Wildfire Threat Analysis in the Boulder River Canyon: Revisited

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We first examined the main Boulder River canyon wildfire threat in September 1997. The summary of our analysis identified the general wildfire context in terms of the historical fire characteristics and the fire behavior potential related to the human presence (refer to the previous report, "A situation analysis of the wildfire threat in the Boulder River canyon," J. Cohen and B. Butler, 9/97). The human presence and wildfire factors have largely not changed since our September 1997 visit and remain the contextual basis for the current wildfire concern. Since our first visit progress has occurred in reducing the wildfire threat to various locations within the canyon; however insect mortality has dramatically increased in some areas prompting concern regarding the wildfire effects. Our visit in July 2005 examined the lower portion of the canyon and found activities that have mitigated the wildfire threat to life and property and serve as examples for continuing mitigation. In addition, recent research[1] on crown fires, home ignitions, and safety zones has modified our perspectives regarding the effects of canopy openings, dead trees and hardwood vegetation on crown fire spread potential. In general we found numerous opportunities in the Boulder River canyon for coexisting with wildland fire—wildland fire that is both inevitable and an ecological process. The following analysis addresses the occurrence of extreme case wildfire behavior in the main Boulder River canyon related to:

- The residential development (including the church camps),
- Life safety, and
- The general wildland fire context.

We focus on extreme case wildfire behavior because this is the situation requiring the greatest preparation and having the least option for suppression intervention.

The residential development

Our revisit included several examples of work done and in progress. We visited several residences and the Clydehurst Church camp. Figures 1 and 2 provide examples of how vegetation has been reduced but not completely eliminated to significantly reduce the threat of structure ignition directly from flames. The area that includes the building in relation to its immediate surroundings within 100-200 feet is called the home ignition zone (HIZ). Research indicates that this area principally determines a building's ignition potential[1]. Reductions and openings in the conifer canopy within the HIZ not only reduce the structure ignition potential but the breaks in the canopy continuity disrupt crown fire spread and thus further reduce the fire intensity. Areas with building clusters (e.g. residences and church camps) have the potential to provide linked HIZ areas of reduced and discontinuous conifer canopy. Figure 2 provides an example (Clydehurst church camp) of gaps between clusters of trees that will largely prevent

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[1] Further information and a technical basis for home ignition and the wildland-urban interface can be found at www.firewise.org and at www.firelab.org; wildland-urban fire research; publications.

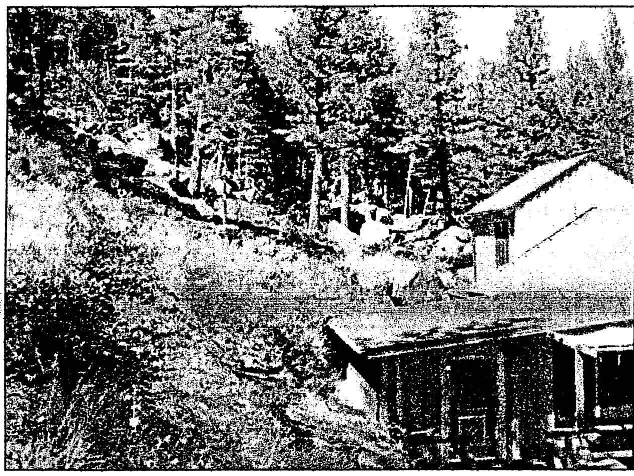
Figure 1

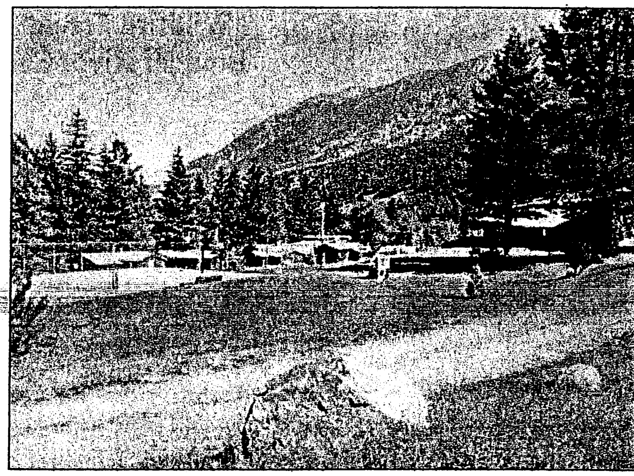
Figure 2

high intensity fire occurrence. Importantly, all the locations of reduced tree density in the HIZ should have an associated reduction in surface and near surface dead and live vegetation, that is, tree branches pruned 6-10 feet above the ground with accumulations of dead woody material removed. Linked or grouped HIZs (as shown in fig. 2) become, in effect, a fuel break that significantly reduces the fire behavior within and immediately around building areas even during extreme conditions.

