Fire Protection Plan

Nakano

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AMSL	Above Mean Sea Level
APN	Assessor's Parcel Number
BMZ	Brush Management Zone
BTU	British Thermal Unit
CAL FIRE	California Department of Forestry and Fire Protection
CBC	California Building Code
CC&Rs	Covenants, Conditions and Restrictions
CFC	California Fire Code
CFPP	Construction Fire Prevention Plan
CMU	Construction Masonry Unit
CVFD	Chula Vista Fire Department
FAHJ	Fire Authority Having Jurisdiction
FMZ	Fuel Modification Zone
FPP	Fire Protection Plan
FRAP	Fire and Resource Assessment Program
GIS	Geographic Information Systems
HOA	Homeowner's Association
I-805	Interstate 805
ISO	Insurance Service Office
LRA	Local Responsibility Area
MPH	miles per hour
NFPA	National Fire Protection Association
Project	Nakano Project
SDFRD	San Diego Fire-Rescue Department
SIAM	Structure Ignition Assessment Model
SRA	State Responsibility Area
USGS	United States Geological Survey
VHFHSZ	Very High Fire Hazard Severity Zone
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 Nakano Project (Project), which proposes a residential development on the 23.77-acre Project site located along the southern border of the City of Chula Vista, San Diego County, California, adjacent to the City of San Diego. As part of the Project, the Project site would be annexed to the City of San Diego prior to construction. The Project proposes the development of a total of 215 residential units, recreational amenities, water quality basins, and internal private driveways. Residential units will be a mix of detached condominiums, duplexes and multi-family townhomes.

The Project site's current designated land use is Open Space and is zoned as A-8 "Agricultural" and has been historically used for agricultural purposes. The Project is located immediately west of Interstate 805 (I-805), immediately south of the Otay River and is regionally located within the Otay Mesa area of San Diego County. The proposed development will be situated on Assessor Parcel Number (APN): 624-071-0200. Primary access to the Project site is via Dennery Road.

The Project site lies within an area considered a Very High Fire Hazard Severity Zone (VHFHSZ), as designated by the Chula Vista Fire Department (CVFD), the San Diego Fire-Rescue Department (SDFRD) and California Department of Forestry and Fire Protection (CAL FIRE). Fire hazard designations are based on topography, vegetation, and weather, amongst other factors. VHFHSZ designation does not indicate that an area is not safe for development. It does indicate that specific fire protection features that minimize structure vulnerability will be required, including Chapter 7A of the California Building Code (CBC) and provisions for maintained fuel modification zones, amongst others described in the FPP.

The Project site was formerly used for agricultural purposes, which ceased in 2010. The Project site is primarily vegetated by moderate-load grass-shrubs, moderate- to- high-load shrubs and chaparrals. Additionally, a small eucalyptus/riparian forest area is adjacent to the proposed Project development site. The Project area, like all of Southern California and San Diego County, is subject to seasonal weather conditions that can heighten the likelihood of fire ignition.

The FPP evaluates and identifies the potential fire risk associated with the Project's land uses and identifies requirements 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 CVFD along with Project-specific measures based on the Project site, its intended use, and its fire environment.

While the Project site is currently within the service area of the CVFD, once annexed to the City of San Diego, SDFRD would be the Fire Authority Having Jurisdiction (FAHJ). SDFRD Station 6 would typically be the unit selected for response to the Project site. The second closest station to the Project site is CVFD Station 3. The Project's population and number of calculated emergency calls were evaluated for their potential to impact SDFRD and CVFD's response capabilities from its nearest existing stations. The addition of approximately 82 calls per year to SDFRD Station 6's 2,252 call volume is considered insignificant. The closest existing fire station's response times conforms to SDFRD 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, may include characteristics that, under favorable weather conditions, could have the potential to facilitate fire spread. Once the

Project community is built, the on-site fire potential will be lower than its current condition due to fire safety requirements that will be implemented on-site. The proposed residential structures would be built using ignition-resistant materials pursuant to the most recent City Fire Codes and Building Codes (Chapter 7-A – focusing on structure ignition resistance from flame impingement and flying embers in areas designated as high fire hazard areas), which are the amended 2019 California Fire Code and 2019 California Building Code. This would be complemented by:

- Site-wide 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 City of San Diego response guidelines, and
- Other components that would provide properly equipped and maintained structures with a high level of fire ignition resistance.

Post wildfire save and loss assessments 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 was available, 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. San Diego County now contains some of the most restrictive codes for building within Wildland Urban Interface (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, and defensible space with the implementation of specified fire safety measures. Based on modeling and analysis of the Project area to assess its unique fire risk and fire behavior, it was determined that the standard of 100-foot-wide brush management zones (BMZs)/fuel modification zones (FMZs) would help considerably to set the Project's structures back from off-site fuels. The BMZs for the Project would be maintained in perpetuity by a funded Homeowner's Association (HOA), or similarly funded entity.

This FPP provides a detailed analysis of the Project, the potential risk from wildfire, and potential impacts on the SDFRD and CVFD, as well as analysis on meeting or exceeding the requirements of the City of San Diego and City of Chula Vista. Further, this FPP provides requirements, recommendations, and measures to reduce the risk and potential impacts to acceptable levels, as determined by SDFRD and CVFD.

1 Introduction

The Fire Protection Plan (FPP) has been prepared for the proposed Nakano Project (Project) in Chula Vista, San Diego County, California. 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 City of San Diego and City of Chula Vista thresholds. Additionally, this FPP establishes and memorialize the fire safety requirements of the Fire Authority Having Jurisdiction (FAHJ), which is currently the Chula Vista Fire Department (CVFD). However, the Project proposes the annexation of the Project site to the City of San Diego, and if approved the San Diego Fire Department would be the FAHJ. 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 current and future 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, and ignition resistive building features, fire protection systems, and 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 assets. The FPP also recommends measures that developer/builders, property owners, and the Homeowner's Association will take to reduce the probability of structural and vegetation ignition.

The Project is located within the boundaries of the CVFD; however, once annexed will be within the boundaries of the SDFRD; therefore, the FPP addresses SDFRDD'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 toward 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 brush management, 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 Project would comply with applicable portions of Chapter 15.36, Fire Code, of the City of Chula Vista's municipal code, as amended, and adopted by reference the 2019 edition of the California Fire Code (CFC) (or current edition at the time of Project approval). Chapter 15.36 is hereafter referred to as the Chula Vista Fire Code. Additionally, the Project would comply with applicable portions of Chapter 5, Article 5: Fire Protection and Prevention, of the City of San Diego's Municipal Code. Chapter 5, Article 5 is hereafter referred to as the San Diego Fire Code. It should be noted that the San Diego Fire Code adopts the 2016 California Fire Code, as amended; whereas, the Chula Vista Fire Code adopts the 2019 California Fire Code, as amended. For the purpose of this FPP, where the Chula Vista Fire Code and San Diego Fire Code differ, the Project will implement the most restrictive requirements. Further, the Project will comply with Chapter 7A of the 2019 California Building Code (CBC); the 2019 California Residential Code, Section 327; and the 2018 Edition of the International Fire Code as adopted by the County. The Project would also be subject to the provisions of Section 4291 of the Public Resources Code; Chapter 12-7A of the CA Reference Standards Code, Title 14, Division 1.5, Chapter 7, Subsection 2, Articles 1-5 and Title 14, Division 1.5, Chapter 7, Subsection 3, Section 1299 of the CA Code of Regulations; Title 19, Division 1, Chapter 7, Subchapter 1, Section 3.07 of the CA Code of Regulations; and Sections 51175-511829 of the CA Government Code.

Chapter 7A of the CBC addresses structural ignition resistance and reducing ember penetration into homes, a leading cause of structure loss from wildfires (California Building Standards Commission 2019). Thus, code compliance is an important component of the requirements of the FPP, given the Project's wildland-urban interface (WUI) location that is within an area statutorily designated as a Very High Fire Hazard Severity Zone (VHFHSZ) within a Local Responsibility Zone (LRA) by the California Department of Forestry and Fire Protection (CAL FIRE) (FRAP 2007). 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 VHFHSZ require fire hazard analysis and the application of fire protection measures to create ignition-resistant structures and defensible communities within these WUI locations. VHFHSZ designations do not, in and of themselves, indicate that it is unsafe to build in these areas. As described in the FPP, the Project would meet applicable code requirements for building in these higher 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 located along the southern border of the City of Chula Vista, adjacent to the City of San Diego; however, the Project does propose the annexation of the Project site to City of San Diego. More specifically, the site is located within the Otay Mesa area, south of the Otay River, east of I-805, and northwest of Dennery Road. Surrounding land uses include the I-805 freeway directly west, vacant land and the Otay River Valley Regional Park to the north, residential to the east (Edge Terrace) and southeast, and the Kaiser Permanente Medical Center to the south. The site is located at approximately 90 to 180 feet above mean sea level, with a downward slope towards the north to the Otay River. The approximate centroid of the project area is within Sections 19 and 24 of Township 18 South, Range 1 and 2 West, of the Imperial Beach, California U.S. Geological Survey 7.5-minute topographic quadrangle. The Project will be situated on APN 624-071-0200 (Figure 1. Project Location). Primary access to the site is via Dennery Road.

The entirety of the proposed property lies within a VHFHSZ in a LRA, as statutorily designated by CAL FIRE (2007) the SDFRD and the CVFD (Figure 2, Fire Hazard Severity Zone Map).

1.2.2 Project Description

The Project consists of development of 215 residential dwellings units consisting of 61 detached condominiums, 84 duplexes and 70 multi-family dwelling units on 23.8 acres with approximately 5 acres of hardscaped/paved roadway area. However, to represent a conservative analysis of potential unit mix, the environmental analysis assumes a maximum of 221 residential units. Development of up to 221 residential units could be supported on-site depending on the ultimate unit mix, but the Project footprint would remain the same. Recreational amenities would include a local-serving park, a regional overlook park associated with the Otay Valley Regional Park, and trail connections to the Otay Valley Regional Park.

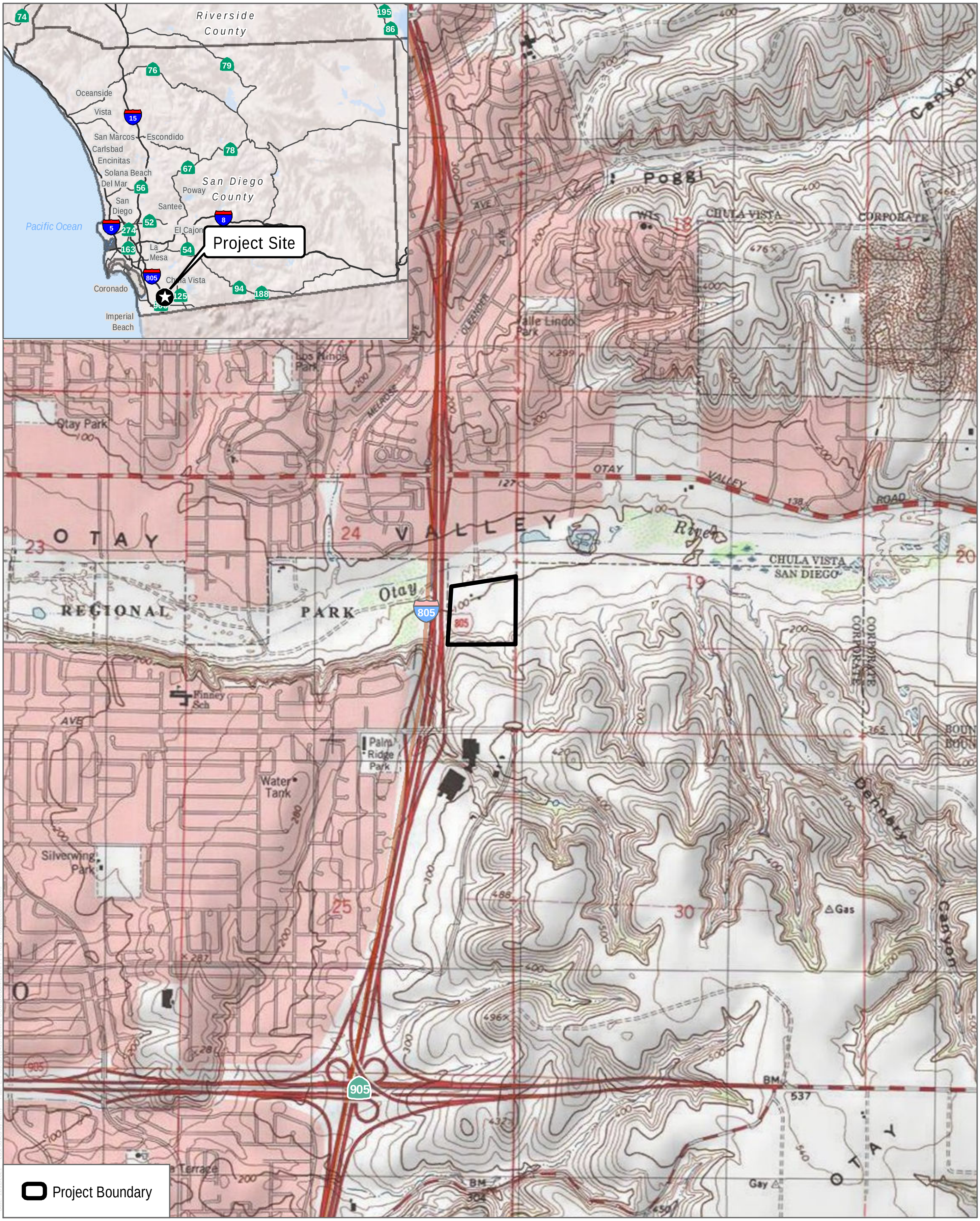
Primary site access would be provided via an off-site connection to Dennery Road, and secondary emergency access would be provided via a connection to Golden Sky Way in the River Edge Terrace residential development. Off-site remedial grading would be required to the north of the site within the City of Chula Vista. The Project includes two scenarios. Under the No Annexation Scenario, the project would remain within the City of Chula Vista. Under the Annexation Scenario, the Project would be annexed into the City of San Diego. While the physical improvements proposed would be the same under either project scenario, the discretionary actions would differ. To facilitate analysis of each development option, this report addresses consistency with the standards and thresholds of both the City of San Diego and the City of Chula Vista.

1.2.3 Current Land Use

The Project site has been historically used for agricultural purposes. It is unknown the exact year when agricultural uses were initiated, but it dates back to at least 1928 (Converse Consultants 2000). Agricultural operations ceased circa 2010 as it was no longer economically viable. The Project site is currently designated by the City of Chula Vista General Plan as Open Space (OS) and is zoned as A-8 for agricultural use (City of Chula Vista 2005). Due to its location and access from only the City of San Diego via Dennery Road, the Project site has long been contemplated for annexation into the City of San Diego. For this reason, the cities of Chula Vista and San Diego have engaged in several city-to-city discussions, public hearings and Letters of Intent to explore reorganization scenarios that would allow the detachment of Nakano from Chula Vista and annexation to San Diego.

Surrounding land uses include the I-805 freeway directly west, vacant land and the Otay River Valley Regional Park to the north, residential to the east (Edge Terrace) and southeast, and the Kaiser Permanente Medical Center to the south.

The Project site is primarily vegetated by moderate-load grass-shrubs, moderate- to- high-load shrubs and chaparrals. Additionally, a small eucalyptus/riparian forest area is adjacent to the proposed Project development site. Elevations within the Project site range from 90 feet AMSL in the northern portion of the Project site to 180 feet AMSL southern portion of the Project site.



SOURCE: USGS 7.5-Minute Series Imperial Beach Quadrangle

FIGURE 1

Project Location

Fire Protection Plan for the Nakano Chula Vista Project

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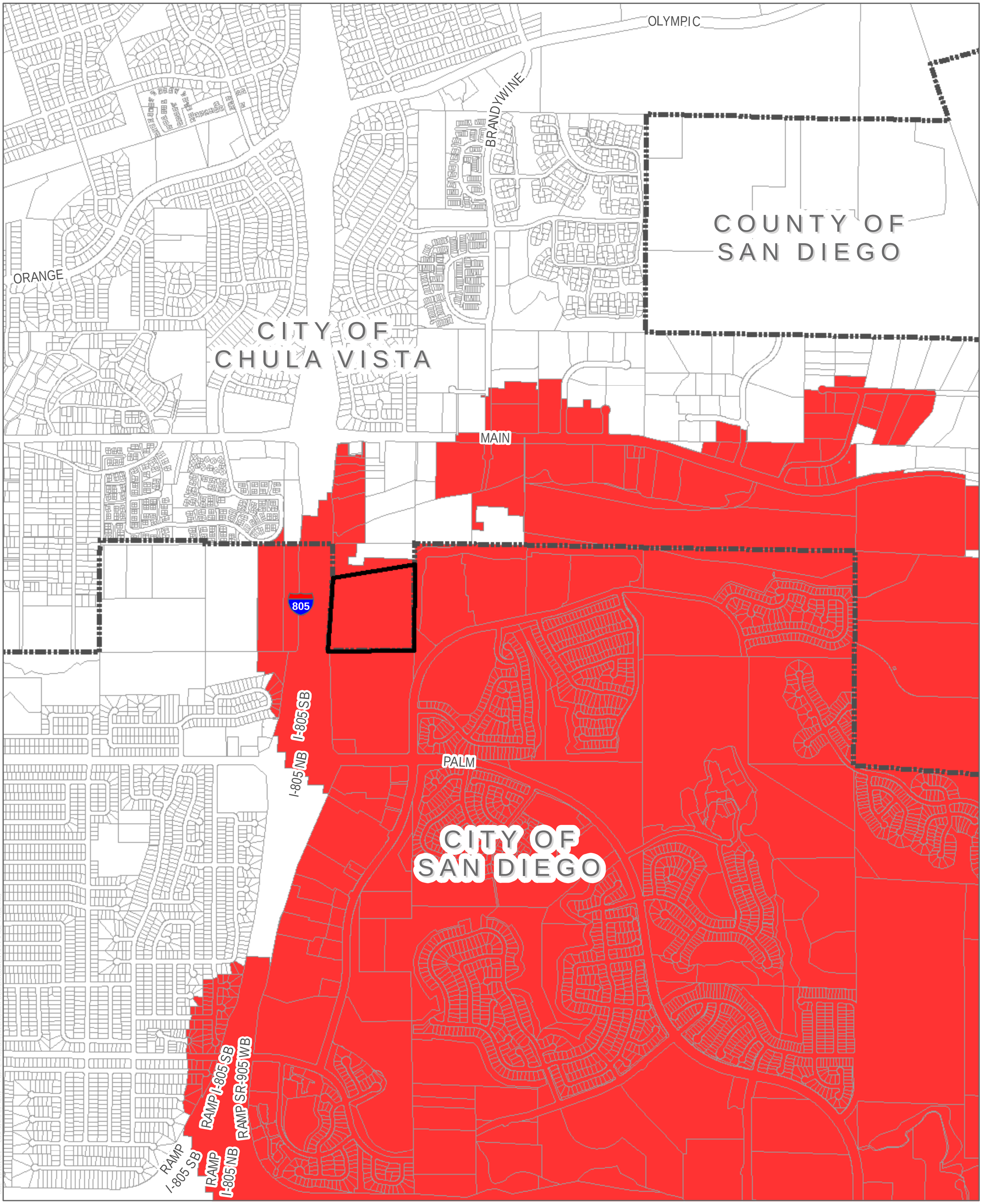

