Gold Mountain Wildfire Hazard Assessment

By Deer Creek Resources, LLC

Additional project resources available online at:

http://deercreekgis.com/goldmtn

July, 2014

Background

In Spring of 2014, Deer Creek Resources, LLC (DCR), was contracted by the Gold Mountain Homeowners Association to conduct a wildfire hazard survey of all lots within the Gold Mountain Community. In April and May, 2014, DCR field crews surveyed the community, and collected fuel loading information and photographs of all of the parcels in Gold Mountain. This objective of this project was to develop overall priorities for the wildfire hazard mitigation work within the Gold Mountain community.

Hazard Assessment Methods

For each lot, field crews matched the observed conditions to reference photos developed for the 2004 Plumas County Hazardous Fuel Assessment[1] . The reference photos depict the major forest condition types across the County, and provide verified estimates of fuel loading by size class for material ranging from grass to large logs. An example fuel loading summary for the photo below is in Appendix C.

Example Reference Photo from 2004 Plumas County Hazardous Fuel Assessment

[1] Callenberger, Barry and Lunder, Zeke. 2006. Plumas County Hazardous Fuel Assessment Strategy. January 20, 2006; 58 p - http://dcgis.us/plumas_fuels.pdf

Field fuel loading data was used along with aerial photo interpretation, digital terrain models, and fire season weather conditions from local weather stations to develop a potential fire behavior score to each lot. This modeling/ranking process is described in Appendix B.

Parcel hazard scores were based upon potential fire behavior, slope steepness, presence of a structure or proximity to developed lots, and proximity to natural barriers to fire spread including barren areas or golf courses.

Hazard Reduction Priorities

The map below establishes priorities for thinning and other hazardous fuel reduction projects in the Gold Mountain area. The reference photos in this document show the wide variety of hazardous fuel accumulations across the property, and identify strategies for reducing the hazard while protecting other natural resource values including aesthetics, wildlife habitat, and hydrology/watershed protection.

Most of the Gold Mountain community was logged heavily through the last century, and like many other forests in the Northern Sierra, it is in need of active forest restoration. Some forest-related problems include overstocked stands of small trees, and also areas that are currently too open and dry that would benefit from a more closed forest canopy.

Managing forest fuels can be very expensive and energy intensive. At one end of the spectrum, we have the landowner that walks their property frequently with their axe and pruning shears, tackling the problem one cup of coffee at a time. At the opposite end, we have the 40 ton diesel-powered mastication machine, which may cost $1,500/acre. In the middle, we have contractors with chippers and chainsaws who can be hired to do the heavy-lifting, with the landowner doing cleanup and other tasks that limit the amount of time that they need to pay the contractor for.

The Gold Mountain community has accomplished an impressive amount of forest stewardship work in its short lifetime. Clearly, an ethic of community forestry exists. The lower-hazard images in this document showcase some of the good work that has been done, providing examples that other landowners can follow to move forward a larger community effort.

The many contractors that have worked to create the low-hazard conditions in the photos below appear to have accomplished a lot of quality work. They are some of the best assets that the commuity has at their disposal, and the Firewise Committee should continue to act as a clearinghouse that promotes and advertises the contractors that have done the best work to date.

2014 Gold Mountain Wildfire Hazard Assessment Project

CO-STATE 40A ROAD
FS 23N33B
FS 23N33G
FS 23N33K
FS 23N23X
FS 23N33K
RIVER TRAIL RD
FS 23N33X - PARALLEL
FS 23N23X
TURNOUT
DEER TRAIL
COOL WATER
INDIAN SHADOWS
ACCESS
VILLAGE TRAIL
VILLAGE TRAIL
DOUBLE EAGLE
CLOUD PAINTER
DANCING BEARS
QUAIL RUN
TWIN PEAKS ROAD
PORTOLA - McCLEARS ROAD A15
HARVEST MOON
CRAIG ROAD
SANDRA LANE
WINDSONG
MORNING SUN
FOX RUN
WINDSONG
PORTOLA - McCLEARS ROAD A15
RED SKY
MORNING STAR
BEAR RUN
EAGLE FEATHER
HEAVENS REST
CART BARN ACCESS
GREAT SPIRIT
NIGHTHAWK
RED SKY
DREAM MAKER
WATER TANKS
FALLING WATER
ACCESS RD
PARK VIEW
SUNBURST
PAINT BRUSH
GOLD STAR
STARTOP
MOON SHADOW
CANYON RIM
CLOUDS REST
BLAZING STAR
BEAR PAW
CLOUDS REST
EAGLES NEST

Wildfire Hazard Reduction Needed

Treatment

- Critical - Significant Thinning and Brushing Needed
- High Priority - Thinning and Regular Maintenance Required
- Moderate Priority - Minor Thinning and Regular Maintenance Required

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Wildfire behavior is the product of numerous factors, some of which are weather-dependent and difficult or impossible to quantify. The suggestions in this assessment are based upon field surveys, technical analysis, and the professional experience of the authors. Errors may exist in this analysis and could include inproper recording of field data due to GPS accuracy or surveyor error, computational errors, data entry mistakes and any other conceivable cause.

This data comprises a simplification of the physical environment intended to allow the authors to make general recommendations about reducing potential fire behavior at the community scale. While this data is useful in assessing relative risk between the many micro-climates present in the Gold Mountain community, site-specific changes in fuel hazard and wildfire risk (such as annual mowing and weed clearance, the growth of flammable ornamental plants and native vegetation, and other changes in the physical environment) will quickly render this data inaccurate. Under extreme burning conditions, most of the Gold Mountain community has the potential to support rapid rates of wildfire spread. There are NO low-priority areas for fire hazard mitigation.

DEER CREEK GIS

0 0.125 0.25 0.5 0.75 1 Miles

Analysis and mapping by Deer Creek Resources, LLC - www.deercreekgis.com - July, 2014

Recommendations

Chipping and Green Waste Disposal

We recommend that the Gold Mountain Firewise committee continue to support a chipping program and develop a green waste program that allows homeowners and their contractors to bring slash from fuels management activities to a central location where it can either be chipped or burned. Also, the Committee should connect landowners with vendors that can collect their pine needles for commercial use.

Pile Burning

We recommend that the HOA consider amending the current CC&Rs to allow burning of slash piles on private lots during safe burning conditions. Acceptable burn days would be identified by a designated party and advertised through signage and a burn-day phone number or website. Homeowners would need to follow burning rules that provided for adequate supervision, preparation, and mop-up.

Alternatively, the CSD could provide a pile-burning crew for a nominal fee, or the HOA could hire a contractor to burn piles at the participating lot-owners' expense. More detailed tips on burn piles and burning can be found in Appendix A.

HOA Ownership for Highest-Hazard Lots

Many of the larger, steep, heavily forested parcels South of the golf course and Nakoma Lodge (Dream Maker and Star Top) are undeveloped, and will pose a major management challenge for whoever builds on them. If these parcels were bought back into community (HOA) ownership for management as a community forest/park, many of the challenges of accomplishing large-scale wildfire hazard reduction work would be reduced. Also, this change in ownership might reduce the costs that the CSD will incur if they have to develop additional water supply infrastructure to supply future homes on the highest ridges. We recommend that the HOA and CSD do an economic analysis on the costs and benefits of removing the highest-elevation (and most fire-prone) undeveloped lots from development.

Snags

Snags are large standing dead trees. They provide critical habitat for species such as woodpeckers that feed on insects dwelling in decomposing wood. Because snags are a result of decay, they are soft enough for woodpeckers and other cavity excavators to make entrance holes and cavities which are then useful for other cavity-dwelling creatures. This assessment encountered very few large snags. In places where they aren't likely to fall on a house, we recommend retaining any large snags during hazard mitigation thinning work.

Specific Wildfire Hazard Mitigation Strategies

Falling squarely upon the transition between West and Eastside Sierra Nevada forests, Gold Mountain has a staggering variety of forest types ranging from shady Douglas fir and cedar forests to sun-blasted patches of juniper and mountain mahogany. The following photos show the wide range of forest conditions across the community, with specific recommendations on how to reduce wildfire hazard for each forest type.

Low hazard pine forest area, thinned in last 5-10 years.

The photo above provides a good example of forest stewardship that accomplishes wildfire hazard reduction while minimizing the impacts on other natural resource values. The down logs (which can be very expensive to remove) provide cover for wildlife and nutrients to the soil. Without smaller branches and twigs on the ground, the logs will not cause rapid rates of fire spread. The remaining trees provide good shade, lowing surface temperatures and reducing the drying affect of the sun on surface vegetation. This, in-turn, narrows the season within which surface fuels will be critically dry. Most of the ladder fuels have been removed and trees have been pruned to 8-10', making it unlikely that a surface fire will be able to get into the crowns of the trees.

