Attachment 1

Fuel Management and Maintenance Program Analysis

Newport Banning Ranch

Newport Beach, California

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Prepared by:

firesafe ::PLANNING SOLUTIONS

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Purpose of Report

Firesafe Planning Solutions performed an assessment of how the fuel management and maintenance program (FMMP) will reduce the intensity of a wildfire approaching The Newport Banning Ranch residential community. This fire analysis report provides the results of the assessment and shows support of the fuel management installation and maintenance program. The study takes into consideration existing vegetative interface fuels, future re-vegetated interface areas, topography, and weather conditions during a fire. The study includes expected fire behavior burning within off-site and on-site vegetation. Additionally exterior and interior located perimeter vegetation treatment and maintenance plan are addressed. The fire intensity from worst case scenario examples has been calculated and the results of fire behavior calculations were are simulated against the fire protection design built into the Newport Banning Ranch (NBR) development.

Geographic Description

The NBR site is not located within an existing Special Fire Protection Area. Once developed, the site will be designate as a Special Fire Protection Area as it is within the sphere of The City of Newport Beach Fire Departments guidelines and city staff has indicated it will require such designation. The future community will be mostly attached to existing development on the south-west, south, and east. The NBR planned community is located east of the city of Costa Mesa. The entire east side of NBR is bordered by existing commercial and residential development. For the sake of wildland interface, the new tracts will fill-in the area between two existing built-out developments similar to an island or bridge connecting the developments together except for the canal located to the west. The north-west side of NBR will have a moderate wildland interface from vegetation within the adjacent oil fields situated 50-75 below the future community. The south side of the community is bordered by Pacific Coast Highway and small moderate hazard vegetative areas near the coastal bluffs.

(Figure 1) Most of the development perimeter in yellow does not have a wild land interface due to existing surrounding developments on the South-West, South, and East. Yellow depicts the entire development dedicated open space boundary areas.

Site Fire Hazard Assessment

A small percentage of the future homes will border the edges of where the existing oil lease lands and other homes will border a few interior located drainage canyons. The interior canyons will continue to support a healthy coastal sage scrub plant community or be restored to coastal sage scrub vegetation or Upland Grassland Restoration/Mitigation area. Droughts have had an impact on existing coastal sage scrub plant communities. The recent rains have caused the shrub type vegetation on the site to support much greener and denser vegetation presently, and non-native grasses and weeds are more prevalent too. During droughts, coastal sage scrub plant communities can have a large percentage of dead material. This is due to the Mediterranean climate where long wet winters promote lots of new growth and long dry summer seasons can cause parts of the plants to die back. The shrubs on the interior located canyon slopes are primarily dominated by Encelia Californica, which grows between 1-3 feet in height and is on

the approved Fire Department plant list. Other types of vegetation in and adjacent to the interior located drainage canyons are:

Oil Lease and Interior Canyon Vegetation:

Type	Approximate Height Ft	Approximate Width Ft
• Baccharis	5	3
• Saltbush	3	8
• Lemonadeberry	7	7
• Toyon	7	7
• Bladder Pod	3	3
• Mulefat	7	3
• Willow	15	12
• Cactus		

Other species found on-site that are determined by The City of Newport Beach Fire Department as being highly combustible are required to be continuously removed from the fuel management zone: Pampas Grass, Buckwheat, Artemisia, Black Sage, Thistles, Mustard, and Castor Bean.

(Figure 2) Photo of the interior canyon vegetation. Notice the vegetation on the slopes of the canyons is mostly only as tall as the cactus is except for the willows in the drainage.

62nd Street Canal Development Perimeter Vegetation: (Not a direct Interface)

Type	Approximate Height Ft	Approximate Width Ft
• Pine	15	10
• Pepper	15	12
• Chinese Elm	15	7
• Juniper	9	7
• Ice Plant / Covers	1	20
• Eucalyptus	20	12

• Willow	15	12
• Palm	25	10-20
• Ornamental shrubs	8	6

(Figure 3) These species are located along the banks of the canal and are not a fire hazard to the proposed structures. The road between the canal bank vegetation and the slope leading up near the future development helps as a fire break. The types of vegetation on the slopes on the opposite side of the canal and road are the same as within the oil lease and interior canyons.

Specific plant palettes are provided in Attachment 2 of this document for the various zones within the fuel modification areas. These palettes have been vetted through various local fire agencies and landscape professionals.

