Wildlife / Dangerous Tree Assessor's Course Workbook

Wildland Fire Safety Course Module

WorkSafeBC
WORKING TO MAKE A DIFFERENCE

BRITISH COLUMBIA
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Ministry of Forests and Range

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FOREWORD

This training course provides information and technical procedures for assessing tree hazards and establishing appropriate safe work practices in situations where there is potential exposure to workers involved in wildland fire fighting, from dangerous trees. It also provides information on habitat quality which can be used to retain some high-value wildlife trees where opportunities exist to assess both tree hazards and wildlife tree habitat value (e.g., in sustained action fires where there is sufficient time to assess wildlife tree habitat components).

Fire crews involved in wildland fire fighting do not have the time to complete a detailed tree assessment to determine if trees that appear dangerous might actually be assessed as safe. Consequently, this course primarily focuses on worker safety and tree defects which can be visually inspected and rated as having "high defect failure potential."

Persons who wish to learn more about wildlife/danger tree assessments applicable to post-fire forestry activities (e.g., tree planting burned areas), should take this training module in conjunction with the "Wildlife/Danger Tree Assessor's Course for Harvesting and Silviculture."

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COURSE BACKGROUND

This module is intended for those who work around potentially dangerous trees in wildland fire operations.

> Those participants wishing to become qualified assessors should have a minimum of 3 years experience in wildland fire supression as well as a knowledge of native tree species

In order to receive a qualifying certificate, students must pass a certifying exam (written and field practical with combined 75% average including minimum 85% on field practical exam).

Certified assessors will be recognized by WorkSafe BC, Ministry of Forests and Range and the Ministry of Environment.

On successful completion of the 2 day course, the certified assessor will be competent in the following:

- indentifying important attributes of wildlife/danger trees;
- assessing trees for their failure potential;
- making appropriate safety decisions regarding assessed trees;
- assessing trees for their potential as wildlife habitat;

COURSE GOALS AND OBJECTIVES

Goals

The goal of the Wildlife/Danger Tree Assessor's course is to present information, practical field experiences and methods for:

- developing dangerous tree and wildlife tree identification procedures;
- maintaining a safe work environment; and
- where possible in wildfire operations, retain selected wildlife tree habitat

Objectives

Participants in the Wildlife/Danger Tree Assessor's Course will be trained to:

- distinguish between safe and dangerous trees, thereby enabling them to determine tree hazards and related safe work procedures for dealing with dangerous trees in wildland fire operations.

- Recognize existing and potential wildlife trees, identify wildlife tree use and understand the importance of wildlife trees.

WHAT IS A WILDLIFE TREE?

Trees in various stages of life, death and decay are important components of the structure and function of all natural forest ecosystems. Wildlife trees are part of this cycle of life and death. They are constantly being formed by biotic and abiotic factors such as insects, fungi, fire and weather.

> *A wildlife tree is any standing dead or live tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife.*

In British Columbia, 80 species of birds, mammals and amphibians depend on wildlife trees for nesting, feeding and shelter. Some wildlife trees are protected under Section 34 of the provincial *Wildlife Act*, which reads as follows:

> *"A person who, except as provided by regulation, possesses, takes, injures, molests or destroys*
>
> *(a) a bird or its egg,*
>
> *(b) the nest of an eagle, peregrine falcon, gyrfalcon, osprey, heron or burrowing owl, or*
>
> *(c) the nest of a bird not referred to in paragraph (b) when the nest is occupied by a bird or its egg commits an offence."*

Depending on their cause of death, specific tree defects and condition, and the type of work activity, some wildlife trees can be dangerous. A discussion of tree danger rating is found in the upcoming sections. More information on wildlife tree habitat value is found in Appendix 1.

Bat roost in cedar snag
Photo courtesy of Province of British Columbia

WILDLIFE TREES AND THE PROCESS OF TREE DEATH AND DECAY

Decay and the associated deterioration and death of trees are normal processes that regularly occur within forested ecosystems and are partly responsible for the ever-changing nature of forests. Casual observation may suggest that, aside from obvious factors such as fires and insect attacks, trees die randomly. However, a closer look reveals that tree death is a complex process. The timing and rate of death depend on several factors, including but not limited to:

A. The tree species: Some trees, such as hardwoods, often succumb to pathogens at a relatively early age (i.e., 50–60 years).

B The location of the tree relative to site and biogeoclimatic zone: Trees located near the edge of their normal range are less resistant to pest attacks than those situated well within their normal range. Trees located on harsh sites are more easily stressed and hence more susceptible to attacks by various pests.

C. The age, health and vigor of the host tree: Trees are most susceptible to injury and attack when they are very young, very old, or otherwise unhealthy or stressed.

D. The pest species: Most pests favour certain host tree species and have little or no effect on other species.

Canker on pine. An obligate pathogen, the canker fungus derives its nutrition by killing host tissue.

White Mottled Rot (Ganoderma applanatum), a heart rot fungus common on hardwoods.

E. The amount or numbers of the pest present and its virulence: Successful attack resulting in significant injury or death almost always requires that the attacking agent be quite strong and/or numerous in order to overcome the natural defenses of the host tree.

Plants can die either in whole or in part. It is common to see forest trees with dead tops, branches, or roots. Tree death can occur slowly or relatively quickly, as with insect attacks. Different mortality processes produce different types of wildlife trees and change the forest in different ways.

Simultaneous and Cumulative Pest Attacks

Often several agents simultaneously attack, weaken and ultimately kill a single tree, a small group of trees, or even an entire stand of trees. At other times the mortality agents occur sequentially and act in an additive manner.

One possible scenario of mortality agents acting sequentially begins with a low intensity forest fire creating a large basal scar on a western larch tree. This scar is subsequently attacked and infected by a decay organism that causes heart rot. After several years the decay has traveled up the trunk of the tree. A heavy snowfall accompanied by high winds causes the trunk of the tree to break off at the 12-meter point. If there are no live limbs below the breakage, the tree is killed. In this example, fire, followed by decay , followed by adverse weather conditions, combined to kill the tree.

Significance of Disease and Decay in our Forests

Virtually all natural tree mortality can be attributed to three broad categories: fire, insects and disease (the latter includes losses due to adverse climatic conditions and pollution). The estimated percentages attributable to each of these categories in B.C. are:

Fire	15%
Insects	20%
Disease	65%

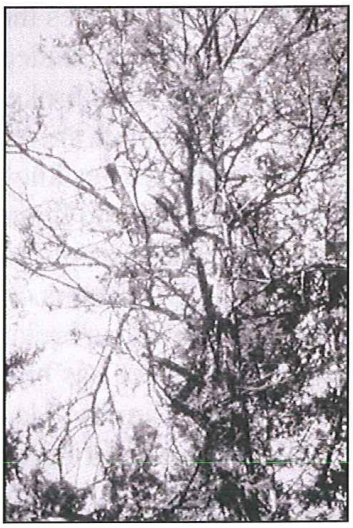
WILDLIFE TREE CLASSIFICATION SYSTEM FOR B.C.

The WildlifeIDanger Tree classification system used in B.C. describes each class ofwildlife tree in several ways. This includes a simple, general description of each class, a list of the wildlife uses associated with that class, and a summary of the decay characteristics. Although this classification system is based on the decay pattern of thick-barked conifers, such as Douglas-fir and ponderosa pine, it is broadly applicable to all British Columbia native trees (conifers and broad-leaved deciduous).

The deterioration and decay processes occur in various stages, corresponding to the tree classes described below. Conifers can have up to 9 tree classes; whereas deciduous trees have 6 classes, reflecting their accele~atedd ecay andfall-down rates as compared to conifers.

Class I: These are live, healthy trees with NO structural defects or injuries that have associated deeay and which could compromise the structuralstrength of the tree. Some live trees may show signs of deterioration or slight damage, such as dead branches, sound live forked or secondary tops, or minor physical injuries (e.g., healed-over stem scrapes). In most cases, these DO NOT have associated decay that might compromise the tree's structural strength.

Class 2: These are live trees, but have some VISIBLE EXTERNAL DEFECT that can affect the tree's structural strength or introduce decay. The fast stages of deterioration often begin while the tree is still alive. Fungi or wood-boring beetles lead the invasion.
Wildlife trees that are alive or in the early stages of decay attract birds that build large open nests, such as Ospreys, Bald Eagles and Great Blue Herons, or cavity excavators such as woodpeckers.

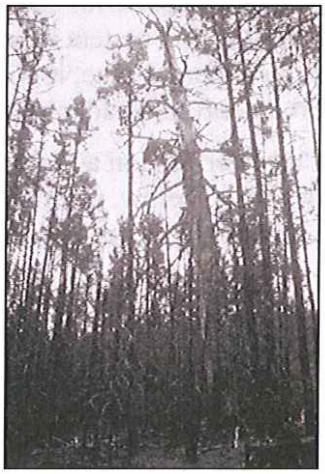


Class 2: showing large hung-up dead limb

The presence of the following **defects on LIVE** trees can be used to distinguish Class 2 trees from Class 1 trees:

- Fungal conks and/or internal decay
- Tree cavities
- Class 2: showing large
- External stem scars hvngup dead limb
- Stem cracks/splits (such as frost cracks)
- Dead tops (including secondary tops and forks)
- Broken tops
- Large dead limbs (>lOcm diameter) - note that natural self pruning is not a defect
- Damaged roots (from disease, fire or mechanical damage) .
- Excessive lean (>30%) AND damaged/diseased roots or a poor anchoring soil substrate - note that "sweep" is not a lean defect . Large canker face
- Unusual stem swellings (may indicate hidden decay)
- Insect or fire damage such that tree is likely to die relatively soon (i.e., become a Class 3 tree)

Class 3,4, and class 5 conifers: The tree has died, and decay begins or continues. Class 3 trees are RECENTLY dead, still bearing their fine branches and twigs, and the bark is "tight". Class 4 trees have lost their fine twigs and only have larger, coarse limbs left, and bark has begun to loosen or shed on parts of the stem. Class 5 trees have usually lost all their limbs but have not yet broken their tops, and the bark will be missing on parts of the stem. Woodpeckers will chisel out nesting cavities, taking advantage of the outer shell of sapwood that protects eggs and nestlings. As time passes, the tree continues to rot and soften. Bark is generally firm in Class 3 trees.



Class 4: dead tree, with only larger coarse limbs

Class 5 broad-leaved deciduous: This is the tree class for deciduous trees before they fall to the ground as coarse woody debris. By this stage, the sapwood and heartwood are soft, portions of the bole have broken away, and most of the limbs are gone. Class 5 for deciduous trees is roughly equivalent to classes 6-7 for coniferous trees.

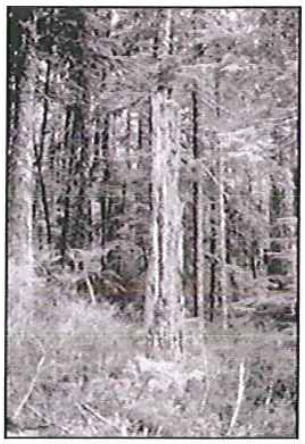
Classes 6 and 7

When the tree reaches these stages, weaker excavators, such as nuthatches and chickadees, can make their nest holes in the soft wood. Branches are often broken off, and slabs of bark loosen from the trunk. Decay is advanced in the upper portions of the trunk. The loss of tree limbs creates knot holes and natural cavities, many of which are soon converted into homes by a variety of animals. Over the years, the tree becomes shorter as portions of the top snap off at weak points. Throughout stages 6 and 7, chunks of bark and sapwood are sloughed off and the upper bole of the tree has broken away. Generally up to 112 of the original top height of the tree has broken away. Once the softer heartwood is exposed, wildlife trees are used less by woodpeckers and more by other animal species. Class 6 for deciduous trees represents a dead fallen tree.

Class 7: soft heartwood, showing numerous nest cavities

Classes 8,9

In the final phases of tree decay, all the sapwood is gone and the heartwood is completely rotted through. By class 8, only about 1/3 or less of the original tree height remains-the heartwood is highly decayed and is often visible as brown-cubical sloughing fragments. At class 9, the stump and the mound of woody debris that surrounds it become an ideal site for new plant growth, providing a ready supply of moisture and nutrients. It has now become suitable habitat for amphibians, such as the clouded salamander, that require moist, thermally buffered environments.

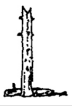


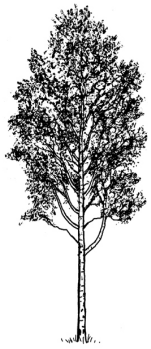
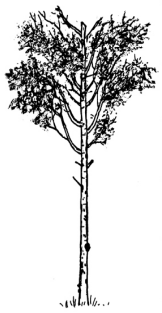
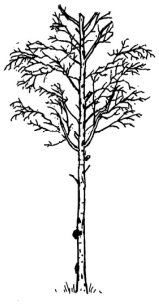
Class 8

TREE CLASS COMPARISON FOR CONIFERS AND HARDWOOD TREES

The following tree decay class diagrams illustrate the general breakage and decay patterns seen in coniferous and deciduous trees. The six step hardwood classification system (broad-leaved deciduous trees) is parallel to the coniferous scheme, but is more accelerated in the middle and latter classes. Both systems are used in this workbook to provide information for rating trees for defect failure potential and ecological habitat value. A detailed description of class 2 trees is found in Appendix 1 (p. 1-6).

	Live					Dead			Dead Fallen
Conifers	1	2	3	4	5	6	7	8	9
Hardwoods	1	2	3	4		5			6

	LIVE		DEAD						DEAD FALLEN
			Hard			Spongy	Soft		
Tree class	1	2	3	4	5	6	7	8	9
						approx. 2/3 original height	approx. 1/2 original height 	approx. 1/3 original height	
Description	**Live/healthy;** no decay or structural damage.	**Live/unhealthy;** internal decay or growth deformities or other structural damage (including stem damage, dead or broken tops); dying tree.	**Dead;** recently dead, needles or fine twigs present.	**Dead;** no needles/twigs; 50% of branches lost; only larger limbs remain; often loose bark.	**Dead;** most branches/bark absent; some internal decay.	**Dead;** very little branches or bark; sapwood/heartwood may be sloughing from upper bole; decay more advanced; lateral roots of larger trees usually softening.	**Dead;** extensive internal decay; outer shell may be hard; lateral roots usually completely decomposed; hollow or nearly hollow shells.		**Debris;** downed trees or stumps.