Low priority for treatment: **Open pine stand, moderate hazard,**

The area in this photo has well-spaced trees and a high canopy base height. The smaller branches on the down-tree in the center-right of the photo should be scattered or removed. Logs larger than 4" in diameter can be left in place.

> By providing both food and microhabitats for many species, coarse woody debris helps to maintain the biodiversity of forest ecosystems. Up to forty percent of all forest fauna is dependent on CWD. Studies in western North America showed that only five per cent of living trees consisted of living cells by volume, whereas in dead wood it was as high as forty percent by volume, mainly fungi and bacteria.[2]
>
> Colonizing organisms that live on the remains of cambium and sapwood of dead trees aid decomposition and attract predators that prey on them and so continue the chain of metabolizing the biomass.

[2] Puplett, Dan. "Ecological Features of the Caledonian Forest - Dead Wood". Trees For Life.

The list of organisms dependent on down logs for habitat or as a food source includes bacteria, fungi, lichens, mosses and other plants, termites, ants, beetles, snails, and amphibians such as salamanders.[3]

Critical priority for thinning: Pine and juniper with heavy ladder fuels

This photo is similar to what the previous photo would look like without thinning. Here, small seedlings and saplings provide 'ladder fuels' that will allow a surface fire to burn up into the crowns of the largest trees. This is referred to as 'torching'.

Regardless of how areas are mapped in this document, any area with the potential for 'torching' should be a **Critical Priority** for treament.

Under windy conditions, (when most large fires have historically occurred in the Gold Mountain area) 'torching' causes ember showers that can start spot fires as far as ½ mile away. Spot fires dramtically increase the difficulty of fire control and are a primary agent that causes small fires to escape initial attack and become large.

[3] Butts, Sally R.; McComb, William C. (January 2000). "Associations of Forest-Floor Vertebrates with Coarse Woody Debris in Managed Forests of Western Oregon". The Journal of Wildlife Management 64 (1): 95–104.

Red Xs in the image above show trees or brush that need to be removed. In general, dense stands of trees should be thinned to a 10-15' spacing, though clumps of several larger trees are acceptable if smaller ladder-fuel trees or brush are removed.

Small trees represent tomorrow's large trees, so great care should be taken to select and retain healthy small trees to fill in the gaps in the forest. As a general rule, retain any

small trees that are more than 10-15' from the base of a larger, overstory tree, selecting Sugar Pine, Douglas Fir, or Ponderosa Pine in preference to Incense Cedar or White Fir.

Moderate treatment priority: Dry pine forest site in need of restoration.

The forest in the photo above shows signs of being heavily logged over the last 50 years. While its open character decreases the likelihood of a crown fire occurring, its open condition allows abundant sunlight and wind to reach the forest floor, desiccating the site, and increasing the number of days that fuel conditions will be critically dry. Forest-thinning projects here should focus on removing ladder fuels while retaining as many overstory trees as possible. Any healthy small trees that are more than 10-15' from a larger tree should be kept. Shade is good!

Large down logs provide valuable cover for wildlife and supply nutrients to build the soil. Any limbs or logs over 4” in diameter can be retained.

Moderate treatment priority: Thinned site, needs minor maintenance

This site has good spacing on the mainly large trees, and a high crown base that will prevent surface fires from entering the canopy. The many small, shade-tolerant incense cedar trees should be removed with an axe or Pulaski tool (pictured here) while they are still small, unless they are in a large opening 10’ or more from an existing large tree.

< An Essential Tool: The Pulaski

The Pulaski is a versatile tool for maintaining forested landscapes.Use the hoe-end to chop out small trees or maintain a trail, and the axe-end to prune low branches or chop small logs into sections for easier handling. Keep it sharp and wear boots or sturdy shoes when using.

Moderate treatment priority: Open Cedar stand, needs maintenance

This stand would be a higher treatment priority if there were more surface fuels or it was on a steeper slope. Surface fuels (mainly needles and duff) are light in this area, and this, coupled with good shielding of surface winds from the closed overstory canopy, will help to keep fire spread-rates slow here.

However, many of the small saplings will soon create ladder-fuel problems, and these should be removed as soon as possible. It is much easier to spend an afternoon cutting them out now with an axe than to hire a crew with chainsaws and a chipper 5 years from now.

The amount of light vs. shade on the forest floor is a good, quick indicator of canopy closure. Any overstory thinning that takes place in Gold Mountain needs to balance the risk of crown fire hazard with the benefits that a closed- canopy provides. These benefits include: Shade, reduced drying of surface fuels, protection from surface winds

Moderate treatment priority: Pine and mountain mahogany

Curl-leaf mountain mahogany

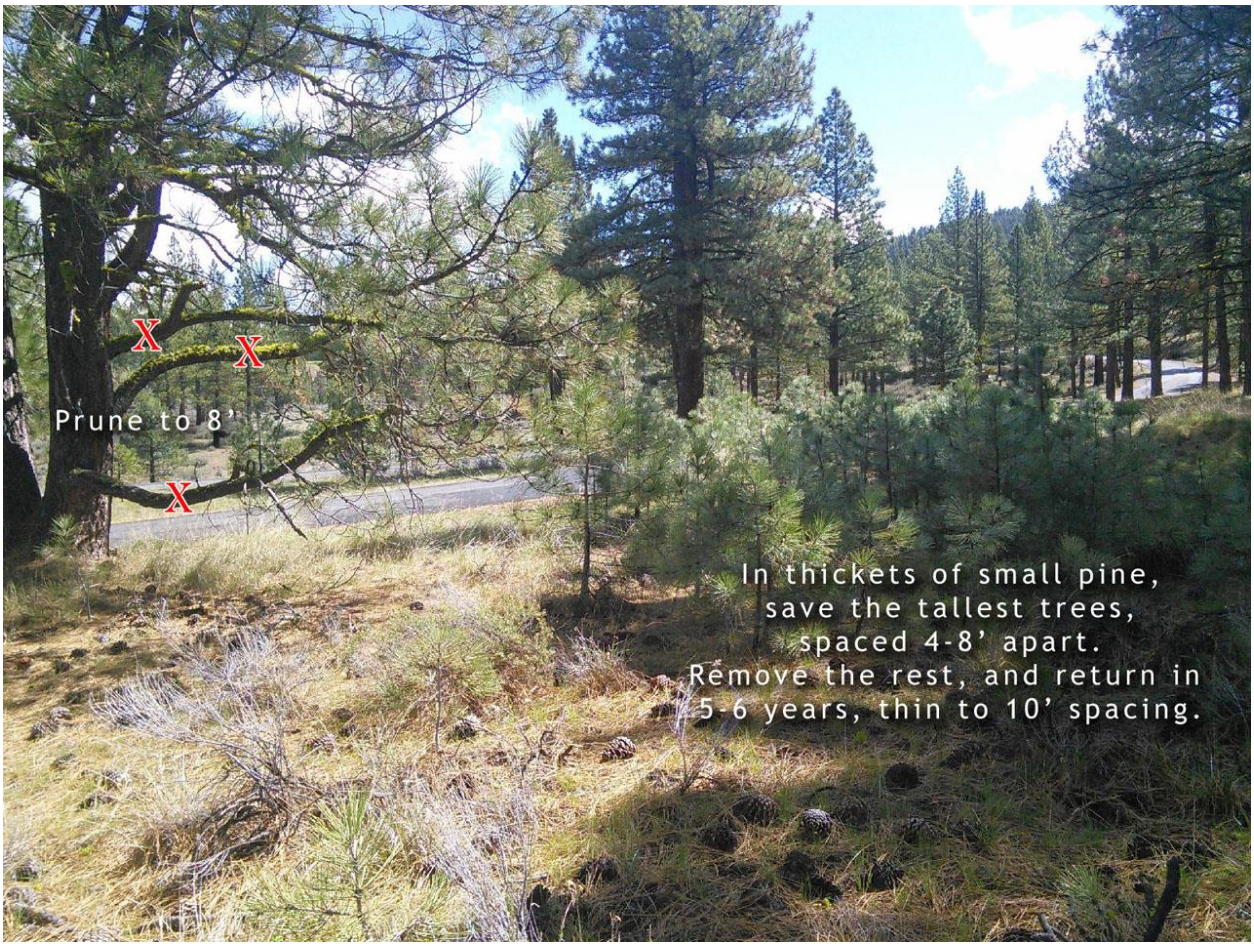
Mountain mahogany can be pruned to reduce the small dead twigs and thin the first several feet to the main stems. In areas where outside of the 100' defensible space zone, and in places where it will not act as a fuel-ladder to spread flames into overstory trees, we recommend leaving as much mountain mahogany as possible.