Reducing the fire behavior intensity of vegetation in the HIZ must be coupled with reducing the direct ignition of the building; that is, the potential for firebrands to directly ignite the structure and any flame contact with the structure. During extreme fire behavior conditions, a "blizzard" of firebrands can occur and small ignitions on or abutting the building can result in total destruction. Preventing firebrand ignitions begins with a nonflammable roof covering. In the wildfire context this means any commercial roofing that is not flammable wood (e.g. nonflammable roofing includes composition shingles and metal). The roofing on the house in fig. 1 is metal and the roofing on the church camp buildings in fig. 2 is composition shingle. Both coverings are effectively nonflammable to firebrands. Firebrand ignitions can also occur at any location on and adjacent to the building where firebrands can enter unscreened openings in and under the structure. Look for any location where firebrands could ignite something that could then ignite the structure. A common example is firewood stacked on porches or under decks. Keep stacked firewood at least 30 feet away from the building. More subtle ignition sources are shown in figures 3 and 4. Figure 3 shows a bird's nest inside an open porch and figure 4 shows accumulated vegetation litter under the porch decking.

A special opportunity exists regarding special use permit recreational cabins. The Forest Service has the opportunity to work with permit users to reduce their cabin HIZs ignition potential. Under the agreement of the special use permit, these cabins could become an example for others on how to reduce vegetation (but not eliminate) and maintain the structure to become highly resistant to ignitions during extreme wildfires.

The church camps potentially have special considerations related to liquid fuel tanks and parked vehicles. Figure 5 shows an example of a fuel tank and vehicles. Fuel tanks should be located at least 100 feet from the nearest buildings and down or across the slope such that leaking fuel cannot threaten structures. Vehicles should also be parked away from the buildings. The fuel tank and parking areas should be cleared of vegetation that can spread fire to and through these areas.

