DRAFT

Fire Fuel Load Modeling Report

Torreyana Project

OCTOBER 2023

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Table of Contents

APPENDICES

FIGURES

TABLES

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Acronyms and Abbreviations

Acronym/Abbreviation	Definition
AMSL	Above Mean Sea Level
BMZ	Brush Management Zones
CAL FIRE	California Department of Forestry and Fire Protection
CBC	California Building Code
City	City of San Diego
CFC	California Fire Code
FRAP	Fire and Resource Assessment Program
ISO	Insurance Services Office
MHPA	Multiple Habitat Preservation Area
MPH	Miles Per Hour
NFPA	National Fire Protection Association
Project	The Torreyana Project
RAWS	Remote Automated Weather Station
SCAL	Southern California
SDFRD	San Diego Fire-Rescue Department
USGS	U.S. Geological Survey
VHFHSZ	Very High Fire Hazard Severity Zone

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1 Introduction

In accordance with Section 142.0412 of the San Diego Municipal Code (Brush Management) and Section 104.9 of the 2022 California Fire Code (CFC), we are requesting an alternate method of fire protection for the Torreyana Project (Project) in the northwest section of the City of San Diego (City), at the north terminus of Torreyana Road and northeast of Callan Road within northern coastal University Community Planning area in the City of San Diego, California. The Project is within the City of San Diego's Subarea Plan (City of San Diego 1997).

The Project consists of the development of two lab office buildings with subterranean parking at the terminus of Torreyana Road. The single primary access to the Project area will be directly from Torreyana Road. Construction activities will include phased demolition of the existing buildings, ground and foundation preparation, utility installation, framing and assembly of the building, building subterranean parking, driveway areas, and landscaping.

The Project impact area and boundary will include the two office lab structures, with subterranean parking lots, outdoor amenities, and brush management. Project construction is currently planned to have four (4) phasing options, which are described in more detail below. Impacts to any areas of natural vegetation or habitat potentially suitable for special status plant species will be avoided. The Project site currently includes native, non-native, and disturbed vegetation communities. Current land uses within and immediately surrounding the study area include Peñasquitos Creek to the north, commercial medical development to the east and west, neighborhood streets, sidewalks, traffic (vehicle and pedestrian), and open space surrounding the Project site. The Project site is adjacent to a Multiple Habitat Planning Area (MHPA), which occurs within the undeveloped urban canyon to the north and east of the Project that extends north to the Torrey Preserve.

An important component of a fire protection system is the Brush Management Zones (BMZs). BMZs are typically designed to gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones and irrigated zones adjacent to each other on the perimeter of the Wildland Urban Interface (WUI) exposed structures. However, based on site-specific limitations, including the project being adjacent to MHPA areas, lot constraints, and project boundary limitations, this Project will incorporate two on-site BMZs, with Zone 1 ranging between 34 feet and 80 feet beyond the structures and Zone 2 ranging between 4 feet and 30 feet in width within the Open Space easement areas along the southern and eastern sides of the structures. Zone 1 will consist of a combination of irrigated planting and hardscape areas and Zone 2 consists of a modified thinning BMZ zone. Along the northern side of the structures, the access driveway provides an additional approximately 30 feet of paved brush management up to the edge of the State-owned open space areas Thus the project proposes a reduced BMZ throughout. In a typical BMZ, Zone 1 extends 35 feet out from the habitable structure towards flammable vegetation and occurs on all level portions of the property, and Zone 2 is the remaining 65 feet that extend beyond Zone 1. According to Section 142.0412(f) of the San Diego Municipal Code, "the Zone 2 width may be decreased by 1 ½ feet for each 1 foot of increase in Zone 1 width," thus the reduced Zone 2 BMZ in the southern portion of the Project. Specific for this Project, Zone 1 extends between approximately 50 feet and 80 feet on-site and Zone 2 extends between 4 feet and 30 feet within the Open Space easement areas along the southern and eastern sides of the two structures, achieving 80 feet total of brush management along the southern side of the structures; Zone 1 extends between approximately 34 feet and 80 feet and Zone 2 extends between 4 feet and 12 feet along the northeast side of Building A; and Zone 1 extends between approximately 34 feet and 80 feet from the north/northwestern side of Building A. Adjacent to the structures will be BMZ-equivalent landscaped area. West/northwest of the structures, Zone 1 extends between 31 feet and 46 feet from the exterior of the structures to the access roadway. The access roadway easement will provide an additional 30 feet of paved brush management along the northern and western sides of the new buildings up to the edge of the State-owned open space area. The Zone 1 area along the western and northwestern sides of the structures include paved hardscapes areas with irrigated landscape areas within the paved areas of the Project site. Sitewide brush management will be implemented in phases that correspond with the phased construction of the buildings. If construction is no longer phased, then all BMZs would be implemented at once prior to demolition of the existing buildings.

This request is in response to our assessment of the site, the Project development footprint, off-site adjacent fuels, and the area's fire history and weather. This Fire Fuel Load Modeling Report (FFLMR) discusses the Project site and its fire environment, fire risk assessment, including fire behavior modeling, and based on the results from the study, requests a variance from the standard BMZ specifications with regard to the widths of Zone 1 and Zone 2 for the proposed Torreyana Project. The existing conditions around the Project area include the MHPA to the north and northeast and open space deeded to the State of California to the east and west of the Project. These areas create a condition where it is not possible to achieve a standard BMZ. As such, the FFLMR provides an alternative approach that provides for a modified Zone 1 and Zone 2 BMZ areas within the building areas that includes significant horizontal separation of the developed area from off-site fuels. Per San Diego Municipal Code, the Fire Chief may modify standard requirements in consideration of the topography, existing and potential fuel load, and other characteristics of the site related to fire protection. As stated in the Municipal Code, (142.0412(i)), an applicant may request approval of alternative compliance for brush management in accordance with Process One if all of the following conditions exist:

1. The proposed alternative compliance provides sufficient defensible space between all structures on the premises and contiguous areas of native or naturalized vegetation as demonstrated to the satisfaction of the Fire Chief based on documentation that addresses the topography of the site, existing and potential fuel load, and other characteristics related to fire protection and the context of the proposed development.
2. The alternative measures proposed for the Project's BMZ avoid impacts to undisturbed native or naturalized sensitive habitat vegetation areas, especially within the adjacent MHPA, while still meeting the purpose and intent of Section 142.0412 to reduce fire hazards around structures and providing a fire break with at least the same functional equivalency.
3. The proposed alternative compliance is not detrimental to the public health, safety, and welfare of persons residing or working in the area.

This report provides Project information, a request for modification, and justifications for the modification.

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2 Project Information

The Project proposes the construction of two new scientific research buildings and demolition of the existing buildings at the north terminus of Torreyana Road within the University Community Planning Area, Council District 1, in the City of San Diego, California (see Figure 1, *Project Location Map and* Figure 2, *Project Area Map*). The Project is located approximately 0.6 miles west of Interstate 805 and 0.4 miles east of County Road S21. The Project is on a parcel, Assessor's Parcel Number (APN): 340-010-30, which is has a total acreage of 6.149 acres. The approximately 6.149-acre Project study area (comprised of the two (2) scientific research buildings (61,800 sq. feet and 49,200 sq. feet) and the 0.5-acre outdoor area) is located north of the intersection of Torreyana Road and Callan Road, at the north terminus of Torreyana Road. The area is bounded by open space to the north, east, and west, and to the south are other commercial buildings (see Figure 1 and Figure 2).

Site Address: Torreyana Project
11085/11095 Torreyana Road
San Diego, California 92121

Contact: **Ferguson Pape Baldwin Architects**
Stefanie Deal, Project Manager
(619) 231-0751

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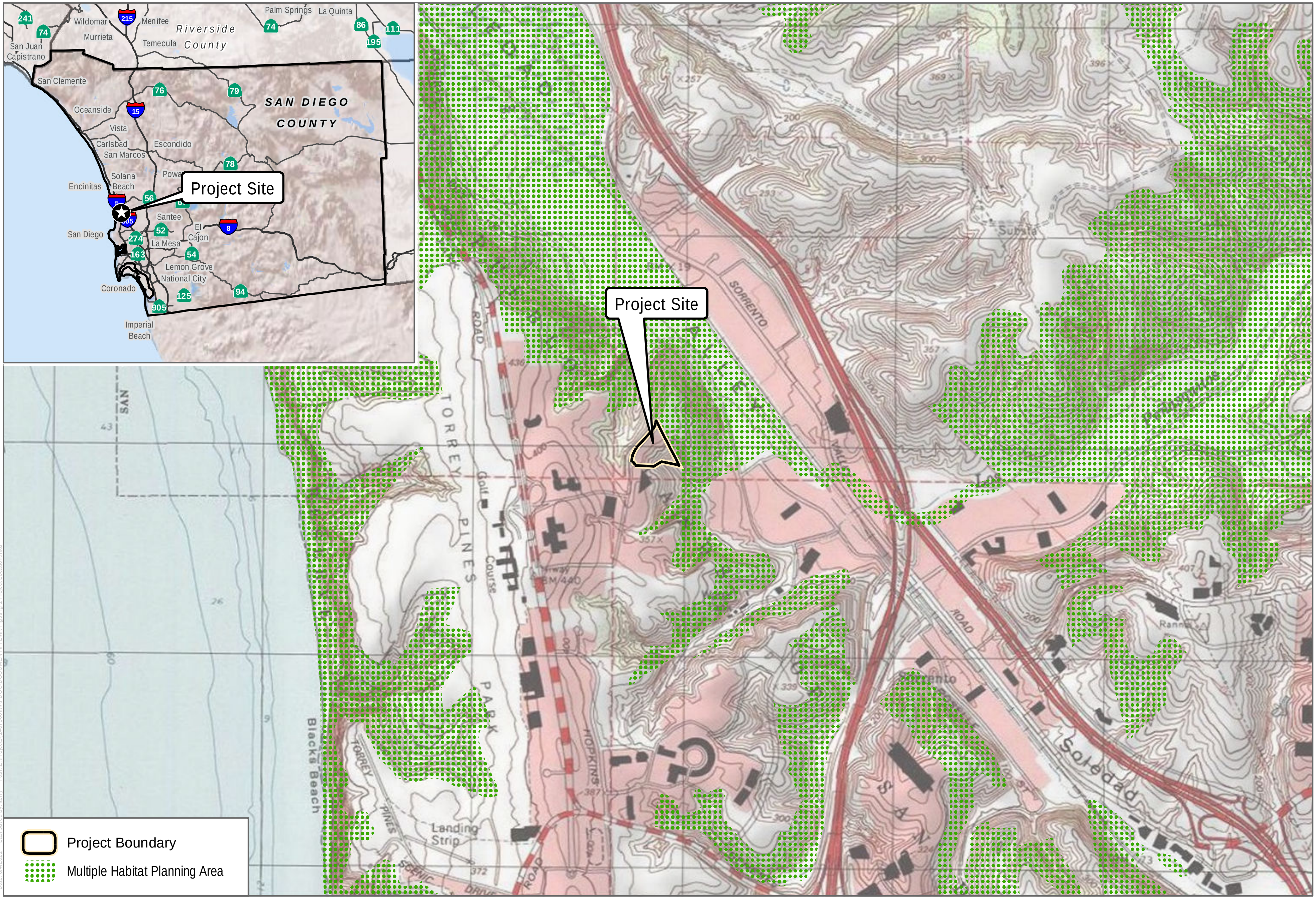

