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February 3, 2014

Mr. Kevin Canning
OC Public Works/OC Planning
300 N. Flower Street, POB 4048
Santa Ana, CA 92702-4048

RE: Esperanza Hills Project (Sch# 2012121071) DEIR #616

Dear Mr. Canning,

Please consider the following expert comments upon the Esperanza Hills Project EIR related to the Public Safety impacts of the Project.[1] The Project as currently proposed has significant adverse fire safety impacts that are not adequately mitigated to a level of insignificance.

Fire and Land Use experts have stated that we need to stop expanding the wildland-urban-interface within the most hazardous fire vulnerable topography.

> *"Preventing homes from being built in rugged fire prone zones should be a priority. Right now, the focus has been on clearing a defensible space around homes. It's becoming real clear that that's not going to solve our problem."*[2] Dr. Jon Keeley

Unfortunately, the Esperanza Hills Project would continue the practice of building within extremely hazardous sites, while attempting to justify the significant public safety impacts of doing so by applying various design features. Developers have spawned a whole new industry often composed of former fire officials utilized to design "Fire Protection Plans". At too many potential project sites, those employed profit by creating rationalizations that provide developers and decision-makers with a false sense of confidence while placing the pubic at significant risk.

The Project is located entirely within a Very High Fire Hazard Severity Zone (VHFHSZ). Fire history makes clear that it is not a question of if a major firestorm will occur, but when the next firestorm will occur.

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[1] Van Collinsworth is a Natural Resource Geographer and former US-Forest Service Wildland Firefighter. Collinsworth has reviewed environmental documents during the last 20 years (including Fire Protection Plans) and provided expert depositions to the courts in regard to these documents. Resume Attached.

[2] "San Diego's Fire Readiness Called into Question" Fox 6 News fire forum coverage, November 27, 2007.

The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP) fundamental contradiction resides within the title itself. If the homes were not susceptible to combustion, there would not be a need for a fire evacuation plan. The FPEEP acknowledges the Project's vulnerability to fire by attempting to address the need for evacuation.

> *"However, during extreme fire conditions, there are no guarantees that a given structure will not burn… wildfires may occur in the area that could damage property or harm persons… the proposed project… should not be considered a shelter-in-place site… Accordingly, evacuation of the site and the area should occur…"*[3]

> *"This FPEP doe not provide a guarantee that all residents and visitors or community members will be safe at all times… The system of fire protection features must be properly maintained for it to function as designed. Even then, fire can compromise the fire protection features through various, unpredictable ways."*[4]

The FPEEP acknowledges that during San Diego County's Cedar and Witch Creek Fires, that homes built with the most recent codes at the time were lost.[5] Its declaration that the homes represented a small percentage of the homes lost is misleading because it fails to mention that homes built with those standards were also a smaller total of the homes threatened. There needs to be an "apple to apples" comparison with a better understanding of the touted improvements so that the potential fire resistance gains are not overestimated and used to rationalize placing people and structures within even higher risk topography.

Fire Safety Impacts for the site are considered significant at the following thresholds.[6]

> *"Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands."*

> *"Impair Implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?"*

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[3] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 104
[4] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 97
[5] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 2.
[6] Esperanza Hills Draft EIR, Chapter 5 – Environmental Setting, Impacts and Mitigation Measures, 5.7 Hazards and Hazardous Materials, Page 5-296.

The EIR at Table 5-7-4 acknowledges that control efforts at the fire head are probably ineffective for fires with flame lengths ranging from 4-8 feet and that for flame lengths over 8 feet "control efforts at the head of the fire are ineffective."[7] The EIR further acknowledges that flame lengths for both Summer and Fall fires are expected to exceed eleven feet. Therefore, fires that ignite under extreme weather conditions are likely to spread rapidly and consume all continuous fuels in the path of the fire head. Under firestorm conditions, it is probable that people and structures in the vicinity of the wildland interface will face a significant threat of loss, injury or death (especially at the fire head).

The EIR acknowledges:

> *"Evacuation of residents would typically occur during large wildfire events that, due to weather patterns and difficulty in gaining control, could threaten the community… Allowance of* ***adequate time will be a key factor*** *in determining the evacuation time frame so that roads do not become congested."* [8]
>
> *"Compliance with the OCFA Ready, Set, Go Program* ***requires early*** *evacuation, and the HOA is required to conduct annual training of the project residents regarding evacuation procedures."* [9]
>
> *"Under extreme weather conditions wildfire may behave aggressively and unpredictably, significantly increasing the area directly affected … Winds associated with extreme weather can carry airborne embers miles ahead of the active fire front,* ***igniting new fires that exponentially accelerate the fire spread rate and proportionally cut down the available time for evacuation****."*[10]
>
> "*The City of Yorba Linda has* ***not*** *prepared a Community Evacuation Plan*. "[11]

The EIR acknowledges that there may not be enough time to evacuate the Project[12] and without substantiation, the EIR concludes that in the event a wildfire would not

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[7] Table 5-7-4 Fire Suppression Interpretation, Esperanza Hills Draft EIR, Chapter 5 – Environmental Setting, Impacts and Mitigation Measures, 5.7 Hazards and Hazardous Materials, Page 5-287.
[8] EIR, Page 5-317, (bold emphasis added).
[9] EIR, Page 5-37, (bold emphasis added).
[10] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 91 (bold emphasis added).
[11] EIR, Page 5-337
[12] *"If community-wide evacuation… is not possible due to dangerous conditions on area roads that would be used for relocating and may effect residents from older, more vulnerable communities… priority residents (described below) will be instructed to temporarily relocate out of the community or to a neighbor's home in the interior of*

allow enough time to safely evacuate the Project, "*an on-site relocation alternative to evacuation is included in the emergency evacuation planning*."[13]

The statement is meaningless in practice because the EIR does not identify dependable "on site relocation alternatives". The Project is a sprawl subdivision without public structures designed for and designated as entrapment shelters. There is no evidence to indicate that private residents will open their homes during a firestorm to other residents (known or unknown) that flee to their doors in a panic, which is a fundamental assumption of the FPEEP.

The EIR bases its finding of insignificance in part upon mitigation that is not feasible: Fire authorities cannot force residents into early evacuation (the City has not even completed a Community Evacuation Plan), nor can they require busy residents to participate in annual training on evacuation procedures. *Public safety impacts remain significant*.

The EIR's conclusions regarding evacuation and shelter in place lack supporting evidence, are controversial and are contradictory

> *"Residents will know that their homes have been constructed to **resist** ignition…resulting in orderly evacuation." "... Evacuation Plan will allow the option for residents to shelter within their homes or in homes not on the direct fire line…"*[14]

If residents are "sheltering" then they are not evacuating "early." They are sheltering until they are forced not to by fire or they panic. If they are evacuating they may be doing so at the direction of public officials, or they may be utilizing their own unprofessional judgment about timing based upon their own interpretation of the mixed messages regarding sheltering and evacuation.

> *"When communications with authorities are not possible, "residents will utilize situational awareness to … make determination to evacuate or conduct temporary on-site sheltering…"*[15]

Lack of, or mistaken "situational awareness" has cost the lives of many professional firefighters. It is not something feasible to be instilled in the general public. Firestorms create their own weather. The fire head's direction can change at any time. Fire whirls and fire tornados can transfer deadly convective or radiant heat at

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the community… evacuation of the community… may require in excess of 1.5 hours… there may be circumstances where less than 1.5-2 hours are available… on-site refuge as a last resort in an emergency wildfire situation." FPEEP Page 82.

[13] EIR, Page 5-318.

[14] EIR, Page 5-339 (bold emphasis added).

[15] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 98

any time with little or no warning. Suggesting that people evacuate early, but have the option to stay in place, or can shelter in someone's home that they don't even know during an emergency introduces the potential for confusion and panic. It also places those homes where residents have ceiled themselves as much as possible at risk of opening themselves to embers, smoke and heat intrusion at exactly the wrong time if someone else is forced to abandon burning structures to request shelter.

What steps are "sheltering" residents [those who have made the decision to shelter] supposed to take in the event of cluster burns that impact or potentially impact their shelter/s?

The FPEEP also makes unsupported assumptions regarding the capabilities of the HOA and the availability of professional personnel.

> *"… an HOA governed community (assuming the HOA is strong and active) has a population that more readily accepts instruction regarding safety rules, including fire evacuation requirements."*[16]

> *"… it would be anticipated that law enforcement and/or fire personnel would be on site to help direct traffic…"*[17]

In fact, major incidents in Southern California are known to overlap and cause the shortage of emergency responders and absence at most of the fire active wildand-urban-interface. The capability assumptions above are significant flaws in the plan.

The EIR downplays Fire Risk introduced by the Project

The FPEEP asserts that the Project "*provides risk reduction to neighboring communities with older, more fire vulnerable structures*"[18]

This assertion is unsubstantiated, incorrect and should be stricken from the EIR.

In fact, the Project creates substantial new wildland-urban-interface (WUI) in need of emergency response that potentially diverts and dilutes available fire suppression resources from the existing WUI. The Orange County Fire Authority (OCFA) preliminary report on the Freeway Complex Fire recognizes, "…*urban conflagrations are beyond the ability of a fire agency to control with initial response*

[16] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 89.
[17] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 90.
[18] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 2.

resources and that triage decisions must be made as to which structures to defend."[19] Some of the homes that burned in the Project vicinity during the Freeway Complex Fire could have been saved if fire resources were not already occupied elsewhere when the structures initially ignited.[20] Fire resources are already overwhelmed by the extent of the existing WUI during major incidents. Furthermore, the conversion of native lands to extensive fuel management zones often converts more fire resistant vegetation into weeds and exotic flash fuels that are two-way fire conduits at greater risk of ignition and rapid rates of initial spread.

The Project is not sited adjacent to existing development, but instead embeds itself within fuels ignitable through embers, radiant heat or flame impingement. The report on the Freeway Complex Fire losses notes the general insulation of homes from direct flame impingement contrasted by their vulnerability to air born embers.[21] Furthermore, the ability to backfire from older homes along the existing WUI is precluded by locating structures and circulation routes in the path of potential backfire operations.[22] The continued vulnerability of existing homes to wind driven embers coupled with the dilution/diversion of fire suppression

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[19] Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, Page 15. *"Triaging of homes in regard to an urban conflagration is very similar to what a paramedic would do for a mass casualty incident. Triage is to allow the organization to do the most good for the greatest number of people when the available resources do not match the need. This same goal applies to the triage of structures in a wildland urban interface fire. Fire personnel are trained to recognize which structures are least-salvageable and then to direct their efforts toward saving those structures that have the greatest potential to be saved. However, even with the best training and practice it takes great discipline to trade off the life of one patient for another, just as it takes the same discipline to drive past a structure that is on fire to defend one that is not. These triage decisions are often made in seconds with little more information than firefighters can gather as they drive down a smoky and ember ridden street."*

[20] Resident Edward Schumann's home burned in the 2008 fire. Mr. Schuman was told by a firefighter that the fire was in his attic and there were no resources available to extinguish it. Also, "*Brush clearance and "hardened" (ignition resistant) homes go far in improving the chances for a home's survival from a wind-driven WUI fire. However, intervention by firefighters is often necessary in saving a home that is determined to be defensible.*" Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, P. 7.

[21] *"Properly established and maintained brush clearance is typically very effective in protecting homes for direct flame impingement and radiant heat. However, it can do little to nothing to protect homes from ember intrusion. Homes must be constructed to withstand ignition from embers that land on homes or enter through attics and other openings."* Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, Page 6.

[22] Backfiring Standard Operating Procedures, Novato Fire Protection District, (attachment).

resources over a longer WUI and the preclusion of backfiring tactics, is a significant adverse impact of Project location/configuration.

In addition, water supply dwindled and hampered the effectiveness of available resources during the Freeway Complex Fire. Water supply would be further taxed by building additional homes / expanding the WUI in the Project vicinity. The report on the Freeway Complex Fire makes clear that water supply cannot be assured during a severe wildland firestorm.

> *"The demands of a single structure fire can tax even a well functioning water system. In contrast to the usual situation where an engine will pump directly from a hydrant to fight a structure fire, in a wildland event the hydrants are used to refill the water tenders and the engine water tanks. The engines then usually use their tank water to attack the fires during their mobile suppression efforts. As ground forces moved into threatened neighborhoods and tried to extinguish or defend dozens of homes, the Yorba Linda water supply was severely impacted. At approximately 2:00 P.M., several radio calls were received reporting fire companies encountering low or no water pressure in various sections of the Hidden Hills area. Fire companies encountered low or no water pressure on Hidden Hills Road, Mission Hills Lane, High Tree Circle, Fairwood Circle, Green Crest Drive, Skyridge Drive and others. With homes burning on multiple fronts Strike Team Leaders directed companies to move to areas that had available water."*[23]

For all of the reasons above, the sheltering benefit asserted by the EIR is limited and inconsequential relative to the severe adverse impacts of diluting availability of fire suppression resources / expanding the WUI, precluding backfire tactics, taxing firefighter water supply and locating new families in harm's way. Clearly, the current Project *exposes people or structures to a significant risk of loss, injury or death involving wildland fires.*

It is also important to recognize that standardized fuel modification zones generally sufficient to prevent structure ignition from direct flame impingement does not assure survival of the associated structures.[24] Even though 189 structures were

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[23] Freeway Complex Preliminary Report to City of Yorba Linda, OCFA, December 2, 2008, Page 13.

[24] "*Fire officials believe that embers driven by raging winds through small openings or against exposed wood were responsible for igniting a majority of the 1,125 homes leveled by the Witch fire, the most destructive in California this year…An analysis of the Witch fire's pattern of destruction points to deficiencies in long-held beliefs about building in fire-prone areas. Fire-resistant walls and roofs are helpful, and brush clearance is essential. But alone they are insufficient in the face of millions of burning embers flying horizontally more than a mile ahead of the flames. Of 497 structures that burned in unincorporated areas of San Diego County during the Witch fire, more*

destroyed (with another 129 damaged) in the Freeway Complex Fire, the Orange County Fire Authority (OCFA) considered "*…brush clearance to be adequate*" based upon its inspections of fuel management zones prior to the fire.[25] Wind driven embers are capable of penetrating the smallest of openings[26] on structures and can ignite spot fires adjacent to structures in ignitable materials that can then damage or ignite structures[27]. Severe convective heat transfers through fire whirls/tornadoes can also bypass standard brush management zones.

> *"Extreme Wildfires can produce firebrand spot-ignitions at distances of a mile or more; however* ***intense firebrand exposures within one-half to one-quarter mile*** *often ignite numerous surface fires within a residential area that spread to contact and ignite homes and****/or firebrands directly ignite homes****."* US Forest Service Fire Scientist Jack Cohen, 4/23/2009 (bold emphasis added).

Homes with standard brush management zones still have the following significant vulnerabilities:

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than half had fire- resistant walls and roofs, a Times analysis of government data showed. Information on construction materials has not been compiled for neighborhoods inside the cities of San Diego and Poway, but senior fire officials estimate that well over 75% of the destroyed homes had fire-resistant exteriors." "**Lessons From the Fire"** Joe Mozingo, Ted Rohrlich and Rong-gong Lin li, Los Angeles Times, December 23, 2007.

[25] *"In 2008, staff inspected 587 WUI parcels and found only 16 out of compliance with minimum requirements for defensible space. By July 22, all properties were in compliance. In addition, staff inspected approximately 790 of some 950 fuel modification parcels to ensure that they were in "substantial compliance" with provisions of the requirements and found 322 in need of some type of corrective action. As of the date of the fire, all but 25 had met minimum requirements. A preliminary assessment of homes destroyed or damaged in the freeway fire indicates that they were victim to ember intrusion rather than direct flame impingement indicating brush clearance was adequate."* Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, page 6.

[26] Research data has been gathered regarding the ineffectiveness of current ventilation standards for preventing ember penetration. BFRL/NIST researchers tested ¼-inch or 6 mm (the recently adopted California WUI standard) 3 mm and 1.5 mm screens. "*For all screen sizes tested, the firebrands were observed to penetrate the screen and produce a self-sustaining smoldering ignition inside the paper beds inside the structure*." Samuel L. Manzello, John R Shields, and Jiann C. Yang, **On the Use of a Firebrand Generator to Investigate the Ignition of Structures in Wildland-Urban Interface (WUI) Fires,** Building and Fire Research Laboratory (BFRL), National Institute of Standards and Technology (NIST), 2007, p. 11.

[27] The Fanita Ranch Fire Protection Plan acknowledged, "The Santa Ana winds with wind gusts of up to 60 mph blowing from the northeast/east pose significant threat from wind-blown embers to all structures within this project." Page 14.

- Vulnerability of structures to embers/firebrands due to extreme events, human error, or inadequate maintenance (i.e., fire tornados or fire whirls, [28] broken windows from flying debris, drapes left over windows, open windows, open doors and garage doors, settlement cracks of structures built in landslide areas, wood piles, gas barbeques and motor-homes and other flammables stored too close to structures, delinquent or inadequate fuel treatments).

Wind-blown embers

[28] "*Observed fire whirl behavior was both unexpected and extreme in these fires, catching many firefighters by surprise and significantly contributing to spotting up to 3/4 mile. 180-degree wind shifts proceeded fire whirls by 45 seconds to a minute."* [Firefighter] *"Respondents reported unusual numbers of fire whirls that ranged from several yards wide up to a 1/2 mile wide. Destructive fire whirls, those causing structural damage unrelated to fire, also were reported. In addition to appearing suddenly, large fire whirls, characterized by a jet engine noise, took in debris such as large tumbleweeds and bushes from the bottom and ejected flaming debris from top—raining embers and violently showering sparks as much as 3/4 of a mile beyond the head of the fire. In one reported case, a fire whirl entered an area that had already burned clean down to three-inch stubble and whirled across several hundred feet of burned area into unburned fuel, carrying fire the whole way and igniting the unburned fuel. Another fire whirl crossed an eight-lane freeway. Small fire whirls merged into larger ones. Some reported fire whirls moving downhill." "What we were expecting to see were fire whirls (4' to 6' tall), what we actually saw were true fire tornadoes. The fire researchers kept telling us what we were seeing was impossible and never seen before. After three days of discussion, the fire researchers started to understand that what they were expecting and what was happening was not jiving. -Division Supervisor"* **Southern California Firestorm 2003 Report for the Wildland Fire Lessons Learned Center**, Mission Centered Solutions, December 8, 2003, page 6.

Attic vent vulnerable to embers within a fire tornado.

- Vulnerability of adjacent homes and the entire development from flame impingement and radiant heat <u>once one</u> or more homes are ignited from embers/extreme events or human error. There remains significant fire risk of structures within 100-feet of each other to cluster burn (especially those with north to east wildland interfaces).[29]

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[29] "*As a type of fuel, involved structures emanated intense radiant heat. Heat levels in the street were unusually high*." **<u>Southern California Firestorm 2003 Report for the Wildland Fire Lessons Learned Center</u>**, Mission Centered Solutions, December 8, 2003, page 7.

Cluster burn example from Cedar fire. Photo by John Gibbins, SDUT.

- Vulnerability of people outside of structures to flame impingement, radiant heat and smoke. (Individuals on foot, on motorized and un-motorized vehicles, hikers and other individuals in natural lands, individuals attempting to evacuate or reach and secure their homes, or individuals simply locked out of vacant structures because they reside in another neighborhood or are children without keys; individuals at inadequate fuel buffers on sloped sections of emergency access routes; firefighters defending structures without adequate safety zones or escape routes).

- Vulnerability of elderly and weak individuals within structures to smoke, stress, or loss of power.

Closer analysis of the 2008 Freeway Complex Fire incident needs to be provided to integrate measures that will avoid and mitigate fire impacts

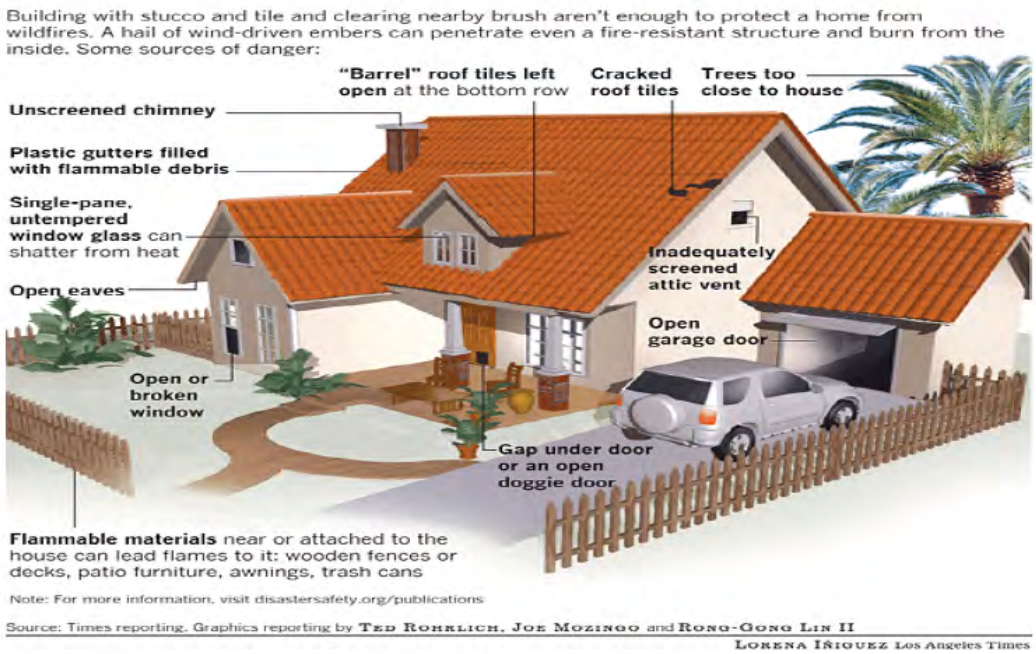
The EIR needs to provide a map of all the structures damaged and destroyed during the Freeway Complex Fire. The map should include fire points of origin, rates of spread and weather conditions during the most damaging burn periods. This information should be utilized to analyze the Project's impacts upon evacuation potential for the Project and its vicinity during Santa Ana wind driven fires originating from the most damaging points of origin at the most damaging time periods. The map should include the specifications for the fuel modification zones at the closest WUI for the damaged/destroyed structures. The EIR is inadequate without providing more than just "worst scenario" for flame length. Even fire resistant homes with standard fuel modification zones are vulnerable to wildfire.[30]

The information compiled on the map should also be used to discuss prospective decisions to evacuate or "stay and defend" property – which is an issue of controversy for the Project and its vicinity. This issue has been raised in the press and differing official positions have been reported. [31]

> *"Officials in Orange County began scaling back on their local version of the "Stay and Defend" plan and began focusing on early evacuation and fire prevention instead. On Feb. 10, OCFA Chief Chip Prather announced to residents of Silverado Canyon that the "Stay and Defend" policy would not work with Orange County."*

[30] Freeway Complex Fire After Action Report, OCFA, Page 19.
[31] Fire Officials Shift from 'Stay and Defend' to 'Ready, Set, Go', Salvador Hernandez, Orange County Register, May 27, 2009. New County Plan Would Train Homeowners to Fight Fires, Salvador Hernandez, Orange County Register, January 15, 2009.

Illustration 1: How Fire-Resistant Homes Can Burn



The damaged or destroyed homes in Yorba Linda had many of the more traditional features that protect homes from flames and radiant heat. In some cases, these features are also effective in protecting homes from embers. However, in a wind driven fire storm, additional protection is necessary.

Flame Lengths and Fire Intensity as related to Safe Evacuation Routes and Fire Safety Zones

The FPEEP considers current/"more mature" vegetation,[32] yet needs to account for the fact that the current vegetation of the site vicinity does not reflect climax vegetation due to only five years of recovery from the 2008 Freeway Complex Fire with below normal precipitation during the recovery period. The climax condition for the site (as evidenced in historical aerial photos) would reflect greater fuel loads and areas of Fuel Models (SH5) and/or (FM4) vegetation with potential for significantly greater flame lengths, fire intensity and ember production.

[32] "modeling…assume…more mature stand conditions…" EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 41.

"Once established, shrub cover will increase corresponding with fuel age (Keeley 2005)"[33]

The FPEEP needs to reveal all of the input assumptions (including relative humidity, wind speed, slope percentage) utilized to generate the FlamMap Model results. The FPEEP (page 40) model results for SH5 generates a maximum flame length of 41 ft., however, providing only limited scenario inputs and summary results does not allow evaluation of other plausible scenarios with associated variable assumptions utilized. BehavePlus Fire Model results run for other project sites with Fuel Model 4 vegetation (a model alternative to SH5) generates maximum flame lengths of 95 ft. and 96.7 ft.[34] Fire Models are only accurate for their variable inputs (these change under real geophysical conditions), which is why field observations for chaparral fires have documented flame lengths exceeding 100 feet during extreme weather conditions.

The wide range in potential "maximum" flame lengths and the limitations of the fire models to predict them have serious implications for firefighter and public safety at the evacuation pinch points adjacent to natural vegetation at the Project.

"Localized changes in slope, weather, or pockets of different fuel types are not accounted for in this analysis, but assumed across the landscape based on the available resolution."[35]

"Flame length… is a somewhat subjective and non-scientific measure of fire behavior, but is ***extremely important to fireline personnel in evaluating fireline intensity*** *and is worth considering as an important fire variable (Rothermel1991)."*[36]

Flame Lengths and Fire Intensity as related to Safe Evacuation Routes and Fire Safety Zones

Radiant and convective heat can be deadly for exposed residents, evacuees and firefighters drawn into defend or dispatched to inappropriately sited structures. A distance factor of 4x maximum flame length is utilized by firefighters to estimate the location of safety zones from radiant heat exposure. The 4x flame length radius

[33] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 26.
[34] Behave Fire Model results for a Santa Ana wind driven fire in Fuel Model 4: Flame Length 96.7 feet, Rate of Spread 2,041 feet/minute, Fire Line Intensity 117 380 BTU's/foot/second "CFPP Cielo Ranch Santa Fe" page 15. Fanita Ranch Fire Protection Plan Behave Fire Model results generated 95 ft. flames in FM 4.
[35] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 41.
[36] EIR Appendix J, The "Esperanza Hills Fire Protection & Emergency Evacuation Plan" (FPEEP), Page 39.

distance from flames may not be sufficient to prevent injury or death if there is severe convective heat transfer.[37] For example, an expected flame length of 100 feet would require a safety zone with a radius of 400 feet from the fuel. 400 feet would likely be insufficient if the available safety zone was sited in, near or above steep topography that funnels convective heat.

Cedar Fire victim perished in area of wide clearance.

The FPEEP fails to analyze whether the Project has configured evacuation routes and safety zones sufficiently to protect firefighters or residents from radiant or convective heat exposure. Of related concern, is the FPEEP's inconsistency with other fire protection plans regarding the expected flame lengths. Compare the FPEEP maximum 41 feet estimate to other BehavePlus Results for FM4 Fuel (95 feet at Fanita and 96.7 at Cielo CFPP).

[37] Butler and Cohen. Firefighter Safety Zones: A Theoretical Model Based Upon Radiative Heating. Firefighter Safety Zones: How Big Is Big Enough?

BehavePlus 3.0.1 Fri, Oct 27, 2006 at 00:01:35

Fanita, under a 60 mph Santa Ana wind in an FM-4

Surface Rate of Spread (maximum)	1966.5	ft/min
Fireline Intensity	113088	Btu/ft/s
Flame Length	95.0	ft
Midflame Wind Speed	30.0	mi/h
Max Eff Wind Exceeded?	No	
Area	30229.3	ac
Perimeter	241689	ft

Fanita Ranch FPP BehavePlus calculation.

TABLE 2.3.6

Expected fire behavior for a North, Northeast and East Santa Ana Wind Condition in a Fuel Model 4
(A Fuel Model 4 is a continuous cover of chaparral vegetation greater than 6' in height)

RATE OF SPREAD	**2,041 feet/minute**
FIRE LINE INTENSITY	**117,380 BTU's/foot/second**
FLAME LENGTH	**96.7 feet in length**

Additional Fire Behavior Calculation Input:

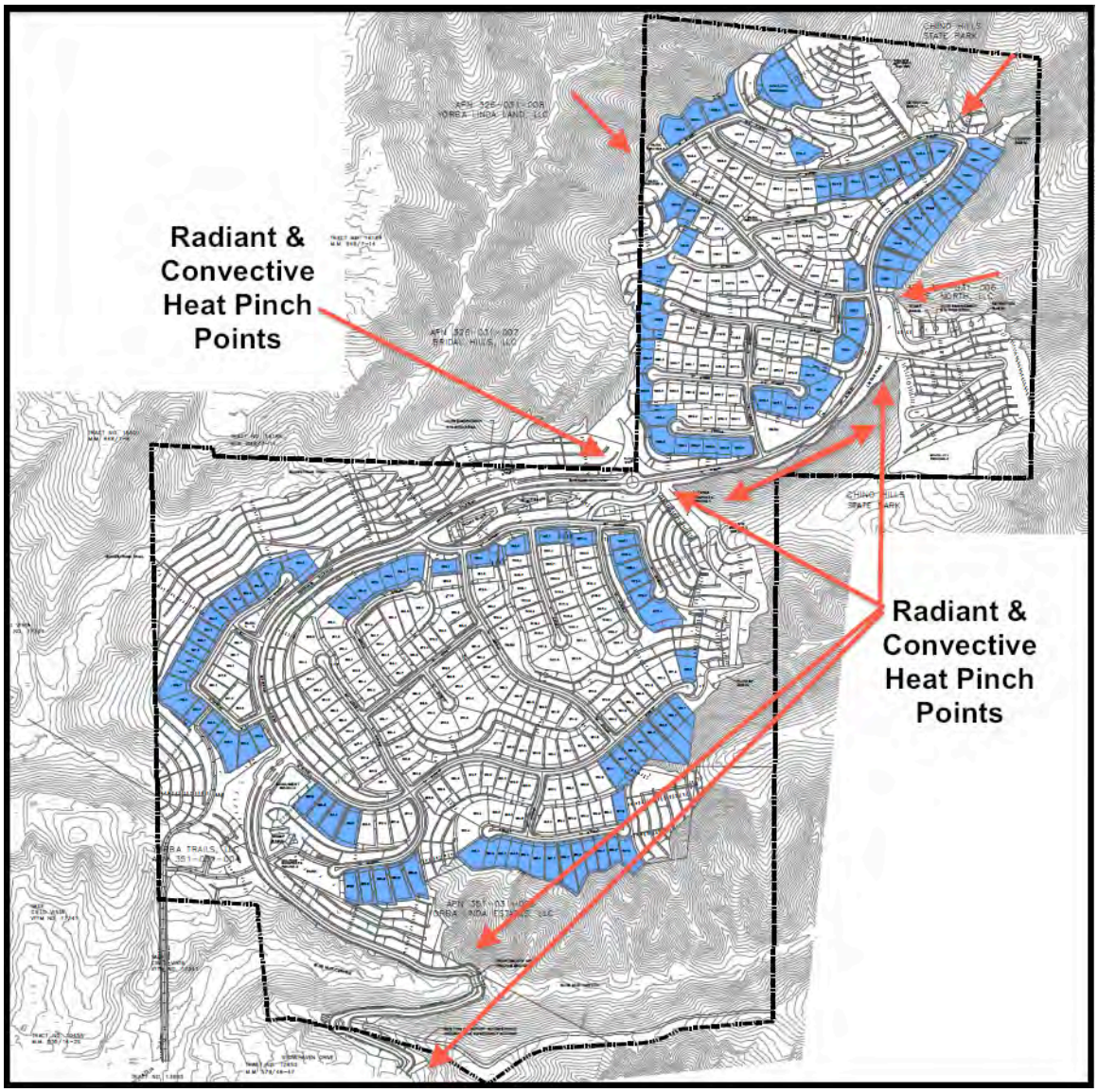
- 60 mph 20-foot wind speed (30.0 mph mid-flame wind speed)
- 30 percent slope
- 45° direction of wind vector to uphill slope

This equates to 7,952 acres in 30 minutes and 31,809 acres in 60 minutes assuming no initial attack.

Rancho Cielo FPP BahavePlus calculation.

A factor of 4x multiple of these outcomes generates safety zone radius distance ranging from 164 feet, to 380 feet (Fanita calculation) or 386.8 feet (Cielo CFPP calculation) to prevent radiant heat injury (without additional convective heat

transfer).[38] So the range is roughly a 164-400 feet radius distance needed from the most dangerous fuels to prevent radiant heat injury. Fuel modification zones for the Project extend to 170 feet, so the unmodified heaviest fuels at 170-feet or more have the potential to inflict radiant heat injury. Convective heat injuries are possible even if the 4x flame length safety factors are adhered to. This reality is significant for evacuees, firefighters or any individual that decides not to evacuate and attempts to defend property.



The Project has radiant and convective heat pinch points and the FPEEP has not considered the implications of potential radiant heat exposure to individuals,

[38] As an example, see the attached diagram that illustrates the lack of adequate escape routes and safety zones on the "Rock Point Peninsula" and the distances required for safety from radiant heat.

evacuees and firefighters.[39] For instance, any firefighter dispatched to the Project during a firestorm needs to have viable escape routes and safety zones available. Where are these escape routes and safety zones? Are there areas of the Project and fire circumstances that firefighters would not be assigned to defend it, or expected to retreat? Under what circumstances are residents expected to evacuate or remain on the Project site and where? If residents are expected to remain on site, then what are they expected to do if confronted by a cluster burn within the Project? If they are expected to evacuate, then what are they expected to do if the streets are gridlocked by traffic or cut off by firestorm? What areas of the Project are the most vulnerable to convective heat transfer? The FPEEP needs to answer these questions and recirculate the findings for pubic review.

Convective Heat / Fire Whirls Pose Extreme Danger

[39] Insufficient "Roadside FMZs will be 10 to 20 feet wide from the edge of the road on both sides of roadways adjacent to natural open space areas." EIR, Page 5-313.

Rudy Reyes was unable to safely evacuate the Cedar Fire.

It has already been documented that without adding new development that traffic circulation is severely constricted or gridlocked at commuter hours and/or under emergency conditions. The intersection of Via del Agua / Yorba Linda Boulevard has an "unsatisfactory" or "F" failing Level of Service, EIR at 4.14-15.

> *"As residents began to evacuate, traffic grid-locked in some areas as emergency apparatus tried to enter the neighborhoods while residents tried to exit."*[40]

[40] Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, page 14. (Bold emphasis added).

Evacuation can be treacherous even without gridlocked streets based upon when the order is given, visibility, the fires direction and rate of spread, distance from fuel loads, etc. and the timing of the decisions made to evacuate. Fire authorities cannot force individuals to evacuate,[41] which can put firefighters in greater jeopardy if lingering residents find themselves in trouble and request emergency assistance.

> *"Wildland urban interface fires present many challenges pertaining to evacuation.* ***The fire spread rate is often so fast that emergency responders can only estimate the rate of spread and direction of travel****. In this case, within minutes of the fire start, spotting was reported one mile down-wind from the head of the fire. Driven by winds of 40 MPH and higher the rate of spread went from the usual estimate of acres per hour in a non wind driven fire to acres per minute."*[42]
>
> ***"… law enforcement does not have the legal authority to force residents out of their homes****; however, law enforcement may restrict the return of residents once they leave.* ***Determining where and when to evacuate is often difficult****. Each decision brings with it a new set of risks and benefits.* ***The greatest risk by permitting residents to remain with their homes is the potential for loss of life****."*[43]
>
> *"The Tea Fire in Montecito resulted in more than two dozen civilian injuries, two of which were critical burns received while trying to flee their residence. In 2006, in Cabazon, the Esperanza Fire resulted in four firefighter fatalities that occurred during structure protection efforts. The Cedar Fire that occurred in San Diego County in 2003 resulted in the death of fourteen civilians and a firefighter all while trying to flee or protect homes.* ***Investigation into the citizen deaths and injuries identified one commonality: they all occurred because people decided to stay and protect their property or they evacuated too late and got caught in the fire front****."*[44]

When land use decisions can site development away from high-risk topography, (whether its fire, flood or landslide zones) what circumstances justify placing people and firefighters at greater risk of severe and life threatening injuries?

---

[41] Under certain circumstances evacuation may pose the greatest risk.
[42] Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, page 15.
[43] Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, page 14.
[44] Freeway Complex Preliminary Report to City of Yorba Linda, Orange County Fire Authority (OCFA), December 2, 2008, page 14.

Firefighter fatality reports conclude that decisions to defend vulnerable structures located on high-risk topography were a primary factor in the fatalities of the Esperanza Fire and the Cedar Fire. The recent loss of a 19-person Granite Mountain crew in Arizona occurred when they were traveling though unburned fuel toward threatened structures at the town of Yarnell.[45]

The Esperanza report identified "Causal" and "Contributing" factors for the firefighter fatalities. The root cause of the deaths was the decision to approve and build the home in a location destined to burn. While some consider this incident an accident, it may more readily be considered a high-risk gamble that was lost. The report identified these top factors:

> *"Contributing Factor 1. Organizational culture - The public (social and political) and **firefighting communities expect and tolerate firefighters accepting a notably higher risk for structure protection** on wildland fires, than when other resources/values are threatened by wildfire." (Bold emphasis added)*
>
> *"Causal Factor 2. The decision by command officers and engine supervisors to attempt structure protection at the head of a rapidly developing fire either underestimated, accepted, and/or misjudged the risk to firefighter safety."*

When faced with a Santa Ana wind driven fire head rapidly approaching Esperanza Hills Project homes, will firefighters be expected to defend or decline to defend threatened homes directly in the path of the fire head?[46]

Water Supply
State of Emergency Declaration by the Governor of California[47]

The EIR should consider the State of Emergency (significant new information) as it relates to water supply for the Project, water supply for fire suppression, the expectation for more severe fire behavior and recirculate its findings.[48]

> **WHEREAS** the State of California is experiencing record dry conditions, with 2014 projected to become the driest year on record; and

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[45] Esperanza Fire Accident Investigation Factual Report, USDA-Forest Service, October 26, 2006. Novato Fire Protection District Cedar Fire Incident Recovery Report, May 26, 2004. Yarnell Hill Incident Reports, https://sites.google.com/site/yarnellreport/

[46] Reference Wildland Structure Protection Standard Operating Procedure, Novato Fire Protection District, Cedar Fire Recovery Report, May 26, 2004 (attached).

[47] http://gov.ca.gov/home.php

[48] California Drought Brings 'Unprecedented' Fire Danger, Joseph Serna, Los Angeles Times, January 18, 2014.

WHEREAS the state's water supplies have dipped to alarming levels, indicated by: snowpack in California's mountains is approximately 20 percent of the normal average for this date; California's largest water reservoirs have very low water levels for this time of year; California's major river systems, including the Sacramento and San Joaquin rivers, have significantly reduced surface water flows; and groundwater levels throughout the state have dropped significantly; and

WHEREAS dry conditions and lack of precipitation present urgent problems: drinking water supplies are at risk in many California communities; fewer crops can be cultivated and farmers' long-term investments are put at risk; low-income communities heavily dependent on agricultural employment will suffer heightened unemployment and economic hardship; animals and plants that rely on California's rivers, including many species in danger of extinction, will be threatened; and the risk of wildfires across the state is greatly increased; and

WHEREAS extremely dry conditions have persisted since 2012 and may continue beyond this year and more regularly into the future, based on scientific projections regarding the impact of climate change on California's snowpack; and

WHEREAS the magnitude of the severe drought conditions presents threats beyond the control of the services, personnel, equipment and facilities of any single local government and require the combined forces of a mutual aid region or regions to combat; and

WHEREAS under the provisions of section 8558(b) of the California Government Code, I find that conditions of extreme peril to the safety of persons and property exist in California due to water shortage and drought conditions with which local authority is unable to cope.

NOW, THEREFORE, I, EDMUND G. BROWN JR., Governor of the State of California, in accordance with the authority vested in me by the state Constitution and statutes, including the California Emergency Services Act, and in particular, section 8625 of the California Government Code **HEREBY PROCLAIM A STATE OF EMERGENCY** to exist in the State of California due to current drought conditions

Within the context of Governor Brown's finding "*that conditions of extreme peril to the safety of persons and property exist in California due to water shortage and drought conditions with which local authority is unable to cope*", it is important to recognize that the Yorba Linda Water District could not provide sufficient reliable service during the Freeway Complex Fire prior to the current State Of Emergency.

Furthermore, the Water District position was that the water system met standards and the size of the fire front was excessive.

> *"…water supply problems are not uncommon in catastrophic events such as the Freeway Complex Fire. It also is important to note that the vast majority of homes that were damaged or destroyed were in areas where water pressure and water flows were available during the firefighting activities…There is no way to guarantee that the magnitude of a natural disaster such as the Freeway Complex Fire will not overwhelm even the most robust water system."*[49]

Firefighter Safety and Performance Expectations:

Considering that "*no structure in the path of a wildfire is completely without need of protection*,"[50] more analysis needs to be provided with a focus upon firefighter safety. Firefighter escape routes and safety zones, and their potential decisions to defend structures for the worst Santa Ana wind driven fire points of origin, time periods and worst weather conditions require analysis.

There have been at least 327 wildland firefighter fatalities in California since 1926.[51] Because of the social and political climate associated with expectations for firefighters to defend property during wildfires, the Project's configuration relative to topography should be analyzed and the conditions that firefighters are expected to engage, decline deployment or retreat from specific portions of the Project described.

> *"Wildland firefighters today are spending more hours fighting fires than ever before, and they are engaging fires of historic magnitude. The risk environment associated with wildland fire is being re- defined, and firefighters too have begun to redefine their own culture as a professional endeavor."*[52]

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[49] Freeway Complex Fire Disaster Response & Water System Assessment, Yorba Linda Water District, January 8, 2009, pages 5 & 24. Report: Reservoir ran dry, pumps were shut down during fire, Erin Welch, Orange County Register January 8, 2009. Note that the fire was not "natural" as it was ignited by a vehicle malfunction.
[50] Incident Response Pocket Guide, National Wildfire Coordinating Group, PMS461 NFES 1077, January 2010, page 12.
[51] Wildland Fire Accidents by State, National Interagency Fire Center, page 2. Wildland firefighter fatalities nationwide exceed one thousand since 1910, page 24. http://www.nifc.gov/safety/safety_documents/State.pdf
[52] Trends in Wildland Fire Entrapment Fatalities…Revisited, James R. Cook, National Wildland Firefighters Association, February 2013

After a review of wildland firefighter fatality incidents, the EIR should describe the conditions that would cause firefighters to reject assignment or retreat.[53] The "Lesson Learned" analyses of fire behavior and firefighter fatality incidents are relevant and available.[54] A firefighter near miss occurred on the Freeway Complex Fire.

> *"Approximately 9:27 a.m., a tragedy almost occurred when COR E5 became surrounded by fire and experienced a burn-over event. When the Freeway Fire began, COR E5 was on scene of a medical aid in a neighborhood less than a mile away. Once COR E5 cleared the medical call, it contacted COR Dispatch and was assigned to the fire. COR E5 chose to access the fire from a service road between the fire origin and the threatened homes. This decision put COR E5 in a dangerous position between the main fire and the threatened homes, with unburned vegetation between the crew and the fast moving head. Within minutes, the COR E5 Captain radioed they were being overrun by fire and were unable to escape. COR BR1, supported by multiple water drops from ORC HC41 and HC241, rescued the trapped firefighters and averted a tragedy. This event resulted in minor burns and smoke inhalation to two firefighters assigned to COR E5. Incident Narrative – Map 4 is a map showing the near miss entrapment."*

Fossil Fuel Extraction

Fire risk on the Project site is increased and complicated by past, current and potential oil extraction that releases combustible methane gas. Note that the EIR has not revealed or considered whether modern hydraulic fracturing "fracking" techniques are or will be utilized under or within the vicinity of the Project site. In fracking, 5 % of well casings fail immediately and all are subject to failure over time due to entropy, which has implications for methane release into groundwater and the atmosphere. Any Project in a VHFHSZ that proposes to mix residential development and fossil fuel extraction by hydraulic fracturing or horizontal drilling needs to better document the status of past, present and future extraction plans in order to avoid or mitigate the associated hazards. This analysis should be performed and the results recirculated for public review. Furthermore, considering that climate change is creating weather extremes and higher intensity fires, there can be no assurance that the inevitable "worst scenario" considered by the Fire Behavior Analysis model will not have even greater severity.

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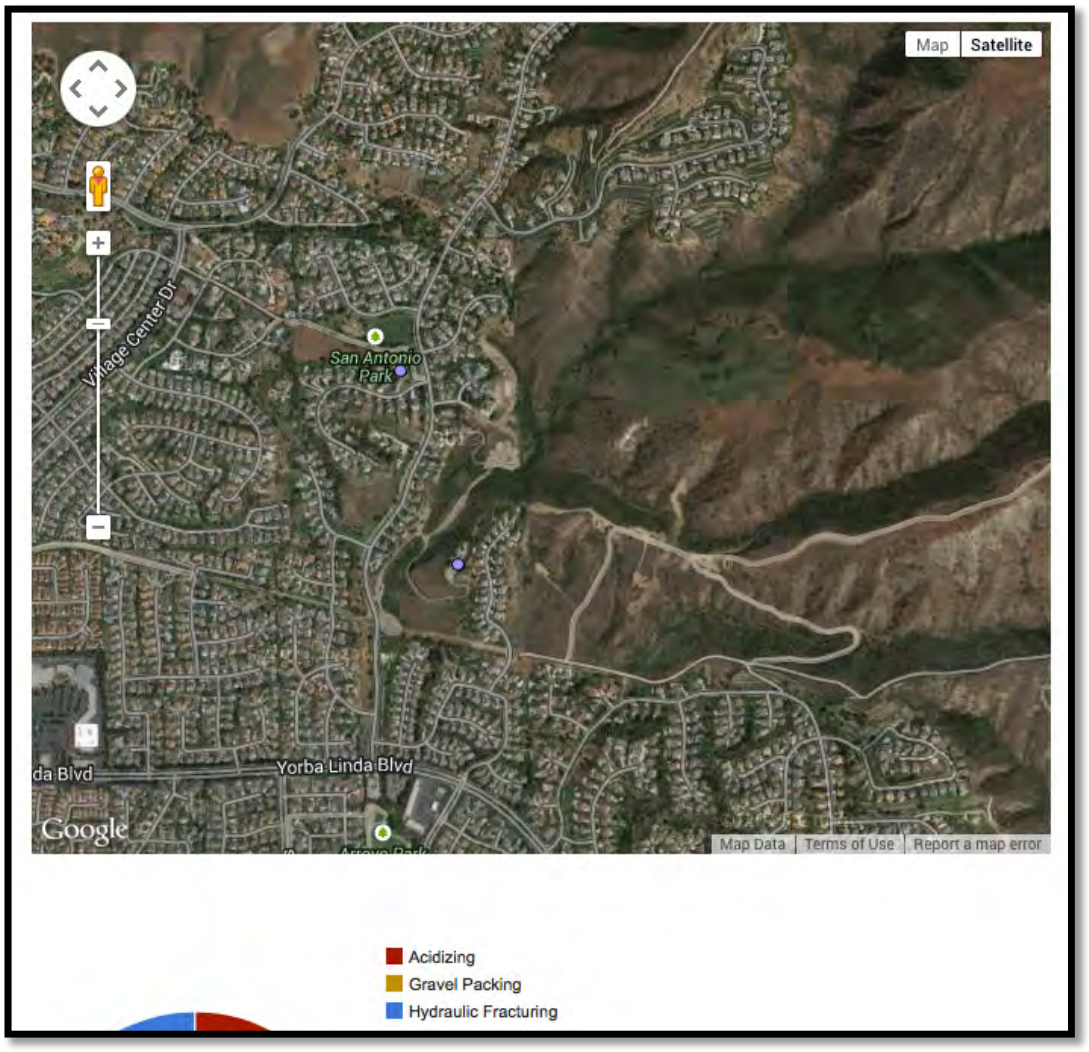
[53] Reference Freeway Complex Fire Incident Narrative – Map 4 Corona Fire Engine 5—Near Miss Entrapment, Freeway Complex Fire After Action Report, OCFA, Pages 31 & 47.

[54] http://www.youtube.com/user/WildlandFireLLC?feature=watch



Hydraulic Fracturing Sites Identified in the Esperanza Hills Project Vicinity June 2013 – January 2014 (Blue Circles)[55]

Alternative Needed that Acknowledges and Addresses High Fire Risk Topography

The Project configuration fails to incorporate feasible land use design features to reduce fire risk. If a Project is to be considered, it should be reconfigured with a new Alternative.

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[55] http://baldwinhillsoilwatch.org/action-center/sc-aqmd-rule-1148-2-maps/ "…oil well stimulation reports for the initial 7 months of reporting: June 2nd, 2013 and January 6th, 2014." South Coast AQMD 1148.2- Well stimulation mapping project.

More lots adjacent to high-risk topographic features should be replaced with parks. There are a number of interior parks that could be consolidated to the exterior of the Project to increase the buffer to homes and provide firefighters potential anchor points for suppression tactics that could be implemented without being slowed by the private yards oriented toward wildlands. More streets should be placed on the perimeter of homes adjacent to wildlands to act as anchor points for suppression tactics and better insulate structures [place the front yards adjacent to natural lands instead of the back yards]. Alleys that allow for ready fire access and a better facilitation for evacuation should separate the backyards of homes. Cul-de-sacs should be eliminated throughout the Project to allow for increased access and evacuation.

Homes directly on the wildland interface should be on larger lots to increase the space between home structures to a minimum of thirty-feet thereby reducing the vulnerability of homes to cluster burn. Homes within 30 feet of each other have significantly greater potential to ignite each other. Homes/lots should be oriented to minimize garage doors, large windows and other openings on the north to east interface with Santa Ana winds. Functional evacuation routes and safety zones for residents and firefighters should be designed and incorporated.

Fire vulnerable topography of the Project site viewed from the northeast.

Conclusion

The Esperanza Hills Project exposes people and structures to a significant risk of loss, injury or death involving wildland fires. The Project is proposed for rugged fire vulnerable topography that is in the path of wind driven fires originating from the northeast in and near the Chino Hills State Park. The EIR does not adequately research and mitigate the significant fire safety issues associated with the Project. The gaps identified in this letter need to be addressed and the document recirculated for further public review and comment.

Thank you for considering these comments,

Van K. Collinsworth
Wildland Fire Expert / Natural Resource Geographer

CC.
Supervisor Todd Spitzer
Kevin K. Johnson, APLC

Attachments:
Resume
Structure Protection / Backfiring Standard Operating Procedures
Significant Freeway Complex Fire Photographs
Freeway Complex Preliminary Report
BehavePlus 3.0.1 Results Excerpt – Fanita Ranch
BehavePlus 3.0.1 Results Excerpt – Rancho Cielo
Use of a Firebrand Generator to Investigate the Ignition of Structures in Wildland-Urban Interface (WUI) Fires
Firefighter Safety Zones: A Theoretical Model Based Upon Radiative Heating
Firefighter Safety Zones: How Big Is Big Enough?
Significant Fire Illustrations
Freeway Complex Fire Disaster Response & Water System Assessment, Yorba Linda Water District
Freeway Complex Fire After Action Report, Orange County Fire Authority
Drought-hit California Unable to Supply State Water

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Wildland Fire and Natural Resource Expert

Experience

Wildland Firefighter - Forestry Technician, USDA Forest Service **1980-1993**

- Responded to fire emergencies in the Western Unites States including major Sana Ana wind driven fires on Engine and Hand Crews. Performed in supervisory positions: Incident Commander, Assistant Operations Chief, Assistant Air Operations Chief, Fire Engine Operator, Assistant Fire Engine Operator, Squad Supervisor. Performed backfire and burnout operations with drip torches and fusees. Coordinated with a heli-torch in chaparral backfiring. Participated in search & rescue operations. Completed and taught fire training courses and exercises. Planned and executed successful prescription burns without escape incidents.

Natural Resource Geographer / Resource Analyst **1994-2014**

- Shape community development and policy through analysis of and contribution to environmental documents, planning efforts and public relations. Review legal notices, hearing notices, staff reports, conditional use permits, general plans, zoning overlays, grading ordinances, fire protection plans, aerial photographs and other planning documents. Provide expert testimony on fire and natural resource issues.
- Performed site field evaluations. Identified and documented resources with high-resolution images and GPS. Created maps, spreadsheets, films and web content for negotiation and public distribution.
- Organized and participated in public forums. Delivered television, radio and telephone press interviews.
- Provided oversight for construction mitigation & monitoring agreements, including the application of storm water regulations; development and implementation of landscaping plans for the SR-125 Tollway.
- Coordinated with Caltrans, CA Regional Water Quality Control Board, County of San Diego, City of San Diego, City of Chula Visa staff, elected officials, planning group representatives and community members to resolve transportation, land use and various community environmental issues.
- Served as a founding member of the Policy Committee for the San Diego Fire Recovery Network. Authored "Preventing Firestorm Disaster" PPT, November 2003, Advising Editors, Jon Keeley, Richard Minnich, Rick Halsey, Patrick Abbott and Jack Cohen.

Instructor – Grossmont Union High School District **1988-1994**

- Designed a high-tech learning laboratory addressing critical needs at multiple skill levels. Most graduates, highest test scores, highest attendance in system.

Education

Master of Arts, Geography/Political Science emphasis, Humboldt State University **1986**

Teaching Credential, Social Science, Humboldt State University **1983**

Bachelor of Arts, Geography, Humboldt State University **1982**

Includes 125-quarter units of Environmental Resource and Biological Sciences.

Title: Wildland Structure Protection Standard Operating Procedure

Overview

Structure protection is a dangerous task often performed at the most intense segments of the fire. Due to the inherent dangers of wildland firefighting in general and structure protection specifically it is imperative that personnel maintain "Situational Awareness" and focus on personnel safety and survival at all times.

Situational Awareness is the process used to identify, comprehend, analyze and react to critical elements of information or events that may impact the crew's ability to carry out assignments safely.

Philosophy

The Novato Fire Districts philosophy is based on a simple premise, *"Every Firefighter Deserves a Round Trip Experience"*. It must be the motto of all members that no structure protection operation is worth risking firefighter injuries, near misses or fatalities.

Structure protection operations are not worth sustaining damage to an engine. Even minor damage to an engine such as, melted lenses or bubbled paint should be considered a near miss, a close call for the crew and investigated as such.

Every structure protection operation must be based on a Situational Awareness and Structure Protection Assessment, and the development of Structure Protection, Safety, Survival and Mop Up Plans.

There may be times when it becomes necessary to turn down an assignment for fear of sustaining firefighter injuries, a potential near miss situation or possible fatality(s). In these situations the individual in charge should follow the District Refusing Risk SOP to the extent possible but without further risking the safety of the crew or engine.

Procedures

Situational Awareness Assessments must be based on:

- Information, events, decisions, orders or actions beginning prior to dispatch and continuing until the crew and engine are safely back in quarters, that may immediately or eventually affect the safety and survivability of the crew and engine

- Communication including questioning each other to increase the Situational Awareness of all crew members

Structure Protection Assessments must be based on:

- The survivability and safety of the crew and the engine
- Actions the homeowner has taken to create an adequate defensible space, non-pyrophytic landscaping and fire resistive construction
- Standard Structure Protection Assessment guidelines
- The potential for changes in weather and fire behavior
- Never accepting or settling for a bad situation
- The fact that what works at home may not work elsewhere in the State and conversely conditions experienced elsewhere can occur at home.

Structure Protection Plans must be based on:

The crew's ability to identify, in the Situational Awareness and Structural Assessments, the cumulative circumstances that conspire to create hazardous situations and their ability to eliminate the hazards or change tactics in time to make the situation safe for themselves and their engine including:

- The ability of the crew and engine to safely survive the passage of the flame front without taking refuge in the engine, structure or deploying a fire shelter
- Establishing Trigger Points which cause an immediate re-assessment of the situation and potential changes in tactics
- Identifying safe alternative options such as prepping and leaving and/or returning after the flame front has passed
- The Standard Firefighting Orders, the Watch Out Situations and the Common Denominators of Fire Behavior on Tragedy Fires
- A physical or mental step back to assure that your actions appear to be in accordance with your plans, and always searching for a safer solution.

*If conditions exist to safely make a direct attack on the fire all Firefighter Safety and Survival guidelines will be followed.

Safety Plans must be based on:

The crew's ability to establish Lookouts, Communications, Escape Routes and Safety Zones (LCES). LCES must be established, re-assessed and revised as conditions change. As Safety Plans change they must be communicated to the

entire crew. In operation, LCES functions sequentially and is a self-triggering mechanism.

Lookouts

- Lookouts assess – and reassess – the fire environment and communicate to each firefighter threats to their safety. Firefighters use escape routes and move to safety zones when threats to safety occur.

- Lookouts should be trained to observe the wildland fire environment and to anticipate and recognize and communicate fire behavior changes.

- Lookouts should be positioned where both the hazard and the firefighters can be seen.

    - Terrain, cover, and fire size determine the number of lookouts needed; every firefighter has the authority and the responsibility to warn others of threats to safety.

    - Lookouts must be in a position to provide the working crews with sufficient warning so that they are able to reach their Safety Zone safely.

Communications

- Set up communications system - radio, voice, or both – by which the lookout warns firefighters promptly and clearly of an approaching threat.

- It is paramount that every firefighter receives the correct message in a timely manner.

Escape Routes

- Escape Routes must be verified by actually traversing the route and assessing the time it takes to reach the Safety Zone.

- Preservation of the homeowner's vegetation, fences, or other structural features that impede the crew's use of the Escape Route(s) should be of minimal concern to the crew and if need be, cleared or removed.

- Driveways or access roads must meet the requirements of an Escape Route if the Safety Zone is not near the structure.

Safety Zones

- A Safety Zone must be an area where survivability is possible without fire shelter deployment.

- The optimum Safety Zones is four times the maximum flame length, measured from the center of the Safety Zone to the nearest fuel on all four sides

- The optimum area of a Safety Zone may be reduced based on varying fuel types, topography and structures or other natural objects that will act as a heat barriers as the flame front passes

- Engines, structures and bodies of water should be considered last resort survival options not Safety Zones.

Last Resort Survival Plans must be based on:

The crew's ability to identify, verify, establish and communicate Last Resort Survival Options before an event occurs. Last Resort Survival Options must be re-assessed, revised and communicated to the entire crew as conditions change. In operation, Last Resort Survival Options should be self-triggering when conditions change and Safety Plans are no longer an option.

- In the event that Safety Plans fail the survivability of the crew must become the only priority.

- Last resort survival options include taking refuge in an engine, structure, fire shelter or body of water

- The most effective option or combination of options will vary according to the conditions present at the time of the event

Mop up Plans must be based on:

The crew's ability access a water supply, the degree to which the structure was exposed to the flame front, other available resources and the urgency to take on a new assignment.

- A thorough mop up of the area surrounding the structure for a minimum of 50' or as dictated by an assessment of the surrounding fuel models

- Checking and re-checking for potential ignitions sources in the interior and exterior of the structure

- Waiting for a sufficient period of time to determine if re-ignition will occur

Summary

No plan to protect a structure should be based on the anticipated need to seek refuge in the engine, structure or in a fire shelter when the flame front passes. On the other hand even the best managed events can change for the worse. In these cases last resort survival options such as entering the engine, structure, shelter deployment body of water, or any combination of these options should be identified early, re-assessed regularly and shared with all crew members.

In no case should policy impede firefighter safety nor should the basic premise of firefighter safety be forgotten or neglected.

- Activities that present a significant risk to the safety of personnel shall be limited to situations where there is a potential to save endangered lives.
- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of personnel, and actions shall be taken to reduce/avoid these risks or change tactics.
- No risk to the safety of personnel shall be acceptable where there is no possibility to save lives or property.

Simply stated:

- We Will risk our lives a lot, in a calculated manner, to save SAVABLE lives.
- We Will risk our lives a little, in a calculated manner, to save SAVABLE property.
- We Will Not risk our lives at all for lives, property or the environment that are already Lost/Cannot Be Saved.

Title: Risk Refusal Standard Operating Procedure

Overview

The Novato Fire Protection District is an all risk organization responsible for responding to and mitigating medical emergencies, vehicle accidents, hazardous material releases, specialized rescue events, structure fires, vehicle fires, and wildland fires. As such we must recognize that there are both acceptable and un-acceptable risks to our personnel that come with this responsibility.

Philosophy

The Novato Fire District philosophy is that "Every Firefighter Deserves a Round Trip Experience". Therefore, every individual has the right and obligation to refuse an assignment, in accordance with this SOP, if that assignment is likely to result in injuries, near miss situations, or fatalities.

Procedure

A Risk Refusal is a situation where an individual having conducted a Risk and Situational Awareness Assessment determines that they cannot undertake the assignment because they deem it unsafe.

Assignments may be refused as unsafe when:

- There is a violation of safe work practices, District Policy, the Firefighting Orders, Watch Out Situations, LCES, etc.
- Environmental conditions make the work unsafe
- Crew members lack the necessary qualifications or experience
- Equipment is defective or unavailable
- The risk can not be mitigated and/or tactics cannot be changed
- An adequate Risk and Situational Awareness Assessment cannot be conducted

When an individual or person in charge chooses to refuse an assignment because they deem it unsafe, they must provide their immediate supervisor with the following information immediately:

- The reason for the for the Risk Refusal

- To the degree possible, safe alternatives for completing that assignment

The Supervisor who receives the Risk Refusal will make every effort to notify the Safety Officer. If there is no Safety Officer, notification will go to the appropriate Supervisor or to the Incident Commander. This assures accountability for decisions and communicates safety concerns to the entire incident organization.

If the Supervisor who receives the Risk Refusal asks another resource to perform the assignment, they are responsible for informing the new resource that the assignment has been refused and the reasons for that refusal.

If an unresolved safety hazard exists or an unsafe act was committed, the individual or person in charge should also document the Risk Refusal with a memo to their immediate Supervisor and/or the Safety Officer.

Summary:

These actions do not necessarily stop an operation from being carried out as long as the identified risk can be mitigated. This SOP is integral to the effective management of risk and the timely identification of hazards through the chain of command to promote firefighter safety and accountability.

In no case should policy impede firefighter safety nor should the basic premise of firefighter safety be forgotten or neglected.

- Activities that present a significant risk to the safety of personnel shall be limited to situations where there is a potential to save endangered lives.

- Activities that are routinely employed to protect property shall be recognized as inherent risks to the safety of personnel, and actions shall be taken to reduce/avoid these risks or change tactics.

- No risk to the safety of personnel shall be acceptable where there is no possibility to save lives or property.

Simply stated:

- We Will risk our lives a lot, in a calculated manner, to save SAVABLE lives.

- We Will risk our lives a little, in a calculated manner, to save SAVABLE property.

- We Will Not risk our lives at all for lives, property or the environment that are already Lost/Cannot Be Saved.

Title: Wildland Firing Operations Standard Operating Procedures

Overview

Firing operations are often critical operations in the fire management job. If planned and executed correctly, they can speed control of a fire and greatly reduce suppression costs. Conversely, if not done right, they can endanger personnel, extend control time, damage property and increase cost.

Philosophy

Firing operations must not jeopardize the safety of personnel or equipment or invalidate suppression action on adjacent Divisions/Groups. Confirmation of this is absolutely mandatory prior to firing. No backfiring action regardless of strategic importance or other critical factors is worth risking one human life! When in doubt choose another safe and appropriate tactic.

Procedure

Backfiring

Backfiring operations are a method of indirect attack typically used against rapidly spreading fires. Safety considerations must be given first priority. Backfiring must be approved by the Incident Commander and should be performed by properly certified and qualified personnel.

The most successful backfiring is conducted from completed control lines. These are best located at a break in the terrain - the lee side of ridgetops is often best choice, canyon bottoms second choice and benches or roads in mid-slope third. The third choice is the most dangerous from the personnel safety standpoint and requires the most skill and understanding of fire behavior.

Backfiring is most often used to contain a rapidly spreading fire. Backfiring provides a wide defense perimeter, and may be further employed to change the force of the convection column. Backfiring is a tactic which makes possible a strategy of locating control lines at places where the fire can be fought safely on the firefighter's terms.

Except for rare circumstances meeting specified criteria, backfiring is executed on a command decision made through the ICS channels of authority. Occasionally a situation may develop requiring immediate action to backfire. Division/Group Supervisors, Initial Attack and Extended Attack Incident Commanders should be authorized to initiate backfiring provided:

- The act does not jeopardize the safety of personnel or invalidate the actions of adjacent resources and personnel.
- A change in weather or fire behavior requires this course of action to maintain control of the situation or control lines
- It is taken to mitigate a safety situation such as creating a safety or deployment zone

One Certified and Qualified individual must be responsible for controlling and directing the backfiring operation. If a qualified individual is not available the operation should not be attempted. In addition to Certified and Qualified individuals it is also necessary to have available:

- A sufficient number of skilled personnel assigned as a firing team
- A sufficient number of resources and personnel assigned to hold the firing operation

Burning Out

Typically Novato Fire District personnel are not certified and qualified to conduct firing operations; however, they may support a back firing operation by a certified and qualified individual or team, if needed.

A Burn Out operation is the intentional burning of fuels inside the control line to strengthen the line. Burning out is almost always done as a part of line construction (direct attack/parallel attack); the control line is considered incomplete unless there is no fuel between the fire and the line. Burn Out operations are typically performed without the approval of the Incident Commander or direct supervisor however, a notification of both is essential to avoid confusion regarding observed fire behavior on the incident.

Guidelines

The following guidelines apply to all firing operations and you must assure that you:

- Do not place fire fighting personnel or the public at risk
- Do not put property at risk
- Will be able to maintain control of the operation
- Will not make the situation worse
- Have a beginning point and an ending point (anchor points)
- Will be able to complete your operation with the personnel and equipment on hand
    - Do not start an operation that in order to complete you must rely on resources that are not on scene, they may never arrive
- Have considered all other options including the use of other tactics

- Will not delay suppression activities by spending the time to gather resources, prepare and execute the firing operation
- ***Coordinate with adjoining resources/personnel***

Conclusion

If you can not unequivocally make meet the guidelines of this SOP in the time available, do not fire!

Significant Freeway Complex Fire Photographs[1]

BRUCE CHAMBERS, THE ORANGE COUNTY REGISTER

MINDY SCHAUER, THE ORANGE COUNTY REGISTER

[1] Source: Orange County Register, November 15, 2008, **http://www.ocregister.com/news/fire-190401-coverage-complete.html**

Freeway Gridlock

Mark Avery, AP

Mark Avery, AP

Santa Ana Wind Driven Firestorm

Kevin Sullivan, The Orange County Register

Kevin Sullivan, The Orange County Register

FREEWAY COMPLEX FIRE
PRELIMINARY REPORT

December 2, 2008

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Freeway Complex Fire
Preliminary Report

Purpose

November 2008 Southern California was devastated by wildland fires. On November 13, 2008 several large fires were burning and being fueled by an extreme Santa Ana wind condition and low humidity. In the aftermath, hundreds of homes were destroyed and thousands of acres burned in Santa Barbara, Los Angeles, Riverside, San Bernardino, and Orange Counties. In total, the fires in Southern California consumed over 850 homes, and burned more than 40,000 acres.

At the request of the Yorba Linda City Council, the preliminary report on the November 15, 2008 Freeway Complex fire is being provided. The comprehensive Freeway Complex Fire After Action Report (AAR), which will be more thorough and detailed, is expected to be completed prior to the March 2009 OCFA Board of Directors (BOD) meeting. A draft of this report will be presented to the Yorba Linda City Council for review and comment prior the final report being submitted to the OCFA Board of Directors. In addition, OCFA staff will provide monthly AAR progress reports to the City Council.