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Fire Hazard Severity Zone Map

Fire Protection Plan for the Nakano Chula Vista Project

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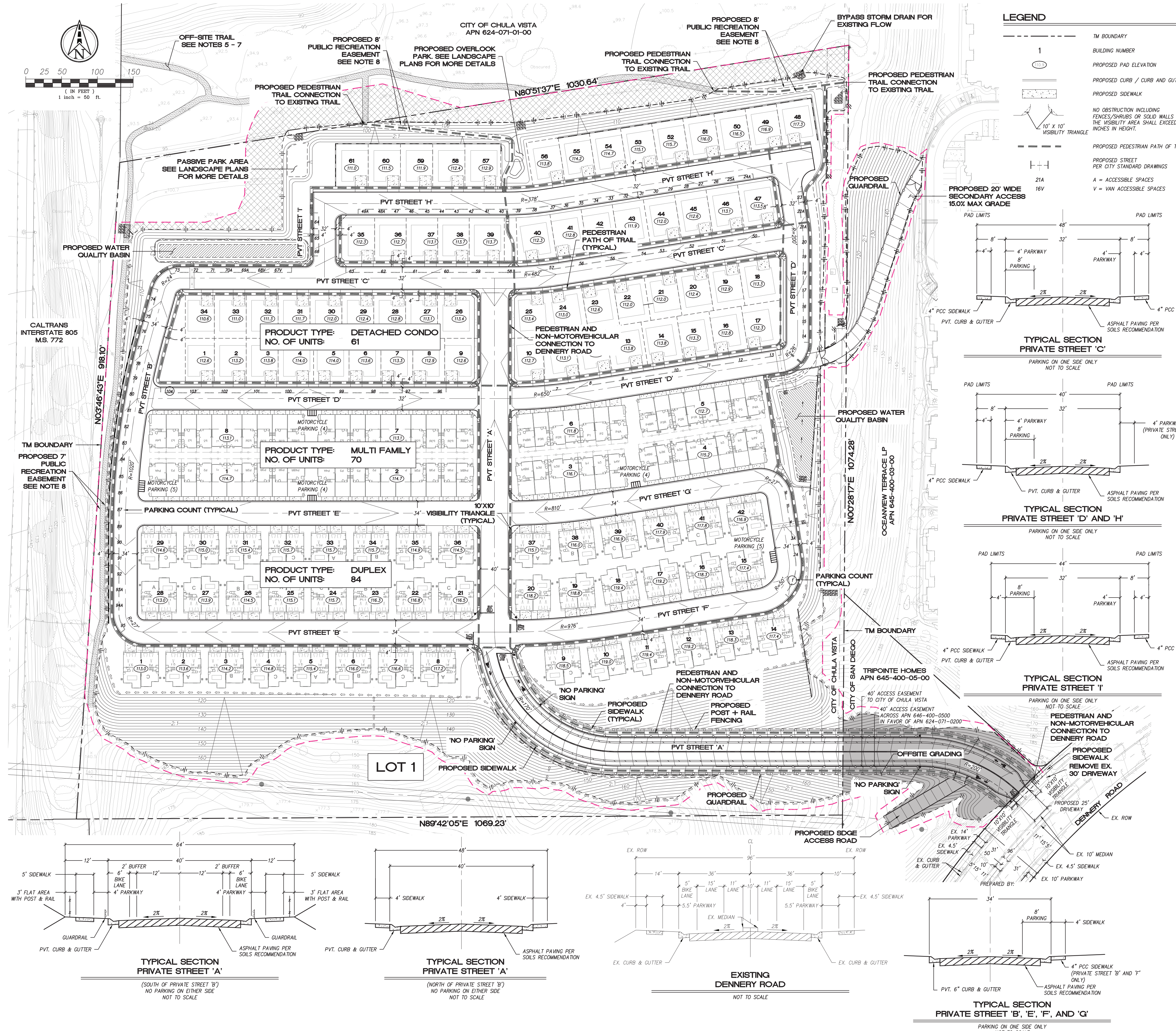

SOURCE: CIVIL SENSE INC. 2023

FIGURE 3

Propose 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 9, 2021, in order to confirm/acquire 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, *Photograph Log*), 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 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 Project site is relatively flat with elevations ranging from 90 feet AMSL in the northern portion of the Project site to 180 feet AMSL southern portion of the Project site.

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 73.4°F, with an average temperature in the summer and early fall months (June–October) of 78.6°F. August and September are typically considered the hottest months of the year. The area is considered to be a semi-arid climate. Annual precipitation typically averages approximately 11.5 inches annually with the wettest months being January and December (Western Regional Climate Center, 2022).

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 covering 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 cover 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.

The prevailing wind pattern is from the west (on-shore), but the presence of the Pacific Ocean causes a diurnal wind pattern known as the land/sea breeze system. During the day, winds are from the west–southwest (sea), and at night winds are from the northeast (land). The highest wind velocities are associated with downslope, canyon, and Santa Ana winds. The Nakano Project area includes topography and vegetation that under the right weather conditions increase fire risk within and adjacent to the Project site.

2.2.3 Vegetation

The Project property and surrounding areas primarily support chaparral, riparian woodlands, and non-native grassland plant communities. The adjacent lands have similar vegetation types, with chaparral and eucalyptus woodlands, as well. 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 in a software program to predict fire behavior characteristics, as discussed in Section 3.1, Fire Behavior Modeling. Vegetative fuels on-site are characteristic of the area and are primarily mixed chaparral and eucalyptus woodland habitats and more concentrated trees within the property riparian forest habitat. 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 brush management zones (BMZs) would be located in the immediate area surrounding the Project site, extending up to 100 horizontal feet from each of the structures. Typical BMZ is 100 feet wide across the Project site; however, where the BMZ is less than 100 feet, this FPP proposes enhanced ignition resistant constructions, as described in Section 6. Consistent with requirements, native and naturalized vegetation occurring within BMZ Zone 2 is not expected to be irrigated, although overall fuel volumes will be reduced by removing dead and dying plants, non-natives, highly flammable species, and thinning the remaining plants so they would not readily facilitate the spread of fire on an ongoing basis. The provided BMZ areas will be maintained on an ongoing basis in order to comply with SDFRD's and CVFD's respective brush management/fuel modification guidelines.

2.2.4 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 have 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 begins its succession again. 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 BMZs 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 moderate to high fuel loads due to the dominance of sparse chaparral and sage scrub-grass fuels.

The vegetation described above translates to fuel models used for fire behavior modeling, discussed in Chapter 3 of this FPP. 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 sparse chaparral or coastal sage scrub cover.

As described, vegetation plays a significant role in fire behavior, and is an important component of the 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 begins its succession again.

In summary, high-frequency fires tend to convert shrublands to grasslands or maintain grasslands, and fire exclusion tends to convert grasslands to shrublands over time as shrubs sprout back or establish and are not disturbed by repeated fires. In general, biomass and associated fuel loading will increase over time, assuming that disturbance (e.g., fire) 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 BMZs for the Project site. The BMZs 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.

2.2.5 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, thirteen (13) fires have burned within 5 miles of the Project site since the beginning of the historical fire data record. Recorded wildfires within 5 miles range from 38.7 acres to 10,394 acres (1911 Unnamed Fire) and the average fire size is approximately 1,247.9. When considering only fires greater than 10 acres and less than 10,000, the average fire size is approximately 485.7 acres. The 1994 Otay #4 Fire (approximately 2,983.4 acres) is the most recent fire within 5 miles of the Project site. No fires have burned on the Project site. CVFD and/ SDFRD 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 8.3 with intervals ranging between 0 (multiple fires in the same year) to 30 years. Based on the analysis, it is expected that there will be wildland fires within 5 miles of the Project site at least every 30 years and on average, eight 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 east/northeast, although a fire approaching from the west during more typical on-shore weather patterns is possible. The proximity of the Project to the open space associated with the Otay River Valley Regional Park to the north has the potential to increase wildfire hazard in the Project vicinity.

2.2.6 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). In Southern California, and San Diego County, 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).

Research indicates that the type of dense, master planned developments, like Nakano, are not associated with increased vegetation ignitions. Syphard and Keeley (2015) summarize all wildfire ignitions included in the CAL FIRE FRAP database – dating back over 100 years. They found, in the case of one Southern California county (San Diego County), 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. In San Diego County, and in areas like Chula Vista, ignitions were more likely to occur close to roads and structures, and at intermediate structure densities.

As figures 4 through 6 illustrate, housing 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 homes. 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 housing poses a higher ignition risk than higher density communities. 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 vast wildland urban interface already exists in the area adjacent to Nakano, with older, more fire-vulnerable structures, constructed before stringent fire code requirements were imposed on residential development, with varying levels of maintained fuel modification buffers in the area. As discussed in detail throughout this FPP, Nakano is a planned ignition resistant community 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 Nakano Project would not be expected to materially increase the risk of vegetation ignitions.

Figure 4. Example higher density development. Homes are 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. Homes 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. Homes 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 2006). This is not the case with the 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 community or moderate density with high maintenance levels, such as Nakano'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 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. 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. Lastly, the on-site fire station and additional humans on the site result in fast detection of fires and fast firefighter response, a key in limiting the growth of fires beyond the incipient stage.

Various recreational opportunities, both legal and illegal exist today. If a wildfire were to ignite from human activity today, fire detection and response could be delayed due to the remoteness of the area not directly visible from populated areas. Delayed detection would contribute to delayed response to the scene due to the lack of site access. Fire size up (determining the needed firefighting resources) and requests for additional resources, including aerial support, also are delayed in comparison to post-construction of the Nakano Project. With the Project, motorized activities on the trails would be prohibited and enforced. If a hiker or mountain biker was to start a fire, detection and response would be anticipated on a fast timeline due to the residents that would be living within the community with the ability to detect fires throughout the property. The quick detection and call to 911 would result in faster response from the on-site fire stations, which can reach anywhere within the project quickly. If a fire is detected and cannot be accessed by a responding fire engine, it can be sized up and additional aerial and other support requested quickly.

2.2.7 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 work to protect the Project site, its structures and their occupants from wildfires. These features also have a similar positive impact on the potential for wildfire ignitions caused by the Project and its inhabitants.

As mentioned previously, the ignition resistant landscapes and structures and the numerous specific requirements would minimize the ability for an on-site fire to spread to off-site fuels, as follows:

1. **Ignition resistant, planned and maintained landscape** – all 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 up to 100-foot FMZ includes specifically selected plant species, low fuel densities, and ongoing HOA funded and applied maintenance, resulting in a buffer between the developed areas and the off-site native fuels.
3. **Annual FMZ inspections** – the Nakano HOA will have a contracted, 3rd party, CVFD-approved or SDFRD-approved FMZ inspector perform two inspections per year to ensure that FMZs are maintained in a condition that is consistent to the City of Chula Vista's or City of San Diego's standards and FPP's requirements.
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 homes 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. Homes and buildings can be built in the VHFHSZs 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 VHFHSZ 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** – sprinklers in residences are designed to provide additional time for occupants to escape the home. Sprinklers in multi-family and commercial structures are 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 homes in the area that do not include interior sprinklers.
6. **Heat Deflecting Wall** – At the top of the slope along the northern, eastern, and western Project site boundaries a 6-foot heat deflecting wall will be constructed of ignition resistant materials.
7. **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.
8. **Water** – providing firefighting water throughout the Project with hundreds of 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 CVFD. Water accessibility helps firefighters control structural fires and helps protect structures from and extinguish wildfires.

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 the fire 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 four modeling scenarios, including one summer, onshore weather condition (northwest of the Project site) and three extreme fall, offshore weather condition (northwest, northeast and south of the Project site). These fire scenarios incorporated observed fuel types representing the dominant vegetation representative of the site and adjacent land, in addition to 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 site.

Vegetation types, which were derived from the field assessment for the Project site, were classified into a fuel model. Fuel models are selected by their vegetation type, 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. Fuel models were also assigned to illustrate post-Project fire behavior 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 anticipated pre- and post- Project vegetation conditions, four different fuel models were used in the current conditions of the fire behavior modeling effort and three additional fuel models were used to depict a fire post construction, as present herein. Modeled areas include moderate load grass-shrub and moderate- to- high-load shrub ground fuels (Fuel Models: FM4, Gs2, Sh2, and Sh5) found throughout the adjacent areas surrounding the Project site, and eucalyptus woodland forest/riparian habitat (Fuel Models: FM9 and Sh4), see Table 1 for fuel model characteristics. A total of four fire modeling scenarios were completed for the Project area. These sites were selected based on the strong likelihood of fire approaching from these directions during a Santa Ana wind-driven fire event (fire scenarios 1a, 2, and 3) and an on-shore weather pattern (fire scenario 1b). Dudek also conducted modeling of the site for post-Brush Management Zones' (BMZ) recommendations for this Proposed Project (Refer to Table 1 for post-BMZ fuel model descriptions). Fuel modification includes establishment of irrigated and thinned zones on the periphery of the development as well as interior landscape requirements. For modeling the post-BMZ treatment condition, fuel model assignments were re-classified for the BMZs 1 (Fuel Model 8) and BMZ 2 (Fuel Model Gr1).

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

Table 1. Existing and Post-Development Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
Existing Conditions			
FM4	Chaparral	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	>4.0 ft.
FM9	Eucalyptus woodland and riparian forest habitat	Represents the eucalyptus woodland/riparian habitat that exists northwest of the Project site	>8.0 ft.
Gs2	Moderate load, dry climate grass-shrub	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	<2.0 ft.
Sh2	Moderate load, dry climate shrubs	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	<2.0 ft.
Sh4	Eucalyptus woodland and riparian forest habitat	Represents the eucalyptus woodland/riparian habitat that exists northwest of the Project site	>8.0 ft.
Sh5	High load, dry climate shrubs	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	>3.0 ft.
Post-Development			
FM8	Compact litter	Fuel Modification Zone 1 and 2: irrigated landscape	<1.0 ft.
Gs1	Sparse, Sparse Load, Dry Climate Grass	Fuel Modification Zone 3: 50% thinning of grasses	>1.0 ft.

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

Table 2: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50th Percentile)	Peak Weather (97th Percentile)
Fuel Models	FM4, FM9, Sh4, and Sh5	FM4, FM9, Gs2, Sh2, and Sh5
1 h fuel moisture	8%	2%
10 h fuel moisture	9%	3%
100 h fuel moisture	15%	8%
Live herbaceous moisture	59%	30%
Live woody moisture	118%	60%
20 ft. wind speed	14 mph (sustained winds)	18 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	300	45, 200, and 300
Wind adjustment factor	0.4	0.4
Slope (uphill)	3%	2 to 10%

3.3 Fire Behavior Modeling Results

The results of fire behavior modeling analysis for pre- and post-Project conditions are presented in Table 3 and Table 4, respectively. Identification of modeling run (fire scenarios) locations is presented graphically in Figure 7, 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 moderate to high intensity throughout the non-maintained surface shrub and chaparral dominated fuels within the Otay River area and small hillside along the southern boundary adjacent to the Project site, as well as within the eucalyptus woodland area/eucalyptus trees along I-805.

As mentioned, the BehavePlus fire behavior modeling software package was utilized in evaluating anticipated fire behavior adjacent to the Proposed Project site. Four focused analyses were completed, each assuming worst-case fire weather conditions for a fire approaching the Project site from the northwest, northeast, and south. The results of the modeling effort included anticipated values for surface fires (flame length (feet), rate of spread (mph), and fireline intensity (Btu/ft/s)) and crown fires (critical surface intensity (Btu/ft/s), critical surface flame length (feet), transition ratio (ratio: surface fireline intensity divided by critical surface intensity), transition to crown fire (yes or no), crown fire rate of spread (mph), critical crown rate of spread (mph), active ratio (ratio: crown fire rate of spread divided by critical crown fire rate of spread), active crown fire (yes or no), and fire type (surface, torching, conditional crown, or crowning)). 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. Four 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 four fire scenarios are explained in more detail below:

- **Scenarios 1a:** This scenario modeled both a fall, off-shore fire (97th percentile weather condition) and a summer, on-shore fire (50th percentile weather condition) burning through the approximately 25-foot tall eucalyptus tree woodland and riparian habitat area within the Otay River on the west side of I-805 and northwest of the Proposed Project site. The terrain is flat (approximately 3% slope) with tall eucalyptus trees and potential ignition sources from a structure fire in the adjacent single-family community to the north, a vehicle fire from traffic along I-805, or embers from a wildland fire from the west of east/northeast of the proposed development. This type of fire would typically spread by jumping from tree to tree before possibly transitioning under I-805 before reaching the developed portion of the Project site.
- **Scenario 1b:** A summer, on-shore fire (50th percentile weather condition) burning in moderate- to- high-load shrub and chaparral dominated vegetation with a small intermix of non-native grassland located northwest of the Project site (east side of I-805 and within the riparian area of the Otay River. Additionally, this scenario models the possibility of a eucalyptus crown fire that are located along the west side of the development and east side of the I-805. The terrain is flat (between 2% and 3% slope) with potential ignition

sources from a vehicle fire from traffic along I-805 or embers from a wildland fire from the west of east/northeast of the proposed development. This type of fire would typically spread moderately fast before reaching the developed portion of the Project site.

- **Scenario 2:** A fall, off-shore fire (97th percentile weather condition) burning in moderate- to- high-load shrub and chaparral dominated vegetation with a small intermix of non-native grassland located north/northeast of the Project development. The terrain is flat (approximately 2% slope) with potential ignition sources from a structure fire in the adjacent single-family community to the east, a vehicle fire from the parking lot to the north, or from a wildland fire from the east/northeast of the proposed development. This type of fire would typically spread moderately fast before reaching the northern portion of the developed area of the Project site.
- **Scenario 3:** A fall, off-shore fire (97th percentile weather condition) burning in moderate- to- high-load shrub and chaparral dominated vegetation with a small intermix of non-native grassland located south of the Project development. The terrain is relatively flat (approximately 10% slope) with potential ignition sources from a structure fire from the adjacent hospital to the south, a vehicle fire from the hospital parking lot to the south or traffic along the I-805, or from embers of a wildland fire from the east/northeast of the proposed development. This type of fire would typically spread moderately fast before reaching the southern portion of the developed Project site.

