O-6.4 REAX

Comment Letter O-6.4

EXHIBIT 4

REAX ENGINEERING

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12 April 2018

Dan Silver, Executive Director
Endangered Habitats League
8424 Santa Monica Blvd., Suite A 592
Los Angeles, CA 90069-4267

Subject: Fire risk impacts of Otay Ranch Village 14 and Planning Areas 16/19 Project

Dear Mr. Silver,

At your request I have reviewed the Fire Protection Plan (FPP) for the planned Otay Ranch Village 14 and Planning Areas 16/19 Project and analyzed potential fire/life safety impacts of this planned development. O-6.4-1

Santa Ana winds

Santa Ana winds (or Santa Anas for short) present major fire/life safety concerns for the Otay Ranch Village 14 and Planning Areas 16/19 Project. Santa Anas are hot and dry winds that blow through Southern California each year, usually between the months of October and April. Santa Anas occur when high pressure forms in the Great Basin (Western Utah, much of Nevada, and the Eastern border of California) with lower pressure off the coast of Southern California. This pressure gradient drives airflow toward the Pacific Ocean.

As air travels West from the Great Basin, orographic lift dries the air as it rises in elevation over mountain ranges. As air descends from high elevations in the Sierra Nevada, its temperature rises dramatically (~5 °F per 1000 ft decrease in elevation). A subsequent drop in relative humidity accompanies this rise in temperature. This drying/heating phenomenon is known as a katabatic wind. Relative humidity in Southern California during Santa Anas is often 10% or lower. Santa Ana winds typically blow from the Northeast toward the Southwest. Sustained Santa Ana winds of 40+ mph with gusts of 60+ mph are not uncommon in Southern California. O-6.4-2

The seasonality of Santa Anas presents a severe fire problem in Southern California which typically sees little rain between May and November. This means that October, November, and December Santa Anas occur after a 6+ month drought when herbaceous surface fuels are completely cured and live woody fuel moisture (*i.e.*, water in shrub-like vegetation) is at yearly lows. Much of the existing vegetation in Southern California is mixed chaparral which is characterized by rapid rates of fire spread and is highly conducive to spotting due to large-scale ember generation.

Given that hot dry Santa Anas occur in part of California that is vegetated by highly flammable chaparral O-6.4-3

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at a time of year when fuel moisture content is at annual lows, it is not surprising that dozens of large loss fires have occurred in Southern California under Santa Ana winds. Table 1 provides a partial list of damaging Southern California fires that were driven by Santa Ana winds. As will be shown later, the Harris Fire listed in Table 1 burned the parcels where the Otay Ranch Village 14 and Planning Areas 16/19 development is planned. O.6.4-3 Cont.

Table 1. Partial list of fires damaging fires occurring under Santa Anas in Southern California.

Name	Date	County	Acres	Structures	Deaths
Bel Air	November 1961	Los Angeles	6,000	484	0
Laguna	September 1970	San Diego	175,000	382	8
Green Meadow	October 1993	Ventura	44,000	53	0
Laguna	October 1993	Orange	14,000	441	0
Cedar	October 2003	San Diego	273,000	2,820	15
Simi	October 2003	Ventura	108,000	37	0
Esperanza	October 2006	Riverside	41,000	34	5
Harris	October 2007	San Diego	90,000	548	8
Witch	October 2007	San Diego	198,000	1,650	2
Sayre	November 2008	Los Angeles	11,000	604	0
Poinsettia	May 2014	San Diego	600	28	1
Lilac	December 2017	San Diego	4,100	157	0
Thomas	December 2017	Ventura/SB	282,000	1,063	1

Assessment of wildland fire threat/hazard/risk based on existing maps

Prior to examining the specific characteristics of the planned development that may be germane to fire/life safety considerations, it is useful to review existing assessments of landscape-scale fire threat, hazard, or risk. Three specific maps are considered here: O-6.4-4

1. Fire Hazard Severity Zone (FHSZ) map. In California, for the purposes of promulgating building regulations, land is categorized into one of three Fire Hazard Severity Zones: moderate, high, or very high. As acknowledged in the FPP, all project parcels fall within Very High Fire Hazard Severity Zones. O-6.4-5

2. FRAP Fire Threat Map. CAL FIRE's Fire Resource Assessment Program (FRAP) also published a Fire Threat Map that is a rating of wildland fire threat based on the combination of potential fire behavior and expected fire frequency. Fire threat is categorized as either moderate, high, very high, or extreme. As shown in Figure 1, the project footprint and most adjacent areas are classified as "very high" with localized pockets of "extreme". O-6.4-6*

3. CPUC Fire Risk Map. In 2017-2018, the California Public Utilities Commission (CPUC) adopted a fire risk map that quantifies the potential impact to people and improved property associated with a fire starting at a particular location. This three-tiered map classifies areas as Tier 1 (moderate), Tier 2 (elevated), or Tier 3 (extreme). Figure 2 shows project parcels overlaid on this CPUC fire risk map. It is seen that project parcels fall in either the "extreme" or "elevated" classifications. O-6.4-7*

In summary, previous wildland fire hazard/threat/risk mapping efforts have classified the areas planned for the Otay Ranch Village 14 and Planning Areas 16/19 Development among the highest wildland fire hazards/threats/risks in California. O-6.4-8

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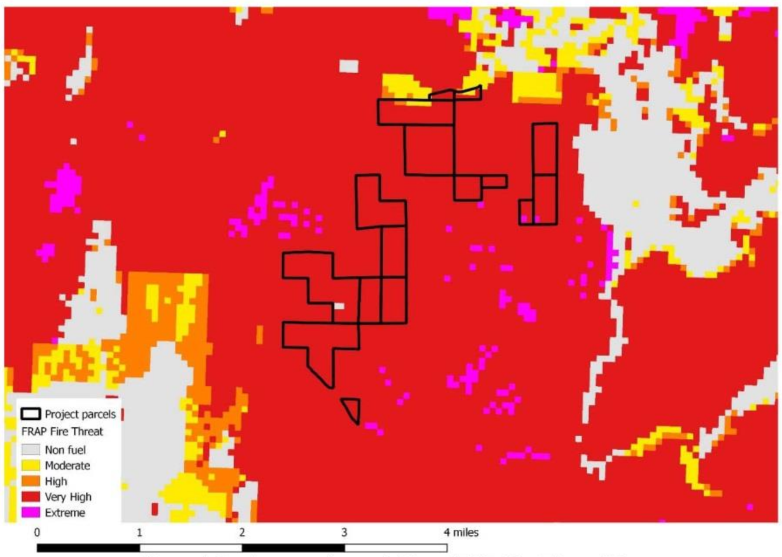

Figure 1. Project parcels overlaid on FRAP Fire Threat Map.

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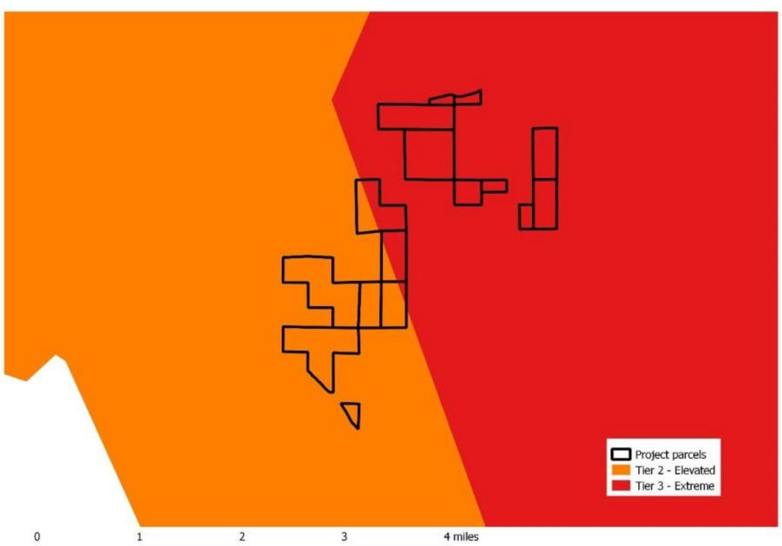

Figure 2. Project parcels overlaid on CPUC Fire Threat map.

O-6.4-10

Fire weather

In the project area, the primary driver of risk from a fire weather perspective is Santa Ana wind events which are normally characterized by an offshore flow out of the Northeast. Strong winds (> 40 mph), high temperatures (> 90 °F), and low relative humidity (< 10%) are possible. Of these factors, wind speed is the most critical factor affecting fire behavior and therefore it is analyzed more closely here. O-6.4-11

The FPP used 40 mph winds as an upper limit on sustained wind speed and 50 mph for an upper limit on guest wind speed, stating "The use of 50 mph winds in modeling efforts is intended to represent wind gusts rather than sustained maximum wind speeds (30-40 mph)." However, using conventional gust factors to relate 10-minute average wind speed to 3 second gust, a 40 mph 10-minute average wind speed would typically show gusts closer to 60 mph than 50 mph.