SOURCE: USGS 7.5-Minute Series Del Mar Quadrangle

DUDEK

FIGURE 1

Project Location

Fire Fuel Load Modeling Report for the Torreyana Project

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SOURCE: AERIAL-BING MAPPING SERVICE; MHPA-SANGIS

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0 175 350 Feet

FIGURE 2

Project Area Map

Fire Fuel Load Modeling Report for the Torreyana Project

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3 Project Description

The project construction footprint and study area currently contain two (2) scientific research buildings (61,800 sq. feet and 49,200 sq. feet) and a 0.5-acre outdoor area on approximately 6.149 acres. The Project would require a coastal development permit (CDP), a neighborhood development permit (NDP), and a site development permit (SDP) to entitle the site up to 122,980 square feet. The proposed Project consists of four (4) phasing options at the north terminus of Torreyana Road, northeast of Callan Road:

- Option 1(shown in the development permit package): The buildings located at 11085 and 11095 will be demolished and replaced with two (2) new warm shell, two-story over basement scientific research buildings totaling approximately 111,000 square feet, with subterranean parking lots and associated BMZs.

- Option 2: The buildings located at 11085 and 11095 will be demolished and replaced with one (1) new warm shell, two-story over basement scientific research building totaling approximately 111,000 square feet, with subterranean parking lots and associated BMZs.

- Option 3: The building located at 11085 will be left existing to remain and the building located on 11095 will be demolished and developed as a new warm shell, two-story over basement scientific research building totaling approximately 49,200 square feet, with subterranean parking lots and associated BMZs.

- Option 4: The building located at 11095 will be left existing to remain and the building located on 11085 will be demolished and developed as a new warm shell, two-story over basement scientific research building totaling approximately 61,800 square feet, with subterranean parking lots and associated BMZs.

Core improvements for all phasing options within the warm shell building(s) shall include stairs, restrooms, and elevators. The warm shell(s) will include the building envelope, house mechanical, electrical, and plumbing systems. The new scientific research building(s) will involve the demolition of the existing buildings and improving on-site facilities. The single primary access to the Project area will be directly from the existing access road off Torreyana Road. Construction activities will include ground and foundation preparation, utility installation, framing and assembly of the building, building and paving of the subterranean parking lots and driveway areas, and landscaping. The site where the proposed structures are located currently houses two R&D buildings; one building is 40,267 square feet and the other is 41,152 square feet, totaling 81,419 square feet. Demolition of these building(s) will coincide with the appropriate phasing option noted above. Demolition scope will be within its respective separate demolition permit. (*Figure 3: Project Site Plan)*. BMZs will be phased along with construction and be implemented prior to the demolition of the associated building. If construction is no longer phased, then all BMZs would be implemented at once prior to demolition of the existing buildings.

The Project parcel is approximately 6.149 acres and includes the development of two scientific research buildings (61,800 sq. feet and 49,200 sq. feet). The Project area currently includes a 2.5-acre open space easement over the southeastern development area, which will remain protected. A 25-foot landscape maintenance area is located along the northwestern edge of the open space. The proposed buildings will be shifted towards the northeast so that they are set back further from the open space areas, and the 25-foot landscape maintenance area will remain usable for Brush Management Zone 2. The Project is within the City Coastal Zone (City of San Diego 2012) as well as within the Multiple Habitat Conservation Program (MHCP) and adjacent to the Multiple Habitat Planning (MHPA) Northern Area. Though the Project is within the MHCP, there are no mapped Conserved Vegetation Communities on the Project site (City of San Diego 1997). The Northern area encompasses Carmel Valley, Sorrento Hills, Torrey

Pines State Preserve, the Los Peñasquitos Lagoon, and Canyon Preserve as well as the developed and undeveloped areas from Black Mountain Ranch to Lopez Canyon and from the Coast to Interstate 15. The MHCP is a conservation planning process that addresses the needs of multiple plant and animal species in northwestern San Diego County. The MHPA is within the Multiple Species Conservation Program (MSCP), which is a comprehensive, regional long-term habitat conservation program designed to provide permit issuance authority for taking of covered species to the local regulatory agencies. The MSCP addresses habitat and species conservation within the northern region of San Diego County (County of San Diego 1998). It serves as an approved habitat conservation plan pursuant to an approved Natural Communities Conservation Plan in accordance with the state Natural Communities Conservation Planning Act (County of San Diego 1998). The MSCP identifies 85 plants and animals to be "covered" under the plan ("Covered Species"). Within the City of San Diego, the MSCP is implemented through the City of San Diego MSCP Subarea Plan (Subarea Plan) (City of San Diego 1997), which applies within 206,124 acres as the time it was created in 1997.

The Project study area is located within the northern area of the Subarea Plan within the University Community Planning Area. The Subarea Plan is characterized by urban land uses with approximately three-quarters either built out or retained as an open space/park system. As mentioned previously, the City MHPA is a "hard-line" preserve developed by the City in cooperation with the wildlife agencies, property owners, developers, and environmental groups. The MHPA identifies biological core resource areas and corridors targeted for conservation, in which only limited development may occur (City of San Diego 1997). The MHPA is considered an urban preserve that is constrained by existing or approved development and is comprised of habitat linkages connecting several large core areas of habitat (City of San Diego 1997). Any areas of the MHPA that may encroach on the development site would be avoided as to not impact sensitive plant communities.

The Project impact area and boundary will include the impact footprint of the building development and associated Zone 1 and Zone 2 Brush Management. Specific for this Project, Zone 1 extends between approximately 50 feet and 80 feet on-site and Zone 2 extends between 4 feet and 30 feet within the Open Space easement areas along the southern and eastern sides of the two structures, achieving 80 feet total of brush management along the southern side of the structures; Zone 1 extends between approximately 34 feet and 80 feet and Zone 2 extends between 4 feet and 12 feet along the northeast side of Building A; and Zone 1 extends between approximately 34 feet and 80 feet from the north/northwestern side of Building A. Adjacent to the structures will be BMZ-equivalent landscaped area. West/northwest of the structures, Zone 1 extends between 31 feet and 46 feet from the exterior of the structures to the access roadway. The access roadway easement will provide an additional 30 feet of paved brush management along the northern and western sides of the new buildings up to the edge of the State-owned open space area. The Zone 1 area along the western and northwestern sides of the structures include paved hardscapes areas with irrigated landscape areas within the paved areas of the Project site. Sitewide brush management will be implemented in phases that correspond with the phased construction of the buildings. If construction is no longer phased, then all BMZs would be implemented at once prior to demolition of the existing buildings. BMZ widths are modified to avoid impacts to sensitive plant communities and any activities would not occur within any mapped MHPA areas. The area west of the access road is within an open space easement that was deeded to the State of California by the City of San Diego. However, the City retained easements and rights of way for vehicular access west of the property (DD 19181.90970). The Project has rights use of the 30-foot-wide road easement per a 2010 preliminary review pts #192079. The eastern portion of the Project is in an open space easement deeded to the state of California. Within this area the Project has the right to a maximum of 25 feet for establishing and maintaining landscaping within the western boundary of the open space easement (Resolution No. R-253635). Within the area, the Project is permitted to landscape, replant flora, install irrigation, and conduct maintenance.

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FIGURE 3

Site Plan – Phasing Option 1

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4 Fire Risk Analysis

4.1 Field Assessment

A field assessment of the Project, including on-site and off-site adjacent areas, was conducted by Dudek on August 3, 2021, in order to document existing site conditions and determine potential actions for addressing the protection of proposed two new scientific research buildings at the north terminus of Torreyana Road in the City of San Diego. Assessments of the area's topography, natural vegetation, and fuel loading, proposed Project impact areas, Zone 1 BMZ areas, assets, fire history, and general susceptibility to wildfire formed the basis of the site risk assessment. Among the field tasks that were completed are:

- Vegetation measurements and mapping refinements
- Fuel load analysis
- Topographic features documentation
- Photograph documentation
- Confirmation/Verification of office-based hazard assumptions.

Site photographs were collected (Appendix A, *Photograph Log*). Field observations were utilized to augment existing site data in generating the fire behavior models and formulating the recommendations detailed in the report.

4.2 Fire Environment

Fire environments are dynamic systems and include many types of environmental factors. 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 vegetation (fuels), climate, and topography. 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 fuel modification 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 Project site is necessary to understand the potential for fire within and around the Torreyana Project.

4.3 Vegetation (Fuels)

Based on species composition and general physiognomy, the existing vegetation communities and land covers surrounding the Project study area support primarily coastal sage scrub with mixed chaparral species. The vegetation communities and land cover types include coastal sage scrub (including disturbed variety), mixed chaparral, ornamental plantings, disturbed land, and urban/developed land. The site's vegetation fire risk is primarily determined by Project-adjacent vegetation that will be preserved in the open space directly adjacent to the site's brush management zones. The growth of vegetation types/fuel models is influenced by aspect (orientation), soil constituents, soil depth, soil moisture, and weather. The vegetation occurring on the slopes adjacent to the site represents the site's fuel load, an important component of the site's wildfire risk assessment. The photographs in Appendix A display the fuels on and adjacent to the property. Vegetation communities were determined from a site visit on August 3, 2021, by a Dudek Fire Protection Planner.

