APPENDIX O

FIRE BEHAVIOR REPORT

Fire Behavior Report

Legacy Ranch, San Juan Capistrano

San Juan Capistrano, California



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Orange County Fire Authority

and

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11/11/24

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Purpose and Scope of Report

Firesafe Planning Inc (Firesafe) performed an assessment of the wildland fire related risks within and adjacent to the Legacy Ranch Project Site in order to establish the appropriate criteria to determine the locations and size of fuel modification zones, defensible space implementation, and protection measures which would be necessary to provide a level of protection which is equal to or greater than the prescriptive requirements of the wildland interface codes, ordinances, standards, and guideline which govern the development of this site. This report provides assessment results and objective defensible space criteria for the project site that are equal to or greater than the risk encountered in a worst-case scenario. The study takes into consideration existing/future vegetative interface fuels, topography, and weather conditions during a fire. The report provides results of computer calculations (fire behavior modeling) that measure the fire intensity and flame lengths from worst-case scenario wildfires in both the extreme (Santa Ana wind) and the predominant (Onshore wind) wind conditions. The results of fire behavior calculations have been incorporated into the design criteria for the fuel modification zones.

General Geographic Description

The Legacy Ranch development (Project Site) is located south of I5/SR73 interchange, west of I-5, east of Golden Lantern, and north of Junipero Serra Rd. within the City of San Juan Capistrano, California as shown below in Figure 1.

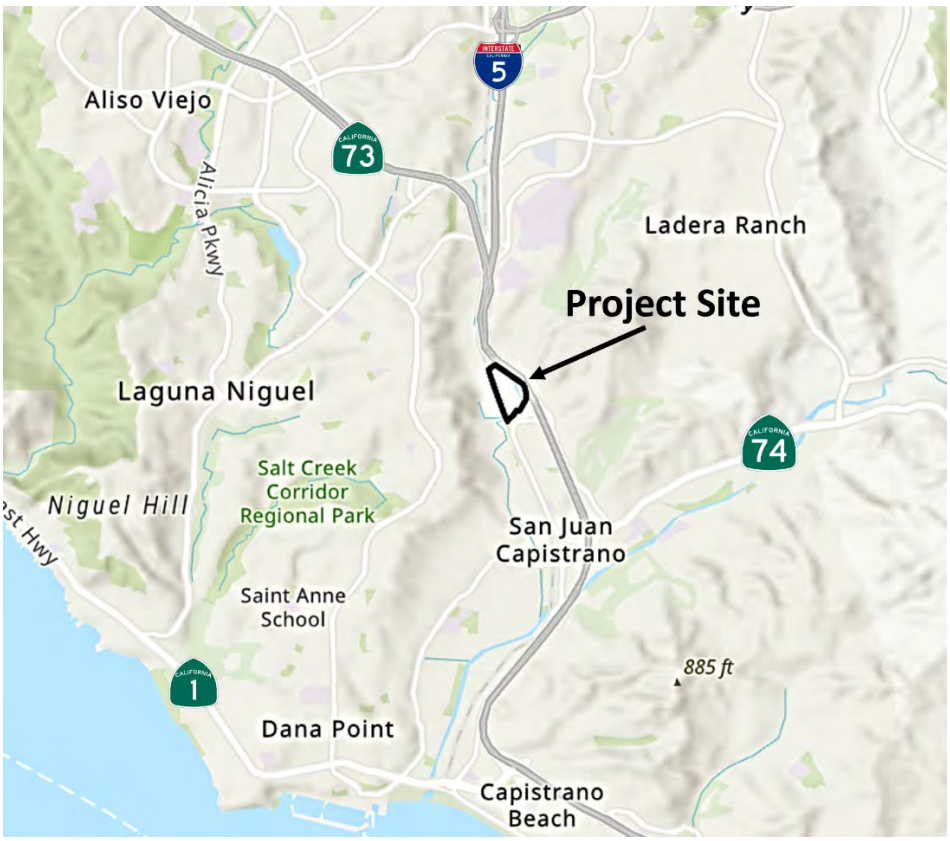


Figure 1 – Location Map



Figure 2 – Project Site Layout

Project Description

The proposed Legacy Ranch's project site is situated on a 65.5-acre property often referred to as the “Northwest Open Space”. The project calls for four "core" spaces including: a hospitality sector (likely to include pop-up restaurants), an agricultural space; a recreational hub; and a full equestrian facility.

Legacy Ranch is an innovative development project designed to enhance the recreational and agricultural offerings of San Juan Capistrano while promoting community engagement and sustainability. The project encompasses five core land use elements: Equestrian Core, Rancho Hospitality Core, Agriculture Core, Entertainment Pavilion Core, and Recreational Core.

Core Land Use Elements

1. Equestrian Core:

This area serves as a hub for equestrian activities, featuring:

- Two 32-stall horse barns and an Otramas Barn to accommodate horses and equestrian events.
- An Otramas covered riding area, vet barn, and riding pen (50 ft diameter) for training and events.
- Extensive riding/roping areas, sorting pen, and a versatile arena designed for competitions.
- Additional facilities include two covered wash stations, trailer parking for 46 vehicles, and a hay equipment storage building.

2. Rancho Hospitality Core:

Designed for events and gatherings, this core includes:

- The Swanner House & Gardens, offering a scenic backdrop for events.
- A 6,000 sq ft catering building, alongside a maintenance/catering prep area and multiple event spaces, including a 3,300 sq ft tent and three event barns (4,500 sq ft each).
- The Ranch House, a multifunctional resort hub, alongside a cabin village and a resort pool and spa.

3. Agriculture Core:

This area promotes sustainable agriculture with:

- An orchard, row crops, and a 3,000 sq ft agricultural barn.
- A dedicated maintenance area and windrow for managing farm operations.

4. Entertainment Pavilion Core:

A vibrant space for leisure and enjoyment featuring:

- A nature playground and a small gauge railroad, ideal for families and children.
- Retail pop-ups and a wellness resort (2,400 sq ft), enhancing the visitor experience.
- A distillery/restaurant building (10,000 sq ft) and a food and beverage building, providing culinary delights.

5. Recreational Core:

Fostering active lifestyles, this core includes:

- An extensive trail system for hiking and biking, a covered patio at the dog park, and a great meadow for relaxation.
- Essential amenities like food service facilities and restroom access, alongside ample parking options.

CalFire Fire Hazard Severity Zones

The Project Site is not located within a current CalFire Local Responsibility Area (LRA) Very High Fire Hazard Severity Zone, as shown in Figure 3. SRA (State Responsibility Area) exists to the west, south, and east of the Project Site but is not immediately adjacent. These fire hazard severity zones are geographical areas designated pursuant to California Public Resources Code Sections 4201 through 4204 and classified as Local Agency Very High Fire Hazard Severity Zones designated pursuant to the California Government Code Sections 51175 through 51189. The SRA areas have recently been updated. and the state (California) is in the process of approving and

distributing the updated zone classification for the SRA areas. None of the SRA areas shown in Figure 3 will be changed in this process. In 2024, the state (state fire marshal's office) will begin the process of updating the LRA areas (light red in figure below) within the entire state. Based on changes to the SRA, additional areas will likely be added to many LRA areas. The status of the Project Site may change.

All areas within Very High Fire Hazard Severity Zones in LRA (Local Responsibility Area) areas and any hazard zone within SRA are required by state code to comply with the Chapter 7A of the California Building Code, Chapter 49 of the California Fire Code, and Section R337 of the California Residential Code as adopted and amended by the local agency (OCFA) for this Project Site. These areas will also be under the requirements of the California Minimum Fire Safe Regulations as currently amended. In the next Fire Code cycle (2027) LRA are which are rated "High" will also be required to meet the same standard as the current "Very High". Provisions in the code allow for areas rated as "Moderate" to be required to conform as well if the local agency having jurisdiction finds that the area requires this level of protection in order to be safe from wildfires.

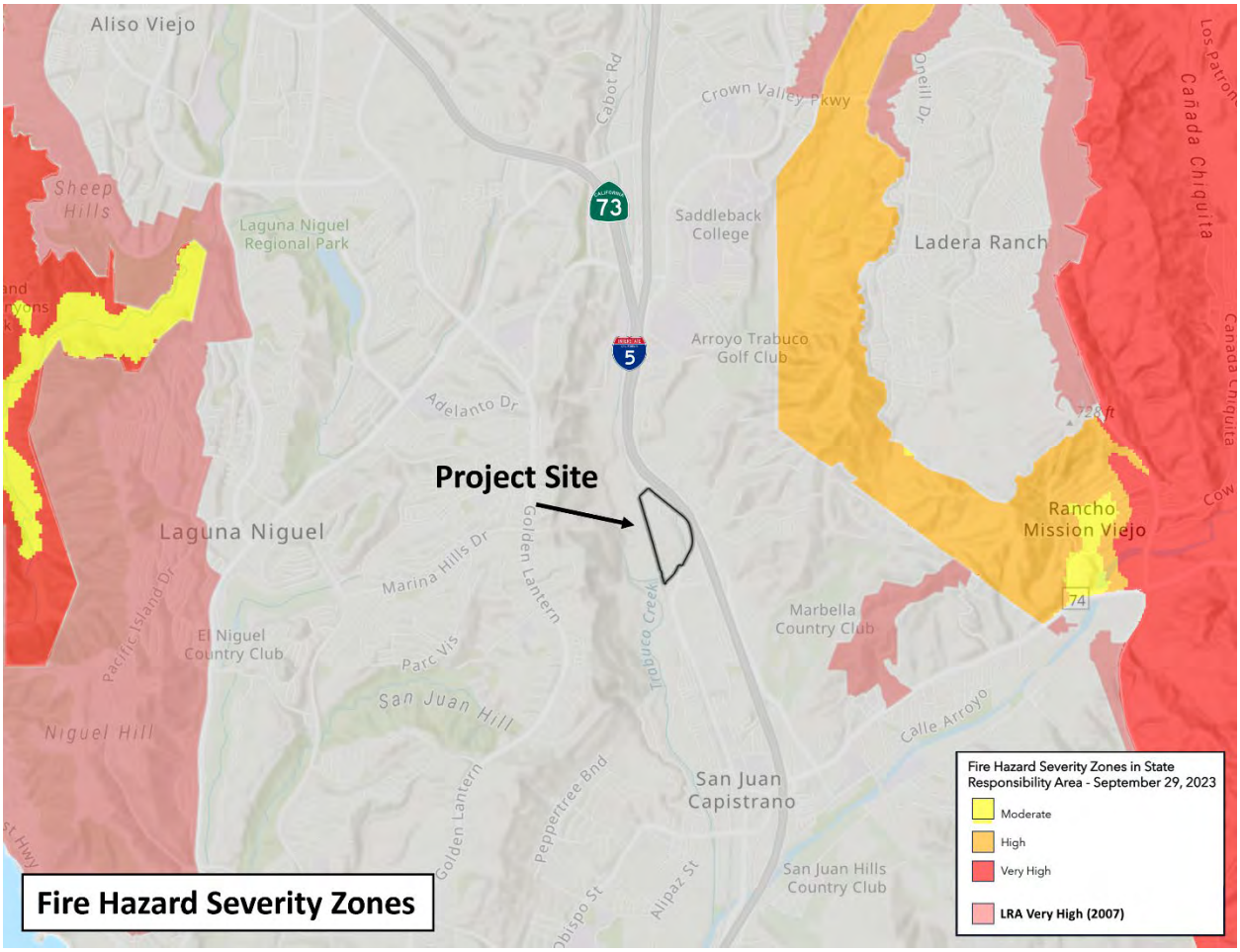


Figure 3 - Existing Fire Hazard Severity Zones (2007/2008)

Fire Risk Assessment

Fire risk assessment is based on several factors. These include the fire history of the development area and the surrounding areas; the vegetation (wildland fuels) that surrounds the project site, the weather history for the general area and the specific site, the topography of the Project Site (elevation, slope, and aspect), and the placement of structures relative to the factors listed above.

The fire behavior analysis for this Project Site was completed to develop a performance-based fire protection system criteria from the modeling results (based on a worst-case scenario) for the Legacy Ranch project site. Using the worst-case scenario fire conditions, it is expected that any future fires will be equal to or less extreme than those modeled here and would produce fire behavior spread/intensity at was within the risks analyzed and therefore provide the appropriate level of protection.

Firesafe completed the fire hazard assessment and expected wildland fire behaviors in order to provide criteria that will provide the necessary built-in protection in the event of a wildland fire. Any revision to the existing, approved fuel modification plans or fire-resistive construction features will need to be reviewed by the Orange County Fire Authority and approved prior to any changes within the wildland interface of the project site.

Fire History

A review of the CalFire database (FRAP), which maintains a statewide spatial database of fire perimeters from BLM, NPS, and USFS fires, 10 acres and greater in size, and CAL FIRE fires, 300 acres and greater in size, since 1980, is shown in the graphic on the next page (Figure 4). Collection criteria for CAL FIRE fires changed in 2002 to include timber fires greater than 10 acres, brush fires greater than 50 acres, grass fires greater than 300 acres, fires destroying three or more structures, and fires causing $300,000 or more damage. In 2008, the collection criteria for CAL FIRE fires eliminated the monetary criterion and redefined the definition of structures.

The Project Site is outlined in yellow in the figures on the next pages (Figures 4 and Figure 5). The fire perimeters are shown in red with a shading effect that allows the overlap between fire perimeters to be seen. The overlap areas are more highly shaded so that it is possible to see the areas with more fire activity and the extent of each of the perimeters without having to provide separate graphics for each.

As shown in the graphics, there have been no large fires on the Project Site and only one within one mile of the center of the project site in the time since records have been kept. The area to the east of the Project Site qualifies as “Historic Fire Corridors”. The probability of a fire in the upwind (NE of project site) is much higher than any of the other directions. This is also the direction that Santa Ana winds are likely to come from during a wind event in this area. Fires in this area tend to be smaller (under 200 acres) than those to the east (1,000’s of acres). Fires in this area are likely to be reported earlier and with all of the developed areas (roads, fire hydrants, breaks in the wildland fuels), fires are less likely to become major large-scale events.

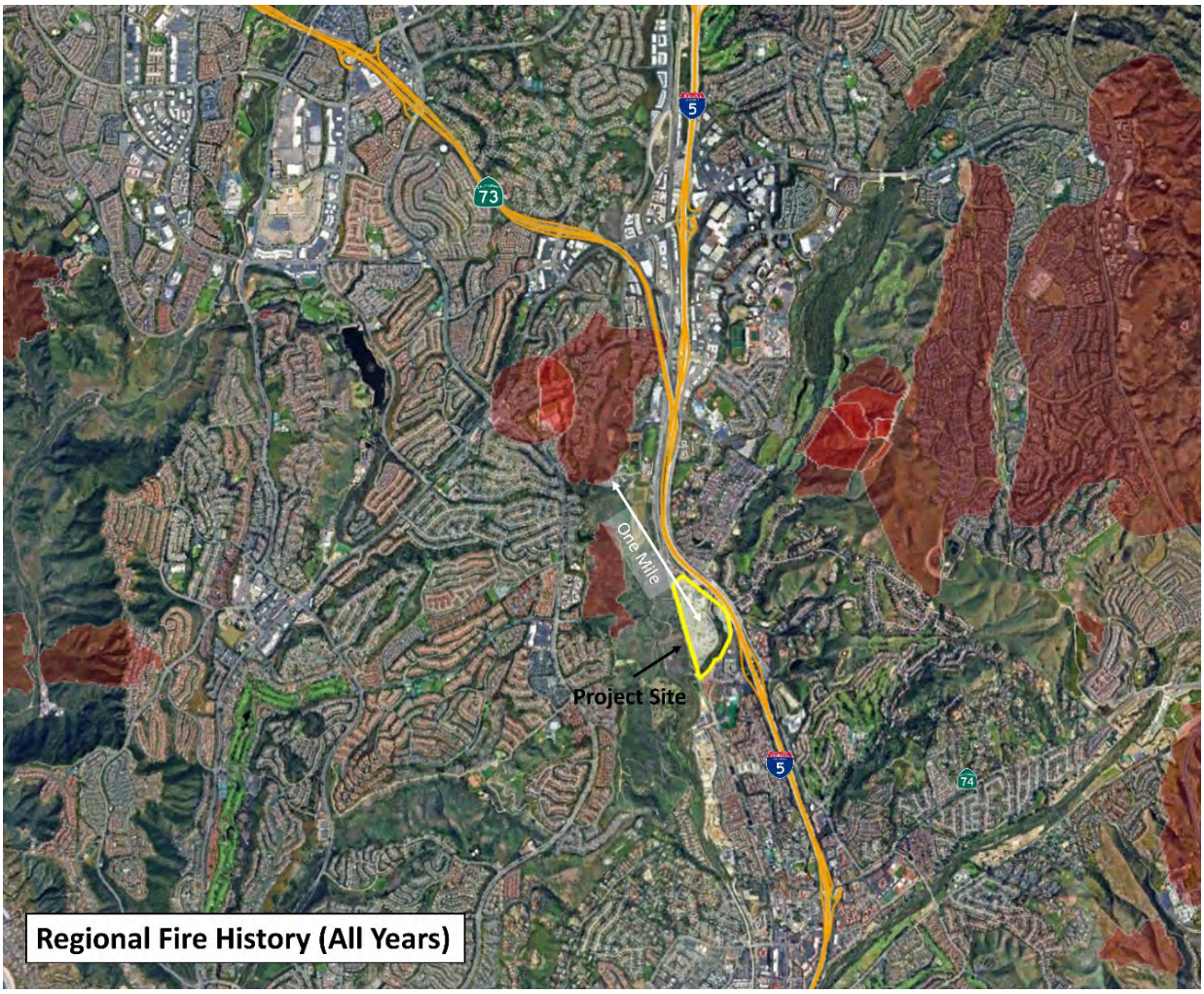


Figure 4 – Regional Fire History

The BehavePlus, Fire Behavior Prediction and Fuel Modeling System is the most popular and one of the most accurate methods for predicting wildland fire behavior in pre-fire defense planning. The BehavePlus fire behavior computer modeling system is utilized by wildland fire experts nationwide. Because the model was designed to predict the spread of a fire, the fire model describes the fire behavior only within the flaming front. The primary driving force in the fire behavior calculations is the dead fuel less than ¼" in diameter; these are the fine fuels that carry the fire. Fuels larger than ¼" contribute to fire intensity, but not necessarily to fire spread.

The BehavePlus fire model describes a wildfire spreading through surface fuels, which are burnable materials within 6' of the ground and contiguous to the ground. This type of modeling demonstrates the potential of a wind-driven fire that could potentially enter the fuel modification zones from the adjacent wildland areas. Outputs for the modeling assume a continuous fuel bed, with a fire burning in equilibrium, which is self-sustaining. Inputs do not vary across the landscape for the BehavePlus model.