In addition to the areas that are currently vegetated with the coastal sage scrub plant community, the project will establish new plantings within the project as a habitat area for raptors. This area will be designed as an upland grasslands area. It will be maintained with specific plant species and will not be allowed to transition into a shrub or chaparral plant community. It will be

maintained by "hand plucking" any plant materials not on the approved list on an annual basis to maintain its value as a raptor habitat.

The Upland Grassland Restoration/Mitigation areas will be established within the center of the project area and adjacent to the developed areas. Most of these will be in the intermediate zone between the wildland and the irrigated fuel modifications zones. These areas will be vegetated with a suite of native bunchgrasses suitable for raptor foraging as summarized below.

UPLAND GRASSLAND PLANT PALETTE

Botanic Name	**Common Name**	**Plant Height**
Melica imperfecta	Coast Range melica	20 to 40 inches
Nassella pulchra	Purple needlegrass	12 to 40 inches
Nassella lepida	Foothill needlegrass	12 to 40 inches
Bothriochloa barbinodis	Beardgrass	24 to 48 inches
Distichlis spicata	Saltgrass	4 to 8 inches
Lasthenia californica	California goldfields	4 to 8 inches

In addition to the raptor areas, a vernal pool on the site will be preserved and enhanced. The plant palette for the Vernal Pool Restoration Area (Planning Area 2e) has been modified to a low-growing suite of appropriate native species that will still provide appropriate habitat consistent with habitat mitigation objectives for the project.

PLANT PALETTE – VERNAL POOL WATERSHED RESTORATION AREA

Botanic Name	**Common Name**	**Plant Height**
Cressa truxillensis	Alkali weed	2 to 6 inches
Distichlis spicata	Saltgrass	4 to 8 inches
Frankenia salina	Alkali heath	4 to 8 inches
Heliotropum curassivicum	Seaside heliotrope	4 to 8 inches
Lasthenia californica	California goldfields	4 to 8 inches
Lupinus bicolor	Miniature lupine	4 to 8 inches
Malvella leprosa	Alkali sida ches	2 to 6 inches
Plantago erecta	Western plantain	3 to 6 inches
Spergularia marina	Saltmarsh sand spurrey	1 to 4 inches

Both the upland grasslands and vernal pool areas are clearly depicted on the Fuel Management Plan graphic attached to this report.

Fuel Management

Fuel management is land that is designated for the installation of plant species and land with selectively removed native vegetation. A fuel management program starts when the local governmental planning department places development construction conditions requiring a fuel management program. Any new development occurring within lands containing highly

combustible native vegetation needs modification of the vegetation at the urban interface in order to protect structures. Native plants are replaced with drought-tolerant, fire-resistant species in order to slow the speed and intensity of an approaching wildfire.

Fuel management programs vary in complexity and designs. They are dependent upon the type and spacing of vegetation as well as topography, weather conditions, and the placement of structure within the development project. Irrigated fuel management zones help to reduce the impacts of wildfire before they spread to structures. The reduction of available native fuels, which have been replaced by fire resistive plant types, will cause a reduction in the intensity of a fire when approaching homes/structures.

Fuel management is as an on-going maintenance program because the program requires zones to be maintained indefinitely. Installing new plants works great initially and maintenance is easy, but proper long-term maintenance can be difficult if not done correctly. Experienced techniques can assist in extending the longest possible life span for the plants. Funds for fuel management maintenance need to be an expected expense in the annual budget of association dues. Proper and consistent maintenance can save on the total long-term cost of maintenance over long periods of time or the failure of the protection system with wide spread consequences to the building owners and the city.

The Fuel Management Program

The fuel management programs designed for the NBR are very similar to approved fuel management programs approved in the County of Orange within the last 5 years. The design of NBR is very similar to the Marblehead Coastal development in the City of San Clemente and the Dana Point Headlands Reserve development. The Marblehead development was approved with fuel management zones less in total width than what is proposed for NBR and additionally there is a greater sized coastal sage scrub habitat preserved within both developments. Marblehead Coastal and Dana Headlands Preserve are similar in proximity to the ocean, topography, and plant species. Both developments were regulated by the California Coastal Commission which created the requirement to preserve specific plant species both on and off-site.

The fuel management and maintenance program (FMMP) requires regular maintenance activities to be done routinely on an indefinite basis by the future Homeowners Association (HOA). The fuel management zones will be originally installed and maintained by the developer until the on-going maintenance responsibility is turned over to the HOA. The maintenance requirements are clearly shown on the fuel management plans. The developer will distribute the approved plans with maintenance requirements directly to the Homeowners Association at a required maintenance turnover meeting. The program requires The City of Newport Beach Fire Department to be present at the maintenance turnover.