The results presented in Tables 4 and 5 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 result presented below and in Table 3, worst-case fire behavior from the eucalyptus tree woodland is expected under peak weather conditions (represented by Fall Weather, Scenario 1a – Fall), while worst-case surface fire behavior is expected under peak weather conditions within the non-maintained shrubs and chaparrals vegetated areas (represented by Scenario 2). The fire is anticipated to be a wind-driven fire from the north/northeast during the fall. Under such conditions, expected surface flame length could potentially reach approximately 41 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 18,348 BTU/feet/second with moderate spread rates of 6.2 mph and could have a spotting distance up to 2.3 miles away. Because embers could spot within 2.3 miles of the Project site, a crown fire could potentially occur within the small eucalyptus woodland area within the riparian Otay River, located approximately 550 feet northwest of the developed portion of the Project site. Potential crown fire flame lengths could reach 58 feet with sustained winds of 18 mph or 147 feet with wind gusts of 50+ mph. Under this scenario, crown fireline intensities reach 20,083 BTU/feet/second with moderately slow crown spread rates of 4.1 mph.

Wildfire behavior in non-maintained shrubs and chaparral within the Otay River west/northwest of the Project site, modeled as FM4 and Sh5 being fanned by 14 mph sustained, on-shore winds. Fires burning from the west/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 moderate- to- high-load shrub/chaparral vegetation fire could have flame lengths between approximately 12 feet and 19 feet in height and spread rates between 0.6 and 0.9 mph. Spotting distances, where airborne embers can ignite new fires downwind or within the small eucalyptus woodland area within the riparian Otay River, located approximately 550 feet northwest of the developed portion of the Project site, range from 0.4 to 0.6 miles. A crown fire could potentially reach 38 feet under these conditions.

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

Fire Scenario	Flame Length[1] (feet)	Spread Rate[1] (mph[5])	Fireline Intensity[1] (Btu/ft/s)	Spot Fire[1] (miles)	Surface Fire to Tree Crown Fire	Tree Crown Fire Rate of Spread (mph)	Crown Fire Flame Length (feet)
Scenario 1a: 3% slope; Fall Off-shore Extreme Wind (97th percentile) - (Northwest of Project site)							
Eucalyptus woodland/Riparian Habitat (FM9)	5.3 (11.7')[6]	0.3 (1.7)	215 (1,193)	0.3 (1.0)	No	1.0 (4.1)	52.9 (136.1)[6]
Riparian Habitat - Timber Shrub (Sh4)	12.1 (23.2)[6]	1.0 (4.1)	1,293 (5,261)	0.6 (1.5)	No	1.0 (4.1)	57.5 (137.8)[6]
Scrub and Chaparral (Sh5)	23.7 (41.2)[6]	1.9 (6.2)	5,546 (18,348)	0.9 (2.3)	Crowning [4]	1.0 (4.1)	69.9 (179.7)[6]
Scenario 1a: 3% slope; Summer on-shore Wind (50th percentile) - (Northwest of Project site)							
Eucalyptus woodland/Riparian Habitat (FM9)	2.9	0.1	57	0.2	No	0.3	38.1
Riparian Habitat - Timber Shrub (Sh4)	2.3	0.1	34	0.1	No	0.3	37.5
Scrub and Chaparral (Sh5)	12.5	0.6	1,379	0.4	Crowning [4]	0.3	43.5
Scenario 1b: 2% slope; Summer on-shore Wind (50th percentile) – Pre-BMZ (Northwest of Project site)							
Chaparral (FM4)	18.9	0.9	3,375	0.6	Crowning [4]	0.3	36.5
Riparian Habitat - Timber Shrub (Sh4)	2.3	0.1	34	0.1	No	0.3	24.3
Scrub and Chaparral (Sh5)	12.5	0.6	1,379	0.4	Crowning [4]	0.3	31.5
Scenario 2: 2% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (North/northwest of Project site)							
Grass/Shrub (Gs2)	9.6 (18.8')[6]	0.9 (3.8)	774 (3,358)	0.4 (1.3)	N/A	N/A	N/A
Moderate load shrubs (Sh2)	8.0 (15.1)[6]	0.2 (0.9)	522 (2,074)	0.4 (1.1)	N/A	N/A	N/A
High load Scrub (Sh5)	23.6 (41.1)[6]	1.9 (6.2)	5,545 (18,348)	0.8 (2.3)	N/A	N/A	N/A
Scenario 3: 10% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (South of Project site)							
Grass/Shrub (Gs2)	9.6 (18.8')[6]	0.9 (3.8)	767 (3,351)	0.4 (1.3)	N/A	N/A	N/A
Moderate load shrubs (Sh2)	8.0 (15.1)[6]	0.2 (0.9)	517 (2,069)	0.4 (1.1)	N/A	N/A	N/A
High load Scrub (Sh5)	23.7 (41.2)[6]	1.9 (6.2)	5,500 (18,303)	0.8 (2.3)	N/A	N/A	N/A

Note:

1. Wind-driven surface fire.
2. Riparian overstory torching increases fire intensity. Modeling included canopy fuel over Sh4, which represents surface fuels beneath the tree canopies.

3. A surface fire in the mixed sycamore riparian forest would transition into the tree canopies generating flame lengths higher than the average tree height (25 feet). Viable airborne embers could be carried downwind for approximately 1.0 mile and ignite receptive fuels.
4. Crowning= fire is spreading through the overstory crowns.
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.

3.3.2 Post-Development Conditions

As previously mentioned, Dudek conducted modeling of the Project site for post-development conditions. Typical brush management for the City of San Diego includes establishment of minimum 35-foot wide irrigated Zones A and a minimum 65-foot wide thinning Zone B on the periphery of the Project site, beginning at the structure. For modeling the post-BMZ treatment condition, the fuel model assignment for eucalyptus woodland/riparian habitat (FM9), riparian habitat - timber shrub (Sh4) and scrub and chaparral (Sh5) were 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 expected in the irrigated and replanted with plants that are acceptable with the San Diego Fire and Rescue Department (SDFRD) (BMZ Zones 1 – Gr1), as well as in an area with thinning of the existing shrubs (BMZ Zone 2 – Sh1/Sh2) under peak weather conditions (represented by Fall Weather, Scenario 2) is presented in Table 4. Under such conditions, expected surface flame length is expected to be significantly lower, with flames lengths reaching approximately 10 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 760 BTU/feet/second with relatively slow spread rates of 1.3 mph and could have a spotting distance up to 0.8 miles away. Therefore, the modified BMZ proposed for the Nakano Residential Development Project are approximately 2.5-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 Model Results – Post-Development Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[3]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[4]
Scenario 1b: 2% slope; Summer on-shore Wind (50th percentile) – Post-BMZ (Northwest of Project site)				
BMZ Zone 1 (Gr1)	1.7	0.2	18	0.1
BMZ Zone 2 (Sh1)	0.6	0.0	2	0.0
Scenario 2: 2% slope; Fall Off-shore, Extreme Winds (97th percentile) – Post-BMZ (North/northwest of Project site)				
BMZ Zone 1 (Gr1)	3.1 (3.1)	0.5 (0.5)	67 (67)	0.2 (0.4)
BMZ Zone 2 (Sh1)	5.3 (9.5)	0.3 (1.3)	210 (760)	0.3 (0.8)
Scenario 3: 10% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (South of Project site)				
BMZ Zone 1 (Gr1)	3.1 (3.1)	0.5 (0.5)	67 (67)	0.2 (0.4)
BMZ Zone 2 (Sh1)	5.2 (9.5)	0.3 (1.3)	208 (760)	0.3 (0.8)

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

Crown Fire:

- Transition to Crown Fire: Indicates whether conditions for transition from surface to crown fire are likely. Calculation depends on the transition ratio. If the transition ratio is greater than or equal to 1, then transition to crown fire is Yes. If the transition ratio is less than 1, then transition to crown fire is No.
- Crown Fire Rate of Spread (mph): The forward spread rate of a crown fire. It is the overall spread for a sustained run over several hours. The spread rate includes the effects of spotting. It is calculated from 20-ft wind speed and surface fuel moisture values. It does not consider a description of the overstory.

Fire Type:

Fire type is one of the following four types: surface (understory fire), torching (passive crown fire; surface fire with occasional torching trees), conditional crown (active crown fire possible if the fire transitions to the overstory), and crowning (active crown fire; fire spreading through the overstory crowns). Dependent on the variables: transition to crown fire and active crown fire.

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 4 and 5. Identification of modeling run locations is presented graphically in Figure 7 of this FPP.

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.

Table 5: Fire Suppression Interpretation

Flame Length (ft)	Fireline Intensity (Btu/ft/s)	Interpretations
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 chaparral and eucalyptus woodland, like those found on and adjacent to the Nakano 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 2001). 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 2005) 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 on-site. The most common type of fire anticipated in the vicinity of the Project Area is a wind-driven fire from the north/northeast, moving through the chaparral, eucalyptus woodland and riparian habitat on the adjacent lands.

With the conversion of the landscape to ignition-resistant development, wildfires may still encroach upon and drop embers on the 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 in 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 ever-expanding 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 site's structures, especially given the ignition resistance of the structures and the planned ongoing maintenance of the entire site landscape. The Project will implement the latest fire protection measures, including fuel modification along the perimeter edges of the development. In addition, the 100-foot BMZ for the Project site would be approximately 10 times wider than the longest calculated flame length conditions for portions of the proposed developed area that abut the BMZ (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 on-site. The potential for off-site wildfire encroaching on, or showering embers on the site is considered moderate to high, 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 communities. The Project will include a robust fire protection system, as detailed in the Project's FPP. This same robust fire protection system provides protections from on-site fire spreading to off-site vegetation. Accidental fires within the landscape or structures in the Project 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 confining fires or extinguishing them. The Project will be a fire-adapted community with a strong resident outreach program that raises fire awareness among its residents.

Table 1. Existing Fuel Model Characteristics

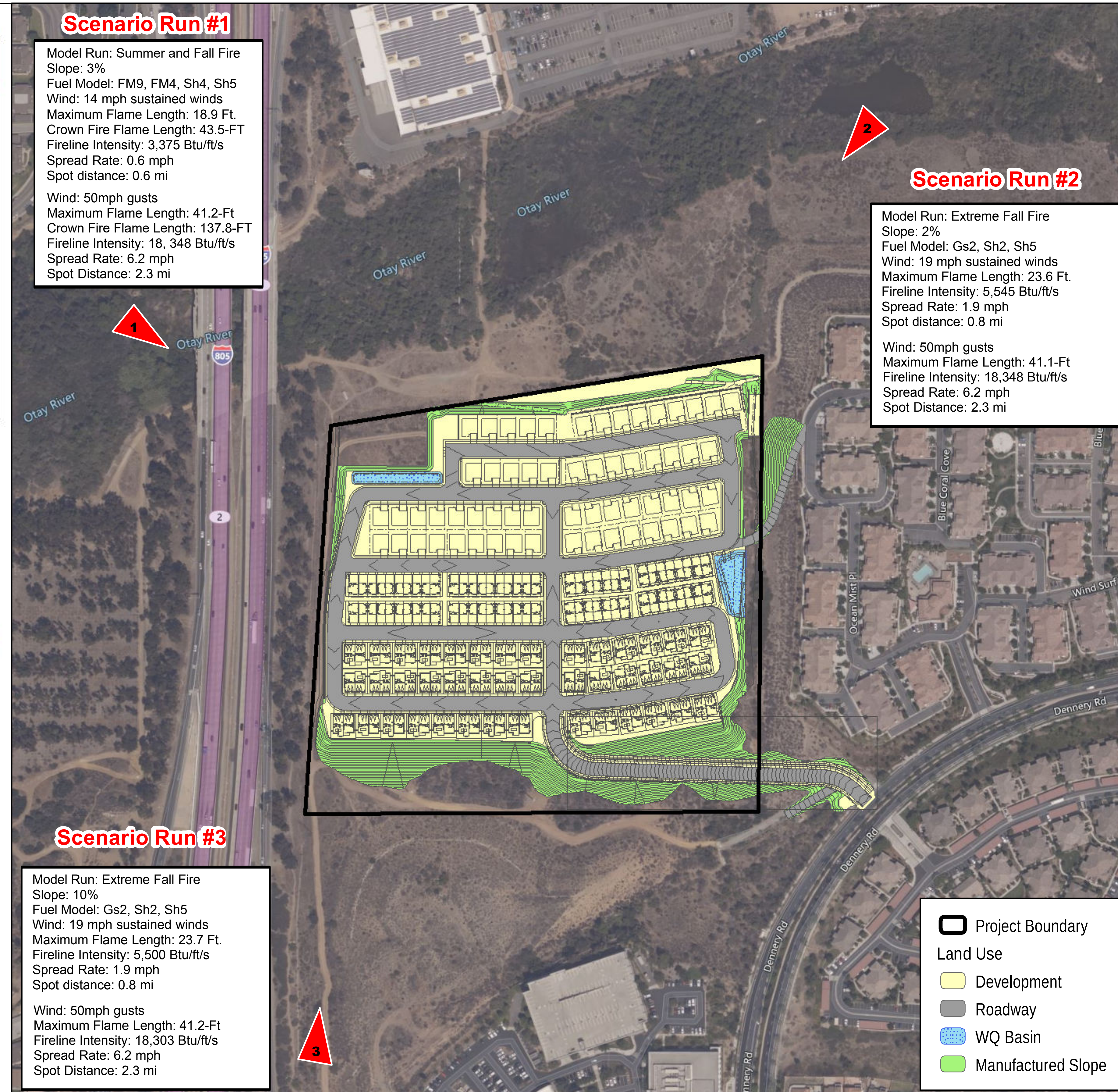
Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
FM4	Chaparral	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	>4.0 ft.
FM9	Eucalyptus woodland and riparian forest habitat	Represents the eucalyptus woodland/riparian habitat that exists northwest of the Project site	>8.0 ft.
Gs2	Moderate load, dry climate grass-shrub	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	<2.0 ft.
Sh2	Moderate load, dry climate shrubs	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	<2.0 ft.
Sh4	Eucalyptus woodland and riparian forest habitat	Represents the eucalyptus woodland/riparian habitat that exists northwest of the Project site	>8.0 ft.
Sh5	High load, dry climate shrubs	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	>3.0 ft.

Table 2. Post-development Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
8	Compact litter	Brush Management Zone 1: irrigated landscape	<1.0 ft.
Gr1	Sparse, Sparse Load, Dry Climate Grass	Brush Management Zone 2: 50% thinning of grasses	>1.0 ft.

Table 3: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50th Percentile)	Peak Weather (97th Percentile)
Fuel Models	FM4, FM9, Sh4, and Sh5	FM4, FM9, Gs2, Sh2, and Sh5
1 h fuel moisture	8%	2%
10 h fuel moisture	9%	3%
100 h fuel moisture	15%	8%
Live herbaceous moisture	59%	30%
Live woody moisture	118%	60%
20 ft. wind speed	14 mph (sustained winds)	18 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	300	45, 200, and 300
Wind adjustment factor	0.4	0.4
Slope (uphill)	3%	2 to 10%



SOURCE: AERIAL-BING MAPPING SERVICE

DUDEK 0 250 500 Feet

FIGURE 7

BehavePlus Analysis Map

Fire Protection Plan for the Nakano Chula Vista Project

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4 Emergency Response Service

The following sections analyze the Project in terms of current CVFD and SDFRD fire service capabilities and resources to provide Fire Protection and Emergency Services. The analysis that follows examines the ability of the existing CVFD and SDFRD fire stations to adequately serve the Project site. Response times were evaluated using Project build-out conditions. It was assumed that phased construction would include access roads to the newly constructed buildings and that the shortest access route to those structures would be utilized.

4.1 Emergency Response Fire Facilities

The Project is currently located within the CVFD jurisdictional response area; however, the Project proposes annexation of the Project site to the City of San Diego. Once annexed, San Diego Fire Department would be the FAHJ. Regardless if annexation is approved, San Diego Fire Department Station 6 would be dispatched for first response. However, within the area's emergency services system, fire and emergency medical services are also provided by other agencies. 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. There are also mutual aid agreements in place with neighboring fire agencies and typically include interdependencies that exist among the region's fire protection agencies for structural and medical responses but are primarily associated with the peripheral "edges" of each agency's boundary.

CVFD provides fire, emergency medical, and rescue services from 10 stations and SDFRD provides services from 51 stations. The Chula Vista Fire Department serves approximately 269,000 residents and San Diego Fire Department Serves 1.41 million residents. San Diego Fire Department Fire Station 6 would provide an initial response; however, Chula Vista Fire Department Stations 9 and 5, as well as SDFRD Station 43 are available to provide a secondary response to the Project, if needed. These four existing stations were analyzed herein due to their proximity to the Project site. Figure 8 illustrates the station locations and Table 6 provides a summary of the SDFRD and CVFD fire and medical delivery system for CVFD Fire Stations 9 and 5 and SDFRD Fire Stations 6 and 29.

Table 6. Closest Responding Stations Summary

Station	Location	Equipment	Staffing
SDFRD Station 6	693 Twining Ave. San Diego	Engine 6	3 person Engine
CVFD Station 9	1410 Brandywine Ave. Chula Vista	Engine 59	3 person Engine
SDFRD Station 29	198 W San Ysidro Blvd, San Diego	Engine 29, Truck 29, Brush 29, Paramedic 29	3 person Engine
CVFD Station 5	341 Orange Ave. Chula Vista	Engine 55	3 person Engine

Source: City of Chula Vista Fire Department 2021 and City of San Diego Fire Department 2021

The closest existing fire station to the Nakano development is SDFRD Station 6 located at 693 Twining Avenue, San Diego, which includes a three (3)-person Engine Company 24-hours per day/seven days a week. Additionally, CVFD Station 9 located at 1410 Brandywine Avenue, Chula Vista and would likely provide a secondary response. SDFRD Station 29 located at 198 W San Ysidro Blvd, San Diego, and CVFD Station 5 located at 341 Orange Avenue, Chula Vista could also provide additional response to the Nakano Project.

4.1.1 Emergency Response Travel Time Coverage

In an effort to understand fire department response capabilities, Dudek conducted an analysis of the travel-time response coverage from the closest, existing station (SDFRD Fire Station 6). The response time analysis was conducted using travel distances that were derived from Google road data and Project development plan data. Travel times were calculated applying the distance at speed limit formula (T=(D/S) * 60, where T=time, D=distance in miles, and S=speed in MPH) as well as 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) for comparison. The ISO response travel time formula discounts speed for intersections, vehicle deceleration, and acceleration, and does not include turnout time. Tables 7 and 8 present tabular results of the emergency response time analysis using the distance at speed formula and the ISO formula, respectively.

