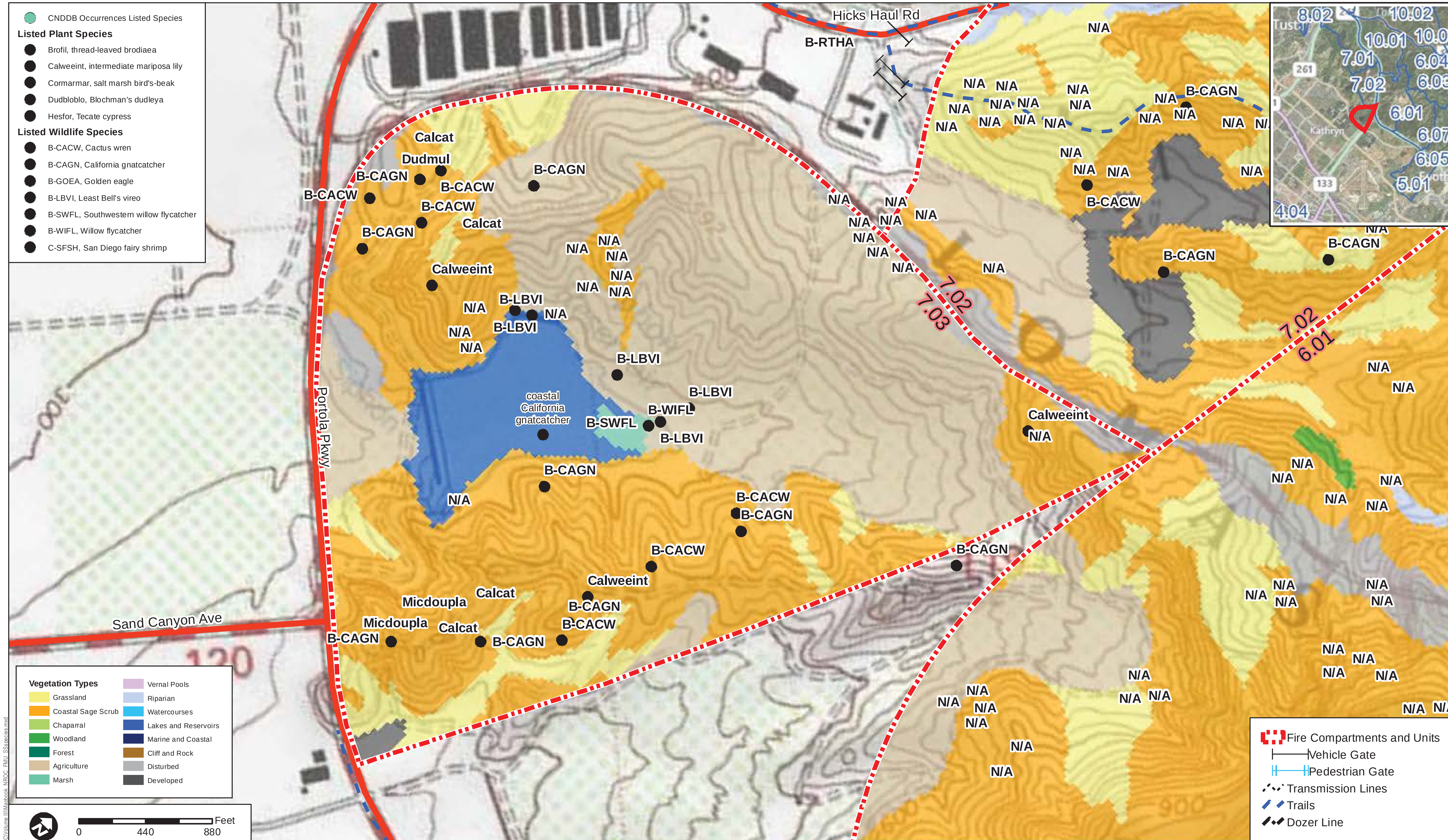

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 7.03

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 8.01</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 211.343 acres
Special Considerations: Sensitive riparian and native grassland habitats, California gnatcatcher</td><td>Access Route:
FMU is accessible from Canyon View Avenue (north) from Jamboree Road; Skylark Place in the northwest and along east side of reservoir from Peters Canyon Road off Jamboree Road.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Coastal Sage Scrub</td><td>39 ac.</td><td>18%</td><td>Cactus wren , California gnatcatcher</td></tr>
<tr><td>Developed</td><td>2 ac.</td><td>1%</td><td></td></tr>
<tr><td>Disturbed</td><td>29 ac.</td><td>14%</td><td></td></tr>
<tr><td>Grassland</td><td>72 ac.</td><td>34%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>20 ac.</td><td>9%</td><td></td></tr>
<tr><td>Riparian</td><td>49 ac.</td><td>23%</td><td>Least Bell's vireo, southwestern willow flycatcher,</td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: coastal California gnatcatcher, coastal cactus wren, orange-throated whiptail lizard, grasshopper sparrow</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 8.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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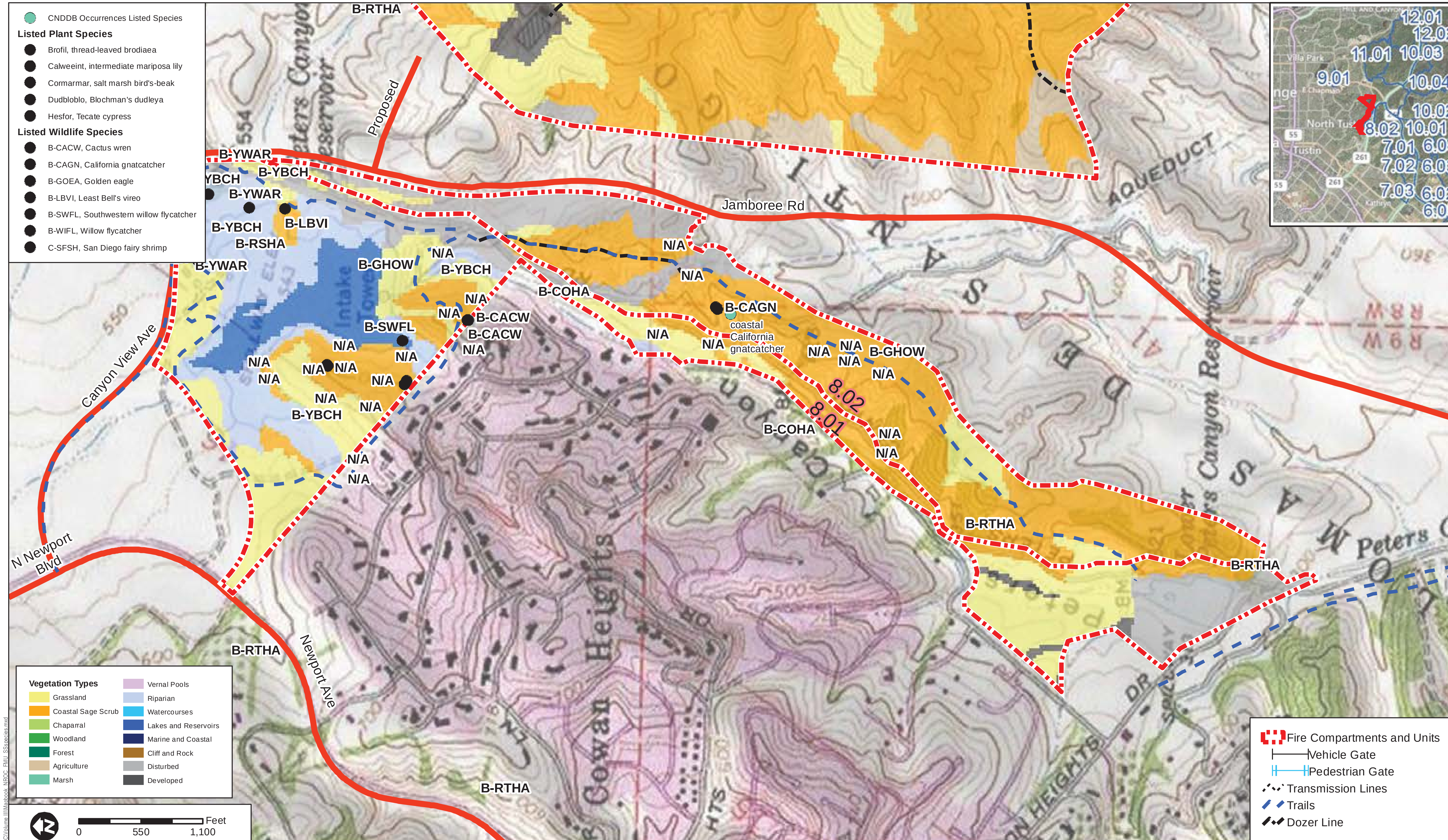