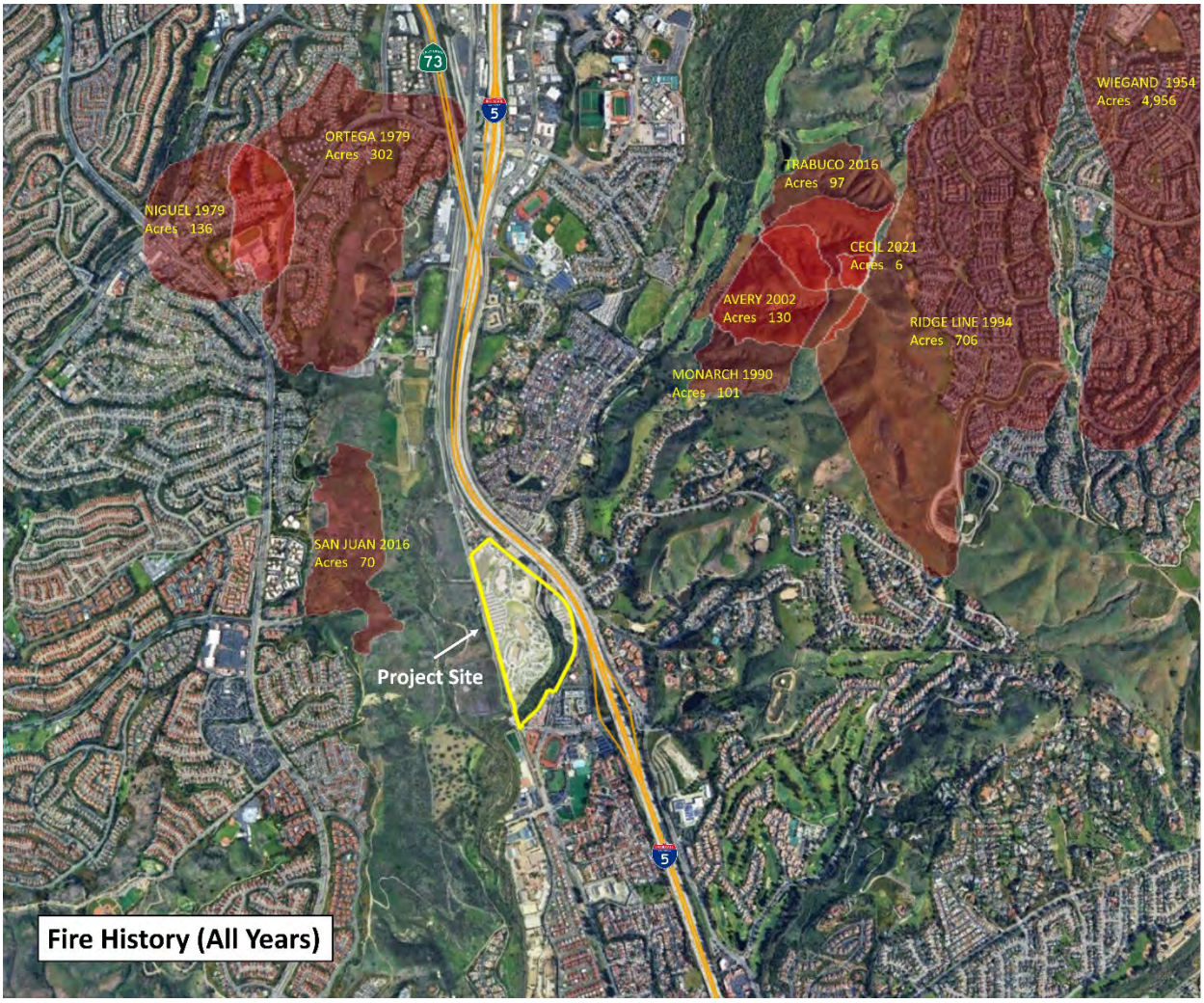


Figure 5 - Fire History Map (Around Project Site)

Fire Behavior Analysis (BehavePlus)

Weather Inputs and Wind Patterns

The worst-case fire conditions exist when topography, fuels, and wind are in alignment. Full alignment (homes are upslope from the fuel modification zones and are in alignment with the extreme winds–Santa Ana) of all three factors. This does occur in the Project Site but only at the edges of the riparian areas (protected areas) as indicated previously in Figure 2. The weather has an impact on the temperature, relative humidity, and wind.

To be able to model the fire behavior, it is important to be able to project the worst-case weather for the project. This is accomplished using automated weather stations. RAWS (Remote Automated Weather Stations) and other automated data collection systems are used for this purpose. The sites used for this study are shown in Figure 6

The overall conclusion for wind speed and direction for the Project Site is that while winds can and do come from every direction, strong, hot, dry winds from a Santa Ana wind event do have

the ability impact the Project Site. Winds at the Bell Canyon RAWS are strong, and the Santa Ana wind events are obvious

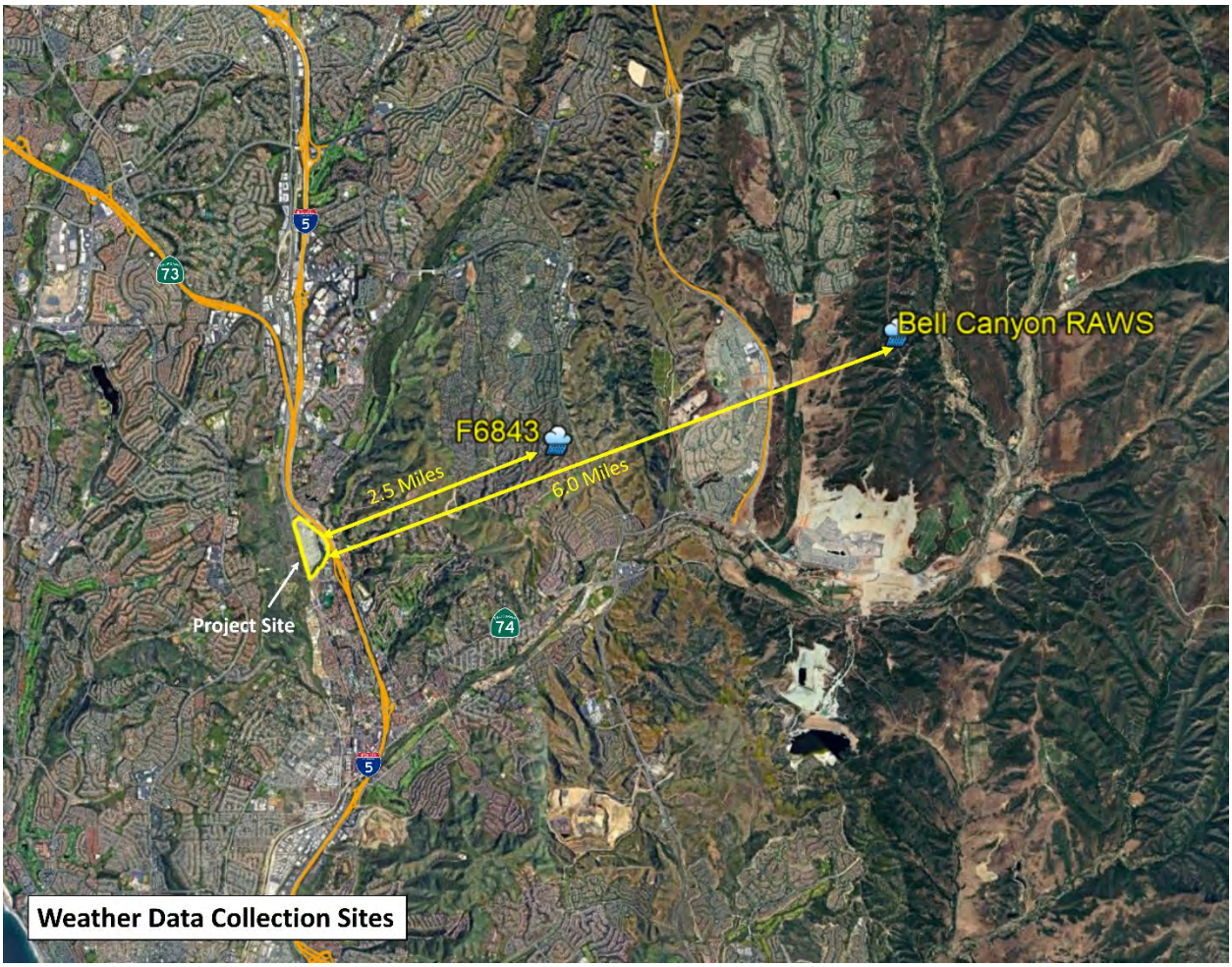


Figure 6 –Weather Data Sites

In Figure 7, on the next page, the stronger winds (NE to E) are obvious. The predominant onshore/offshore flow makes up the majority of the wind direction in the wind rose which covers 14 years of data. In Figures 8 and 9, 22 years of data (12/2/99 to 11/15/22) from the Bell Canyon RAWS. While the dataset has some single values with extreme winds, the 99th percentile data points for wind speed (27 mph) and wind gusts (47 mph) are not extreme. This site provides an understanding of the regional weather conditions. The Bell Canyon site is location approximately 6 miles NE of the project site.

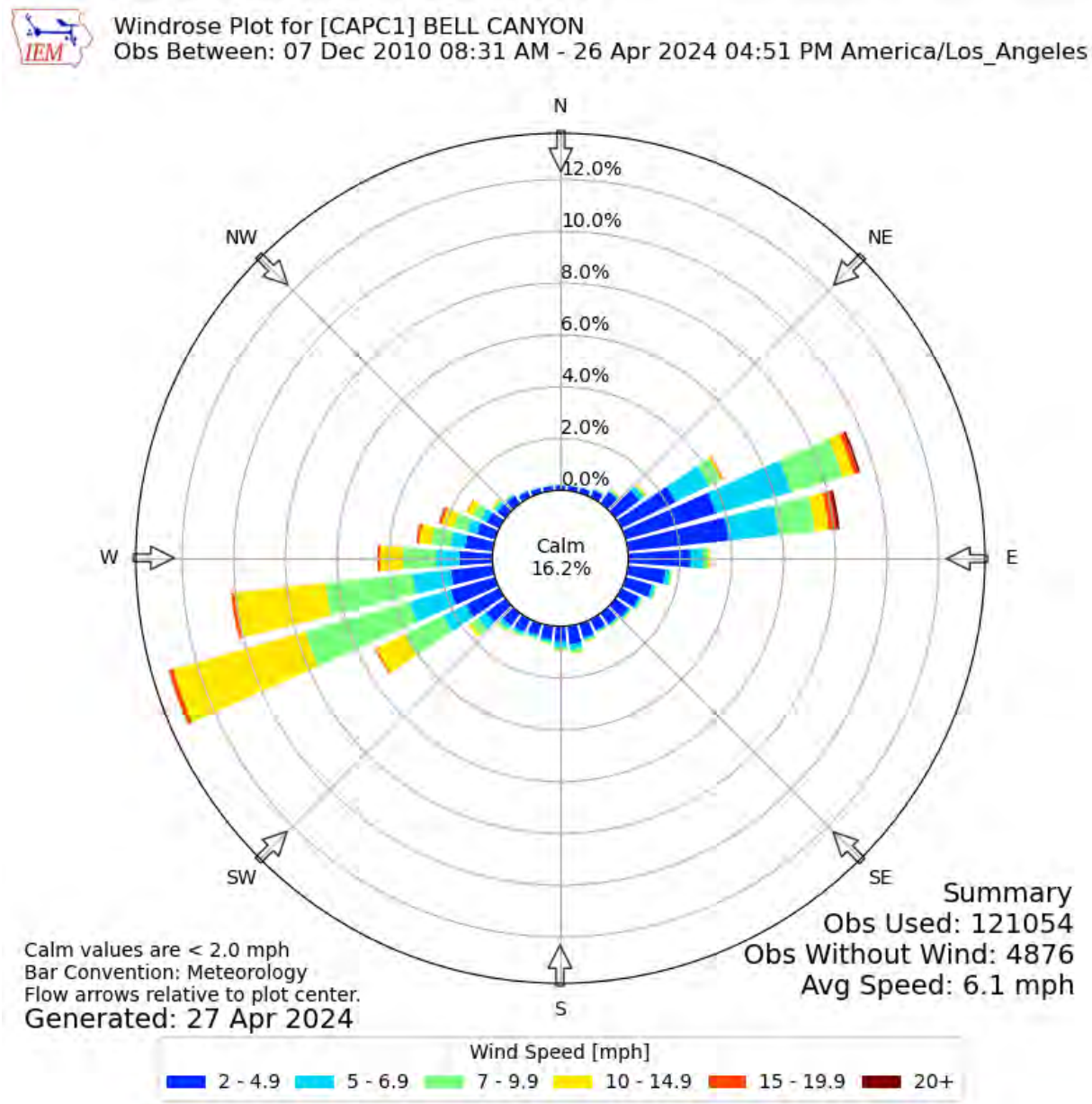


Figure 7 – Bell Canyon RAWS Windrose

Looking at the other weather data, we see that the 3rd percentile value for RH (Relative Humidity) is 3%. The upper temperature at 99th percentile is 93 degrees. Less than 1% of the wind gust in the data set are over 50 mph (this aligns with the 99th percentile of 47 mph).

The private weather site F6843 is located about 2.5 miles to the NE of the project site as well. The weather pattern here is different as it is within the coastal influence and is situated in an area that is less impacted by the Santa Ana wind events (west side of ridgeline whereas Bell Canyon RAWs is on a ridgeline). Given this more sheltered position, the winds are more variable and in fact do come from nearly every direction on a more regular basis than those found at the Bell Canyon RAWS. Figure 10 provides a wind rose (created from 4.5 years of data).

12/2/99 19:30	
11/15/22 9:51	
8,384	days
22.97	years

	Temp	RH	Wind	Direction	Gust
Min	0	0	0	0	0
Max	115	100	182	360	198
Average	64	60.5	6.7	171	12.3
3rd percentile	46	3	0	0	0
97th percentile	88	100	18		33
98th percentile	90	100	22		39
99th percentile	93	100	27		47

Figure 8 – RAWS Data Summary (Bell Canyon)

CAPC1			Wind Gust (mph)				
	Count	**Cardinal**	<20	>20	>30	>40	>50
3.8%	7,174	N	5,689	1,466	482	227	160
3.1%	5,935	NNE	4,646	1,286	442	201	134
5.1%	9,714	NE	9,021	686	214	63	27
13.9%	26,274	ENE	24,194	1,995	679	182	44
6.9%	13,085	E	12,333	704	169	54	27
3.0%	5,649	ESE	5,278	367	141	64	27
2.2%	4,239	SE	3,887	349	121	51	25
2.4%	4,590	SSE	4,168	418	159	58	18
6.1%	11,498	S	7,043	4,448	2175	1,314	293
6.6%	12,415	SSW	7,280	5,128	1644	891	249
6.7%	12,731	SW	11,036	1,680	610	339	140
18.5%	35,030	WSW	32,281	2,702	203	85	31
9.2%	17,330	W	15,636	1,660	173	48	22
4.1%	7,746	WNW	6,790	933	158	48	23
2.4%	4,568	NW	4,319	241	71	26	17
2.0%	3,804	NNW	3,486	316	91	51	41
3.8%	7,122	Null	6,959	146	39	10	2
100.0%	188,904		164,046	24,525	7571	3,712	1,280
	-		**86.8%**	**13.0%**	**4.0%**	**2.0%**	**0.7%**

Figure 9 – Wind Speeds by Wind Direction (Bell Canyon)

Figures 11 and 12 provide the same type of information that was provided for the Bell Canyon RAWS. The minimum RH is 3%, the maximum wind is 43 mph, and the maximum wind gust is only 35 mph. This is because wind gusts are only counted where they have a duration of 20 seconds or less. The 43 mph obviously lasted longer than 20 seconds and was counted as sustained wind.

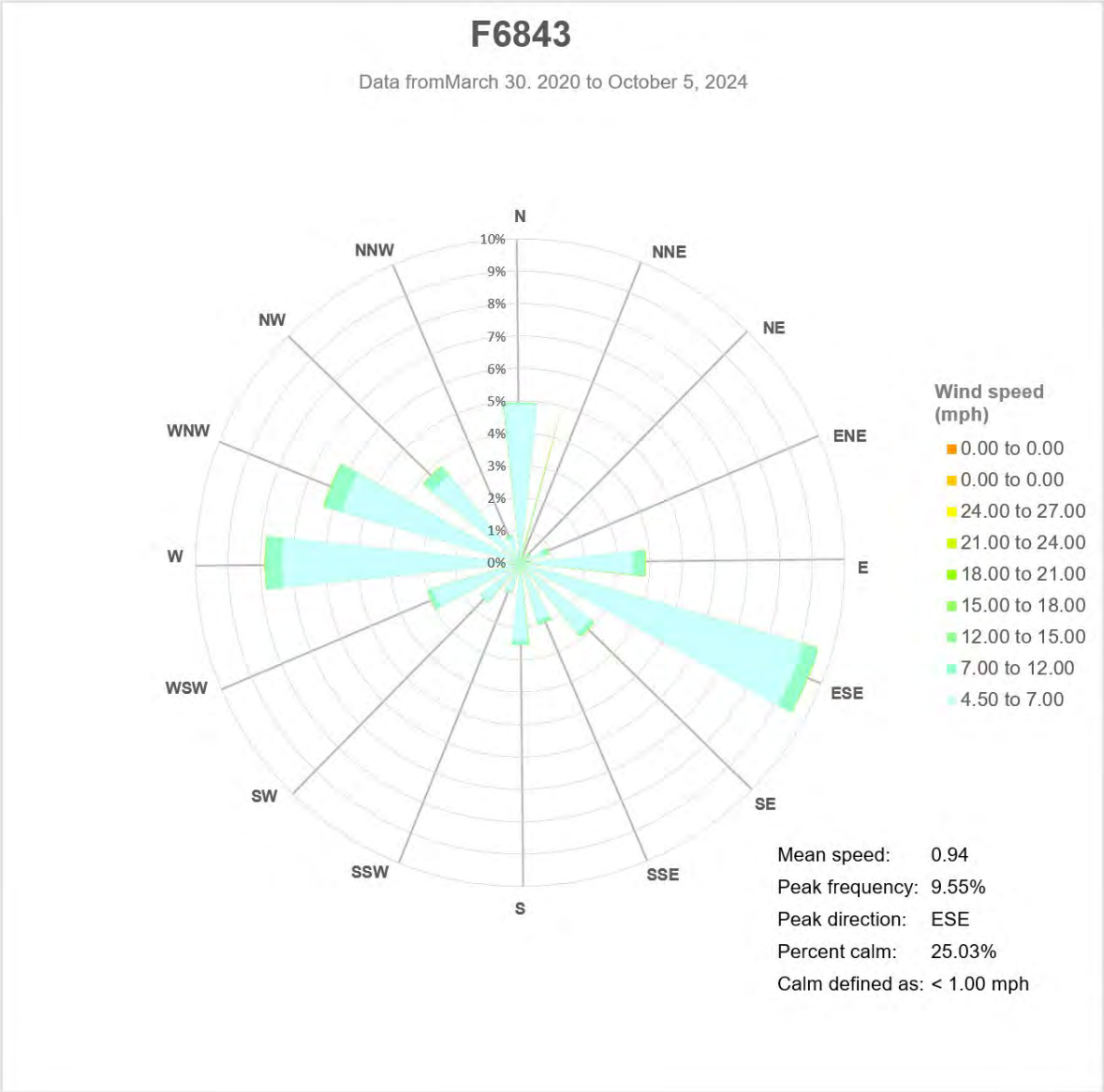


Figure 10 – Windrose F6843

10/5/2024	Start
3/30/2020	End
1,650	days
55	months
4.5	years

Weather Site F6843

	Temp	RH	Wind	Dir	Gust
	Fahrenheit	%	Miles/hour	Degrees	Miles/hour
Min	37	3.0	0.0		0
Max	110	99.0	43.0		35
Average	62	71.8	1.0	183	4
99th	91	98.0	5.0		14
1st	44	13.0	0.0		0

Figure 11 - Summary Data F6843

A review of the wind direction and speed indicates that only 5 measurements in 4.5 years exceeded 35 mph. Values between 25 and 35 mph have 54 occurrences. The light red shading below indicates the values and direction of note along with the yellow shading which indicates the wind directions which are more prevalent, regardless of the wind speed. All of these wind directions are examined in relationship to the project site wind interface.