Table 7. Project Emergency Response Analysis using Speed Limit Formula

Station	Travel Distance to Project Entrance	Travel Time to Project Entrance[1]	Maximum Travel Distance[2]	Maximum Travel Time	Total Response Time[3]
SDFRD Station 6	1.0 mile	1 minutes 43 seconds	1.4 miles	2 minutes 24 seconds	4 minutes 24 seconds
CVFD Station 9	2.6 miles	4 minutes 28 seconds	3.0 miles	5 minutes 8 seconds	7 minutes 8 seconds
SDFRD Station 29	3.2 miles	5 minutes 29 seconds	3.6 miles	6 minutes 10 seconds	8 minutes 10 seconds
CVFD Station 5	3.5 miles	6 minutes 00 seconds	3.9 miles	6 minutes 41 seconds	8 minutes 41 seconds

Notes:

1. Assumes travel distance and time to the Project entrance off Dennery Road from fire station, and application of the distance at speed limit formula (T=(D/S) * 60, where T=time, D=distance in miles, and S=speed in MPH), a 35 mph travel speed, and does not include turnout time.
2. Assumes travel distance and time to the furthest point within the Project site from fire station, and application of the distance at speed limit formula (T=(D/S) * 60, where T=time, D=distance in miles, and S=speed in MPH), a 35 mph travel speed, and does not include turnout time.
3. Emergency response time target thresholds include travel time to furthest point within the Project site from fire station, and application of the distance at speed limit formula (T=(D/S) * 60, where T=time, D=distance in miles, and S=speed in MPH) a 35 mph travel speed along with dispatch and turnout time, which can add an additional two minutes to travel time.

Table 8. Project Emergency Response Analysis using ISO Formula

Station	Travel Distance to Project Entrance	Travel Time to Project Entrance[1]	Maximum Travel Distance[2]	Maximum Travel Time	Total Response Time[3]
SDFRD Station 6	1.0 mile	2 minutes 21 seconds	1.4 miles	3 minutes 2 seconds	5 minutes 2 seconds
CVFD Station 9	2.6 miles	5 minutes 4 seconds	3.0 miles	5 minutes 45 seconds	7 minutes 45 seconds
SDFRD Station 29	3.2 miles	6 minutes 5 seconds	3.6 miles	6 minutes 46 seconds	8 minutes 46 seconds
CVFD Station 5	3.5 miles	6 minutes 36 seconds	3.9 miles	7 minutes 17 seconds	9 minutes 17 seconds

Notes:

1. Assumes travel distance and time to the Project entrance off Dennery Road from fire station, and application of the ISO formula, T=0.65+1.7(Distance), a 35 mph travel speed, and does not include turnout time.
2. Assumes travel distance and time to the furthest point within the Project site from fire station, and application of the ISO formula, T=0.65+1.7(Distance), a 35 mph travel speed, and does not include turnout time.
3. Emergency response time target thresholds include travel time to furthest point within the Project site from fire station, and application of the ISO formula, T=0.65+1.7(Distance), a 35 mph travel speed along with dispatch and turnout time, which can add an additional two minutes to travel time.

Emergency response time target thresholds include travel time along with dispatch and turnout time, which can add two minutes to travel time. SDFRD Station 6 would provide an initial response as the closest existing fire station. As indicated in Table 7 and Table 8, the total response time from SDFRD Station 6 to the furthest residence on the Project site conforms to the response time standard of six (6) minutes and 30 seconds of fire dispatch receiving the 9-1-1 call, 90% of the time. Across all SDFRD Stations, this standard was met on 76% of all calls in FY2021 (City of San Diego 2022). The second engine to the Project site is estimated to arrive within approximately 7 minutes and 8 seconds (Speed Limit Formula) or 7 minutes and 45 seconds (ISO Formula). All response calculations are based on an average response speed of 35 mph, consistent with nationally recognized National Fire Protection Association (NFPA) 1710. Based on these calculations, the Project would meet the City of San Diego's response time standard from existing fire stations.

4.2 Estimated Calls and Demand for Service

Emergency call volumes related to typical projects, such as new residential developments, can be reliably estimated based on the historical per-capita call volume from a particular fire jurisdiction. The SDFRD documented 158,373 total incidents for 2020, generated by a city-wide (San Diego) service area total population of approximately 1,410,000 persons. The City of San Diego's per capita annual call volume is approximately 112 calls per 1,000 persons. The resulting per capita call volume is 0.112.

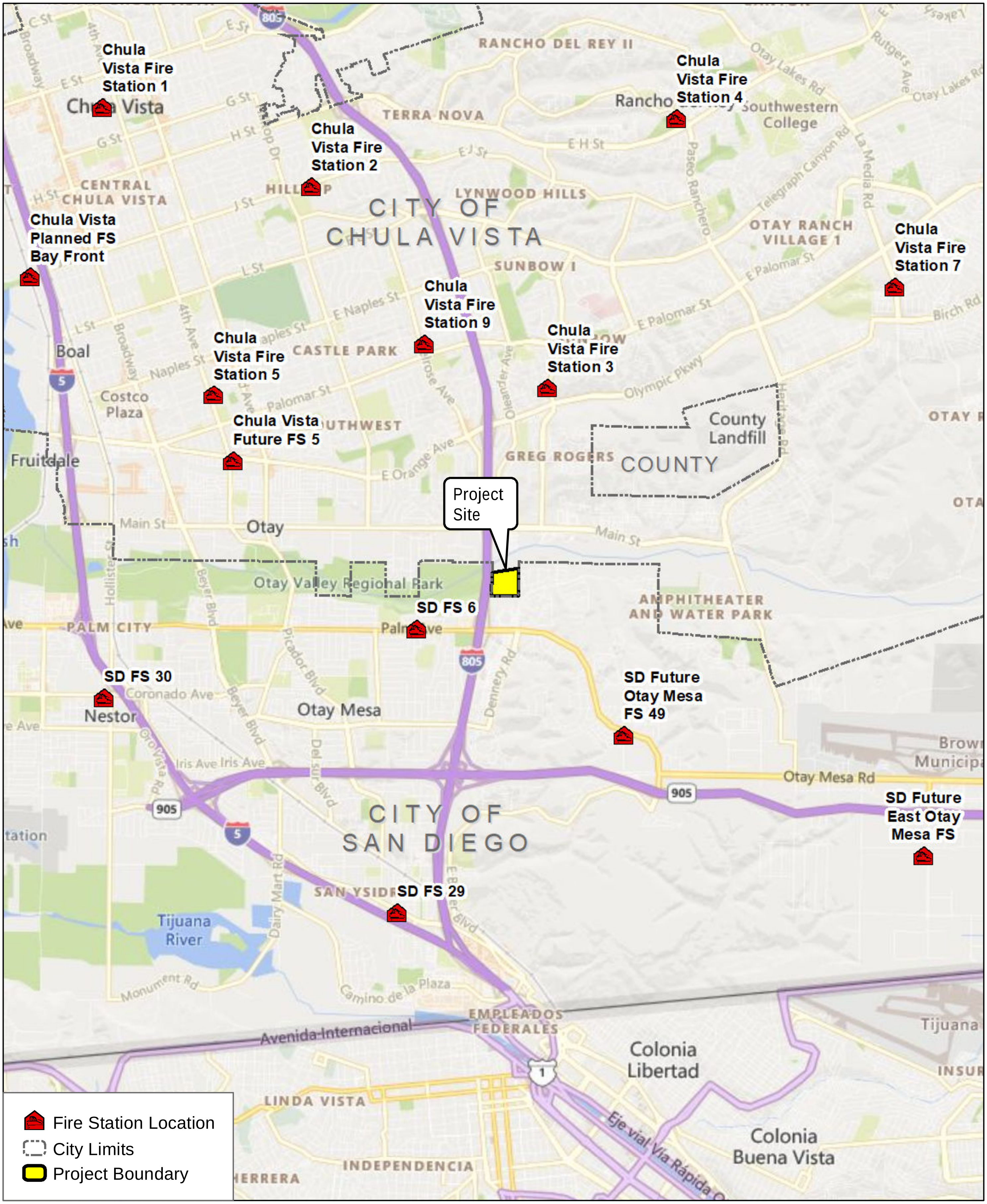
The estimated incident call volume at buildout from the Project is based on a conservative estimate of the maximum potential number of persons on-site at any given time (considered a "worst-case" scenario). The Project includes 215 residential units, which includes a mix detached condominiums, duplexes and multi-family townhomes. Using City of San Diego Fire Department's estimate per capita call volume of 0.112 (112 annual calls per 1,000 population), the Nakano Project's estimated 729 residents[5] would generate up to 82 additional calls per year (7 calls per month). The type of calls expected would primarily be medical-related.

Response Capability Impact Assessment

The available firefighting and emergency medical resources in the vicinity of the Project site include an assortment of fire apparatus and equipment considered fully capable of responding to the type of fires and emergency medical calls potentially occurring within the Project site. In 2020 SDFRD Station 6, the primary responding station for the Project, responded to a total of 2,252 incidents with an approximate call volume of 6 calls a day in 2021 (SDFRD 2021).

The Nakano Project includes 215 new residential dwelling units. The Nakano development is conservatively projected to add up to 82 calls per year (approximately 7 calls per month), mostly medical, initially within SDFRD Station 6's first-in response jurisdiction. The addition of 82 calls per year is not considered a significant impact given SDFRD Station 6's annual call volume of 2,252 calls per year. A busy suburban fire station would run 10 or more calls per day. An average station runs about 5 calls per day. The level of service demand for the Nakano Project site slightly raises overall call volume but is not anticipated to impact the existing fire station to a point that they cannot meet the demand. Station 6 would respond to an additional 82 calls per year (approximately 7 calls per month), 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.

[5] The Nakano Project proposes the development of 215 residential units. Per SANDAG Demographic and Socioeconomic Estimates for the City of San Diego's Otay Mesa Community Plan Area, the average persons per household is 3.39. Therefore, this FPP assumes the Project's population would be estimated at 729 (215 housing units x 3.39 average persons per household = 728.85 estimated Project population).



SOURCE: BASE-ESRI; FIRE DATA-SANGIS

DUDEK

0 2,500 5,000 Feet

FIGURE 8

Fire Station Locations

Fire Protection Plan for the Nakano Chula Vista Project

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5 Buildings, Infrastructure and Defensible Space

This FPP demonstrates that the Project would comply with applicable portions of the Chula Vista Fire Code (Chapter 15.36), and the San Diego Fire Code (Chapter 5, Article 5). The Project also complies with Chapter 7A of the 2019 California Building Code (CBC); the 2019 California Residential Code, Section 327; and 2018 Edition of the International Fire Code as adopted by the CVFD. The Project would also be subject to the provisions of section 4291 of the Public Resources Code; Chapter 12-7A of the CA Reference Standards Code, Title 14, Division 1.5, Chapter 7, Subsection 2, Articles 1-5 and Title 14, Division 1.5, Chapter 7, Subsection 3, Section 1299 of the CA Code of Regulations; Title 19, Division 1, Chapter 7, Subchapter 1, Section 3.07 of the CA Code of Regulations; and Sections 51175-511829 of the CA Government Code. The Project will meet or exceed applicable codes or will provide alternative materials and/or methods that meet or exceed the intent of the code. While these standards will provide a high level of protection to structures for the Project, there is no guarantee that compliance with these standards will prevent damage or destruction of structures by fire in all cases. A response map update, including roads and fire hydrant locations, in a format compatible with current department mapping, shall be provided to both SDFRD and CVFD.

The following summaries highlight important fire protection features. All underground utilities, hydrants, water mains, curbs, gutters, and sidewalks will be installed, and the drive surface shall be approved prior to combustibles being brought on site.

5.1 Site Access

Site access, including fire lane, driveway, and entrance road widths, primary and secondary access, gates, turnarounds, dead end lengths, signage, aerial fire apparatus access, surface, and other requirements will comply with the requirements of the 2019 California Fire Code, CVFD standards, and SDFRD standards. Fire access will be reviewed and approved by CVFD and/or SDFRD prior to construction.

The developer will provide information illustrating the new roads, in a format acceptable to the City of Chula Vista and City of San Diego, for updating of respective City maps.

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 be consistent with the City of Chula Vista's roadway standards and the 2019 CFC Section 503. Additionally, an adequate water supply and approved paved access roadways shall be installed prior to any combustibles being brought on-site and will include:

- The primary access to the Project is provided via Dennery Road.
- Secondary access will be provided via an accessible emergency use road located in the northeastern portion of the project and enables travel to the east through the adjacent River Edge Terrace community via Golden Sky Way. The road will meet fire apparatus access road code requirements.

- Internal circulation is comprised of a loop roadway system. 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 residential lots. Any dead-end streets serving new residential structures that are longer than 150 feet will have approved provisions for fire apparatus turnaround.
- The road system will be developed to be consistent with the City of Chula Vista's roadway standards and the 2019 CFC, Section 503.2.1. All roads would comply or exceed applicable CVFD and SDFRD requirements regarding sizing, condition, maintenance, and secured access.
- The interior residential access roads will be designed to accommodate a minimum of a 75,000-pound (lb.) fire apparatus load.
- Private and public streets for each phase shall meet all Project approved fire code requirements and/or mitigated exceptions for maximum allowable dead-end distance, paving, and fuel management before combustibles being brought to the site.
- Access roads to private lots to be completed and paved prior to issuance of building permits and prior to the occurrence of combustible construction

5.1.2 Gates

Gates securing the fire apparatus access roads shall comply with all of the following criteria:

- The minimum gate width shall be 13 feet (3964 mm).
- Gates shall be of the swinging or sliding type.
- Construction of gates shall be of materials that allow manual operation by one person.
- Gate components shall be maintained in an operative condition at all times and replaced or repaired when defective.
- Electric gates shall be equipped with a means of opening the gate by fire department personnel for emergency access. Emergency opening devices shall be approved by the Fire Code Official.
- Manual opening gates shall not be locked with a padlock or chain and padlock unless they are capable of being opened by means of forcible entry tools or when a key box containing the key(s) to the lock is installed at the gate location.
- Locking device specifications shall be submitted for approval by the Fire Code Official.
- Electric gate operators where provided shall be listed in accordance with UL 325.
- Gates intended for automatic operation shall be designed, constructed and installed to comply with the requirements of ASTM F 2200.

5.1.3 Dead-End Roads

Dead-end fire apparatus access roads in excess of 150 feet (45 720 mm) in length shall be provided with an approved area for turning around fire apparatus (2019 CFC Section 503.2.5). The Project has an internal looped roadway and no dead-end roads are proposed.

5.1.4 Grade

The Project complies with the CVFD and SDFRD requirements. Fire apparatus access roads shall not exceed 15 percent in grade. The emergency access road may include grades up to 20%, in which case, grades over 15% and no greater than 20% will be provided with a broomed Portland Cement finish or equivalent to the fire authority's satisfaction.

5.1.5 Surface

All on-site roads shall be constructed and maintained to support the imposed loads of fire apparatus (75,000 lbs.) and shall be improved with asphalt paving materials. All underground utilities, hydrants, water mains, curbs, gutters and sidewalks must be installed, and the drive surface shall be approved by CVFD and SDFRD prior to combustibles being brought on site.

5.1.6 Vertical Clearance

Minimum unobstructed vertical clearance of 13 feet 6 inches will be maintained for the entire required width for all streets, including driveways that require emergency vehicle access.

5.1.7 Premise Identification

Identification of roads and structures will comply with 2019 CFC standards, CVFD and SDFRD, as follows:

1. All structures required to be identified by street address numbers at the structure, placed in a position that is visible from the street or road fronting the property. Numbers to be minimum 4 inches high with 0.5-inch stroke and contrast with background.

3. Proposed roads within the development will be named, with the proper signage installed at intersections to satisfaction of the CVFD and/or SDFRD and the City of Chula Vista's Department of Public Works.
4. Streets will have street names posted on non-combustible street signposts. Letters/numbers will be 4 inches high, reflective, on a 6-inch-high backing. Signage will be 7 feet above grade. There will be street signs at the entrances to the development, all intersections, and elsewhere as needed subject to approval of the Fire Chief.

5.2 Ignition Resistant Construction and Fire Protection

All new structures within the Proposed Project will be constructed to at least the California Fire Code standard. Each of the proposed buildings will comply with the enhanced ignition-resistant construction standards of the 2019 CBC (Chapter 7A) and Chapter 5 of the Urban-Wildland Interface code, except where buildings require enhanced ignition resistance as part of an alternative material and method proposal. 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 and should reduce the potential for ordering evacuations in a wildfire, there is no guarantee that compliance with these standards will prevent damage or destruction of structures by fire in all cases.

There are two primary concerns for structure ignition: 1) radiant and/or convective heat and 2) burning embers (NFPA 1144 2008, Ventura County Fire Protection District 2011, IBHS 2008, and others). Burning embers have been a focus of building code updates for at least the last decade, and new structures in the Wildland Urban Interface (WUI) built to these codes have proven to be very ignition resistant. Likewise, radiant and convective heat impacts on structures have been minimized through the Chapter 7A exterior fire ratings for walls, windows and doors. Additionally, provisions for modified fuel areas separating wildland fuels from structures have reduced the number of fuel-related structure losses. As such, most of the primary components of the layered fire protection system are required by the CVFD and SDFRD but are worth listing because they have been proven effective for minimizing structural vulnerability to wildfire and, with the inclusion of required interior sprinklers, of extinguishing interior fires, should embers succeed in entering a structure. Even though these measures are now required by the latest Building and Fire Codes, at one time, they were used as mitigation measures for buildings in WUI areas, because they were known to reduce structure vulnerability to wildfire. These measures performed so well, they were adopted into the code. The following project features are required for new development in WUI areas and form the basis of the system of protection necessary to minimize structural ignitions as well as providing adequate access by emergency responders:

1. The 7A Materials and Construction Methods for Exterior Wildfire Exposure (CBC) chapter details the ignition resistant requirements for the following key components of building safely in wildland urban interface and fire hazard severity zones:

    a. Roofing Assemblies (covering, valleys and gutters)
    b. Vents and Openings
    c. Exterior wall covering
    d. Open Roof Eaves
    e. Closed Roof Eaves and Soffits
    f. Exterior Porch Ceilings
    g. Floor projections and underfloor protection
    h. Underfloor appendices
    i. Windows, Skylights and Doors
    j. Decking
    k. Accessory structures

2. New class-A fire rated roof and associated assembly. With the proposed class-A fire rated roof, areas where there will be attic or void spaces requiring ventilation to the outside environment, the attic spaces will require either ember-resistant roof vents or a minimum 1/16-inch mesh (smaller sizes restrict air flow) and shall not exceed 1/8-inch mesh for side ventilation (recommend BrandGuard, O'Hagin or similar vents). All vents used for this Project will be approved by SDFRD.