Conceptual Fuel Management Zone Options:

Each option listed is considered to provide an approximately equal level of fire protection compared to each other. Options are needed to retain plants existing on-site that are already on the Fire Department approved plant list and that balance the needs of the California Coastal Commission. <u>One type of option may be designed or all options may be used in different areas</u>

for the future precise fuel management plan design. The following options were safe designs based on results the size of the wildland areas, type of vegetation, and amount of vegetation, the fuel/structure wind alignments, and the BehavePlus Calculation Results Analysis in this report.

Profile 1

Management Zone: 120 feet in total width

Irrigated Zone "A" Maintained by the HOA or Homeowner

- Zone "A" is a minimum of 20' in width when immediately adjacent to structures except as approved by the NBFD adjacent to Coast Highway. This zone is generally flat level grade.
- No combustible construction will be allowed in Zone "A".
- Zone "A" will generally be off of the homeowners lot, although in some instances this zone may be within a homeowners property line, in which outer controlled drip irrigation may be used.
- Irrigation to mimic the ambiant rainfall.
- The exisiting vegetation removed and replanted with plants listed on the approved plans for Zone "A" Plant Palette.
- Fire Department highly combustible plants will be removed during the regular maintenance.
- Home buyers required to sign disclosures. (See Attachement 4)
- Meet all Fire Department Zone "A" maintenance requirements.

Irrigated Zone "B" Maintained by the HOA

- Zone "B" extends further outward, not less than 50', away from the structures towards the native vegetative areas. The HOA will maintain this areas as a "Public Bluff Park".
- No combustible construction will be allowed in Zone "B".
- Plants are originally installed and maintained conforming to required spacing arrangements of the fuel maitenance plan.
- Irrigation to mimic the ambiant rainfall.
- The exisiting vegetation removed and replanted with plants listed on the approved plans for Zone "B" Plant Palette.
- There is no environmentally sensitive habitat in the zone so there is no restriction of thinning activities throughout the year.
- Fire Department highly combustible plants will be removed during the regular maintenance.
- Meet all Fire Department Zone "B" maintenance requirements.

Nonirrigated Zone "C" Maintained by the Conservancy/HOA

- Zone "C" extends further outward, 50' or more when adjacent the "B" or "2" zones. Provides a buffer betweent the native vegetative areas and the fuel modification areas.
- The exisiting vegetation removed and replanted with plants listed on the approved plans for Zone "C" Plant Palette. An upland grasslands will be constructed.
- Plants are originally installed and maintained conforming to required spacing arrangements.

- There is no thinning activities in this zone. Plants not on the approved plant palette will be removed by “hand plucking” on an ongoing basis. This will be a habitat area.
- This zone is not irrigated.

Profile 2

Management Zone: 120 feet in total width

In the case of this option this zone will include fully irrigated areas. Some of the native species on the Fire Department list do not need the same amount of water as others on the list. Excessive water will make some species grow faster than needed and will not necessarliy cause greater fuel moistures beyond their maximum capcity anyway. The NBR will incorporate structure setbacks from slope ridges anyway for private homeowners to have lawns and hardscaping features that act as Zone “1”. Structure setbacks provide a separation from the un-maintained coastal sage vegegation outside of the fuel management zone limits. Homeowners will be restricted to specific plant pallets even when there is not a Zone “1”.

Irrigated Zone “1” Maintained by the HOA or Property Owner

- Zone “1” will be 20’ off of the property owners lot. It is generally flat level grade. This zone generally uses he public right-of-way.
- The exisiting vegetation removed and replanted with plants listed on the approved plans for Zone “1” Plant Pallette.
- Fire Department highly combustible plants will be removed during the regular maintenance.
- This area will be fully irrigated.
- No combustible construction will be allowed in Zone “1”.
- Home buyers required to sign disclosures. (See Attachement 4)

Irrigated Zone “2” Maintained by the HOA and/or Resort

- Zone “2” extends further outward from Zone “1” away from the structures towards the native vegetative areas. This area is 50'-230' in width and is maintained by the HOA as a "Public Bluff Park".
- No combustible construction will be allowed in Zone “2”.
- This area will be fully irrigated.
- The exisiting vegetation will be removed and replanted with plants listed on the approved plans for Zone “2” Plant Pallette.
- Plants are originally installed and maintained conforming to required spacing arrangements.
- There is no environmentally sensitive habitat in the zone so there is no restriction of thinning activities throughout the year.
- Fire Department highly combustible plants will be removed during the regular maintenance.