Conditions at Time of the Fire

A Red Flag Warning was in effect for the 24-hour period preceding the start of the Freeway Fire on Saturday, November 15, 2008 and had been extended through 10:00 A.M. for an area including Orange County by the National Weather Service (NWS). This decision by the NWS is based on local weather data and is an important planning triggering event for the OCFA. The Weather Condition Summary contained in this preliminary report comes from climatic archives taken from the two closest National Oceanic and Atmospheric Administration (NOAA) certified Remote Automated Weather Stations (RAWS) to the origin of the Freeway Fire; Fremont Canyon and the Corona Airport. The RAWS provides hourly weather information by collecting, storing and forwarding data to computerized systems. Several indicators are measured including air temperature, local wind speeds and relative humidity around the clock.

The Freemont Canyon (RAWS) site is located on a Santa Ana Mountain ridge above the origin of the fire.

Freemont Canyon RAWS - Santa Ana Mountains

Time	Temperature	Wind Speed	Humidity
9:00 A.M.	75°	43 mph, Gusts to 61 mph	8%
3:00 P.M.	80°	25 mph, Gusts to 45 mph	7%

The second RAWS is located at the Corona Airport and is approximately 3 miles east of the fire's origin, near the entrance to Santa Ana Canyon.

Corona Airport RAWS - Santa Ana Canyon

Time	Temperature	Wind Speed	Humidity
9:00 A.M.	83°	20 mph, Gusts to 24 mph	6%
3:00 P.M.	90°	29 mph, Gusts to 37 mph	4%

Advanced Planning

During periods of extreme weather, OCFA routinely monitors weather forecasts and takes actions commensurate with these forecasts and predictions. OCFA has a comprehensive Standard Operating Procedure (SOP) titled *Extreme Weather Plan Winds/Red Flag and Rain/Floods* (OM 209.13). This SOP provides a standardized operational approach in response to extreme or predicted extreme weather conditions.

Additionally, OCFA has an SOP titled *Red Flag Alert/Hazardous Fire Conditions Program* (OM 209.12). This SOP describes the Red Flag Alert Program which is designed to prevent large fires that may occur as a result of extreme weather conditions and OCFA's actions in response to Red Flag Alerts that are issued by the U.S. Weather Service. Essentially this program is an intensive, cooperative; watch and-warning fire prevention patrol, and public awareness program conducted by local, state, and federal fire agencies in conjunction with private cooperators during periods of extreme fire danger.

In preparation for the expected extreme fire conditions, the OCFA implemented an emergency staffing pattern on November 14, 2008 which included:

- One Type-III Strike Team with 4-person staffing
- Staffing of a second helicopter
- Increased staffing on five engine companies in the wildland interface areas from three to four firefighters each (these are referred to as the "Grey Book" stations)
- An additional fire dispatcher was added to the Emergency Communication Center

At the inception of the Freeway Fire Southern California was already besieged by two other resource intensive wildfires in the counties of Santa Barbara and Los Angeles County. The Tea Fire started on November 13, 2008 and burned through the community of Montecito located in Santa Barbara County. It would ultimately char 1,940 acres, destroy 210 homes, damage 9 others and cost 5.7 million dollars to extinguish. The Sayre Fire started on November 14, 2008 in the community of Sylmar in Los Angeles County. This fire charred 11,262 acres, destroyed 487 homes, 1 commercial building and 146 outbuildings. The cost of fighting this fire was 13.5 million dollars.

As a cooperating member of the California Fire and Rescue Emergency Mutual Aid Plan, the OCFA had three strike teams of engines deployed out-of-county at the start of the Freeway Fire . The mutual aid system is founded on the principle of neighbor helping neighbor. When an emergency is of such a nature that it overwhelms an agency's ability to manage it on their own, other California fire departments provide resources. The system allows for an orderly escalation and distribution of resource commitment to one or more incidents and from a single resource to several hundred.

During most wildland fires, Mutual Aid resources are requested and assembled in preparation for anticipated strategic actions. However, with wildland fires that rapidly turn into urban interface conflagrations such as the November 2008 fires, planning must make way for rapid initial attack strategies and the immediate deployment of available resources.

November 14, 2008 OCFA Out-of-County Strike Teams	
Tea Fire	One OCFA Type-III Strike Team (9328-C) was committed to the Tea Fire on 11/13/08 at 9:00 P.M.
Tea Fire	One OCFA engine (OES-E303) was committed as part of OES Type-I Strike Team (1830C) to the Tea Fire on 11/13/08 at 11:47 P.M.
Tea Fire	One OCFA Type-I Strike Team (1400-A) was committed to the Tea Fire on 11/14/08 at 3:55 A.M.
Sayre Fire	One OCFA Type-I Strike Team (1402-A) was committed to the Sayre fire on 11/15/08 at 00:40 A.M.

In addition, neighboring MetroNet fire agencies committed three strike teams of engines to the Tea and Sayre Fires and additional OES engines for the OES strike team. This represents a total of 35 fire engines and seven strike team leaders from the OCFA and other Orange County fire agencies assigned to fires outside of the county at the inception of the Freeway Fire. As OCFA resources are committed on a mutual aid response personnel are recalled to staff relief engines to ensure adequate station coverage. Staffing the OCFA's relief/surge engine fleet, all fire engines sent out of county had been covered either through the use of backfill (10 engines) or by the on-coming shift personnel (5 engines). All the essential station openings had been covered prior to the start of the Freeway Fire.

Fire History of the Area

Yorba Linda has an extensive history of wildland fire due to its location within the Santa Ana Canyon. Weather, vegetation and topography are the significant factors contributing to the rapid spread and impact of wildland fires. Since 1980, the Yorba Linda area has experienced 25 separate wildland fires burning a total of 82,734 acres; events range from one (1) to 19,986 acres. The most notable and devastating of these are the 1982 Gypsum Incident (19,986 acres), the 1980 Owl Incident (18,332 acres), the 1980 Carbon Canyon Incident (14,613 acres) and the 2006 Sierra Peak Incident (10,506 acres). The commonality of each of these larger fires is the Santa Ana Wind and the effect it has on vegetation and fire behavior. The Santa Ana Canyon funnels the wind, increasing its speed and magnifying the effects on the available fuel bed. The

frequency of fire in this area has allowed non-native vegetation of volatile grasses and weeds to become the dominate fuel type.

Pre-planning for emergency events is a familiar concept to the OCFA. Operational plans exist or are under development for many high risk areas. A few weeks prior to the Freeway Fire, in an effort to bring stakeholder agencies (OCFA, LACO, Corona FD, Cal Fire RRU/BDU, San Bernardino CFD, Chino Valley IFD, Anaheim FD, Orange FD, USFS, and South Ops.) together to develop and review operational plans for the wildland urban interface area along the 91 Freeway corridor a table top "gaming" exercise was conducted. This exercise provided chief officers the opportunity to consider fire progression and fire spread potential. Trigger points were also developed with a course of action for each one. This exercise proved to be highly beneficial as some of the first responding officers were participants in the gaming process.

An example of one of these trigger points is demonstrated through actions taken by OCFA Battalion 2 while enroute to the fire. Based upon the radio traffic from the initial attack companies, Battalion 2 ordered two strike teams to report to OCFA Station 53 in East Yorba Linda. The purpose was to get ahead of the fire and place additional engines into Yorba Linda which was in the direct path of the rapidly advancing fire from Corona.

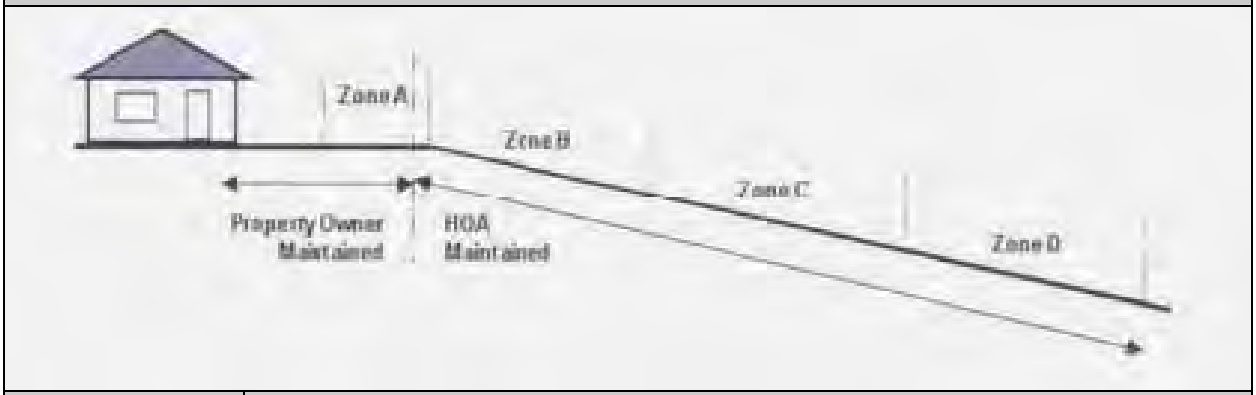
Fire Prevention: Brush Clearance and Construction

Land use planning and fire prevention play a key role in reducing the wildfire threat to communities in the wildland-urban interface (WUI). To adequately protect communities in these areas, a combination of brush clearance measures and ignition resistant construction of structures is necessary.

Brush Clearance

The Orange County Fire Authority has enforced "fuel modification" requirements since the County adopted these provisions in 1979 to protect homes in the WUI. The requirements and provisions are also included in the local ordinances of the 22 cities protected by OCFA. Homes constructed in Yorba Linda since 1980 are most likely protected by a fuel modification program.

Fuel modification is a program consisting of four zones totaling 170 feet in width. Features include: set-backs and irrigated zones along with a selection of appropriate plant palettes for each zone. A 20 foot "non-combustible zone" is included in the yards of homes adjacent to fuel modification areas where fencing, patio covers, decks, etc. must be constructed of non-combustible materials.

OCFA Fuel Modification	
	
A Zone	20 feet wide and on level ground, landscaped with approved plants Helps prevent direct flame impingement on the structure and deflect radiant heat
B Zone	Minimum of 50 feet wide Irrigated and landscaped with approved plants Slows fire and reduces fire intensity
C and D Zones*	Each zone is a minimum of 50 feet wide All dead and dying materials are removed Native vegetation thinned 50% in C zone, 30% in D zone Slows fire and reduces fire intensity *Some older fuel modifications have only a C Zone

Homes constructed in the WUI prior to 1980 are required to maintain "defensible space" between their home and the property line that separates them from the WUI. Defensible space is less prescriptive than fuel modification and consists of thinning vegetation and ensuring tree branches are not within ten feet of chimneys.

The provisions for fuel modification and defensible space have evolved over the past 30 years and, although proven effective in protecting communities during wildfire incidents, are not without implementation challenges. The most significant implementation challenge is maintenance.

Maintenance of Brush Clearance

OCFA does not have a formal WUI inspection program. As a result, if areas are not properly maintained on a voluntary basis by the responsible landowner, they can become overgrown and, in some instances, irrigation can be stopped due to cost or poor maintenance of water lines. OCFA staff attempts to identify the worst cases and work with landowners to restore the land to an approved condition. In Yorba Linda, this is complicated by the fact that, unlike most of Orange County where fuel modification zones are owned and maintained by a homeowner's association, the OCFA must usually work with each individual homeowner on compliance plans or, in some cases, to access the area for inspection.

In 2008, staff inspected 587 WUI parcels and found only 16 out of compliance with minimum requirements for defensible space. By July 22, all properties were in compliance. In addition, staff inspected approximately 790 of some 950 fuel modification parcels to ensure that they were in "substantial compliance" with provisions of the requirements and found 322 in need of some type of corrective action. As of the date of the fire, all but 25 had met minimum requirements. A preliminary assessment of homes destroyed or damaged in the freeway fire indicates that they were victim to ember intrusion rather than direct flame impingement indicating brush clearance was adequate.

Prior to the fire, staff had made it a priority to conduct a complete inspection of all homes protected by fuel modification to ensure all zones are planted, irrigated and maintained as required. This will be the first comprehensive inspection conducted by OCFA and is expected to take more than a year. This effort may also be combined with an educational component that informs the homeowner of action they can take to protect their home through plant choices outside the fuel modification zones. Information on action that can be taken to prevent fire and embers from entering their homes through open windows, combustibles stacked too close to their home, or inadequate construction features will also be included.

Ignition Resistant Construction

Properly established and maintained brush clearance is typically very effective in protecting homes for direct flame impingement and radiant heat. However, it can do little to nothing to protect homes from ember intrusion. Homes must be constructed to withstand ignition from embers that land on homes or enter through attics and other openings.

The Office of the State Fire Marshal has worked with stakeholders for several years developing "ignition resistant building standards" that were adopted by the California Building Standards Commission and became applicable in January 2008. These standards, which dictate construction methods for roofs, eaves, vents, walls, doors, windows, and patio covers and decks, apply to all homes constructed in "Very High Fire Hazard Severity Zones" or locally designate WUI areas. The State has not yet sent Orange County the final maps for adoption by the City but has indicated they will be mailed early next year. In the interim, the regulations are applicable in the "Special Fire Protection Areas" (SFPA), adopted by the City in 1996.

In 1996, the City also adopted an ordinance for construction within designated SFPA areas. Many construction requirements of that 1996 ordinance are similar to the new statewide standards although notable improvements relative to application and protection of walls and vents were made to the new provisions. It is also notable that, according to our records, none of the homes damaged or destroyed in the Freeway Fire were constructed after 1996 and thus, were not protected by provisions required by the City's ordinance for WUI areas.

The application of ignition resistant construction requirements is critical to the survivability of homes that are subject to ember intrusion hundreds of feet from the interface. Maps depicting impact areas must be locally adopted.

Water for Firefighting

Brush clearance and “hardened” (ignition resistant) homes go far in improving the chances for a home’s survival from a wind-driven WUI fire. However, intervention by firefighters is often necessary in saving a home that is determined to be defensible. Water is essential to aiding firefighters in these efforts.

OCFA's Planning and Development Services Section reviews all plans for new development to ensure an adequate water supply is provided in accordance with the adopted Fire Code for the city. Like all California jurisdictions, Yorba Linda is required by State law to adopt the California Fire Code (CFC) and adopted the latest edition in 2007. The CFC requires all structures be within a specified distance to an approved water supply. An "approved" water supply can be defined by the adopting jurisdiction or, the adopting jurisdiction may choose to adopt the water supply provisions found in Appendix B of the CFC. At OCFA's recommendation, Yorba Linda adopts Appendix B, which specifies the water supply; know as "fire flow" based on the square footage of the structure and the construction type. Fire flow is comprised of the flow volume (gpm), residual pressure (psi), and duration of flow (in hours). Another table indicates the number of fire hydrants that must supply this fire flow and their spacing relative to structures protected.

Incident Summary

On Saturday, November 15, 2008 at 9:07:37 A.M., the Orange County Fire Authority responded to a 911 cell phone report of a vegetation fire in the area of the west bound 91 Freeway, west of the Green River off-ramp. OCFA’s initial dispatch to the incident was a High Watershed Response, which included the following:

- Two Battalion Chiefs (ORCB2 and ANAB1)
- Seven Engines (ORC E10, E53, E15, E832 and ANA E8, E9 and E10)
- Two Helicopters (ORC HC41 and HC-241)
- Two Patrols (ORC P10 and P32)
- One Fire Bulldozer (ORC Dozer 2)
- One Water Tender (ORC W10)

At 9:01 A.M. the Corona Fire Department received the initial 911 call reporting the fire and had dispatched three engines and one Battalion Chief to a report of a vegetation fire at the west bound 91 Freeway and Green River.

- COR Brush-1, Brush-3, Engine-2 and Battalion 3

After arriving on scene Corona Battalion 3 assumes the Freeway Incident Command. COR B3 reports that the fire is advancing at a rapid rate and is immediately threatening structures.

Even as the initial response was traveling to the incident the OCFA Emergency Communications Center continue to receive a large volume of 911 calls reporting the fire. A total of 711 telephone

calls were handled by the ECC in the first four hours of the incident. At 9:11 A.M. the response is augmented by the following resources:

- One Type III Strike Team (9329C) responding from the RFOTC
- OC Sheriff helicopter (Duke 1)
- One Division Chief (D-5)
- One Hand Crew and the Crew Superintendent (Crew 1)

At 9:19 A.M. while still enroute and having heard the Freeway Incident Commander's report, ORC Battalion 2 uses established trigger points and immediately orders additional resources.

- Two Type-I Strike Team's (1403-A and 1404-A) – These engines were directed to assemble and stage at OCFA Fire Station 53 in Yorba Linda approximately 2.5 miles down wind from the point of origin.
- Two fixed wing aircraft and a lead plane

Within 15 minutes of the original dispatch the following resources had been added to the incident.

- One Battalion Chief (ORC B3)
- One Engine (ORC E221)
- Two Water Tenders (ORC W7 and W16)
- One Patrol (ORC P16/CAFS)
- One Reserve Hand Crew (ORC Crew 18)

Resources either on scene or ordered within the first 20 minutes of the fire totaled 26 Engines and 5 aircraft

When Battalion 2 arrived on scene at 9:25 A.M., he met with Corona Battalion 3 and Anaheim Battalion 1. They discussed the fire conditions and spread. By then the fire had grown to over 20 acres with a rapid rate of spread and long range spotting (flying embers) occurring well in advance of the fire. The fire was continuing to spread in a westerly direction towards the Green River Homes development of Corona. Structures had begun to burn in the Penny Royal and Feather River area. All available resources were deployed for structure protection.

It was apparent from the onset that this would become a rapidly spreading and significant fire. At 10:12 A.M. the OCFA Incident Commander (Division 5) called for all highest ranking responding agency chief officers to report to the command post to establish a unified command. The unified command post was established at the Green River Golf Course. The Unified Command Team eventually included the OCFA, O.C. Sheriff's Department (OCSD), Anaheim Fire Department (AFD), Brea FD, LA County Fire Department (LACO), Chino Valley IFD, Corona Fire Department (COR), and Cal Fire.

At 10:14 A.M. Helicopter 41 reports that the main fire has spotted one mile ahead of itself. At 10:20 A.M. ORC B2 instructs the ECC to notify the Brea P.D. and the Yorba Linda City Manager of the risk to homes in the Brush Canyon area and that there is a need to evacuate homes within Thomas Brother's Map Page 741, Grids E4, F4, and G5. B2 reports that the fire

will reach the homes within 30 minutes. B2 orders four additional Type-I Strike Teams to stage at Fire Station 53.

During the first hour of the fire the ECC Supervisor established that the OCFA would be the Central Ordering Point for the fire. ECC dispatchers initiated move-up and cover protocols to fill open fire stations caused by the fire response. The OCFA activated and staffed the Department Operations Center (DOC) in the ECC to manage essential operational functions and to provide assistance to the Freeway Fire Incident Commanders. At approximately 9:30 A.M., Division 3 arrived at the DOC and assigned OCFA personnel to report to the County of Orange EOC on Loma Ridge, the OCSD DOC at the Sheriff's facility in Santa Ana, and the Yorba Linda EOC in the Yorba Linda Community Center.

A second vegetation fire is reported in the City of Brea near Carbon Canyon

At 10:46 A.M. a second vegetation fire is reported in the area of the Olinda Alpha Landfill in the City of Brea. The OCFA dispatch center sent the following units from available resources covering nearby fire stations.

- Two Battalion Chiefs (ORC B1 and B8)
- Four Engines (ORC E817, E47, E62 and E223)
- Two Patrols (ORC P23 w/CAFS and P26)
- One Paramedic (ORC M26)
- One Safety Officer

Olinda Alpha Landfill Fire Timeline	
10:46 A.M.	OCFA receives 911 call
11:00 A.M.	OCFA B-8 arrived on scene reported 2-3 acres moving rapidly toward structures and ordered three Type-I Strike Teams and firefighting aircraft
11:08 A.M.	Units from Brea FD and Fullerton FD are dispatched to the fire. Brea B-1, E-1, E-2, E-3, E-304 Fullerton E-1 and E-4
11:28 A.M.	OCFA and Brea FD form a unified command at the "Dump Fire"
17:17 A.M.	Incident commanders at the Freeway Fire roll the Dump Fire into the Freeway Fire and designate the Dump Fire as Branch III of the Freeway Complex.

Freeway Complex Fire Timeline and Fire Spread Summary	
9:00 A.M.	A vegetation fire is established in the vicinity of the 91 and Green River. Aided by above average air temps and single digit RH, Santa Ana winds push fire through the riverbed vegetation and into the surrounding foothills west and north of Green River Golf Course.
9:25 A.M.	Fire is bumping up against and destroying homes in the city of Corona on Feather River Rd and Penny Royal Rd., east of the golf course.
9:45 A.M.	Fire is immediately threatening the golf course and the order to evacuate is given. Fire is also making a run to the WNW and becoming well established in Chino Hills State Park.
10:04 A.M.	The order is given to the BNS Railroad to stop all rail traffic in the affected area.
10:31 A.M.	Reports of fire running into Brush Canyon and threatening homes in Yorba Linda on Evening Breeze, Blue Ridge and Big Horn.
10:52 A.M.	Reports of homes burning in the area of Paseo de Toronto and Bryant Elementary School.
12:53 P.M.	The fire jumps the 91 Fwy and threatens structures in Anaheim Hills
1:08 P.M.	The fire is now taking structures in Hidden Hills
1:18 P.M.	Structures are threatened on Stonehaven, west of Hidden Hills
2:03 P.M.	Reports of structures on fire in the area of New River and Esperanza, west of Yorba Linda Blvd
3:05 P.M.	Reports of structures on fire in the areas of San Antonio and Alder, north of Yorba Linda Blvd
3:13 P.M.	Reports of homes on fire in the area of San Antonio and Fairmont
3:14 P.M.	Reports of numerous businesses threatened in SAVI Ranch
5:08 P.M.	Homes reported to be burning in the area of Black Forest and Banyan Rim
7:00 P.M.	Cal Fire Incident Management Team. Six assumes control of the fire and continues to support the established Unified Command
7:47 P.M.	Report of fire in the Yorba Linda Blvd and Kellogg area
8:15 P.M.	Fire is now reported to be in Telegraph Canyon and approaching Carbon Canyon
9:53 P.M.	Fire has become established in the area of Lambert and the 57 Freeway

Freeway Complex Statistics

The Freeway Fire burned approximately 10,000 acres in the first 12-hours. After just 24-hours, the fire had consumed 23,640 acres and numerous homes.

- 30,305 acres burned
- 187 Residential structures destroyed (includes multi-family residences)
- 127 residential structures damaged
- 2 commercial properties destroyed

- 2 commercial properties damaged
- 11 outbuildings destroyed
- 32 outbuildings damaged
- $16.1 million in suppression costs to date, 11/26/08

Mutual Aid

As signatory to the California Master Mutual Aid agreement, the OCFA provides mutual aid assistance to those communities in need. In the same respect, when the OCFA is in need mutual aid is provided by fire agencies who are able to do so. During the Santiago Fire in 2007, there were nine other major fires in California. This unusual circumstance required the OCFA to be self sufficient for the first 48 hours of that fire.

In contrast, when the Freeway Fire started there were two fires of significance in Southern California; the Tea Fire in Santa Barbara County and the Sayre Fire in Los Angeles County were both well underway and seeking mutual aid resources. Prior to the start of the Freeway Fire the OCFA had sent one Type-III and one Type-I Strike Team. to the Tea Fire. MetroNet cities had sent three Type I Strike Teams along with an OES engine Type-I Strike Team from both OCFA and MetroNet cities to the Tea Fire. The Sayre Fire received one Type-I Strike Team from the OCFA and one Type-I Strike Team from MetroNet.

When the Freeway Fire began there were immediate requests for both Type-I and Type-III Strike Teams beyond what could be provided by local agencies. In total 35 Strike Teams of various types were ordered within the first four hours of the incident. Of these, seven Type-I and one Type-III Strike Teams were filled with resources within Orange County as immediate need requests . By 11:00 A.M. six Strike Teams (5 Type-I and 1 Type-III) had arrived from Riverside County. By 1:30 P.M. a total of 19 Strike Teams and one task force were operating on the complex. This was in additions to the 58 engines, 3 trucks, 8 patrols and 5 water tenders that responded as single increments to the complex in the first four hours of the incident. In total, prior to 2:00 P.M. there were 159 engines assigned to and operating on the Freeway Complex.

This rapidity in which resources were filled is largely due to the lack of competition for resources from other fires and a change in mutual aid policy. This change initiated in 2007 allowed for Operational Area and Region Coordinators to directly order and request up to five Strike Teams across operational area boundaries based on the closest resource concept; this is in contrast to the previous rule that permitted only one Strike Team resource to be ordered outside the regional system.

Air Resources

At the time of the initial dispatch of the first air resources to the fire on November 15 (9:08 A.M.), winds at the Fullerton Airport were light and blowing offshore. When the crews of OCFA Helicopters 41 and 241 lifted off they noted that the smoke column rising from the fire in Corona was building and beginning to bend with the influence of the Santa Ana wind. As they headed toward the Santa Ana Canyon the flight crews experienced a 20 to 30 knot head wind. Although their airspeed indicated 110 knots, their actual ground speed was only 70 knots. Wind turbulence was a continual factor for the helicopters as they began making water drops in the interface where the fire was threatening residences. The low lying smoke challenged the pilots' ability to maintain visual flight conditions while making concentrated, effective drops.

The initial aircraft response consisted of OCFA H-41, H-241 and OCSO Duke-1. Duke-2 was later added to the response to assist with water dropping missions. Both OCFA helicopters arrived on scene at the fire at 9:29 A.M. and began dropping water on the fire near the threatened homes. Duke-1 arrived shortly afterward. Because the Sheriff's helicopter does not have a fixed water tank, Duke-1 must land and deploy their 170 gallon bucket prior to engaging in the firefighting efforts.

While engaged in fire fighting, a Corona City Fire crew was overrun by the rapidly escalating fire front. With the fire environment becoming untenable OCFA flight crews began making water drops on the firefighters' position. The firefighters sustained minor injuries. A burn over investigation was initiated by Cal Fire.

At 9:19 A.M. ORC Battalion 2 ordered "Fixed wing aircraft" which resulted in the dispatch of two S2T Air Tankers and an Air Attack out of San Bernardino. The first fixed wing assets arrived at 10:10 A.M. and at the direction of Air Attack began making drops along the North flank of the fire. At 10:24 A.M. ORC HC 41 relayed a resource request from Air Attack to OCFA dispatch "For three additional Air Tankers with a Lead Plane and four Type 2 helicopters."

The Freeway Complex eventually had 17 fire fighting helicopters assigned. These helicopters were comprised of local and state government fire helicopters, law enforcement and commercial vender *call when needed* (CWN) aircraft. During the first six hours of the fire, the OCFA helicopters dropped 48,400 gallons of water and fire retardant foam on the fire. By the end of the second day they delivered over 88,000 gallons of water and foam during water dropping missions on the Freeway Complex. During that same two day period, twelve fixed wing Air Tankers with four Lead Planes being fueled and re-supplied out of San Bernardino and Hemet Ryan air bases dropped 208,791 gallons of retardant on the fire. Tanker 910 (DC-10 aircraft) made a total of ten drops (8 on 11/15 and 2 on 11/16) in the Yorba Linda/ Chino Hills area for a total of 109,445 gallons of retardant. This availability of air resources is also in contrast to the Santiago Fire, where much of California's airborne fire suppression ability was engaged in the numerous other fires in place when the Santiago Fire began.

Water Supply

The demands of a single structure fire can tax even a well functioning water system. In contrast to the usual situation where an engine will pump directly from a hydrant to fight a structure fire, in a wildland event the hydrants are used to refill the water tenders and the engine water tanks. The engines then usually use their tank water to attack the fires during their mobile suppression efforts. As ground forces moved into threatened neighborhoods and tried to extinguish or defend dozens of homes, the Yorba Linda water supply was severely impacted. At approximately 2:00 P.M., several radio calls were received reporting fire companies encountering low or no water pressure in various sections of the Hidden Hills area. Fire companies encountered low or no water pressure on Hidden Hills Road, Mission Hills Lane, High Tree Circle, Fairwood Circle, Green Crest Drive, Skyridge Drive and others. With homes burning on multiple fronts Strike Team Leaders directed companies to move to areas that had available water.

In an effort to ensure that rekindles were kept to a minimum a Patrol with Compressed Air Foam System (CAFS) Task Force was established and put under the direction of a Battalion Chief. The Task Force remained in the Hidden Hills area extinguishing fires and laying down protective foam on unburned structures.

The Yorba Structure Protection Group was using two water tenders to shuttle water to the fire companies. The water tenders systematically began checking fire hydrants until one was found that had enough pressure to fill the water tanks. Eventually water tenders had to fall back to the hydrants at the lowest point in the system to refill. A request for service was placed to the Water District via the Yorba Linda EOC at approximately 2:00 P.M. The Water District responded into the area quickly but was unable to immediately determine the reason for the pressure loss, resulting in the service not being restored for some time. At approximately 5:00 P.M. the water tenders found that the pressure had improved sufficiently enough to permit filling. Also at 5:50 P.M. the Yorba Linda Water District requested three fire engines to assist them in supplementing the water grid system at Pepper and Manzanita.

Evacuations

The Freeway Fire raced from Riverside County on forty to fifty mile per hour winds into the City of Yorba Linda. At approximately 10:20 A.M. the OCFA ECC received direction from OCFA Battalion 2 to advise the City of Yorba Linda that evacuations should be initiated in the areas of Brush Canyon and that the fire would be upon those homes within thirty minutes. Within 90 seconds the Brea PD was notified to initiate the evacuations and the City Manager was contacted. At 10:31 A.M. the first reports are received that the fire is spotting and homes are threatened on Bighorn Mountain Way in Yorba Linda. At 10:39 A.M. OCFA Helicopter 41 confirms that homes on Bighorn Mountain Way, Blue Ridge Drive, and Evening Breeze Drive are threatened.

Although a collaborative decision, the responsibility for civilian evacuation is statutorily a law enforcement function, which also allows the fire department to focus on control efforts. It is impossible to know how many citizens evacuated at any one time in any single area of the city; however it is known that nearly 9,000 dwelling units were impacted in Yorba Linda by the evacuation order as a result of the fires that comprised the Freeway Complex. It is estimated that at the height of the firefight approximately 24,000 citizens were evacuated or kept from returning to their homes due to safety concerns.

As residents began to evacuate, traffic grid-locked in some areas as emergency apparatus tried to enter the neighborhoods while residents tried to exit. The Brea Police Department and other assisting law enforcement agencies took control of the traffic flow which helped firefighters gain access to threatened homes. In any firefighting effort rescue is the first priority. However, in this case resident self evacuation was in effect assuring that rescue from an active fire front would be minimized. It is noteworthy that with such an expansive and escalating evacuation boundary the residents stayed calm and followed evacuation directions. At 11:30 A.M. Patrol 10 reported to incident command that evacuations in their area were orderly and without incident.

Law enforcement agencies possess the legal authority to conduct evacuations of populated areas. Although a mandatory evacuation was declared, law enforcement does not have the legal authority to force residents out of their homes; however, law enforcement may restrict the return of residents once they leave. Determining where and when to evacuate is often difficult. Each decision brings with it a new set of risks and benefits. The greatest risk by permitting residents to remain with their homes is the potential for loss of life. The fact that there was no loss of life or serious injury to residents should not go unnoticed.

Similar wildland urban interface fires in other communities have not been so fortunate. The Tea Fire in Montecito resulted in more than two dozen civilian injuries, two of which were critical burns received while trying to flee their residence. In 2006, in Cabazon, the Esperanza Fire resulted in four firefighter fatalities that occurred during structure protection efforts. The Cedar Fire that occurred in San Diego County in 2003 resulted in the death of fourteen civilians and a firefighter all while trying to flee or protect homes. Investigation into the citizen deaths and injuries identified one commonality: they all occurred because people decided to stay and protect their property or they evacuated too late and got caught in the fire front.

Although there was no loss of life in Yorba Linda, there may have been close calls. The following was put into the call history by an OCFA dispatcher during the fire.

> "Wife called to report her husband is trapped somewhere in the Yorba Linda Fire. He was working in the area and started to hose down houses then became trapped. She was unable to give any type of location. She was advised to keep trying to contact her husband to find out his location. He is not answering his cell."

We do not know who this man was or what impact his efforts may have had. What we do know is that he found himself at risk and may have faced serious injury or death. We also know that because the call came into the ECC, firefighters on the line were notified to be alert for trapped

civilians. Having to focus the already limited resources on both firefighting and potential rescue situations does impact the efficiency of the emergency operations.

Recently the OCFA held a summit for Southern California fire officials to discuss a program designed to help communities better prepare residents of wildland urban interface areas. This program is named *Leave Early or Stay and Defend* (LEOSAD) and is a development of the Australian fire service. The OCFA is evaluating the viability of this program. A key premise of LEOSAD is that residents have a vested interest in protecting their property in the face of a catastrophic fire event. It also reinforces that these urban conflagrations are beyond the ability of a fire agency to control with initial response resources and that triage decisions must be made as to which structures to defend.

Wildland urban interface fires present many challenges pertaining to evacuation. The fire spread rate is often so fast that emergency responders can only estimate the rate of spread and direction of travel. In this case, within minutes of the fire start, spotting was reported one mile down-wind from the head of the fire. Driven by winds of 40 MPH and higher the rate of spread went from the usual estimate of acres per hour in a non wind driven fire to acres per minute.

Recent simulation training for a fire along the 91 Freeway corridor gave incident commanders some practical trigger points when and where to call for evacuation. Radio traffic supports that when these trigger points were reached planned actions were put into motion. The manner and timeliness in which residents were notified is being reviewed. After the Santiago Fire in 2007 the County of Orange led the development and implementation of a public notification/alert system called *AlertOC* which has been adopted and activated in many cities throughout the county.

The City of Yorba Linda is in the process of implementing AlertOC and plans to use the system to communicate to Yorba Linda residents and businesses affected by local emergency events. Residents may use the online process to register their contact information. AlertOC is designed to be implemented by designated city officials during an emergency.

Triaging of homes in regard to an urban conflagration is very similar to what a paramedic would do for a mass casualty incident. Triage is to allow the organization to do the most good for the greatest number of people when the available resources do not match the need. This same goal applies to the triage of structures in a wildland urban interface fire. Fire personnel are trained to recognize which structures are least-salvageable and then to direct their efforts toward saving those structures that have the greatest potential to be saved. However even with the best training and practice it takes great discipline to trade off the life of one patient for another, just as it takes the same discipline to drive past a structure that is on fire to defend one that is not. These triage decisions are often made in seconds with little more information than firefighters can gather as they drive down a smoky and ember ridden street.

Investigation

The fire originated in Riverside County near the 91 Freeway and the Green River off-ramp in the City of Corona. The area of origin is the jurisdiction of Cal Fire. Cal Fire investigators assumed the responsibility for the fire investigation. The preliminary fire cause is reported as accidental; the result of a vehicle exhausts system igniting roadside vegetation. The Landfill Fire is also currently under investigation.

Cost and Reimbursement

Annually the OCFA establishes *Cost Reimbursement Rates* for personnel and equipment resources that are requested on an *Assistance-by-Hire* basis by local, state and federal agencies seeking OCFA services. The personnel rates are based on budgeted salary and benefit costs and also include indirect costs such as financial services, purchasing, and human resources. Equipment rates are based on rate schedules provided by Cal Fire and the Federal Emergency Management Agency (FEMA). To date the cost for the Freeway Complex Fire is estimated at $16.1 million dollars.

Within the first hours of the fire, a Federal Management Assistance Grant (FMAG) was submitted for each of the Freeway and Landfill fires. Both were subsequently approved. Due to the magnitude of the incident, FEMA and the State's Office of Emergency Services (OES) declared the Freeway Complex Fire as a Major Incident. This made Public Assistance Funding available to the participating agencies.

The OCFA is responsible for a small percentage of the cost of fighting the fire on the first day. Cal Fire will assume the remaining firefighting costs.

Recovery

Even as the Freeway Complex Fire was being brought under control, efforts began to address the post fire risk to lives and property that could arise during the coming rainy season. The combined effects of vegetation loss and the effect on soils from fire, created conditions that greatly increased the threat of flooding, erosion, and debris flow in the impacted areas.

In order to prepare for the winter season, the OCFA along with the California State Office of Emergency Services (OES) coordinated assessments of the burned areas with State Emergency Assessment Teams (S.E.A.T.). These teams were made up of representatives from CAL FIRE, California Geological Survey, Department of Water Resources, Department of Fish and Game, Department of Parks and Recreation and Regional Water Quality Control Boards.

The S.E.A.T. members conduct a rapid assessment of the fire area to identify hazards and subsequent mitigations including:

- Identifying on-site and downstream. threats to public health or safety from land sliding, debris torrents, flooding, road hazards, and other fire related problems.
- Identifying threats to watershed resources, including: excessive erosion; impaired water quality; threats to wildlife, fisheries, and botanical values; and cultural resources.
- Determining measures needed to prevent or mitigate identified threats.

The report provided by the S.E.A.T. members suggests mitigations that can be used to reduce but not entirely eliminate all risk from the identified hazards. Some possible recommendations:

- Straw mulching and erosion control fabric or blankets
- Straw wattles to provide a mechanical barrier to water flow and trap sediment
- Hydro-mulching in selected areas

Any recommended mitigations will normally be implemented by private, local, state and federal agencies. The S.E.A.T. has no control over the implementation of the mitigations.

Rain Event

A moderate to heavy rain storm was predicted for the Orange County area on November 26-27, 2008. Predicted rainfall amounts ranged from 1.5 inches to 2.5 inches. The OCFA began preparations for the possibility of mud and debris flows by working closely with the local communities of Yorba Linda, as well as the Santiago Fire areas. Evacuation plans were coordinated with local government and law enforcement agencies in the areas directly impacted by the fires.

The three main objectives for the OCFA were to provide incident management and support in the event of significant flooding and debris flow in the burn areas. Second, to coordinate weather related calls for service to the city of Yorba Linda if the call volume were to overwhelm the OCFA's Communication Center. And third, to assist with the timely and orderly evacuation of residential areas as necessary.

The following OCFA resources were pre-staged in order to reduce reaction time and get needed help to any impacted areas as soon as possible. The augmented resources were staged at the Yorba Linda Community Center.

- Incident Management Team
- One Dozer
- Two Swift Water Rescue units
- One Hand Crew
- One Type 3 Strike Team
- Reserve Patrols 10 and 32

The City of Yorba Linda and its residents played a significant role in preparing for the rain event. Even while fire crews were continuing to overhaul the burn areas, community efforts were underway to fill, distribute and place sandbags, straw bales and other mitigation efforts.

Incident Summary

On November 15, 2008 the Cities and Communities of Yorba Linda, Corona, Anaheim, Brea, Carbon Canyon, Diamond Bar, and Chino Valley were tested by fire. In short the residents and businesses in the affected areas were victim of an urban conflagration. What has become a common occurrence in Southern California this dramatic and damaging fire known as the Freeway Fire Complex focused its full furry into residential neighborhoods that once enjoyed panoramic views of the urban wildland interface (WUI). Fanned by Santa Ana winds this fire grew from a roadside start in light grasses to a consuming furnace moving faster than ground forces were able to predict. Analogous to taking a bag of confetti, lighting it on fire and tossing it in front of a high powered fan; showers of embers rained down without discrimination.

Pushed by winds greater than 40 mph, fueled by single digit relative humidity and in alignment with favorable terrain the Freeway Fire capitalized on these key burn factors to consume more than 30,000 acres, destroy 200 structures, and damage 161 others at a cost of more than 16.1 million dollars.

Initiating a unified incident command structure the OCFA with the assistance of more than 276 mutual aid agencies fought back for five days to gain control and then spent several more days to ensure that every open fire line was closed and every burned structure was overhauled. Combining a well coordinated ground attack with a military like air assault every effort was made to protect homes, businesses and infrastructure while ensuring public safety as best as possible. In the end, properties were lost and damaged, and while devastating, satisfaction must be found in that no lives were lost and only a few minor injuries were reported. In that satisfaction the OCFA recognizes that even the loss of one home is unacceptable and has already begun the organizational learning process.

This preliminary report is the precursor to a more formal and detailed After Action Review. Staff has already been assigned to manage the process and the goal has been established to have the finished report ready by March 1, 2009. Regular updates will be provided to the Yorba Linda City Council as the report is developed. The OCFA will not be waiting for the final report to initiate needed changes or action items. For instance, the OCFA had initiated the process of subscribing to the Alert OC public notification system and will work with the City of Yorba Linda, other partner cities, and law enforcement agencies to ensure systems and processes are reviewed and established that will ensure prompt public notification of emergency situations.

The OCFA understands the concern in regard to ensuring an adequate water supply is available and accessible for fires and other emergencies. In that regard the OCFA has already initiated meetings with the Yorba Linda Water District to determine the nature and cause of water delivery issues related to the Freeway Fire. As soon as practical the OCFA will initiate discussion with other municipal water districts and city water departments. The focus of these

meetings will be to determine how water agencies can work together to enhance service during emergencies.

As previously discussed in this report the OCFA has already initiated action toward future implementation of the "Leave Early or Stay and Defend" (LEOSAD) program. Understanding that homeowners have a vested interest in the protection of their property, the OCFA desires to provide a proven methodology that will meet that goal while making safety of the homeowner a key principle. In that regard, the OCFA will work with the City of Yorba Linda and community leaders to develop educational methodologies and vendor resources to ensure that the LEOSAD philosophy is widely disseminated and supported.

Furthermore as the recovery process begins the OCFA is committed to ensuring that those residents and business owners who sustained either a wholesale loss or even the most minor of damage receive the assistance most needed. Fire Prevention personnel are ready to assist in every phase of the recovery. OCFA Fire Prevention staff will work with the City of Yorba Linda Building Department to streamline permit and plan check processes. The OCFA's Fire Marshal has initiated an assessment of the damage relative to brush clearance and building construction and will review existing codes and ordinances. Working with City staff, they will make recommendations to City Council on revisions that will better protect homes from flames and ember intrusion.

The OCFA has provided this preliminary report to meet the need and request of the City of Yorba Linda. While not able to provide final and determinant information at this early phase of the incident review, it is sincerely hoped that the information contained herein has been satisfactorily developed and presented.

Glossary of Terms

CONFLAGRATION – An uncontrolled burning or fire that threatens human life, property and the environment.

CONTAINMENT – A fire is contained when it is surrounded on all sides by some form of boundary, line or clearance, but is still burning and has the potential to jump or escape the containment line.

CONTROLLED – A fire is controlled when there is no further threat of it jumping or escaping outside the containment line.

COOPERATING AGENCY – An agency supplying assistance including but not limited to direct tactical or support functions or resources to the incident control effort.

DEFENSIBLE SPACE -Creating a fire safe landscape for at least 30 feet around homes (and out to 100 feet or more in some areas), to reduce the chance of a wildfire spreading to structures. This is the basis for creating a "defensible space" - an area that will help protect a home and provide a safety zone for the firefighters battling flames.

DEPARTMENT OPERATIONS CENTER (DOC) – Also known as "Expanded Dispatch". A DOC provides agency dispatching capability independent and separate from routine emergency dispatch. The DOC is activated and staffed for large or complex incidents allowing personnel to focus efforts solely on the incident, maintaining situation status, processing orders for resources and maintaining a direct link with EOCs.

ECC – Emergency Communications Center. Also known as a Dispatch Center, an ECC is the center of an agencies information and communication capability tasked with receiving and processes incoming calls for help. ECC personnel determine the nature of the request and forward it to the appropriate resource.

EXTREME FIRE BEHAVIOR – "Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved: High rate of spread, prolific crowning and/or spotting, presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, and dangerously.

FIRE LINE - A strip of area where the vegetation has been removed to deny the fire fuel, or a river, a freeway or some other barrier which is expected to stop the fire. Hose lines from fire engines may also contribute to a fire being surrounded and contained.

FIRE PERIMETER – The entire outer edge or boundary of a fire.

FMAG – Fire Management Assistance Grant. A federal assistance program managed by FEMA through the state Office of Emergency Services (OES). This program is designed to help state and/or local jurisdictions impacted by high cost, high damage wildland fires.

FUEL MODIFICATION – The practice of modifying and irrigating vegetation to reduce fuel energy output. Highly flammable wildland vegetation is replaced with managed areas of light or fire resistive fuels thereby allowing firefighters the ability to control a fire while relatively small.

FUELS - Combustible material.

GREY BOOK – The Gray Book is the agreement between Cal Fire and the six contract counties that addresses direct fire protection of State Responsibility Area (SRA) within each of the contract counties. Orange County, along with the other contract counties receives funding from the state to provide protection to the SRA

HANDCREW – A team of wildland firefighters primarily assigned to fire line construction activities. Handcrews also mop up hot spots; burn out vegetation to provide fuel free zones and assist with hose lays.

INCIDENT COMMANDER – This ICS position is responsible for overall management of the incident and reports to the Agency Administrator for the agency having incident jurisdiction.

INCIDENT COMMAND SYSTEM (ICS) – A standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

INCIDENT MANAGEMENT TEAM (IMT) – The incident commander and appropriate general and command staff personnel assigned to an incident. Also known as an Incident Command Team.

INITIAL ATTACK (IA) – An aggressive suppression action taken by first arriving resources consistent with firefighter and public safety and values to be protected.

INTERFACE ZONE – It is the area where the wildlands come together with the urban areas. Also referred to as the I-Zone. Also referred to as Wildland Urban Interface (WUI)

MASTER MUTUAL AID SYSTEM – Master Mutual Aid creates a formal structure in which a jurisdictions personnel, facilities and equipment can voluntarily assist other jurisdictions when their capabilities are overwhelmed.

OES – The California Governor's Office of the Emergency Services.

PATROL UNIT – An OCFA fire apparatus designed for wildland firefighting built on heavy duty passenger crew-cab truck chassis and carries 100-gallons of water in a pressurized tank. OCFA Patrols are assigned to fire stations adjacent to wildland interface areas.

RATE OF SPREAD (ROS) – The relative activity of a fire as it extends out from the point of origin and the total perimeter of the fire. It is usually expressed in acres per hour.

SANTA ANA WINDS – Is a type of Foehn wind. A Foehn wind is a warm, dry and strong general wind that flows down into the valleys when stable, high pressure air is forced across and then down the lee side slopes of a mountain range. The descending air is warmed and dried due to adiabatic compression producing critical fire weather conditions. Locally it is called by various names such as Santa Ana winds and Sundowners.

SEAT TEAM – State Emergency Assessment Team (SEAT). A team comprised of multi-agency and multi-disciplined resource specialists assembled to assess fire damage, suppression effects and prepare mitigation measures. Upon development of a rehabilitation plan, the team makes recommendations on hazard mitigation.

STRIKE TEAM - An engine strike team consists of five fire engines of the same type and a lead vehicle. The strike team leader is usually a captain or a battalion chief. Strike Teams can also be made up of bulldozers and handcrews.

SPOT FIRE OR SPOTTING – A small fire that is ahead of the main fire, caused from hot embers being carried (generally by winds) to a receptive fuel bed or structure. Spotting indicates extreme fire conditions.

RED FLAG WARNING – Term used by fire weather forecasters to alert users to an ongoing or imminent critical fire weather pattern.

REHABILITATION – The activities necessary to repair damage or disturbance caused by wildfire or the wildfire suppression activity.

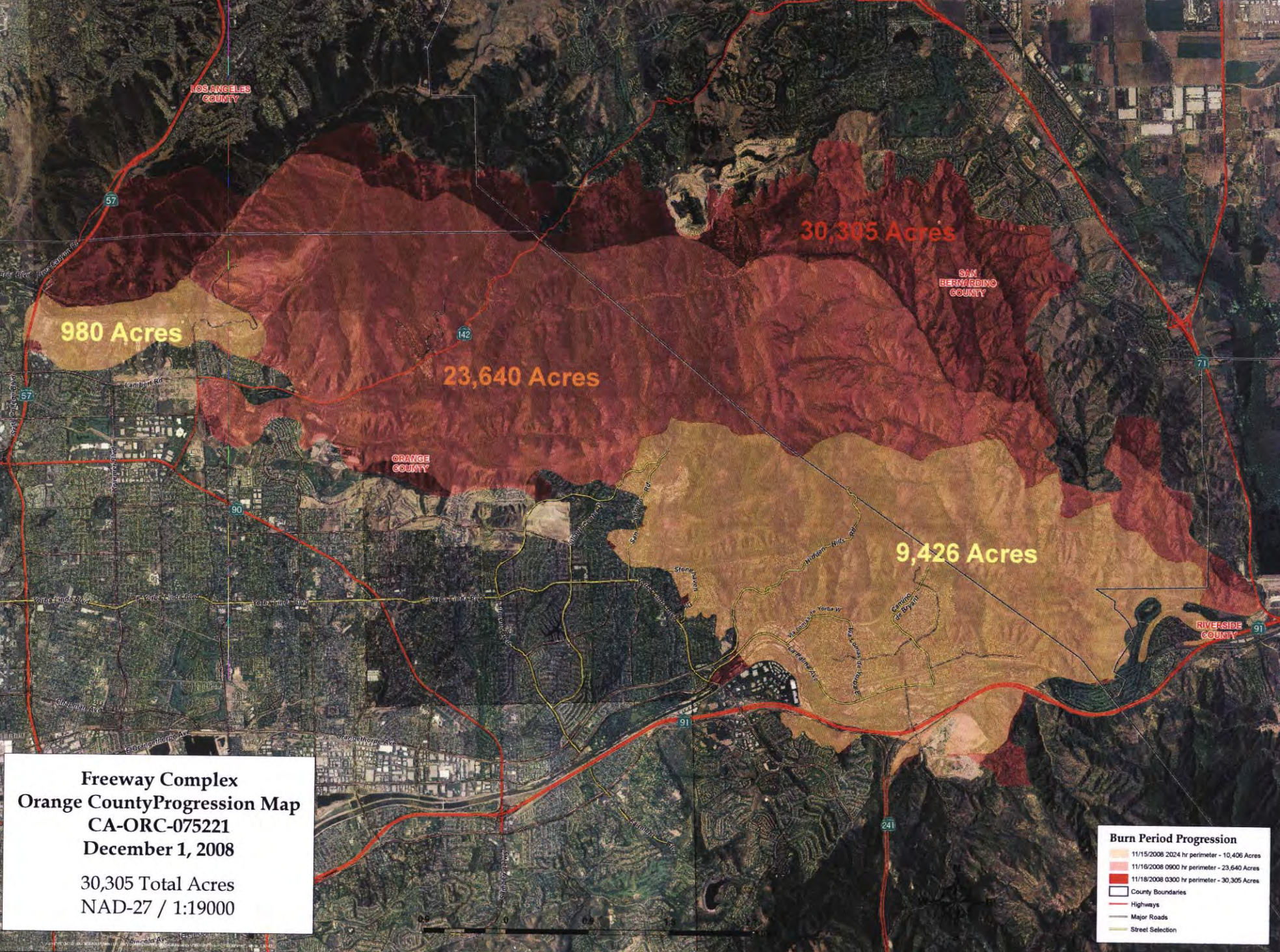
STATE RESPONSIBILITY AREA (SRA) - The California Board of Forestry and Fire Protection classifies areas in which the primary financial responsibility for preventing and suppressing fires is that of the state. CDF has SRA responsibility for the protection of over 31 million acres of California's privately-owned wildlands.

UNIFIED COMMAND – In ICS, unified command is a unified team effort which allows all agencies with jurisdictional responsibility for the incident, either geographical or functional, to manage an incident by establishing a common set of incident objectives and strategies.

WATER TENDER – A specialized firefighting apparatus capable of transporting a minimum of 1000 gallons of water from a water source directly to the fire scene.

WILDLAND ENGINE (Type III) – Fire engines designed for the wildland firefighting environment. Constructed on heavy-duty commercial truck chassis with high ground clearance and often equipped with four wheel drive. Type III engines carry 500 gallons of water and have a minimum pump capacity of 120gpm at 250psi

WILDLAND/URBAN INTERFACE – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.



Freeway Complex
Orange CountyProgression Map
CA-ORC-075221
December 1, 2008

30,305 Total Acres
NAD-27 / 1:19000

Burn Period Progression

- 11/15/2008 2024 hr perimeter - 10,406 Acres
- 11/16/2008 0900 hr perimeter - 23,640 Acres
- 11/18/2008 0300 hr perimeter - 30,305 Acres
- County Boundaries
- Highways
- Major Roads
- Street Selection

Modules: SURFACE, SIZE

Description: Fanita, under a 60 mph Santa Ana wind in an FM-4

Fuel/Vegetation, Surface/Understory

Fuel Model		4

Fuel Moisture

1-h Moisture	percent	2
10-h Moisture	percent	3
100-h Moisture	percent	5
Live Herbaceous Moisture	percent	
Live Woody Moisture	percent	50

Weather

20-ft Wind Speed	mi/h	60
Wind Adjustment Factor		0.5
Direction of Wind Vector (from upslope)	deg	180

Terrain

Slope Steepness	percent	45

Fire

Elapsed Time	h	1.0

Run Option Notes

Calculations are only for the direction of maximum spread [SURFACE].

Fireline intensity, flame length, and spread distance are always for the direction of the spread calculations [SURFACE].

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

Direction of the wind vector is the direction the wind is pushing the fire [SURFACE].

Output Variables

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

Fireline Intensity (Btu/ft/s) [SURFACE]

Flame Length (ft) [SURFACE]

Midflame Wind Speed (mi/h) [SURFACE]

Max Eff Wind Exceeded? [SURFACE]

Area (ac) [SIZE]

Perimeter (ft) [SIZE]

(continued on next page)

Input Worksheet (continued)

Notes

RUN #6

A late season wildfire under 60 mph Santa Ana wind conditions in a FM-4, continuous chaparral vegetation over 6' in height.

Fanita, under a 60 mph Santa Ana wind in an FM-4

Surface Rate of Spread (maximum)	1966.5	ft/min
Fireline Intensity	113088	Btu/ft/s
Flame Length	95.0	ft
Midflame Wind Speed	30.0	mi/h
Max Eff Wind Exceeded?	No	
Area	30229.3	ac
Perimeter	241689	ft

TABLE 2.3.4
Expected fire behavior for a Prevailing Southwest Wind Condition in a Fuel Model 4 (A Fuel Model 4 is a continuous cover of chaparral vegetation greater than 6' in height)
RATE OF SPREAD **200.3 feet/minute** **FIRE LINE INTENSITY** **9,652 BTU's/foot/second** **FLAME LENGTH** **30.6 feet in length**
Additional Fire Behavior Calculation Input: • 15 mph 20-foot wind speed (7 mph mid-flame wind speed) • 30 percent slope • 270° direction of wind vector to downhill slope

This equates to 231 acres in 30 minutes and 953 acres in 60 minutes assuming no initial attack.

TABLE 2.3.5
Expected fire behavior for a Late Fire Season Above Average Southwest Wind Condition in a Fuel Model 4 (A Fuel Model 4 is a continuous cover of chaparral vegetation greater than 6' in height)
RATE OF SPREAD **783 feet/minute** **FIRE LINE INTENSITY** **45,027 BTU's/foot/second** **FLAME LENGTH** **62.2 feet in length**
Additional Fire Behavior Calculation Input: • 30 mph 20-foot wind speed (15.0 mph mid-flame wind speed) • 30 percent slope • 270° direction of wind vector to downhill slope

This equates to 2,105 acres in 30 minutes and 8,420 acres in 60 minutes assuming no initial attack.

TABLE 2.3.6
Expected fire behavior for a North, Northeast and East Santa Ana Wind Condition in a Fuel Model 4 (A Fuel Model 4 is a continuous cover of chaparral vegetation greater than 6' in height)
RATE OF SPREAD **2,041 feet/minute** **FIRE LINE INTENSITY** **117,380 BTU's/foot/second** **FLAME LENGTH** **96.7 feet in length**
Additional Fire Behavior Calculation Input: • 60 mph 20-foot wind speed (30.0 mph mid-flame wind speed) • 30 percent slope • 45° direction of wind vector to uphill slope

This equates to 7,952 acres in 30 minutes and 31,809 acres in 60 minutes assuming no initial attack.

Modules: SURFACE, SIZE

Description: TM 5441 in a FM-4 under a 60 MPH Santa Ana wind

Fuel/Vegetation, Surface/Understory

Fuel Model		4

Fuel Moisture

1-h Moisture	percent	2
10-h Moisture	percent	3
100-h Moisture	percent	5
Live Herbaceous Moisture	percent	
Live Woody Moisture	percent	50

Weather

20-ft Wind Speed	mi/h	60
Wind Adjustment Factor		0.5
Direction of Wind Vector (from upslope)	deg	0

Terrain

Slope Steepness	percent	30

Fire

Elapsed Time	h	.5, 1

Run Option Notes

Calculations are only for the direction of maximum spread [SURFACE].

Fireline intensity, flame length, and spread distance are always for the direction of the spread calculations [SURFACE].

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

Direction of the wind vector is the direction the wind is pushing the fire [SURFACE].

Output Variables

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

Heat per Unit Area (Btu/ft2) [SURFACE]

Fireline Intensity (Btu/ft/s) [SURFACE]

Flame Length (ft) [SURFACE]

Direction of Maximum Spread (from upslope) (deg) [SURFACE]

Midflame Wind Speed (mi/h) [SURFACE]

Max Eff Wind Exceeded? [SURFACE]

Area (ac) [SIZE]

(continued on next page)

Input Worksheet (continued)

Perimeter (ft) [SIZE]

Notes

This BehavePlus run calculates the flame length for 3 sites on the north side of TM 5441. This run is at the request of RSFFPD who indicated that north slope fuels behave like a FM-4. FM-4 fuels consist of continuous chaparral over 6 feet in height. This run depicts a late season Santa Ana wind on a 30% up slope.

TM 5440, 5441, ... for a FM4 under an 60 mph Santa Ana wind

Elapsed Time	ROS (max)	Heat per Unit Area	Fireline Intensity	Flame Length	Direction Max ROS	Midflame Wind Speed >
h	ft/min	Btu/ft2	Btu/ft/s	ft	deg	mi/h >
0.5	2041.2	3450	117380	96.7	0	30.0
1.0	2041.2	3450	117380	96.7	0	30.0

TM ~~5440~~, 5441; for a FM4 under a ~~above ave SW~~ wind Compit santa Ana

< Elapsed Time	Max Wind Exceeded	Fire Area	Fire Perimeter
< h		ac	ft
0.5	No	7952.2	125304
1.0	No	31808.7	250607

ON THE USE OF A FIREBRAND GENERATOR TO INVESTIGATE THE IGNITION OF STRUCTURES IN WILDLAND-URBAN INTERFACE (WUI) FIRES

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ABSTRACT

An experimental apparatus has been constructed to generate a controlled and repeatable size and mass distribution of glowing firebrands. The present study reports on a series of experiments conducted in order to characterize the performance of this firebrand generator. Firebrand generator characterization and subsequent structural ignition experiments were performed at the Fire Research Wind Tunnel Facility (FRWTF) at the Building Research Institute (BRI) in Tsukuba, Japan. The firebrand generator was fed with mulch generated from Korean Pine trees. To produce repeatable initial conditions for each experiment, the Korean Pine mulch was sorted using a series of filters prior to being loaded into the firebrand generator. The size and mass distribution of firebrands produced from the generator was tuned to be representative of firebrands produced from burning trees. After the size and mass distribution of firebrands was characterized, the device was then used to direct firebrand fluxes towards a structure installed inside the FRWTF. A gable vent was installed on the front face of the structure and three different steel screens were installed behind the gable vent to ascertain the ability of the screen to block firebrands from penetrating into the structure. The mechanism of firebrand penetration through screens was observed for the first time. The firebrands were not quenched by the presence of the screen and would continue to burn until they were able to fit through the screen opening. Results of the study are presented and discussed.

INTRODUCTION

The Wildland-Urban Interface (WUI) is defined where structures meet or intermingle with undeveloped wildland. Fires in the WUI pose a significant threat to communities throughout the USA. From 1984, WUI fires have consumed an average of 850 homes per year[1]. Presently, it is estimated that some 3.2 million homes in California alone are located in the WUI[1]. The destruction from a single WUI fire event can be tremendous. In 2003, for example, WUI fires in the vicinity of San Diego, California displaced nearly 100,000 people and destroyed over 3000 homes, leading to over $2B in insured losses[1].

For structures to burn in WUI fires, they must be ignited. Research conducted in tandem with post-fire analysis by the US Forest Service and the California Department of Forestry suggests that spotting is the major source of structural ignition in WUI fires[2]. Spot fires are defined as new fires that propagate away from the main fire line due to lofted firebrands. These firebrands are produced as vegetation and structures burn in WUI fires. Understanding how these hot firebrands can ignite surrounding structures is an important consideration in mitigating fire spread in communities[3].

Japan has been plagued by structural ignition from firebrands as well. The initial fire outbreak mechanism is different in Japan than the USA. Japan is a country subjected to many earthquakes due to its geographical location. After these earthquakes have occurred, many fires are produced. At the same time, traditional ceramic roofing tiles are displaced as a result of the earthquakes exposing the bare wood roof under pining. Firebrands are produced as structures burn and with the presence of high winds these firebrands are dispersed throughout the atmosphere and produce spot fires which result in severe urban fires that are difficult to extinguish.

Due to the sheer complexity involved, it is useful to delineate the firebrand problem into three main areas: the generation from vegetation and structures, subsequent transport through the atmosphere, and the ultimate ignition of fuels after firebrand impingement. Of these processes, firebrand transport has been investigated most extensively[4-12]. These models have generally assumed firebrand sizes to perform transport calculations, since little quantitative data exists with regard to firebrand size or firebrand mass produced from vegetation and structures. Unfortunately, a very limited number of studies have been performed investigating firebrand generation from vegetation and structures[13-14] and the ultimate ignition of materials due to firebrand attack[15-20]. The general lack of knowledge of the type of firebrands that are produced as well as the type of materials that may be ignited has greatly hampered further understanding of this problem.

A pragmatic approach to mitigate firebrand ignition of structures in WUI fires is to design homes that are more resistant to firebrand ignition. Consequently, building codes and standards are needed to guide construction of new structures in areas known to be prone to WUI fires in order to reduce structural ignition in the event of a firebrand attack[1]. To the authors' knowledge, no experimental methods are presently available to generate a controlled flux of firebrands on a realistic scale and direct this firebrand flux onto structural elements to ascertain their resistance to ignition as a part of a full scale structural system.

To this end, an experimental apparatus has been constructed to generate a controlled and repeatable size and mass distribution of glowing firebrands. The present study reports on a series of experiments conducted in order to characterize the performance of this firebrand generator. Firebrand generator characterization experiments were performed at the FRWTF at the Building Research Institute (BRI) in Tsukuba, Japan. The effort described is part of an international collaboration established between the National Institute of Standards and Technology (NIST) in the USA and the Building Research Institute (BRI) in Japan to quantify firebrand production from vegetation and investigate firebrand ignition of structures. The firebrand generator was fed with mulch generated from Korean Pine trees. The size and mass distribution of firebrands produced from the generator was selected to be representative of firebrands produced from burning vegetation. After the size and mass distribution of firebrands was characterized, the device was then used to direct firebrand fluxes towards a structure installed inside the FRWTF. A gable vent was installed on the front face of the structure and three different steel screens were installed behind a gable vent to ascertain the ability of the screen to block firebrands from penetrating into the structure. Behind the screen, shredded paper of fixed moisture content was placed in pans to observe if the firebrands that penetrated the vent and subsequent screen were able to produce an ignition event.

EXPERIMENTAL DESCRIPTION

Figure 1 is a drawing of the experimental apparatus. The present apparatus is a scaled up version of a smaller first generation, proof-of-concept device[21]. The bottom left panel displays the procedure detailing the methodology for loading the Korean Pine tree mulch into the apparatus. The mulch pieces were deposited into the firebrand generator by removing the top portion. The mulch pieces were supported using a stainless steel mess screen (0.35 cm spacing), which was carefully selected. Two different screens were used to filter the mulch pieces prior to loading into the firebrand generator. The

first screen blocked all mulch pieces larger than 25 mm in diameter. A second screen was then used to remove all needles from the mulch pieces. The justification for this filtering methodology is provided below. A total of 2.1 kg of mulch was used as the initial mass for each of the experiments. The average moisture content of the mulch pieces used at ignition was 10 % (dry basis).

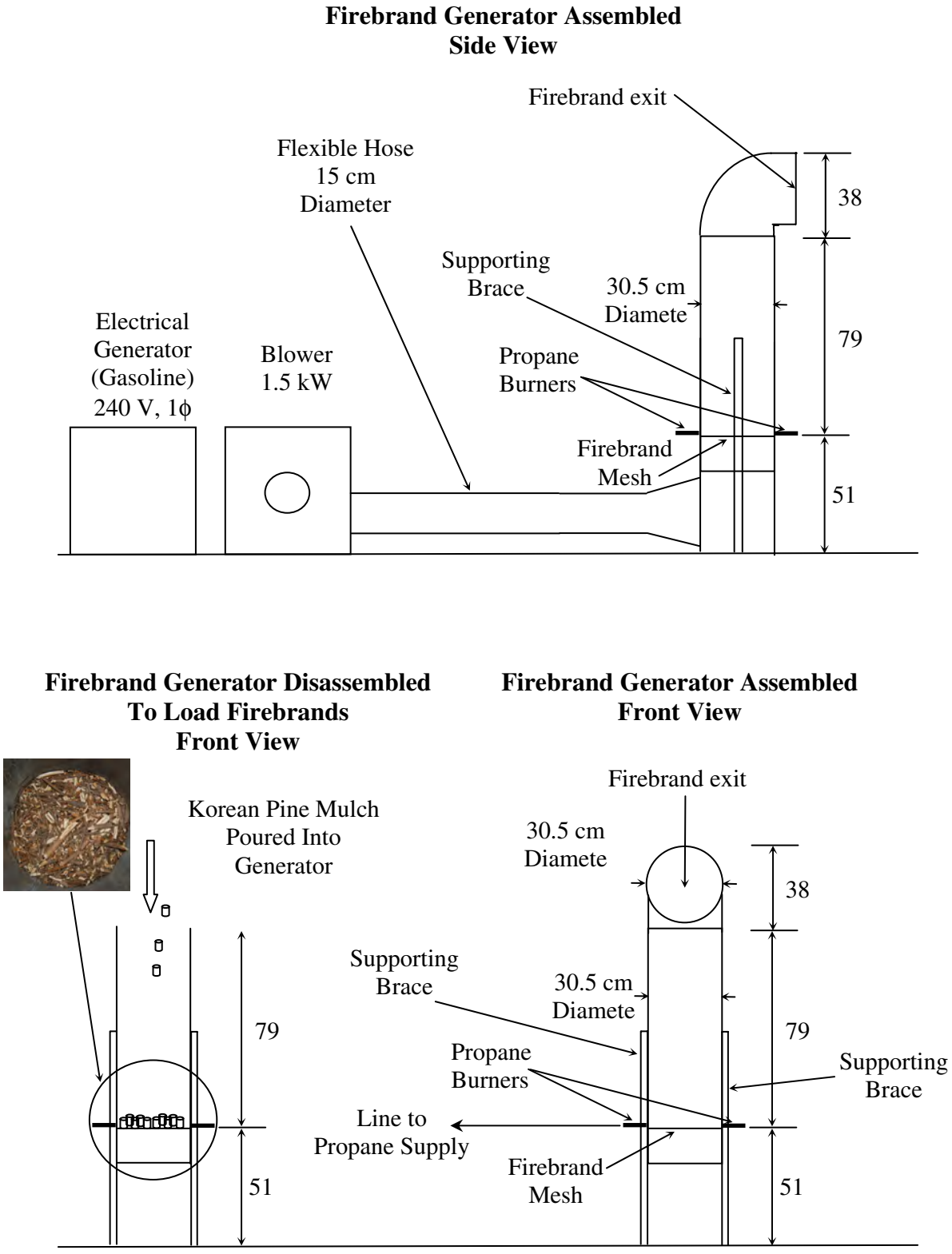

Figure 1 Schematic of the firebrand generator. Both front and side views are shown.