	LIVE		DEAD			DEAD FALLEN
Tree class	1	2	3	4	5	6
						

WHAT IS A DANGEROUS TREE?

In the past, the term "snag" has been synonymous with "dangerous tree" and was historically defined in forestry operations as:

"a standing dead or dying tree over 3 metres in height"

However, live trees may have features that could be hazardous to workers.

The following interpretation of "dangerous tree" now applies and is quoted from WorkSafe BC Regulation Section 26:

A DANGEROUS TREE...

...is any tree (regardless of its size) that is a hazard to a worker due to:

- location or lean
- physical damage
- overhead hazards
- deterioration of limbs, stem or root system
- a combination of the above.

With reference to dangerous trees and the workplace,
WorkSafe BC's Occupational Health and Safety Regulation 26.11 (1) states:

26.11 (1) If it is known or reasonably foreseeable that work will expose a worker to a dangerous tree,

(a) the tree must be felled, or

(b) a risk assessment of the tree must be undertaken by a person who has completed a training program acceptable to the Board.

Consider the following simple equation which illustrates the relationship between risk, tree hazard or condition, and exposure (i.e. work activity or location). Risk can be minimized by either eliminating the hazard or eliminating exposure to the tree.

RISK = HAZARD x EXPOSURE

Exposure is not limited to the active work area, but also includes the perimter of the work (within 1 tree length or greater depending on site factors such as slope), as well as other locations such as rest areas and staging areas. (See Glossary for definition of work area.)

The procedures for determining whether a tree is dangerous to workers under various levels of disturbance, and work activities, and the appropriate steps and safety procedures for mitigating the hazard, are described in the following sections.

DETERMINING TREE DANGER RATING

There are five steps required to determine tree danger rating:

STEP 1 **Conduct site assessment overview.** Look for site factors which suggest tree decline or potential tree failure. Refer to Table 1.

STEP 2 **Determine level of ground or tree disturbance** [VLR, 1, 2 , 3, 4] and type of work activity. See Table 2.

STEP 3 **Conduct visual tree inspection.** Assess the tree(s) for visual hazard indicators (see tables 3, 3A and 3B). If the root condition is suspect (i.e., the roots have been burned into, severed or uplifted), a shallow root excavation with a Pulaski may be necessary.

STEP 4 **Make the appropriate safety decision** (either Safe or Dangerous), and implement necessary actions.

STEP 5 **Provide Documentation** of assessed trees and assessed areas (includes date, location, level of disturbance, marking procedures and how danger trees have been managed).

The 5 step process is described in the sections that follow. Persons interested in dangerous tree assessments must understand that the process described herein must be combined with field training and diligent practice.

Step 1: Conduct Site Assessment Overview

Table 1. Site Assessment Overview (for all tree species)

How to use this table: The following site/stand factors should be reviewed during a walk through of the site, prior to individual tree inspection. The site overview provides a context for inspection of individual trees (i.e., it will identify overall site problems such as damaged roots and soil condition, or windthrow hazard). Specific tree defect failure ratings are summarized in Table 3A. **For wildfire sites the most important site hazard indicators are bolded below.** Information and stand/site indicators found in the site overview can provide useful clues as to the condition and the potential danger of individual trees.

Site/Stand Factors	Hazard Indicators/Influences
Stand history and condition	• evidence of past tree failure • **natural disturbance history** (e.g., old burn, old root rot area) • stand age and structure • tree species composition • evidence of root and/or stem diseases • **soil or slope instability, steep slopes** • sites where air tanker or water scooper aerial drops have recently occurred • sites where blasting has recently occurred
Flooding	• high water table • evidence of water damaged/decayed roots • area prone to flooding
Windthrow potential	• topography (e.g., ridge crests) • prevailing winds (e.g., valley bottom outflows) • evidence of significant windthrow • **area of high or recent exposure** • stems with height/diameter ratio >90 (i.e. have small live crowns & low stem taper which increases blowdown potential.) • saturated soils • **shallow soils** • restricted rooting depth (clays, bedrock)
Crown condition	• stress cone crop • thinning foliage • chlorosis • rounded crown • small live crown (<20%) • crown imbalance (majority of branch weight on one side)
Resinosis	• higher than normal stem or basal pitch flow
Tree lean	• **trees recently leaning due to windstorm, root damage, shifting root mat or other causes**.
Severity of fire/burn and BUI thresholds	• **depth and severity of burn** • **amount of root burn** • **damage to anchoring soil layer** • **deep basal stem burn**
Time since fire	• If BUI Values are above the established thresholds and there is continuous active burning within the area of work • If more than three days with continuous burning have passed since the last assessment • Also consider the depth and degree of root damage(burning) in the area to be assessed.

Canadian Forest Fire Danger Rating System

Fuel Type	BUI Threshold Value
C–1	>40
C–2, C–3, C–4, C–5, C–6	>60
C–7	>80
D–1	>30
M–1, M–2, M–3, M–4	>40

Build-up Index (BUI)

The Build-up Index (BUI) represents a numerical rating for the amount of fuel available for combustion in the sub-surface layer located between forest litter (non-decomposed vegetation) and mineral soil (parent material, hardpan, rock). This fuel layer is more commonly known as organic soil and is where the roots of trees are located, seeking nutrients and moisture. The lack of moisture entering this layer over a period of time causes drying. This drying over time is represented by the BUI value. The higher the numerical rating, the drier the soil is. The drier the soil, the more the organic matter within it becomes available as fuel to wildfire. When more soil is consumed during a fire, the risk to tree instability increases. This instability may be caused by the burning of the root system itself, or the undermining of the anchoring soil layer which supports the roots. Either one can compromise worker safety. For this reason the BUI threshold values for various fuel types are used as an indicator of potential tree instability and hazard (see Table 1).

Different fuel types have different BUI threshold values. This is due to the relationship between soil condition (amount, depth, structure and moisture of organic layers), climate and tree species. Consequently, different forest soils have different fuel consumption rates (e.g., fires in spruce stands often burn away live roots as well as undermine the anchoring soil layer surrounding the near-surface “plate-root” system of spruces).

FBP System
Fuel types

Group	Identifier	Description
Coniferous	C-1	Spruce-lichen woodland
	C-2	Boreal spruce
	C-3	Mature jack or lodgepole pine
	C-4	Immature jack lodgepole pine
	C-5	Red & white pine
	C-6	Conifer plantation
	C-7	Ponderosa pine - Douglas fir
Deciduous	D-1	Leafless aspen
Mixedwood	M-1	Boreal mixedwood- leafless
	M-2	Boreal mixedwood- green
	M-3	Dead balsam fir mixedwood- leafless
	M-4	Dead balsam fir mixedwood- green
Slash	S-1	Jack or lodgepole pine slash
	S-2	White spruce/balsam slash
	S-3	Coasta cedar/hemlock/Douglas fir slash
Open	O-1a	Matted grass
	O-1b	Standing grass

* M-1 & M-2 are transitional between C-2 and D-1

Step 2: Determine Level of Ground or Tree Disturbance

Level of Disturbance

Various work activities are associated with differing levels of disturbance. Activities rated as very low risk (VLR) or low (I) disturbance create negligible ground or tree disturbance and as a result, expose workers to very little danger.* However, as the level of disturbance increases, so does the potential danger. As a result, fewer activities are appropriate around potentially dangerous trees under situations of higher ground or tree disturbance, or where exposure to people and facilities is of long or constant duration (eg. fire camps, staging areas). Table 2 relates level of disturbance with various work activities.

Table 2 Level of Disturbance

Level of Disturbance (LOD)	Type of Work Activity
Very Low Risk (VLR) **	• surveys • stand reconnaissance • patrolling ** • tree marking, boundary marking • fire guard/control line layout • establishing hose lays in green (unburned) areas • burning off • road or trail travel with light vehicles (ATV, pickups <5500 kg GVWR) in green (unburned) areas
1 (Table 3)	• fire control and mop-up with hand tools and/or water hoses (manual activities only) • establishing hose lays in black (burned) areas • road or trail travel with light vehicles (ATV, pickups <5500 kg GVWR) in black (burned) areas • road travel with heavy vehicles (>5500 kg GVWR) on ballasted and PERMANENT roads (a cleared Right-of-Way) • tree bucking • slashing
2 and 3 (Table 3a)	• manned pump sites • tree falling *** • use of heavy mechanized equipment • use of light and intermediate helicopters where workers are exposed to rotorwash • road travel with heavy vehicles (>5500 kg GVWR) on non-ballasted, TEMPORARY roads (no cleared right-of-way)
4 (Table 3b)	• use of medium and heavy helicopters where workers are exposed to rotorwash • fire camps, fire bases • staging and marshalling

* NOTE Risk can be considered as a combination of tree hazard (condition) AND exposure to that hazard (i.e. work activity and location). RISK = HAZARD x EXPOSURE

** NOTE Very Low Risk (VLR) activities usually result in negligible amounts of ground or tree disturbance and have very low exposure time to potential tree hazards. Consequently, the risk of injury or damage due to tree hazards is very low under these circumstances. **Workers should keep a "heads-up" and stay away from any obvious dangerous trees and overhead tree hazards (e.g.,insecurely lodged trees; hanging tops or limbs). A pre-work inspection is not required for VLR activities except for foot patrolling (see pg 17 for further explanation).**

*** NOTE Does not include falling dangerous trees

Wind Influence

- Workers must be aware of wind conditions and the influence of wind on tree stability. Strong winds increase the potential of trees failing.
- Potentially dangerous trees within reach of work areas must be assessed by a certified danger tree assessor who determines whether the tree(s) are safe or dangerous. Trees that are determined to be dangerous must be removed or managed in accordance with established practices **BEFORE** workers enter the area.
- **HOWEVER**, if winds become strong (i.e., >65km/hr; winds set whole trees in motion and cause branches to break and fly in the air, walking is impeded by the wind), workers should consider leaving the work area and go to a safe refuge.

Patrolling in Burned Stands

Foot patrols in burned areas to locate “hot spots” is considered a **Very Low Risk** work activty. Consequently, a pre-work assessment for dangerous trees is NOT required.

However, **the following procedures must be implemented:**

- A certified assessor must have conducted a current site assessment overview of the work area or a similiar area on that same fire that typifies conditions found on the work area (i.e., similar terrain, fuel type and fire intensity) in order to determine the general stand condition and level of fire damage PRIOR to the foot patrol.

- Any specific information gathered by the above site assessment (i.e. amount and type of burn damage, site factors such as steep slopes, hung-up trees, etc.) must be communicated to the foot patrol crew **PRIOR** to their work commencing.

- When foot patrolling in a burned stand is conducted as a multi-person parallel walk through, each crew person should be spaced at least ½ tree length apart (generally 15-20 m, depending on stand height), being cautious of all hazards identified by the site assessment overview.

- While patrolling, crews must be careful not to disturb or dislodge damaged trees (i.e. do not strike or push trees), which might be unstable or hazardous, while paying particular attention to the effects of wind disturbance on potentially unstable trees.

- If patrol crew members observe locations which require mop-up or other work procedures, these sites must be assessed by a certified assessor for the intended LOD PRIOR to those work activities commencing.

Step 3: Conduct Tree Assessments

Visual Tree Inspection

The determination of tree safety/danger is generally a visual process. Only trees which are considered by a certified assessor to be "suspect" or potentially dangerous after conducting "the site assessment overview" need a visual tree inspection. Careful observation of potential tree defects and hazards can generally result in determination of an individual tree's failure potential and resultant safety decision within several minutes.

Tree Hazards

A tree can be potentially dangerous if it has defects in its top, branches, stem or root system. The degree of hazard will vary with the size of the tree, type and location of the defect, the severity of any damage, the tree species, and nature of the work activity or target.

The danger tree assessment process requires that assessors identify tree hazards and know how to recognize, evaluate and manage for all types of hazards.

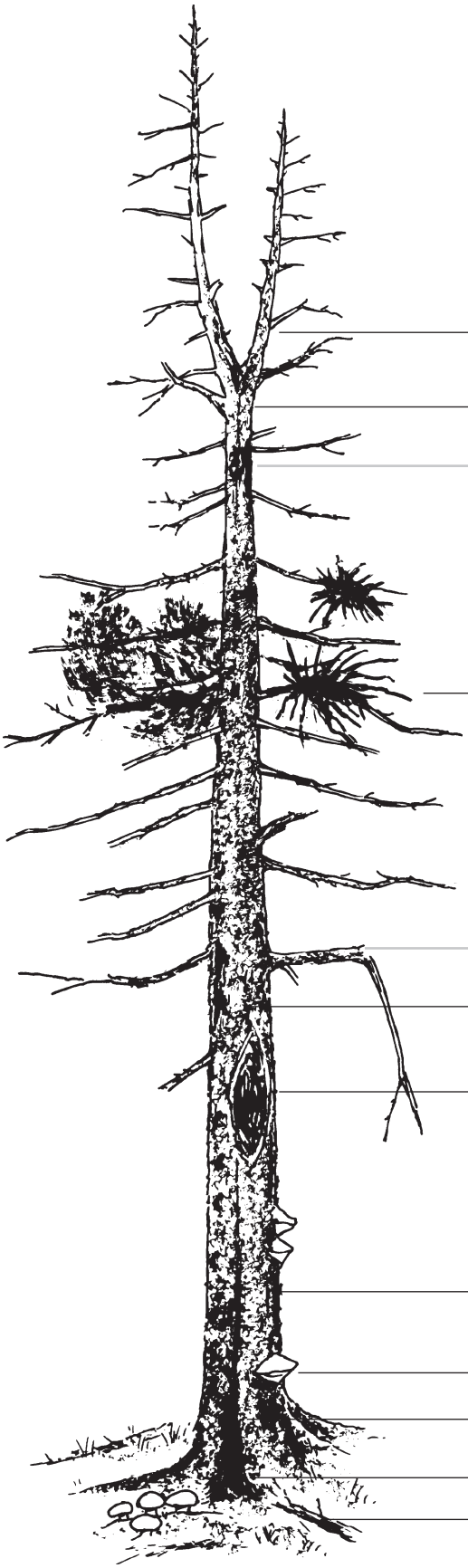
Live or Dead Tree Defects

Tree defects can be separated into three categories: top and branch defects, stem defects, and root and butt defects.