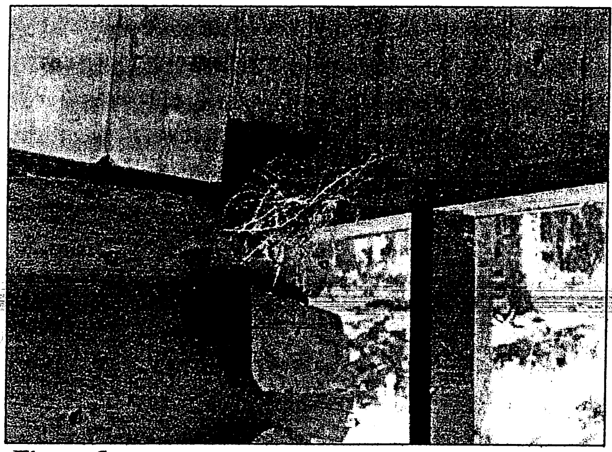
Figure 3

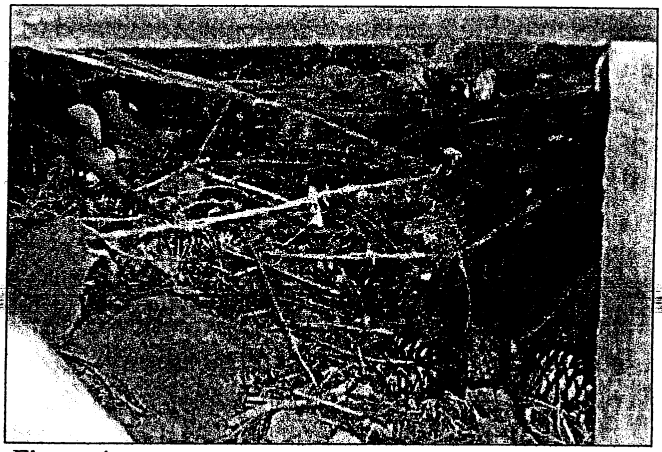
Figure 4


Figure 5

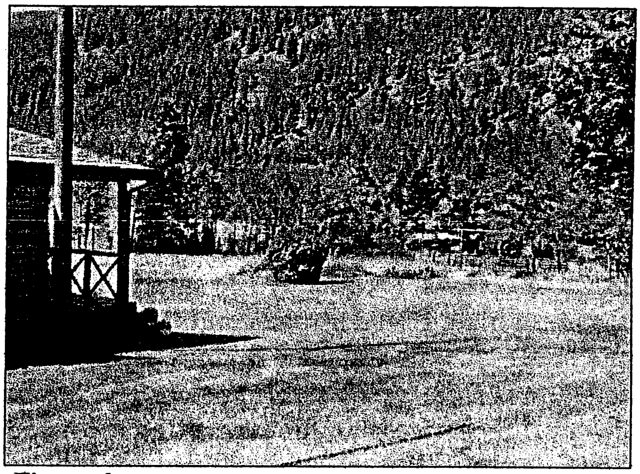
Figure 6

The HIZ defines the extreme wildfire threat to buildings specifically in terms of the building characteristics in relation to its immediate surroundings (within 100-200 ft). The high intensity wildfire has no direct flame effect on the building ignition potential outside the HIZ. In general, the extreme wildfire context in the Boulder is one of high intensity crown fire. The occurrence is inevitable and ecologically appropriate for the lodgepole pine and spruce-fir forests. Forest fuel reduction can be very effectively accomplished over relatively small areas (10s of acres) but is impractical and ecologically inappropriate for the Boulder ecosystems. This should emphasize our recognition that firebrand ignitions can occur well beyond the principal wildfire location during extreme wildfire conditions. For example, we should expect firebrand ignitions in the bottom of the main Boulder from a crown fire burning upwind in the adjacent wilderness area. Thus, firebrand occurrence within the HIZ cannot be eliminated, but as discussed above, the ignition potential of the HIZ can be very effectively mitigated. That is, we cannot mitigate a highly vulnerable HIZ with fuel reduction activities beyond the HIZ; a highly vulnerable HIZ remains highly vulnerable even when surrounded by a fuel break. Reducing the ignition potential of single and clustered HIZs as discussed above produces the only sufficient "fuel break" for protecting buildings.

Areas of significant insect mortality have occurred within and adjacent to the Boulder corridor. The dead and dying trees have prompted concern over how it will influence fire behavior. The high burning rate of live conifer needles principally produces the intense crown fires. Even at high moisture contents (compared to dead fuel moistures), high burning rates require the fine needles that are distributed in the tree canopy. When, during a wildfire, the tree canopy needles consume, that location ceases to have an intense crown fire. Dead trees having their needles may increase the chances of initiating crown fire, but given a crown fire, the dead needles will increase the fire intensity only within the area of insect kill. When the needles fall from the tree canopy the tree loses the principal crown fire fuel. These needles are now part of the more compact and much less intensely burning surface fuel bed. Thus, the crown fire spread is impeded at this location. Primary attention for removing insect killed trees that retain their needles should occur within the HIZ and in any areas where intense fire behavior will produce a life safety concern (falling dead trees usually do not become a problem until after the needles have dropped).

Individual and clustered HIZs having low ignition potential in conjunction with existing open areas and hardwood patches provide discontinuities in the conifer canopy and thus make a continuous spreading crown fire unlikely in the Boulder corridor. Reducing the HIZ ignition potential not only directly decreases the destruction risk to the given structure, but potentially reduces the general fire intensity in adjacent areas. This can favorably impact life safety considerations and prompts the following question: "If the residences are highly resistant to ignition, why would anyone necessarily have to leave them during a wildfire?"

Life safety

Life safety is about preventing fatalities during an extreme wildfire that includes all reasonable options. Frequently life safety considerations begin and end with reactive evacuation. The current main Boulder road conditions, i.e. more than 20 miles of a largely unimproved, single lane road with one-lane bridges often at bends in the road, strongly suggests that reactive evacuation is a not a reasonable option. The previous report (September 1997) recommends a multi-level proactive plan for evacuating most people out of the canyon to avoid a mass evacuation under an imminent wildfire threat. That recommendation remains valid but other options can be pursued.