The firebrand generator was driven by a 1.5 kW blower that was powered by a gasoline electrical generator. The gasoline electric generator provided the blower with the necessary power requirements (see figure 1). These power requirements were not available at the FRWTF, necessitating the use of a portable power source. Furthermore, the firebrand generator was designed to be fully portable in order to test ignition of any structure or structural element.

The experiments were conducted in the following manner. After the Korean Pine tree mulch was loaded, the top section of the firebrand generator was coupled to the main body of the apparatus (see figure 1). With the exception of the flexible hose, all components of the apparatus were constructed from galvanized steel sections (0.8 mm in thickness). The blower was then switched to provide a low flow for ignition (1.0 m/s flow inside the duct measured upstream of the wood pieces). The two propane burners were then ignited individually and simultaneously inserted into the side of the generator. Each burner was connected to a 0.635 cm diameter copper tube with the propane regulator pressure set to 344 kPa at the burner inlet; this configuration allowed for a 1.3 cm flame length from each burner. The Korean Pine mulch was ignited for a total time of 45 seconds. After 45 seconds of ignition, the fan speed of the blower was increased (2.0 m/s flow inside the duct measured upstream of the wood pieces). The burners were subsequently switched off at 90 seconds after ignition. This sequence of events was selected in order to generate a continuous flux of glowing firebrands for approximately six minutes duration.

The principle behind the operation of the apparatus was rather simple, after ignition, the mulch would begin to burn and the density decreased until which point the low air flow passing through the support mesh was able to loft and exit the device as firebrands at low velocity. The timing and fan blower speed timing is not random; if a higher fan speed of the blower was selected, the firebrands produced would be forced out of the exit earlier, resulting in flaming firebrands, which was not desired in this phase of characterization.

The firebrand generator was installed inside the test section of the FRWTF at BRI. A drawing of the facility is shown in Figure 2 and displays the location of the firebrand generator with respect to the structure used for ignition testing. The facility was equipped with a 4.0 m fan used to produce the wind field and was capable of producing up to a 10 m/s wind flow. The wind flow velocity distribution was verified using a 21 point hot wire anemometer array. To track the evolution of the size and mass distribution of firebrands produced, a series of water pans was placed downstream of the firebrand generator. A total of 157 rectangular pans (water-filled) were used to collect firebrands. Each pan was 49.5 cm long by 29.5 cm wide. The arrangement and width of the pans was not random; rather it was based on scoping experiments to determine the locations where the firebrands would most likely land. After the experiments were completed, the pans were collected and the firebrands were filtered from the water using a series of fine mesh filters. The firebrands were subsequently dried in an oven held at 104 °C for eight hours. The firebrand sizes were then measured using precision calipers (1/100 mm resolution). Following size determination, the firebrands were then weighed using a precision balance (0.001 g resolution). For each experiment conducted, more than 200 firebrands were dried and measured.

After the generator was characterized, the structure used for vent penetration experiments was installed inside the FRWTF (see Figure 2). Prior to conducting the experiments, computer simulations were performed using the NIST Fire Dynamics Simulator (FDS) to help guide the location of the structure with respect to the firebrand generator. Figure 3 is a detailed drawing of the front face of the structure, showing the location of the gable vent. The overall dimensions of the structure were 3.06 m in height, 3.04 m wide, and 3.05 m in depth. A common type of gable vent, 30.5 cm wide by 45.7 cm long, was used. Experiments were conducted using the same vent but modifying the screen placed behind the vent. Three different screen sizes were used, 1.5 mm, 3 mm, and 6 mm. The justification for these sizes is provided below.

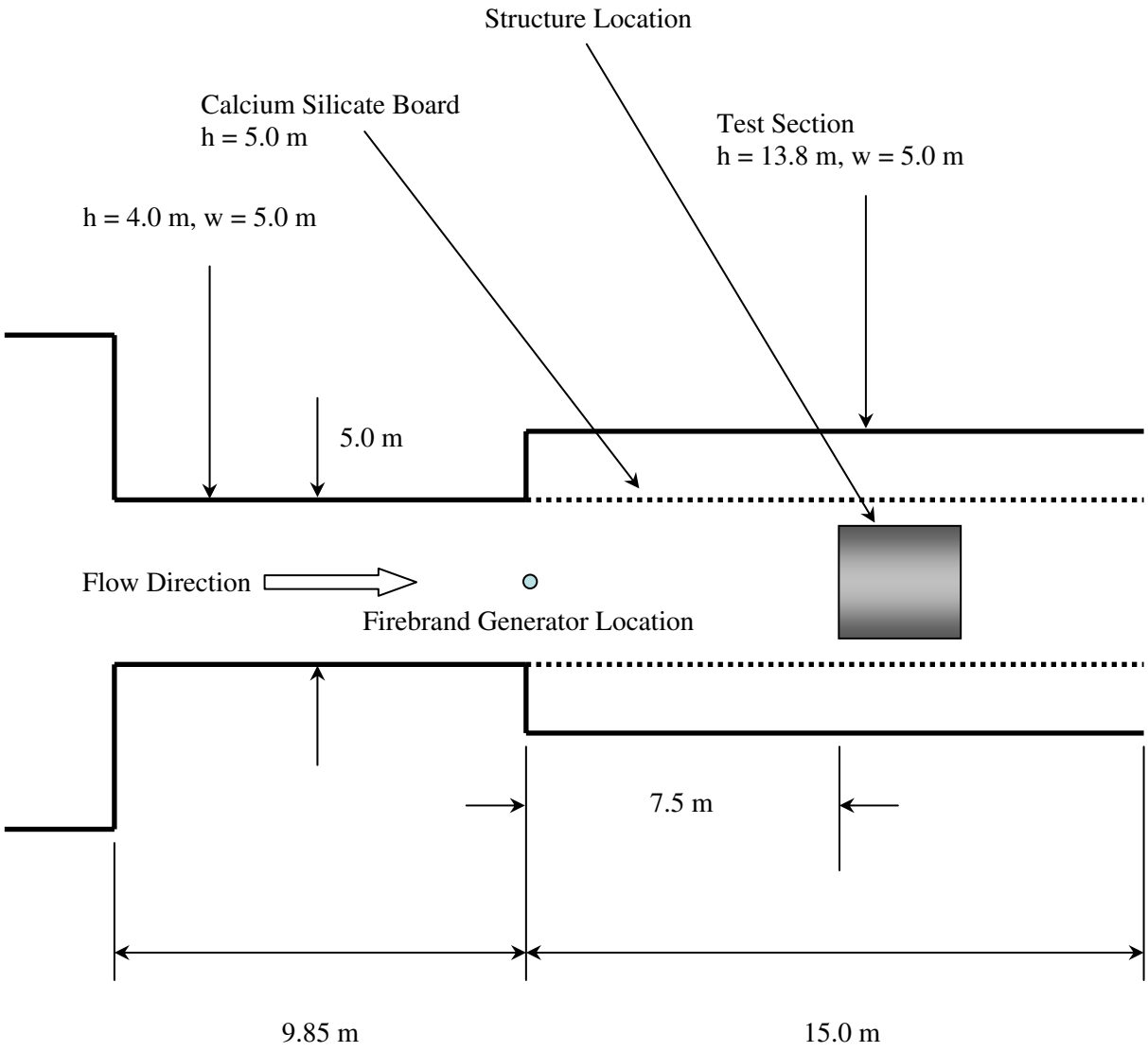

Figure 2 Drawing of the FRWTF (Top View). The location of the firebrand generator is shown.

Two pans, 49.5 cm long by 29.5 cm wide, filled with shredded paper (5 % moisture content dry basis) were placed under the vent opening (behind the screen) to ascertain ignition inside the structure. Firebrands that were able to penetrate the vent and subsequent screen landed in the paper filled pans. Shredded paper was used as a surrogate for cellulosic fuels typically found in attic spaces. The moisture content of 5 % was selected based on work of Manzello *et al.*[18]; firebrands ignite paper at 5 % moisture content.

RESULTS AND DISCUSSION

Experiments were first conducted to determine the size and mass distribution of the firebrands produced from the firebrand generator. The impetus for these experiments was to be able to produce firebrands that are characteristic of those produced by burning trees. Manzello *et al.*[14,22] have performed a series of experiments to characterize firebrand production from burning trees. Based on the results of two different tree species of varying crown height and moisture content (Douglas-Fir Trees and Korean Pine Trees) burning singly under no wind, cylindrical firebrands were observed to be produced. It was observed that the mass distribution of firebrands produced from two different tree species under similar moisture levels and crown size ranges were similar for mass classes up to 0.4 g. A noticeable difference

was observed in the larger mass classes. It was also observed that more than 85 % of the firebrands produced from trees were in mass classes up to 0.4 g.

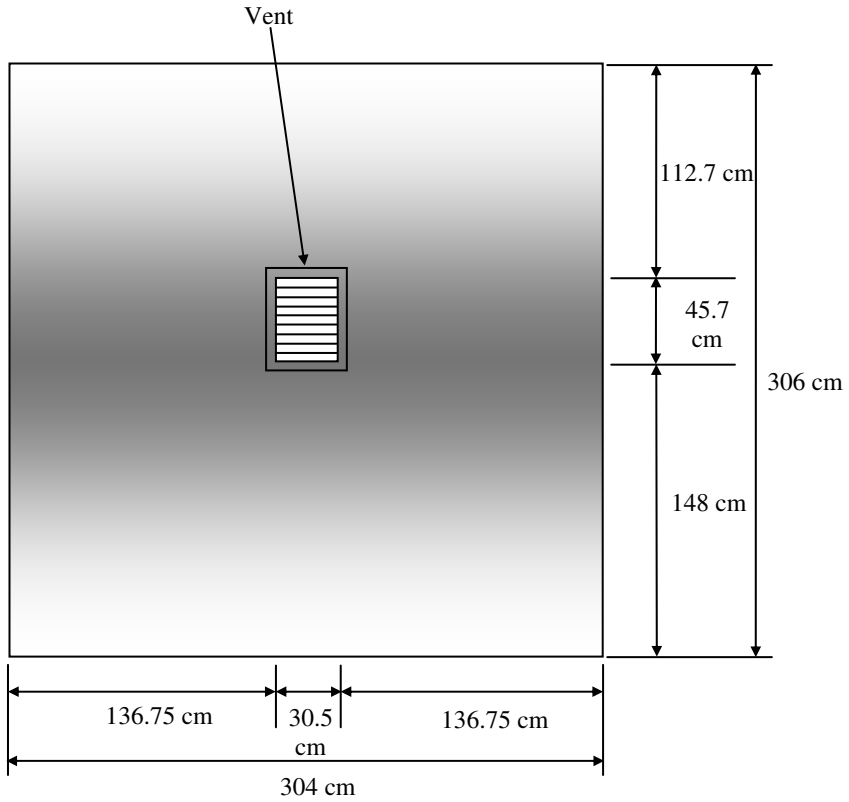

Figure 3 Schematic of the front face of the structure. The location of the gable vent is shown.

Accordingly, the input conditions for the firebrand generator were intentionally selected to produce firebrands with mass classes up to 0.4 g. This was accomplished by sorting the Korean Pine tree mulch using a series of filters prior to being loaded into the firebrand generator. Figures 4 displays a picture of typical firebrands produced from the firebrand generator under these conditions. Since many of the firebrands produced are cylindrical, the length and diameter of the generated firebrands was measured. This information was then used to calculate the surface area of the firebrands produced and was plotted as a function of the measured firebrand mass (see Figure 5). Figure 5 also displays the same analysis performed for firebrands collected from Douglas-Fir trees as well as Korean Pine Trees under similar moisture content. From the figure, the firebrand generator was capable of producing the size and mass distribution of firebrands from burning trees up to 0.4 g.

Figure 4 Digital picture of the firebrands produced from the firebrand generator. These images are taken after the firebrands were extracted from the water filled collection pans and dried.

The average total mass of firebrands generated per experiment was 131 g (varied from 110 g to 163 g). The total firebrand mass was an important parameter to characterize since it allows for a comparison of the total mass of firebrands generated from the device as compared to the amount of firebrands generated from a single tree burn. Based upon the results of the tree burning experiments, the firebrand generator, under the present operating conditions, was capable of producing about 2.5 times the total mass of firebrands produced from a single 4.5 m crown height Douglas-Fir tree. For completeness, figure 6 displays the measured size distribution of the cylindrical firebrands produced from the generator.

Once the firebrand size and mass distribution was characterized and similar to that produced from burning trees up to 0.4 g, the vent penetration experiments were conducted. In order to ensure repeatability of the firebrand size and mass distributions generated, the sorted Korean Pine tree mulch was metered out and weighed using a precision balance for each subsequent experiment.

Figure 7 displays a digital picture of a typical experiment conducted with a 3 mm screen mesh in place. A wind flow of 9 m/s was selected to direct firebrands towards the structure. The reason for this flow selection was twofold: the firebrands were observed to be lofted from the generator and carried to the structure, and it was desired to replicate a firebrand shower in these experiments as firebrand showers in WUI fires are observed under windy conditions (*e.g.* Santa Ana winds).

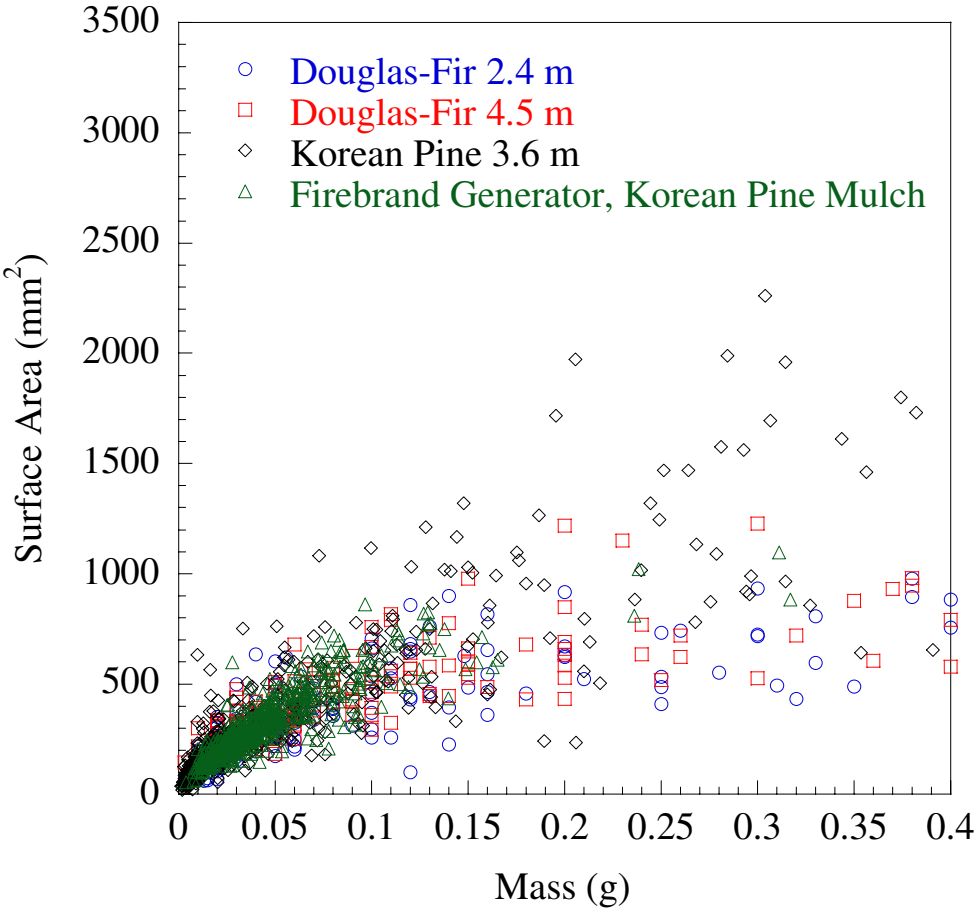

Figure 5 Comparison of firebrands produced from burning trees to those produced from the firebrand generator.

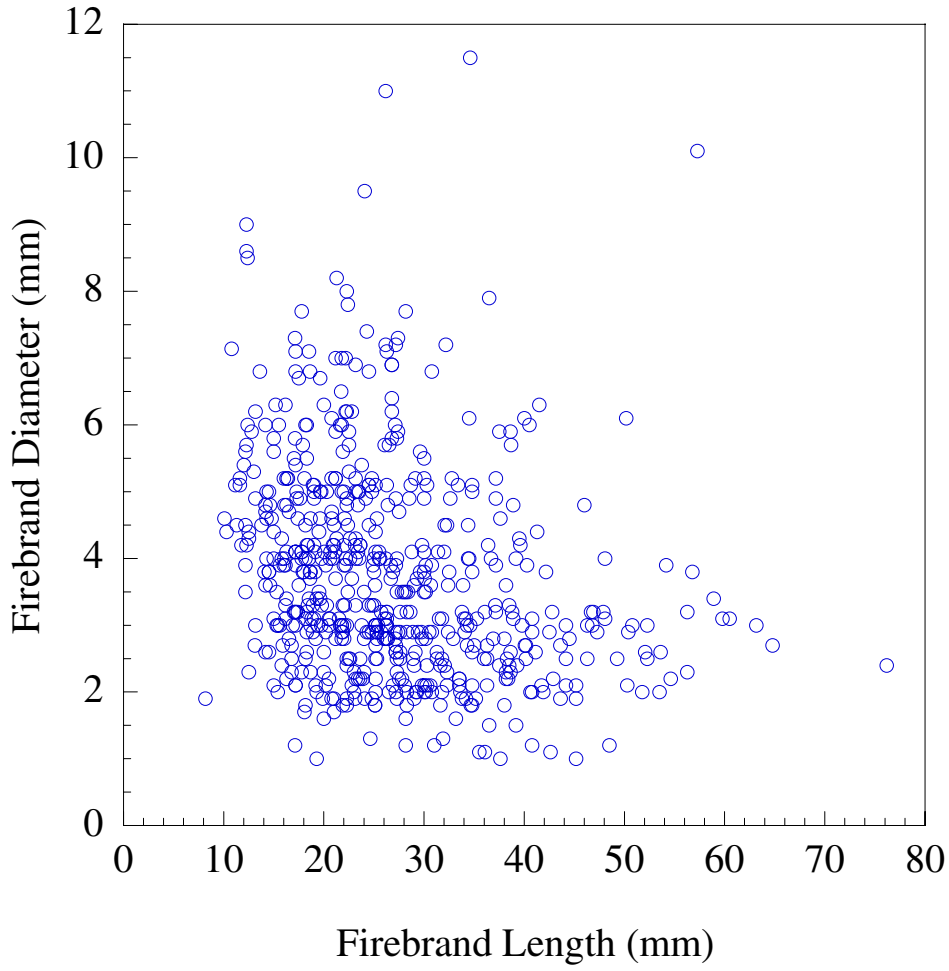

Figure 6 Size distribution of firebrands produced from the firebrand generator.

Three different steel screen sizes were tested in these experiments. The first screen size used was 6 mm (1/4"). This size was selected since it has been recommended in the recently adopted WUI California Building Standards intended to mitigate firebrand penetration through building vents[23]. However, smaller screen sizes of 3 mm and 1.5 mm are commercially available. Consequently, it was desired to test these smaller sizes as well. Only non-combustible steel screens were used in this study. Prior to conducting the experiments, it was hypothesized that combustible screens (*e.g.* plastic) would be of no use to preventing firebrand penetration into a structure. For each screen size, three similar experiments were performed.

Two standard video cameras were located inside the structure; one camera directly behind the vent/screen assembly and another camera focused on the shredded paper bed below the vent/screen assembly. Figure 8 displays still mages taken from video graphic records obtained from the camera focused behind the vent/screen assembly for a 3 mm screen.

The mechanism of firebrand penetration through screens was observed for the first time. Firebrands were blown through the vent and were pressed against the steel screen. The firebrands were not quenched by the presence of the screen and would continue to burn until they were able to fit through the screen opening. For all screen sizes tested, the firebrands were observed to penetrate the screen and produce a self-sustaining smoldering ignition inside the paper beds installed inside the structure. Figure 9 displays a digital photograph taken 10 minutes after the experiment was completed demonstrating the self-sustaining

smoldering propagation inside the paper bed for a 6 mm screen. It is important to point out that for the 6 mm screens tested; a majority of the firebrands simply flew through the screen, resulting in an ignition of the paper behind the screen considerably more quickly as compared to the smaller screen sizes of 3 mm and 1.5 mm.

The flow field was characterized using a 21 point anemometer array outside the structure in front of the building vent. In addition to this, the flow field was measured at six points, 1 cm behind the vent/screen assembly. It was desired to characterize the flow field through the vent/screen assembly as future work will attempt to provide similar flow conditions using a bench scale wind generator and investigate the salient dynamics of firebrand penetration through vents at reduced scale.

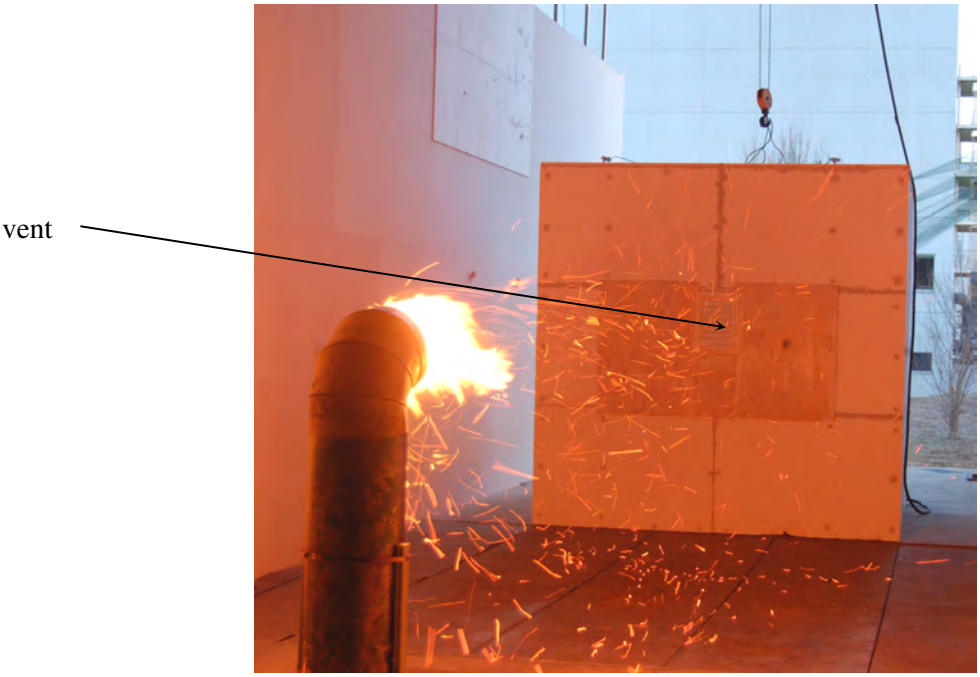

Figure 7 A digital picture of a typical experiment. A 3 mm steel screen is located behind the gable vent in this particular experiment. The arrow shows the vent location.

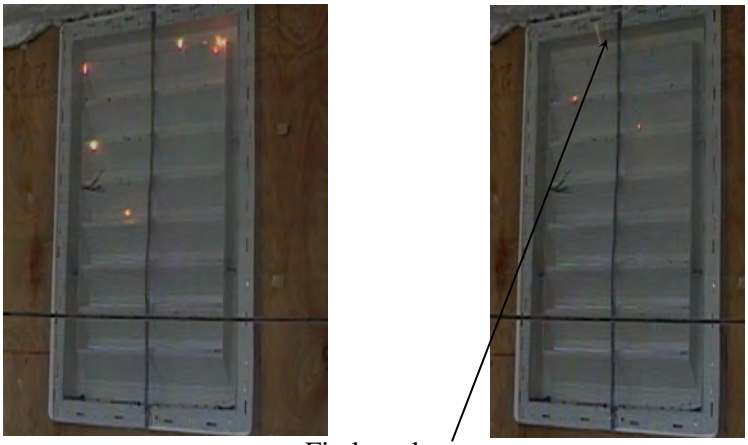

Figure 8 Images of the steel screen (3 mm) located behind the gable vent. Panel (b) shows a firebrand penetrating the screen after burning to a small enough size (see arrow).
The results of these experiments have demonstrated the danger of firebrand storms in WUI fires. In Japan, many building have similar vents used for ventilation as in the USA. It is desired to use these results to provide scientific guidance for enhanced WUI building standards in the USA. Additional experimental work will be required to design building vents that can resist the penetration of firebrands. Finally, the utility of the firebrand generator has been demonstrated. It was simple to operate and capable to direct repeatable firebrand fluxes for structural ignition studies.

Figure 9 Picture taken 10 minutes after completion of the experiments. Self-sustaining smoldering ignition is observed in the shredded paper bed at 5 % moisture content (dry basis). This image was taken for a 6 mm screen installed behind the vent. The obscuration in the image was due to smoke production due to smoldering combustion.

CONCLUSIONS

The effort described in this paper is part of an international collaboration established between the National Institute of Standards and Technology (NIST) in the USA and the Building Research Institute (BRI) in Japan to quantify firebrand production from vegetation and investigate firebrand ignition of structures. The firebrand generator was fed with mulch generated from Korean Pine trees. The size and mass distribution of firebrands produced from the generator was selected to be representative of firebrands produced from burning trees. After the size and mass distribution of firebrands was characterized, the device was then used to direct firebrand fluxes towards a structure installed inside the FRWTF. A gable vent was installed on the front face of the structure and three different steel screens were installed behind a gable vent to ascertain the ability of the screen to block firebrands from penetrating into the structure. Behind the screens, shredded paper of fixed moisture content was placed in pans to observe if the firebrands that penetrated the vent and subsequent screen were able to produce an ignition event.

The mechanism of firebrand penetration through screens was observed for the first time. Firebrands were blown through the vent and were pressed against the steel screen. The firebrands were not quenched by the presence of the screen and would continue to burn until they were to fit through the screen opening. For all screen sizes tested, the firebrands were observed to penetrate the screen and produce a self-sustaining smoldering ignition inside the paper beds installed inside the structure. For the 6 mm screens tested a majority of the firebrands simply flew through the screen, resulting in an ignition of the paper behind the screen considerably more quickly as compared to the smaller screen sizes of 3 mm and 1.5 mm. The results of these experiments demonstrate the danger of firebrand storms in WUI fires.

It is desired to use these results to provide scientific guidance for enhanced WUI building standards in the

USA. In Japan, firebrands produce fire spread by not only landing on bare wood roofs but also by firebrands penetrating through vent openings; these results can provide valuable information in Japan. Additional experimental work will be required to design building vents that can resist the penetration of firebrands. Future work will attempt to provide similar flow conditions using a bench scale wind generator and investigate the salient dynamics of firebrand penetration through vents at reduced scale.

ACKNOWLEDGMENTS

Mr. Syuuji Nanno and Mr. Kazutaka Nakamura (BRI Guest Researchers, under the supervision of Dr. Ichiro Hagiwara of BRI) completed some of the analysis for the firebrand mass and size distributions; their able help in this regard is appreciated. Dr. William 'Ruddy' Mell is acknowledged for assisting in FDS simulations. Mr. Alexander Maranghides, NIST Large Fire Laboratory Manager, is acknowledged for providing access to the LFL to test the operation of the firebrand generator. Dr. William Grosshandler, Fire Research Division Chief, is acknowledged for supporting this research at NIST. The work conducted by BFRL-NIST staff at BRI was possible through a Memorandum of Understanding (MOU) in place between BFRL-NIST and BRI.

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Firefighter Safety Zones: A Theoretical Model Based on Radiative Heating

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Abstract. Quantitative information regarding safety zone size for wildland firefighters is limited. We present a 3-surface theoretical model that describes the net radiant energy transfer to a firefighter standing a specified distance from a fire of specified height. Model predictions compare favorably with qualitative data from entrapments on four wildfires and two previously published models. Calculations indicate that for most fires, safety zones must be greater than 20 m wide to ensure firefighter survival. A general rule-of-thumb derived from this work is that a safety zone radius must be equal to or greater than 4 times the maximum flame height.

Keywords: Net radiant energy transfer; entrapment; wildfires; safety zones.

Introduction

Firefighter safety is a primary concern in both initial and extended attack on wildfires. Unfortunately, situations arise wherein firefighters are threatened and even trapped by fire. Firefighters in the U. S. Forest Service are taught to take action to prevent entrapments. One of the required actions is that firefighters actively identify areas to which they can retreat to escape injury. These areas have been labeled safety zones.

Beighley (1995) defined safety zone as "an area distinguished by characteristics that provide freedom from danger, risk, or injury." The National Wildfire Coordinating Group (USDA/USDI 1995) has defined safety zone as: "An area (usually a recently burned area) used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe . . . areas that can be used with relative safety by firefighters and their equipment in the event of blowup in the vicinity." Although safety zones have been the topic of much discussion among firefighters, few quantitative studies have been reported (Alexander 1994, 1995).

Continued occurrence of firefighter entrapments suggests a need for increased understanding about safety zones. What may not be clear are the factors that determine the size of a safety zone necessary to prevent firefighter injury. We present a mathematical model describing safety zone size as a function of flame height and distance from the flame. Predictions are compared against data from four wildfires.

Convective energy transport is not addressed in this study. Without a doubt, convection can play a major role in energy transfer between a fire and firefighters in its vicinity. For example, it is not uncommon for firefighters to observe intensely burning fire whirls. When close to the edge of a forest canopy, a wind-driven crown fire can generate turbulent eddies that will migrate some distance ahead of the fire front. In these cases, convection is a major energy transfer mechanism. Quantitative information on the magnitude and effect of convective heating in front of wildfires is needed.

Previous Work.

Some of the information required to specify safety zone size is the rate of energy transfer from the flame to its surroundings and the effect of that energy on humans.

Only a few reported studies directly address the distribution of energy in front of a wildland fire. Bond and Cheney (1986) described measurements made in 9 m diameter clearings overburned by a crown fire with 25 m flame heights. Air temperatures were measured with radiation shielded, naturally aspirated, platinum resistance thermometers located 2 and 5 m above the ground. They measured peak air temperatures of 300 °C at the center of the clearing. Survival would have been unlikely without the protection of a fire shelter.

Others have discussed the design and performance of fire shelters under different heating regimes and the characteristics of a fire shelter deployment site (King and Walker 1964; Jukkala and Putnam 1986; Knight 1988). A fire shelter is a device used to protect firefighters from injury in a fire. Fire shelters currently approved for use by U. S. Forest Service firefighters consist of pup-tents

constructed of lightweight highly reflective aluminum foil and fiberglass. All U. S. Forest Service firefighters are required to carry a fire shelter with them while working on or near the fire.

As one would suspect, it is difficult to find analytical studies reporting the effect of heat on human skin. Most of the work that has been done was performed on prisoners of war during World War II or on military volunteers in later studies. Green and Schimke (1971) state that 12 kW-m^{-2} will cause injury, no exposure time is given. Others suggest that the upper limit of incident radiant heat flux on bare skin that can be sustained without injury for a short time (less than 2 minutes) is approximately 2.3 kW-m^{-2} (Stoll and Greene 1959; Budd and Cheney 1984; Fogarty 1996).

Other studies have explored the performance of fabrics used in firefighter clothing (Braun and others 1980; Behnke 1982; Bond and Cheney 1986). These studies have led to several proposed testing methods that do not require human subjects. The data reported by Braun and others (1980) suggest that when firefighters wear Nomex cloth (210 g-m^{-2}), second degree burns will occur after 90 seconds at incident radiant heat fluxes of approximately 7 kW-m^{-2}. The Nomex shirts and trousers currently used by wildland firefighters in the U. S. have fabric weights of 190 and 280 g-m^{-2} respectively.

Analytical Model

We present a mathematical model based on a 3-surface radiative enclosure. This model is used to predict the net radiant energy transfer to a firefighter from a flame as a function of flame height and the distance between the firefighter and the flame. The flame was approximated as a flat sheet of given height and width with uniform temperature and emissivity (figure 1). The firefighter was approximated as another flat surface. Gray diffuse radiant exchange was assumed.

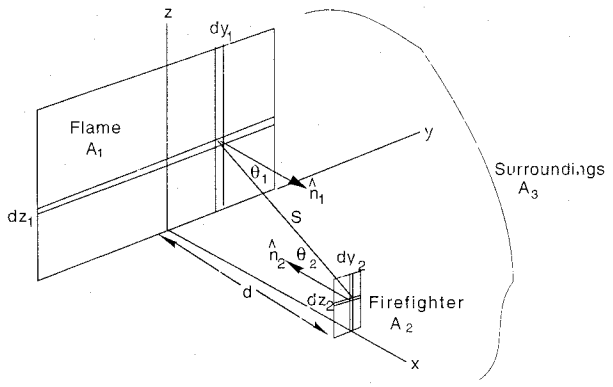

Figure 1. Schematic of geometry used in mathematical model.

Laboratory and field measurements suggest that a flame radiative temperature of 900 °C and emissivity of 1 are appropriate for large wildland fires. Assuming that the firefighter's clothing was subject to some radiative heating, we assigned a surface temperature of 45 °C to surface 2 with an emissivity of 0.8 (Incropera and Dewitt 1985). The surroundings act as an energy sink, absorbing energy emitted by the flame and reflected from the firefighter; however, they do not significantly affect the net energy transfer to the firefighter. The surroundings were assumed to be approximately 22 °C with an emissivity of 1.

The net radiant flux q_i on surface i can be defined as:

$$q_i = A_i (J_i - G_i) \tag{1}$$

Where radiosity J_i from surface i with emissivity ε_i and temperature T_i is:

$$J_i = \varepsilon_i \sigma T_i^4 + (1-\varepsilon_i) G_i \tag{2}$$

The Stefan-Boltzman constant σ is approximated by 5.67 x 10^{-11}kW-m^{-2}-K^{-4}. Irradiation G_i incident on surface i with n being the total number of surfaces can be defined as:

$$G_i = \sum_{j=1}^{n} F_{i-j} J_j \tag{3}$$

The radiant view factor between the flame and firefighter (F_{1-2}) is the fraction of radiant energy leaving the flame (surface 1) that arrives at the firefighter (surface 2). Mathematically it is expressed as:

$$F_{1-2} = \frac{1}{A_1} \int_{A_1} \int_{A_2} \frac{\cos \mu_1 \cos \mu_2}{\pi S^2} dA_2 dA_1 \tag{4}$$

Where A_1 and A_2 are the respective surface areas with differential areas dA_1 and dA_2. μ_1 and μ_2 are the angles between the respective surface normal vectors $\hat{n}_1$ and $\hat{n}_2$ and line of length S connecting the differential areas.

We numerically integrated equation 4 to obtain the radiation view factors and then solved equations 1 through 4 to obtain q_2. Solutions were computed assuming flat terrain.

Discussion

Webster (1986) presents work by Tassios and Packham (1964) that discusses theoretical values of incident radiant heat on a firefighter. They predict a maximum heat flux of 60 kW-m^{-2} incident on a firefighter standing 6 m from a 21 m tall flame. Fogarty (1996) combined work reported by Leicester (1985) and Thomas (1963) to develop a model that predicts incident radiant energy on firefighters as a function of fireline intensity and distance from

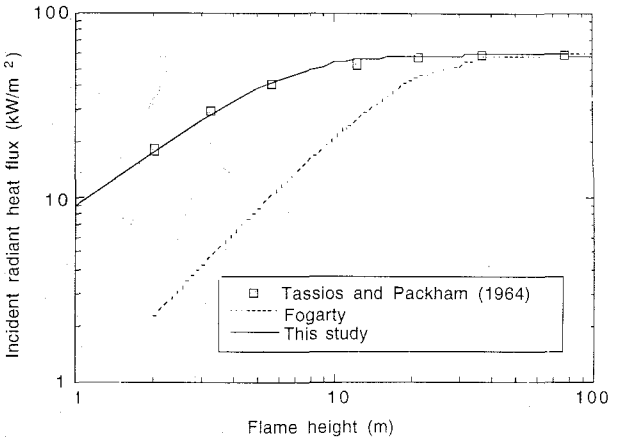

Figure 2. Comparison between previous models and that presented in this study. For this comparison we assumed a flame temperature of 1200 K and flame width of 20 m, the firefighter was approximated as a flat surface 1 m wide by 2 m tall located 6 m from the flame.

the fire. Green and Schimke (1971) discuss safety zones principally in the context of fire break size; they present required separation distances as a function of burning index. Unfortunately they did not provide sufficient information to relate fire break size to flame heights. Figure 2 presents predictions from the model presented in this study and those from the models presented by Tassios and Packham (1964) and Fogarty (1996). We assumed a flame temperature of 1200 K, flame and firefighter emissivities of unity, 20 m wide flame and 1 m wide by 2 m tall firefighter. Our model quantitatively matched that of Tassios and Packham (1964); however, it does not agree so well with Fogarty's (1996) model for flame heights less than 20 m. The agreement between the models shown in figure 2 lends credibility to the model presented herein--differences can be attributed to variations in flame temperature, surface dimensions, emissivities and model geometry. The fact that we could only find three studies relating fire behavior to firefighter safety zones indicates that lack of quantitative information on this subject.

Predictions for a range of separation distances and flame heights are shown as surface contours in Figure 3. Clearly, the incident radiant heat flux is strongly dependent on distance from the flame and flame height. We selected an incident heat flux level of 7 kW-m^{-2} as the maximum level tolerable by firefighters wearing Nomex clothing and protective head and neck equipment.

The trends shown in Figure 3 suggest that in most cases safety zones must be relatively large. We compared separation distances predicted by our model against those reported on four wildfires: the Mann Gulch Fire, the Battlement Creek Fire, the Butte Fire and the South Canyon Fire.

The Mann Gulch Fire overran 16 firefighters on August 5, 1949. Only the foreman and two crew members of the 18-man smokejumper crew survived.

The fire crew were hiking up a steep, as much as 76 percent, slope. The fire was approaching them from below and was burning through an open stand of scattered, mature (60 to 100+ year old) *Pinus ponderosa* (ponderosa pine) with a grass understory. Flames were 10 m high (Rothermel 1993). Recognizing that the fire was outrunning them and had approached to within 50 m of the crew. The foreman stopped and lit an escape fire with the intention that the crew could lie down in the burned out area to escape the main fire. Rothermel (1993) indicates that the escape fire burned about 90 m before the main fire overran it. Assuming an elliptical shape for the burned area, with its width approximately half the length, the safety zone created by the escape fire would have been about 45 m wide. Figure 3 indicates a minimum safety zone size of 40 to 50 m.

The Battlement Creek Fire occurred in western Colorado during July, 1976 (USDI/USDA 1976). The fire burned on steep slopes covered with 2 to 4 m high *Quercus gambeli* (Gambel oak). Flames were estimated to be 7 to 10 m above canopy. Four firefighters were cut off from their designated safety zone. When the fire overran them, they were lying face down on the ground without fire shelters in an 8 m wide clearing near the top of a ridge. Tragically, only one of the four survived, and he suffered severe burns over most of his body. Figure 3 suggests that for this fire, a minimum safety zone size is 40 m, with 55 m being preferable. Clearly, the 8 m wide clearing did not qualify as a safety zone.

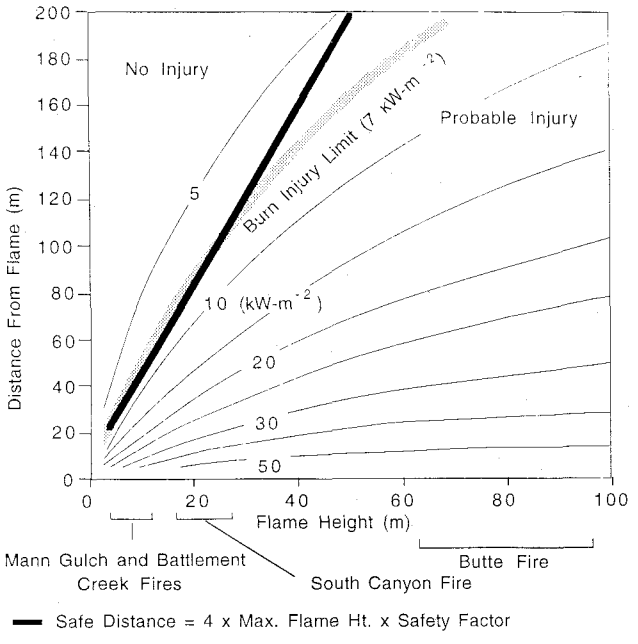

Figure 3. Lines represent predicted net radiant heat flux to a firefighter as a function of flame height and distance from the flame. It is assumed that the firefighter is wearing fire retardant clothing (Nomex) and protective head and neck equipment. Heavy shaded line represents burn injury threshold (7 kW-m^{-2}).

Flame heights were reported to be 60 to 100 m high on the Butte Fire. It burned on steep slopes covered with mature *Pinus contorta* (lodgepole pine) and *Psuedotsuga menziesii* (Douglas-fir) during August 1985 (Mutch and Rothermel 1986). Figure 3 indicates a minimum required separation distance of approximately 240 m. In fact, safety zones 90 to 125 m in diameter were prepared (Mutch and Rothermel 1986). This was not sufficiently large to meet the definition of a safety zone, as indicated by the fact that 73 firefighters had to deploy in fire shelters to escape the radiant heat.

During the afternoon of July 6, the South Canyon Fire burning in western Colorado "blewup", burning across the predominately *Quercus gambeli* (Gambel oak) covered slopes with 15 to 30 m tall flames and spread rates of 1.3 to 2.5 m-s^{-1} (USDA/USDI 1994). Fourteen firefighters were overrun by the fire and died while attempting to deploy their fire shelters along a 3 to 4 m wide fireline on a 55 percent slope. Eight other firefighters deployed their fire shelters in a burned out area approximately 45 m wide. They remained in their shelters while three separate fire runs occurred 160 m away from them (Petrilli 1996); none were injured. Survivors felt they were far enough from the flames that survival with minor injuries would have been possible without the protection of a fire shelter (Petrilli 1996). One firefighter who did not deploy in a shelter, but remained on a narrow ridge below the eight firefighters during the "blowup" experienced no injuries (USDA/USDI 1994). Figure 3 suggests that in this situation the safety zone must be large enough to allow 60 to 120 m separation between the firefighters and flames.

A general rule-of-thumb can be derived from Figure 3 by approximating the injury limit with a straight line. After doing so, it appears that safety zone size predicted by this model should be at least 4 times the maximum flame height. In some instances--such as the Mann Gulch, Battlement Creek and Butte fires--the fire may burn completely around the safety zone. In such fires, the separation distance suggested in Figure 3 is the radius of the safety zone, meaning the safety zone diameter should be twice the value indicated. Factors that will reduce safety zone size include reduction in flame height by thinning or burnout operations, shielding the safety zone from direct exposure to the flame by locating it on the lee side of ridges or other geographical structures, or reducing flame temperatures by applying fire retardant to the area around the safety zone.

This model did not include a safety factor. A safety factor of 2 to 4, possibly higher, would be appropriate for this situation (Baumeister 1978). This means that the distance predicted by the rule-of-thumb should be multiplied by the safety factor to obtain the recommended safe separation distance.

We calculated the net radiant energy transferred to a fire shelter like that used by firefighters in the U. S. Forest Service. The fire shelter is based on the concept that the surface will reflect the majority of the incoming radiant energy. An average emissivity for the aluminum foil exterior of a fire shelter is 0.07 (Incropera and Dewitt 1985), indicating that approximately 93 percent of the energy incident on a fire shelter is reflected away (Putnam 1991). Model predictions shown in Figure 4 suggest that heat levels remain below the injury limits for deployment zones wider than 15 m. However, this model does not account for convective heating which could significantly increase total energy transfer to a fire shelter, especially when deployed within one or two flame lengths of the fire.

Conclusions

We have presented a theoretical model that predicts safety zone sizes consistent with the information gathered from firefighter entrapments on four wildfires. The agreement between the model presented in this study and those presented in previous studies and also with the information from actual wildfire entrapments lends credibility to this work. We emphasize that this study represents a mathematical evaluation of the radiant heat transfer from wildland fires; it does not include any convective energy transfer, which can be significant. For example, firefighters caught in the Butte and South Canyon Fires recall intense turbulent gusts and loud noise associated with the fire front's passage. It is possible that hot turbulent eddies can be generated in and around large fires. Convective heat transfer from such eddies may increase the required safety zone size.

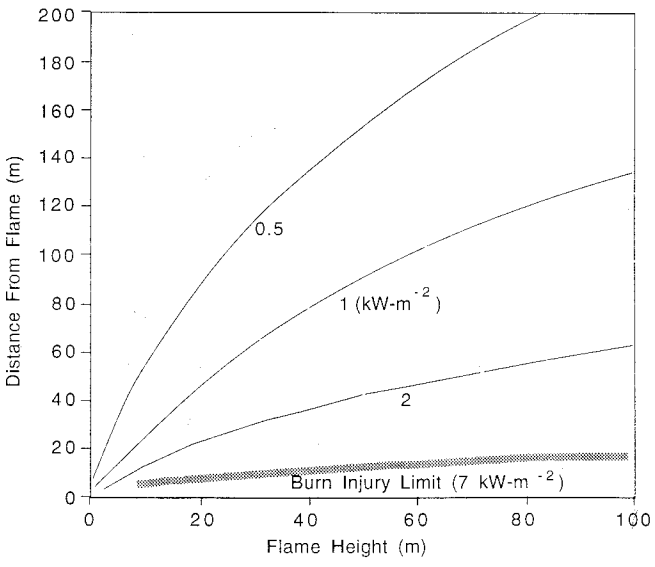

Figure 4. Predicted net radiant heat flux into a fire shelter as a function of flame height and distance between the fire shelter and flames. Heavy shaded line represents burn injury threshold (7 kW-m^{-2}).

Acknowledgments. Marty Alexander of the Canadian Forest Service deserves credit for initially suggesting the study. The U. S. Department of Interior through the Interior Fire Coordinating Committee in Boise, Idaho formally requested proposals for safety zone standards and subsequently provided some financial assistance for this study. Ted Putnam of the U. S. Forest Service's Missoula Technology and Development Center in Missoula, Montana provided valuable information and advice on the effects of heat on human. We also thank the several technical reviewers for their constructive criticism and comments.

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Firefighter Safety Zones: How Big Is Big Enough?

Bret W. Butler and Jack D. Cohen

All wildland firefighters working on or near the fireline must be able to identify a safety zone. Furthermore, they need to know how "big" is "big enough."

Beighley (1995) defined a safety zone as "an area distinguished by characteristics that provide freedom from danger, risk, or injury." The National Wildfire Coordinating Group proposed that a safety zone be defined as "a preplanned area of sufficient size and suitable location that is expected to prevent injury to fire personnel from known hazards without using fire shelters" (USDA/USDI 1995).

In our study of wildland firefighter safety zones, we focused on radiant heating only. In "real" wildland fires, convective energy transport in the form of gusts, fire whirls, or turbulence could contribute significantly to the total energy received by a firefighter. However, convection is subject to buoyant forces and turbulent mixing, both of which suggest that convective heating is important only when a firefighter is relatively close to the fire. One reason that firefighters in potential entrapment situations are told to lie face down on the ground is to minimize their exposure to convective heating. We hope to define more clearly the relationship between convective heating and safety zone size in future work.

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> A safety zone should be large enough so that the distance between the firefighters and flames is at least four times the maximum flame height.

What Do We Know?

Two questions are important when specifying safety zone size: 1) What is the radiant energy distribution in front of a flame? and 2) How much heat can humans endure before injury occurs? Concerning the first question, Fogarty (1996) and Tassios and Packham (1984) related the energy received by a firefighter to fireline intensity and distance from the flame front. Green and Schimke (1971) presented very specific information about fuel break construction on slopes and ridges in the Sierra Nevada mixed-conifer forest type. Others have discussed the performance of fire shelters under different heating regimes (for example, King and Walker 1964; Jukkala and Putnam 1986; Knight 1988). As one would expect, there is not much information related to the second question. The available information suggests that 0.2 Btu/ft^2/s (2.3 kW/m^2) is the upper limit that can be sustained without injury for a short time (Stoll and Greene 1959; Behnke 1982). Studies by Braun and others (1980) suggest that when a single layer of 6.3 oz/yd^2 (210 g/m^2) Nomex cloth is worn, second degree burns will occur after 90 seconds when a firefighter is subjected to radiant fluxes greater than 0.6 Btu/ft^2/s (7 kW/m^2).

The Nomex shirts and trousers currently used by wildland firefighters have fabric weights of 5.7 and 8.5 oz/yd^2 (190 and 280 g/m^2), respectively. Few studies, however, have explored relationships between flame height and the safety zone size necessary to prevent burn injury.

Theory Versus Reality

We formulated a theoretical model to predict the net radiant energy arriving at the firefighter wearing Nomex clothing as a function of flame height and distance from the flame (Butler and Cohen [In press]). Figure 1 displays the results.

The amount of radiant energy arriving at the firefighter depends both on the distance between the firefighter and the flame and on the flame height. The information shown suggests that in most cases safety zones must be relatively large to prevent burn injury.

We compared safety zone sizes predicted by our model against those reported on four wildfires: the

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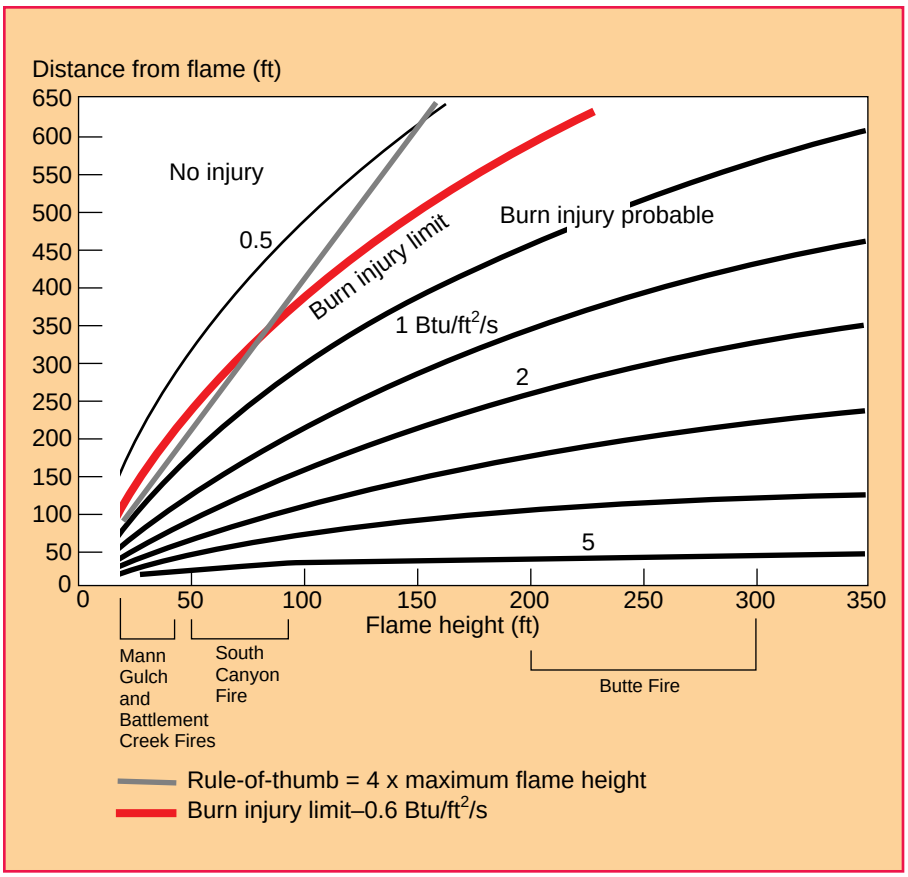

Figure 1—*Lines represent predicted radiant energy arriving at the firefighter as a function of flame height and distance from the flame. It is assumed that the firefighter is wearing fire-retardant clothing and protective head and neck equipment. The heavy shaded line represents the burn injury threshold of 0.6 Btu/ft²/s (7 kW/m²). The heavy solid black line indicates the rule of thumb for the size of the safety zone.*

Mann Gulch Fire, the Battlement Creek Fire, the Butte Fire, and the South Canyon Fire.

The Mann Gulch Fire overran 16 firefighters on August 5, 1949. Wag Dodge, one of only three survivors, lit a fire and then lay face down in the burned-out area as the main fire burned around him. The Mann Gulch Fire occurred in an open stand of scattered, mature ponderosa pine (60 to 100+ years old) with a grass understory. Flame heights of 10 to 40 feet (3 to 12 m) were estimated to have occurred at the time of entrapment. Rothermel (1993) indicates that Dodge's fire burned about 300 feet (92 m) before the main fire overran it. Assuming an elliptical shape for the burned area, with its width approximately half the length, the safety zone created by Dodge's escaped fire would have been about 150 feet (46 m) wide. Figure 1 indicates that the safety zone needed to be large enough to separate the firefighters and flames by 90 to 150 feet (27 to 46 m) or approximately the same width as the area created by Dodge's fire.

The Battlement Creek Fire occurred in western Colorado during July of 1976 (USDI 1976). The fire burned on steep slopes covered with 6- to 12-foot- (2- to 4-m-) high Gambel oak. Flames were estimated at 20 to 30 feet (6 to 9 m) above the canopy. Four firefighters were cut off from their designated safety zone. When the fire overran them, they were lying face down on the ground without fire shelters in a 25-foot- (8-m-) wide clearing near the top of a ridge. Tragically, only one of the four survived, and he suffered severe burns over most of his body. Figure 1 suggests that for this fire, the safety zone should have been large enough to separate firefighters from flames by 150 feet (46 m). Clearly, the 25-foot- (8-m-) wide clearing did not qualify as a safety zone.

Flame heights were reported to be 200 to 300 feet (62 to 92 m) high on the Butte Fire that burned on steep slopes covered with mature lodgepole pine and Douglas-fir during August of 1985 (Mutch and Rothermel 1986). Figure 1 indicates that a cleared area greater than 1,200 feet (370 m) across would have been needed to prevent injury to the firefighters standing in its center. In fact, safety zones 300 to 400 feet (92 to 123 m) in diameter were prepared (Mutch and Rothermel 1986). This diameter was not sufficiently large enough to meet the definition of a safety zone, as indicated by the fact that 73 firefighters had to deploy in fire shelters to escape the radiant heat. As the fire burned around the edges of the deployment zone, the intense heat forced the firefighters to crawl while inside their shelters to the opposite side of the clearing.

On July 2, 1994, the South Canyon Fire was ignited by a lightning strike to a ridgetop in western Colorado. During the afternoon of July 6, the South Canyon Fire "blew up," burning across the predominately Gambel-oak-covered slopes with 50- to 90-foot- (15- to 28-m-) tall flames (South Canyon

Fire Accident Investigation Team 1994). Tragically, 14 firefighters were overrun by the fire and died while attempting to deploy their fire shelters. Twelve of the firefighters died along a 10- to 12-foot- (3- to 4-m-) wide fireline on a 55-percent slope, the other two in a steep narrow gully. Eight other firefighters deployed their fire shelters in a burned out area approximately 150 feet (46 m) wide. They remained in their shelters during three separate crown fire runs that occurred 450 feet (138 m) away from them; none of these eight firefighters was injured (Petrilli 1996). One firefighter estimates that air temperatures inside the shelters reached 115 °F (46 °C) and remembers smoke and glowing embers entering the fire shelters during the crown fire runs. Survivors felt they were far enough from the flames that survival with minor injuries would have been possible without the protection of a fire shelter (Petrilli 1996). A firefighter who did not deploy in a shelter but remained on a narrow ridge below the eight firefighters during the "blowup" experienced no injuries (South Canyon Fire Accident Investigation Team 1994). Figure 1 suggests that in this situation, the safety zone must be large enough to separate the firefighters and flames by 250 to 350 feet (77 to 115 m).

A general rule of thumb can be derived from figure 1 by approximating the injury limit with a straight line. After doing so, it appears that a safety zone should be large enough that the distance between the firefighters and flames is at least four times the maximum flame height. In some instances—such as the Mann Gulch, Battlement Creek, and Butte fires—the fire may burn completely around the safety zone. In such fires, the separation distance suggested in figure 1 is the radius of the safety zone, meaning the safety zone diameter should be twice the value indicated.

What About Fire Shelters?

We calculated the net radiant energy transferred through a fire shelter like those used by firefighters in the USDA Forest Service. The fire shelter is based on the concept that the surface will reflect the majority of the incoming radiant energy. An average emissivity for the aluminum-foil exterior of a fire shelter is 0.07, indicating that approximately 93 percent of the energy incident on a fire shelter is reflected away (Putnam 1991). Model predictions shown in figure 2 suggest that heat levels remain below the injury limits for deployment zones wider than 50 feet (15 m), even with 300-foot- (92-m-) tall flames. However, this model does not account for convective heating that could significantly increase the total energy transfer to shelters deployed within a few flame lengths of the fire.

Conclusions

Radiant energy travels in the same form as visible light, that is, in the line of sight. Therefore, locating safety zones in areas that minimize firefighters' exposure to flames will reduce the required safety zone size. For example, topographical features that act as radiative shields are the lee side of rocky outcroppings, ridges and the tops of ridges, or peaks containing little or no flammable vegetation. Safety zone size is proportional to flame height. Therefore, any feature or action that reduces flame height will have a corresponding effect on the required safety zone size. Some examples are burnout operations that leave large "black" areas, thinning operations that reduce fuel

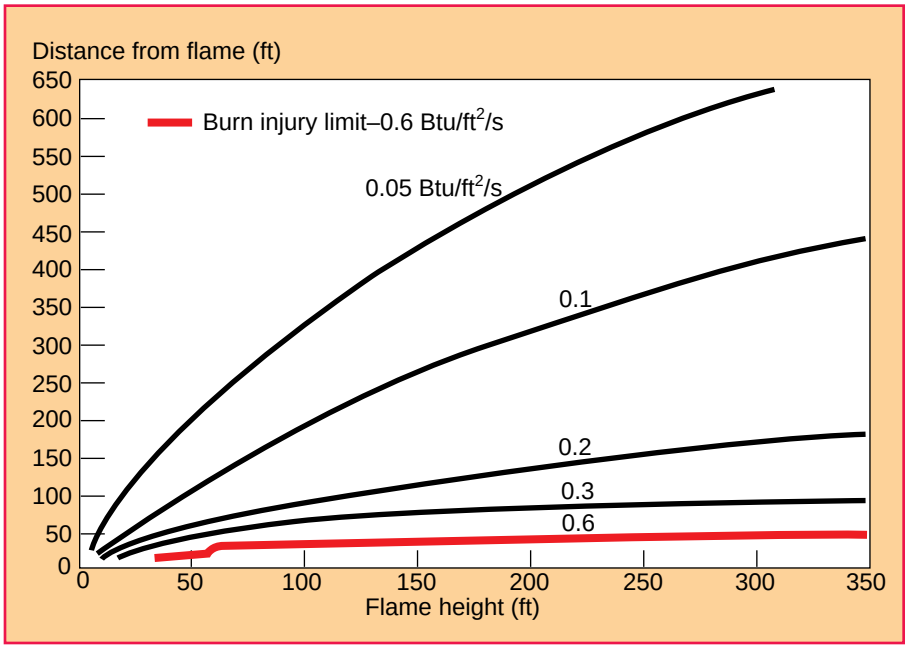

Figure 2—*Predicted radiant energy on a fire shelter as a function of distance between the fire shelter and flames, and flame height. The heavy shaded line represents the burn injury threshold for a firefighter inside a deployed fire shelter.*

Continued on page 16

load, and retardant drops that decrease flame temperatures.

We emphasize that while this study addresses the effects of radiant energy transfer, convection is not addressed. Convective energy transfer from gusts, fire whirls, or turbulence could significantly increase the total heat transfer to the firefighter and thus the required safety zone size. Further work in this area is needed.

Acknowledgments

The United States Department of the Interior's Fire Coordinating Committee, Boise, ID, provided financial assistance for a portion of this study. Ted Putnam of the Forest Service's Missoula Technology and Development Center, Missoula, MT, provided valuable information and advice on the effects of heat on human tissue.

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Selected Fire Illustrations

Convective Heat Transfer through Fire Whirls can render a Safety Zone 4x Flame Length Inadequate [Butler & Cohen].

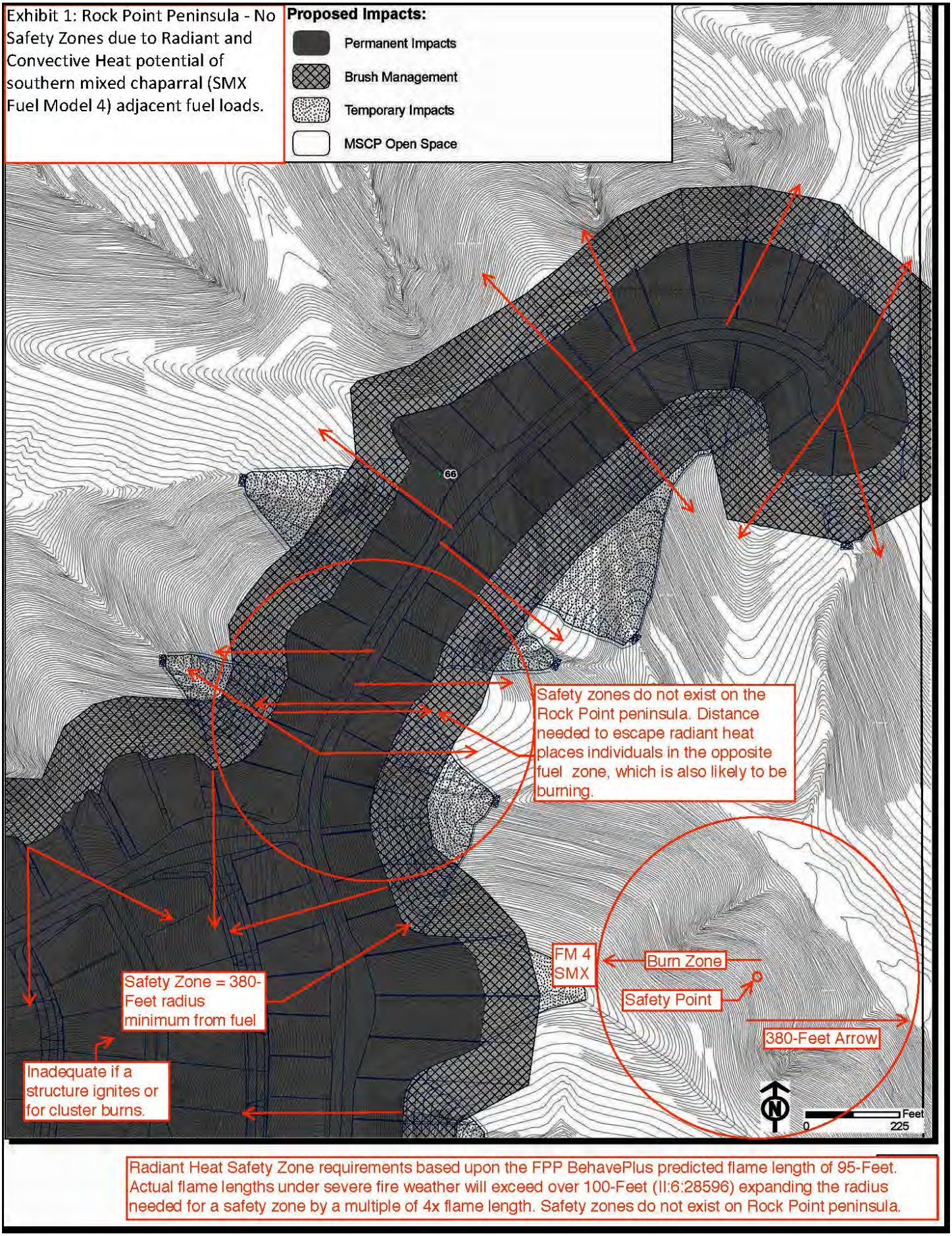


Exhibit 1: Rock Point Peninsula - No Safety Zones due to Radiant and Convective Heat potential of southern mixed chaparral (SMX Fuel Model 4) adjacent fuel loads.
Proposed Impacts:
Permanent Impacts
Brush Management
Temporary Impacts
MSCP Open Space
66
Safety zones do not exist on the Rock Point peninsula. Distance needed to escape radiant heat places individuals in the opposite fuel zone, which is also likely to be burning.
FM 4 SMX
Burn Zone
Safety Point
380-Feet Arrow
Safety Zone = 380-Feet radius minimum from fuel
Inadequate if a structure ignites or for cluster burns.
N
0
225
Feet
Radiant Heat Safety Zone requirements based upon the FPP BehavePlus predicted flame length of 95-Feet. Actual flame lengths under severe fire weather will exceed over 100-Feet (II:6:28596) expanding the radius needed for a safety zone by a multiple of 4x flame length. Safety zones do not exist on Rock Point peninsula.

Radiant Heat Burn Injury Limit – Safe Distance Relative to Flame Height
Butler & Cohen, Firefighter Safety Zones
4X Flame Height may be Inadequate for Convective Energy Transfer

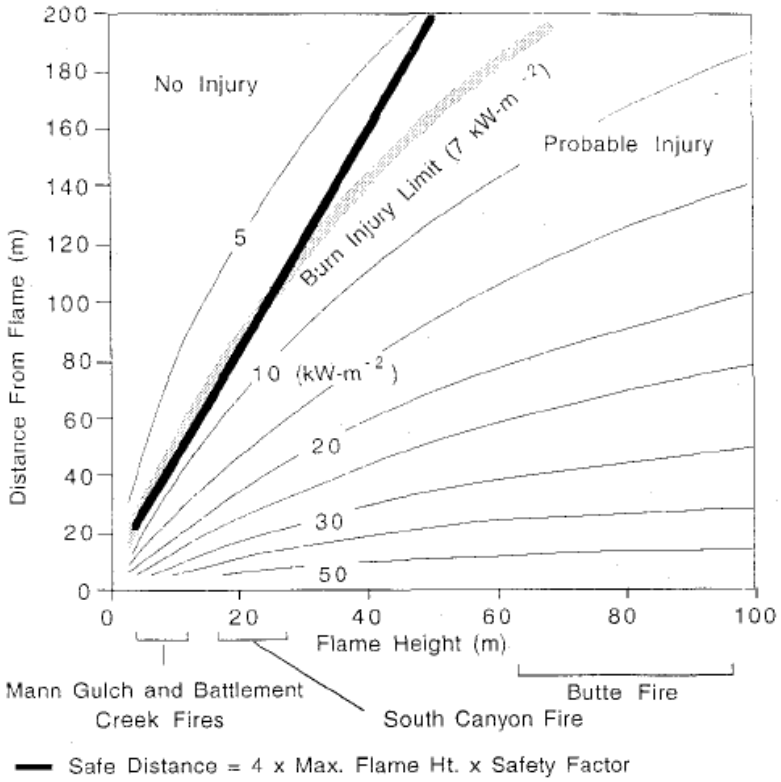


Figure 3. Lines represent predicted net radiant heat flux to a firefighter as a function of flame height and distance from the flame. It is assumed that the firefighter is wearing fire retardant clothing (Nomex) and protective head and neck equipment. Heavy shaded line represents burn injury threshold (7 kW-m^{-2}).