- Tables 3A and 3B provide a summary of High Failure Potential tree defects associated with live or dead trees.
- Trees with **NO** defects or only defects which fall below the High Failure threshold description are often rated safe.
- However, see Step 4 for further safety procedure information.

On the following two pages are diagrams of the major tree defects.

Generalized Tree Defects or Indicators Which Influence Tree Failure



Eight Common Dangerous Tree Defects (for further description see Table 3A)

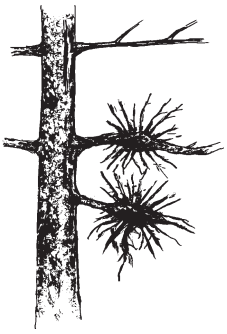
Hazardous tops (HT)

proportion of tree height

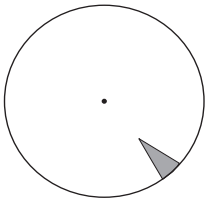
single leader secondary top that resulted from an old top breakage

Dead and broken limbs (DL)

Witches' broom (WB)



Split trunk (ST)



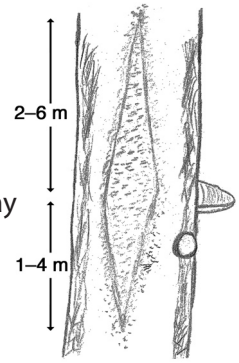
>2 cm width
> 25% into stem

Stem damage (scarring, fire damage, or butt rot) (SD)

Butt and stem cankers (CA)

Fungal fruiting bodies (conks and mushrooms) (CM)*

Fungal decay columns



Thick sloughing bark (SB)

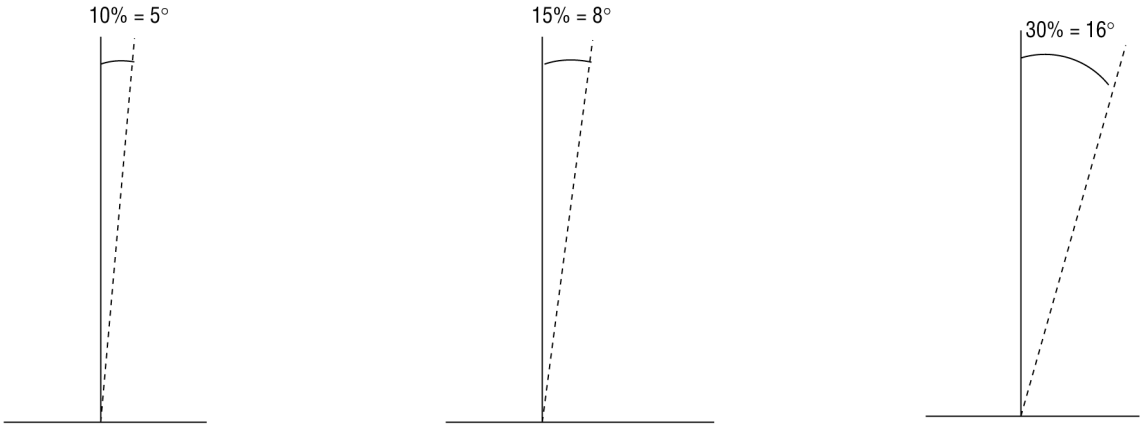
Column of heartrot decay extending above and below fungal fruiting body (conk). General rule of thumb —decay often extends 2–6 m above conk and 1–4 m below. **Circular nest cavities(NC) are a good indicator of the location of the heartrot decay** (drawing not to scale).

Tree lean and **Roots** must also be evaluated as part of the "Visual Inspection Process" (Step 3). Specific failure potential criteria for tree lean and root inspection are described in Table 3A.

Tree Lean

Tree lean may be recent or long-standing.

Long-standing lean trees have often subsequently grown a vertical top in the time since the lean occurred. Live lean trees develop tension and compression wood at stress points, to aid in support. They also develop a reinforced root system, where disturbed, to compensate for prior damage. Unless the roots are disturbed further or decay is present, **the potential for failure of long-standing leaning trees is low, and such trees need not be considered a hazard.**



Recently-leaning trees are tilted over their entire length. Since there is no evidence of subsequent reinforcement of the root system or bole wood, assessors must assume hazard potential.

Lean

Assessors should also identify other rooting problems which can compound the effects of high tree lean. These include shallow roots or substrate, burned, damaged or decayed roots and/or lifted roots, burned or disturbed anchoring soil layers, or adjacent history of windthrow.

Leaning trees which are **securely lodged** in a large sound tree with no chance of breaking free, have negligible lean hazard. Leaning trees in this condition must be evaluated on an individual basis.

Sweep

Sweep is defined as the curvature or distortion of the stem, and is often associated with competition for sunlight, snowpack and steep slope conditions. Sweep should not be confused with lean.

Slope is an important determinant of the direction of falling, and how far and with what force a tree will roll or slide after falling. Danger trees falling on slopes may travel farther than the length of the tree.

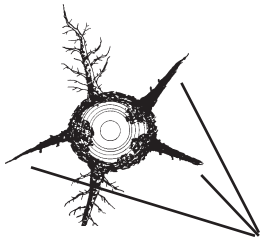
Steep slope

ROOT CONDITION (BASED ON VISUAL INSPECTION)

Root condition should be assessed at the root collar (as close to the ground as possible).

If visual inspection indicates questionable root stability**,** then a shallow root excavation and cautious chopping or probing into the roots with a Pulaski or other suitable hand tool should be done to expose the condition of the roots and to determine whether the tree should be considered dangerous for the particular work activity.

Example 1:



dead or decaying roots

This tree has 5 major later roots. Excavation with a pulaski showed that 3 roots had decay and were unstable. The tree was assessed as dangerous.

Example 2:

Heavy equipment used during fire guard construction has severed the root system of this tree, resulting in more than 50% lateral roots damaged. This is a high failure potential defect

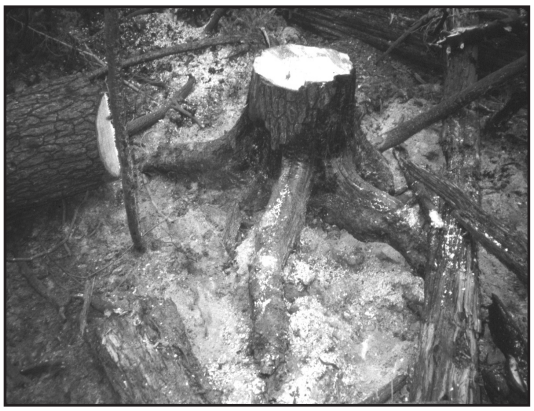
Trees with **>50% of lateral roots *damaged, burned or decayed*** have a HIGH failure potential rating (see Table 3A). This condition should not be confused with roots where the soil duff layer has **been scraped or burned away**—merely **exposing the roots, not damaging them**.

Watch for root systems which have been **severely burned along with the supporting/anchoring soil layer**. These "propped" roots can be very unstable.

- Trees on **shallow soils over bedrock or hardpan**, or with high water tables, will have shallow root systems. Also look for **root pull and cracked or lifting soil mats**. They will become more hazardous over time and should be examined carefully before work commences.

Root Disease

- **Trees growing in or near areas where root disease is seen to be present** are likely to be diseased as well. Watch for stand openings associated with uprooted trees, standing trees with thin or discoloured crown foliage (chlorosis), and fruiting bodies of root disease-causing fungi near the base of trees.



Burned and severed roots – high failure potential. Tree felled.

Table 3 describes the 3 **significant tree hazards which indicate a high failure potential and therefore a Dangerous rating for level 1 disturbance/work activities**—lesser hazards(as described in Table 3a) can be rated Safe for level 1 activities. In most cases a site assessment overview conducted by a qualified person will be sufficient to identify the significant tree hazards at level 1.

Table 3. Danger Tree Assessment Process for Level 1 Disturbance Activities — 3 Significant Hazard Indicators

D = Dangerous	**D** if tree has one or more of the following **significant tree hazards indicators** that are **at risk of imminent failure:** • **Insecurely lodged trees or Insecure hang-up** 1. Insecurely lodged trees (a tipped tree that is likely to shake free of the support trees and fall to the ground); or 2. Dislodged but hung-up limbs or tops (consider size and height above ground) at risk of shifting free during light winds or other tree motion • **Highly unstable tree**: Examples 1. >50% of tree cross-sectional area damaged or decayed 2. Spongy snags with heart rot conks along the majority of the length of the stem (eg. class 5-6 conifers or class 4 deciduous) or soft snags (eg. class 7-8 conifers or class 5 deciduous); or 3. >50% lateral roots damaged or with advanced decay • **Recent lean** towards the work area **AND** decayed root system (>50% of roots have advanced decay) or damaged and lifting anchoring soil layer (consider soil conditions and anchoring)
S = Safe	All other trees

The qualified person must be sufficiently experienced and/or trained to be able to recognize and ensure workers avoid exposure to the above significant hazards. Crews should be instructed to keep a “heads-up” for any of the 3 significant hazards and to stay away (generally greater than 1.5 defect lengths) from any trees showing these hazards. However, any trees that the qualified person determines or suspects to be dangerous must be dealt with as follows **BEFORE** any workers enter that area:

- have tree(s) or hazardous parts removed
- flag a no-work zone of appropriate size and shape around tree(s) and instruct workers to stay out of this area (generally 1.5 defect lengths in size).

NOTE: Work crews must also observe wind speed conditions. If wind conditions become strong enough (i.e. winds set whole trees in motion), workers should consider leaving the work area and go to a safe refuge.

Table 3a. **Dangerous Tree Criteria for Level 2 and 3 Disturbance Activities**
NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 2 and 3 disturbances.
Trees with lesser defects can be rated SAFE for level 2 and 3 - take care to not brush trees if failing adjacent trees.

Defect Category	**Species Group**	
	Douglas-fir, larch, pines, spruces	**Western redcedar, yellow cedar**
Hazardous top (HT)	Class 2-5 trees: Defective top (any size: e.g., secondary top) where **structural weakness is evident; OR** **Class 4 and 5 trees: Defective** top (e.g., secondary top) which have **> 30% of tree height**	Class 2-5 trees:Defective top (any size) as a fork, co-dominant or multiple stem where **structural weakness is evident; OR** **Where a dead top is >20% of the tree height**
Dead limbs (DL)	▪ Dead limbs >10 cm diameter **with structural weakness** ▪ Cracked, decayed, broken or hung-up limbs	▪ Dead limbs >15 cm diameter **with structural weakness** ▪ Cracked, decayed, broken or hung-up limbs
Witches' broom (WB)	Brooms >~\ m diameter on live or dead branches **AND** evidence of decay, cracking or failure	n/a
Split trunk (ST) (includes frost, lightning, wind and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stem wood	Class 2 and 3 trees: Crack or split >2 cm wide extending > 50% of tree diameter into stem **AND** evidence of decay in surrounding stem wood. Class 4-8 trees: Crack or split > 2cm wide **AND** evidence of decay in surrounding stem wood
Stem damage (SD) includes scarring, fire, machine and animal damage or butt rot)	>50% of tree cross-sectional area damaged, burned, scarred or fractured	>50% of tree cross-sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) bark applicable to Douglas-fir, larch, ponderosa pine and cottonwood >50cm dbh)	Large pieces of bark or sapwood separated and sloughing from bole of tree	Bark n/a Long slabs of sapwood hanging from bole of tree
Butt and stem cankers (CA)	> 50% of butt or stem circumference as a perennial canker face*	n/a
Fungal fruiting bodies CM) (conks and mushrooms)**	**Any heartrot fungus present** Exception: For veteran and dominant trees, if Phellinus pini conks present **BUT** NO other visible defects/damage to stem that allow oxygen exchange (e.g., broken top,, scarring, nest cavity, etc.) = SAFE; • Sap-rotting fungi present on any tree < 30 cm dbh where saprot depth is > 5 cm	n/a
Tree lean (TL) (for class 1-3 trees)	**Lean >15%** toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope) - For candelabra-branched trees, where candelabras are predominantly on lean side of tree — lean >10% toward target/work area and tree has rooting problems
Tree lean (TL) (for class 4-8 trees)	**Lean >10%** toward target/work area **AND** tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root inspection (RI)	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots

1 - A secondary top is a growth leader which forms after the breakage or die-back of the original tree top

Table 3a. **Dangerous Tree Criteria for Level 2 and 3 Disturbance Activities (concluded)**

NOTE: Any tree defects as described in the boxes below will be rated as DANGEROUS for level 2 and 3 disturbances. Trees with lesser defects can be rated SAFE for level 2 and 3 - take care to not brush these trees if falling adjacent trees.