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 8.01

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 8.02</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 121 acres
Special Considerations: Sensitive riparian and native grassland habitats, California gnatcatcher, riparian habitat, WUI on eastern and western edge, Lower Peter’s Canyon Reservoir</td><td>Access Route:
Access is good and provided via dirt access roads at top of ridge and near bottom of slope around Lower Peter's Canyon Reservoir through gated access off Peters Canyon Road.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Coastal Sage Scrub</td><td>87 ac.</td><td>72%</td><td>California gnatcatcher</td></tr>
<tr><td>Developed</td><td>0.01 ac.</td><td>0.01%</td><td></td></tr>
<tr><td>Disturbed</td><td>23 ac.</td><td>19%</td><td></td></tr>
<tr><td>Grassland</td><td>11 ac.</td><td>9%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal California gnatcatcher, coastal cactus wren, orange-throated whiptail lizard, grasshopper sparrow</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 8.02 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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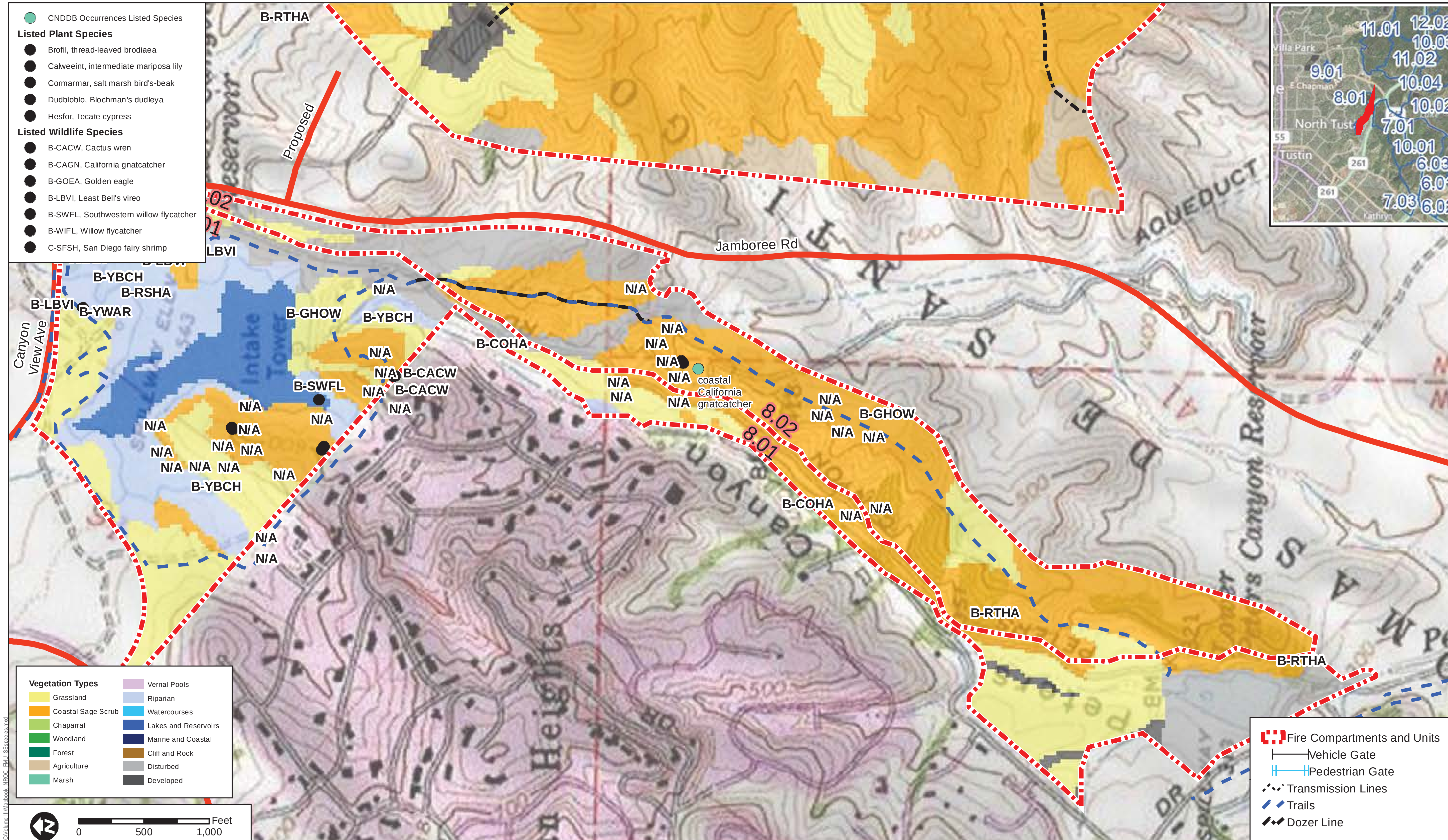

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 8.02

Nature Reserve of Orange County Wildland Fire Management Plan - Volume II

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FIRE MANAGEMENT UNIT 9.01

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 140 acres
Special Considerations: Southern cactus scrub/cactus wren habitat dominate site</td><td>Access Route:
Access is limited to trails that are not drivable. A paved road (E. Glen Albyn Lane)provides access to a substation in the northwestern portion of the FMU, North Cannon Street provides access along the eastern FMU boundary, residential paved roads provide limited access to western, southern, and northern boundaries.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Coastal Sage Scrub</td><td>112 ac.</td><td>80%</td><td>California gnatcatcher</td></tr>
<tr><td>Developed</td><td>5 ac.</td><td>3%</td><td></td></tr>
<tr><td>Disturbed</td><td>17 ac.</td><td>12%</td><td></td></tr>
<tr><td>Grassland</td><td>6 ac.</td><td>4%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: coastal California gnatcatcher, coastal cactus wren, orange-throated whiptail lizard, many stemmed dudleya (1 site)</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 9.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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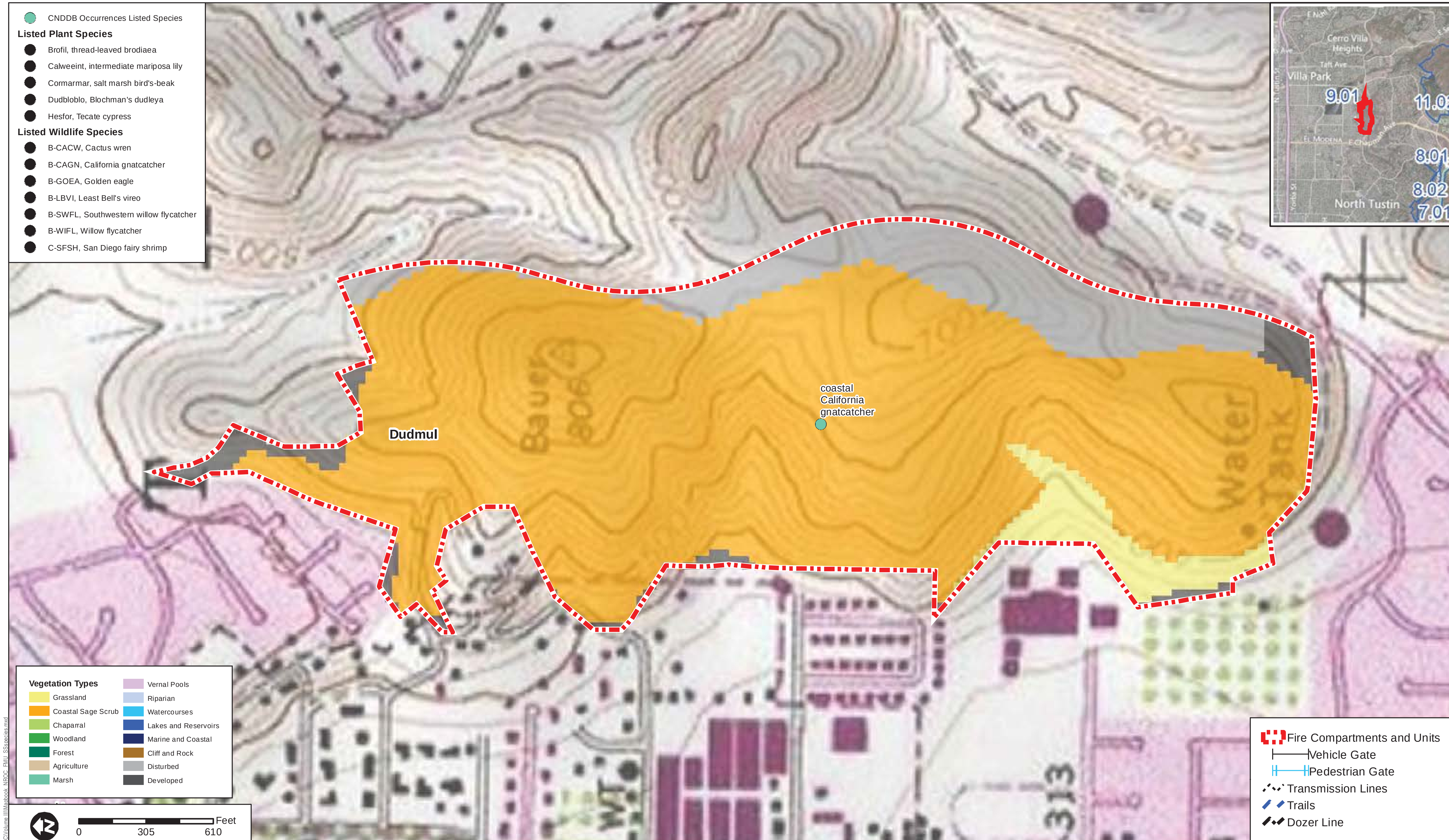

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 9.01

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FIRE MANAGEMENT UNIT 10.01

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 1756 acres Special Considerations: Area supports high quality coastal sage scrub and oak woodlands			Access Route: Access on perimeter of FMU provided along East Santiago Canyon Road (north/east), East Trans Corridor - SR 241 (south/west), Jeffrey Road to Hicks Haul Road (south/east), East end of Hicks Haul Road is gated (#2749W) and Loma Ridge Jeep Trail (central FMU)
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Agriculture	4 ac.	0.2%	
Chaparral	18 ac.	1%	intermediate mariposa lily
Coastal Sage Scrub	837 ac.	48%	Cactus wren, California gnatcatcher, intermediate mariposa lily
Developed	27 ac.	2%	
Grassland	741 ac.	42%	
Riparian	41 ac.	2%	
Vernal Pools	2 ac.	0.1%	
Watercourses	2 ac.	0.1%	
Woodland	84 ac.	5%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: Catalina mariposa lily, intermediate mariposa lily, coastal California gnatcatcher, coastal cactus wren, American badger, western spadefoot toad

Pre-Fire Activity

Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 10.1 and implement as feasible.

During Fire Actions

Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.

Post-Fire Activity

Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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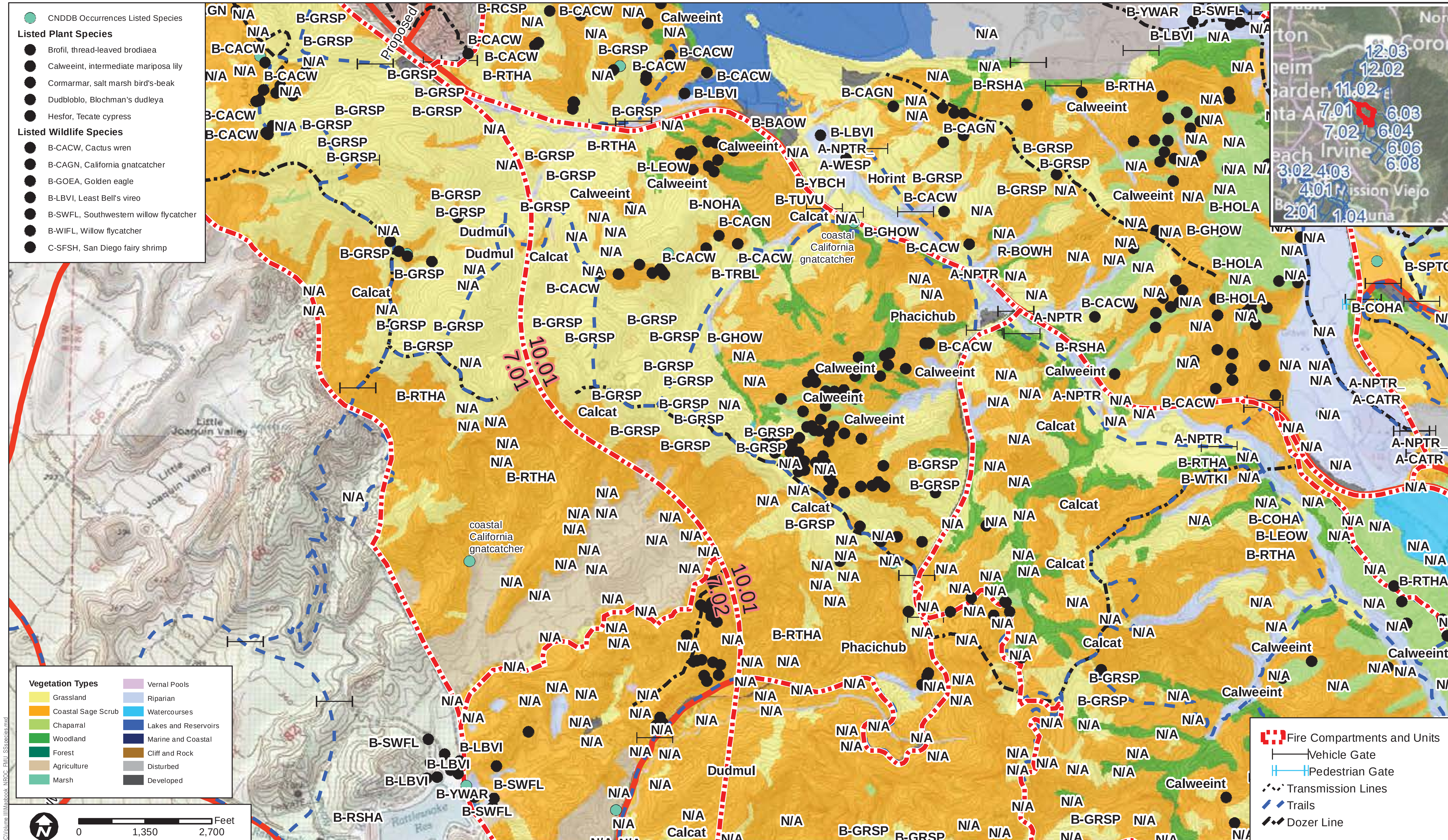