Cedar Fire Fatality Despite Clearance

Safe Distance Estimates

"We emphasize that this study represents a mathematical evaluation of the radiant heat transfer from wildland fires**; it does not include any convective energy transfer, which can be significant**. For example, firefighters caught in the Butte and South Canyon Fires recall intense turbulent gusts and loud noise associated with the fire front's passage. It is possible that hot turbulent eddies can be generated in and around large fires. **Convective heat** transfer from such eddies **may increase the required safety zone size."**
II:101: 29196

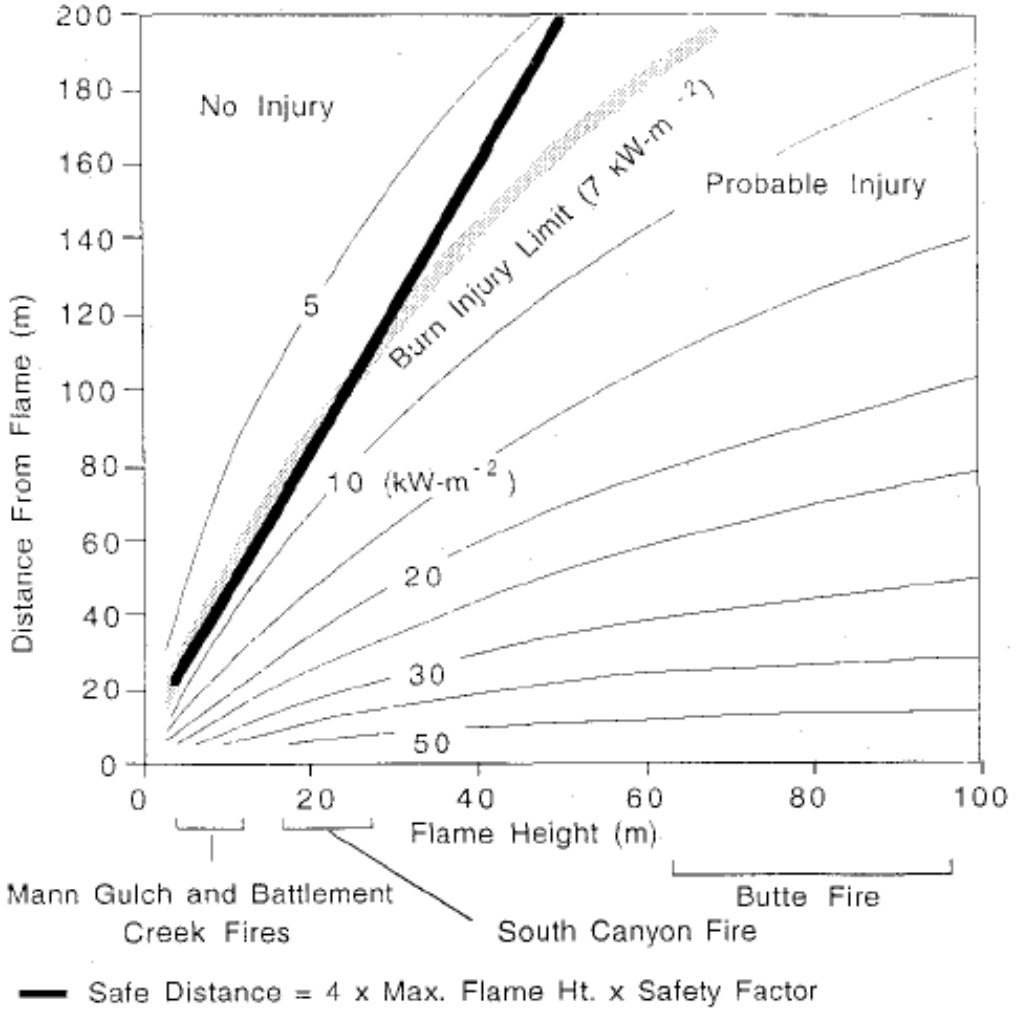


Figure 3. Lines represent predicted net radiant heat flux to a firefighter as a function of flame height and distance from the flame. It is assumed that the firefighter is wearing fire retardant clothing (Nomex) and protective head and neck equipment. Heavy shaded line represents burn injury threshold (7 kW-m^{-2}).

Firefighter Safety Zones: A Theoretical Model Based on Radiative Heating
Bret W. Butler and Jack D. Cohen
Int. J. Wildland Fire 8 (2): 73-77, 1998
II:101:29193

Convective Heat Transfer through Fire Whirls can render a Safety Zone 4x Flame Length Inadequate

Firebrands can penetrate screen smaller than 1/8-inch
City RTC references larger screens 1/8 – 1/4-inch.

Excerpt photos II:101:29036-37
Heat Transfer/Safety Zones II:101:29193, Screen Size 4:101:28339, II:101:29165-66

"The **firebrands were not quenched by the presence of the screen** and would continue to burn until they were to fit through the screen opening. **For all screen sizes tested, the firebrands were observed to penetrate the screen** and produce a self-sustaining smoldering ignition…For the 6 mm screens tested a majority of the firebrands simply flew through the screen…**The results of these experiments demonstrate the danger of firebrand storms in WUI fires**."

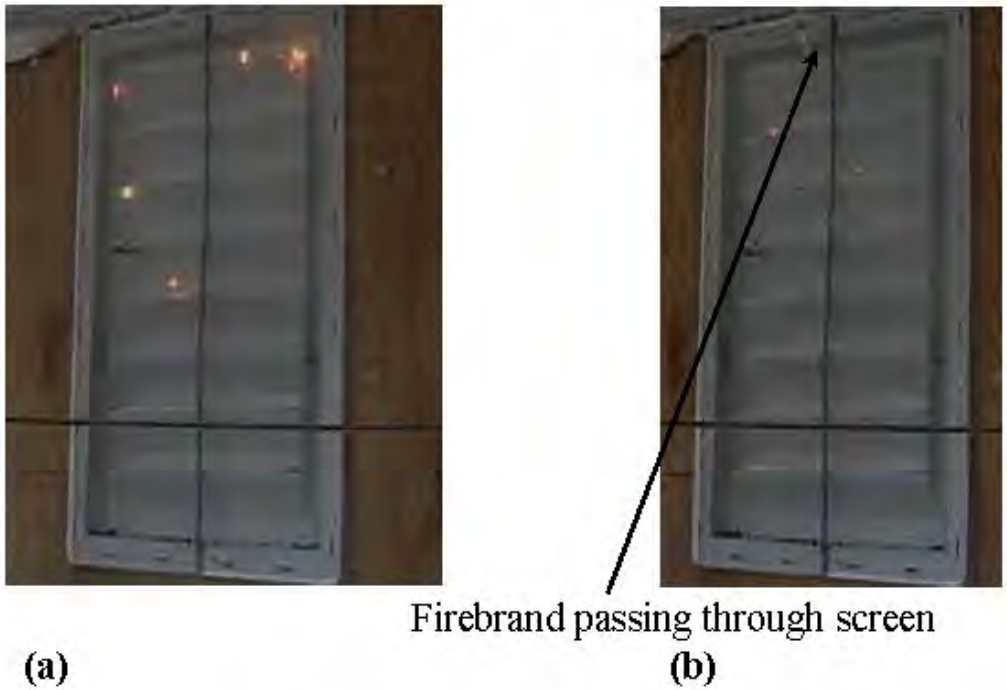


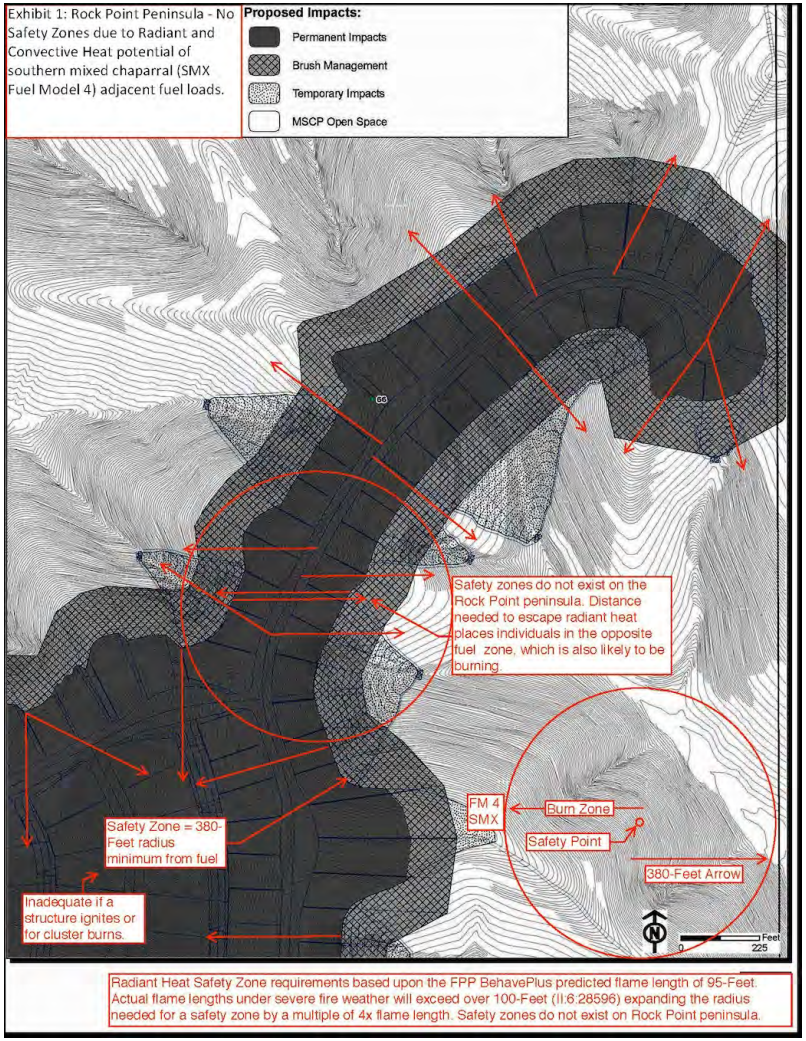
Figure 8 Images of the steel screen (3 mm) located behind the gable vent. Panel (b) shows a firebrand penetrating the screen after burning to a small enough size (see arrow).

"ON THE USE OF A FIREBRAND GENERATOR TO INVESTIGATE THE IGNITION OF STRUCTURES IN WILDLAND-URBAN INTERFACE (WUI) FIRES"
Samuel L. Manzello*, John R. Shields, and Jiann C. Yang, Building and Fire Research Laboratory (BFRL)
National Institute of Standards and Technology (NIST)

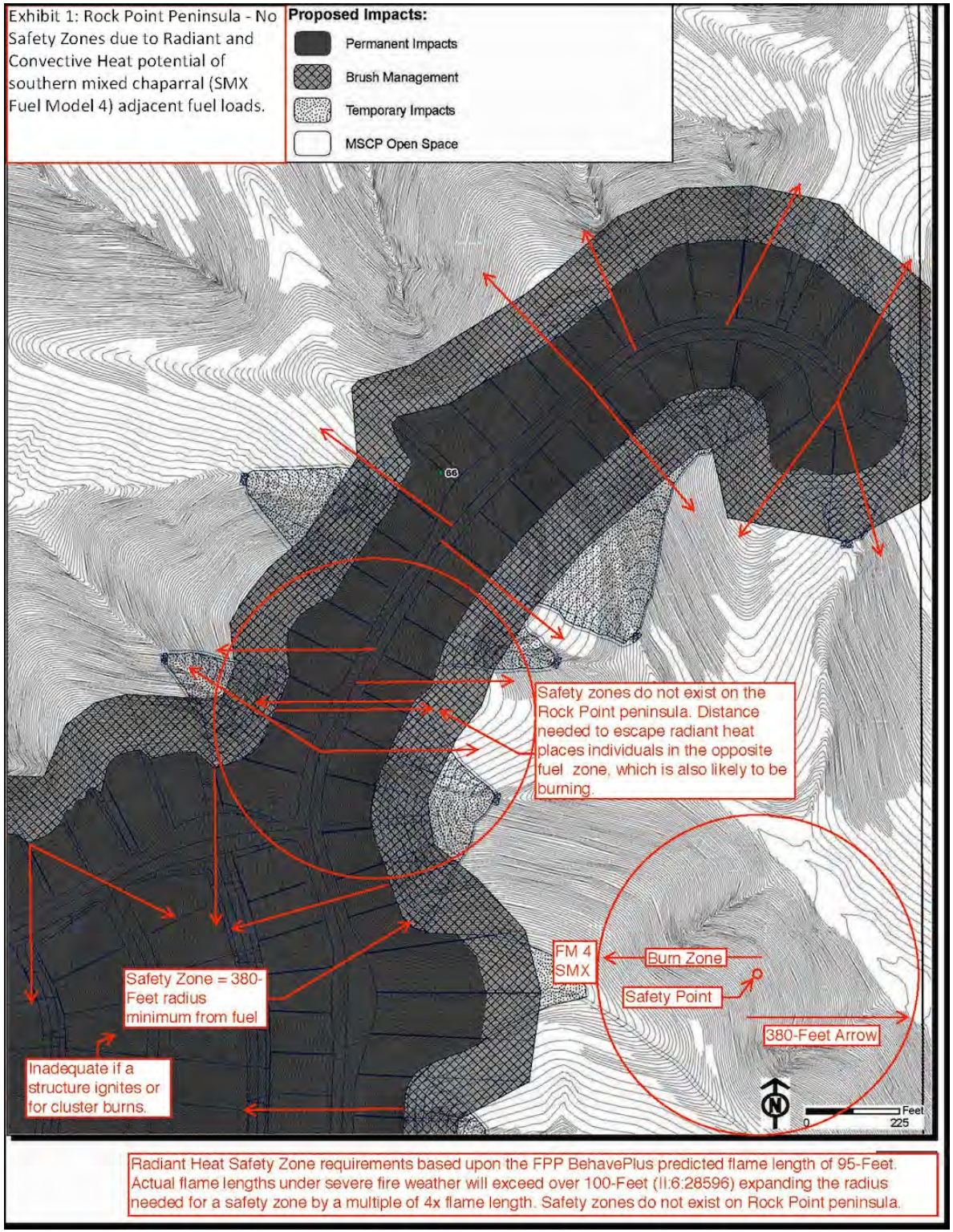
Hazards of Rock Point Fire Wick

- Extremely vulnerable to **cluster burns** due to the configuration of the Rock Point peninsula and overall WUI design.

- FM-4 SMX Fuels

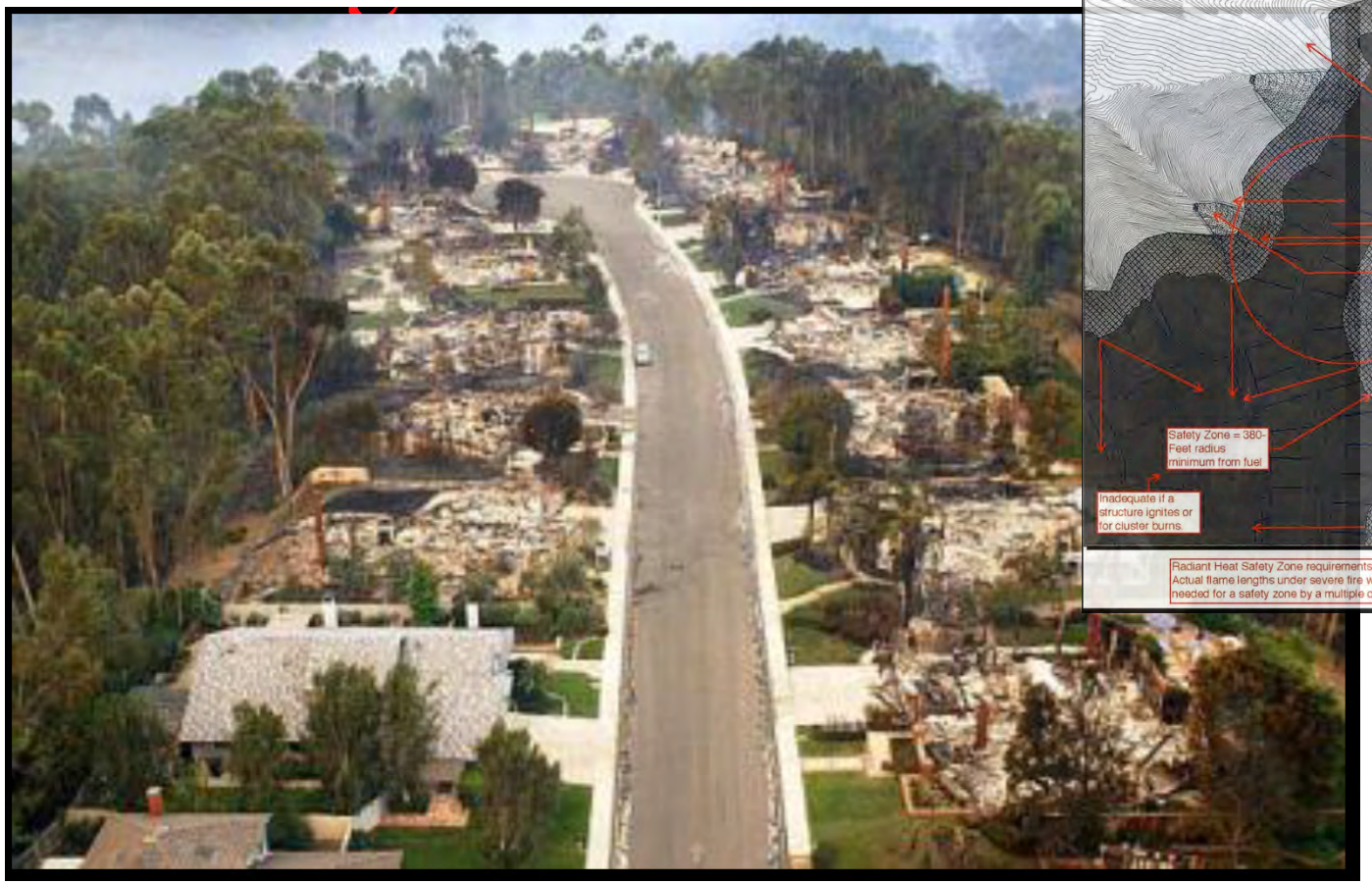


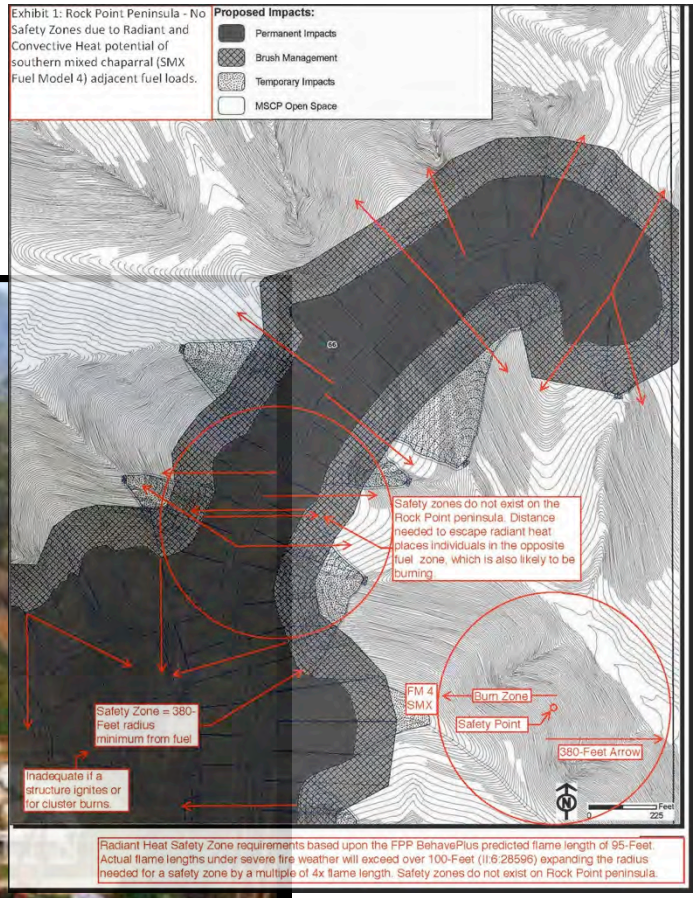
Rock Point Peninsula



Not enough distance from fuel to establish points of safety – or firefighter safety zones

Cluster Burn Hazard





I:193:16206, I:331:27887

Wider Lots on the WUI could Reduce the Risk of Cluster Burn

Narrow Lots generally 70-105 Feet

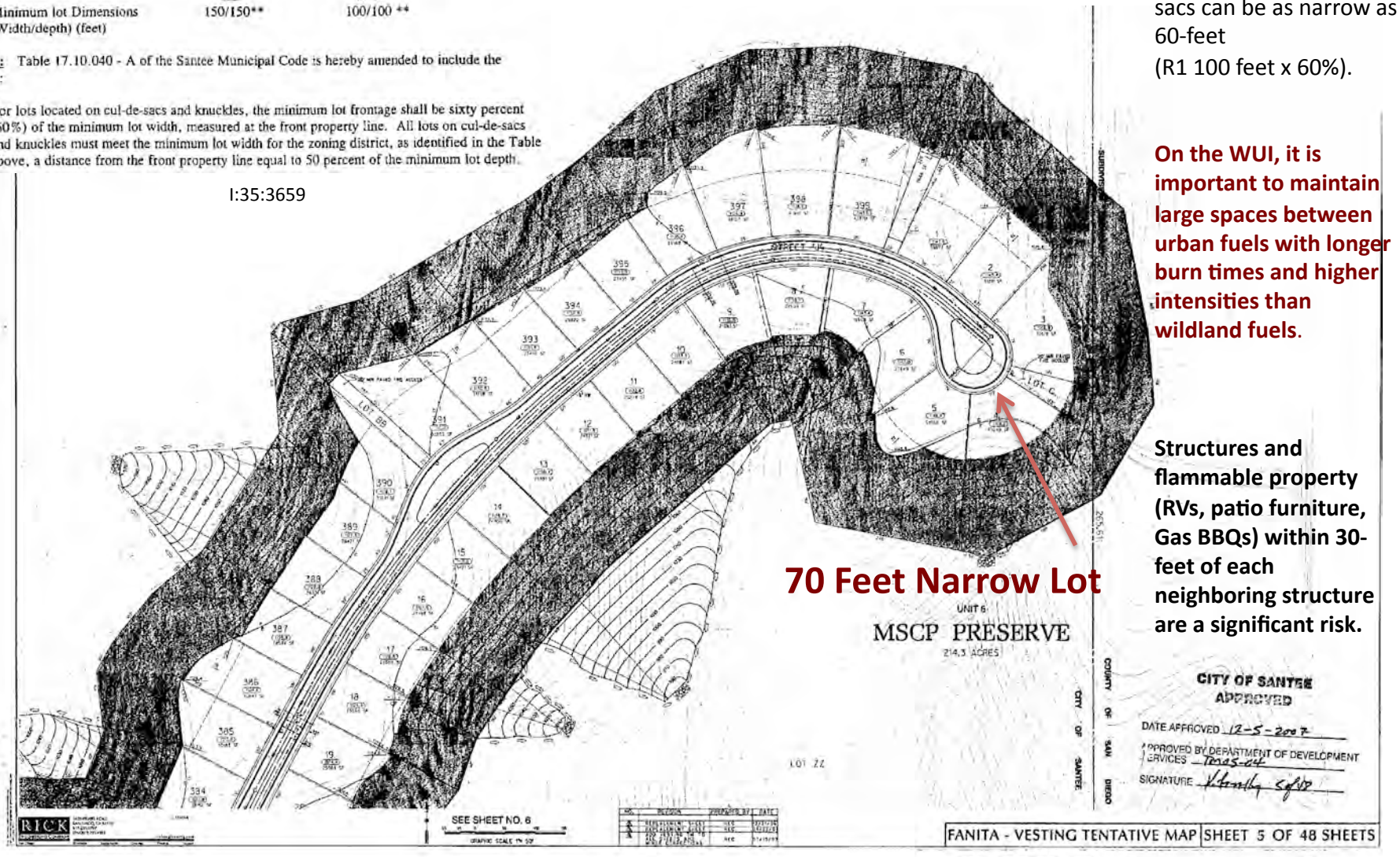
Section 2: Table 17.10.040 (A) (3) of the Santee Municipal Code is hereby amended to read as follows:

	HL	R-1
Minimum lot Dimensions (Width/depth) (feet)	150/150**	100/100 **

Section 3: Table 17.10.040 - A of the Santee Municipal Code is hereby amended to include the following:

** For lots located on cul-de-sacs and knuckles, the minimum lot frontage shall be sixty percent (60%) of the minimum lot width, measured at the front property line. All lots on cul-de-sacs and knuckles must meet the minimum lot width for the zoning district, as identified in the Table above, a distance from the front property line equal to 50 percent of the minimum lot depth.

I:35:3659



Width of lots on cul-de-sacs can be as narrow as 60-feet
(R1 100 feet x 60%).

On the WUI, it is important to maintain large spaces between urban fuels with longer burn times and higher intensities than wildland fuels.

Structures and flammable property (RVs, patio furniture, Gas BBQs) within 30-feet of each neighboring structure are a significant risk.

019852

Backfiring SOPs

- The following guidelines apply to all firing operations and you **must** **assure** that you:

- Do not place fire fighting personnel **or the public at risk**
- **Do not put property at risk**
- **Will be able to maintain control of the operation**
- Will not make the situation worse
- Have a **beginning point and an ending point (anchor points)**
- Will be able to **complete your operation with the personnel and equipment on hand**
- Do not start an operation that in order to complete you must rely on resources that are not on scene, **they may never arrive**
- Have considered all other options including the use of other tactics
- **Will not delay suppression activities by spending the time to gather resources, prepare and execute the firing operation**
- Coordinate with adjoining resources/personnel
- **Conclusion**
- **If you can not unequivocally meet the guidelines of this SOP in the time available, do not fire!**

Novato Fire Protection District, Cedar Fire Incident Recovery Report, May 26, 2004, II:101:29191-92

"An FM-4, chaparral vegetation greater than 6-feet in height, provides the greatest rates of spread and energy release with flame length **usually exceeding 100 feet**. Wildfires burning under Santa Ana wind conditions in this type of vegetation are the most destructive and difficult to control."

FPP @ II:6:28596

"2.3 Predicting Wildland Fire Behavior
'Whether wildland fire behavior can be predicted depends on how accurate the answer is expected to be. The minute-by-minute movement of a wildland fire will probably never be totally predictable-certainly not from weather conditions forecast many hours before the fire. Nevertheless, practice and experienced judgment in assessing the fire environment, coupled with a systematic method of calculating fire behavior, yields surprisingly good results (Rothermel 1983)'."

FPP @ II:6:28607

Different Wind Speeds Create Different Flame Length
FPP SMX-FM4 Comparison of SW versus NE Wind Fires

RUN #4

A late season wildfire on the west slopes of Fanita under an above average 30 mph Southwest wind in a FM-4, continuous chaparral vegetation over 6' in height. This wind condition is associated with the breakdown of a sustained Santa Ana wind episode.

BehavePlus 3.0.1 Thu, Oct 26, 2006 at 23:55:45 Page 3

Fanita, under an above average SW wind in an FM-4

Surface Rate of Spread (maximum)	811.7	ft/min
Fireline Intensity	46678	Btu/ft/s
Flame Length	63.2	ft
Midflame Wind Speed	15.0	mi/h
Max Eff Wind Exceeded?	No	
Area	8857.9	ac
Perimeter	103475	ft

BehavePlus 3.0.1 Thu, Oct 26, 2006 at 23:55:45 Page 1

Modules: SURFACE, SIZE

Description	Fanita, under an above average SW wind in an FM-4	
Fuel/Vegetation, Surface/Understory		
Fuel Model		4
Fuel Moisture		
1-h Moisture	percent	2
10-h Moisture	percent	3
100-h Moisture	percent	5
Live Herbaceous Moisture	percent	
Live Woody Moisture	percent	50
Weather		
20-ft Wind Speed	mi/h	30
Wind Adjustment Factor		0.5
Direction of Wind Vector (from upslope)	deg	0
Terrain		
Slope Steepness	percent	45
Fire		
Elapsed Time	h	1.0

FPP II:6:2862-64

RUN #6

A late season wildfire under 60 mph Santa Ana wind conditions in a FM-4, continuous chaparral vegetation over 6' in height.

BehavePlus 3.0.1 Fri, Oct 27, 2006 at 00:01:35 Page 3

Fanita, under a 60 mph Santa Ana wind in an FM-4

Surface Rate of Spread (maximum)	1966.5	ft/min
Fireline Intensity	113088	Btu/ft/s
Flame Length	95.0	ft
Midflame Wind Speed	30.0	mi/h
Max Eff Wind Exceeded?	No	
Area	30229.3	ac
Perimeter	241689	ft

BehavePlus 3.0.1 Fri, Oct 27, 2006 at 00:01:35 Page 1

Modules: SURFACE, SIZE

Description	Fanita, under a 60 mph Santa Ana wind in an FM-4	
Fuel/Vegetation, Surface/Understory		
Fuel Model		4
Fuel Moisture		
1-h Moisture	percent	2
10-h Moisture	percent	3
100-h Moisture	percent	5
Live Herbaceous Moisture	percent	
Live Woody Moisture	percent	50
Weather		
20-ft Wind Speed	mi/h	60
Wind Adjustment Factor		0.5
Direction of Wind Vector (from upslope)	deg	180
Terrain		
Slope Steepness	percent	45
Fire		
Elapsed Time	h	1.0

FPP II:6:2868-70

Different Fuel Moisture & Winds Create Different Flame Length
FPP SMX-FM4 Comparison of SW versus NE Wind Fires

RUN #2

A summer afternoon wildfire on the west slopes of Fanita under a prevailing 15 mph Southwest wind in a FM-4, continuous chaparral vegetation over 6' in height..

BehavePlus 3.0.1 Thu, Oct 26, 2006 at 23:46:46 Page 3

Fanita, under a prevailing SW wind in an FM-4

Surface Rate of Spread (maximum)	271.7	ft/min
Fireline Intensity	13097	Btu/ft/s
Flame Length	35.2	ft
Midflame Wind Speed	9.0	mi/h
Max Eff Wind Exceeded?	No	
Area	1441.5	ac
Perimeter	36327	ft

BehavePlus 3.0.1 Thu, Oct 26, 2006 at 23:46:46 Page 1

Modules: SURFACE, SIZE

Description: Fanita, under a prevailing SW wind in an FM-4

Fuel/Vegetation, Surface/Understory		
Fuel Model		4
Fuel Moisture		
1-h Moisture	percent	4
10-h Moisture	percent	6
100-h Moisture	percent	8
Live Herbaceous Moisture	percent	
Live Woody Moisture	percent	80
Weather		
20-ft Wind Speed	mi/h	15
Wind Adjustment Factor		0.6
Direction of Wind Vector (from upslope)	deg	0
Terrain		
Slope Steepness	percent	45
Fire		
Elapsed Time	h	1.0

FPP II:6:28656-58

RUN #6

A late season wildfire under 60 mph Santa Ana wind conditions in a FM-4, continuous chaparral vegetation over 6' in height.

BehavePlus 3.0.1 Fri, Oct 27, 2006 at 00:01:35 Page 3

Fanita, under a 60 mph Santa Ana wind in an FM-4

Surface Rate of Spread (maximum)	1966.5	ft/min
Fireline Intensity	113088	Btu/ft/s
Flame Length	95.0	ft
Midflame Wind Speed	30.0	mi/h
Max Eff Wind Exceeded?	No	
Area	30229.3	ac
Perimeter	241689	ft

BehavePlus 3.0.1 Fri, Oct 27, 2006 at 00:01:35 Page 1

Modules: SURFACE, SIZE

Description: Fanita, under a 60 mph Santa Ana wind in an FM-4

Fuel/Vegetation, Surface/Understory		
Fuel Model		4
Fuel Moisture		
1-h Moisture	percent	2
10-h Moisture	percent	3
100-h Moisture	percent	5
Live Herbaceous Moisture	percent	
Live Woody Moisture	percent	50
Weather		
20-ft Wind Speed	mi/h	60
Wind Adjustment Factor		0.5
Direction of Wind Vector (from upslope)	deg	180
Terrain		
Slope Steepness	percent	45
Fire		
Elapsed Time	h	1.0

FPP II:6:2868-70

	# of Homes
Yorba Linda Estates	373
Sage Development	112
Total Homes	485

Aspen Way

Sage Development 112 Homes

San Antonio Road

Via Del Agua

Stonehaven Drive

Yorba Linda Water District

Freeway Complex Fire Disaster Response & Water System Assessment

January 8, 2009

A report of facts and findings of the November 15, 2008 Freeway Complex Fire

Table of Contents

Freeway Complex Fire Report

Chapter 1 - Purpose & Objective

The primary purpose and objective of this report is to provide information on the events and facts surrounding the Freeway Complex Fire as they relate to the Yorba Linda Water District (YLWD). This report was prepared internally by YLWD staff and includes information derived by multiple sources including the YLWD's Emergency Operation Center (EOC) log, employee interviews, employee logs, Supervisory Control and Data Acquisition (SCADA) logs, and other sources to ensure the facts contained herein are presented in as accurate a manner as possible.

Chapter 2 – Executive Summary

The Freeway Complex Fire was a fire storm like no other that the Yorba Linda area has ever experienced. The weather conditions including the wind speed and direction, temperature, and relative humidity were all contributing factors that along with the fire, formed a destructive combination. The fire burned 30,305 acres (at a rate of 1,000 acres/hour for the first 24 hours) in total, threatening some 9,500 homes, destroying 118 and damaging another 60 within the Yorba Linda Community.

Upon commencement of the Freeway Complex Fire, the staff of the Yorba Linda Water District responded by mobilizing and activating the EOC in a timely manner. During the EOC activation period, every effort was made to ensure water supplies were available within the areas with the highest water demands for firefighting activities. YLWD personnel were dispatched to various YLWD facilities throughout the event to confirm the operation of booster pump stations, to perform damage assessments of the water system and to make necessary repairs where possible.

During the fire emergency, YLWD staff skillfully managed the system's complex infrastructure to maximize water flow under extremely difficult circumstances. YLWD also requested and received assistance from Mutual Aid partners which supplied extra pumps that staff employed effectively in strategic areas of the water distribution system. Overall, water supplies were sufficient throughout YLWD's water system. The system as a whole delivered about 20 million gallons to the fire fight which primarily threatened the highest elevations and some service areas received six to nine times their normal volume of water within a very narrow time period.

However, YLWD's preliminary internal review conducted for this assessment determined that during the peak of the fire storm water service appears to have been interrupted in a limited number of streets in the Hidden Hills Upper Service Area.

All of these issues are discussed in more detail in the following report.

Chapter 3 - Water System Background

YLWD provides water service to over 24,000 homes and businesses within a 23 square-mile territory serving the cities of Yorba Linda, portions of Brea, Anaheim, and Placentia, and a small unincorporated area in the County of Orange. The elevations and topography within YLWD vary from approximately 250 feet above mean sea level to approximately 1,300 feet, thus creating the need for multiple water pressure zones (service areas) to ensure water flow and pressure are provided that meet general guidelines and standards developed by the American Water Works Association (AWWA). For the purpose of this report, 12 service areas, which overlie YLWD, will be discussed and referenced to. These areas are outlined in Table 3-1 and illustrated in Exhibit "A".

Table 3-1: Reservoir Service Areas

Area	Reservoir Areas	Elevation (ft)
1	Highland Reservoir	428
2	Lakeview Reservoir	570
3	Valley View & Fairmont Reservoirs	675
4	Bryant Ranch Reservoir	680
5	Gardenia Reservoir	780
6	Springview Reservoir	780
7	Elk Mountain Reservoir	780
8	Little Canyon Reservoir	1,000
9	Santiago Reservoir	1,000
10	Quarter Horse Reservoir	920
11	Chino Hills Reservoir	1,300
12	Camino de Bryant Reservoir	1,165

Water pressure and water flow throughout the distribution system are accomplished through the combination of storage reservoirs, which create a gravity-fed system, and booster pump stations, which pump water from one pressure zone to another. This movement of water is typically pumped from a lower elevation zone to a higher elevation zone. In all, there are 13 storage reservoirs within YLWD with a total capacity of 49.9 million gallons.

Water is supplied from two sources, imported water from Metropolitan Water District through three physical connections into the distribution system, and nine groundwater wells capable of

producing approximately 14,000 gallons per minute, cumulatively. Currently, YLWD uses both sources on an equal basis with approximately 50% imported water and 50% groundwater serving the needs of the residents.

Chapter 4 - Water System Design Standards

Water agencies within the United States typically use design standards established by the American Water Works Association (AWWA). These standards apply to the construction of storage reservoirs, installation of transmission and distribution pipelines, fire hydrants, valves, and other appurtenances. YLWD uses and conforms to these standards when designing and constructing water systems.

Chapter 5 - Mobilization of YLWD Personnel and EOC Activation

The Freeway Complex Fire began at 9:05 a.m., November 15, 2008 in Riverside County at the edge of the 91 Freeway at Green River, and expanded rapidly into Orange County. Shortly after reaching the Orange County boundary, the fire split into two separate paths; the first into the Santa Ana Riverbed, continuing west and south into Anaheim Hills, and the second west and north into the hills of Yorba Linda. The fire continued to Olinda Ranch along Carbon Canyon Road in Brea, burned through much of Chino Hills, then spread north into the Diamond Bar area.

A Red Flag Warning was issued by the National Weather Service for areas including Orange County and was in effect 24-hours preceding the start of the Freeway Complex Fire on November 15, 2008. This warning was then extended through 10:00 a.m. on the 15th. The Freemont Canyon Remote Automated Weather Station reported a wind speed of 43 mph, with gusts to 61 mph at 9:00 a.m., the day of the fire. The temperature was 75 degrees with a relative humidity level of 8%.

YLWD Staff became aware of the fire situation at 10:40 a.m. November 15, 2008, and mobilized the YLWD Emergency Operations Center (EOC). At 10:54 a.m., YLWD's Production Plant Operators, who have the responsibility of operating and controlling water supply throughout the distribution system, began overriding the normally automated water delivery system and reported directly to the EOC. At 12:00 p.m. the EOC was officially activated by the General Manager. Between 12:45 and 12:50 p.m. YLWD sent representatives to act as liaisons to the City of Yorba Linda's EOC and to the Orange County Fire Authority (OCFA) Incident Command Post, which was established at the Yorba Regional Park.

Throughout the day and into the evening, YLWD personnel continued to arrive at the EOC for duty. The EOC was active for a total of 26 hours and officially de-activated at 2:00 p.m. Sunday

November 16, 2008, by the General Manager. Documentation indicates a total of 659 hours were worked by YLWD personnel during the EOC activation period.

Chapter 6 - Incident Timeline Summary

YLWD compiled a detailed log of all activities that occurred on November 15 and 16, 2008. This log represents all EOC activities that transpired during the fire storm event. The complete EOC log is available from YLWD upon request.

The following timeline summarizes and highlights the significant events that transpired at the EOC.

Saturday, November 15, 2008

9:05 a.m. Commencement of the Freeway Complex Fire

10:40 a.m. YLWD Staff first became aware of the fire situation once the YLWD on-duty standby operator was notified that the fire had started in the Yorba Linda area.

10:54 a.m. The on-duty operator notified Metropolitan Water District and requested an additional 50% supply increase of imported water into YLWD's water system. Additionally, multiple pump stations were placed in manual mode and turned 'on' to further fill reservoirs in anticipation of additional water needs for fire fighting.

12:00 p.m. YLWD's EOC was officially activated at the Operations Center located at YLWD's headquarters. An evaluation of the entire water system for damage and water supply commenced immediately.

12:05 p.m. The Water Emergency Response Organization of Orange County (WEROC) was notified of YLWD's official EOC activation.

12:45 p.m. YLWD dispatched a supervisor to act as liaison at the City of Yorba Linda EOC.

12:50 p.m. A team of senior level operators were dispatched to act as liaisons with the Orange County Fire Authority's (OCFA) Unified Command established at the Incident Command Post located at Yorba Regional Park.

1:19 p.m. SCADA communications at Santiago Booster Pump Station (BPS) was disrupted due to the fire storm. Remote communications to the Hidden Hills Booster Pump Station (BPS) and Santiago Reservoir were also lost at this time.

1:30 p.m. An operator was dispatched to both the Hidden Hills BPS and the Santiago BPS. Upon arrival at the Hidden Hills BPS, the operator confirmed the pumps were running, and were providing water to the Santiago Lower Zone and up to the Santiago Reservoir as needed. The severity of fire storm prevented YLWD personnel from traveling to the Santiago BPS at this time.

3:20 p.m. At the EOC, unconfirmed reports were heard of water loss in the Hidden Hills area through the television media.

3:50 p.m. YLWD personnel were dispatched to the Hidden Hills area with a police escort.

4:00 p.m. A transmission pipeline (cross feeder) valve was opened by YLWD Operators to supplement the Santiago Lower Zone with water from Area 8 (Little Canyon Reservoir).

4:00 p.m. YLWD personnel arrived at the Hidden Hills BPS and confirmed all pumps were in operation.

4:15 p.m. YLWD personnel reached the Santiago BPS. They reported all pumps were shut down, including the gas engine pump, which had shut down due to overheating as indicated by a sensor on the engine. YLWD personnel manually started two electric motor pumps and the gas engine pump.

5:10 p.m. YLWD officials issued a Boil Water Advisory (Exhibit "E") for residents in the entire Hidden Hills area due to the temporary loss of water pressure in the Upper Zones and the rapid draw down of water in the Santiago Reservoir supplying both the Santiago Upper and Lower Zones.

6:10 p.m. Through WEROC and YLWD requests for mutual aid, a fire pumper truck from OCFA was dispatched to Mazanita and Smoketree to augment water supplies from Area 6 (Springview Reservoir) to Area 8 (Little Canyon Reservoir).

6:20 p.m. YLWD personnel arrived at the Santiago BPS to investigate and restore SCADA communications. Air in the pipelines at the pump station was observed and reported. This was an indicator that the Santiago Reservoir was being drawn down to a level that would not provide sufficient water to flood the booster pumps' suction tubes. As a protective measure to avoid damage to the pumps, the decision was made to shut down all pumps until such time as water levels were restored in the Santiago Reservoir.

6:22 p.m. A mobile water pump from Laguna Beach County Water District arrived at YLWD's EOC staging area and was dispatched to Pepper and Mazanita to

augment water supplies from Area 6 (Springview Reservoir) to Area 8 (Little Canyon Reservoir).

6:50 p.m. An additional fire pumper truck from the City of Garden Grove arrived at the District's Fairmont Booster Pump Station to augment water supplies from Area 6 (Springview Reservoir) to Area 8 (Little Canyon Reservoir).

7:00 p.m. A mobile water pump from Santa Margarita Water District arrived at YLWD's EOC staging area and was dispatched to Umbria and Trentino to augment water supplies from Area 10 (Quarter Horse Reservoir) to Area 8 (Little Canyon Reservoir).

11:00 p.m. YLWD personnel traveled to the Santiago BPS and reported the Santiago Reservoir remained empty.

Sunday, November 16, 2008

12:45 a.m. The cross feeder valve originally opened to supplement the Santiago Lower Zone with water from Area 8 (Little Canyon Reservoir) was closed allowing the Santiago Reservoir and the Little Canyon Reservoirs to operate independently and recover separately as needed.

8:00 a.m. YLWD personnel arrived at the Santiago BPS and reported a level of eight feet of water. All pumps were subsequently turned on and the Santiago Upper Zone was restored to normal water pressure shortly thereafter.

8:00 a.m. YLWD crews began shutting down water services to homes where damage or destruction had occurred or where water leaks were observed.

2:00 p.m. YLWD's EOC was deactivated.

Chapter 7 - Water System Demands

At 12:00 p.m., November 15, 2008, YLWD's EOC was officially activated. YLWD proceeded to complete an analysis of the water system, which included the evaluation of all the storage reservoirs and the amount of water available in storage. At 12:18 p.m., all reservoirs combined were at 56% capacity, which represented a total storage of 27.9 million gallons of water. Table 7-1 provides a detailed breakdown of each reservoir and its status at 12:18 p.m.

The water maintained in storage is typical as YLWD balances anticipated seasonal water demands with daily water quality requirements. YLWD operators must regularly cycle the water in storage to insure high quality drinking water is supplied throughout the distribution system at all times. An engineering study conducted in September 2002, entitled "Water Reservoir Nitrification Prevention and Control", by Corollo Engineers, recommended cyclical storage practices to prevent water nitrification from occurring in the chloraminated water supplies. Chloramination is the disinfection process typically used by the Metropolitan Water District in their imported water supplies. If chloraminated water remains in storage for an extended period of time, nitrification can occur, which potentially causes the presence of bacteria and could result in rapid degradation of water quality.

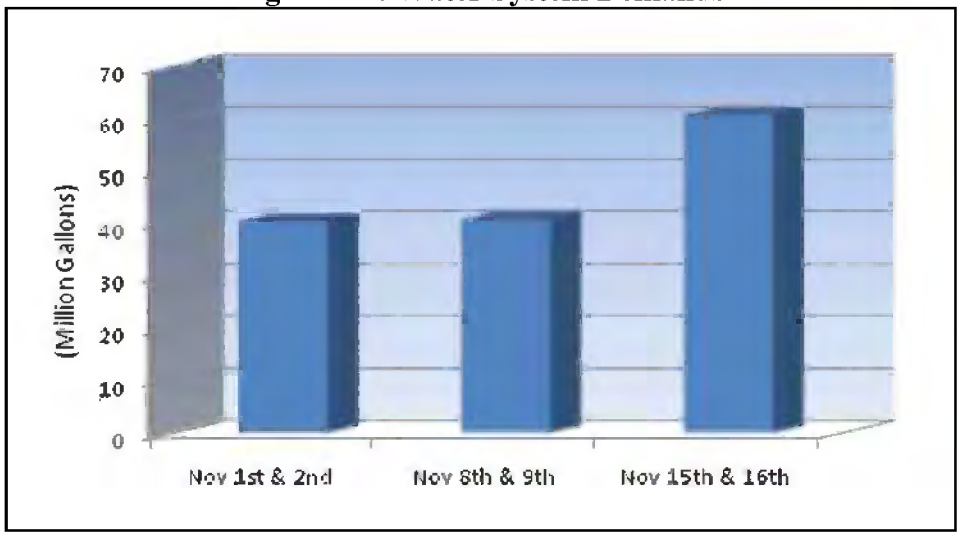
Table 7-1: Water in Storage

Reservoir Name	Total Capacity (mil. gallons)	Water in Storage (%)	Water in storage (mil. gallons)
Highland	4.6	68%	3.1
Lakeview	8.0	48%	3.8
Valley View	2.0	70%	1.4
Fairmont	7.4	66%	5.0
Bryant Ranch	2.5	58%	1.4
Gardenia	2.0	91%	1.8
Springview	8.0	56%	4.5
Elk Mountain	6.2	46%	2.8
Little Canyon	0.8	63%	0.5
Santiago	1.1	80%	0.9
Quarter Horse	3.5	49%	1.7
Chino Hills	0.6	42%	0.2
Camino de Bryant	3.2	23%	0.8
Totals	49.9 mg	56%	27.9 mg

During the two 24-hour periods of Saturday, November 15, and Sunday, November 16, the water demands combined for both days exceeded typical demands from the previous two weeks by over 20 million gallons. Figure 7-1 indicates that the combined water demand throughout the

water system on November 15th and 16th, encompassing all reservoir service areas, was approximately 60 million gallons. When compared to the previous two weeks for a combined total of 40 million gallons, this amounts to a 50% increase or 20 million gallons above normal.

Figure 7-1: Water System Demands



The demands experienced throughout the water system can be further evaluated and analyzed to determine which areas demanded higher water supplies for firefighting needs. Each reservoir service area was analyzed utilizing data from YLWD's SCADA system, which continued to gather data during the fire storm event, with the exception of the Hidden Hills area as addressed further in this report. This data was then compared to the previous two weeks, Table 7-2.

YLWD's SCADA system is a computerized network designed to operate and monitor the groundwater wells, import water connections, booster pump stations, and reservoirs. Each facility within YLWD is automated by its integration into the SCADA system. Operating within pre-programmed parameters, the system self regulates, monitors and notifies operators through a sophisticated alarm system controlling the amount of water to be pumped into each reservoir and service area. Conversely, all facilities may also be controlled remotely from YLWD's headquarters through the SCADA system. All SCADA transactions are logged into a database for future retrieval and analysis. This database was utilized in determining water demands during the fire storm event.

The magnitude of the impact for each area is best illustrated in the "% Increase" column of Table 7-2. This value represents the percentage increase of water demand for a particular area over and above the demand of the average from the previous two weeks. Figure 7-2, provides a graphical representation of these effects.

Table 7-2: Water Demands per Area (million gallons)

Area	Nov 1st & 2nd	Nov 8th & 9th	Nov 15th & 16th	% Increase
1 (Highland Reservoir)	4.6	4.7	5.2	12%
2 (Lakeview Reservoir)	10.7	10.5	12.1	15%
3 (Valley View & Fairmont Reservoir)	8.6	8.7	11.0	27%
4 (Bryant Ranch Reservoir)	3.0	3.1	4.8	57%
5 (Gardenia Reservoir)	1.7	1.6	2.3	39%
6 (Springview Reservoir)	3.6	4.2	5.9	51%
7 (Elk Mtn. Reservoir)	1.6	1.9	4.0	129%
8 (Little Canyon Reservoir)	2.0	2.0	4.2	110%
9 (Santiago Reservoir)	2.3	2.0	5.1	137%
10 (Quarter Horse Reservoir)	0.6	0.6	1.3	117%
11 (Chino Hills Reservoir)	0.7	0.7	1.8	157%
12 (Camino de Bryant Reservoir)	1.2	0.9	3.3	214%
Totals	**40.6 mg**	**40.9 mg**	**61.0 mg**	**50%**

Another key factor when evaluating system and pressure demands is peaking. Peaking is the maximum amount of water produced within a particular reservoir service area over a specified length of time. The top three reservoir service areas that displayed significant increase over normal are illustrated in Figure 7-2, identified as Areas 8, 9 and 12. The peaking data of these zones was further analyzed to determine the magnitude of demands placed on these particular areas:

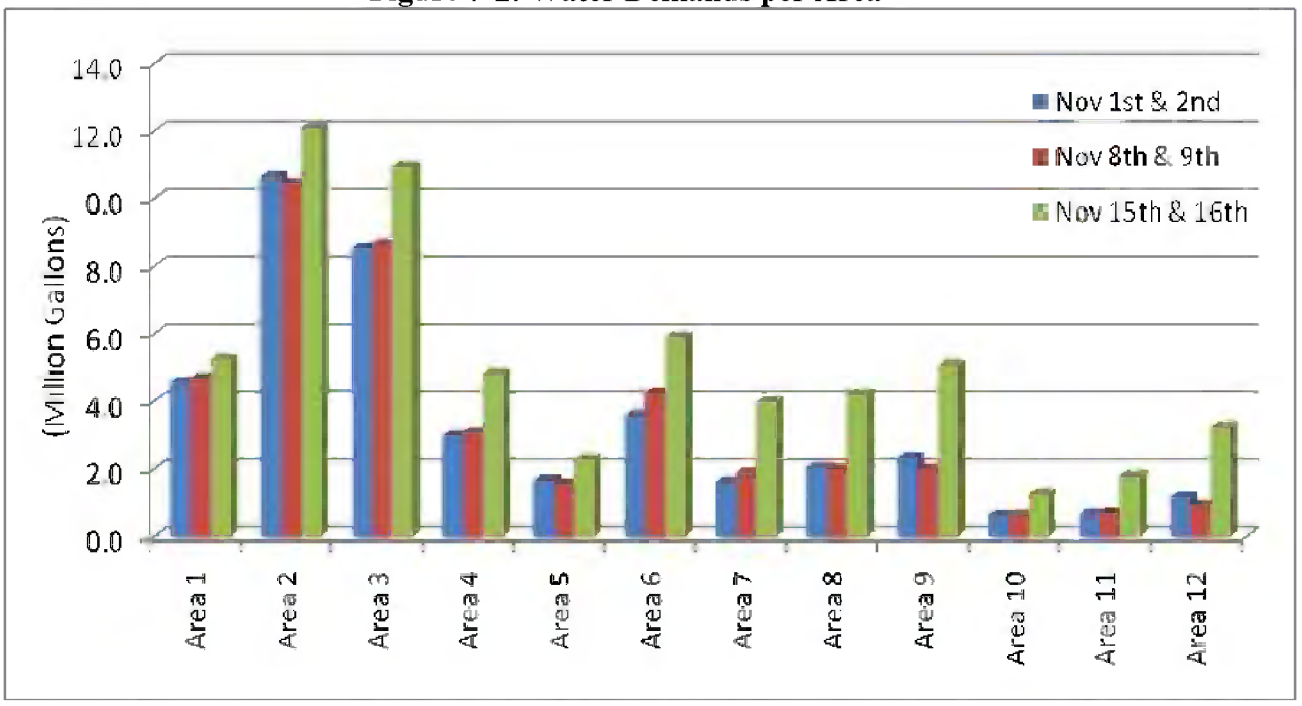
- **Area 8 (Little Canyon Reservoir)** - YLWD records indicate that peaking occurred between 4:30 p.m. and 8:30 p.m., November 15, with a total production of 686,820 gallons. The week prior, total production for this area between 4:30 p.m. and 8:30 p.m. was 108,978 gallons. The result is a peaking factor of 630% of typical demand.

- **Area 9 (Santiago Reservoir)** – While communications were severed with the Santiago Reservoir at 1:19 p.m., November 15, as discussed further in this report, YLWD personnel were able to confirm operation of the Hidden Hills BPS, which pumps to the Santiago Reservoir. All pumps within this pump station were in full operation during the fire storm event. Calculations therefore indicate that peaking occurred between 1:30 p.m. and 7:00 p.m., November 15, with a total production of 1,568,808 gallons. The week

prior, total production for this area between 1:30 p.m. and 7:00 p.m. was 261,294 gallons. The result is a peaking factor of 600% of typical demand.

- **Area 12 (Camino de Bryant Reservoir)** - SCADA records indicate that peaking occurred between 11:50 a.m. and 1:50 p.m., November 15, with a total production of 533,715 gallons. The week prior, total production for this area between 11:50 a.m. and 1:50 p.m. was 56,655 gallons. The result is a peaking factor of 940% of typical demand.

Figure 7-2: Water Demands per Area



The peaking demands described within these areas can be further correlated with Exhibit "B", which illustrates the number of fire crew dispatches/calls occurring between the hours of 10:20 a.m., November 15, 2008 and 4:00 a.m., November 16, 2008. These dispatched calls were derived by documents provided by OCFA. Table 7-3 provides the quantity of fire crew dispatches per area.

Table 7-3: Dispatches by Area

Location Areas	No. of Dispatches/Calls
Area 3 (Fairmont & Valley View)	4
Area 4 (Bryant Ranch)	16
Area 6 (Springview)	26
Area 7 (Elk Mountain)	8
Area 8 (Little Canyon)	23
Area 9 (Santiago)	22
Area 11 (Chino Hills)	9
Area 12 (Camino de Bryant)	9

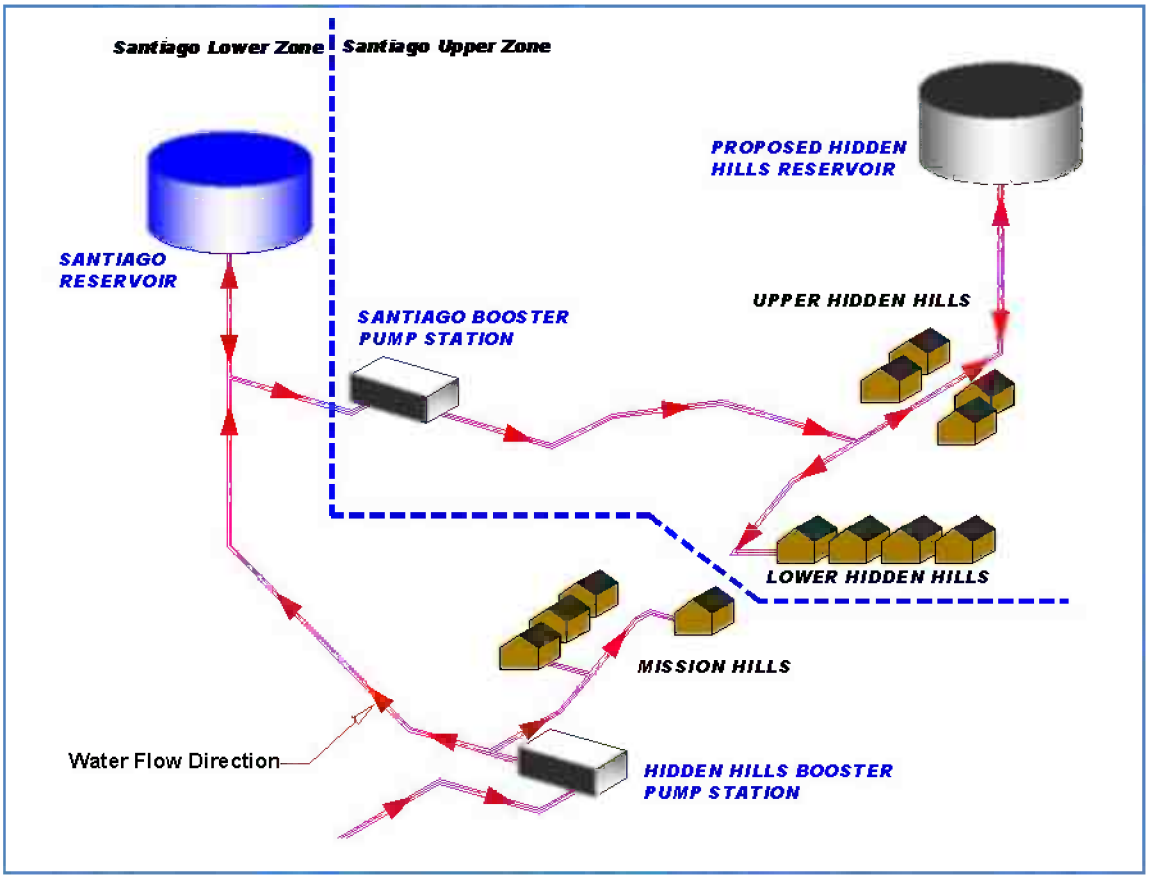
The number of fire hydrants used simultaneously during the fire storm, within each area, cannot be confirmed. Exhibit "B" is intended to illustrate the potential magnitude of the fire services required during the event. Each dispatch/call within Exhibit "B" reflects the areas most impacted by the fire storm as it continued to travel in a westerly direction. This is further evident as the dispatches/calls are at times clustered in certain areas.

Chapter 8 - Hidden Hills Area

The Hidden Hills area consists of approximately 240 homes and of those, approximately 180 homes are within Area 9 (Santiago Reservoir). This particular area can be further defined with two distinct pressure zones, which shall be referred to as Santiago Lower Zone and Santiago Upper Zone as illustrated in Exhibit "C".

Water pressure within the Santiago Lower Zone is maintained in combination by the Santiago Reservoir, with a capacity of 1.1 million gallons, through a conventional gravity-fed system and secondly through a series of four electric pumps at the Hidden Hills BPS. This pump station is capable of producing 1,900 gallons per minute fed from YLWD's connection with Metropolitan Water District and YLWD's Area 6 (Springview Reservoir). On the day of the fire, the Santiago Reservoir was approximately 80 percent full (See Table 7-1). Figure 8-1 provides a schematic diagram of the Hidden Hills area.

Figure 8-1: Hidden Hills Schematic Diagram



The Santiago Upper Zone's water pressure is provided by the Santiago BPS consisting of three electric pumps, capable of producing 900 gallons per minute, and one gas engine pump, with a capacity of 1,200 gallons per minute for a combined capacity of 2,100 gallons per minute. The Santiago BPS is located adjacent to the Santiago Reservoir. This particular upper zone area is a closed zone and water pressure is maintained by the pumps, specifically one with a Variable Frequency Drive (VFD), which continuously adjusts its flow to meet actual demands at any given time. On a typical day, e.g. prior to the fire storm, the maximum peak demand required in the Santiago Upper Zone is less than 500 gallons per minute.

Pumping water into this closed zone results in an elevation climb of approximately 300 feet from the base of the Santiago BPS to the north-east corner of this particular zone, which is illustrated in Exhibit "D". The Santiago BPS is located at an elevation of 1,000 feet, and is required to provide water pressure and flow to the highest home at approximately 1,310 feet in elevation.

At 1:19 p.m., November 15, the fire storm reached the Santiago Reservoir, where SCADA communications to the reservoir, the Santiago BPS, and the Hidden Hills BPS were lost. Cable damage from the fire created an electrical short, damage to a SCADA component known as a PLC and subsequently a power outage of SCADA equipment housed in the Santiago BPS. No pump damage occurred due to the fire.

The damaged SCADA PLC at the Santiago BPS forced a shut-down of all electric pumps providing water pressure to the Santiago Upper Zone. However, the gas engine has a mechanical pressure sensor, independent of the SCADA control system and may have continued to operate.

Immediately following the loss of communications, YLWD personnel were dispatched at 1:30 p.m. to both the Hidden Hills BPS and the Santiago BPS. Upon arrival at the Hidden Hills BPS, YLWD personnel confirmed all pumps were running and providing water to the Santiago Lower Zone and the Santiago Reservoir. YLWD personnel were not able to reach the Santiago BPS due to the life threatening conditions of the fire storm.

At 3:20 p.m. at the YLWD EOC, staff first heard unconfirmed reports of water loss in the Hidden Hills area through the television media. With the assistance of a police escort, YLWD personnel arrived at the Hidden Hills BPS at 4:00 p.m. and once again confirmed all pumps were in operation. YLWD personnel were finally able to reach the Santiago BPS at 4:15 p.m., and reported all pumps were shut down, including the gas engine pump, which had shut down between 1:19 p.m. and 4:15 p.m. due to overheating as indicated by a sensor on the engine. The exact time the gas engine shut down is unknown due to the loss of SCADA communications and it is not known how much water the gas engine pump was able to supply to the Santiago Upper Zone before it ceased operating. YLWD personnel started two electric and the gas engine pumps manually. The third electric pump, with the VFD, was not able to start due to the power loss of SCADA equipment at the time.

Following the manual startup of the pumps at the Santiago BPS, shortly after 4:15 p.m., YLWD personnel proceeded upwardly within the Santiago Upper Zone to bleed fire hydrants of entrapped air. Water pressure was noted on four fire hydrants located on Greencrest, leading over to Hidden Hills Road. At the top of Hidden Hills Road, water pressure was not yet present. It was also reported that multiple fire engines were located at Mission Hills and Skyline extracting water from fire hydrants.

At 6:20 p.m., YLWD personnel arrived at the Santiago BPS to investigate and restore communications. It was reported that air was present in the pump station, an indicator that the Santiago Reservoir was empty, although the Hidden Hills BPS continued to operate. As a protective measure to avoid damage to the pumps, YLWD decided to shut down all pumps at the Santiago BPS until such time water was restored in the Santiago Reservoir. YLWD proceeded to shift its focus and efforts westerly as water demands began to increase within Area 6 (Springview Reservoir) and Area 8 (Little Canyon Reservoir). The Santiago reservoir was drained completely some time between 4:15 and 6:20 p.m.

At 11:00 p.m., YLWD personnel once again traveled to the Santiago Reservoir and reported the reservoir remained empty. The water demands within the Santiago Lower Zone prevented the Santiago Reservoir from filling during the late hours of November 15. During this time, the demands placed on the Santiago Reservoir and the Hidden Hills BPS were a combination of fire fighting activities at the Santiago Lower Zone and Area 8 (Little Canyon Reservoir), as the cross feeder valve remained in the opened position until 12:45 a.m., November 16. The following day at 8:00 a.m., November 16, YLWD personnel arrived at the Santiago Reservoir and reported a level of eight feet of water, or approximately 376,000 gallons. All pumps were subsequently turned on and the Santiago Upper Zone was restored to normal water pressure shortly thereafter.

During the fire storm event, YLWD did not receive any reports of water loss within the Santiago Lower Zone. Water demands within this zone were met by both the Hidden Hills BPS and the water flowing from Area 8 (Little Canyon Reservoir) through the cross feeder valve.

Chapter 9 - Issuance of Boil Water Advisory

At 5:10 p.m., November 15, YLWD officials issued a Boil Water Advisory (Exhibit "E") for residents in the Hidden Hills area due to the loss of water pressure, for both the Santiago Upper and Lower Zones. Although no reports of water outages had been reported in the Santiago Lower Zone, this area was included as a precautionary measure. The media was contacted and asked to broadcast the Boil Water Advisory. The notice was also posted on YLWD's web site soon thereafter.

A Boil Water Advisory is a public statement advising customers to boil tap water before consuming it. Advisories are issued when an event has occurred, such as the loss of water pressure, allowing the possibility for the water distribution system to become contaminated. An advisory does not mean that the water is contaminated, but rather that the possibility exists.

As no other water outages were reported throughout other parts of YLWD's water distribution system, the issuance of additional Boil Water Advisories was not necessary. This was confirmed through routine water quality sampling taken throughout YLWD's distribution system the following week.

Following the issuance of the Boil Water Advisory in the Hidden Hills area, YLWD conducted multiple water bacteriological tests throughout the affected area as required by state law. Lifting of the Boil Water Advisory can only be approved by the State Department of Public Health with bacteria free results confirmed by a State certified third-party laboratory. YLWD collected water samples at 15 different locations on two separate occasions and were submitted to the laboratory for testing. Results are obtained following an incubation period of 48 hours, which is the required time for the sample to exhibit any possible contamination.

During the Boil Water Advisory period, as YLWD waited for the laboratory results, YLWD delivered bottled water to the residents affected by the Advisory. Bottled water was purchased and additionally donated by a bottled water supplier. Additional reserves of bottled water not needed during the Boil Water Advisory have been donated to local food banks and other non-profit organizations.

On November 20, 2008, the State Department of Public Health granted authorization to lift the Boil Water Advisory. Residents were notified by a reverse 911 system that contacts residents by telephone. Contact with 13,400 residential accounts reaching a population estimated at 42,900 (13,400 accts x 3.2 people/acct) was confirmed, Exhibit "F".

Chapter 10 - Fire Hydrant Preventative Maintenance & Servicing Program

YLWD has more than 3,850 fire hydrants located in both residential and commercial areas throughout its service boundaries. The district's preventative maintenance program requires that all fire hydrants be serviced on a yearly basis. This servicing encompasses flushing, testing water pressure, cleaning, and lubricating the hydrant threads. YLWD's Operations Department maintains records of these procedures and the maintenance performed on each hydrant.

During the fire storm event, it was reported that a number of fire hydrants were inoperable at the time, primarily in the Hidden Hills area. On November 16, 2008, YLWD personnel drove to the Hidden Hills area and observed that three fire hydrants were in a 'bagged' or 'taped' condition. These hydrants were placed into this condition by individuals other than YLWD crews. Two of the hydrants were located at 22476 Mission Hills Road and 22255 Mission Hills Road, and the third was located at 3510 Fairmont Avenue. The three hydrants were in need of repairs, which were completed the following day on November 17, 2008.