4.3.1 Coastal Sage Scrub (including disturbed)

Coastal sage scrub is a native vegetation community that, is composed of a variety of soft, low, aromatic shrubs, characteristically dominated by drought-deciduous species—such as California sagebrush (*Artemisia californica*), California buckwheat (*Eriogonum fasciculatum*), and sages (*Salvia* spp.)—with scattered evergreen shrubs, including lemonade sumac (*Rhus integrifolia*) and laurel sumac (*Malosma laurina*).

Coastal sage scrub is the dominant vegetation community, including the disturbed variety, which makes up a large portion of the habitat of the canyon east and south of the proposed Project and the disturbed variety is found along the edges of the development. Coastal sage scrub is considered a Tier II habitat by the City's Biology Guidelines (City of San Diego 2018a) and impacts to this community would be considered significant.

4.3.2 Mixed chaparral

Mixed chaparral is a native vegetation community supporting dense stands of broad-leaved sclerophyll shrubs, typically deep-rooted and about 1.5-3 meters tall. There is typically little to no understory vegetation, but often substantial leaf litter. This community is commonly dominated by chamise (*Adenostoma fasciculatum*), manzanitas (*Arctostaphylos* spp.), and blue-colored lilacs (*Ceanothus* spp.).

Mixed chaparral is east of the Project site and intermixes with coastal sage scrub. Mixed chaparral is considered a Tier IIIA habitat by the City's Biology Guidelines (City of San Diego 2018a) and impacts to this community would be considered significant.

4.3.3 Disturbed Land

Disturbed Land are areas that have been had physical anthropogenic disturbance and as a result, cannot be identified as a native or naturalized vegetation association. However, these areas do have a recognizable soil substrate. The existing vegetation is typically composed of non-native ornamental or exotic species.

This land cover consists of dirt access paths and areas of non-native annual species. Where present, vegetation in this community consists primarily of wild mustard (*Hirshfeldia incana*) and crown daisy (*Glebionis coronaria*). This land cover is ranked as Tier IV and is not considered sensitive under the City's Biology Guidelines (City of San Diego 2018a). Thus, impacts to these areas would not require mitigation.

4.3.4 Ornamental Planting

Ornamental plantings refer to areas where non-native ornamental species and landscaping schemes have been installed and maintained, usually as part of commercial or residential property.

This vegetation community occurs within the study area, primarily within the vegetated areas at the edge of the buildings and within the parking lot. This vegetation community is ranked as Tier IV and is not considered sensitive under the City's Biology Guidelines (City of San Diego 2018a) and therefore impacts to this community would not require mitigation.

4.3.5 Urban/Developed Land

Urban/developed land represents areas that have been constructed upon or otherwise physically altered to an extent that native vegetation communities are not supported. This land cover type generally consists of semi-permanent structures, homes, parking lots, pavement or hardscape, and landscaped areas that require maintenance and irrigation (e.g., ornamental greenbelts). Typically, this land cover type is unvegetated or supports a variety of ornamental plants and landscaping.

Within the study area, this land cover type predominantly consists of residential development and paved streets to the south, east, and north. This land cover is not ranked under the City's Biology Guidelines (City of San Diego 2018a) and therefore impacts to urban/developed lands do not require mitigation.

Note: Each vegetation community corresponds to a designated fuel model (pre-determined vegetation type, densities, and structural characteristics) for fire behavior modeling purposes. Dudek has classified each of the cover types that will remain off-site and/or adjacent to the building footprints into fuel models, as discussed further below. Site-adjacent vegetation is important relative to wildfire as some vegetation, such as brush and grassland habitats are highly flammable while other vegetation, such as wetland communities or forest understory, is less flammable due to its higher plant moisture content, compact structure, and available shading from overstory tree canopies. The off-site, adjacent areas that will not be converted will represent the fire threat and were modeled (see section 5.7: Fire Behavior Modeling) to aid fire protection planning for this site.

4.4 Climate

Northern San Diego and the Project area are influenced by the Pacific Ocean and are frequently under the influence of 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 San Diego area is approximately 70°F, with average highs in the summer and early fall months (July–October) reaching 76°F. The average precipitation for the area is approximately 10.4 inches per year, with the majority of rainfall concentrated in the months of December (1.5 inches), January (2.1 inches), February (1.7 inches), and March (2.0 inches), while smaller amounts of rain are experienced during the other months of the year (Weather Atlas, 2020).

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), averaging 2 miles per hour (mph). During the summer season, the diurnal winds may average slightly higher (approximately 19 mph) than the winds during the winter season due to greater pressure gradient forces. Surface winds can also be influenced locally by topography and slope variations. The highest wind velocities are associated with downslope, canyon, and Santa Ana winds.

Typically, the highest fire danger is produced by the high-pressure systems that occur in the Great Basin which results in the Santa Ana winds of Southern California. Sustained wind speeds recorded during recent major fires in San Diego County exceeded 30 mph and may exceed 50 mph during extreme conditions. The Santa Ana wind conditions are a reversal of the prevailing southwesterly winds that usually occur on a region-wide basis during late summer and early fall. Santa Ana winds are warm winds that flow from the higher desert elevations in the north through the mountain passes and canyons. As they converge through the canyons, their velocities increase.

Consequently, peak velocities are highest at the mouths of canyons and dissipate as they spread across valley floors or mesas. Santa Ana winds generally coincide with the regional drought period and the period of highest fire danger. The Project site is affected by Santa Ana winds. Winds funneled through mountains and onto the flat mesas dissipate and produce lower average wind conditions. The wind information used for fire behavior modeling for this site includes actual data from a Remote Automated Weather Station (RAWS) (Mission Valley RAWS Station) located ten miles southeast of the Project site at an approximate elevation of 300 feet, similar to the elevation of the Project.

4.5 Topography

The Project sits at the top of a small ridge that sloped downward on the western and eastern sides of the Project site. There are two small canyons adjacent to either side of the Project site. The elevation in the study area ranges from approximately 353 feet to 328 feet above mean sea level (AMS). The Project is within the City Coastal Zone (City of San Diego 2012).

Topography affects wildfire movement and spread. Steep terrain typically results in faster fire spread due to pre-heating (and drying) of uphill vegetation. Flat areas typically result in slower fire spread, absence of windy conditions. Topography may form unique conditions which result in concentrated winds or localized fire funneling, such as saddles, canyons, and chimneys (land formations that collect and funnel heated air upward along a slope). Similarly, terrain may slow the spread of fire. For example, fire generally moves slower downslope than upslope. Terrain may buffer or redirect winds away from some areas based on canyons or formations on the landscape. The occurrences of terrain features that may affect fire behavior on the Project site were analyzed and incorporated into the risk assessment and in the development of fire protection features.

4.6 Fire History

Fire history data provides valuable information regarding fire spread, fire frequency, ignition sources, and vegetation/fuel mosaics across a given landscape. Fire frequency, behavior, and ignition sources are important for fire response and planning purposes. 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, or, what type of fire burned on the site, and how a fire may spread. According to available data from the California Department of Forestry and Fire Protection's (CAL FIRE) Fire and Resource Assessment Program (FRAP 2021), approximately thirteen (13) fires have burned within 5 miles of the Project area since the beginning of the historical fire data record (Refer to Appendix B, *Fire History Map*). These fires occurred between 1935 and 2003. The largest fire was the 2003 Cedar fire which was approximately 270,686 acres and occurred approximately 4.3 miles southeast of the Project site. The average fire size was approximately 22,109 acres (including the 2003 Cedar fire) and approximately 1,394.6 acres (excluding the 2003 Cedar fire). There have been no fires in the historical record that burned onto the Torreyana Project site. The San Diego Fire and Rescue Department (SDFRD) may have data regarding smaller fires (less than 10 acres) that have occurred near the site that are not included in CAL FIRE's dataset.

Based on an analysis of the fire history data set, specifically, the years in which the fires burned, the average interval between wildfires burning within a 5-mile radius of the Project site was calculated to be approximately 7 years with intervals ranging between 0 and 29 years. Based on the analysis, along with changes in the watershed over the last few decades that resulted in the conversion of fuels to lower flammability urbanization, the Project area is expected to be subject to a wildfire that may include smaller fires during typical weather conditions and has the potential for larger wildfires during extreme weather conditions based on an analysis of the fire history.

4.7 Fire Behavior Modeling

4.7.1 Fire Behavior Modeling Background

Fire behavior modeling has been used by researchers for approximately 50+ years to predict how a fire will move through a landscape given specified fuels, terrain, and weather (Linn 2003). The models have had varied complexities and applications throughout the years. One model has become the most widely used 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 2005; 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; Granber 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 has 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 the 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 to 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, the analysis incorporated predominant fuel characteristics, slope percentages, and representative fuel models observed on site. The BehavePlus fire behavior fuel modeling system was used to analyze anticipated fire behavior within and adjacent to key areas just outside of the proposed BMZs.

As Rothermel summarized, predicting wildland fire behavior is not an exact science. As such, the movement of 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 fire prevention and protection 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 uniforms. However, because wildfires almost always burn under non-uniform conditions, the length of the projection period and choice of fuel model must be carefully considered to obtain useful predictions.
- Fourth, the BehavePlus fire behavior computer modeling system was not intended for determining sufficient fuel modification zone/defensible space widths. However, it does provide the average length of the flames, which is a key element for determining "defensible space" distances for minimizing structure ignition.

Although BehavePlus has some limitations, it can still provide valuable fire behavior predictions which can be used as a tool in the decision-making process. In order to make reliable estimates of fire behavior, one must understand the relationship of fuels to the fire environment and be able to recognize the variations in these fuels. Natural fuels are made up of the various components of vegetation, both live and dead, that occur on a site. The type and quantity will depend upon the soil, climate, geographic features, and the fire history of the site. The major fuel groups of grass, shrub, trees and slash are defined by their constituent types and quantities of litter and duff layers, dead woody material, grasses and forbs, shrubs, regeneration, and trees. Fire behavior can be predicted largely by analyzing the characteristics of these fuels. Fire behavior is affected by seven principal fuel characteristics: fuel loading, size and shape, compactness, horizontal continuity, vertical arrangement, moisture content, and chemical properties.

The seven fuel characteristics help define the 13 standard fire behavior fuel models[1] and the five more recent 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 modeling efforts. The following describes the distribution of fuel models among general vegetation types for the standard 13 fuel models and the custom Southern California fuel models (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 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:

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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.