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 10.01

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 10.02</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 4031 acres
Special Considerations: Area supports many rare plants and unique/rare wildlife associated with riparian habitats including Arroyo toad pond turtle and speckled dace</td><td>Access Route:
Access on perimeter of FMU along Lake View SCE Road (north); State Spur Road and Black Star Canyon Road and Red Rock Ridge Road (east); dam facility road (west); east Santiago Canyon Rd (south); some access internally in FMU on Red Spur, Haul Roads; and other trails/roads. Numerous gates in and around FMU perimeter.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>866 ac.</td><td>22%</td><td></td></tr>
<tr><td>Cliff and Rock</td><td>3 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>1441 ac.</td><td>36%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Developed</td><td>77 ac.</td><td>2%</td><td></td></tr>
<tr><td>Disturbed</td><td>178 ac.</td><td>4%</td><td></td></tr>
<tr><td>Grassland</td><td>469 ac.</td><td>12%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Lakes and reservoirs</td><td>514 ac.</td><td>13%</td><td></td></tr>
<tr><td>Riparian</td><td>376 ac.</td><td>9%</td><td>Least Bell’s vireo, southwestern willow flycatcher</td></tr>
<tr><td>Watercourses</td><td>0.01</td><td>0.01%</td><td>Northern leopard frog</td></tr>
<tr><td>Woodland</td><td>107 ac.</td><td>3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder’s database: Catalina mariposa lily, intermediate mariposa lily, coastal California gnatcatcher, coastal cactus wren, chaparral bear grass, Santa Ana speckled dace, Southwestern pond turtle, Arroyo toad</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 10.2 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus and leopard frog from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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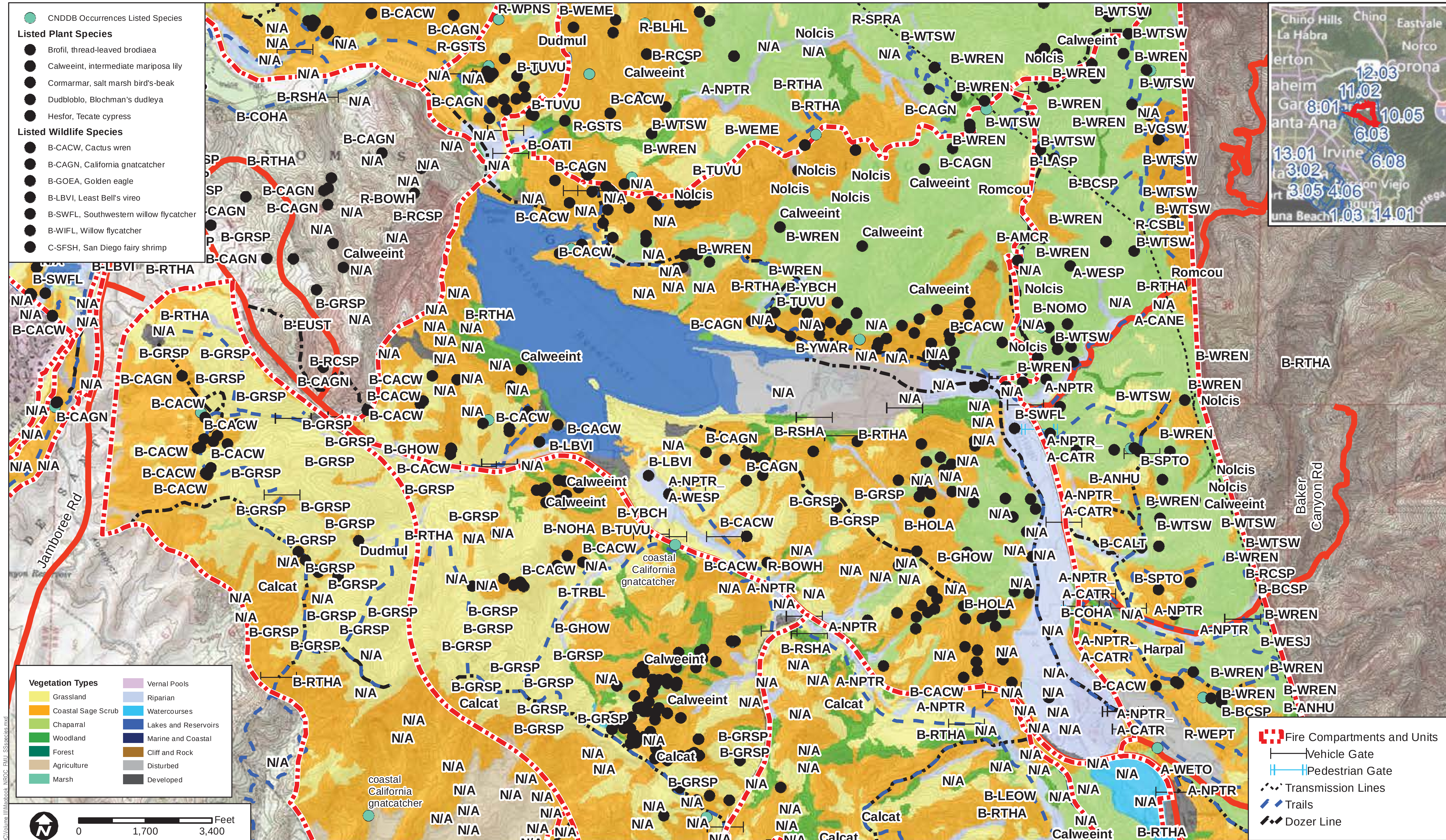

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 10.02

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FIRE MANAGEMENT UNIT 10.03

<table>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 912 acres
Special Considerations: Southern California Edison powerlines cross unit, area supports many rare/unique plant species</td><td>Access Route:
Access to FMU is moderate considering its narrow shape; MWD road through gate #2146Y to Coal Road intersection (gate # 2246X) in the south boundary, SR-241 along the west boundary, Coal Road along the east boundary and Upper Blind Canyon Rd through interior of FMU. The northern boundary follows North and south Windy Ridge Roads.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>470 ac.</td><td>52%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Coastal Sage Scrub</td><td>350 ac.</td><td>38%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Grassland</td><td>63 ac.</td><td>7%</td><td></td></tr>
<tr><td>Riparian</td><td>16 ac.</td><td>2%</td><td></td></tr>
<tr><td>Woodland</td><td>12 ac.</td><td>1%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Many-stemmed dudleya, Catalina mariposa lily, intermediate mariposa lily, coastal cactus wren, chaparral bear grass, spadefoot toad, Tecate cypress small stand</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 10.3 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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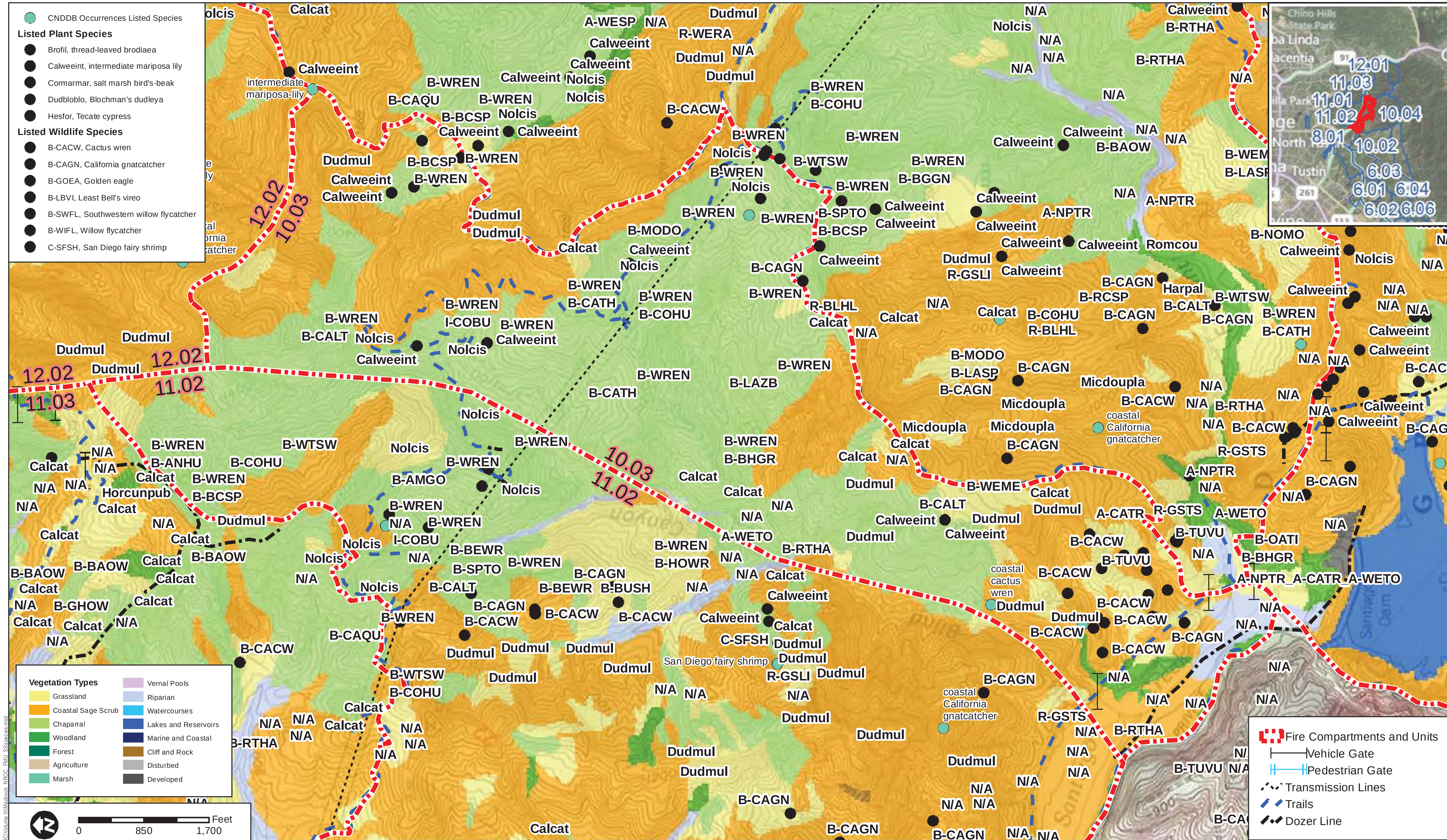

