Appendix Q

Fire Protection Plan

FINAL

Fire Protection Plan

West Campus Upper Plateau

JANUARY 2023

Prepared for:

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AMSL	Above Mean Sea Level
APN	Assessor's Parcel Number
BTU	British Thermal Unit
CAL FIRE	California Department of Forestry and Fire Protection
CBC	California Building Code
CFC	California Fire Code
CFPP	Construction Fire Prevention Plan
FAHJ	Fire Authority Having Jurisdiction
FMZ	Fuel Modification Zone
FPP	Fire Protection Plan
FRA	Federal Responsibility Area
FRAP	Fire and Resource Assessment Program
GIS	Geographic Information Systems
I-215	Interstate 215
ISO	Insurance Service Office
RCFD	Riverside County Fire Department
MARB	March Air Reserve Base
March JPA	March Joint Powers Authority
MPH	miles per hour
NFPA	National Fire Protection Association
Project	Upper West Campus Plateau Project
SRA	State Responsibility Area
USGS	United States Geological Survey
VHFHSZ	Very High Fire Hazard Severity Zone
WMWD	Western Municipal Water District
WRCC	Western Regional Climate Center
WUI	Wildland Urban Interface

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Executive Summary

This Fire Protection Plan (FPP) has been prepared for the Upper West Campus Plateau Project (Project), which proposes the development of a ring of seven Business Park parcels, three Mixed Use parcels, three Industrial parcel, and two Public Facilities parcels, and an open space area. The Project site located in unincorporated, Riverside County, California within March Joint Powers Authority (March JPA).

The Project site is currently undeveloped and is located in the western portion of the March JPA planning area, west of the current terminus at Cactus Avenue, to the east and south of the Mission Grove neighborhood, and to the north of the Orangecrest neighborhood. The Project site comprises approximately 818 acres within the March JPA planning area, located approximately half a mile west of Interstate (I) 215. The proposed development will be situated on multiple parcels, which include Assessor Parcel Numbers (APN's): 276-120-001, 276-170-007, 294-020-001, 297-080-003, 297-080-004, 297-090-001, 297-090-002/-003/-004/-007/-008/-009, and 297-100-093. The Conservation Area is located within the following 19 Assessor's Parcel Numbers: 276-120-001, 276-170-007, 294-020-001/-002, 294-040-031/-038, 297-080-002/-003/-004/-005, 297-090-002/-003/-004/-005/-006/-007/-008/-009, and 297-110-036. Primary access to the Project site is via Cactus Avenue.

The Project site is not within an area designated as a Fire Hazard Severity Zone (FHSZ) by the Riverside County General Plan Safety Element or California Department of Forestry and Fire Protection (CAL FIRE) (CAL FIRE 2007, Riverside County 2021). Although the Project site is not designated as a FHSZ, it is approximate to areas designated by the County of Riverside as Wildland Urban Interface (WUI) (Riverside County 2021) and areas designated as FHSZ (CAL FIRE 2007). Fire hazard and WUI designations are based on topography, vegetation, and weather, amongst other factors. that specific fire protection features that minimize structure vulnerability. Although the Project site is not specifically designated as a FHSZ or WUI, given the proximity to areas identified as FHSZ and WUI, this FPP recommends the incorporation of Chapter 7A of the California Building Code (CBC) and provisions for maintained fuel modification zones, amongst others to provide a redundant layering of protection for the Project and surrounding communities.

The Project site is currently undeveloped, and predominantly comprised of non-native grasslands, disturbed habitat and urban/developed land cover (i.e., roads and structures). There are several small areas of native upland vegetation within the Project site, including flat-topped buckwheat, Encelia scrub, and Riversidian sage scrub. While there are no large stands of riparian vegetation communities within the Project site, there are small stands of southern riparian forest, southern willow scrub, and mulefat scrub on the Project site. Site elevations range from 1,765 feet above mean sea level (amsl) in the central portion to 1,645 feet amsl in the northeast portion of the site. The Project area, like all of Southern California and Riverside County, is subject to seasonal weather conditions that can heighten the likelihood of fire ignition and spread, and, considering the site's terrain and vegetation, may result in a fast-moving and intense wildfire.

The FPP evaluates and identifies the potential fire risk associated with the Project's land uses and identifies recommendations for water supply, fuel modification and defensible space, access, building ignition and fire resistance, and fire protection systems, among other pertinent fire protection criteria. The purpose of this FPP is to generate and memorialize the fire safety requirements and standards of the RCFD along with Project-specific measures based on the Project site, its intended use, and its fire environment.

Fire service would be provided by the RCFD; however, the closest responding stations to the Project site would be from the City of Riverside Fire Department (RFD). The Project population and number of calculated emergency calls were evaluated for their potential to impact RFD's response capabilities from its nearest existing stations. The addition of fewer than 181 calls per year to Station 11's 1,955 call volume is considered insignificant. The closest existing fire station's response time conforms to internal response time standards for all structures within the Project site.

As determined during the analysis of the Project site and its fire environment, in its current condition, the site may include characteristics that, under favorable weather conditions, could have the potential to facilitate fire spread. Under extreme conditions, wind-driven wildfires from the northeast may cast burning embers onto the property. Once the Project is built, the onsite fire potential will be lower than its current condition due to the conversion of ignitable fuels to ignition resistant landscapes and fire safety requirements that will be implemented. The proposed structures would be built using applicable ignition-resistant materials and construction methods pursuant to the most recent County Fire and Building Codes for wildland urban interface (WUI) areas. , which are the locally amended 2019 California Fire Code and 2019 California Building Code. This would be complemented by:

- Ignition resistant landscapes,
- Perimeter fuel modification zone,
- Improved water availability, capacity, and delivery system,
- Project area firefighting resources,
- Fire department access throughout the developed areas,
- Monitored defensible space/fuel modification,
- Interior, automatic fire sprinkler systems in all structures,
- Monitored interior sprinklers in applicable structures,
- Fire response travel times based on County response guidelines, and
- Other components that would provide properly equipped and maintained structures with a high level of fire ignition resistance.

Post-wildfire assessments of saves and losses have revealed specifics of how structures and landscapes can be constructed and maintained to minimize their vulnerability to wildfire. Among the findings were:

- How construction materials and methods protect homes;
- How fire and embers contributed to ignition of structures;
- What effects fuel modification had on structure ignition;
- The benefits of fast firefighter response; and
- How much (and how reliable) water is available

These and other site-specific features were critically important to structure survivability. Following these findings over the last 20 years and continuing on an ongoing basis, the Fire and Building codes are revised, appropriately. Riverside County has adopted some of the most restrictive codes for building within WUI areas that focus on preventing structure ignition from heat, flame, and burning embers.

Fire risk analysis conducted for the Project resulted in the determination that wildfire has occurred and will likely occur near the Project area again, but the Project would provide ignition-resistant landscapes (drought-tolerant and low-fuel-volume plants) and ignition-resistant structures, along with defensible space as defined in this FPP. Based on modeling and analysis of the Project area to assess its unique fire risk and fire behavior, it was determined that the Riverside County standard of 100-foot-wide fuel modification zones (FMZs) would help considerably to set the Project's structures back from adjacent fuels. Where the Project is unable to meet the full 100-foot FMZ, there will be enhanced construction features, such as a 6-foot heat deflecting wall constructed of concrete masonry units (CMUs) between onsite structures and unmaintained open space. The Project's FMZs would be maintained in perpetuity by the Owner, Property Manager, or similarly responsible entity.

This FPP provides a detailed analysis of the Project, the potential wildfire risk, and potential impacts on the RCFD, as well as analysis on meeting or exceeding Riverside County requirements. Further, this FPP provides requirements, recommendations, and measures to reduce the risk and potential impacts to acceptable levels.

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1 Introduction

The Fire Protection Plan (FPP) has been prepared for the proposed West Campus Upper Plateau (Project) in unincorporated Riverside County, California within the March Joint Powers Authority (March JPA). The purpose of the FPP is to evaluate the potential impacts resulting from wildland fire hazards and identify the measures necessary to adequately mitigate those risks to a level consistent with County of Riverside (County) thresholds. Additionally, this FPP establishes and memorialize the fire safety requirements of the Fire Authority Having Jurisdiction (FAHJ), which is the Riverside County Fire Department (RCFD). Requirements and recommendations detailed in the FPP are based on Project site-specific characteristics, applicable code requirements, and input from the Project's applicant, planners, engineers, and architects, as well as the FAHJ.

As part of the assessment, the FPP has considered the fire risk presented by the Project site including the property location and its topography, geology, surrounding combustible vegetation (fuel types), climatic conditions, fire history, and the proposed land use. The FPP addresses: water supply, access, structural ignitability, ignition resistive building features, fire protection systems, equipment, impacts to existing emergency services, defensible space, and vegetation management. The FPP also identifies fuel modification zones and recommends the types and methods of treatment that, when implemented and maintained, are designed to protect the Project's built assets and population. The FPP also recommends measures that the developer/builders will take to reduce the probability of structural and vegetation ignition.

The Project is located within the boundaries of the RCFD and thus the FPP addresses RCFD's response capabilities and response travel time within the Project area, along with projected funding for facility improvements and fire service maintenance.

The following tasks were performed during completion of this FPP:

- Gather site-specific climate, terrain, and fuel data;
- Collect site photographs[1];
- Process and analyze the data using the latest geographic information system (GIS) technology;
- Predict fire behavior using scientifically based fire behavior models, comparisons with actual wildfires in similar terrain and fuels, and experienced judgment;
- Analyze and guide the design of proposed infrastructure;
- Analyze the existing emergency response capabilities;
- Assess the risk associated with the Project site;
- Evaluate nearby firefighting and emergency medical response resources; and
- Prepare the FPP detailing how fire risk will be mitigated through a system of fuel modification, structural ignition resistance enhancements, and fire protection delivery system upgrades.

1 Field observations were used to augment existing digital site data in generating the fire behavior models and formulating the recommendations presented in the FPP. Refer to Appendix A, Representative Site Photographs, for site photographs of existing site conditions.

1.1 Applicable Codes and Existing Regulations

The FPP demonstrates that the West Campus Upper Plateau Project will comply with applicable portions of Riverside County Fire Department Fire Prevention Standards and County Ordinances No. 460 and No. 787-8. The Project will also be consistent with the 2019 California Building Code (CBC), Chapter 7A; 2019 edition of the California Fire Code (CFC), Chapter 49; and the 2018 edition of the International Fire Code (IFC) as adopted and amended by RCFD. Additionally, RCFD references Fire Prevention Standards for informational purposes in clarifying and interpreting provisions of the CFC, National Fire Protection Association (NFPA) and California Public Resources Code (PRC). Chapter 7A of the CBC focuses primarily on preventing ember penetration into buildings, a leading cause of structure loss from wildfires. Additionally, based on the mitigation measures in the West Campus Upper Plateau Project EIR and Project design features, including this FPP, the Project is consistent with the October 2022 California Office of the Attorney General's "Best Practices for Analyzing and Mitigating Wildfire Impacts of Development Projects Under the California Environmental Quality Act.

Appropriately, based on the area's urbanization and minimal unmaintained open space areas, the Project site is not within an area designated as a Fire Hazard Severity Zone (FHSZ) by the Riverside County General Plan Safety Element or California Department of Forestry and Fire Protection (CAL FIRE) (CAL FIRE 2007, CAL FIRE 2022, Riverside County 2021). The Project site, formerly identified as a Federal Responsibility Area, was reclassified in a recent update of the Riverside County General Plan Safety Element as March Joint Powers Authority with no FHSZ designation. As the lands have been reclassified, the Project site would be considered within a State Responsibility Area, as the Project site is under Riverside County jurisdiction.

Fire hazard designations are based on topography, vegetation, and weather, among other factors with more hazardous sites, including steep terrain, unmaintained fuels/vegetation, and WUI locations. Projects situated in a High Fire Hazard Severity Zone (FHSZ) require fire hazard analysis and the application of fire protection measures to create ignition-resistant structures and defensible communities within these WUI locations. Although the Project site is not designated as a High or Very High FHSZ, it is approximate to areas designated by the County of Riverside as Wildland Urban Interface (WUI) (Riverside County 2021, CAL FIRE 2019) and areas designated as High FHSZ and Very High FHSZ by CAL FIRE (CAL FIRE 2007), as depicted in Figures 2a through 2c.

Therefore, while not required by code, the Project would meet code requirements for building in high fire hazard areas. These codes have been developed through decades of wildfire structure save and loss evaluations to determine the causes of building losses and saves during wildfires. The resulting fire codes now focus on mitigating former structural vulnerabilities through construction techniques and materials so that the buildings are resistant to ignitions from direct flames, heat, and embers, as indicated in the 2019 California Building Code (Chapter 7-A, Section 701A Scope, Purpose, and Application) (California Building Standards Commission 2019).

1.2 Project Summary

1.2.1 Location

The Project site is approximately 818 acres within the March JPA planning area, located approximately half a mile west of Interstate 215 (I-215). More specifically, the Project site is in the western portion of the March JPA planning area, west of Cactus Avenue's current terminus, to the east and south of the Mission Grove neighborhood, and to the north of the Orangecrest neighborhood in the City of Riverside, California (Figure 3-1, Project Location). The Development Area would include the extensions of Cactus Avenue, Brown Street, and Barton Street. The latitude and longitude of the approximate center of the Project site is 33.906375″ north and −117.305077″ west. The Project site is in Township 3 South, Range 4 West, including Sections 15, 16, 17, 20, 21, 22 within the Riverside East 7.5-minute quadrangle, as mapped by the U.S. Geological Survey. The Development Area is located within the following 13 Assessor's Parcel Numbers: 276-120-001, 276-170-007, 294-020-001, 297-080-003, 297-080-004, 297-090-001, 297-090-002/-003/-004/-007/-008/-009, and 297-100-093. The Conservation Area is located within the following 19 Assessor's Parcel Numbers: 276-120-001, 276-170-007, 294-020-001/-002, 294-040-031/-038, 297-080-002/-003/-004/-005, 297-090-002/-003/-004/-005/-006/-007/-008/-009, and 297-110-036.

1.2.2 Project Description

The Project consists of two components, pursuant to, and consistent with the Center for Biological Diversity Settlement Agreement: 1) the Development Area (the Specific Plan Area, herein referred to as the Development Area), and 2) the Conservation Easement. Additionally, the existing Eastern Municipal Water District water tank located north of the Development Area would be assigned a General Plan land use designation of Public Facilities; no physical changes to this water tank would occur. The Development Area would be comprised of 65.32 acres of Business Park land use, 143.31 acres of Industrial land use, 42.22 acres of Mixed-Use land use, 2.84 acres of Public Facilities land use, 78.00 acres of Parks, Recreation and Open Space land use, and 37.91 acres of Circulation land use. The Conservation Easement would be 445.43 acres.

1.2.3 Current Land Use

Existing development within the Project site consists of a water tower, an existing public facility, paved and dirt access roads, and 16 bunkers that were previously used for munitions storage by the Air Force prior to March AFB's realignment in 1993. All of the bunkers are currently used by Pyro Spectaculars for the storage of fireworks. While the Development Area encompasses existing development and previously disturbed land, the Conservation Area primarily consists of open space and undeveloped land.

The Project site is surrounded by residential uses to the north, west, and south; the Meridian West industrial project, located within the March JPA planning area, to the east; and two new industrial buildings built by Exeter, located in Riverside County, to the east and north. The residential uses to the north and west are part of the Mission Grove neighborhood in the City of Riverside. The residential uses to the south are part of the Orangecrest neighborhood in the City of Riverside. The closest schools to the Project site, Benjamin Franklin Elementary School and Amelia Earhart Middle School, are located south of the Project site in the Orangecrest neighborhood. The Benjamin Franklin Elementary School is located approximately 0.8 miles south of the Project site and the Amelia Earhart Middle School is located approximately 1 mile south of the Project site.

The parcels immediately to the east of the Project site are designated as Business Park (BP) and Industrial (IND). The parcels immediately to the north, west, and south of the Project site are not part of the March JPA planning area. The nearest residential area is located approximately 300 feet north of the Development Area, which is described in greater detail in Section 1.3.2.

The Project site is currently undeveloped, and predominantly comprised of non-native grasslands, disturbed habitat and urban/developed land cover (i.e., roads and structures). There are several small areas of native upland vegetation within the Project site, including flat-topped buckwheat, Encelia scrub, and Riversidian sage scrub. While there are no large stands of riparian vegetation communities within the Project site, there are small stands of southern riparian forest, southern willow scrub, and mulefat scrub on the Project site. Site elevations range from 1,765 feet above mean sea level (AMSL) in the central portion to 1,645 feet AMSL in the northeast portion of the site.

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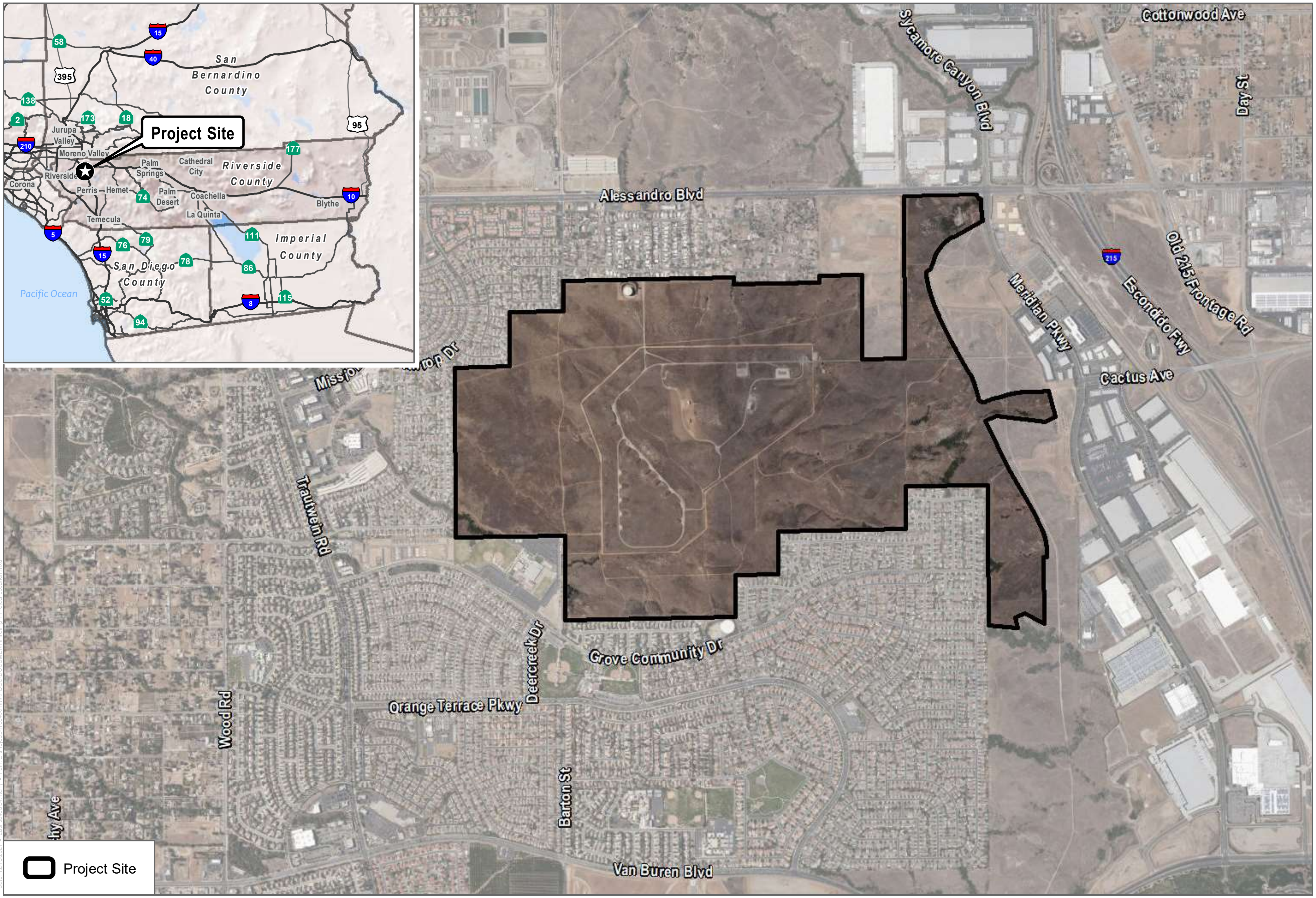