> Curlleaf mountain-mahogany is good forage for all classes of browsing animals in both summer and winter; it is one of the few browse species that meets or exceeds the protein requirements for wintering big game animals.
>
> In mature stands, much of curlleaf mountain-mahogany foliage is out of reach of smaller browsing animals but provides excellent winter cover.
>
> The wood of curlleaf mountain mahogany is so hard and dense that it will not float. It provides excellent fuel, producing intense heat and burning for long periods. Because curlleaf mountain-mahogany wood burns slowly, and is highly prized as a barbecue fuel. Source: http://extension.usu.edu/rangeplants/htm/curl-leaf-mountain-mahogany

Moderate treatment priority: **Pine stand on flat ground, moderate hazard**

This photo is typical of many of the flatter areas to the North of County Road A-15. In these flat, open pine stands, outside of the 100' radius of existing homes, care should be taken not to remove too much of the brush. Brush removal should focus on disrupting the continuity of the plants

High treatment priority: Pine thickets – restoration opportunity



Pine regeneration is often very vigorous in areas where the soil has been disturbed (either by logging, fire, road-building, construction, or other grading). Thickets like the one in the photo above are common in the Gold Mountain area. While the trees are small, they are easily thinned with an axe or Pulaski (fire axe).

These thickets provide an opportunity to select a few of the most vigorous trees to retain for the future forest. Cut saplings should be removed from the site.

< Essential Tool: Loppers
Loppers are good for pruning live limbs off of trees, thinning brush, or removing small pine saplings. Cut saplings below the lowest green branches or they may continue to grow. Loppers aren't great for dead branches, use your Pulaski instead.

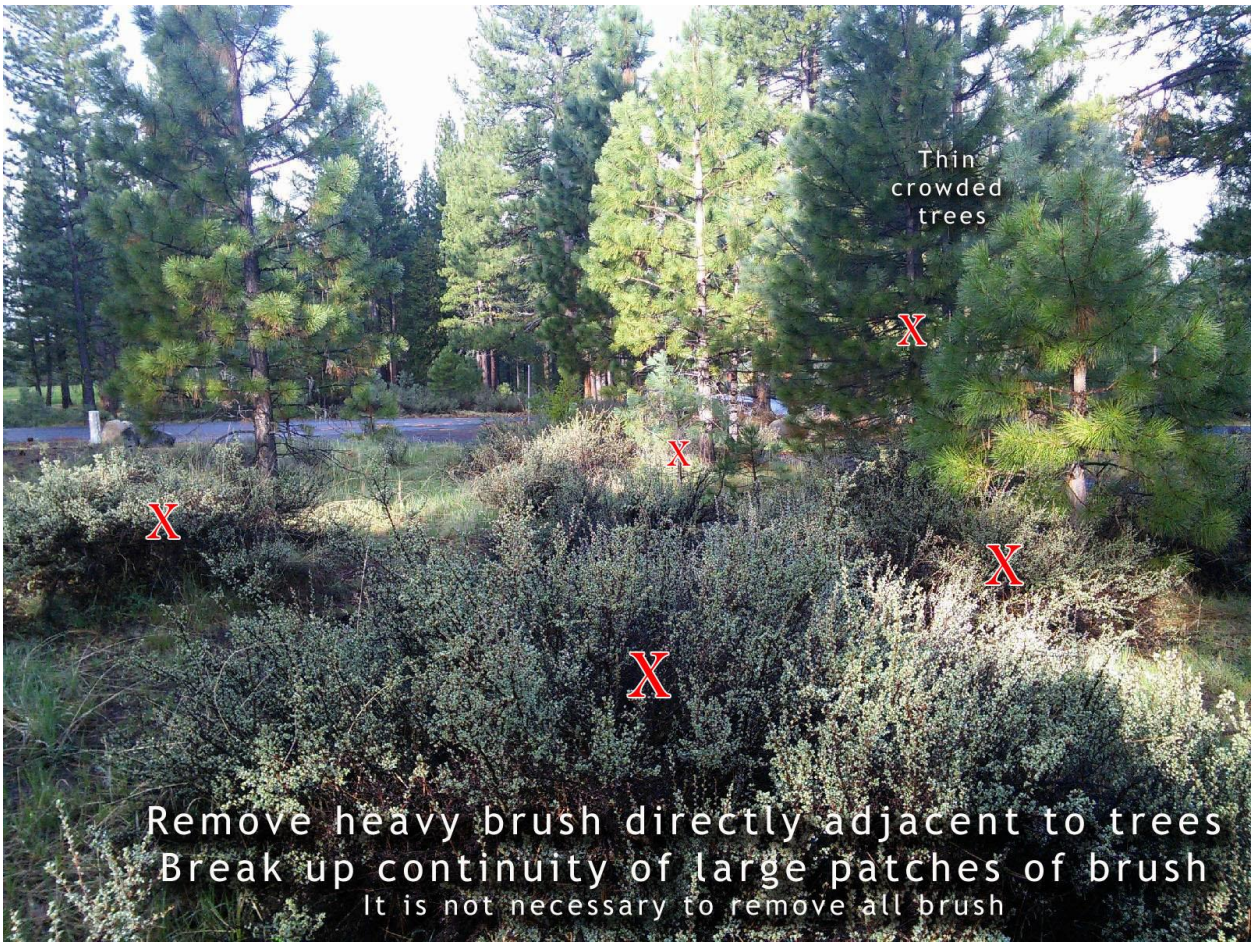
High treatment priority: Pine and cedar, high hazard.

Large down logs provide important cover and habitat for wildlife. Hazardous fuel reduction in this photo should focus on pruning up the trees, and removing brush, ladder fuels, and branches less than 4" in diameter.

As in other photos of dry, exposed sites, a longer-term objective for this site should be to increase the number of large, well-spaced trees and shade.

This photo is typical of the high-priority lots in this survey.

High priority for treatment: Pine and brush, high hazard



Bitterbrush Fuel Modification Treatment Prescription

In bitterbrush fields, separate fuel continuity by isolating patches and creating mini fuelbreaks in a circumference around the patches. These isolated patches can be of varying shapes and sizes depending on the layout of the landscape. In addition to separating fuels into patches, individual plants can be selected to leave while cutting in between them at an average spacing of ten to fifteen feet.

Bitterbrush will both tip-sprout and stump-sprout; therefore, the cutting of bitterbrush can be combined with a variation of two treatment methods where half of the brush is cut to the ground and the other half is cut three feet from the ground, allowing tips to sprout to create fresh wildlife browse

Retain a diversity of shrub species throughout the site, especially species that are less abundant than bitterbrush such as curl-leaf mountain mahogany should be retained wherever possible, thinning around the patch to separate it from heavier fuels.

(Source: "Sierra Nevada Community Conservation and Wildfire Protection Plan Guidebook", Forever Green Forestry, 2007)

High priority for treatment : Pine and brush on a slope, high hazard

The slopes in the Northeast corner of the community along Dancing Bears and Quail Run are exposed to full summer sun. The increased dryness of these South-facing slopes means that fires will spread uphill incredibly fast here. Especially in areas adjacent to homes, work should focus on annual weed-eating of the grasses within 200' of homes, removing dead brush, and reducing the continuity of live brush so that plants are at least 10 feet apart.

High priority for treatment: Gully topography, moderate hazard

The contour of the land will help fires to burn uphill quickly in gullies and swales. Projects is these locations should focus on removing fine fuels and ladder fuels, and reducing continuity of brush. Near homes, grass areas downslope of the home should be trimmed after it has turned brown at the beginning of each summer.

On lots that have not yet been built, future builders should avoid siting homes or other buildings at the top of gully-type features.

The trees in this photo are well spaced and have a high canopy base. Fuels work in this type of setting should concentrate on protecting homes upslope.

