APPENDIX B

Marking Guidelines for Fire-Injured Trees and Hazard Trees
for the Pondo Fire Salvage Project

Guideline Objectives

These guidelines will provide a means to identify and remove both trees that were killed or severely injured as a result of fire and/or insect attack, and were pre-fire hazard trees within the Ponderosa Fire area on the Feather River Ranger District, Plumas National Forest. These guidelines are based both on the fire injured tree marking guidelines developed by Region 5 Forest Health Protection (Report #RO-11-01, Smith and Cluck, May 2011) and on hazard tree marking guidelines developed by Region 5 Forest Health Protection (Report #RO-12-01, Angwin, Cluck, Zamgino, Oblinger and Woodruff, April 2012).

Guideline for Fire Injured Trees

The guideline criteria for delayed conifer tree mortality are based on the post-bud break model (percent of crown length killed) for yellow pine, sugar pine, incense cedar, white fir, and Douglas-fir (percent of crown volume killed) models. The percent crown kill guideline is also used in combination with tree dbh, cambium kill rating and/or the presence or absence of bark beetle activity.

A probability of mortality of 0.4 (Pm=0.4) was selected for this project to meet the management objectives of:

1) Removing trees that were killed.
2) Abating the hazard from trees that are likely to fail and cause injury to either people or property.
3) Reducing snag density and increasing safety for tree planters in those areas that will be reforested.
4) Removing trees that have a high probability of mortality in order to recover their economic value due to limiting the number of entries, since two roads would be re-decommissioned after harvest.

Mark for removal any tree that meets the following criteria:

1. Any tree with no green needles.

2. For all species, trees should be marked for removal if any combination of the following:

    a. Boring dust or frass (in bark crevices, webbing along the bole, or that accumulates at the base of the trees),
    b. Pitch tubes with pink or reddish boring dust associated with them,
    c. And/or pouch fungus conks.
    d. This specifically excludes basal attacks by the red turpentine beetle on pines (large pitch tubes associated with coarse boring dust generally restricted to the lower 2 to 3 feet of the bole or woodpecker activity restricted to this area) and when the above indicators are only associated with wounds, old fire scars, etc. The presence or absence of red turpentine beetle pitch tubes will be accounted for in criteria 3 below.

3. Any tree that meets or exceeds the following fire-injured conifer mortality guidelines (Table B-1) at the Pm = 0.4 level. This assessment will be made by:

    a. Visually estimating the percent of the original pre-fire crown length that was killed (yellow pine, sugar pine, incense cedar, and white fir) or crown volume (Douglas-fir) (Figure 1).
    b. Determining the presence or absence of red turpentine beetle pitch tubes (yellow and sugar pine) (Figure 7).
    c. Estimating tree diameter,
    d. And determining the cambium kill rating (Figure 5).
    Evaluation of Cambium Injury: After sampling the cambium within 3" of the ground line at 4 equally spaced locations, determine the number of samples with dead cambium (0 to 4). This number is the cambium kill rating (CKR). The cambium kill rating then would be used to add or subtract a percentage to the percent of crown length killed estimate (Table B-1).

Evaluation of Crown Injury

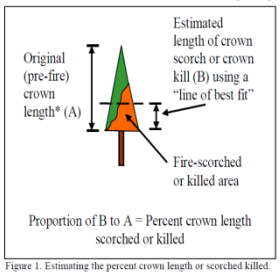

Figure 1. Estimating the percent crown length or scorched killed.

Evaluation of Red Turpentine Beetle Activity

Figure 7. Red turpentine beetle pitch tubes.

Evaluation of Cambium Injury

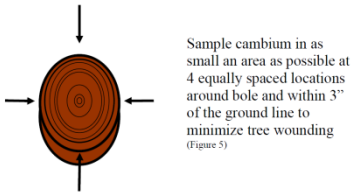

Table B-1: Specific criteria for marking fire-injured trees at the probability of mortality (Pm) = 0.4 level.