Summary of Requirements for All Management Zones:

- No highly combustible plant species allowed per code.
- Horizontal and vertical plant spacing specifications are required.
- Dead and dying material removed regularly in “A”, “B”, “1” and “2” zones.

- Zone “C” is maintained as an upland grassland habitat.

Calculating Fire Behavior

This report uses a scientific approach to describe a wildland fire hazard assessment and expected wildland fire behavior within and outside of the fuel management zone. Computer projections simulate a fire burning within the native vegetative fuels directly outside the boundaries of the management zones. This report will demonstrate why fuel management zones will help protect structures in the community.

Firesafe Planning Solutions used a computer software program titled, “BehavePlus Fire Modeling System 3.0.2” to predict the level of wildfire intensity for a fire approaching NBR. BehavePlus, is a fire behavior prediction and fuel modeling system and is one of the most accurate methods for predicting wildland fire behavior. The BehavePlus fire behavior computer modeling system is utilized by wildland fire experts nationwide. The Fire Behavior and Fuel Modeling System, developed by research scientists from USDA-Forest Service (Andrews & Bevens 2003; Burgan & Rothermel 1984) will be used to evaluate both wildfire risk as well as the proposed Vegetation Management recommendations.

The BehavePlus system provides an indication of how vegetative fuels will burn under specific fuel, weather, and topography conditions. The BehavePlus system is a set of computer programs based upon energy release from specific fuels during a fire and is employed by wildfire professionals both nationally and internationally to predict wildfire behavior. Fuel Models used in BEHAVE have been classified into specific groups, based upon fuel loading (tons/acre), fuel height, and surface to volume ratio. The differences in fire behavior among these models are basically related to fuel and their distribution among fuel particle size classes. Observation of the location and positioning of fuels in the field determines which fuel groups are presented. Vegetative fuels are recognized as fuel models within the BehavePlus program. The fuel models in the computer program, are also referenced from the book titled, “Aids to Determining Fuel Models for Estimating Fire Behavior”. The fuel models were designed to aid in determining fuel types and are used in calculating and estimating fire behavior.

The fire model describes the fire behavior only within the flaming front of the fire. The primary moving force in the fire is dead fuel less than ¼” in diameter. These are the finest fuels that carry the fire. Fuels larger than ¼” contribute to fire intensity, but not necessarily to fire spread as much as the fine fuels. The BehavePlus fire model describes a wildfire spreading through surface fuels, which are the burnable materials within 6’ of the ground and contiguous to the ground.

This type of modeling will demonstrate that the FMMP is the best fire defense system for NBR. The Modeling will show that the structures are significantly further away than the most extreme flame lengths and intensity that would be produced. Instead of estimating with the exact fuel models for calculating fire behavior, we will input worst case scenario factors and fuel models to ensure a further safety cushion in the computer fire behavior calculations and results analysis.

BehavePlus Related References:

1. *Aids to Determining Fuel Models for Estimating Fire Behavior, Hal E. Anderson. General Technical Report INT-122 April 1982.United States Department of Agriculture - Forest Service, Intermountain Station, Ogden, Utah 84401.*

2. *BehavePlus: Fire Behavior Prediction and Fuel Modeling System - BURN Subsystem. General Technical Report INT-194. Patricia L. Andrews, United States Department of Agriculture - Forest Service, Intermountain Station, Ogden, Utah 84401*

Wildland Interface Fuel Types

These fuels are considered highly combustible in the native setting and can be analyzed for their fire performance based on many factors. The type and amount of fuels in the wildland area located immediately outside of the fuel management zone are generally:

20 % Native grasses from 1-2'in height:

These fuels present the potential for a fast spreading wind driven fire. Fire intensity is low but the rate of spread is high. With structures setbacks and enhanced construction requirements in place, they do not present a significant hazard. This type of fire is generally in a localized small area.

60% Coastal sage shrubs 3- 4' in height:

The shrubs present the potential for a fast spreading wind driven fire. Fire intensity and ember production has the potential to high at the wildland interface area because the shrubs are covering 2/3 of the land outside of the zone limits. The shrubs will not a fire hazard to the homes after the fuel management zone is installed, structures are setback, and construction requirements are in place.