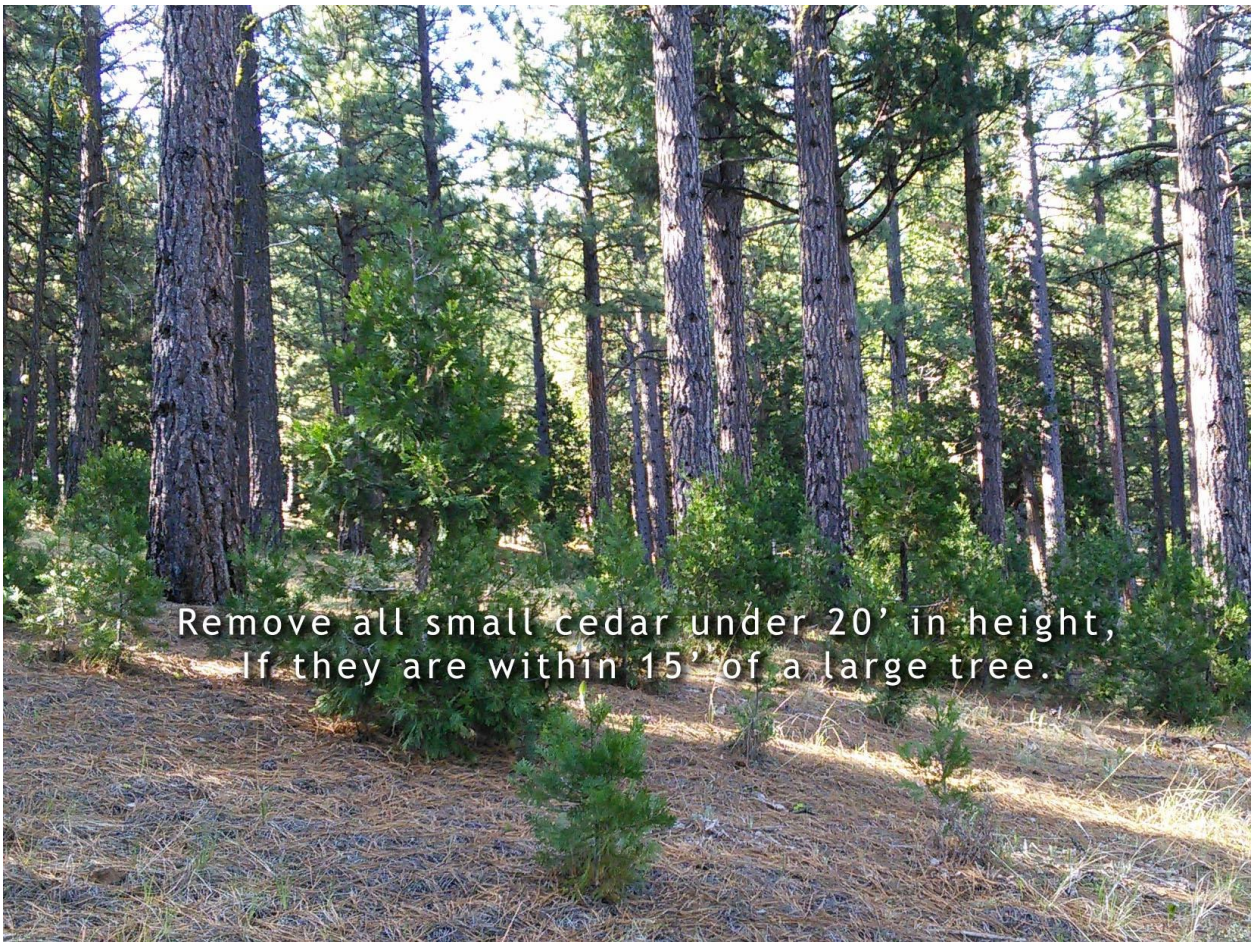
Critical treatment priority: Pine and brush, high hazard,

In areas with heavy brush, removal efforts should focus on areas with 10' of existing large trees, and the trees should be pruned at the same time. Brush provides important browse for deer and other animals. Outside of the 100' radius of existing homes, it is not necessary or preferable to remove all brush. Fuels treatment should focus on disrupting the continuity of the brush.

Bitterbrush

Bitterbrush has a long taproot or taproots that can be as long as 18 feet, as well as a few shallow roots. It is an important browse plant and is favored by deer. Mule deer use of bitterbrush peaks in September, when it may compose 91 percent of the diet. Deer mice and kangaroo rats also use bitterbrush, and the seed is a large part of their diets. Because it is a favorite browse, its vigor is often used to gauge the condition of rangeland. Source: Montana Fish, Wildlife, and Parks.

Critical treatment priority: Thinned site in need of maintenance



This site appears to have been thinned in the last 10-15 years. Shade-tolerant incense cedar are in the process of turning the understory into a dense thicket. Left untreated, the cedar will create conditions that support torching wildfire behavior that can kill the large, overstory trees and create long-distance spotting. Also, dense cedar can become drought-stressed and die.

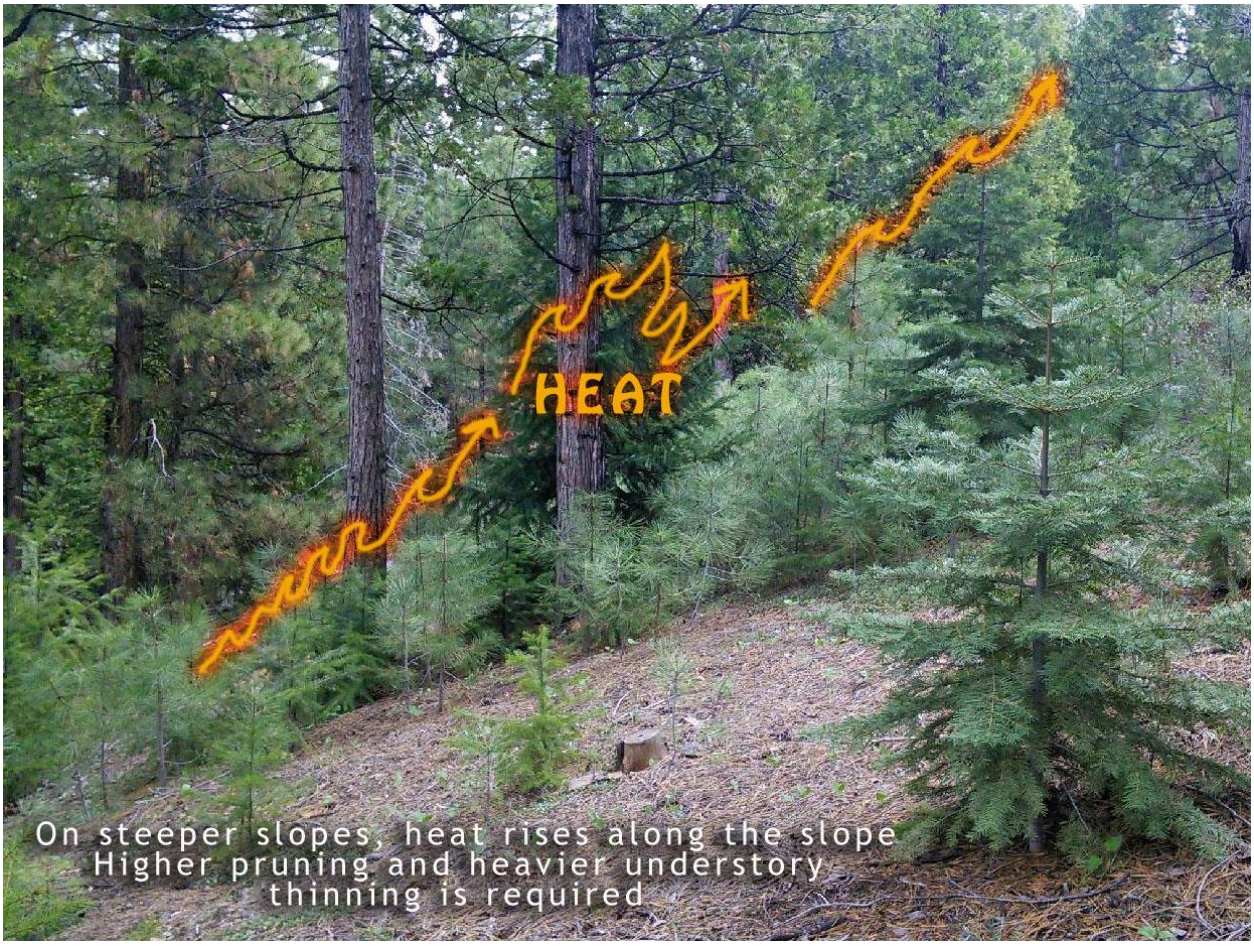
Surface fuel loads are light in this photo, and this will slow the spread of fires burning into this lot, somewhat offsetting the ladder-fuel hazard posed by the small cedar trees

Critical priority for treatment:Pine and fir on a slope, extreme hazard

This photo is typifies the 'Critical' fuel loading areas with the Gold Mountain community. The arrangement of the canopy fuels is such that any surface fire will almost immediately become an active crown fire. Under mid-summer weather conditions, flame lengths will be over 100 feet, and embers will start spot fires up to ½ mile away. Initial fire attack resources will be unable to contain all of the spot fires, as they will not know where they all are, and the fire will spread until weather conditions change, or the fire runs out of fuel.