A fourth fire hydrant located at Juniper and Smoketree was also 'bagged' during the fire storm event by individuals other than YLWD personnel. Upon arrival on November 17, 2008, YLWD crews confirmed full operation of this particular hydrant and it was placed into operation immediately.

YLWD maintenance records confirm that the two fire hydrants on Mission Hills Road were serviced on January 22, 2008, and the fire hydrant at 3520 Fairmont Avenue was serviced on February 5, 2008. At that time, all three fire hydrants were completely operational.

All three fire hydrants are of a type known as "dry barrel". The advantage that this type of hydrant provides is that they restrict water loss and prevent a water geyser effect in the event the hydrant is severed from its base, as would occur if a vehicle strikes the hydrant. The design of these hydrants incorporate a type of coupling that can be damaged if inexperienced users attempt to open or close the hydrant incorrectly. Although only YLWD personnel and fire crews have

authorized access to hydrants, it is possible that unauthorized and inexperienced persons may have used and damaged the YLWD fire hydrants without YLWD's knowledge and not reported the damage to YLWD. It is also possible that the hydrants were damaged during the fire storm event.

Chapter 11 - Mutual Aid

During the fire storm event, YLWD submitted requests, through WEROC, for mutual aid on November 15, 2008. These requests, common practice in emergency situations of this magnitude, were for water pumps to augment certain areas of the water distribution system where demands began to compromise existing system capabilities. Figure 11-1 shows the locations of mutual aid, provided by the following:

1. **Laguna Beach County Water District** – At 3:00 p.m., YLWD officials requested a large capacity pump (2,000 gallons per minute) which arrived at 6:22 p.m. and was dispatched to Pepper and Mazanita to augment water supplies from Area 6 (Springview Reservoir) to Area 8 (Little Canyon Reservoir).

2. **Santa Margarita Water District** – At 4:45 p.m., YLWD officials requested a large capacity pump (2,000 gallons per minute) which arrived at 7:00 p.m. and was dispatched to Umbria and Trentino to augment water supplies from Area 10 (Quarter Horse Reservoir) to Area 8 (Little Canyon Reservoir).

3. **Orange County Fire Authority** – At approximately 5:30 p.m., YLWD officials requested a fire pumper truck from the Operation Area of WEROC which arrived at 6:10 p.m. and was dispatched to Mazanita and Smoketree to augment water supplies from Area 6 (Springview Reservoir) to Area 8 (Little Canyon Reservoir).

4. **City of Garden Grove Fire Department** – A secondary fire pumper truck arrived at 6:50 p.m. and was dispatched to Fairmont Pump Station to augment water supplies from Area 6 (Springview Reservoir) to Area 8 (Little Canyon Reservoir).

Figure 11-1: Mutual Aid Locations

Chapter 12 - Capital Improvement Program/Hidden Hills Reservoir Project

YLWD has a five year capital improvement program for fiscal years 2007-12 totaling $70.8 million. The following is a summary list of the projects and the current status for each:

Project Name	**Cost Estimate**
	$
Projects Completed:	
Lakeview Booster Pump Station (5000 GPM)	$4,500,000
Meter Replacement Program, Phase 1	$2,804,000
2005 C.I. Replace (Ohio/Buena Vista/Grandview)	$2,600,000
Zone 4 Transmission S&S, R 5 (36 inch)	$1,700,000

Project Name (con't)	Cost Estimate
Well No. 19 Long Term Storage Program	$1,200,000
Zone 3 Transmission S&S, R 5 (18 inch)	$1,000,000
Miraloma Storm Drain Pipeline	$525,000
Edison Power Pole Relocations	$250,000
Richfield Road Widening	$350,000
Miraloma Through Street Improvements	$250,000
S&S TTM 16209 Downstream Improvements (Rio del Oro)	$93,000
YLWD/S&S Kellogg Sewer Improvements	$1,500,000
Grandview Sewer	$260,000
New Administration Building	$7,700,000
Sub-total	**$24,732,000**
Projects in Construction Phase:	
Lakeview Reservoir (8MG) (90% complete and in service)	$11,500,000
Highland Reservoir Replacement (6MG) (30% complete)	$11,200,000
Zone 4C Reconfiguration	$2,070,000
Water Meter Replacement Project, Phase 2 (50% complete)	$1,000,000
GIS Implementation Project (95% complete)	$700,000
Radio Read Water Meter Conversion Project, Phase 1 (50%)	$160,000
Sub-total	**$26,630,000**
Projects in Design Phase:	
Fairmont Booster Pump Station Site Improvements	$300,000
OC-51 Upgrade	$242,000
Hidden Hills Reservoir (2MG) and Santiago Booster Upgrades	$9,000,000
Wells No. 20 & 21	$2,000,000
Lakeview Sewer Lift station Upgrades	$200,000
Groundwater Capacity Restoration	$1,000,000
Sub-total	**$12,742,000**
Projects not yet Started:	
Anaheim Intertie Connection Improvements	$500,000

Project Name (con't)	Cost Estimate
Highland BPS Replacement Project	$4,000,000
Zone 5 (1000) Booster Station	$1,080,000
Fairmont Booster Pump station Reconfiguration	$400,000
Foxtail Drive Pipeline	$245,000
Elk Mountain Res. Site Improvements	$300,000
Fire Flow Improvement (Via Sereno & Ohio)	$125,000
Sub Total	**$6,650,000**
Total Projects	**$70,754,000**

Among the top priority projects for the Five-Year Capital Improvement Plan is the Hidden Hills Reservoir Project. YLWD is now in the final permitting process for the project, which will supplement the existing water supply and provide reserve capacity to both the Santiago Lower and Upper Zones. The proposed project consists of a new two-million gallon capacity Hidden Hills Reservoir and improvements to the existing Santiago BPS at an estimated construction cost of $9 million dollars.

In 2000, Shapell Industries purchased nearly 1,300 acres in Improvement District No. 2, planning for further development. However, until developer design plans are finalized, the District is unable to determine either the size or the location of any necessary infrastructure, e.g. the reservoir.

YLWD's 2005 Master Plan identified fire flow requirements for the Hidden Hills area, specifically the Santiago Upper Zone based on the decision to serve the current population in that area, rather than waiting for the finalized housing tract plans for future development.

In 2006, Shapell Industries dedicated nearly 1,280 acres of its original planned development to the Chino Hills State Park. This allowed the District to confirm that the Hidden Hills Reservoir, initially designed to serve the entire track of homes with a capacity of 4 million gallons could now serve the existing area of Hidden Hills Estates, at half the size.

The re-design of the project is now essentially complete, and it is anticipated that the construction bidding process could take place in March 2009, with award of the contract in May 2009. Construction could be complete by September 2010.

However, in order to proceed with the bidding process and meet this proposed schedule, YLWD must secure two permits, one from a local private developer known as Shapell Industries, and a second from the State of California Department of Parks and Recreation. YLWD Staff is completing negotiations with staff of Shapell Industries and anticipates receipt of the required document by February 2009.

Concerning the second permit, YLWD Staff met on September 10, 2008 with staff of the State of California to discuss permit issues. The State requested additional design details concerning the access road and requested an updated biological survey of the proposed construction area. On October 31, YLWD submitted the new design drawings and the updated biological survey to the State. At a meeting on December 5, the State indicated that approval of the permit was contingent upon review and input by the State of California Department of Fish & Game and the U.S. Fish & Wildlife Service to ensure environmental compliance. By December 15, YLWD Staff had separate discussions with each of these two agencies and has provided follow-up information for their review. Additional discussions are planned with these state and federal agencies throughout January 2009.

Chapter 13 - Public Outreach and Communication

Following the fire storm event, YLWD focused on providing information to the public concerning the water system, the status of the Boil Water Advisory, and other news and information that was deemed pertinent. The primary means of communication was YLWD's web site. As information became available, the web site was updated on a timely basis as it provided the best means of communication under the circumstances. Additionally, YLWD utilized its electronic sign which was posted at the entrance of the Hidden Hills area to notify residents of the Boil Water Advisory and the subsequent lifting of the advisory.

As previously discussed, a reverse 911 system was also utilized to notify residents regarding the lifting of the Boil Water Advisory. Contact with 13,400 residents was confirmed from the reverse 911 system (Exhibit "F").

To date, the web site continues to be updated with the latest fire information which can be found at www.ylwd.com.

Chapter 14 - Damages & Cost Reimbursement

Physical damage to YLWD facilities from the fire storm event includes the following:

- (2) Air vac devices
- (3) Fire hydrants
- SCADA equipment at the Santiago Reservoir site
- Replaced damaged conduit
- Re-painting of the Quarter Horse Reservoir site fencing

YLWD officials are currently finalizing documents for submission to the Federal Emergency Management Agency (FEMA) for reimbursement for these losses. Additionally, other costs for which YLWD officials will be seeking FEMA reimbursement include the following:

- Incident Response $ 100,000
  - YLWD labor
  - General provisions for the EOC activation

- Water quality notification and support $ 60,000
  - Bottled water distribution
  - Communications expenditures
  - Reverse 911 notification

- Sand and erosion control for the following sites: $ 25,000
  - Gardenia Reservoir
  - Quarter Horse Reservoir
  - Little Canyon Reservoir
  - Chino Hills Reservoir
  - Copper Canyon Drive/Bryant Cross Feeder 16" and 24" pipeline
  - Santiago Reservoir and Santiago BPS

- Slope stabilization for the following sites: $ 23,000
  - Gardenia Reservoir
  - Quarter Horse Reservoir
  - Little Canyon Reservoir
  - Santiago Reservoir

As of the date of this Report, YLWD will be seeking a total of $236,000 from FEMA.

Chapter 15 – Conclusions

Based on objective measurements, the water system functioned well, given the demands placed on it. During the peak of the fire, when water was being drained from the system in extraordinary volumes, service was interrupted in a limited area of upper Hidden Hills. It should be noted that water supply problems are not uncommon in catastrophic fires such as the Freeway Complex fire. It also is important to note that the vast majority of homes that were damaged or destroyed were in areas where water pressure and water flows were available during the firefighting activities. (Attached are Exhibits "G", "G-1", G-2", and "G-3", which illustrates homes that were damaged or destroyed during the fire storm event within the boundaries of YLWD.)

Furthermore, though construction of the proposed Hidden Hills Reservoir will supplement water supplies in the Hidden Hills Upper Zone, the effects of the additional supply in that particular zone if the reservoir had been in operation, are difficult to assess with any certainty. There is no way to guarantee that the magnitude of a natural disaster such as the Freeway Complex Fire will not overwhelm even the most robust water system.

It has been the policy and practice of YLWD to continually upgrade and expand the water system in an effort to provide the best possible service to its customers. Consistent with that and with the findings of this assessment, YLWD is proceeding with the Hidden Hills Reservoir project, as well as the other above mentioned projects to maximize the capacity and efficiency of the water system.

Upon release of the OCFA final report, YLWD may amend this report or develop an additional report that may update information based on OCFA facts and analysis.

Acronym Definitions

AWWA – American Water Works Association

BPS – Booster Pump Station

EOC – Emergency Operations Center

OCFA – Orange County Fire Authority

PLC – Programmable Logical Control

PSI – Pounds per Square Inch

SCADA – Supervisory Control and Data Acquisition

WEROC – Water Emergency Response of Orange County

YLWD – Yorba Linda Water District

Exhibit "A" – Reservoir Zones Area Map (Attached)

Exhibit "B" – Dispatched Calls Area Map (Attached)

Exhibit "C" – Hidden Hills Water Pressure Areas

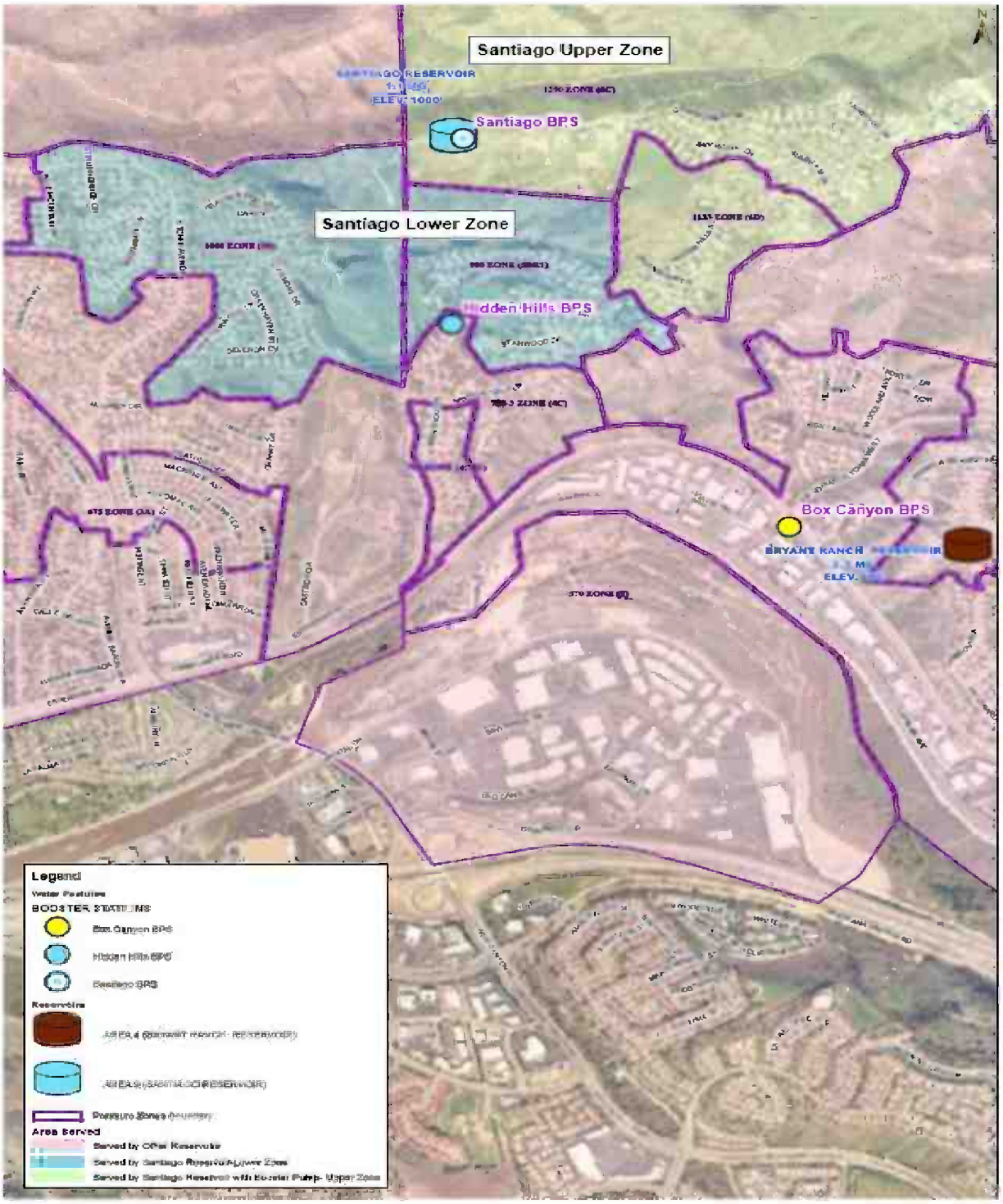
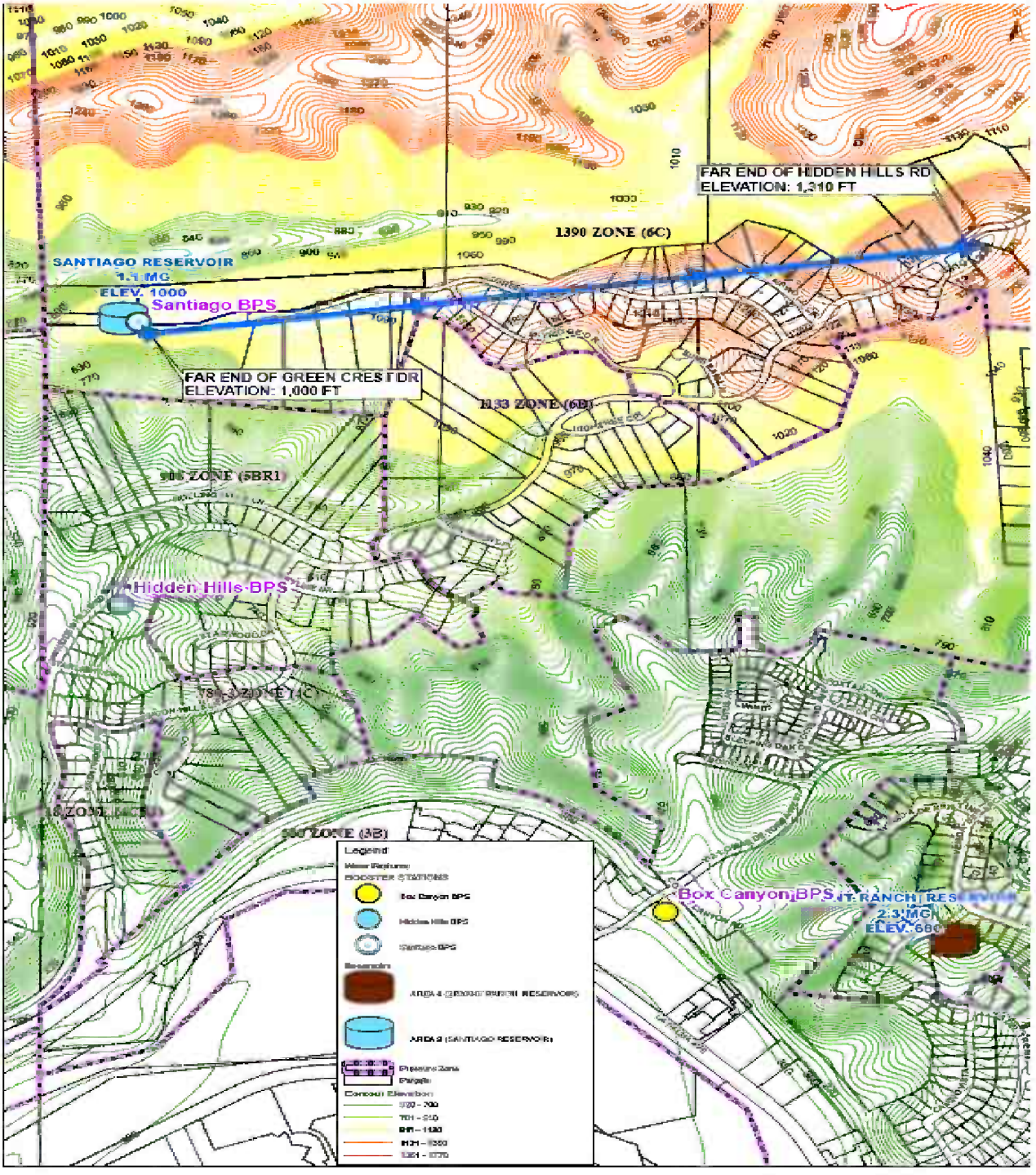


Exhibit "D" – Hidden Hills Contour Elevation Map



Yorba Linda Water District

Exhibit "E" – Boil Water Advisory

For Immediate Release (addendum to the earlier press release)
November 15, 2008

WATER QUALITY ADVISORY

Due to the continuous drop in water pressure as a result of the fire-fighting efforts to extinguish the fire, the Yorba Linda Water District has issued a boil order of tap water to the residents located at:

Hidden Hills Estates ---ONLY,
in Yorba Linda, specifically the following streets:

• Hidden Hills Road	**• Green Mount Place**
• Hidden Glen Lane	**• Rolling Hills Drive**
• Fairwood Circle	**• Skyline Drive**
• Greencrest Drive	**• Starwood Place**
• Sun Beam Lane	**• Starlight Drive**
• Sky Ridge	**• Westwood lane**
• High Tree Circle	**• Brentwood**
• Crescent Drive	
• Mission Hills	

Methods of Disinfection
Chlorination: Add 1/8 teaspoon (~0.75 mL) of unscented household chlorine bleach to one gallon of clear water and mix. If the water is cloudy, add 1/4 teaspoon (~1.50mL) and mix. Chlorine bleaches are inexpensive and can be secured from most grocery, discount, or drug stores. However, check the label to ensure that the active ingredient, sodium hypochlorite, is 5.25 percent .

Wait thirty (30) minutes after adding chlorine before using the water for drinking or cooking purposes.

Boiling: The water used for drinking and cooking may also be purified by boiling. In this method, bring the water to a full boil for at least one (1) minute (at altitudes above one mile, boil for three minutes). Cool and aerate the boiled water by pouring it through the air from one clean container to another, or mixing rapidly with a clean utensil. Aeration will reduce the flat taste caused by boiling.

Water purification tablets may also be used by following
the manufacturer's instructions.

NOTE: Water filtering or treatment units may not remove all of the contaminants that the advisory or notice is targeting.

Failure to follow this advisory could result in stomach or intestinal illness.

The Yorba Linda Water District will notify residents as soon as can be determined that
the water is safe to drink.

For more information call YLWD at 714 701-3000 or 714 701-3100

California Department of Health Services: 714 558-4997 or 714 547-0430

Exhibit "F" – Reverse 911 Message

"Hello, this is Michael Payne, General Manager of the Yorba Linda Water District with a water quality and safety alert. The Yorba Linda Water District in conjunction with the California Department of Public Health has determined all Yorba Linda Water District water is safe to drink right out of the tap. As a safety precaution residents in a small portion of the Yorba Linda Water District service area Hidden Hills had been notified to boil tap water for drinking or cooking purposes. That order went into effect November 15 but has now been lifted. Again, all Yorba Linda Water District water is safe to drink right out of the tap. I also caution residents not to operate or tamper with fire hydrants. The District inspects and tests all fire hydrants annually. Improper operation can cause severe injury or death. It can also damage the water system. Thank you for allowing us to serve your community."

PROBOLSKY RESEARCH

STRATEGIC MEMORANDUM

TO: Michael A. Payne
Yorba Linda Water District

FROM: Adam D. Probolsky
Probolsky Research LLC

SUBJECT: Water Alert Message Broadcast Calls

DATE: November 20, 2008

On Thursday November 20, 2008 Probolsky Research delivered water alert message broadcast calls on behalf of the Yorba Linda Water District (YLWD) to District customers. Out of 17,414 phone numbers that were dialed, 13,404 received the message either via answering machine or a live person answering the phone (representing a 77% message completion rate). The following graph illustrates a detailed distribution of activity:

STRATEGIC MEMORANDUM

Exhibit "G" – Area of Significant Structure Damages (Overall Map) (Attached)

Exhibit "G-1" – Area of Significant Structure Damages (West) (Attached)

Exhibit "G-2" – Area of Significant Structure Damages (Central) (Attached)

Exhibit "G-3" – Area of Significant Structure Damages (East) (Attached)

Orange County Fire Authority

After Action Report
Freeway Complex Fire

November 15, 2008

A Report to the
Orange County Fire Authority
Board of Directors

FREEWAY COMPLEX FIRE

AFTER ACTION REPORT

November 15, 2008

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Foreword

On November 15, 2008, our communities were impacted by what ultimately became one of the largest wildland fires ever to strike Orange County. The Freeway Fire, which started in the City of Corona on the border of Riverside and Orange Counties, was driven by fierce Santa Ana winds. It spread quickly on a massive fire front, causing widespread damage in the cities of Yorba Linda, Anaheim, and Corona, as well as to Chino Hills State Park. The fire merged with a second one-the Landfill Fire, that had started in the Carbon Canyon area. This caused further damage in the City of Brea and community of Olinda Village, ultimately threatening Chino Valley and driving into Los Angeles County, where it menaced the City of Diamond Bar. Miraculously, no lives were lost or major injuries occurred during this wildland/urban conflagration. However, 381 structures belonging to residents of all impacted jurisdictions were damaged or destroyed by these fires.

The Freeway Complex Fire tasked our fire and law enforcement personnel to extremes. They courageously fought to protect lives and as many homes as possible that were lying in the path of this fast moving firestorm. Ultimately, thousands of homes were saved. I am extremely proud of the heroic work of our fire and law enforcement personnel, the coordination among the many jurisdictions threatened by the fire, and the gallant efforts of hundreds of residents during and after this disaster.

Many of the homes saved were the result of fire-resistant construction features that had been put in place in recent years. The majority of the homes claimed by the fire were built prior to the newer wildland urban interface building requirements. In most cases, these homes succumbed to fires caused by the intrusion of embers driven by fierce winds. Like paper confetti thrown into a fan, these embers rained down on our communities well ahead of the fire.

This was not the first time a fast moving wildfire burned through these communities. In 1980, driven by Santa Ana winds, the Owl Fire (October 28, 1980) and the Carbon Fire (November 16, 1980) burned in the same areas. The difference 28 years later, with regard to structures taken by the fire, is the number of homes now located within this historic fire corridor.

As with any disaster, the lessons learned from this event will help better prepare our communities for the future as we collectively confront the all-too-frequent occurrence of these destructive "mega-fires." The Orange County Fire Authority's and my own renewed commitment is to (1) find additional measures we can implement to better protect our communities from these types of fires, (2) work continually toward enhancing our local capabilities to respond to major incidents of this type, and (3) find new ways for the residents in our communities to help.

Respectfully,

Chip Prather
Fire Chief


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Executive Summary

In what has become a year-round occurrence for California firefighters, the 2008 fire season was one of the worst in the state's history—scorching roughly 1.4 million acres. It began in May when dry lightning storms in Northern California sparked over two thousand wildfires. In the fall of 2008, wildland fires threatened Southern California when the Santa Ana winds battered the region.

As the winds raised the temperature and lowered the humidity, the first of several significant wildland-urban interface fires began on October 12, 2008: the Marek Fire. Occurring in the Lakeview Terrace area of Los Angeles County, this fire consumed nearly 5,000 acres, destroyed 40 homes, and damaged 9 others. Then on October 13, the Sesnon Fire began in the Porter Ranch community of Los Angeles County. By the time it was contained, almost 15,000 acres had been scorched and 26 residences had been damaged or destroyed.

The fire siege continued in November as the Santa Ana winds returned. A moderate wind event had been forecasted for November 13–15 in the Southern California region. On the evening of November 13 at approximately 6:00 p.m., an unattended campfire sparked a blaze that was driven by 70 mph winds into the cities of Montecito and Santa Barbara. Known as the Tea Fire, it consumed nearly 2,000 acres and over 230 homes, as well as evacuating nearly 9,000 residents.

On November 14 at 10:29 p.m., only one day later, the fast-moving Sayre Fire broke out in Los Angeles County. Driven by 60 mph Santa Ana winds, it ripped through the northern San Fernando Valley burning all in its path. By the time the fire was controlled, 11,262 acres had been seared and more than 600 structures had been destroyed, including 480 mobile homes at the Oakridge Mobile Home Park. The *Los Angeles Times* called it "the worst loss of homes due to fire in the city of Los Angeles" and reported it "appeared to be the largest number of housing units lost to fire in the city of Los Angeles, surpassing the 484 residences destroyed in the 1961 Bel Air Fire."[1]

Due to extreme weather conditions and increased fire activity, the Orange County Fire Authority (OCFA) implemented an emergency staffing pattern on November 15. Additional resources—including one Type 3 strike team, a second helicopter, and increased personnel on engine companies located in the wildland interface areas—were put in place for the third day of strong Santa Ana winds.

On Saturday, November 15 at 9:01 a.m., the Corona Fire Department received the initial report of a vegetation fire at the westbound 91 Freeway and Green River: the Freeway Fire. Within minutes, the OCFA began receiving reports of the fire at its Emergency Command Center. Driven by hot Santa Ana winds in excess of 60 mph, combined with 8 percent humidity and long-range spotting of one mile or greater, this fire would cause the most catastrophic loss of homes in Orange County since the Laguna Fire in 1993.

The Freeway Fire marched quickly to the west and through the Green River Homes community, spotting far ahead of the main fire. From the onset, it was apparent this would become a rapidly

[1] Tami Abdollah and Howard Blume. November 16, 2008. *Schwarzenegger calls for review after Sylmar tragedy as blazes rage on*, Los Angeles Times. Accessed http://www.latimes.com/news/local/valley/la-me-firemain17-2008nov17,0,2305426.story on January 14, 2009.

spreading and significant conflagration. One hour after it was reported, erratic winds drove the fire in several directions, including north into the Chino Hills State Park, south across the 91 Freeway towards the City of Anaheim, and west into the hills of Yorba Linda. The fire then turned to the northwest, impacting the communities of Carbon Canyon and Diamond Bar.

At 10:43 a.m. on November 15, the OCFA Emergency Command Center received a report of a second fire: the Landfill Fire. This one was located in the area of the Olinda Alpha Landfill, near Valencia Avenue and Carbon Canyon. Fanned by the wind, it spread quickly toward the cities of Brea and Diamond Bar and the 57 Freeway. Borrowing resources from the Freeway Fire, the OCFA and the Brea Fire Department dispatched crews to fight the new threat. Around 5:30 p.m. on November 16, the decision was made to merge the Landfill Fire and the Freeway Fire into a Complex, due to their geographical proximity. By merging the two into the Freeway Complex Fire, it allowed for the sharing of incident management and logistical support and provided a single base of operations for continuity and efficiency.

The Freeway Complex Fire was contained on November 19, 2008, at 7:00 a.m. after consuming over 30,000 acres and impacting six cities in four counties. This was the largest fire in Orange County, since the Green River Fire in 1948. During the final stages of the fire, control lines were secured and aggressive restoration action and recovery efforts were initiated to protect burned areas from flooding and debris flows due to the winter rains.

The fire burned 30,305 acres and damaged or destroyed over 381 homes, commercial structures, and out-buildings. Numerous vehicles, city parks, and sensitive ecological areas in the Chino Hills State Park and the Santa Ana River riparian area were also damaged or destroyed. The impact to residents and businesses from smoke exposure or damage, as well as the economic impact, is difficult to calculate.

To date, the cost for fighting the Freeway Complex Fire is approximately $16.1 million. As a result of the Local Government Fiscal Responsibility Agreement made between OCFA, CAL FIRE, and FEMA/OES, the OCFA will be responsible for a percentage of the cost of fighting the fire on the first day. After reimbursement is received from federal and state resources, the OCFA cost share responsibility is approximately $33,000.

Thankfully, no deaths or serious injuries to residents or firefighters were attributed to the fire; however, 14 firefighters suffered minor injuries. At its height, the Freeway Complex Fire forced as many as 40,000 people from their homes across the four impacted counties: Orange, Los Angeles, Riverside, and San Bernardino.

A unified command and strong coordination between fire and law enforcement was the key to evacuating large numbers of residents and animals in the path of this rapidly burning fire. The efforts of firefighters and citizens and the existing fire prevention measures—those requiring defensible space, non-combustible roofs, fuel modification zones, and ignition resistant construction—were the major factors in saving hundreds of homes.

Ultimately, over 3,800 personnel from more than 260 fire agencies—with over 650 fire engines—were assigned to the incident. The Brea Police Department, which was tasked with large-scale evacuations over a widespread area as well as traffic and crowd control, received assistance from various Southern California law enforcement agencies. Approximately 375 officers from 19 local

police agencies, along with deputies from the Orange County Sheriff's Department, Los Angeles County Sheriff's Department, Riverside County Sheriff's Department, and the Department of Homeland Security responded to the call. The incident was managed by a unified command structure, which included the OCFA, Los Angeles County Fire Department, CAL FIRE, Corona Fire Department, Brea Fire Department, Anaheim Fire Department, Chino Valley Fire District, and the Orange County Sheriff's Department.

While the Freeway Complex Fire presented the OCFA with several difficult challenges, other factors contributed to its complexity. These included several years of drought that increased available dead fuels and lowered live fuel moistures resulting in intense fire behavior and burning conditions. The two fires—the Freeway and the Landfill—started less than two hours apart and placed a great demand on emergency response resources. The topography and the east-west alignment of the Santa Ana Canyon—together with offshore winds—resulted in extremely rapid fire spread, long-range spotting due to flying embers, large-scale evacuations, and the difficult task of deploying resources to protect lives and property over a broad and unpredictable area.

A number of the conclusions in this After Action Report point to things that went well such as OCFA's advance planning and additional staffing for the extreme weather conditions throughout the region. Additionally, OCFA's ongoing fire prevention efforts contributed directly to saving thousands of homes, by providing firefighters with defensible space to protect threatened structures. Other conclusions illustrate areas that can be improved or should be reviewed for follow-up action with the appropriate agency or policy group.

The recommendations contained in this report are intended to help the OCFA better prepare for this type of disastrous wildland fire in the future and improve local capability and surge capacity where possible. Some of these recommendations will require further study, review, and cost analysis to determine the feasibility of implementation. Others are no cost items to implement, or require follow-up action with the appropriate agency or group.


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Historical Information

The Santa Ana Canyon has an extensive wildland fire history. The canyon's geographical location plays a major role in directing wildland fire into Orange County. Since 1980, the Santa Ana Canyon area has experienced 25 separate wildland fires, burning a total of 82,734 acres with the events ranging from 1 to 19,986 acres. Until the recent Freeway Complex Fire, the most notable and devastating events have been the 1980 Carbon Canyon Fire (14,613 acres), the 1980 Owl Fire (18,332 acres), the 1982 Gypsum Fire (19,986 acres), and the 2006 Sierra Peak Fire (10,506 acres).

The Santa Ana Canyon's steep topography and east-west alignment serve as a wind funnel. The geography increases the wind's speed and magnifies the effects of fire on the available fuel bed, contributing to the rapid rate of fire spread. Additionally, the encroachment of civilization into the wildland-urban interface (WUI) enhances the severity of wildland fires during Santa Ana wind conditions. The frequency of fire in this area has allowed non-native vegetation of volatile grass, weeds, and shrubs to become the dominant fuel type.

One particular fire of interest is the 1980 Owl Fire—given that several parallels can be drawn between it and the Freeway Fire. The weather, fuel conditions, and point of origin of the two were jarringly similar. Both fires began as Southern California was experiencing Santa Ana wind conditions. The forecast for the Owl Fire was for continued strong, dry winds blowing 15 to 50 mph with gusts to 60 mph. At the start of the Freeway Fire, wind speeds were sustained at 43 mph with gusts of 61 mph and extremely low humidity. The Owl Fire began on October 28, 1980, at 1:47 a.m. near Highway 71 and Prado Dam in Riverside County. The Freeway Fire started in nearly the same area on the north side of the 91 Freeway at Green River. Both fires, fanned by strong Santa Ana winds and fed by dry fuels, quickly burned into Chino Hills and marched west into Orange County.

The Santa Ana Canyon's steep topography and east-west alignment serve as a wind funnel—increasing the wind's speed and contributing to the rate of fire spread.

Initial Response

The Owl Fire After Action Report states, "The first arriving fire unit on scene reported the fire at five acres in size moving out." The fire's radio traffic was being monitored then by what was known as the Orange County Fire Department's Emergency Command Center. "Although the fire was over two miles away from the Orange County line, all who heard the report on conditions knew the potential that existed: historically, Orange County seems to be the recipient of major wildland fires that start outside its boundaries." Immediately, plans were put into effect to place resources ahead of the Owl Fire's arrival into Yorba Linda.

Familiar with the area's fire history, OCFA Battalion Chief Reeder ordered two Type 1 engine strike teams to stage at Fire Station 53 in Yorba Linda in anticipation that the Freeway Fire would eventually reach the City. However, after hearing requests for resources in Corona, the two strike teams responded to the 91 Freeway and Green River. Prior to arriving on scene, Chief Reeder also ordered fire attack aircraft.

Fire Behavior

As the 1980 Owl Fire's progress was monitored, it became obvious "this was a major fire and that it was spotting as much as a half-mile ahead of itself" and "thick volumes of smoke obscured the actual location of the fire line, further hampering firefighting efforts." Reports from the fire crews on the fire line "showed that the fire was gaining momentum and consuming at least 1,000 acres per hour. At 3:30 a.m. there was little doubt that no amount of effort would stop this blaze before it reached the highly populated areas of Orange County: this fire was going to hit the extreme eastern edge of Yorba Linda very, very hard."

This same extreme fire behavior was observed during the 2008 Freeway Complex Fire. The strong winds kept the thick column of smoke from rising. Instead, it stayed close to the ground, making it extremely difficult to see the fire's perimeter and progression. OCFA Helicopter 41 reported seeing spot fires from one to one and a half miles ahead of the fire front. These same winds pushed the Freeway Complex Fire at an incredible rate of spread. **Historical Information – Map 1** shows over 10,000 acres were consumed in the first 12 hours—roughly 14 acres per minute. That's nearly the length of 14 football fields every 60 seconds.

The Freeway Complex Fire consumed over 10,000 acres in the first 12 hours—roughly 14 acres per minute. That's nearly the length of 14 football fields every 60 seconds.

Divided Fronts

The Owl Fire divided into two distinct fire fronts primarily due to wind and topography. One burned in a northwesterly direction into "Aliso Canyon in a largely uninhabited area, and never became a major problem." The second and main fire front continued towards Orange County, pushed by 50 mph winds.

The Freeway Fire also traveled in two different directions. One front headed in the direction of Chino Hills State Park, the cities of Yorba Linda and Chino Hills, and the community of Sleepy Hollow in Carbon Canyon. The other followed the Santa Ana River, crossed the 91 Freeway, and moved into the City of Anaheim.

Staging Areas

To prepare for the fire front's arrival, resources dispatched to the Owl Fire were staged in eastern Yorba Linda. "As the fire ate its way towards Yorba Linda, strike teams began positioning themselves along streets in the interface area … all of this complicated by smoky conditions so severe that it caused smoke detectors in many homes to activate." The fire arrived battering the area at the east end of La Palma Avenue and Esperanza Road and along the east side of Dominguez Ranch Road at about 11:00 a.m. This was nearly nine hours after the start of the fire. In 1980, these roads formed the eastern border of Yorba Linda. "Firefighters, along with residents that had elected to remain behind to hose down their roofs, were hit with a blinding gale of choking smoke and showers of burning embers."

By comparison, during the Freeway Fire, resources were ordered to stage at Station 53 located within the eastern border of Yorba Linda in anticipation of the threat. At about 10:00 a.m., the fire

was burning near the river bottom along the Green River Golf Course. At 10:08 a.m., OCFA Helicopter 41 reported a large spot fire one mile ahead of the main fire front. Immediately, additional engine strike teams, aircraft, and helicopters were ordered to augment the resources protecting the city. Additional orders were given at 10:20 a.m. to notify the Brea Police Department to begin evacuations in the area of Brush Canyon. The OCFA Emergency Command Center also telephoned the Yorba Linda City Manager. A message was left notifying him that the fire was now heading toward his city and would arrive in 30 minutes. At 10:39 a.m.—31 minutes later, the fire was threatening the communities of Big Horn and Evening Breeze. This occurred approximately 90 minutes after the start of the fire and less than 30 minutes since the report of the spot fire. The first structure fire was reported at 10:58 a.m. on Merryweather Circle—about three miles from the point of origin.

Fire Containment

The Owl Fire was 100 percent contained on October 30, 1980, at 5:00 a.m. after burning 18,832 acres and destroying 3 homes. Over 136 engines and 790 firefighters, along with 4 helicopters, battled the fire for two days to bring it under control. The Owl Fire After Action Report credits the subsiding winds for the ability of firefighters to stop the progression of the fire. Refer to the **Owl Fire After Action Report** at http://www.ocfamedia.org/_uploads/PDF/ofaar.pdf for more details.

The Freeway Complex Fire was declared under control on November 19, 2008, at 7:00 a.m. after consuming 30,305 acres and destroying 187 homes. More than 650 engines and 3,800 firefighters, with 17 helicopters and 12 air tankers, succeeded in keeping the loss of homes from being much worse.

Although the number of acres consumed is very different for each fire, what is rather striking is the final "footprint" or fire perimeter of both fires. **Historical Information – Map 2**, both followed the geographical contours as they were driven by the strong winds through the Santa Ana Canyon, resulting in nearly identical burn perimeters.

More than 650 engines and 3,800 firefighters, with 17 helicopters and 12 air tankers were assigned to the Freeway Complex Fire.

Summary

Traditionally, the fire season in Southern California has been from May through September. Over the past 15 years, a trend has emerged where Orange County—and Southern California—has experienced some of its most devastating wildfires from October through April. In fact, two major fires in Orange County in the past six years have occurred in February: the 2006 Sierra Fire and the 2002 Green Fire. Another occurred in March: the 2007 Windy Ridge Fire. Most recently, the Santiago Fire occurred in October 2007.

In the two-month period of October and November 2008, Southern California experienced several significant wind events sparking multiple wildfires. Five of these became major incidents resulting in thousands of acres burned, numerous homes destroyed, and countless people displaced. These fires shared several common denominators, including (1) Santa Ana winds; (2) competition for resources due to multiple, simultaneous fire activity throughout Southern California; and (3)

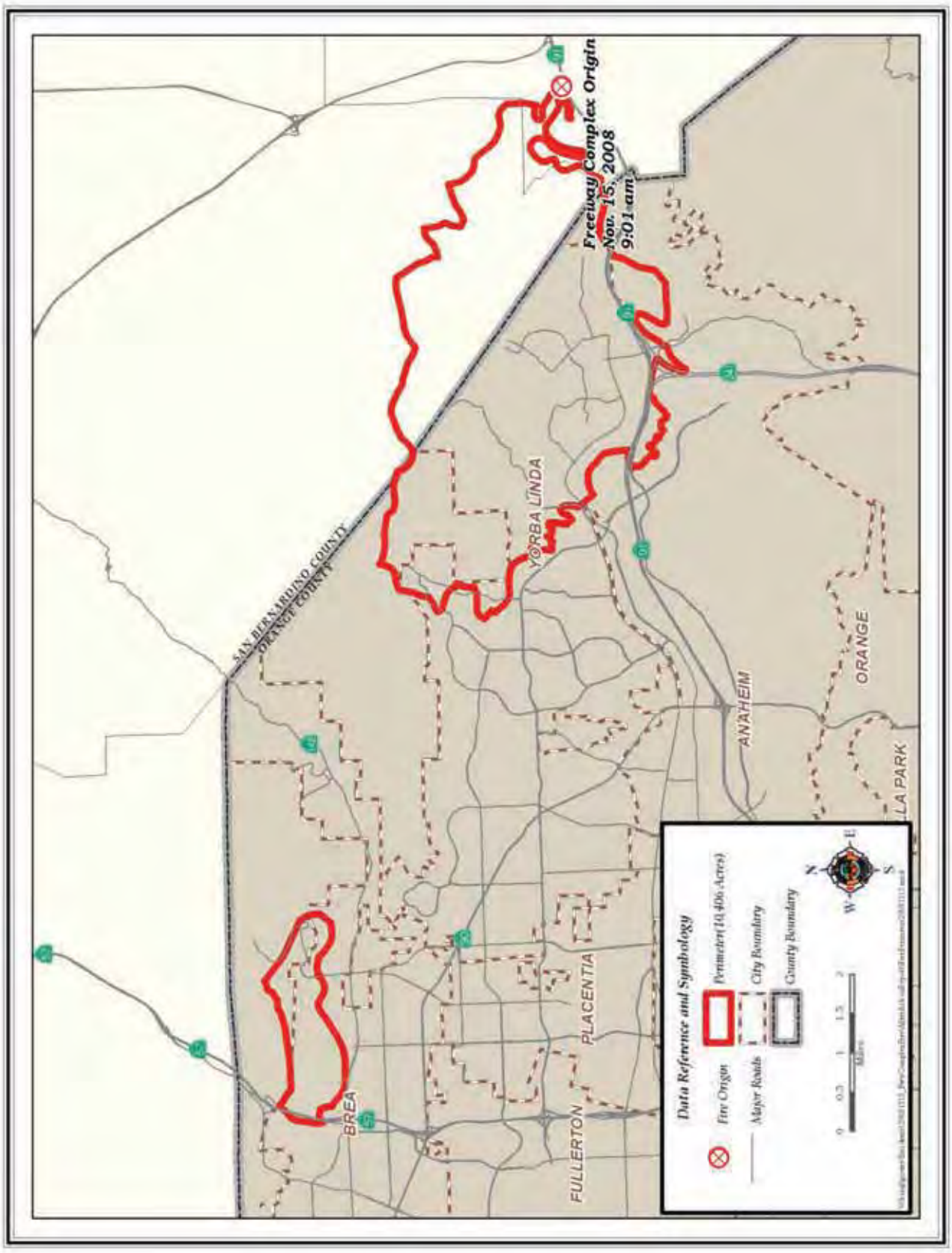
wildland fire occurrence late or outside the traditional fire season.

Over the past 60 years, Orange County has experienced a number of major wildland fire disasters. Table 1: Sixty-Year Major Fire History—Orange County, lists selected Orange County wildland fires that covered large geographic areas, burned out of control for an extended period of time, and/or resulted in extraordinary property loss—homes, businesses, and valuable watershed. The Freeway Complex Fire was the largest wildland fire in terms of acreage—over 30,305 acres—the OCFA has faced in the past 40 years. The fire was one of the most challenging and complex due to the rapid rate of spread, wildland-urban interface (WUI) encroachment, vast evacuations, and sustained Santa Ana winds.

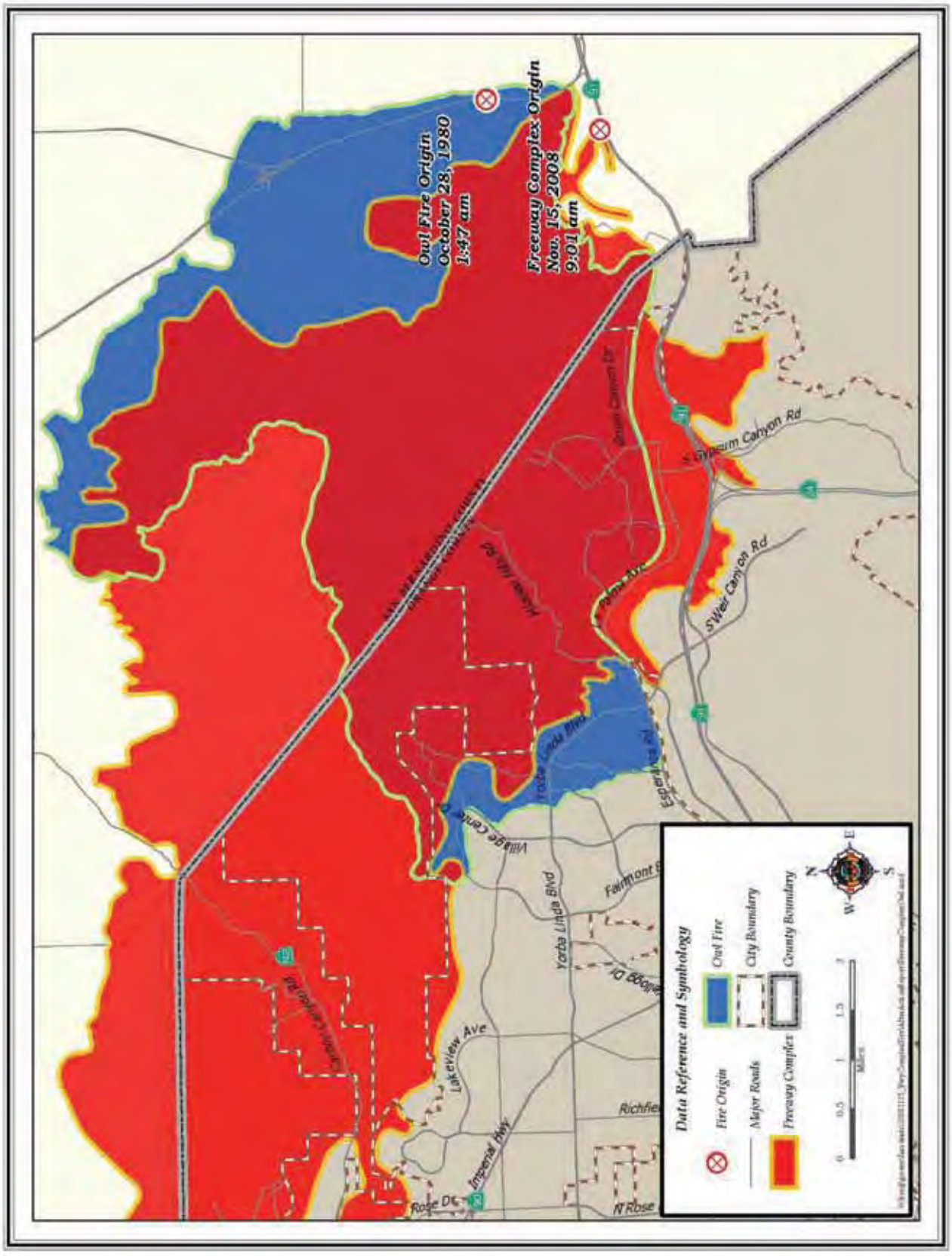
Table 1: Sixty-Year Major Fire History—Orange County

INCIDENT YEAR	INCIDENT NAME	ACRES CLAIMED	COUNTY(IES) INVOLVED
1948	Green River	53,079	Orange
1958	Steward	69,444	Orange/San Diego
1967	Paseo Grande	51,075	Orange/Riverside
1980	Indian	28,408	Orange/Riverside
1980	Owl	18,332	Orange/Riverside
1982	Gypsum	19,986	Orange
1993	Laguna	16,682	Orange
1993	Ortega	21,010	Orange
2007	Santiago	28,517	Orange
2008	Freeway	30,305	Orange/Riverside/San Bernardino/Los Angeles

Historical Information – Map 1
Freeway Complex Fire—12-Hour Perimeter 11-15-08 9:00 p.m.



Historical Information – Map 2
Owl Fire and Freeway Complex Fire—Fire Perimeter Overlay



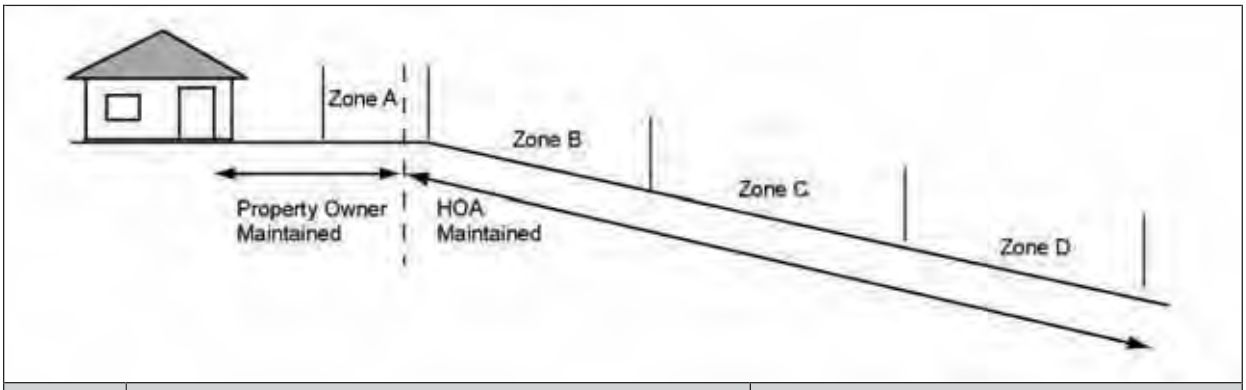
Fire Prevention

Land use planning and fire prevention play a key role in reducing the wildfire threat to communities in the wildland-urban interface (WUI). To adequately protect communities in WUI areas, a combination of brush clearance measures, ignition resistant construction of structures, and community preparedness and participation is necessary.

Brush Clearance

In 1979, Orange County adopted "fuel modification" provisions for new developments to protect homes in the WUI. The OCFA has enforced these requirements ever since. The provisions and requirements are also included in the local ordinances of the 22 cities protected by OCFA. Homes constructed in Yorba Linda since 1980 are most likely protected by a fuel modification program.

Table 2: OCFA Fuel Modification Program



ZONE	REQUIREMENTS	PURPOSE
A	• 20 feet wide and on level ground • Landscaped with approved plants • No combustible construction permitted	Limits direct flame impingement on structures and deflects radiant heat
B	• Minimum of 50 feet wide • Irrigated and landscaped with approved plants	Slows fire and reduces intensity
C/D*	• Minimum of 50 feet wide for each zone • All dead and dying materials are removed • Native vegetation thinned 50% in Zone C and 30% in Zone D	Slows fire and reduces intensity

*Some older areas may *only* have a Zone C.

The fuel modification program for OCFA communities requires the creation of a minimum of 170 feet of irrigated and non-irrigated zones and setbacks. Landscaping should include a selection of appropriate plant palettes for each zone. This is unlike State law that requires 100 feet of clearance—or to the property line if 100 feet is not available.

The OCFA fuel modification program also differs from State law by containing provisions to ensure adequate space is available to protect structures before building permits are issued. If 170

feet is not available, the landowner must either (1) obtain dedicated, legal off-site easements from the adjacent property owner or (2) mitigate the lack of defensible space with construction features that can withstand the anticipated radiant heat. Requirements for on-going maintenance are also included in the property deed and/or homeowner association by-laws.

Homes constructed in the WUI prior to 1980 are required to maintain "defensible space" between the home and the property line separating it from the WUI. Defensible space is less prescriptive than fuel modification and consists of thinning vegetation and ensuring tree branches are not within ten feet of chimneys.

Although fuel modification and defensible space provisions are typically applied at the perimeter of a development—the "edge" of the WUI, homes on or near interior slopes are also at risk. The vegetation in these areas should also be managed to reduce the risk of home loss from fires.

Arrow pointing to an overgrown interior slope prior to the Freeway Complex Fire

Arrow pointing to the same slope after the Freeway Complex Fire showing the tragic loss of homes along the ridge

The provisions for fuel modification and defensible space have evolved over the past 30 years. Although proven effective in protecting communities during wildfire incidents, the provisions are not without implementation challenges. The most significant of these is maintenance.

Maintenance of Brush Clearance

The OCFA does not have a formal WUI inspection program. As a result, if areas are not properly maintained and irrigated by the responsible landowner, overgrowth and/or plant death may occur. OCFA staff attempts to identify the worst cases and work with landowners to restore the land to an approved condition. In Yorba Linda, this is complicated since most fuel modification areas are on individual properties managed by a single homeowner. This is unlike most of Orange County where fuel modification zones are owned and maintained by a homeowners' association.

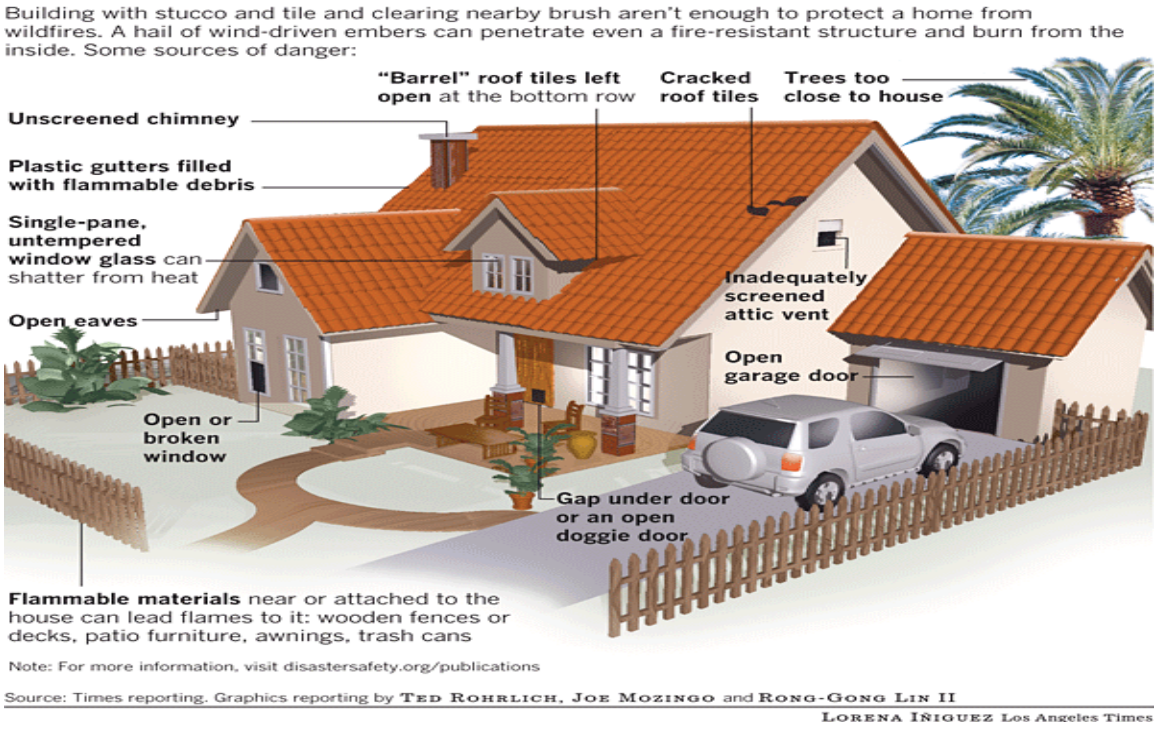
Despite the lack of a formal program, OCFA determined both the 2007 and 2008 fire seasons posed a significant enough risk to revise priorities and put efforts toward mitigation of this risk. Due to the severity of drought conditions and anticipated fire activity in 2008, the OCFA conducted inspections of all WUI properties in its jurisdiction. In Yorba Linda, the OCFA inspected the 589 parcels that are part of the defensible space program: homes/neighborhoods developed before 1979. The OCFA found only 16 out of compliance with minimum requirements

for defensible space. Additionally, 794 fuel modification parcels were inspected to ensure they were in "substantial compliance" with provisions of the post-1979 formal fuel modification program requirements. Of those inspected, 325 needed some type of corrective action. Prior to the start of the Freeway Fire, all but 25 had met the minimum requirements.

Ignition Resistant Construction

Properly established and maintained brush clearance is typically very effective in protecting homes from direct flame impingement and radiant heat. However, it does not provide additional protection from ember intrusion. Homes must be constructed to withstand ignition from embers that land on homes or enter through attics and other openings.

Illustration 1: How Fire-Resistant Homes Can Burn



The damaged or destroyed homes in Yorba Linda had many of the more traditional features that protect homes from flames and radiant heat. In some cases, these features are also effective in protecting homes from embers. However, in a wind driven fire storm, additional protection is necessary.

Following the disastrous 1993 Laguna Beach Fire, the Orange County Board of Supervisors commissioned a report to assess the damage and make recommendations to minimize the impact of future wildfires. The subsequent report, written in 1995, contained development requirements, including water supply, street design, brush clearance—current fuel modification provisions were found adequate, and construction features to "harden homes" from wildfire.

These requirements became effective January 1, 1996, as local amendments to the California building and fire codes that went into effect that date. The application of the requirements was limited to those County areas and cities that chose to adopt the Very High Fire Hazard Severity Zones mapped by CAL FIRE. Although Yorba Linda chose not to adopt the CAL FIRE maps, the

City Council did adopt and apply the local amendments in designated areas, referred to as Special Fire Protection Areas (SFPA).

Recently, the California legislature determined homes were not adequately protected since structure losses from wildfire continues to grow. Pursuant to that finding, the legislature charged the Office of the State Fire Marshal (OSFM) to take action to reduce the impact of future fires. The OSFM worked with stakeholders and University of California (UC) Berkley's fire lab to develop new "ignition resistant" building standards and material testing criteria. These standards—which dictate construction methods for roofs, eaves, vents, walls, doors, windows, and patio covers and decks—apply to all homes constructed in "Very High Fire Hazard Severity Zones" or locally designated wildland-urban interface areas, beginning in January 2008.

Homes must be constructed to withstand ignition from embers that land on homes or enter through attics and other openings.

Orange County has not received the final Very High Fire Hazard Severity Zone designation maps for adoption by the City of Yorba Linda. The County anticipates the maps will be released later in 2008. In the interim, the regulations are applicable in the SFPA adopted by the City in 1996. Many construction requirements of that 1996 ordinance are similar to the new statewide standards. Notably, improvements relative to application and protection of walls and vents were made to the new provisions. **Fire Prevention – Table 4** shows a comparison of OCFA's current requirements to the regulations adopted by the State Building Standards Commission in 2006, effective in 2008.

Access and Water for Firefighting

Brush clearance and "hardened"—ignition resistant—homes go far to increase the chances for a home's survival from a wind-driven WUI fire. However, intervention by firefighters is often necessary in saving a home determined to be defensible. Thus, emergency access and water availability play an integral part in aiding firefighters in these efforts.

OCFA's Planning and Development Services Section reviews all plans for new development to ensure adequate access and water supply is provided in accordance with the City-adopted Fire Code. Like all California jurisdictions, State law requires Yorba Linda to adopt the California Fire Code (CFC). The City adopted the 2007 edition in that same year.

Local amendments present in the CFC since 1996 require 28-foot wide roadways in high fire hazard areas, as well as a minimum of two ways into all communities with 150 or more homes.

The CFC also requires all structures to be within a specified distance to an "approved" water supply. An "approved" water supply can be defined by the adopting jurisdiction, or the jurisdiction may choose to adopt the water supply provisions found in Appendix B of the CFC. At OCFA's recommendation, Yorba Linda adopted the Appendix B provisions. One table specifies the water supply, known as "fire flow," based on the square footage of the structure and the construction type. Fire flow is comprised of the flow volume (gallons per minute [gpm]), residual pressure (pounds per square inch [psi]), and duration of flow (in hours). Another table indicates the number of fire hydrants that must supply this fire flow and their spacing relative to protected structures. (See the **OCFA Fire Master Plans for Commercial and Residential Development** at http://www.ocfa.org/_uploads/pdf/guideb09.pdf for additional CFC details.)

Using these tables, a typical street with homes not exceeding 3,600 square feet would be protected by hydrants that deliver 1,500 gpm each for a minimum of 2 hours at 20 psi residual pressure. For homes between 3,600 and 4,800 square feet, hydrants must deliver 1,750 gpm for 2 hours at 20 psi residual pressure. Locally adopted amendments require hydrant spacing of 300 feet along the street.

Getting water for structure protection

During the Freeway Fire, the demand for water by the structure protection engines exceeded the available supply. Areas of Yorba Linda, such as Hidden Hills, had loss of water pressure during which firefighters had to shuttle water from other areas. As defensible space and ignition construction have been studied over the years, so to have been the water needs in the WUI. New standards have been drafted and are available for local adoption.

Fire "Losses" and "Saves"

Although 117 homes were destroyed and another 77 were damaged—as well as 27 out-buildings and 22 vehicles, **Table 3** below shows the losses were a small percentage of the structures and vehicles threatened within the fire perimeter/evacuation zone. This was due to a combination of brush clearance, home construction, and aggressive firefighting.

Table 3: Fire Losses and Structures Saved Within the City of Yorba Linda

Category	Residential		Commercial/Industrial		Other	
	Total No.	Percentage of Total (%)	Total No.	Percentage of Total (%)	Vehicles	Out-Buildings
Threatened	9,525	100.00	126	100.00	N/A	N/A
Destroyed	117	1.22	0	0.00	45	10
Damaged	77	.80	2	1.59	22	27
Saved*	9,331	97.96	124	98.00	NA	NA
Dollar Loss	Structures: **$84,361,455** Contents: **$39,989,500** Total: **$124,350,955**					

*Does not include damaged structures considered as partial "saves." *Based on OCFA Fire Incident Reporting Data.*

An assessment of homes destroyed or damaged indicates they were victims of ember intrusion rather than direct flame impingement—suggesting brush clearance was adequate. The exceptions were instances where embers ignited one home and then burned the homes on either side in "cluster burns," which continued until firefighters stopped the spread.

Although the burned homes were somewhat "hardened" to embers, the construction was not adequate for the conditions presented with this fire. Embers entered homes—mainly through attics—as they penetrated roofs through the ends of barrel-shaped clay tiles, loose flashing at roof/wall interfaces, grooves at roof valleys, and combustible rain gutters—particularly those containing plant debris. Embers also entered attics through unprotected eaves and attic vents.

Several homes were lost to embers gathering under unprotected—exposed wood underside—balconies or wooden decks and patio covers. Once these ignited, the flames burned through walls and entered homes.

Notably, all the homes damaged or destroyed were constructed prior to 1996. Thus, they were not protected by the CFC provisions required by the City's ordinance for WUI areas. However, the homes in Casino Ridge met the requirements of the 1996 ordinance. They were also protected by a relatively new fuel modification program. Firefighters stated they were able to focus resources and efforts on other areas of the city as this community was developed to withstand a wildfire with little firefighting intervention.

Challenges

The application of (1) ignition resistant construction requirements and (2) brush maintenance requirements are both critical to the survivability of homes subjected to intense heat and ember intrusion—even those located hundreds of feet from the interface. Although proven effective in protecting communities during wildfire incidents, these requirements are not without implementation challenges. The most significant are:

Fire front approaching the Casino Ridge community

Maintenance of Fuel Modifications

Fuel modification requirements in communities developed after 1980 and brush clearance measures in those developed prior to 1980 must be maintained to be effective. Currently, OCFA does not have a formal inspection and enforcement program to ensure the over 14,000 parcels and lots are adequately maintained. As a result, areas can become overgrown and, in some instances, irrigation can be lacking due to cost or poor maintenance of water lines. OCFA staff attempts to identify the worst cases and work with landowners to restore the land to an approved condition. Due to the lack of penalties for failure to comply, sometimes several parcels/lots remain out of compliance for several years. This presents a hazard to community homes and adjoining lands.

> The most significant challenge is protecting the areas established prior to current fuel modification and construction requirements.

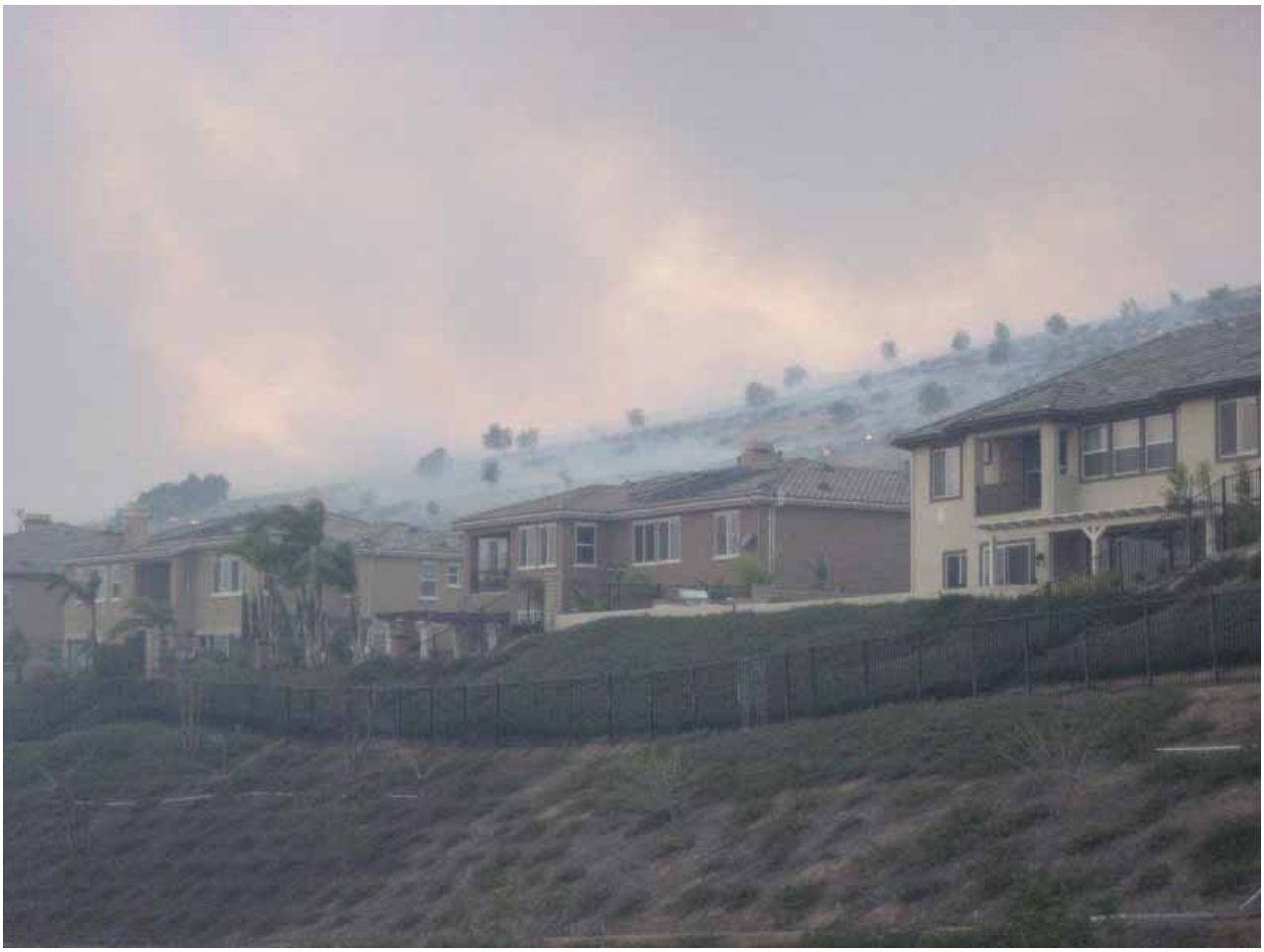
Application of Construction Requirements

Applying ignition resistant construction requirements is critical to the survivability of homes subjected to ember intrusion both at the interface and within a few hundred feet of the interface. Maps depicting impact areas must be locally adopted. This process is often controversial, since the development community typically expresses concern over rising costs, real estate disclosure, and insurance premiums. As a result, areas needing protection—based on topography, fuels, weather, and fire history—are often left unmapped due to local action/inaction.