Defect Category	Species Group	
	Hemlock, true firs	Broad-Leaved deciduous
Hazardous top (HT)	**Class 2-5 trees:** Defective top (any size e.g., secondary top) where **structural weakness is evident; OR** **Class 4 and 5 trees**; Defective top (e.g., secondary top) **>20% of tree height**	**Class 2-5 trees**: Defective top (any size) in the form of a fork, co-dominant or multiple stems where **structural weakness is evident; OR** Where dead top **> 20% of tree height**
Dead limbs (DL)	▪ Dead limbs >10 cm diameter with structural weakness ▪ Cracked, decayed, broken or hung-up limbs	▪ Dead limbs >10 cm diameter with structural weakness ▪ Cracked, decayed, broken or hung-up limbs
Witches' broom (WB)	Brooms >1 m diameter on live or dead branches AND evidence of decay, cracking or failure	n/a
Split trunk (ST) (includes frost, lightning, wind-and impact-induced cracks)	Crack or split >2 cm wide extending >25% of tree diameter into stem AND evidence of decay in surrounding stem wood	Crack or split >2 cm wide extending > 25% of tree diameter into stem AND evidence of decay in surrounding stem wood
Stem damage (SD) includes scarring fire, machine, and animal damage or butt rot)	50% of tree cross-sectional area damaged, burned, scarred or fractured	> 25% of tree cross - sectional area damaged, burned, scarred or fractured
Thick sloughing bark or sloughing sapwood (SB) (bark applicable to Douglas-fir, larch, ponderosa pine and cottonwood >50cm dbh)	n/a	Large pieces of bark separated and sloughing from bole of tree
Butt and stem cankers (CA)	n/a	• >20% of butt or stem circumference as a perennial canker face* • > 50% of butt or stem circumference as a canker face on a dead tree
Fungal fruiting bodies (CM) ** (conks and mushrooms)	Any heartrot fungi present; **OR** Sap-rotting fungi present on trees <60 cm dbh where saprot depth is > 5 cm	Any heartrot fungi present *** Sap-rotting fungi present on trees <60cm dbh where saprot depth is > 5 cm
Tree lean (TL) (for class 1-3)	Lean >15% toward target/work area AND tree has rooting problems (i.e., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >15% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Tree lean (TL) (for class 4-8 trees)	Lean >10% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)	Lean >10% toward target/work area AND tree has rooting problems (e.g., damaged roots; shallow, compacted or wet soils; cracked or lifting root mat; steep slope)
Root Inspection (RI)	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots	Occurrence of any of the following: root pull or lifting root mat; visible damage or decay to roots affects >50% of lateral roots.

NOTE: Structural weakness includes decay, cracking, breakage, embedded bark or cracking at single leaders, forks or multiple stem unions, presence of conks, stem scars, and woodpecker cavities. (NC)

Additional Relevant Notes to Table 3a

A single leader secondary top is a growth leader **(live or dead)** on a tree which formed after the breakage or die-back of the original tree top.

* **Perennial cankers** are generally circular to lens-shaped cankers that can persist for years, and slowly expand at about the same rate as the radial growth of the affected live tree. They gradually take on a sunken appearance as tissues under the dead cambium do not grow along with the surrounding wood. They are sometimes called ''exploding cankers."

** If identity of wood decay fungus cannot be determined (e.g., saprot or heartrot), then default to Dangerous rating.
OR if there are conks distributed along the bole length, then default to Dangerous rating.

*** An alternate safe work procedure for dealing with fungal conks on live trembling aspen is described in **Appendix 7**.

**** A list of common tree species names and their species codes is found in **Appendix 9**.

Nest Cavities (NC)
Nest cavities (which are usually circular in shape) should be considered as **stem damage** and as an indication of **internal decay.** However, some trees with nest cavities will have sufficient sound shell in this section of the tree, but this will vary with tree species and size, type of decay pathogen present, and other factors (e.g., other tree damage, site moisture, species of excavating bird, etc.). Assessors must therefore practice due diligence when evaluating trees containing cavity nests - these valuable wildlife trees warrant thorough assessment before concluding with the tree assessment

Use of Cab-Guarded Machinery
Where heavy mechanized machinery is being used (e.g., for guard construction), it is recommended that only machines with manufacturer-installed cabs and associated protective cab structures be used. There should be no workers on the ground outside of these machines while they are working and within reach of surrounding trees.

TABLE 3B. DANGER TREE ASSESSMENT PROCESS FOR LEVEL 4 DISTURBANCE ACTIVITIES

When conducting level 4 disturbance assessments, only **the following four types of trees are rated safe.** All other trees will be rated Dangerous for level 4 activities.

Level 4 disturbance

S = Safe
if tree is one of the following:

- class 1 tree (all species)
- class 2 trees with NO structural defects (all species) (usually wind- or snow-snapped green trees, very light fire scorching).
- class 2 **cedars** with LOW failure potential defects (refer to table at right)
- class 3 **conifers** with NO structural defects (tree recently killed by insects, climate or light intensity fire— these will have no structural damage or decay)

D = Dangerous all other trees
(fall tree; create a no-work zone;
or remove hazardous parts)

Any leave tree that is damaged during the work activity must be reassessed if work is to continue within reach of the tree.

CLASS 2 CEDAR TREES ARE SAFE FOR LOD 4 IF THEY FIT THE FOLLOWING CRITERIA:

Defect Category	Western Redcedar, Yellow cedar LOW FAILURE POTENTIAL
Hazardous top (HT)	**S**econdary top (live or dead) as single leader, V-shaped fork or multiple stems <30% of tree height, with **no evidence** of decay, cracking, failure or other structural weakness
Dead limbs (DL)	Dead limbs <15 cm diameter with **no evidence** of decay, cracking or failure; OR Dead limbs (no size limit) on class 2 trees with **no evidence** of decay, cracking or failure
Split trunk (ST) (includes frost, lightning and wind-induced cracks; does not include dry checking)	Crack or split >2 cm wide extending <50% of tree diameter into stem; **no evidence** of decay in surrounding stemwood
Stem damage (SD) (includes scarring, fire damage, machine damage, animal damage or butt rot)	<50% of tree cross-sectional area damaged, scarred or fractured with **no evidence** of decay in remaining stemwood
Tree lean (TL)	Lean <30% (16°) toward target/work area **and** tree has no rooting problems
Lean — candelabra branched trees (for class 1 and 2 trees) (where candelabras are predominantly on lean side of tree)	Lean <10% (5°) toward target/work area **and** tree has no rooting problems
Root inspection	**No visible problems:** no root pull or lifting root mat. Any visible structural damage to roots only affects **<25% of lateral roots** (remaining roots undamaged)

Step 4: Determine Safety Ratings and Appropriate Procedures

Once a tree(s) has been determined to have a dangerous defect, the appropriate safety procedures must be undertaken. These are described below.

Safety Procedures (for "suspect" trees that have been assessed)

S
- tree safe to work around, retain tree—no removal or modification necessary
- mark tree as Safe (**if required**)
- monitor tree if appropriate
- reassess tree a later time as an "indicator" of site specific changes to tree hazard due to changes in fire condition

D
- mark tree as Dangerous (**if required**)
- remove tree
- remove dangerous part of tree (e.g., hazardous limb)
- install flagged no-work zone (NWZ)
- inform workers of location of NWZ's
- use of spotters (see explanation below)

USE OF SPOTTERS (Operational Safe Work Standard #1)

Where specific wildfire suppression operations are critical to controlling the fire and **there is no other practical alternative safety procedure**, the use of spotters to watch suspect or potentially dangerous trees in order to allow other workers to carry out activities may be utilized as long as **this is for a short duration only,**

If this practice is to be employed, then it is essential that all workers on-site are aware of the procedures to be used and appropriate action required if a tree appears in any way to be posing a threat of injury to any workers on-site at that time.

All procedures **must be documented** and placed on the appropriate incident file

SUMMARY OF ASSESSMENT REQUIREMENTS

All work activities EXCEPT those defined as **"Very Low Risk**" require a pre-work inspection by a certified danger tree assessor to determine if there are any trees that might endanger workers. A summary of activity level assessment requirements is shown below. For a discussion of liability and dangerous tree assessments, see Appendix 3.

- Very Low Risk (VLR) – No pre-work site inspection is required.

  ** **EXCEPTION Foot Patrolling in Burned Stands****
  Still requires a pre-work inspection

- **Level 1 Disturbance Activities** – A pre-work inspection by a certified danger tree assessor is required. If trees with significant tree hazards (see table 3) are observed, then the appropriate safety procedures must be taken BEFORE work activities begin.

- **Level 2, 3 or 4 Disturbance Activities** – A pre-work inspection by a certified danger tree assessor is required. If suspect trees (see tables 3A, 3B) are identified, then further assessment by the certified danger tree assessor is required and the appropriate safety procedures must be taken BEFORE work activities begin.

DANGEROUS TREES ALONG ROADSIDES

Potentially dangerous trees along and within reach of active roads should be assessed accordingly to the appropriate level of disturbance (LOD). (e.g. level 1 for road travel with light vehicle in burned areas.)

Other factors to consider are:

- Amount of lean toward road
- Distance from road
- Slope towards road
- Rooting condition
- Any hazardous tree defects (eg large dead top) that can reach the road.

NO-WORK ZONES (NWZ)

The purpose of NWZs is to keep workers out of this area. Only the perimeter of the NWZ, if it is adjacent to an active work area, needs to be assessed for additional tree hazards.

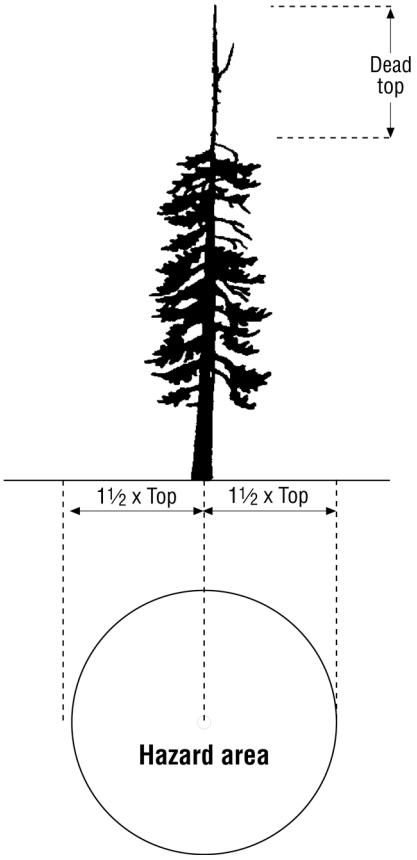
NWZs length is generally 1.5 times the defect length. This length can be modified (larger or smaller) depending on the site-specific conditions such as slope or size of surrounding green timbre.

- When the decision has been made to retain a tree that has been assessed as dangerous to workers, a no-work zone must be clearly identified and marked on site. This includes high value wildlife trees that have been assessed as dangerous. The no-work zone must include all the area on the ground that could be reached by any dislodged portion of the tree.
- The shape of the no-work zone must accommodate the nature of the hazard and the lean of the tree.
- On steep ground, the no-work zone will be extended downhill to protect workers.
- No-work zones can be adjusted in size depending on the size of the surrounding live timber (e.g., a small danger tree surrounded by much larger trees that “shield” the adjacent area have a NWZ radius less than 1.5 defect lengths).
- A kick-back area should be included for semicircular no-work zones. The size and shape of this area is determined by tree lean, condition and form (branching).

The most common types of no-work zones are illustrated on the following pages.

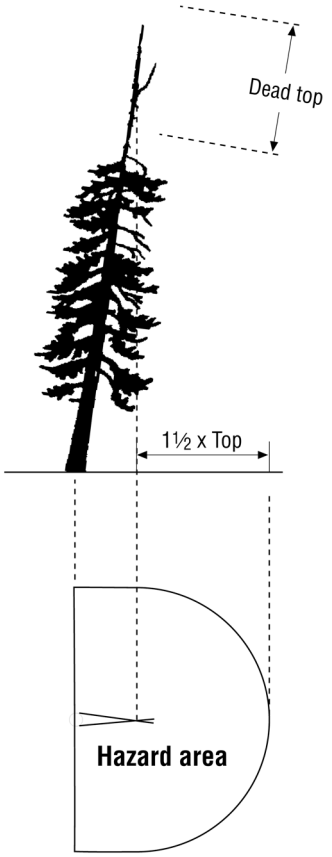
A. Sound tree, no lean, hazardous top, flat ground

1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½ top length distance. This distance is the radius of the no-work zone.



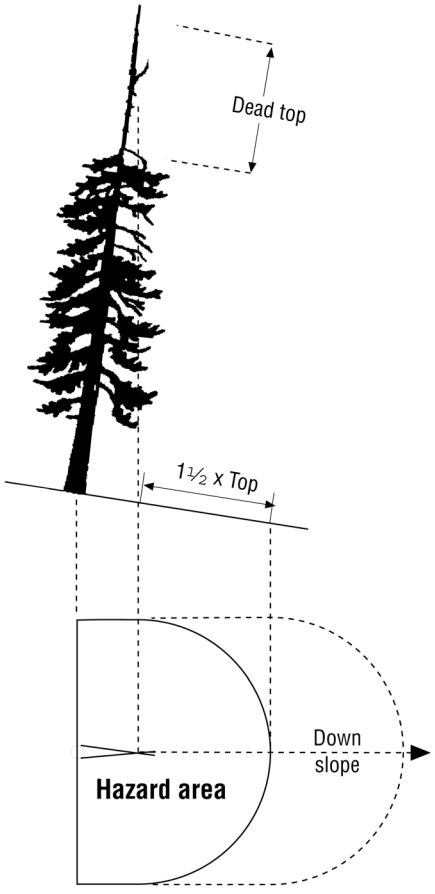
B. Sound tree with lean, hazardous top, flat ground

1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½ top length distance.
3. Determine from the lean how far from the base of the tree the top might land.