			Wind Speed							
	Count	Percentage	<10	>10	>15	>20	>25	>30	>35	>40
N	6,936	4.9%	6,697	143	25	10	2	-	-	-
NNE	253	0.2%	121	111	30	11	3	-	-	-
NE	543	0.4%	309	202	71	22	6	-	-	-
ENE	1,303	0.9%	959	285	90	19	4	-	-	-
E	5,432	3.9%	4,915	412	134	21	2	-	-	-
ESE	13,405	9.6%	13,040	285	74	17	2	-	-	-
SE	4,122	2.9%	3,876	188	53	9	2	1	-	-
SSE	2,783	2.0%	2,557	153	39	12	2	1	-	-
S	3,585	2.6%	3,270	215	57	19	3	-	-	-
SSW	1,344	1.0%	1,201	92	20	6	1	-	-	-
SW	2,225	1.6%	2,091	78	14	5	1	-	-	-
WSW	4,171	3.0%	3,858	205	39	14	4	-	-	-
W	11,050	7.9%	10,121	625	126	26	7	2	-	-
WNW	8,849	6.3%	7,841	667	128	27	9	-	-	-
NW	5,401	3.8%	4,770	422	66	16	5	1	-	-
NNW	1,258	0.9%	1,061	137	31	10	1	-	-	-
Blank/calm	67,690	48.2%	-	-	-	-	-	-	-	-
	140,350									
			66,687	4,220	997	244	54	5	-	-
			47.5%	3.0%	0.7%	0.2%	0.04%	0.004%		

Figure 12 – Wiind Direction/Speed Analysis F6843

In Figure 13, on the next page, the seven wind directions from the data in Figure 12 are illustrated on a graphic (yellow arrows0 of the project site for reference. The W, WNW and NW winds are more than likely storms during the winter and spring where much of the weather is the result of weather fronts originating in the Gulf of Alaska and traveling down the west coast. Regardless of the origin, the three winds would take fire in the riparian areas away from the development areas of the project site. The N wind either moves fire away or runs parallel to the development area. Finally, the NE, E and ESE winds are the ones that have the ability to impact the project site in a meaningful way and each will be discussed along with the two blue arrow (S and SW) which are the heat generated onshore flow that can does happen on hot days when the inland land mass heats up causing a low pressure which is normally filled by the movement of cooler air from over the ocean.

Using the Wind Ninja software, the project site interface was modeling for wind impacts using a domain average of 35 mph. Figure 14 provides the output for an E wind in the area of the riparian interface. Note the blue areas are in the bottom of the drainage where the wind is sheltered. The green areas are less than the domain average (ranging from 21-26 mph). The depth of the drainage is significant (covered in the topography section of this report) but at this orientation to the wind, the impacts are negligible.



Figure 13 – Wind Direction Orientation Map

The NE and ESE winds are equally unaffected by the drainage (Figures 15 and 16). This could be due to the amount of vegetation within the drainage and/or it could be that the interaction between the topography and the wind is simply not significant at this location and the specific wind directions. Either way, no significant impact is found.

In Figure 17, the South wind is illustrated. An area of wind acceleration occurs within the riparian at the south end of the project site. While the wind speeds do not exceed 40 mph in this area, they are significantly higher than the rest of the interface. In Figure 18, a similar occurrence happens with the SW wind. In this case the maximum wind speed in the acceleration area is under 35 mph.