Existing Communities

The most significant challenge is protecting the areas established prior to current fuel modification and construction requirements. The pre-1980 established areas lack adequate brush clearance, and

some have home lots that are too small to create adequate defensible space on the property. Homeowners often cannot obtain permission for off-site clearance from neighbors or government entities. Environmental restrictions also hinder the ability to create defensible space. State and Federal agencies have conflicting missions with the fire service relative to control of native vegetation, although this was not the case during the 2008 inspection cycle.



Casino Ridge area of Yorba Linda with current fuel modifications and construction requirements

Fire Prevention – Table 4
Comparison of Current OCFA Requirements and New State Regulations

California Building Code Requirements for "Hardening Homes" *Indicates more restrictive requirement if not equivalent.	
Former Yorba Linda Ordinance (January 1996–January 2008)	**New State Code (July 2008)**
Applies to structures located in Very High Fire Hazard Severity Zones and Special Fire Protection Areas that are within 100 feet of fuel modification zones. Most provisions apply only to structures having an exposed side. Exposed side is defined as an exterior wall of a structure within 100 feet of the fuel modification zone.	Applies to all structures located in Very High Fire Hazard Severity Zones and locally designated Wildland Fire Areas. All exterior sides—not just the exposed sides—shall meet the requirements of Chapter 7A.*
Exterior Wall: Exposed side of exterior wall shall be of non-combustible construction or 1-hour fire-resistive construction for the exterior portion.	**Exterior Wall:** Shall be of approved non-combustible or ignition resistant material or heavy timber.
Glazed Openings: Shall be multi-glazed with at least two panes.	**Glazed Openings:** Shall be tempered glass or glass block or have a fire resistive rating of not less than 20 minutes.*
Doors: Shall be minimum 1 3/8 inches thick solid core or metal non-combustible.	**Doors:** Shall be non-combustible or solid core or 20-minutes rated.
Attic Vents: Not allowed on exposed sides. Other sides must be protected by metal louvers and 1/4-inch mesh corrosion-resistant metal screen. Vents shall not exceed 144 sq. inch per opening.*	**Attic Vents**: Shall be covered with 1/4-inch corrosion-resistant metal screen; no size limit.
Eave or Cornice Vents: Not allowed on exposed sides.	**Eave or Cornice Vents**: Prohibited unless they can resist the intrusion of flame and burning embers into the attic.
Roof Valley: Flashing shall not be less than 26 gauge galvanized sheet installed over a 36-inch under layment consisting of one layer of No. 72 ASTM cap sheet running the full length of valley.	**Roof Valley**: Flashing shall not be less than 26 gauge galvanized sheet installed over a 36-inch under layment consisting of one layer of No. 72 ASTM cap sheet running the full length of valley.
Roof Gutters: Shall be provided with means to prevent accumulation of leaves and debris.	**Roof Gutters**: Shall be provided with means to prevent accumulation of leaves and debris.
Roof Assembly: New construction and reconstruction shall be fire retardant Class A roof assembly.	**Roof Assembly**: New construction and reconstruction shall be fire retardant Class A roof assembly.
Skylights: Shall have a non-combustible frame with dual glazing of heat strengthened or fully tempered glass or 3-rated assembly.*	**Skylights**: No requirements
Roof Covering: Where roof profile allows a space between roof covering and roof deck, the space shall be fire stopped with approved material or have one layer of No. 72 ASTM cap sheet installed over the combustible decking.	**Roof Covering**: Where roof profile allows a space between roof covering and roof deck the space shall be fire stopped with approved material or have one layer of No. 72 ASTM cap sheet installed over the combustible decking.
Decking: Those on exposed side to be 1-hour rated, non-combustible or heavy timber.	**Decking:** Specific requirement for decking surface shall be of ignition resistant material, heavy timber, or non-combustible material.
INTENTIONALLY LEFT BLANK	Ignition resistant material definition provided: Tested according to ASTM 84 for 30 minutes.
INTENTIONALLY LEFT BLANK	Flame spread less than 25 with evidence of no progressive combustion.

Advance Planning

Although a Red Flag Warning was not in effect for Orange County on November 15, 2008, it was in other Southern California counties. Due to these warnings, CAL FIRE requested a special staffing pattern be implemented across the region. The OCFA asked CAL FIRE to approve the staffing enhancements for implementation on November 14, 2008. The following staffing pattern was approved by CAL FIRE and in place the morning of November 15:

- One Type 3 strike team with four-person staffing—five engines and a Chief Officer
- The staffing of a second helicopter
- The increased staffing of five engine companies in the wildland interface areas—from three firefighters each to four—referred to as the "Grey Book" stations
- An additional fire dispatcher at the Emergency Command Center

A conference call with CAL FIRE, USFS, and multiple county fire agencies was conducted at 9:00 a.m., November 15. OCFA's Assistant Chief Kramer and Division Chief Fleming, the OCFA Duty Officer, attended the meeting. A briefing on the status of the Tea and Sayre fires was provided, as well as current weather for Orange and other counties. The forecast for Orange County did not include a Fire Weather Watch or Red Flag Warning. In fact, the predicted winds for the local area were supposed to be relatively light—diminishing by 2:00 p.m. that day. OCFA routinely monitors weather forecasts and takes appropriate action. When extreme winds and red-flag conditions do exist, the OCFA implements procedures established by Operations SOP 209.13, *Extreme Weather Plan Winds/Red Flag & Rain/Floods*.

As a cooperating member of the California Fire and Rescue Emergency Mutual Aid Plan, the OCFA committed three strike teams of engines out-of-county prior to the start of the Freeway Fire. The mutual aid system is founded on the principle of neighbor helping neighbor. When an emergency overwhelms an agency's ability to manage it on its own, other fire departments voluntarily provide resources, if possible. The system allows for an orderly escalation and distribution of resources.

Additionally, neighboring Orange County MetroNet fire agencies had committed four strike teams of engines to the Tea and Sayre fires, including an OES engine strike team. A total of 35 fire engines and 7 strike team leaders from the OCFA and other County fire agencies were assigned to fires outside the County at the start of the Freeway Fire.

As OCFA resources are committed on a mutual aid response, personnel are recalled to staff relief engines to ensure adequate station coverage. All OCFA stations vacated due to the deployment of units outside the County were covered either through the use of backfill (ten engines) or by the on-coming shift personnel (five engines). **Table 5** shows the commitment of strike teams on November 14, 2008, by the OCFA and MetroNet Out-of-County Strike Teams.

Table 5: OCFA and MetroNet Out-of-County Strike Teams
November 14, 2008

Fire	Strike Team	Day/Time Committed
Tea	ORC Strike Team 9328C and XOR Strike Team 1421A and 1422A	November 13, 2008
Tea	OES Strike Team 1830C, including one OCFA engine (OES-E303), as part of OES Type 1 strike team (1830C)	November 13, 2008, 11:47 p.m.
Tea	ORC Strike Team 1400A	November 14, 2008, 3:55 a.m.
Sayre	ORC Strike Team 1402A	November 15, 2008, 12:40 a.m.
Sayre	XOR Strike Team 1423A	November 15, 2008

Pre-planning for emergency events is routine for the OCFA. Operational plans exist or are under development for many high-risk areas. A few weeks prior to the Freeway Complex Fire, a tabletop exercise was conducted to bring stakeholder agencies (OCFA, LACO, Corona Fire Department, CAL FIRE RRU/BDU, San Bernardino CFD, Chino Valley IFD, Anaheim Fire Department, Orange Fire Department, USFS, and South Operations) together. The goal was to develop and review operational plans for the wildland-urban interface area along the 91 Freeway corridor. The exercise provided chief officers the opportunity to consider a variety of events to better understand fire progression and fire spread potential. Decision trigger points and a course of action were also developed for each event. This tabletop exercise proved to be highly beneficial; some of the first responding chief officers to the Freeway Fire had been exercise participants.

One trigger point and its course of action was demonstrated through by OCFA Battalion 2 while en-route to the fire. Based upon the radio traffic from the initial attack crews, Battalion 2 ordered two strike teams to report to OCFA Station 53 in east Yorba Linda. This was done to get ahead of the fire and place additional engines into Yorba Linda, which was in the direct path of the rapidly advancing fire from Corona.

When the Department Operation Center opened at 11:30 a.m., the call back of off-duty personnel was initiated to get all available relief and surge apparatus in-service.

As the request for resources at the fire increased, the OCFA needed to begin staffing uncovered fire stations, relief, and surge apparatus. When the Department Operation Center (DOC) opened at 11:30 a.m., staff was tasked to initiate the call back of off-duty personnel and to get all available relief and surge apparatus in-service as soon as possible. Battalion Manpower Coordinators were organized to handle the hundreds of telephone calls necessary to meet this goal. The majority of necessary staffing was achieved within eight hours. By 10:00 p.m. November 15, all critical staffing needs had been met.

On Sunday, November 16—with continued Santa Ana winds along with multiple fires burning in Southern California and the potential for area resource drawdown—the Duty Officer ordered all suppression personnel be held on duty. This action increased manpower available to staff emergency apparatus from normal daily staffing of 253 personnel to 462 suppression personnel. By noon on Sunday, all personnel who were not required were released.

In addition to the extra engines that were staffed by full-time firefighters, OCFA reserve firefighters staffed ten patrols, three squads, four water tenders, one helicopter support unit, and five engines. These units were assigned to stand-alone Reserve Stations 3, 11, 14, and 16 and combination Station 23. The staffing level in the Emergency Command Center (ECC) was augmented with two additional dispatchers and one additional dispatch supervisor. One Division Chief and two Staff Captains were recalled to begin staffing the DOC.

The advance planning accomplished early Friday, November 14, prior to the Freeway Fire and the following staffing actions proved to be key in OCFA's ability to engage the fire. As the fire rapidly spread into neighborhoods in east Yorba Linda and Anaheim Hills, the OCFA was still able to sustain response coverage for other portions of its service area.

Emergency crews from throughout the state respond to the request for mutual aid


FIRE
ORANGE COUNTY
CALIFORNIA
AUTHORITY
Est. 1995

Incident Narrative

Summary

The following is a chronological perspective of the firefighting efforts that took place in the cities of Corona, Yorba Linda, Anaheim, Brea, Chino Hills, and Diamond Bar on November 15 through 19, 2008. The event is now known as the Freeway Complex Fire. This report is as accurate and complete as possible. Since the specifics of this incident are complex and it occurred so rapidly, the actions of every fire company, the events that took place in every community, or the circumstances that surrounded every loss cannot be described in detail. Personnel from all ranks and assignments were interviewed, hundreds of documents were reviewed, and several hundred radio transmissions were listened to in the development of this narrative.

Though it started as a wildland urban interface fire, the Freeway Complex Fire quickly became an urban conflagration. Destroyed structures included 203 residences, 2 commercial structures (one in Yorba Linda and one in Brea), and 17 out-buildings. Damaged structures included 117 residences, 6 commercial structures, and 36 out-buildings. In total, 30,305 acres of watershed were consumed across six cities and four counties. Suppression costs exceeded $16.1 million, and property loss has been estimated at nearly $150 million.

Preplanning

The Freeway Complex Fire occurred in a designated mutual threat zone. The original vegetation fire in this jurisdictionally contiguous area received initial attack responses from multiple agencies, including the OCFA (ORC), Corona Fire (COR), Anaheim Fire (ANA), CAL FIRE, and the United States Forest Service (USFS). The high degree of coordination behind this emergency response was not accidental. Three weeks prior to the incident, a tabletop exercise scenario was conducted with these and other area responders. Predicted fire spread, values at risk, operational trigger points, communications, and other related issues were discussed and modeled. This tabletop exercise was greatly responsible for some of the quick decision making behind early resource ordering, including additional engine strike teams and aircraft.

The Freeway Complex Fire destroyed or damaged approximately 320 residences, 8 commercial structures, and 53 out-buildings.

Based upon the predicted weather patterns, which included strong Santa Ana winds and low humidity for the weekend, the OCFA had placed a special staffing pattern into effect on Friday, November 14, 2008. To prepare for the weather pattern, the OCFA had one Type 3 engine strike team (ORU 9329C), consisting of five wildland engines and a Chief Officer (Hawkins), staged at the OCFA Regional Fire Operations and Training Center (RFOTC). In addition to ORC Helicopter 41 (HC41) that was already on duty, ORC Helicopter 241 (HC241) was staffed with a pilot and crew chief. Also, five fire engines located at stations near wildland areas were up-staffed from three firefighters to four. An additional dispatcher was also added to the Emergency Command Center (ECC).

A day earlier, on November 13, ten engines from the OCFA (ORC Strike Team 1400A and ORU Strike Team 9328C) were sent to the Tea Fire in Santa Barbara County. In addition, the Office of

Emergency Services (OES) engine strike team based in Orange County was activated. It was sent to the Tea Fire along with three Type 1 engine strike teams from non-OCFA fire departments in Orange County. At 12:40 a.m. on November 15, five additional OCFA engines (ORC Strike Team 1402A) were sent to the Sayre Fire in Los Angeles County. Prior to the start of the Freeway Fire, all vacancies created within OCFA fire stations by these deployments were filled.

Day 1 - November 15, 2008

At 9:01 a.m. on November 15, the Corona Fire Department (COR) received reports of a vegetation fire on the north side of the 91 Freeway, east of Green River Drive. COR Dispatch sent units, including a Battalion Chief (COR B3 [Samuels]) and three engines (COR BR1, BR3, and E2).

At 9:03 a.m., the OCFA ECC received the first of many 911 calls reporting the same fire along the north side of the westbound 91 Freeway east of Green River Drive. The first caller reported the fire to be approximately one-half acre but building rapidly. Subsequent calls gave varying descriptions and locations, indicating to the dispatchers the fire was moving rapidly west along the freeway toward the Green River Golf Course. **Incident Narrative – Map 3** shows the point of origin of the Freeway Complex Fire

The ECC entered a *High Watershed Dispatch* into the Computer Aided Dispatch (CAD) system at 9:07 a.m., sending units to the fire's reported location. This initial dispatch was comprised of the following:

- One Division Chief (ORC D5 [Fleming])
- Three Battalion Chiefs (ORC B2 [Reeder], ORC B3 [Aubrey], and ANA B1 [Pilar])
- Seven, single increment engines (ORC E10, E15, E53, and E832 and ANA E8, E9, and E10)
- One ORU Strike Team 9329C (ORC B27 [Hawkins]; ORC E247, E250, E307, E318, and E339)
- Two hand crews (ORC Crew 1 and Reserve Crew 18)
- Three helicopters (ORC HC41 and HC241; OCSD Duke)
- Two patrols (ORC P10 and P32)
- One fire bulldozer (ORC Dozer 2)
- Three water tenders (ORC W7, W10, and W16)

In **Table 6**, Freemont Canyon RAWS indicated responding personnel had to contend with mild temperatures of 75°F, low relative humidity of 8 percent, and strong east/northeast winds sustained at 43 mph, gusting up to 61 mph. Winds were higher than expected based on the recent National Weather Service (NWS) predictions and morning briefing on statewide fire conditions.

Freemont Canyon RAWS

Table 6: Freemont Canyon RAWS—Santa Ana Mountains

Time	Temperature (°F)	Wind Speed/Gust Speed (mph)	Relative Humidity (%)
9 a.m.	75	43/61	8
3 p.m.	80	25 /45	7

ORC Battalion 2 (Reeder) was on the initial dispatch and, while responding to the fire, was monitoring the radio traffic of the COR units already on the scene. At 9:19 a.m., Battalion Chief Reeder relayed to the ECC that COR units were on scene and reporting an immediate threat to structures. Battalion Chief Reeder requested two Type 1 engine strike teams—ten engines and two Chief Officers—stage at OCFA Station 53 in Yorba Linda; this anticipated the fire's possible move into Orange County. He also requested fixed wing aircraft—air tankers—be dispatched.

The first order for air tankers was placed at 9:19 a.m. They were dispatched at 9:35 a.m. and arrived over the fire at 10:10 a.m.

The order for aircraft was placed by the OCFA ECC to the CAL FIRE Perris ECC; however, the order was not immediately filled. Shortly before 9:12 a.m., COR Dispatch contacted CAL FIRE Perris ECC and discussed the need for ground resources and a helicopter. Air tankers were not ordered by COR Battalion 3 (Samuels) when the initial equipment request was made. When Chief Reeder's order was delivered to CAL FIRE Perris ECC, there was some confusion regarding the actual need for fixed wing aircraft. More calls between COR Dispatch and CAL FIRE Perris ECC resulted in confirmation for the air tanker request only after COR E5 was reported to be surrounded by fire. The air tankers were dispatched at 9:35 a.m. out of San Bernardino Airport. The first air tanker arrived at 10:10 a.m.

A minute after Battalion Chief Reeder made his requests, Anaheim Fire Engine 10 (ANA E10) reported COR was on scene. Approximately one acre of grass was burning along the north side of the 91 Freeway. At 9:21 a.m., two strike teams from OCFA were dispatched to stage at Fire Station 53. ORC Strike Team 1403A included ORC Battalion 44 (Cruz) and ORC E8, E23, E34, E35, and E53. ORC Strike Team 1404A included ORC Battalion 7 (Whitaker) and ORC E27, E31, E38, E55, and E826. While en-route to Station 53, the strike team leaders heard the requests for immediate need resources and diverted to the City of Corona with the hope to help stop the fire there. This decision left the original request unfilled—to have two strike teams stage at ORC Station 53.

Palm trees show how strong the wind blew during the fire

COR Battalion 3 (Samuels) arrived on scene about the same time and assumed the Freeway Fire Incident Command. This information was provided to the ECC at 9:23 a.m. and was relayed to responding units. ANA Battalion 1 (Pillar) arrived a few minutes later and was assigned Structure Protection Group (SPG) responsibility. Around 9:30 a.m., Pillar placed an order to the Incident Commander for three additional engine strike teams—15 engines.

Firefighting resources arriving on scene experienced Santa Ana winds blowing between 40 to 60 mph. Homes located on Penny Royal Drive and Feather River Road in Corona were identified by ORC Battalion 2 (Reeder) as immediately threatened. Units on scene attempted to take tactical positions to best facilitate structure protection. Incident Commander Samuels faced a rapidly escalating wind-driven wildland fire that was extending into a nearby residential neighborhood. With limited resources on scene, he directed a flanking attack on the wildland fire. With assistance coming from CAL FIRE – Riverside County, the United States Forest Service (USFS), and Orange County, the opportunity for control was hopeful.

Approximately 9:27 a.m., a tragedy almost occurred when COR E5 became surrounded by fire and experienced a burn-over event. When the Freeway Fire began, COR E5 was on scene of a medical aid in a neighborhood less than a mile away. Once COR E5 cleared the medical call, it contacted COR Dispatch and was assigned to the fire. COR E5 chose to access the fire from a service road between the fire origin and the threatened homes. This decision put COR E5 in a dangerous position between the main fire and the threatened homes, with unburned vegetation between the crew and the fast moving head. Within minutes, the COR E5 Captain radioed they were being overrun by fire and were unable to escape. COR BR1, supported by multiple water drops from ORC HC41 and HC241, rescued the trapped firefighters and averted a tragedy. This event resulted in minor burns and smoke inhalation to two firefighters assigned to COR E5. **Incident Narrative – Map 4** is a map showing the near miss entrapment.

By 9:30 a.m., CAL FIRE Battalion Chief Deyo arrived on scene and briefly spoke with the Incident Commander. He also met with CAL FIRE Battalion Chief McBride, who had been sent to the fire as the CAL FIRE Agency Representative. Chief Deyo was directed to assume the role of Operations Section Chief for the Freeway Fire. Subsequently, he conducted a reconnaissance of the fire and established control objectives.

During Chief Deyo's reconnaissance, radio communication problems between agencies on two different radio systems became critical. CAL FIRE was operating on the statewide VHF frequencies, while COR, Anaheim Fire, and OCFA units were operating on their 800 MHz radios. Operating on a single compatible radio system is the safest and most preferred communication methodology. ANA Battalion 1 (Pilar) provided Chief Deyo with an 800 MHz portable radio, enabling him to communicate with other command-level personnel. Later that day, Orange County Communications (OCC) was asked to initiate a patch between the VHF and the 800 MHz systems to establish one common command frequency.

Aerial view of the fire's path along the Green River Golf Course and homes bordering the Santa Ana River riparian.

Around 9:30 a.m., the OCFA ECC became the Central Ordering Point for the fire. This was done to ensure all resource orders for personnel, supplies, and equipment were properly placed and tracked. The effectiveness of the central ordering point is crucial to the success of the fire control efforts. As the need grew, resource orders were entered into the Regional Ordering Support System (ROSS), which allowed access to firefighting and support resources from multiple regions in Southern California.

Shortly after assuming the Central Ordering Point responsibility, an order for additional aircraft was placed to South OPS. Orders for engine strike teams, hand crews, and bulldozers would soon follow. A recent change in the resource ordering rules, which was a result of lessons learned in the 2007 fire siege, allowed for 5 engine strike teams—25 engines—to be directly requested from neighboring mutual aid regions. These 25 engines from the CAL FIRE – Riverside County immediately responded without processing delays. Around 10:30 a.m., the first of these strike teams arrived at the fire. The others arrived around noon.

The first ORC fire engine arrived in Corona and moved into the fire area at 9:23 a.m. The fire was uncontrolled and unpredictable. In response, ORC Battalion 3 (Aubrey) directed ORC E27—assigned to ORC Strike Team 1404A—to take independent action upon arrival. Indicating the fire was moving rapidly, the threat to structures was such that individual company officers had to rely on their situation to dictate tactics and operational priorities. This is a departure from desired and normal command and control strategy, but it necessary when confronted with a wide and rapidly progressing fire front. For the next 30 minutes, resources responding into Corona were directed into the threatened residential areas between the fire origin and the Green River Golf Course.

OCFA helicopter makes a water drop over fire

The fire was bordered by a golf course, an active river, and a multi-lane freeway. All set up the best potential containment opportunity for the Freeway Fire. Unfortunately, at 10:00 a.m., a spot fire was reported west of the Green River Golf Course. Hand crews and bulldozers were staged nearby and quickly encircled the spot, containing it to a small area. At 10:08 a.m., while returning to the golf course to pick up a load of water, ORC HC241 noticed another spot fire west of the golf course, approximately 1.1 miles from the nearest burning structure. In less time than it took for HC241 to snorkel a load of water from the golf course pond—about 45 seconds, this spot fire, coupled with the topography and the wind, headed at high speed for the City of Yorba Linda. HC241 attempted to slow the fire by dropping its load of water, but the impact was negligible. When interviewed, a helicopter crew member described the water drop as "a thimble of water in a firestorm." **Incident Narrative – Maps 5 and 6** are maps showing the multiple spot fires caused by erratic fire behavior.

ORC Division 5 (Fleming) arrived on the scene at 10:05 a.m. and proceeded to establish a unified command with Chief Officers from COR, CAL FIRE, Anaheim Fire, and Chino Valley Independent Fire District. The location of this initial command post, established at 10:12 a.m., was at the Jack in the Box parking lot at Crest Ridge and Green River Drive, Corona.

The BNSF railcars left on tracks were not threatened by fire and did not contain any hazardous cargo.

While firefighters were working near the railroad right-of-way, Burlington Northern Santa Fe (BNSF) Railroad was requested to stop all rail traffic through the fire area as a safety precaution. The outcome of the request inadvertently resulted in several railcars being abandoned on the tracks, prompting concerns from citizens and firefighters that some railcars may have been carrying hazardous materials. OCFA Safety Officer Hutnyan was sent to the area and tasked to examine the situation. He quickly determined the railcars were not directly threatened by fire and, in fact, did not have hazardous cargo. The railcars were eventually removed from the area by BNSF employees.

At 10:10 a.m., Air Attack and the first fixed wing air tanker were reported to be flying over the fire. This began the coordinated air assault to protect homes along the wildland interface. It also began establishing perimeter control lines to help direct the fire's spread away from other inhabited areas. Air assets would prove to be critical in establishing these control lines and protecting firefighters and threatened structures. In total, 17 firefighting helicopters flew approximately 108 hours and dropped in excess of 278,357 gallons of water. Twelve fixed wing air tankers and four lead airplanes fueled and re-supplied out of Hemet Ryan and San Bernardino Air Bases, flew approximately 110 hours and dropped 308,435 gallons of retardant on the fire. This figure includes the work of Tanker 910 (DC-10 aircraft). It made ten drops—eight on November 15 and two on November 16—in the Yorba Linda/Chino Hills area for a total of 109,445 gallons of retardant.

At 10:20 a.m., ORC Battalion 2 (Reeder) reported the fire would reach the city limits of Yorba Linda within 30 minutes. Recognizing the threat to Yorba Linda, Battalion Chief Reeder placed an immediate need request for four more Type 1 engine strike teams—20 engines and 4 Chief Officers—to stage at OCFA Station 53 in the City of Yorba Linda. He also requested the Brea Police Department and the City of Yorba Linda be notified of the impending arrival of the fire. They were to start evacuations. Battalion Chief Reeder predicted the fire would impact homes located in the Brush Canyon community within map page 741 grids E4, F4, and G5 (Thomas Brothers 2009 Edition). The ECC made contact with the Brea Police Department and City staff shortly thereafter.

Although a collaborative decision, the responsibility for evacuation is statutorily a law enforcement function. This allows fire departments to focus on control efforts. The number of citizens who evacuated at any one time in any single area of the City is unknown; however, nearly 9,000 dwellings were impacted in Yorba Linda by the evacuation order as a result of the Freeway Complex Fire. At the height of the firefight, an estimated 24,000 citizens of Yorba Linda were evacuated or kept from returning to their homes due to safety concerns.

Evacuations Underway

At the onset of the evacuation, traffic gridlocked in some areas as emergency apparatus tried to enter the neighborhoods while residents tried to exit. The Brea Police Department and other assisting law

enforcement agencies took control of the traffic flow, which helped firefighters gain access to threatened homes. In any firefighting effort, rescue is the first priority. However, in this case, resident self-evacuation was in effect assuring rescue from an active fire front would be minimized. Notably, with such an expansive and escalating evacuation boundary, the residents stayed calm and followed evacuation directions. Throughout the morning, reports of orderly—but slow—evacuations were relayed to the ECC.

ORC Assistant Chief 2 (Kramer) responded to the fire at 10:23 a.m. Assistant Chief Kramer assumed the role of ORC Incident Commander as part of the unified command. The responsibility of the Operation Section Chief position for the Freeway Complex Fire was assigned to ORC Battalion 2 (Reeder). To provide strong leadership and incident management, the fire area was divided into manageable geographical and functional areas of responsibility. The highest level of these responsibilities were branches, of which two were initially established for the Freeway Complex Fire. Branch I was the Yorba Linda Branch assigned to ORC Division 5 (Fleming) and included all structure threats in Yorba Linda. Within the Branch, smaller geographical divisions and functional groups were established. Several Structure Protection Groups were tasked first to protect those homes at the greatest threat of burning and second, wherever possible, to extinguish already established fires in structures, vehicles, and vegetation. **Incident Narrative – Map 7** shows a map of the Freeway Complex Fire Branch and Division boundaries.

Branch II was assigned to CAL FIRE Battalion Chief Deyo, who initially had been assigned Operations Section Chief when the fire was in Corona. Branch II included the wildfire control efforts that eventually burned through the Chino Hills State Park. This front raced into the City of Chino Hills through Tonner and Carbon Canyons to the Los Angeles County line—burning into the city limits of Diamond Bar. Divisions Y and Z were established within Branch II. The primary objective focused on establishing perimeter control to minimize the spread of the fire. Battalion Chief Deyo also faced the challenge of ensuring firefighting efforts were continuing in Corona, while trying to release as many resources back to Orange County.

With the fire burning out of Aliso Canyon and backing into Brush Canyon, it now headed toward Big Horn Mountain Way, Blue Ridge Drive, Merryweather Circle, Evening Breeze Drive, Pine Meadow Way, Camino de Bryant, Kodiak Mountain Drive, and Brush Canyon Drive. Any available fire units were moved to these and other threatened neighborhoods. The Operation Section Chief (Reeder) placed a call to the ECC ordering 20 engine strike teams—100 engines—of various configurations. Orange City Division Chief Eichoff assumed the Yorba Linda Structure Protection Group from ORC Battalion 3 (Aubrey), who was assigned to assist Branch I. Division Chief Eichoff recognized the community of Hidden Hills was going to be overrun by the fire and instructed unassigned units to move there.

With the fire advancing into the City of Yorba Linda, the Operations Section Chief ordered an additional 20 engine strike teams—100 engines and 20 Chief Officers.

At 10:43 a.m., a 911 caller reported a second fire to the ECC. This one was burning near the Olinda Alpha Landfill, located off Valencia Avenue near Carbon Canyon. The Brea Fire Department (BRE) confirmed they were responding to a fire reported near the landfill. The OCFA sent a modified high watershed dispatch response, including:

- Two Battalion Chiefs (ORC B23 [Phillips] and B8 [Wells])

- Four engines (ORC E47, E62, E223, and E817)
- One medic unit (ORC M26)
- Two patrols (ORC P23 and P26)

The same wind that was driving the Freeway Fire into Yorba Linda was now pushing the new fire through the east through the City of Brea toward Diamond Bar and the 57 Freeway. Brea Fire units arrived on scene at 10:49 a.m. and reported a one-acre fire moving quickly. ORC Battalion 8 (Wells) arrived on scene at 10:55 a.m. He reported the fire in Brea was two to three acres adjacent to the Olinda Alpha Landfill. He also reported there was a direct threat to structures and ordered three Type 1 engine strike teams—15 engines—and air support. Battalion Chief Wells assumed the Landfill Fire Incident Command and initiated communications with BRE units.

Within minutes, Battalion Chief Wells made contact with BRE Battalion Chief Montoya. A unified command, along with three structure protection groups, was established for the Landfill Fire. Additionally, units were assigned to begin perimeter control efforts. The highest concern was the Landfill Fire would eventually cross the 57 Freeway and destroy the homes west of it. The command post was subsequently moved to Brea Fire Station 3 at the intersection of Lambert Road and Kraemer Boulevard.

About 10:50 a.m., ORC Wildland 1 (Ewan) arrived at the Freeway Fire. To gauge the direction and speed of the wildland fire, he attempted to flank it and get far enough in front to predict its path. Ewan later reported he was unable to drive fast enough to keep up with the fire spread, which at times was estimated to be over 1,000 acres per hour. Motorists driving west on the 91 Freeway reported that at speeds of 50 mph, they were unable to stay ahead of the fire's main body.

The first two strike teams into Yorba Linda, XOR ST1424A (Espinoza) and XOR ST1425A (Hirsch), arrived about 10:56 a.m. They deployed along Alpine Lane, Big Horn Mountain Way, and Blue Ridge Drive. Facing fires driven by wind gusts up to 70 mph, these two strike teams and dozens of others moved from neighborhood to neighborhood throughout the day and into the night.

The Freeway Fire crossed the city limits of Yorba Linda at 10:58 a.m., destroying its first of hundreds of homes in Orange County. After racing through Brush Canyon, the fire burned the residence at 27185 Merryweather Circle before fire crews were able to mount a defense. At the same time, ORC HC241 reported seeing small fires in the area of the Black Gold Country Club. This was several miles downwind from the main body of the Freeway Fire and upwind from the Landfill Fire. Due to the location of the fires, HC241 reported these as new fires, not spot fires from either the Freeway Fire or the Landfill Fire. With a water drop from HC241, golf course personnel were able to contain the small spots with garden hoses. **Incident Narrative – Map 8** shows a map of the first homes impacted by the Freeway Fire in Yorba Linda.

At the same time, the ECC received multiple reports of a fire on the hillside below the Robert Diemer Water Filtration Plant. ORC E9, E37, and E61 and Staff 2 were deployed to that location. ORC E61 arrived at 11:13 a.m. and reported that this appeared to be a new vegetation fire. In less than 30 minutes, the units on scene were able to get the fire under control. These units were then redeployed to the Freeway Fire.

In Branch II, CAL FIRE Division Chief Toups was assigned Division Y at 11:30 a.m. Chief Toups was tasked to determine where control lines could be established and how firing operations might

be used to provide containment. Highway 71 was to be a key holding point, wanting to keep the fire south of Aliso Canyon. By noon, the wind had pushed the fire well past Aliso Canyon, heading for Chino Hills State Park and the thousands of acres of vegetation that would subsequently be consumed before any control was attained.

The fire moved through residential neighborhoods from Brush Canyon to the San Antonio neighborhood—a 5.5 mile span in less than five hours.

As the fire progressed into Yorba Linda and grew to be a threat to more neighborhoods, the unified command also grew. The unified command for the Freeway Fire now included representatives from OCFA, CAL FIRE, Corona Fire, Chino Valley Independent Fire District, Anaheim Fire, and the Brea Police Department.

The unified incident commanders established initial control objectives, which were to hold the fire east of Aliso Canyon and Yorba Linda Boulevard, south of North Ridge Trail, and north of the 91 Freeway. Initial objectives also were to evacuate east of Yorba Linda Boulevard and La Palma Avenue and to establish a Chino Hills State Park Contingency Plan.

Ember shower in advance of flame front.

In Yorba Linda, decorative vegetation, palm trees, and even ground cover on center medians served to fuel the fire's progression. Embers were driven into attic vents, underneath roof tiles, and into any unprotected openings. Firefighters employed a firefighting tactic known as "bump and run"— moving from home to home and street to street after knocking down visible fire. Dispatchers continued to relay reported structure threats to the Operations Section Chief, and available units were deployed.

With every major incident or disaster, the OCFA Department Operations Center (DOC) is activated. The DOC supports the needs and demands of the incident, directs the recall of personnel, coordinates the backfill of apparatus, and monitors other operational needs. At 11:30 a.m., ORC Division 3 (Robinson), who had assumed the Duty Officer assignment from Chief Fleming, arrived at the ECC. The DOC was activated and staffed by noon. Once opened and staffed, incident communications and incident ordering was moved into the DOC. As soon as was possible, Fire Management Activity Grants (FMAG) were submitted to the State of California Office of Emergency Services (OES) for each fire. Both were subsequently approved, thereby establishing reimbursement criteria for the cost of fighting the fires.

A primary function of the DOC was to ensure available relief apparatus were staffed and made available for emergency response and/or station coverage. The paramedic engine reconfiguration procedure was implemented. Twelve advanced life support (ALS) paramedic engine companies were divided and then reconfigured to either (1) a basic life support (BLS) engine company or (2) a paramedic assessment engine company (PAU), plus six paramedic vans. This allowed for more engines to be deployed, while maintaining ALS medical coverage in the unaffected areas.

Department manpower coordinators (MPC) were organized and directed to hire personnel for all un-staffed apparatus. During the incident, 36 relief/surge engine companies and a truck company were staffed and placed into service. Some of these units were sent to the incident, and others were used to provide station coverage. While searching for relief apparatus, several engine companies thought to be in reserve were discovered to have been placed into service by off-duty personnel. They were self-dispatched to the Freeway Fire. This was done outside the normal command and control systems. Personnel on these units injected themselves into the firefight without checking in with fire ground commanders or notifying them where they were operating. Some units also lacked proper communication equipment. These actions created serious personnel safety and fireground accountability concerns.

Critical decisions were made by the assigned Duty Officer regarding coverage of empty OCFA fire stations. Given the continued weather and an uncertainty as to the causes of the Freeway and Landfill fires—both of which were burning in the most northern portions of Orange County and directly upwind from structures—a conservative coverage pattern was maintained for all remaining OCFA response areas. All reserve companies were staffed, dispatch criteria was modified for selected call types, and surge apparatus was outfitted for service.

As the fire moved into Yorba Linda, the Incident Command Post (ICP) was relocated to Yorba Linda Regional Park. A Logistic Section Chief, ORC Battalion 13 (Runnestrand), was dispatched to the park to begin the establishment of a formal base camp. Later, the location and size of this park was determined to not be well suited to handle the necessary long-term logistical needs of an incident this size. The base camp was relocated to Irvine Regional Park at midnight the first day. This facility, better suited to support a large incident, was within a reasonable travel distance to the fire. Branch V was considered too remote to be adequately supported from the base, so a spike camp was established.

Palm tree ignites by flying embers.

By 11:30 a.m., ORU Strike Team 9329C – Hawkins had been released from the Corona area and was fully engaged in Box Canyon. As the fire moved toward the Hidden Hills community, these engines and others protected homes along Foxtail Drive and Via Lomas de Yorba. Because the fire had moved into the area so quickly and without warning, residents in these areas were trying to evacuate while firefighting resources were attempting to gain access. It soon became evident the residents were in significant danger from the fire. The Brea Police Department was called to expedite the evacuation. Reports were also received that fire was impacting homes near Los Monteros and Los Adornos. ORC Patrol 23 reported to the Incident Commander that the Archstone Apartments located at River Bend and Cross Creek Roads were also immediately threatened. The fire continued its rapid and uncontrollable assault on multiple fronts. **Incident Narrative – Map 9** shows a map of the Freeway Fire progression into the Hidden Hills community.

At approximately 11:45 a.m., several units were deployed into the Savi Ranch commercial district. The units followed up on numerous reports of automatic fire alarms and also extinguished fires that had moved into the trees and ornamental vegetation. Flying embers found openings and combustible material at several of the businesses. These fires were extinguished as they were found. For the next several hours, units were committed to the area to ensure commercial losses were kept to a minimum.

In Brea, at the Landfill Fire, additional structure protection groups (SPG) were established. Brea Battalion 2 (Wood) was assigned the Kraemer SPG and given engine resources (XOR ST 1427A) to protect the homes surrounding Brea Fire Station 3. Brea Engine 2 reported the fire was within 200 yards of Brea-Olinda High School, and a request was made to the Brea Police Department to close Wildcat Way to all public traffic. In Brea, four homes were destroyed; six others damaged. The Brea Olinda School District sustained major damage around its high school campus, including the loss of several secondary buildings at Brea Canyon High School. **Incident Narrative – Map 10** shows a map indicating the perimeter of the Freeway and Landfill Fires.

Los Angeles County Fire Department Assistant Chief Watson and Deputy Chief Bryant arrived at the Landfill Fire command post. They discussed their concern that the north flank of the fire presented a threat to the Tonner Canyon, Diamond Bar, La Habra, and Hacienda Heights communities. With limited available resources, Battalion Chiefs Wells and Montoya asked if Los Angeles County Fire Department would be able to provide tactical support to those communities.

Battalion Chiefs Montoya and Wells reorganized the Landfill Fire firefighting effort. They created two branches and four structure protection groups. Single increment initial attack resources were formed into a strike team to better coordinate firefighting efforts and fire ground accountability (ORC Strike Team 1406A [Brice]). During this meeting, Battalion Chief Reeder contacted Battalion Chief Wells and advised of the anticipated merging of the Freeway Fire and the Landfill Fire sometime that evening. The decision would ultimately be made to manage the two fires as a Complex, and establish the Landfill Fire as Branch III of the Freeway Complex Fire.

A Yorba Linda neighborhood as the fire consumed the hills nearby.

The unified incident commanders determined an Incident Management Team (IMT) would be required to assist in this emerging disaster. CAL FIRE IMT 6 was on standby in Riverside County and was activated at noon. Team members began to arrive at 1:00 p.m., with the team ultimately assuming full command of the fire at 7:00 p.m. on November 15.

The strong Santa Ana winds did not allow smoke from this massive fire to rise—rather, it created a shearing effect. This resulted in a thick, gray blanket of smoke cutting off aerial views and lowering the ground level visibility to just a few feet in front of firefighters. ORC Battalion 15 (Boyle), responding as part of CAL FIRE IMT 6, was assigned to provide an update on the fire

location and progression. Due to the smoke conditions and continued rapid rate of fire spread, Chief Boyle was unable to provide this valuable intelligence to the command team and commented, "It seemed like the fire was everywhere."

The main body of the Freeway Fire was preceded by a broad ember shower distributed by the Santa Ana wind.

The main body of the Freeway Fire was preceded by a broad ember shower distributed by the Santa Ana winds. Embers crossed the 91 Freeway into Anaheim Hills at 12:46 p.m. The Helicopter Coordinator (HELCO) reported the fire was well established within the vegetation south of the 91 Freeway. Wind driven, the fire flashed toward several residential streets in Anaheim, including Rimwood Road, Canyon Vista Drive, Larkwood Street, South Morningstar Drive, and Laurel Tree Drive. The fire reached East Whitewater Drive and the Cascade Apartments at approximately 1 p.m. Overall, the City of Anaheim sustained loss or damage to 25 single-family homes and 60 apartment units.

MetroNet Dispatch received 911 at 12:46 p.m. as the fire jumped the 91 Freeway. First reports questioned if this was a spot fire from the Freeway Fire or a new fire within the City of Anaheim. Initial attack resources were dispatched apart from the command and control of the Freeway Complex Fire. This limited the resources available for deployment into Yorba Linda as Anaheim Fire worked to control the new threat. Eventually, this fire would be identified as Branch IV in the fire organization, but was frequently referred to as the Anaheim Branch.

The fire's potentially devastating impact on Anaheim homes and businesses required the incident command's immediate attention. This historical fire corridor was well-known. Had the fire in Anaheim escaped containment, one flank potentially could have followed the path and eventually matched the destruction of the 1967 Paseo Grande Fire. This could have extended fire through Anaheim Hills and into the cities of Villa Park, Orange, and Tustin—devastating the communities of Orange Park Acres, Santiago Hills, and Cowan Heights.

To minimize the threat, most of the helicopters operating on the Freeway Fire were directed to concentrate control efforts on the Anaheim side of the 91 Freeway. Dozens of water drops were made and—in combination with the efforts of the assigned ground units—containment was achieved. **Incident Narrative – Map 11** shows a map of the spot fire across the 91 Freeway into the City of Anaheim.

Firefighters fill a Water Tender at a lower elevation to take to engines fighting fires at higher elevations due to the lack of hydrant pressure.

By 1:00 p.m., the fire was well established in the Yorba Linda community of Hidden Hills. Fire engines (ORC Strike Team 1403A), a Patrol/CAFS task force led by ORC Battalion 22 (Antrim), along with Water Tenders 16 and 40, and engines from Anaheim engaged in the fight. Fire units encountered low or no water pressure on Hidden Hills Road, Mission Hills Lane, High Tree Circle, Fairwood Circle, Green Crest Drive, Skyridge Drive, and other streets. With homes burning on multiple streets and no

water, strike team leaders directed engine companies to move to areas that had available water. However, because the Patrol/CAFS task force was supported by the water tenders, it was able to effectively operate with less water than that required by an engine. Unfortunately, due to rapidly diminishing water pressures, even the water tenders were driven further down the hill to be refilled. These resources remained in the Hidden Hills community to protect houses that had not burned and to ensure extinguished homes did not rekindle. The availability and use of the CAFS was a direct result of recommendations made in the 2007 Santiago Fire After Action Report.

The water supply issue was reported to the Yorba Linda Water District (YLWD) through the City of Yorba Linda EOC at approximately 2:00 p.m. YLWD personnel responded to the area and were able to make adjustments to improve the water delivery in several areas. Due to the fire threat, water district personnel were unable to access the Santiago booster pump station. When YLWD personnel were initially able to make access to the pump station, they determined there had been sufficient heat to cause the pump station for the Santiago Reservoir to automatically shut down. Once this occurred, the continued water use eventually drained the Santiago Reservoir responsible for supplying water to the Hidden Hills and other nearby communities. YLWD personnel spent several hours completing repairs. They worked into the night and the next day to ensure a steady supply of water.

Daytime seems like night under extreme smoke conditions.

The water supply for this area was further impaired—unknowingly—by fire suppression units and some of their fire control tactics. Faced with multiple structures fully involved in fire, many engines resorted to the use of master streams to contain the fire spread. This meant a single fire engine could have pumped more than 1,000 gpm. On some streets, multiple master streams were used. This limited water availability for engines arriving later. Additionally, the 4-inch diameter hose lines that were laid in the street to supply engines physically blocked later arriving units' access to neighborhood streets. These tactics were modified, and the master streams were shut down. Water tenders were also deployed into the impacted areas to help mitigate the water deficit.

In Branch II, plans were also underway to contain the fast-moving brush fire. Retardant drops from air tankers were directed along South Ridge Trail. They had a minimal effect, and the wind pushed the fire into Chino Hills State Park. A contingency plan was enacted in the likely case the fire would reach the community of Chino Hills. The Chino Hills Structure Protection Group was established, but it was not staffed until later that evening when more resources were available. The immediate goal was to keep the fire within the boundaries of South Ridge Trail, Water Canyon Ridge, and Slaughter Canyon. This plan was subsequently supported with the use of engines, bulldozers, hand crews, and aircraft.

Reports of the Landfill Fire crossing the 57 Freeway at Lambert Road east of State College Avenue were received at 1:21 p.m. A request was made to the California Highway Patrol (CHP) to close the freeway due to smoke and fire conditions. The fire was actively spotting in multiple directions, and on-scene resources moved from neighborhood to neighborhood protecting structures. By this time, Los Angeles County (LACO) Fire ground and air resources had been

moved into to reinforce the Tonner Canyon flank. These resources would eventually be used to support the contingency and control objectives for Branch V. LACO helicopters were used to suppress and contain the fire north of Brea Olinda High School and the neighborhoods west of the 57 Freeway.

At 1:30 p.m., homes adjacent to the Eastside Community Park located on Heatheridge Drive and Hidden Hills Road were reported to be burning. ORC Strike Team 1404A (Whitaker) and XOR Strike Team 1425A (Hirsch) had at least five, fully involved structures on Heatheridge Drive. Fifteen minutes later and a mile away, homes in the Village Center area on Willow Tree Lane, Ridge Park Drive, Juniper Avenue, Alder Avenue, and Deodar Drive were burning.

ORC strike teams assigned to the Tea Fire in Santa Barbara County and the Sayre Fire in Los Angeles County were reassigned to the Freeway Fire. ORC Strike Team 1400A (Valenzuela) arrived around 2:00 p.m. and joined the other units already engaged in Yorba Linda. ORC Strike Team 1402A (Kinoshita) returned at 4:30 p.m. ORU Strike Team 9328C (McCoy) was released late that evening from the Tea Fire and arrived sometime around midnight, the first day.

The three Orange County MetroNet strike teams (XOR) were also released from Tea and Sayre Fires and reassigned to the Freeway Fire. XOR Strike Team 1421A (Head) arrived about 3:45 p.m. and began working in the Anaheim Hills area. XOR Strike Team 1422A (Duncan) arrived at 3:30 p.m. and was assigned to structure protection in the community of San Antonio. XOR Strike Team 1423A (Thomas) started working in the Fairmont area soon after arriving at 4:45 p.m.

Aerial view of the fire's aftermath on a neighborhood in east Yorba Linda

A critical point in time for the Freeway Complex Fire was 2:30 p.m. No less than 15 homes were simultaneously burning on Juniper Avenue, Deodar Drive, and other streets in the San Antonio community. By this time, sufficient strike teams had arrived to allow a switch from the "bump and run tactic" to a more offensive "anchor and hold strategy." This ensured damage and loss of homes would be minimized.

At 2:30 p.m., Branch II (Deyo) and Division Y (Toups) met with Branch I resources in the San Antonio community. With numerous homes threatened, strike teams were requested to provide structure protection. By this time, several out-of-county strike teams had reported to the fire. As many strike teams as possible were directed into the area between Village Center Drive and San Antonio Road. **Incident Narrative – Map 12** shows a map of the Freeway Fire impacting the San Antonio community.

By 3:00 p.m., the weather began to change in favor of the fire control efforts. The temperature remained in the mid-70s and the relative humidity at 7 percent. However, the change in sustained wind speed to below 40 mph—sometimes as low as 10 mph in some areas—began to make the greatest difference. The advancing structure loss was stopped within the San Antonio neighborhood. Although a positive sign for fire ground commanders, the threat to—and the loss of—structures did not end. Over the next several hours, dozens of new fires were reported, or fires

thought to be extinguished rekindled within communities along the Freeway Complex Fire's path. Fire crews returned hours later to streets previously thought clear of fire, only to find multiple homes burning anew. Many of these latent fires occurred from embers intruding into concealed spaces within homes and smoldering undetected.

> The change in sustained wind speed to below 40 mph—sometimes as low as 10 mph in some areas—began to make the greatest difference.

A reconnaissance flight was conducted for the Landfill Fire at approximately 3:00 p.m., and a decision was made to change strategy from a defensive posture to an aggressive offensive tactic. This resulted in controlling the spread of the fire and keeping it from repeatedly jumping the 57 Freeway and spreading uncontrolled into residential neighborhoods. The Landfill Fire would ultimately result in the loss of four homes and damage to six others. The Brea Canyon and Brea Olinda High Schools also sustained fire damage and 980 acres of vegetation were burned.

Sometime between 4:00 and 4:30 p.m., the fire in Branch II that was burning down slope against the wind into Yorba Linda became realigned with the topography and wind. Numerous spot fires were reported at Condor Ridge. Control efforts with retardant drops proved unsuccessful, and at 4:45 p.m., the fire continued driving westward into Telegraph Canyon.

Around 5:00 p.m., a second spot fire was reported on the south side of the 91 Freeway at Coal Canyon. ORC Superintendent 1 (Hanson) led an aggressive ground effort with bulldozers and handcrews to contain the new threat. Containing this fire closed the back door and kept the Freeway Complex Fire from reaching Sierra Peak and making the run at Windy Ridge, which could have threatened additional communities.

By 5:30 p.m., the wildland fire was continuing to move through Upper Waterman Canyon at an incredible rate. Within minutes, another tragic outcome was narrowly avoided. Earlier in the day, CAL FIRE Crew Strike Team 9387G was assigned to this area in Branch II. The crew buses were parked in an unburned area of San Juan Hill located in Upper Waterman Canyon. As the fire burned across the canyon, the crew buses were going to be overrun. The crew bus drivers took tried to relocate their vehicles ahead of the quickly approaching front. Orders were given for all personnel to seek safety by entering the already burned area—known as "entering the black." Eight of the inmate crew members inadvertently took off through the unburned fuel—known as "the green." Two firefighters assigned to CAL FIRE Strike Team 9410C were sent to retrieve and direct them into a safe area. After the fire front passed, all personnel were accounted for. No injuries were sustained, but the two crew buses sustained minor damage from being so close to the flames.

The decision to merge the Landfill and Freeway Fires into a Complex occurred between 5:00 and 5:30 p.m. A complex is comprised of two or more fires in a geographically adjacent area. When implemented, managing an incident as a complex allows for shared incident management and logistical support with a central base of operations for continuity and efficiency. As the fire grew, the

Cityscape of Yorba Linda during the first night

branch assignments expanded to accommodate the vast boundary of the fire. The Landfill Fire was subsequently identified as Branch III and assigned to BRE Battalion 1 (Montoya) and ORC Battalion 8 (Wells). Branch IV was established when the fire subsequently jumped the 91 Freeway and moved into the City of Anaheim. This branch was also referred to as the Anaheim Branch. With the addition of LACO to the unified command, Branch V was later identified to include parts of Tonner Canyon and the City of Diamond Bar. Additional control objectives were established including keeping the fire east of the 57 Freeway and south of the City of Diamond Bar. LACO units would establish in this area to help make a stand.

At 5:50 p.m., Incident Command received a request from YLWD personnel to provide engines to assist with water supply problems. Three engines—ORG E2, STA E2, and GGVE5—were assigned and were able to sustain water availability by pumping water from one supply grid of the system to another. These engines pumped through the night until the YLWD brought in a high-volume portable pump to take over for fire engines. According to the YLWD After Action Report, the water shortage was primarily caused by fail-safe actions of pumping equipment and the high demand on the system caused by firefighting efforts. These two situations resulted in a complete emptying of the Santiago Reservoir.

By 7:00 p.m., firefighters were advancing into all neighborhoods affected by the Freeway Complex Fire. Strike teams from all over Southern California were still arriving to help. CAL FIRE IMT 6 officially took responsibility for the management of the Freeway Complex Fire. Formal briefings were taking place, and logistical needs such as food and water were supplied to personnel. Fuel as ordered for vehicles that had been at working all day. A unified communication plan was initiated resulting in significant radio communication improvement by the following morning.

At an earlier briefing for the Landfill Fire, the Freeway Fire was predicted to burn into Carbon Canyon and make a direct run at the community of Olinda Village. Olinda Village sits in a confluence of canyon sides creating a "bowl" where residents have built homes, businesses, a church, and a school. Olinda Village is heavily lined with pine, eucalyptus, and a variety of ornamental vegetation. The Hollydale Mobile Estates is a large mobile home park where many village residents live.

At 8:30 p.m. on this first day, a strike team of engines—ORC Strike Team 1405A (Brown)—was assigned to the Olinda Village area. He developed control objectives to keep the fire south of Carbon Canyon Road, east of the eastern most boundary of Olinda Village, west of Copo de Oro, and north of Verbena Lane. Tactical priorities included the protection of the Hollydale Mobile Estates and the Carbon Canyon Christian High School. A special emphasis was placed on protecting the power lines along Carbon Canyon Road—as these supplied the main power to Olinda Village and the water supply pumps for the area.

At the same time, in Branch II, the perimeter control efforts remained active. The fire continued to burn on multiple fronts through canyons aligned with the wind. The Rolling M Ranch presented a new structure protection challenge. Two crew strike teams and a Chino Hills engine were assigned to this area. Other strike teams of bulldozers and hand crews were working to build a control line at Bane Canyon. However, at 9:00 p.m., the fire was spotted one-fourth of a mile away in Slaughter Canyon. The plan was abandoned. By midnight, the Freeway Complex Fire had reached the City of Chino Hills and was burning behind homes located near Butterfield Road and the Los Serranos Golf and Country Club. **Incident Narrative – Map 13** is a map of the local canyons.

On November 16 around 2:00 a.m., the wind direction shifted from off-shore to a sustained on-shore direction. This was reported by personnel at Olinda Village and Branch II in Aliso Canyon. At 3:30 a.m., the Freeway Complex Fire had progressed through the Chino Hills State Park into Telegraph Canyon. It then had moved into the Carbon Canyon area. Highly erratic burning conditions were seen with flame heights reported up to 50 feet and visibility at near zero. **Incident Narrative – Map 14** shows a fire progression map of the Freeway Fire advancing into Olinda Village.

As the Freeway Complex Fire moved toward the Olinda Village area, an evacuation plan was implemented. Engines were moved to protect structures as the fire was burning directly into the Hollydale Mobile Estates. Largely due to the significant amount of preparation made by engine crews earlier in the day, the flame front was repelled and the community of Olinda Village was spared significant loss. One mobile home in Hollydale and a home on Olinda Drive were destroyed. By 7:00 a.m. on November 16, the threat to Olinda Village had passed.

The wind shift had an impact on fire control actions in the Chino Hills area. At 3:00 a.m., the fire burned freely near the upper end of Aliso Canyon. Branch II ordered evacuations of hundreds of homes south of Soquel Canyon and west of Highway 71. An extensive firing operation was conducted as part of the structure protection effort. Fifteen engines worked until sunrise to ensure there were no losses. Another large firing operation from Euclid to Carbon Canyon Road was completed by 9:00 a.m.

Chief Toups (Division Y) was relocating Branch II resources into the Sleepy Hollow area off Carbon Canyon Road when he encountered engines assigned to Branch V. These local government engines had just completed a firing operation around homes bordering the Saint Joseph's Hill of Hope off Carbon Canyon Road in what they called a structure protection effort. Chief Toups asked the Strike Team Leader to cease from any additional firing as the wind direction and terrain were not properly aligned for this type of operation. The reason given for the firing operation was structure protection, but the unintended consequence was to create a condition which drew the main body of the Freeway Complex Fire deeper into Tonner Canyon. Once established within the canyon, the fire would be aligned and head toward the Los Angeles County line and the city limits of Diamond Bar. **Incident Narrative – Map 15** shows a map of the Freeway Fire progressing into Tonner Canyon.

Smoke column rising through the inversion layer

Day 2 - November 16, 2008

The Freeway Complex Fire was battled through the day on November 16. Aircraft, bulldozers, hand crews, and engine companies worked throughout the day to establish a control perimeter around the fire. By midnight on that second day, the goal was achieved. Overhaul and line improvement continued over the next couple of days.

The re-population of evacuated areas was a priority for Incident Command. Residents of areas that were not under mandatory evacuation were allowed to return to their homes at their choosing. Those under a mandatory evacuation order had to wait until a determination was made that the threat was fully abated. After conducting an aerial reconnaissance of the Complex, Incident Commanders decided at 3:00 p.m. on November 16 that most areas under the evacuation order could be repopulated. OCFA Occupant Liaison personnel assisted homeowners in gaining access to homes to recover personal property and by listening to and answering questions.

Days 3-5, November 17-19, 2008

Neighborhoods that had been impacted by the fire had fire companies assigned to ensure burned homes were properly overhauled and no new fires would occur as a result of hidden or smoldering embers. Neighborhoods, homes, and cars that were not burned—but may have received a covering of fire retardant—were washed to minimize damage.

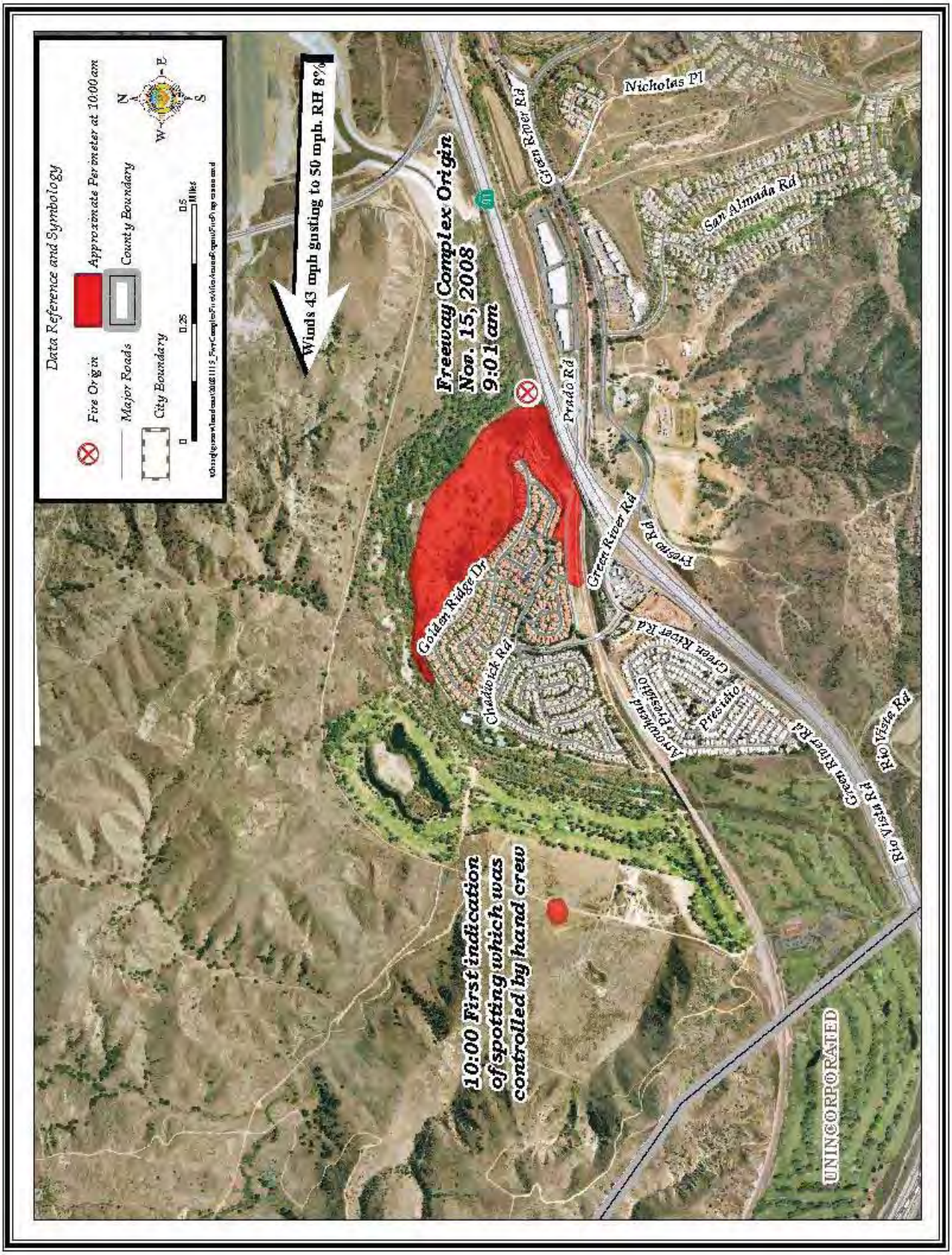
On November 19, 2008, at 7:00 a.m., the Freeway Complex Fire was declared to be fully contained. At its peak, more than 3,800 firefighting and support personnel were assigned to the incident. More than 360 structures were destroyed or damaged, and over 30,000 acres of valuable watershed were consumed. The extinguishment effort for the incident is estimated to cost $16.1 million, with property loss exceeding $150 million. Injuries were few and relatively minor. Most importantly, no lives were lost to either civilians or firefighters.

The fire contained; damage assessment begins in a Yorba Linda neighborhood

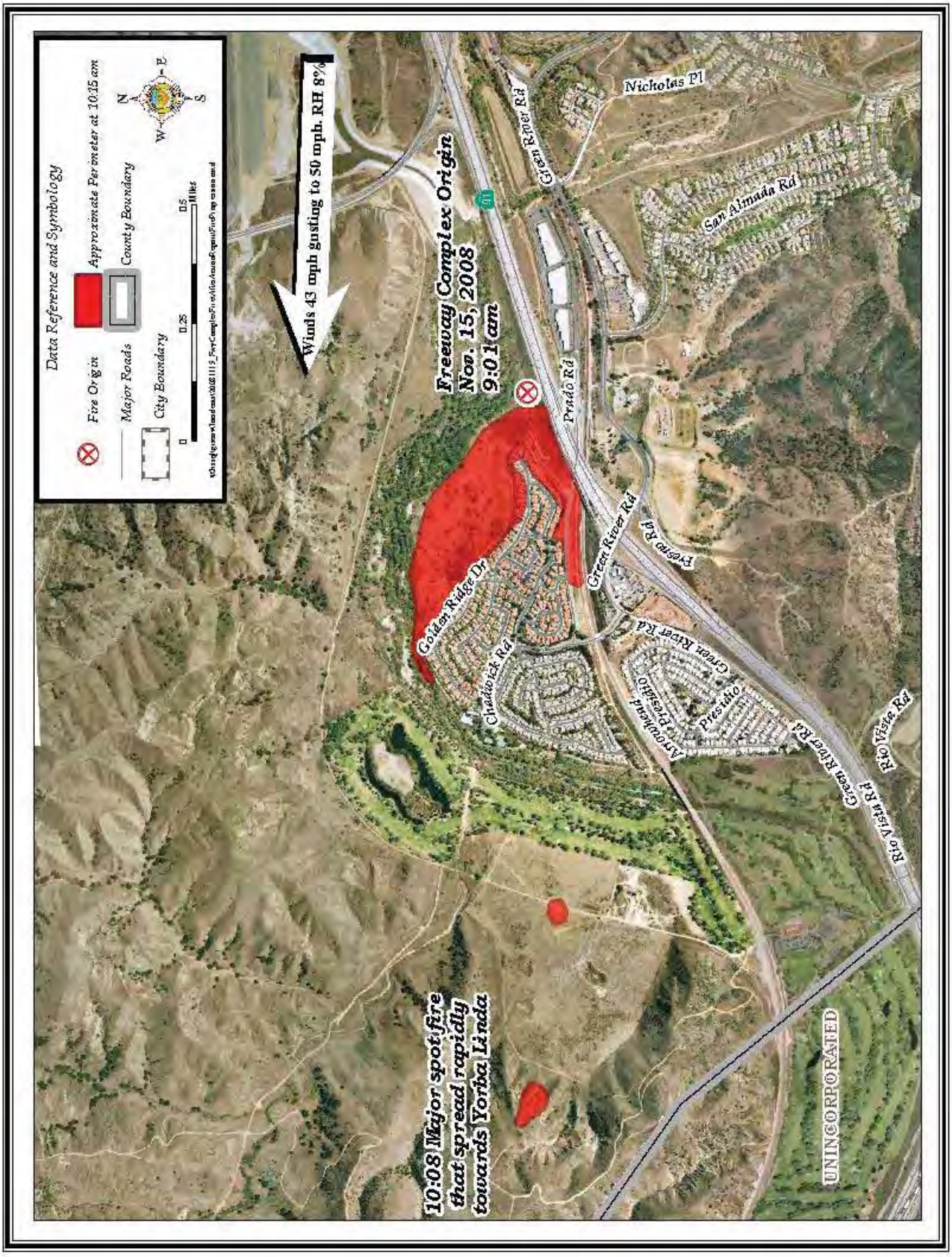
Incident Narrative – Map 3
Freeway Complex Fire—Origin 9:01 a.m.

