Applying the Lessons Learned

Basic Wildland-Urban Interface Fire Safety Concepts

(Re)building

1. A wood shingle roof has a higher probability of igniting from burning firebrands than native chaparral vegetation.
2. Even with a 100-foot 'brush clearance,' a house with a wooden roof has a 20 times greater probability of burning than a house with a non-wood roof (think firebrands).
3. Even a small two-story structure on level ground can create enough radiant heat during its burnout period to ignite wood siding, etc., on homes within an approximately 60-foot radius.
4. While the burnout period for chaparral fuels in a wind-driven fire is generally less than 15 minutes, the burnout period for structural fuels (houses) may last hours. During this time period your home may be subjected not only to invisible radiation heat from a neighboring burning house (convection heat if it sits on a slope below) that raises surrounding vegetation and structural fuels to the ignition point, but also to visible firebrands that may invade your home unnoticed.

(Re)landscaping

5. For a point source of radiation such as a tree or bush, the heat intensity decreases with the square of the distance from the source. Therefore, a tree burning within 20 feet of a window transfers only one-fourth the heat to the house compared with a tree burning within 10 feet, and only one-sixteenth of the heat compared with a tree within 5 feet.
6. For a line source of radiation, such as a hedge or row of trees, the heat intensity only decreases with the distance instead of the square of the distance, and a house receives this heat from all points along the line. Thus the heat intensity received 20 feet from a burning hedge is still one-half that at 10 feet and one-fourth that at 5 feet.
7. Increasing the number of flammable landscape plants around a home and increasing the number of trees, or both, will make a home more prone to fire, despite legal brush clearance.
8. The term 'fire resistant' is a misnomer in relation to flammability of plants and gives the homeowner a false sense of security, as all plants will burn under the proper fire weather conditions. In fire ecology the term 'fire-resistant' denotes that a plant is adapted to fire such as having thick bark (e.g., mature Ponderosa Pine), or when burned will readily resprout from epicormic roots or shoots (e.g., Coast Live Oak), or will regenerate through prolific seeding (e.g., Cistus sp.) These species named can burn readily under the proper conditions if not maintained in a fire-safe manner.
9. Landscape fuels that burn adjacent to a house create enough conductive and radiant heat to ignite wood siding, wooden decks, trellises, and can break windows. Unprotected windows are often the 'Achilles heel' for fire entry even on a 'fire-safe' designed home.
10. A six-foot-tall mature, continuous chaparral fuel mass burning on steep slopes can create enough radiant and convective heat during its burnout period to ignite upslope homes more than 100 feet away (in other words the flames and heat produced can reach across a 100-foot-wide fire safety zone (30-100-foot irrigated zone) to ignite flammable components on the house, especially if the house is unattended.

Fire Safety Concepts Related to Structures

(Major factors of home losses during the 1961 Bel Air/Brentwood Fire)

Home construction

1. 75% of buildings destroyed had wood shingle roofs.
2. 66% of dwellings which sustained any damage were first ignited on the roof.
3. 12% of dwellings destroyed had unprotected eaves as their point of entry for the fire.
4. 3% of dwellings destroyed had underflooring as their point of entry.
5. 1.5% of dwellings destroyed had windows as their point of entry.

Home Location

6. 70% of dwellings destroyed were located within 50 feet of chaparral.
7. 45% of dwellings destroyed had minimal or no slope setback.
8. 45% of all stilted or cantilevered homes were destroyed (mostly side-slope).
9. The burning of homes along ridge tops was not random but was directly correlated with the intersection of main and tributary canyons.
10. Homes situated in steep canyons, at the top of canyons, draws, saddles, along narrow ridges, without adequate slope setback, etc., were especially vulnerable to fire.

Fire Exposure (Risk)

Wildland fire exposure or risk can be defined as the probability that a given home, subdivision, or community will experience wildland fires within a given time period.

The degree of exposure (risk) an individual home, community, or section of a community faces is a function of the fire history (frequency & severity) in the surrounding vegetation, or probability of fire within a certain vegetation type, increase in fire frequency brought on by encroachment of the community into flammable watershed areas and nearby human activity, and site-specific exposure factors such as the proximity to flammable vegetation, siting of structures, construction materials, construction style, etc. (see below).