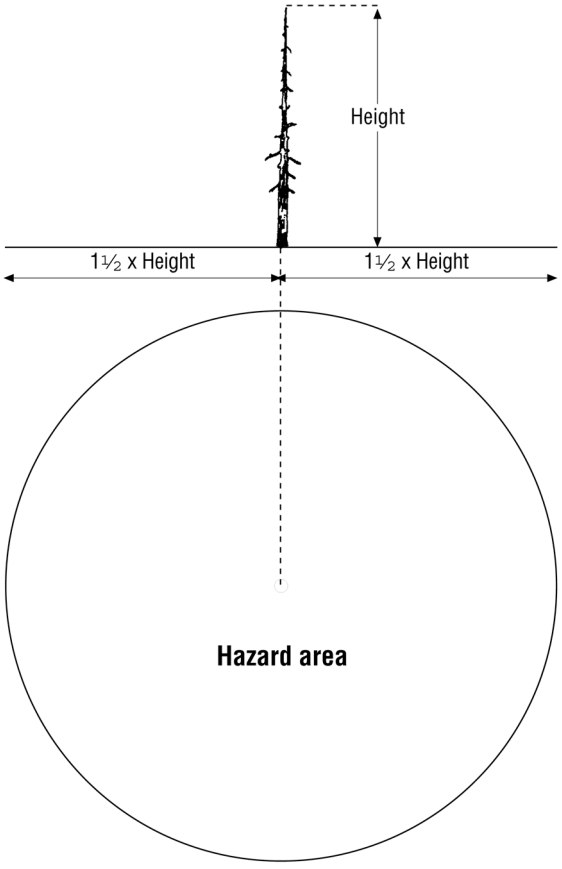
C. Sound tree with lean, hazardous top, on slope

1. Determine the length of top that might dislodge.
2. Add ½ of this length, to get a 1½ top length distance (horizontal distance from tree).
3. From the lean, determine how far from the base of the tree the top might land.
4. On slopes >30%, extend the no-work zone downslope. This distance must be determined on a site-specific basis.



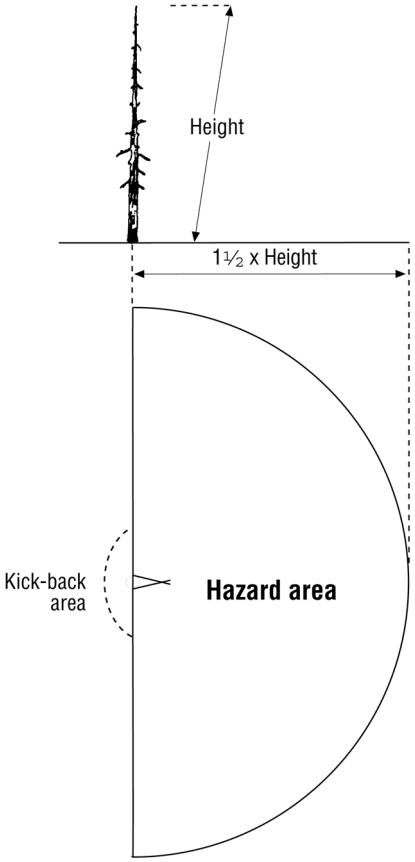
D. Unsound or hazardous tree, no lean, flat ground

1. Measure the height of the tree.
2. The no-work zone is a circle around the tree, with a radius of up to 1½ times the height.



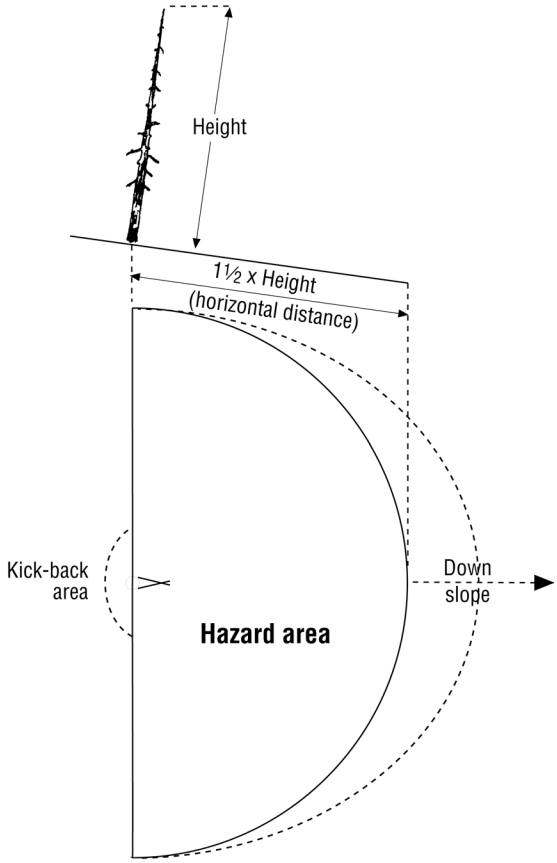
E. Unsound or hazardous tree, with lean, flat ground

1. Measure the height of the tree.
2. Add ½ of this length to get a 1½ tree length no-work zone.

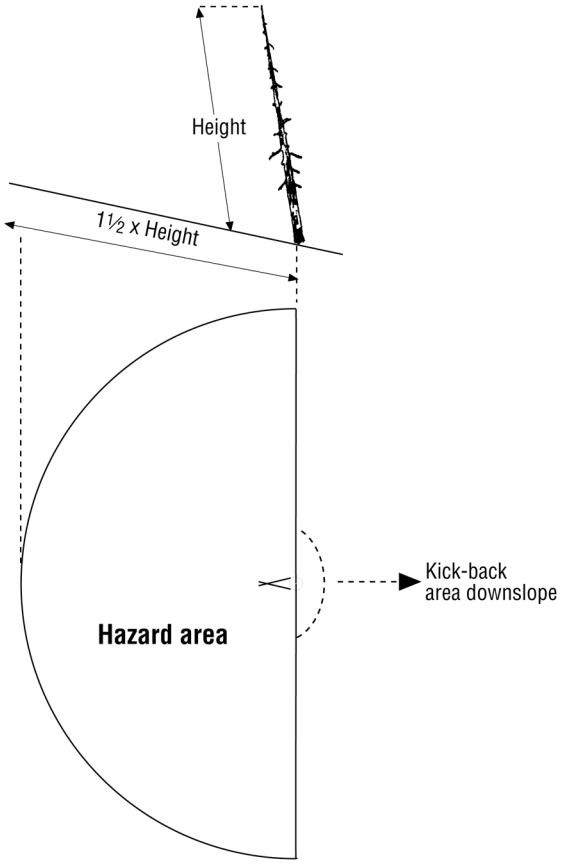


F. Unsound or hazardous tree, with lean, on slope

1. Measure the height of the tree.
2. The no-work zone is a half-circle extending 90° on each side of the lean, with a radius of 1½ times the height of the tree.
3. On slopes >30%, extend the no-work zone downslope. This distance must be determined on a site-specific basis.
4. Trees on a >30% slope need to be carefully assessed for their wildlife tree value, as the no-work zone will take up a large part of the treatment area.



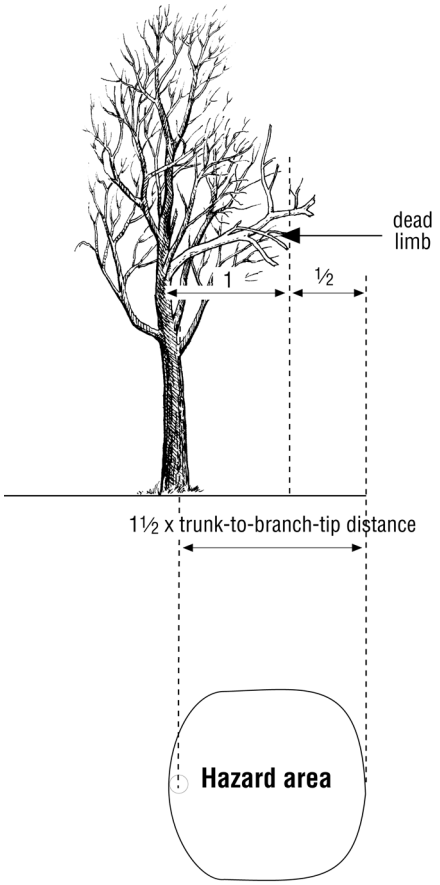
5. Where the tree slopes uphill, the no-work zone should be 1½ times the tree height going upslope.
6. Where the tree slopes uphill, depending on the slope of the hill, a kick-back area will be added on a site-specific basis.



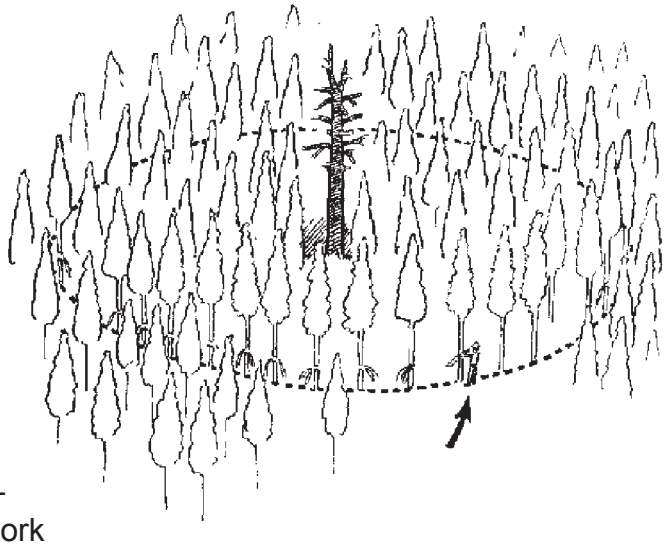
G. Deciduous, sound tree, no lean, defective branches

1. Determine the length of defective limbs that might dislodge.
2. Add ½ of this length to get a 1½ limb length distance.

The 1½ limb length distance must be calculated for all defective limbs on the tree.

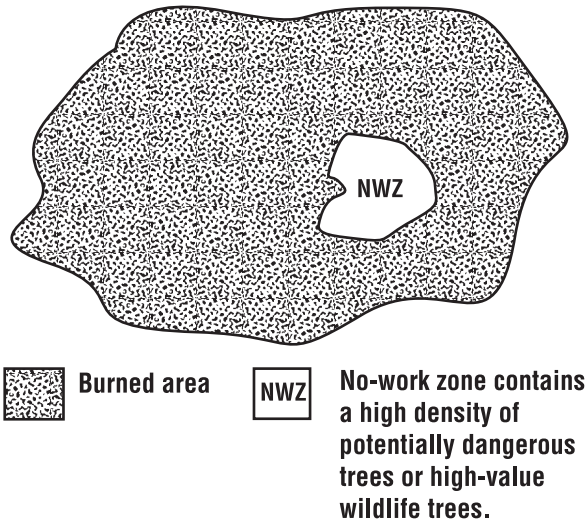


FLAGGING NO-WORK ZONES AROUND SINGLE TREES



- No-work zones will generally only be installed around dangerous but high-value wildlife trees, or around trees too dangerous to fell. The assessor should ensure that all no-work zones are easily identifiable in the field, and their locations communicated to workers who may subsequently be in the area.
- Once the no-work zone has been calculated by the assessor, the area should be flagged.
- Flagging should be placed at sufficient intervals so that workers will always be able to see the NWZ boundary from any position along its perimeter. When necessary, flag the inside of the no-work zone with a second color tape to indicate the centre. This will indicate the orientation of the NWZ to workers.
- **No forest worker is allowed to enter the no-work zone except to remove a specific tree hazard to the work area** (e.g., danger tree faller or guarded mechanical feller buncher enters zone to remove a dangerous tree along NWZ edge).
- For short duration and exposure fire situations (e.g. Initial Attack) flagging of NWZ may not be necessary. HOWEVER, NWZ boundaries must still be clearly identified on site and documented.

DELINEATING LARGER NO-WORK ZONE AREAS



- In wildfire burns with a high density of stems, where potentially hundreds or thousands of standing dead trees remain, it is not possible to assess each tree for potential safety hazards. In this circumstance, some areas may not be treated (e.g., mop-up activities) or will be treated at a later time or may contain numerous high-value wildlife trees. These areas should be delineated with "no-work zone" flagging or other physically identifiable boundary.
- Any dangerous trees along the edges of these no-work zones which can reach =the work area, should be removed before work activities commence.
- No forest worker is allowed to enter the no-work zone except to remove a specific tree hazard to the work area (e.g., danger tree faller or guarded mechanical feller buncher enters zone to remove a dangerous tree along NWZ edge).
- The locations of no-work zones and no-work zone boundaries which have been flagged on the ground MUST be communicated to any workers who may subsequently be in the area.
- See documentation requirements in Step 5.

MARKING OF TREES ASSESSED AS SAFE OR DANGEROUS

- Trees which have **NO VISUAL HAZARD INDICATORS** (e.g., trees with no structural damage or disease and no indication of other problems based on the site assessment overview) **DO NOT** have to be assessed nor marked. Only mark trees assessed as "Dangerous" or assessed as "Safe" suspect trees.
- Trees which have "suspected hazards" and are then determined to be either "Dangerous" or "Safe" based on the site assessment overview and visual tree inspection **may** be marked in the field as follows:
  - mark trees determined to be Dangerous with colour flagging, or by painting a large "D" on it or other suitable marking which must be documented and communicated to workers on site. The tree must then be removed or a **flagged** no-work zone established around it before workers enter this area.
  - suspect trees determined to be Safe **MAY** be marked by painting a large "S" on it or other suitable marking which must be documented and communicated to workers on site. These "SAFE" trees will include a tree that upon initial observation appears dangerous, but **after assessment** is found to be safe.
  - safe tree flagging should only be used on individual trees, NOT AREAS!
- If trees are spray marked either "D" or "S", this will be with fluorescent spray paint - blue or lime green recommended - at eye level on the tree with the letters large enough to be seen from 1½ tree lengths away from all directions.
- **Whatever flagging or paint colours are used, must be documented.**
- Refer to Appendix 5 for suggested danger tree marking procedures.

AREA MARKING

It is essential to visibly mark any areas which have been assessed in the field so that workers will know if that area has been assessed and the appropriate safety procedures implemented. It is recommended that assessed areas be marked with the following flagging colour scheme:

- **Orange**: Indicates area has been assessed. Assessors initials, date and time of assessment, LOD, and if necessary, a brief description of the area (e.g., 1.5 tree lengths from edge of guard only) should be written on the flagging. Orange flagging will be **hung in plain view at the assessment start and finish points each day** (assessors should record GPS coordinates for these points). This information must be recorded on the appropriate site/planning map.

- **Plain Lime Green**: Indicates the assessed area has been felled out. Green flagging must be written on by the faller, including their name and date. Green flagging will be hung on top of the orange flagging and the site/planning map will be coloured green for felled areas at the end of each day.