3. Multi- pane glazing with a minimum of one tempered pane, fire-resistance rating of not less than 20 minutes when tested according to NFPA 257 (such as SaftiFirst, SuperLite 20-minute rated glass product), or be tested to meet the performance requirements of State Fire Marshal Standard 12-7A-2

4. Automatic, Interior Fire Sprinkler System to code by occupancy type for all habitable, residential dwellings.

5. Modern infrastructure, access roads, and water delivery system.

5.3 Infrastructure and Fire Protection Systems Requirements

The following infrastructure components are made in order to comply with the City of Chula and City of San Diego Vista requirements, the 2019 California Fire Code, CVFP's and SDFRD's Fire Code standards, and nationally accepted fire protection standards, as well as additional requirements to assist in providing reasonable on-site fire protection.

5.3.1 Water Supply

The Project will be consistent with 2019 CFC for fire flow and fire hydrant requirements within a VHFHSZ. These internal waterlines will also supply sufficient fire flows and pressure to meet the demands for required on-site fire hydrants and interior fire sprinkler systems for all structures. Water supply must meet a 2-hour fire flow requirement of 2,500 gpm with 20-psi residual pressure, 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

Hydrants shall be located along fire access roadways and cul-de-sacs as determined by the CVFD Fire Marshal to meet operational needs. Hydrants will be consistent with CVFD Design Standards and provided every 500 feet (on-center).

5.3.3 Automatic Fire Sprinkler Systems

All structures within the Project site will include interior sprinklers, per code requirements (Section R313.3 of the 2019 California Residential Code, Chapter 9, Section 903 of the 2019 California Fire Code, and Section 602 of the Urban-Wildland Interface Code). Sprinklers will be specific to each occupancy type and based on the most recent NFPA 13, 13R, or 13D, requirements.

5.3.4 Residential Hazard Detectors

All residential units shall have a fire alarm system be installed in accordance with NFPA 72, Fire Protection Signaling System and CVFD and SDFRD requirements. The fire alarm system will be supervised by a third-party alarm company. The system will be tested annually, or as needed, with test results provided to CVFD and/or SDFRD.

Additionally, all residences will be equipped with residential smoke detectors and carbon monoxide detectors and comply with current CBC, CFC, and California Residential Code standards.

All residential dwelling units shall have electric-powered, hard-wired smoke detectors with battery backup per CVFD.

5.4 Ongoing Building Infrastructure Maintenance

The Project's HOA(s) shall be responsible for long term funding and maintenance of private roads and fire protection systems, including fire sprinklers and fire hydrants.

5.4 Defensible Space and Vegetation Management

5.4.1 Defensible Space and Fuel Management Zone Requirements

An important component of a fire protection system for the Project is the provision for fire-resistant landscapes and modified vegetation buffers. Fuel Modification Zones (FMZ) or Brush Management Zones (BMZ) 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 WUI exposed structures.

Perimeter structures will be located adjacent to FMZ/BMZ areas that separate the Project from naturally vegetated open space areas that surround the Project site. Based on the modeled extreme weather flame lengths for the Project site, wildfire flame lengths are projected to be approximately between 2.3 to 41.2 feet high in areas of Development Footprint-adjacent chapparal and eucalyptus woodland vegetation. The fire behavior modeling system used to predict these flame lengths was not intended to determine sufficient FMZ/BMZ 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 Nakano Project site the proposed FMZ/BMZ widths between the naturally vegetated open space areas and the property lot lines are proposed to be consistent with CVFD and SDFRD's FMZ/BMZ guidelines which are 100 feet (where achievable), approximately 2.5 times the modeled flame lengths based on the fuel type represented adjacent to the Development Footprint. For the purposes of this FPP, the defensible space proposed for the Project will be referred to as FMZ; however, the FMZ is equivalent to the BMZ, which is used by the City of San Diego to describe defensible space.

The FMZ will be constructed from the structure outwards towards undeveloped areas. Figure 9 illustrates the FMZ Plan proposed for the Nakano Project site, including a minimum 5-foot-wide ember-resistant Zone 0, 45-foot-wide irrigated Zone 1, and a 50-foot-wide thinning area Zone 2. Where the FMZ width deviates from the CVFD standards, appropriate alternative materials and methods are provided including block wall and/or upgraded window glazing to include dual tempered panes. Additionally, a fire access road zone will provide a minimum of 20-feet of fuel modification from the edge of any public or private roadway on each side and 13.6-feet of vertical clearance is included as well.

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. To that end, the Project site, based on its location and ember potential, is required to include the latest ignition and ember resistant construction materials and methods for roof assemblies, walls, vents, windows, and appendages, as mandated by the CVFD and SDFRD Fire and Building Codes (e.g., Chapter 7A).

Defensible Space Requirements

A FMZ or BMZ 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 CVFD's and SDFRD'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. Chula Vista Fire Code (Chapter 15.36) 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 VHFHSZ.

City of Chula Vista

A typical landscape/fuel modification installation per the City of Chula Vista's Fire Code consists of a 50-foot-wide Zone 1 and a 50-foot wide Zone 2 for a total of 100 feet in width.

City of San Diego

A typical landscape/brush management installation in the City of San Diego consists of a 35-foot-wide, irrigated Zone 1 and a 65-foot-wide, non-irrigated Zone 2. Zone 2 widths may be decreased by 1.5 feet for each 1 foot of increased Zone 1 width.

Until the Project is annex to the City of San Diego, the CVFD is the FAHJ and will approve and enforce the requirements of this FPP. Therefore, the Project will be consistent with the City of Chula Vista's vegetation management requirements (15.36.065 – Vegetation Management and Clearance). However, once the Project is annexed into the City of San Diego, the SDFRD will be the FAHJ and will enforce the requirements of this FPP. Although the Project's FMZ, which meets the more restrictive requirements of the CVFD, this FPP demonstrates that the FMZ developed for this Project meets the intent of the City of San Diego's fire code, which include the alternative materials and methods discussed in Section 6.

A Fuel Modification Plan shall be reviewed and approved by CVFD and/or SDFRD for consistency with defensible space and fire safety guidelines. Figure 9 conceptually displays 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 CVFD and/or SDFRD. 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 staff of the appropriate fire authority having jurisdiction upon completion of landscape install before a certificate of occupancy being granted by the building code official.

Project Fuel Modification Zone Treatments

Zone 0, Ember-resistant– minimum 5 feet from structures

Zone 0 extends 5 feet from buildings, structures, decks, etc.

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 your home. 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 your roofs, gutters, decks, porches, stairways, etc.
- Remove all branches within 10 feet of any chimney or stovepipe outlet
- Limit plants in this area to low growing, nonwoody, properly watered and maintained plants
- Limit combustible items (outdoor furniture, planters, etc.) on top of decks
- Relocate firewood and lumber to Zone 2
- Replace combustible fencing, gates, and arbors attach to the home 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 1, Irrigated – minimum 45 feet from Zone 0

Zone 1 extends 45 feet from the outer edge of Zone 0.

- Remove all dead plants, grass and weeds (vegetation).
- Remove dead or dry leaves and pine needles from your yard, roof and rain gutters.
- Remove branches that hang over your roof and keep dead branches 10 feet away from your chimney.
- Trim trees regularly to keep branches a minimum of 10 feet from other trees.
- Relocate wood piles to Zone 2.
- 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 patio furniture, wood piles, swing sets, etc.

Zone 2, Thinning

Zone 2 extends from 50 feet from the outer edge of Zone 1

- Cut or mow annual grass down to a maximum height of 4 inches.
- Create horizontal space between shrubs and trees. (See diagram)
- Create vertical space between grass, shrubs and trees. (See diagram)
- 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.

Roadside Fuel Management – up to 20 feet

- Adjacent to the access road shall be 10-20 feet of fuel modification and vegetation will be thinned 50%.

- Thinning will prioritize the removal of vegetation in the following order: 1) invasive-non native species 2) non-native species 3) flammable native species 4) native species and 5) regionally sensitive species.
- Plants not removed by thinning should be cut six inches above ground without pulling out the roots.
- Certain native plants, such as those found in coastal sage scrub, should be cut back within 12 inches of the root crown and regrowth maintained as low succulent mounds.
- Fuel loads should be further reduced by pruning remaining plants into fire-safe specimens by removing dead and excessively twiggy growth.
- Roadside fuel modification shall be maintained by the Project's HOA.

Specific Landscaping Requirements

The following requirements are provided for HOA-maintained fuel modification zones. All landscaping shall be maintained by the HOA.

Plants used in the fuel modification areas or landscapes will include drought-tolerant, fire-resistive trees, shrubs, and groundcovers. The planting list and spacing will be reviewed and approved by SDFRD and/or CVFD, included on submitted landscape plans. The plantings will be consistent with the Suggested Plant Reference Guide (refer to Appendix D-1). The suggested plant reference guide intends to provide examples of plants that are less prone to ignite or spread flames to other vegetation and combustible structures during a wildfire. Additional Plants can be added to the landscape plant material palette with approval from SDFRD and/or CVFD.

Pre-Construction Requirements

- Perimeter fuel modification areas must be implemented and approved by the SDFRD and/or CVFD 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 combustion) or chemical (volatile chemicals increase flammability or combustion characteristics). The plants included in the Undesirable Plant List (Appendix D-2) are unacceptable from a fire safety standpoint and will not be planted on the site or allowed to establish opportunistically within fuel modification zones or landscaped areas. No fuel modification zones are proposed within the MSCP areas, thus no vegetation within the MSCP will be removed.

5.4.2 FMZ Vegetation Management

All fuel modification area vegetation management within the BMZs shall be completed annually by May 1 of each year and more often as needed for fire safety, as determined by the SDFRD.

The individual homeowners shall be responsible for all fuel modification vegetation management on their lots in compliance with this FPP and the SDFRD requirements. The Project HOA shall be responsible for all fuel modification vegetation management for all common areas of the Project site, including roadsides clearance and fuel modification zones. The Project HOA will assure private homeowner lots comply with the plan initially and on an ongoing basis. Chapter 7A requirements for ongoing maintenance of fire-resistive building materials and fire sprinkler systems will be included in the CC&R's and Deed encumbrances for each lot. Additionally, the Project HOA shall be responsible for ensuring long-term funding and ongoing compliance with all provisions of the FPP, including vegetation planting, fuel modification on the perimeter, and maintenance requirements on all common areas and roadsides.

Maintenance of FMZ's and Defensible Space is an important component for the long-term fire safety of the Project. maintenance obligations will be as follows:

- All future plantings shall be in accordance with CVFD Vegetation Management and Clearance guidelines and/or SDFRD Brush Management guidelines.

- All lots will be required to submit plans to the Fuel Modification prior to landscaping being installed and must be identified in the CC&R's.

- Changing landscaping in common areas or individual lots will be revied by the Fuel Modification Unit and approved prior to installation.

- Walls may be required on lots based on the location of structure and proximity to slope and be determined upon final tract submittal or individual lot review.

Project HOA:

- The Project HOA will maintain the access roads, including a minimum of 20 feet clearance on each side of the road(s) within the Development Footprint adjacent to open space areas.

- The Project HOA will be required to annually maintain the FMZs (or as needed).

- The Project HOA will maintain all common areas, including trees planted along roadways and in other areas throughout Project.

5.4.3 Annual FMZ Compliance Inspection

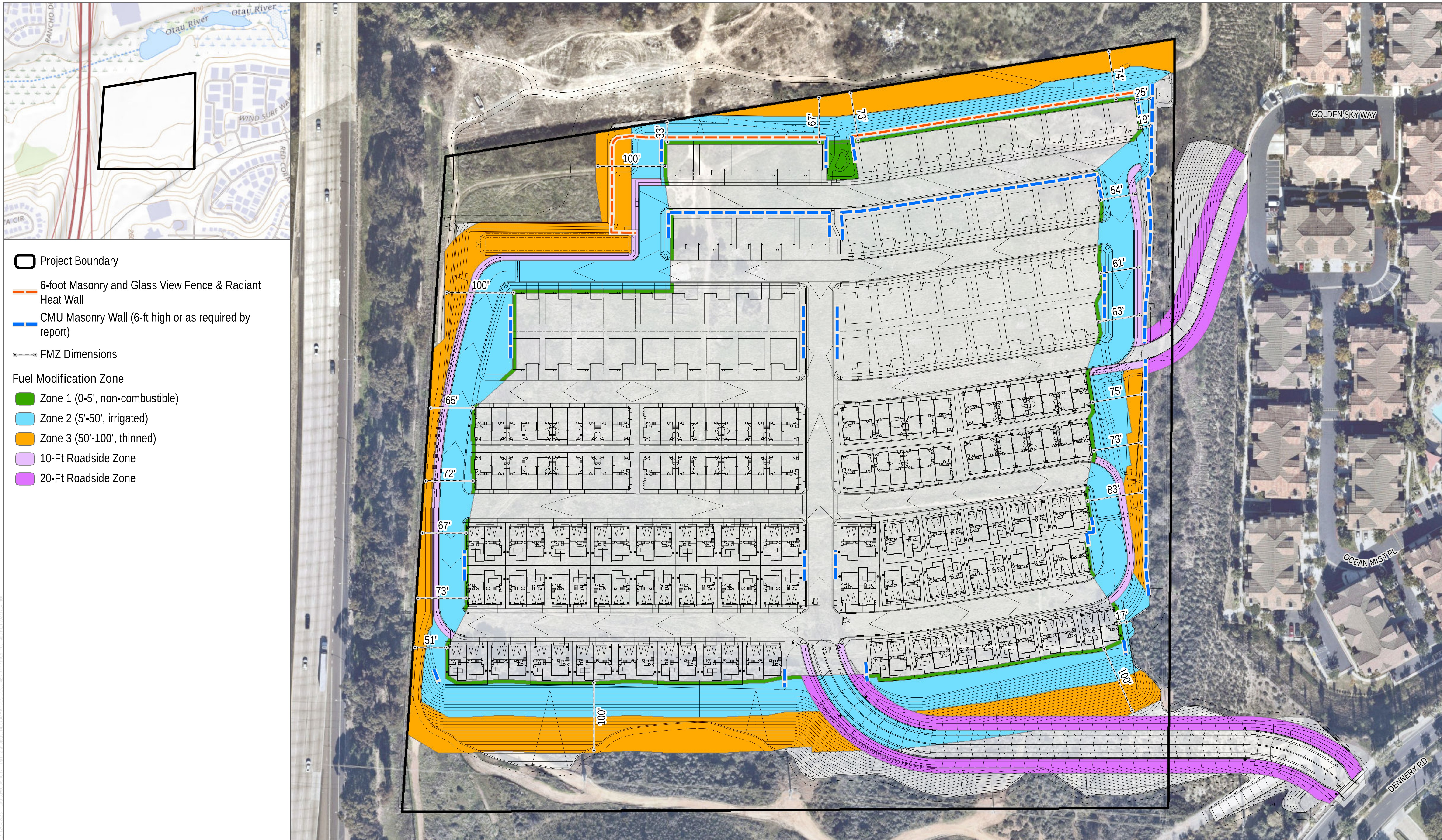
To confirm that the Project's FMZs and landscape areas are being maintained in accordance with this FPP and the CVFD's and/or SDFRD's fuel modification guidelines, the Project HOA will obtain an FMZ inspection and report from a qualified CVFD and/or SDFRD-approved 3rd party inspector in May/June of each year certifying that vegetation management activities throughout the Project site have been performed. If the FMZ areas are not compliant, the Project HOA will have a specified period to correct any noted issues so that a re-inspection can occur, and certification can be achieved. Annual inspection fees are subject to the current Fire Department Fee Schedule.

5.4.4 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 CVFD 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.



SOURCE: AERIAL- SANGIS 2020 IMAGERY; DEVELOPMENT - CIVIL SENSE 2023

DUDEK

0 62.5 125 Feet

FIGURE 9

Fuel Modification Plan

Fire Protection Plan for the Nakano Chula Vista Project

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5.5 Pre-Construction Requirements

An on-site inspection must be conducted by the personnel of the CVFD and/or SDFRD and final approval of the fuel modification plan must be issued prior to a certificate of occupancy being granted by the building code official.

As an additional consultant recommendation, 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 fuel modification zones established.

5.6 Construction Activities in High Fire Hazard Severity Zone

The Project will comply with all CVFD and/or SDFRD requirements for activities in FHSZs. it is recommended that a construction fire prevention plan (CFPP) be prepared for the Project prior to commencement of construction activities that will designate fire safety measures to reduce the possibility of fires during the construction phase. The CFPP should include the following measures: fire watch/ fire guards during hot works and heavy machinery activities, hose lines attached to hydrants or a water tender, Red Flag warning weather period restrictions, required on-site fire resources, and others as determined necessary.

6 Alternative Materials and Methods

As previously mentioned, due to the constraints within the Project site, the full standard FMZ is not achievable. As such, this FPP incorporates the use of a 6-foot heat-deflecting wall that will be positioned along the exposed northern and eastern boundaries of the Project site. 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 brush management 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).

These results support Cohen's (2000) findings that if a community's homes have a sufficiently low home ignitability (i.e., 2017 San Diego County Consolidated Code and 2016 California Building Code), the community can survive exposure to wildfire without major fire destruction. This provides the option of mitigating the wildland fire threat to homes/structures at the residential location without extensive wildland fuel reduction. Cohen's (1995) studies suggest, as a rule-of-thumb, larger flame lengths and widths require wider fuel modification zones to reduce structure ignition. For example, valid Structure Ignition Assessment Model (SIAM) results indicate that a 20-foot high flame has minimal radiant heat to ignite a structure (bare wood) beyond 33 feet (horizontal distance). Whereas, a 70-foot high flame may require about 130 feet of clearance to prevent structure ignitions from radiant heat (Cohen and Butler 1996). This study utilized bare wood, which is more combustible than the ignition resistant exterior walls for structures built today.

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 20.5 feet.

As indicated in this report, the FMZs and additional fire protection measure proposed for the Project provides equivalent wildfire buffer for structures adjacent to open space land where the full FMZ is not achievable. Rather, they 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 northern, eastern and western boundaries 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 brush management zone. As detailed in Section 5.4, the FMZ for the Project would include a minimum 5-foot-wide ember-resistant area, Zone 0, a minimum 45-foot-wide irrigated area, Zone 1, and up to 50-foot-wide thinning area, Zone 2. In order to provide compensating structural protection in the absence of a 100-foot wide FMZ, and in addition to the residences being built to the latest ignition resistant codes, structures in the structures on the northern and eastern boundaries of the Project site 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; 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.
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 CVFD.
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 CVFD and/or SDFRD.

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

Early evacuation for any type of wildfire emergency at the Project site is the preferred method of providing for resident safety, consistent with the CVFD and SDFRD's current approach within San Diego County. As such, the Project's Homeowner's Association would formally adopt, practice, and implement a "Ready, Set, Go!" approach to evacuation[6]. The "Ready, Set, Go!" concept is widely known and encouraged by the State of California and most fire agencies. Pre-planning for emergencies, including wildfire emergencies, focuses on being prepared, having a well-defined plan, minimizing the potential for errors, maintaining the Project site's fire protection systems, and implementing a conservative (evacuate as early as possible) approach to evacuation and Project area activities during periods of fire weather extremes.