SOURCE: Bing Maps 2021

DUDEK

0 1,000 2,000 Feet

FIGURE 1

Project Location

Fire Protection Plan for West Campus Upper Plateau Project

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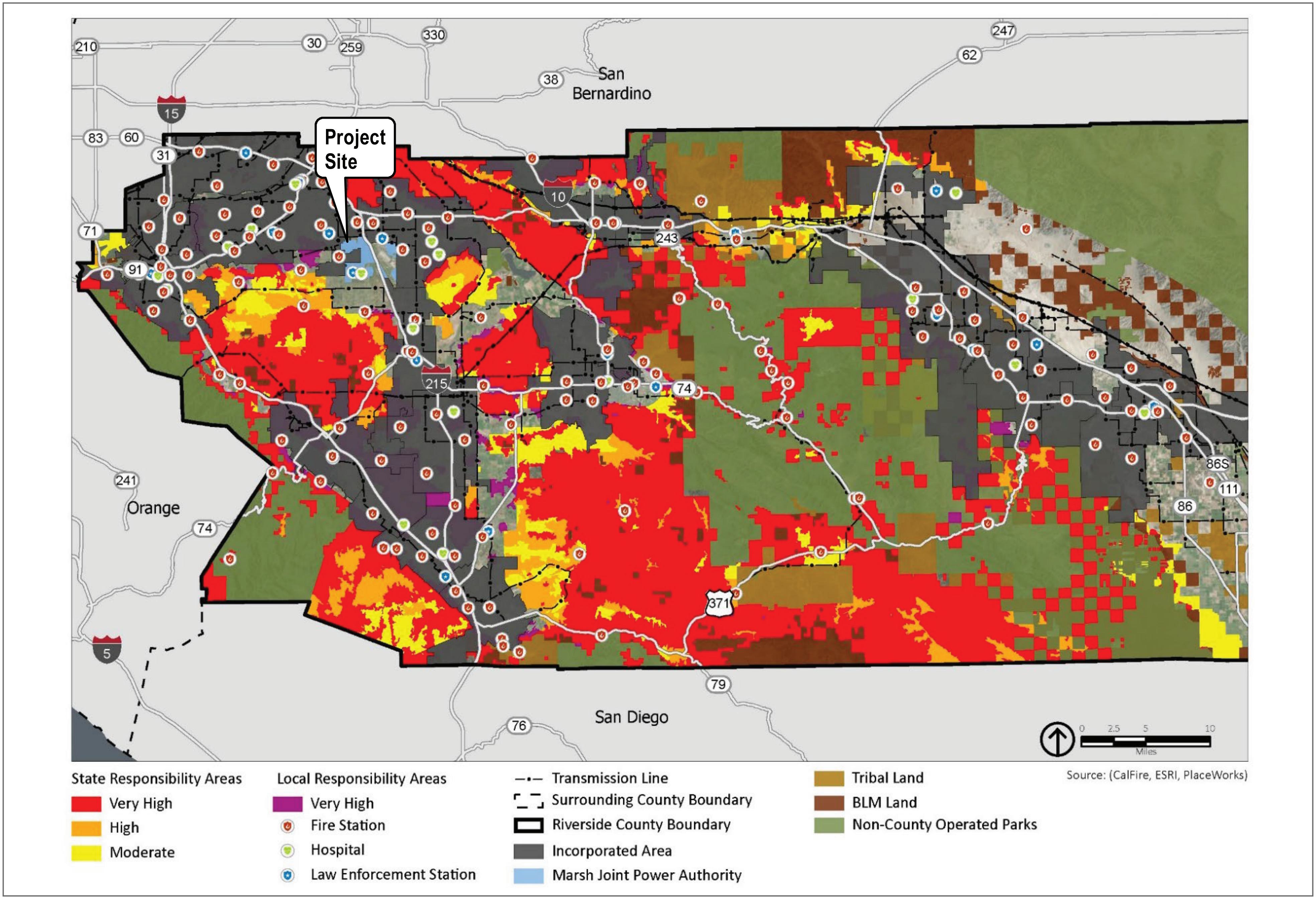

SOURCE: County of Riverside 2021

DUDEK

FIGURE 2a

Fire Hazard Severity Zone – Riverside County

Fire Protection Plan for West Campus Upper Plateau Project

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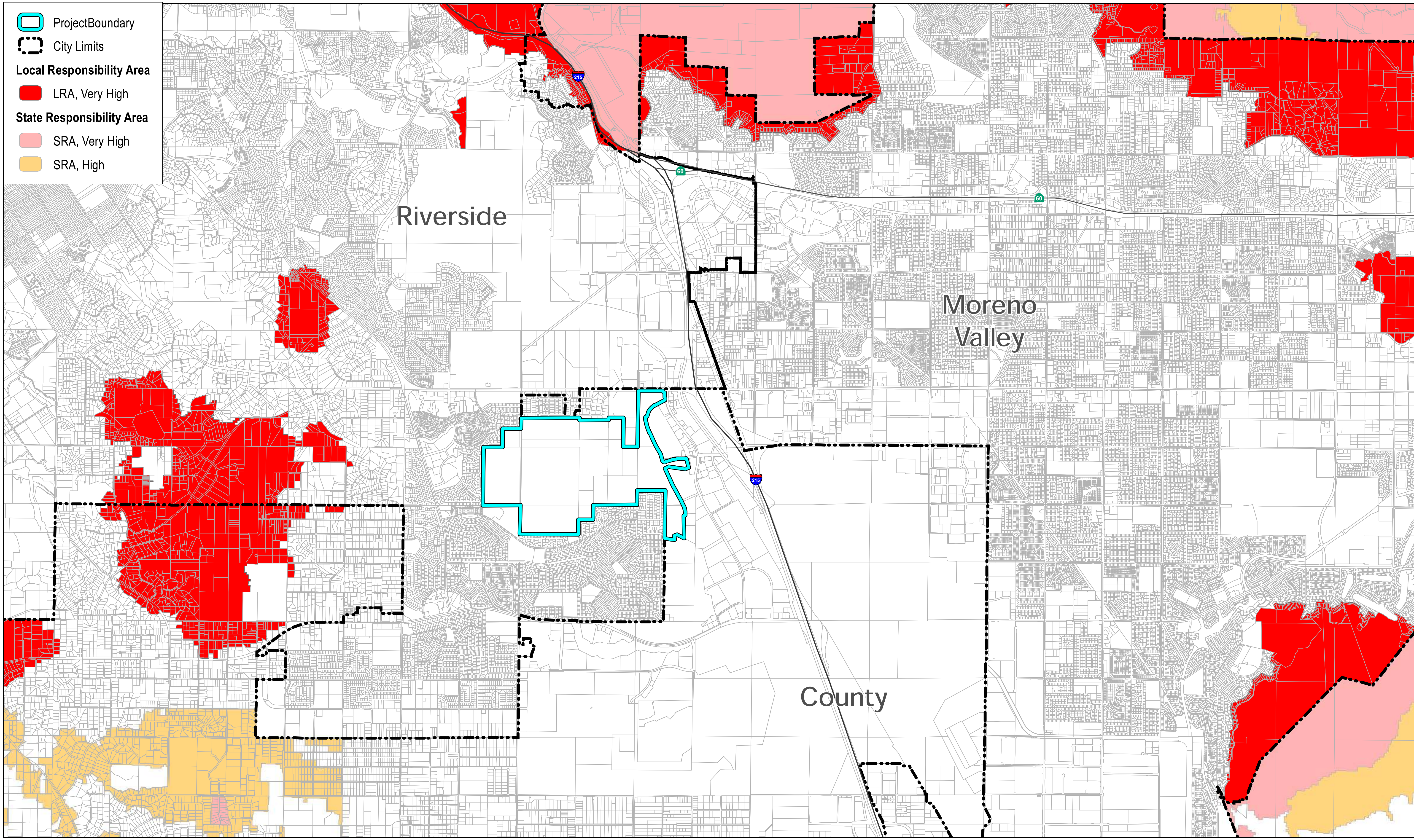

Document Path: Z:\Projects\j1364001\MAPDOC\DOCUMENT\Fire\Fig 2b CALFIRE Fire Hazard Severity Zone.mxd

SOURCE: PARCELS- RIVERSIDE COUNTY GIS; FIRE DATA- CALFIRE

DUDEK

0 2,000 4,000 Feet

FIGURE 2b

Fire Hazard Severity Zones - CAL FIRE

Fire Protection Plan for West Campus Upper Plateau Project

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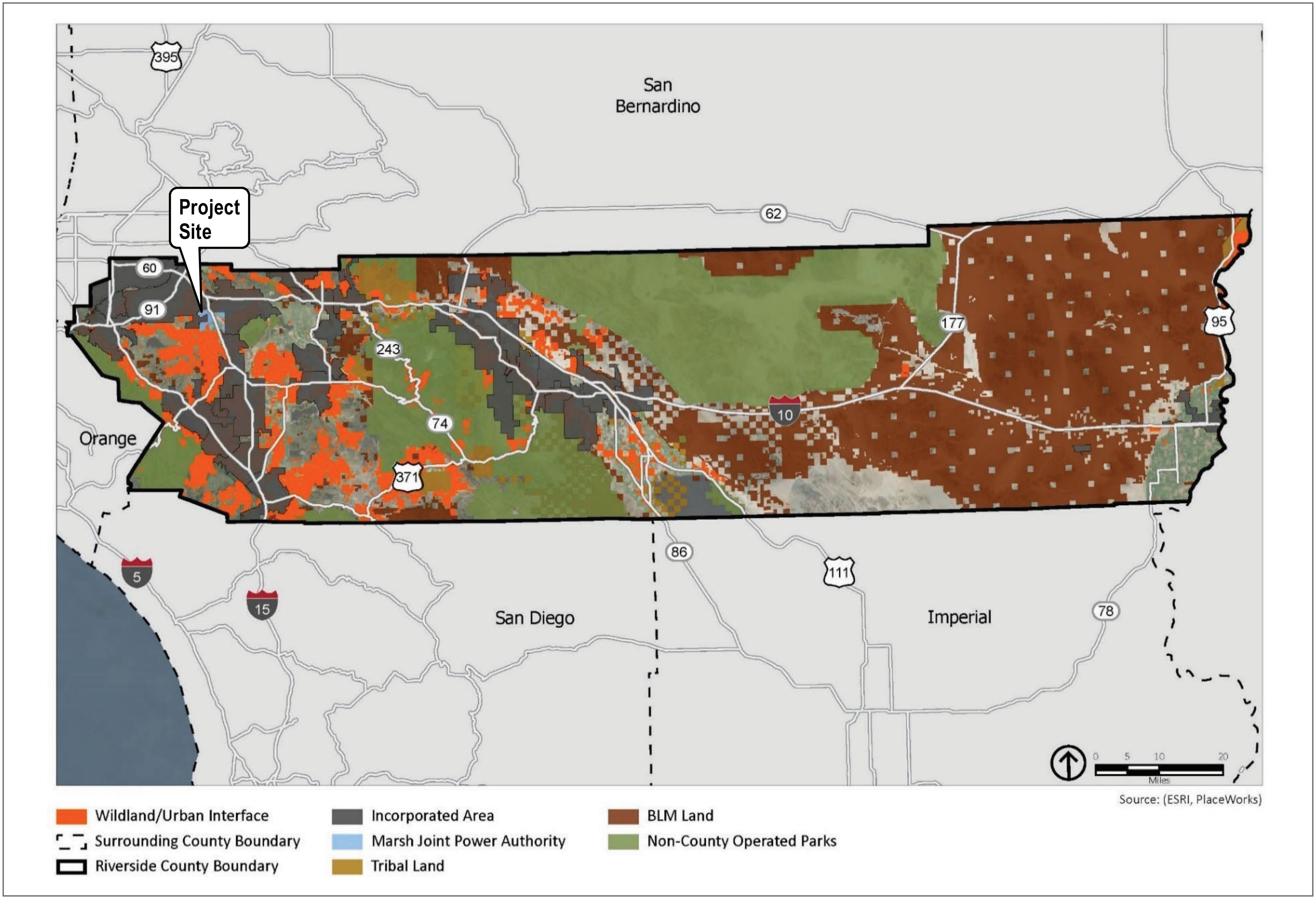

SOURCE: County of Riverside 2021

FIGURE 2c

Wildland Urban Interface – Riverside County

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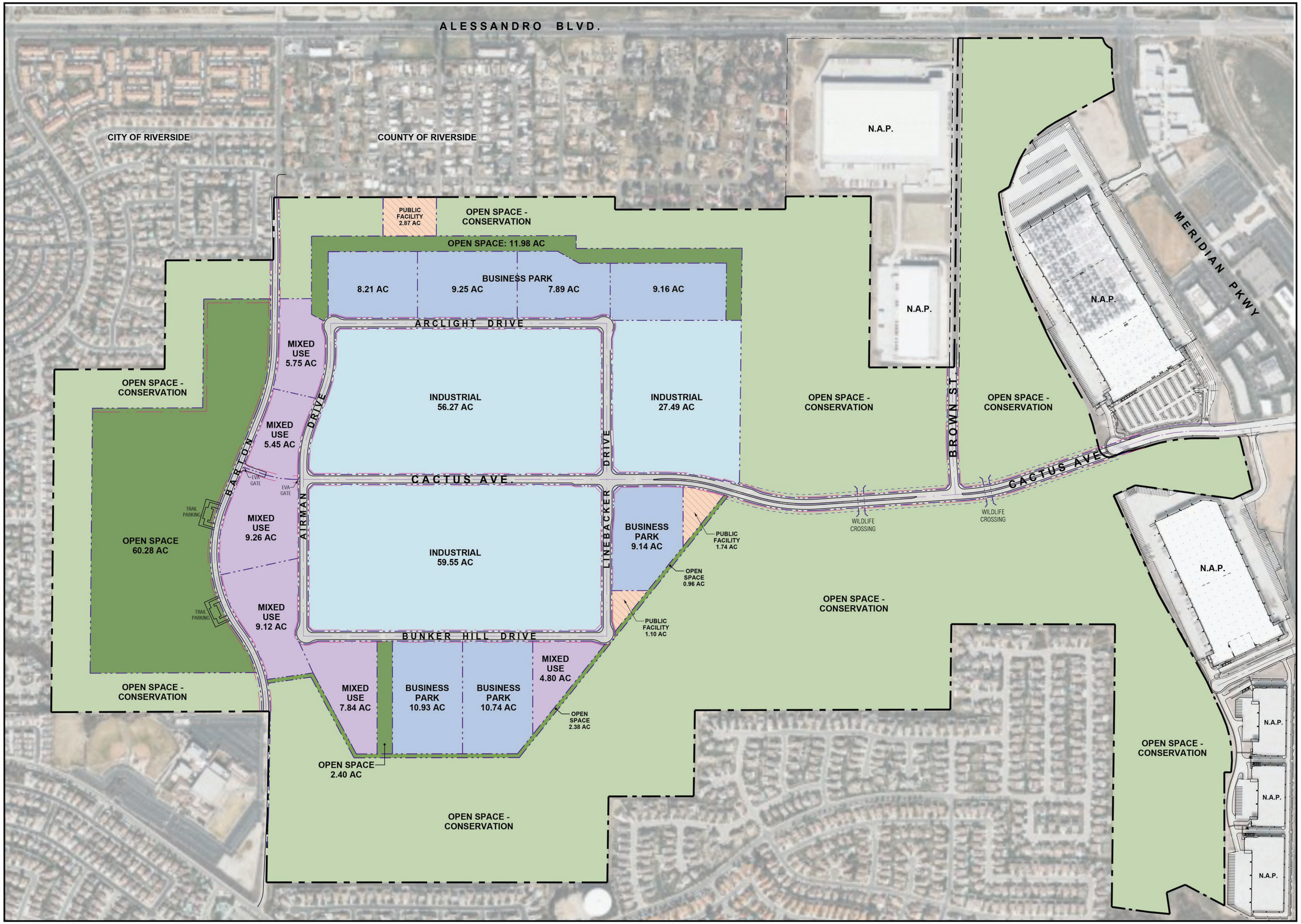

LAND USE LEGEND

MIXED USE:	42.22 AC
BUSINESS PARK:	65.32 AC
INDUSTRIAL:	143.31 AC
STREETS:	37.91 AC
PUBLIC FACILITIES:	2.84 AC
OPEN SPACE:	78.00 AC
NET DEVELOPABLE:	369.60 AC
PUBLIC FACILITY - EXISTING	2.87 AC
OPEN SPACE- CONSERVATION	445.43 AC
GROSS ACREAGE:	817.90 AC

SOURCE: RGA 2022

DUDEK

0 500 1,000 Feet

FIGURE 3

Project Site Plan

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2 Project Site Risk Analysis

2.1 Environmental Setting and Field Assessment

After review of available digital Study Area information, including topography, vegetation types, fire history, and the Project's Development Footprint, a Dudek Fire Protection Planner conducted a Project site evaluation on November 16, 2021, in order to confirm/acquire Project site information, document existing site conditions, and to determine potential actions for addressing the protection of the Project's structures. While on-site, Dudek's Fire Planner assessed the area's topography, natural vegetation, and fuel loading, surrounding land use, and general susceptibility to wildfire. Among the field tasks that were completed included:

- Topography evaluation;
- Vegetation/fuel assessments;
- Photograph documentation of the existing condition;
- Confirmation/verification of hazard assumptions;
- Off-site, adjacent property fuel and topography conditions;
- Surrounding land use confirmations;
- Necessary fire behavior modeling data collection;
- Ingress/egress documentation;
- Nearby Fire Station reconnaissance.

Study Area photographs were collected (refer to Appendix A, *Representative Site Photographs*), and fuel conditions were mapped using aerial images. Field observations were utilized to augment existing site data in generating the fire behavior models and formulating the requirements and recommendations detailed in the FPP.

2.2 Site Characteristics and Fire Environment

Fire environments are dynamic systems and include many types of environmental factors and site characteristics. Fires can occur in any environment where conditions are conducive to ignition and fire movement. Areas of naturally vegetated open space are typically comprised of conditions that may be favorable to wildfire spread. The three major components of the fire environment are topography, vegetation (fuels), and climate. The state of each of these components and their interactions with each other determines the potential characteristics and behavior of a fire at any given moment. It is important to note that wildland fire may transition to urban fire if structures are receptive to ignition. Structure ignition depends on a variety of factors and can be prevented through a layered system of protective features including fire-resistive landscapes directly adjacent to the structure(s), application of known ignition resistive building materials and methods, and suitable infrastructure for firefighting purposes. Understanding the existing wildland vegetation and urban fuel conditions on and adjacent to the site is necessary to understand the potential for fire within and around the Project site.

The following sections discuss the characteristics of the Project area and the surrounding region. The intent of evaluating conditions at a macro-scale provides a better understanding of the regional fire environment, which is not constrained by property boundary delineations.

2.2.1 Topography

Topography influences fire risk by affecting fire spread rates. Typically, steep terrain results in faster fire spread up-slope and slower spread down-slope. Terrain that forms a funneling effect, such as chimneys, chutes, or saddles on the landscape can result in especially intense fire behavior. Conversely, flat terrain tends to have little effect on fire spread, resulting in fires that are driven by vegetation and wind.

The topography of the Project site consists of low rolling hills, with undulating topography. Site elevations range from 1,765 feet above mean sea level (AMSL) in the central portion to 1,645 feet AMSL in the northeast portion of the site. Drainage is generally from the elevated central portion of the site to the perimeters, through natural drainage features incised into the rolling hills.

Topographic features that may facilitate fire spread are the slope and canyon alignments, which may serve to funnel or channel winds, thus increasing their velocity and potential for influencing wildfire behavior. From a regional perspective, the alignment of tributary canyons and dominant ridges is conducive to channeling and funneling wind, thereby increasing the potential for more extreme wildfire behavior in the region.