Species	Condition	DBH (inches)	Percent Crown Length Killed	Cambium Kill Rating And Adjustment %				
				0	1	2	3	4
Yellow Pine (Ponderosa and Jeffery pine)	Red turpentine beetle present Post-bud break	10 - <30"	40	+5	+5	0	-10	-10
		30 - 40"	--	--	--	--	--	--
		>40 - 50"	--	--	--	--	--	--
	Red turpentine beetle absent Post-bud break	10 - <30"	55	+5	+5	0	-10	-10
		30 - 40"	25	+5	+5	0	-5	-5
		>40 - 50"	5	+5	+5	0	-5	-5
Sugar Pine	Red turpentine beetle present Post-bud break	10 - 60"	30	+5	+5	+5	+5	-20
	Red turpentine beetle absent Post-bud break	10 - 60"	60	+5	+5	+5	+5	-20
Incense Cedar	Post-bud break	10 - 60"	80	-	-	-	-	-
White Fir	Post-bud break	10 - 35"	70	0	-5	-5	-10	-10
		35 - 60"	50	0	-5	-5	-10	-10
Species	**Condition**	**DBH (inches)**	**Percent Crown Volume Killed**	**Cambium Kill Rating and Adjustment %**				
				0	**1**	**2**	**3**	**4**
Douglas-Fir	Post-bud break	4 - 60"	55	+5	0	-5	-10	-20

Guidelines for Hazard Trees

The criterion for hazard trees uses an updated version of the "7-Point Hazard Tree Rating System". This is based on failure impact (target) and failure potential (tree defect).

7-Point Hazard Tree Rating System

Two values are determined for each tree being rated – 1) failure impact (target) and 2) failure potential (tree defect). Both are determined independently and then combined to establish the hazard rating. Point values for failure impact and failure potential are as follows:

1. Failure Impact (Target)

The first value, the failure impact, integrates the likelihood of impact, the amount of damage if failure occurs, and the value of the target (monetary or possibility of injury or death). One of the following values is selected:

1 point = Low failure impact: minor damage is expected if failure occurs. Probability of impacting a target (exposure time) is low (e.g., transitory exposure only); defective tree or tree parts is small; target is of low value.

2 points = Medium failure impact: moderate damage is expected if failure occurs. Probability of impacting a target (exposure time) is moderate (e.g., daytime or intermittent exposure only); defective tree or tree parts is sufficient size to cause moderate damage; target is of moderate value.

3 points = High failure impact: extensive damage is expected if failure occurs. Probability of impacting a target (exposure time) is high (e.g., overnight exposure); defective tree or tree parts is of a size to cause extensive damage; target of high value.

2. Failure Potential (Tree Defect)

The second value, the failure potential, requires the inspector to estimate the likelihood that, prior to the next inspection, the defective tree or tree part will fail during the season when the target is present. Determining the tree failure potential requires an evaluation of the defects and the failure potential of the defect for the tree species involved.

Tree defect is based on the following factors: a) cracks, b) weak branch unions or forked tops, c) decay in stem or branches, d) cankers, e) dead tree, top, or branches, f) bark and wood boring beetles, g) root damage and root disease, and h) lean and poor architecture.

The following values are applied:

0 points = no defects identified
1 point = low potential for failure: minor defects.
2 points = medium potential for failure: moderate defects.
3 points = high potential for failure: serious defects.

Add 1 point if multiple, interacting defects are present, e.g. leaning tree with other defects.

Score 4 points (the maximum score) if the tree is dead.

3. **Possible Hazard Ratings: 1 = Lowest and 7 = Highest**

The hazard rating is determined by adding the failure impact and the failure potential values. This can then be used to determine what action may be necessary to reduce the hazard.