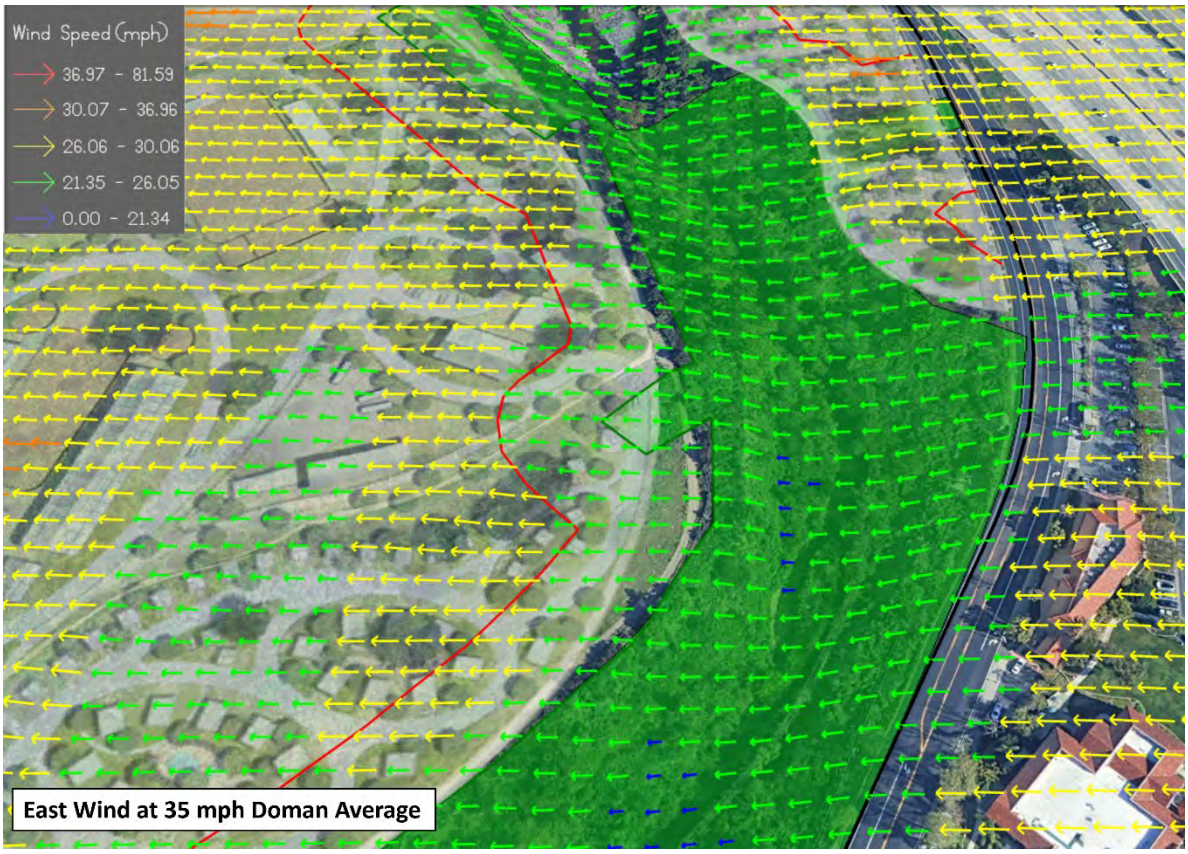


Figure 14 - East Wind at 35 mph Domain Average Wind Speed

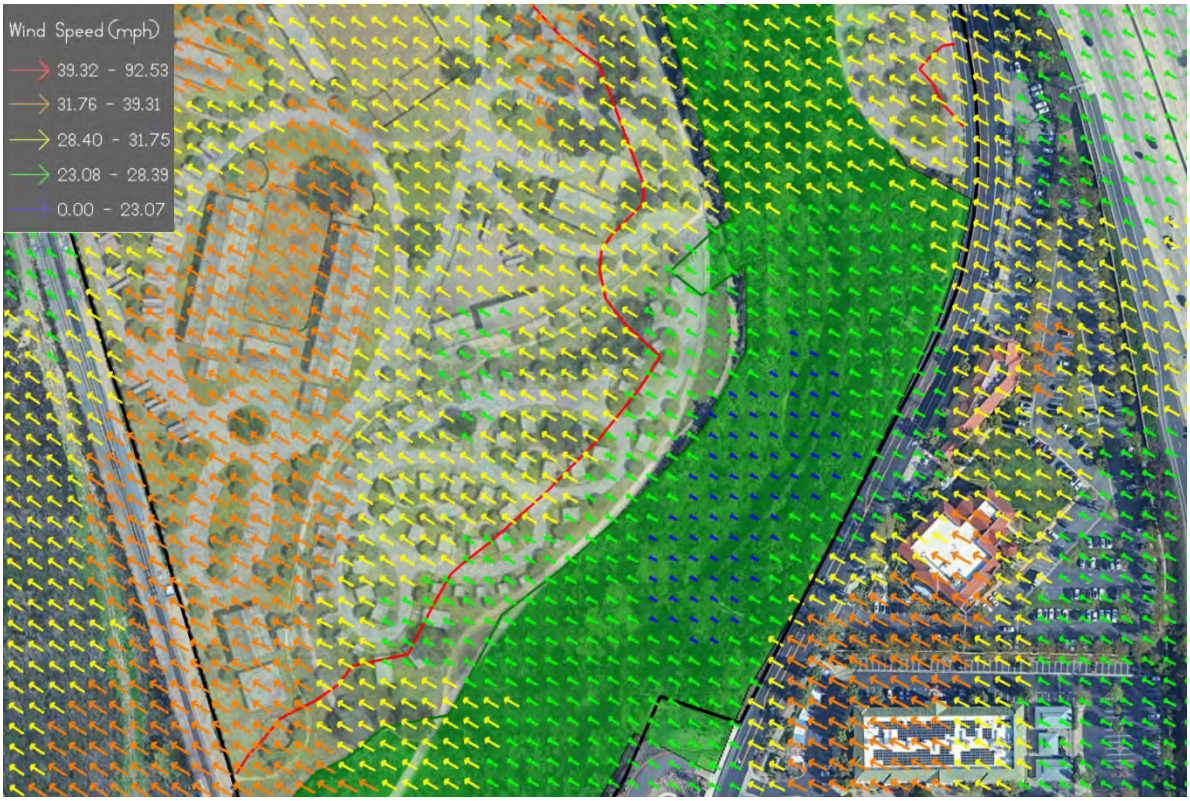


Figure 15 – ESE wind at 35 mph Domain Average Wind

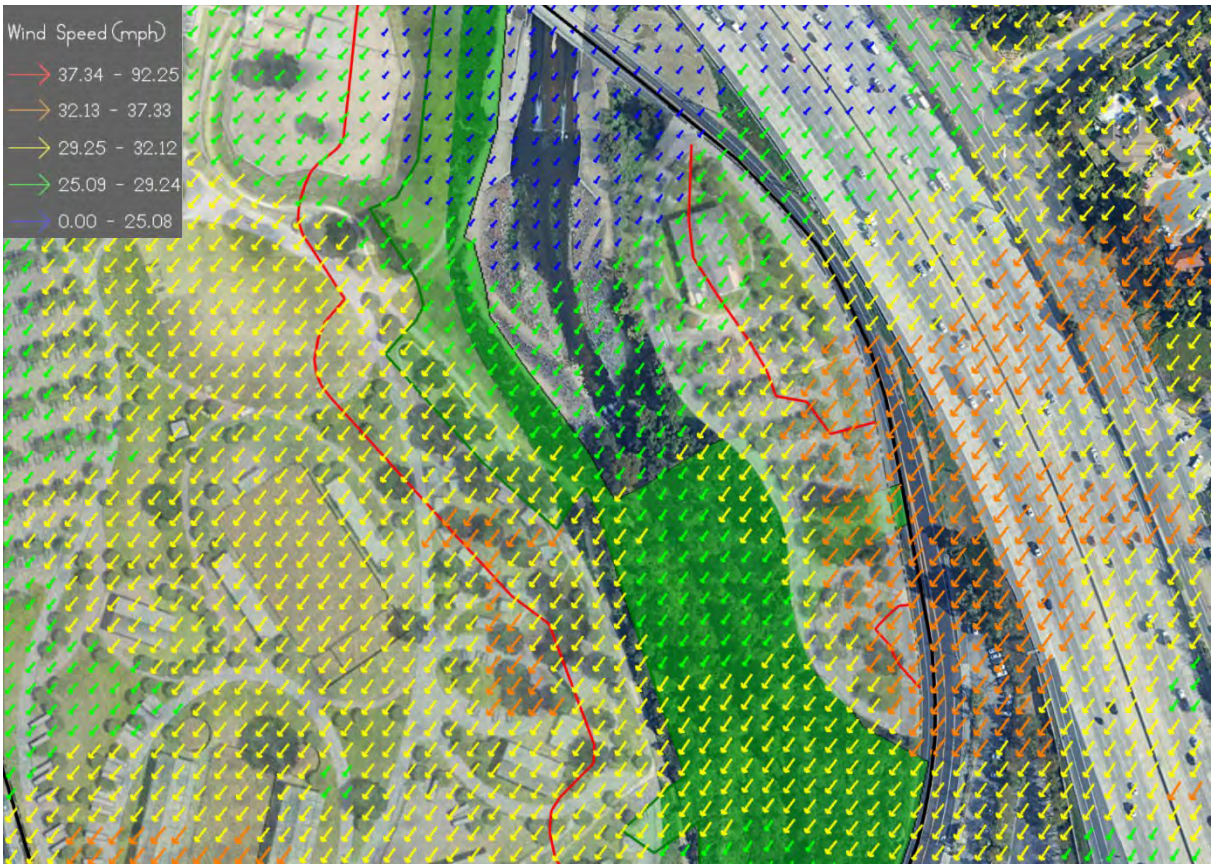


Figure 16 – NE wind at 35 mph Domain Average Wind

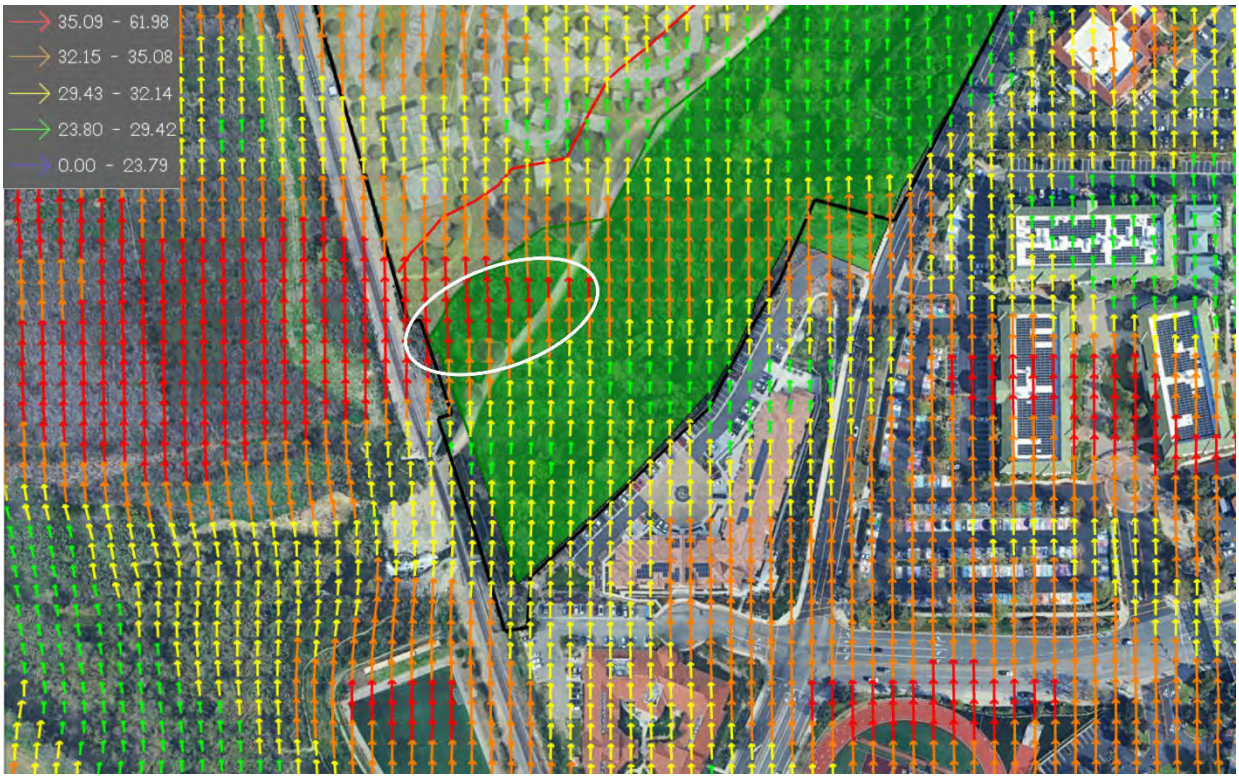


Figure 17 – S wind at 30 mph Domain Average Wind

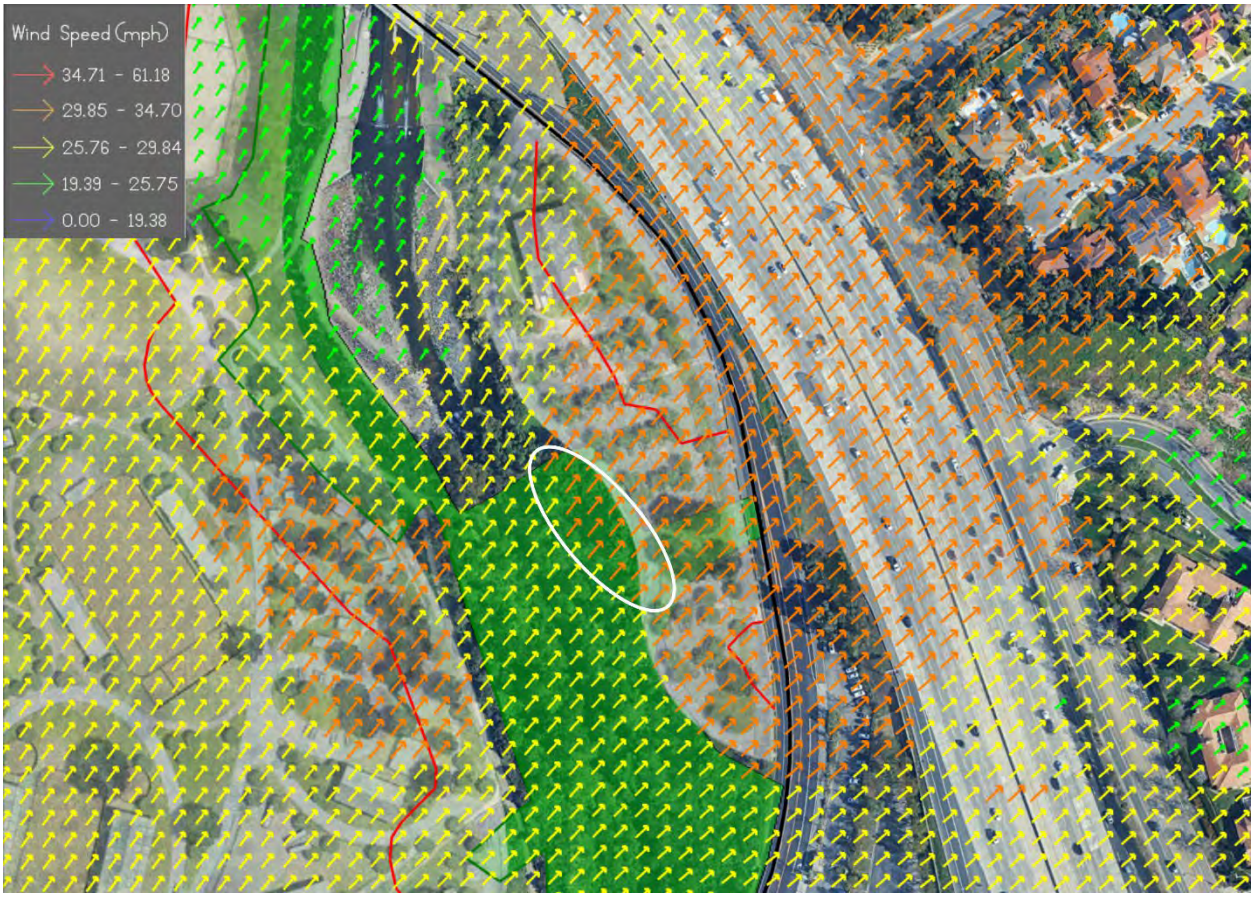


Figure 18 – SW wind at 30 mph Domain Average Wind

Based on the data provided, wind assumptions for the fire modeling scenarios are winds at 35 mph domain average for all but the heat generated onshore and onshore winds at an average 30 mph. Modeling has been accomplished with winds from 0-65 mph for the most impactful wildland fuels in order to show how the prescribed mitigation measures are well beyond the level of winds that are shown to be around the project site.

Wildland Interface Fuel Types

For the purposes of the BehavePlus modeling, the standardized fuel models were used as provided by the National LANDFIRE Database maintained by the U.S. Department of the Interior | U.S. Geological Survey. Figure 19, on the next page, illustrates the wildland fuels adjacent to the Project Site.

Fuel Parameters are grouped into GR (grasses), GS (grass/shrub mixtures), SH (Shrubs), TU (Timber Understory), and TL (Timber Litter). The project-specific fuel are as follows:

Fuel **Model GR1** (101) Dry Climate Grass is short, patchy, and possibly heavily grazed. Spread rate moderate; flame length low. Dynamic. Moisture of extinction is 15%. Fuel bed depth is 0.4 feet.

Fuel **Model GR2** (102) Dry Climate - Moderately coarse continuous grass, average depth about 1 foot. Spread rate high; flame length moderate. Dynamic. Moisture of extinction is 15%. Fuel bed depth is 1.0 feet.

Fuel Model GS1 (121) Dry Climate - Shrubs are about 1-foot high, low grass load. Spread rate moderate; flame length low. Dynamic. Moisture of extinction is 15%. Fuel bed depth is 0.9 feet.

Fuel **Model GS2** (122) Dry Climate - Shrubs are 1 to 3 feet high, moderate grass load. Spread rate high; flame length moderate. Dynamic. Moisture of extinction is 15%. Fuel bed depth is 1.5 feet.

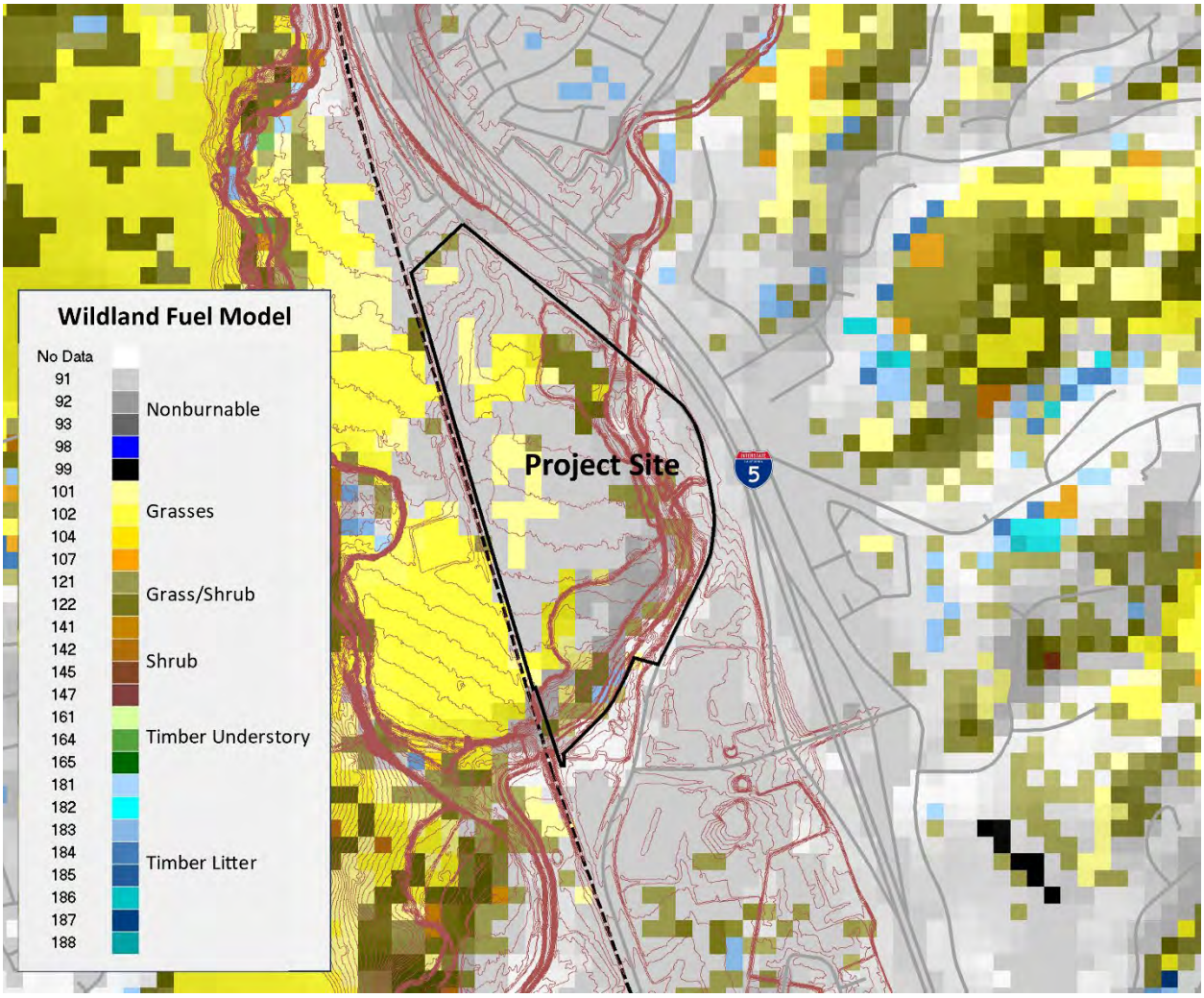


Figure 19 – Wildland Fuels (Landfire Database – Scott and Burgan 40)

As shown above in Figure 19, the Project Site is currently covered in grass and grass/shrub mixtures. A site visit found Timber understory models are in the bottom and sides of the drainage in the riparian areas. Some Timber Litter models are present but are not significant to fire progression or overall fire risk to the project site.

While not included on the Landfire database Wildland Fuels map, the following fuel models will be referenced in the fire behavior discussion where the worst-case scenario is contemplated. These include:

Fuel **Model SH5** (145) Dry Climate - Heavy shrub load, depth 4 to 6 feet. Spread rate very high; flame length very high. Moisture of extinction is 15%. Fuel bed depth is 6.0 feet.

Fuel **Model TU5** (165) Dry Climate - Fuelbed is high load conifer litter with shrub understory. Spread rate moderate; flame length moderate. Moisture of extinction is 25%. Fuel bed depth is 1.0 feet.

In addition to the standard fuel models (Scott and Burgan 40), one specific Southern California fuel model is applicable to this site and that is the Sage/Buckwheat model (SCAL18). This is the predominant fuel type in the GS fuels on the site. The parameter are shown below:

Fuel **Model SCAL18** is a southern California specific model for coastal sage scrub and Buckwheat OR dominated by coastal sage scrub AND greater than 15 years maturity OR dominated by northern mixed chaparral AND greater than or equal to 3 years maturity AND less than or equal to 12 years maturity. The vegetation has an average fuel depth of 3 feet and a moisture of extinction of 25%.

Fuels Discussion

Fuels near and on the project site are grasses, grass/scrub mixtures, and riparian areas, as shown previously in Figure 19. Each of the grids is 30 meters square (just under ¼ acre). Fuels parameters for each grid are determined by the predominant fuel types. This does mean that other fuels can and may be present in each grid. Four of the fuel models above are primarily represented within the interface area (101- gr1, 102 – gr2, 121 – gs1, and 122 – gs2). This report will also use a southern California specific fuel (SCAL18) which is not included in the LANDFIRE Database but is more accurate for this Project Site in some areas. The gs5, 145 model will be modeled with the most extreme fire behavior of the Scott and Burgan 40 fuel model and will be included as a reference point. The gs5 is a six-foot-deep chaparral fuel that is not present on the site or within the immediate area in quantities large enough to be the predominant fuel in single grid. Lastly, a tu5 (timber understory) will be included for the areas where shrubs are growing under the tree canopies within the riparian areas.

The worst-case fuel models will be used for the worst-case risk analysis.

Much of the project site that is not within the riparian area has been maintained by either discing or other fuels management processes, leaving the flatter areas of the site with limited fuels. Photos on the next two pages illustrate fuels from the project site.

Photo 1 – Typical grass/herbaceous fuels in the foreground



Photo 2 – Typical grass/shrub fuels



Photo 3 – Typical shrub fuels



Photo 4 – Riparian – “Do Not Touch”



Slope and Aspect Inputs

Slope is an important input to the BehavePlus modeling software. For this reason, a slope analysis was completed using the Landfire database for this area. Below is a graphic representation of the average slope within each of the 30-meter grids in the dataset.

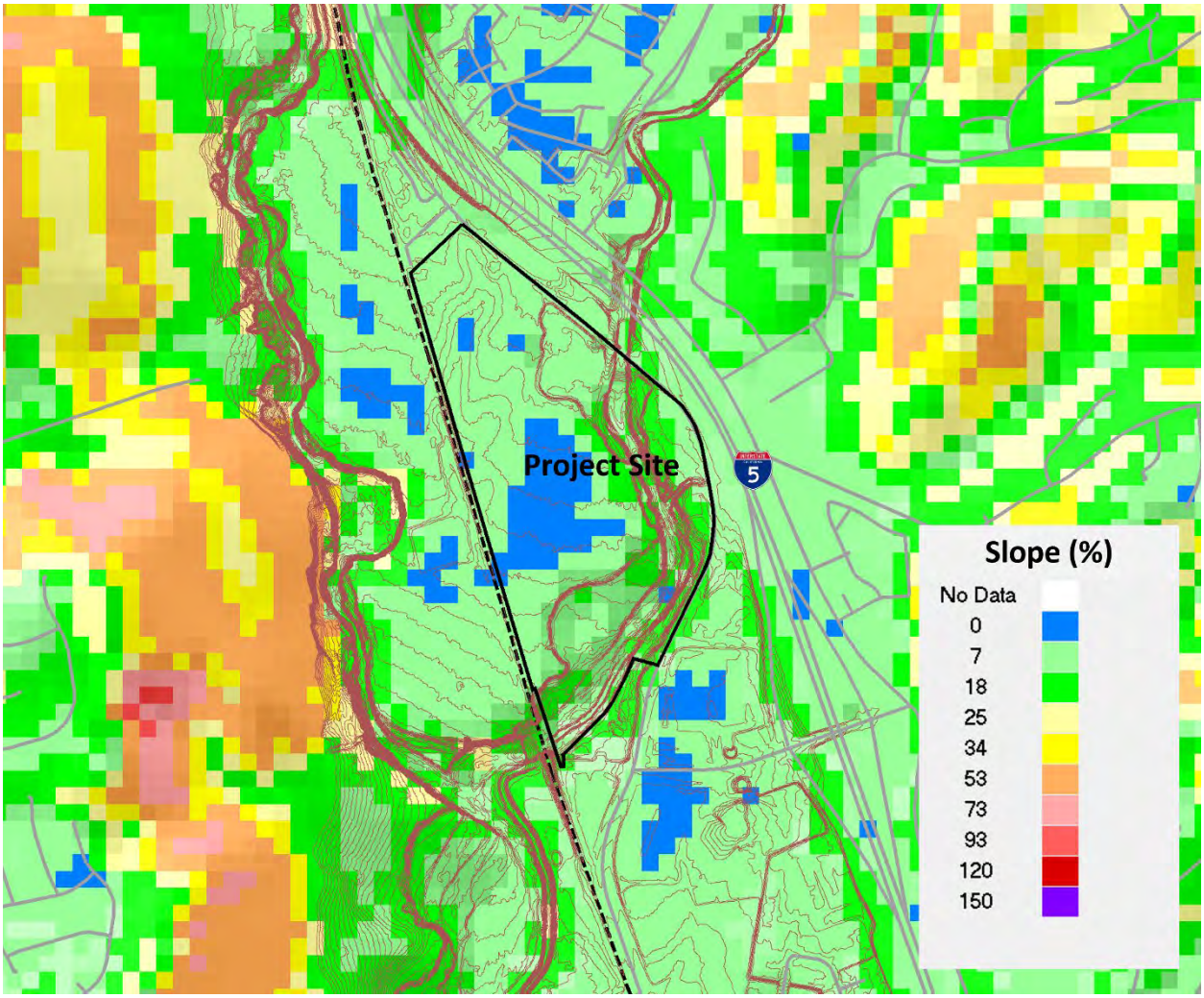


Figure 20 – Slope Map

The maximum slope in any grid within the immediate areas is 18% based on the 30-meter grids; however, the averaging removes the fact that significant slopes exist at the edges to the riparian areas. In Figure 21, on the next page, two-foot contours (black lines) have been added to the areas within the project site and adjacent to it. It is clear that the project site is situated between two drainages (Oso Creek and Trabuco Creek) with significant areas of steep slopes in the areas which are protected on the project site and in the drainage to the west (Oso Creek Drainage).

In order to assess these areas within the project site, sections have been created to illustrate the nature of the slopes at the interface. These five section provide the insight that has allow Firesafe to model the worst-case fire scenario based on conditions as they actually exist at the project site interface. The location of each section is shown in Figure 21.

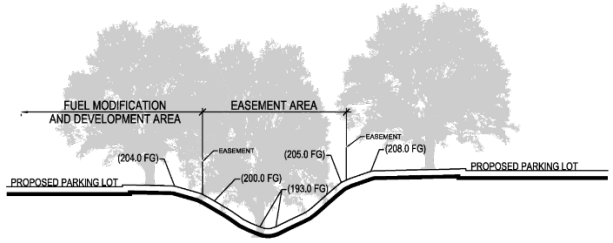


Figure 21 – Section Locations

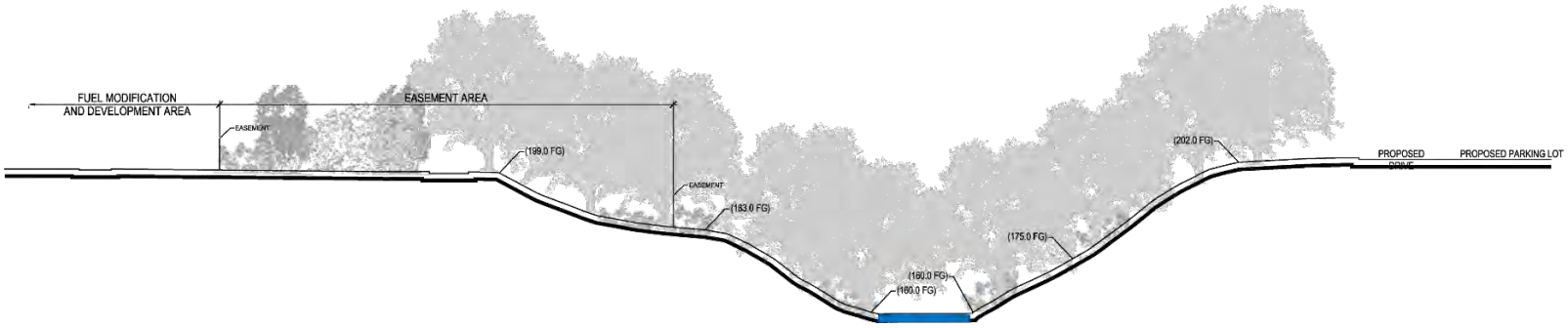
Section A:A is a short drainage the runs perpendicular to the main creek drainage. It will be maintained in its current form. Some removal of non-native/invasive plants may be possible, but it will be assumed to be pristine and vegetated as it currently is.