2.2.2 Climate

The Project site, like much of Southern California, is influenced by the Pacific Ocean and a seasonal, migratory subtropical high-pressure cell known as the “Pacific High.” Wet winters and dry summers with mild seasonal changes characterize the Southern California climate. This climate pattern is occasionally interrupted by extreme periods of hot weather, winter storms, or dry, easterly Santa Ana winds. The average high temperature for the Project area is approximately 79.5°F, with an average temperature in the summer and early fall months (June-September) of 91.6°F. July and August are typically considered the hottest months of the year. The area is considered to be a semi-arid climate. Annual precipitation typically averages approximately 10 inches annually with the wettest months being January and February (Western Regional Climate Center, 2021).

From a regional perspective, the fire risk in southern California can be divided into three distinct “seasons” (Nichols et al. 2011, Baltar et al 2014). The first season, the most active season and occurring during the summer months, extends from late May to late September. This is followed by an intense fall season characterized by fewer but larger fires. This season begins in late September and continues until early November. The remaining months, November to late May occur during the mostly dormant, winter season. Mensing et al. (1999) and Keeley and Zedler (2009) found that large fires in the region consistently occur at the end of wet periods and the beginning of droughts. Typically, the highest fire danger in southern California coincides with Santa Ana winds. The Santa Ana wind conditions are a reversal of the prevailing southwesterly winds that usually occur on a region-wide basis near the end of fire season during late summer and early fall. They are dry, warm winds that flow from the higher desert elevations in the east through the mountain passes and canyons. As they converge through the canyons, their velocities increase. Localized wind patterns on the Project site are strongly affected by both regional and local topography.

2.2.3 Vegetation

The Project site is currently undeveloped, and predominantly comprised of non-native grasslands, disturbed habitat and urban/developed land cover (i.e., roads and structures). There are several small areas of native upland vegetation within the Project site, including flat-topped buckwheat, Encelia scrub, and Riversidian sage scrub. While there are no large stands of riparian vegetation communities within the Project site, there are small stands of southern riparian forest, southern willow scrub, and mulefat scrub on the Project site. The vegetation cover types were assigned a corresponding fuel model for use during site fire behavior modeling. Section 3.0 describes the fire modeling conducted for the Project area.

Extensive vegetation type mapping is useful for fire planning because it enables each vegetation community to be assigned a fuel model, which is used to predict fire behavior characteristics, as discussed in Section 3.1, Fire Behavior Modeling. The Project site surface conditions generally consist of unimproved earthen terrain, with mostly low-load native grasses and grass-shrub vegetation communities. The area proposed for development and within the Project grading limits will be converted to ignition resistant landscapes, roads, structures, and landscaped vegetation following Project completion. Vegetative fuels within proposed fuel modification zones will be removed or structurally modified as a result of development, altering their current structure and species composition, irrigation and maintenance levels, resulting in a perimeter wildfire buffer.

Post-development vegetation composition proximate to the Project footprint is expected to be significantly different than current conditions. Following build-out, irrigated and thinned landscape vegetation associated with fuel modification zones (FMZ) A and B would be located in the immediate area surrounding the Project Site, extending up to 100 horizontal feet from each of the structures. Typical FMZ is 100 feet wide; however, the southern and southeastern portions of the Project site may not meet the full 100-foot FMZ. Structures adjacent to this area will receive code-exceeding, structural ignition resistive enhancements. Native and naturalized vegetation occurring within FMZ Zone C is not expected to be irrigated, although overall fuel volumes will be reduced by removing dead and dying plants, non-natives, and highly flammable species, along with thinning the remaining plants so they would not readily facilitate fire spread. To comply with RCFD requirements, the designated FMZ areas along with the site-wide landscaped areas, will be maintained on an ongoing basis.

2.2.3.1 Vegetative Fuel Dynamics

The vegetation characteristics described above are used to model fire behavior, discussed in Section 3.0 of this FPP. Variations in vegetative cover type and species composition have a direct effect on fire behavior. Some plant communities and their associated plant species express increased flammability based on plant physiology (resin content), biological function (flowering, retention of dead plant material), physical structure (bark thickness, leaf size, branching patterns), and overall fuel loading. For example, non-native grass-dominated plant communities become seasonally prone to ignition and produce lower intensity, higher spread rate fires. In comparison, sage scrub can produce higher heat intensity and higher flame lengths under strong, dry wind patterns, but does not typically ignite or spread as quickly as light, flashy grass fuels.

As described, vegetation plays a significant role in fire behavior, and is an important component of fire behavior models discussed in the report. A critical factor to consider is the dynamic nature of vegetation communities. Fire presence and absence at varying cycles or regimes disrupts plant succession, setting plant communities to an earlier state where less fuel is present for a period of time as the plant community re-initiates its succession process. In summary, high-frequency fires tend to convert shrublands to grasslands or maintain grasslands, while fire exclusion tends to convert grasslands to shrublands, over time. In general, biomass and associated fuel loading will increase over time, assuming that disturbance (fire, or grading) or fuel reduction efforts are not diligently implemented. It is possible to alter successional pathways for varying plant communities through manual alteration. This concept is a key component in the overall establishment and maintenance of the proposed fuel modification zones on-site. The Project's FMZs will consist of irrigated and maintained landscapes as well as thinned native fuel zones that will be subject to regular "disturbance" in the form of maintenance and will not be allowed to accumulate excessive biomass over time, which results in reduced fire ignition, spread rates, and intensity. Conditions adjacent to the Project's footprint (outside the fuel modification zones), where the wildfire threat will exist post-development, are classified as low to moderate fuel loads.

Variations in vegetative cover type and species composition have a direct effect on fire behavior. For example, California sagebrush scrub can produce higher heat intensity and higher flame lengths under strong, dry wind patterns, but does not typically ignite or spread as quickly as light, flashy grass fuels. The corresponding fuel models for each of these vegetation types are designed to capture these differences. Vegetation distribution throughout the Project site varies by location and topography. Areas, where the Project's Development Footprint is located, are primarily surrounded by low flame length producing grasslands.

It is possible to alter successional pathways for varying plant communities through manual alteration. This concept is a key component in the overall establishment and maintenance of the proposed FMZs for the Project site. The FMZs will consist of irrigated and maintained landscapes that will be subject to regular "disturbance" in the form of maintenance and will not be allowed to accumulate excessive biomass over time, which results in reduced fire ignition, spread rates, and intensity.

2.2.4 Fire History

Fire history is an important component of a site-specific FPP. Fire history data provides valuable information regarding fire spread, fire frequency, ignition sources, and vegetation/fuel mosaics across a given landscape. One important use for this information is as a tool for pre-planning. It is advantageous to know which areas may have burned recently and therefore may provide a tactical defense position, what type of fire burned on the Project site, and how a fire may spread.

Fire history represented in the FPP uses the California Department of Forestry and Fire Protection (CAL FIRE) Fire and Resource Assessment Program (FRAP) database. FRAP summarizes fire perimeter data dating to the late 1800s, but which is incomplete due to the fact that it only includes fires over 10 acres in size and has incomplete perimeter data, especially for the first half of the 20th century (Syphard and Keeley 2016). However, the data does provide a summary of recorded fires and can be used to show whether large fires have occurred in the Project area, which indicates whether they may be possible in the future.

According to available data from the CAL FIRE in the FRAP database, thirty-nine (39) fires have burned within 5 miles of the Project site since the beginning of the historical fire data record (CAL FIRE 2021). Recorded wildfires within 5 miles range from approximately 40 acres to approximately 5,277 acres (1960 Unnamed Fire) and the average fire size is approximately 1,197 acres. The 2017 Opera Fire (approximately 1,458 acres) and 2017 Blaine Fire (approximately 159 acres) are the most recent fires within a 5 -mile radius of the Project site. No fires have burned on the Project site. RCFD may have data regarding smaller fires (less than 10 acres) that have occurred on-site that have not been included herein. Fire history for the general vicinity of the Project site is illustrated in Appendix B, Fire History Map.

Based on an analysis of the fire history data set, specifically, the years in which the fires burned, the average interval between wildfires within 5 miles of the Project site was calculated to be less than one with intervals ranging between 0 (multiple fires in the same year) to 10 years. Based on the analysis, it is expected that there will be wildland fires within 5 miles of the Project site at least every 10 years, and on average every two years, as observed in the fire history record. Based on fire history, wildfire risk for the Project site is associated primarily with a Santa Ana wind-driven wildfire burning or spotting on-site from the north or east, although a fire approaching from the south during more typical on-shore weather patterns is possible.

2.2.5 Fire Protection Features' Beneficial Effect on Wildfire Ignition Risk Reduction

Each of the fire protection features provided as part of the code requirements or customized for this Project are based on the FPP's evaluation results. These features also have a similar positive impact on the minimization of the potential for wildfire ignitions caused by the Project and its employees and visitors to spread off-site into preserved areas by providing:

1. **Ignition resistant, planned and maintained landscape** – all Project site landscaping of common areas and fuel modification zones will be subject to strict plant types that are lower ignition plants with those closest to structures requiring irrigation to maintain high plant moistures which equates to difficult ignition. These areas are closest to structures, where ignitions would be expected to be highest, but will be prevented through these ongoing maintenance efforts.
2. **Fuel Modification Zone** – the FMZ, which would be 100 feet includes specifically selected plant species, very low fuel densities (only 30% retention of native plants in outer zones and irrigated inner zones), and ongoing maintenance, resulting in a wide buffer between the developed areas and the off-site native fuels.
3. **Annual FMZ inspections** – the developer will have a contracted, 3rd party, RCFD-approved FMZ inspector perform two inspections per year to ensure that FMZs are maintained in a condition that is consistent to the County's and FPP's requirements and would provide a benefit of a wide barrier separating wildland fuels from on-site ignitions.
4. **Ignition resistant structures** – all structures will be built to the Chapter 7A (CBC) ignition resistant requirements that have been developed and codified as a direct result of after fire save and loss assessments. These measures result in structures that are designed, built and maintained to withstand fire and embers associated with wildfires. It must be noted that the wide FMZs would not result in wildfire directly next to these structures. Structures can be built in the HFHSZs and WUI areas when they are part of an overall approach that contemplates wildfire and provides design features that address the related risk. A structure within a HFHSZ that is built to these specifications can be at lower risk than an older structure in a non-fire hazard severity zone. The ignition resistance of on-site structures would result in a low incidence of structural fires, further minimizing potential for Project-related wildfires.
5. **Interior fire sprinklers** – commercial sprinklers are designed to provide additional time for occupants to escape the structures. Sprinklers in commercial structures are also designed to provide structural protection. The common benefit of fire sprinklers is that they are very successful at assisting responding firefighters by either extinguishing a structural fire or at least, containing the fire to the room of origin and delaying flash over. This benefit also reduces the potential for an open space vegetation ignition by minimizing the possibility for structure fires to grow large and uncontrollable, resulting in embers that are blown into wildland areas. This is not the case with older existing structures in the area that do not include interior sprinklers.
6. **Fire access roads** – roads provide access for firefighting apparatus. Project roads provide code-consistent access throughout the community. Better access to wildland areas may result in faster wildfire response and continuation of the fire agencies' successful control of wildfires at small sizes.
7. **Water** – providing firefighting water throughout the Project with fire hydrants accessible by fire engines is a critical component of both structural and vegetation fires. The Project provides firefighting water volume, availability, and sustained pressures to the satisfaction of RCFD. Water accessibility helps firefighters control structural fires and helps protect structures from and extinguish wildfires.

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3 Anticipated Fire Behavior

3.1 Fire Behavior Modeling

Following field data collection efforts and available data analysis, fire behavior modeling was conducted to document the type and intensity of fires that would be expected adjacent to the Project site given characteristic features such as topography, vegetation, and weather. Dudek utilized BehavePlus software package version 6 (Andrews, Bevins, and Seli 2008) to analyze potential fire behavior[2].

3.2 Fire Behavior Modeling Analysis

An analysis was conducted to evaluate fire behavior variables and to objectively predict flame lengths, intensities, and spread rates for five modeling scenarios, including two summer, onshore weather condition (northwest and west/southwest from the Project site) and three extreme fall, offshore weather condition (east, northeast, and south of the Project site) scenarios. These fire scenarios incorporated observed fuel types representing the dominant vegetation on the site and adjacent land along with site slope gradients, wind, and fuel moisture values. Modeling scenario locations were selected to better understand different fire behavior that may be experienced on or adjacent to the Project site.

Vegetation types, which were derived from the site field assessment, were classified into fuel models. Fuel models are selected by their vegetation characteristics, fuel stratum most likely to carry the fire, and depth and compactness of the fuels. Fire behavior modeling was conducted for vegetative types that are both on and adjacent to the proposed development as these are the fuels that would potentially be available to fire. Fuel models were also assigned to illustrate post-Project landscape changes. Fuel models were selected from Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model (Scott and Burgan 2005).

Based on the site visit and the anticipated pre- and post- Project vegetation conditions, three different fuel models were used in the fire behavior modeling effort to represent the current vegetation conditions throughout the Project site and one additional fuel model was used to depict a fire post construction, as presented herein. Fuel model attributes are summarized in Table 1. Modeled areas include short/sparse to low-load grasses (Gr1 and Gr2) throughout the project site, intermixed with low load grass/shrubs communities (Gs1). For modeling the post-development condition, fuel model assignments were re-classified to FM8 representing an irrigated landscape and Gs2 representing 50% thinning grass landscape up to 100 feet from the structures.

Table 1. Fuel Models Used for Fire Behavior Modeling

Fuel Model	Description	Location of Fuel Models	Fuel Bed Depth (Feet)
Existing Conditions			
Gr1	Short, sparse, dry climate grasses	Fuel type exists throughout the entire project site.	1.0 ft.

2 A discussion of fire behavior modeling is presented in Appendix C, Fire Behavior Modeling.

Table 1. Fuel Models Used for Fire Behavior Modeling

Fuel Model	Description	Location of Fuel Models	Fuel Bed Depth (Feet)
Gr2	Low load, dry climate grasses	Fuel type exists throughout the entire project site; Fuel type will represent post development 50% thinning zone.	>2.0 ft.
Gs1	Low Load, dry climate grass-shrub	Fuel type intermixed throughout the project site.	<3.0 ft.
FM8	Short needle litter	Fuel type representing post development fully irrigated setback and irrigated zones	<1.0 ft.
Post-Development Conditions			
FM8	Irrigated Landscape	Fuel type will occur post development within Zone B - Irrigated zone.	<1.0 ft.
Gs1	Low Load, Dry Climate Grass-Shrub	Fuel type will occur post development within Zone B - Irrigated zone.	<2.0 ft.
Gs2	Moderate load, Dry Climate Grass-Shrub	Fuel type throughout and adjacent to the Project boundary; also will occur post development within Zone C - 50% thinning zone.	<3.0 ft.

Table 2 summarizes the weather and wind input variables used in the BehavePlus modeling process.

Table 2. Fuel Moisture and Wind Inputs

Model Variable	Summer Weather Condition (50th Percentile)	Peak Fall Weather Condition (97th Percentile)
Fuel Models	FM8, Gr1, Gr2, and Gs1	FM8, Gr1, Gr2, and Gs1
1 hr. Moisture	5%	1%
10 hr. Moisture	6%	4%
100 hr. Moisture	12%	6%
Live Herbaceous Moisture	45%	30%
Live Woody Moisture	95%	60%
20-foot Wind Speed (mph)	14 mph (sustained winds)	17 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	260 and 300	45, 100 and 180
Wind adjustment factor	0.4	0.4
Slope (uphill)	4 to 5%	5 to 7%

3.3 Fire Behavior Modeling Results

The results of fire behavior modeling analysis for pre- and post-Project conditions are presented in Tables 3 and 4, respectively. Identification of modeling run (fire scenarios) locations is presented graphically in Figure 4, BehavePlus Fire Behavior Analysis.

As presented, in the Fire Behavior Analysis (Appendix C), wildfire behavior on the Project site is expected to be primarily of low to moderate intensity throughout the non-maintained surface grasses and grass-shrub dominated fuels throughout the entire Project site. Five focused analyses were completed for both the existing and the post project conditions, each assuming worst-case fire weather conditions for a fire approaching the project site from the northwest, southwest, east, south, and southwest. The results of the modeling effort included anticipated values for surface fires (flame length (feet), rate of spread (mph), fireline intensity (Btu/ft/s), and spotting distance (miles). The fire behavior variables are an important component in understanding fire risk and fire agency response capabilities.

Flame length - the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2008).

Fireline intensity – is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire.

Fire spread rate - represents the speed at which the fire progresses through surface fuels and is another important variable in initial attack and fire suppression efforts (Rothermel and Rinehart 1983).

Spotting distance - is the distance a firebrand or ember can travel down wind and ignite receptive fuel beds. Three fire modeling scenario locations were selected to better understand the different fire behavior that may be experienced on or adjacent the site based on slope and fuel conditions; these three fire scenarios are explained in more detail below:

- **Scenario 1:** A summer, on-shore fire (50th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the northwestern portion of the Project site. The terrain is flat (approximately 5% slope) with potential ignition sources from a vehicle or single-family residential structure fire north/west of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 2:** A fall, off-shore fire (97th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the northeastern portion of the Project site. The terrain is flat (approximately 7% slope) with potential ignition sources from a vehicle or structure fire north/east of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 3:** A fall, off-shore fire (97th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the eastern portion of the Project site. The terrain is flat (approximately 5% slope) with potential ignition sources from a vehicle or structure fire east of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 4:** A fall, off-shore fire (97th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the southern portion of the Project site. The terrain is flat (approximately 6% slope) with potential ignition sources from a vehicle or structure fire south of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 5:** A summer, on-shore fire (50th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the southwestern portion of the Project site. The terrain is flat (approximately 5% slope) with potential ignition sources from a vehicle or structure fire south/west of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.

The results presented in Tables 3 and 4 depict values based on inputs to the BehavePlus software and are not intended to capture changing fire behavior as it moves across a landscape. Changes in slope, weather, or pockets of different fuel types are not accounted for in this analysis. For planning purposes, the averaged worst-case fire behavior is the most useful information for conservative fuel modification design. 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.

3.3.1 Existing Conditions

Based on the BehavePlus analysis (Table 4), fire behavior in existing site fuels is expected to be low to moderate flame lengths and intensities. Existing grasses and shrubs under peak weather conditions (represented by Fall Weather, Scenario 3) produce flames lengths reaching approximately 18 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 3,037 BTU/feet/second with relatively slow spread rates of 6.2 mph and could have a spotting distance up to 1.3 miles away. Therefore, the 100-foot Fuel Modification Zone (FMZ) proposed for the West Campus Upper Plateau Project is approximately 5-times the flame length of the worst-case fire scenario under peak weather conditions and would provide adequate defensible space to buffer the Project from a wildfire approaching the Project's perimeter.

Table 3. RAWS BehavePlus Fire Behavior Modeling Results – Existing Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[1]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles) [2]
Scenario 1: 5% slope, Summer, On-shore Winds from the northwest (Current conditions)				
Sparse load grasses (Gr1)	2.1	0.2	28	0.1
Low load grasses (Gr2)	5.8	0.7	258	0.2
Low load grass-shrubs (Gs1)	3.9	0.3	111	0.2
Scenario 2: 7% slope, Fall, Offshore, Extreme Fall Winds from the northeast (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.1 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	873 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	7.0 (14.0)	0.7 (3.0)	385 (1,763)	0.3 (1.1)
Scenario 3: 5% slope, Fall, Offshore, Extreme Fall Winds from the east (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.2 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	870 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	6.9 (14.0)	0.7 (3.0)	384 (1,763)	0.3 (1.1)
Scenario 4: 6% slope, Fall, Offshore, Extreme Fall Winds from the south (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.2 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	867 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	7.0 (14.0)	0.6 (3.0)	383 (1,763)	0.3 (1.1)
Scenario 5: 4% slope, Summer, Onshore Winds from the southwest (Current conditions)				
Sparse load grasses (Gr1)	2.1	0.2	28	0.1

Table 3. RAWS BehavePlus Fire Behavior Modeling Results – Existing Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[1]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles) [2]
Low load grasses (Gr2)	6.3	0.9	311	0.3
Low load grass-shrubs (Gs1)	4.3	0.3	133	0.2

Notes:
1 MPH=miles per hour.
2 Spotting distance from a wind driven surface fire; it should be noted that the wind mph in parenthesis represent peak gusts of 50 mph.