Fire Hazard

Wildland fire hazard can be defined as the potential severity of a fire in a given area due to the availability of:

1. Natural vegetative fuels
   Type and size of fuels, age, fuel continuity, fuel loading (amount of fuel), litter production (amount and type of litter produced by the plant during its seasonal growing cycle).

2. Landscaping/ornamental fuels
   Type and size of fuels, age, fuel continuity, fuel loading (amount of fuel), litter production (amount and type of litter produced by the plant during its seasonal growing cycle), maintenance of flammable landscape vegetation (or lack thereof) to make it less flammable or 'nonflammable.'

3. Man-made structural fuels and their design/location
   Size and type of flammable structural components such as wood roofs, wood decks, wood siding, exposed windows, wood window frames, open/non-enclosed eaves, non-protected exterior attic and underfloor vents (permitting fire entry into the interior of the structure), flammable fencing and railing, non-skirted underflooring of house or deck (unprotected from fire entry from underneath or the sides), flammable outdoor furniture, etc.

4. Topography (terrain)
   Topography and the siting of a structure are very critical factors in fire exposure or risk. For example, fire can travel uphill 16 times faster than downhill. A fire spreading uphill resembles a fire spreading before a strong wind. Other factors being equal, a fire burning on level ground will spread twice as fast when it reaches 30% slopes. The rate of spread will again double as the slope reaches 55%. Heat energy release rates will be correspondingly faster and greater as indicated by greater flame length per foot of fire line.

5. The overall development pattern of the area.
   Location and siting of homes within mountain topography (side-slope homes, homes located along ridges with minimum setback, homes located in saddles or draws, etc., are at greatest risk and are often considered 'a design for disaster'). Construction of homes, exposure of construction

materials, exposure distance to flammable vegetation and flammable structural fuels (such as closeness of homes to each other).

6. Typical fire weather conditions
   Low humidity, high drying winds, and high temperatures.

Dying in wildland fires

Old Topanga Fire Nov 2, 1993

On November 2, 1993, during the initial phases of the Old Topanga Fire (Malibu-Topanga Fire), another predictable but preventable design-for-disaster resulted in the incineration of two elderly mountain residents. They lived in a non-permitted temporary makeshift fire-trap trailer (almost all trailers in a wildland fire environment can be considered fire traps) without utilities such as water and electricity. The trailer home was accessible during the dry season by a narrow dirt road that led through the chaparral and across several small draws. The situation was known to fire personnel of close-by Los Aneles County Fire Camp 8, other County Department personnel as well as nearby wildland residents, some of whom had befriended the couple and assisted as needed and on whom they relied for assistance in possible emergencies. After the fire broke out, the wife, working in Santa Monica, heard about it and rushed home in the afternoon through traffic, roadblocks and fire lines to evacuate her invalid husband. After evacuating her husband and driving back along the dirt road to safety, her pickup was overrun by fire close to the safety of stand-alone fire-safe homes at the end of the dirt road below Fire Camp 8. The most accessible home at the beginning of the dirt road was empty and locked because the residents were on vacation and another had just been sold. Fire supervisory personnel at Fire Camp 8 familiar with the situation had apparently also been transferred prior to the fire, and the new personnel may have not been aware of the situation or could not assist as Fire Camp 8 was still in disarray at this time, as buildings and wood piles within the fire camp had also caught on fire.

In the area where the two fatalities occurred, the 1993 Old Topanga Fire had burned through an incomplete burnout within the 1985 Piuma Fire. The burnout was characterized by standing dead fuels characterized by a higher dead-to-live fuel ratio than would normally be found in 8-year-old chaparral regrowth. Additionally, because of further disturbance, the degraded woody chaparral had a high herbaceous flash fuel component.