The FPP used the San Miguel Remote Automated Weather Station (RAWS) approximately 4 miles west of the project site to develop estimates for wind speed during Santa Ana events. San Miguel RAWS is sited in a relatively flat area where wind speeds are likely to be considerably lower than ridge-top wind speeds near the project site. Ridge top wind speeds near the project site are better characterized by wind speeds measured at Otay Mountain RAWS approximately 7 miles south/southeast of the project parcels. In the May 2014 Santa Ana event, peak wind gusts measured at San Miguel RAWS were 30 mph, whereas at Otay Mountain RAWS they were 58 mph. O-6.4-12*

Fuels

When assessing how current fuel conditions compare to potential future fuel conditions, it is important to note that most of the project footprint and surrounding areas has burned twice in the last 15 years. The Mine/Otay Fire (see Figure 3a) burned approximately 46,000 acres in 2003 and the Harris Fire (Figure 3b) burned approximately 90,000 acres in 2007. The FPP correctly notes that "... vegetation on the property is still in early stages of recovery toward a climax species composition." Essentially, current fuel conditions are not representative of fuel conditions after 30+ years of regrowth in the absence of fire or other disturbances. Therefore, evaluation of climax fuel conditions is critical to a proper fire safety analysis. O-6.4-13

Figure 4a below is a reproduction of Figure 4 from the FPP. This vegetation map provides species composition information that is used in the FPP to estimate climax fuel conditions for fire behavior modeling purposes. As can be seen from Figure 4a, the FPP only maps fuels within project parcels. However, when assessing potential fire/life safety impacts of a planned development, it is also important to assess fuels adjacent to the project footprint because fires ignited within the project footprint may spread into adjacent wildland or wildland urban interface areas. For that reason, Figure 4b shows a simplified vegetation map that uses Wildlife Habitat Relationships (WHR) published by FRAP[1] to map vegetation in and adjacent to project parcels. O-6.4-14*

The vegetation map in Figure 4b will be used later in the fire behavior modeling section of this letter. However, it is noted here that the red areas in Figure 4b are mapped as mixed chaparral which, in its climax condition, is conducive to rapid fire spread and long range (> 1 mile) spotting. Chaparral was a primary fuel for most of the damaging fires listed in Table 1. The orange areas in Figure 4b are mapped as coastal scrub, which generally has lower fuel loads than chaparral but can also support rapid fire spread.

[1] http://frap.fire.ca.gov/data/frapgisdata-sw-fveg_download

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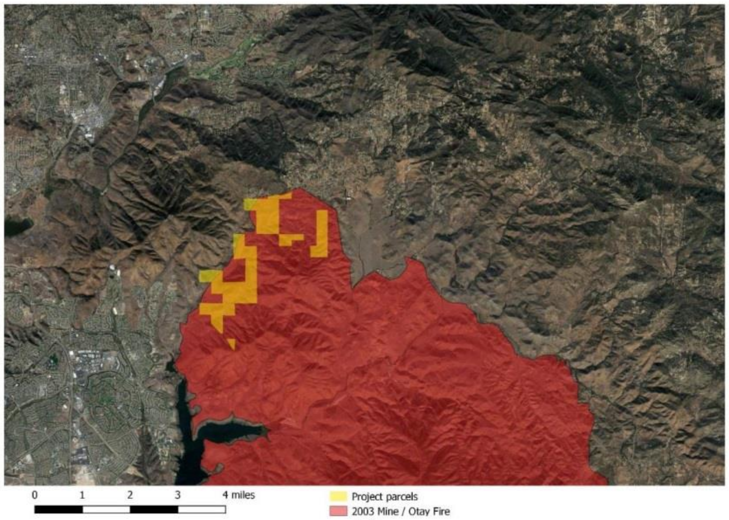

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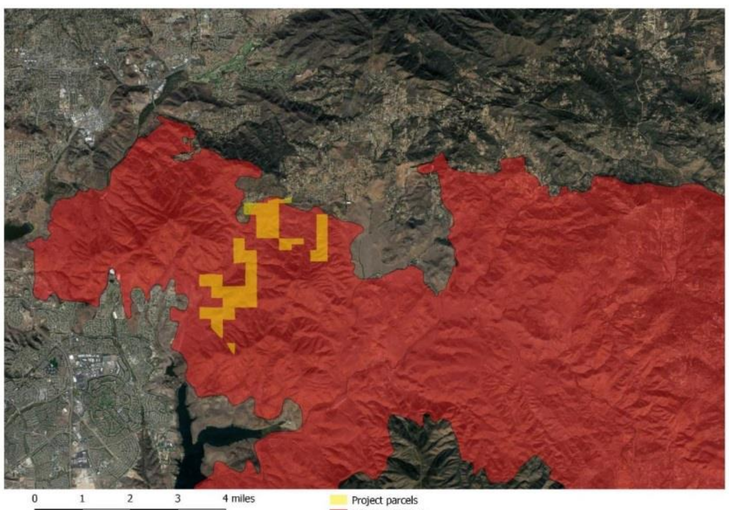

(b)

Figure 3. Recent large fires in the vicinity of the project area. (a) 2003 Mine/Otay Fire. (b) 2007 Harris Fire.

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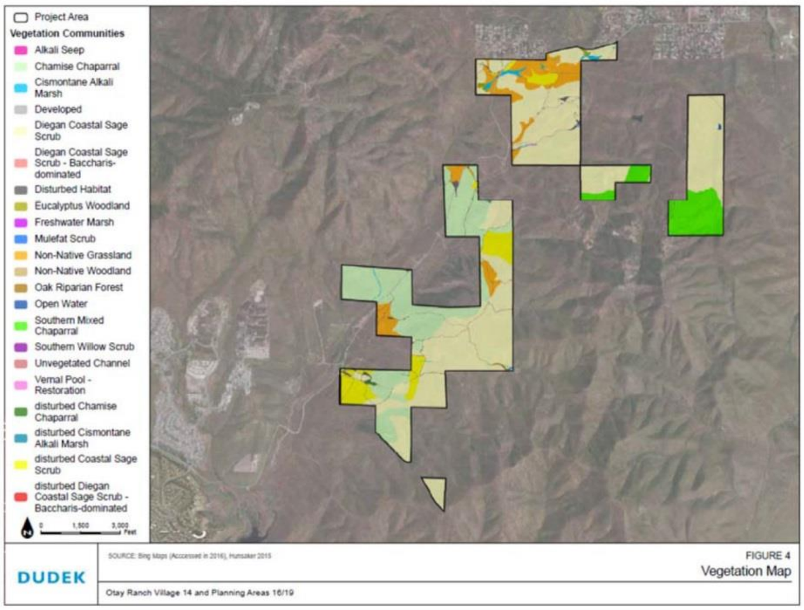

(a)

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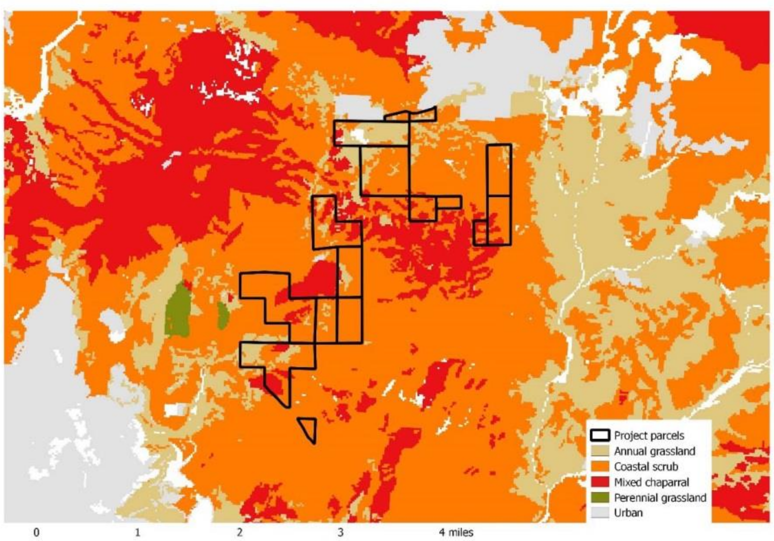

(b)

Figure 4. Vegetation in and around project site. (a) Figure 4 from FPP. (b) FVEG WHR type.

O-6.4-17

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Topography

Areas adjacent to the project footprint are characterized by complex terrain ranging in elevation from approximately 500 ft to 1,900 ft above sea level. Terrain surrounding the project area is visualized in Figure 5a with a hybrid digital elevation model / hillshade raster[2] and in Figure 5b with a slope map. Peak slope steepness in the areas adjacent to the project parcels is approximately 40 degrees (84%). Since Figure 5b gives slope in degrees but the FPP discusses slope in percent, the conversion of slope in degrees to slope in percent is given in Table 2.