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 10.03

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<tr><th colspan="4">FIRE MANAGEMENT UNIT 10.04</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 3832 acres
Special Considerations: Southern California Edison powerlines overhead, Steep topography, several spur/dead end roads; few access roads</td><td>Access Route:
Access is limited to perimeter on Lake View SCE Road (south/east); N. Windy Ridge Road (north/NW); South Windy Ridge Rd (west); Mine SCE Rd and other transmission line maintenance roads.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>2560 ac.</td><td>67%</td><td>Tecate cypress, chaparral nolina</td></tr>
<tr><td>Cliff and Rock</td><td>9 ac.</td><td>0.2%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>920 ac.</td><td>24%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Disturbed</td><td>0.17 ac.</td><td>0.01%</td><td></td></tr>
<tr><td>Forest</td><td>2 ac.</td><td>0.1%</td><td></td></tr>
<tr><td>Grassland</td><td>139 ac.</td><td>4%</td><td>intermediate mariposa lily</td></tr>
<tr><td>Riparian</td><td>130 ac.</td><td>3%</td><td>willow flycatcher</td></tr>
<tr><td>Woodland</td><td>72 ac.</td><td>2%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Catalina mariposa lily, intermediate mariposa lily, coastal cactus wren, chaparral bear grass, spadefoot toad, golden eagle and other nesting raptors, several species of bats in rock outcrops, and canyon woodlands</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Chaparral nolina is a prolific fire follower; no action needed for this species. Tecate cypress is fire adapted however this stand is vulnerable to extinction from fire burning through the stand in the future if occurs sooner than 40 years. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 10.4 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Control frequent fires where intermediate mariposa lily is located. Although Tecate cypress is fire adapted, fires occurring too frequently in Tecate cypress groves may destroy them by eliminating reproduction. Tecate cypress thickets are conducive to crown fires, which kill most trees. Fires at intervals of less than 35 to 40 years would be likely to reduce stand density and therefore, fire should be controlled to avoid the Tecate cypress stand. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments. Tecate cypress trees release large quantities of seed after fire. Seedling establishment occurs primarily in the first growing season following fire. Areas around the stand, if it burns, should be protected from erosion in order to protect seedlings.</td></tr>
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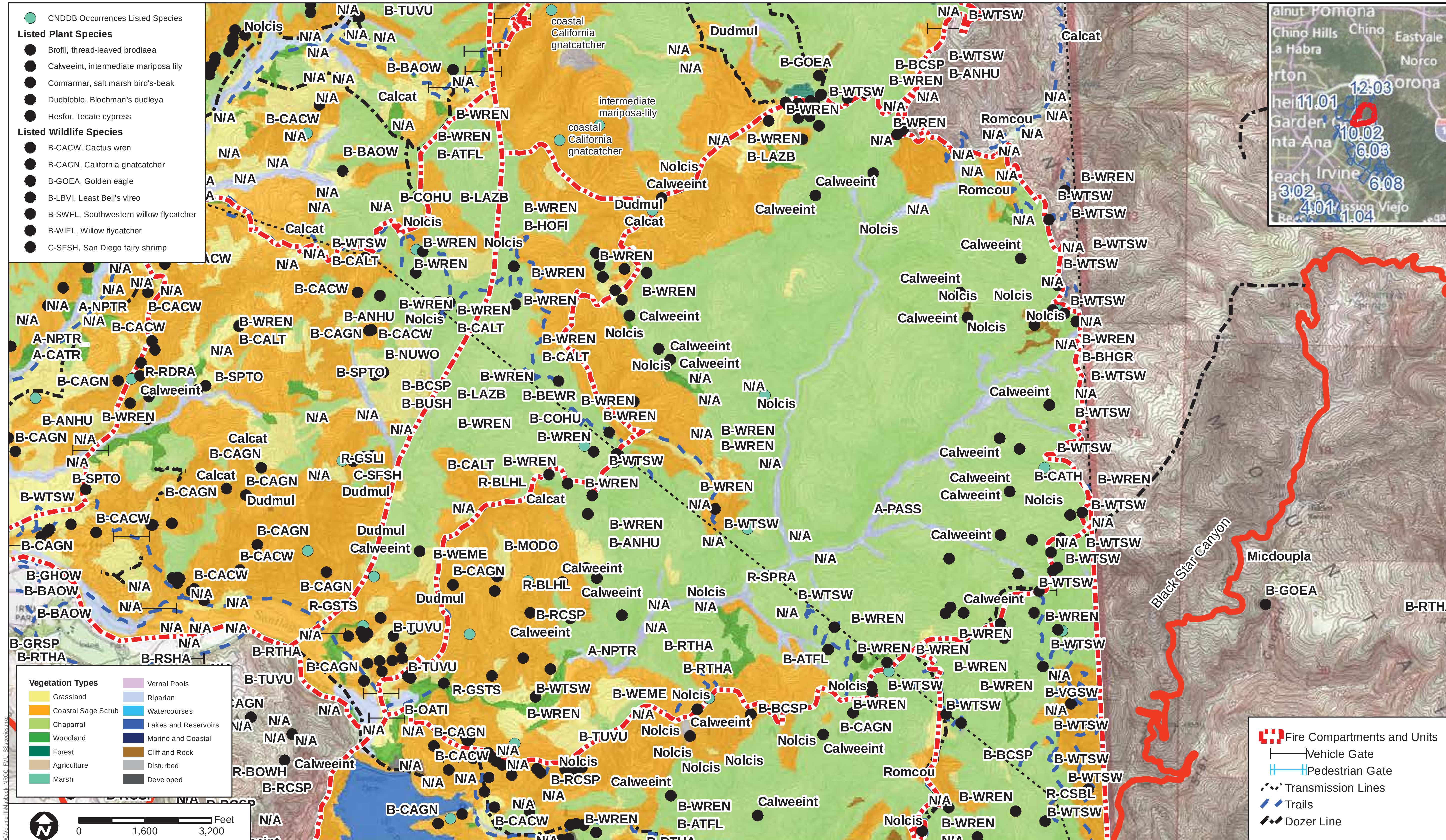

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 10.04

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FIRE MANAGEMENT UNIT 10.05

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 2249 acres
Special Considerations: Streams/creeks and adjacent lands support Arroyo toad and potentially Santa Ana speckled dace and pond turtle; SCE powerlines cross unit along CNF/Irvine Ranch Boundary

Access Route:
Access is limited to perimeter roads including: Santiago Canyon Road (southwest); Black Star Canyon Road (southwest); State Spur Road (west); Lake View SCE Road (northwest); transmission line maintenance roads eastern portion along transmission line corridor

Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Agriculture	1 ac.	0.1%	
Chaparral	1235 ac.	55%	intermediate mariposa lily
Cliff and Rock	0.6 ac.	0.01%	
Coastal Sage Scrub	629 ac.	28%	Cactus wren, California gnatcatcher, intermediate mariposa lily
Developed	67 ac.	3%	
Disturbed	66 ac.	3%	
Forest	2 ac.	0.1%	
Grassland	149 ac.	7%	
Riparian	52 ac.	2%	Willow flycatcher
Watercourses	2 ac.	0.1%	
Woodland	45 ac.	2%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: Chocolate lily, Chaparral beargrass, Intermediate mariposa lily, Santa Ana speckled dace, California gnatcatcher, Several species of bats, Nesting raptors, Pond turtle, Arroyo toad

Pre-Fire Activity

Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 10.5 and implement as feasible.

During Fire Actions

Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.

Post-Fire Activity

Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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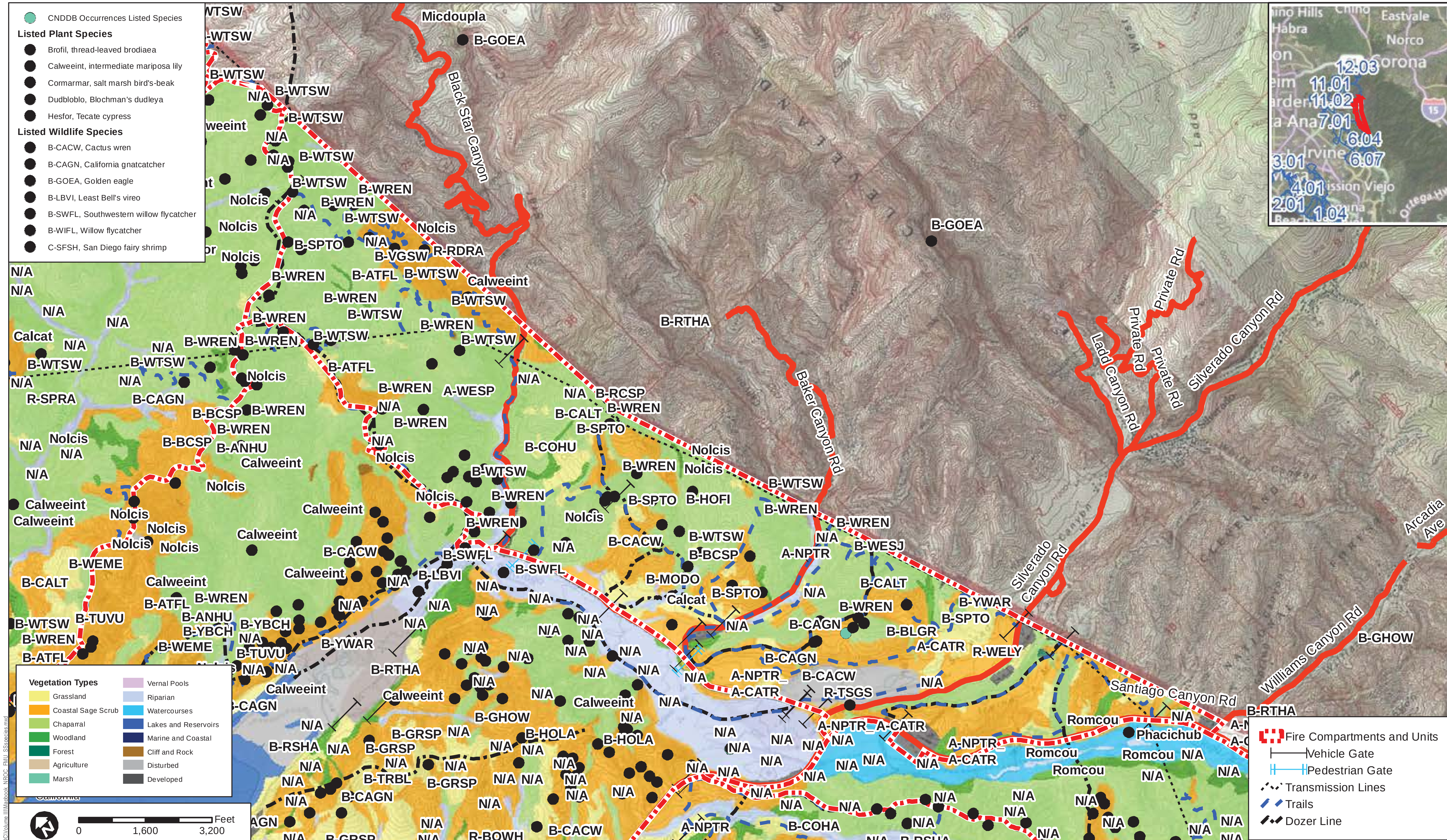