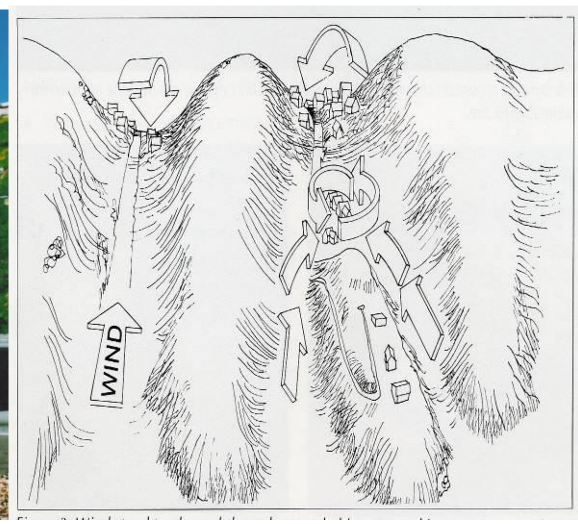
The wind direction may have been an additional factor in denying the wife a safe escape as she was gunning her truck down the dirt road to reach her husband. Instead of blowing in a more southerly direction as could have been expected and which would have first blown the fire largely into Las Flores Canyon, the wind was blowing in a westerly direction and directed flames and firebrands first into Carbon Canyon, the canyon to the west of Las Flores Canyon.

Oakland Hills-Tunnel Fire October 20th, 1991

The Oakland Hills-Tunnel Fire started as a small "brush fire" in the Berkeley Hills on Saturday and was thought to be extinguished by the local fire department when they retired for the weekend. However, the next morning, October 20th, the weather changed with gusty winds picking up and, before 11:00 a.m., had quickly reignited the fire not properly extinguished in the pine needle littler below a pine tree.

The wind quickly pushed spot fires onto adjacent slopes covered with flash fuels and then onto highly explosive pine and eucalyptus trees and onto homes. The first wooden home (an exposed corner home) caught fire almost instantly before firefighters could even respond. The first fire victim, a lady, was caught by total surprise and died as her house was quickly incinerated while she was desperately dialing for help.

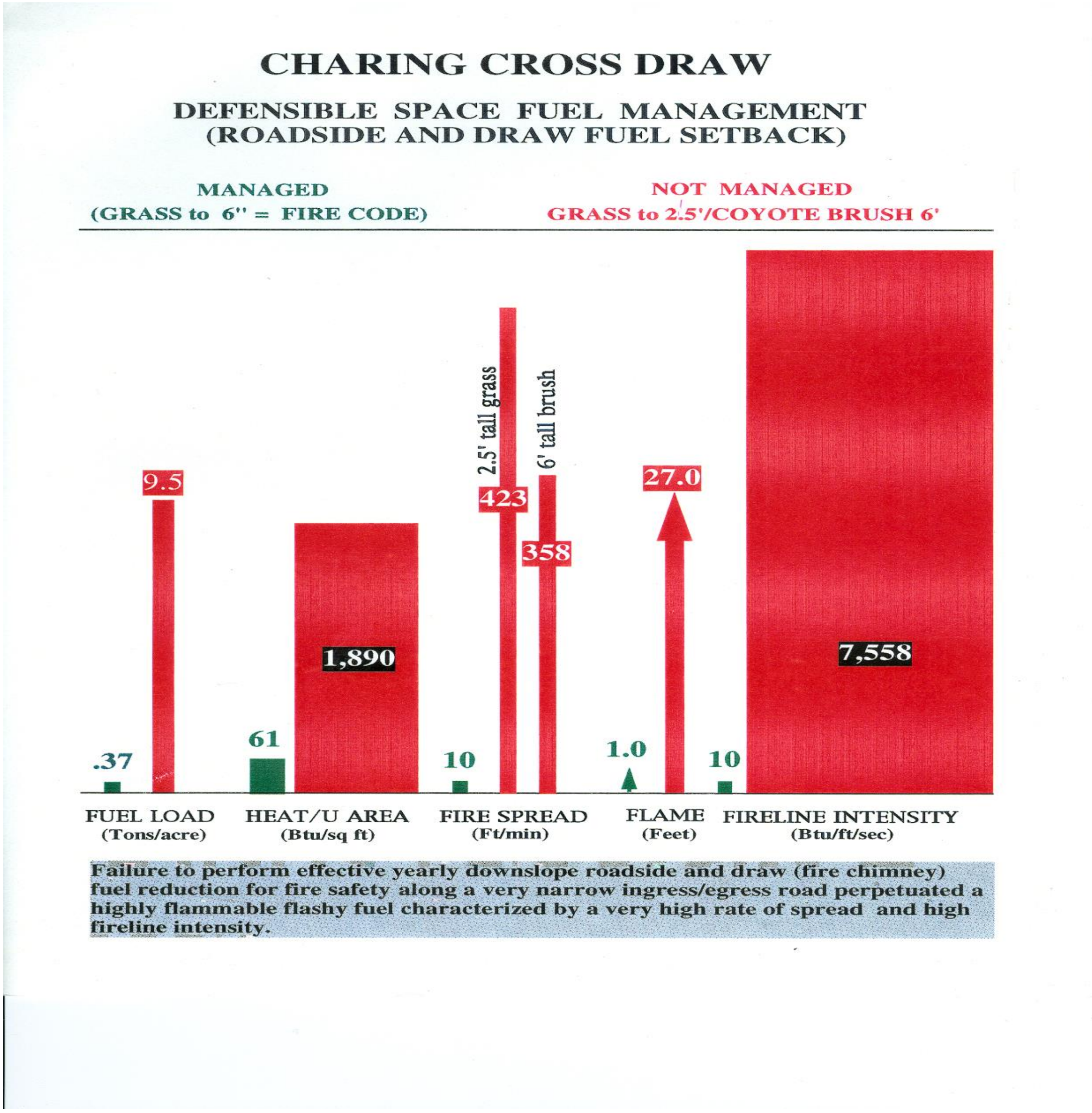
In the interim, exploding trees in the neighborhood had crowned out and the resulting firestorm flames, stretched by high winds, along with the rain of firebrands, engulfed street after street largely lined with wooden and wood roof homes. Since it was a Sunday morning, many people were at home. As the large seemingly fire-safe Parkwood apartment complex became engulfed with flames, the single exit from it became clogged with cars and fleeing pedestrians. Piles of woodchips had been stored near the single exit there as they were being spread out within the landscaping. As the pedestrians were trying to flee, they were showered with blinding wood chip firebrands as well as wood chip debris.