- **Yellow**: No Work Zone flagging indicates presence of a No Work Zone. All No work zones must be clearly identified and marked on site and when appropriate will be marked in yellow on the site/planning map..

When fireline staff sees orange and green flagging, they will know the area has been assessed and felled, and it is safe for work entry. If you do not see any flagging in an area, do not assume the area has been assessed!!

These colours are only a guideline. It is critical that whatever system is in place is communicated to all workers on site.

GUIDELINES FOR KEEPING OR REMOVING DANGER TREES

- Fell all danger trees in main part of work area along access and evacuation trails. This includes trees marked "D" and any other trees which the faller (or machine operator) finds unsafe to the work area as a result of the falling process.
- Use qualified fallers.
- Use explosives or appropriate machinery, where necessary, to fell danger trees too dangerous for hand felling.
- If danger trees are too dangerous to fell safely, install an appropriate sized no-work zone around them.
- If felling danger trees will create excessive fuel loading and create fire control difficulties, assess if the area can be left and declared a no-work zone. This procedure must be discussed and approved with supervisor.
- Leave danger trees around perimeter if they lean sufficiently away from the present work area and not into an adjacent work area.
- Remove danger trees above and below roads if they pose a potential hazard to road activity.
- Where possible, dangerous trees can be removed with adequately guarded machinery.

Step 5: Provide Documentation

DOCUMENTATION

The certified tree assessor must document the following information on the FS 502c field card, or other retrievable format. Also refer to Appendix 4 for examples of assessment documentation.

- assessor's name
- date and time of assessment
- location of assessed area or trees (where appropriate this should be mapped to scale)
- marking protocol for individual trees assessed as "Safe" or "Dangerous" (i.e., paint or flagging colour) (see Appendix 5)
- location and method of identifying no-work zones (i.e., location mapped or described, and type of boundary flagging used)
- locations of areas assessed as safe (map or describe location and include relevant boundary flagging or tree marking procedures). Include GPS coordinates (UTMS) if available
- level of disturbance/work activity the area was assessed for (i.e., road travel; workers in area using heavy equipment; tree falling; etc.)
- describe how the above information was communicated to appropriate personnel (i.e., develop a safety plan). The assessor must give a brief explanation/orientation to crews on site concerning the safety procedures associated with danger tree assessments (i.e., tree marking protocol, location of no-work zones, locations of areas assessed as safe).
- documentation must be available and retrievable (i.e., copied to fire file)
- documentation (data forms, maps of assessed area) must be forwarded to the Danger Tree Specialist once the assessment work has been completed for a given area. (i.e. on a daily basis)

See Appendix 4 for examples of documentation.

WORK PROCEDURES FOR ASSESSED AREAS

Once an area has been assessed, there is still work required before crews can be allowed to enter:

- Assuming that the assessor has found dangerous trees, a qualified danger tree faller must now cover the area. The faller must remove all trees marked as dangerous, except those that are retained within No Work Zones.
- The faller must be supplied with a map showing the relative location and numbers of trees to be felled. This map and numbers will ensure the faller does not miss any trees.
- The areas that are completed (assessed/felled/NWZs) must be included in the ongoing documentation for both large and small fires.
- The procedures for reassessment of areas/trees must also be followed depending on site conditions.

Also refer to Appendix 6 (Ministry of Forests Wildfire Management Branch Operational Safe Work Standard #1) for additional information on dangerous tree assessment and related safety procedures.

REASSESSMENT OF TREES

Reassessment of previously assessed trees should occur before workers enter the area. This reassessment will be required **ONLY IF**: **ONE OR MORE OF THE FOLLOWING CONDITIONS APPLY**

– BUI values are above established thresholds **AND** there is continuous active burning within the area of work

– more than **3 days with continuous burning** have passed since the last assessment

– work activity in the area creates more disturbance than what the area was originally assessed for. (Level of Disturbance has increased)

- If an area is reassessed, any tree previously marked as safe, but which after sometime is now determined to be dangerous (e.g., because of a smoldering fire burning the roots), shall then have an "X" sprayed over the "S" and be marked with a "D." It should then be removed or a no-work zone established around it.
- Assessments in green (unburned) areas outside of the active fire area need only be done once for the appropriate level of disturbance (work activity)

NOTE: Assessments in green (unburned) areas outside of the active fire area need only be done once for the appropriate level of disturbance (work activity).

LARGE FIRE OPERATIONS

- Because of the size and relative logistics of fighting large fires, danger tree assessments in these scenarios require careful planning, coordination and communication.
- The requirement for Wildlife Danger Tree assessments is now an integral part of fire operations. Danger tree assessors must be aware of the operations objectives in order to do the most effective job of tree assessment.
- In order to keep crews productive, it can require several assessors and fallers in the field each day to ensure enough area is assessed and danger trees removed ahead of the fire crews.
- Large fire operations and documentation require that a seasoned/experienced assessor be in charge of the overall operation (**"Danger Tree Specialist"**).

DANGER TREE SPECIALIST

- The "Danger Tree Specialist" will be responsible for ensuring that all assessors working on the project are completing assessments to the required standard. If able, he/she should spend time with each assessor to ensure continuity and consistency of field assessments, documentation and implementation of appropriate safety procedures.
- The "Danger Trees Specialist" will work in conjunction with the Planning Section to ensure that the completion, documentation, mapping and communication of ongoing assessments are produced in a timely manner.
- On a daily basis, the "Danger Tree Specialist" must produce a summary of all areas assessed and pass this information on to the Planning Section.
- The assessment of Danger Trees must be part of the project safety plan.

GLOSSARY

biogeoclimatic subzone A representative class of ecosystem under the influence of the same regional climate. It is associated with a distinct climax (or near-climax) group of plants. For example, the Sub-Boreal Spruce Moist Cool (SBSmk) subzone is characterized by a hy brid spruce-huckle berry-highbush cranberry plant association.

blind conk Sometimes called swollen knots; are significant indicators of decay. They typically appear as pronounced swellings around knots, and are the result of the tree attempting to heal over an old conk. Often the affected knot and new conk is partially covered by sound wood, which is implied by the term “blind” conk.

build up index (BUI) A numerical rating of the total amount of fuel available for combustion that combines duff moisture code (DMC) and drought code (DC).

canker Dead portion of the cambium and bark on a branch or the main stem. Cankers can be raised or sunken and are sometimes surrounded by a raised lip of tissue.

certified danger tree assessor A person who has successfully passed one or more of the “Wild life/Danger Tree Assessor’s Course” modules sponsored by the Wildlife Tree Committee of British Columbia since November 1998, and who holds a valid certificate which signifies this desig nation.

chlorotic Yellowing of normally green foliage tissue due to lack of chlorophyll. Usually indicates poor growing conditions or some sort of tree stress (e.g., root disease).

coarse woody debris Fallen trees and parts of trees on the forest floor.

conk The fruiting body of a wood decay fungus; bracket-like or reclined or flat on the host or ground, but not a mushroom. Usually woody or leathery in texture.

dangerous tree A live or dead tree whose trunk, root system or branches have deteriorated or have been damaged so as to be a potential danger to workers in the vicinity.

drought code (DC) A numerical rating of the average moisture content of deep, compact, organic layers. This code indicates seasonal drought effects on forest fuels, and the amount of smoldering in deep duff layers and large logs.

duff moisture code (DMC) Numerical rating of the average moisture content of loosely compacted organic layers of moderate depth. This code indi cates fuel consumption in moderate duff layers and medium-sized woody material.

embedded (included) - -bark	Bark that is pushed inside a developing branch or stem crotch, causing visible cracking and a weakened structure.
fire intensity	The rate of heat energy release per unit time per unit length of fire front. Frontal fire intensity is a major determinant of certain fire effects and difficulty of control.
fire perimeter	The entire outer edge or boundary of a fire.
hazardous top (HT)	A suspect or defective top section (live or dead) of a hazardous because of visible structural weakness, especially if there is evidence of decay or cracking. The defect length is defined by the point of visible stem deformation (stem swelling or goiter, spike, multi-tops or candelabra, fork, kink or other such deformity) or stem damage that makes the top prone to failure.
forest activity	Any activity that requires workers to be in the field where they may be in the vicinity of living or dead trees.
hazardous top	A suspect or defective top section (live or dead) of a tree that may be hazardous because of visible structural weakness, especially if there is evidence of decay or cracking. The defect length is defined by the point of visible stem deformation (stem swelling or goiter, spike, multi-tops or candelabra, fork, kink or other such deformity) or stem damage that makes the top prone to failure.
live cull	A live tree with some visible external defect such as a broken, dead, or forked top, split or scarred trunk, or fungal conks.
live class 1 tree	A living, growing tree with good vigor, no structural problems, and no visible signs of disease or decay.
no-work zone (NWZ)	A flagged area on the ground (must be indicated on site map) where no worker shall enter except to remove hazards. Workers will be informed about no-work zones prior to commencement of work on site. No-work zones are usually 1½ times the length of the tree defect, but can be modified larger or smaller depending on site-specific conditions such as slope or size of adjacent standing timber.
pathogen	A living organism that incites disease in a host.
qualified person	A person experienced in the specified work activity and who, by reason of education, training, experience or a combination thereof, is able to recognize and evaluate hazards associated with trees, with due regard for the anticipated work activity and possible disturbance of the tree(s).
resinosis	An abnormal flow of resin or pitch from conifers, often from the base or lower stem. Resinosis can indicate the presence of tree pathogens or damage.

rust	A disease caused by infection with one of the rust fungi, often producing brown to red spores at some point during the infection.
saprot fungi	A general group of fungal organisms which decay in the outer sapwood layer of trees. Saprots tend to be more commonly found on dead trees. Because of their shallow depth of penetration (2 cm – 5 cm is usual), they generally only contribute to tree structural failure on small diameter dead trees (e.g., <30 cm dbh).
scaffold branching	Multiple stem and branch attachments characteristic of some deciduous trees. They consist of a system of co-dominant branches and lack a central leader.
secondary top	A growth leader on a tree which usually forms after the breakage or die-back of the original tree top. Secondary tops (live or dead) can occur as single leaders, forks or multiple tops. They may be hazardous, especially if there is **evidence of decay or cracking at the point of the original top breakage or stem deformity.**
sloughing	Starting to separate and eventually falling or breaking away from the tree trunk.
spike top	The pointed **dead tip of a living tree** from which most of the needles and branches have fallen off. The length of this “spike-shaped” dead tip is variable and can sometimes be up to 1/3 or more of the tree height for species such as cedars. This top dieback may be caused by insects, disease, or climatic factors.
suspect tree	Suspect trees are any live or dead tree with a visible defect which could cause failure of the tree, either whole or in part, for the applicable level of disturbance. Suspect trees require a visual inspection as well as a site assessment by a qualified person or a certified danger tree assessor, in order to determine whether they are dangerous for a particular level of disturbance/ type of work activity.
veteran tree	A tree which is significantly older than the trees of the main canopy (usually 150 years of age or greater). The tree may have survived one or more fires as evidenced by fire scars. Veteran trees are usually isolated in distribution and often extend well above the main tree canopy. Because of their large size, they usually provide valuable wildlife tree habitat.
wildlife tree	A standing dead or live tree with special characteristics that provide valuable habitat for the conservation or enhancement of wildlife.

Wildlife Tree Committee A committee organized in 1985 to find ways of maintaining wildlife tree habitat in forestry activities without endangering the safety of forest workers.

work area Includes area of actual fire fighting within the fire perimeter and adjacent areas by 1½ or more tree lengths, as well as access roads, evacuation routes, helicopter landing areas, rest areas, staging areas, marshalling points, and incident facilities.

work place Includes all locations where a worker is or is likely to be engaged in work activities. In the case of forest workers, this includes locations where they are exposed to trees.

APPENDIX 1 – HABITAT ECOLOGY

WHAT CONSTITUTES GOOD WILDLIFE TREE HABITAT?

When considering the needs of wildlife it is important to recognize that all trees are not equal in value. Given the large number of wildlife tree-dependent species and wide range of wildlife uses of these trees, there can be no simple system for determining which trees provide the best habitat for wildlife. The most significant indicators of wildlife tree quality are height and diameter, decay stage, location, distribution and cause of death.

Wildlife Tree Characteristics:

- greater than 15 m in height preferable
- greater than 30 cm dbh preferable (interior)
- greater than 70 cm dbh preferable (coastal)
- decay classes 2–6 conifers and 2–4 hardwoods most valuable
- windfirm, sound root system
- broken top
- some large branches
- some intact bark with space behind loose bark
- nest cavities, feeding excavations
- some evidence of decay (visible fungal conks or cankers)

Height and diameter

Generally, the larger the diameter of a wildlife tree, the greater the variety of species that benefit from it. Most wildlife tree-dependent species prefer tall, larger diameter trees because they offer greater security. A tree with a large trunk provides the potential for a spacious cavity with strong walls. Thick-walled cavities protect their occupants against predators and inclement weather. Large dead trees usually remain standing for many years, providing wildlife habitat for a much longer time than small trees, which fall soon after they die. Large trees are also important for open nesters such as Bald Eagles, Ospreys, and some hawks and owls.

Decay stage

Each stage in the decay process has particular value to certain wildlife species. The earlier the stage of decay, the harder the wood will be. Strong excavators (woodpeckers) usually nest and roost in “hard” trees, while weak excavators (nuthatches, chickadees) prefer “soft” trees. Soft trees also provide the substrate for the numerous species of invertebrates that comprise the food supply of many wildlife species. “Hard” trees which still have branches provide good hunting perches for predatory birds. They also have great future value since most of them, except for those that are fire hardened, will eventually become soft. Fire hardened wildlife trees are not usually suitable for excavating nest holes, but they are often good feeding sites, especially in the first 1–2 years after the fire.