Section B:B runs across the Trabuco Creek Drainage in the area of the transition from the flood control (where most of the vegetation has been and will continue to be removed) to the riparian areas which will not be allowed to have fuel management activities.

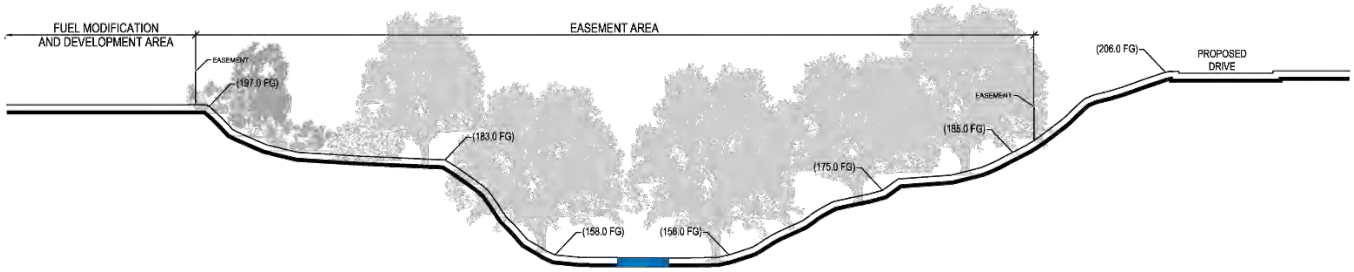
Section C:C is typical of the majority of the riparian area. It contains a large number of trees, some benches (flat areas) and a mix of shrubs, grass areas and full canopy overstory. The area at the bottom generally has water flowing most if not all of the year. At this specific location, there are not extreme drop offs or steep slopes but several areas of both of these conditions do exist which the riparian area.



SECTION A - A SCALE: 1" = 20'-0"

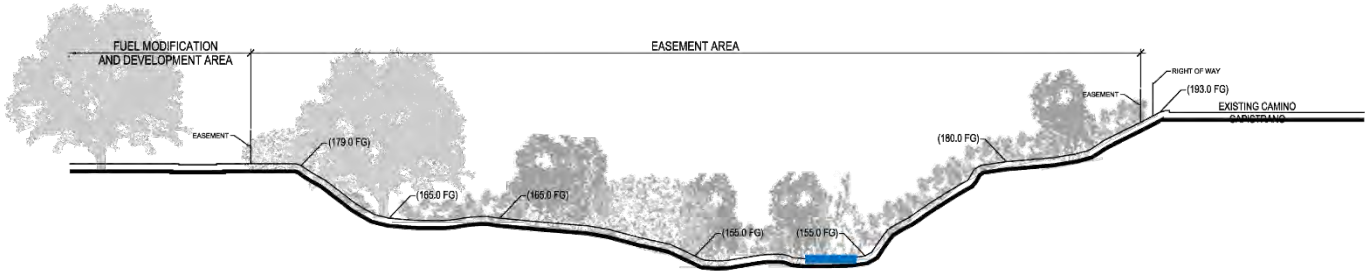


SECTION B - B SCALE: 1" = 20'-0"



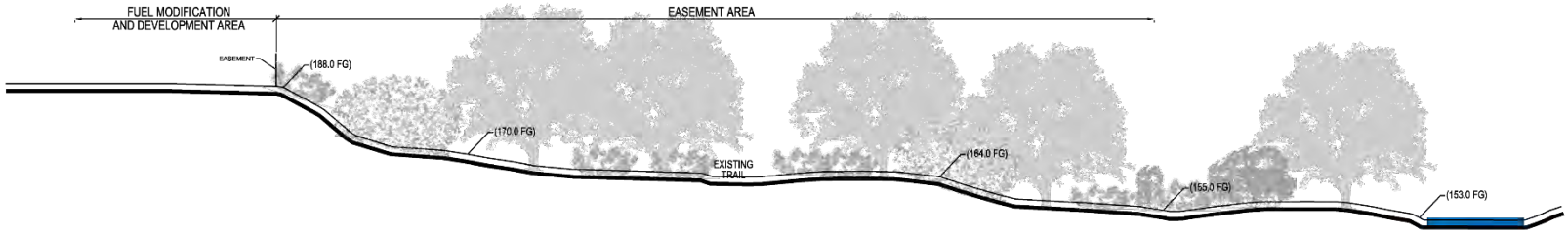
SECTION C - C SCALE: 1" = 20'-0"

Section D:D is further south and in this area the riparian area is wider, and the vegetation has fewer trees and more shrubs.



SECTION D - D SCALE: 1" = 20'-0"

Section E:E is at the south end of the project site. At this point, the flow channel is closer to the opposite side of the drainage and the overall riparian area is flatter and vegetation is thick and plentiful. This are represent one the most likely area for fire to run up on the project site due to the vegetation configuration and the onshore wind combining with the slope that does exist.



SECTION E - E SCALE: 1" = 20'-0"

The combination of slope and aspect, when aligned with the stronger winds and continuous fuels, will produce the worst-case scenario and that occurs on the riparian interface at several locations. The modeling assumption will use 100% as the default slope.

It is important not only to know the topographic influences but also how these influences interact with the fire weather. For example, the north aspect receives less direct sunlight and therefore retains more moisture which leads to thicker vegetation. South aspects are the exact opposite, moisture is limited, and growth is sparer. Most of the project site is flat (no aspect). The areas of the riparian that are not flat have opposite banks that, some cases will balance each other out resulting in an average slope that is not accurate.

Below is the aspect map (Figure 22) for the project site. While it has some affect, it is not significant to most of the interface from a fire perspective as the slopes are generally under the tree canopies for a substantial portion of the riparian interface. The modeling will run the fire directly upslope as the default assumption.

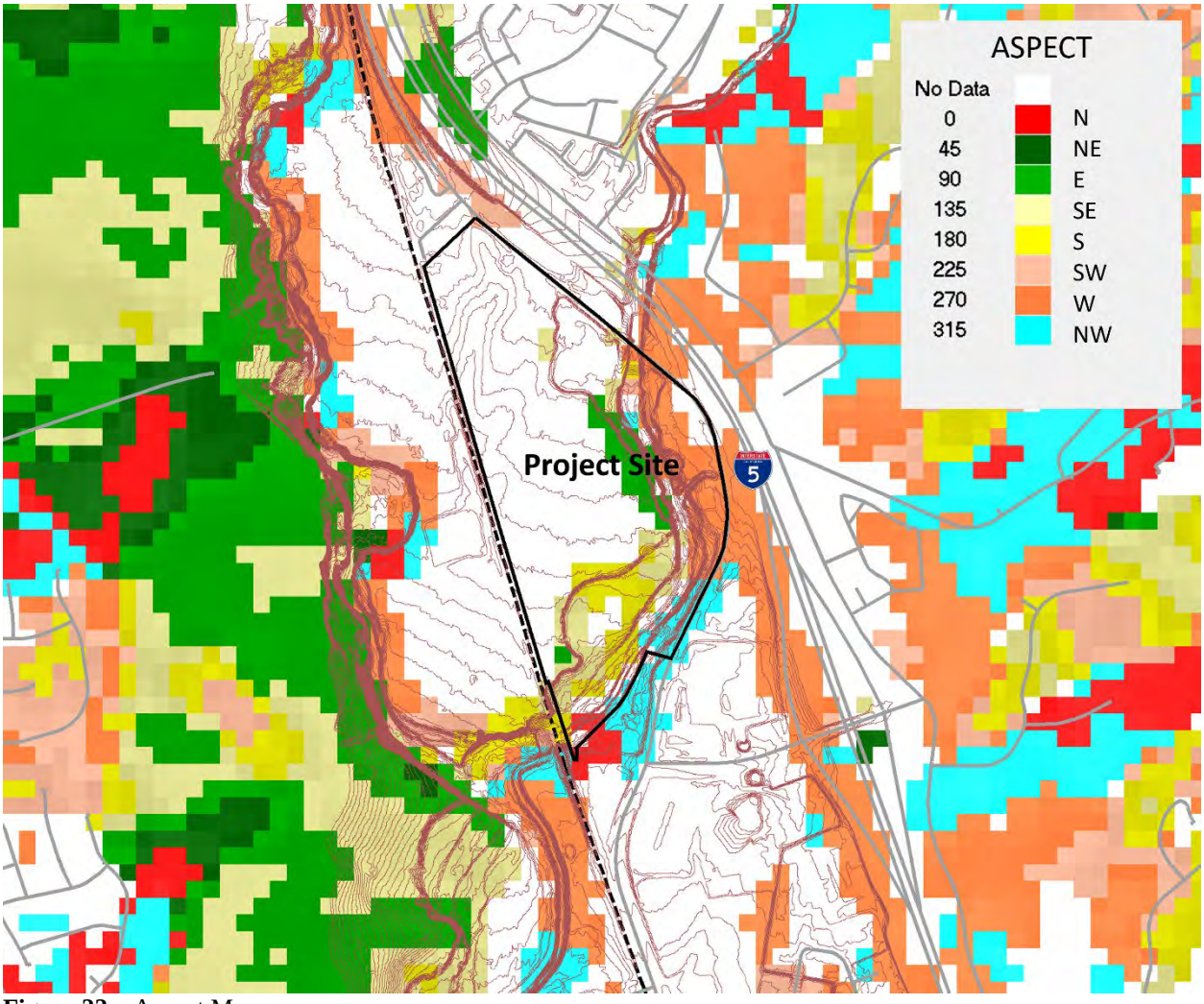


Figure 22 – Aspect Map

The project site Elevation Map (Figure 23) provides an illustration of how the property falls from north to south. The drainage/riparian areas are obviously lower, and the entire site is situated between two ridgelines that create the valley in which it exists.

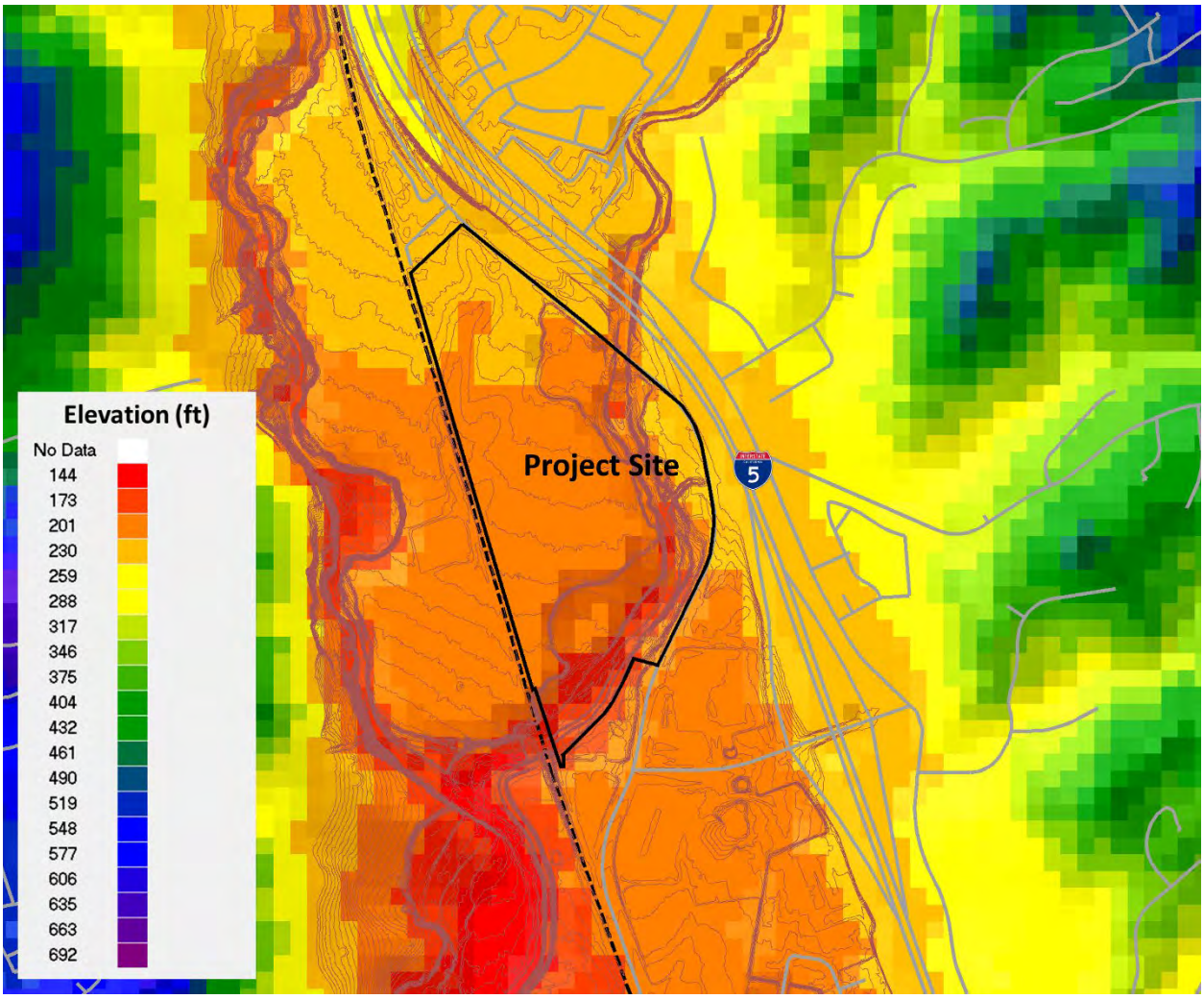


Figure 23 – Elevation Map

Fire Behavior Terminology

For the discussion of fire behavior, the terms shown in Figure 24, will be used to describe fire activities on portions of the fire perimeter. Head Fire is nearly always the largest and generally the hottest portion of the fire perimeter. The Heal or base is normally fire which is backing into the wind and flanking fire, a slower burning fire than Head Fire but more active than fire at the base.

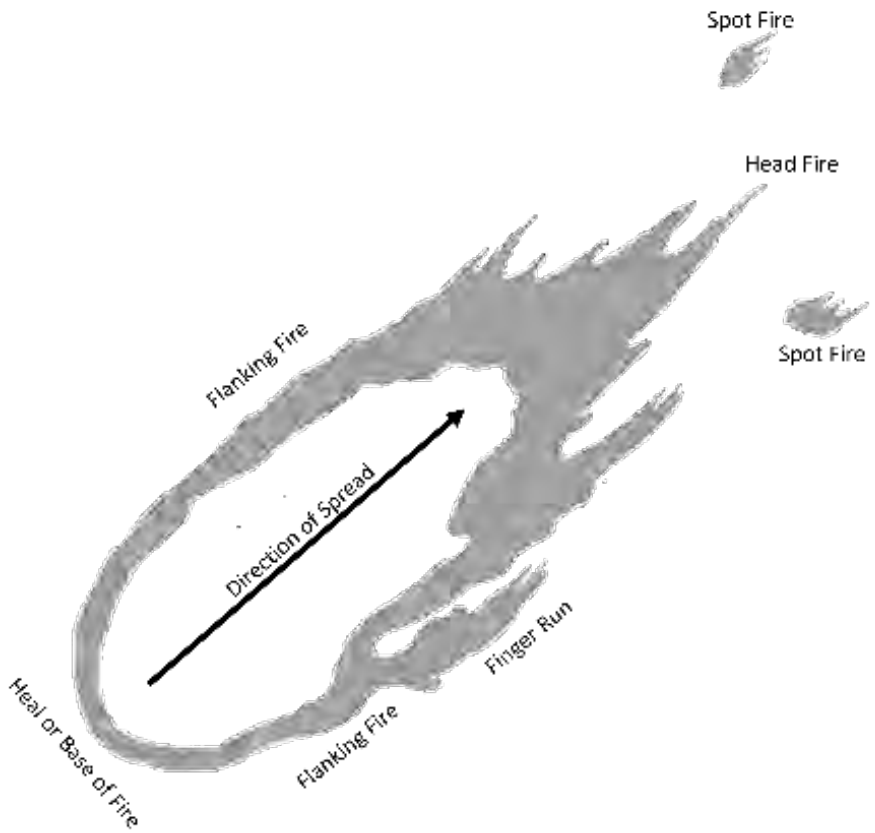


Figure 24

Wind Patterns and Inputs

Using Wind Ninja, a computational fluid dynamics software, it is possible to illustrate the increases in winds due to their relationship to the topography, have been determined to be a minor factor with this interface during strong wind situations.

No significant wind channeling (direction change due to topography) occurs within the Project Site on any of the modeled wind patterns at the interface junction; the changes in topography at the interface are either too minor to overcome the winds or are not orientated to the wind a manner which impacts the wind flow in any of the scenarios for the worst-case fire conditions. However, the topography does speed the wind up (accelerations) and slow it down (sheltering) as shown in Figure 25. Acceleration occurs at the edges of the riparian areas of the Project Site as was shown in the series of Wind Ninja outputs previously.

In the graphic on the next pages, the wind has been modeled with respect to topography utilizing the *Wind Ninja* software. Blue and green areas have slower wind, and orange and red have faster wind compared to the yellow, which is the average of the area modeled. Each color represents 20% of the modeling area's total values, with yellow being the middle 20%. The range of wind speeds is relatively small in most cases (wind varies only 3-4 mph in the middle 60% of the data) and much greater in the upper and lower 20% areas. These same colors and associated wind speeds were used in Figures 14-18 to indicate wind speeds on those graphics.