3.3.2 Post-Development Conditions

As previously mentioned, Dudek conducted modeling of the Project site for post-fuel modification zones. Typical fuel modification includes establishment of minimum 100-foot wide noncombustible zone (Zone A), irrigated zone (Zone B) and a 70-foot-wide thinning zone (Zone C) on the periphery of the project site, beginning at the structure. For modeling the post-FMZ treatment condition, the fuel model assignment for non-native grasslands was re-classified according to the specific fuels management (e.g., irrigated, fire resistive landscaping and 50% thinning) treatment.

Based on the BehavePlus analysis, post development fire behavior is expected to be reduced in irrigated and replanted zones where plants that are acceptable with the Riverside County Fire Department (RCFD) (Zone A and Zone B – FM8) will be utilized and ongoing maintenance of the existing grasses and shrubs (Zone C – Gr2) would occur. Under extreme weather conditions, expected surface flame length is expected to be significantly lower in the areas where fuel modification occurs, with flames lengths reaching approximately 18 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 3,037 BTU/feet/second with relatively slow spread rates of 6.2 mph and could have a spotting distance up to 1.3 miles away. Therefore, the 100-foot Fuel Modification Zone (FMZ) proposed for the West Campus Upper Plateau Project is approximately 5-times the flame length of the worst case fire scenario under peak weather conditions and would provide adequate defensible space to augment a wildfire approaching the perimeter of the Project site.

Table 4. RAWS BehavePlus Fire Behavior Modeling Results – Post-Project Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[1]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles) [2]
Scenario 1: 5% slope, Summer, On-shore Winds from the northwest (Current conditions)				
FMZ Zone A and B (FM8)	1.3	0.0	9	0.1
FMZ Zone C (Gr2)	5.8	0.7	258	0.2
Scenario 2: 7% slope, Fall, Offshore, Extreme Fall Winds from the northeast (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	873 (3,037)	0.4 (1.3)
Scenario 3: 5% slope, Fall, Offshore, Extreme Fall Winds from the east (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)

Table 4. RAWS BehavePlus Fire Behavior Modeling Results – Post-Project Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[1]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles) [2]
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	870 (3,037)	0.4 (1.3)
Scenario 4: 6% slope, Fall, Offshore, Extreme Fall Winds from the south (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	867 (3,037)	0.4 (1.3)
Scenario 5: 4% slope, Summer, Onshore Winds from the southwest (Current conditions)				
FMZ Zone A and B (FM8)	1.4	0.0	11	0.1
FMZ Zone C (Gr2)	6.3	0.9	311	0.3

Notes:
1 MPH=miles per hour
2 Spotting distance from a wind driven surface fire; it should be noted that the wind mph in parenthesis represent peak gusts of 50 mph

Surface Fire:

- **Flame Length (feet):** The flame length of a spreading surface fire within the flaming front is measured from midway in the active flaming combustion zone to the average tip of the flames.
- **Fireline Intensity (Btu/ft/s):** Fireline intensity is the heat energy release per unit time from a one-foot-wide section of the fuel bed extending from the front to the rear of the flaming zone. Fireline intensity is a function of rate of spread and heat per unit area and is directly related to flame length. Fireline intensity and the flame length are related to the heat felt by a person standing next to the flames.
- **Surface Rate of Spread (mph):** Surface rate of spread is the "speed" the fire travels through the surface fuels. Surface fuels include the litter, grass, brush and other dead and live vegetation within about 6 feet of the ground.

The information in Table 5 presents an interpretation of the outputs for five fire behavior variables as related to fire suppression efforts.

Table 5. Fire Suppression Interpretation

Flame Length (ft)	Fireline Intensity (Btu/ft/s)	Interpretations
Under 4 feet	Under 100 BTU/ft/s	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 to 8 feet	100-500 BTU/ft/s	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8 to 11 feet	500-1000 BTU/ft/s	Fires may present serious control problems -- torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
Over 11 feet	Over 1000 BTU/ft/s	Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

3.4 Project Area Fire Risk Assessment

Wildland fires are a common natural hazard in most of southern California with a long and extensive history. Southern California landscapes include a diverse range of plant communities, including vast tracts of grasslands and shrublands, like those found on and adjacent to the Project site. Wildfire in this Mediterranean-type ecosystem ultimately affects the structure and functions of vegetation communities (Keeley 1984) and will continue to have a substantial and recurring role (Keeley and Fotheringham 2003). Supporting this are the facts that 1) native landscapes, from forest to grasslands, become highly flammable each fall and 2) the climate of southern California 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 six-month drought period each year. Based on this research, the anticipated growing population expanding into WUI areas, and the regions' fire history, it can be anticipated that periodic wildfires may start on, burn onto, or spot into the Project site. The most common type of fire anticipated in the vicinity of the Project area is a wind-driven fire from the east/southeast, moving through the grasslands and scrub on the and around the Project site.

With the conversion of the landscape to ignition-resistant development, wildfires may still encroach upon and drop embers on the Project site but would not be expected to burn through the site or produce sustainable spot fires due to the lack of available fuels. Studies indicate that even with older developments that lacked the fire protections provided by the Project, wildfires declined steadily over time (Syphard, et. al., 2007 and 2013) and further, the acreage burned remained relatively constant, even though the number of ignitions temporarily increased. This is due to the conversion of landscapes to ignition resistant, maintained areas, more humans monitoring areas resulting in early fire detection and discouragement of arson, and fast response from the fire suppression resources that are located within these developing areas.

Therefore, it will be important that the latest fire protection technologies, developed through intensive research and real-world wildfire observations and findings by fire professionals, for both ignition resistant construction and for creating defensible space in the WUI areas are implemented and enforced. The Project, once developed, would not facilitate wildfire spread and would reduce projected flame lengths to levels that would be manageable by firefighting resources for protecting the Project site's structures, especially given the ignition resistance of the structures and the planned ongoing maintenance of the entire site landscape and FMZs. The Project will implement the latest fire protection measures, including fuel modification along the perimeter edges of the development. In addition, the 100-foot FMZ provided for the majority of the Project site would be approximately 5.5 times wider than the longest calculated flame length conditions for portions of the proposed developed area that abut grassland communities (reference Table 4).

Given the climatic, vegetative, topographic characteristics, and local fire history of the area, the Project Site, once developed, is determined to be subject to periodic wildfires that may start on, burn toward, or spot onto the site. The potential for off-site wildfire encroaching on, or showering embers on the site is considered moderate, but the risk of ignition from such encroachments or ember showers is considered low based on the type of ignition resistant landscapes and construction and fire protection features that will be provided for the structures.

While it is true that humans are the cause of most fires in California, there is no data available that links increases in wildfires with the development of ignition-resistant projects that are placed in areas where significant urbanization already exists. The Project will include a robust fire protection system. This same robust fire protection system provides protections from on-site fire spreading to off-site vegetation. Accidental fires within the Project's landscapes or structures will have limited ability to spread. The landscape throughout the Project and on its perimeter will be highly maintained and much of it irrigated, which further reduces its ignition potential. Structures will be highly ignition resistant on the exterior and the interiors will be protected with automatic sprinkler systems, which have a very high success rate for containing fires, if not extinguishing them.

3.4.1 Analysis of Wildfire Risk from Adding New Residents

Humans (i.e., human related activities or human created features, services, or processes) are responsible for the majority of California wildfires (Syphard et al. 2007, 2008; Romero-Calcerrada et al. 2008). Certain human activities result in sparks, flames, or heat that may ignite vegetative fuels without proper prevention measures in place. These ignitions predominantly occur as accidents, but may also be purposeful, such as in the case of arson. Roadways are a particularly high source for wildfire ignitions due to high usage and vehicle caused fires (catalytic converter failure, overheated brakes, dragging chains, tossed cigarette, and others) (Romero-Calcerrada et al 2008)). In Southern California, the population living at, working in, or traveling through the wildland urban interface is vast and provides a significant opportunity for ignitions every day. However, it is a relatively rare event when a wildfire occurs, and an even rarer event when a wildfire escapes initial containment efforts. Approximately 90 to 95 percent of wildfires are controlled below 10 acres (CAL FIRE 2019; Santa Barbara County Fire Department 2019).

Research indicates that the type of dense, clustered and full landscape conversion projects, like the Upper West Campus, are not associated with increased vegetation ignitions. Syphard and Keeley (2015) summarize all wildfire ignitions included in the CAL FIRE Fire and Resource Assessment Program (FRAP) database – dating back over 100 years. For example, they found that in San Diego County, which is similar to most of southern California, equipment-caused fires were by far the most numerous, and these also accounted for most of the area burned, followed closely by the area burned by power line fires. Ignitions classified as equipment caused frequently resulted from exhaust or sparks from power saws or other equipment with gas or electrical motors, such as lawn mowers, trimmers or tractors and associated with lower density housing. Ignitions were more likely to occur close to roads and structures, and at intermediate structure densities.

As figures 4 through 6 illustrate, project building density directly influences susceptibility to fire because in higher density developments, there is one interface (the community perimeter) with the wildlands whereas lower density development creates more structural exposure to wildlands, less or no ongoing landscape maintenance (an intermix rather than interface), and consequently more difficulty for limited fire resources to protect well-spaced structures. The intermix includes housing amongst the unmaintained fuels whereas the proposed project converts all fuels within the footprint and provides a wide, managed fuel modification zone separating homes from unmaintained fuel and creating a condition that makes defense easier. Syphard and Keeley go on to state that "The WUI, where housing density is low to intermediate is an apparent influence in most ignition maps "further enforcing the conclusion that lower density development poses a higher ignition risk than higher density development." They also state that "Development of low-density, exurban housing may also lead to more homes being destroyed by fire" (Syphard et al. 2013). A wildland urban interface already exists in the area adjacent to the Project, dominated by older, more fire-vulnerable structures, constructed before stringent fire code requirements were imposed on residential development, with varying levels of maintained fuel modification buffers. As discussed in detail throughout this FPP, the Project is an ignition resistant business center designed to include professionally managed and maintained fire protection components, modern fire code compliant safety features and specific measures provided where ignitions are most likely to occur (such as roadways). Therefore, the development of the Project would not be expected to materially increase the risk of vegetation ignitions.

Figure 4. Example higher density development that is ignition resistant and excludes readily ignitable vegetative fuels throughout and provides a perimeter fuel modification zone. This type of new development requires fewer fire resources to defend and can minimize the likelihood of on-site fires spreading off-site.

Figure 5. Example of moderate density development. Structures are located on larger properties and include varying levels of ignition resistance and landscape / fuel modification provision and maintenance. This type of development results in a higher wildland exposure level for all homes and does not provide the same buffers from wildfire encroaching onto the site, or starting at a structure and moving into the wildlands as a higher density project.

Figure 6. Example of "lower density" development where structures are interspersed amongst wildland fuels, are of varying ages, and include varying levels of fuel modification zone setbacks. Homes are exposed on most or all sides by flammable vegetation and properties rely solely on owners for maintenance, are often far distances from the nearest fire station, and have minimal buffer from on-site fire spreading to wildlands.

Moreover, frequent fires and lower density housing growth may lead to the expansion of highly flammable exotic grasses that can further increase the probability of ignitions (Keeley et al. 2012). This is not the case with the proposed project as the landscapes are managed and maintained to remove exotic fuels that may establish over time.

As discussed above, research indicates that it is less likely for higher density developments to be impacted by wildfires than lower density developments. The same protections that starve wildfire of fuels and minimize or prevent wildfire from transitioning into a higher density development like the Project's also serve to minimize or prevent on-site fires from transitioning into the wildlands. Further, the requirement that all structures will include interior fire sprinklers that are structure protection rated, significantly reduces the likelihood that a building fire spreads to the point of flashover, where a structure will burn beyond control and produce embers. Interior sprinklers are very efficient, keeping fires to the room of origin, or extinguishing the fire before the responding firefighters arrive. Similarly, the irrigated fuel modification zones are positioned throughout the development areas as well as the first zones on the perimeter of the project and masonry walls adjacent the conserved open space. Irrigated zones include plants with high internal moisture and spacing between plants and plant groups that 1) make it difficult to ignite and 2) make it difficult for fire to spread plant to plant.

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Table 1: Existing Fuel Model Characteristics

Fuel Model	Description	Location	Fuel Bed Depth (Feet)
Gr1	Short, sparse, dry climate grasses	Fuel type exists throughout the entire project site.	1.0 ft.
Gr2	Low load, dry climate grasses	Fuel type exists throughout the entire project site; Fuel type will represent post development 50% thinning zone.	>2.0 ft.
Gs1	Low Load, dry climate grass-shrub	Fuel type intermixed throughout the project site.	<3.0 ft.
FM8	Short needle litter	Fuel type representing post development fully irrigated setback and irrigated zones	<1.0 ft.

Table 3: RAWS BehavePlus Fire Behavior Model Results – Existing Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[5]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[6]
Scenario 1: 5% slope, Summer, On-shore Winds from the northwest (Current conditions)				
Sparse load grasses (Gr1)	2.1	0.2	28	0.1
Low load grasses (Gr2)	5.8	0.7	258	0.2
Low load grass-shrubs (Gs1)	3.9	0.3	111	0.2
Scenario 2: 7% slope, Fall, Offshore, Extreme Fall Winds from the northeast (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.1 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	873 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	7.0 (14.0)	0.7 (3.0)	385 (1,763)	0.3 (1.1)
Scenario 3: 5% slope, Fall, Offshore, Extreme Fall Winds from the east (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.2 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	870 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	6.9 (14.0)	0.7 (3.0)	384 (1,763)	0.3 (1.1)
Scenario 4: 6% slope, Fall, Offshore, Extreme Fall Winds from the south (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.2 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	867 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	7.0 (14.0)	0.6 (3.0)	383 (1,763)	0.3 (1.1)
Scenario 5: 4% slope, Summer, Onshore Winds from the southwest (Current conditions)				
Sparse load grasses (Gr1)	2.1	0.2	28	0.1
Low load grasses (Gr2)	6.3	0.9	311	0.3
Low load grass-shrubs (Gs1)	4.3	0.3	133	0.2

Table 4: RAWS BehavePlus Fire Behavior Model Results – Post Project Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[7]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[8]
Scenario 1: 5% slope, Summer, On-shore Winds from the northwest (Current conditions)				
FMZ Zone A and B (FM8)	1.3	0.0	9	0.1
FMZ Zone C (Gr2)	5.8	0.7	258	0.2
Scenario 2: 7% slope, Fall, Offshore, Extreme Fall Winds from the northeast (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	873 (3,037)	0.4 (1.3)
Scenario 3: 5% slope, Fall, Offshore, Extreme Fall Winds from the east (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	870 (3,037)	0.4 (1.3)
Scenario 4: 6% slope, Fall, Offshore, Extreme Fall Winds from the south (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	867 (3,037)	0.4 (1.3)
Scenario 5: 4% slope, Summer, Onshore Winds from the southwest (Current conditions)				
FMZ Zone A and B (FM8)	1.4	0.0	11	0.1
FMZ Zone C (Gr2)	6.3	0.9	311	0.3

Document Path: Z:\Projects\j1405400\MAPDOC\DOCUMENT\FPP\DRAFT FIG X BehavePlusAnalysisMap.mxd

SOURCE: AERIAL- BING MAPPING SERVICE

DUDEK

0 250 500 1,000 Feet

FIGURE 7

BehavePlus Fire Modeling Analysis Map

WCUP - West Campus Upper Plateau Fire Protection Plan Project

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4 Emergency Response Service

4.1 Emergency Response Fire Facilities

The Project site is located within RCFD response area; however, the closest fire station to the Project site is the City of Riverside Fire Department (RFD) Station 11, as depicted in Figure 5. There are mutual aid agreements in place with neighboring fire agencies so that the closest unit is dispatched, regardless of jurisdiction. These interdependencies often exist among fire protection agencies for structural and medical responses associated with the peripheral “edges” of each agency’s boundary. Table 4, Closest Responding Fire Stations Summary, presents a summary of the location, equipment, staffing levels, maximum travel distance, and travel time for the three closest, existing RCFD, RFD and Moreno Valley Fire Department (MVFD) stations responding to the Project site. Travel distances are derived from Google Road data while travel times are calculated applying the nationally recognized Insurance Services Office (ISO) Public Protection Classification Program’s Response Time Standard formula (T=0.65 + 1.7 D, where T= time and D = distance). The ISO response travel time formula discounts speed for intersections, vehicle deceleration and acceleration, and does not include turnout time. The following sections analyze the Project in terms of current RCFD Fire Service capabilities and resources to provide Fire Protection and Emergency Services.

Table 6. Closest Responding Stations Summary

Station	Location	Equipment	Staffing*	Maximum Travel Distance**	Travel time**
RFD Station 11	19595 Orange Terrace Pkwy, Riverside	Engine 11	One captain, one engineer, one firefighter and one firefighter/paramedic	2.2 miles	4 minutes, 23 seconds
RFD Station 13	6490 Sycamore Canyon Boulevard, Riverside	Truck 13	One captain, one engineer, one firefighter and one firefighter/paramedic	2.8 miles	5 minutes, 25 seconds
MVFD Station 6	22250 Eucalyptus Ave, Moreno Valley	Engine 6	3-person Engine	3.4 miles	6 minutes, 26 seconds
RCFD/MVFD Station 65	15111 Indian Street, Moreno Valley	Engine	3-person Engine	4.5 miles	8 minutes, 18 seconds

Notes:

* Staffing levels from 2016 Riverside County Fire Department Tri Data Report or RFD website (https://www.riversideca.gov/fire/about-contact/stations)

** Assumes travel distance and time to the closest Project site entrance

RFD Station 11 is staffed 24/7 with career firefighters, would provide initial response, and is located at 19595 Orange Terrace Parkway in Riverside. RFD Station 11 has one Engine Truck staffed with four firefighter personnel. RFD Station 11 will be capable of responding within 4 minutes and 23 seconds, which equates to roughly a 6 minute 23 second response time. Secondary response would be provided from RFD Station 13, which is located at 6490 Sycamore Canyon Boulevard in Riverside and can respond within 5 minutes and 25 seconds. RFD Station 13 has one Quint Truck staffed with four firefighter personnel. MVFD Station 6 has a 3-person Engine and would also be able to respond to the Project site in 6 minutes and 26 seconds.

Within the area's emergency services system, fire and emergency medical services are also provided by other fire departments. Generally, each agency is responsible for structural fire protection and wildland fire protection within their area of responsibility. However, mutual aid agreements enable non-lead fire agencies to respond to fire emergencies outside their district boundaries. In the Project area, fire agencies cooperate under a statewide master mutual aid agreement for wildland fires.

On March 7, 2017, the Riverside County Board of Supervisors (Board) received and filed RCFD's "Alternative Staffing Model Recommendation." The Alternative Staffing Model Recommendation was fiscally driven and developed by RCFD due to funding difficulties to retain 3-person engine companies. The RCFD FY 17-18 Service Alternatives report, dated March 7, 2017, recommends the following response times based on four Board Approved Land Use Classifications as described in Table 7:

Table 7. Land Use Classification Information with Staffing/Time Response Standards

Land Classification	Population Density	Fire Staffing Characteristics	Response Time
HEAVY URBAN	>700 per square mile	Land use includes large commercial and industrial complexes, large business parks, high-rise and wide rise community centers and high-density residential dwelling units of 10 to 20 units per acre.	5:00 minutes, 90% of the time
URBAN	>500 per square mile	Land use includes large commercial and industrial complexes, large business parks, high-rise and wide rise community centers and high-density residential dwelling units of 8 to 20 units per acre.	6:30 minutes, 90% of the time
RURAL	100 to 500 per square mile	Light industrial zones, small community centers and residential dwelling unit density of 2 to 8 units per acre.	10:30 minutes, 90% of the time
OUTLYING	<100 per square mile	Areas of rural mountain and desert, agricultural uses, small scale commercial, industrial and manufacturing, service commercial, medium industrial and low density residential dwelling units; 1 dwelling unit per acre to 1 dwelling unit per 5 acres.	17:30 minutes, 90% of the time

Source: Riverside County Fire Department FY 17-18 Service Alternatives. March 7, 2017.