Location

Animals that require dead trees for nesting, denning or feeding usually need live trees nearby for protective cover and foraging habitat. Nest trees of primary cavity excavators (PCEs) are often found at the edge of cutblocks, roads or natural forest gaps. The species composition and structure of the surrounding plant community also influence wildlife use of trees. Some wildlife species such as kestrels, flycatchers and bluebirds require trees surrounded by low or early-seral vegetation (grass-forb, shrub-seedling, pole-sapling) which can function as hunting perches and harbour prey species. Woodpeckers, owls, Vaux’s Swifts and others are dependent on the taller tree communities that develop later (young, mature or old-growth). Wildlife trees adjacent to water bodies are important for cavity-nesting ducks, Great Blue Herons, Ospreys, Bald Eagles and Belted Kingfishers. The preferred topographic location of roost trees may vary from season to season.

Determining wildlife tree value

Generally, the following characteristics indicate the relative habitat value of a wildlife tree.

Wildlife Tree Value	Characteristics
HIGH a high value tree has at least two of the characteristics listed in the adjacent column and, where possible, is within the upper 10–15% of the diameter range distribution	• internal decay (heartrot or natural/ excavated cavities present) • crevices present (loose bark or cracks suitable for bats) • large brooms present • active or recent wildlife use (feeding, nesting, denning) • tree structure suitable for wildlife use (suitable for large nest, hunting perch sites, bear den, etc.) • largest trees for site (height and/or diameter) and veteran trees • locally important wildlife tree species
MEDIUM	• large, stable trees that will likely develop two or more of the above attributes
LOW	• trees not covered by high or medium categories

Notes

Class 2 Trees

Definition

Class 2 trees are live trees with **a visible defect which directly compromises the structural strength of the tree**. This will (or has the potential to) cause whole or partial breakage or uprooting of the tree, or a portion thereof. Consequently, these will be defects which are almost always associated with internal decay or some form of stem or root system damage. The **presence of the following defects on LIVE trees** can be used to differentiate Class 2 trees from Class 1 trees:

- Fungal conks
- Tree cavities (natural or created by wildlife)
- External stem scars (usually will be caused by mechanical or fire damage, or the breakage of large limbs)
- Stem cracks/splits (must have associated decay; not a simple dry check):
    * This condition will include “included bark” (cracking/splitting) at live stem fork unions, and is most common in large deciduous trees.
    * **NOTE**: if you cannot clearly see the crack and therefore are uncertain whether there is associated decay, then categorize this as a defect
- Dead tops (any size — either as a dead spike, dead fork, or dead multiple top)
- Broken tops
- Large dead limbs (> 10 cm diameter)
- Damaged roots (mechanical, fire or disease)
- Excessive lean (>30 %) AND damaged/diseased roots or a poor anchoring soil substrate. “Sweep is not a lean defect
- Large canker face (>50 % of tree circumference)
- Unusual stem swellings (may indicate hidden decay)

Class 1 trees are live, healthy trees and are free of the above defects. Minor defects such as stem scrapes, bark scorching, small dead limbs, live forks and live multiple tops, will usually have no associated decay or loss of columnar shell thickness, and will therefore NOT reduce the tree’s structural strength NOR present a worker safety hazard.

The ability to distinguish between Class 1 and Class 2 trees is most important when working under Level 4 disturbance. At this level (as per the WDTAC guidelines), all Class 1 trees, Class 2 cedars with low failure potential defects, and class 2 trees with no structural defects are rated as safe.

APPENDIX 2 – COMMON PATHOGENS OF TREES IN BRITISH COLUMBIA

COMMON PATHOGENS OF TREES IN BRITISH COLUMBIA

REGION: North Coast—Bella Coola is the approximate southern limit

Diseases	*Common/Scientific name*	*Hosts*	*Notes*
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; amabilis, grand and subalpine fir; white and Sitka spruce Douglas-fir and western redcedar	High elevations only on coast, Not found on Queen Charlottes
	Red Ring Rot *Phellinus pini*	Mountain and western hemlock; amabilis, grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir, yellow-cedar, larch and western redcedar	Throughout the host range
	Brown Crumbly Rot *Fomitopsis pinicola*	Occurs on a wide range of hosts, including most conifers. It has not been reported on yellow-cedar, black spruce or maple in B.C. Red alder, paper birch, aspen and cottonwood	Is one of the most frequently occurring decay fungi in B.C. Is very common on dead trees but can cause considerable damage to live trees
	Hemlock Dwarf Mistletoe *Arceuthobium tsugense*	Hemlock	Throughout the host range
Root diseases	Annosus Root Rot *Heterobasidion annosum*	Occurs on a wide variety of coniferous and broad-leaved species: western hemlock, amabilis and grand fir, white and Sitka spruce, lodgepole pine, Douglas-fir, western redcedar, bigleaf maple, and alder	Affects trees west of the Coast Mountains
	Tomentosus Root Rot	Sitka and white spruce *Inonotus tomentosus*	Mainly in ICH (Interior Cedar Hemlock) zone
Insects			
Bark beetles	Western Balsam Bark Beetle *Dryocoetes confusus*	Subalpine fir	Throughout the host range.
Defoliators	Tent Caterpillar *Malacosoma disstria*	Trembling aspen	Throughout the host range
	Western Blackheaded Budworm *Acleris gloverana*	Western hemlock, amabilis fir, Sitka spruce	Throughout the host range
	Green Striped Forest Looper *Melanolophia imithea*	Western hemlock	Throughout host range

REGION: South Coast—Bella Coola is the approximate northern limit

Diseases	*Common/Scientific name*	*Hosts*	*Notes*
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; amabilis, grand and subalpine fir; white and Sitka spruce Douglas-fir and western redcedar	High elevations only on coast
	Red Ring Rot *Phellinus pini*	Mountain and western hemlock; amabilis, grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir, yellow-cedar, larch and western redcedar	Throughout the host range
	Aspen Trunk Rot *Phellinus tremulae*	Only on trembling aspen	Found where trembling aspen occurs on the south coast
	Brown Crumbly Rot *Fomitopsis pinicola*	Occurs on a wide range of hosts, including most conifers; has not been reported on yellow-cedar, black spruce or maple in B.C. Red alder, paper birch, aspen and cottonwood	Is one of the most frequently occurring decay fungi in B.C. Is very common on dead trees but can cause considerable damage to live trees
	Hemlock dwarf mistletoe *Arceuthobium tsugense*	Hemlock	Throughout the host range
Root diseases	Armillaria Root Rot *Armillaria ostoyae*	All native conifer species are susceptible except mountain hemlock	Throughout the host range south of 57° latitude
	Annosus Root Rot *Heterobasidion annosum*	Occurs on a wide variety of coniferous and broad-leaved species: western hemlock, amabilis and grand fir, white and Sitka spruce, lodgepole pine, Douglas-fir, western redcedar, bigleaf maple, and alder	Affects trees west of the Coast Mountains
	Laminated Root Rot *Phellinus weirii*	Douglas-fir; grand, Pacific silver and white firs; mountain hemlock	Throughout the host range, but most damaging to Douglas-fir in coastal stands
	Blackstain root disease *Leptographium wageneri*	Douglas-fir	Throughout the host range
Insects			
Bark beetles	Douglas-fir Beetle *Dendroctonus pseudotsugae*	Douglas-fir	Mainly eastern Vancouver Island and lower mainland north to host range
Defoliators	Western Hemlock Looper *Lambdina fiscellaria lugubrosa*	Western hemlock	Occurs primarily south of latitude 56° along the coast
	Western Blackheaded Budworm *Acleris gloverana*	Western hemlock; amablis fir; Sitka spruce	Throughout the host range along the south coast
	Western Spruce Budworm *Choristoneura occidentalis*	Douglas-fir; true firs; spruce	Throughout the host range along the south coast

REGION: North and Central Interior—from approximately Williams Lake and north

Diseases	*Common/Scientific name*	*Hosts*	*Notes*
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; amabilis, grand and subalpine fir; white and Sitka spruce; Douglas-fir and western redcedar	Main cause of heart rot in mature hemlock and true firs
	Red Ring Rot *Phellinus pini*	Mountain and western hemlock; amablis, grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir, yellow-cedar, larch and western redcedar	Throughout the host range
	Aspen Trunk Rot *Phellinus tremulae*	Only on trembling aspen	Found where trembling aspen occurs
	White Spongy Trunk Rot *Fomes fomentarius*	White birch	Throughout host range
	Lodgepole Pine Dwarf Mistletoe *Arceuthobium americanum*	Lodgepole pine	Throughout host range
Root diseases	Tomentosus Root Rot *Inonotus tomentosus*	Amablis and subalpine fir; Engelmann, black and white spruce; lodgepole, ponderosa and white bark pine; Douglas-fir; western hemlock; larch	Found in spruce-pine forests, particularly spruce stands in northern interior
Insects			
Bark beetles	Mountain Pine Beetle *Dendroctonus ponderosae*	All pines, especially lodgepole	Throughout the host range
	Spruce Beetle *Dendroctonus rufipennis*	Engelmann, white and Sitka spruce	Throughout the host range
	Western Balsam Bark Beetle *Dryocoetes confusus*	Subalpine fir	Throughout the host range, on the east of the Coast Mountains
Defoliators	Forest Tent Caterpillar	Trembling aspen *Malacosoma disstria*	Throughout the host range
	Large Aspen Tortrix *Choristoneura conflictana*	Trembling aspen	Throughout host range
	2-year Cycle Budworm *Choristoneura biennis*	White spruce; subalpine fir	Sub-Boreal Spruce zone McBride, Hazelton and north
	Western Blackheaded Budworm *Acleris gloverana*	Subalpine fir; white spruce	Throughout the host range
	Eastern Spruce Budworm *Choristoneura fumiferana*	Subalpine fir; white spruce	Fort Nelson area

REGION: South Interior—from approximately Williams Lake and south

Diseases	***Common/Scientific name***	***Hosts***	***Notes***
Stem diseases	Brown Stringy Trunk Rot *Echinodontium tinctorium*	Mountain and western hemlock; grand and subalpine fir; white spruce; Douglas-fir; western redcedar	Interior wet belt. Main cause of heart rot in mature hemlock and true firs
	Red Ring Rot *Phellinus pini*	Mountain and western hemlock; grand and subalpine fir; black, white, Engelmann and Sitka spruce; jack, lodgepole, ponderosa and western white pine; Douglas-fir; larch; western redcedar	Throughout the host range
	Lodgepole Pine Dwarf Mistletoe *Arceuthobium americanum*	Lodgepole pine	Throughout host range
Phellinus tremulae	Aspen Trunk Rot	Only on trembling aspen occurs	Found where trembling aspen
	Brown Crumbly Rot *Fomitopsis pinicola*	Occurs on a wide range of hosts, including most conifers; has not been reported on yellow-cedar, black spruce or maple in B.C. Red alder; paper birch; aspen; cottonwood	One of the most frequently occurring decay fungi in B.C. Very common on dead trees but can cause considerable damage to live trees occurs
	White Spongy Trunk Rot *Fomes fomentarius*	White birch	Throughout host range
Root diseases	Armillaria Root Rot *Armillaria ostoyae*	All native conifer species are susceptible except mountain hemlock	Most prevalent in south interior
	Tomentosus Root Rot *Inonotus tomentosus*	Amablis and subalpine fir; Engelmann, black and white spruce; lodgepole, ponderosa and white bark pine; Douglas-fir, western hemlock; larch	Less common than in north interior. Usually in moist spruce stands at high elevations
	Laminated Root Rot *Phellinus weirii*	Douglas-fir; grand fir; western hemlock	Rare, east of Purcell Mountains
	Blackstain root disease *Leptographium wageneri*	Douglas-fir	Primarily West Kootenays
Insects			
Bark beetles	Mountain Pine Beetle *Dendroctonus ponderosae*	All pines, especially lodgepole	Throughout the host range.
	Spruce Beetle *Dendroctonus rufipennis*	Engelmann and white spruce	Throughout the host range
	Western Balsam Bark Beetle *Dryocoetes confusus*	Subalpine fir	Throughout the host range
Defoliators	2-year Cycle Budworm *Christoneura biennis*	Engelmann spruce; subalpine fir	High elevation in southeastern B.C.
	Forest Tent Caterpillar *Malacosoma disstria*	Trembling aspen	Throughout the host range.
	Western Hemlock Looper *Lambdina fiscellaria lugubrosa*	Western hemlock	Primarily in the interior wet belt
	Western Spruce Budworm *Choristoneura occidentalis*	Douglas-fir; true firs; spruce	Okanagan and West Kootenays
	Douglas-fir Tussock Moth *Orgyia pseudotsugata*	Douglas-fir	Throughout Okanagan and drier areas of West Kootenays

APPENDIX 3 – A DISCUSSION OF LIABILITY AND DANGEROUS TREE ASSESSMENT

A DISCUSSION OF LIABILITY AND DANGEROUS TREE ASSESSMENT

"Duty of care" is the legal responsibility of the landowner or someone acting on their behalf (i.e., forest manager, park manager) to reasonably ensure the safety of persons working on or using that property. The duty of care is often established by various Acts or policies such as the Occupiers Liability Act. The Duty of Care invokes a certain standard of conduct called the "standard of care." Standard of care is defined as the best available guidelines and practices used to fulfill a particular "duty of care." Standard of care is recognized according to established procedures at an accepted level of standards. The Wildlife/Danger Tree Assessment process and associated course (WDTAC) is recognized in B.C. as the current "standard of care" relative to the determination of tree danger and hazards.

Relative to persons who might be assessing trees for work activities or other situations, as long as these are qualified persons (i.e., they have successfully completed standardized training in dangerous tree assessment or have demonstrated knowledge and experience of the work activity and hazards involved) who have applied the accepted standard of care for dangerous tree assessment (i.e., the WDTAC process), and have done so with due diligence (i.e., they were not negligent in following the accepted procedures or techniques), then they should not be held liable if a subsequent accident were to happen relative to a previously assessed tree. The assessment by said person would be viewed as consistent with "what a reasonable and prudent person (i.e., trained with similar qualifications) would have concluded under similar circumstances." Therefore, there would be no case for liability since liability has to be proven, usually by showing that some sort of negligence was involved. Generally, liability hinges on whether or not there was a duty of care to be exercised, and if so, whether or not it was negligently implemented (i.e., the accepted standard of care was not adhered to). In other words, was the person "duly diligent" in performing the work required?