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 10.05

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 11.01</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression</td></tr>
<tr><td colspan="3">Size: 1420 acres
Special Considerations: Area consists of NCCP/NROC lands and lands protected through conservation easements that are considered to have high resource value. Unit contains large area of habitat for cactus wren. Outdoor Education Center</td><td>Access Route:
Access to FMU is better than most FMUs with Edition Ridge on the West boundary; Serrano Avenue Southwest boundary; MWD access road via gate 2143W to outdoor education center, MWD road continues as eastern boundary of FMU which is also accessible form the north from S. Hidden Canyon Road via gate 1744X.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Chaparral</td><td>336 ac.</td><td>24%</td><td></td></tr>
<tr><td>Cliff and Rock</td><td>3 ac.</td><td>0.2%</td><td></td></tr>
<tr><td>Coastal Sage Scrub</td><td>422 ac.</td><td>30%</td><td>Cactus wren, California gnatcatcher</td></tr>
<tr><td>Developed</td><td>19 ac.</td><td>1%</td><td></td></tr>
<tr><td>Disturbed</td><td>40 ac.</td><td>3%</td><td></td></tr>
<tr><td>Grassland</td><td>243 ac.</td><td>17.1%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>17 ac.</td><td>1%</td><td></td></tr>
<tr><td>Marsh</td><td>11 ac.</td><td>0.7%</td><td></td></tr>
<tr><td>Riparian</td><td>293 ac.</td><td>21%</td><td>least Bell's vireo, southwestern willow flycatcher, white-tailed kite</td></tr>
<tr><td>Woodland</td><td>36 ac.</td><td>3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4">Known sensitive species based on stakeholder's database: Coastal California gnatcatcher, cactus wren, Red diamond rattlesnake, Red-shouldered hawk, Many-stemmed dudleya Intermediate mariposa lily</td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 11.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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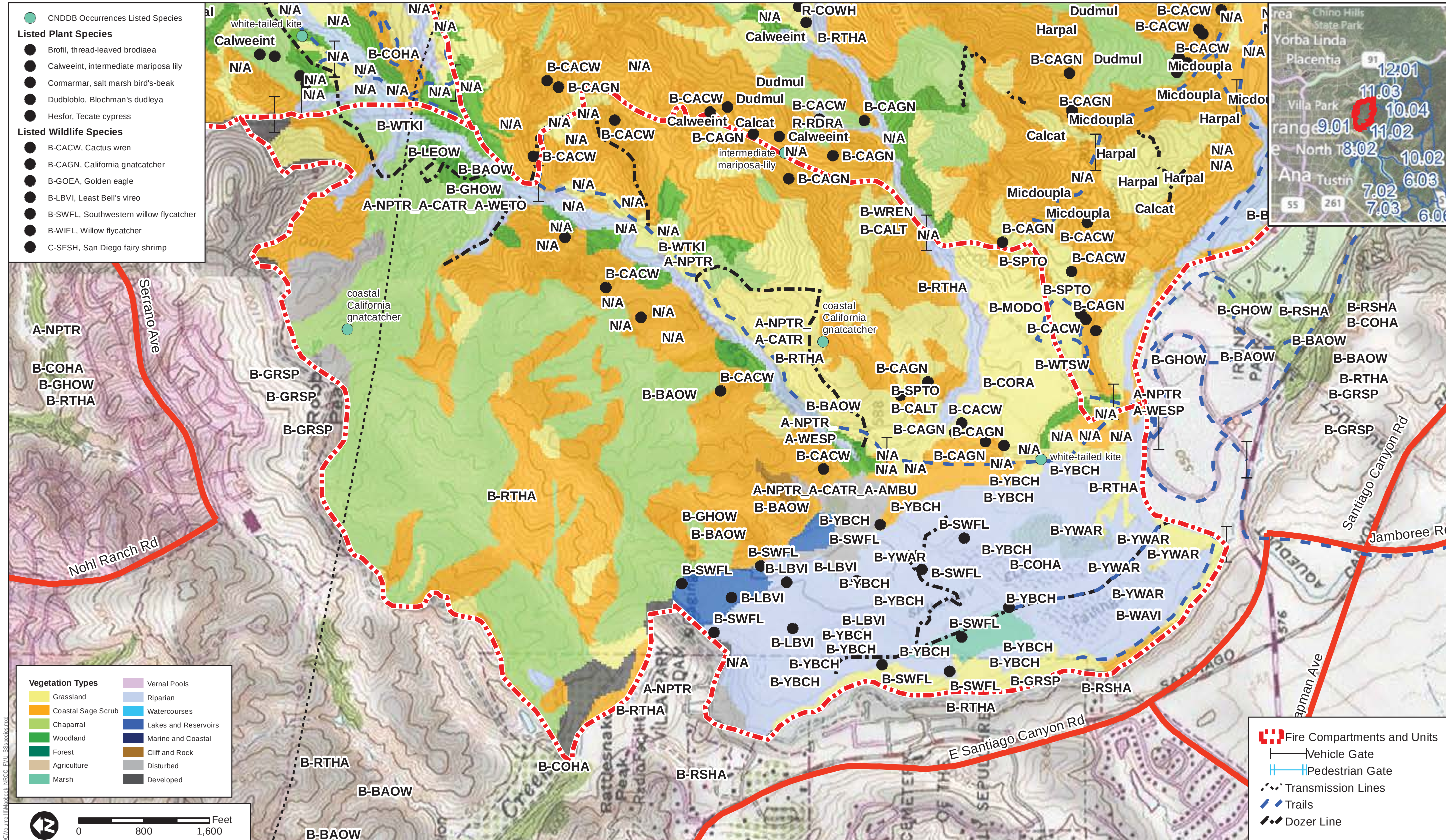

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7108-01

SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 11.01

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FIRE MANAGEMENT UNIT 11.02			
FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 1849 acres Special Considerations: Area consists of lands protected through conservation easements that are considered to have high resource value. Southern California Edison power lines border unit on the north			Access Route: Access to FMU is provided by Edison transmission line road (Upper Blind Canyon Road) via gate 1844X in the north, MWD access road along ridgeline on the west, SR 241 on the east, and Regional Park roads/MWD access on the south; access to the middle portion of the FMU is very restricted with no roads. Numerous locked gates in southern portion of FMU.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	362 ac.	20%	Intermediate mariposa lily
Cliff and Rock	1 ac.	0.1%	
Coastal Sage Scrub	1086 ac.	59%	Cactus wren, California gnatcatcher, intermediate mariposa lily
Developed	0.0001 ac.	0.001%	
Grassland	311 ac.	17%	intermediate mariposa lily, San Diego fairy shrimp
Riparian	54 ac.	3%	
Woodland	35 ac.	2%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: San Diego fairy shrimp, Coastal California gnatcatcher, San Diego cactus wren, Rosy boa, Red diamond rattlesnake, Red-shouldered hawk, Several sensitive species of bats, Many-stemmed dudleya, Intermediate mariposa lily, Chaparral bear-grass, Many stemmed dudleya			
Pre-Fire Activity			
Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 11.02 and implement as feasible.			
During Fire Actions			
Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect locations of cactus and San Diego Fairy shrimp from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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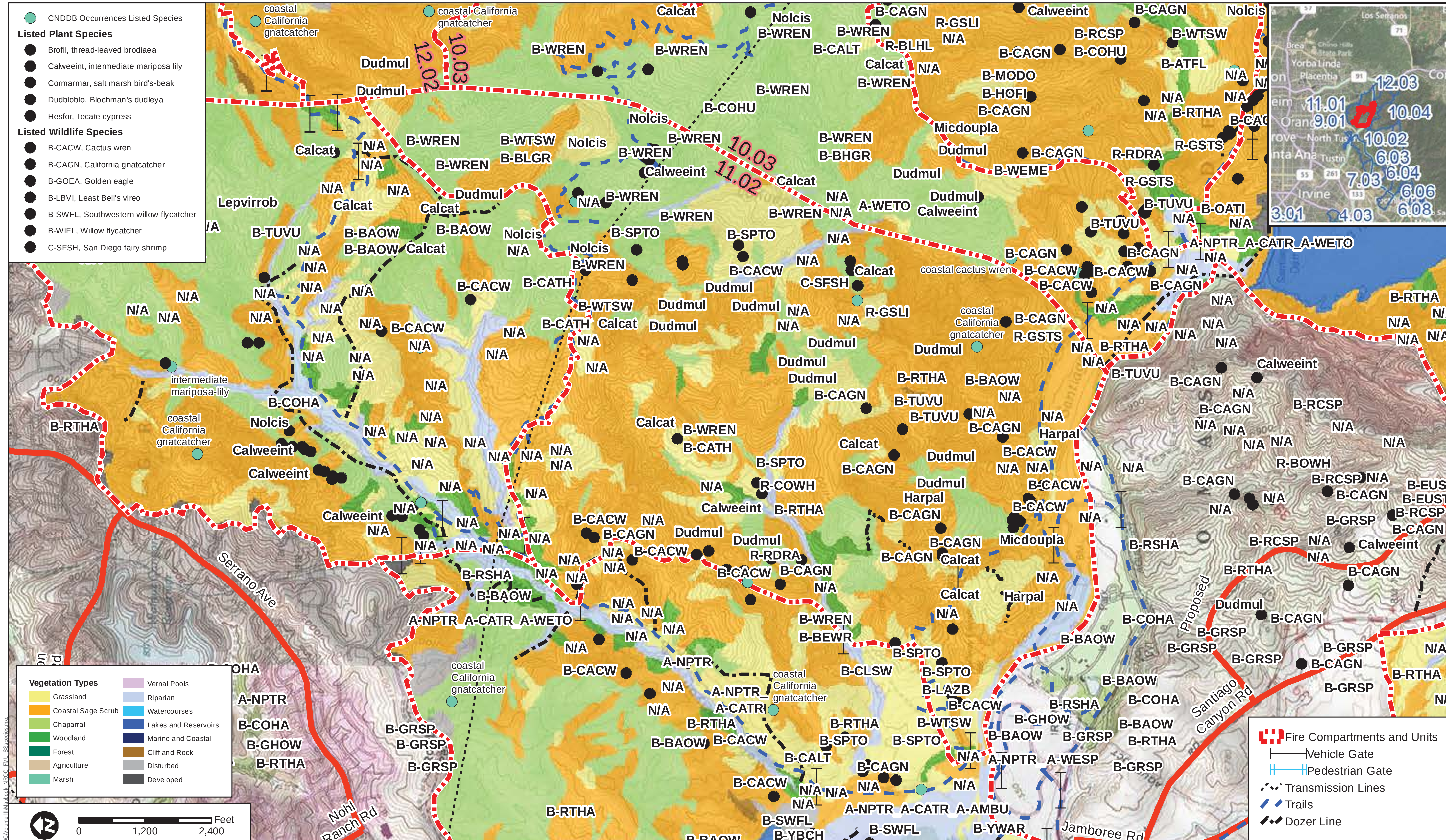