Project residents and occupants would be provided ongoing education regarding wildfires and the FPP's requirements. The educational information must include maintaining the landscape and structural components according to the appropriate standards designed for the community. Informational handouts, community website pages, mailers, fire-safe council participation, inspections, and seasonal reminders are some methods that would be used to disseminate wildfire and relocation awareness information. CVFD and/or SDFRD would review and approve all wildfire educational material/programs before printing and distribution.

[6] https://www.chulavistaca.gov/departments/fire-department/ready-set-go and https://www.sandiego.gov/fire/safety/tips/readysetgo

8 Conclusion

The requirements and recommendations set forth in this FPP meet fire safety, building design elements, infrastructure, fuel management/modification, and landscaping recommendations of the applicable codes. The recommendations provided in the FPP have also been designed specifically for the proposed construction of structures within areas designated as VHFHSZ. 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 CVFD and SDFRD 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 City of Chula Vista's and City of San Diego's regulatory standards. Further, the proposed fuel modification on perimeter edges adjacent to the open space areas would provide a buffer between fuels in the open space and structures within the Project site.

Fire is a dynamic and somewhat unpredictable occurrence and as such, this FPP does not guarantee that a fire will not occur or will not result in injury, loss of life, or loss of property. There are no warranties, expressed or implied, regarding the suitability or effectiveness of the recommendations and requirements in this FPP, under all circumstances.

The Project's developers, contractors, engineers, and architects are responsible for the proper implementation of the concepts and requirements set forth in the FPP. Homeowners and property managers are also responsible for maintaining their structures and lots, including fuel modification and landscape, as required by this FPP, the CVFD and/or SDFRD, and as required by the City of Chula Vista Fire Code and/or City of San Diego Fire Code. Alternative methods of compliance with this FPP can be submitted to the FAHJ for consideration.

It will be extremely important for all homeowners to comply with the recommendations and requirements described and required by the FPP on their property. The responsibility to maintain the fuel modification and fire protection features required for the Project site lies with the homeowners. The HOA or similar entity would be responsible for ongoing education and maintenance of the common areas, and the CVFD and/or SDFRD would enforce the vegetation management requirements detailed in this FPP. Such requirements would be made a part of deed encumbrances and CC&Rs for each lot, as appropriate.

It is recommended that the homeowners or other occupants who may reside within the Nakano Project adopt a conservative approach to fire safety. The 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 residents on-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. It is important for anyone living at the WUI to educate themselves on practices that will improve safety.

The goal of the fire protection features, both required and those offered above and beyond the Codes, provided for the Project is to provide the structures with the ability to survive a wildland fire with little intervention of firefighting forces. Preventing ignition to structures results in a reduction of the exposure of firefighters and residents to hazards that threaten personal safety. It will also reduce property damage and losses. Mitigating ignition hazards and fire spread potential reduces the threat to structures and can help the fire department optimize the deployment of personnel and apparatus during a wildfire. The analysis in this FPP provides support and justifications for acceptance of the proposed fuel modification zones for the proposed Nakano Project Development Footprint based on the site-specific fire environment.

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Appendix A
Photograph Log

Photograph 1: Photograph looking west across the Project site, standing in the southeast corner of the Project site, at the proposed entrance to the development off Dennery Road.

Photograph 2: Photograph looking east/southeast towards the proposed entrance into the Project site, standing in the southeast corner of the Project site, just inside the existing driveway off Dennery Road.

Photograph 3: Photograph looking north towards the existing single- and multi-family residential community adjacent to the eastern side of the development. Photograph taken standing in the southeast corner of the Project site, at the proposed entrance to the development off Dennery Road.

Photograph 4: Photograph looking west/southwest along the existing access road along the southern portion of the Project site. Photograph taken standing in the southeast corner of the Project site, at the proposed entrance to the development off Dennery Road.

Photograph 5: Photograph looking east towards the existing single- and multi-family residential community adjacent to the eastern side of the development.

Photograph 6: Photograph looking north along the eastern property boundary of the Project site. Note the existing single- and multi-family residential community adjacent to the eastern side of the development.

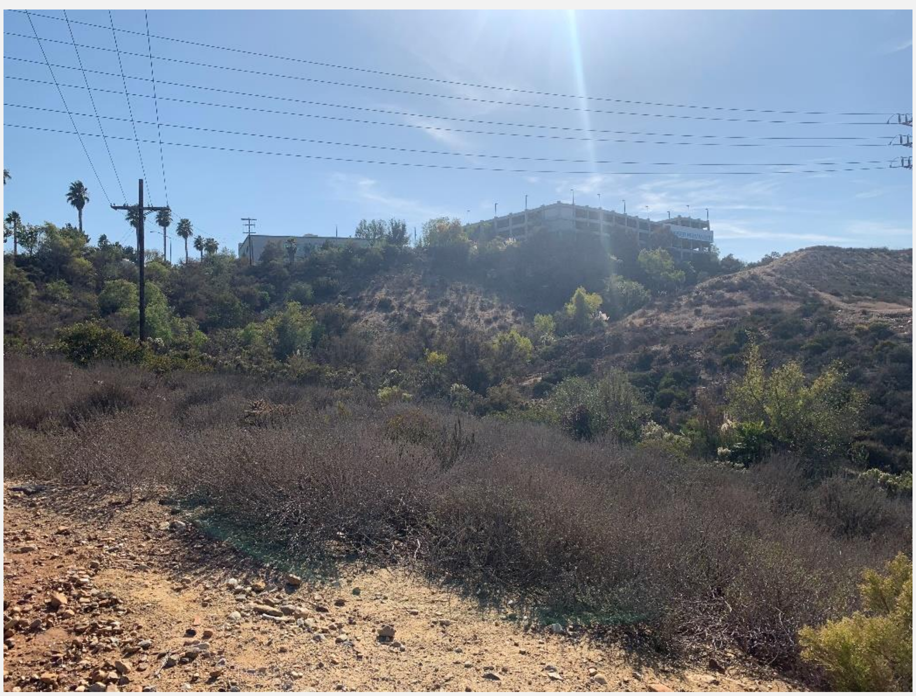
Photograph 7: Photograph looking west across the southern portion of the Project site/southern property boundary and the natural vegetation along the southern side of the proposed development.

Photograph 8: Photograph looking south towards the existing vegetation near the entrance of the project site situated along Dennery Road.

Photograph 9: Photograph looking west/northwest across the southern portion of the Project site, standing in the southeast corner of the Project site, near the proposed entrance to the development off Dennery Road.

Photograph 10: Photograph looking south towards the existing vegetation near the entrance of the project site situated along Dennery Road. Photograph taken standing along the existing driveway in the southeast portion of the Project site.

Photograph 11: Photograph looking west across the southern portion of Project site, standing in the southeast corner of the Project site near the proposed entrance to the development off Dennery Road.



Photograph 12: Photograph looking southwest towards the existing Kaiser Hospital and vegetation above the southern portion of the property. Photograph taken standing along the existing driveway in the southeast portion of the Project site.

Photograph 13: Overview photograph looking towards the northern side of the proposed development. Photograph taken looking north.

Photograph 14: Overview photograph looking towards the north/northwest portion of the proposed development. Photograph taken looking northwest.

Photograph 15: Overview photograph looking towards the north/northeast portions of the proposed development. Photograph taken looking north/northeast.

Photograph 16: Overview photograph looking towards the west/southwest portion of the proposed development. Photograph taken looking west.

Photograph 17: Overview photograph of the existing native and non-native vegetation located above the southern portion of the proposed development. Photograph taken looking west.

Photograph 18: Photograph looking north/northeast along the eastern property boundary of the Project site. Note the existing single- and multi-family residential community adjacent to the eastern side of the development.

Photograph 19: Photograph looking southeast towards the existing vegetated area southeast of the proposed development.

Photograph 20: Photograph looking west towards the existing vegetated area above and south of the proposed development, standing near the center portion of the southern portion of the proposed development.

Photograph 21: Photograph looking southeast towards the existing Kaiser Hospital and vegetation above the southern portion of the property. Photograph taken standing along the existing driveway above the southwest portion of the Project site.

Photograph 22: Photograph looking south towards the existing Kaiser Hospital and vegetation above the southern portion of the property. Photograph taken standing along the existing driveway above the southwest portion of the Project site.

Photograph 23: Photograph looking north along the western property boundary towards the northwest portion of the proposed development. Note the location of existing eucalyptus trees adjacent to the western side of the development.

Photograph 24: Photograph looking west towards the area above the southwest side of the development. Notre I-805 and the existing eucalyptus trees along the western side of the development.

Photograph 25: Photograph looking southwest down Dennery Road, standing near the proposed entrance in the development.

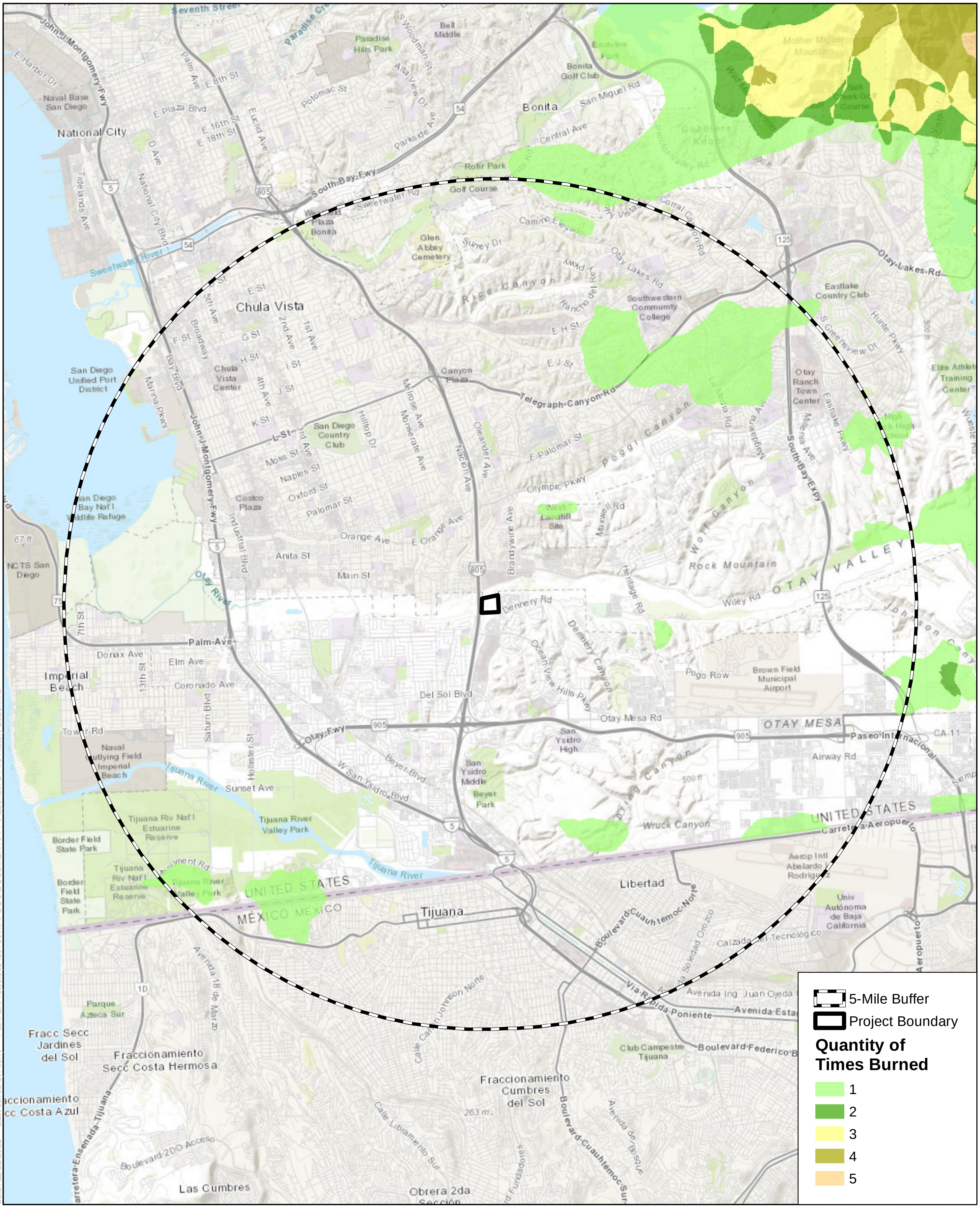
Photograph 26: Photograph looking south over the eucalyptus and riparian habitat within the Otay River, located across the I-805 and northwest of the property.

Photograph 27: Overview photograph of the proposed development, looking across the riparian habitat within the Otay River above the northern portion of the development. Photograph taken facing south/southeast standing in the parking lot of the commercial development north of the property.

Photograph 28: Photograph of the Otay River and the eucalyptus/riparian vegetation above the northwest portion of the development.

Appendix B

Fire History



SOURCE: BASE MAP- ESRI MAPPING SERVICE; FIRE DATA-CALFIRE 2020

DUDEK

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APPENDIX B

Fire History Map

Fire Protection Plan for the Nakano Chula Vista Project

Appendix C
Fire Behavior Analysis

FIRE BEHAVIOR MODELING SUMMARY NAKANO RESIDENTIAL DEVELOPMENT, CHULA VISTA, CALIFORNIA

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 development. As Rothermel summarized, 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 brush management 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 (SCAL):

- 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

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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 Nakano Residential Development 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 the City of Chula Vista, California. Refer to Figure 4, *Fire Behavior Modeling Map* for fire modeling scenario locations and Appendix C for the Fire Behavior Modeling Summary results As is customary for this type of analysis, four scenarios were evaluated, including one summer, onshore weather condition (northwest of the Project Site) and three extreme fall, offshore weather condition (northwest, northeast and south of the Project Site). The Project site is surrounded by an existing single-family residential development to the east, a hospital to the south, a commercial development to the north, and Interstate 805 (I-805) and open space land/the Otay River to the west (separated by I-805) and to the north (separates the commercial development to the north). On the west side of I-805 and northwest of the Proposed Project Site is a small eucalyptus/riparian forest. With that said, fuels and terrain within and adjacent to the Proposed Project development area could produce flying embers that may affect the project, but defenses will be 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 brush management 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. The 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 project site were classified into the aforementioned numeric fuel models. As is customary for this type of analysis, the terrain and fuels within and adjacent to the Proposed Project area were 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. Fuel beds, including moderate-load grass-shrubs, moderate- to- high-load shrubs and chaparrals, and a small eucalyptus/riparian forest area, are adjacent or in near proximity to the proposed Project development site. These fuel types can produce flying embers that may affect the homes within the development, but defenses will be built into the structure(s) to prevent ember penetration. Table 1 provides a description of the six fuel models observed in the vicinity of the site that were subsequently used in the analysis for this project. Modeled areas include moderate load grass-shrub and moderate- to- high-load shrub ground fuels (Fuel Models: FM4, Gs2, Sh2, and Sh5) found throughout the adjacent areas surrounding the Project site, and eucalyptus woodland forest/riparian habitat (Fuel Models: FM9 and Sh4). A total of four fire modeling scenarios were completed for the Project area. These sites were selected based on the strong likelihood of fire approaching from these directions during a Santa Ana wind-driven fire event (fire scenarios 1a, 2, and 3) and an on-shore weather pattern (fire scenario 1b). Dudek also conducted modeling of the site for post-Brush Management Zones' (BMZ) recommendations for this Proposed Project (Refer to Table 2 for post-BMZ fuel model descriptions). Brush management includes establishment of irrigated and thinned zones on the periphery of the development as well as interior landscape requirements. For modeling the post-BMZ treatment condition, fuel model assignments were re-classified for the BMZs 1 (Fuel Model 8) and BMZ 2 (Fuel Model Gr1).

Table 1. Existing Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
FM4	Chaparral	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	>4.0 ft.
FM9	Eucalyptus woodland and riparian forest habitat	Represents the eucalyptus woodland/riparian habitat that exists northwest of the Project site	>8.0 ft.
Gs2	Moderate load, dry climate grass-shrub	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	<2.0 ft.
Sh2	Moderate load, dry climate shrubs	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	<2.0 ft.
Sh4	Eucalyptus woodland and riparian forest habitat	Represents the eucalyptus woodland/riparian habitat that exists northwest of the Project site	>8.0 ft.
Sh5	High load, dry climate shrubs	Represents the vegetation communities located throughout the adjacent areas surrounding the Project without maintenance	>3.0 ft.

Table 2. Post-development Fuel Model Characteristics

Fuel Model Assignment	Vegetation Description	Location	Fuel Bed Depth (Feet)
8	Compact litter	Brush Management Zone 1: irrigated landscape	<1.0 ft.
Gr1	Sparse, Sparse Load, Dry Climate Grass	Brush Management Zone 2: 50% thinning of grasses	>1.0 ft.

The results of this analysis were utilized in generating the Brush Management Zone map (Figure 9 of FPP) and Fire Behavior Modeling Summary results. This analysis models fire behavior outside of the BMZs (off-site) as these areas would be the influencing wildfire areas post-development of the site. The following section presents the fire weather and fuel moisture inputs utilized for the fire behavior modeling conducted for the Proposed Project.

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. Natural slope values ranging from 2% to 10% were measured around the perimeter of the Project site from U.S. Geological Survey (USGS) topographic maps. Slope gradients for landscape areas are assumed to be flat (3%) or 50% (2:1 Manufactured slopes), as presented on the project's site plan.

2.3 Weather Analysis

Historical weather data for the Southern San Diego region was utilized in determining appropriate fire behavior modeling inputs for the Project area. To evaluate different scenarios, data from 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 San Miguel Station RAWS (ID number 045737)[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 2002 and 2021 (extent of available data record) for 97th percentile weather conditions and from June 1 through September 30 for each year between 2002 and 2020 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 determined. Initial wind direction and wind speed values for the five 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 3 summarizes the wind and weather input variables used in the Fire BehavePlus modeling efforts.