20% Remaining Vegetation Types

Chaparral type tree-form shrubs and trees outside of the zone limits will not be fire hazard to the homes because the homes will be far enough away so heat travel will not cause direct flame impingement or radiant heat ignition of the homes. Embers intrusion will be deflected by the construction features of the homes.

(Figure 4) This type of vegetation will fit into a BehavePlus fuel model type SCAL 18. Although the site vegetation is not as dense as the vegetation described within the model, so fire behavior will be even lower than predicted.

Wind Patterns and Structure Alignment

The result of wild fire intensity is determined by wind speed, wind direction, the age of fuels, and the amount of moisture in the air. Wind direction determines how dry or moist the relative humidity in the air is. Fire intensity and rate of fire spread are usually determined by the speed of the winds. We entered the two most extreme wind patterns and speeds relating to wildfires into the BehavePlus model. All other lesser wind patterns and wind speeds normally produce less fire intensity based on a fire in wildland fuels. The two most extreme wind patterns/structure location alignments are:

- 50 mph northeast Santa Ana wind. (Generally occurring in the late fall, during low fuel moisture times). A review of RAWS data for the area could not find any recorded wind gusts above this level for the past 10 years
- A rare 30 mph dry southwest on-shore, normally prevailing wind. (Generating from over the ocean, after dry air is pushed out to sea by a Santa Ana condition).

<u>A 50 mph north-east wind scenario would mostly affect homes on the interior canyon because a fire affecting the north-west perimeter will be moving laterally or away from the homes located on the north-west perimeter</u>

North -West Development Interface Photos

(Figure 5) We used BehavePlus to calculate and predict a south-west wind directed fire coming from the vegetation within the oil lease that could affect the North-West perimeter of the development. The oil lease has many roads which serve as continuity breaks in the scattered fuels.

(Figure 6) We used BehavePlus to calculate and predict a south-west wind directed fire coming from the vegetation within the oil lease that could affect the North-West perimeter of the development. The fuels in the oil lease area are not even as severe as the SCAL 18 model we used in many areas. Fire behavior will actually be less than the worst case scenario we calculated in those areas.

(Figure 7) We used BehavePlus to calculate and predict a south-west wind directed fire coming from the vegetation within the oil lease that could affect the North-West perimeter of the development. The fuels in the oil lease area are not even as severe as the SCAL 18 model we used. Fire behavior will actually be less than the worst case scenario we calculated.

(Figure 8) This is a photo of the most extreme north side of the future development which is directly adjacent to existing development.

(Figure 9) Photo of the west aspect facing slope below the future development located on the west side of the development. A south-west wind directed fire coming from the vegetation within the oil lease could affect the North-West perimeter of the development.

Interior Development Canyon Interface Photos

(Figure 10) We used BehavePlus to calculate and predict south-west wind and north-east wind directed fires coming from native vegetation within interior open space canyons. Unless the wind happens to change in the midle of a fire event, the fire will continue to move only one direction of the two directions shown. Homes located on the perimeter of the interior canyons

shown will have all of the CBC Chapter 7A construction requirements in place even though they are not required by code in moderate or high severity mapped levels.

(Figure 11) We used BehavePlus to calculate and predict south-west wind and north-east wind directed fires coming from native vegetation within interior open space canyons. On the right is a lower canyon drainage with Willow species. The fuels on the right are not in the fuel mangement zones and have a fairly high fuel moisture content. On the left is the coastal sage scrub vegetation Fuel Model SCAL 18

(Figure 12) We used BehavePlus to calculate and predict south-west wind and north-east wind directed fires coming from native vegetation within interior open space canyons. In the background is a lower canyon drainage with Willow species. The fuels in the forefront are the

coastal sage scrub vegetation Fuel Model SCAL 18. The Pampas Grass will be removed if in the management zones and the Encelia would remain and be horizontally spaced not to create a fuel mass exceeding 50% of the total area.

(Figure 13) We used BEHAVE to calculate and predict south-west wind and north-east wind directed fires coming from native vegetation within interior open space canyons. The fuels in the forefront are the coastal sage scrub vegetation Fuel Model SCAL 18. The Encelia would remain and be horizontally spaced. Areas in between shrub groups will have low grasses.

(Figure 14) We used BEHAVE to calculate and predict south-west wind and north-east wind directed fires coming from native vegetation within interior open space canyons. The fuels in the forefront is Encelia. In the distance you can see the upslope vegetation which will be leading up to homes. Homes located on the perimeter of the interior canyons shown will have all of the CBC Chapter 7A construction requirements in place even though they are not required by code in moderate or high Fire Hazard severity levels.