Post fire: Charing Cross draw with coyote brush resprouting.

Close by at Charing Cross Road, tragedy had already unfolded at an ingress-egress chokepoint. Here the paved side-slope-situated street narrowed from two lanes to about twelve feet in width as a wide draw/small canyon vegetated largely with weedy grasses interspersed with native coyote brush dissected the road at this point. Some cars attempting to escape the fire had stalled out and jammed up along this narrow stretch of road. People then abandoned their cars with able-bodied persons fleeing along the road to safety past the chokepoint. Oakland Police Officer John Grubensky was directing the fleeing residents past the road chokepoint draw to safety until the convection and radiation heat coming largely from below rushed over him and engulfed his body. The last person to escape alive remembered that his pants legs were already on fire as he was encouraging her to run past him. He and five other civilians were found burned to death in this location and others were found nearby.

Could this tragedy have been prevented or at least minimized through effective preplanning? Yes! It is well known that houses built side-slope in draws or on top of draws have a poor chance of survival in a wildfire, because winds tend to channel the heat and flames through natural channels such as canyons and draws. There is really little escape when being caught in the open in such a heat funnel even before the flames actually arrive. The graph below titled Charing Cross Draw dramatically points this out.



The draw was vegetated by a mixture of dead grasses and up to six-foot-tall coyote brush: a highly explosive fuel mixture. The graph indicates that, even on only moderate terrain, such an explosive fuel mixture could produce 27-foot-long flames compared to 1-foot-long flames for six-inch-tall grass, cleared as required by fire code along roads for a minimum of ten feet. The graph further dramatically indicates that the fireline heat intensity for the existing highly flammable vegetation is more than 700x greater (!) than if there would have been proper roadside clearance as required by fire code, such as reducing flammable fuels such as grass to no more than six inches in height (stubble height). However, along narrow side-slope roads and chokepoints such as Charing Cross, common sense would dictate that the clearance distance be at least thirty feet (or even greater) downslope, such as is required for structures in wildland areas. But even before flames impinged on the people trying to escape along the Charing Cross draw, most had apparently already choked on the smoke and were dying from inhaling superheated air as the combined convection and radiation heat sources coming upslope as well as the flames that followed would have been even greater than modelled as indicated by the graph.