Incident Narrative – Map 4
Corona Fire Engine 5—Near Miss Entrapment

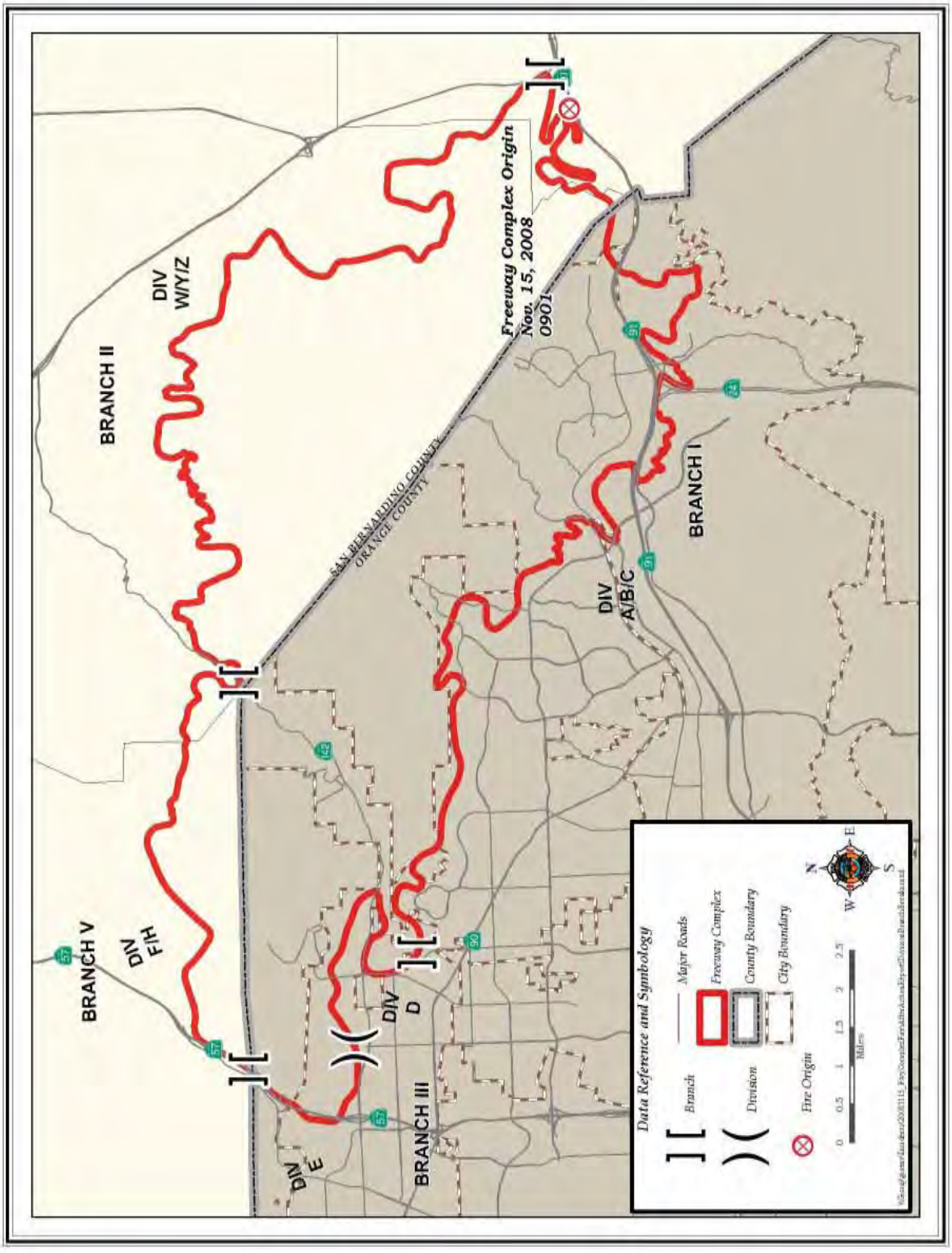
Incident Narrative – Map 5
First Indication of Spotting—10:00 a.m.



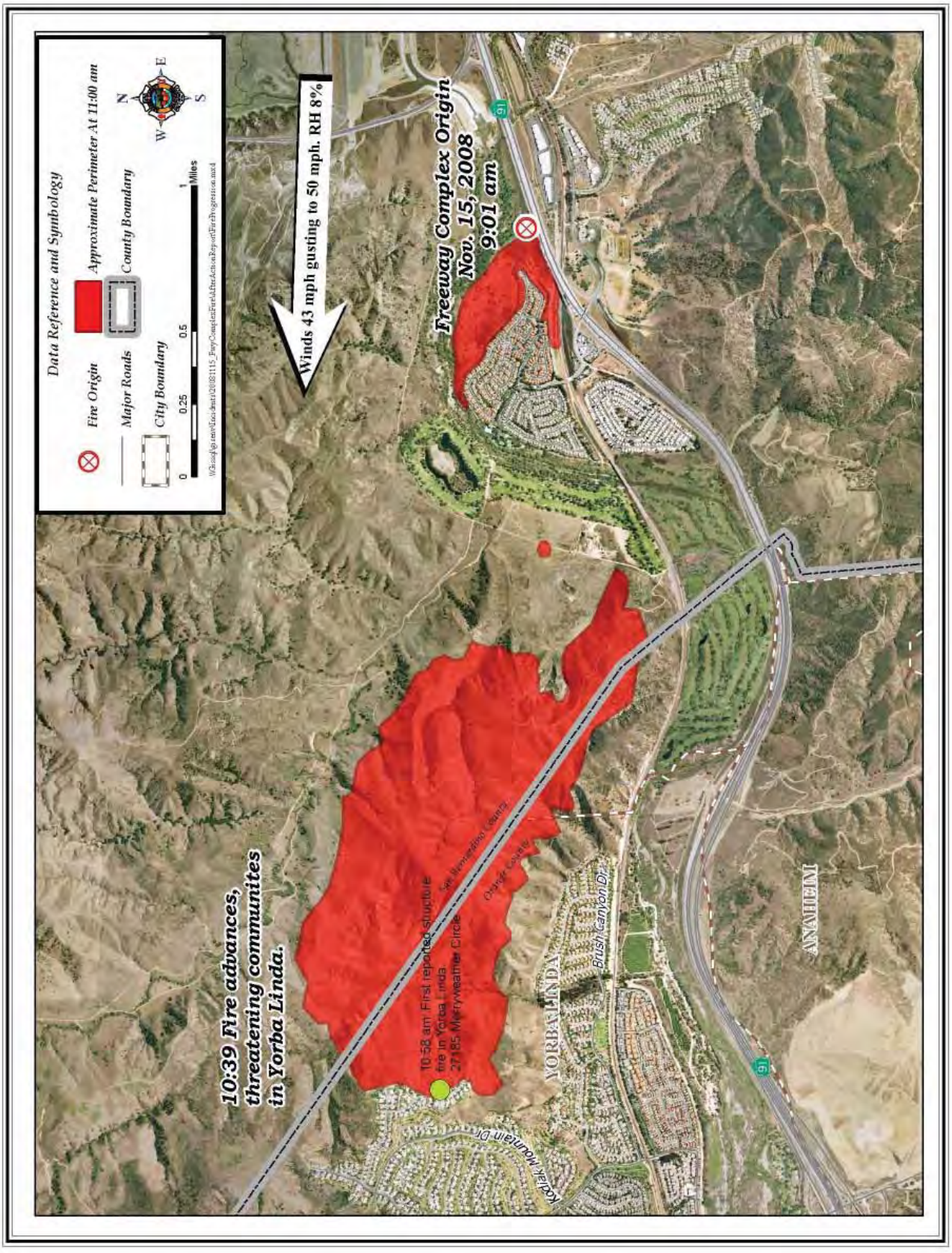
Incident Narrative – Map 6
Second Spot Sighted—10:08 a.m.



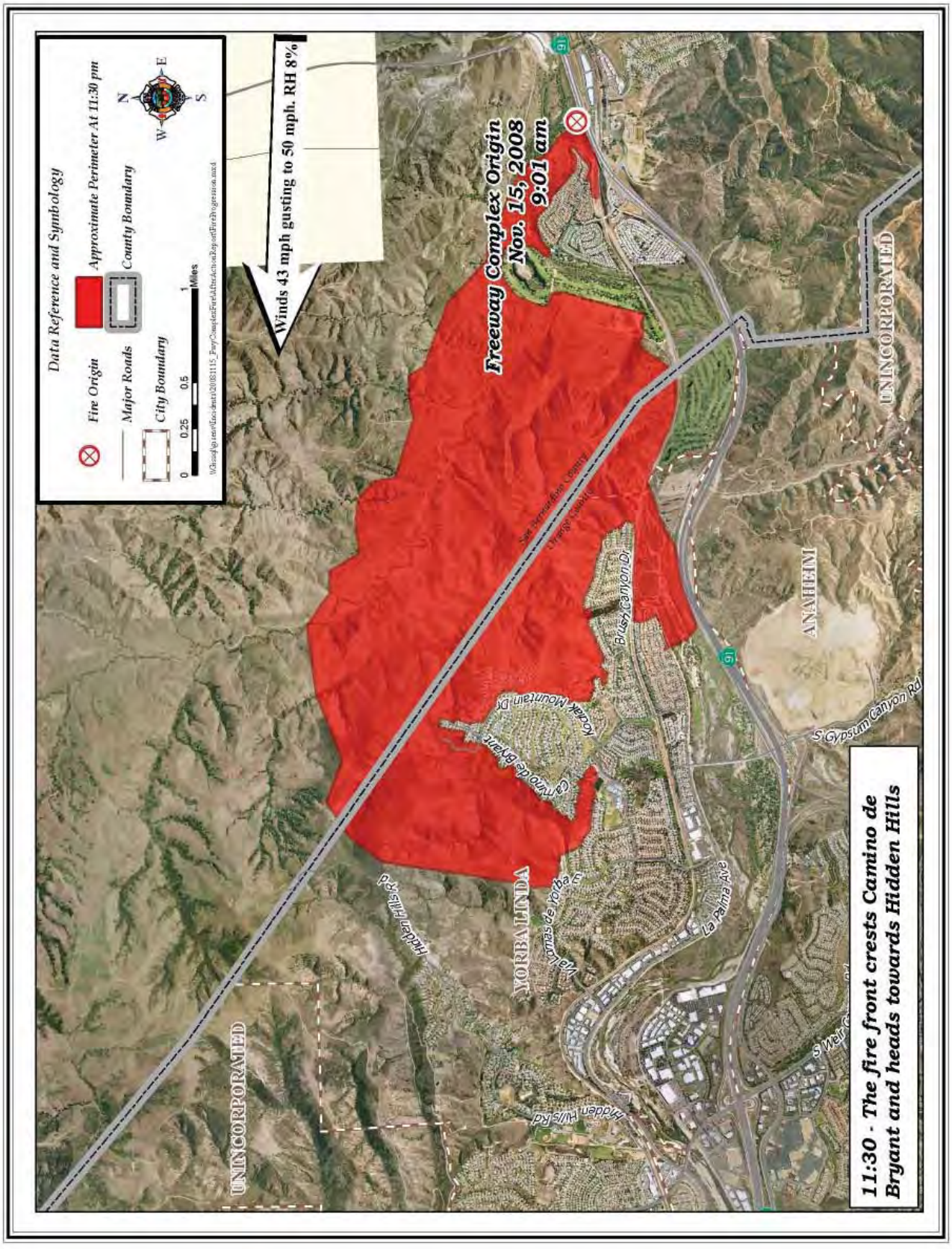
Incident Narrative – Map 7
Freeway Complex Fire—Branch and Division Map



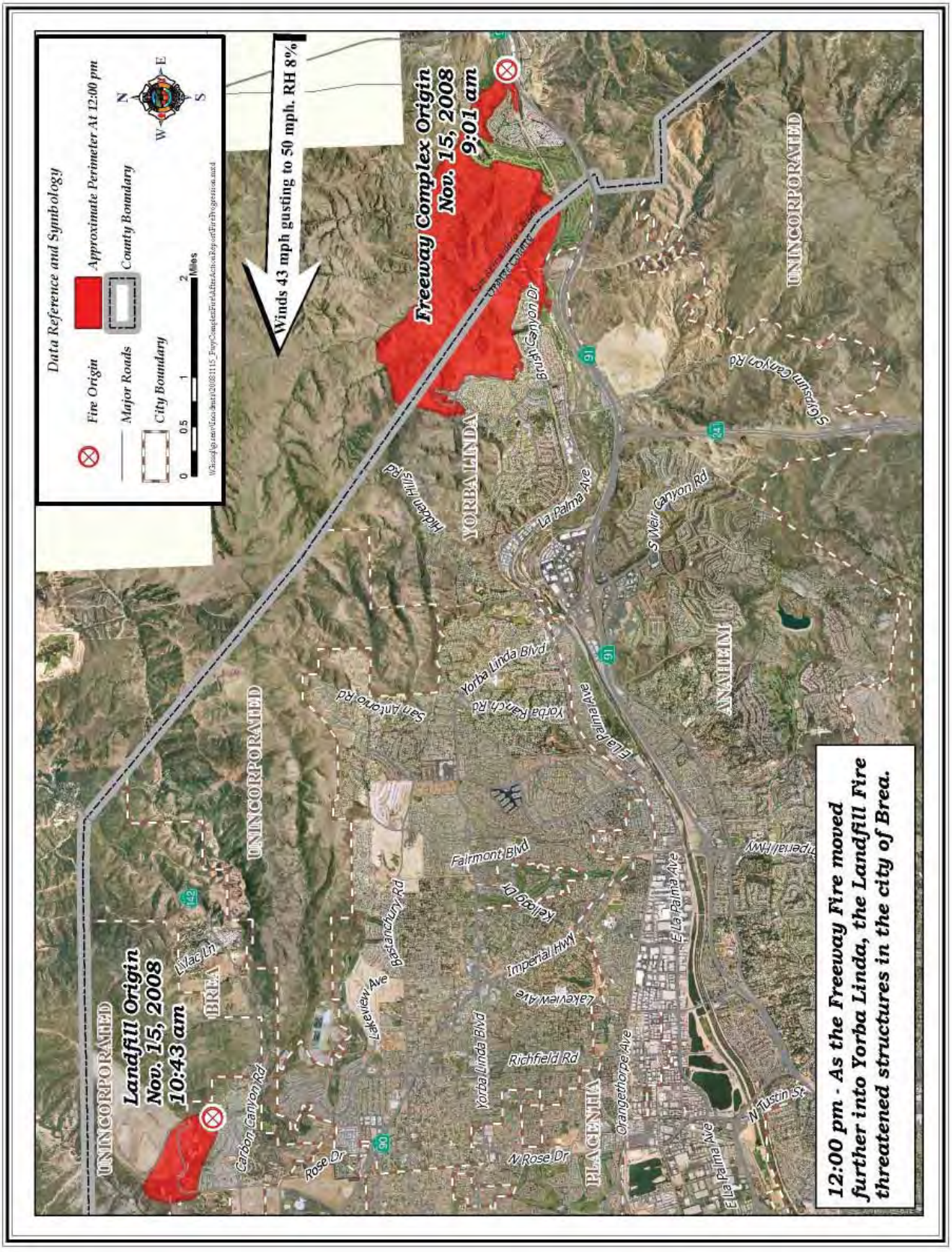
Incident Narrative – Map 8
Freeway Fire Reaches Structures in Yorba Linda—10:39 a.m.



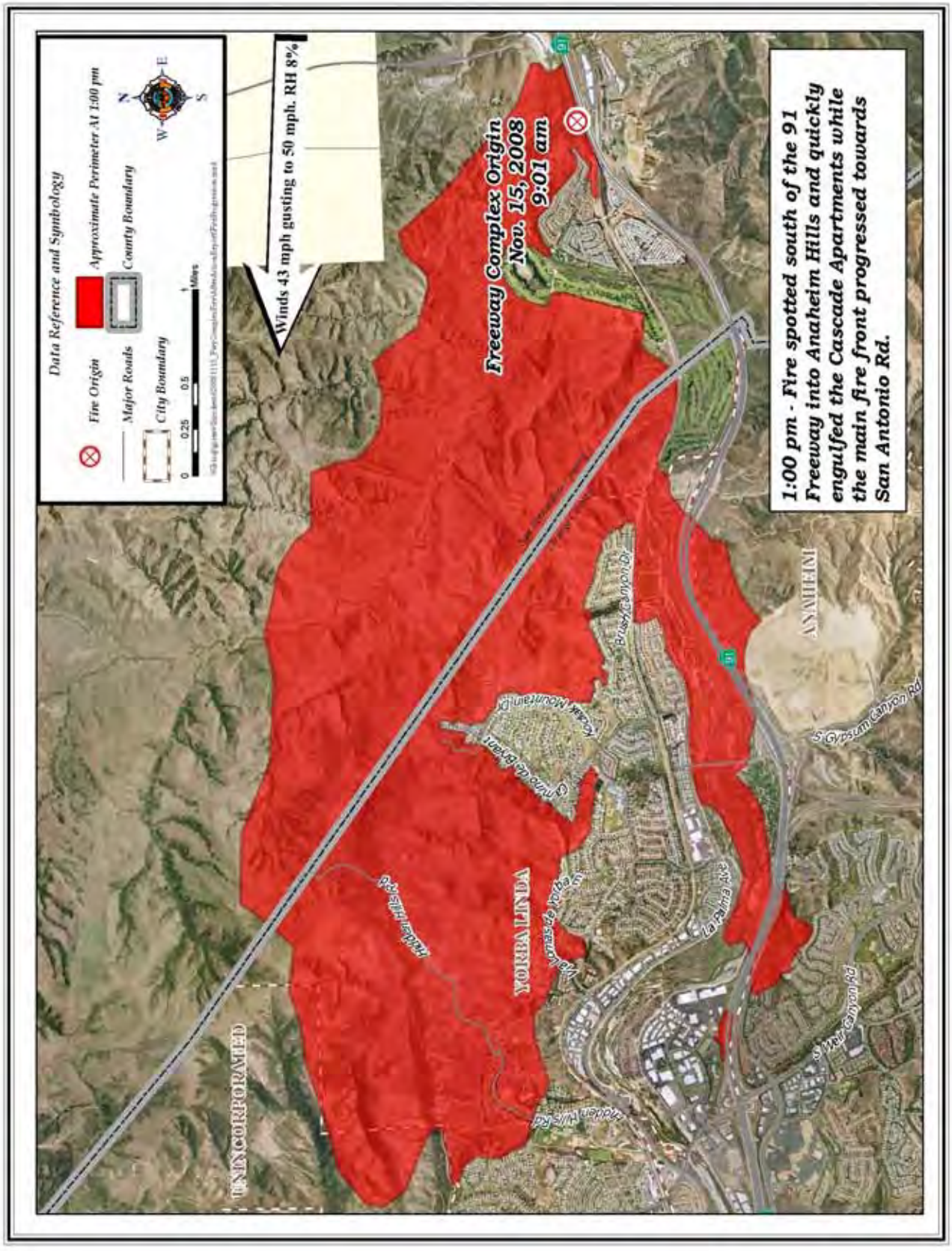
Incident Narrative – Map 9
Freeway Fire Moves Towards Hidden Hills—11:30 a.m.



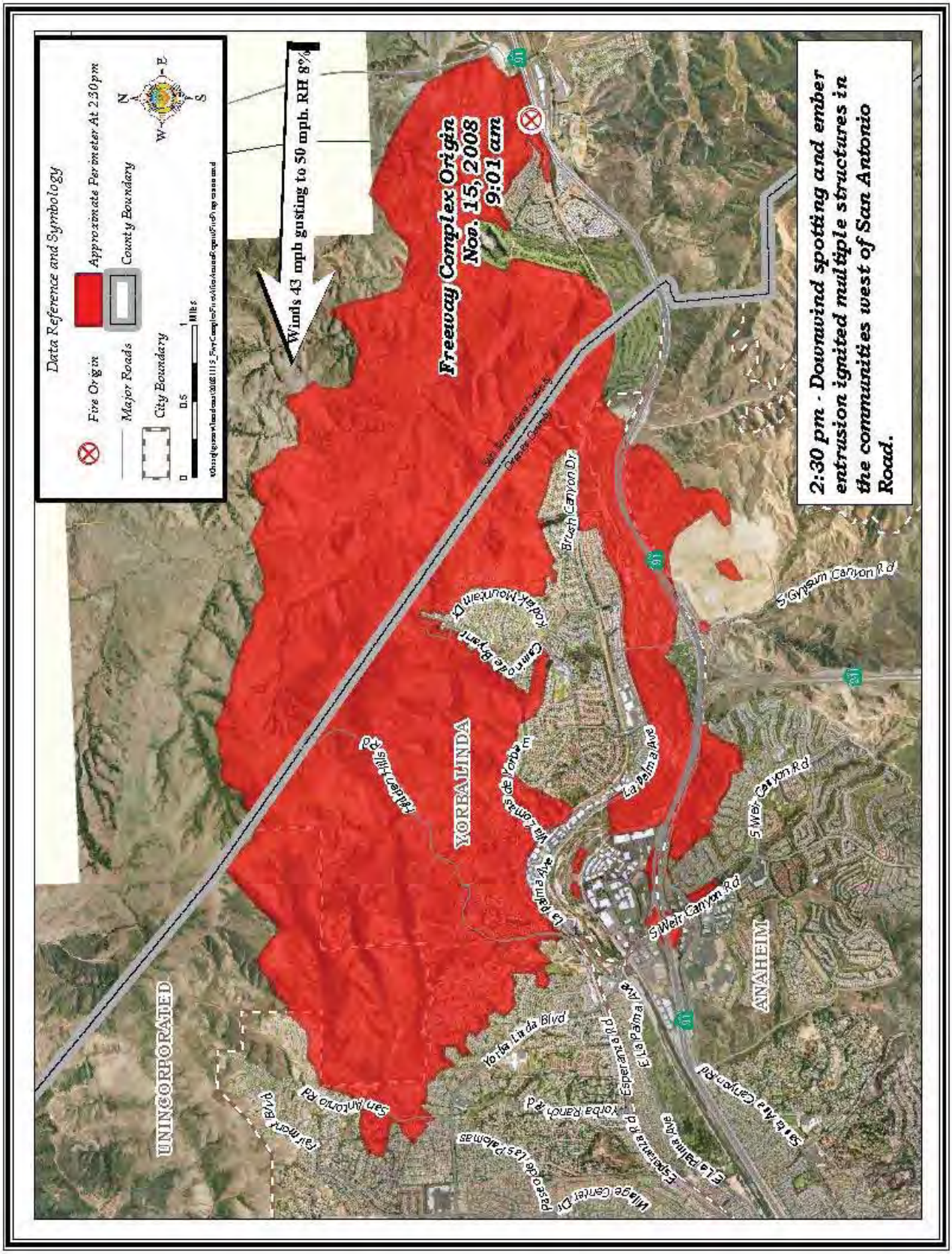
Incident Narrative – Map 10
Perimeter of the Freeway and Landfill Fires—12:00 p.m.



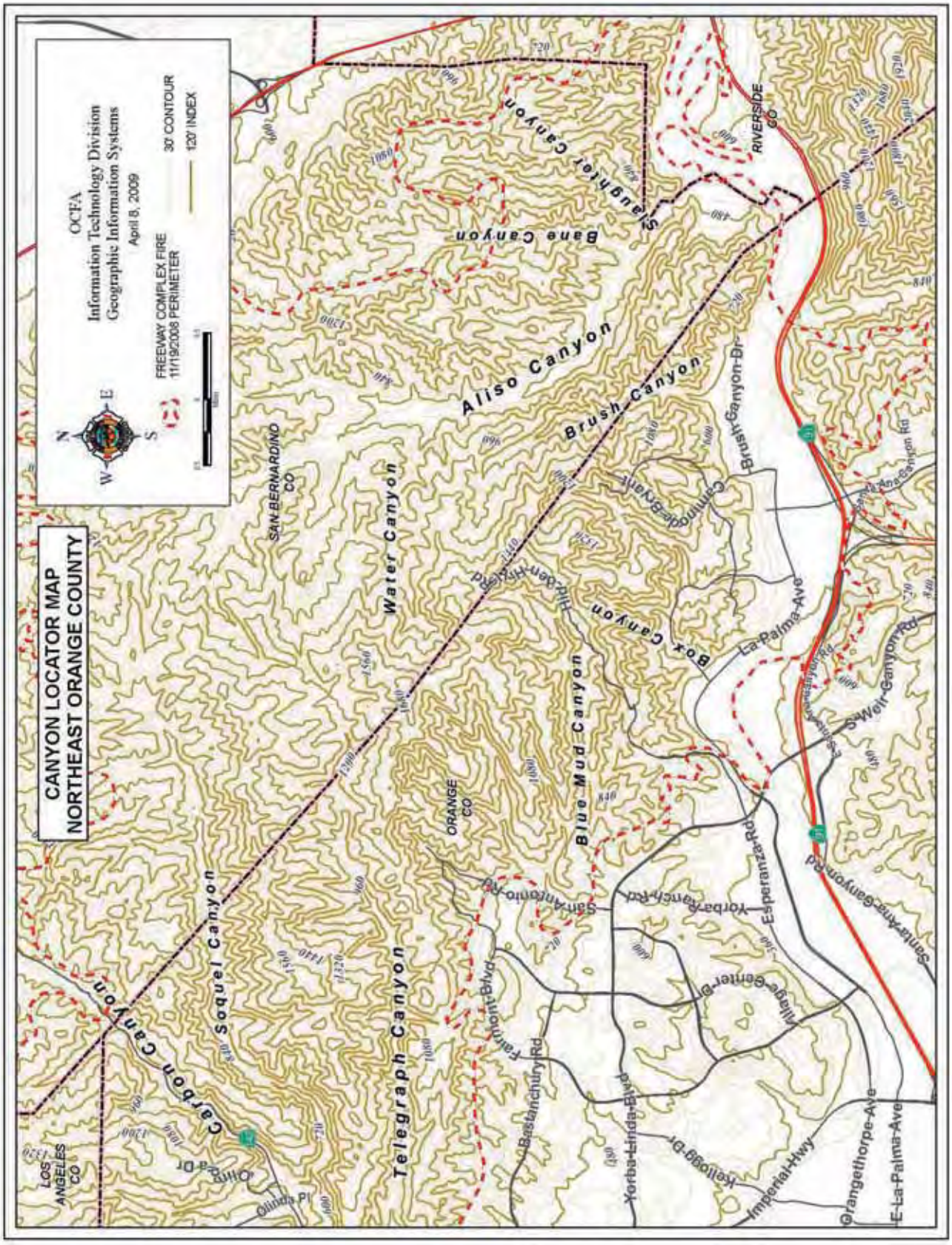
Incident Narrative – Map 11
Freeway Fire Spots Across the 91 Freeway into Anaheim—1:00 p.m.



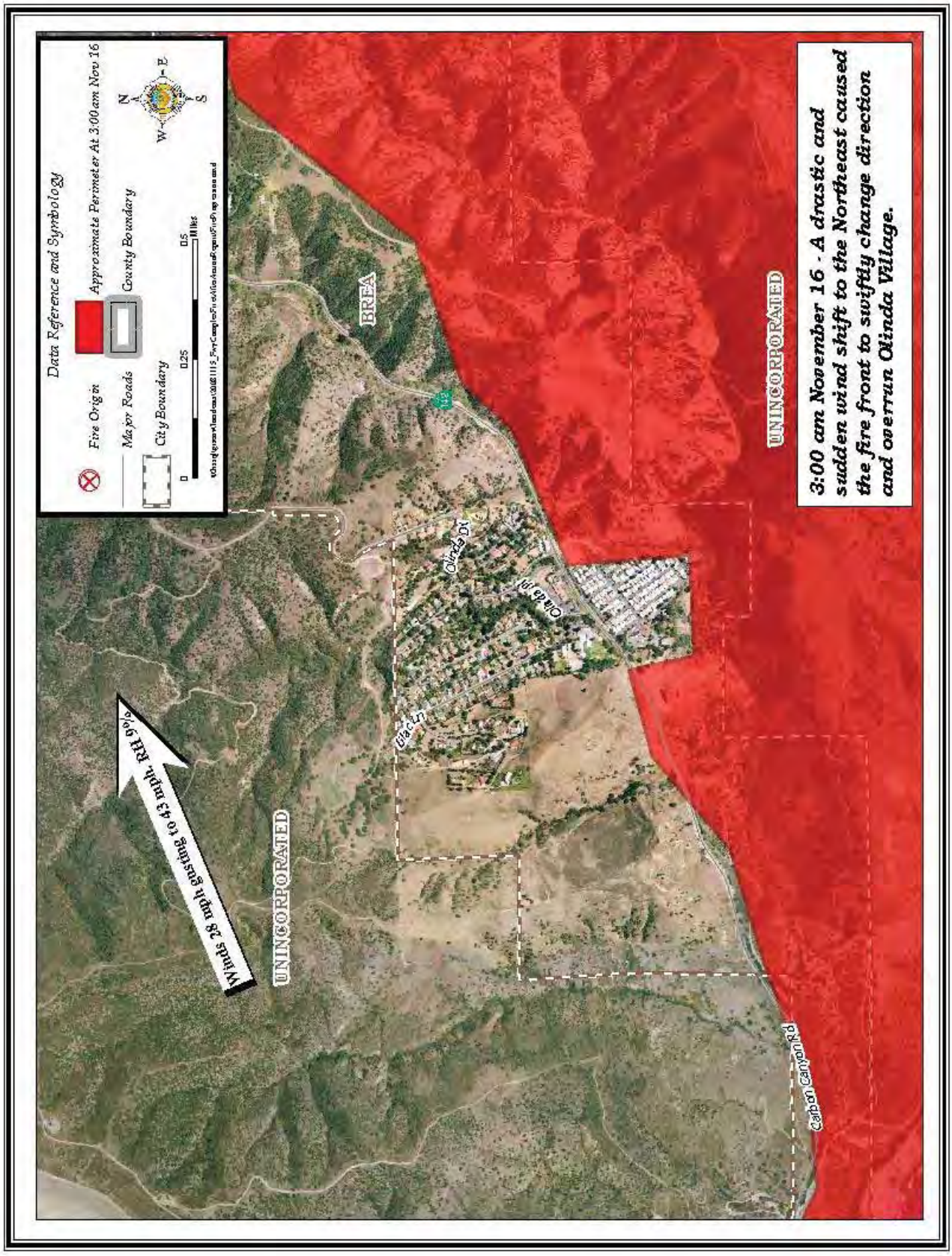
Incident Narrative – Map 12
Freeway Fire Reaches the San Antonio Community—2:30 p.m.



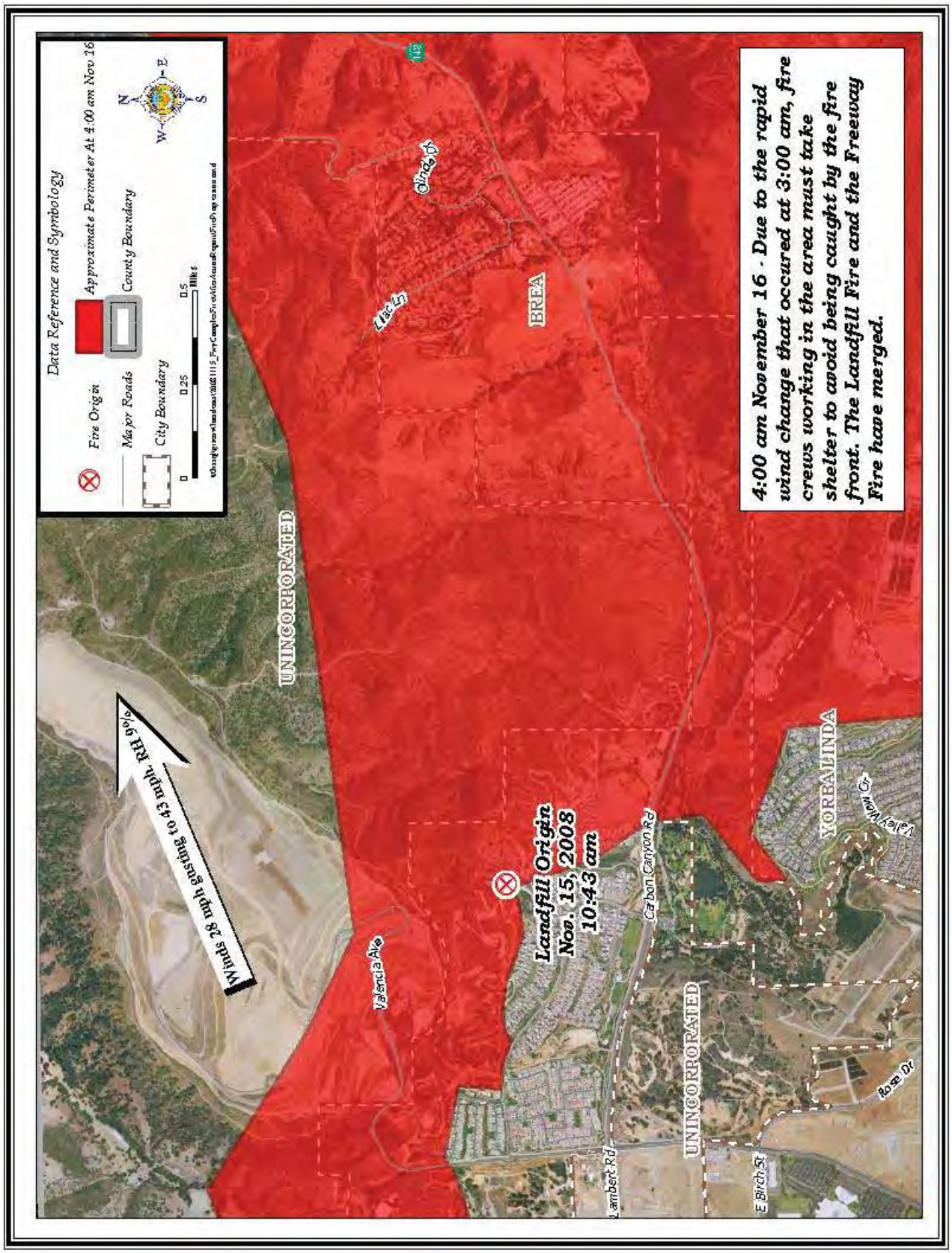
Incident Narrative – Map 13
Canyon Locator



Incident Narrative – Map 14
Freeway Fire Reaches Olinda Village—3:00 a.m.



Incident Narrative – Map 15
Freeway Fire Moves Towards Tonner Canyon—4:00 a.m.

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Notification, Evacuation, and Repopulation

The first indication that residents of the City of Yorba Linda were about to be seriously threatened by the Freeway Fire came at approximately 10:20 a.m. on November 15. After estimating the fire's rate of spread, OCFA Battalion 2 Chief (Reeder) projected the fire would impact the community of Brush Canyon within 30 minutes. He directed the OCFA ECC to notify the Yorba Linda City Manager and advise the Brea Police Department to begin mandatory evacuations of the Brush Canyon area. At 10:22 a.m., Brea Police began evacuations of the eastern portion of Yorba Linda (Thomas Brothers Map page 741, grids E4, F4, and G5).

Ten minutes later, at 10:32 a.m., the Freeway Fire threatened the neighborhood of Big Horn Mountain Way in Yorba Linda. At 10:39 a.m., ORC Helicopter 41 confirmed homes on Bighorn Mountain Way, Blue Ridge Drive, and Evening Breeze Drive were under direct threat. Nineteen minutes later, the first of hundreds of homes lost in Yorba Linda burned on Merryweather Circle.

Although a collaborative decision, the responsibility for evacuation is statutorily a law enforcement function, which allows the fire department to focus on fire control efforts. Brea Police had a Supervisor assigned to the Unified Command early in the incident. One of their primary responsibilities was the rapid assembly of officers to meet the evacuation needs of this fast-moving fire. The Orange County EOC After Action Report estimates the evacuation orders impacted over 9,000 dwellings in the City of Yorba Linda. During the height of the fight, and estimated 24,000 citizens were evacuated or kept from returning to their homes in the City of Yorba Linda. The City of Anaheim began evacuations when the Freeway Fire crossed the 91 Freeway. A few miles away, the City of Brea initiated evacuations in residential areas in the path of the Landfill Fire. These extensive evacuation demands put a strain on local law enforcement, requiring mutual aid resources from agencies across the County to assist with evacuation needs. Refer to http://www.ocfamedia.org/_uploads/PDF/fcfaarybl.pdf for the **City of Yorba Linda After Action Report** for additional details.

Traffic gridlocked as evacuating residents and incoming emergency apparatus tried to access the same neighborhood streets. Officers at the various roadblocks and checkpoints took action to remedy the congestion—enabling fire apparatus to access the most impacted neighborhoods.

The weekend and mid-morning timing of the Freeway Fire were major factors complicating the evacuation. Since the Freeway Fire occurred on a Saturday—instead of a weekday—more residents were home, instead of at work or school. Notably, even with such a large and escalating evacuation boundary, the majority of residents remained calm and followed evacuation orders. Although slow, reports were received during the morning that evacuations were orderly and without incident.

Law enforcement agencies possess the legal authority to conduct evacuations of populated areas. However, even when a mandatory evacuation is declared, law enforcement does not have the legal authority to force residents from their homes. Officers may restrict the return of residents once they leave their property. Determining when and where to evacuate is often difficult since each evacuation decision brings with it a set of risks and rewards. The greatest risk to permitting residents to remain with their homes is the potential threat to safety.

Evacuation of residents is one of the challenges created by a wildland-urban interface fire. The Freeway Fire spread so rapidly emergency responders could only estimate the direction and the time of impact to a given neighborhood. Within minutes of ignition, spotting was reported one mile downwind from the main body. Although a fire's rate of spread is typically measured in acres per hour, the Freeway Fire was driven by 40 mph winds and required measurement in acres per minute. Motorists driving on the 91 Freeway reported they could not keep up with the fire as it spread through wildland areas—even while driving at speeds of 50 mph.

Simulation training conducted on October 27, 2008, for a WUI fire in the mutual threat zone along the 91 Freeway provided incident commanders some possible trigger points of when and where to call for evacuation. During the fire, these same trigger points were utilized to make the evacuation decisions. When the potential existed for the fire to escape planned, control boundaries, evacuations were ordered.


The Brea Police Department conducting evacuations.

The manner and timeliness in which residents were notified is being reviewed. After the 2007 Santiago Fire, the County of Orange led in the development and implementation of a public notification system. The AlertOC notification program has been adopted and implemented in many cities throughout the County. The City of Yorba Linda was in the beginning stages of implementing the program. Since the fire, the Alert OC program has moved into the next phase of implementation and is now capable of making public notifications.

Deciding when to repopulate an evacuated neighborhood is one of the most difficult made by law enforcement and incident commanders—given the unpredictable nature of a WUI fire. Although a frustrating ordeal for residents, evacuation orders are to prevent homeowners from entering the dangerous conditions usually present in fire-burned areas.

The OCFA uses an Occupant Liaison Program to keep homeowners informed; to assist them in retrieving items such as medication, money, or clothing left while evacuating; and to provide emotional support. When appropriate, Occupant Liaison Teams may escort residents to their property. These efforts are to prevent homeowners from independently returning to their property and into a potentially dangerous situation.

After a reconnaissance flight deemed most areas to be safe, the mandatory evacuations were lifted on November 16 at 3:00 p.m. Even then, law enforcement officers were directed to allow only verified residents or those who had legitimate business—insurance adjusters, clean-up crews, etc.—into the impacted neighborhoods.

Even though the fire was extinguished, fire crews needed to maintain a presence within the impacted neighborhoods for several days. Firefighters conducted patrols looking for new fire

starts, as well as overhauled burned structures. Fire apparatus needed to be able to move freely from street to street as crews cleaned off fire retardant that drifted onto unburned homes and vehicles. Wildland engines, handcrews, and helicopters conducted mop-up operations in the wildland and—where necessary—removed hazards adjacent to homes created by partially burned trees and vegetation.

The orderly evacuation of residents during a WUI fire can be challenging and may create delays for fire apparatus.


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Water Supply

The demands of a single structure fire can tax a well functioning water system. Normal firefighting efforts often involve one fire engine connected to a fire hydrant. The water is supplied directly to the fire or to one or more fire engines. In contrast, in an urban conflagration such as the Freeway Complex Fire, multiple engines move into threatened neighborhoods to extinguish flames and defend multiple homes on numerous streets.

Water systems must incorporate "fire flow" as an element of system design and functionality. Needed fire flow is the amount of water available for providing fire protection at selected locations throughout a community. The OCFA Planning and Development Services Section reviews all plans for new development to ensure an adequate fire flow is provided according to the City's adopted Fire Code. Like all California jurisdictions, the City of Yorba Linda is required by State law to adopt the California Fire Code (CFC). The latest Fire Code edition was adopted in 2007. This newly adopted code allows for doubling of the required fire flow in areas where "conditions indicate an unusual susceptibility to group fires or conflagrations." This should be considered in all new developments within a city that is adjacent to a wildland-urban interface or within a designated High Hazard Zone.

Using the fire code tables, a typical street with homes not exceeding 3,600 square feet would be protected by fire hydrants capable of delivering 1,500 gpm for a minimum of two hours with no less than 20 pounds psi of residual pressure. For homes between 3,600 and 4,800 square feet, fire hydrants must deliver 1,750 gpm for two hours with no less than 20 pounds psi of residual pressure. Locally adopted amendments require fire hydrant spacing of 300 feet along the street. The typical fire flow demand is based on fighting a single structure fire and protecting the immediate exposures.

Faced with multiple structures, many fully involved in fire, some Company Officers resorted to the use of master streams to contain the fire spread. This meant a single fire engine may have pumped more than 1,000 gpm—affecting the available water supply. On some streets, multiple master streams were deployed. Once water demand issues were identified, tactics were modified. The master streams were shut down in favor of smaller hand lines.

Around 2:00 p.m. on November 15, several radio transmissions were received from fire companies reporting low or no water pressure in various sections of Yorba Linda. Some areas were Hidden Hills Road, Mission Hills Lane, High Tree Circle, Fairwood Circle, Green Crest Drive, and Skyridge Drive. With homes burning on multiple fronts, Strike Team Leaders had to make critical decisions. They directed fire companies to areas that had available water, thereby giving firefighters a chance to protect and save homes.

To provide structure protection and ensure rekindles were minimized, a Compressed Air Foam System (CAFS) Task Force with five Patrol units remained in the Hidden Hills area. The CAFS Task Force, under the direction of OCFA Battalion Chief Antrim, extinguished fires and laid protective foam on unburned structures for several hours. Two water tenders were ordered to the impacted area to shuttle water to the fire companies. These tenders systematically began checking fire hydrants until one was found with enough pressure to fill the tanks. Eventually, water tenders had to fall back to the hydrants at the lowest point in the system to refill.

According to the YLWD After Action Report, the water demand use for the first two days of the fire was nearly 20 million gallons above normal.

A request for service was placed to the Yorba Linda Water District (YLWD) through the Yorba Linda EOC about 2:00 p.m. YLWD personnel responded quickly and were able to make adjustments to improve the water delivery in several areas. According to the YLWD After Action Report, YLWD personnel were initially unable to access the Santiago Pump Station because of the extraordinary fire conditions. When they were able to make access, personnel determined there had been sufficient heat to cause the pump station for the Santiago Reservoir to automatically shut down. Once this occurred, the continued demand eventually drained the Santiago Reservoir, the supply for Hidden Hills and other nearby communities.

At 5:50 p.m., the YLWD requested three fire engines assist them in supplementing the water grid system at Manzanita Avenue and Smoke Tree Avenue. Additionally, two mobile water pumps were brought in from the Laguna Beach County Water District and the Santa Margarita Water District. They supplemented water supplies at the reservoirs serving the impacted areas. YLWD's efforts took several hours to complete; its personnel worked through the night and into the following day to ensure a secure water supply.

Water District Task Force

On January 20, 2009, the OCFA's Emergency Planning and Coordination Battalion Chief (Ferdig) attended the first meeting of a task force organized by the Water Emergency Response Organization of Orange County (WEROC). This organization coordinates and supports comprehensive emergency preparedness programs for the Orange County water industry.

The task force is to create a Water Utility and Fire Department Coordination Template for water agencies along the WUI. The template would include—but would not be limited to—areas such as water pressure zones, fire hydrant specifications, types of available equipment, necessary equipment, and identification of critical infrastructure in need of protection during a disaster. Some of the participating agencies on the task force are:

- Laguna Beach County Water District
- Yorba Linda Water District
- Moulton Niguel Water District
- South Coast Water District
- Irvine Ranch Water District
- City of Orange Water Department
- Orange County Fire Authority
- OC Emergency Management Bureau

The task force's goals are (1) to develop a stronger working relationship between water districts and fire agencies; (2) to develop implementation standards for use during red-flag conditions; (3) to develop a water district liaison program; and (4) to develop a standard template for providing fire agencies information about the water supply available during firefighting efforts.

The water supply template will assist each water district within the WUI to create an agency-specific plan. These plans will be tested using a tabletop exercise simulating multiple wildland fires impacting Orange County simultaneously. Refer to the **YLWD After Action Report at** http://www.ocfamedia.org/_uploads/PDF/fcfaarylwd.pdf for additional details.

Mutual Aid

The California Fire and Rescue Emergency Mutual Aid Plan is an extension of—and supportive document to—the California Emergency Plan. The plan provides for systematic mobilization, organization, and operation of necessary fire and rescue resources of the state and its political subdivisions in mitigating the effects of disasters, whether natural or man-caused.

Valley View Conservation Camp handcrew from Elk Creek, Ca

No community has the resources sufficient to cope with any and all emergencies. Thus, fire officials must preplan emergency operations to ensure the efficient use of available resources. Basic to California's emergency planning is a statewide system of fire service mutual aid. Each jurisdiction first relies upon its own resources with mutual aid resources being available from other agencies to augment local response when conditions warrant. The master Mutual Aid Plan outlines and governs what is commonly referred to as the Mutual Aid System for fire service in California.

The Mutual Aid System for fire service in California has been described by the United States Fire Administration as "unparalleled in the United States." The system is founded on the principle of fire departments providing resources to one another during times of major emergencies when a local agency is overwhelmed and does not have the ability to handle the incident on its own. The system allows resources committed to an incident to escalate from a few engines to hundreds. The State is divided into six mutual aid regions to facilitate coordination of mutual aid. Coordinators are identified at the local and national levels, under the umbrella of the Governor's Office of Emergency Services (OES) Fire and Rescue Branch.

Emergencies may reach such a magnitude as to require mutual aid resources from adjacent local, County, and State levels. Specific requests for mutual aid are processed from the local agency to the County Operational Area Coordinator. OCFA is the coordinator for the Orange County Operational Area. From the County, the request goes to the Regional Coordinator (LACO) and then to the State Coordinator (OES), if necessary. Each ascending level has access to greater numbers of firefighting resources from throughout the State.

During most wildland fires, mutual aid resources are requested and assembled in preparation for anticipated strategic actions. However, with fires that rapidly turn into WUI conflagrations—such as the Freeway Complex Fire—little time to plan for strategic actions is available, and resources are needed immediately. This is compounded further when multiple major fires occur simultaneously. Delays can be disastrous. Oftentimes, different fires are requesting the same resources.

When the Freeway Complex Fire began, only two fires of significance were blazing in Southern California: the Tea Fire in Santa Barbara County and the Sayre Fire in Los Angeles County. These fires were burning out of control, and numerous homes were already lost when the Freeway

Complex Fire began. Numerous mutual aid requests to both fires had been filled or were pending when the Freeway Complex Fire began. The OCFA had sent a Type 1 and a Type 3 strike team—10 engines—to the Tea Fire while MetroNet cities sent three Type 1 strike teams—15 engines. Additionally, the Orange County-based Office of Emergency Services (OES) strike team—5 engines—was activated and sent to Santa Barbara County. The OCFA staffs one of the OES engines with the other four being staffed by MetroNet cities. The Sayre Fire in Los Angeles County, having started after the Tea Fire, only received one Type 1 strike team from the OCFA and one Type 1 strike team from the MetroNet cities.

Riverside County fire crews protect homes in Yorba Linda

Prior to the Freeway Complex Fire being reported, all vacancies created by the deployment of OCFA fire engines to Santa Barbara and Los Angeles Counties had been filled. This was achieved by activating the OCFA relief engine fleet and "recalling" off-duty personnel or personnel reporting for normal duty at 8:00 a.m. on November 15.

At the onset of the Freeway Complex Fire, immediate resource requests were placed for Type 1 and Type 3 strike teams beyond what could be provided by the OCFA and local agencies. In total, 35 strike teams—175 engines—of various types were ordered within the first four hours of the incident. The OCFA and other Orange County cities provided seven Type 1 strike teams and one Type 3 strike team—40 engines total. By noon, six strike teams—30 engines—had arrived from Riverside County. By 1:30 p.m., a total of 19 strike teams—95 engines—and 1 task force—6 engines—were operating on the fire. This was in addition to the 58 engines, 3 trucks, 8 patrols, and 5 water tenders that responded as single increments to the Freeway and Landfill Fires. While some resources were coming from an extended distance, prior to 2:00 p.m., 159 engines were assigned to and operating on the Freeway Complex Fire.

> The early ordering of resources made it possible for 159 engines, 3 trucks, 8 patrols, and 5 water tenders to be operating on the Freeway Fire by 1:30 p.m.

The availability of resources was largely due to the lack of competition for resources from other fires. A change in the resource ordering policy after the 2007 fire siege also proved to be beneficial. This change allowed for Operational Area and Regional Coordinators to directly request up to five strike teams—25 engines—across operational area boundaries based on the closest resource concept. This was in contrast to the previous rule that permitted only one strike team to be obtained outside the regional ordering system.

Air Resources

Unless owned and operated by local government, air resources—helicopters, fixed wing air tankers, lead planes, and air attack platforms—are coordinated by CAL FIRE and the United States Forestry Service (USFS). In Southern California, the Southern Region Operations Center in Riverside is the base for this joint operation.

Air resource requests are prioritized based on factors, including threat to life and property. New fire starts receive the highest priority for aircraft, because the greatest opportunity for control is during the initial attack phase. Aircraft assigned to active fires may be diverted to a new incident unless a "no divert" order has been established. No divert orders are only established when aircraft are on fires where structures are burning or immediately threatened and there are no higher priority fires in the region.

On Friday, November 14, 2008, CAL FIRE pre-positioned four air tankers, two helicopters, and two air attack aircraft in Southern California. These aircraft augmented CAL FIRE resources of two air tankers, one helicopter, and one air attack already in place at the Hemet and Ramona airbases. The net effect of the pre-positioning of Northern California-based aircraft to Southern California was to double the number of available aircraft at each airbase.

Air Tanker dropping retardant along a ridgeline

To prepare for the Red Flag Warning expected across parts of Southern California, CAL FIRE signed a one-week contract for the DC-10 Air Tanker 910 based out of the San Bernardino International Airport. The Federal airbase in San Bernardino was also up-staffed with four air tankers, two lead planes, and two air attack aircraft. On Saturday, November 15, all State and Federal aircraft were assigned an 8:00 a.m. start time. The initial attack aircraft for the Freeway Complex Fire were dispatched at 9:35 a.m. with the first aircraft arriving at 10:10 a.m.

OCFA Helicopters 41 (HC41) and 241 (HC241) were dispatched to the Freeway Complex Fire from Fullerton Airport at 9:08 a.m. on November 15. The winds at Fullerton Airport were light and blowing offshore. After lift-off, the flight crews saw the smoke column rising from the fire in Corona was building and beginning to bend. The Santa Ana wind was having a strong influence. A 30–40-knot headwind was measured by an airspeed indication of 110 knots and a ground speed reading of 70 knots. Wind turbulence, coupled with the building low level smoke, made it difficult for the helicopter pilots to maintain visual flight conditions and make effective water drops.

Orange County Sheriff's Department (OCSD) helicopter Duke 1 also responded on the initial dispatch with the ORC helicopters. Duke 1 arrived over the fire about 9:30 a.m. but had to land to

deploy its 170-gallon bucket prior to engaging in the firefight. Duke 1 and the ORC helicopters were initially using the lake and water hazards of the Green River Golf Course as their water source. The buffeting wind soon made hovering to fill the bucket and water tanks too hazardous. A ground-based water point was established, so the helicopters could land and be filled safely.

OCFA helicopter uses a snorkel to refill its water tank.

Incident commanders on the ground quickly recognized the need for additional aircraft. At 9:19 a.m., they ordered one air attack, two air tankers, and two additional Type 2 helicopters. At 10:10 a.m., these air resources arrived over the Freeway Complex Fire. The aircraft order was augmented once again at 10:10 a.m., with an order for one lead plane, three air tankers, and four Type 2 helicopters.

Helicopters may fly at sunrise and up to 30 minutes after sunset. On the first day, all initial attack aircraft flew the maximum possible hours. Around 8:30 p.m., the aircraft were released to their home bases. Mandatory work-rest cycles for pilots demand they receive eight hours of uninterrupted rest before flying again. This meant the earliest a pilot could take off to return to the fire on Sunday, November 16, was about 6:00 a.m. With the preflight inspection time, flight time to the helibase, and briefing time once there, an 8:00 a.m. start time was projected for all assigned helicopters. By 9:00 a.m., all assigned helicopters were flying over the fire.

OCFA helicopter coming in for another load of water.

By the conclusion of the Freeway Complex Fire, 17 firefighting helicopters had been assigned. These were supplied from local, state, and federal agencies, as well as helicopters from private vendors that were on a call when needed (CWN) contract basis. During the first six hours of the Freeway Complex Fire, OCFA helicopters dropped 48,400 gallons of water and foam. By the end of the second day, a total of 88,000 gallons had been dropped. During that same two-day period, 12 fixed wing air tankers with four lead planes operating from the San Bernardino and Hemet air bases dropped 208,791 gallons of retardant. The DC-10, Air Tanker 910, made a record-setting ten air drops applying a total of 109,445 gallons of retardant in the Yorba Linda and Chino Hills areas.

All aircraft orders were filled for the Freeway Complex Fire. However, one Federal helicopter was diverted to a new fire start while it was awaiting demobilization from its base. The availability of air resources greatly differed in comparison to the 2007 Santiago Fire, where much of California's airborne fire suppression resources were already actively engaged in firefighting efforts—or were grounded due to severe wind conditions.

Air tanker lays a retardant line in front of the fire to slow its forward progress.


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Logistics Support

The Incident Command System (ICS) has proven itself valuable in managing emergency incidents worldwide. ICS is a flexible, scalable response framework where firefighters from various agencies, who may not routinely work together, can fight major incidents through standard response and operation procedures. A critical component of ICS is the logistical support function. This effort can be compared to establishing and maintaining a small, temporary city designed for the sole purpose of supporting all the needs of an incident. In the case of the Freeway Complex Fire, the proximity of the fire to several hundred Yorba Linda homes and the near 70 mph winds made it apparent that the logistical needs for this incident were going to be significant and challenging.

The Incident Base takes shape in Irvine Park.

The extreme weather conditions and the potential for loss of lives and structures made it clear full implementation of the Logistics Section (LOGS) would be required. ORC Battalion Chief Runnestrand was ordered as the Logistic Section Chief for the Freeway Complex Fire. Personnel from the OCFA Service Center provided much-needed logistical support with water, food, and deployment of a logistical cache that is stocked and ready for immediate use. The cache included 10,000 feet of wildland hose, foam, tools, and medical supplies. Within the first hour, an order was placed for 500 sack lunches. This order was increased to 2,000 within the next hour.

The Logistics Section from CAL FIRE Incident Command Team 6 eventually assumed all logistical needs for the Freeway Complex Fire. The Logistics Section Chief, his Deputy, and the leaders for each of the six logistics units blended effortlessly with OCFA personnel who had already begun the logistic coordination. The decision was made to keep this blended effort throughout the fire, which was another lesson learned from the 2007 Santiago Fire.

Initially, the Yorba Regional Park was designated as the incident base due to its proximity to the fire. As the fire threatened the City of Yorba Linda, and before the base had been completely established, the decision was made to move it to Irvine Regional Park. This facility had been used in previous incidents and was familiar to the OCFA logistics team. Additionally, the park's size, parking, and convenient access to major freeways better met the demands of the nearly 4,000 personnel and equipment assigned to the incident. Overall, the support needs were met in an effective and efficient manner.

The success of LOGS on the Freeway Complex Fire was largely the result of the support, cooperation, and hard work of individuals representing the Orange County Sheriff's Department, Irvine Regional Park staff, Citizens Emergency Response Teams (CERT), and numerous vendors

and businesses throughout the area, along with the exemplary training and professionalism of the firefighting personnel.

The following six units combine to make the Logistics Section for a major incident such as the Freeway Complex Fire:

The **Food Unit** set up a mobile kitchen, allowing the serving of breakfast by the second morning. Until that was established, a mobile catering vendor was used to provide hot meals. Separate contract vendors provided sack lunches to meet the demand for on-the-line feeding of suppression crews and base personnel. Due to the more than 3,800 firefighters needed for this fire, the kitchen was unable to meet the meal demands in a timely manner and was augmented by the catering vendor. This solution met the needs of the incident efficiently and effectively.

The **Medical Unit** is tasked with providing everything from basic First Aid to advanced life support for incident personnel. A Medical Plan was published in the Incident Action Plan (IAP) and was followed successfully. No deaths or major injuries were reported on this incident. Contributing to the smoothness of this operation was the proximity to urban medical facilities and the training of many firefighters as Emergency Medical Technicians or Paramedics.

The **Communication Unit** provides the radio, pager, and Internet communication needs of the incident. Because of the mix of resources from within the County and beyond, a communications radio frequency patch was established allowing for shared radio communications with those having VHF radios and those with 800 MHz radios. This greatly enhanced communications and contributed to the safety of on-the-line resources in the early portion of the incident. Once the radio cache of 200 radios from the National Interagency Fire Cache (NIFC) arrived, the communication plan was transitioned to VHF radios for the remainder of the incident. The OCFA Logistics/Communications trailer was useful as a mobile office space to secure, protect, and deploy the equipment. Later, it became the on-site dispatch facility for the incident.

The OCFA Communications trailer supports incident communications.

The **Supply Unit** orders and disburses supplies necessary for the incident. Everything from the requests for fire engines and aircraft to the purchase of sleeping bags and batteries is funneled through this unit. Staff from the OCFA Service Center was invaluable in providing early support and assistance. The wildland cache—a predetermined complement of tools, equipment, and supplies stocked by the OCFA and available for immediate use—was brought to the base. It provided needed resources until the larger cache from South Operations arrived.

The **Facilities Unit** creates and maintains the physical layout of the incident base camp. Consideration must be given to all aspects of supporting the incident. Included are the staging of operations; maintaining and repairing of apparatus; feeding and housing of assigned personnel,

including the special needs of inmate crews; providing suitable working space for the administrative and support positions including—but not limited to—the Incident Command Post (ICP); and providing showers, laundry, and other support functions for personnel assigned for extended periods.

The Facilities Unit on the Freeway Complex Fire benefited from several factors in creating an efficient base camp. A pre-existing agreement with Irvine Regional Park and the familiarity with the layout coupled with the outstanding cooperation with the park staff, made for a quick and painless setup. The close proximity to the OCFA's RFOTC allowed for a sharing of assets—especially early on—that normally would not be considered. The CERT personnel filled many roles within this unit and clearly contributed to its success. Finally, the Orange County Sheriff's Department's command vehicles (Samantha 1 and 2) were put to good use and were greatly appreciated.

The Facilities Unit on the Freeway Complex Fire created an efficient base camp to support the needs of more than 3,800 personnel.


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Incident Communications

During the first 24 hours of the Freeway Complex Fire, incident radio communications were initiated using the County of Orange 800 MHz Countywide Coordinated Communications System (CCCS). The fire service in Orange County has been on the 800 MHz System for the past 20 years. Since 1999, it has been the countywide network shared by all public safety agencies in Orange County. Over 16,000 mobile, portable, and base station radios are on the system servicing fire, law, public works, and lifeguard agencies throughout the County. All mobile and portable radios have common channels for inter-agency communications.

The 800 MHz CCCS has proven to be a highly sophisticated and reliable communications system for the public agency users in Orange County. Several other fire and law agencies throughout Southern California use radios with common national 800 MHz frequencies—the same as those used on the Orange County system.

The 800 MHz radio system was well-used by all first responders. A total of 78,892 transmissions were conducted midnight-to-midnight on November 15. This represents the seventh busiest day in the history of the 800 MHz CCCS. Only one "busy" event—all channels were busy—occurred during this time. On November 16, usage dropped to about 63,000 transmissions, as fire agencies transitioned much of their radio communications to the VHF (Very High Frequency) radio channels provided by the CAL FIRE IMT. All 800 MHz radio systems remained operational, although some fire damage was sustained at two radio sites.

During the fire, the 800 MHz system was never at full capacity. Despite the intense communication needs, the 800 MHz system's design assured excess capacity was always available. The system was designed and built to handle high volume radio traffic as experienced during the 2007 Santiago Fire. **Table 7** below provides a comparison of a normal daily 800 MHz radio system number of transmissions. The comparison date of November 15, 2007, was chosen simply as the same time of year and a non-major fire day.

Table 7: Total Number of 800 MHz CCCS Transmissions
(All Disciplines Countywide)

Date – 2008	Number of Transmissions	Date – 2007	Number of Transmissions
November 15	78,892*	November 15	57,184
November 16	63,719	November 16	56,522
November 17	58,099	November 17	52,601
November 18	57,552	November 18	44,703
November 19	58,474	November 19	50,141
November 20	54,951	November 20	53,615
November 21	59,878	November 21	52,769

*This day represented the seventh busiest day in the history of the 800 MHz CCCS.

As indicated in the table above, the first 24 hours of the incident were the busiest. An approximate 38 percent increase in radio traffic occurred on the 800 MHz Radio system as compared to the

same dates in 2007. This activity level started to decrease as the CAL FIRE IMT arrived. The IMT used the VHF radio system for major incident radio communications. As the incident continued to expand, an order was placed for the National Incident Fire Cache (NIFC) to support the large number of resources responding from various agencies throughout the state.

The NIFC cache includes radios, repeaters, and common frequencies standard to all fire agencies throughout the country. All Orange County fire agencies maintain radios common to the system used with the NIFC radios on VHF spectrum. The NIFC cache maintains over 40,000 radios available for use during major incidents, such as Hurricane Katrina, earthquakes, and multiple fires as in the October 2007 fire siege. Resources responding are also required to have VHF radios as part of their mutual aid response equipment. Standard training on the operation and support of the NIFC system assigned to major incidents is provided throughout the year and throughout the country. The change in radio systems occurred on Sunday, November 16, at 7:00 a.m., the second day of the fire, during the morning shift change.

As of Sunday, November 16, 800 MHz radio transmissions were slightly higher than normal and remained at that level throughout the duration. As the fire progressed and more out-of-area resources arrived, most of fire communications had been moved to the VHF radio channels. Although, the 800 MHz radios was still being used by the OCFA and other Orange County agencies for supplementary communications.

A radio "patch" had been initiated between the VHF "Orange County Access" channel and the 800 MHz "4C" talk group on November 16. Radio patches connects two different radio systems operating on different frequency bands, allowing for seamless communication. This allowed any VHF radio being used at the incident to communicate with command staff operating on the Orange County 800 MHz system (Channel 4C). This patch remained operational on the command channel until the end of incident. Feedback from communications staff assigned to the incident indicated this worked well, including in places where the incident radio repeaters did not work.

Personnel using VHF radios made early reports indicating they were unable to make contact with those using 800 MHz radios. This was mainly due to the radio "patch" frequencies not yet being in place. The problem was corrected once the patch was established. This concern and others regarding user familiarity and training are being addressed by an After Action Communications Committee comprised of representatives from CAL FIRE and OCFA.

Additionally, a number of reports of VHF radios not being able to cover specific areas in Carbon Canyon were received by the communications staff. This problem is inherent in the area for all wireless communications, due to the deep and narrow canyons. This problem was corrected by placing a manual repeater in the Carbon Canyon area of Sleepy Hollow. Coverage and interoperability is always a safety concern when mixing radios from different systems with different users. Commanders and supervisors had to take extra precautions to ensure any emergency radio traffic would be heard and acknowledged.

Several of the 2007 Santiago Fire After Action Report communications recommendations were implemented for the Freeway Complex Fire with good success:

- A total of 32 relief engine/strike team communications kits were in place. Each kit contained the necessary radios and pagers for use by emergency crews assigned to surge fire engines activated during the incident.
- Every OCFA first responder apparatus was provided with VHF radios compatible with state and federal resources communications.
- An 800 MHz to VHF radio patch was set up on the Command Channel for interoperable communications among all agencies responding.
- Satellite data communications was set up at the incident base in the early stages of the incident.


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Emergency Operations Center

The Freeway Complex Fire impacted a vast geographical area, including several cities and counties. The cities of Anaheim, Brea, Chino Hills, Diamond Bar, and Yorba Linda activated their Emergency Operations Centers (EOC) as the fire moved into their communities.

The Yorba Linda Assistant City Manager activated the EOC at approximately 12:45 p.m. on November 15. City personnel with EOC responsibilities were called back to help staff the center. The OCFA dispatched Battalion Chief Valbuena to the Yorba Linda EOC at 12:30 p.m. to serve as an Agency Representative to provide fire information and situation status in support of EOC operations. Two OCFA Fire Prevention personnel were also sent to assist the Agency Representative and help with structure damage assessment. Additionally, the Yorba Linda Water District (YLWD) sent a representative to act as liaison to the City of Yorba Linda's EOC. Both OCFA and YLWD representatives worked jointly to address the water supply problems that occurred during the fire. These jurisdictional EOCs assisted with coordinating local issues in cooperation with the County EOC, such as evacuation of residents, coordination of evacuation centers, street closures, coordination with school districts and businesses, and coordination of local government resources.

With the initial activation of the City of Yorba Linda and the City of Orange EOCs, and the predicted fire activity of the Freeway Fire, the County of Orange Operational Area EOC was activated on Saturday, November 15, 2008, at 11:00 a.m.

Early in the incident, the Operational Area EOC was activated to support the roles and responsibilities of the County of Orange. This activation requires personnel pre-identified to the policy group and other personnel trained in support functions to be contacted. The personnel responds to the EOC located at the Orange County Sheriff's Department's Loma Ridge Communications Facility near the City of Orange. Representatives from the County Executive Office, Orange County Public Works, Orange County Sheriff's Department, Probation, OCFA, Orange County Waste and Recycling, Health Care Agency, Social Services Agency, and the County Emergency Manager make up the policy group. An EOC Liaison, Public Information Manager, and various staff supported the policy group. This group was faced with several decisions during the EOC activation, including health issues related to air quality, evacuation of residents, closure of major roadways, and identification of shelter needs.

The County EOC- Policy Room

One of the first tasks completed by the Emergency Management staff was to notify the Chair of the Board of Supervisors, the Emergency Management Council, the Operational Area Executive Board, Operational Area Members, County agencies, and the State Office of Emergency Services of the incident.

The general public was kept informed through press releases, media interviews, and jurisdictional websites. This was the first test of the new Operational Area EOC website. The website served as a critical point for information distribution. Public information was actively managed via the website, including the dissemination of 25 news releases and/or media advisories and regular press briefings.

An additional method of releasing pertinent information to the public was the new County mass notification system, AlertOC. AlertOC was used during the EOC activation on behalf of the City of Yorba Linda. The request for the County to activate this system came at 3:52 p.m., and the message was issued at 4:09 p.m. The system was used to alert residents in the immediate path of the fire to evacuate the area.

The Orange County Social Services Agency, American Red Cross, and the Orange County Department of Education all collaborated and helped coordinate the opening and management of evacuation shelters for residents affected by the fire. The shelter locations included Katella High School, Valencia High School, and the Brea Community Center. Two other shelters—Travis and Esperanza—were initially opened, but they had to be closed due to the impact of smoke. Over the three days these shelters were opened, they registered over 919 individuals—with 229 evacuees staying in the shelters overnight and nearly 1,320 meals provided.