[4] San Miguel RAWS Station Latitude and Longitude: 32.686321, -116.977819

Table 3: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50th Percentile)	Peak Weather (97th Percentile)
Fuel Models	FM4, FM9, Sh4, and Sh5	FM4, FM9, Gs2, Sh2, and Sh5
1 h fuel moisture	8%	2%
10 h fuel moisture	9%	3%
100 h fuel moisture	15%	8%
Live herbaceous moisture	59%	30%
Live woody moisture	118%	60%
20 ft. wind speed	14 mph (sustained winds)	18 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	300	45, 200, and 300
Wind adjustment factor	0.4	0.4
Slope (uphill)	3%	2 to 10%

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. Four 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, northeast, and south. 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), as well as crown fires (critical surface intensity (Btu/ft/s), critical surface flame length (feet), transition ratio (ratio: surface fireline intensity divided by critical surface intensity), transition to crown fire (yes or no), crown fire rate of spread (mph), critical crown rate of spread (mph), active ratio (ratio: crown fire rate of spread divided by critical crown fire rate of spread), active crown fire (yes or no), and fire type (surface, torching, conditional crown, or crowning)) for a fire going through the small eucalyptus woodland/riparian area northwest of the Project site. 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. Four 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 four fire scenarios are explained in more detail below:

Fire Scenario Locations and Descriptions:

- **Scenarios 1a:** This scenario modeled both a fall, off-shore fire (97th percentile weather condition) and a summer, on-shore fire (50th percentile weather condition) burning through the approximately 25-foot tall eucalyptus tree woodland and riparian habitat area within the Otay River on the west side of I-805 and northwest of the Proposed Project site. The terrain is flat (approximately 3% slope) with tall eucalyptus trees and potential ignition sources from a structure fire in the adjacent single-family community to the north, a vehicle fire from traffic along I-805, or embers from a wildland fire from the west of east/northeast of the proposed development. This type of fire would typically spread by jumping from tree to tree before possibly transitioning under I-805 before reaching the developed portion of the Project site.

- Scenario 1b: A summer, on-shore fire (50th percentile weather condition) burning in moderate- to- high-load shrub and chaparral dominated vegetation with a small intermix of non-native grassland located northwest of the Project site (east side of I-805 and within the riparian area of the Otay River. Additionally, this scenario models the possibility of a eucalyptus crown fire that are located along the west side of the development and east side of the I-805. The terrain is flat (between 2% and 3% slope) with potential ignition sources from a vehicle fire from traffic along I-805 or embers from a wildland fire from the west of east/northeast of the proposed development. This type of fire would typically spread moderately fast before reaching the developed portion of the Project site.
- Scenario 2: A fall, off-shore fire (97th percentile weather condition) burning in moderate- to- high-load shrub and chaparral dominated vegetation with a small intermix of non-native grassland located north/northeast of the Project development. The terrain is flat (approximately 2% slope) with potential ignition sources from a structure fire in the adjacent single-family community to the east, a vehicle fire from the parking lot to the north, or from a wildland fire from the east/northeast of the proposed development. This type of fire would typically spread moderately fast before reaching the northern portion of the developed area of the Project site.
- Scenario 3: A fall, off-shore fire (97th percentile weather condition) burning in moderate- to- high-load shrub and chaparral dominated vegetation with a small intermix of non-native grassland located south of the Project development. The terrain is relatively flat (approximately 10% slope) with potential ignition sources from a structure fire from the adjacent hospital to the south, a vehicle fire from the hospital parking lot to the south or traffic along the I-805, or from embers of a wildland fire from the east/northeast of the proposed development. This type of fire would typically spread moderately fast before reaching the southern portion of the developed Project site.

4 Fire Behavior Modeling Results

The results presented in Tables 4 and 5 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 brush management 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.

As presented in Table 4, wildfire behavior on the Project site is expected to be primarily of moderate to high intensity throughout the non-maintained surface shrub and chaparral dominated fuels within the Otay River area and small hillside along the southern boundary adjacent to the Project site, as well as within the eucalyptus woodland area/eucalyptus trees along I-805. Worst-case fire behavior from the eucalyptus tree woodland is expected under peak weather conditions (represented by Fall Weather, Scenario 1a – Fall), while worst-case surface fire behavior is expected under peak weather conditions within the non-maintained shrubs and chaparrals vegetated areas (represented by Scenario 2). The fire is anticipated to be a wind-driven fire from the north/northeast during the fall. Under such conditions, expected surface flame length could potentially reach approximately 41 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 18,348 BTU/feet/second with moderate spread rates of 6.2 mph and could have a spotting distance up to 2.3 miles away. Because embers could spot within 2.3 miles of the Project site, a crown fire could potentially occur within the small eucalyptus woodland area within the riparian Otay River, located approximately 550 feet northwest of the developed portion of the Project site. Potential crown fire flame lengths could reach 58 feet with sustained winds of 18 mph or 147 feet with wind gusts of 50+ mph. Under this scenario, crown fireline intensities reach 20,083 BTU/feet/second with moderately slow crown spread rates of 4.1 mph

Wildfire behavior in non-maintained shrubs and chaparral within the Otay River west/northwest of the Project site, modeled as FM4 and Sh5 being fanned by 14 mph sustained, on-shore winds. Fires burning from the west/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 moderate- to- high-load shrub/chaparral vegetation fire could have flame lengths between approximately 12 feet and 19 feet in height and spread rates between 0.6 and 0.9 mph. Spotting distances, where airborne embers can ignite new fires downwind or within the small eucalyptus woodland area within the riparian Otay River, located approximately 550 feet northwest of the developed portion of the Project site, range from 0.4 to 0.6 miles. A crown fire could potentially reach 38 feet under these conditions.

Based on the BehavePlus analysis, post development fire behavior expected in the irrigated and replanted with plants that are acceptable with the San Diego Fire-Rescue Department (SDFRD) (BMZ Zone 1 – Gr1), as well as in an area with thinning of the existing shrubs (BMZ Zone 2 – Sh1/Sh2) under peak weather conditions (represented by Fall Weather, Scenario 2) is presented in Table 5. Under such conditions, expected surface flame length is expected to be significantly lower, with flames lengths reaching approximately 10 feet with wind speeds of 50+ mph. Under this scenario, fireline intensities reach 760 BTU/feet/second with relatively slow spread rates of 1.3 mph and could have a spotting distance up to 0.8 miles away. Therefore, the modified BMZ proposed for the Nakano Residential Development Project are approximately 2.5-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 Model Results – Existing Conditions

Fire Scenario	Flame Length[1] (feet)	Spread Rate[1] (mph[5])	Fireline Intensity[1] (Btu/ft/s)	Spot Fire[1] (miles)	Surface Fire to Tree Crown Fire	Tree Crown Fire Rate of Spread (mph)	Crown Fire Flame Length (feet)
Scenario 1a: 3% slope; Fall Off-shore Extreme Wind (97th percentile) - (Northwest of Project site)							
Eucalyptus woodland/Riparian Habitat (FM9)	5.3 (11.7')[6]	0.3 (1.7)	215 (1,193)	0.3 (1.0)	No	1.0 (4.1)	52.9 (136.1)[6]
Riparian Habitat - Timber Shrub (Sh4)	12.1 (23.2)[6]	1.0 (4.1)	1,293 (5,261)	0.6 (1.5)	No	1.0 (4.1)	57.5 (137.8)[6]
Scrub and Chaparral (Sh5)	23.7 (41.2)[6]	1.9 (6.2)	5,546 (18,348)	0.9 (2.3)	Crowning [4]	1.0 (4.1)	69.9 (179.7)[6]
Scenario 1a: 3% slope; Summer on-shore Wind (50th percentile) - (Northwest of Project site)							
Eucalyptus woodland/Riparian Habitat (FM9)	2.9	0.1	57	0.2	No	0.3	38.1
Riparian Habitat - Timber Shrub (Sh4)	2.3	0.1	34	0.1	No	0.3	37.5
Scrub and Chaparral (Sh5)	12.5	0.6	1,379	0.4	Crowning [4]	0.3	43.5
Scenario 1b: 2% slope; Summer on-shore Wind (50th percentile) – Pre-BMZ (Northwest of Project site)							
Chaparral (FM4)	18.9	0.9	3,375	0.6	Crowning [4]	0.3	36.5
Riparian Habitat - Timber Shrub (Sh4)	2.3	0.1	34	0.1	No	0.3	24.3
Scrub and Chaparral (Sh5)	12.5	0.6	1,379	0.4	Crowning [4]	0.3	31.5
Scenario 2: 2% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (North/northwest of Project site)							
Grass/Shrub (Gs2)	9.6 (18.8')[6]	0.9 (3.8)	774 (3,358)	0.4 (1.3)	N/A	N/A	N/A
Moderate load shrubs (Sh2)	8.0 (15.1)[6]	0.2 (0.9)	522 (2,074)	0.4 (1.1)	N/A	N/A	N/A
High load Scrub (Sh5)	23.6 (41.1)[6]	1.9 (6.2)	5,545 (18,348)	0.8 (2.3)	N/A	N/A	N/A
Scenario 3: 10% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (South of Project site)							
Grass/Shrub (Gs2)	9.6 (18.8')[6]	0.9 (3.8)	767 (3,351)	0.4 (1.3)	N/A	N/A	N/A
Moderate load shrubs (Sh2)	8.0 (15.1)[6]	0.2 (0.9)	517 (2,069)	0.4 (1.1)	N/A	N/A	N/A
High load Scrub (Sh5)	23.7 (41.2)[6]	1.9 (6.2)	5,500 (18,303)	0.8 (2.3)	N/A	N/A	N/A

Note:

1. Wind-driven surface fire.
2. Riparian overstory torching increases fire intensity. Modeling included canopy fuel over Sh4, which represents surface fuels beneath the tree canopies.
3. A surface fire in the mixed sycamore riparian forest would transition into the tree canopies generating flame lengths higher than the average tree height (25 feet). Viable airborne embers could be carried downwind for approximately 1.0 mile and ignite receptive fuels.
4. Crowning= fire is spreading through the overstory crowns.
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.

A crown fire with the modeled flame lengths listed in Table 4 would not be expected based on the BMZs being proposed, the ongoing maintenance of the BMZs, and the high moisture levels within the riparian zone areas. An active crown fire flame length modeled using the BehavePlus software is calculated based on the active crown fire intensity, which assumes that the crown fire is fully active.

Table 5: RAWS BehavePlus Fire Behavior Model Results – Post Project Conditions

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[5]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles)[6]
Scenario 1b: 2% slope; Summer on-shore Wind (50th percentile) – Post-BMZ (Northwest of Project site)				
BMZ Zone 1 (Gr1)	1.7	0.2	18	0.1
BMZ Zone 2 (Sh1)	0.6	0.0	2	0.0
Scenario 2: 2% slope; Fall Off-shore, Extreme Winds (97th percentile) – Post-BMZ (North/northwest of Project site)				
BMZ Zone 1 (Gr1)	3.1 (3.1)	0.5 (0.5)	67 (67)	0.2 (0.4)
BMZ Zone 2 (Sh1)	5.3 (9.5)	0.3 (1.3)	210 (760)	0.3 (0.8)
Scenario 3: 10% slope; Fall Off-shore, Extreme Winds (97th percentile) – Pre-BMZ (South of Project site)				
BMZ Zone 1 (Gr1)	3.1 (3.1)	0.5 (0.5)	67 (67)	0.2 (0.4)
BMZ Zone 2 (Sh1)	5.2 (9.5)	0.3 (1.3)	208 (760)	0.3 (0.8)

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.

Crown Fire:

- Transition to Crown Fire: Indicates whether conditions for transition from surface to crown fire are likely. Calculation depends on the transition ratio. If the transition ratio is greater than or equal to 1, then transition to crown fire is Yes. If the transition ratio is less than 1, then transition to crown fire is No.

[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 45 mph.

- Crown Fire Rate of Spread (mph): The forward spread rate of a crown fire. It is the overall spread for a sustained run over several hours. The spread rate includes the effects of spotting. It is calculated from 20-ft wind speed and surface fuel moisture values. It does not consider a description of the overstory.

Fire Type:

Fire type is one of the following four types: surface (understory fire), torching (passive crown fire; surface fire with occasional torching trees), conditional crown (active crown fire possible if the fire transitions to the overstory), and crowning (active crown fire; fire spreading through the overstory crowns). Dependent on the variables: transition to crown fire and active crown fire.

The information in Table 6 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 4 and 5. Identification of modeling run locations is presented graphically in Figure 4 of the FPP.

Table 6: 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-1

Suggested Plant List

Suggested Plant List
For Fuel Modification Projects in San Diego, Riverside, and Orange Counties

	Code	Botanical Name	Common Name	Plant Form
1.	W	Abelia x grandiflora	Glossy Abelia	Shrub
2.	□	Acacia redolens desert carpet	Desert Carpet	Shrub
3.	□	Acer macrophyllum	Big Leaf Maple	Tree
4.	X	Achillea millefolium	Common Yarrow	Low shrub
5.	W	Achillea tomentosa	Wooly Yarrow	Low shrub
6.	X	Aeonium decorum	Aeonium	Ground cover
7.	X	Aeonium simsii	ncn	Ground cover
8.	W	Agave attenuata	Century Plant	Succulent
9.	W	Agave shawii	Shaw's Century Plant	Succulent
10.	N	Agave victoriae-reginae	ncn	Ground cover
11.	X	Ajuga reptans	Carpet Bugle	Ground cover
12.	W	Alnus cordata	Italian Alder	Tree
13.	□	Alnus rhombifolia	White Alder	Tree
14.	N	Aloe aborescens	Tree Aloe	Shrub
15.	N	Aloe aristata	ncn	Ground cover
16.	N	Aloe brevifolia	ncn	Ground cover
17.	W	Aloe vera	Medicinal Aloe	Succulent
18.	W	Alyogyne huegelii	Blue Hibiscus	Shrub
19.	□	Ambrosia chamissonis	Beach Bur-Sage	Perennial
20.	□	Amorpha fruticosa	Western False Indigobush	Shrub
21.	W	Anigozanthus flavidus	Kangaroo Paw	Perennial accent
22.	□	Antirrhinum nuttalianum ssp. nuttalianum	ncn	Subshrub
23.	X	Aptenia cordifolia x 'Red Apple'	Red Apple Aptenia	Ground cover
24.	W	Arbutus unedo	Strawberry Tree	Tree
25.	W	Arctostaphylos 'Pacific Mist'	Pacific Mist Manzanita	Ground cover
26.	W	Arctostaphylos edmundsii	Little Sur Manzanita	Ground cover
27.	□	Arctostaphylos glandulosa ssp.glandulosa	Eastwood Manzanita	Shrub
28.	W	Arctostaphylos hookeri 'Monterey Carpet'	Monterey Carpet Manzanita	Low shrub

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= Plant species native to Riverside, Orange and San Diego Counties. Acceptable in all fuel modification (wet or dry zones) in all locations.

N = Plant species acceptable on a limited basis (maximum 30% of the area at time of planting) in wet fuel modification zones adjacent to native open space reserve lands. Acceptable in all other fuel modification locations and zones.

• If seed collected from local seed source.

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	Code	Botanical Name	Common Name	Plant Form
29.	**N**	Arctostaphylos pungens	ncn	Shrub
30.	**N**	Arctostaphylos refugioensis	Refugio Manzanita	Shrub
31.	**W**	Arctostaphylos uva-ursi	Bearberry	Ground cover
32.	**W**	Arctostaphylos x 'Greensphere'	Greensphere Manzanita	Shrub
33.	**N**	Artemisia caucasica	Caucasian Artemisia	Ground cover
34.	**X**	Artemisia pycnocephaia	Beach Sagewort	Perennial
35.	**X**	Atriplex canescens	Four-Wing Saltbush	Shrub
36.	**X**	Atriplex lentiformis ssp. Breweri	Brewer Saltbush	Shrub
37.	□	Baccharis emoryi	Emory Baccharis	Shrub
38.	**W** □	Baccharis pilularis ssp. Consanguinea	Chaparral Bloom	Shrub
39.	**X**	Baccharis pilularis var. pilularis "Twin Peaks #2'	Twin Peaks	Ground cover
40.	□	Baccharis salicifolia	Mulefat	Shrub
41.	**N**	Baileya multiradiata	Desert Marigold	Ground cover
42.	**W**	Beaucarnea recurvata	Bottle Palm	Shrub/Small tree
43.	**N** □	Bougainvillea spectabilis	Bougainvillea	Shrub
44.	**N** □	Brahea armata	Mexican Blue Palm, Blue Hesper Palm	Palm
45.	**N** □	Brahea brandegeei	San Jose Hesper Palm	Palm
46.	**N** □	Brahea edulis	Guadalupe Palm	Palm
47.	□	Brickellia californica	ncn	Subshrub
48.	**W** □	Bromus carinatus	California Brome	Grass
49.	□	Camissonia cheiranthifolia	Beach Evening Primrose	Perennial subshrub
50.	**N**	Carissa macrocarpa	Green Carpet Natal Plum	Ground cover/Shrub
51.	**X**	Carpobrotus chilensis	Sea Fig Ice Plant	Ground cover
52.	**W**	Ceanothus gloriosus 'Point Reyes'	Point Reyes Ceanothus	Shrub

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	Code	Botanical Name	Common Name	Plant Form
53.	**W**	Ceanothus griseus "Louis Edmunds'	Louis Edmunds Ceanothus	Shrub
54.	**W**	Ceanothus griseus horizontalis	Yankee Point	Ground Cover
55.	**W**	Ceanothus griseus var. horizontalis	Carmel Creeper Ceanothus	Shrub
56.	**W**	Ceanothus griseus var. horizontalis "Yankee Point"	Yankee Point Ceanothus	Shrub
57.	□	Ceanothus megacarpus	Big Pod Ceanothus	Shrub
58.	**W**	Ceanothus prostratus	Squaw carpet ceanothus	Shrub
59.	□	Ceanothus spinosus	Green bark ceanothus	Shrub
60.	**W**	Ceanothus verrucosus	Wart-Stem Ceanothus	Shrub
61.	**W**	Cerastium tomentosum	Snow-in-summer	Ground cover/shrub
62.	**W**	Ceratonia siliqua	Carob	Tree
63.	**W**	Cercis occidentalis	Western Redbud	Tree/shrub
64.	**X**	Chrysanthemum leucanthemum	Oxeye Daisy	Groundcover
65.	**W**	Cistus crispus	ncn	Shrub
66.	**W**	Cistus hybridus	White Rockrose	Shrub
67.	**W**	Cistus incanus	ncn	Shrub
68.	**W**	Cistus incanus ssp. corsicus	ncn	Shrub
69.	**W**	Cistus salviifolis	Sageleaf Rockrose	Shrub
70.	**W**	Cistus x purpureus	Orchid Rockrose	Shrub
71.	**W**	Citrus species	Citrus	Tree
72.	□	Clarkia bottae	Showy Fairwell to Spring	Annual
73.	□	Cneoridium dumosum	Bushrue	Shrub
74.	□	Collinsia heterophylla	Chinese Houses	Annual
75.	**W** □	Comarostaphylis diversifolia	Summer Holly	Shrub
76.	**N**	Convolvulus cneorum	Bush Morning Glory	Shrub