- Grass Models GR1 through GR9
- Grass Shrub Models GS1 through GS4
- Shrub Models SH1 through SH9
- Timber Understory Models TU1 through TU5
- Timber Litter Models TL1 through TL9
- Slash Blowdown Models SB1 through SB4

BehavePlus software was used in the development of the Torreyana Project Fuel Load Modeling Report (FFLMR) 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.

4.7.2 Fire Behavior Modeling Approach

Dudek utilized the BehavePlus software package to analyze fire behavior potential for the Project site. Refer to Figure 4, *Fire Behavior Modeling Map* for fire modeling scenario locations. As is customary for this type of analysis, four fire scenarios were evaluated, including one Summer, onshore weather condition (northwest from the Project Site), and three extreme Fall, offshore weather condition (north, northeast, and southeast of the Project Site) models. Fuels and terrain beyond that distance can produce flying embers that may affect the Project, but the structures and surrounding landscape will be built to extreme ignition and ember resistant standards which will minimize the possibility of ignition. It is the fuels next to the BMZs and within the BMZs that would have the potential to affect the Project's structure from a radiant and convective heat perspective as well as from direct flame impingement but based on the site's terrain (northern portion) and the extended BMZ irrigated zones and hardscape, the vertical separation between vegetative fuels and the site's structures is significant.

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.

4.7.2.1 Vegetation (Fuels)

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

Vegetation types were derived from a site visit that was conducted on August 9, 2021, by a Dudek Fire Protection Planner. Based on the site visit, two different fuel models were used in the fire behavior modeling effort presented herein to describe the existing vegetation; two more fuel models were used in the fire modeling efforts to describe the anticipated vegetation after the brush management zones (BMZs) are in place. Fuel model attributes are summarized in Table 1. Modeled areas include pine tree stands along the eastern side of the existing buildings with (Fuel Model TL3 = Moderate load conifer litter). Mature tree canopies for existing pine trees (*Pinus spp.)* are assumed to have a canopy base height of approximately 50 feet off the ground. Canopy bulk density, the weight of canopy fuels per cubic foot of volume, is assumed to be the maximum allowable value in BehavePlus to represent broadleaf trees which, given canopy density and leaf size, have more weight per area than conifer trees (the standard for this value input in BehavePlus (Heinsch and Andrews 2010)). Foliar moisture, the moisture content of canopy foliage, is assumed to be 100%, a reasonable estimate in lieu of site-specific data (Scott and Reinhardt 2001).

Table 1: Existing Fuel Model Characteristics

Fuel Model	Description	Location	Fuel Bed Depth (Feet)
Sh5	High Load, Dry Climate Shrub	Fuel type adjacent to the norther, western, eastern, and southeastern Project boundary.	>4.0 ft.
Tl3	Moderate load conifer litter	Fuel type found on the east side of existing structures at top of the slope.	>6.0 ft.
Sh2	Moderate load, dry climate shrub	Fuel type will occur along with the roadside brush management on the western side of the post-development within a 50% thinning zone.	<2.0 ft.
FM8	Irrigated Landscape	Fuel type will occur post-development within Zone A - setback irrigated zone.	<1.0 ft.

The results of the analysis were utilized in generating the Brush Management Zone maps. The analysis models fire behavior outside of proposed 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 Project.

4.7.2.2 Topography

Slope is a measure of an 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. Slope values ranging from 12 to 41% were measured around the perimeter of the proposed Project site from U.S. Geological Survey (USGS) topographic maps.

4.7.2.3 Weather Analysis

Historical weather data for the San Diego region was utilized in determining appropriate fire behavior modeling inputs for the Proposed Project area fire behavior evaluations. To evaluate different scenarios, data from both the 50th and 97th percentile moisture values were derived from a Remote Automated Weather Station (RAWS) and utilized in the fire behavior modeling efforts conducted in support of the report. Weather data sets from the Mission Valley RAWS[4] were utilized in the fire modeling runs.

4 https://wrcc.dri.edu/cgi-bin/rawMAIN.pl?caCMVA
Latitude: 32.783191 Longitude: -117.136046; Elevation: 300 ft.)

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 2016 and 2020 (extent of available data record) for 97th percentile weather conditions and from June 1 through September 30 for each year between 2016 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 two BehavePlus runs were manually entered during the data input phase. The input wind speed and direction is roughly an average surface wind at 20 feet above the vegetation over the analysis area. Table 2 summarizes the wind and weather input variables used in the Fire BehavePlus modeling efforts.

Table 2: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50th Percentile)	Peak Weather (97th Percentile)
Fuel Models	Sh2 and Sh5	Sh5, FM8, and Sh1
1 h fuel moisture	8%	2%
10 h fuel moisture	9%	4%
100 h fuel moisture	15%	8%
Live herbaceous moisture	58%	30%
Live woody moisture	116%	60%
20 ft. wind speed	12 mph (sustained winds)	18 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	300	12 to 41
Wind adjustment factor	0.4	0.4
Slope (uphill)	40%	22 to 35%

4.7.2.4 BehavePlus Fire Behavior Modeling Effort

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 north, east/northeast, and south/southeast. 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 the initial attack and fire suppression efforts (Rothermel and Rinehart 1983). Spotting distance is the distance a firebrand or ember can travel downwind 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 to the site based on slope and fuel conditions; these four fire scenarios are explained in more detail below:

- **Scenario 1A:** A fall, off-shore fire (97th percentile weather condition) burning in high load chaparrals north of the Project site. The terrain is moderately sloped (approximately 12% slope) with potential ignition sources from a wildfire originating at the base of steep drainage downslope and north of the Project site. This type of fire would typically spread uphill the drainage before shifting directions and continuing up the slope with more on-shore winds pushing the fire towards the Project site.

- **Scenario 1B:** A summer, on-shore fire (50th percentile weather condition) burning in high load chaparrals west/northwest of the Project site. The terrain is steep (up to 40% slope) with potential ignition sources from a wildfire originating downslope from a vehicle or structure fire originating in the developments to the north. This type of fire would typically spread uphill towards the Project site.

- **Scenario 2:** A fall, off-shore fire (97th percentile weather condition) burning in high load chaparral northeast of the Project site. The terrain is steep (up to 41% slope) with potential ignition sources from a wildfire originating downslope from a vehicle or structure fire originating in the developments to the north/northeast. This type of fire would typically spread uphill until it reaches the peak of an adjacent hillside, then transition downslope towards the Project site. This transition from a fire spreading uphill then switching to a downhill fire is beneficial to the Project by decreasing the rate of spread.

- **Scenario 3:** A fall, off-shore fire (97th percentile weather condition) burning in high load chaparral before potentially transitioning to a crown fire within the canopies of the pine trees adjacent to the existing structures. The terrain is steep (up to 40% slope) with potential ignition sources from a wildfire a vehicle or structure fire originating in the developments to the southeast. This type of fire would typically spread uphill towards the Project site.

4.7.2.5 BehavePlus Fire Behavior Modeling Results

The results presented in Tables 3 and 4 depict values based on inputs to the BehavePlus software and are not intended to capture changing fire behavior as it moves across a landscape. Changes in slope, weather, or pockets of different fuel types are not accounted for in the analysis. For planning purposes, the averaged worst-case fire behavior is the most useful information for conservative fuel modification design. Model results should be used as a basis for planning only, as actual fire behavior for a given location will be affected by many factors, including unique weather patterns, small-scale topographic variations, or changing vegetation patterns.

Based on the BehavePlus analysis result presented below and in Tables 3 and 4, worst-case fire behavior is expected in untreated, surface shrub and chaparral fuels south/southeast of the proposed Project site under Peak weather conditions (represented by Fall Weather, Scenario 3). The analyzed worse-case fire is anticipated to be a wind-driven fire from the east during a fall, Santa Ana wind event. Under such conditions, predicted surface flame lengths would be approximately 23 feet under 18 mph sustained winds and could reach up to 40 feet under wind speeds of up to 50-plus mph. Under this scenario, fireline intensities reach 17,623 BTU/feet/second with fast spread rates of 6 mph and could have a spotting distance up to 2.3 miles away. Once the fire progresses to the top of the slope, the fire could potentially transition from a wind-driven surface fire to an active crown fire within the canopies of the pine trees adjacent to the existing structures at the top of the slope. Under such conditions, predicted active crown fire flame lengths could exceed 160 feet under wind speeds of up to 50-plus mph; the active crown intensity could reach 22,680 BTU/feet/second with fast spread rates of 4.1 mph.

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 chaparral scrub fire is modeled to have flame lengths of 10.6 feet in height and spread rates of 0.4 mph. Spotting distances, where airborne embers can ignite new fires downwind of the initial fire, could extend 0.3 miles.

As previously mentioned, Dudek conducted modeling of the site for post-brush management zones. For modeling the post-BMZ treatment condition, the fuel model assignment for chaparral-covered hillsides was re-classified according to the specific fuels management (e.g., irrigated, fire-resistive landscaping, and 50% thinning) treatment.

Based on the BehavePlus analysis, post-development fire behavior is expected along the northern and eastern sides of the Project site in irrigated and replanted areas, with plants that are acceptable with the City of San Diego (Zone 1 BMZ - FM8). In addition, the Project will include adjacent roadside BMZ with a 20-foot roadside fuel modification area adjacent to the western side of the access road. The area west of the access road is within an open space easement that was deeded to the State of California by the City of San Diego. However, the City retained easements and rights of way for vehicular access (DD 19181.90970). Under worst-case offshore fall wind conditions, the expected surface flame length is expected to be significantly lower, with flames lengths reaching approximately 2.6 feet with wind speeds of 50+ mph. Under this scenario, fire line intensities reach 45 BTU/feet/second with relatively slow spread rates of 0.1 mph and could have a spotting distance up to 0.3 miles away. As part of the brush management requirements set forth by the FFLMR, the pine trees located along the eastern side of the property will be removed and the approximately 160-foot crown fire flame lengths will be eliminated, and the new structures will be significantly more fire safe.