Based on the Project area's inclusion of large commercial and industrial complexes, it is assumed that the Project may be classified as "Heavy Urban," with a 5.0-minute first-in fire engine response time. As previously mentioned, response to the Project site from the closest existing Fire Station (RFD Station 11) would achieve under a 5-minute travel time to the entrance of the Project with a 6 minute 23 second response time. This response time is considered to be adequate given the Project's fire safety features, including full NFPA 13 fire sprinklers, per code and the flexibility allowed by the response time 90 percent achievement rate. The Project may not adversely impact the overall goal achievement due to the low number of calls (discussed below) that are projected.

According to the RCFD 2016 TriData Report[3], units should travel to calls within the defined response time goal for the appropriate population density classification 90 percent of the time. As noted in the report, RCFD Station 65 was in compliance of meeting the defined response time 82.8%. Additionally, areas that have fewer units available or are farther from neighboring stations are more impacted than others by an increase in emergency calls. They have greater workload sensitivity– as the workload increases their ability to meet the demand decreases. RFD Stations 11 and 13 are considered to have a moderate sensitivity workload with the capacity for more workload.

4.2 Estimated Calls and Demand for Service

The following estimated annual emergency call volume generated by the Project (Commercial-Industrial products) is based upon per capita data for 2017 from RCFD calls within their jurisdiction[4].

- Total population served by: 46,712 (as of 2015, RCFD 2016 TriData Report)
- Total annual calls: 3,225. Per capita call generation: 0.07
- Total annual fire calls, including structure, vegetation, vehicle fires, and other fire calls (2.60% of total calls): 84. Per capita call generation: 0.002
- Total annual Emergency Medical Services (75% of total calls): 2,429. Per capita call generation: 0.052
- Total other calls (Rescue, Traffic Collisions, Hazardous Materials, Public Service, etc.; 22.1% of total calls): 712. Per capita call generation: 0.015

Using the data above, the estimated annual emergency call volume for the Project site was calculated. Per the Project's Environmental Impact Report, the total maximum estimated total population of the Project site, is projected to be 2,600 persons. Based on this population estimate, the calculated call volumes by type of call are provided in Table 6.

Table 8. Calculated Call Volume (Conceptual Based on 2,600 Persons)

Type of Call	Per Capita Call Generation Factor	Number of Estimated Annual Calls
Total Other Calls	0.015	39
Total Fires	0.002	6
Total EMS Calls	0.052	136
Total Calls	0.07	181

As mentioned, the new industrial/commercial development will increase the call volume at a rate of a conservatively calculated (the actual number of calls may be lower than this estimate) up to 181 calls per year (15 calls per month or 0.5 calls per day). RFD Fire Station 11 emergency response in 2021 totaled 1,955 calls per year[9], or 5.35 calls per day. 13 emergency responses in 2021 totaled 1,341 calls per year[5], or 3.67 calls per day. The level of service demand for the Project raises overall call volume but is not anticipated to impact the existing fire stations to a point that they cannot meet the demand. For perspective, five calls per day are typical in an urban or suburban area. A busy fire station company would be one with 10 to 15 or more calls per day. When the Project site is built out, Fire RFD Station 11 could potentially respond to an additional 3 calls per week on average, although the number will likely be lower than that based on the conservative nature of the population and calls per capita data used in this estimate.

3 Riverside County Fire Department, Operational, Standards of Cover, and Contract Fee Analysis, March 2016, TriData LLC
4 2017 Riverside County Fire Department Annual Report Incidents for fiscal year 2017, Page 14
5 Email communication with Brian Guzzetta, Training Captain, City of Riverside Fire Department

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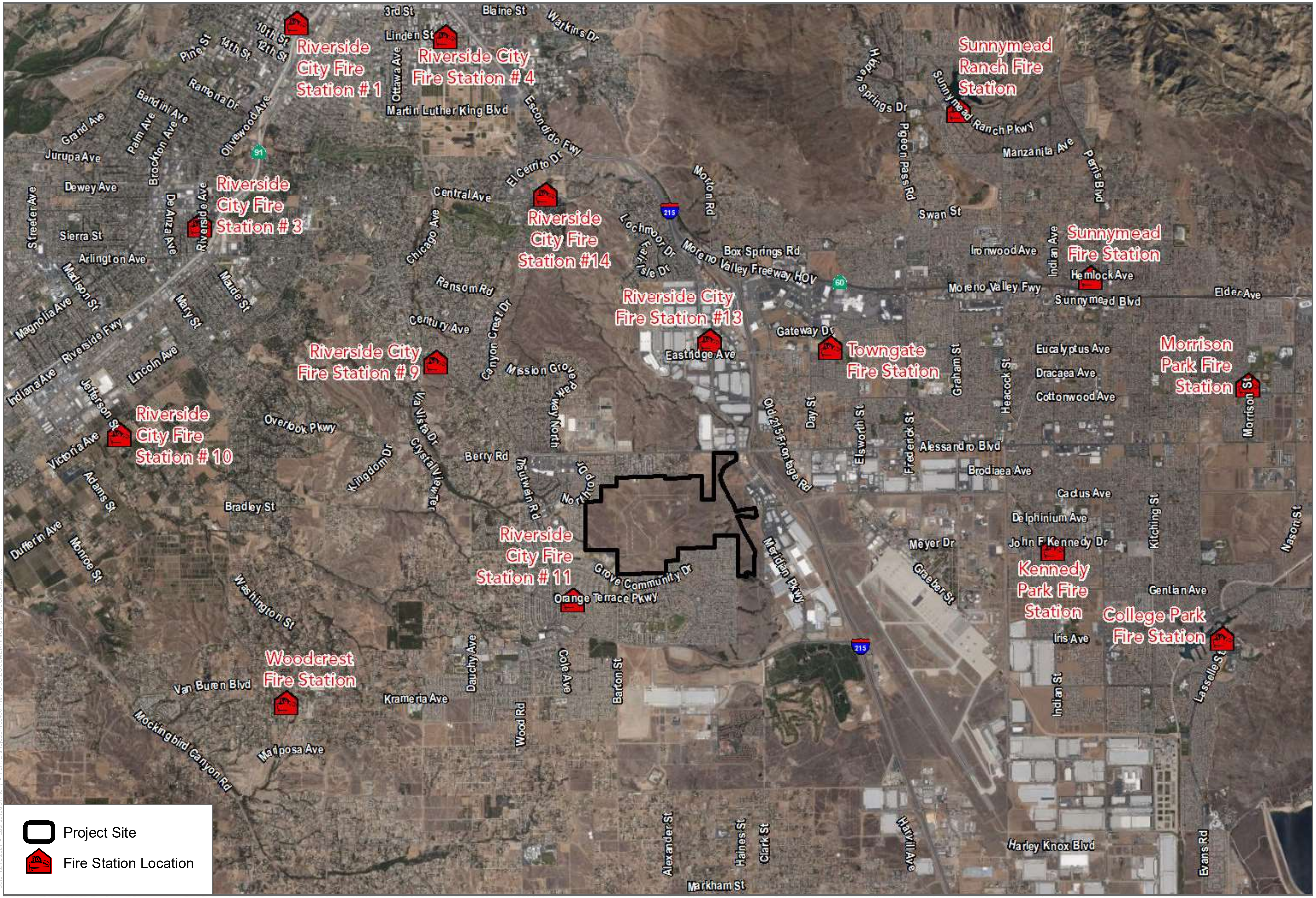

SOURCE: Bing Maps 2021; County of Riverside GIS data

DUDEK

0 3,500 7,000 Feet

FIGURE 8

Fire Station Locations

Fire Protection Plan for West Campus Upper Plateau Project

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5 Buildings, Infrastructure and Defensible Space

The RCFD Fire Code and 2019 CFC and 2019 CBC adopted by reference (with several modifications) governs the building, infrastructure, and defensible space requirements detailed in this FPP. Although the Project is not required to comply with codes governing development within areas designated as High FHSZ, Very High FHSZs, and/or WUI, the Project will meet these codes (e.g. Chapter 7A) at the time the Project is submitted to the building and fire department for review and approval, or will provide alternative materials and/or methods, if warranted. The following summaries highlight important fire protection features.

A response map update, including roads and fire hydrant locations, in a format compatible with current RCFD mapping shall be provided to RCFD.

5.1 Fire Apparatus Access

5.1.1 Access Roads

The Project would involve the construction of new structures, roadways, and would generate new trips to and from the Project site. Project site access, including road widths and connectivity, will comply with the requirements of the County's Road Standards and Specifications (Ordinance 461). Additionally, an adequate water supply and approved paved access roadways shall be installed prior to any combustibles being brought onsite and will include:

- Primary access to the Project site is provided via Cactus Avenue on the eastern Project site boundary. Secondary access would be provided via Barton Street on the northwestern corner of the Project site.
- Internal circulation is comprised of a loop roadway system that connects both the primary and secondary access points. All interior circulation roads include all roadways that are considered common or primary roadways for traffic flow through the Project site and for fire department access serving all proposed lots. Any dead-end streets serving new structures that are longer than 150 feet will have approved provisions for fire apparatus turnaround.
- All roads comply with access road standards of not less than 24 feet, unobstructed width and are capable of supporting an imposed load of at least 75,000 pounds.
- Interior circulation streets and parking lot roadways that are considered roadways for traffic flow through the Project site will meet fire department access requirements when serving the proposed structures.
- Typical, interior Project roads, including collector and local roads, will be constructed to minimum 24-foot, unobstructed widths and shall be improved with aggregate cement or asphalt paving materials.
- Private or public streets that provide fire apparatus access to buildings three stories or more in height shall be improved to 30 feet unobstructed width.
- Private and public streets for each phase shall meet all Project approved fire code requirements, paving, and fuel management prior to combustible materials being brought to the Project site.
- Vertical clearance of vegetation (lowest-hanging tree limbs), along roadways will be maintained at clearances of 13 feet, 6 inches to allow fire apparatus passage.

- Cul-de-sacs and fire apparatus turnarounds will meet requirements and RCFD Fire Prevention Standards.
- Any roads that have traffic lights shall have approved traffic pre-emption devices (Opticom) compatible with devices on the Fire Apparatus.
- Roadways and/or driveways will provide fire department access to within 150 feet of all portions of the exterior walls of the first floor of each structure.
- Roadway design features (e.g., speed bumps, humps, speed control dips, planters, and fountains) that could interfere with emergency apparatus response speeds and required unobstructed access road widths will not be installed or allowed to remain on roadways.
- Access roads shall be usable by fire apparatus to the approval of RCFD prior to lumber drop onsite. Developer will provide information illustrating the new roads, in a format acceptable to the RCFD for updating of Fire Department response maps.

5.1.2 Dead-End Roads

- Each planning area varies in the number of ingress/egress roads or streets. Dead end streets no longer than 350 feet shall have approved provisions for fire apparatus turnaround or cul-de-sac. Cul-de-sac streets may exceed 350 feet, but not 600 feet in length with provisions for appropriate mitigations to the approval of the Fire Marshal or Fire Chief.
- Fire apparatus turnarounds to include turning radius of a minimum 45 feet, measured to inside edge of improved width (RCFD Fire Prevention Standard).

5.1.3 Gates

Gates on private roads are permitted, but subject to Fire Code requirements and standards, including:

- Gates shall be equipped with conforming sensors for detecting emergency vehicle “opticom” strobe lights from any direction of approach, if required.
- All entrance gates will be equipped with a key switch, which overrides all command functions and opens the gate.
- Gate activation devices will be equipped with a battery backup or manual mechanical disconnect in case of power failure.
- Further, gates will be:
  - Minimum 20 feet wide of clearance for one-way traffic when fully open at entrance.
  - Minimum of two feet wider than road width at exit.
  - Constructed from non-combustible or exterior fire-rated treated wood materials.
  - Inclusive of provisions for manual operation from both sides, if power fails. Gates will have the capability of manual activation from the development side or a vehicle (including a vehicle detection loop).

5.1.4 Driveways

Any structure that is 150 feet or more from a common street in the development shall have a paved fire apparatus access road meeting the following specifications:

- Grades 15% or less with surfacing and sub-base consistent with Riverside CFC.

5.1.5 Premise Identification

Identification of roads and structures will comply with RCFD Fire Prevention Standards, as follows:

- All commercial/industrial structures required to be identified by street address numbers at the structure. Numbers to be minimum eight inches high with one-inch stroke, visible from the street. Numbers will contrast with background and shall be electrically illuminated during the hours of darkness where building setbacks exceed 100 feet from the street or would otherwise be obstructed; numbers shall be displayed at the property entrance. Numbers will contrast with background.
- Multiple structures located off common driveways or roadways will include posting addresses on structures and on the entrance to individual driveway/road or at the entrance to the common driveway/ road for faster emergency response.
- Proposed private and public streets within the development will be named, with the proper signage installed at intersections to satisfaction of the Department of Public Works.
- Streets will have street names posted on non-combustible street signposts; letters/numbers will be per RCFD standards.
- Temporary street signs shall be installed on all street corners within the Project prior to the placing of combustible materials on-site. Permanent signs shall be installed prior to occupancy of buildings.

5.1.6 On-going Infrastructure Maintenance

Project Owner/Property Management Company shall be responsible for long term funding and maintenance of internal private roads.

5.1.7 Pre-Construction Requirements

It is the recommendation of this FPP, prior to bringing lumber or combustible materials onto the Project site, improvements within the active development area shall be in place, including utilities, operable fire hydrants, an approved, temporary roadway surface, and construction phase fuel modification zones established. These features will be approved by the fire department or their designee prior to combustibles being brought on-site.

5.2 Ignition Resistant Construction and Fire Protection

All new structures within the Project site will be constructed to Fire Code standards. Each of the proposed buildings will comply with the enhanced ignition-resistant construction standards of the 2019 CBC (Chapter 7A). These requirements address roofs, eaves, exterior walls, vents, appendages, windows, and doors and result in hardened structures that have been proven to perform at high levels (resist ignition) during the typically short duration of exposure to burning vegetation from wildfires.

While these standards will provide a high level of protection to structures in this development, there is no guarantee that compliance with these standards will prevent damage or destruction of structures by fire in all cases.

5.3 Infrastructure and Fire Protection Systems Requirements

5.3.1 Water Supply

Water service for Project site will be provided by Western Municipal Water District (WMWD). All water storage and hydrant locations, mains, and water pressures would be designed to fully comply with Riverside County Fire Code Fire Flow Requirements.

The Project will be consistent County Fire Code Section 8.32.050 and California Fire Code Section 903.2 for fire flow and fire hydrant requirements within a HFHSZ. These internal waterlines will also supply sufficient fire flows and pressure to meet the demands for required onsite fire hydrants and interior fire sprinkler systems for all structures. Water supply must meet a 2-hour fire flow requirement of 2,500 gpm, which must be over and above the daily maximum water requirements for this development. Water utilities will be connected prior to any construction.

5.3.2 Fire Hydrants

Fire Hydrants shall be located along fire access roadways and adjacent to each structure, as determined by the RCFD Fire Marshal and current fire code requirements to meet operational needs. Fire Hydrants will be consistent with applicable Design Standards.

5.3.3 Automatic Fire Sprinkler Systems

All structures, of any occupancy type, will be protected by an automatic, internal fire sprinkler system. Fire sprinklers systems shall be in accordance with RCFD, and National Fire Protection Association (NFPA) Standards 13. Fire sprinkler plans for each structure will be submitted and reviewed by RCFD for compliance with the applicable fire and life safety regulations, codes, and ordinances as well as the RCFD Fire Prevention Standards for fire protection systems.

5.4 Defensible Space and Vegetation Management

5.4.1 Defensible Space and Fuel Modification Zone (FMZ) Requirements

An important component of a fire protection system for the Project is the provision for fire-resistant landscapes and modified vegetation buffers. FMZs are designed to provide vegetation buffers that gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones, restricted vegetation zones, and irrigated zones adjacent to each other on the perimeter of the exposed structures outward toward areas of open space.

Perimeter structures will be located adjacent to FMZ areas that separate the Project from naturally vegetated open space areas surrounding the Project site's Development Footprint. Based on the modeled extreme weather flame lengths for the Project site, wildfire flame lengths are projected to be approximately between 2.0 to 18 feet high in areas of Development Footprint-adjacent grassland fuels. The fire behavior modeling system used to predict these flame lengths was not intended to determine sufficient FMZ widths, but it does provide the average predicted length of the flames, which is a key element for determining "defensible space" distances for providing firefighters with room to work and minimizing structure ignition. For the Project site the FMZ widths between the naturally vegetated open space areas and structures are proposed to be 100 feet (where achievable), approximately 5.5 times the modeled flame lengths based on the fuel type represented adjacent to the Development Footprint. The FMZs will be constructed from the structure outwards towards undeveloped areas.

Figure 6 illustrates the FMZ Plan proposed for the Upper West Campus Plateau Project site, including a minimum 5-foot-wide non-combustible Zone A, a 25- to 95-foot wide irrigated Zone B, and up to a 70-foot wide thinning Zone C. Additionally, there are Zone B equivalent areas, which include hardscape and landscape that provides equivalent function as a typical Zone B. The Zone B equivalent areas typically include roads, sidewalks and related landscape within the developed portions of the property. A fire access road extending from a minimum of 20-feet from the edge of any public or private roadway with 10-feet of horizontal clearance on each side and 20-feet of vertical clearance is included as well. Additionally, to mitigate for the reduced FMZ in the southern and southeastern portions of the Project site, where the FMZ is potentially less than 100 feet, there will be enhanced construction features, such as a 6-foot heat deflecting wall constructed of concrete masonry units (CMUs) between on-site structures and unmaintained open space.

Although FMZs are very important for setting back structures from adjacent unmaintained fuels, the highest concern is considered to be from firebrands or embers as a principal ignition factor on this site. To that end, the Project site, based on its location and ember potential, is recommended to include the latest ignition and ember resistant construction materials and methods for roof assemblies, walls, vents, windows, and appendages, as mandated by the RCFD and County's Fire and Building Codes (e.g., Chapter 7A).

Riverside County Fuel Modification Zone Standards

An FMZ is a strip of land where combustible vegetation has been removed and/or modified and partially or completely replaced with more adequately spaced, drought-tolerant, fire-resistant plants in order to provide a reasonable level of protection to structures from wildland fire. The purpose of the section is to document RCFD's standards and make them available for reference. However, we are proposing a site-specific fuel modification zone program with additional measures that are consistent with the intent of the standards. Riverside County Fire Code (Chapter 8.32) is consistent with the 2019 California Fire Code (Section 4907 — Defensible Space), Government Code 51175 – 51189, and Public Resources Code 4291, which require that fuel modification zones be provided around every building that is designed primarily for human habitation or use within a HFHSZ.

A typical landscape/fuel modification installation per the County's Fire Code consists of a 30-foot-wide Zone A and a 70-foot-wide Zone B for a total of 100-feet in width. However, the Project will consist of a 5-foot-wide non-combustible Zone A, 25- to 95-foot wide irrigated Zone B or equivalent and up to a 70-foot wide thinning Zone C. The Fuel Modification Plan herein and all subsequent Fuel Modification Plans prepared for the Development Area shall be reviewed and approved by the RCFD for consistency with defensible space and fire safety guidelines. Figure 6 displays conceptual FMZs for the Project site.

To ensure long-term identification and maintenance, a fuel modification area shall be identified by a permanent zone marker meeting the approval of RCFD. All markers will be located along the perimeter of the fuel modification area at a minimum of 500-feet apart or at any direction change of the fuel modification zone boundary. FMZs will be maintained on at least an annual basis or more often as needed to maintain the fuel modification buffer function.

An on-site inspection will be conducted by the RCFD upon completion of landscape install before a certificate of occupancy being granted by the County's building code official.

Project Fuel Modification Zone Treatments

Zone A: Non-Combustible Zone

Zone A extends 5-feet from buildings and structures.