BehavePlus Fire Behavior Inputs and Results:

Fuel Moistures:

The fuel moistures used in the modeling for the BehavePlus calculation are the worst case scenario. Relative humidity, temperature, slope aspect, time of day, and month of the year all have an impact on the determination of the actual percentage of dead fuel moisture. The values listed below are at or below the lowest recorded levels for the area being analyzed.

Fuel moisture changes over time. In general, the dead fuel moisture will move about 2/3 of the difference between its current moisture level in the fuel and that of the air around in varying increments based on the size (amount of surface area to total mass) of the fuel. Fuel are grouped by the time it takes to move the 2/3 distance. "One hour" fuel is less than ½ inch thick. It is the most volatile of the fuels. "Ten hour" fuel is between ½ inch and 1 inch thick. "Hundred hour" fuel is between 1 inch and 3 inches and "Thousand hour" fuel is above 3 inches in thickness. Thousand hour fuels are relatively stable and are not used in this model

Live fuel moisture is the moisture found in the leaf and woody portion of a shrub. Live fuel moisture is calculated by cutting a small branch and weighing it, placing it in a low temperature oven for 12 hours, removing the branch and weighing it again. The difference in weight is the loss of moisture in the leaves and woody portion of the branch. For this reason, live moisture may exceed 100% of the dry weight of the plant. Live fuel moisture is the highest in the spring and early summer, and the lowest in late summer, fall and early winter. Los Angeles County Fire Department samples live fuel moistures from sites throughout Los Angeles County each month.

Fuel moisture recorded from the sites still apply to Orange County area and serve as an indicator of moisture content. We are using worst case moistures to indicate the results of worst case wild fire. All other fires when there are greater fuel moistures within the shrubs, will result in less fire intensity than we are predicting.

South, Southwest and West Wind Condition Fuel Moisture Inputs: Late fire season 30-MPH southwest wind pattern.

*	1-Hour Fine Fuel Moisture	3%
*	10-Hour Fuel Moisture	5%
*	100-Hour Fuel Moisture	7%
*	Live Herbaceous Fuel Moisture	30%
*	Live Woody Fuel Moisture	60%

North, Northeast and East Wind Condition Fuel Moisture Inputs: Santa Ana Winds

*	1-Hour Fine Fuel Moisture	2%
*	10-Hour Fuel Moisture	3%
*	100-Hour Fuel Moisture	5%
*	Live Herbaceous Fuel Moisture	30%
*	Live Woody Fuel Moisture	50%

BehavePlus Fire Behavior Inputs and Results:

<u>The North-West Development Perimeter Side / South -West Wind Driven Fire</u>
The North-West side of the development is mostly subject to south-west normal prevailing wind direction fire weather:

(Figure 15) BehavePlus fuel model type SCAL 18 on the slope leading up to the future development.

<u>BehavePlus Inputs:</u>
Wind Direction: South-west wind moving to a north-east direction
Wind Speed: 30 mph wind speed, upslope, unsheltered
Slope: 15% degree slope

BehavePlus Outputs:

Fuel Model	SCAL18	Grass4	GrassSrub2
Max Rate of Spread (feet/min)	194	908	266
Fireline Intensity (Btu/ft/s)	13,141	7,643	2,476
Flame Length (feet)	**35.3**	27.5	16

Interior Canyon North-East Wind Driven Fire

(Figure 16) BehavePlus fuel model type SCAL 18 in the interior canyon leading up to the future development. Encelia shrubs are present in the foreground.

BehavePlus Inputs:

Wind Direction: North-East wind moving to a south-west direction
Wind Speed: 50 mph wind speed, upslope, unsheltered
Slope: 60% degree slope

BehavePlus Outputs:

Fuel Model	SCAL18	Grass4	GrassSrub2
Max Rate of Spread (feet/min)	384	1,945	676

Fireline Intensity (Btu/ft/s)	27,885	18,339	6,924
Flame Length (feet)	**49.9**	41.1	26.3

BehavePlus Calculation Results Analysis

The modeling for this project used the extreme conditions in every case. Winds were modeled at or above the strongest gusts recorded over the past 10 years. Fuel moistures were estimated at or below those recorded in existing databases. Slopes were used that created the greatest impact for rate of spread (this is not always the steepest slope as the slope its self begins to shelter the fuel from the extreme aspects of the wind when it becomes barrier).