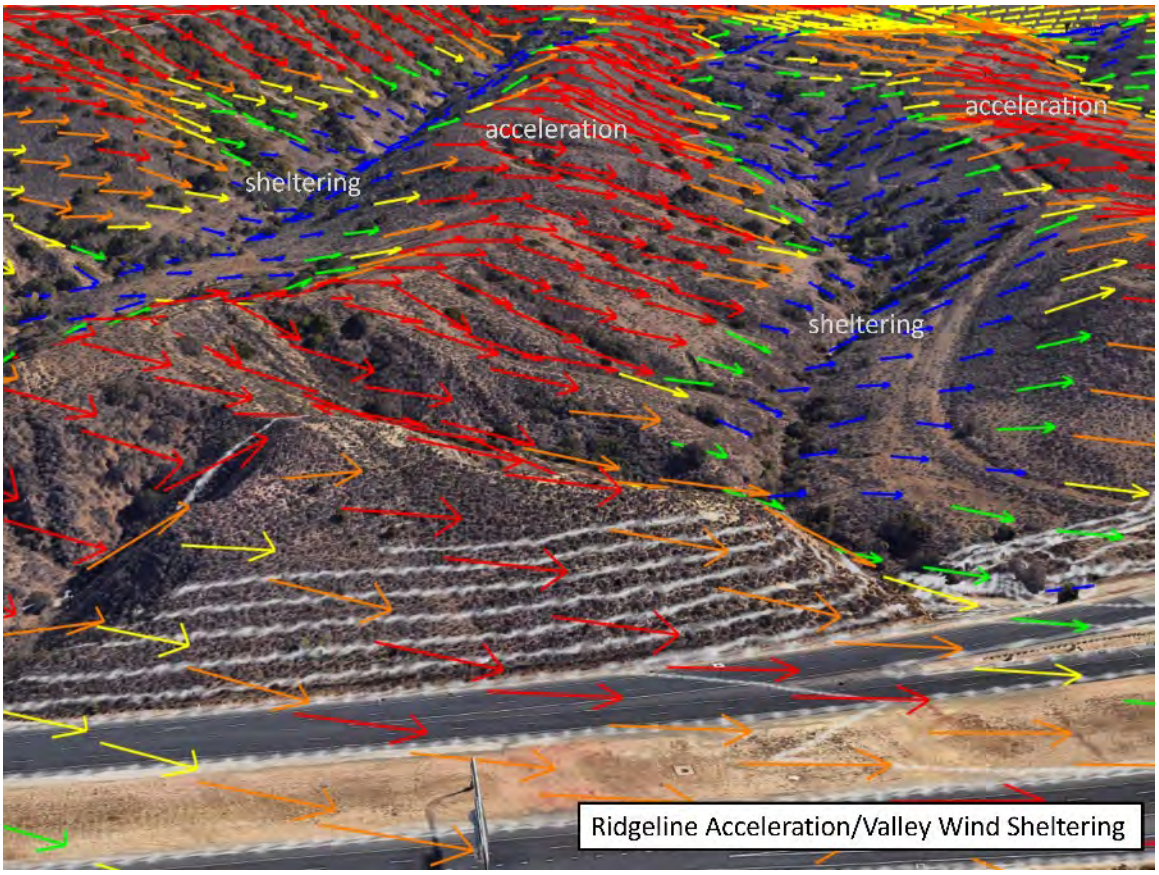


Figure 25 – Ridgeline Acceleration and Valley Wind Sheltering Example

The fire modeling will be completed with the fire running upslope, in alignment with the wind, assuming a continuous fuelbed. Since this worst-case condition can be applied to any location on the interface, it will become the default calculation for all interfaces with the riparian areas. Only areas which have a flat interface and limited vegetation will have a different calculation for the worst-case risk profile.

BehavePlus Fire Behavior Inputs and Results:

Worst case fire weather was used. Inputs for the BehavePlus Fire Behavior Model are as follows:

- Moisture Scenario will be 3, 4, 5, 30, 50 (extreme)
  - One-hour dead fuel moistures were calculated at 3%; ten-hour at 4% and 100-hour at 5%.
  - Live Herbaceous fuels were calculated at 30% in the wildland.
  - Live Woody fuels were calculated at 50% in the wildland.
- Wind will be assumed to be from:
  - N. NE, E, ESE, W, NW and WNW at 35 mph domain average

  - S and SW at 30 mph domain average
  - Modeling will be completed for winds from 0-65 mph in 5 mph intervals
- Fuel models to be used
  - LCP_LF2023_FBFM40_240_CONUS is used
  - No Modifications to any layers have been used
- 20-foot wind speeds will be used with 0.5 adjustment factor to flame length wind speeds
- Temperatures were assumed to be over 100 degrees
- Development areas are used as fire barriers due to fuel modification and defensible space protection. Project site burn-through is not expected
- Fire scenario will be with sustained winds (no diurnal effect)
- No fuel conditioning is used with the worst-case moisture scenario
- Foliar Moistures are assumed to be 100
- Fuels have not been adjusted to any disease or drought impacts
- Aspects of the slopes are scenarios running directly upslope for static modeling and in accordance with the Landfire data set
- Spread direction is shown at the maximum spread point.

Worst-case National Wildfire Coordinating Group Fireline Handbook models have been used for analysis, specifically, fuel models gs2, sh5, tu5, and a southern California specific model (SCAL18 – Sage and Buckwheat). The inputs to the fire modeling are shown in Figure 26 below.

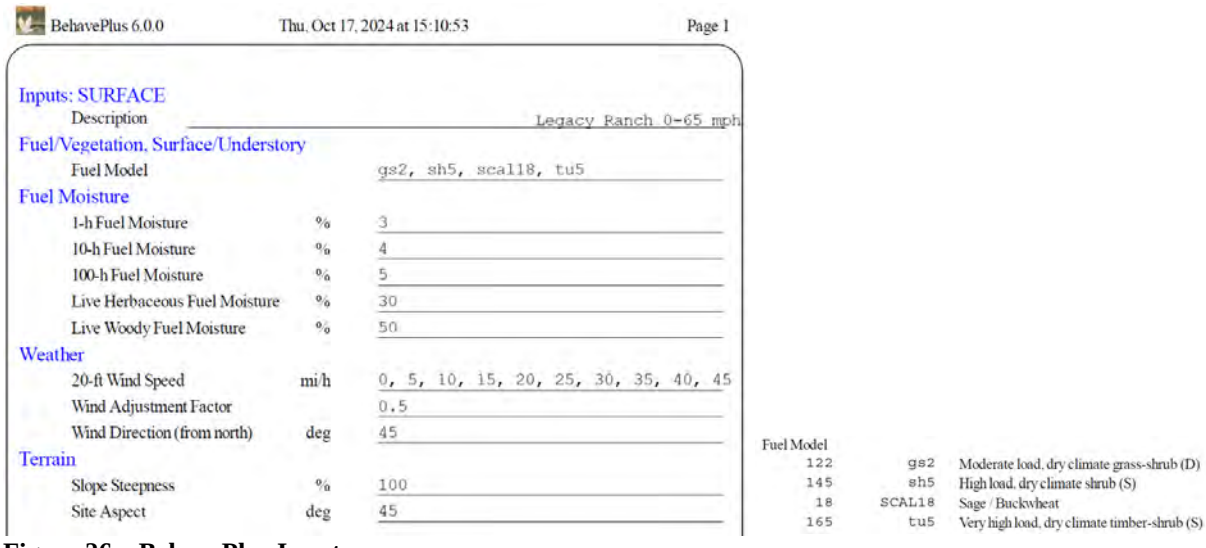


Figure 26 – BehavePlus Inputs

Full details for the BehavePlus run are available in the appendixes. Version 6.0.0 of the BehavePlus modeling program was used for this analysis.

BehavePlus Plus Related References:

1. Standard fire behavior fuel models: a comprehensive set for use with Rothermel's surface fire spread model. Scott, Joe H.; Burgan, Robert E. 2005. General Technical Report RMRS-GTR-153. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station p. 72.

2. BehavePlus Plus fire modeling system, version 5.0: Variables. Andrews, P. L. 2009. General Technical Report RMRS-GTR-213WWW Revised. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station.

The outputs are attached in the appendixes but have been summarized here (Figure 27 below) for discussion purposes.

Legacy Ranch 0-65 mph

Head Fire

Surface Fire Flame Length (ft)

20-ft Wind Speed	Fuel Model			
mi/h	gs2	sh5	SCAL18	tu5
0	9.3	22.3	23.7	12.9
5	10.2	25.3	27.7	14.2
10	11.5	28.7	30.8	15.6
15	13.0	31.9	33.4	16.9
20	14.6	35.0	35.8	18.3
25	16.1	37.9	37.9	19.5
30	17.6	40.7	39.9	20.8
35	19.1	43.3	41.8	22.0
40	20.5	45.9	43.5	23.1
45	21.9	48.3	45.2	24.2
50	23.2	50.7	46.8	25.3
55	23.4	52.9	48.3	26.3
60	23.4	55.1	49.7	27.3
65	23.4	57.2	51.1	28.3

Figure 27 – BehavePlus Outputs

Under the worst-case scenario for a wind event which aligns with the slope and fuels, using the worst-case fuels, a maximum flame length of 45.9 feet can be achieved when the fire is running directly upslope, with the wind in a continuous fuelbed. It is important to note that a fire at this rate consumes 722 feet of fuel each minute (rate of spread). Within the riparian area on the interface, the worst-case condition, where fire is orientated to the development areas, at no point is more than 355 feet of fuel available, meaning that a sustained fire of this size and energy is

simply not possible. Only a partial run of fire at this level of intensity would be able to occur. Flanking fire could be present at the interface for much longer periods but not head fire.

In order to ensure the safety of the structures within the Project Site, it is necessary to determine the fire hazard profile by examining the potential for a fire within the interface to damage or ignite a structure within the Project Site. This can happen in one of four ways. First is direct contact with the fire. The maximum flame length is 45.9 feet. Any distance greater than this will keep the flames off of the structure. The second is radiant heat. The laws of physics indicate that the decay of radiant heat is calculated by dividing the energy produced by the square of the distance from the heat source. While this is simplified, it is overall very accurate.

The NFPA Fire Protection Research Foundation published a report entitled *Pathways for Building Fire Spread at the Wildland Urban Interface* in 2015. The work was done by staff at the University of Maryland. The report states:

> *The first is radiant exposure. Unlike convection heat transfer, which requires a moving fluid medium, radiation can travel relatively undeterred until impeded by a solid object, typically thought of here as the exterior of a home which may potentially ignite. As the separation distance from the home to the fire increases, the radiant exposure significantly decreases (**proportional to one over the distance squared**), eventually making it impossible at some distance to ignite. This analysis is often used for assessment of safe separation distances between structures and potential fuels.*
>
> Michael J. Gollner, Raquel Hakes, Sara Caton, and Kyle Kohler, *Pathways for Building Fire Spread at the Wildland Urban Interface, Final Report*, Prepared by: Department of Fire Protection Engineering, University of Maryland, Published by Fire Protection Research Foundation/NFPA March 2015, Page 26

The laws of physics indicate that the decay of radiant heat is calculated by dividing the energy produced by the square of the distance from the heat source (Figure 28, below).

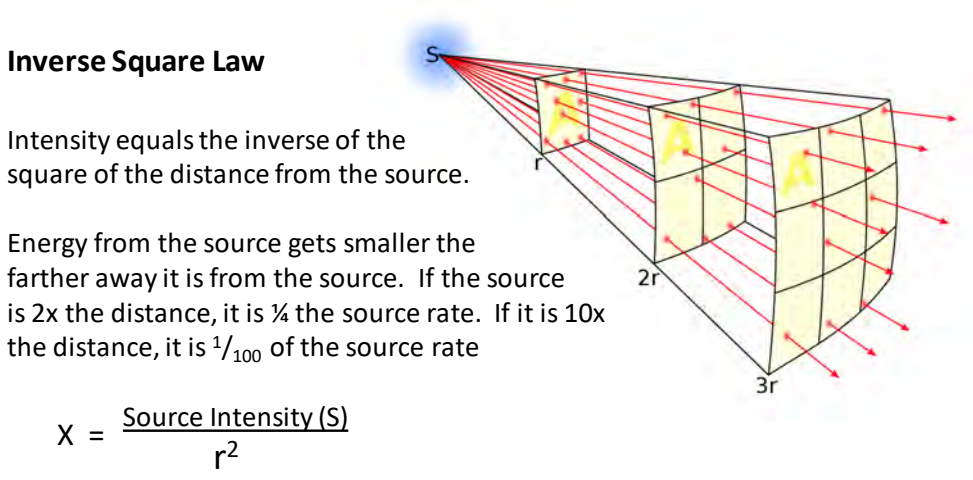


Figure 28 – Inverse Square Law

While this is simplified, it is overall accurate at a conceptual level. Several models exist for the calculation of the Radiant Heat Flux on a structure from various fire sources. Most are complicated

and have a set of complex assumptions that must be made. The Inverse Square Law does not specify a unit of measure. The formula is relational between the distance and the source. The drop in heat from the source to distance r is relational to distant 2r and 3r.

Firesafe uses a simple formula as a "yardstick" for generalized assumptions about radiant heat from fire. This formula is the FI (Fireline Intensity) from the Behave outputs over the distance in feet squared. Because Newton's Law is relational, it does not specify a unit of measure. Firesafe has derived its "rule of thumb" from the, using the formula shown below.

radiant heat flux < 20kw/m^2 at distance of 2x maximum flame length

Jack D. Cohen and Bret W. Butler completed research and published, "Modeling Potential Structure Ignitions from Flame Radiation Exposure with Implications for Wildland/Urban Interface Fire Management", for the 13th Fire and Forest Meteorology Conference in Lorne, Australia in 1996, which was the starting point for the entire "structure ignition zone" body of work that followed. They concluded the 40 meter was a sufficient distance to protect a structure from a 20-meter flame length. This distance would not exceed the amount of heat flux needed to have piloted ignition of a wood surface due to the radiant heat decay and the lack of exposure duration (residence time).

Several studies have found this relationship. In this study, a mathematical model was developed to predict the radiant energy incident on a firefighter as a function of flame height and the distance between the firefighter and the flame (Butler and Cohan, 1996). The results are shown in "Figure 29. The chart has an additional overlay (no change to underlying values) which highlights the at two time the flame length in distance from the fire (orange line).

In nearly all cases, two times the maximum flame length will provide a radiant heat flux value under 20 kW/m^2. This stands to reason as flame length (LF) is a function of fireline intensity (I) in Byram's formula $LF=0.0775*I^{0.46}$ which most closely approximates the interchanges between these two values (fireline intensity and flame length) in the Behave program.

We should be very clear here; this is not the only factor in the amount of heat that might be subject to a specific structure. The real world is much more complicated than a simple formula. Most literature indicates that a hardened structure should be able to withstand 20 to 30 kW/m^2 for a period of 5 minutes or less and not ignite. Using the two times the maximum flame length on the worst-case fire should place the actual value much less than the ones calculated here when a fire actually burns in the interface.

Jack Cohen's Structural Ignition Assessment Model (SIAM) also provided data on radiant heat flux as a factor of the amount of time for which the exposure to radiant heat impacted the ignition of the building material. In the example shown in Figure 31, as the temperature decreases, the time to ignition increases dramatically.

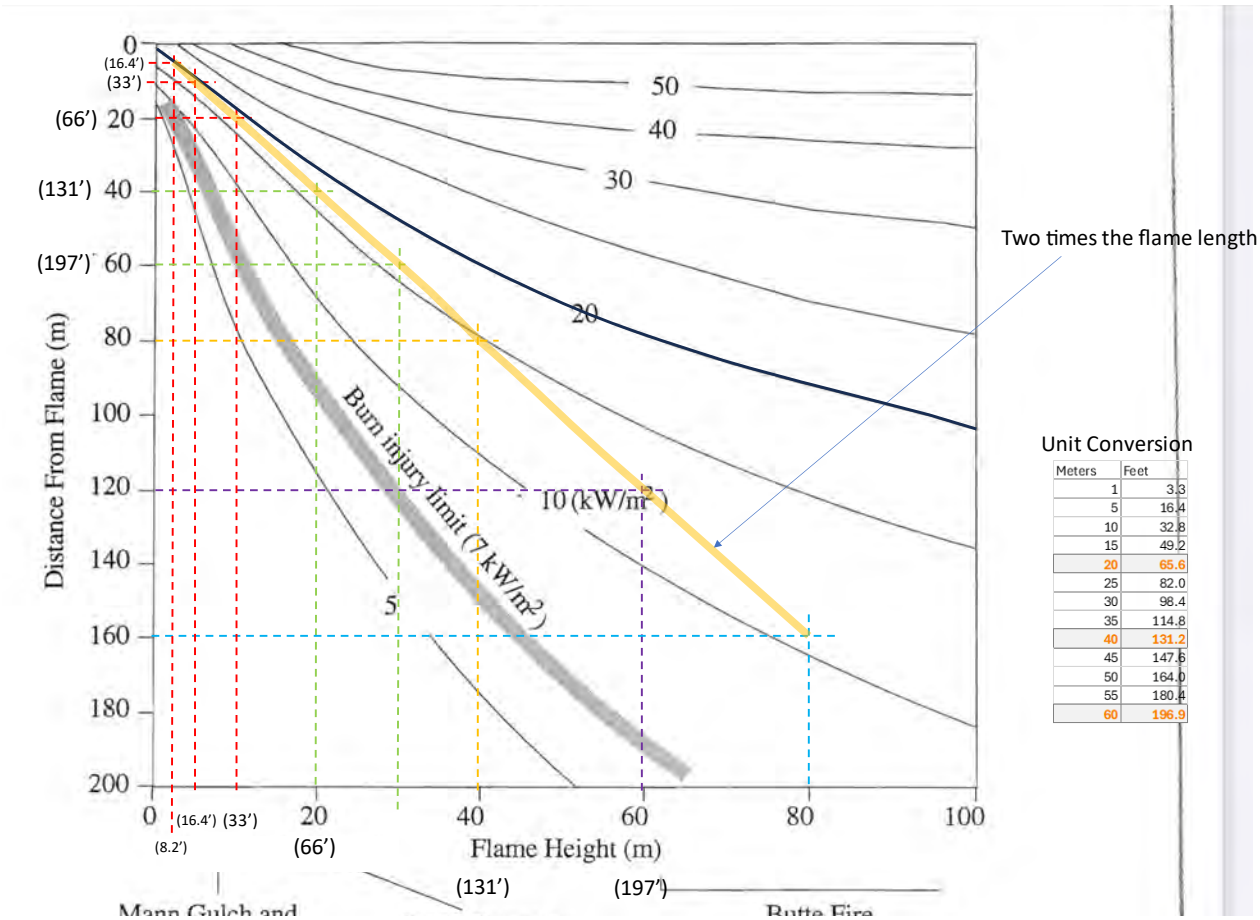


Figure 29 – Source of Radiant Heat Formula

kW/m² Rate	Time to Ignition seconds	minutes	
60	10	0.17	
50	16	0.27	
40	28	0.47	
37			Damage to process equipment and collapse of mechanical structures
31	60	1.00	
30	66	1.10	
22	210	3.50	
20	337	5.50	Piloted wood ignition after 5.5 minutes
18			Death in 50% of victims after 30 seconds
16			Blistering of exposed skin after 5 seconds
12.5	1,200	20.00	20 minutes to ignition/2nd degree burn in 8 seconds
10			Pain on exposed skin after 3 sec/ death in 1% of victims after 40 seconds
			Ignition of most fabrics
7			Max exposure in PPE for 90 sec
6.4			Pain on exposed skin after 8 sec
5.0			2nd degree burns on exposed skin in 40 seconds
4.7			Causes pain in 15 -20 second/burns after 30 second
4.3	18,000	300.00	5 hours to ignition
4.0			First degree burns after 20 seconds
2.3			Pain on exposed skin after 2 minutes
2.1			Minimum to cause pain after 60 second
1.7			Minimum to cause pain
1.0			Equal to the maximum radiant heat transfer on a clear sunny day

Figure 30 – Impact of Radiant Heat

For reference, it should be noted again that the same level of radiant heat (16 kW/m^2) that will produce 2nd degree burns on exposed skin in five seconds requires 27 minutes to ignite a wood wall in Jack Cohen's testing of radiant heat flux.