The FPP states "Although slopes can range from 5% up to 40% within the Study Area, the Proposed Project's average slope to approximately 300 feet outside the perimeter of the Development Footprint is approximately 19.5%." More relevant than slope in the project footprint is slope in areas adjacent to the project footprint where a fire ignited within the project footprint would spread to. Figure 6 shows areas near the project footprint where slope exceeds 40%. While most of the project parcels are in areas where slope is < 40%, much of the surrounding country is characterized by steep hills with slopes in excess of 40%. O-6.4-18*

The significance of this is twofold:

1) Fires spread faster upslope than on flat ground, and O-6.4-19*
2) Firefighting efforts (whether with hand crews or mechanical equipment) are hindered by steep slopes. O-6.4-20*

By analyzing slope only within and immediately adjacent to the project parcels, the FPP understates the potential role that the steepness of the surrounding terrain has on fire spread and control. O-6.4-21*

Table 2. Conversion of slope in degrees to percent. O-6.4-22*

Slope (°)	Slope (%)
5	8.7
10	17.6
15	26.8
20	36.4
25	46.6
30	57.7
35	70.0
40	83.9
45	100.0

[2] A digital elevation model (DEM) is a gridded representation of terrain elevation. A hillshade raster simulates the effects of the sun's rays by drawing shadows on a map that would be cast by terrain features.

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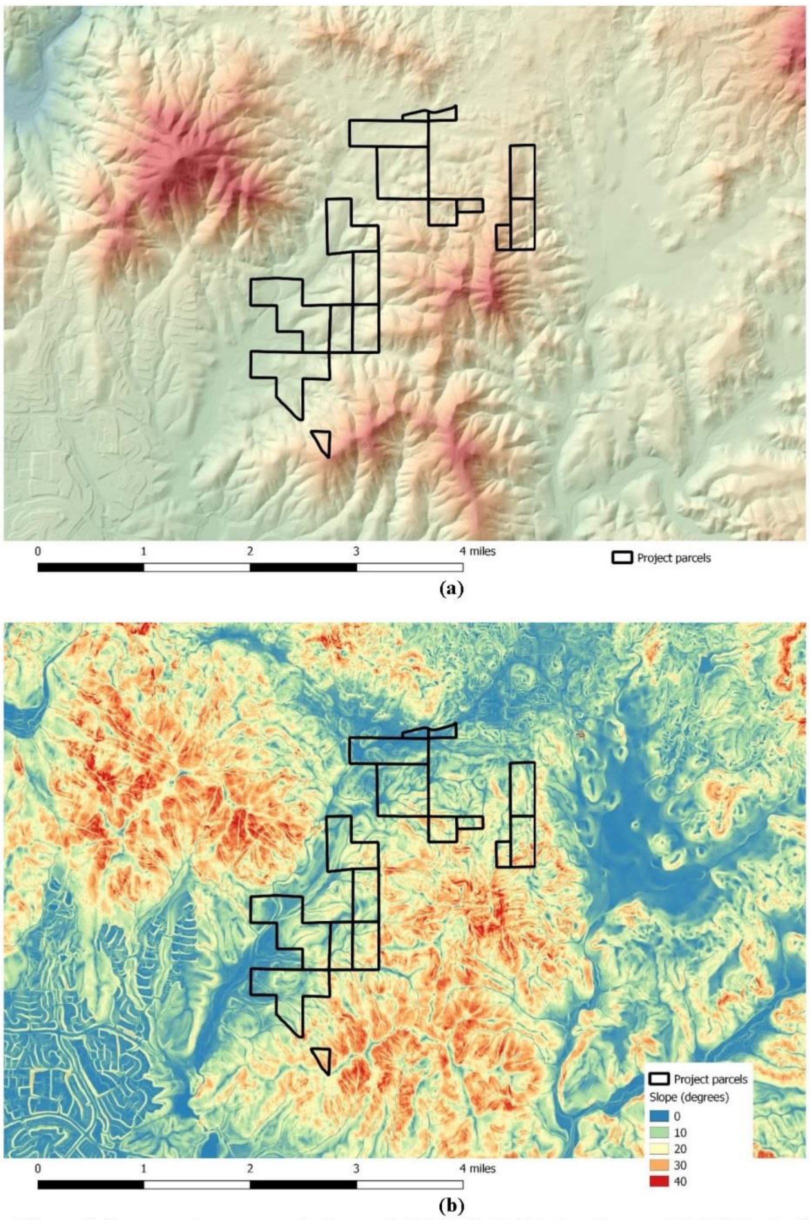

Figure 5. Topography near project area. (a) Hybrid digital elevation model / hillshade. (b) Slope.

O-6.4-23

O-6.4-24

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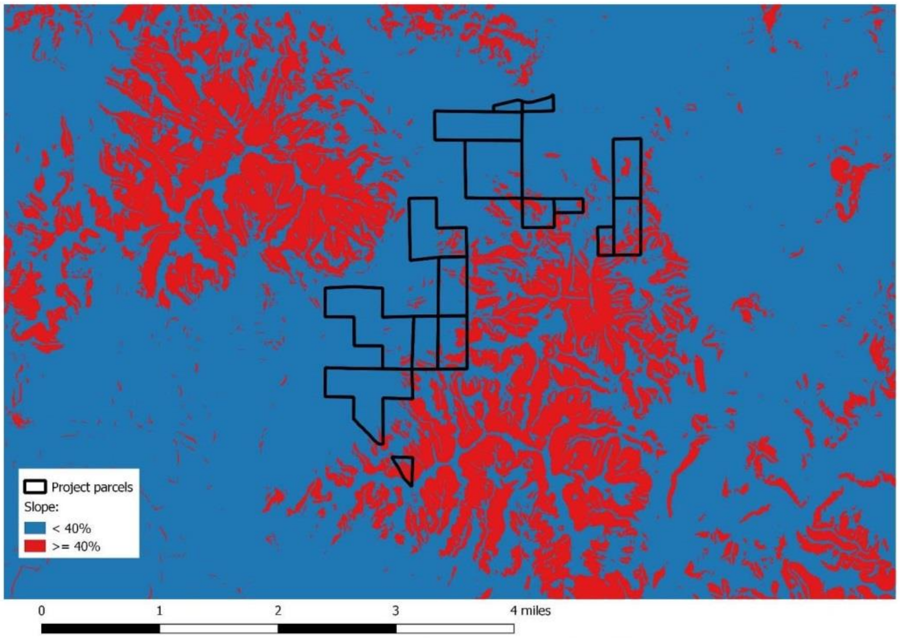

Figure 6. Areas where slope exceeds 40%.

O-6.4-25

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Fire behavior

Section 4 and Appendix E of the FPP describe fire modeling that was conducted as part of the Draft Environmental Impact Report. The FPP uses this fire modeling to provide estimated spread rates and flame lengths under various weather conditions that are in turn used to assess the efficacy of planned fuel management zones and other fire protection features. The primary inputs that affect fire modeling are fuel bed type (called a fire behavior fuel model or fuel model for short), fuel moisture content (live and dead), slope, and wind speed. O-6.4-26

As explained previously, the project site and most of the adjacent areas have burned twice in the last 15 years and current fuel conditions are not representative of climax conditions after regrowth is complete. O-6.4-27 However, climax fuel conditions can be estimated from WHR types shown previously in Figure 4b by "crosswalking" each WHR type to a fuel model. From Figure 4b, most of the WHR types in the project footprint and adjacent areas as coastal scrub with smaller amounts of mixed chaparral and grassland. In climax conditions, these WHR types can reasonably crosswalked to fire behavior fuel models as shown in Table 3:

O-6.4-28*

Table 3. Fuel models associated with WHR type under climax conditions

WHR Type	Climax fuel model
Annual grassland	1 – Short grass
Coastal scrub	SCAL18 – Sage/buckwheat
Mixed chaparral	SH5/145 – High load dry climate shrub

As a check on the fire behavior modeling presented in the FPP, BehavePlus was used here to estimate spread rate, flame length, and spotting distance over a range of wind speed and slope for the following fixed/assumed inputs:

- 1-hour dead fuel moisture content: 2%
- 10-hour dead fuel moisture content: 3%
- 100-hour dead fuel moisture content: 4%
- Live herbaceous fuel moisture content: 30%
- Live woody fuel moisture content: 60%
- Ridge to valley elevation difference: 0 ft
- Mid-flame wind speed calculated from 20-ft wind speed and calculated wind adjustment factor
- Slope: Flat, 20°, 40°
- Wind speed: 40 mph, 50 mph, 60 mph

O-6.4-29*

A range of wind speeds and slopes were analyzed to quantify potential fire behavior in the areas adjacent to the project footprint because one of the biggest fire safety impacts of this project is a fire igniting within the project footprint and spreading to adjacent areas. Fire modeling presented in the FPP appears to focus only on fire behavior in areas immediately adjacent to project parcels, as opposed to undeveloped areas > ¼ mi from the project footprint (*i.e.*, those areas to which a fire ignited within the project footprint could spread to). Based on this analysis, it is concluded the FPP underestimates potential fire behavior in the areas adjacent to the project parcels. For example, the FPP shows flame lengths of 31 ft – 34 ft in fuel model SCAL18, whereas the current results show flame lengths of 38 ft to 49 ft. O-6.4-30*

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Increase in ignition probability

Most wildland fires are caused by humans as opposed to natural causes such as lightning. Common anthropogenic causes of fire include arson/incendiary, equipment use, debris burning, smoking, vehicles, fireworks, electricity, and outdoor cooking (barbecuing). Structure fires sometimes spread and initiate wildland fires. For these reasons, it should be apparent that the presence of development in the wildland urban interface – which adds roads, structures, vehicles, and people to previously undeveloped areas – results in increased probability of fire starts.