These areas require significant thinning of understory ladder fuels abd pruning of the larger trees. Effort should be taken to not overthin the larger trees, as they provide valuable shade and, if properly thinned and pruned, pose little threat during future fires.

Critical priority for treatment: **Pine and fir on a slope, extreme hazard**



Here is another 'Critical' lot. This photo has the same crown fire hazard issues as in the photo above.

While it is necessary to thin the understory more heavily in these midslope areas, if trees are well-pruned and surface and ladder fuels are removed, all overstory trees over 12" diameter should be retained.

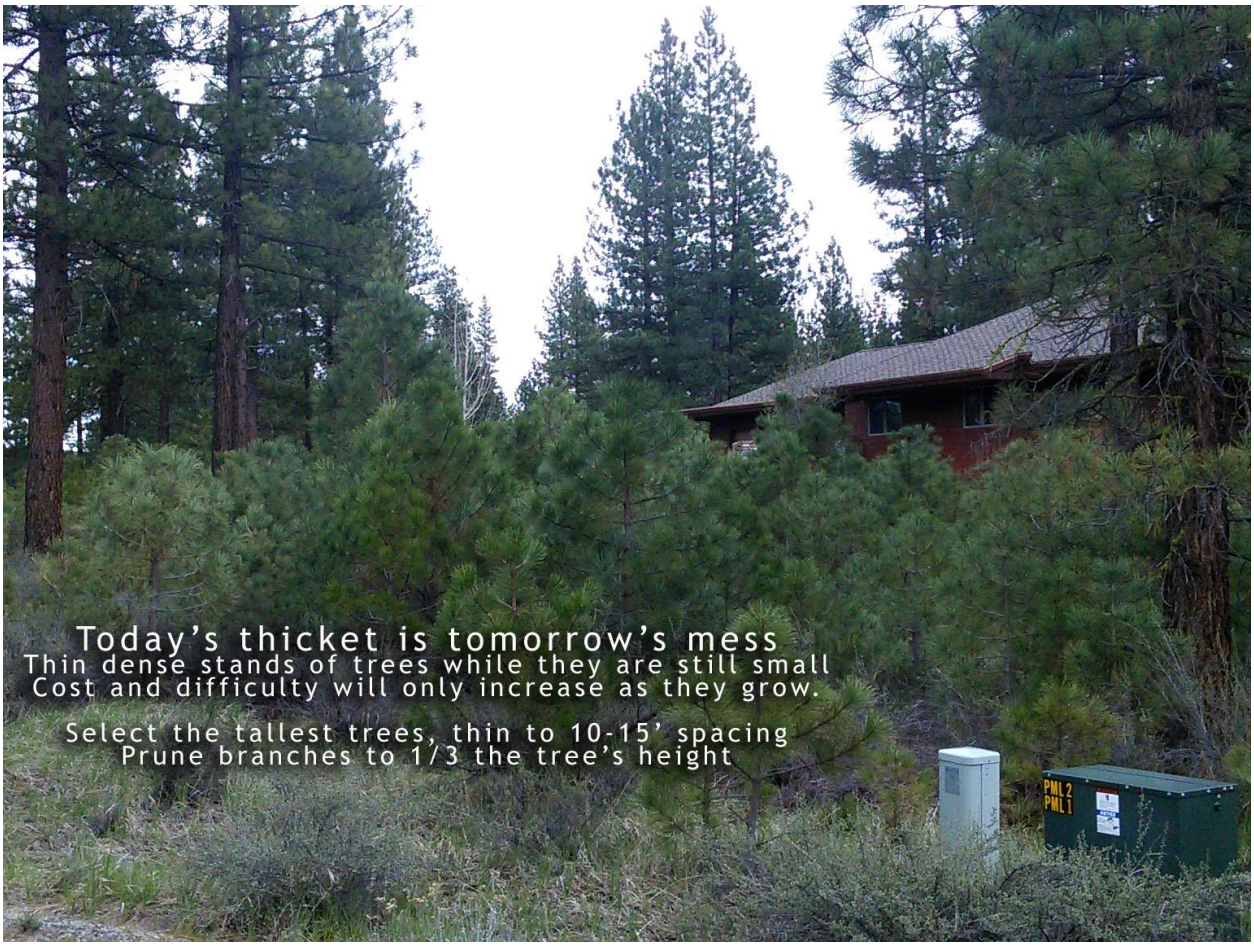
Critical priority for treatment: White fir on heavily logged site, high hazard

This photo shows another site which has been logged heavily over the last 50 years and is in need of restoration. The dead top and red slash in this photo are White Fir, a shade-tolerant species that has increased in abundance in dry pine forests as a result of logging and fire suppression. White Fir are susceptible to beetle kill during drought events, and are less desirable than pine or Douglas Fir.

The many weak and scraggly White Fir trees in the understory should be thinned and the remaining trees should be pruned to 1/3 their height or 10’, whichever is less. Logs over 4” diameter can be retained. All red slash should be removed.

Increasing shade and canopy-closure are important longer-term objectives in these stands. Transplanting of Douglas Fir or pine seedlings into the larger openings in the springtime is an economical and enjoyable way to accomplish this.

Critical priority for treatment: Pine thicket, extreme hazard



As in the previous pine thicket photo, this stand needs to be aggressively thinned. Brush and grass in the foreground will carry fire quickly into the pine thicket.

These trees are larger than those in the previous pine thicket photo, and the stand should be thinned to 10-15' spacing.

These pine thickets also tell a cautionary tale about the potential use of mechanical harvesting equipment for forest thinning. Any activity that causes soils disturbance in pine forests has the potential to trigger heavy natural regeneration of small pine trees.

Critical treatment priority: **Juniper and brush on a slope, extreme hazard**

Critical treatment priority: **Brush next to a home, extreme hazard,**

Recent CAL FIRE defensible space inspections of the Gold Mountain community found an impressive level of compliance with Public Resources Code 4291, which requires 100' of Defensible Space around occupied structures. As vegetation never stops growing, maintaining compliance is an ongoing chore.

Critical treatment priority: Pine forest needing restoration

Another site showing signs of logging-caused damage and in need of restoration work. Trees should be planted in large openings, small, crowded understory trees should be thinned, and remaining trees should be pruned.

Dead branches should be removed, and brush should be cleared from the bases of larger residual trees.

Appendix A: Pine and Mixed Conifer Conservation and Fuel Modification Objectives (Adapted from the "Sierra Nevada Community Conservation and Wildfire Protection Plan Guidebook", Forever Green Forestry, 2007).

Treatment activities within ponderosa pine and mixed conifer stands will result in the reduction of tree density and volume of understory and mid-story fuels. It will also work toward the restoration of natural plant composition and structure. Recruitment of old-growth forest stands is another recommended objective for long-term fire safety and ecosystem health. One of the main objectives for the long-term maintenance and health of this forest type is the reintroduction of low- to moderate-intensity fire. Brown, Agee, and Franklin (2004) state:

A forest that is fire-resilient has characteristics that limit fire intensity and increase the resistance of the forest to mortality. The first principle is to manage surface fuels to limit flame length…The second principle is to make it more difficult for canopy torching to occur by increasing the height to flammable crown fuels…The third principle is to decrease crown density by thinning overstory trees, making tree-to-tree crowning less probable. This will not be necessary on all sites and will be effective only if linked to the application of the first two principles[4].

Pine and Mixed Conifer Fuel Modification Treatment Prescriptions

• Treatment emphasis will focus on thinning from below in an effort to reduce and separate both vertical and horizontal fuel layer continuity.

• Canopy thinning is recommended only if the fire hazard cannot be reduced adequately through treating the surface and ladder fuels. Understory thinning is the preferred treatment. [5] [6]

• Favored trees to leave in decreasing order of preference are: black oak, sugar pine, ponderosa pine, Jeffery pine, tanoak, canyon live oak, incense cedar, Pacific madrone, Douglas fir, and white fir. Thinning treatments will focus on the retention of species diversity, making allowances for favoring species best suited for a given location.