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

Fire Scenario	Flame Length[1] (feet)	Spread Rate[1] (mph[3])	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: 12% slope; Fall offshore extreme wind from the north with 18 mph sustained winds (50+ gusts) (97th percentile)							
High load, dry climate Chaparral scrub (Sh5)	23.6' (40.9')[4]	1.9 (6.1)	5,477 (18,098)	0.8 (2.3)	N/A	N/A	N/A
Scenario 1b: 40% slope; Summer onshore extreme wind from the NW with 12 mph sustained winds (50th percentile)							
High load, dry climate Chaparral scrub (Sh5)	10.6'	0.4	965	0.3	N/A	N/A	N/A
Scenario 2: 41% slope; Fall offshore extreme wind from the NE with 18 mph sustained winds (50+ gusts) (97th percentile)							
High load, dry climate Chaparral scrub (Sh5)	22.2' (40.2')	1.6 (5.9)	4,812 (17,422)	0.7 (2.3)	N/A	N/A	N/A
Scenario 3: 40% slope; Fall offshore extreme wind from the SE with 18 mph sustained winds (50+ gusts) (97th percentile)							
Moderate load conifer litter (Tl3)	1.6' (2.1)	0.0 (0.1)	16 (27)	0.4	No	1.0 (4.1)	41.1' (105.8')
High load, dry climate Chaparral scrub (Sh5)	22.7' (40.4')	1.7 (6.0)	5,025 (17,623)	0.4	Yes[2]	1.0 (4.1)	62.3' (160.2')

Note:
1. Wind-driven surface fire.
2. Crowning= fire is spreading through the overstory crowns.
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 50 mph.

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

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[5]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles) [6]
Scenario 1a: 12% slope; Fall offshore extreme wind from the north with 18 mph sustained winds (50+ gusts) (97th percentile)				
BMZ Zone 2 - Thinning (Sh2)	8.0' (15.0')	0.2 (0.9)	516 (2,049)	0.4 (1.1)
Scenario 1b: 40% slope; Summer onshore extreme wind from the NW with 12 mph sustained winds (50th percentile)				
BMZ Zone 1 - Irrigated (FM8)	0.9'	0.0	4	0.1
Scenario 2: 41% slope; Fall offshore extreme wind from the NE with 18 mph sustained winds (50+ gusts) (97th percentile)				
BMZ Zone 1 - Irrigated (FM8)	1.8' (2.6')	0.1 (0.1)	19 (45)	0.1 (0.3)
Scenario 3: 40% slope; Fall offshore extreme wind from the SE with 18 mph sustained winds (50+ gusts) (97th percentile)				
BMZ Zone 1 - Irrigated (FM8)	1.8' (2.6')	0.1 (0.1)	20 (45)	0.1 (0.3)

[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.

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 the 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 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 the transition from surface to crown fire are likely. The 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), a 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 3 and 4. Identification of modeling run locations is presented graphically in Figure 4 of the report.

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 a 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 the head of fire are ineffective.

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Table 1: Existing Fuel Model Characteristics

Fuel Model	Description	Location	Fuel Bed Depth (Feet)
Sh5	High Load, Dry Climate Shrub	Fuel type adjacent to the northern, western, eastern, and southeastern Project boundary.	>4.0 ft.
TI3	M rate load conifer litter	Fuel type found on east side of existing structures at top of the slope.	>6.0 ft.
Sh2	Moderate load, dry climate shrub	Fuel type will occur along the roadside brush management on the western side of the post development within 50% thinning zone.	<2.0 ft.

Table 2: Variables Used for Fire Behavior Modeling

Model Variable	Summer Weather (50th Percentile)	Peak Weather (97th Percentile)
Fuel Models	Sh2 and Sh5	Sh5, FM8, and Sh1
1 h fuel moisture	8%	2%
10 h fuel moisture	9%	4%
100 h fuel moisture	15%	8%
Live herbaceous moisture	58%	30%
Live woody moisture	116%	60%
20 ft. wind speed	12 mph (sustained winds)	18 mph (sustained winds); wind gusts of 50 mph
Wind Directions from north (degrees)	300	12 to 41
Wind adjustment factor	0.4	0.4
Slope (uphill)	40%	22 to 35%

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

Fire Scenario	Flame Length[1] (feet)	Spread Rate[1] (mph[3])	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: 12% slope; Fall offshore extreme wind from the north with 18 mph sustained winds (50+ gusts) (97th percentile)							
High load, dry climate Chaparral scrub (Sh5)	23.6' (40.9')[4]	1.9 (6.1)	5,477 (18,098)	0.8 (2.3)	N/A	N/A	/A
Scenario 1b: 40% slope; Summer onshore extreme wind from the NW with 12 mph sustained winds (50th percentile)							
High load, dry climate Chaparral scrub (Sh5)	10.6'	0.4	965	0.3	N/A	N/A	/A
Scenario 2: 41% slope; Fall offshore extreme wind from the NE with 18 mph sustained winds (50+ gusts) (97th percentile)							
High load, dry climate Chaparral scrub (Sh5)	22.2' (40.2')	1.6 (5.9)	4,812 (17,422)	0.7 (2.3)	N/A	N/A	N/A
Scenario 3: 40% slope; Fall offshore extreme wind from the SE with 18 mph sustained winds (50+ gusts) (97th percentile)							
Moderate load conifer litter (TI3)	1.6' (2.1)	0.0 (0.1)	16 (27)	0.4	No	1.0 (4.1)	41.1' (105.8')
High load, dry climate Chaparral scrub (Sh5)	22.7' (40.4')	1.7 (6.0)	5,025 (17,623)	0.4	es[2]	1.0 (4.1)	62.3' (160.2')

Note:

1. Wind-driven surface fire.
2. Crowning= fire is spreading through the overstory crowns.
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 50 mph.

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

Fire Scenario	Flame Length (feet)	Spread Rate (mph)[1]	Fireline Intensity (Btu/ft./sec)	Spot Fire (Miles) [2]
Scenario 1a: 12% slope; Fall offshore extreme wind from the north with 18 mph sustained winds (50+ gusts) (97th percentile)				
BMZ Zone 2 - Thinning (Sh2)	8.0' (15.0')	0.2 (0.9)	516 (2,049)	0.4 (1.1)
Scenario 1b: 40% slope; Summer onshore extreme wind from the NW with 12 mph sustained winds (50th percentile)				
BMZ Zone 1 - Irrigated (FM8)	0.9'	0.0	4	0.1
Scenario 2: 41% slope; Fall offshore extreme wind from the NE with 18 mph sustained winds (50+ gusts) (97th percentile)				
BMZ Zone 1 - Irrigated (FM8)	1.8' (2.6')	0.1 (0.1)	19 (45)	0.1 (0.3)
Scenario 3: 40% slope; Fall offshore extreme wind from the SE with 18 mph sustained winds (50+ gusts) (97th percentile)				
BMZ Zone 1 - Irrigated (FM8)	1.8' (2.6')	0.1 (0.1)	20 (45)	0.1 (0.3)

SOURCE: AERIAL-BING MAPPING SERVICE

DUDEK

0 175 350 Feet

FIGURE 4

BehavePlus Analysis Map

Fire Fuel Load Modeling Report for the Torreyana Project

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5 Brush Management Zones

As indicated in the preceding sections of the report, an important component of a fire protection system is the Brush Management Zones. BMZs are typically designed to gradually reduce fire intensity and flame lengths from advancing fire by strategically placing thinning zones and irrigated zones adjacent to each other on the perimeter of the WUI exposed structure(s). BMZs are arguably more important when situated adjacent to older structures that were built prior to the latest ignition resistant codes and interior sprinkler requirements.

Based on the modeled flame lengths for the Torreyana Project, the site's fire environment, and experienced judgment from similar projects, flame lengths under extreme fall weather conditions for native shrubs on the eastern portion of the Project area can reach approximately 40 feet. Once the fire progresses to the top of the slope, the fire could potentially transition from a wind-driven surface fire to an active crown fire within the canopies of the pine trees adjacent to the existing structures at the top of the slope. Under such conditions, predicted active crown fire flame lengths could exceed 160 feet. 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. As mentioned, the BMZs proposed for the Project are not standard SDFRD widths. Note that with the Project, three pine trees along the southern property boundary, adjacent to the southern side of Building 2 will be removed, eliminating this worst-case crown fire potential.

As mentioned, based on site-specific limitations, including the project being adjacent to MHPA areas, lot constraints, and project boundary limitations, this Project will incorporate two on-site BMZs, with Zone 1 ranging between 34 feet and 80 feet beyond the structures and Zone 2 ranging between 4 feet and 30 feet in width within the Open Space easement areas along the southern and eastern sides of the structures. Zone 1 will consist of a combination of irrigated planting and hardscape areas and Zone 2 consists of a modified thinning BMZ zone. Along the northern side of the structures, the access driveway provides an additional approximately 30 feet of paved brush management up to the edge of the State-owned open space areas. 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 however, within the Coastal Overlay Zone a maximum reduction of 30 feet of Zone 2 is permitted. Based on the Project's site, land ownership, adjacent to mapped MHPA areas, and grading plans, it is not feasible to achieve the City's standard BMZ widths along the Project's perimeter boundaries. Specific for this Project, Zone 1 extends between approximately 50 feet and 80 feet on-site and Zone 2 extends between 4 feet and 30 feet within the Open Space easement areas along the southern and eastern sides of the two structures, achieving 80 feet total of brush management along the southern side of the structures; Zone 1 extends between approximately 34 feet and 80 feet and Zone 2 extends between 4 feet and 12 feet along the northeast side of Building A; and Zone 1 extends between approximately 34 feet and 80 feet from the north/northwestern side of Building A. Adjacent to the structures will be BMZ-equivalent landscaped area. West/northwest of the structures, Zone 1 extends between 31 feet and 46 feet from the exterior of the structures to the access roadway. The access roadway easement will provide an additional 30 feet of paved brush management along the northern and western sides of the new buildings up to the edge of the State-owned open space area. The Zone 1 area along the western and northwestern sides of the structures include paved hardscapes areas with irrigated landscape areas within the paved areas of the Project site. Sitewide brush management will be implemented in phases that correspond with the phased construction of the buildings. If construction is no longer phased, then all BMZs would be implemented at once prior to demolition of the existing buildings (*Figure 5_Brush Management Plan*). Due to adjacent MHPA, open space, and land ownership restrictions the BMZ widths have been reduced; no BMZ activities would occur within mapped MHPA areas. As such, Zone 1 will consist of a partially irrigated landscape area along with a concrete driveway and parking areas and Zone 2 Brush Management thinning area varying in width from 4 to 30 feet.