While this conclusion is common sense, multiple scientific studies have concluded the same. A study that analyzed 27 years of data in Canada[3] concluded "Fire ignition densities decreased exponentially as distance to road or populated place increased, and largest ignition trends occurred closest to both variables." Similarly, a 2007 study entitled "Human Influence on California Fire Regimes"[4] stated: O-6.4-31

> We found highly significant relationships between humans and fire on the contemporary landscape, and our models explained fire frequency (R^2 = 0.72) better than area burned (R^2 = 0.50). Population density, intermix WUI, and distance to WUI explained the most variability in fire frequency, suggesting that the spatial pattern of development may be an important variable to consider when estimating fire risk.

For the above reasons, the planned Otay Ranch Village 14 and Planning Areas 16/19 development greatly increases the probability of ignition occurring within its footprint, which is currently mostly undeveloped land. The FPP acknowledges "The Proposed Project would introduce potential ignition sources, particularly more people in the area." This increased ignition probability introduced by the subject development increases fire risk for homes in the Eastern part of Chula Vista, particularly those East of Hunte Parkway, because a fire ignited within the project footprint under Santa Ana winds would spread directly toward Chula Vista. O-6.4-32*

Potential impacts to nearby communities

Under Santa Ana winds, a fire ignited within the project footprint would spread toward population centers to the Southwest such as the Eastern part of Chula Vista. During such fires, most structure losses occur in Widland Urban Interface (WUI) areas. Figure 7 shows the project parcels relative to WUI areas. Based on fire modeling described earlier, fires burning through shrub and chaparral vegetation between the project footprint and WUI areas to the Southwest would spread at rates of > 3 mph with flame lengths > 40 ft and spotting distances of 2+ miles. O-6.4-33*

The FPP does not adequately address adjacent communities' increased risk from fire that will be created by the Otay Ranch Village 14 and Planning Areas 16/19 Development. O-6.4-34* Instead, the DEIR and FPP conclude that the project would mitigate any increase in ignition sources with irrigated areas and fuel modification zones and that the project, due to these irrigated areas and fuel modification zones, would improve fire safety in the project area and adjacent communities. O-6.4-35* I do not agree with this conclusion because, for example, a fire ignited in Planning Areas 16/19 under Santa Ana winds would spread Southwest toward population centers through complex steep terrain vegetated by chaparral and coastal scrub at rates of several mph with spotting distances > 1 mile, largely unimpeded by fuel modification zones, irrigated areas, etc. Thus, the increase in ignition probability associated with the project has a more significant negative impact O-6.4-36*

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[3] Gralewicz, N.J., Nelson, T.A., Wulder, M.A., "Spatial and temporal patterns of wildfire ignitions in Canada from 1980 to 2006," *International Journal of Wildland Fire* **21**: 230-242 (2012).
[4] Syphard, A.D., Radeloff, V.C., Keeley, J.E., Hawbaker, T.J., Clayton, M.K., Stewart, S.I., and Hammer, R.B., "Human influence on California fire regimes," *Ecological Applications* **17** 1388–1402 (2007).

on adjacent communities' risk from fire when compared with any potential positive fire risk impacts associated with the project's fuels modification or irrigation. O-6.4-36* Cont.

O-6.4-37

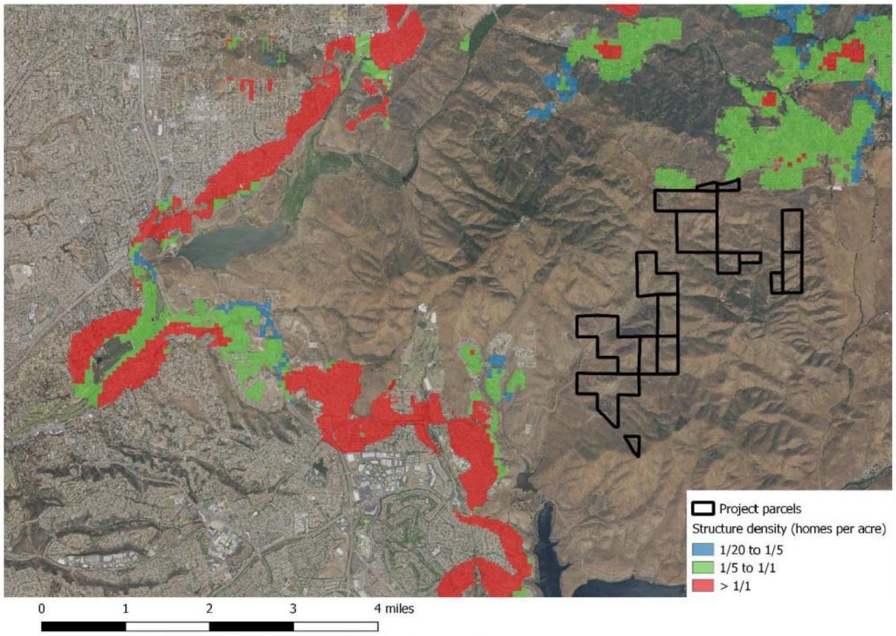

Figure 7. Project parcels relative to Wildland Urban Interface areas.

Potential impacts to evacuating occupants

Under high winds and rapidly spreading fires, occupants can become trapped in vehicles while evacuating. Proctor Valley Road is the primary evacuation route for Otay Ranch Village 14 and Planning Areas 16/19. As shown in Figure 8, it runs approximately 5.5 miles from Jamul (north) to Chula Vista (south). Proctor Valley Road runs approximately Northeast / Southwest and is therefore almost perfectly aligned with the wind direction under Santa Ana wind conditions (recall that Santa Anas blow from the Northeast toward the Southwest). Consequently, a fire traveling from Jamul toward the project footprint from the Northeast, or starting within the North part of the project footprint, may block large stretches of Proctor Valley Road simultaneously. This is not addressed in the FPP or DEIR's evacuation plan. O-6.4-38*

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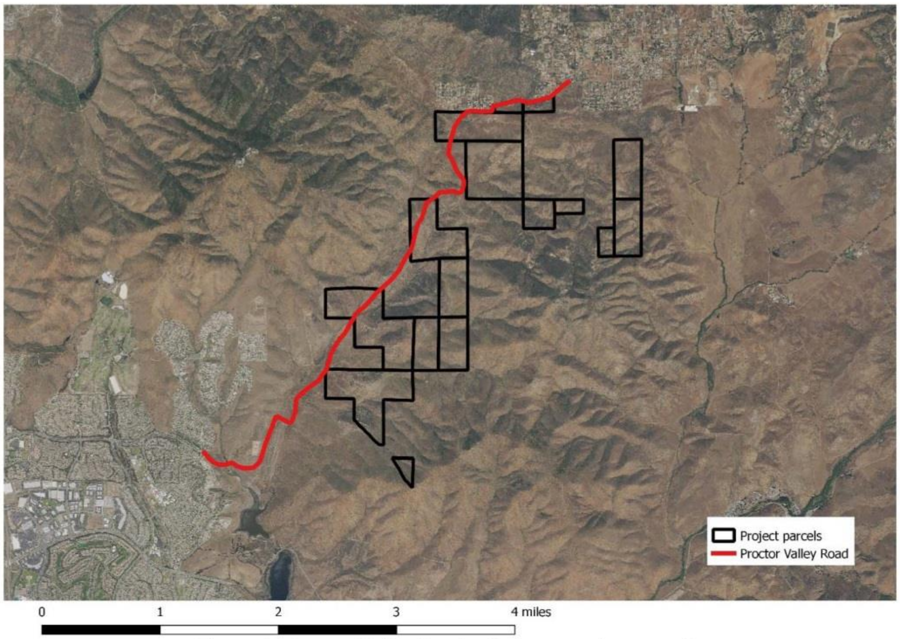

Figure 8. Proctor Valley Road relative to project parcels.