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 11.02

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FIRE MANAGEMENT UNIT 11.03

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 1616 acres Special Considerations: Area consists of NCCP/NROC lands and lands protected through conservation easements that are considered to have high resource value. Southern California Edison power lines cross southern edge of unit			Access Route: Access to FMU is better than most FMUs; occurs along boundary lines at MWD access road (southwest), Windy Ridge Road, through the middle of the FMU, Jeep trail in the northern half of the FMU; SR 241 on eastern edge, horse trail and Blue Sky Way along western edge.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	654 ac.	40%	Intermediate mariposa lily
Cliff and Rock	1 ac.	0.1%	
Coastal Sage Scrub	581 ac.	36%	Cactus wren, California gnatcatcher, Chaparral nolina, intermediate mariposa lily
Developed	14 ac.	1%	
Disturbed	27 ac.	2%	
Grassland	212 ac.	13%	
Riparian	84 ac.	5%	White-tailed kite
Woodland	43 ac.	3%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: Coastal California gnatcatcher, San Diego cactus wren, Rosy boa, Red diamond rattlesnake, Red-shouldered hawk, Several sensitive species of bats, Many-stemmed dudleya, Intermediate mariposa lily, Chaparral bear-grass, Many stemmed dudleya			
Pre-Fire Activity			
Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 11.03 and implement as feasible. Chaparral nolina is a strong fire follower, no action needed for this species.			
During Fire Actions			
Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect locations of cactus and erosion into drainage occupied by arroyo toad using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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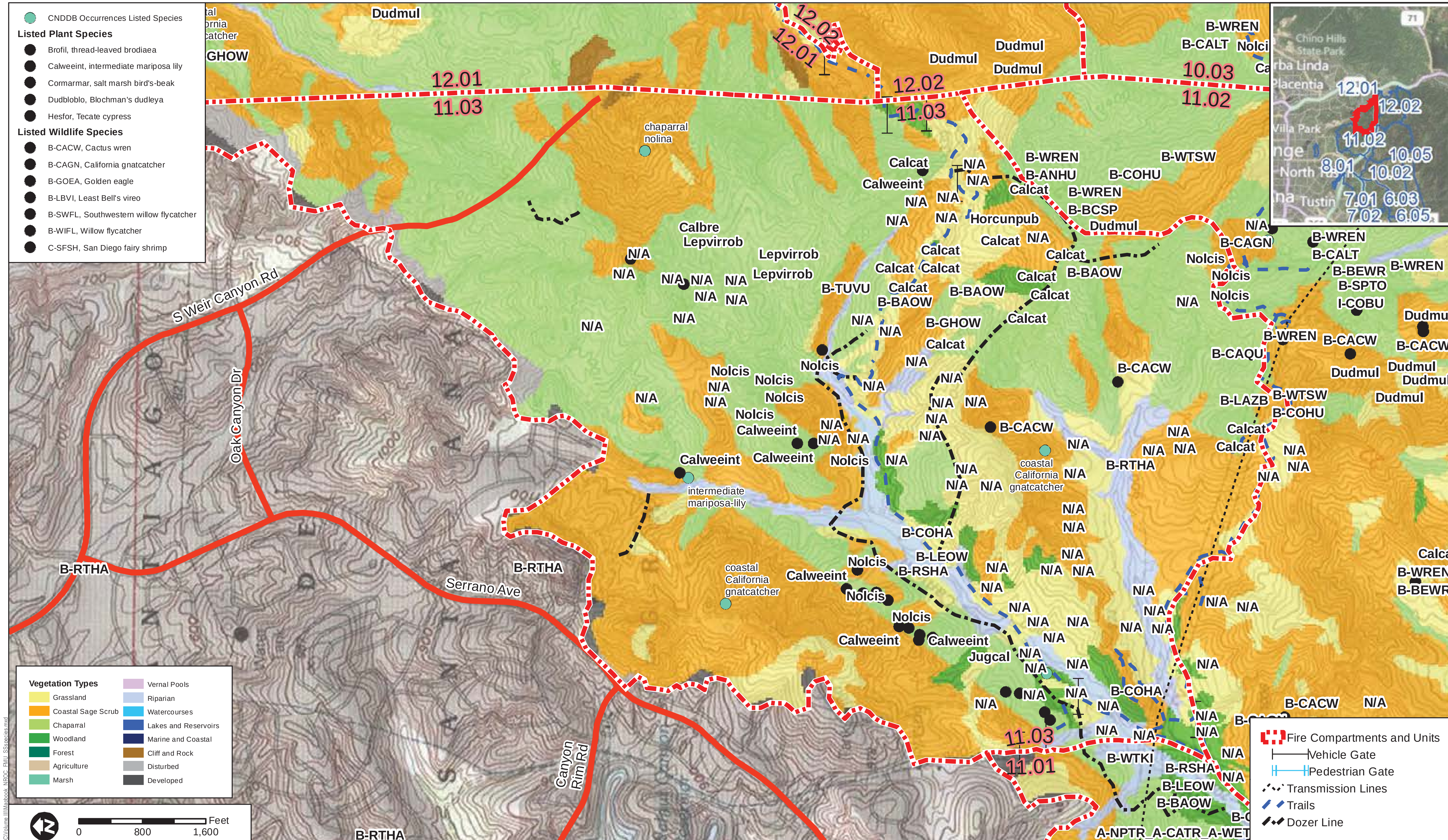

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 11.03

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FIRE MANAGEMENT UNIT 12.01

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 675 acres Special Considerations: western boundary is SR 241 Eastern Transportation Corridor, will have WUI and fuel mod in northern portion, Tecate Cypress, old firebreak not maintained.			Access Route: Access to FMU occurs along a jeep trail on the eastern boundary; Jeep trail is accessed from the north on Gypsum Canyon Road and SR 91; SR 241 forms boundary on western side - neither have access to interior of FMU; constrained access to interior of FMU.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	234 ac.	35%	intermediate mariposa lily
Cliff and Rock	12 ac.	2%	
Coastal Sage Scrub	340 ac.	50%	Cactus wren, California gnatcatcher
Disturbed	0.14 ac.	0.001%	
Grassland	71 ac.	11%	
Riparian	18 ac.	3%	
Woodland	0.25 ac.	0.01%	
Sensitive Environmental Resources			
Known sensitive species based on stakeholder's database: Tecate Cypress			
Pre-Fire Activity			
Avoid fire suppression activities which can be harmful to intermediate mariposa lily; intermediate mariposa lily is threatened by frequent fires. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 12.01 and implement as feasible.			
During Fire Actions			
Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect locations of cactus from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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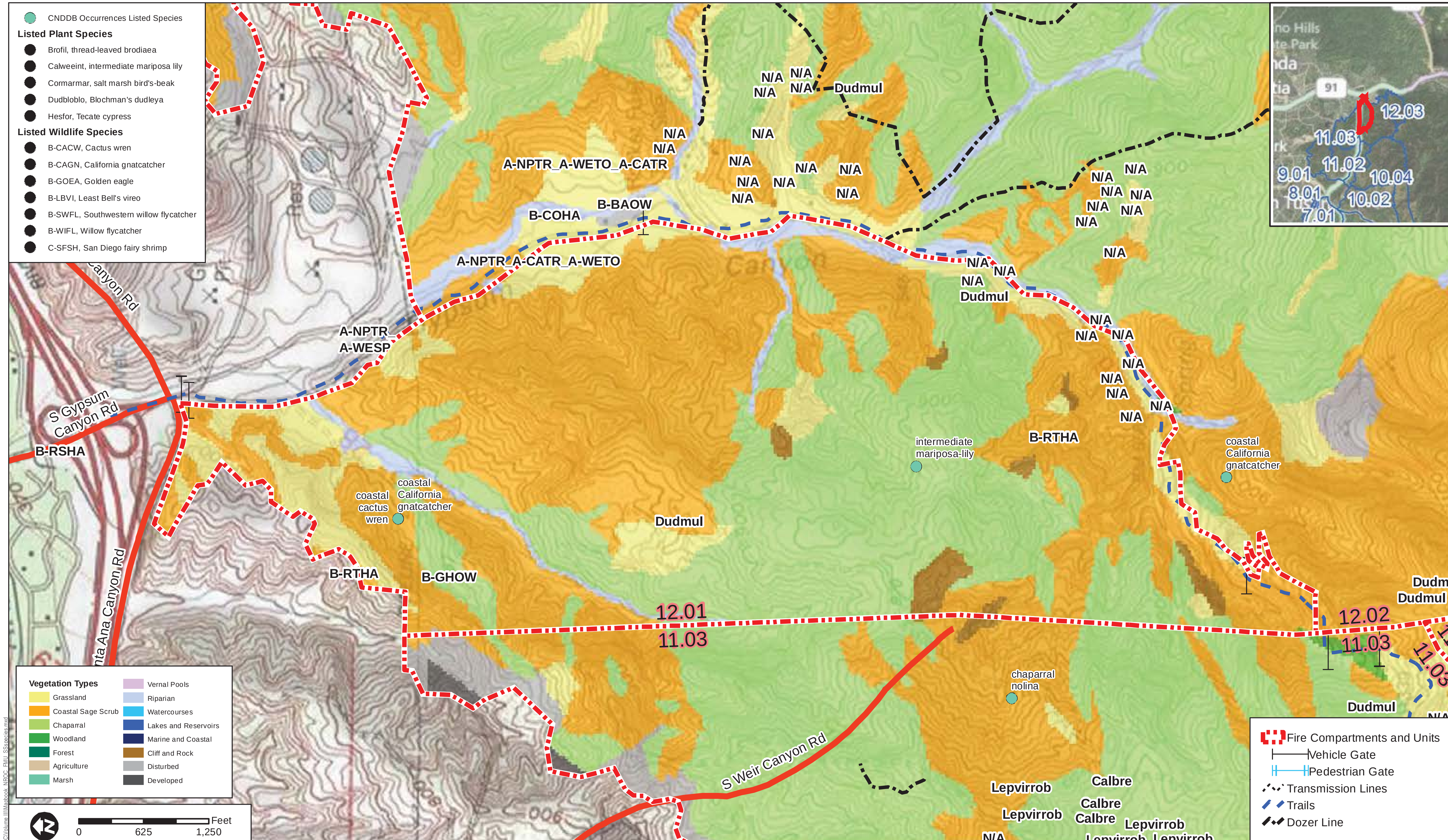

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 12.01

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FIRE MANAGEMENT UNIT 12.02

FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression

Size: 2048 acres
Special Considerations: Eastern edge, rock quarry to north of FMU is being reclaimed, OCFA maintains roads for Southern California Edison, Tecate Cypress

Access Route:
Access to FMU occurs along North Windy Ridge Road on eastern and southern FMU boundary and along a jeep trail on the western boundary; north accessible on dirt roads on old Quarry site; overall access is constrained on much of the FMU.

Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	1282 ac.	61%	Tecate cypress
Cliff and Rock	6 ac.	0.3%	
Coastal Sage Scrub	570 ac.	27%	Braunton's milk-vetch, California gnatcatcher
Disturbed	26 ac.	1%	
Forest	65 ac.	3%	
Grassland	110 ac.	5%	intermediate mariposa lily, golden eagle
Riparian	54 ac.	3%	
Woodland	0.25 ac.	0.01%	

Sensitive Environmental Resources

Known sensitive species based on stakeholder's database: Tecate Cypress

Pre-Fire Activity

Avoid fire suppression activities which can be harmful to intermediate mariposa lilyand Braunton's milk-vetch; intermediate mariposa lily is threatened by frequent fires. Tecate cypress is fire adapted however this stand is vulnerable to extinction from fire burning through the stand in the future if occurs sooner than 40 years. Braunton's milkvetch is a fire-adapted species. The thick seed coat requires scarification by fire or mechanical disturbance to germinate and populations have increased dramatically following wildfire events. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 12.02 and implement as feasible.

During Fire Actions

Control frequent fires where intermediate mariposa lily is located. Although Tecate cypress is fire adapted, fires occurring too frequently in Tecate cypress groves may destroy them by eliminating reproduction. Tecate cypress thickets are conducive to crown fires, which kill most trees. Fires at intervals of less than 35 to 40 years would be likely to reduce stand density and therefore, fire should be controlled to avoid the Tecate cypress stand. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.

Post-Fire Activity

Tecate cypress trees release large quantities of seed after fire. Seedling establishment occurs primarily in the first growing season following fire. Areas around the stand, if it burns, should be protected from erosion in order to protect seedlings. Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.

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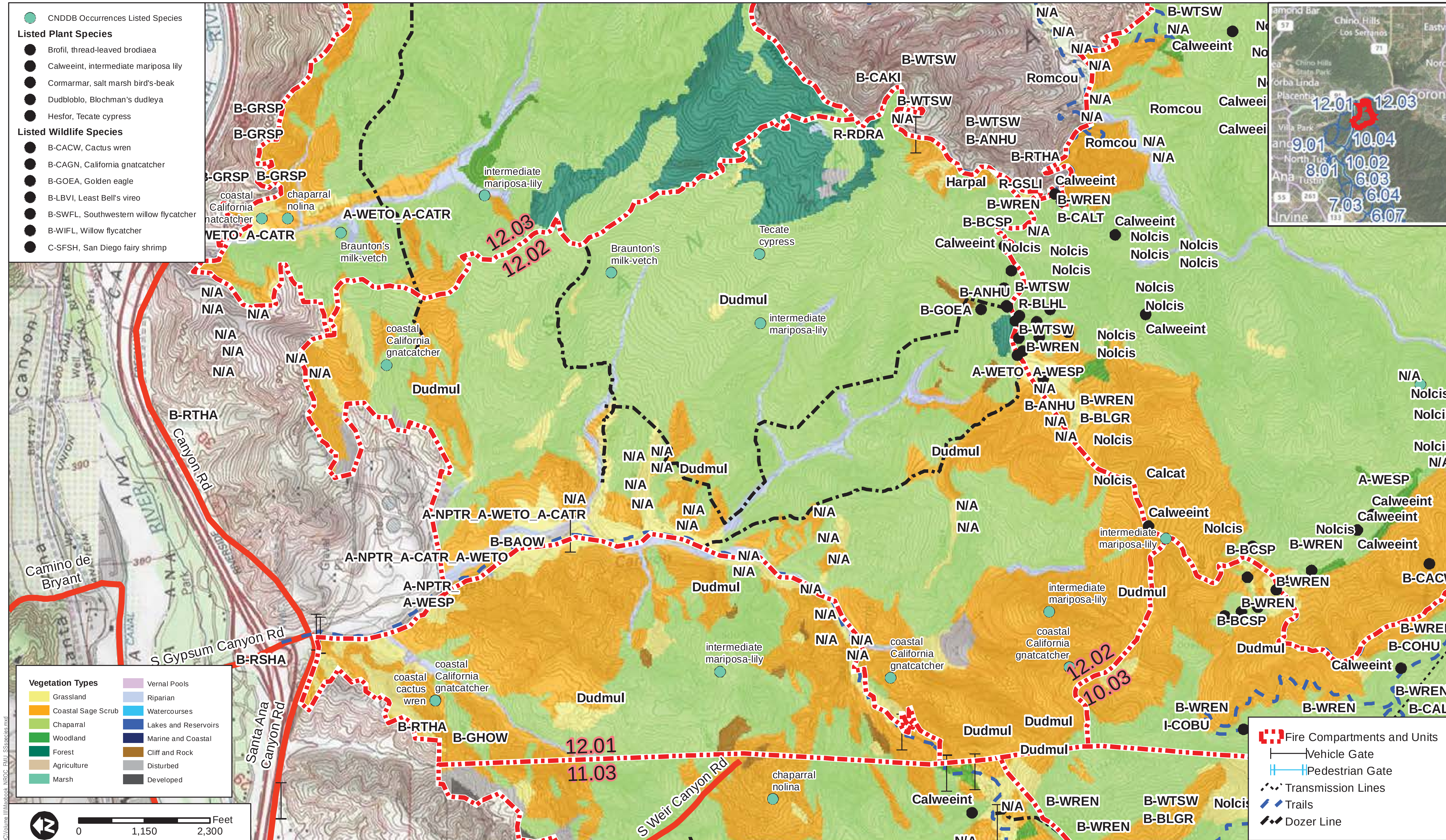

SOURCE: USGS topo 2012; Orange County 2012

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Listed Species - Fire Management Unit 12.02

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FIRE MANAGEMENT UNIT 12.03			
FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 902 acres Special Considerations: north main divide road, OCFA maintains roads for Southern California Edison			Access Route: Access to FMU occurs along North Windy Ridge Road or gated access under SR 91 from freeway ramps; no access off-road.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Chaparral	610 ac.	68%	Chaparral nolina
Coastal Sage Scrub	110 ac.	12%	Braunton's milk-vetch, California gnatcatcher
Forest	126 ac.	14%	
Grassland	15 ac.	2%	intermediate mariposa lily
Riparian	30 ac.	3%	
Woodland	11 ac.	1%	
Sensitive Environmental Resources			
Pre-Fire Activity			
Avoid fire suppression activities which can be harmful to intermediate mariposa lily and Braunton's milk-vetch; intermediate mariposa lily is threatened by frequent fires. Map locations to determine if fire suppression is warranted. Chaparral nolina is a strong fire follower, no action needed for this species. Braunton's milkvetch is a fire-adapted species. The thick seed coat requires scarification by fire or mechanical disturbance to germinate and populations have increased dramatically following wildfire events. Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 12.03 and implement as feasible.			
During Fire Actions			
Control frequent fires where intermediate mariposa lily is located. Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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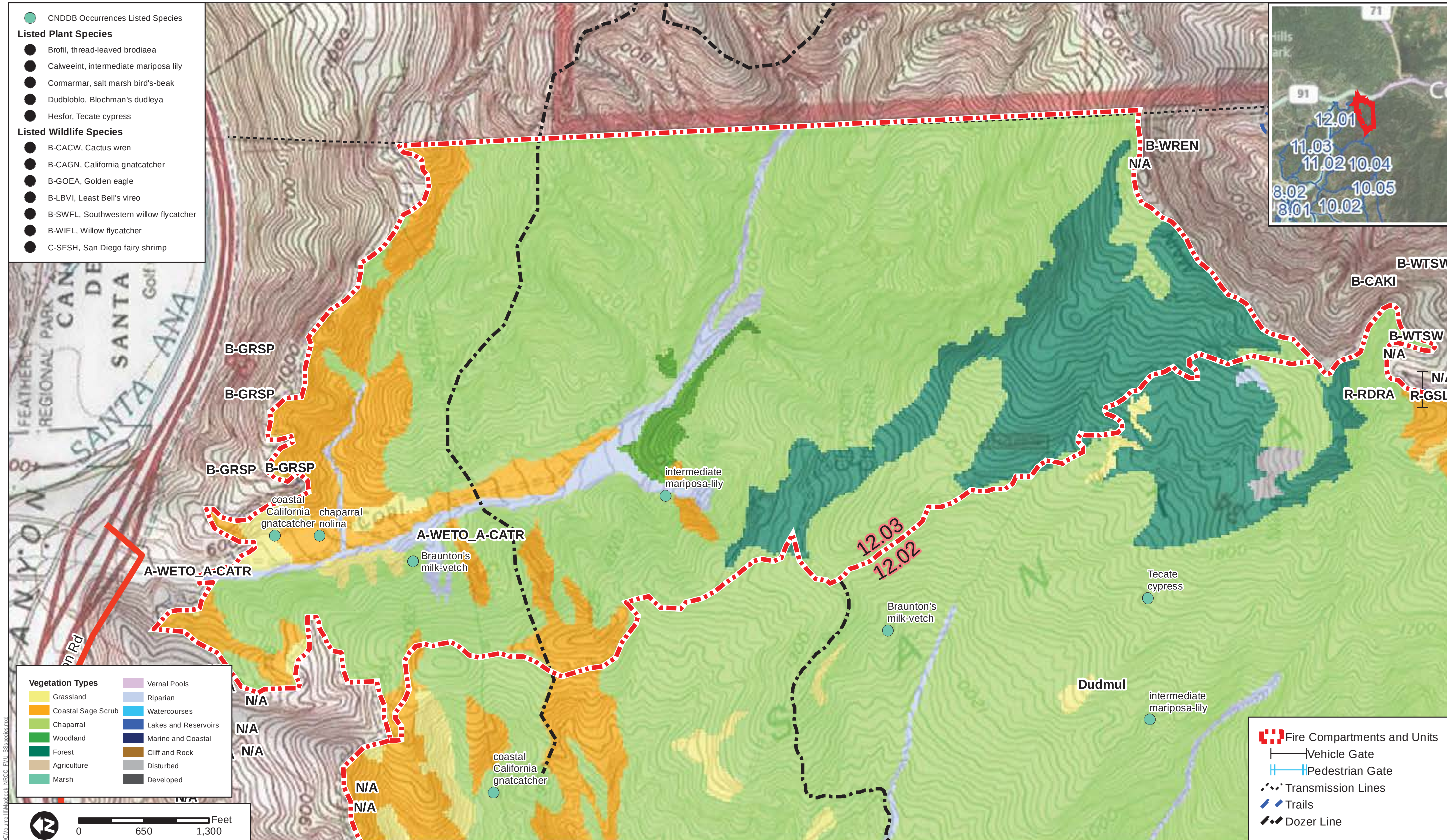