HAZARD RATING = FAILURE IMPACT + FAILURE POTENTIAL (TOTAL SCORE 1-7)

4. **The following actions should be taken based on the hazard rating**:

Hazard Rating	Hazard Potential	Suggested Action
1-3	Low	No Action or Monitor (document and tag or map tree)
4-5	Moderate	Monitor (document and tag and map tree) or Mitigate (remove defective tree, tree part or target)
6-7	High	Mitigate Immediately (promptly remove defective tree, tree part or target)

References for the Pondo Fire Salvage and Hazard Tree Marking Guidelines

Angwin, P.A., Cluck, D.R., Zamgino, P.J., Oblinger, B.W., and W.C. Woodruff. 2012. *Hazard Tree Guidelines for Forest Service Facilities and Roads in the Pacific Southwest Region*. US Forest Service, Forest Health Protection, Region 5, CA (Report #RO-12-01. 40p.

Hood, S.M., S.L. Smith, and D.R. Cluck. 2007. *Delayed conifer tree mortality following fire in California*. In: Powers, Robert F., tech. editor. Restoring fire-adapted ecosystems: proceedings of the 2005 national silviculture workshop. Gen. Tech. Rep. PSW-GTR-203, Albany, CA: Pacific Southwest Research Station, Forest Service, U.S. Department of Agriculture: p. 261-283.

Smith, S.L. and D.R. Cluck. 2011. *Marking guidelines for fire-injured trees in California*. US Forest Service, Forest Health Protection, Region 5, Susanville, CA. Report # RO-11-01. 13 p.

Failure Impact (Target)

3 points = High failure impact: extensive damage expected if failure occurs. Probability of impacting a target (exposure time) high (e.g., overnight exposure); defective tree or tree parts large enough to cause extensive damage; target of high value. Examples include campsites, lodges, hotels, dormitories, residences and 24-hour visitor service and restroom facilities.

2 points = Medium failure impact: moderate damage expected if failure occurs. Exposure time moderate (daytime or intermittent only); defective tree or tree parts of sufficient size to cause moderate damage; target of moderate value. Moderately used paved trails, picnic and other day use areas, interpretive sites, amphitheaters and kiosks, moderate to high-use road networks within campgrounds, roadside attractions, such as vista points or historic stops, information stations, visitor centers, fee collection portals, high use daytime parking areas, designated trailhead parking areas, plazas, staging areas and commercial sites, roads and intersections with moderate to high traffic volume, haul routes during periods of commercial use, active projects along roads where work is stationary.

1 point =Low failure impact: Minor damage expected if failure occurs. Exposure time low; defective tree or tree parts is small; target of low value. Highway corridors or improved Forest Service roads with little or sporadic traffic, unimproved roads, turnouts, bicycle paths, or structures with sporadic occupancy, such as storage buildings.

Failure Potential (Defect)

3 points = high potential for failure: serious defects.
2 points = medium potential for failure: moderate defects.
1 point = low potential for failure: minor defects.
0 points = no defect observed

Add 1 point if multiple, interacting defects are present, e.g. leaning tree with other defects.

Score 4 points (the maximum score) if tree is dead.

Cracks

High (3 points):
- Crack goes completely through stem or branch.
- Stem has two cracks on the same segment with a cavity or extensive decay.
- Crack in contact with another defect or is at the base of a leaning tree.
- Branch (4" or larger) with any crack.
- Conifer stem with a single crack with inrolled bark and a cavity or decay inside.

Medium (2 points):
- Hardwood stem with a single crack with a cavity or decay (the decay should also be evaluated based on the "Stem and Branch Decay" criteria below).

Low (1 point):
- Trees with a single frost crack and no internal decay.

Branch Unions/Forked Tops

High (3 points):
- Weak branch union (V-shaped with inrolled bark) that is also cracked, cankered, decayed or streaming pitch. Strong (U-shaped) branch unions with these defects, except as listed below, should be assessed on the basis of the associated defects.
- Heavy U-shaped branches of all species except for pines and incense cedar that form when branches turn up to become leaders. Pine and incense cedar receive a high rating only if an associated defect (cracked, cankered, decayed or streaming pitch) is also present at the branch union.
- Large epicormic branches on decaying stems and branches.