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Summary and concluding remarks

This letter and the analysis described herein have identified several deficiencies with the Draft Environmental Impact and Fire Protection Plan for the planned Otay Ranch Village 14 and Planning Areas 16/19 Development. Actual fire hazard to the project is higher than described due to factors including higher wind speeds, surrounding steep topography, and anticipated vegetation succession. The FPP also does not adequately address the increase in fire risk to adjacent communities introduced by this project due to the increased ignition probability that it presents. Collectively due to these deficiencies, the DEIR and FPP also do not address the possibility that the development's primary evacuation route, Proctor Valley Road, becomes blocked due to its alignment with wind direction under Santa Ana conditions. O-6.4-40

Sincerely,

Chris Lautenberger

Christopher W. Lautenberger, PhD, PE

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Professional Profile

Chris Lautenberger is a co-founder of Reax Engineering Inc. in Berkeley, CA. His responsibilities span building code and fire code consulting, fire science research, design of fire protection and life safety systems, thermal sciences, atmospheric processes, and forensic reconstruction of fires. Lautenberger's work combines fire/building codes and related standards with technical aspects of fire science such as combustion, heat transfer, fluid dynamics, thermodynamics, fire dynamics, and fire modeling. Dr. Lautenberger has co-taught Masters-level courses in Fire Dynamics and Fire Modeling in the Department of Fire Protection Engineering at California Polytechnic State University, San Luis Obispo. Before co-founding Reax Engineering, he worked as a Fire Protection Engineer at Arup Fire in San Francisco, CA.

Professional Licensure

Licensed Professional Engineer, State of California, # FP1676 (Fire Protection Engineering)

Education

PhD – Mechanical Engineering, University of California at Berkeley, January 2003 - December 2007
- Dissertation title: "A Generalized Pyrolysis Model for Combustible Solids"
- Major field: Combustion
- Minor fields: Wildland Fire Science and Fluid Dynamics

MS – Fire Protection Engineering, Worcester Polytechnic Institute, January 2000 - December 2001
- Thesis title: "CFD Simulation of Soot Formation and Flame Radiation"

BS – Mechanical Engineering, Worcester Polytechnic Institute, August 1995 - December 1999

Professional Experience

8/08 – present **Reax Engineering Inc.** Berkeley, CA *Founding Partner and Principal Engineer*

Representative activities:
- Fire protection engineering – code consulting, fire/life safety systems, sizing of atrium smoke exhaust systems, development of equivalencies or alternate methods of design, peer review
- Fire modeling – smoke alarm/detector activation, heat detector/sprinkler activation, time to untenability or incapacitation by smoke and heat
- Prediction of smoke and heat release rates from small-scale fire test data
- Materials and product flammability assessment – ignitability, combustion, flame spread
- General thermal sciences and fire dynamics analyses and modeling
- Wildland fire modeling and hazard/risk mapping
- Wind/weather modeling and atmospheric dispersion modeling
- Forensic fire reconstruction and origin & cause hypothesis testing

Selected Fire Protection Engineering project work:
- Calculation of Light Rail Vehicle heat release rates in the San Francisco Central Subway using fire growth modeling and fire testing (San Francisco, CA)
- Analysis of rail vehicle design fires, testing, and modeling for Los Angeles County Metropolitan Transit Authority (Los Angeles, CA)
- Material property estimation for fire development modeling in new rail vehicle
- Development of code compliance and fire protection strategy for rack storage of flammable liquid/aerosol storage in multipurpose warehouse (Reno, NV)

- Development of automatic sprinkler protection criteria and analysis of flammable liquids processes at semiconductor plant (Santa Rosa, CA)
- Analysis of building code and testing requirements for exterior wall requirements and development of an alternate means of protection (Burlington, VT)
- Analysis of building code requirements at new shared works space occupancy (Walnut Creek, CA)
- Application of computer fire modeling and egress modeling to determine appropriate smoke exhaust rate for atrium at Marist College (Poughkeepsie, NY)
- Analysis of wildland urban interface fire and life safety concerns at proposed subdivisions in Oakland, CA, St. Helena, CA, and Encinitas, CA
- Sizing of atrium smoke exhaust rate in the new Student Union Building at San Jose State University (San Jose, CA)
- Development of a model for ignition of HEPA filters by embers at the Hanford nuclear waste treatment plant (Richland, WA)
- Assessment of structural performance-based fire protection/life safety designs while acting as Owner's Representative for a hotel and casino
- Design of FM-200 clean agent fire suppression system for PG&E substation (San Mateo, CA)
- Modeling smoke and heat detector activation to develop a request for alternate means of protection at a large theater (Cincinnati, OH)
- Analysis of fire code issues related to residential gas explosion (Las Vegas, NV)
- Analysis of atrium smoke control system in residential highrise (Dallas, TX)

Selected thermal sciences & general project work:

- Heat transfer analysis and pyrolysis modeling for proposed municipal solid waste to energy incineration technology
- Thermo-chemical analysis and heat transfer modeling of biomass torrefaction (low temperature pyrolysis) reactor
- Detailed Computational Fluid Dynamics (CFD) modeling of fluid flow and heat transfer in a rotary kiln biochar reactor
- CFD-based furnace modeling, heat transfer analysis, and pyrolysis modeling of proposed screw auger wood chip pyrolysis reactor
- Development of a comprehensive three-dimensional computational model for predicting heat release and emissions from charcoal combustion
- Flammability and thermal property assessment of new wall board product
- CFD modeling of blast wave from a bird bomb
- Thermodynamic analysis of non-traditional methods for carbon capture and sequestration
- Calculation of overhead electrical utility catenary curves and excursions in high winds
- Atmospheric dispersion modeling of pollutant transport using EPA's AERMOD software

Selected wildland fire hazard analysis and modeling project work:

- Applied wind modeling and wildland fire modeling to develop a California wildland fire threat map that identifies areas at elevated risk from fires ignited by overhead electrical utilities that are co-located with communication infrastructure (this "Reax Map" was adopted by the California Public Utilities Commission [CPUC] on an interim basis in 2010)
- Retained as subject matter expert by several California electrical utilities and communications companies regarding ongoing CPUC proceedings to develop a statewide fire hazard/risk map
- Conducted high resolution wind/weather modeling to analyze historical fire weather in Southern California from 1979 – 2012
- Developed a customized wildland fire hazard model for a large electrical utility. This involved application of high-resolution numerical weather prediction and wildland fire modeling to quantify wildland fire risk associated with overhead electrical utilities
- Determined maximum reasonably foreseeable Santa Ana wind speed in Malibu Canyon using wind modeling and pole-mounted anemometers installed specifically for this project
- Developed ELMFIRE (Eulerian Level Set Model of Fire Spread), a parallelized model for simulating wildland fire spread and quantifying wildland fire risk via Monte Carlo simulation

- High resolution smoke plume modeling to assess potential for Libby Amphibole Asbestos (LAA) to be transported by large-scale wildland fires

Selected wildland fire forensic reconstructions and analyses:

- Reconstruction of initial spread of the 2011 Bastrop Complex Fire (Bastrop, TX)
- Analysis of ignition, initial spread, and smoke transport from the 2009 Murrindindi Bushfire (Victoria, Australia)
- Origin and cause hypothesis testing, fire spread modeling, and fire plume modeling for the 2007 Moonlight Fire near Westwood, CA
- Simulation of smoke transport from the 2010 Crown Fire near Palmdale, CA
- Reconstruction of the spread of the 2008 Iron Complex Fire in Northern California and assessment of the impact of firing activities on timber loss in private inholdings
- Calculation of trajectory and temperature histories of metallic particles allegedly generated by clashing between aluminum and copper electrical conductors and analysis of grass-fire ignition potential, initial spread rate, and plume dynamics (Victoria, Australia)
- Analysis of wildland fires ignited by exhaust particles from a locomotive including analysis of particle trajectories and fuel ignitability (Victoria, Australia)

Selected structure fire forensic reconstructions and analyses:

- Reconstruction of fatal fire in manufactured home (Castleberry, AL)
- Analysis of ignitability of water/antifreeze mixture discharged from residential sprinkler system, analysis of initial fire spread, and assessment of burn injuries (Herriman, UT)
- Analysis of ignition, initial spread, and effect of automatic sprinkler system failure on the outcome of the 2010 Roseville Galleria Fire (Roseville, CA)
- Origin hypothesis testing for fatal alleged arson fire (Calcasieu Parish, Louisiana)
- Fire cause hypothesis testing and analysis of residential LPG explosion for alleged arson fire (Round Mountain, CA)
- Analysis of role of inoperable fire hydrant on manual fire suppression efforts and associated property damage during total loss fire in residential apartment building (Atlanta, GA)
- Reconstruction of fatal apartment fire: inter-apartment fire spread, time to smoke alarm activation, identification of contributory building code issues (Carrboro, NC)

12/10 – present **California Polytechnic State University, San Luis Obispo** *Instructor*

- Fire Protection Engineering Instructor in Cal Poly's Masters degree program
- Teaching responsibilities include FPE 502 Fire Dynamics and FPE 504 Fire Modeling