The Project will also include the removal of three (3) existing pine trees along the southern property boundary, adjacent to Building 2 to increase defensible space and lower crown fire behavior. The pine trees that are proposed to be protected in place along the eastern property boundary, as well as along the western side of the Project's access roadway, will be required to meet all vertical and horizontal spacing requirements of the City of San Diego, detailed on Figure 5 of this FFLMR.

The BMZs for the Project will be phased and correspond with the phased construction of the buildings. BMZs would be implemented around their respected buildings prior to the demolition of the existing building. In the event of phasing options 1 and 2, BMZs will be implemented throughout the development site prior to the buildings being demolished. In the event of phasing option 3, BMZs in the northern portion of the Project would be implemented prior to the demolition of the existing building. The roadside brush management will also be implemented during phasing options 1, 2, and 3. In the event of phasing option 4 the remaining BMZs will be implemented in the southern portion of the Project prior to the demolition of the existing building. Site-wide BMZs would be completed at the end of phasing option 4.

The Project specific Zone 1 and Zone 2 brush management area, removal of three existing pine trees along the southern property boundary and adjacent to the southern side of Building 2 to increase defensible space and lower crown fire behavior and pruning the remaining existing pine trees along the eastern property boundary to meet the vertical and horizontal spacing requirements of the City of San Diego, along with the ignition resistance of the office facilities is expected to provide a fire-hardened site. The irrigated zone 1 areas around the perimeter of the structures plus the Zone 2 thinning areas extending out from Zone 1 along the southern and eastern sides of the structures, and the building construction provide a level of fire protection that is considered at least as robust as a standard BMZ, providing the same practical effect and enabling the deviation from the standard. If construction is no longer phased, then all BMZs would be implemented at once prior to demolition of the existing buildings.

Landscape Area Requirements – 0 to 5 feet from the structures

- The landscape area will be BMZ equivalent landscaping adjacent to the structures, outside the BMZ Zone.
- This area will mostly consist of hardscape with irrigated landscaping
- Plant species used in landscaping will not be fire facilitating species and comply with the prohibited plant list (Appendix C)
- The landscape area will have ongoing maintenance.

Zone 1 Requirements – between 34 and up to 80 feet from the structures (outside Landscape Area)

- Zone 1 will consist of primarily irrigated landscape along with a paved development area.
- Zone 1 width shall be provided between native or naturalized vegetation and any structure. The width shall be measured from the exteriors of the structure to the vegetation.
- There shall be no habitable structures, structures that are directly attached to habitable structures, or other combustible construction that can mean transmitting fire to habitable structures,

- Structures such as fences, gazebos, walls, palapas, play structures, and non-habitable gazebos with this zone shall be made of non-combustible, one hour-fire rated, or Type IV heavy timber as defined in the CBC.

- Plants within Zone 1 shall be primarily low-growing and less than 4 feet in height with the exception of trees. Plants shall be low-fuel and fire-resistive.

- Trees within Zone 1 shall be located away from structures to a minimum distance of 10 feet as measured from the structure to the drip line of the tree at maturity and spaced horizontally and vertically in accordance with the Landscape Standards of the Land Development Manual.

- Canopy of existing trees that extend within 10 feet of and structure shall be pruned to maintain a minimum horizontal and vertical clearance of 10 feet of the structure and/or a chimney outlet.

- Permanent irrigation is required for all planting areas within Zone 1 with the following exceptions:

    - When planting areas only contain species that do not grow taller than 24 inches in height

    - When planting areas contain only native or naturalized species that are not summer-dormant and have a maximum height at plant maturity of less than 24 feet.

- Zone 1 irrigation overspray and runoff shall not be allowed into adjacent areas of native or naturalized vegetation

- Zone 1 shall be maintained regularly by pruning and thinning plants, controlling weeds, and maintain irrigation systems.

Specific Brush Management Zone Requirements for Torreyana Project

1. Within the Zone 1 BMZ area, the vegetation that is not fire resistive shall be cleared and re-planted with fire-resistant plants. Zone 1 will be permanently irrigated. In the Zone 2 areas (where applicable), all dead and dying vegetation shall be removed. Native vegetation may remain in this area provided that the vegetation is modified so that combustible vegetation does not occupy more than 50% of the square footage of this area. Weeds and annual grasses are to be mowed to a height of 4–6 inches. Any chipping that is done on-site should be spread not to exceed 6 inches in depth.
2. All trees shall be planted and maintained at a minimum of 10 feet from the tree's mature drip line to any combustible structure. Additionally, the removal of three existing pine trees along the southern property boundary and adjacent to the southern side of Building 2 to increase defensible space and lower crown fire behavior and pruning to the remaining existing pine trees along the eastern property boundary to meet vertical and horizontal spacing requirements of the City of San Diego.
3. Landscaping and BMZs will adhere to the plant palette and brush management criteria and will consist of low-maintenance, fire-resistive plants.
4. Zones 1 and 2 brush management will be maintained annually, or as required by the SDFRD, per the City's BMZ standards.

5.1 Brush Management Area Vegetation Maintenance

All brush management area vegetation management shall occur as needed for fire safety, compliance with the BMZ requirements detailed in the report, and as determined by the SDFRD. The Property Manager or similar funded entity, shall be responsible for all vegetation management throughout the Project area, in compliance with the requirements detailed herein and SDFRD requirements (SD Municipal Code 54.02.06). The Property Manager or similar entity shall be responsible for ensuring long-term funding and ongoing compliance with all provisions of the report. The Property Manager or similar entity will be responsible for enforcing the landscape maintenance at least annually and prepare a report for submittal to the SDFRD.

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Project Boundary

BMZ Dimension

Brush Management Zone 1 (irrigated/hardscape)

Brush Management Zone 2 (Thinning)

Project Land Uses

Building Footprint

Development (Landscape/Hardscape)

Fire Engine Turnaround

Parking Garage Entry

Surface Parking

Access Roadway

Existing Park

Open Space Easement Area

BRUSH MANAGEMENT NOTES:

1. The BMZs for the Project will be implemented in phases that correspond with the phased construction of the buildings. BMZ would be implemented around their respected buildings prior to the demolition of the old building occurring. If construction is no longer phased, then all BMZs would be implemented at once prior to demolition of the existing buildings.

2. Projections extending over 4 feet from the structure is required to have exterior fire sprinklers installed.

3. Three pine trees along the southern property boundary (Tree Nos. 61, 62, and 63) will be removed per the Project's Tree Survey Plan set. The pine trees that are proposed to be protected in place along the eastern property boundary, as well as along the western side of the Project's access roadway, will be required to meet all vertical and horizontal spacing requirements of the City of San Diego. SeeTree Spacing Detail above.

SOURCE: AERIAL-SANGIS IMAGERY 2017; DEVELOPMENT-FERGUSON PAPE BALDWIN ARCHITECTS 2022

0 30' 60' 120'
1"=60'-0"
NORTH

DUDEK

FIGURE 5

Proposed Brush Management Plan

Fire Fuel Load Modeling Report for the Torreyana Project

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6 Access

6.1 Fire Apparatus Access

6.1.1 Primary Access Roads

The Project would involve the phased demolition of the existing structures, construction of new structures, roadways, and parking areas. Currently, the City of San Diego has adopted by reference the 2022 California Fire Code (CFC). Project site access, including road widths and connectivity, will exceed the City code requirements and be consistent with the 2022 CFC. Additionally, adequate water supply and approved paved access roadways shall be installed prior to any combustibles being onsite. Access to the site begins at the intersection of Torreyana Road and Callan Road and travels northbound along Torreyana Road. Access to the Project is directly from the north terminus of Torreyana Road. Torreyana road terminates with a cul-de-sac that the Project entrance would be accessed from. The length of the Project access road is 630 feet and 28 feet wide and provides access to both proposed buildings as well as to the two subterranean parking lots. At the mid-point of the access, the road is a 150-foot fire access point between the two buildings. At the northern terminus of the access, the road is a fire apparatus turnaround.

There will be no other interior road systems other than the primary access road. The Project access road will comply with all fire apparatus access road standards set forth in the CFC Section 503. The access roads will be designed to accommodate a 75,000-pound minimum imposed load of fire apparatus and shall be surfaced to provide all-weather capabilities. The fire apparatus access road shall have an unobstructed width of no less than 20-feet exclusive on shoulders and have an unobstructed vertical clearance of 13 feet and 6 inches (CFC Section 503.2.1).

6.1.2 Road Widths and Circulation

Access to the Project site will be from the northern terminus of Torreyana Road. The onsite existing access road is 630 feet long and will provide access to the new buildings and the two subterranean parking structures. The road will terminate northwest of Building a with a “Y” fire apparatus or equivalent approved turnaround. At the midpoint of the access road, there will be an additional 150-foot fire access road between the two buildings. The Project access road will provide primary ingress and egress; there are no other access roads or internal circulation roads on the Project site. The access roads will have an obstructed width of no less than 20-feet, exclusive of shoulders, and an unobstructed vertical clearance of 13 feet and 16 inches (CFC Section 503.2.1).

6.1.3 Dead-End Roads

Per Section 503.2.5. of the CFC dead-end fire apparatus roads that exceed 150 feet in length shall have an approved turning area for fire apparatus. Torreyana Road from the intersection of Callan Road to the northern terminus is approximately 450 feet long. Torreyana Road is an existing dead-end road and at the north, terminus has a cul-de-sac with an approximate 45-foot radius. The Project access road is a 630-foot dead-end road. There will be two fire apparatus turnarounds along the Project access road to mitigate the dead-end road length. At the mid-point off the road between the two buildings will be a 150-foot driveway. At the terminus of the Project, the access road will be a “Y” fire apparatus or equivalent approved turnaround. The fire apparatus turn around will comply with San Diego Fire-Rescue Department’s requirements for fire apparatus turnrounds radii.