Three separate fuel models were used to project the maximum fire behavior for this project. Southern California Model 18 (Sage/Buckwheat) was used for the interior pristine areas that will be allowed to continue in their natural state. Both grass (GR4 moderate grass, dry climate) and grass/shrub mix (GS2 moderate load, dry climate) models were used to insure that fire behavior was correctly modeled as the upland grassland interface matures.

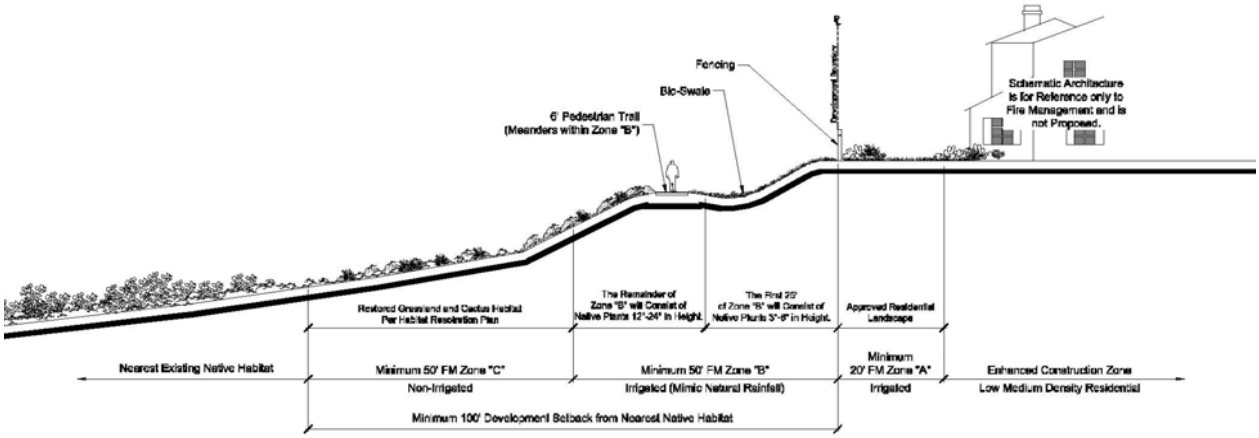
It should be noted that while the GR4 model is more volatile in terms of rate of spread and flame length, the SCAL18 model has the greatest threat in terms of total volume of fire/heat and impact on the adjacent structures. Under the existing plan, the SCAL18 fuel will always be separated from the structures by the grassland (Zone C) and the modified fuel zones (Zone A or Zone 1 and Zone B or Zone 2). The fuel modification system has been designed so that SCAL18 fuel is no closer than 120 feet from the structures with the exception of the area adjacent to Pacific Coast Highway where this distance is 110 feet at specific “pinch points”. In the exception area, the fuel massing in the pristine area is low and maximum rate of spread is simply not possible. The maximum flame length in the SCAL18 zone is 49.9 feet. For this reason, C Zone/habitat area is never less than 50 feet in width and in many cases in two times the minimum.

The grass or grass/shrub interface (Zone C) will produce a maximum flame length of 41 feet in the worst case scenario. This would be a wind driven fire, traveling upslope, in extreme weather (low humidity and high temperature), unsheltered and with a continuous fuel bed. This zone will double as a raptor habitat. It will NOT be thinned or modified in for fire needs. It will be maintained by “hand plucking” materials which are not on the approved palette. It will be upland grasslands. It should start out as primary grassland and may eventually become a grass/shrub mixture. It was modeled in both configurations. The C Zone is not irrigated. The maximum flame length that can be achieved at the Zone B or Zone 2/Zone C juncture is 41 feet. For this reason, the Zone B and/or the Zone 2 minimum width is 50 feet.

The B zone is irrigated and will provide the necessary buffer for a defensible space. The heat sink properties of the lush irrigated B zone will result in a 75% flame length reduction in this zone. This is due to the zone being cleared, replanted, and permanently irrigated with only

plants listed on the approved plans. Plants are originally installed and maintained conforming to code required horizontal spacing arrangements. Due to the fact that the C zone has a low fuel loading in term of duration of flame front, the actual flames from the C zone will be significantly reduced prior to reaching the B zone. The duration of the flaming front should not be long enough to remove enough moisture from the B zone plants to have them ignite. As long at the dead and duff components of the A and B zone maintenance plans have been followed, no fire will move past the B zone.
The A zone is the buffer that provides for the defensible space. While no direct flame is intended at the zone /1 juncture with the zone B/2 area, an additional area of 20 feet (with the one exception) is provided that will allow fire crews to safetly position themselves into that interface between the wildland and the structures for suppression efforts.