12/07 – 2/11 **University of California at Berkeley** *Post Doctoral Researcher*

- Conducted research on NSF Grant 0730556, "Tackling CFD Modeling of Flame Spread on Practical Solid Combustibles"
- Assessed predictive capabilities of Fire Dynamics Simulator (FDS) for simulating flame spread and fire growth
- Modified subroutines to improve predictive capabilities of FDS for flame spread modeling
- Developed pyrolysis model and material property estimation techniques needed to simulate the pyrolysis of real-world solid fuels
- Developed computer model for ignition of fuel beds by hot particles and fire brands to predict ignition of fuel beds and initiation of spot fires

1/02 – 6/08 **Arup Fire** San Francisco, CA *Fire Protection Engineer*

- Assisted clients with fire safety design and achieving code compliance or performance-based solutions for hospitals, casinos, malls, libraries, schools, museums, airports, and offices
- Assessed fire performance of buildings using fire modeling and egress analyses in support of alternate methods of design
- Developed and programmed a CFAST-based Monte-Carlo fire simulator
- Simulated fire development in a rail vehicle and calibrated the model with large-scale experimental fire test data

- Representative projects include Wynn Las Vegas, Hard Rock Hotel and Casino Las Vegas, Kaiser Permanente templates, New Los Angeles Federal Courthouse, San Mateo Public Library, California Academy of Sciences, Bay Area Rapid Transit (BART) Montgomery Street Station, and Seattle Public Library

10/00 – 12/01 **FM Global Research (formerly Factory Mutual Research Corporation)** Norwood, MA

- Examined existing soot formation and oxidation models in the literature and used this research to postulate a new engineering soot model that is compatible with FDS
- Worked with FM Global and NIST scientists to add this new model for soot formation and oxidation to FDS, and performed simulations of laminar and turbulent diffusion flames

5/00 – 8/00 **Code Consultants, Inc.** Saint Louis, MO

- Responsible for examining proposed building designs for compliance with relevant codes
- Performed engineering analyses to support equivalencies

Dissertation and Thesis

1/03 – 12/07 **PhD Dissertation** *University of California, Berkeley*

- Developed a generalized pyrolysis/material decomposition model (Gpyro) to simulate the gasification, pyrolysis, and combustion of condensed-phase fuels
- Developed an optimization technique that uses a genetic algorithm to extract material pyrolysis properties needed for simulation of solid-phase pyrolysis from bench-scale fire tests
- Performed FDS-based simulations of ignition, flame spread, and fire growth in normal and reduced gravity environments as part of a NASA-sponsored project

9/00 – 12/01 **MS Thesis** *Worcester Polytechnic Institute*

- Developed a model for soot formation/oxidation in non-premixed flames
- Implemented model in FDS to calculate soot formation and flame radiation

8/98 – 5/99 **Major Qualifying Project (MQP)** *Worcester Polytechnic Institute*

- Developed an experimental program and ran several real-scale room/corner fire tests in WPI's room calorimeter to evaluate the flame spread characteristics of composite wall linings

Peer Reviewed Publications

1. Lautenberger, C., de Ris, J., Dembsey, N.A., Barnett, J.R. & Baum, H.R., "A Simplified Model for Soot Formation and Oxidation in CFD Simulation of Non-premixed Hydrocarbon Flames," *Fire Safety Journal* **40**: 141-176 (2005).
2. Lautenberger, C., Zhou, Y.Y. & Fernandez-Pello, A.C., "Numerical Modeling of Convective Effects on Piloted Ignition of Composite Materials," *Combustion Science and Technology* **177**: 1231-1252 (2005).
3. Lautenberger, C. & Fernandez-Pello, A.C., "Approximate Analytical Solutions for the Transient Mass Loss Rate and Piloted Ignition Time of a Radiatively Heated Solid in the High Heat Flux Limit," *Fire Safety Science* **8**: 445-456 (2005).
4. Lautenberger, C., Rein, G. & Fernandez-Pello, A.C., "Application of a Genetic Algorithm to Estimate Material Properties for Fire Modeling from Bench-Scale Fire Test Data," *Fire Safety Journal* **41**: 204-214 (2006).
5. Rein, G., Lautenberger, C., Fernandez-Pello, A.C., Torero, J.L. & Urban, D.L., "Application of Genetic Algorithms and Thermogravimetry to Determine the Kinetics of Polyurethane Foam in Smoldering Combustion," *Combustion and Flame* **146**: 95-108 (2006).
6. Rich, D., Lautenberger, C., Torero, J.L., Quintiere, J.G. & Fernandez-Pello, C., "Mass Flux of Combustible Solids at Piloted Ignition," *Proceedings of the Combustion Institute* **31**: 2653-2660 (2007).
7. Kwon, J.-W., Dembsey, N.A., & Lautenberger, C.W., "Evaluation of FDS v4: Upward Flame Spread," *Fire Technology* **43**: 255-284 (2007).
8. Avila, M.B., Dembsey, N.A., Kim, M.E., Lautenberger, C., & Dore, C., "Fire Characteristics of Polyester FRP composites with Different Glass Contents," *Composites Research Journal* **2**: 1-14 (2008).
9. Lautenberger, C., Kim, E., Dembsey, N. & Fernandez-Pello, C., "The Role of Decomposition Kinetics in Pyrolysis Modeling – Application to a Fire Retardant Polyester Composite," *Fire Safety Science* **9**: 1201-1212 (2008).

10. Dodd, A.B., Lautenberger, C. & Fernandez-Pello, A.C., "Numerical Examination of Two-Dimensional Smolder Structure in Polyurethane Foam," *Proceedings of the Combustion Institute* **32**: 2497-2504 (2009).
11. Lautenberger, C. & Fernandez-Pello, A.C., "Generalized Pyrolysis Model for Combustible Solids," *Fire Safety Journal* **44**: 819-839 (2009).
12. Lautenberger, C. & Fernandez-Pello, A.C., "A Model for the Oxidative Pyrolysis of Wood," *Combustion and Flame* **156**: 1503-1513 (2009).
13. Hadden, R., Scott, S., Lautenberger, C., & Fernandez-Pello, A.C., "Ignition of Combustible Fuel Beds by Hot Particles: an Experimental and Theoretical Study," *Fire Technology* **47**: 341-355 (2011).
14. Fereres, S., Lautenberger, C., Fernandez-Pello, C., Urban, D.L., & Ruff, G.A., "Mass Loss Rate at Ignition in Reduced Pressure Environments," *Combustion and Flame* **158**: 1301-1306 (2011).
15. Lautenberger, C. & Fernandez-Pello, C., "Optimization Algorithms for Material Pyrolysis Property Estimation," *Fire Safety Science* **10**: 751-764 (2011).
16. Dodd, A.B., Lautenberger, C., & Fernandez-Pello, A.C., "Computational Modeling of Smolder Combustion and Spontaneous Transition to Flaming," *Combustion and Flame* **159**: 448–461 (2012).
17. Matala, A., Lautenberger, C., & Hostikka, S., "Generalized direct method for pyrolysis kinetics parameter estimation and comparison to existing methods," *Journal of Fire Sciences* **30**: 339-356 (2012).
18. Fereres, S., Lautenberger, C., Fernandez-Pello, A.C., Urban, D.L., and Ruff, G.A., "Understanding ambient pressure effects on piloted ignition through numerical modeling," *Combustion and Flame* **159**: 3544–3553 (2012).
19. Wong, W., Alston, J., Lautenberger, C., and Dembsey, N., "CFD Flame Spread Model Validation: Multi-component Data Set Framework," *Journal of Fire Protection* Engineering **23**: 85-134 (2013).
20. Lautenberger, C., "Wildland Fire Modeling with an Eulerian Level Set Method and Automated Calibration," *Fire Safety Journal* **62**: 289-298 (2013).
21. Lautenberger, C., "Gpyro3D: A Three Dimensional Generalized Pyrolysis Model," *Fire Safety Science* **11**: 193-207 (2014).
22. Fernandez-Pello, A.C., Lautenberger, C., Rich, D., Zak, C., Urban, J., Hadden, R., Scott, S., and Fereres, S., "Spot fire ignition of natural fuel beds by hot metal particles, embers, and sparks," *Combustion Science and Technology* **187**: 269-295 (2015).
23. Yashwanth, B.L., Shotorban, B., Mahalingam, S., Lautenberger, C.W., and Weise, D.R., "A numerical investigation of the influence of radiation and moisture content on pyrolysis and ignition of a leaf-like fuel element," *Combustion and Flame* **163**: 301–316 (2016).
24. Lautenberger, C., "Mapping Areas at Elevated Risk of Large-Scale Structure Loss Using Monte Carlo Simulation and Wildland Fire Modeling," *Fire Safety Journal* **91**: 768-775 (2017).