• Create overall structural characteristics (arrangement of live and dead fuels) appropriate for restoration of the historical fire regime of frequent, low- to moderate-

[4] Brown, Richard T., James K. Agee, and Jerry Franklin (2004). "Forest Restoration and Fire: Principles in the Context of Place." *Conservation Biology* 18(4): pp. 903–912.

[5] Stephens, S.L. (1998). "Effects of fuels and silviculture treatments on potential fire behavior in mixed conifer forests of the Sierra Nevada, CA." *Forest Ecology and Management* 105: pp. 21–34.

[6] Stephens, S.L., and J.J. Moghaddas (2005a). "Experimental fuel treatment impacts on forest structure, potential fire behavior, and predicted tree mortality in a mixed conifer forest." *Forest Ecology and Management* 215: pp. 21–36.

intensity forest underburns[7]. This structure includes an overstory with low fuel volumes and a sparse understory with patches of interspersed even-aged young trees, shrubs, and native perennial grasses. This structure will facilitate maintenance by future low-intensity fires by creating gaps where fuel connectivity (both horizontal and vertical) is low.

• Pine and oak leave-trees will be released by thinning small trees and brush ten feet out from drip lines. Emphasis will be placed on thinning on the southern and western exposures because pines thrive in open forests stands with abundant sun.

• Variable density treatment is a thinning practice to create diversity in a forest stand, leaving portions of the stand unthinned, with other areas thinned more thoroughly. It can be implemented within mixed-conifer forest types by reducing both understory and crown density within the stand. Separate fuel continuity through the creation of repeating skips and gaps[8] of varying sizes and shapes. Treatments will emphasize the retention of randomly spaced tree groupings by identifying the largest trees for old-growth recruitment, moisture retention, and wildlife habitat. Release around the drip lines of groupings and some individual trees by thinning excessive stems, pole-sized trees, and shrubs. The objectives are to release individual trees, limit competition, reduce fuel loads around groupings (clumps) of trees, and enhance site structural diversity. [9]

• To reduce the possibility of beetle infestation, consider not cutting pines until the fall. Beetles are attracted to the scent of fresh-cut pine and could infest the stand. You can mark the pines to be cut when implementing your fuel treatments earlier in the year, then return between October to May to remove pines and their slash, as beetles tend to be dormant during this period.

See www.fire.ca.gov/rsrc-mgt_pestmanagement_socalbeetle.php for more information on beetle infestations in California.

• In areas with no overstory, small conifer saplings and poles will be thinned to fifteen by fifteen feet between live trees. In more open, arid, savannah-type locations, pine and oak should be favored. In some openings, shrub species may be favored or complete vegetation removal may occur to create variable density.

[7] Underburn: A prescribed fire method where burning is conducted in the understory of the forest below the dominant trees.

[8] Repeating Skips and Gaps: The forest structure throughout a treatment area following a variable density treatment where some areas are retained and not thinned (skips) and other portions of the stand are heavily harvested (gaps). The range of size of the skips and gaps are from a few hundred square feet to up to an acre where site conditions dictate.

[9] Stephens, S.L., and P.Z. Fule (2005). "Western pine forests with continuing frequent fire regimes: Possible reference sites for management." *Journal of Forestry* 103(7): pp. 357–362.

• Retain all age and size classes[10] of all native species for vertical and horizontal structural diversity[11] throughout the landscape, but not within the same stand. However, thin around the edges of multi-canopied, vertically structured tree groupings of varying sizes to separate them from other fuels.

• Retain seedlings and saplings of favored species to replace future trees that will die.

• Retain a wide variety of age, size, and decay classes[12] including dead and dying vegetation, consistent with fire hazard reduction goals. Retain some deformed trees (e.g. pistol butts[13], forked tops, trees with a low percentage of live crown, etc.) for genetic diversity and wildlife habitat[14].

• Retain vegetation with evidence of wildlife use (e.g. bird or woodrat nests, burrows, cavities, and hollows, etc.). Retain sheltered connectivity [15] and major game trails between selected tree and vegetation patches. Retain large downed woody debris[16] for moisture retention, mycorrhizal inoculation sites, and wildlife habitat. Retain or create large snags for wildlife[17].

• Leave green islands or patches of tree or shrub thickets (e.g. doghair conifer patches) for wildlife habitat. Retain an average of one patch per acre no greater than twenty by twenty feet. Protect green islands by reducing fuels around it[18].

• Retain as much canopy closure as possible in ephemeral and perennial stream gulches.

• Enhance productive understory shrub and herbaceous vegetation by thinning conifers to allow dappled sunlight. Retain ten to thirty percent of understory shrub cover as scattered and isolated patches.

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[10] Size Class: The division of trees by the size of their diameter, sometimes split into three categories—seedlings, pole, and saw timber—or by diameter in inches.

[11] Vertical and Horizontal Structure Diversity: Describes the configuration of trees within a forest stand that create a variation of structure where trees stand straight up and down (vertical) or grow at an angle (horizontal).

[12] Decay Classes: Decomposing wood is categorized based on the level of decomposition, broken into five classes.

[13] Pistol Butts: Trees within a forest stand that have a crooked sweep beginning at the base of the tree, then growing straight toward the sky. A "pistol butt" tree indicates erosive soil movement on the slopes of a particular area.

[14] Stephens, S.L., and D.L. Fry, E. Franco-Vizcaino, M.M. Collins, and J.J. Moghaddas (2007). "Coarse woody debris and canopy cover in an old-growth Jeffrey pine–mixed conifer forest from the Sierra San Pedro Martir, Mexico." *Forest Ecology and Management* 240: pp. 87–95.

[15] Sheltered Connectivity: Contiguous areas within a thinning treatment that are retained for wildlife cover and to support wildlife movement.

[16] Downed Woody Debris: The remains of dead trees, branches, and various woody brush that sit on the forest floor—generally refers to trunks of trees.

[17] Stephens et al. (2007) and Stephens, S.L., and J.J. Moghaddas (2005b). "Fuel treatment effects on snags and coarse woody debris in a Sierra Nevada mixed conifer forest." *Forest Ecology and Management* 214: pp. 53–64.

[18] Doghair: An excessively dense stand of trees. An example is an acre with 35,000 trees, all smaller than seven inches DBH.

• Thin and/or remove codominant[19] white fir and Douglas fir in order to release dominant pines or oaks (possibly for merchantable materials). If these trees cannot be economically utilized, leave them on site to serve as downed wood for wildlife habitat. Remove all material less than three inches DBH.

Slash Treatment

• Avoid any treatment that involves lop and scatter of slash under the tree canopy.

• Avoid lop and scatter of pine limbs and tops over two inches diameter so pine beetles will not enter downed, freshly cut treatment slash. It is best to avoid lop and scatter in pine sites to prevent beetle infestations. If cut materials must sit over the summer and are greater than two inches diameter, put into piles and cover with clear plastic to control beetle populations.

• Ensure surface fuels are less plentiful and more compact than before treatment. Do this by lopping into small pieces, weighing them down with larger pieces, and ensuring that all slash is in direct contact with the ground to facilitate quick decomposition. Cutting material from the mid-story and crown and placing it on the surface will increase short-term fire hazard, but reduce long-term hazards.

Burning

• Pile and burn pine slash prior to spring (May through July) when possible to prevent beetle infestations.

• When cutting pine between October and May, treat fuels immediately by burning.

• Follow general chaparral and foothill woodland burning prescriptions as described above for treatment of slash in ponderosa pine and mixed conifer forests.