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	Code	Botanical Name	Common Name	Plant Form
77.	**W**	Coprosma kirkii	Creeping Coprosma	Ground cover/Shrub
78.	**W**	Coprosma pumila	Prostrate Coprosma	Low Shrub
79.	□	Coreopsis californica	California Coreopsis	Annual
80.	**W**	Coreopsis lanceolata	Coreopsis	Ground cover
81.	**N**	Correa pulchella	Australian Fuchsia	Ground cover
82.	**W**	Cotoneaster buxifolius	ncn	Shrub
83.	**W**	Cotoneaster congestus 'Likiang'	Likiang Cotoneaster	Ground cover/Vine
84.	**W**	Cotoneaster parneyi	ncn	Shrub
85.	**X**	Crassula lactea	ncn	Ground cover
86.	**X**	Crassula multicava	ncn	Ground cover
87.	**X**	Crassula ovata	Jade Tree	Shrub
88.	**X**	Crassula tetragona	ncn	Ground cover
89.	**W** □	Croton californicus	California Croton	Ground cover
90.	**X**	Delosperma 'alba'	White Trailing Ice Plant	Ground cover
91.	□	Dendromecon rigida	Bush Poppy	Shrub
92.	□	Dichelostemma capitatum	Blue Dicks	Herb
93.	**N**	Distictis buccinatoria	Blood-Red Trumpet Vine	Vine/Climbing vine
94.	**N**	Dodonaea viscosa	Hopseed Bush	Shrub
95.	**X**	Drosanthemum floribundum	Rosea Ice Plant	Ground cover
96.	**X**	Drosanthemum hispidum	ncn	Ground cover
97.	**X**	Drosanthemum speciosum	Dewflower	Ground cover
98.	□	Dudleya lanceolata	Lance-leaved Dudleya	Succulent
99.	□	Dudleya pulverulenta	Chalk Dudleya	Succulent
100.	**W**	Elaeagnus pungens	Silverberry	Shrub
101	□	Encelia californica	California Encelia	Small shrub

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	Code	Botanical Name	Common Name	Plant Form
102.	□ ●	Epilobium canum [Zauschneria californica]	Hoary California Fuchsia	Shrub
103.	□	Eriastrum sapphirinum	Mojave Wooly Star	Annual
104.	**N**	Eriobotrya japonica	Loquat	Tree
105.	□	Eriodictycon crassifolium	Thick-Leaf Yerba Santa	Shrub
106.	□	Eriodictycon trichocalyx	Yerba Santa	Shrub
107.	**W** □	Eriophyllum confertiflorum	ncn	Shrub
108.	**W**	Erythrina species	Coral Tree	Tree
109.	**N**	Escallonia species	Several varieties	Shrub
110.	**W** □	Eschscholzia californica	California Poppy	Flower
111.	**X**	Eschscholzia mexicana	Mexican Poppy	Herb
112.	**N**	Euonymus fortunei	Winter Creeper Euonymus	Ground cover
113.	**N**	Feijoa sellowiana	Pineapple Guava	Shrub/Tree
114.	**N**	Fragaria chiloensis	Wild Strawberry/ Sand Strawberry	Ground cover
115.	□	Frankenia salina	Alkali Heath	Ground cover
116.	**W**	Fremontodendron californicum	California Flannelbush	Shrub
117.	**X**	Gaillardia x grandiflora	Blanketflower	Ground cover
118.	**W**	Galvezia speciosa	Bush Snapdragon	Shrub
119	**W**	Garrya ellipta	Silktassel	Shrub
120.	**X**	Gazania hybrids	South African Daisy	Ground cover
121.	**X**	Gazania rigens leucolaena	Trailing Gazania	Ground cover
122.	□	Gilia capitata	Globe Gilia	Perennial
123.	**W**	Gilia lepthantha	Showy Gilia	Perennial
124.	**W**	Gilia tricolor	Bird's Eyes	Perennial
125.	**W**	Ginkgo biloba	Maidenhair Tree	Tree
126.	□	Gnaphalium californicum	California Everlasting	Annual
127.	**W**	Grewia occidentalis	Starflower	Shrub
128.	□	Grindelia stricta	Gum Plant	Ground cover

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	Code	Botanical Name	Common Name	Plant Form
129.	**N □**	Hakea suaveolens	Sweet Hakea	Shrub
130.	**W**	Hardenbergia comptoniana	Lilac Vine	Shrub
131.	**N**	Helianthemum mutabile	Sunrose	Ground cover/Shrub
132.	□	Helianthemum scoparium	Rush Rose	Shrub
133.	□	Heliotropium curassavicum	Salt Heliotrope	Ground cover
134.	**X**	Helix canariensis	English Ivy	Ground cover
135.	**W**	Hesperaloe parviflora	Red Yucca	Perennial
136.	□ □	Heteromeles arbutifolia	Toyon	Shrub
137.	**X**	Hypericum calycinum	Aaron's-Beard	Shrub
138.	**N**	Iberis sempervirens	Edging Caandytuft	Ground cover
139.	**N**	Iberis umbellatum	Globe Candytuft	Ground cover
140.	□	Isocoma menziesii	Coastal Goldenbush	Small shrub
141.	□	Isomeris arborea	Bladderpod	Shrub
142.	**W**	Iva hayesiana	Poverty Weed	Ground cover
143.	**N**	Juglans californica	California Black Walnut	Tree
144.	□	Juncus acutus	Spiny Rush	Perennial
145.	□	Keckiella antirrhinoides	Yellow Bush Penstemon	Subshrub
146.	□	Keckiella cordifolia	Heart Leaved Penstemon	Subshrub
147.	□	Keckiella ternata	Blue Stemmed Bush Penstemon	Subshrub
148.	**W**	Kniphofia uvaria	Red Hot Poker	Perennial
149.	**W**	Lagerstroemia indica	Crape Myrtel	Tree
150.	**W**	Lagunaria patersonii	Primrose Tree	Tree
151.	**X**	Lampranthus aurantiacus	Bush Ice Plant	Ground cover
152.	**X**	Lampranthus filicaulis	Redondo Creeper	Ground cover
153.	**X**	Lampranthus spectabilis	Trailing Ice Plant	Ground cover
154.	**W**	Lantana camara cultivars	Yellow Sage	Shrub
155.	**W**	Lantana montevidensis	Trailing Lantana	Shrub
156.	□	Lasthenia californica	Dwarf Goldfields	Annual

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	Code	Botanical Name	Common Name	Plant Form
157.	**W**	Lavandula dentata	French Lavendar	Shrub
158.	**W**	Leptospermum laevigatum	Australian Tea Tree	Shrub
159.	**W**	Leucophyllum frutescens	Texas Ranger	Shrub
160.	□	Leymus condensatus	Giant Wild Rye	Large grass
161.	**N**	Ligustrum japonicum	Texas Privet	Shrub
162.	**X**	Limonium pectinatum	ncn	Ground cover
163.	**X**	Limonium perezii	Sea Lavender	Shrub
164.	**W** □	Liquidambar styraciflua	American Sweet Gum	Tree
165.	**W**	Liriodendron tulipifera	Tulip Tree	Tree
166.	**X**	Lonicera japonica 'Halliana'	Hall's Japanese Honeysuckle	Vining shrub
167.	□	Lonicera subspicata	Wild Honeysuckle	Vining shrub
168.	**X**	Lotus corniculatus	Bird's Foot Trefoil	Ground cover
169.	□	Lotus heermannii	Northern Woolly Lotus	Perennial
170.	□	Lotus scoparius	Deerweed	Shrub
171.	**W**	Lupinus arizonicus	Desert Lupine	Annual
172.	**W**	Lupinus benthamii	Spider Lupine	Annual
173.	□	Lupinus bicolor	Sky Lupine	Flowering annual
174.	□	Lupinus sparsiflorus	Loosely Flowered Annual Lupini/Coulter's Lupine	Annual
175.	**W**	Lyonothamnus floribundus ssp. asplenifolius	Fernleaf Ironwood	Tree
176.	**W**	Macadamia Integrifolia	Macadamia Nut	Tree
177.	**W**	Mahonia aquifolium 'Golden Abundance'	Golden Abundance Oregon Grape	Shrub

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	Code	Botanical Name	Common Name	Plant Form
178.	**W**	Mahonia nevinii	Nevin Mahonia	Shrub
179.	□	Malacothamnus fasciculatus	Chaparral Mallow	Shrub
180.	**X**	Malephora luteola	Trailing Ice Plant	Ground cover
181.	**W**	Maytenus boaria	Mayten Tree	Tree
182.	**W**	Melaleuca nesophila	Pink Melaleuca	Shrub
183.	**N**	Metrosideros excelsus	New Zealand Christmas Tree	Tree
184.	□ •	Mimulus species	Monkeyflower	Flower
185.	□	Mirabilis californica	Wishbone Bush	Perennial
186.	**N**	Myoporum debile	ncn	Shrub
187.	**N**	Myoporum insulare	Boobyalla	Shrub
188.	**W**	Myoporum parvifolium	ncn	Ground cover
189.	**W**	Myoporum 'Pacificum'	ncn	Shrub
190.	□	Nassella [stipa] lepida	Foothill needlegrass	Ground cover
191.	□	Nassella [stipa] pulchra	Purple needlegrass	Ground cover
192.	□	Nemophila menziesii	Baby Blue Eyes	Annual
193.	**X**	Nerium oleander	Oleander	Shrub
197.	□	Oenothera hookeri	California Evening Primrose	Flower
198.	**W**	Oenothera speciosa	Showy Evening Primrose	Perennial
199.	**X**	Ophiopogon japonicus	Mondo Grass	Ground cover
200.	□ •	Opuntia littoralis	Prickly Pear	Cactus
201.	□ •	Opuntia oricola	Oracle Cactus	Cactus
202.	□ •	Opuntia prolifera	Coast Cholla	Cactus
203.	**W**	Osmanthus fragrans	Sweet Olive	Shrub
204.	**X**	Osteospermum fruticosum	Trailing African Daisy	Ground cover
205.	**X**	Parkinsonia aculeata	Mexican Palo Verde	Tree
206.	**W**	Pelargonium peltatum	Ivy Geranium	Ground cover

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	Code	Botanical Name	Common Name	Plant Form
207.	**X**	Penstemon species	Beard Tongue	Shrub
208.	**W**	Photinia fraseri	ncn	Shrub
209.	**W**	Pistacia chinensis	Chinese Pistache	Tree
210.	**X**	Pittosporum undulatum	Victorian Box	Tree
211.	□	Plantago erecta	California Plantain	Annual
212.	● ●	Plantago insularis	Woolly Plantain	Annual
213.	**X**	Plantago sempervirens	Evergreen Plaintain	Ground cover
214.	**W**	Platanus racemosa	California Sycamore	Tree
215.	**W**	Plumbago auriculata	Plumbago Cape	Shrub
216.	□	Populus fremontii	Western Cottonwood	Tree
217.	**X**	Portulacaria afra	Elephant's Food	Shrub
218.	□	Potentilla glandulosa	Sticky Cinquefoil	Subshrub
219.	**X**	Potentilla tabernaemontanii	Spring Cinquefoil	Ground cover
220.	**X**	Prunus caroliniana	Carolina Cherry Laurel	Shrub/Tree
221.	□	Prunus ilicifolia ssp. ilicifolia	Holly Leaved Cherry	Shrub
222.	**X**	Prunus lyonii	Catalina Cherry	Shrub/Tree
223.	**N**	Punica granatum	Pomegranate	Shrub/Tree
224.	**W**	Puya species	Puya	Succulent/shrub
225.	**W**	Pyracantha species	Firethorn	Shrub
226.	□	Quercus agrifolia	Coast Live Oak	Shrub
227.	□ □ ●	Quercus berberdifolia	California Scrub Oak	Shrub
228.	□ □ ●	Quercus dumosa	Coastal Scrub Oak	Shrub
229.	**X**	Quercus engelmannii	Engelmann Oak	Tree

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	Code	Botanical Name	Common Name	Plant Form
230.	**X**	Quercus suber	Cork Oak	Tree
231.	**X**	Rhamnus alaternus	Italian Buckthorn	Shrub
232.	□	Rhamnus californica	California Coffee Berry	Shrub
233.	□	Rhamnus crocea	Redberry	Shrub
234.	□	Rhamnus crocea ssp. ilicifolia	Hollyleaf Redberry	Shrub
235.	**N**	Rhaphiolepis species	Indian Hawthorn	Shrub
236.	□	Rhus integrifolia	Lemonade Berry	Shrub
237.	**N**	Rhus lancea	African Sumac	Tree
238.	□ □	Rhus ovata	Sugarbush	Shrub
239.	□	Ribes aureum	Golden Currant	Shrub
240.	□	Ribes indecorum	White Flowering Currant	Shrub
241.	□	Ribes speciosum	Fuchsia Flowering Gooseberry	Shrub
242.	**W**	Ribes viburnifolium	Evergreen Currant	Shrub
243.	□ •	Romneya coulteri	Matilija Poppy	Shrub
244.	**X**	Romneya coulteri 'White Cloud'	White Cloud Matilija Poppy	Shrub
245.	**W** □	Rosmarinus officinalis	Rosemary	Shrub
246.	**W** □	Salvia greggii	Autumn Sage	Shrub
247.	**W** □	Salvia sonomensis	Creeping Sage	Ground cover
248.	□	Sambucus mexicana	Mexican Elderberry	Tree
249.	**W**	Santolina chamaecyparissus	Lavender Cotton	Ground cover
250.	**W**	Santolina virens	Green Lavender Cotton	Shrub
251.	□	Satureja chandleri	San Miguel Savory	Perennial
252.	□	Scirpus acutus	Hard-Stem Bulrush	Perennial
253.	□	Scirpus californicus	California Bulrush	Perennial

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	Code	Botanical Name	Common Name	Plant Form
254.	X	Sedum acre	Goldmoss Sedum	Ground cover
255.	X	Sedum album	Green Stonecrop	Ground cover
256.	X	Sedum confusum	ncn	Ground cover
257.	X	Sedum llineare	ncn	Ground cover
258.	X	Sedum x rubrotinctum	Pork and Beans	Ground cover
259.	X	Senecio serpens	ncn	Ground cover
260.	□	Sisyrinchium bellum	Blue-Eyed Grass	Ground cover
261.	□	Solanum douglasii	Douglas Nightshade	Shrub
262.	□	Solanum xantii	Purple Nightshade	Perennial
263.	W	Stenocarpus sinuatus	Firewheel Tree	Tree
264.	W	Strelitzia nicolai	Giant Bird of Paradise	Perennial
265.	W	Strelitzia reginae	Bird of Paradise	Perennial
266.	□	Symphoricarpos mollis	Creeping Snowberry	Shrub
267.	W	Tecoma stans [Stenolobium stans]	Yellow Bells	Shrub/Small tree
268.	X	Tecomaria capensis	Cape Honeysuckle	Ground cover
269.	N	Teucrium chamaedrys	Germander	Ground cover
270.	N	Thymus serpyllum	Lemon Thyme	Ground cover
271.	N	Trachelospermum jasminoides	Star Jasmine	Shrub
272.	□	Trichostema lanatum	Woolly Blue-Curls	Shrub
273.	X	Trifolium hirtum 'Hyron'	Hyron Rose Clover	Ground cover
274.	X	Trifolium fragiferum 'O'Connor's'	O'Connor's Legume	Ground cover
275.	□	Umbellularia californica	California Laurel	Tree
276.	□	Verbena lasiostachys	Western Vervain	Perennial

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	Code	Botanical Name	Common Name	Plant Form
277.	**N**	Verbena peruviana	ncn	Ground cover
278.	**X**	Verbena species	Verbena	Ground cover
279.	**X**	Vinca minor	Dwarf Periwinkle	Ground cover
280.	□	Vitis girdiana	Desert Wild Grape	Vine
281.	**X**	Vulpia myuros 'Zorro'	Zorro Annual Fescue	Grass
282.	**W**	Westringia fruticosa	ncn	Shrub
283.	**W**	Xanthorrhoea species	Grass Tree	Perennial accent/ Shrub
284.	**W**	Xylosma congestum	Shiny Xylosma	Shrub
285.	**X**	Yucca species	Yucca	Shrub
286.	□	Yucca whipplei	Yucca	Shrub

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QUALIFICATION STATEMENTS FOR SELECT PLANT SPECIES

□ = Plant species acceptable on a limited use basis:

2. Acacia redolens desert carpet

May be used in the upper 1/2 of fuel modification zone 2 (30 to 70 feet). The plants may be planted at 8 feet on center minimum spacing in meandering zones not to exceed a mature width of 24 feet or a mature height of 24 feet.

43. Bougainvillea spectabilis [procumbent varities]

Procumbent to mounding varieties may be used in the mid fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters at 6 feet once center spacing not to exceed 8 plants per cluster. Mature spacing between individual plants or clusters shall be 30 feet minimum.

44. Brahea armata
45. Brahea brandegeei
46. Brahea edulis

May be used in the upper and mid fuel modification zone 2 (30 to 70 feet). The plants shall be used as single specimens with mature spacing between palms of 30 feet minimum.

129. Hakea suaveolens

May be used in the mid fuel modification zone 2 (30-70 feet). The plants shall be used as single specimens with mature spacing between plants of 30 feet minimum.

136. Heteromeles arbutifolia

May be used in the mid to lower fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or cluster shall be 30 feet minimum.

164. Liquidambar styraciflua

May be used in the mid to lower fuel modification zone 2 (30 to 70 feet). The plant shall be used as single specimens with mature spacing between trees at 30 feet minimum.

227. Quercus berberdifolia

228. Quercus dumosa

May be used in the mid to lower fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or clusters shall be 30 feet minimum.

238. Rhus ovata

May be used in the mid to lower fuel modification zone 3 (30 to 70 feet) within inland areas only. The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or clusters shall be 30 feet minimum.

245. Romarinus officinalis
246. Salvia greggii
247. Salvia sonomensis

May be used in the mid to upper fuel modification zone 2 (30 to 70 feet). The plants may be planted in clusters of up to 3 plants per cluster. Mature spacing between individual plants or clusters shall be 15 feet minimum.

Appendix D-2
Undesirable Plant List

Undesirable Plant List
For Fuel Modification Projects in San Diego, Riverside, and Orange Counties

	Botanical Name	Common Name	Plant Form
1.	Acacia species •	Acacia	Shrub/Tree
2.	Adenostoma fasciculatum	Chamise	Shrub
3.	Adenostoma sparsifolium	Red Shank	Shrub/Tree
4.	Artemisia californica	California Sagebrush	Shrub
5.	Bamboos	Bamboo	Shrub
6.	Cedrus species	Cedar	Tree
7.	Cupressus species	Cypress	Tree
8.	Eriogonum fasciculatum	Common Buckwheat	Shrub
9.	Eucalyptus species	Eucalyptus	Shrub/Tree
10.	Juniperus species	Junipers	Succulent
11.	Pennisetum	Fountain Grass	Ground cover
12.	Pinus species	Pines	Tree
13.	Rosmarinus species	Rosemary	Shrub
14.	Salvia species • •	Sage	Shrub

• Except:
Acacia redolens desert carpet (Desert Carpet ground cover)

• • Except:
Salvia colubariae (chia)
Salvia sonomensis (Creeping Sage)