A Local Assistance Center was established near the affected population of the Freeway Complex Fire. The City of Anaheim graciously hosted the Local Assistance Center at the East Anaheim Gymnasium. This location was large enough for public, private, and non-profit agencies to come together and provide assistance to the local residents and businesses.

Orange County Community Resources, Animal Control Division, assisted with the establishment of animal shelters. The Orange County Animal Shelter was opened to accept small animals, while the Los Alamitos Race Course and the Huntington Beach Equestrian Center were opened to accept large animals.

Early on, the EOC Manager requested County counsel to create an emergency proclamation in accordance with County of Orange ordinance and the Operational Area Emergency Plan. The local proclamation was signed on Saturday, November 15, 2008. The State of California was informed of the signed emergency proclamation and that Orange County was requesting a State Gubernatorial Proclamation and Federal Declaration of Emergency. The Governor issued a State Proclamation late Saturday, November 15; however, a federal declaration was not issued until Monday, November 17.

Governor Schwarzenegger receives a briefing.

The 2008 Freeway Complex Fire challenged the County Emergency Operations Center on a different level than the 2007 Santiago Fire. During the Freeway Complex Fire, the County's main responsibility revolved around operational area coordination and mutual aid support. The lessons learned during the Freeway Complex Fire will improve the County's coordination of information

and resources during a major incident or catastrophic event. As staff to the Emergency Management Council and the Operational Area Executive Board, the Sheriff's Department Emergency Management Bureau will ensure enhancement of existing plans, procedures, training, and response.

By the end of the incident, the cities of Yorba Linda, Brea, Anaheim, and Chino Hills and the County of Orange Operational Area had all declared a local emergency. Additionally, due to fire and/or smoke conditions, the Brea Olinda Unified School District, Placentia Yorba Linda School District, Anaheim Hills Montessori, Calvary Christian School, St. Angela Merici Catholic School, St. Francis of Assisi Catholic School, Christian Preschool and Elementary School, and the St. Joseph Catholic School and Preschool were closed for one or more days.

The cost for the response to the Freeway Complex Fire for the County's EOC, Orange County Sheriff's Department field response, and Orange County Public Works Storm Center and field response along with the damages sustained to the Brea Olinda Landfill are currently estimated at $3,585,000. The Operational Area EOC was officially deactivated at 7:00 p.m. on Monday, November 17. Refer to the **Orange County Sheriff's Department After Action Report** at http://www.ocfamedia.org/_uploads/PDF/fcfaarocsd.pdf for additional details.


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Media and Public Communications

The Corporate Communications Section was responsible for disseminating information and handling public relations during the Freeway Complex Fire. This included the responsibility for the activation of the Media Center, conducting the Public Information Officer (PIO) function for the incident command, updating of the OCFA website, and handling inquiries from elected officials. OCFA Board of Directors and City Managers were issued advisories via email. The advisories kept board members informed and allowed them to make inquiries to the Corporate Communications Battalion Chief. With the extreme fire behavior, rapid spread, and threat to homes, the OCFA new there would be great media interest.

The OCFA Media Center was activated soon after the start fire. Personnel were called back to duty and were answering telephone calls by 10:00 a.m. Staffed by four personnel from Community Relations and Education in the first couple of hours, additional professional staff from Finance, Fire Prevention, and Human Resources were put into service answering calls by noon the first day. The Media Center staff was further supplemented with two personnel from CAL FIRE. Their PIO experience was invaluable as they were able to assist OCFA personnel in handling media inquiries and by answering calls from the public. From the onset on November 15 until the fire was declared fully controlled on November 19, the Media Center received over 6,000 calls from the public and the media.

Communications between the OCFA Media Center and the Orange County Emergency Operations Center (EOC) was efficient throughout the incident. A total of 25 press releases and media advisories with information on evacuations and road closures were issued in a coordinated fashion between the Media Center and the EOC.

Reporting the Fire

OCFA was able to assign a Community Education Specialist to the Disaster Center established for Yorba Linda residents. The Education Specialist distributed informational fliers and was able to answer questions from the community. On the third and fourth day of the incident, the Community Education Specialists also conducted school programs for the entire school population of two of the elementary schools in Yorba Linda. The programs educated the children on the disaster in their community and helped to allay their fears. The school programs were very well received by the students and faculty.

The OCFA website (www.ocfa.org) received almost 1.4 million inquiries during the first day of the incident. Nearly 5 million inquiries were made from November 15 through November 25, 2008. Prior to November, the average number of inquiries to the website was 25,171 per day. The website was a key source of information about the fire. OCFA personnel provided updates to the website as often as possible. A fire progression map was uploaded every 12 hours. Only a small number of personnel were available to perform website updates, and the updating was a slow and cumbersome process. At times, fire and evacuation information needed updating, but qualified personnel were not available. Complaints were received about the freshness of website

information and the difficulty of navigating through the site as well as conducting information searches.

OCFA was also in the midst of a PIO transition at the time of the Freeway Complex Fire. The newly selected PIO was not scheduled to start his assignment and was on vacation at the beginning of the incident. The Corporate Communications Battalion Chief served as the initial point of contact for media inquiries. To gather information, he responded directly to the Incident Command Post that had been established at the Green River Golf Course. All media inquiries were referred to him, and the number of cell phone calls being received was overwhelming. This made it extremely difficult to communicate with the Media Center and delayed getting updated information relayed. Around noon, a Fire Prevention Specialist was assigned to answer calls and handle all communication with the Media Center—while the Battalion Chief provided media interviews.

OCFA Assistant Chief of Operations Mark Kramer briefs news crews.

The rapid spread of the incident and the difficulty in communications between the field and the Media Center lead to some confusion. Incongruent information ended up being disseminated to the media. Additionally, the media became aware of water supply issues on the incident prior to field PIOs and the Media Center; this contributed to the confusion and inaccurate information.

The Incident Management Team PIO arrived early in the afternoon the first day. The PIO transition meeting was attended by the Chino Hills Fire District PIO, CAL FIRE – Riverside County PIO, Anaheim City PIO, and Anaheim Police Department PIO. Coordination between CAL FIRE – Riverside County, the IMT PIO, and OCFA was good throughout the incident.

The OCFA PIO returned from vacation upon learning of the Freeway Fire and arrived at the incident at around 10:00 p.m. the first day. Since the incident had already been transitioned to the IMT, the OCFA PIO was assigned to the base camp and worked with the pool of PIOs who were already assigned. The OCFA PIO worked the night shift. However, it would have been more advantageous to have the OCFA PIO work during the day because of his knowledge and familiarity with the local media. After the first day, most of the media inquiries came during the day.

Fire Investigation

The Freeway Fire originated in Riverside County near the 91 Freeway and the Green River off-ramp in the City of Corona. The area of origin is the jurisdiction of CAL FIRE; therefore, CAL FIRE investigators assumed the responsibility for the fire investigation. The preliminary fire cause is reported as accidental. The preliminary cause may be the result of a vehicle exhaust system igniting roadside vegetation. The fire investigation report is expected to be complete by the end of March 2009.

CAL FIRE arson investigators search the area of origin of the Freeway Fire for evidence.

The Landfill Fire, investigated by the Brea Police Department along with investigators from the OCFA, was determined to have been caused by inadequate maintenance of power lines supplying electricity to equipment in an oil field. The electrical lines are owned by Breit-Burn Management Company in Los Angeles. Investigators believe arcing or a discharge of current from the power lines caused the brush near the lines in the fields northeast of Valencia Avenue and Carbon Canyon Road to ignite.

The origin of the Landfill Fire is seen behind the homes in the City of Brea.


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Volunteer Groups and Resources

Many volunteer groups assisted during the Freeway Complex Fire in various capacities. Major volunteer groups included:

- American Red Cross
- Salvation Army
- Community Emergency Response Team (CERT)
- OCFA Chaplains
- Trauma Intervention Program (TIP)

These volunteer groups provided invaluable assistance to a wide variety of non-suppression and incident support activities. The positive attitude, helping nature, and initiative of these groups were recognized and appreciated by OCFA staff, the Incident Command staff, and those who responsible for supervising and managing various support functions.

The American Red Cross is the lead agency responsible for establishing and staffing evacuation centers during disasters and other major emergencies requiring evacuation of large numbers of residents. During the Freeway Complex Fire, three evacuation shelters were established. The first was at Valencia High School in the City of Placentia; the second at Katella High School in the City of Anaheim; and the third at the Brea Community Center. While these shelters were in operation, 202 volunteers and staff worked, 919 people registered, and 1,320 meals were served—along with numerous snacks. All three shelters were opened Saturday, November 15 and closed Monday, November 17.

Evacuated residents are served dinner at one of the local high school evacuation centers.

The Community Emergency Response Team (CERT) Program educates people about disaster preparedness for hazards impacting their community. CERT trains people in basic disaster response skills such as fire safety, light disaster and rescue, team organization, and disaster medical operations. Using classroom and field exercise training, CERT members assist others in their neighborhood or workplace following an event when professional responders are not immediately available to help. CERT members also are encouraged to support emergency response agencies by taking a more active role in emergency preparedness projects in their community. CERT is part of the Federal Government's Citizen's Corp Program. More than 150 volunteers and 38 partner agency staff assisted with the American Red Cross response.

The CERT Mutual Aid Program (CMAP) is an organization of Orange County CERT jurisdictions and citizen volunteers. They are dedicated to collaboration and coordination of volunteer activities in a disaster response. Jurisdiction coordinators and volunteers are governed and supported by a mutual aid agreement, approved in August 2008 by the Orange County Executive Committee and

added to the County's emergency response plan. The mutual aid agreement identifies the CMAP organization and outlines the course of action to be taken to activate Orange County volunteers.

The request for the activation of CERT volunteers for the Freeway Complex Fire was based on a previous use of volunteers during the October 2007 Santiago Fire. In the early morning hours of Sunday, November 16, a request from the Orange County EOC was received to activate mutual aid volunteers to the Irvine Regional Park base camp. Calls were made to CMAP Coordinators to begin the process of volunteer and equipment activation. Agencies affected by the fires (Anaheim, Fullerton, and Placentia) activated CERT members within their own jurisdictions.

CERT volunteer assists in directing resources at the Freeway Complex Fire Incident Base.

During the Freeway Complex Fires, 254 civilian volunteers covered 168 hours of activation at the Irvine Regional Park base camp. Volunteers worked shifts ranging anywhere from 4 to 12 hours. Coordinators were present for all shifts. Support roles included traffic safety management at base camp and assisting in strike team demobilization. A request was made to fill CMAP volunteer shifts from Sunday, November 16, to Wednesday, November 19, with a possibility of expanded volunteer coverage to Friday, November 21.

CMAP operational periods were selected by CERT Coordinators. The CERT Coordinators worked 12-hour shifts (4:00 p.m.–4:00 a.m. and 4:00 a.m.–4:00 p.m.), and the CMAP volunteers were assigned 12-hour shifts (5:00 p.m.–5:00 a.m. and 5:00 a.m.–5:00 p.m.), with an additional 4-hour shift in the morning and evening to assist with volunteer changeover.

CMAP representatives from Newport Beach, Seal Beach, Garden Grove, San Juan Capistrano, Huntington Beach, Costa Mesa, and Anaheim responded as Technical Specialists from November 16 to November 21. Coordinators from Newport Beach, Seal Beach, San Juan Capistrano, Huntington Beach, and Garden Grove filled the 12-hour on-site shifts. Huntington Beach and Costa Mesa representatives coordinated volunteer scheduling.

Representation of CERT members included Costa Mesa (43); Newport Beach (34); Garden Grove (60); San Juan Capistrano (22); Irvine (11); Huntington Beach (24); Dana Point (10); Santa Ana (2); Anaheim (1); and West Orange County CERT, which included the cities of Seal Beach, Westminster, Cypress, Los Alamitos, La Palma, and Buena Park (47).

The CMAP organization has worked with the Urban Area Security Initiative (UASI) Grant Program since 2005. Its goal is to create regional equipment caches to support CERT programs countywide and to respond upon request. The cities of Seal Beach, Dana Point, Fullerton, and Anaheim have dedicated supplies for CMAP response. Seal Beach provided the response equipment trailer and tow vehicle for this activation—while the Garden Grove CERT program provided a volunteer rehab vehicle and radios.

On Sunday, November 16, OCFA implemented its Occupant Liaison Program. OCFA personnel with fire department vehicles were assigned to the American Red Cross Centers and went into the fire areas to support the citizens of Yorba Linda. The Occupant Liaison Program provides customer service for information, coordination, and comfort to individuals experiencing emergency incidents such as fires, floods, mudslides, or any other type of incident resulting in the displacement of the occupants from their residences or places of business. Four Occupant Liaison Teams—comprised of an OCFA Fire Prevention Inspector, a Trauma Intervention Program (TIP) representative, and an OCFA Chaplain were available.

The Trauma Intervention Program (TIP) is a non-profit volunteer organization of specially trained citizen volunteers. They provide immediate emotional and practical support to victims and their families following a tragedy or traumatic event. TIP provided volunteers to the OCFA Occupant Liaison Teams. They were invaluable in assisting with counseling residents who had been evacuated or whose homes were damaged or destroyed.

The Salvation Army is a non-profit organization with a history of providing services and programs during times of disaster in Orange County over the last 100 years. Its community services also include transitional housing, emergency shelters, counseling, and responding to emergency disasters. Over the last couple of years, the Salvation Army has responded to many local disasters including the Santiago and Freeway Complex Fires. Through the mobilization of over 100 volunteers, the Army provided assistance to those affected by the disasters with food, clothing, and counseling, as well as services provided to first responder fire and law enforcement personnel. The Army mobilized its Emergency Disaster Canteens providing food, beverages, water, and a variety of personal items. The Salvation Army responds to emergency disaster events by providing a myriad of equipment, supplies, and volunteers.

OCFA has a long-standing and very active volunteer Chaplain Program. Members of the Chaplain Program were an important piece of the Occupant Liaison Team. They were on-hand and available to support and assist residents with their spiritual needs during this crisis. They also helped with other non-suppression support duties.

Many other accounts of individual volunteers providing assistance during the Freeway Complex Fire abound. Having trained, qualified, and eager volunteers who are capable of assisting in non-suppression activities freed up full-time firefighting personnel. In turn, they could focus solely on fire suppression efforts. Additionally, they assisted in providing human services, aid, and comfort to evacuated residents and those whose homes were damaged or destroyed. The contributions and assistance of all volunteer groups and the individual volunteers were invaluable.


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Fiscal Impacts

Each year, the OCFA establishes cost reimbursement rates. They are used to bill for personnel and equipment resources requested on an assistance-by-hire basis by state, federal, and other agencies needing OCFA services. The personnel rates are based on budgeted salary and benefit costs. Also included are indirect costs such as financial services, purchasing, and human resources. Equipment rates are based on rate schedules provided by CAL FIRE and the Federal Emergency Management Agency (FEMA). These rates recover OCFA's costs when assisting other agencies or when an OCFA incident is declared a major incident subject to public assistance funding.

Public assistance funding is authorized by the Stafford Act and funded through FEMA. The Stafford Act:

- Gives the President the authority to administer federal disaster assistance.
- Defines the scope and eligibility criteria of the major disaster assistance programs.
- Authorizes grants and direct assistance to the states.
- Defines the minimum federal cost-sharing levels.

As of January 31, 2009, OCFA's costs from the Freeway Complex Fire are estimated at $2.3 million. Due to the magnitude of the fire, both FEMA and the State's Office of Emergency Services (OES) declared the Freeway Complex Fire as a major incident. They offered to provide public assistance funding to the participating agencies.

Following guidelines for federal public assistance, on November 20, 2008, a Local Government Fiscal Responsibility Agreement was made between CAL FIRE, FEMA/OES, and OCFA concerning reimbursement of resources for the Freeway Complex Fire. Based on the Local Government Fiscal Responsibility Agreement, OCFA expects reimbursement of approximately 94 percent of costs associated with the fire. **Table 8** below shows costs and the source of anticipated reimbursements.

Table 8: OCFA Cost Reimbursement

Reimbursement	FEMA	CAL FIRE	OES	Total
Claim Submitted	$527, 210.20	$1,575, 775.84	$184,670.07	$2,287,656.08
Estimated Percent of Reimbursement (%)	93.80	100	100	
Estimated Total Reimbursement	$494,523.17	$1,575,775.84	$184,670.07	$2,254,969.08
OCFA's Share	**$32,687.03**	**$0.00**	**$0.00**	**$32,687.03**


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Recovery Efforts

As the Freeway Complex Fire was being controlled, efforts began to address the post-fire risk to lives and property that could arise during the coming rainy season. The combined effects of vegetation loss and the effect on soils from fire, created conditions greatly increasing the threat of floods, erosion, and debris flow in the impacted areas.

To prepare for the winter, the OCFA, along with the California State Office of Emergency Services (OES), coordinated assessments of the burned areas with Burn Area Recovery Teams (BART). These teams consisted of representatives from CAL FIRE, California Geological Survey, Department of Water Resources, Department of Fish and Game, Department of Parks and Recreation, and Regional Water Quality Control Boards. Refer to the **Burn Area Recovery Team Report** for more details— http://www.ocfamedia.org/_uploads/PDF/fcfaarbart.pdf.

The BART members conducted a rapid assessment of the fire area to identify hazards and subsequent mitigations including:

- Identifying on-site and downstream threats to public health or safety from land sliding, debris torrents, flooding, road hazards, and other fire-related problems.
- Identifying threats to watershed resources, including excessive erosion; impaired water quality; threats to wildlife, fisheries, and botanical values; and cultural resources.
- Determining measures needed to prevent or mitigate identified threats.

Sand bags in place west of Banyon Rim.

The BART report provides mitigations to reduce—but not entirely eliminate—risk from the identified hazards. Suggestions such as straw mulching and erosion control fabric or blankets, straw wattles to provide a mechanical barrier to water flow and trap sediment, hydro-mulching in selected areas, and K-rails to direct water run-off, if used properly, are very effective.

The following are some of the recommendations for specific areas from the BART report:

- Where possible, drainage basins be expanded and cleaned of all debris. Adequately sized culverts should be placed within the debris basins so flood waters will be discharged effectively. Residents are discouraged from using plastic ground covers: they cause an acceleration of water runoff within the burn area.

- The Ranch in the Olinda Village area will require a large soil berm, K-rail, or rip-rap to direct watershed discharge around the threatened property.

- In general, residences located at the base of the hills in Chino Hills, Yorba Linda, and Brea should take precautions to limit impacts of future rainfall through the use of K-rail,

sandbags, or other flood prevention barriers. Additionally, keeping existing culverts free of debris would be a priority to ensure proper drainage.

- Expect higher than normal watershed discharges with possible debris flow in all rain events for the next two or more rain seasons.

- Specific areas along the BNSF railroad were addressed: Box Canyon and Horse Shoe Bend. An early warning monitoring system with various monitoring points along the hillside above the railroad is advised. Additionally, a minimum of three debris basins should be constructed around Horse Shoe Bend. This will ensure debris is collected prior to making contact with the railroad tracks.

- Emergency evacuation plans should be implemented for all communities within the burn area.

- Any dead/fire burned trees and vegetation and live standing trees that could cause damming or choking of debris in creeks or drainage basins should be removed immediately. A plan should be developed and approved by appropriate agencies to remove problem vegetation for any remaining downstream areas.

- All county, private, and state roads and trails should be monitored for washout and debris flow during and after precipitation events.

- The Chino Hills State Park should be monitored for debris and sediment flows during and after rain events, as large amount of debris may flow into the sediment basin reservoir and cause erosion along roads, bridges, and trails.

Use of K-rail to channel future debris flow around homes.

Resident's preparation for possible mud and debris flow proved to be beneficial.

A moderate to heavy rainstorm was predicted for the Orange County area on November 26–27, 2008. Predicted rainfall amounts ranged from 1.5 inches to 2.5 inches. The OCFA began preparations for the possibility of mud and debris flows by working closely with the local communities of Yorba Linda, as well as the Santiago Fire areas. Evacuation plans were coordinated with local government and law enforcement in the areas directly impacted by fires.

The three main objectives for the OCFA were to (1) provide incident management and support if significant flooding and debris flow occurred in the burn areas, (2) coordinate weather-related calls for service with the City of Yorba Linda, and (3) assist with the timely and orderly evacuation of residential areas as necessary.

The following OCFA resources were pre-staged to reduce reaction time and get needed help to any impacted areas quickly. The augmented resources were staged at the Yorba Linda Community Center.

- An Incident Management Team
- One Bulldozer
- Two Swift Water Rescue units
- One Handcrew
- One Type 3 Strike Team
- Two Reserve Patrols: 10 and 32

Dozer clearing mud off the street following the rains that hit the fire consumed areas of Yorba Linda.

The City of Yorba Linda and its residents played a significant role in preparing for the rain event. While fire crews were continuing to overhaul the burn areas, community efforts were underway to fill, distribute, and place sandbags, straw bales, and other mitigation efforts. This effort also drew volunteer participation from across the city, as well as from other cities across the county.


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Major Challenges

- Over the last decade, Southern California has experienced eight years of drought conditions, contributing to an increase in dead fuels, explosive and dryer fuels, and more intense fire behavior.[2]

- A sustained Santa Ana wind event contributed to two significant fires starting less than two hours apart in the same area of Orange County. The extreme winds, rapid fire spread, and urban interface environment created a wide fire front. This had a major impact on resource availability.

- Houses with unprotected vents and other openings became vulnerable to ember intrusion. Raging winds turned burning fuel into an "ember-storm," threatening at-risk homes in the fire's path.

- The OCFA, pursuant to a Board-adopted policy, dispatches a minimum of 18 firefighters to a single "working structure fire" (4 engines, 1 truck company, and 1 paramedic) as the necessary "Effective Firefighting Force." That ratio of firefighters to working structure fire was not possible to achieve during the Freeway Complex Fire.

- While conducting structure protection during the Freeway and Landfill Fires, interior firefighting was often needed. A Federal mandate and best practice, the "Two-in and Two-out Rule" demands that in the absence of a life safety or rescue scenario, two or more firefighters are required to conduct interior firefighting with a minimum of two additional firefighters on standby outside the occupancy ready to conduct firefighter rescue. To comply with this safety rule, four-person staffing is required on a single engine company. Since most OCFA engines are staffed with three firefighters, they were not safe nor within legal guidelines to conduct interior operations without support from a second company.

- Wind blown embers, carried aloft by the fire's thermal column, created spot fires more than a mile ahead of the main fire front. These spot fires then merged with the main flame front. This rapidly compressed the transformation time from brush fire into urban conflagration.

- The Freeway Fire and the Landfill Fire began in rapid succession and made resource tracking, command and control, and communications more difficult during the initial attack phase. Many responding agencies converged on the incident simultaneously making resource accountability extremely difficult.

- Two additional brush fires—the Landfill and Diemer Fires, in western Yorba Linda—along with the Freeway Complex Fire jumping the 91 Freeway in two places, further stretched the already taxed resources.

[2] US Geological Survey. *Water Watch Past Stream Flow Conditions*. Accessed http://water.usgs.gov/waterwatch/?m=statesum&r=ca&w=statesum%2Cmedian on March 6, 2009.

- Two strike teams were requested by ORC Battalion Chief Reeder to stage at Station 53 in preparation of the fire's arrival to Yorba Linda. These strike teams self-diverted to Green River and the 91 Freeway.

- The incident impacted two Office of Emergency Services regions, four counties (Los Angeles, Orange, Riverside, and San Bernardino), and five emergency dispatch centers. Impacting these major geographical areas created communication, operational, and command challenges.

- The lack of common radio communications presented significant challenges. Some local agencies do not have VHF high band capability as required by FIRESCOPE. Many agencies continued to use their own radio systems or failed to follow the established communications plan. This further exacerbated the fire-ground communications problem. Additionally, the terrain in the fire area was extremely broken and mountainous--hampering radio transmissions.

- Self-dispatching of off-duty firefighters on relief apparatus to the fire presented challenges to personnel accountability and safety. In some instances, these resources were not discovered to be at the fire for 12 hours or more.

- Many mutual aid resources had difficulty navigating through unfamiliar local communities. Resources lacked a reliable mapping method of locating specific fire-impacted areas.

- The incident was run as a unified complex. It started as two fires in the same general area, and a central ordering point was established for both fires through the OCFA. The large incident culture and command structure are unfamiliar to many local agencies, creating confusion.

- An initial challenge occurred in working with law enforcement to form a unified command structure and to have a single decision maker. Prior experience on the part of the participating agencies facilitated this process.

- The conflict between state (SEMS) and national (NIMS) definitions for evacuation terminology continues to cause confusion for the media and public (mandatory vs. order/warning).

- The loss of water pressure in the Hidden Hills community and in other neighborhoods was a major challenge for the ground forces protecting threatened structures.

- More than 375 law enforcement personnel from various agencies assisted the Brea Police Department during the fire. Providing them with accurate and timely information on areas to be evacuated or repopulated was challenging.

- A rapidly developing fire that stretched over a large urban area made it difficult for the OCFA Media Center to stay current on fire conditions and information.

- Fire extinguishment efforts placed an extreme demand on the water system. Whether due to the use of master stream devices, the numerous firefighting hose lines, and/or the scores of garden hoses left running at individual homes, the demand on the system taxed the water capacity and deliverability.

- Homeowners—those remaining within the fire perimeter and those who evacuated—created traffic challenges inhibiting the movement of fire apparatus.

- The speed and unpredictability by which the fire moved through the urban interface made it challenging to stay ahead the fire and rapidly identify areas to be evacuated.

- Ornamental vegetation provided an unexpected source of fire brands the wind was able to carry deep into residential neighborhoods. Palm trees were a significant contributor to this problem.

- Wooden decks, balconies, and other unprotected structures provided an entry way for embers and flames to enter homes.

- Due to the demand to keep pace with a rapidly moving fire, a "bump and run" tactic was employed. In some cases, structures had to be left unattended after initial extinguishment, resulting in some rekindles and the loss of structures. This may not have occurred had there been sufficient units to employ an "anchor and hold" strategy.

- Fire retardant "drift" from air tankers created a major safety and post-fire clean-up challenge. Large amounts of fire retardant from aircraft was either dropped on homes or drifted far from the target due to the winds.

- The Department Operation Center (DOC) was not established until OCFA Division Chief Robinson arrived at the OCFA Emergency Command Center (ECC) at approximately 11:30 a.m. on November 15. This led to difficulty in receiving, placing, and tracking orders early in the fire.

- The presence of private fire protection services created operational challenges and a level of confusion among residents. These resources, normally sponsored by homeowners' insurance companies, currently have no operational guidelines, certification standards, and no common communications with the incident commanders.

- A Red Flag Warning or a Red Flag Fire Weather Watch had not been issued for Orange County. Wind prediction for the day was significantly different than experienced. This resulted in the OCFA not implementing its Extreme Weather Plan (SOP 209.13) or the Red Flag Alert Program (SOP 209.12). Either or both would have increased public awareness and implemented operational procedures in response to the extreme weather conditions.

- Due to the size and rapid growth of the incident, meeting all logistical needs in the early stages was challenging.


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Successes

- Importantly, no loss of life occurred. Reported injuries were few and considered minor.

- Hundreds of structures were successfully protected. Low humidity and high winds made this a very dangerous time for fires in the wildland urban interface (WUI). Although structures were lost and damaged, if not for the excellent work of the firefighters and citizens who protected their homes, the losses would have been greater.

- The Unified Command Incident Management Team worked well together. Although the team was large, each agency was mindful of the others' needs. This helped create common ground on difficult issues. As challenges arose, all the agencies worked toward the common goal of meeting the incident needs.

- Coordination with law enforcement was excellent. The early integration proved to be extremely advantageous for citizen evacuation. Additionally, the placement of law enforcement personnel within Operational Branches helped reduce the lag time for evacuations.

- The advance planning and tabletop exercise given in preparation for an incident in the mutual threat zone provided for a more effective command and control.

- A smooth transition occurred from the initial attack incident commanders and the incident management team. This can be attributed to an attitude of cooperation and respect.

- Despite the radio communication problems, water supply issues, and the time required to assemble the required firefighting assets to meet the demand of this urban conflagration, personnel worked hard to contain this incident and to minimize loss.

- Interagency cooperation was effective in solving issues and obtaining necessary resources. Operationally-related activities such as traffic control, evacuation, and repopulation were easy to implement due to the close coordination between the involved agencies.

- The integration of OCFA personnel into all general staff positions provided the CAL FIRE IMT 6 with local knowledge and expertise essential to the successful conclusion. Local agency participation in strategy meetings helped obtain agency support and "buy in" for the operational plan.

- The Orange County Access Channel was used as the Incident Command Net. Thus, all ORC 800 MHz radio users, and VHF high band users, could communicate on one common channel.

- The use of OCFA's new Compressed Air Foam System (CAFS) units was highly successful. The high mobility of the units allowed for quick pick-up and redeployment. The foam lasted longer than expected and freed other resources for other assignments.

- The OCFA was able to quickly provide representatives to the County and City Emergency Operation Centers. This enabled a direct line of communication between the impacted jurisdictions and the incident command team.

- Using Community Emergency Response Team (CERT) personnel—to perform various functions within the incident base—freed fire personnel for other assignments.

- The incident was able to provide three structural engines to support the local water supply system.

Recommendations

Mitigation and Preparation

1. Continue regional planning efforts. Establish interoperable communication plans for mutual threat zones. *In Progress*

2. Develop regional operating plans (similar to Silverado Canyon Fire Plan) for high fire severity zones. *In Progress*

3. Develop a rapid attack mobilization plan that facilitates dispatch, mobilization, and situation management practices during major emergencies or Red Flag Warning conditions. *In Progress*

4. Work with local water agencies to evaluate potential threats and weaknesses to the water distribution systems and facilities housing critical infrastructure. Assist in the development of a mutual aid plan between water agencies permitting inter-agency cooperation during major emergencies. Develop contingency plans and practical exercises to test for vulnerabilities. *In Progress*

Prevention and Public Education

1. Facilitate the development and enforcement of applicable building and fire codes for fuel modification and building construction in the wildland-urban interface (WUI) environment. *In Progress*

2. Develop informational material for ornamental vegetation planting and maintenance to reduce flame spread and ember production.

3. Provide sufficient Occupant Liaison personnel to assist residents when returning to evacuated areas. Selected OCFA professional staff, when trained, may fit this role appropriately.

4. Ensure the terminology used in regard to public evacuation is commonly understood and is in conformance with SEMS/NIMS and/or FIRESCOPE to minimize confusion between public agencies.

Operations and Response

Resources

1. Complete development of a formal plan for placing "surge capacity" engines in service. The plan should address storage of the units, outfitting, communications, and staffing. *In Progress*

2. Complete the modification of five patrols to compressed air foam system (CAFS) units. Develop use and response configuration plans. *In Progress*

3. Establish a full-time fire handcrew. Handcrews are needed to meet our wildland fire suppression mission. Fire crews are consistently listed as critical resource needs during every wildland fire. *Delayed due to budget*

4. Develop and consider alternatives for staffing additional fire bulldozers when needed.

5. Develop internal staffing criteria for water tenders, patrols, and other critical resources when Reserve personnel are unable to respond. *In Progress*

6. Develop a policy pertaining to the use of privately-owned resources such as water tenders, earth moving equipment, and other support resources that may be used when offered during emergency situations.

7. Follow through with the staffing recommendations from the Santiago Fire to increase the staffing at stations with a Type III engine to four personnel. In the interim, achieve this through the use of back-fill for two months during the peak of fire season as a reasonable stopgap until this can be achieved. *In Progress*

8. Work with law enforcement to develop more effective evacuation and repopulation procedures.

Communications

1. Increase CAL FIRE Command Net radio coverage in Orange County by adding two or more additional radio repeaters. *In Progress*

2. Exercise radio interoperability in Orange County regularly. Radio users must be familiar with VHF radio operations.

3. Establish a VHF frequency group for State Responsibility Areas (SRA) in Orange County, so all responding units can operate on this group. The command and tactical nets should be established before an incident occurs. *Complete*

4. Continue efforts to equip all resources in Orange County with VHF radio capability per FIRESCOPE. *In Progress*

Incident Command/Management

1. Develop a program to increase the availability of Incident Management Team(s) for year-round response within Orange County.

2. Continue to evaluate ICS training needs and offer appropriate courses to all personnel including Command staff. *In Progress*

3. Provide periodic refresher training on the use of firing operations to all chief officers.

4. Review and consider currently available technology, such as Toughbook laptop computers, for use in all command vehicles and eventually on every fire engine. These computers

should have mapping software installed and maintained. These tools have proven to be invaluable resources on fires and provide critical information for planning and firefighting purposes.

5. Continue the development and use of ICS trainee positions to facilitate succession planning and the development of incident management teams. *In Progress*

6. Identify additional potential assignments for OCFA professional staff on major incidents. *In Progress*

7. Develop a policy for interacting with private fire protection resources.

Air Operations

1. Develop best practice staffing and deployment model for the OCFA helicopter program.

2. Develop a policy on first and best use of law enforcement helicopters. Where appropriate, assist local law enforcement agencies to obtain red-card certification for pilots, fueling operations, and helicopter use on local government fires.

3. Train and qualify additional OCFA personnel as Air Ops Branch Director (AOBD), Air Support Group Supervisor (ASGS), Helicopter Coordinator (HLCO), and Helibase Manager (HEMB).

4. Complete night vision goggle training to provide night flying capability. *In Progress*

5. Research the feasibility and local use of unmanned aerial vehicles (UAV) to facilitate mapping during smoky conditions.

6. Pre-identify helispots and water source dip sites in fire prone areas.

7. Increase mobile refueling capability for helicopters.

8. Establish a land use agreement with Corona Airport for future deployments.

9. Develop best practices for aircraft use on wildfires. Aircraft are a proven asset and, unlike ground forces, are limited by daylight flying time. Practice and policy should be developed to ensure "first light" use of all air assets.

10. Provide periodic training to Chief Officers on the use of interagency radios and communications with the aircraft command and control elements (ATGS and HLCO).

Emergency Command Center

1. Develop an operations manual for the OCFA Department Operations Center (DOC). The manual should identify critical positions within the DOC and outline critical tasks needing to be completed during a major emergency or event. *In Progress*

2. Order ECC support personnel to support incident command teams and expanded dispatch as needed. This will help with ensuring orders are placed correctly and assist the plans section on arriving resources.

3. Provide managerial support in the absence of the ECC Chief. The DOC Manager must be able to provide managerial support and operational and tactical guidance to the ECC Supervisor.

4. Empower ECC Supervisors to modify normal dispatch procedures to meet operational needs and station coverage during major emergencies.

Logistics

1. Ensure adequate fuel and equipment support is available during major emergencies.

2. Identify and pre-plan additional base camp locations for WUI fires. *In Progress*

Training

1. Provide *S-215 - Fire Operations in the Wildland/Urban Interface* course to all OCFA company officers. Include annual refresher on the use of firing operations. *In Progress*

2. Continue to train with law enforcement personnel in the complexities of extended attack incidents and unified command procedures.

3. Conduct on-site training of the Freeway Complex Fire for Chief Officers of the affected agencies.

4. Train OCFA Fire Prevention personnel to be able to function as a City EOC Agency Representative.

5. Provide training to selected professional staff to assist the Public Information section.

6. Provide WUI structure protection tactics training to all operations personnel.

7. Initiate a training program with the water districts that includes ICS/NIMS/SEMS, and with tabletop exercises.

Volunteer Groups

1. Continue the use of Community Emergency Response Teams (CERT) for logistical support. Seek additional duties they may safely perform during major emergencies.

2. Develop a policy and procedure for accepting community support and offers to help or provide resources.

Public Information

1. Improve the OCFA website so incident information is easily and readily available. The site should incorporate technology to allow for interactive maps and data search.

2. Develop procedures for initiating frequent community briefings. Topics should include incident status, evacuation information, repopulation expectations, and other relevant information of interest.

3. Conduct training with Cities regarding Emergency Operations Center activities such as evacuation and repopulation procedures, media information distribution, and public notification.

As a result of the 2007 Santiago Fire, a detailed After Action Report was written that included its own set of recommendations. Prior to the Freeway Complex Fire, many of these recommendations had been implemented and proved to be beneficial. Others are being developed and worked on by established work groups. The use of these work groups should continue, and the recommendations within this report should be distributed among them.


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Glossary

AGENCY REPRESENTATIVE – Individual assigned to an incident from an assisting or cooperating agency. He/she has been delegated authority to make decisions on matters affecting that agency's participation at the incident. Agency Representatives report to the Incident Liaison Officer.

AIR ATTACK – Airplanes flying over an incident, providing tactical coordination with the incident commander on the ground, and directing air tankers and helicopters to critical areas of a fire for retardant and water drops.

ANCHOR AND HOLD STRATEGY – Structure protection tactic often used in a wildland urban interface fire. Firefighting forces engage the fire and then remain in selected areas to ensure no or limited fire starts after the passing of the fire front.

ARCING – Luminous discharge of current—formed when a strong current jumps a gap in a circuit or between two electrodes.

BASE CAMP – Location at which primary logistics functions for an incident are coordinated and administered—only one base camp per incident.

BRANCH – Organizational level having functional or geographic responsibility for major parts of incident operations. The Branch level is organizationally between Section and Division/Group in the Operations Section, and between Section and Units in the Logistics Section. Branches are identified by the use of roman numerals or by functional name (e.g., medical, security).

BUMP AND RUN STRATEGY – Structure protection tactic often used in a wildland urban interface fire where firefighting forces must keep moving ahead of the advancing fire. They attempt to control spot fires and/or provide initial knock-down of fires established within a structure.

BURN AREA RECOVERY TEAM (BART) – Team comprised of multi-agency and multi-disciplined resource specialists assembled to assess fire damage and suppression effects and to prepare mitigation measures. Upon development of a rehabilitation plan, the team makes recommendations on hazard mitigation.

BURN OVER – Wildfire situation where—because of wind-shift, topography, and/or poor planning—a person (firefighter) is caught in an inescapable fire and literally has fire burn over, under, and around him/her; this is the leading cause of firefighter deaths during wildfires.

CENTRAL ORDERING POINT – Facility or dispatch center where all personnel, supplies, and equipment requests are placed and tracked.

CHIEF OFFICERS – Agency Administrators, Fire Chiefs, Deputy Chiefs, Assistant Chiefs, Division Chiefs, and Battalion Chiefs with executive and/or management-level responsibilities.

COMPLEX – Two or more individual incidents located in the same general area that is assigned to a single Incident Commander or to Unified Command.

COMPRESSED AIR FOAM SYSTEM (CAFS) – Used in firefighting to deliver fire retardant foam for the purpose of extinguishing a fire or protecting unburned areas from becoming involved in flame. CAFS units are effective when used to pre-treat structures and vegetation with foam in advance of the fire to protect it from heat and flames.

CONFLAGRATION – Uncontrolled burning or fire that moves across natural and man-manmade barriers and threatens human life or property and the environment.

CONTAINMENT – Fire is contained when it is surrounded on all sides by some form of boundary, line, or clearance but is still burning and has the potential to jump or escape the containment line.

CONTROLLED – Fire is controlled when no further threat of it escaping outside the containment line exists.

COOPERATING AGENCY – Agency supplying assistance including—but not limited to—direct tactical or support functions or resources to the incident control effort.

DEFENSIBLE SPACE – Creating a fire safe landscape for at least 30 feet around homes—out to 100 feet or more in some areas—to reduce the chance of a wildfire spreading to structures. – Essentially, an area helping to protect a home and provide a safety zone for the firefighters battling flames.

DEFENSIVE – Firefighting mode primarily focusing on the protection of exposures through the confinement of the fire to a selected area.

DEPARTMENT OPERATIONS CENTER (DOC) – DOC provides agency dispatching capability independent and separate from routine emergency dispatch. The DOC is activated and staffed for large or complex incidents allowing personnel to focus efforts solely on the incident: maintaining situation status, processing orders for resources, and maintaining a direct link with EOCs.

EMERGENCY COMMAND CENTER (ECC) – Dispatch Center, an ECC is the center of an agency's information and communication capability. It is tasked with receiving and processing incoming calls for help. ECC personnel determine the nature of the request and forward it to the appropriate resource.

EXTREME FIRE BEHAVIOR – "Extreme" implies a level of fire behavior characteristics ordinarily precluding methods of direct control action. One or more of the following is usually involved high rate of spread, prolific crowning and/or spotting, presence of fire whirls, and/or strong convection column. Predictability is difficult since such fires often exercise some degree of influence on their environment and behave erratically and dangerously.

FIRE LINE – Area where the vegetation has been removed to deny the fire fuel—or a river, a freeway, or some other barrier expected to stop the fire. Hose lines from fire engines may also contribute to a fire being surrounded and contained.

FIRE MANAGEMENT ASSISTANCE GRANT (FMAG) – Federal assistance program

managed by FEMA through the State Office of Emergency Services (OES). Program is designed to help state and/or local jurisdictions impacted by high cost, high damage wildland fires.

FIRE PERIMETER – Entire outer edge or boundary of a fire.

FIRING OPERATIONS – Setting a controlled fire with the intent to create a fire break so the path of the fire will be impeded.

FIXED WING AIRCRAFT (AIR TANKERS) – Aircraft designed for the purpose of picking up and depositing fire retardant on a fire while in mid-air.

FUEL MODIFICATION – Modification and irrigation of combustible vegetation to reduce fuel energy output. Highly flammable wildland vegetation is replaced with managed areas of light or fire resistive fuels and thereby allowing firefighters the ability to control a fire while relatively small.

FUELS – Combustible material or vegetation.

GREY BOOK – Agreement between CAL FIRE and the six contract counties that addresses direct fire protection of State Responsibility Area (SRA) within each of the contract counties. Orange County, along with the other contract counties, receives funding from the state to provide protection to the SRA

HANDCREW – Team of wildland firefighters primarily assigned to fire line construction activities. Handcrews also mop up hot-spots, burn out vegetation to provide fuel free zones, and assist with hose lays.

HIGH WATERSHED DISPATCH – Level of dispatching ensuring the appropriate type and number of wildland firefighting resources based on current weather conditions.

INCIDENT COMMAND SYSTEM (ICS) – Standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

INCIDENT COMMANDER – ICS position responsible for overall management of the incident. Reports to the Agency Administrator for the agency having incident jurisdiction.

INCIDENT MANAGEMENT TEAM (IMT) – Incident commander and appropriate general and command staff personnel assigned to an incident. Also known as an Incident Command Team.

INITIAL ATTACK (IA) – Aggressive suppression action taken by first arriving resources with the priorities of protecting life, property, and the environment.

INTERFACE ZONE – Area where the wildland comes together with the urban areas. This is often referred to as the I-Zone or the Wildland Urban Interface (WUI).

MASTER MUTUAL AID SYSTEM – Creates a formal structure in which a jurisdictions

personnel, facilities, and equipment can voluntarily assist other jurisdictions when capabilities are overwhelmed.

MASTER STREAM – Controllable, high-capacity water jet used for manual firefighting or automatic fire protection systems; also known as a monitor, deluge gun, or deck gun.

MUTUAL THREAT ZONE – Area in which two or more jurisdictions have responsibility to protect in case of a fire, flood, or other emergency.

OFFENSIVE ATTACK – Putting water directly on the flames with the intent to extinguish.

OFFICE OF EMERGENCY SERVICES (OES) – The California Governor's Office of the Emergency Services.

PATROL UNIT – OCFA fire apparatus designed for wildland firefighting built on a heavy-duty passenger crew-cab truck chassis. It carries 100 gallons of water in a pressurized tank. OCFA Patrols are assigned to fire stations adjacent to wildland interface areas.

RATE OF SPREAD (ROS) – Relative activity of a fire as it extends from the point of origin and the total perimeter of the fire. Usually expressed in acres per hour.

RED FLAG WARNING – Term used by fire weather forecasters to alert users to an ongoing or imminent critical fire weather pattern.

REGIONAL ORDERING SUPPORT SYSTEM (ROSS) – Computer software program, which automates the resource ordering, status, and reporting process during a wildfire; tracks all tactical, logistical, service, and support resources mobilized by the incident dispatch community.

REHABILITATION – Activities necessary to repair damage or disturbance caused by wildfire or the wildfire suppression activity.

REKINDLED – Act of catching on fire once again; usually caused by a fire not fully extinguished.

RIPARIAN AREA – Interface between land and a stream—usually an ecological area with the abundance of both plants and animals.

SANTA ANA WINDS – Type of Foehn wind—a warm, dry, and strong general wind that flowing down into the valleys when stable, high pressure air is forced across and then down the lee side slopes of a mountain range. The descending air is warmed and dried due to adiabatic compression producing critical fire weather conditions. Locally, it is called by various names such as Santa Ana and Sundowner winds.

SOUTH OPS – Formally known as the Southern California Geographic Area Coordination Center (OSCC), it is the focal point for coordinating the mobilization of resources for wildland fire and other incidents throughout the Geographic Area. Located in Riverside, the Center also provides Intelligence and Predictive Services.

SPECIAL STAFFING – Persons put in place on assigned fire apparatus in addition to the normal staffing—usually done in case of an emergency such as a fire, wind event, or flood.

SPIKE CAMP – Remote camp usually near a fireline and lacking the logistical support a larger fire camp would have.

SPOT FIRE OR SPOTTING – Small fire ahead of the main fire—caused by hot embers being carried (generally by winds) to a receptive fuel bed or structure. Spotting indicates extreme fire conditions.

STATE RESPONSIBILITY AREA (SRA) – The California Board of Forestry and Fire Protection classifies areas in which the primary financial responsibility for preventing and suppressing fires is that of the state. CAL FIRE has SRA responsibility for the protection of over 31 million acres of California's privately-owned wildlands.

STRIKE TEAM – Engine strike team consisting of five fire engines of the same type and a lead vehicle. Strike team leaders are usually a Captain or a Battalion Chief. Strike teams can also be made up of bulldozers and handcrews. A strike team comprised of structure engines is designated with the letter "A"; i.e., 1400A. A strike team comprised of wildland engines is designated with the letter "C"; e.g., 9329C.

STRUCTURE PROTECTION GROUP – Two or more fire apparatus capable of pumping water for the purpose of preventing homes in a designated area from being burned by wildfire nearby.

UNIFIED COMMAND – Unified team effort allowing all agencies with jurisdictional responsibility for the incident, either geographical or functional, to manage an incident by establishing a common set of incident objectives and strategies.

WATER TENDER – Specialized firefighting apparatus capable of transporting a minimum of 1,000 gallons of water from a water source directly to the fire scene.

WILDLAND ENGINE (Type 3) – Fire engines designed for the wildland firefighting environment. Constructed on heavy-duty commercial truck chassis with high ground clearance and often equipped with four wheel drive. Type 3 engines carry 500 gallons of water and have a minimum pump capacity of 120 gpm at 250 psi.

WILDLAND URBAN INTERFACE (WUI) – Line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.


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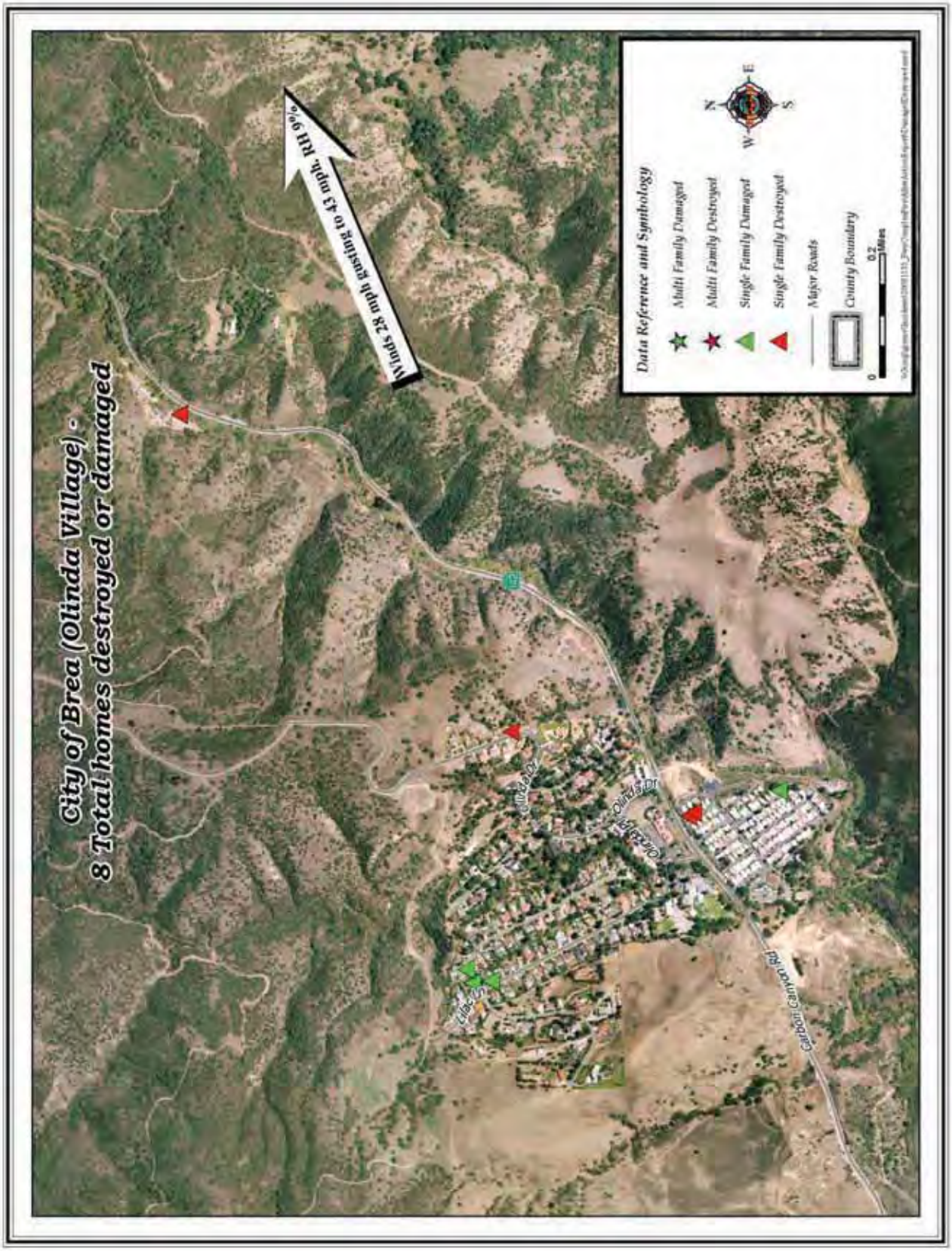
Appendix–Homes Destroyed or Damaged

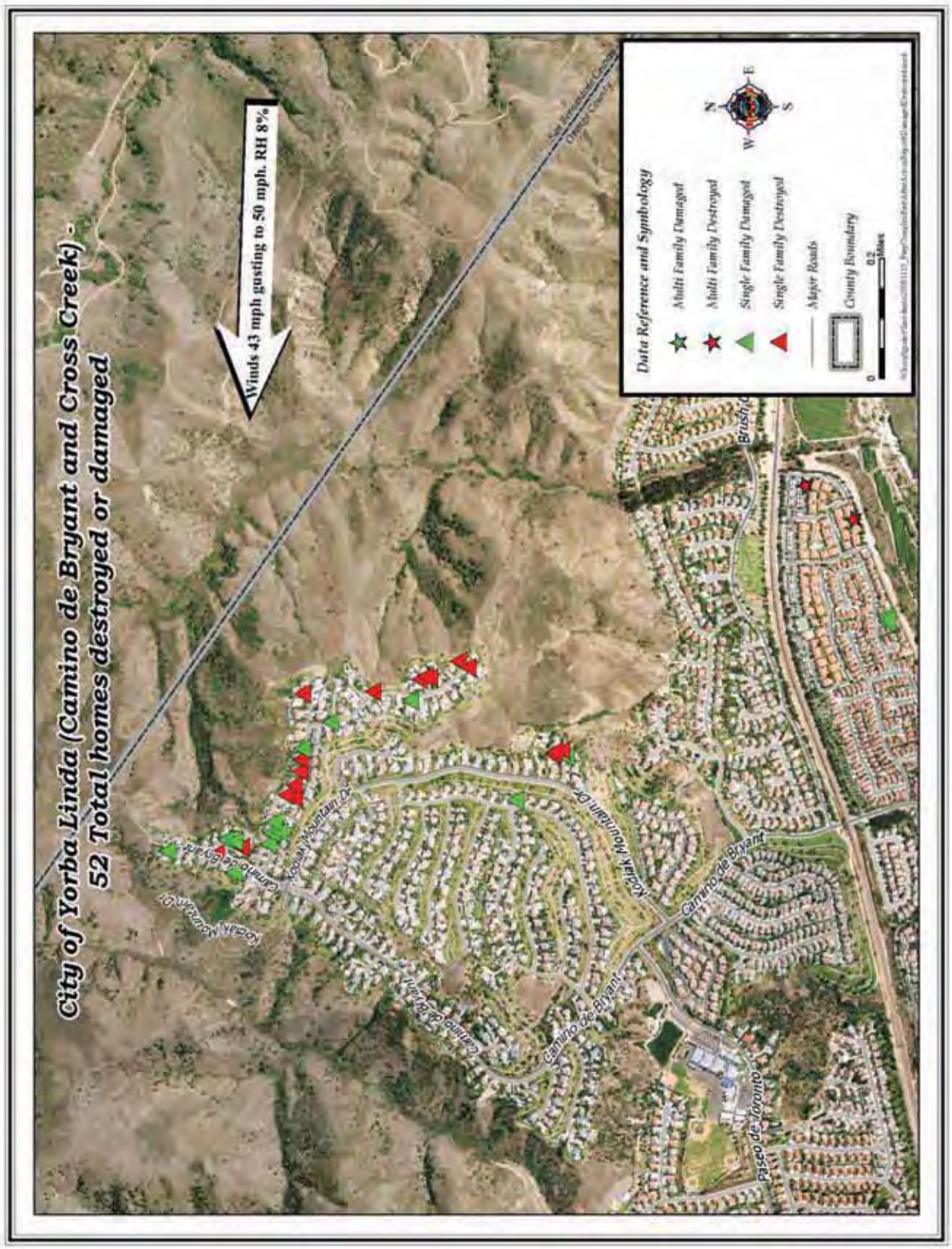
Map 16: City of Anaheim—Homes Destroyed or Damaged

Map 17: City of Brea—Homes Destroyed or Damaged

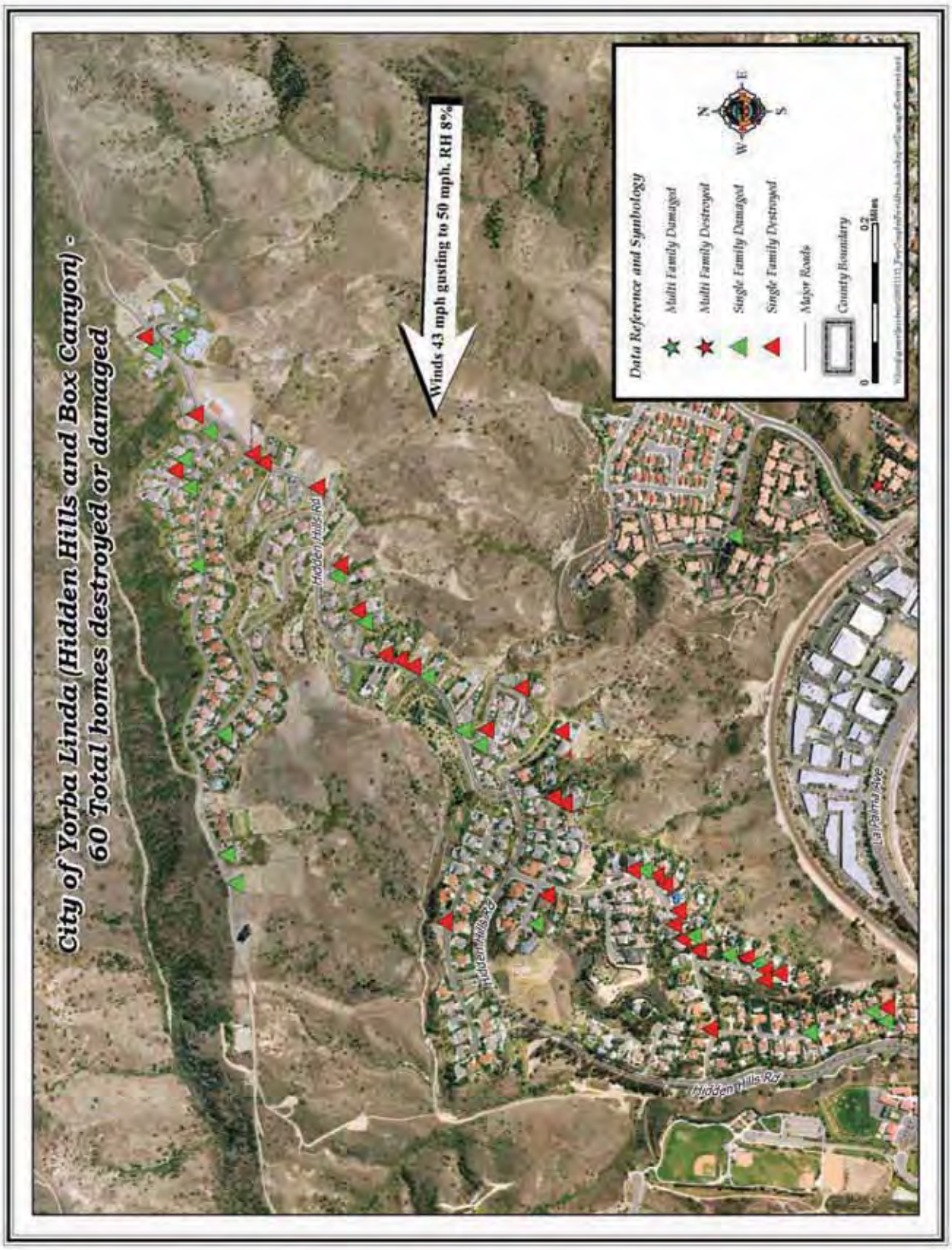


Map 18: City of Corona—Homes Destroyed of Damaged

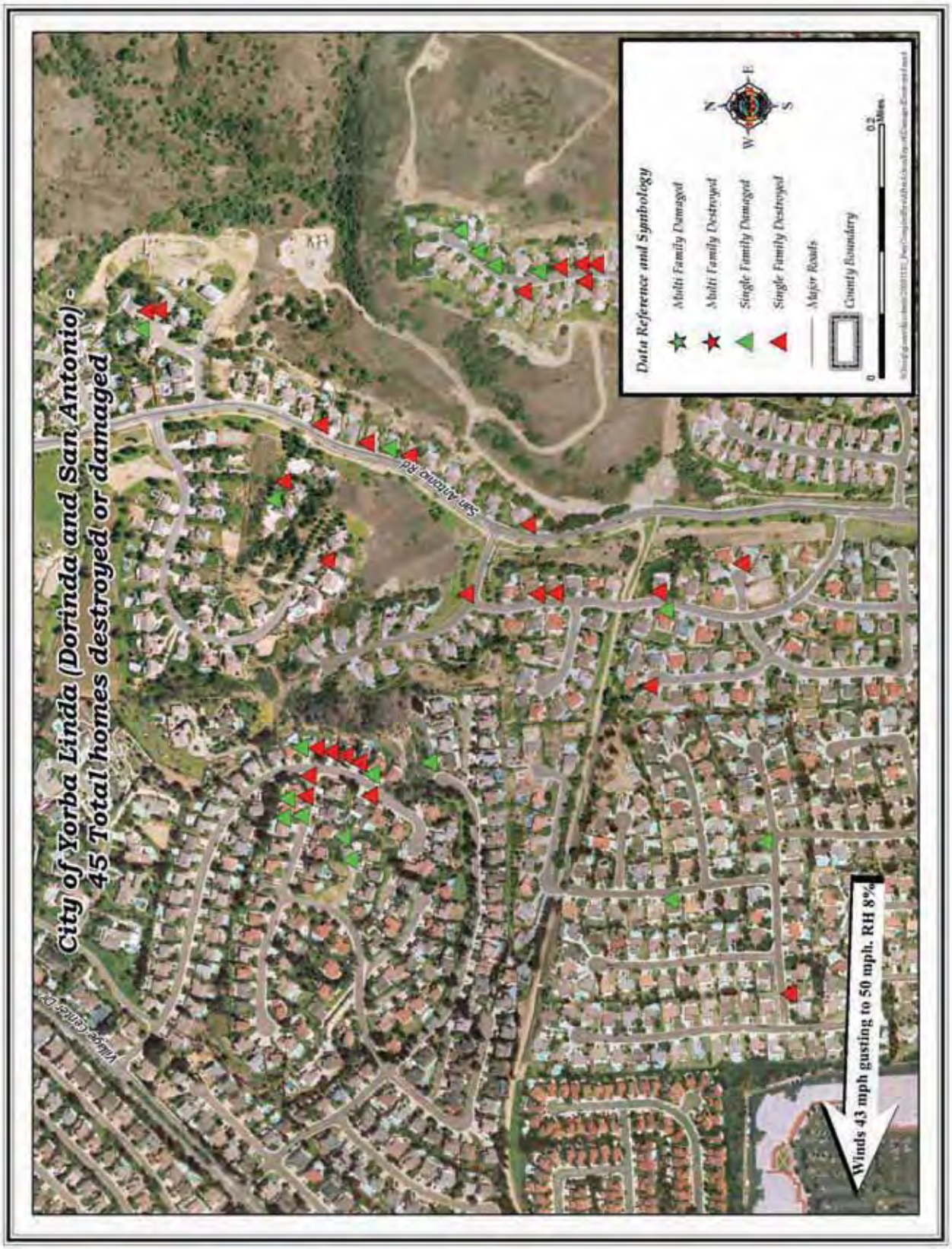
Map 19: City of Yorba Linda—Camino de Bryant and Cross Creek



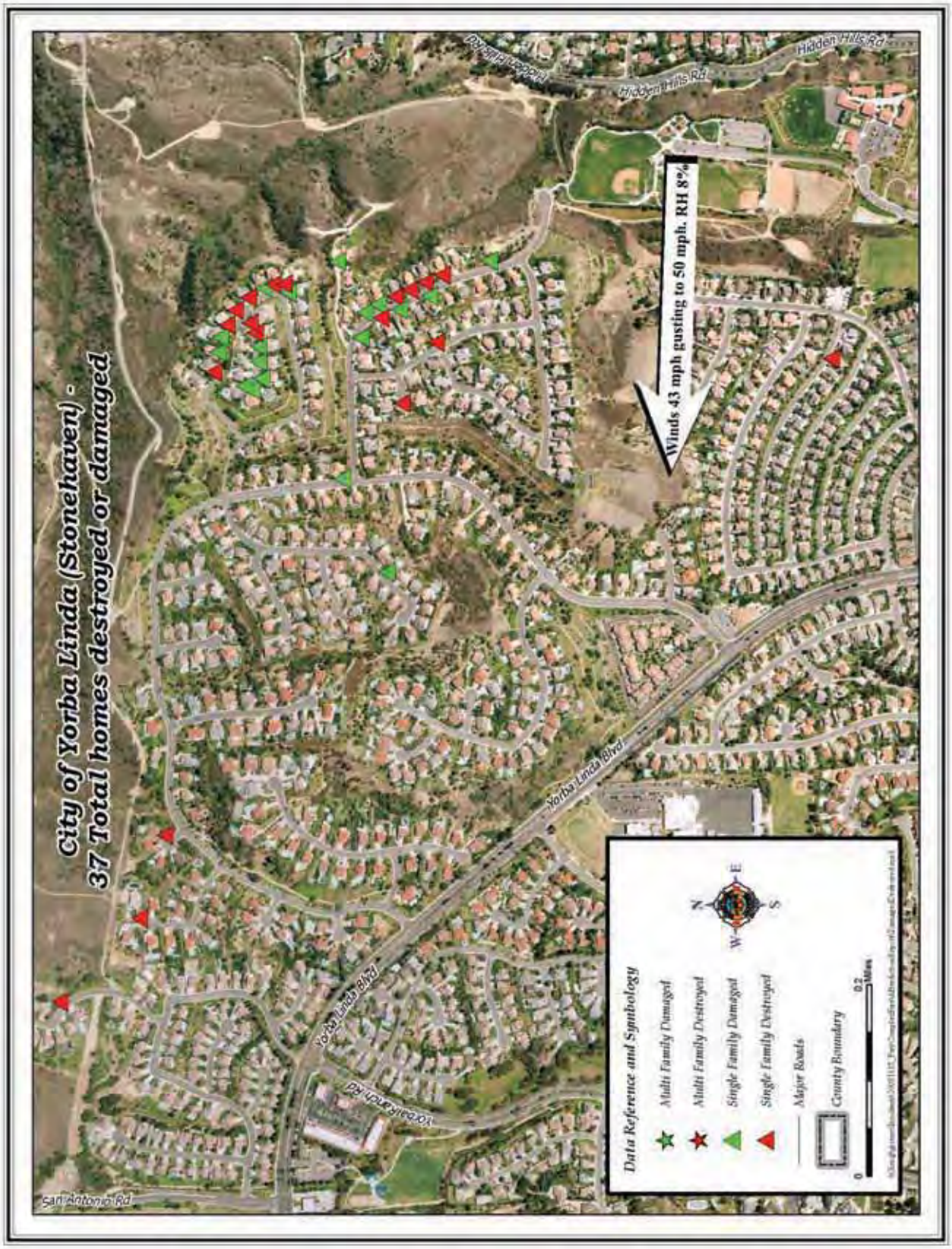
Map 20: City of Yorba Linda—Hidden Hills and Box Canyon



Map 21: City of Yorba Linda—Dorinda and San Antonio



Map 22: City of Yorba Linda—Stonehaven

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A most important thank you to the readers of this Report, who by taking time to study the actions and outcomes of the Freeway Complex Fire will be better prepared to respond to, support and manage emergency incidents that threaten communities, disrupt lives, and consume natural and financial resources.

A final thank you and acknowledgment to all of the citizens who were affected by the Freeway Complex Fire. The men and women of the Orange County Fire Authority sincerely thank you for allowing us to be your fire department.


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BBC NEWS

US & CANADA

1 February 2014 Last updated at 05:38 ET

Drought-hit California unable to supply state water

California's water agency has announced it may for the first time be unable to deliver water to local agencies, amid a worsening drought.

Two-thirds of state residents and 1m acres (404,500 hectares) of farmland get part or all of their drinking and irrigation supplies from the agency.

A state-wide drought was declared earlier this month, as the largest reservoirs sank to record low levels.

Forecasters have warned 2014 could be California's driest year on record.

The extreme conditions have already caused a wildfire that destroyed homes in the Los Angeles area.

Previous extremely dry years led to catastrophic wildfire seasons in California in 2003 and 2007.

'Drought is real'

It is the first time in the water agency's history that it has predicted a so-called "zero allocation", which will affect around 25m people.

State governor Jerry Brown said the announcement was a "stark reminder that California's drought is real".

He urged residents to conserve water, suggesting they avoid flushing toilets unnecessarily and to turn off the tap while shaving.

Meanwhile a spokesman for the state's farming federation called the news "a terrible blow".

The water originates from the Sacramento-San Joaquin River Delta.

It is delivered to local agencies via a vast network of reservoirs, pipelines, aqueducts and pumping stations.

The 29 agencies that draw from the state's water-delivery system have other sources, Associated Press reports, although these too have been badly hit.

More US & Canada stories

Stars pay tribute to actor Hoffman [/news/world-us-canada-26014039]

Robert De Niro is among actors and filmmakers mourning the sudden death of Philip Seymour Hoffman, 46, who died after an apparent drug overdose.