Book Chapters

1. Lautenberger, C., Torero, J.L. & Fernandez-Pello, A.C., "Understanding Materials Flammability," in *Flammability Testing of Materials Used in Construction, Transport and Mining*, Edited by V. Apte, Woodhead Publishing, Cambridge, UK pp. 1-21, 2006.
2. Lautenberger, C. & Fernandez-Pello, A.C., "Pyrolysis Modeling, Thermal Decomposition, and Transport Processes in Combustible Solids," in *Transport Phenomena in Fires*, Edited by M. Faghri and B. Sunden, WIT Press, Billerica, MA pp. 209-248, 2008.
3. Lautenberger, C. & Fernandez-Pello, A.C., "Spotting Ignition of fuel beds by firebrands," in *Computational Methods and Experimental Measurements XIV*, Edited by C.A. Brebbia and G.M. Carlomango, WIT Press, Billerica, MA pp. 603-612, 2009.
4. Lautenberger, C. & Hostikka, S., "Large Scale Fire Modeling," in *Flame Retardancy of Polymeric Materials*, Second Edition, Edited by C.A. Wilkie and A.B. Morgan, Marcel Dekker pp. 551 – 585, 2010.
5. Lautenberger, C., Tien, C.L., Lee, K.Y., and Stretton, A.J., "Radiation Heat Transfer," in *SFPE Handbook of Fire Protection Engineering*, 5th Edition, Springer, pp. 102-137 (2016).

Selected Conference Publications and Technical Reports

1. Beyler, C., Hunt, S., Lattimer, B., Iqbal, N., Lautenberger, C., Dembsey, N., Barnett, J., Janssens, M., & Dillon, S. "Prediction of ISO 9705 Room/Corner Test Results". United States Department of Transportation. United States Coast Guard Research and Development Center. Washington, DC. 1999.
2. Lautenberger, C., Stevanovic, A., Rich, D., & Torero, J., "Effect of Material Composition on Ignition Delay of Composites," *Composites 2003*, Anaheim CA, October 2003.
3. Lautenberger, C., Stevanovic, A., Rich, D., Torero, J. & Fernandez-Pello, A.C., "An Experimental and Theoretical Study on the Ignition Delay Time of Composite Materials," *Western States Section/The Combustion Institute*, Los Angeles CA, October 2003.

4. Rein, G., Lautenberger, C., Fernandez-Pello, A.C., Torero, J.L. & Urban, D.L., "Derivation of the Kinetics Parameters of Polyurethane Foam Using Genetic Algorithms," *Fourth Joint Meeting of the US Sections of the Combustion Institute*, Philadelphia PA, March 2005.
5. Rein, G., Lautenberger, C. & Fernandez-Pello, A.C., "On the Derivation of Polyurethane Kinetics Parameters Using Genetic Algorithms and its Application to Smoldering Combustion," *Fourth International Conference on Computational Heat and Mass Transfer*, Paris France, Vol. 1 pp. 578-584, May 2005.
6. Rein, G., Lautenberger, C. & Fernandez-Pello, A.C., "Using Genetic Algorithms to Derive the Parameters of Solid-Phase Combustion from Experiments," *20th International Colloquium on the Dynamics of Explosions and Reactive Systems*, Montreal, Canada, August 2005.
7. Rich, D., Lautenberger, C., McAllister, S. & Fernandez-Pello, A.C., "Microgravity Flame Spread Rates Over Samples of Polymer and Polymer/Glass Composites," *Western States Section/The Combustion Institute*, Boise ID, March 2006.
8. Coles, A., Wolski, A., Lautenberger, C.W., & Dembsey, N.A., "Building Code Requirements for Performance Based Designs and Fire Modeling", *Composites 2006*, St. Louis, MO, October 2006.
9. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., "Modeling the Effect of Environmental Variables on Opposed-Flow Flame Spread Rates with FDS," *International Congress on Fire Safety in Tall Buildings*, Santander, Spain, October 2006.
10. McAllister, S., Rich, D., Lautenberger, C., & Fernandez-Pello, C., "Modeling Microgravity and Normal Gravity Opposed Flame Spread over Polymer/Glass Composites," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 2007, AIAA Paper 2007-740.
11. Lautenberger, C., McAllister, S., Rich, D., & Fernandez-Pello, C., "Effect of Environmental Variables on Flame Spread Rates in Microgravity," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 2007, AIAA Paper 2007-383.
12. Chatterjee, P., de Ris, J.L., & Lautenberger, C.W., "A General Combustion Model for Radiation Dominated Non-premixed Flames," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, 2007.
13. McAllister, S., Rich, D., Lautenberger, C., Fernandez-Pello, C. & Yuan, Z.G., "Modeling Microgravity and Normal Gravity Flame Spread Rates over Samples of Polymer and Polymer/Glass Composites," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007.
14. Lautenberger, C. & Fernandez-Pello, C., "A Generalized Pyrolysis Model for Combustible Solids," *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007.
15. Coles, A., Wolski, A., & Lautenberger, C., "Using Fire Dynamics Simulator for Fire Growth Modeling," *Interflam 2007*, London, UK, September 2007.
16. Dembsey, N., Avila, M., Kim, E., Lautenberger, C., & Dore, C., "Fire Characteristics of Polyester FRP Composites with Different Glass Contents," *Composites & Polycon 2007* Tampa, FL, October 2007.
17. Lautenberger, C. & Fernandez-Pello, A.C., "Modeling Ignition of Combustible Fuel Beds by Embers and Heated Particles," *Forest Fires 2008*, 2008.
18. Coles, A., Lautenberger, C., Wolski, A., Smits, B., & Wong, K., "Using Computer Fire Modeling to Reproduce and Predict FRP Composite Fire Performance," *Composites & Polycon 2009*, 2009.
19. Kim, E., Dembsey, N., & Lautenberger, C., "Parameter Estimation for Pyrolysis Modeling Applied to Polyester FRP Composites with Different Glass Contents," *Fire and Materials 2009*, 2009.
20. Lautenberger, C., Wong, W., Dembsey, N., Coles, A., & Fernandez-Pello, C., "Large-Scale Turbulent Flame Spread Modeling with FDS5 on Charring and Noncharring Materials," *Fire and Materials 2009*, 2009.
21. Coles, A., Wolski, A., & Lautenberger, C., "Predicting Design Fires in Rail Vehicles," *13th International Symposium on Aerodynamics and Ventilation of Vehicle Tunnels* (ISAVVT 13), 2009.
22. Dodd, A.B., Lautenberger, C., & Fernandez-Pello, A.C. "Numerical Modeling of Smoldering Combustion and Transition to Flaming," *Sixth US National Combustion Meeting*, University of Michigan, Ann Arbor, MI, 2009.
23. Scott, S, Hadden, R., Fereres, S., Lautenberger, C., & Fernandez-Pello, A.C., "Ignition of Combustible Fuel Beds by Embers and Heated Particles," *Western States Section/The Combustion Institute*, Irvine, CA, October 2009.
24. Fereres, S., Lautenberger, C., Fernandez-Pello, C., Urban, D., & Ruff, G., "Effect of Ambient Pressure on Mass Loss Rate at Piloted Ignition," *Western States Section/The Combustion Institute*, Boulder, CO, March 2010.
25. Lautenberger, C., Rich, D., Kramer, M., Fernandez-Pello, C., and Stephens, S., "Communication Infrastructure Provider Assets in the Wildland Setting: CIP Fire Threat Map," June 9, 2010.
26. Lautenberger, C., Wong, W.C., Coles, A., Dembsey, N., & Fernandez-Pello, C., "Comprehensive Data Set for Validation of Fire Growth Models: Experiments and Modeling," *Interflam 2010*, Nottingham, UK, July 2010.
27. Thiry, A., Suzanne, M., Bellivier, A., Bazin, H., Coppalle, A., & Lautenberger, C., "Different Approaches for Fire Source Modeling – Application to Arcueil Experiments," *Interflam 2010*, Nottingham, UK, July 2010.

28. Dodd, A., Lautenberger, C., Fernandez-Pello, C., & Putzeys, O., "Examination of the Spontaneous Transition from Smoldering to Flaming: Comparison of Simulations and Experiments," *Interflam 2010*, Nottingham, UK, July 2010.
29. Fereres, S., Lautenberger, C., Fernandez-Pello, C., Ruff, G., & Urban, D., "Modeling the effect of ambient variables on piloted ignition of solid combustible materials," *Seventh US National Combustion Meeting*, March 2011.
30. Matala, A., Lautenberger, C., & Hostikka, S., "Direct method for estimation of pyrolysis kinetics and comparison to existing methods," *Seventh US National Combustion Meeting*, March 2011.
31. Lautenberger, C., "Modeling Wildland Fire Spread Using an Eulerian Level Set Method and High Resolution Numerical Weather Prediction," *International Congress on Fire Computer Modeling*, October 2012, Santander, Spain.
32. Lautenberger, C., Sexton, S., & Rich, D., "Understanding Long Term Low Temperature Ignition of Wood," *International Symposium on Fire Investigation Science and Technology*, College Park, MD, September 22-24, 2014, p. 361.
33. Zicherman, J., Lautenberger, C., & Wolski, A., "Challenges in Establishing Design Fires for Passenger Rail Vehicles," *Proceedings of Fire and Materials 2015*, Interscience Communications, February 2-4 2015, San Francisco, CA, pp. 749 – 764.