The ember-resistant zone is currently not required by law, but science has proven it to be the most important of all the defensible space zones. This zone includes the area under and around all attached decks and requires the most stringent wildfire fuel reduction. The ember-resistant zone is designed to keep fire or embers from igniting materials that can spread the fire to Project buildings. The following provides guidance for this zone, which may change based on the regulation developed by the Board of Forestry and Fire Protection.

- Use hardscape like gravel, pavers, concrete and other noncombustible mulch materials. No combustible bark or mulch.
- Remove all dead and dying weeds, grass, plants, shrubs, trees, branches and vegetative debris (leaves, needles, cones, bark, etc.); Check roofs, gutters, stairways, etc.
- Limit plants in this area to low growing, nonwoody, properly watered and maintained plants
- Relocate firewood and lumber to Zone B.
- Replace combustible fencing, gates, and arbors attach to structures with noncombustible alternatives.
- Consider relocating garbage and recycling containers outside this zone.
- Consider relocating boats, RVs, vehicles and other combustible items outside this zone.

Zone B: Paved/Irrigated Zone

Zone B extends up to 100 feet from buildings and structures.

- Remove all dead plants, grass and weeds (vegetation).
- Remove dead or dry leaves and pine needles from landscaping, roof and rain gutters.
- Remove branches that hang over rooves.
- Trim trees regularly to keep branches a minimum of 10 feet from other trees.
- Relocate wood piles to Zone B.
- Remove or prune flammable plants and shrubs near windows.
- Remove vegetation and items that could catch fire from around and under decks, balconies and stairs.
- Create a separation between trees, shrubs and items that could catch fire, such as wood piles.

Zone C: Thinning Zone

Zone C extends from Zone B up to 100 feet from buildings and structures

- Cut or mow annual grass down to a maximum height of 4 inches.
- Create horizontal space between shrubs and trees. (See Figure 7)
- Create vertical space between grass, shrubs and trees. (See Figure 7)
- Remove fallen leaves, needles, twigs, bark, cones, and small branches. However, they may be permitted to a depth of 3 inches.
- All exposed wood piles must have a minimum of 10 feet of clearance, down to bare mineral soil, in all directions.

Fire Access Road Zone

Extends a minimum of 10 feet from the edge of any public or private roadway that may be used as access for fire-fighting apparatus or resources adjacent to open space. Clear and remove flammable growth for a minimum of 10 feet on each side of the access roads. Additional clearance beyond 10 feet may be required upon inspection.

1. Required clearance extends a minimum of 10 feet from the edge of any public or private roadway as well as an unobstructed vertical clearance of 20-feet.
2. Landscaping and native plants shall be appropriately spaced and maintained.
3. Trees found in Appendix D can be planted, if they are far enough from structures and Fire Department accesses, and do not overhang any structures or access at maturity.

Roadside fuel modification for the Project consists of maintaining ornamental landscapes, including trees, clear of dead and dying plant materials. Roadside fuel modification shall be maintained by the Project.

Pre-Construction Requirements

- Perimeter fuel modification areas must be implemented and approved by the RCFD before combustible materials are brought on site.
- Existing flammable vegetation shall be reduced by 50% on vacant lots upon commencement of construction.
- Dead fuel, ladder fuel (fuel which can spread fire from the ground to trees), and downed fuel shall be removed, and trees/shrubs shall be properly limbed, pruned, and spaced per the plan.

Undesirable Plants

Certain plants are considered to be undesirable in the landscape due to characteristics that make them highly flammable. These characteristics can be physical (structure promotes ignition or combustible) or chemical (volatile chemicals increase flammability or combustion characteristics). The plants included in the FMZ Undesirable Plan List (refer to Appendix D) are unacceptable from a fire safety standpoint and shall not be planted or allowed to establish opportunistically within the FMZs or landscape areas.

5.4.2 Vegetation Management Maintenance

Vegetation management, i.e., assessment of the fuel modification zone and fuel modification area's condition and removal of dead and dying and undesirable species; as well as thinning as necessary to maintain specified plant spacing and fuel densities, shall be completed annually by May 1 of each year, and more often as needed for fire safety, as determined by the RCFD. The vegetation management will be funded by the Project and shall be conducted by their contractor(s). The Project shall be responsible for all vegetation management throughout the development, in compliance with the Project FPP that is consistent with requirements.

The permanent fuel maintenance zones required for the Project will be maintained by the applicant during construction, and by the owner of each pad or a Property Management Association, which will be responsible for vegetation management once the Project is built out and the adjacent areas are developed. The Owner or Property Management Company will be responsible for streetscape and vegetation management in perpetuity.

On-going/as-needed fuel modification maintenance during the interim period while the Project is built out and adjacent parcels are developed, which may be one or more years, will include necessary measures for consistency with the FPP, including:

- Regular Maintenance of dedicated Open Space.
- Removal or thinning of undesirable combustible vegetation and replacement of dead or dying landscaping.
- Maintaining ground cover at a height not to exceed 18 inches. Annual grasses and weeds shall be maintained at a height not to exceed three inches.
- Removing accumulated plant litter and dead wood. Debris and trimmings produced by thinning and pruning should be removed from the Project site or chipped and evenly dispersed in the same area to a maximum depth of 4 inches.
- Maintaining manual and automatic irrigation systems for operational integrity and programming. Effectiveness should be regularly evaluated to avoid over or under-watering.
- Complying with these FPP requirements on a year-round basis. Annual inspections are conducted following the natural drying of grasses and fine fuels, between the months of May and June, depending on precipitation during the winter and spring months.

5.4.3 Environmentally Sensitive Areas/Open Space

There should not be a need to modify the FMZ as it is planned to meet the fuel management needs of the Project site and comply with the fire code. However, if unforeseen circumstances were to arise that require hazard reduction within an area considered environmentally sensitive or part of the area designated Open Space Conservation, it may require approval from the County and the appropriate resource agencies (California Department of Fish and Game, U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers) prior to any vegetation management activities occurring within those areas.

5.4.4 Prohibited Plants

Certain plants are considered prohibited in the landscape due to characteristics that make them highly flammable. These characteristics can be physical (structure promotes ignition or combustion) or chemical (volatile chemicals increase flammability or combustion characteristics). The plants included in the Prohibited Plant List (Appendix D) are unacceptable from a fire safety standpoint and will not be planted on the Project site or allowed to establish opportunistically within fuel modification zones or landscaped areas.

5.4.5 Construction Phase Vegetation Management

Vegetation management requirements shall be implemented at commencement and throughout the construction phase. Vegetation management for the Project area shall be performed pursuant to the FPP and RCFD requirements on all building locations prior to the start of work and prior to any import of combustible construction materials. Adequate fuel breaks shall be created around all grading, site work, and other construction activities in areas where there is flammable vegetation. Combustible materials will not be brought on-site without prior fire department approval.

In addition to the requirements outlined above, the Project will comply with the following important risk-reducing vegetation management guidelines:

- All-new power lines shall be installed underground for fire safety purposes. Temporary construction power lines may be allowed in areas that have been cleared of combustible vegetation.
- Caution must be used not to cause erosion or ground (including slope) instability or water runoff due to vegetation removal, vegetation management, maintenance, landscaping, or irrigation.

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SOURCE: AERIAL-BING MAPPING SERVICE; DEVELOPMENT- RGA 2022

DUDEK

0 405 810 Feet

FIGURE 9

Fuel Modification Plan

Fire Protection Plan for West Campus Upper Plateau Project

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6 Alternative Materials and Methods

As previously mentioned, due to the constraints within the southern and southeastern portions of the Project site, the full recommended FMZ may not be achievable, depending on the final location of structures. As such, this FPP incorporates the use of a heat-deflecting wall that will be positioned along the exposed boundary of the Development Area where the full FMZ is not achievable. This additional fire protection measure is customized for the Project site based on the analysis results and focus on providing functional equivalency as a 100 feet wide fuel modification zone adjacent to open space areas. Additionally, based on fire behavior analysis, fuels within the open space areas are not expected to pose a significant threat to Project structures.

Research has indicated that the closer a fire is to a structure, the higher the level of heat exposure (Cohen 2000). However, studies indicate that given certain assumptions (e.g., 10 meters of low fuel landscape, no open windows), wildfire does not spread to homes unless the fuel and heat requirements (of the home) are sufficient for ignition and continued combustion (Cohen 1995, Alexander et al. 1998). Construction materials and methods can prevent or minimize ignitions. Similar case studies indicate that with nonflammable roofs and vegetation modification from 10–18 meters (roughly 32–60 feet) in southern California fires, 85–95% of the homes survived (Howard et al. 1973, Foote and Gilless 1996). Similarly, San Diego County after fire assessments indicate strongly that the building codes are working in preventing home loss: of 15,000 structures within the 2003 fire perimeter, 17% (1,050) were damaged or destroyed. However, of the 400 structures built to the 2001 codes (the most recent at the time), only 4% (16) were damaged or destroyed. Further, of the 8,300 homes that were within the 2007 fire perimeter, 17% were damaged or destroyed. A much smaller percentage (3%) of the 789 homes that were built to 2001 codes were impacted and an even smaller percentage (2%) of the 1,218 structures built to the 2004 Codes were impacted (IBHS 2008). Damage to the structures built to the latest codes is likely from flammable landscape plantings or objects next to structures or open windows or doors (Hunter 2008).

Obstacles, including non-combustible walls can block or deflect all or part of the radiation and heat, thus making narrower fuel modification distances possible. Fire behavior modeling conducted for the Project indicates that fires in the open space area would result in roughly 10-foot flame lengths under summer conditions. Extreme conditions may result in longer flame lengths approaching 18 feet.

As indicated in this report, the FMZs and additional fire protection measures proposed for the Project provides an equivalent wildfire buffer for structures adjacent to open space land where the full FMZ is not achievable. These recommendations are based on a variety of analysis criteria including predicted flame length, fire intensity (Btu), Project site topography and vegetation, extreme and typical weather, position of structures on pads, position of roadways, adjacent fuels, fire history, current vs. proposed land use, neighboring communities relative to the Project, and type of construction. The fire intensity research conducted by Cohen (1995), Cohen and Butler (1996), and Cohen and Saveland (1997) and Tran et al. (1992) supports the fuel modification alternative proposed for the Project.

6.1 Additional Structural Protection Measures

The following additional measures will be implemented to “mitigate” potential structure fire exposure related to the reduced FMZs in the southern and southeastern portions of the Project site. These measures are customized for the Project site, its unique topographical and vegetative conditions, and focus on providing functional equivalency as a full fuel modification zone. As detailed in Section 5.6, the FMZ for the Project would include a minimum 5-foot non-combustible zone, up to 95-foot-wide irrigated zone or equivalent, and up to a 70-foot-wide thinning zone. In order to provide compensating structural protection in the absence of a 100-foot wide FMZ, and in addition to the structures being built to the latest ignition resistant codes, structures in the southern and southeastern portions of the Project site that are unable to achieve the full 100-foot FMZ will also include the following features for additional fire prevention, protection, and suppression:

1. Windows will be upgraded on the preserved vegetation side of the structures subject to FMZ less than 100 feet to include dual pane, both panes tempered, exceeding the code requirement.
2. Minimum 1-hour fire rated exterior walls and doors (including roll up doors); one layer of 5/8-inch type X gypsum sheathing applied behind the exterior covering or cladding on the exterior side of the framing, from the foundation to the roof, for all exterior walls of each building facing the open space areas.
3. The vents will be ember-resistant for (recommend BrandGuard, O'Hagin, or similar vents). All vents used for this Project will be approved by RCFD.
4. A 6-foot heat deflecting wall will be constructed of concrete masonry units (CMUs) between on-site structures and unmaintained open space.
5. Annually hire a 3rd party inspector to evaluate FMZ areas site wide to confirm they meet the requirements of this FPP and RCFD.

Implementation of these additional fire protection features would justify a reduced FMZ. The information provided herein supports the ability of the proposed structures and FMZs to withstand the predicted short duration, low to moderate intensity wildfire, and ember shower that would be expected from a wildfire burning in the vicinity of the Project site or within the Project site's landscape.

7 Wildfire Education Program

The business owners of the Upper West Campus Specific Plan Project will be provided a proactive educational component disclosing the potential wildfire risk and this report's requirements. This educational information provided by the Owner or Property Management must include maintaining the landscape and structural components according to the appropriate standards and embracing a "Ready, Set, Go " stance on evacuation. All educational materials should be reviewed and approved by RCFD.

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8 Conclusion

The requirements and recommendations set forth in this FPP meet fire safety, building design element, infrastructure, fuel management/modification, and landscaping recommendations of codes governing development in High and Very High FHSZ and WUI. The recommendations provided in the FPP have also been designed specifically for the proposed construction of structures within areas designated as FHSZ and/or WUI. When properly implemented on an ongoing basis, the fire protection strategies proposed in this FPP should significantly reduce the potential fire threat to vegetation on the community and its structures, as well as assist RCFD in responding to emergencies within the Project site. The fire protection system provided for the Project site includes a redundant layering of code-compliant, fire-resistant construction materials and methods that have been shown through post-fire damage assessments to reduce the risk of structural ignition. Additionally, modern infrastructure would be provided, and all structures are required to include interior, automatic fire sprinklers consistent with the County's regulatory standards. Further, the proposed fuel modification for structures adjacent to the open space areas would provide a buffer between fuels in the open space and structures within the Project site.

The requirements and recommendations provided in this FPP have been designed specifically for the Project. This analysis and its fire protection justifications are supported by fire science research, results from previous wildfire incidents, and fire agencies that have approved these concepts. The Project design features, asphalt roads and parking stalls, and a fully irrigated landscape, would provide a level of safety equal to a 100-foot wide FMZ.

Ultimately, it is the intent of this FPP to guide the fire protection efforts for the Project in a comprehensive manner. Implementation of the measures detailed in this FPP will reduce the risk of wildfire at the Project site and will improve the ability of firefighters to fight fires on the properties and protect property and neighboring resources, irrespective of the cause or location of ignition.

It must be noted that during extreme fire conditions, there are no guarantees that a given structure will not burn. Precautions and minimizing actions identified in this report are designed to reduce the likelihood that fire will impinge upon the Project's assets or threaten its visitors. Additionally, there are no guarantees that fire will not occur in the area or that fire will not damage property or cause harm to persons or their property. Implementation of the required enhanced construction features provided by the applicable codes and the fuel modification requirements provided in this FPP will reduce the Project site's vulnerability to wildfire. It will also help accomplish the goal of this FPP to assist firefighters in their efforts to defend structures.

It is recommended that the Upper West Campus Plateau Project maintain a conservative approach to fire safety. This approach must include maintaining the landscape and structural components according to the appropriate standards and embracing a "Ready, Set, Go!" stance on evacuation. The Project is not to be considered a shelter-in-place development. However, the fire agencies and/or law enforcement officials may, during an emergency, as they would for any new development providing the layers of fire protection as the Project, determine that it is safer to temporarily refuge employees or visitors on the Project site. When an evacuation is ordered, it will occur according to pre-established evacuation decision points or as soon as notice to evacuate is received, which may vary depending on many environmental and other factors. Fire is a dynamic and somewhat unpredictable occurrence and it is important for anyone living at the WUI to educate themselves on practices that will improve safety.

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Appendix A

Photograph Log

Photograph 1. View of an existing dirt access road and the low-lying grass-shrub vegetation along the rear yards of the existing single-family residential community to the north of the Project site. Photograph taken facing east standing just inside of the Vista Grande Drive paved road terminus.

Photograph 2. View of the existing Vista Grande Dr. dirt road access road and the low-lying grass-shrub vegetation in the northern portion of the Project site (open space-conservation and open space areas). Photograph taken facing south standing just inside of the Vista Grande Drive paved road terminus.

Photograph 3. View of an existing on-site public facility (water tank) located at the terminus of Vista Grande Drive. Photograph taken facing southwest standing just inside of the Vista Grande Drive paved road terminus.

Photograph 4. View looking north towards the existing single-family residential community to the north of the Project site. Photograph taken facing north standing just inside of the Vista Grande Drive paved road terminus. Note the gate marks the end of the paved portion of Vista Grande Drive.

Photograph 5. View of the on-site Vista Grande Dr. dirt road access road and the low-lying grass-shrub vegetation located in the northern portion of the Project site (open space-conservation and open space areas). Photograph taken facing south/southeast standing along the Vista Grande Drive dirt access road.

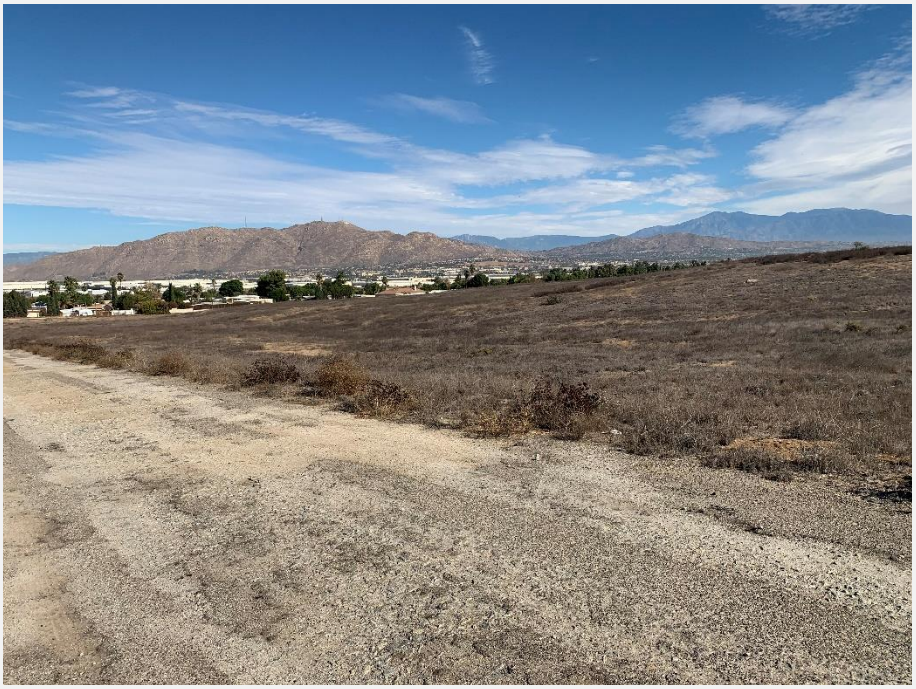
Photograph 6. Photograph example of the low-lying grass-shrub vegetation that is located throughout the entire Project site (represented as Gr1 – short, sparse dry-climate grass, Gr2 – low load dry climate grasses, and Gs1 – low load grass-shrub). Specific image taken in the northern portion of the Project site.

Photograph 7. View of the on-site low-lying grass-shrub vegetation located in the northern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing south/southeast standing along the Vista Grande Drive dirt access road.

Photograph 8. View of the on-site Vista Grande Drive dirt access road and low-lying grass-shrub vegetation located in the northern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing south/southwest standing along the Vista Grande Drive dirt access road.

Photograph 9. View of the on-site low-lying grass-shrub vegetation located in the northwestern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing west standing along the dirt access road just outside of the retired AFB fenced facilities area.

Photograph 10. View of the on-site low-lying grass-shrub vegetation located in the northwestern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing northwest standing along the dirt access road just outside of the retired AFB fenced facilities area.



Photograph 11. View of the on-site low-lying grass-shrub vegetation located in the northern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing north/northeast standing along the Vista Grande Drive dirt access road.

Photograph 12. View of the on-site low-lying grass-shrub vegetation located in the northwestern portion of the Project site, just outside of the fenced AFB facility (proposed business park area). Photograph taken facing west/northwest standing along the dirt access road just outside of the retried AFB fenced facilities area.

Photograph 13. View of the on-site low-lying grass-shrub vegetation located in the northwestern portion of the Project site, looking east towards the Vista Grande Drive access road (proposed business park area). Photograph taken facing east standing along the dirt access road just outside of the retired AFB fenced facilities area.

Photograph 14. View of the on-site low-lying grass-shrub vegetation located in the northwestern portion of the Project site, looking west towards the western property boundary. Photograph taken facing west standing along the dirt access road just outside of the retired AFB fenced facilities area.