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7 Justification for Modified Brush Management Zones

As presented in this Fire Fuel Load Modeling Report, the BMZs provided for the proposed Torreyana Project are not standard BMZs. Rather, the BMZs provided for the Torreyana Project include Zone 1 areas that will be fully irrigated that vary in distance to provide between approximately 50 feet and 80 feet on site plus up to an additional 30 feet of Zone 2 thinning within the Open Space easement areas along the southern and eastern sides of the two structures, achieving 80 feet total of brush management in most areas; Zone 1 extends between approximately 34 feet and 80 feet along the northeast side of Building A; and Zone 1 extends between approximately 34 feet and 80 feet from the north/northwestern side of Building A. Adjacent to the structures will be BMZ-equivalent landscaped area. West of the structures, Zone 1 extends between 34 feet and 46 feet from the exterior of the structures to the access roadway. The access roadway easement will provide an additional 30 feet of paved brush management along the northern and western sides of the new buildings up to the edge of the State-owned open space area. The Zone 1 area along the western and northwestern sides of the structures include paved hardscapes areas with irrigated landscape areas within the paved areas of the Project site. The BMZs adjacent MHPA and open space area are considered to meet the intent of the City's standard, since they will have BMZs ranging between 34 and 80 feet in width and are suitable for the type of fire anticipated from off-site fuels. The majority of vegetation in the area will be replaced with permanently irrigated fire restive species and paved development; thus, significantly reducing surface flame lengths. Zone 1 is reduced on the northern side as it is not feasible to implement typical BMZ because it potentially will encroach into open space belonging to the State or the MHPA. The Project is within the Coastal Overlay Zone and cannot implement impact-neutral thinning within the MHPA. The Project will also remove three pine trees adjacent to the southern property boundary. Removing the pine trees closest to the structures would prevent a surface fire from transitioning to a crown fire and the new structures would be significantly more fire safe than the existing conditions. Further, the proposed alternative compliance minimizes the impacts to undisturbed native and/or naturalized vegetation while still meeting the purpose and intent of Section 142.0412 of the City Code (SDMC 142.0412.i). This is a decision that will need to be made by the City. With that said, it is anticipated that the proposed structure will be able to withstand the short duration, low to moderate intensity fire and ember shower that is projected from off-site, adjacent fuels based on several factors, as discussed below.

7.1 Structure Ignition

There are three primary concerns for structure ignition: 1) radiant and/or convective heat, 2) burning embers, and 3) direct flame contact (NFPA 1144 2008, 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 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 provided for the Torreyana Project is required by the City of San Diego and state codes but are worth listing because they have been proven effective for minimizing structural vulnerability to wildfire and, with the inclusion of a required NFPA 13 automatic interior fire sprinkler system to extinguish interior fires, should embers succeed in entering a structure. The structure would include highly resistant materials and construction methods that will be built to California Essential Services Buildings

Standards, which are least as ignition resistant as Chapter 7A of the San Diego Building Code. 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. Application of CBC Chapter 7A, ignition resistant building requirements
2. Exterior walls and doors to CBC Chapter 7A standards or equivalent
3. Dual-pane glazing with one tempered pane glass windows (or equivalent) to CBC Chapter 7A requirements
4. Areas requiring ventilation to the outside environment will require either ember-resistant roof vents or a minimum 1/16-inch mesh and shall not exceed 1/8-inch mesh for side ventilation (see 2022 CBC Chapter 7A Section 706A-Vents, or then current edition). All vents used for this project will be approved by SDFRD.
5. NFPA 13 required automatic, interior fire sprinkler system to code for occupancy type to be installed to NFPA installation standards. Additionally, for projections extending over 4 feet from the structure, the installation of an exterior fire sprinkler system is required and shall be designed and installed by an approved Fire Sprinkler Engineer. The exterior fire sprinkler system is required to comply with the 'Exposed Protection' requirements of NFPA 13, Sections 11.3.2 (including both subsections 11.3.2.1 and 11.3.2.2), which describe the design and installation standards that are required to be followed. The exterior fire sprinkler heads will be installed under all projections (roofs, overhangs, etc.).
6. A fully irrigated landscape planted with drought-tolerant, fire resistive plants will be planted within all BMZs. No prohibited, highly flammable plant species shall be planted, as listed in Appendix C. The landscaping will be routinely maintained and will be watered by an automatic irrigation system that will maintain healthy vegetation with high moisture contents that would prevent ignition by embers from a wildfire.
7. The new building designs also provide an unimpeded, all-weather pathway (minimum three feet wide) around the majority of the scientific research buildings for firefighter access around the perimeter of the structure.

7.2 Fuel Separation

As experienced in numerous wildfires, including the most recent firestorms in San Diego County (2003 and 2007), homes in the WUI are potential fuel. The distance between the wildland fire that is consuming wildland fuel and the home ("urban fuel") is the primary factor for structure ignition (not including burning embers). 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 to 18 meters (roughly 32 to 60 feet) in southern California fires, 85% to 95% of the homes survived (Howard et al. 1973, Foote and Gilless 1996). Similarly, San Diego County after fire assessments indicates 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 sufficiently low home ignitability, 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 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 requires about 130 feet of clearance to prevent structure ignitions from radiant heat (Cohen and Butler 1996). The study utilized bare wood, which is more combustible than the ignition-resistant exterior walls for structures built today. Obstacles, including steep terrain and non-combustible walls, can block or deflect all or part of the radiation and heat, thus making narrower fuel modification distances possible. Fires in ravines, chutes, coves, v-drainages and steep-sided canyons can, under specific conditions, result in an upward draft, similar to a fireplace chimney. Chimneys on the landscape are created when air is drawn in from lower elevations, creating strong upslope drafts. The result can be an acceleration of radiant and convective heat as well as the actual fire spread, similar to opening the damper in a fireplace chimney. Areas, where the terrain includes a restriction or narrowing, can result in this type of acceleration. The terrain features adjacent to the Stevenson site include few mild examples of these "chimneys" that are not expected to significantly alter fire behavior.

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8 Conclusion

The goal of the BMZs along with the fire protection features provided for the Torreyana Project is to provide the structures with the ability to survive a wildland fire while minimizing intervention of firefighting forces. Preventing ignition to the structures will result in a reduction of the exposure of firefighters/visitors to hazards that threaten personal safety and will reduce property damage and losses. Mitigating ignition hazards and fire spread potential reduce the threat to the structure and can help the SDFRD optimize the deployment of personnel and apparatus during a wildfire. The analysis in the Fire Fuel Load Model Report provides support and justifications for acceptance of the proposed BMZ for the Project based on the site-specific fire environment. As presented in the report, the alternative measures proposed for the proposed Project's BMZ supplement the standard requirements and provide at least functional equivalency. The post-project condition will represent a significantly reduced fire hazard as well as a significantly hardened Project site (landscape and structures) that will be at less risk than the current condition.

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9 Limitations

The Fire Fuel Load Modeling Report does not provide a guarantee that occupants and visitors will be safe at all times because of the fire protection features it requires. There are many variables that may influence overall safety. The report provides requirements and recommendations for the implementation of the latest fire protection features that have proven to result in reduced wildfire-related risk and hazard.

For maximum benefit, the Torreyana occupants and visitors, contractors, engineers, and architects are responsible for the proper implementation of the concepts and requirements set forth in the report. The Property Manager (or similar entity) is responsible for maintaining the structure and the proposed BMZs as required by the report, the applicable Fire Code, and the SDFRD, which helps protect against catastrophic loss as a result of a wildland fire.

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Appendix A

Torreyana Project Photograph Log

Photo log

Torreyana

Photograph 1: Photograph of native vegetation along the western site of the Project site. Photograph taken facing north.

Photograph 2: Photograph of native vegetation along the western site of the Project site. Photograph taken facing west.

Photograph 3: Photograph of native vegetation along the western site of the Project site. Photograph taken facing west.

Photograph 4: Photograph of native vegetation along the western site of the Project site. Photograph taken facing northwest.

Photograph 5: Photograph of the existing approximately 96-ft. diameter cul-de-sac located at the end of Torreyana Road. Photograph taken facing south.

Photograph 6: Photograph of driveway entrance to neighboring development, south of the Project site. Photograph taken facing southwest.

Photograph 7: Photograph of the existing driveway entrance to Project site. Photograph taken facing northeast.

Photograph 8: Photograph of existing driveway/parking lot along the western side of the Project site. Photograph taken facing north.

Photograph 9: Photograph of existing driveway/parking lot along the western side of the Project site. Photograph taken facing north.

Photograph 10: Photograph of one of the existing buildings located on the Torreyana Project site. Photograph taken facing east.

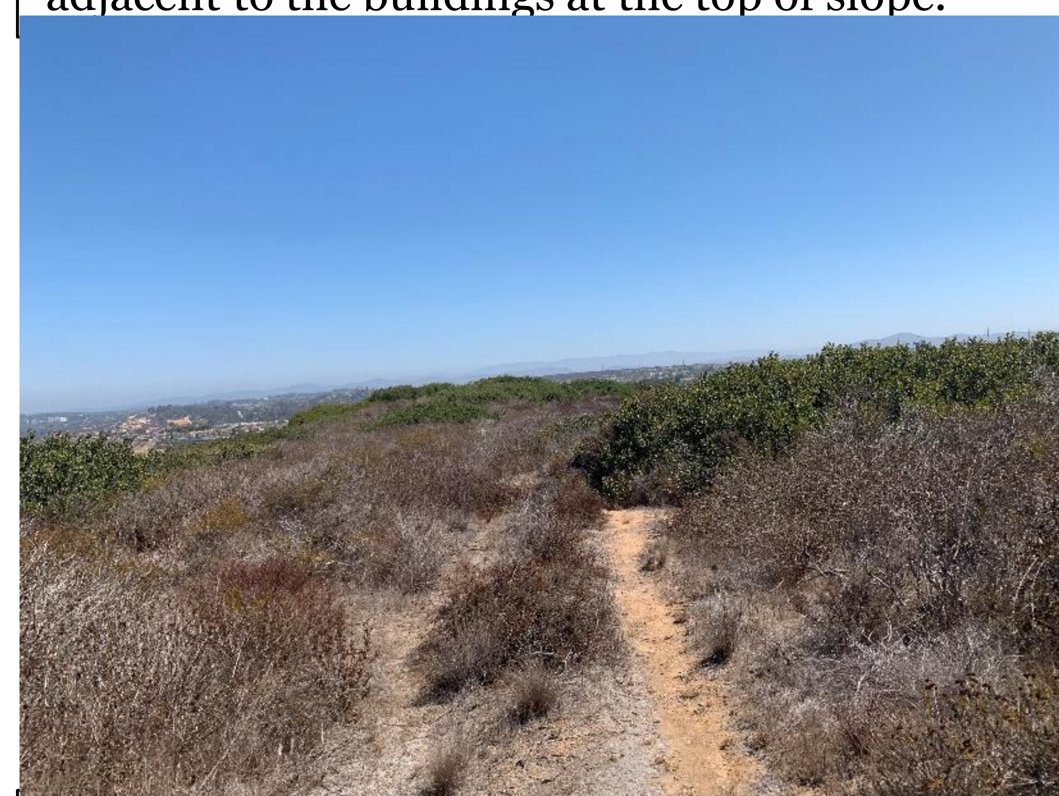
Photograph 11: Photograph of the second existing buildings located on the Torreyana Project site. Photograph taken facing northeast.