The arragnement of the zones are shown in an example below:



Structure ignitions from wild vegetation fires comes mostly from two sources, firebrands and radiant and covective heat. Ignition of a structure by convective heat transfer requires direct flame impingement. If the flame lengths are less than the measured distance to non-managed combustible vegetation from a structure, there is a probability of structure ignition. This is not the case with this project. The future structures will not ignite from the direct effects of fire as they are never within a distance which provides for a probabiltiy of ignition. Fires in fuels measured directly outside the fuel modification zones do not have sufficient flame lengths to be contacting the homes.

During strong and dry winds, convective firebrands have the capability of being carried by drafts and strong winds for long distances. The chance of firebrands igniting a structure will depend on the size of the firebrand and the type of receptive construction materials on the structure. Firebrands landing on combustible roofing and decks are common sources for structure ignition. Firebrands can also enter a structure through broken windows, unscreened vents, decks and chimneys, and any small opening.

The chance of a structure fire caused by firebrands is not a concern for the NBR as **all homes** will be constructed with Class A roofing and roofing assemblies and attic venting requirements from Chapter 7A from the 2007 California Building Code (CBC). In addition, **all structures**

adjacent to a fuel management zone will further be constructed to meet the minimum requirements of Chapter 7A for exterior wall and eave surface, window and door requirements, appendages and underfloor protection. Therefore, due to the fact that mostly non-combustible building materials will be used in the construction of structures, the radiant heat issue needs to be addressed.

Wildland fires could cause ignition to existing developments by radiating heat to a structure. Radiation exposure depends on the intensity and the duration of the fire. Radiant heat decreases as the distance between the fire and the structure increases. Single-pane windows are subject to breaking from radiant heat and provide an opening for embers to enter a structure. Structure windows adjacent to fuel management zones will be dual pane with one pane tempered in case of an ember hitting a heated window. Radiant heat has a short lifetime in a concentrated area because the fire passes by structures that have been constructed to the latest codes and continues to move onward.

Radiant and convective heat transfer energy is not enough to reach the future structures to the point of ignition because the fuels measured are more than 100 feet away from the homes when you total the distance of the management zone and the structure setbacks. See the following information regarding a valid structure assesment model used by the fire service and professionals throughout the nation titled "SIAM".

Flames and fire intensity are significanlty reduced within the fuel modification zone. The fuel management zone also reduces the amount of embers projected into the air because the plant mateial is replanted with plants with greater fire resistive characteristics and the plants are spaced and thinned.

Structure Ignition Assessment Model (SIAM).
A USDA-Forest Service research study and report entitled the "Structure Ignition Assessment Model (SIAM)" by Jack D. Cohen, Intermountain Fire Science Laboratory, Missoula, Montana has helped to validate how much distance is required to keep structures from igniting due to wildland fire radiant heat.

SIAM research further suggests that for reducing structure ignitions from radiant and convective heat sources, vegetation management (fuel treatment) beyond some relatively short (100 feet) distance from a structure built of non-combustible materials has little significant benefit for reducing flame generated ignitions. Vegetation management cannot be practically extensive enough to significantly reduce airborne firebrand ignitions landing on combustible roofs or other fuelbeds on privately controlled land around a home. In lighter fuels such as grass and short grass, fuel treatment can be reduced to 50-feet and still protect a structure that is built of non-combustible materials.

Future structures will be set back even further from the intensity of a fire burning outside the limits of the fuel management zone. Back and side yards incorporate ornamental plants and trees in a turf or planter type setting. Fire suppression efforts combined with the fuel management zone protection and the latest known building construction practices will ensure the best possible outcome for a safe development.

Report Summary

This development is designed and protected by the most recently developed codes. BehavePlus was used estimate the maiximum intensity of a fire moving towards this development, and flame lengths and fire intensity will ultimately be reduced by the installation and maintenance of the FMMP.

Using a systematic approach, the threats presented by the vegiation that will remain after the completion of this project have been mitigated to a point where they do not present a risk to the structure or occupants of this project once completed. The usage of fuel modification, enhance construction features and ongoing maitenance will insure that this community remains protected from the threat of wildfires as long as the conditions required by this program are in compliance.