Medium (2 points):
- Weak (V-shaped) union with inrolled bark.

Low (1 point):
- Heavy U-shaped branches of pines and incense cedar that form when side branches turn up to become leaders (no additional defect in the branch union).

Stem or Branch Decay

High (3 points):
- Less than ⅓ of the tree's radius (or diameter) is sound. Additional sound wood needed if tree is leaning, decay is off-center or present between four feet above the groundline and the lowest live branch, or is associated with an open cavity.

Stem or Branch Decay (cont.)

High (3 points)
- Cavity, decay or fruiting body associated with an open crack or weak branch union.
- Decay in a horizontal branch.
- True fir and hardwoods with known, but unmeasured decay, especially if a cavity is open to the outside.

Medium (2 points):
- Trees with greater than ⅓ of the tree's radius in sound wood may or may not have medium failure potential, depending on the extent of decay, species of decay fungus and position within the tree. At the very least, trees with identified decay should be closely monitored on a regular schedule and after significant weather events.
- Douglas-fir, incense cedar and pine species with known, but unmeasured decay, especially if a cavity is open to the outside.

Note: All trees with moderate or high failure impact ratings should be thoroughly evaluated for decay with the proper equipment and/or mitigated regardless of the species.

Fungal Fruiting Bodies

High (3 points):
- *Phaeolus schweinitzii* conks associated with butt swell on Douglas-fir.
- One or more Indian paint fungus (*Echinodontium tinctorium*) conks on true fir or hemlock
- Five or more red ring rot *(Porodaedalia (Phellinus) pini*) conks on Douglas-fir, ponderosa pine, Jeffrey pine, lodgepole pine, or more than one on true fir or hemlock.
- One or more quinine (*Fomitopsis officinalis*) conks on Douglas-fir, pines, western larch, spruce or hemlock.
- One or more sulfur fungus (*Laetiporus sulphureus*) conks on a wide range of conifers and hardwoods, including Douglas-fir, true firs, pines, hemlocks, spruces, larch, western redcedar, oaks, maples, birch and willow.

Medium (2 points)
- *P. schweinitzii* conks without associated with butt swell on Douglas-fir.
- Fewer than five red ring rot (*P. pini*) conks on Douglas-fir, ponderosa pine, Jeffrey pine, lodgepole pine, or one on true fir or hemlock.
- Incense cedar pecky rot conks (*Oligoporus* amarus) conks on incense cedar greater than 150 years old.

Cankers

High (3 points):
- Cankers with associated fruiting bodies of decay fungi.
- Cankers with associated internal decay.
- Canker physically connected to a crack or other defect.
- Single or multiple cankers without decay over more than ½ of the tree's circumference, particularly if the cankers are between four feet above the groundline and the lowest live branch.
- Basal cankers in true fir that affect over ⅓ of the bole circumference.

Cankers (cont.)

High (3 points):

- Cankers in oak or tanoak caused by *Phytophthora ramorum* (ramorum canker or sudden oak death) that affect more than ⅓ of the bole circumference, or have associated decay fungi, ambrosia beetles or bark beetles.
- Deep charring in true fir over more than ⅓ of the bole circumference when the relationship between deep char and cambial mortality has been confirmed.
- Deep charring in sugar pine, ponderosa pine, Jeffrey pine, incense cedar or Douglas-fir over ½ of the bole circumference when the relationship between deep char and cambial mortality has been confirmed.

Medium (2 points):

- For all species other than true fir, single or multiple cankers without decay that affect less than ½ of the tree's circumference (including fire-caused cankers).
- For true fir, single or multiple cankers without decay that affect less than ⅓ of the bole circumference (including fire-caused cankers).
- For oak or tanoak, cankers caused by *Phytophthora ramorum* (ramorum canker or sudden oak death) without associated decay, ambrosia beetles or bark beetles that affect less than ⅓ of the bole circumference.
- A large old wound or canker with no decay at the base of a leaning tree.