Photograph 12: Photograph of the vegetation located along the western driveway. Photograph taken facing north.

Photograph 13: Photograph of the native vegetation located along the northern side of the Project site. Photograph taken facing north.

Photograph 14: Photograph of the eastern side of the existing buildings. Photograph taken facing south. Note the existing pine trees located adjacent to the buildings at the top of slope.

Photograph 15: Photograph of the existing vegetation located along the northern/northeastern side of the Project site. Photograph taken facing northeast.



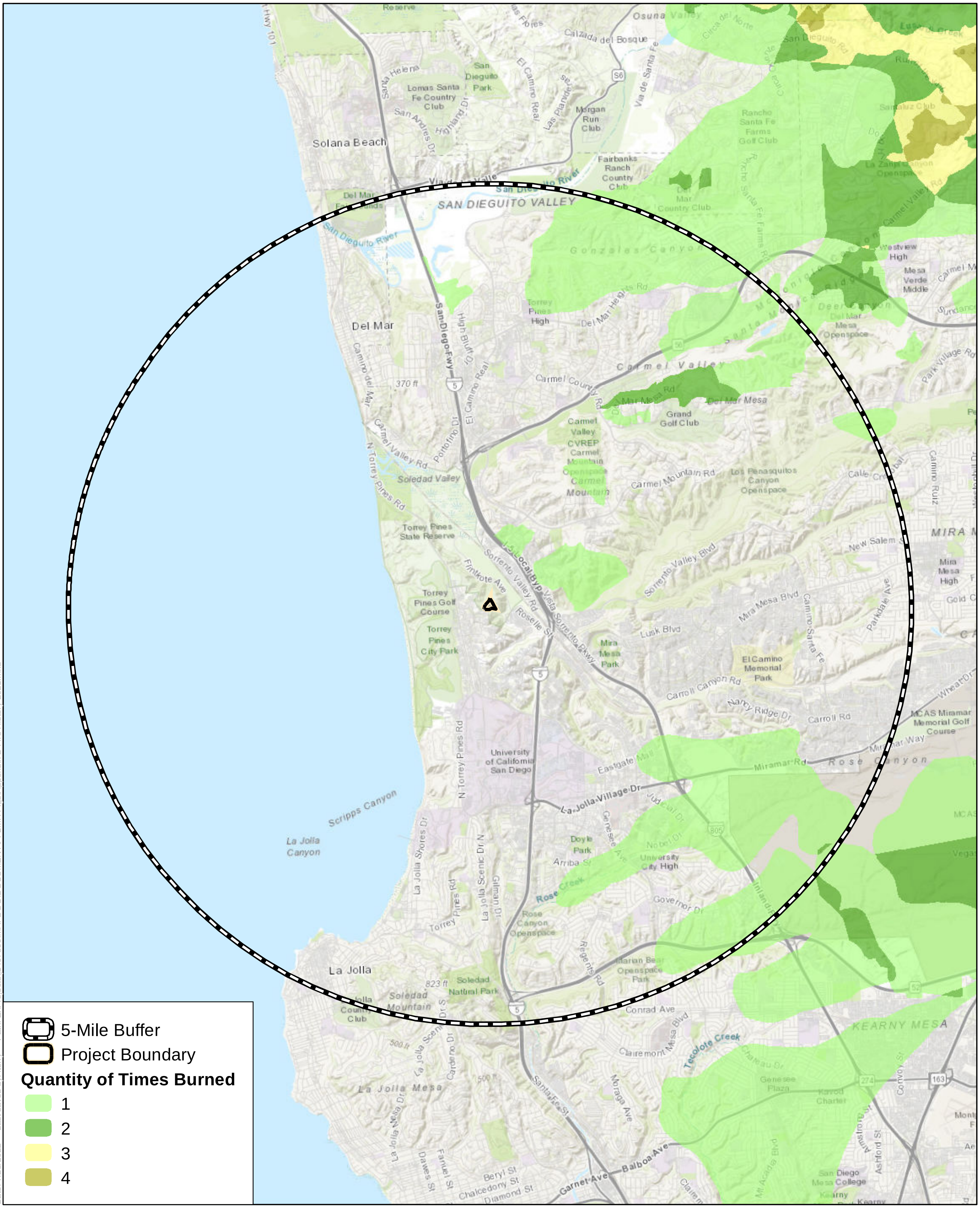
Photograph 16: Photograph of the existing vegetation located along the northern/northeastern side of the Project site. Photograph taken facing northeast.

Photograph 17: Photograph of the existing vegetation located along the eastern side of the Project site. Photograph taken facing south. Note the pine trees directly adjacent to the existing buildings.

Photograph 18: Photograph of the southern side of the existing buildings located on the Torreyana Project site. Photograph taken facing northeast. Note the pine trees located directly adjacent to the existing buildings.

Appendix B

Project Vicinity Fire History Map



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

0 1 2 Miles

APPENDIX B

Fire History Map

Fire Fuel Load Modeling Report for the Torreyana Project

Appendix C

Prohibited Plant List

UNDESIRABLE PLANT LIST

The following species are highly flammable and should be avoided when planting within the first 50 feet adjacent to a structure. The plants listed below are more susceptible to burning, due to rough or peeling bark, production of large amounts of litter, vegetation that contains oils, resin, wax, or pitch, large amounts of dead material in the plant, or plantings with a high dead to live fuel ratio.

BOTANICAL NAME	COMMON NAME
Abies species	Fir Trees
Acacia species	Acacia (trees, shrubs, groundcovers)
*Adenostoma sparsifolium***	Red Shanks
*Adenostoma fasciculatum***	Chamise
Agonis juniperina	Juniper Myrtle
*Anthemis cotula****	Mayweed, Stinking Chamolile
Araucaria species	Monkey Puzzle, Norfolk Island Pine
*Arctostaphylos species***	Manzanita
*Artemesia californica***	California Sagebrush
Arundo donax	Giant Cane
Bambusa species	Bamboo
*Brassica species****	Mustard
Callistemon species	Bottlebrush
Calocedrus decurrens	Incense Cedar
*Cardaria draba****	Hoary Cress, Perennial Peppergrass
Ceanothus species	Ceanothus
Cedrus species	Cedar
Chamaecyparis species	False Cypress
Cinnamomum species	Camphor Tree
*Cirsium vulgare****	Wild Artichoke
*Conyza Canadensis****	Horseweed
Coprosma pumila	Prostrate Coprosma
Cortaderia selloana	Pampas Grass
Cotoneaster lacteus	Cotoneaster
Cryptomeria japonica	Japanese Cryptomeria
Cupressocyparis leylandii	Leylandii Cypress
Cupressus forbesii	Tecate Cypress
Cupressus glabra	Arizona Cypress
Cupressus macrocarpa	Monterey Cypress
Cupressus sempervirens	Italian Cypress
*Cynara cardunculus****	Artichoke Thistle
Cytisus species	Scotch Broom, French Broom,etc.
Dodonea viscosa	Hopseed Bush

Elaeagnus angustifolia	Russian Olive
Elaeagnus pungens	Silverberry
*Eriogonum fasciculatum***	Common Buckwheat
Eucalyptus species	Eucalyptus
*Gensita species****	Broom
*Heterotheca grandiflora***	Telegraph Plant
Jubaea chilensis	Chilean Wine Palm
Juniperus species	Junipers
*Lactuca serriola****	Prickly Lettuce
Larix species	Larch
Lonicera japonica	Japanese Honeysuckle
Miscanthus species	Eulalia Grass
*Muehlenbergia species***	Deer Grass
Nicotiana species	Tree Tobacco
Palmae species	Palms
Pennisetum setaceum	Fountain Grass
Picea species	Spruce Trees
*Pickeringia Montana***	Chaparral Pea
Pinus species	Pines
Podocarpus species	Fern Pine
Pseudotsuga menziesii	Douglas Fir
Ricinus communis	Castor Bean
Rosmarinus species	Rosemary
*Salsola australis****	Russian Thistle, Tumbleweed
*Salvia species***	Sage
Schinus molle	California Pepper
Schinus terebinthifolius	Brazilian Pepper
*Silybum marianum****	Milk Thistle
Spartium junceum	Spanish Broom
Tamarix species	Tamarisk
Taxodium species	Cypress
Taxus species	Yew
Thuja species	Arborvitae
Trachycarpus fortunei	Windmill Palm
Tsuga species	Hemlock
*Ulex europea****	Gorse
*Urtica urens***	Burning Nettle
Washingtonia species	California/Mexican Fan Palm

** San Diego County native species
*** Introduced weeds to San Diego County

California Department of Forestry and Fire Protection (619) 590-3100
United States Forest Service (619) 674-2901
County Fire Service Coordinator (858) 495-5092
County Farm and Home Advisor (858) 694-2845
Insurance Information Network of California -- Brochures

(www.iinc.org <http://www.iinc.org>) or call (800) 397-1679

REFERENCES

- Combustible Vegetation and Other Flammable Materials Ordinance. Sections 68.401 thru 86.406 of the County of San Diego's Zoning Ordinance.
- California Department of Fish and Game (858) 467-4201
- U.S. Fish and Wildlife Service (760) 431-9440
- Protecting Your Property From Soil Erosion (www.sdcounty.ca.gov/dpw/docs/fire/homeerosion.pdf <http://www.sdcounty.ca.gov/dpw/docs/fire/homeerosion.pdf>)
- Homeowner's Guide for Flood, Debris, and Erosion Control After Fires (www.sdcounty.ca.gov/dpw/docs/fire/AfterFire.pdf <http://www.sdcounty.ca.gov/dpw/docs/fire/AfterFire.pdf>)
- Burn Institute (www.burninstitute.org)