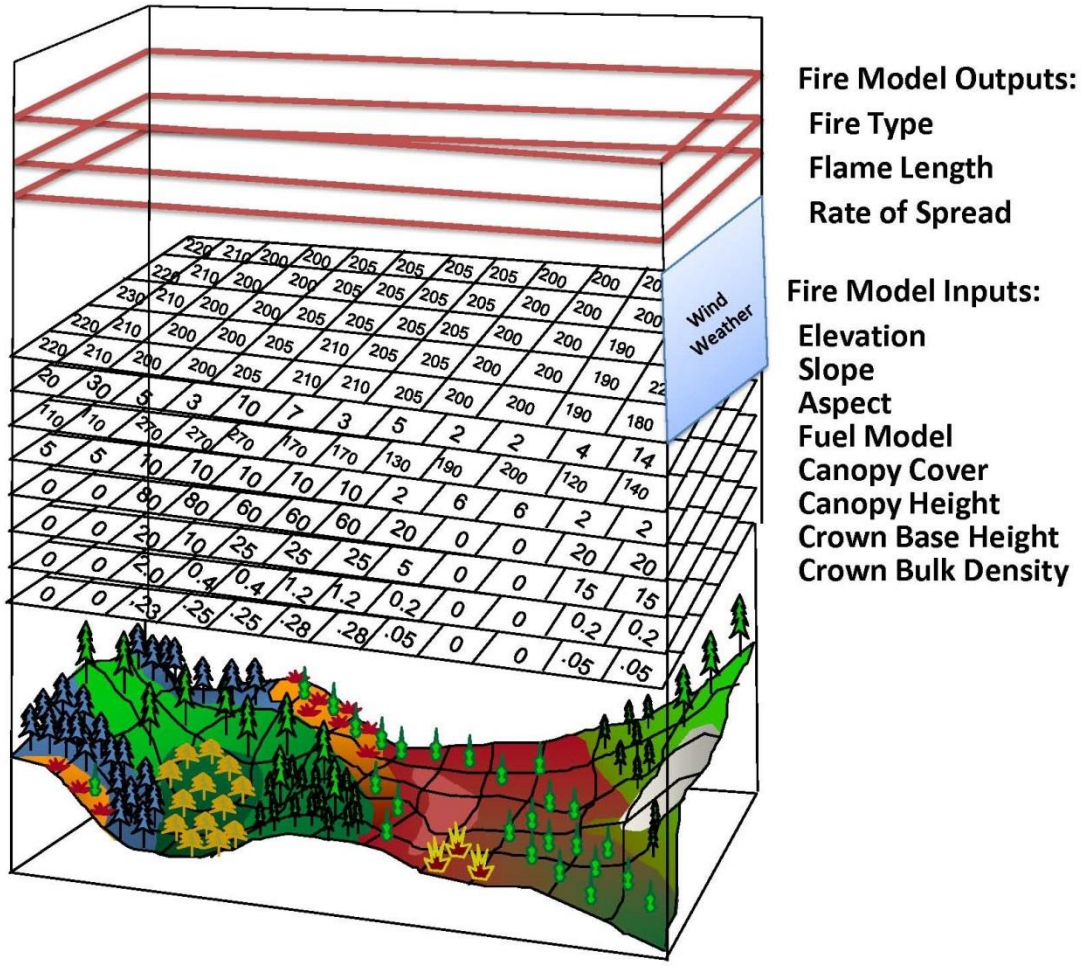
• Follow burning with the sowing of native grasses in the mineral-rich ashes and disturbed soils in order to reduce colonization by non-native species and restore herbaceous understory.

[19] Codominant: Species that share dominance or are of equal importance. For example, a fir-pine forest may be dominated by both firs and pines.

Appendix B: Predictive Wildfire Behavior Modeling

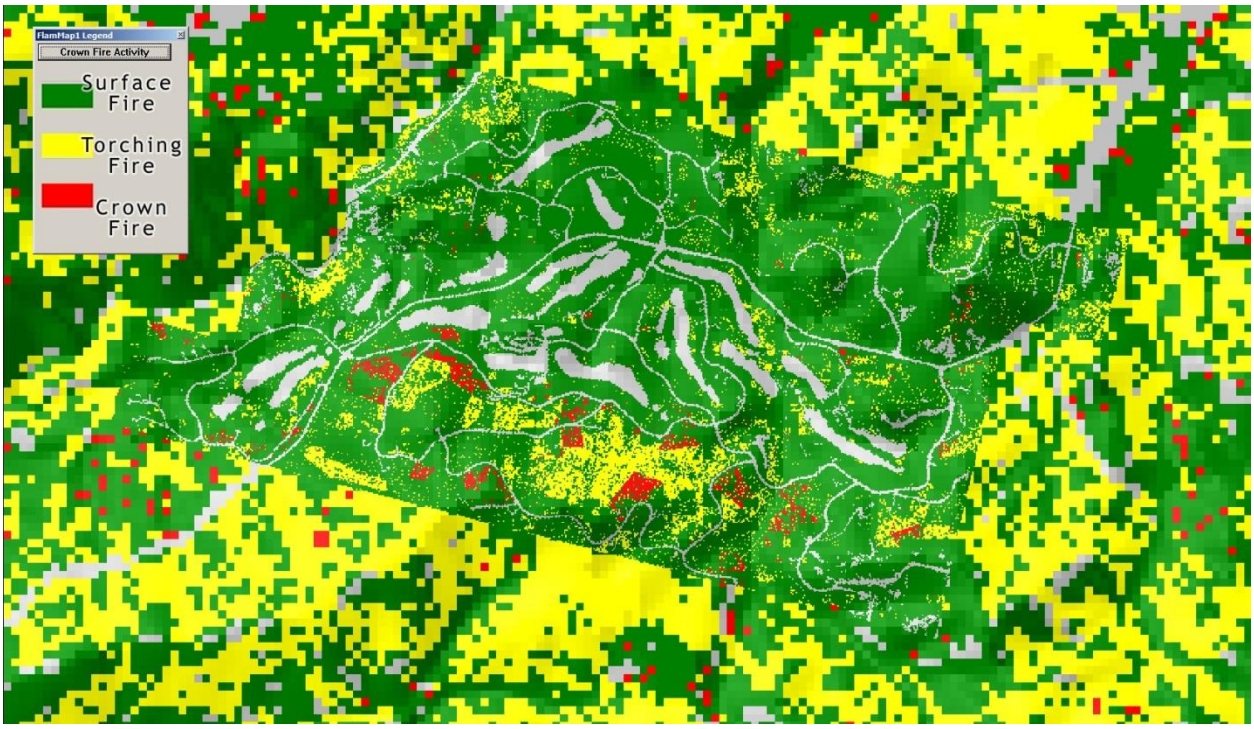
DCR used the FlamMap fire behavior modeling software to conduct an analysis of potential wildfire behavior within the Gold Mountain area. FlamMap computes potential fire behavior characteristics such as spread rate, flame length, and rate of fire spread over an entire landscape for constant weather and fuel moisture conditions.

The figure below depicts the different types of data that were used for the fire behavior modeling portion of the community hazard assessment. The grid size used for the model has a piece of data for approximately every 225 square feet.