Low (1 point):

- True fir with bole swelling from dwarf mistletoe with no bark sloughing or evidence of decay.
- Lodgepole pine or ponderosa pine with basal (hip) cankers from western gall rust with no bark sloughing or evidence of decay.
- Lodgepole pine or ponderosa pine with elongated stalactiform rust cankers covering less than ⅓ of the bole circumference.

Dead Tree, Top Or Branches

Extremely High (4 points):

- Dead tree.

High (3 points):

- Dead top greater than ten feet long or smaller ones with associated decay or other defect (note that old dead tops of pine, incense cedar, juniper or Douglas-fir may not have high failure potential).
- Dead branches greater than two inches in diameter, branches that are hanging or lodged in the crown, large dead dwarf mistletoe brooms and large live dwarf mistletoe brooms with associated decay or defect.

Medium (2 points):

- Dead tops less than ten feet long with no associated decay or other defect (note that old dead tops of pine, incense cedar, juniper or Douglas-fir may have lower than medium failure potential).
- Any branch greater than two inches in diameter and more than ⅔ dead (remove the entire branch).
- Live dwarf mistletoe brooms with no associated decay or other defect (monitor closely).

Low (1 point):

- Old spike tops in pine, incense cedar, juniper or Douglas-fir that give evidence of long-term persistence.

Bark and/or Wood Boring Beetle-Attacked Trees

High (3 points) If any of the following over at least ⅓ of the bole circumference (excluding basal attack by red turpentine beetle):

- Pitch tubes with pink or reddish (not clear) boring dust.
- Pouch fungus conks and/or current woodpecker (not sapsucker) activity.
- Boring dust or frass in bark crevices, webbing along the bole, or accumulation of boring dust or frass at the base of the tree.

Bark and/or Wood Boring Beetle-Attacked Trees (cont.)

High (3 points):

If tree has significant bark and/or wood boring beetle activity, as indicated by:

- 50% or more of the foliage-bearing crown actively fading, as indicated by a uniform change in color over that part of the crown. Dead tops that have no foliage do not count toward this 50%. Also does not include drought-induced needle cast (non-uniform fading restricted to the older needles) or branch mortality ("flagging") caused by dwarf mistletoe/*Cytospora* infections in true fir.

Root Damage and Root Disease

High (3 points):

- Recently leaning trees, or with recent root-lifting, soil movement or mounding near the base, or with broken/decayed roots.
- Inadequate root support, with more than half of the root system within the drip line severed, broken, undermined or decayed by erosion or excavation.
- Host tree species visibly infected with root disease fungi, adjacent to visibly infected trees or stumps, or with advanced crown symptoms in the immediate area where Heterobasidion root disease has been identified.

Medium (2 points):

- Less than ½ of the root system within the drip line severed, broken, undermined or decayed by erosion or excavation.
- Host tree with few or no crown symptoms within 50 feet of a confirmed root disease-infected tree or stump or within 50 feet of a host tree with advanced crown symptoms.

Leans and Poor Tree Architecture

High (3 points):

- Leaning with an angle greater than 45° from vertical.
- Leaning with other contributing defects.
- Freshly leaning tree with recent root lifting, soil movement or mounding near the base.
- Lean associated with unstable soils or cracks in the tree.
- Uncorrected lean compounded by unbalanced crown shape weighted in the direction of the lean.
- Uncorrected lean at a location with frequent storm or wind injury.

Medium (2 points):

- Uncorrected lean with an angle between 10°and 45° from vertical without other contributing defects. Monitor closely for changes in the lean.
- Branches with a twist, sharp angle or bend.
- Branches that are lopsided or unbalanced with respect to the rest of the crown, especially if nearby trees were pruned or removed within the last ten years.

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