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 12.03

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<table>
<tr><th colspan="4">FIRE MANAGEMENT UNIT 13.01</th></tr>
<tr><td colspan="4">FIREFIGHTING PROTOCOL: Standard - Containment while minimizing damage from suppression</td></tr>
<tr><td colspan="3">Size: 217 acres
Special Considerations: Atypical for NROC FMU’s, urban park - heavily urbanized, channelized Santa Ana river to west, old oil production area, WUI areas, access along Victoria, road network throughout, pond/marsh</td><td>Access Route:
FMU is bordered by Santa Ana River on west side with no access points. East side can be accessed from Placentia Avenue and Victoria Street or 19th Street along southern boundary.</td></tr>
<tr><td colspan="3">Vegetation (fuel) types</td><td>Listed, Fully Protected, and Narrow Endemic Species</td></tr>
<tr><td>Coastal Sage Scrub</td><td>1 ac.</td><td>1%</td><td></td></tr>
<tr><td>Developed</td><td>13 ac.</td><td>6%</td><td></td></tr>
<tr><td>Disturbed</td><td>13 ac.</td><td>6%</td><td></td></tr>
<tr><td>Grassland</td><td>153 ac.</td><td>71%</td><td></td></tr>
<tr><td>Lakes and reservoirs</td><td>2 ac.</td><td>1%</td><td></td></tr>
<tr><td>Riparian</td><td>34 ac.</td><td>16%</td><td></td></tr>
<tr><td>Watercourses</td><td>0.8 ac.</td><td>0.3%</td><td></td></tr>
<tr><td colspan="4">Sensitive Environmental Resources</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td colspan="4">Pre-Fire Activity</td></tr>
<tr><td colspan="4">Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 13.01 and implement as feasible.</td></tr>
<tr><td colspan="4">During Fire Actions</td></tr>
<tr><td colspan="4">Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.</td></tr>
<tr><td colspan="4">Post-Fire Activity</td></tr>
<tr><td colspan="4">Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.</td></tr>
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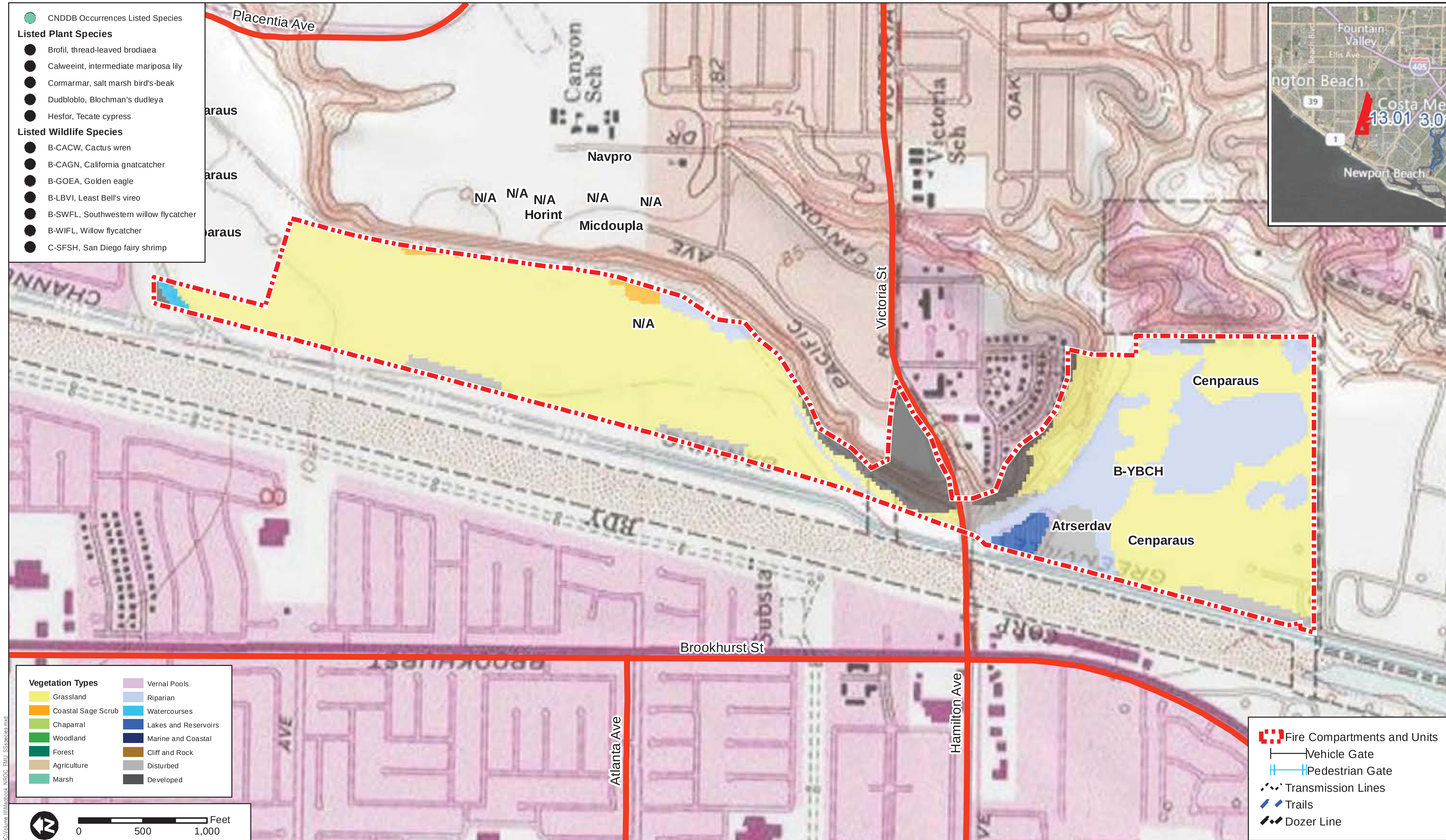

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 13.01

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FIRE MANAGEMENT UNIT 14.01			
FIREFIGHTING PROTOCOL: Assertive – High Risk, aggressive suppression			
Size: 334 acres Special Considerations: WUI to west and south, outlying FMU, agricultural lands to eastern edge			Access Route: Access is off Golden Lantern via connector streets. Oso Rancho Capistrano Trail is at the east side of FMU.
Vegetation (fuel) types			*Listed, Fully Protected, and Narrow Endemic Species*
Agriculture	5 ac.	1%	
Coastal Sage Scrub	55 ac.	17%	California gnatcatcher
Developed	10 ac.	3%	
Grassland	258 ac.	78%	
Riparian	4 ac.	1%	
Watercourses	2 ac.	0.5%	
Sensitive Environmental Resources			
Pre-Fire Activity			
Refer to WFMP Appendix A Fire Management Unit Hazard Assessment Recommendations for FMU 14.01 and implement as feasible.			
During Fire Actions			
Incident Command coordinates with RAFT representative, as necessary; particularly before ground disturbing activities.			
Post-Fire Activity			
Protect hillsides from erosion by using BMPs for post-fire runoff, erosion and sediment control, including straw fiber rolls, weed-free straw mulching, sand or gravel bag barriers, or similar and other BMPs as directed by the post-fire BAER or RAFT assessments.			

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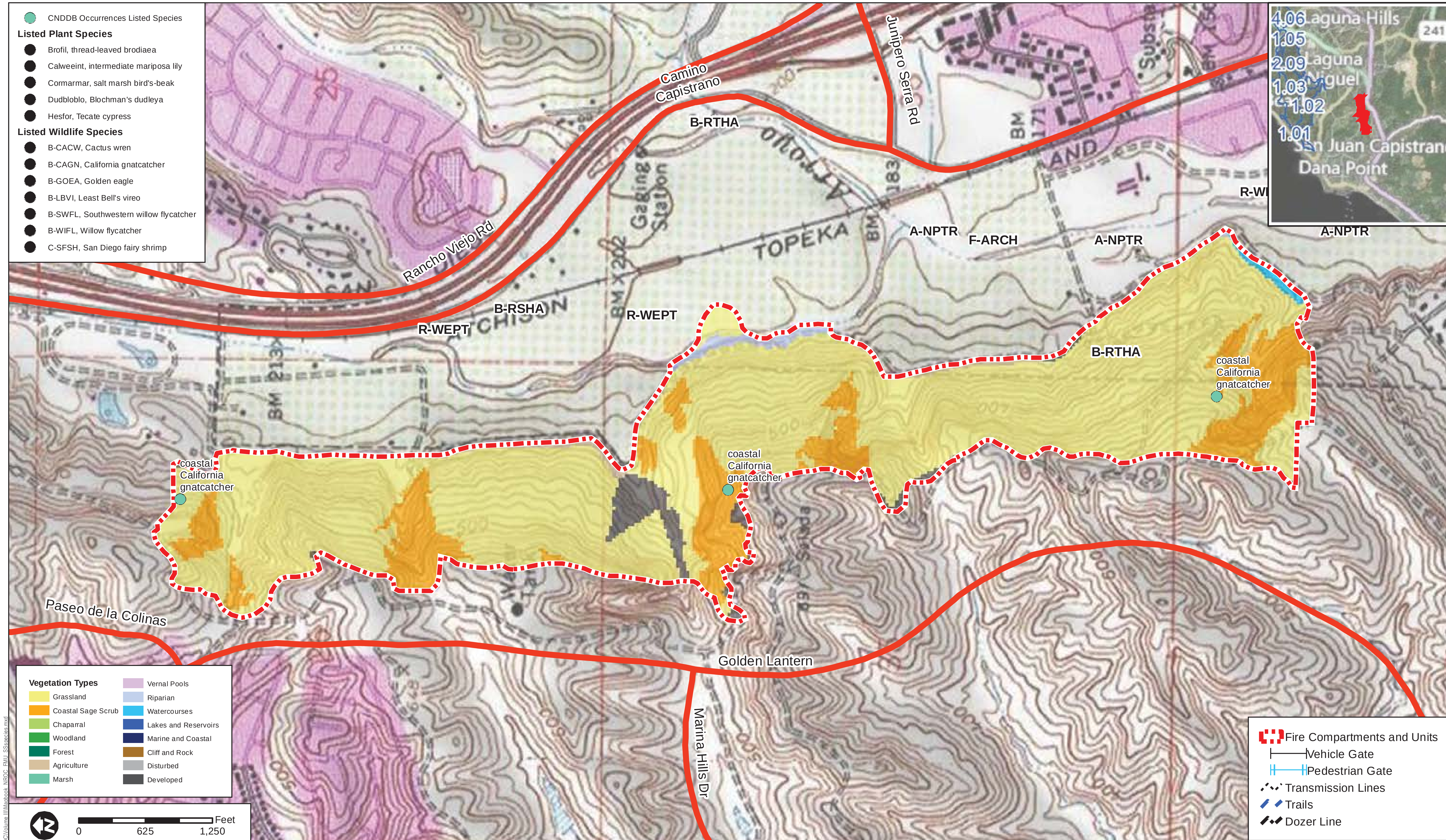

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SOURCE: USGS topo 2012; Orange County 2012

Listed Species - Fire Management Unit 14.01

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