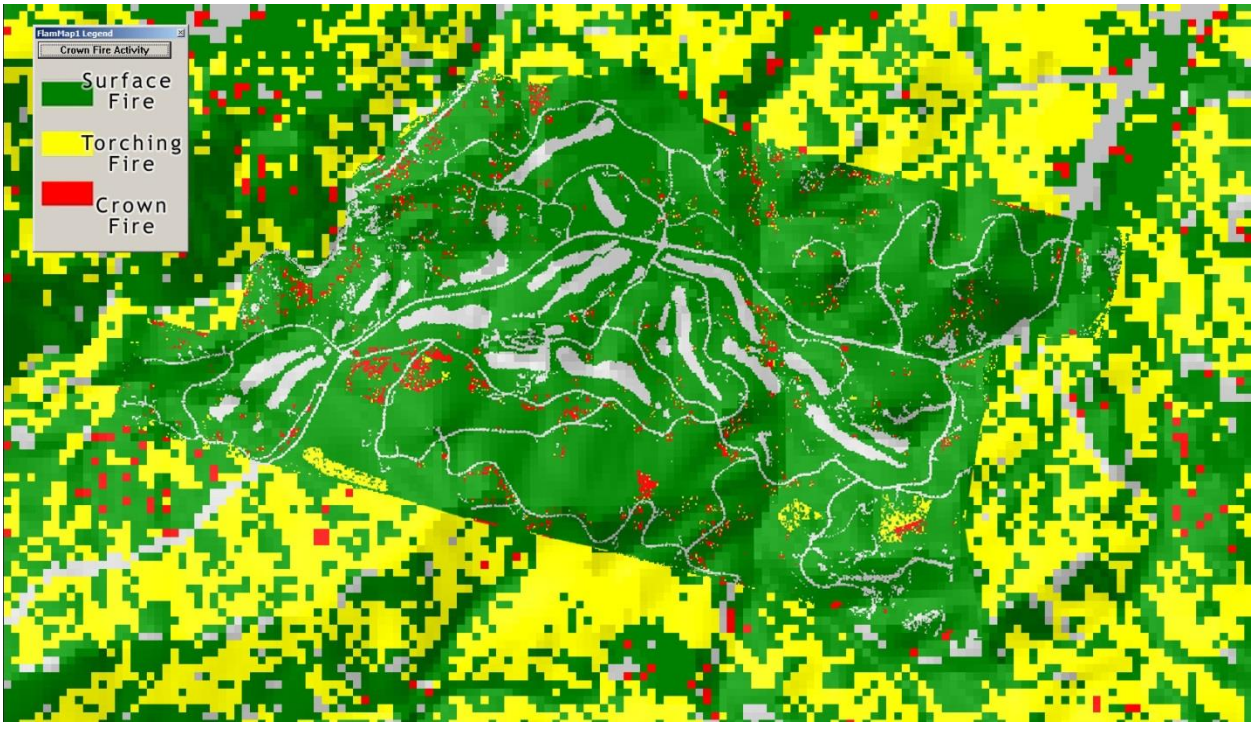


The DCR modeling effort used lot-based fuel loading data from the fieldwork portion of this assessment. Aerial photo interpretation were used to map canopy closure. 2010 forest fuels and vegetation data from the nationwide LANDFIRE fuels mapping effort were used in areas outside of the project area, and is not based upon ground surveys. It covers ¼ per pixel, and it appears to overestimate actual hazard.
Weather data for the modeling came from fire behavior modeling work being done for the Eastern portion of the Sierra County Community Wildfire Protection Plan update.

Potential Wildfire Behavior – FlamMap Model Outputs



Potential Wildfire Type – Current Conditions.



Potential Wildfire Type - Ideal conditions, with most ladder fuels thinned. Some of the steepest, thickest areas will still experience crown fire without additional thinning.

The maps above show potential Crown Fire Activity as modeled by the FlamMap fire behavior modeling software.

- **Surface fire:** The fire is generally on the ground, high likelihood of initial attack success.
- **Torching Fire:** A passive crown fire, (torching and short range spotting).
- **Active crown fire:** Fire actively moving in the crowns of trees with mid to long range spotting).

Yellow and Red areas inside of the community will experience torching and long-range spotting. Green areas are places where fires are generally suppressible.

The difference between these two modeling scenarios is that the 'Ideal Conditions' model assumes that understory thinning and pruning has raised the canopy base height to 10 feet across the entire property.

What this modeling suggests is that the densest, steepest stands will require the heaviest thinning, and that the densest areas may require removing some of the larger, intermediate trees. No dominant trees should be cut, nor should any over 12" DBH.

Application of FlamMap analysis to lot hazard score

DCR collected both surface and canopy fuel loading data for each lot in the Gold Mountain community. The FlamMap crown fire map provides a good visualization of the places where the surface and canopy conditions are conducive to the development of torching and crown fire behavior. Lots that showed any potential for either torching or crown fire behavior were flagged, and generally received a High or Critical Priority for hazardous fuels reduction work.

Appendix C: Example plot data from 2004 Plumas County Hazardous Fuels Assessment Photoseries

Derivative Fuel Model - Loading (tons per acre)

	Total Loading with Needles	Total Loading w/o Needles	Fuelbed Bulk Depth	Needles	1 Hr	10 Hr	100 Hr	1000 Hr
Crowns, Boles, + Tops	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dead Down Woody Fuel	6.00	6.00	0.00	0.00	0.20	2.00	3.80	0.50
Total Surface Fuel	6.00	6.00	0.64	0.00	0.20	2.00	3.80	0.50

Representative Fuel Model: 9Z - Hardwood (long-needle pine) litter - High										
	Total Loading with Needles	Total Loading w/o Needles	Fuelbed Bulk Depth	Needles	1 Hr	10 Hr	100 Hr	1000 Hr	Herb	Shrub
	0.00	4.53	0.26	0.00	3.79	0.54	0.20	0.00	0.00	0.00

Crown Fuels Characterization			
Crown Fire Model	Fixed - Van Wagner	Canopy Fuel Loading for Crowning(lbs)	9.60
Canopy Base Height(ft)	4	Canopy Ceiling Height(ft)	60
Basal Area	271.80	Canopy Bulk Density Method: Max. Canopy	0.01430
Fire Behavior Environment			
1 Hour Reference Fuel Moisture(%)	3.10	1 hour Fuel Moisture (%)	3.10
10 hour Fuel Moisture(%)	4.20	100 hour Fuel Moisture (%)	9.10
Herb Fuel Moisture(%)	44.30	Woody Fuel Moisture(%)	66.50
Wind Speed(mph)	9	Wind Reduction Factor	0.3
Midflame Wind Speed (mph)	3	Temperature(f)	85
Slope (%)	40	Foliar Moisture Content (%)	105
Spotting and Probability of Ignition Environment			
1 hour Fuel Moisture(%)	3	Temperature(f	85
Fuel Shading (%)	50	20 Ft Wind Speed (mph)/Canopy Downwind	9/Open
Tree Height (ft)	60	Mean Cover Height (ft)	60
Species	Ponderosa Pine, Lodgepole Pine	DBH (in)	8
Number of Torching Trees	1		
Fire Behavior Results			
Rate of Spread(ch/hr)	9.90	Max Windspeed Met	No
Flame Length(ft): Critical	3.2	Surface	3.8
Fireline Intensity(btu/ft/sec): Critical	70	Surface	105
Crown Rate of Spread(ch/hr)	37.80	Crown Fraction Burned using RMRS RP-29	0.94
Rate for Active Crowning	39.10	Maximum Rate of Spread(ch/hr)	39.60
Probability of Ignition	85	Spotting Dist. from Torching Trees(mi)	0.19
Spotting Dist. from Surface Fires (mi)	0.08	Fire Flame Length(ft)	22.20
Torching Index	4.49	Crowning Index	9.18
Power of Wind	2.34	Power of Fire	9.05
Resultant Fire Spread and Type			
Fire Rate of Spread(ch/hr)	37.8	Fire Type	Passive Crown Fire
Other Effects			
Hours Fire Has Been Growing	1	Elliptical Fire Size(ac)	66.95

Tree Effects:

Plt #	Tree #	Dia	Species	Ht	Crown Ratio	Trees Per Ac	Strct	Crown Scorched(%)	Probability of Mortality(%)
1	1	14	Pine, Ponderosa	60	0.65	40	D	100	97
1	2	17	Incense cedar	45	0.90	40	CD	100	96
1	3	12	Pine, Ponderosa	55	0.60	40	CD	100	98
1	4	7	Pine, Ponderosa	60	0.50	40	CD	100	99
1	5	10	Pine, Ponderosa	45	0.50	40	CD	100	99
1	6	6	Pine, Ponderosa	33	0.50	40	I	100	100
1	7	11	Pine, Ponderosa	50	0.50	40	I	100	98
1	8	12	Pine, Ponderosa	40	0.60	40	I	100	98
1	9	7	Pine, Ponderosa	40	0.40	40	I	100	99
1	10	3	Pine, Ponderosa	30	0.40	80	S	100	100
1	11	5	Pine, Ponderosa	35	0.40	80	I	100	100
1	12	5	Incense cedar	20	0.25	40	S	100	100
1	13	5	Incense cedar	18	0.60	40	S	100	100

Appendix D: Wildfire Preparedness and Fire Education Websites

Wildfire is Coming. Are you ready?	http://www.readyforwildfire.org/
Making your Family Disaster Plan	http://www.ready.gov/america/makeaplan/index.html
Disaster Planning guide template	http://ready.adcouncil.org/beprepared/fep/index.jsp
California Emergency Management Agency	http://www.calema.ca.gov/
Plumas Fire Safe Council	http://www.plumasfiresafe.org
CAL FIRE Wildland-Urban Interface/Defensible Space Regulations	http://tiny.cc/CALFIRE_Codes
CAL FIRE Wildfire Prevention Regulations	http://www.fire.ca.gov/about/downloads/preventionlaws.pdf
Home Ignition Prevention/Ember Awareness	http://www.livingwithfire.info/be-ember-aware
Builders Wildfire Mitigation Guide	http://firecenter.berkeley.edu/bwmg/
Wildfire Preparedness for Horse Owners	http://www.ext.colostate.edu/pubs/livestk/01817.html
California Fire Safe Council	http://www.firesafecouncil.org/
Red Cross - Sacramento/Sierra Chapter	http://sacsierraredcross.org/
Fire Adapted Communities (Educational Resource)	http://www.fireadapted.org/
Firewise Communities (Educational Resource)	http://www.firewise.org/