This is about time and distance. The values shown in Figure 32 (Table 1 from Cohen's report) show the various heat flux values that have been used as thresholds for many of the fire safety zone studies and radiant heat studies on structures.

These come from *Modeling Potential Structure Ignitions from Flame Radiation Exposure with Implications for Wildland/Urban Interface Fire Management*, by Jack D. Cohen and Bret W. Butler, presented at the 13th Fire and Forest Meteorology 81 Conference. Lorne, Australia 1996 and are in line with the values used from several sources to produce Figure 31.

> Jack Cohen's SIAM (Structural Ignition Assessment Model) uses a radiant heat flux threshold of 20 kWm^2 for 5.5 minutes as the baseline for structure ignition (Cohen, J.D., 1995. Structure Ignition Assessment Model (SIAM), USDA Forest Service Gen. Tech. Rep. PSW-GTR-158)

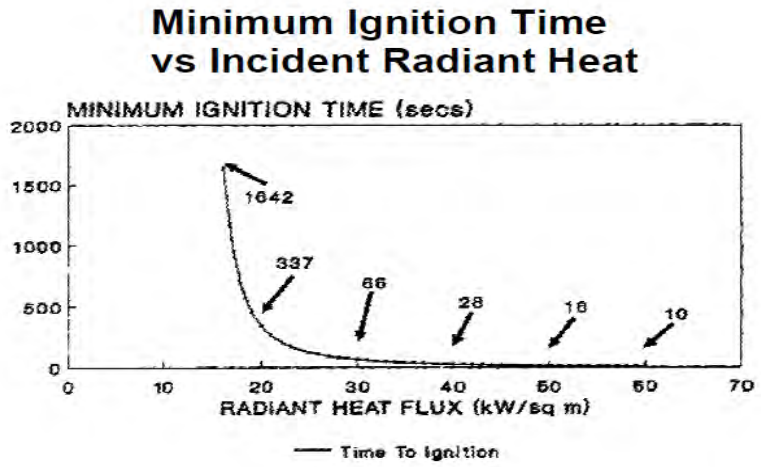


Figure 3. The minimum time for piloted wood ignition depends on the incident radiation heat flux (given as a constant) that is greater than the critical heat flux of 13.1 kW/m^2.

Figure 31 – Radiant Heat vs. Minimum Ignition Time

Table 1. The effects of radiant exposure on human skin and wood indicate that humans are greatly more sensitive than wood during a WUI fire.

Heat Flux (kW/m^2)	Effect of Exposure
6.4	Pain on exposed skin after 8 secs. (Drysdale 1985).
7.0	Maximum estimated exposure for a firefighter wearing wildland firefighting clothing and head and neck protection over a period of approximately 90 secs, (Butler and Cohen 1997).
10.4	Pain on exposed skin after 3 sees. (Drysdale 1985)
16.0	Blistering of exposed skin after 5 secs. (Stoll 1969).
20.0	Piloted wood ignition after more than 5.5 minutes (ignition model).

Figure 32 - Jack Cohen, *Modeling Potential Structure Ignitions from Flame Radiation Exposure with Implications for Wildland/Urban Interface Fire Management Table 1*

In the test fires that Jack Cohen used for this study, a fire which was 2.5-meter-wide, and 20 meters high was used to show the impacts on radiant heat flux of spacing within the fuel bed. All four burn scenarios had radiant heat flux values of 20 kW/m^2 or less at a distance of 40 meters (2 times the flame height) as shown in Figure 33.

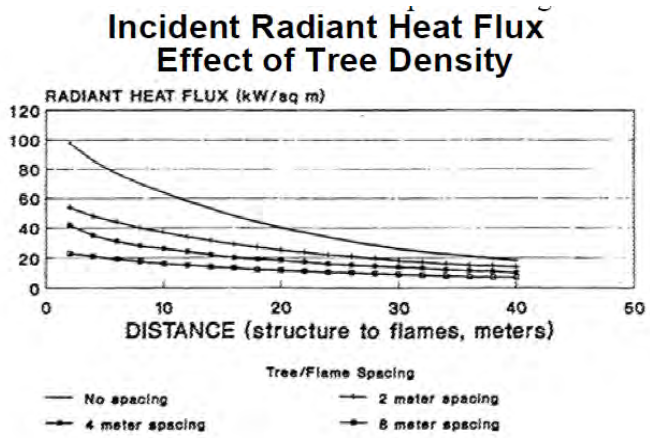


Figure 5. Given a constant flame size, the flame/trees are 2.5 meters wide, 20 meters high, and extend along a 50 meter flame front. The incident radiation heat flux depends on the flame-wall distance and the flame/tree spacing.

Figure 33 – Radiant Heat vs Distance

The conclusion Jack Cohen reached was that after 40 meters, radiant heat was no longer a problem, regardless of the size of the fire. At 30 meters and about 30 kW/m^2, ignition time was only 90 seconds, but at 40 meters and 20kW/m^2, the ignition time was over 800 seconds. In this test, the flame was 20m high and 50m wide. The 2x flame length ratio was achieved in this test fire as well. See Figure 34 for a graphic example of this conclusion.

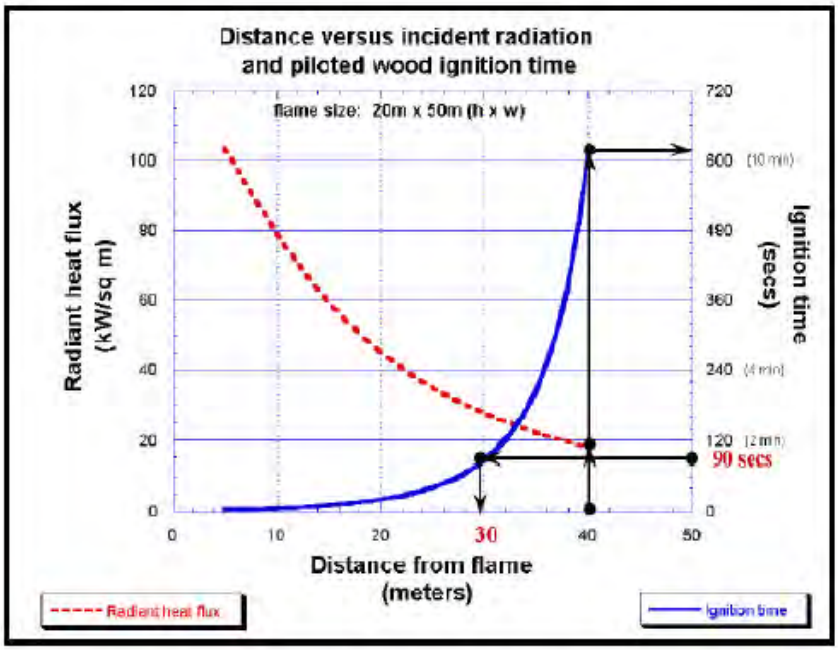


Figure 2-- SIAM calculates the incident radiant heat flux and the minimum time for piloted ignition as a function of distance for the given flame size. The flame is assumed to be a uniform, parallel plane, black body emitter.

Figure 34 – SAIM Calculations for Radiant Heat Flux

The third method of fire encroachment is convected heat. This impact area is generally about 75% of the radiant heat impact zone. While small pulses of convected heat may exceed the radiant heat zone and be a danger to the respiratory tracts of firefighters, these pulses are not sufficient enough in duration to cause ignition of structural materials.

Convection exposure is a more difficult issue as the science of this factor is limited with current studies underway to further expand our knowledge of this area of wildland fire science. Some facts are known:

> Radiative heat fluxes peak between 20 and 300 kW/m^2. The convective heat flux is characterized by rapid fluctuation between positive and negative convective values owing to alternating packets of cool air intermingled with hot combustion products. The convective heat flux peaks between 22 and 140 kW/m^2. *Frankman 2013, Measurements of convective and radiative heating in wildland fires, CSIRO Publishing, International Journal of Wildland Fire http://dx.doi.org/10.1071/WF11097, page K.*
>
> In a time-resolved heat flux data study from two different locations and times in the same prescribed fire event data was collected. They were grouped into a low intensity set (hereafter labelled Burn 1) and a moderate intensity set (hereafter labelled Burn 2). Both sets were evaluated to determine the effect of sampling rate on the interpretation of convective and radiative heat fluxes. Findings from the analyses have direct application to measurement methods and interpretation of energy transport measurements in wildland fires. *Frankman 2013b, The effect of sampling rate on interpretation of the temporal characteristics of radiative and convective heating in wildland flames, CSIRO Publishing, International Journal of Wildland Fire 2013, 22, 168–173 http://dx.doi.org/10.1071/WF12034*
>
> Overall, fire convective energy is lower than fire radiative energy, but the peak energy pulses of the convective heat flux are greater in the convective heat than in the radiant heat (Figure 35). Convective heat has pulses of cooler air which lower the overall energy average as shown in Figure 36, on the next page.

The point here is not to get into a discussion of how convective heat energy vs radiant heat energy contributes to ignition of fuels but rather to show on the macro level that convective energy is not as likely to be a factor in structure ignition if the distance provided between the fire and structure are great enough to stop radiant heat from igniting it.

In Figure 36, notice how the blue lines (convective heat) exceed the red lines (radiant heat), but the overall average is less for the blue line, AND the blue lines have negative (cooling) values, whereas the red lines do not. It is not that convective heating by superheated gases does not play a role in fire propagation or in fire phenomena such as “area ignitions”. They do, but the fuels and topography around the Project Site do not lend themselves to these issues without a large continuous fuel bed to create the environment necessary to have this effect make an impact on the Project Site.

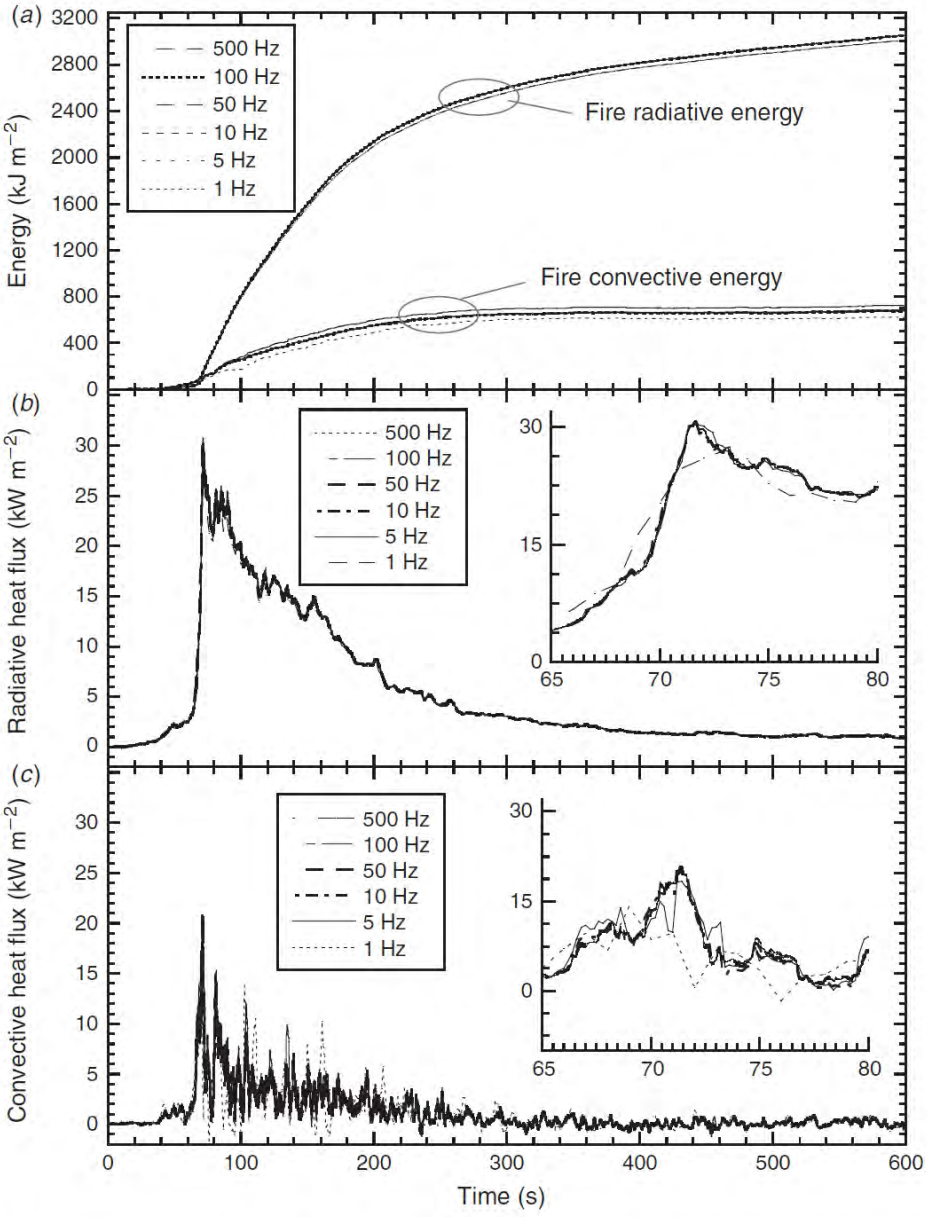


Fig. 2. Integrated energy and 2-s moving averages for Burn 2. (*a*) Fire radiative energy and convective energy calculated from integral of measured fluxes, (*b*) fluxes calculated using a 2-s moving average of the 500-, 100-, 50-, 10-, 5- and 1-Hz radiative flux signals, (*c*) fluxes calculated using a 2-s moving average the 500-, 100-, 50-, 10-, 5- and 1-Hz convective flux signals. Inset figures in (*b*) and (*c*) are included to further illustrate the difference in signal between the moving averages of the various sample rates over a short time frame.

Figure 35 – Convective Heat vs Radiant Heat

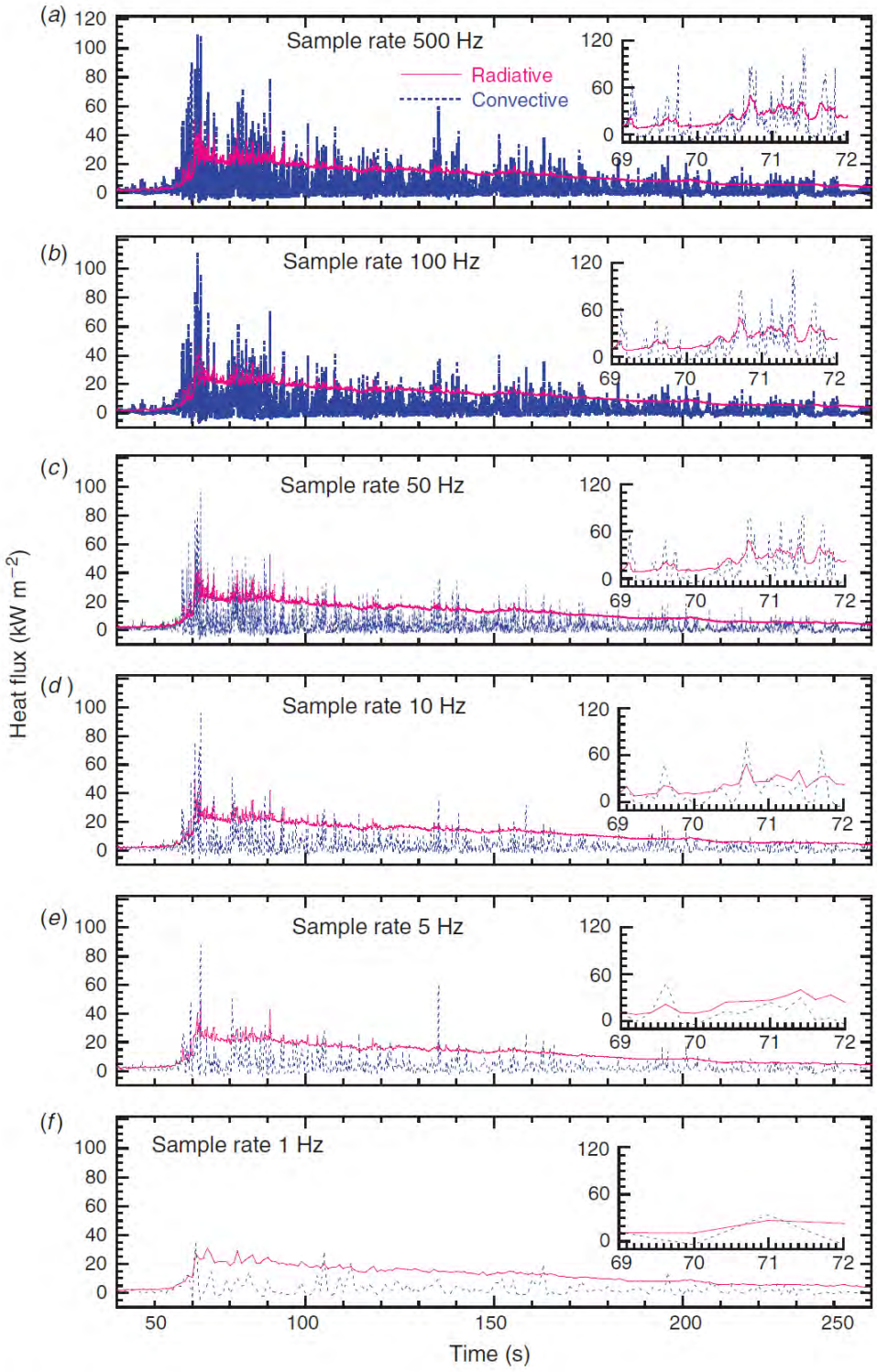


Fig. 1. The effect of sample rate on measured heat flux in Burn 2. (*a*) presents the initial signal captured at 500 Hz, (*b*) presents the 500-Hz signal down-sampled to 100 Hz and so on to 1 Hz for (*f*). The inset figures depict the signal over a 4-s time period centred at or near ignition.