Photograph 15. View of the on-site low-lying grass-shrub vegetation located in the northeastern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing northeast standing along the dirt access road just outside of the retired AFB fenced facilities area.

Photograph 16. View of the on-site low-lying grass-shrub vegetation located in the northeastern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing north standing along the dirt access road just outside of the retired AFB fenced facilities area.

Photograph 17. View of the on-site low-lying grass-shrub vegetation located in the northern portion of the Project site, just outside of the fenced retired AFB facility (proposed business park area). Photograph taken facing north looking at the existing Vista Grande Drive entrance standing along the dirt access road just outside of the retired AFB fenced facilities area.

Photograph 18. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation located along the proposed Arclight Drive road. Photograph taken facing east standing at corner of Airman Drive and Arclight Drive.

Photograph 19. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation located along the proposed Arclight Drive road. Photograph taken facing southeast standing along Arclight Drive in the center of the site.

Photograph 20. Photograph taken inside the fenced retired AFB facilities area of existing structures and the on-site low-lying grass-shrub vegetation located south of Arclight Drive. Photograph taken facing southeast standing along Arclight Drive.

Photograph 21. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation located in the northeastern portion of the project site, just north of Arclight Drive. Photograph taken facing northwest.

Photograph 22. Photograph taken inside the fenced retired AFB facilities area of existing structures located at the eastern end of Arclight Drive. Photograph taken facing east standing along proposed Arclight Drive.

Photograph 23. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation located in the eastern portion of the project site, just south of proposed Arclight Drive. Photograph taken facing south standing along proposed Arclight Drive.

Photograph 24. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation and existing Linebacker Drive located in the eastern portion of the project site. Photograph taken facing southeast standing at the intersection of the existing Arclight Drive and Linebacker Road.

Photograph 25. Photograph taken inside the fenced retired AFB facilities area of existing structures located at the eastern end of Arclight Drive. Photograph taken facing east/southeast.

Photograph 26. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation located in the eastern/northeastern portion of the project site (proposed Industrial area). Photograph taken facing northeast.

Photograph 27. Photograph taken inside the fenced retired AFB facilities area of the on-site low-lying grass-shrub vegetation located in the eastern/northeastern portion of the project site (proposed Industrial area). Photograph taken facing west.

Photograph 28. Photograph taken inside the fenced retired AFB facilities area of existing structures and the low-lying grass-shrub vegetation located in the center of the Project site. Photograph taken facing north standing along the existing Linebacker Road.

Photograph 29. Photograph taken inside the fenced retired AFB facilities area of existing structures located along the east side of the existing Linebacker Road. Photograph taken facing south standing along the existing Linebacker Road.

Photograph 30. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the southern portion of the Project site. Photograph taken facing south/southwest towards the southern open space-conservation area.

Photograph 31. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the southern portion of the Project site. Photograph taken facing west along the southern AFB fenced area.

Photograph 32. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the southern portion of the Project site. Photograph taken facing south/southwest towards the southern open space-conservation area.

Photograph 33. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the southern portion of the Project site. Photograph taken facing north standing at the intersection of the existing Airman Drive and Cactus Circle East.

Photograph 34. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the southern portion of the Project site. Photograph taken facing south/southwest towards the southern open space-conservation area.

Photograph 35. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the western portion of the Project site. Photograph taken facing west.

Photograph 36. View of an existing dirt access road and the low-lying grass-shrub vegetation along the rear yards of the existing single-family residential community to the north of the Project site. Photograph taken facing east.

Photograph 37. Photograph taken inside the fenced retired AFB facilities area of low-lying grass-shrub vegetation located in the western portion of the Project site. Photograph taken facing west.

Photograph 38. Photograph taken of the open space vegetation located along the northern side E. Alessandro Blvd.

Photograph 39. Photograph of the existing dirt road access road along the single-family homes north of the project site and the low-lying grass-shrub vegetation in the northeastern portion of the Project site (open space-conservation and open space areas). Photograph taken facing west.

Appendix B
Fire History

5-Mile Buffer

Project Site

Quantity of Times Burned

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Date: 6/15/2022 - Last saved by: lterry - Path: Z:\Projects\j1364001\MAPDOC\DOCUMENT\Fire\Appendix B Fire History 2021.mxd

SOURCE: BASE MAP- ESRI MAPPING SERVICE; FIRE DATA-CALFIRE 2021

[redacted]

N

0 1 2 Miles

APPENDIX B

Fire History Map

Fire Protection Plan for West Campus Upper Plateau Project

Appendix C

Fire Behavior Analysis

1 BehavePlus Fire Behavior Modeling History

Fire behavior modeling has been used by researchers for approximately 50+ years to predict how a fire will move through a given landscape (Linn 2003). The models have had varied complexities and applications throughout the years. One model has become the most widely used as the industry standard for predicting fire behavior on a given landscape. That model, known as “BEHAVE”, was developed by the U. S. Government (USDA Forest Service, Rocky Mountain Research Station) and has been in use since 1984. Since that time, it has undergone continued research, improvements, and refinement. The current version, BehavePlus 6.0, includes the latest updates incorporating years of research and testing. Numerous studies have been completed testing the validity of the fire behavior models’ ability to predict fire behavior given site specific inputs. One of the most successful ways the model has been improved has been through post-wildfire modeling (Brown 1972, Lawson 1972, Sneeuwjagt and Frandsen 1977, Andrews 1980, Brown 1982, Rothermel and Rinehart 1983, Bushey 1985, McAlpine and Xanthopoulos 1989, Grabner, et. al. 1994, Marsden-Smedley and Catchpole 1995, Grabner 1996, Alexander 1998, Grabner et al. 2001, Arca et al. 2005). In this type of study, Behave is used to model fire behavior based on pre-fire conditions in an area that recently burned. Real-world fire behavior, documented during the wildfire, can then be compared to the prediction results of Behave and refinements to the fuel models incorporated, retested, and so on.

Fire behavior modeling conducted on this site includes a relatively high-level of detail and analysis which results in reasonably accurate representations of how wildfire may move through available fuels on and adjacent the property. Fire behavior calculations are based on site-specific fuel characteristics supported by fire science research that analyzes heat transfer related to specific fire behavior. To objectively predict flame lengths, spread rates, and fireline intensities, this analysis incorporated predominant fuel characteristics, slope percentages, and representative fuel models observed on site. The BehavePlus fire behavior modeling system was used to analyze anticipated fire behavior within and adjacent to key areas just outside of the proposed lots. Predicting wildland fire behavior is not an exact science. As such, the movement of a fire will likely never be fully predictable, especially considering the variations in weather and the limits of weather forecasting. Nevertheless, practiced and experienced judgment, coupled with a validated fire behavior modeling system, results in useful and accurate fire prevention planning information. To be used effectively, the basic assumptions and limitations of BehavePlus must be understood.

- First, it must be realized that the fire model describes fire behavior only in the flaming front. The primary driving force in the predictive calculations is dead fuels less than one-quarter inch in diameter. These are the fine fuels that carry fire. Fuels greater than one inch have little effect while fuels greater than three inches have no effect on fire behavior.
- Second, the model bases calculations and descriptions on a wildfire spreading through surface fuels that are within six feet of the ground and contiguous to the ground. Surface fuels are often classified as grass, brush, litter, or slash.
- Third, the software assumes that weather and topography are uniform. However, because wildfires almost always burn under non-uniform conditions, length of projection period and choice of fuel model must be carefully considered to obtain useful predictions.

- Fourth, the BehavePlus fire behavior computer modeling system was not intended for determining sufficient fuel modification zone/defensible space widths. However, it does provide the average length of the flames, which is a key element for determining "defensible space" distances for minimizing structure ignition.

Although BehavePlus has some limitations, it can still provide valuable fire behavior predictions which can be used as a tool in the decision-making process. 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 on a site. The type and quantity will depend upon the soil, climate, geographic features, and the fire history of the site. 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[1] and the five custom fuel models developed for Southern California[2]. 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 BehavePlus. 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[3] developed for use in BehavePlus modeling efforts. These new models attempt to improve the accuracy of the standard 13 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 new 40 fuel models:

- Grass — Models GR1 through GR9
- Grass-shrub — Models GS1 through GS4
- Shrub — Models SH1 through SH9

1 Anderson, Hal E. 1982. Aids to Determining Fuel Models for Estimating Fire Behavior. USDA Forest Service Gen. Tech. Report INT-122. Intermountain Forest and Range Experiment Station, Ogden, UT.
2 Weise, D.R. and J. Regelbrugge. 1997. Recent chaparral fuel modeling efforts. Prescribed Fire and Effects Research Unit, Riverside Fire Laboratory, Pacific Southwest Research Station. 5p.
3 Scott, Joe H. and Robert E. Burgan. 2005. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Gen. Tech. Rep. RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 72 p.

- Timber-understory Models TU1 through TU5
- Timber litter Models TL1 through TL9
- Slash blowdown Models SB1 through SB4

BehavePlus software was used in the development of the West Campus Upper Plateau Project (Proposed Project) Fire Protection Plan (FPP) in order to evaluate potential fire behavior for the Project site. Existing site conditions were evaluated, and local weather data was incorporated into the BehavePlus modeling runs.

2 Fuel Models

Dudek utilized the BehavePlus software package to analyze fire behavior potential for the Proposed Project site in Riverside County. As is customary for this type of analysis, five scenarios were evaluated, including two summer, onshore weather condition (northwest and southwest of the Project Site) and three extreme fall, offshore weather condition (northeast, east, and south of the Project Site). The Project site is located on the former March Air Force Base (AFB) munitions bunker in the western portion of the March JPA planning area. The Project site is surrounded by single-family residential homes to the north, south, and west and commercial buildings to the east. With that said, fuels and terrain within and adjacent to the Project development area could produce flying embers that may affect the project, but defenses have been built into the structures to prevent ember penetration and to extinguish fires that may result from ember penetration. It is the fuels directly adjacent to and within fuel modification zones that would have the potential to affect the project’s structures from a radiant and convective heat perspective as well as from direct flame impingement. BehavePlus software requires site-specific variables for surface fire spread analysis, including fuel type, fuel moisture, wind speed, and slope data. The output variables used in this analysis include flame length (feet), rate of spread (feet/minute), fireline intensity (BTU/feet/second), and spotting distance (miles). The following provides a description of the input variables used in processing the BehavePlus models for the Proposed Project site. In addition, data sources are cited and any assumptions made during the modeling process are described.

2.1 Vegetation (Fuels)

To support the fire behavior modeling efforts conducted for this FPP, the different vegetation types observed within the project areas and adjacent to the developed portion of the project site were classified into the aforementioned numeric fuel models. As is customary for this type of analysis, the terrain and fuels within the project areas and adjacent to the developed portion of the project site are used for determining flame lengths and fire spread. It is these fuels that would have the potential to affect the project’s structures from a radiant and convective heat perspective as well as from direct flame impingement.

The Project site is located on the former March AFB munitions bunker in the western portion of the March JPA planning area. The Project site surface conditions generally consist of unimproved earthen terrain, with mostly low-load native grasses and grass-shrub vegetation communities. Vegetation types were derived from a site visit that was conducted on November 16, 2021 by a Dudek Fire Protection Planner. Based on the site visit and the anticipated pre- and post- Project vegetation conditions, three different fuel models were used in the fire behavior modeling effort to represent the current vegetation conditions throughout the Project site and one additional fuel model was used to depict a fire post construction, as presented herein. Fuel model attributes are summarized in Table 1. Modeled areas include short/sparse to low-load grasses (Gr1 and Gr2) throughout the project site, intermixed with low load grass/shrubs communities (Gs1). For modeling the post-development condition, fuel model assignments were re-classified to FM8 representing an irrigated landscape and Gs2 representing 50% thinning grass landscape up to 100 feet from the structures.

Table 1: Existing Fuel Model Characteristics

Fuel Model	Description	Location	Fuel Bed Depth (Feet)
Gr1	Short, sparse, dry climate grasses	Fuel type exists throughout the entire project site.	1.0 ft.
Gr2	Low load, dry climate grasses	Fuel type exists throughout the entire project site; Fuel type will represent post development 50% thinning zone.	>2.0 ft.
Gs1	Low Load, dry climate grass-shrub	Fuel type intermixed throughout the project site.	<3.0 ft.
FM8	Short needle litter	Fuel type representing post development fully irrigated setback and irrigated zones	<1.0 ft.

2.2 Topography

Slope is a measure of angle in degrees from horizontal and can be presented in units of degrees or percent. Slope is important in fire behavior analysis as it affects the exposure of fuel beds. Additionally, fire burning uphill spreads faster than those burning on flat terrain or downhill as uphill vegetation is pre-heated and dried in advance of the flaming front, resulting in faster ignition rates. The site is mostly flat with slopes approximately 4 to 7% throughout measured around the perimeter of the proposed project site from U.S. Geological Survey (USGS) topographic maps.

2.3 Weather

Historical weather data for the Riverside County region was utilized in determining appropriate fire behavior modeling inputs for the Proposed Project area fire behavior evaluations. To evaluate different scenarios, data from both the 50th and 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 report. Weather data sets from the Clark RAWS[4] were utilized in the fire modeling runs.

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 the RAWS was evaluated from August 1 through November 30 for each year between 2000 and 2021 (extent of available data record) for 97th percentile weather conditions and from June 1 through September 30 for each year between 2000 and 2021 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 BehavePlus. Wind speed data resulting from the Fire Family Plus analysis was also

4 https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCCLK
Latitude: 33.856239 Longitude: -117.273220; Elevation: 1,720 ft.)

determined. Initial wind direction and wind speed values for the two BehavePlus runs were manually entered during the data input phase. The input wind speed and direction is roughly an average surface wind at 20 feet above the vegetation over the analysis area. Table 2 summarizes the wind and weather input variables used in the Fire BehavePlus modeling efforts.

Table 2: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50th Percentile)	Peak Weather (97th Percentile)
Fuel Models	FM8, Gr1, Gr2, and Gs1	FM8, Gr1, Gr2, and Gs1
1 h fuel moisture	5%	1%
10 h fuel moisture	6%	4%
100 h fuel moisture	12%	6%
Live herbaceous moisture	45%	30%
Live woody moisture	95%	60%
20 ft. wind speed	14 mph (sustained winds)	17 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	260 and 300	45, 100 and 180
Wind adjustment factor	0.4	0.4
Slope (uphill)	4 to 5%	5 to 7%

3 Fire Behavior Modeling Efforts

As mentioned, the BehavePlus fire behavior modeling software package was utilized in evaluating anticipated fire behavior adjacent to the Proposed Project site. Five focused analyses were completed for both the existing project site conditions and the post project conditions, each assuming worst-case fire weather conditions for a fire approaching the project site from the northwest, southwest, east, south, and southwest. The results of the modeling effort included anticipated values for surface fires (flame length (feet), rate of spread (mph), fireline intensity (Btu/ft/s), and spotting distance (miles). The aforementioned fire behavior variables are an important component in understanding fire risk and fire agency response capabilities. Flame length, the length of the flame of a spreading surface fire within the flaming front, is measured from midway in the active flaming combustion zone to the average tip of the flames (Andrews, Bevins, and Seli 2008). Fireline intensity is a measure of heat output from the flaming front, and also affects the potential for a surface fire to transition to a crown fire. Fire spread rate represents the speed at which the fire progresses through surface fuels and is another important variable in initial attack and fire suppression efforts (Rothermel and Rinehart 1983). Spotting distance is the distance a firebrand or ember can travel down wind and ignite receptive fuel beds. Three fire modeling scenario locations were selected to better understand the different fire behavior that may be experienced on or adjacent the site based on slope and fuel conditions; these three fire scenarios are explained in more detail below:

Fire Scenario Locations and Descriptions:

- **Scenario 1:** A summer, on-shore fire (50th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the northwestern portion of the Project site. The terrain is flat (approximately 5% slope) with potential ignition sources from a car or single-family residential structure fire north/west of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.

- **Scenario 2:** A fall, off-shore fire (97th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the northeastern portion of the Project site. The terrain is flat (approximately 7% slope) with potential ignition sources from a car or structure fire north/east of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 3:** A fall, off-shore fire (97th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the eastern portion of the Project site. The terrain is flat (approximately 5% slope) with potential ignition sources from a car or structure fire east of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 4:** A fall, off-shore fire (97th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the southern portion of the Project site. The terrain is flat (approximately 6% slope) with potential ignition sources from a car or structure fire south of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.
- **Scenario 5:** A summer, on-shore fire (50th percentile weather condition) burning in sparse to low-load grasses and grass-shrub dominated vegetation in the southwestern portion of the Project site. The terrain is flat (approximately 5% slope) with potential ignition sources from a car or structure fire south/west of the property. This type of fire would typically spread relatively slow within the project area before reaching the developed portion of the Project site.

4 Fire Behavior Modeling Results

The results presented in Tables 3 and 4 depict values based on inputs to the BehavePlus software and are not intended to capture changing fire behavior as it moves across a landscape. Changes in slope, weather, or pockets of different fuel types are not accounted for in this analysis. For planning purposes, the averaged worst-case fire behavior is the most useful information for conservative fuel modification design. 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.

Based on the BehavePlus analysis, wildfire behavior on the Project site is expected to be primarily of low to moderate intensity throughout the non-maintained surface grasses and grass-shrub dominated fuels throughout the entire Project site. Worst-case fire behavior is expected in untreated, surface grass-/grass-shrubs vegetation under peak weather conditions (represented by Fall Weather, Scenario 3). The fire is anticipated to be a wind-driven fire from the east/southeast during the fall. Under such conditions, expected surface flame length is expected to be significantly lower in the areas where fuel modification occurs, with flames lengths reaching approximately 18 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 3,037 BTU/feet/second with moderate spread rates of 6.2 mph and could have a spotting distance up to 1.5 miles away.

Fires burning from the southwest/northwest and pushed by ocean breezes typically exhibit less severe fire behavior due to lower wind speeds and higher humidity. Under typical onshore weather conditions, a low-load grass/grass-shrub vegetation fire could have flame lengths between approximately 2 feet and 6 feet in height and spread rates between 0.2 and 0.7 mph. Spotting distances, where airborne embers can ignite new fires downwind of the initial fire, range from 0.1 to 0.3 miles.

Based on the BehavePlus analysis (Table 4), post development fire behavior is expected in irrigated and replanted with plants that are acceptable with the Riverside County Fire Department (RCFD) (Zone A and Zone B – FM8), as well in a thinned area of the existing grasses and shrubs (Zone C – Gr2) under peak weather conditions (represented by Fall Weather, Scenario 3). Under such conditions, expected surface flame length is expected to be significantly lower in the areas where fuel modification occurs, with flames lengths reaching approximately 18 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 3,037 BTU/feet/second with relatively slow spread rates of 6.2 mph and could have a spotting distance up to 1.3 miles away. Therefore, the 100-foot Fuel Modification Zone (FMZ) proposed for the West Campus Upper Plateau Project is approximately 5-times the flame length of the worst case fire scenario under peak weather conditions and would provide adequate defensible space to augment a wildfire approaching the perimeter of the Project site.

Table 3: RAWS BehavePlus Fire Behavior Model Results – Existing Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[5]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[6]
Scenario 1: 5% slope, Summer, On-shore Winds from the northwest (Current conditions)				
Sparse load grasses (Gr1)	2.1	0.2	28	0.1
Low load grasses (Gr2)	5.8	0.7	258	0.2
Low load grass-shrubs (Gs1)	3.9	0.3	111	0.2
Scenario 2: 7% slope, Fall, Offshore, Extreme Fall Winds from the northeast (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.1 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	873 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	7.0 (14.0)	0.7 (3.0)	385 (1,763)	0.3 (1.1)
Scenario 3: 5% slope, Fall, Offshore, Extreme Fall Winds from the east (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.2 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	870 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	6.9 (14.0)	0.7 (3.0)	384 (1,763)	0.3 (1.1)
Scenario 4: 6% slope, Fall, Offshore, Extreme Fall Winds from the south (Current conditions)				
Sparse load grasses (Gr1)	4.0 (4.0)	0.7 (0.7)	115 (115)	0.2 (0.5)
Low load grasses (Gr2)	10.1 (18.0)	1.8 (6.2)	867 (3,037)	0.4 (1.3)
Low load grass-shrubs (Gs1)	7.0 (14.0)	0.6 (3.0)	383 (1,763)	0.3 (1.1)
Scenario 5: 4% slope, Summer, Onshore Winds from the southwest (Current conditions)				
Sparse load grasses (Gr1)	2.1	0.2	28	0.1
Low load grasses (Gr2)	6.3	0.9	311	0.3
Low load grass-shrubs (Gs1)	4.3	0.3	133	0.2

[5] mph = miles per hour
[6] Spotting distance from a wind driven surface fire; it should be noted that the wind mph in parenthesis represent peak gusts of 50 mph.