The length of the "escape route" (the main Boulder road) and its condition significantly reduce its value as a reasonable life safety option during an extreme wildfire in the Boulder. Opportunities exist for establishing safe areas within the canyon. Segments of the main Boulder road then become escape routes to these safe areas. Safe-areas will be free of significant fire occurrence. For example, such an area would have mostly green grass mowed to within a few inches of the ground surface. Opportunities might include large openings around and within the church camps (figs. 2 and 5) as well as areas within large meadows and meadows with extensive patches of hardwoods (fig. 6). In concurrence with the "Main Boulder Fuel Reduction FEIS," opportunities exist to create/enhance aspen patches by significantly reducing the existing conifer canopy. Many of these areas will require seasonal maintenance and collaboration with private owners where the areas occur on private land. Such areas can be developed to minimize the length of road traveled and where possible between the bridges on the main Boulder road.

Fuel reduction along the main Boulder road can also reduce the potential extreme case fire intensity at the road and thus reduce the life safety risk while traveling to a safety area. As previously suggested with linked HIZs, the road corridor fuel reduction will contribute to the landscape level conifer canopy fragmentation and thus the continuity of crown fire in the Boulder high use areas. Existing projects, executed and planned, will contribute to this fuel reduction. Figure 7 provides an example of recent road corridor fuel reduction. Tree density has been reduced to separate the canopies along with pruning and surface woody debris removal. Figure 8 shows an adjacent area with no fuel reduction. It should be noted that areas of such fuel reduction become windier and drier in the surface fuels. The fuel reduction significantly decreases the overall fire intensity along both sides of the road but does not prevent fire occurrence and may enhance surface spread. An exception to increasing surface exposure can occur in areas with aspen. In these cases, reducing the conifer density will increase aspen sprouting and produce a beneficial vegetation type change related to fire occurrence (this concurs with the Boulder FEIS).

Figure 7

Figure 8

The general wildland fire context

The cumulative result of specific measures to decrease building ignition potential and increase life safety is to greatly reduce the continuity and occurrence of high intensity crown fire in the high use areas of the corridor. The mitigation of wildfire intensity in the main Boulder must be a combined effort between private and public land ownership. The most effective building protection occurs within the HIZ and the HIZ largely resides on private land. Mitigations on the Forest Service managed public land cannot substitute for HIZ mitigations. The overall fuel reduction goals cannot occur without the participation of both private owners and the Forest Service. Both parties are required for decreasing the home ignition potential (within the HIZ), creating and maintaining safety areas, and enhancing the main Boulder road as an escape route (to safety areas within the main Boulder). Treatment of each aspect will synergistically produce benefits for the whole corridor. This becomes especially important when we recognize that wildfire occurrence in the Boulder is inevitable as well as being an ecological process.

The main Boulder derives many of its favorable attributes from the surrounding Absaroka-Beartooth Wilderness area. Ecosystems comprise the Wilderness and make it a dynamic, living thing. Although our society negatively perceives insect tree mortality and high intensity wildfires, their occurrences have been principal to the natural history of the ecosystems that comprise the Boulder.

Insects that feed on trees are natural in the Boulder. Bark beetles and spruce bud worms are endemic to the ecosystems. Factors that stress the trees and increase forest continuity can result in extensive tree mortality. The stress can be caused by extended drought and over crowding of the trees. Unbroken expenses of forest can enhance insect spread. It is likely that wildland fires have interacted with the insect populations. Past fire occurrence may have decreased the extent of the dense, even aged forest and thereby limited the extent of insect mortality.

The evidence of past high intensity fire reveals itself as distinct patches on the slopes above the canyon bottom. Our perception of the wildfire threat prompts our desire to exclude fire and to ignore fire as a key ecological process. Realizing that wildland fires are inevitable should urge us to recognize that excluding wildfires does not eliminate fire, it unintentionally selects for only those occurrences that defy our suppression capability—the extreme wildfires that are continuous over extensive areas. If we wish to avoid these extensive wildfires and restore fire to a more normal ecological condition, our only choice is to allow fire occurrence under conditions other than the extremes. Our choices become ones of compatibility with the inevitable fire occurrences rather than ones of attempted exclusion. Appropriate management considerations for restoring appropriate wildland fire on the public lands surrounding the main Boulder are inhibited by considerations for property and life safety. However, as discussed in this report, we can effectively protect property and life safety by pursuing choices that reduce vulnerability to wildfire.