Short Courses

1. *Lawrence Livermore National Laboratories Fire Modeling Short Course – A Short Course Presented to Fire Protection Engineers.* Co-taught, with Professor James Milke (University of Maryland) and Professor Frederick Mowrer (California Polytechnic State University), a 3-day short course on fire dynamics and fire modeling for Lawrence Livermore and Lawrence Berkeley National Laboratories employees (March 20 – 22, 2012).

Selected Presentations and Invited Lectures

1. "A Practical CFD Model for Soot Formation and Flame Radiation," *International Conference on Engineered Fire Protection Design*, San Francisco, CA, June 13, 2001.
2. "Effect of Material Composition on Ignition Delay of Composites," *Composites 2003 Convention and Trade Show*, Anaheim, CA, October 2, 2003.
3. "Experimental and Theoretical Study on Ignition Delay of Composites," *Western States Section of the Combustion Institute Fall 2003 Meeting*, Los Angeles, CA, October 20, 2003.
4. "Approximate Analytical Solutions for the Transient Mass Loss Rate and Piloted Ignition Time of a Radiatively Heated Solid in the High Heat Flux Limit," *The Eighth International Symposium on Fire Safety Science*, Beijing, China, September 20, 2005.
5. "Effect of Environmental Variables on Flame Spread Rates in Microgravity," *45th AIAA Aerospace Sciences Meeting and Exhibit*, Reno, NV, January 8, 2007.
6. "Generalized Pyrolysis Model for Combustible Solids," *2007 Annual Fire Conference*, National Institute of Standards and Technology, Gaithersburg, MD, April 4, 2007.
7. "Generalized Pyrolysis Model for Combustible Solids," *5th International Seminar on Fire and Explosions Hazards*, Edinburgh, UK, April 24, 2007.
8. "Generalized Pyrolysis Model for Combustible Solids," FM Global Research, Norwood, MA, June 19, 2007 (invited seminar).
9. "Pyrolysis Modeling – What Level of Accuracy is Needed to Match Current Gas-Phase Accuracy?," *The Ninth International Symposium on Fire Safety Science*, Fire Spread Modeling Workshop, Karlsruhe, Germany, September 21, 2008 (invited presentation).
10. "Estimating Material Properties for Numerical Pyrolysis Modeling from Laboratory Experiments," *The Ninth International Symposium on Fire Safety Science*, Karlsruhe, Germany, September 21, 2008 (invited presentation).
11. "The Role of Decomposition Kinetics in Pyrolysis Modeling – Application to a Fire Retardant Polyester Composite," *The Ninth International Symposium on Fire Safety Science*, Karlsruhe, Germany, September 26, 2008.
12. "Fire Growth Modeling in Buildings – Where We Are and Where We Need to Be," IIE Seminar, University of Edinburgh, Edinburgh, UK, October 30, 2008 (invited seminar).
13. "Some Unsolved Problems in Fire Dynamics: The Needed Physics and Mathematics," *Mathematical Problems in Fire Safety Engineering Joint Workshop*, Edinburgh, UK, October 31, 2008 (invited seminar).
14. "Large-Scale Turbulent Flame Spread Modeling with FDS5 on Charring and Noncharring Materials," *Fire and Materials 2009*, San Francisco, CA, January 26, 2009.

15. "Fire Growth Modeling: Small-Scale Flammability Tests to Large Scale Fire Behavior," *ASTM E5 Research Review*, Vancouver, BC, June 15, 2009 (invited presentation).
16. "Optimization Algorithms for Material Pyrolysis Property Estimation," *The Tenth International Symposium on Fire Safety Science*, College Park, MD, June 21, 2011.
17. "The Role of Fire Science, Fire Dynamics, and Fire Modeling in Testing Forensic Fire Investigation Hypotheses," IIE Seminar, University of Edinburgh, Edinburgh, UK, August 20, 2012 (invited seminar).
18. "Modeling Wildland Fire Spread Using an Eulerian Level Set Method and High Resolution Numerical Weather Prediction," *International Congress on Fire Computer Modeling*, October 19, 2012, Santander, Spain.
19. "Gpyro3D: A Three Dimensional Generalized Pyrolysis Model," *The Eleventh International Symposium on Fire Safety Science*, Christchurch, New Zealand, February 10, 2014.
20. "Understanding Long Term Low Temperature Ignition of Wood," *International Symposium on Fire Investigation Science and Technology*, College Park, MD, September 22, 2014.
21. "Current Status of Applied Fire Dynamics Simulations," 2015 Northern California/Nevada SFPE Fire Protection Engineering Seminar, San Ramon, CA, April 8, 2015 (invited seminar).

Publication and Presentation Awards

- Best Paper Overall at *Composites & Polycon 2007*, Tampa, FL, October 2007 for Dembsey, N. *et al.*, "Fire Characteristics of Polyester FRP Composites with Different Glass Contents," presented by N. Dembsey.
- Best paper (second prize) at the *Fifth International Seminar on Fire and Explosion Hazards*, Edinburgh, UK, April 2007 for Lautenberger, C. & Fernandez-Pello, C., "Generalized Pyrolysis Model for Simulating Charring, Intumescent, Smoldering, and Noncharring Gasification," presented by C. Lautenberger.
- 2011 International Association for Fire Safety Science Best Thesis Award (Americas Region) for 2007 PhD Dissertation entitled "Generalized Pyrolysis Model for Combustible Solids". This IAFSS award recognizes the best research dissertation at the PhD and Masters levels in the field of fire safety science and engineering that was completed between 2007 and 2010.
- International Association for Fire Safety Science Best Paper Award (honorable mention) for 2008 paper entitled "The Role of Decomposition Kinetics in Pyrolysis Modeling – Application to a Fire Retardant Polyester Composite," by Lautenberger, C., Kim, E., Dembsey, N. & Fernandez-Pello, C. [*Fire Safety Science* **9:** 1201-1212 (2008)].
- 2014 Society of Fire Protection Engineer's Jack Bono Award for the paper from Volume 23 of the *Journal of Fire Protection Engineering* that has most contributed to the advancement and application of professional Fire Protection Engineering for the paper entitled "CFD Flame Spread Model Validation: Multi-component Data Set Framework," by Wong, W., Alston, J., Lautenberger, C., and Dembsey, N., [*Journal of Fire Protection Engineering* **23**: 85-134 (2013)].
- 2017 Philip Thomas Medal of Excellence. This is awarded to the author(s) of the best paper presented at the previous International Association for Fire Safety Science (IAFSS) Symposium. It is based on five criteria that are used to identify the best paper: pertinence, utility, significance, rationality, and eloquence.

Conference/Journal Advisory Boards/Technical Committees

- Associate Editor of *Fire Technology*, 2014 - present
- Member of Scientific Advisory Board for *International Congress on Combustion and Fire Dynamics*, Santander, Spain, October 2010
- Member of Technical Program Committee (Compartment Fires) for the *Tenth International Symposium on Fire Safety Science* (IAFSS Symposium), College Park, MD, June 2011
- Member of Scientific Advisory Board for *International Congress on Fire Computer Modeling*, Santander, Spain, October 2012

Journal Referee / Peer Review

- *Advances in Engineering Software*
- *Advances in Materials Science and Engineering*
- *Applied Thermal Engineering*
- *Artificial Intelligence Review*
- *Asia-Oceania Symposium on Fire Science and Technology*
- *Brazilian Journal of Chemical Engineering*
- *Chemical Engineering Science*

- *Combustion and Flame*
- *Combustion Science and Technology*
- *Construction and Building Materials*
- *Ecological Modeling*
- *Energy & Fuels*
- *Engineering Science and Technology*
- *Experimental Thermal and Fluid Science*
- *Express Polymer Letters*
- *Fire and Materials*
- *Fire Safety Journal*
- *Fire Safety Science* (IAFSS Symposia)
- *Fire Technology*
- *Fuel Processing Technology*
- *Industrial & Engineering Chemistry Research*
- *International Colloquium on the Dynamics of Explosions and Reactive Systems*
- *International Journal of Computational Fluid Dynamics*
- *International Journal of Heat and Mass Transfer*
- *International Journal of Thermal Sciences*
- *International Journal of Wildland Fire*
- *Journal of Advances in Modeling Earth Systems*
- *Journal of Fire Protection Engineering*
- *Journal of Fire Sciences*
- *Proceedings of the Combustion Institute*
- *Science of the Total Environment*
- *Thermochimica Acta*

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