Table 4: RAWS BehavePlus Fire Behavior Model Results – Post Project Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[7]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[8]
Scenario 1: 5% slope, Summer, On-shore Winds from the northwest (Current conditions)				
FMZ Zone A and B (FM8)	1.3	0.0	9	0.1
FMZ Zone C (Gr2)	5.8	0.7	258	0.2
Scenario 2: 7% slope, Fall, Offshore, Extreme Fall Winds from the northeast (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	873 (3,037)	0.4 (1.3)
Scenario 3: 5% slope, Fall, Offshore, Extreme Fall Winds from the east (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	870 (3,037)	0.4 (1.3)
Scenario 4: 6% slope, Fall, Offshore, Extreme Fall Winds from the south (Current conditions)				
FMZ Zone A and B (FM8)	2.0 (3.0)	0.1 (0.2)	25 (62)	0.1 (0.4)
FMZ Zone C (Gr2)	10.1 (18.0)	1.8 (6.2)	867 (3,037)	0.4 (1.3)
Scenario 5: 4% slope, Summer, Onshore Winds from the southwest (Current conditions)				
FMZ Zone A and B (FM8)	1.4	0.0	11	0.1
FMZ Zone C (Gr2)	6.3	0.9	311	0.3

The following describes the fire behavior variables (Heisch and Andrews 2010) as presented in Tables 3 and 4:

Surface Fire:

- Flame Length (feet): The flame length of a spreading surface fire within the flaming front is measured from midway in the active flaming combustion zone to the average tip of the flames.
- Fireline Intensity (Btu/ft/s): Fireline intensity is the heat energy release per unit time from a one-foot wide section of the fuel bed extending from the front to the rear of the flaming zone. Fireline intensity is a function of rate of spread and heat per unit area, and is directly related to flame length. Fireline intensity and the flame length are related to the heat felt by a person standing next to the flames.
- Surface Rate of Spread (mph): Surface rate of spread is the "speed" the fire travels through the surface fuels. Surface fuels include the litter, grass, brush and other dead and live vegetation within about 6 feet of the ground.

The information in Table 5 presents an interpretation of the outputs for five fire behavior variables as related to fire suppression efforts. The results of fire behavior modeling efforts are presented in Tables 3 and 4. Identification of modeling run locations is presented graphically in Figure 4 of the FPP.

[7] mph = miles per hour
[8] Spotting distance from a wind driven surface fire; it should be noted that the wind mph in parenthesis represent peak gusts of 45 mph.

Table 5: Fire Suppression Interpretation

Flame Length (ft)	Fireline Intensity (Btu/ft/s)	Interpretations
Under 4 feet	Under 100 BTU/ft/s	Fires can generally be attacked at the head or flanks by persons using hand tools. Hand line should hold the fire.
4 to 8 feet	100-500 BTU/ft/s	Fires are too intense for direct attack on the head by persons using hand tools. Hand line cannot be relied on to hold the fire. Equipment such as dozers, pumpers, and retardant aircraft can be effective.
8 to 11 feet	500-1000 BTU/ft/s	Fires may present serious control problems -- torching out, crowning, and spotting. Control efforts at the fire head will probably be ineffective.
Over 11 feet	Over 1000 BTU/ft/s	Crowning, spotting, and major fire runs are probable. Control efforts at head of fire are ineffective.

Appendix D
Prohibited and Suggested Plant Lists

Botanical Name	Common Name	Comment*
Trees		
Abies species	Fir	F
Agonis juniperina	Juniper Myrtle	F
Casuarina cunninghamiana	River She-Oak	F
Chamaecyparis species (numerous)	False Cypress	F
Cryptomeria japonica	Japanese Cryptomeria	F
Cupressocyparis leylandii	Leyland Cypress	F
Cupressus species *(C. fobesii, C. glabra, C. sempervirens,)*	Cypress (Tecate, Arizona, Italian, others)	F
Eucalyptus species (numerous)	Eucalyptus	F, I
Juniperus species (numerous)	Juniper	F
Lithocarpus densiflorus	Tan Oak	F
Melaleuca species *(M. linariifolia, M. nesophila, M. quinquenervia)*	Melaleuca (Flaxleaf, Pink, Cajeput Tree)	F, I
Picea (numerous)	Spruce	F
Palm species (numerous)	Palm	F, I
Pinus species *(P. brutia, P. canariensis, P. b. eldarica, P. halepensis, P. pinea, P. radiata, numerous others)*	Pine (Calabrian, Canary Island, Mondell, Aleppo, Italian Stone, Monterey)	F
Platycladus orientalis	Oriental arborvitae	F
Pseudotsuga menziesii	Douglas Fir	F
Tamarix species *(T. africana, T. aphylla, T. chinensis, T. parviflora)*	Tamarix (Tamarisk, Athel Tree, Salt Cedar, Tamarisk)	F, I
Taxodium species *(T. ascendens, T. distichum, T. mucronatum)*	Cypress (Pond, Bald, Monarch, Montezuma)	F
Taxus species *(T. baccata, T. brevifolia, T. cuspidata)*	Yew (English, Western, Japanese)	F
Thuja species *(T. occidentalis, T. plicata)*	Arborvitae/Red Cedar	F
Groundcovers, Shrubs & Vines		
Acacia species	Acacia	F, I
Adenostoma fasciculatum	Chamise	F
Adenostoma sparsifolium	Red Shanks	F
Agropyron repens	Quackgrass	F, I
Anthemis cotula	Mayweed	F, I
Arctostaphylos species	Manzanita	F
Arundo donax	Giant Reed	F, I
Artemisia species *(A. abrotanium, A. absinthium, A. californica, A. caucasica, A. dracunculus, A. tridentata, A. pynocephala)*	Sagebrush (Southernwood, Wormwood, California, Silver, True tarragon, Big, Sandhill)	F
Atriplex species (numerous)	Saltbush	F, I
Avena fatua	Wild Oat	F
Baccharis pilularis	Coyote Bush	F
Bambusa species	Bamboo	F, I
Bougainvillea species	Bougainvillea	F, I
Brassica species *(B. campestris, B. nigra, B. rapa)*	Mustard (Field, Black, Yellow)	F, I

Botanical Name	Common Name	Comment*
Bromus rubens	Foxtail, Red brome	F, I
Castanopsis chrysophylla	Giant Chinquapin	F
Cardaria draba	Hoary Cress	I
Cirsium vulgare	Wild Artichoke	F,I
Conyza bonariensis	Horseweed	F
Coprosma pumila	Prostrate Coprosma	F
Cortaderia selloana	Pampas Grass	F, I
Cytisus scoparius	Scotch Broom	F, I
Eriogonum species *(E. fasciculatum)*	Buckwheat (California)	F
Fremontodendron species	Flannel Bush	F
Heterotheca grandiflora	Telegraph Plant	F
Hordeum leporinum	Wild barley	F, I
Juniperus species	Juniper	F
Lactuca serriola	Prickly Lettuce	I
Larrea tridentata	Creosote bush	F
Lolium multiflorum	Ryegrass	F, I
Lonicera japonica	Japanese Honeysuckle	F
Mimulus aurantiacus	Sticky Monkeyflower	F
Miscanthus species	Eulalie Grass	F
Muhlenbergia species	Deer Grass	F
Nicotiana species *(N. bigelovii, N. glauca)*	Tobacco (Indian, Tree)	F, I
Pennisetum setaceum	Fountain Grass	F, I
Perovskia atroplicifolia	Russian Sage	F
Phoradendron species	Mistletoe	F
Pickeringia montana	Chaparral Pea	F
Rhus (R. diversiloba, R. laurina, R. lentii)	Sumac (Poison oak, Laurel, Pink Flowering)	F
Ricinus communis	Castor Bean	F, I
Rhus Lentii	Pink Flowering Sumac	F
Salvia species (numerous)	Sage	F, I
Salsola australis	Russian Thistle	F, I
Solanum Xantii	Purple Nightshade (toxic)	I
Silybum marianum	Milk Thistle	F, I
Thuja species	Arborvitae	F
Urtica urens	Burning Nettle	F

*F = flammable, I = Invasive

Notes:

1. Plants on this list that are considered invasive are a partial list of commonly found plants. There are many other plants considered invasive that should not be planted in a fuel modification zone and they can be found on The California Invasive Plant Council's Website www.cal-ipc.org/ip/inventory/index.php. Other plants not considered invasive at this time may be determined to be invasive after further study.
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 Fuel Modification Zones and elsewhere in this development shall be subject to approval of the Fire Code Official.
5. 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.

SUGGESTED PLANT LIST FOR A DEFENSIBLE SPACE

BOTANICAL NAME	**COMMON NAME**	**Climate Zone**
TREES		
Acer		
platanoides	Norway Maple	M
rubrum	Red Maple	M
saccharinum	Silver Maple	M
saccarum	Sugar Maple	M
macrophyllum	Big Leaf Maple	C/ (R)
Alnus rhombifolia	White Alder	C/I/M (R)
Arbutus		
unedo	Strawberry Tree	All zones
Archontophoenix		
cunninghamiana	King Palm	C
Arctostaphylos spp.**	Manzanita	C/I/D
Brahea		
armata	Blue Hesper Palm	C/D
edulis	Guadalupe Palm	C/D
Ceratonia siliqua	Carob	C/I/D
Cerdidium floridum	Blue Palo Verde	D
Cercis occidentalis**	Western Redbud	C/I/M
Cornus		
nuttallii	Mountain Dogwood	I/M
stolonifera	Redtwig Dogwood	I/M
Eriobotrya		C/I/D
japonica	Loquat	C
Erythrina caffra	Kaffirboom Coral Tree	I/M
Gingko biloba "Fairmount"	Fairmount Maidenhair Tree	I/D/M
Gleditisia triacanthos	Honey Locust	
Juglans		I
californica	California Walnut	C/I
hindsii	California Black Walnut	I/D/M
Lagerstroemia indica	Crape Myrtle	I
Ligustrum lucidum	Glossy Privet	C/I/M
Liquidambar styraciflua	Sweet Gum	I
Liriodendron tulipifera	Tulip Tree	
Lyonothamnus floribundus		C
ssp. Asplenifolius	Fernleaf Catalina Ironwood	C/I/D
Melaleuca spp.	Melaleuca	C/I
Parkinsonia aculeate	Mexican Palo Verde	
Pistacia	Chinese Pistache	
chinensis	Pistachio Nut	C/I/D

vera	Pistachio Nut	I
Pittosporum		
phillyraeoides	Willow Pittosporum	C/I/D
viridiflorum	Cape Pittosporum	C/I
Platanus		
acerifolia	London Plane Tree	All zones
racemosa**	California Sycamore	C/I/M
Populus		
alba	White Poplar	D/M
fremontii**	Western Cottonwood	I
trichocarpa	Black Cottonwood	I/M
Prunus		
xblireiana	Flowering Plum	M
caroliniana	Carolina Laurel Cherry	C
ilicifolia**	Hollyleaf Cherry	C
lyonii**	Catalina Cherry	C
serrulata 'Kwanzan'	Flowering Cherry	M
yedoensis 'Akebono'	Akebono Flowering Cherry	M
Quercus		
agrifolia**	Coast Live Oak	C/I
engelmannii	Engelmann Oak	I
** suber	Cork Oak	C/I/D
Rhus		
lancea**	African Sumac	C/I/D
Salix spp.**	Willow	All zones (R)
Tristania conferta	Brisbane Box	C/I
Ulmus		
parvifolia	Chinese Elm	I/D
pumila	Siberian Elm	C/M
Umbellularia californica**	California Bay Laurel	C/I

SHRUBS		
Agave	Century Plant	D
americana	Century Plant	D
deserti	Shawis Century Plant	D
shawi**		
Amorpha fruticosa**	False Indigobush	I
Arbutus		
menziesii**	Madrone	C/I
Arctostaphylos spp.**	Manzanita	C/I/D
Atriplex**		
canescens	Hoary Saltbush	I
lentiformis	Quail Saltbush	D
Baccharis**		
glutinosa	Mule Fat	C/I
pilularis	Coyote Bush	C/I/D
Carissa grandiflora	Natal Plum	C/I
Ceanothus spp.**	California Lilac	C/I/M
Cistus spp.	Rockrose	C/I/D
Cneoridium dumosum**	Bushrue	C
Comarostaphylis**		
diversifolia	Summer Holly	C
Convolvulus cneorum	Bush Morning Glory	C/I/M
Dalea		
orcuttii	Orcutt's Delea	D
spinosa**	Smoke Tree	I/D
Elaeagnus		
pungens	Silverberry	C/I/M
Encelia**		
californica	Coast Sunflower	C/I
farinose	White Brittlebush	D/I
Eriobotrya		
deflexa	Bronze Loquat	C/I
Eriophyllum		
confertiflorum**	Golden Yarrow	C/I
staechadifolium	Lizard Tail	C
Escallonia spp.	Escallonia	C/I
Feijoa sellowiana	Pineapple Guava	C/I/D
Fouqueria splendens	Ocotillo	D
Fremontodendron**		
californicum	Flannelbush	I/M
mexicanum	Southern Flannelbush	I
Galvezia		
juncea	Baja Bush-Snapdragon	C
speciosa	Island Bush-Snapdragon	C
Garrya		
elliptica	Coast Silktassel	C/I
flavescens**	Ashy Silktassel	I/M

Heteromeles arbutifolia**	Ashy Silktassel	I/M
Lantana spp.	Toyon	C/I/M
Lotus scoparius	Lantana	C/I/D
Mahonia spp.	Deerweed	C/I
	Barberry	C/I/M
Malacothamnus		
clementinus		
	San Clemente Island Bush Mallow	C
fasciculatus**		
	Mesa Bushmallow	C/I
Melaleuca spp.		
Mimulus spp.**	Melaleuca	C/I/D
Nolina	Monkeyflower	C/I (R)
parryi		
parryi ssp. wolfii	Parry’s Nolina	I
Photinia spp.	Wolf’s Bear Grass	D
Pittosporum	Photinia	All Zones
crassifolium		
rhombifolium		CI/I
tobira ‘Wheeleri’	Queensland Pittosporum	C/I
undulatum	Wheeler’s Dwarf	C/I/D
viridiflorum	Victorian Box	C/I
Plumbago auriculata	Cape Pittosporum	C/I
Prunus	Cape Plumbago	C/I/D
caroliniana		
ilicifolia**	Carolina Laurel Cherry	C
lyonii**	Hollyleaf Cherry	C
Puncia granatum	Catalina Cherry	C
Pyracantha spp.	Pomegranate	C/I/D
Quercus	Firethorn	All Zones
dumosa**		
Rhamus	Scrub Oak	C/I
alaternus		
californica**	Italian Blackthorn	C/I
Rhaphiolepis spp.	Coffeeberry	C/I/M
Rhus	Rhaphiolepis	C/I/D
integrifolia**		
laurina	Lemonade Berry	C/I
lentii	Laurel Sumac	C/I
ovata**	Pink-Flowering Sumac	C/D
trilobata**	Sugarbush	I/M
Ribes	squawbush	I
viburnifolium		
speciosum**	Evergreen Currant	C/I
Romneya coulteri	Fuschia-Flowering Gooseberry	C/I/D
Rosa	Matilija Poppy	I
californica**		
minutifolia		

Salvia spp.**	California Wild Rose	C/I
Sambucus spp.**	Baja California Wild Rose	C/I
Symphoricarpos mollis**	Sage	All Zones
Syringa vulgaris	Elderberry	C/I/M
Tecomaria capensis	Creeping Snowberry	C/I
Teucrium fruticans	Lilac	M
Toxicodendron**	Cape Honeysuckle	C/I/D
diversilobum	Bush Germander	C/I
Verbena		
lilacina	Poison Oak	I/M
Xylosma congestum		
Yucca**	Lilac Verbena	C
schidigera	Shiny Xylosma	C/I
whipplei		
	Mojave Yucca	D
	Foothill Yucca	I

GROUNDCOVERS		
Achillea**	Yarrow	All Zones
Aptenia cordifolia	Apteria	C
Arctostaphylos spp.**	Manzanita	C/I/D
Baccharis**		
pilularis	Coyote Bush	C/I/D
Ceanothus spp.**	California Lilac	C/I/M
Cerastium tomentosum	Snow-in-Summer	All Zones
Coprosma kirkii	Creeping Coprosma	C/I/D
Cotoneaster spp.	Redberry	All Zones
Drosanthemum hispidum	Rosea Ice Plant	C/I
Dudleya		
brittonii	Brittonis Chalk Dudleya	C
pulverulenta**	Chalk Dudleya	C/I
virens	Island Live Fore-ever	C
Eschscholzia californica**	California Poppy	All Zones
Euonymus fortunei		
‘Carrierei’	Glossy Winter Creeper	M
‘Coloratus’	Purple-Leaf Winter Creeper	M
Ferocactus viridescens**	Coast Barrel Cactus	C
Gaillardia grandiflora	Blanket Flower	All Zones
Gazania spp.	Gazania	C/I
Helianthemum spp.**	Sunrose	All Zones
Lantana spp.	Lantana	C/I/D
Lasthenia		
californica**	Common Goldfields	I
glabrata	Coastal Goldfields	C
Lupinus spp.**	Lupine	C/I/M
Myoporum spp.	Myoporum	C/I
Pyracantha spp.	Firethorn	All zones
Rosmarinus officinalis	Rosemary	C/I/D
Santolina		
chamaecyparissus	Lavender Cotton	All Zones
virens	Santolina	All Zones
Trifolium frageriferum	O’Connor’s Legume	C/I
Verbena		
rigida	Verbena	All Zones
Viguiera laciniata**	San Diego Sunflower	C/I
Vinca		
minor	Dwarf Periwinkle	M

VINES		
Antigonon leptopus	San Miguel Coral Vine	C/I
Distictis buccinatoria	Blood-Red Trumpet Vine	C/I/D
Keckiella cordifolia**	Heart-Leaved Penstemon	C/I
Lonicera		
japonica 'Halliana'	Hall's Honeysuckle	All Zones
subspicata**	Chaparral Honeysuckle	C/I
Solanum		
jasminoides	Potato Vine	C/I/D

PERENNIALS		
Coreopsis		
gigantean	Giant Coreopsis	C
grandiflora	Coreopsis	All Zones
maritime	Sea Dahlia	C
verticillata	Coreopsis	C/I
Heuchera maxima	Island Coral Bells	C/I
Iris douglasiana**	Douglas Iris	C/M
Iva hayesiana**	Poverty Weed	C/I
Kniphofia uvaria	Red-Hot Poker	C/M
Lavandula spp.	Lavender	All Zones
Limonium californicum		
var. mexicanum	Coastal Statice	C
perezii	Sea Lavender	C/I
Oenothera spp.	Primrose	C/I/M
Penstemon spp.**	Penstemon	C/I/D
Satureja douglasii	Yerba Buena	C/I
Sisyrinchium		
bellum	Blue-Eyed Grass	C/I
californicum	Golden-Eyed Grass	C
Solanum		
xantii	Purple Nightshade	C/I
Zauschneria**		
californica	California Fuschia	C/I
cana	Hoary California Fuschia	C/I
'Catalina'	Catalina Fuschia	C/I

ANNUALS		
Lupinus spp.**	Lupine	C/I/M

Vertical and Horizontal Spacing Requirements for Planting Installation in Fuel Modification Zones