Figure 36 – Convective Heat Rate

The final method of fire encroachment would be embers and brands. The Institute for Business and Home Safety (IBHS) makes the following statement:

> Buildings are ignited by embers and flames during wildfires. Flying embers and wind-blown, ground-traveling burning debris are by far the most prevalent attack mechanisms threatening structures during a wildfire. CAL FIRE identified embers as the major cause of home loss (Mell et al., 2010). Potter and Leonard (2011) reported that "well over 90% of houses were ignited in the absence of direct flame attack or radiant heat (exceeding 12 kW/m2) from the main fire front." Hence, embers cause a great deal of damage, whether directly or indirectly. *WILDLAND FIRE EMBERS AND FLAMES: Home Mitigations That Matter,Faraz Hedayati, PhD, Stephen L. Quarles, PhD, Steven Hawks, IBHS Research, April 2023, page 6.*

Embers can and will travel great distances. The Project Site will be protected from this threat by compliance with California Building Code Chapter 7A and California Residential Code Section R337 as appropriate.

Radiant Heat Protection vs Ember Intrusion Protection

Standardized Fuel Modification Zones use thinning zones and irrigated vegetation to reduce the impacts of fire as it approaches a structure throughout southern California and the western United States. While the distance may change, the process does not. The graphic below shows the 170-foot prescriptive fuel modification zone used in the City of San Juan Capistrano and many other locations in and around southern California. The design of this protection system is based on decreasing the amount of available fuel to the fire front and thereby decreasing the fire activity (flame length and fireline intensity). The graphic below (Figures 37) is an attempt to show how that protection works.

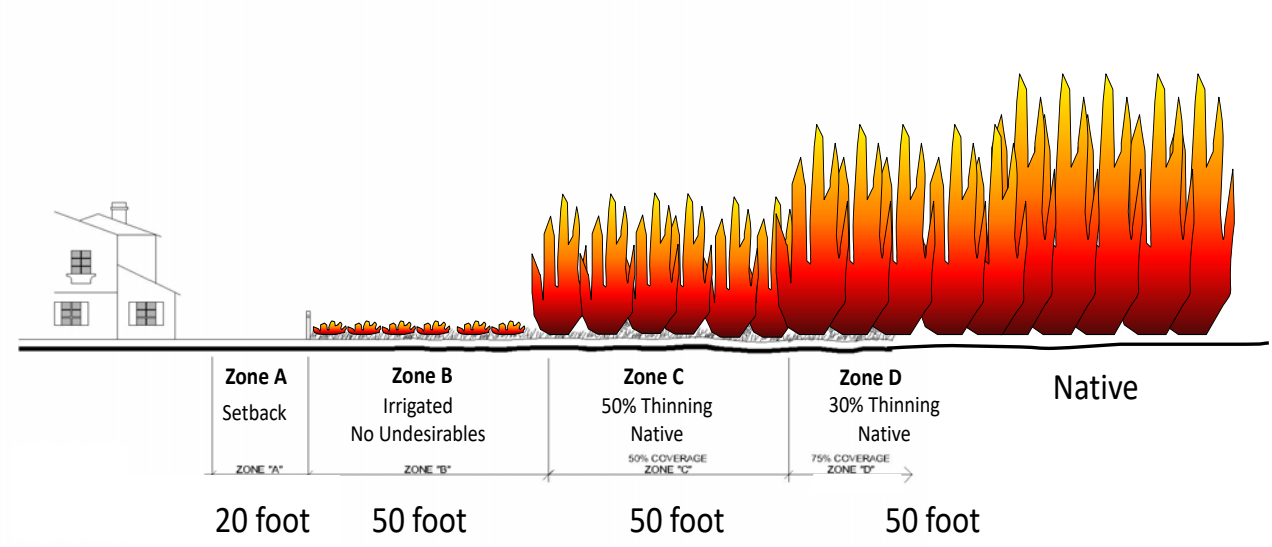


Figure 37 – Prescriptive Fuel Modification Zones

Here is the same interface with the modeling inputs and outputs (Figure 38). By the time the fire reaches the Zone A/Zone B interface, the flames are small enough to allow for the Zone A distance to completely decay the radiant heat energy.

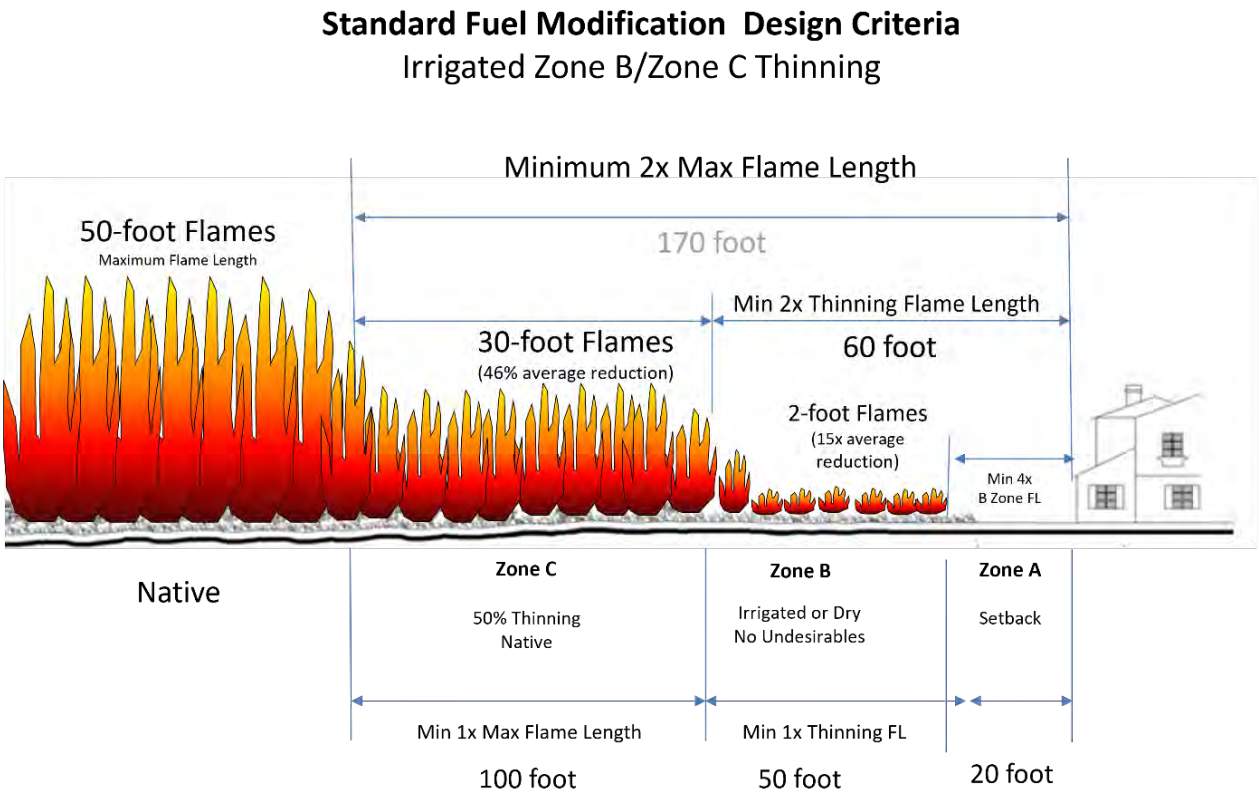


Figure 38 – Standard Fuel Modification with Calculations

Fuel Modification Zones are an effective tool in providing the necessary time, distance and shielding needed to protect structures from a wildland fire. Reducing the fuels nearest to the structure reduces the intensity of the fire while it increases the distance between the native fuels and the structure. Adding irrigated vegetation (which acts as a heat sink), the fire is further diminished and some of the energy of the fire is consumed in the process of driving off the moisture (latent heat of evaporation). These actions, coupled with modified plantings provide the conditions necessary to stop the fire from burning into the development area.

Design Criteria

For the project site, no thinning zones are needed or desired. The setback from the native needs to be as efficient as possible. Having the fire burn at lesser rate for 100 feet does not benefit the project site and the riparian areas cannot be modified. This requires a different but equal solution.

At the interface of the riparian to the development area of the project site, a distance of 100 feet is needed to counter the worst-case scenario radiant heat that could be generated. Direct flame contact would not be possible. The convected heat impact would not span this distance either. The 100 feet would need to be a combination of Zone A and Zone B for the entire distance. No thinning zone is allowed. The edge of the riparian needs to have either a mineral earth path, a radiant heat wall or some other method of stopping the fire progression at this point. This can be accomplish with a six-foot-high block wall, a tempered glass over block wall, a mineral earth path that is two time wider than the adjacent fuels (assumed to six feet high/ equals a 12’ wide path or a noncombustible surface such as a road/pavers/hardscape.

The 100 feet could be irrigated or dry but must meet the criteria for spacing that is appropriate for the type of zone it uses. Alternatives acceptable to the Orange County Fire Authority can be utilized through the AM&M (Alternative Materials and Methods) process (Fire Code Section 104.10).

Fire Behavior Summary

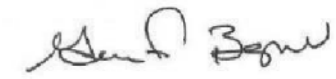
The static modeling indicates that flame lengths of 45.9 feet are possible under perfect conditions, in the worst case scenario for winds at the Project Site within the data that is available. The design criteria for the Project Site must properly protect the structures from a wildland fire under all conditions. Most of the fuels are not aligned with the slope and wind and fuels. Within the Project Site, the fuels are not continuous enough to drive fire behavior to the level of the equilibrium spread rates used in the modeling and valid at the north perimeter. Riparian interfaces are safe at 100' of irrigated fuel modification with limited fuelbeds and no alignment to extremely strong winds. The entire defense system is designed to protect all of the structures regardless of the specific location adjacent to the native fuels on the perimeter and interior of the project site where they interface with the riparian areas.

The fuel modification for this Project has assumed a lack of maintenance in the open space riparian areas within and adjacent to the Project Site. The overall interface for the Project Site has light to moderate fuels with the exception of the riparian areas. Alignment with strong Santa Ana winds with downslope fuels does not occur within the project site (full alignment) that could drive a fire in the interface to extreme conditions. While the static modeling assumes this condition, it is not currently present or expected in the future on or near the Project Site. Winds around the project are variable and the analysis has assumed the winds could come from any direction and not just the normal onshore and offshore flow conditions that are the nature of most of the fire weather in southern california.

A distance of 100 feet is adequate for the protection of the project site under the conditions analyzed. Under normal conditions, the project could and would be safe with half this distance but under a worst-case scenario, the additional margin is warrented. The technical results provided as part of the Fire Behavior Analysis within this report were obtained using BehavePlus Plus version 6.0.0 and Wind Ninja 3.8.1 software.

This Fire Behavior Analysis reviewed the wildland interface conditions (past, present, and future), the required construction features under the current codes and ordinances, and the additional features and mitigation measures required for site-specific conditions that result in the project's ability to be protected under wildland fire conditions. Firesafe submits this report to the Orange County Fire Authority the proposed Project Site.

Respectfully;



Gene F. Begnell
Fire Protection Analyst
Firesafe Planning Inc

Concurrence;



David Oatis
Principal,
Firesafe Planning Inc

Appendix A
Site Photos Locations



Photo locations are shown on the map above as reference points. Several photos were taken from each general location and are within a few feet of each other. For simplicity, these photo sites have been grouped in the locations shown above.

Photo Site 1 – Looking Northwest



Looking Southeast



Photo Site 2 – Looking Northeast



Looking East



Photo Site 3 – Looking North Northeast



Looking South



Photo Site 4 – Looking Northeast



Looking South



Photo Site 5 – Looking Southwest



Looking Southeast



Photo Site 6 – Looking Northwest



Looking Southeast



Photo Site 7 –Looking North Northeast



Looking Southwest



Photo Site 8 –Looking North Northwest



Looking North



Photo Site 9 –Looking West



Looking Northwest



Photo Site 10 – Looking Southwest



Looking West



Photo Site 11 –Looking Southeast



Looking South



Photo Site 12 – Looking South



Looking Southeast



Photo Site 13 –Looking West



Looking Northwest



Photo Site 14 – Looking West



Looking North



Photo Site 15 –Looking West



Looking North



Photo Site 16 – Looking West



Looking North



Photo Site 17 –Looking West



Looking North



Photo Site 18 –Looking West



Looking North



Photo Site 19 – Looking South



Looking North



Photo Site 20 –Looking West



Looking East



Photo Site 21 –Looking South



Looking West



Photo Site 22 –Looking South



Looking West



Photo Site 23–Looking North



Looking South



Photo Site 24 –Looking South



Looking West



Photo Site 25 –Looking Northwest



Looking Southeast



Photo Site 26 –Looking Southeast



Looking North



Photo Site 27 –Looking South



Looking West



Photo Site 28 –Looking Southeast



Looking West



Photo Site 29 –Looking Northwest



Looking Southeast



Photo Site 30 –Looking Southeast



Looking Northwest



Photo Site 31 –Looking Northeast



Photo Site 32 –Looking Northeast



Photo Site 33) –Looking North



Looking East



Photo Site 34 –Looking North



Looking South



Photo Site 35 –Looking South



Looking Southwest



Photo Site 36 –Looking East



Looking South Southeast



Photo Site 37 –Looking Easgt



Photo Site 38 –Looking West



Photo Site 39 – Looking North



Looking Northeast



Photo Site 40 – Looking South



Looking Southeast



Photo Site 41 –Looking Southeast



Looking Southwest



Photo Site 42 –Looking East



Looking Southwest



Photo Site 43 –Looking Northeasgt



Looking West



Photo Site 44 –Looking Northeast



Looking Southwest



Photo Site 45 –Looking South



Looking North



Photo Site 46 –Looking South



Looking North



Photo Site 47 –Looking South



Looking Northwest



Photo Site 48 –Looking North



Looking South



Photo Site 49 –Looking North



Looking South



Photo Site 50 –Looking North



Looking East



Photo Site 51–Looking East



Looking South from east of the railroad tracks



Photo Site 52 –Looking East



Looking North



Photo Site 53 –Looking Southeast



Looking West



Appendix B
Fire Modeling Outputs

Inputs: SURFACE

Description		Legacy Ranch 0-65 mph

Fuel/Vegetation, Surface/Understory

Fuel Model		gs2, sh5, scal18, tu5

Fuel Moisture

1-h Fuel Moisture	%	3
10-h Fuel Moisture	%	4
100-h Fuel Moisture	%	5
Live Herbaceous Fuel Moisture	%	30
Live Woody Fuel Moisture	%	50

Weather

20-ft Wind Speed	mi/h	0, 5, 10, 15, 20, 25, 30, 35, 40, 45
Wind Adjustment Factor		0.5
Wind Direction (from north)	deg	45

Terrain

Slope Steepness	%	100
Site Aspect	deg	45

Run Option Notes

Maximum effective wind speed limit IS imposed [SURFACE].

Fire spread is in the HEADING direction only [SURFACE].

Wind is in specified directions [SURFACE].

Wind and spread directions are degrees clockwise from north [SURFACE].

Wind direction is the direction from which the wind is blowing [SURFACE].

Output Variables

Surface Fire Rate of Spread (ft/min) [SURFACE]

Surface Fireline Intensity (kW/m) [SURFACE]

Surface Fire Flame Length (ft) [SURFACE]

Flame Residence Time (min) [SURFACE]

(continued on next page)

Input Worksheet (continued)

Notes

Legacy Ranch 0-65 mph

Head Fire

Surface Fire Rate of Spread (ft/min)

20-ft Wind Speed	Fuel Model			
mi/h	gs2	sh5	SCAL18	tu5
0	75.1	150.6	81.2	29.1
5	91.8	198.8	113.8	35.5
10	121.0	260.6	143.1	43.6
15	158.0	328.7	171.3	52.4
20	201.2	401.3	198.7	61.8
25	249.7	477.4	225.6	71.6
30	302.9	556.5	252.1	81.7
35	360.3	638.2	278.3	92.1
40	421.7	722.1	304.2	102.8
45	486.6	807.9	329.8	113.8
50	555.0	895.6	355.2	124.9
55	565.2	985.0	380.5	136.3
60	565.2	1076.0	405.5	147.8
65	565.2	1168.3	430.4	159.5

Legacy Ranch 0-65 mph

Head Fire

Surface Fireline Intensity (kW/m)

20-ft Wind Speed	Fuel Model			
mi/h	gs2	sh5	SCAL18	tu5
0	2483	16779	19164	5120
5	3036	22155	26871	6249
10	4002	29034	33787	7668
15	5227	36623	40434	9222
20	6657	44713	46911	10870
25	8262	53199	53264	12593
30	10022	62013	59522	14377
35	11922	71109	65700	16214
40	13951	80455	71812	18097
45	16100	90025	77865	20022
50	18361	99798	83868	21985
55	18700	109757	89825	23982
60	18700	119889	95741	26011
65	18700	130182	101620	28070

Legacy Ranch 0-65 mph

Head Fire

Surface Fire Flame Length (ft)

20-ft Wind Speed	Fuel Model			
mi/h	gs2	sh5	SCAL18	tu5
0	9.3	22.3	23.7	12.9
5	10.2	25.3	27.7	14.2
10	11.5	28.7	30.8	15.6
15	13.0	31.9	33.4	16.9
20	14.6	35.0	35.8	18.3
25	16.1	37.9	37.9	19.5
30	17.6	40.7	39.9	20.8
35	19.1	43.3	41.8	22.0
40	20.5	45.9	43.5	23.1
45	21.9	48.3	45.2	24.2
50	23.2	50.7	46.8	25.3
55	23.4	52.9	48.3	26.3
60	23.4	55.1	49.7	27.3
65	23.4	57.2	51.1	28.3

Legacy Ranch 0-65 mph

Head Fire

Flame Residence Time (min)

20-ft Wind Speed	Fuel Model			
mi/h	gs2	sh5	SCAL18	tu5
0	0.21	0.31	0.49	0.31
5	0.21	0.31	0.49	0.31
10	0.21	0.31	0.49	0.31
15	0.21	0.31	0.49	0.31
20	0.21	0.31	0.49	0.31
25	0.21	0.31	0.49	0.31
30	0.21	0.31	0.49	0.31
35	0.21	0.31	0.49	0.31
40	0.21	0.31	0.49	0.31
45	0.21	0.31	0.49	0.31
50	0.21	0.31	0.49	0.31
55	0.21	0.31	0.49	0.31
60	0.21	0.31	0.49	0.31
65	0.21	0.31	0.49	0.31

Discrete Variable Codes Used
Legacy Ranch 0-65 mph

Fuel Model		
122	gs2	Moderate load, dry climate grass-shrub (D)
145	sh5	High load, dry climate shrub (S)
18	SCAL18	Sage / Buckwheat
165	tu5	Very high load, dry climate timber-shrub (S)