"Due diligence" is the process of performing a task to the best of one's knowledge, ability and, as far as reasonably possible, according to the prescribed procedures.

When determining whether "due diligence" was taken, the following will be considered:

- Who was involved? A combination of the following determine one's capability for completing the particular task:
  - ~ knowledge
  - ~ training
  - ~ experience
  - ~ skills
- What was done?
  - ~ was the work done as well as others would do it? Done according to accepted procedures?
  - ~ what is required by regulation for the work done?

APPENDIX 4 – SAMPLE DANGEROUS TREE ASSESSMENT DOCUMENTATION

Wildfire Danger Tree - Daily Assessment Form

Assessment Date:	Incident #:
Assessor(s) Name(s):	Location:

DT Task Force? Yes☐ No☐

					FBP			
1	Work activity		LOD		Fuel Type		BUI	
2	Work activity		LOD		Fuel Type		BUI	
3	Work activity		LOD		Fuel Type		BUI	

GPS		Lat		Long			Lat.		Long.	
1	Start	°	.	°	.	Stop	°	.	°	.
2	Start	°	.	°	.	Stop	°	.	°	.
3	Start	°	.	°	.	Stop	°	.	°	.

Coordinate Line: Linear? Yes☐ No☐… or Encompass spot(s)? Yes☐ No☐

Map submitted: Yes☐ No☐. Sketch map (over): Yes☐ No☐. Scaled map: Yes☐ No☐

Site assessment Overview:

The assessment of the area above was completed as per the standards set out in the Wildfire Danger Tree Assessors Course and conducted to the following criteria:

☐ Assessments were conducted to a min. of 1½ tree lengths of all work areas
Assessments were conducted to a max. of _____ metres from the : ☐ Established Fireline (or)
☐ Fire edge (or) ☐ Other:
All areas assessed this date [☐ have] or [☐ have not] been managed
☐ All areas assessed this date are considered safe *
☐ All areas assessed this date are considered safe to the following point:

The following marking protocol was used:

Dangerous trees:		No work zones:	
Safe trees:		Assessed boundary:	
Begin/end:			

# trees assessed:		# trees felled:		# NWZ established:	

Additional Comments:

Information passed on to:

Signature:	Title:
Date:	Time submitted:

APPENDIX 5 – DANGER TREE MARKING/FLAGGING PROTOCOL

Example Danger Tree Marking/Flagging Protocol in Wildland Fire Operations

To ensure work areas on fire situations can be easily identified on the ground relative to their status concerning wildlife/danger tree assessment and hence worker safety, the following procedures are **SUGGESTED**. **However, it is most important that whatever flagging or paint colours are used, that these be communicated to all workers on site.**

Flagging Colours
No Flagging or paint present: Only applicable to areas open for Very Low Risk (VLR) activities with appropriate safety/work procedures implemented. Heads-up, be aware of dangerous tree defects.

Orange: Indicates area has been assessed, but danger trees have NOT yet been removed.
Assessors initials, date and time of assessment, and next assessment date should be on an appropriate number of ribbons and maps with updates undertaken as appropriate. The LOD level should also be indicated on flagging and accompanying maps.

Yellow: Indicates no-work-zone (NWZ) around dangerous areas or individual trees/defects that have been assessed as dangerous.

Lime Green (Safe Tree/Area): To be used as an indicator that the area has been felled out (i.e., danger trees have been removed or NWZs in place around some individual trees) by a qualified person. Therefore, this area is now safe for workers. Can also be used on high value individual wildlife trees that have been assessed as Safe and which are to be retained.

Paint
Where possible, use same paint colour as the flagging colours described above.
Use paint for marking danger trees with 'D' on three sides (fluorescent lime green or blue recommended). When paint is in short supply, a stripe can be painted around dangerous trees.

Paint can also be used to place an arrow on the tree to identify hung-up limbs and tops and install a **no work zone** to accommodate the hazard. This will help to minimize fuel loading, as the tree can remain standing. Paint is also useful for making traffic signs such as 'warning', 'no-entry' and 'danger tree removal'.

Please note that paint should only be used in situations where flagging is not available. Flagging is easily removed, changed and/or updated; paint is not as amenable to change.

Communication

Ideally, the assessors will be working in conjunction with the fallers and will provide a detailed map of the areas assessed and felled.

Each assessor and or faller will hand in the maps, field cards and assessment forms to the Danger Tree Specialist at the end of every day.

The danger tree removal process and all records must be accessible and retrievable. This will give all personnel an accurate and up-to-date record of what has been assessed and felled, when and where it was done, and when it needs to be reassessed.

If workers are scheduled to work in an area subsequent to that area being assessed, and the appropriate safety procedures have been implemented (i.e., danger trees felled or placed in NWZs), then all assessment information (i.e., marking procedures, locations of NWZs, locations of assessed areas) **must be clearly communicated to all workers in the field PRIOR to them beginning their proposed work.**

APPENDIX 6 – OPERATIONAL SAFE WORK STANDARD #1

WILDFIRE DANGEROUS TREES

Applies to	Personnel employed by or contracted with the Forest Service and involved in ground fire suppression operations.
Purpose	To provide a safe work environment and to meet Workers' Compensation Occupational Health & Safety Regulations. The Forest Service will have Safe Work Standards that constitute safe methods, conditions and requirements for workers involved in fire line suppression operations.
Critical Safety State-ments	**In wildfire operations, if a worker will be put at undue risk of being injured by a suspect or potentially dangerous tree, the tree must be removed <u>or</u> assessed by a Certified Danger Tree Assessor who determines whether the tree is safe or dangerous and manages it in accordance with the established practices.**
Exceptions	In Very Low Risk activities (site survey, reconnaissance, tree marking, boundary and fire guard/control layout, establishing hose lays in green unburned areas, burning off, road travel with light vehicles such as ATV's, pickups <-5500 kg GVWR in green unburned areas) a formal Dangerous tree assessment is NOT required. Workers need to keep a "heads up" and stay away from any obvious dangerous trees and overhead tree hazards (insecurely lodged trees, hanging top or limbs). Where specific wildfire suppression operations are critical to controlling the fire and there is no other practical alternative safety procedure, the use of spotters to watch suspect or potentially dangerous trees in order to allow workers to carry out activities may be utilized, as long as it is for a short duration only. If this practice is to be employed, then it is essential that all workers on site are aware of the procedures to be used and appropriate action required if a tree appears in any way to be posing a threat of injury to workers on-site at that time. All procedures must be documented and placed on the appropriate incident file. If conditions call for an alternate safe work procedure from these standards, an amending written practice will be developed to address the specific situation and ensure the safety of personnel. The appropriate Fire Centre Manager or the Director must approve this practice.
Contact	Jeff McDonnell at jeff.mcdonnell@gov.bc.ca or phone 250 554-5536

DEFINITION(s)

Dangerous Tree	Any tree that is hazardous to workers because of location or lean, physical damage, overhead hazards, deterioration of limbs, stem or root system, or a combination of these.
Certified Danger Tree Assessor	A person who has successfully passed one or more of the "Wildlife/ Danger Tree Assessor's course" modules sponsored by the Wildlife Tree Committee of British Columbia since November 1998, and who holds a valid certificate which signifies this designation. For wildfire applications the assessor must hold a valid "wildfire module" certificate.

PROCEDURES

Hazards

During the initial site survey and fire attack planning process, the types and locations of potential hazards (including potentially dangerous trees) will be disclosed to workers. Appropriate action will be taken to avoid or mitigate hazards.

WIND INFLUENCE

Workers must be aware of wind conditions and the influence of wind on tree stability. Strong winds increase the potential of trees failing. Potentially dangerous trees within reach of work areas must be removed or managed by a certified assessor who determines whether the tree is safe or dangerous, and manages it in accordance with the established practices. If wind conditions become strong enough (i.e., winds set whole trees in motion and cause branches to break and fly in the air, or walking is impeded by the wind), workers should consider leaving the work area and go to a safe refuge.

Assessment

A certified danger tree assessor will rate the tree as:

Safe The tree can be left standing (i.e., less than 50% stem damage to coniferous trees or less than 50% of roots severed, burned, or damaged by heavy equipment, fire, decay or any combination of these.)

Dangerous The tree must be removed, or remove dangerous part of the tree (e.g., hazardous limb), or a No Work Zone must be established and flagged around it.

Assessment for dangerous trees is required for the active work area, the perimeter of the work area (within 1 ½ tree lengths or greater, depending on site factors such as slope), and other locations including but not limited to rest areas, staging areas, and access and egress routes.

Communication

Once an assessment is complete, the following details must be communicated to the workers in the area:

1. The location of the areas that have been assessed for dangerous trees;
2. The marking method used for trees assessed as “dangerous” or “safe”;
3. The location and marking method used for No Work Zones;
4. The type of work activity the area has been assessed for.

Re-assessment

Re-assessment of previously assessed trees or areas is normally not required. However re-assessment is required if one or more of the following conditions occur:

1. Buildup Index values are above the established thresholds and there is continuous active burning within the area of work, or
2. More than three days with continuous burning have passed since the last assessment, or
3. The work activity in the area creates more disturbance than what the area was originally assessed for.

In these situations, re-assessment will determine if tree stems and root systems have deteriorated and the appropriate safety procedures can then be implemented.

Falling Danger Trees

No person will fall dangerous trees unless they have formal training in falling and have demonstrated competence in falling dangerous trees. No person will blast dangerous trees unless they have formal blasting training.

Machine-constructed fire guards do not normally require pre-falling of Dangerous Trees because of short exposure time and Roll Over Protection Systems used on heavy equipment.

APPENDIX 7 – ALTERNATE SAFE WORK PROCEDURE FOR DECAY DEFECTS ON TREMBLING ASPEN

Alternate Safe Work Procedures for Decay Defects on Trembling Aspen

Rationale

Trembling aspen (Populus tremuloides) is one of the most common deciduous trees which occurs throughout most of interior British Columbia. Where it occurs, it is perhaps the most valuable wildlife tree for cavity excavating birds because of its propensity to develop heart rot decay as a live tree, relatively soon in its life span. In most cases this heart rot is caused by the fungi Phellinus tremulae, which is restricted to the heartwood of the tree and is often successfully compartmentalized by the tree. Consequently, depending on the diameter and vigour of the tree, the internal decay is restricted to the heartwood, with the tree developing a sound outer shell of later heartwood and sapwood. The result is a live tree which can often exhibit numerous fruiting bodies of P. tremulae (brownish-gray conks are usually visible just below branch stubs), yet have enough sound outer wood in the stem cross-section to provide columnar strength to the bole of the tree (i.e., the minimum required shell thickness is $\geq$ 30% of the tree radius). Trees in this condition make excellent nest sites for cavity excavating birds, and while they are still alive, often do not suffer stem breakage.

Related Danger Tree Assessment Guidelines

According to the tree failure criteria described in the Wildland Fire Safety Module, the presence of "...any heart rot fungi" found on broad-leaved deciduous trees results in a "Dangerous" rating for those trees, under Level 2-4 work activities. Most mature aspen have P. tremulae conks or blind conks --- this means that these trees would automatically get a "D" rating if there is exposure to workers (except for Level 1 work activities). In some areas of the province where aspen is abundant, this may mean that an undue number of live and/or minimally damaged aspen would be rated "D" for Level 2-4 work activiteis --- this would result in an unnecessary amount of tree felling and subsequent fuel loading in these situations, as well as a loss of wildlife habitat. An alternate job safety procedure is recommended for aspen, as follows.

Alternate Job Safety Procedure for Trembling Aspen (Level 2-4 work activities)

1. Conduct a site assessment overview in order to determine the general size and condition of aspen in the work area.
2. Look for visible conks and blind conks on tree trunks (usually seen as rough textured, blackish swellings at the base of branch stubs)
3. Look for aspen trees which have broken or snapped. If trees have sufficient decay to be a safety hazard (ie.e, they have insufficient sound shell), then it is very likely that you will observe some broken and snapped trees, and trees with extensive woodpecker nest holes along the trunk.
4. If you do not see many broken or snapped aspen (with or without fire damage), then conclude that live standing aspen with NO OTHER DAMAGE other than visible conks, can be declared "Safe" to work around during the period of the work activity (subject to 72 hour reassessment period as per allt rees).
5. Document your observations of aspen bsed on the site assessment overview
6. Determine and document marking procedures for aspen. If live aspen with conks are generally not breaking in the stand, then you will likely NOT have to mark aspen which have visible conks, but no other damage.

7 The above 6 steps ONLY apply to LIVE aspen with visible conks or blind conks, AND which do NOT have other damage. Trees with other damage (e.g., fire scarring, dead tops, damaged roots, etc.) must be assessed according to Table 3, 3A or 4 from the Wildland Fire Safety Module course manual, and dealt with accordingly.

APPENDIX 8 – COMMOM TREE SPECIES CODES

Common Tree Species Name and Codes

Tree Species	Code Symbol
Douglas -fir	Fd
Western larch	Lw
Lodgepole pine	Pl
Pondersoas pine (Yellow pine)	Py
Western white pine	Pw
White spruce	Sw
Engelmann spruce	Se
Sitka spruce	Ss
Subalpine fir	Bl
Amabilis fir	Ba
Grand fir	Bg
Western hemlock	Hw
Western redcedar	Cw
Yellow cedar	Cy
Black cottonwood	Ac
Trembling Aspen	At
Paper birch	Ep
Red alder	Dr
Maple	Mb

APPENDIX 9 – WHERE TO GET RESOURCE MATERIALS

Where to Get Resource Materials

The following resource materials and contacts can be obtained as follows:

- FS502b, FS502c and FS502c cards - contact Ministry of Forests, Protection Branch, Victoria BC (250) 387-5965

- *Tree Book - Learning to Recognize Trees of British Columbia* - contact Crown Publications, Victoria, BC (250) 386-4636

- *Common Tree Diseases of British Columbia* - contact Natural Resources Canada, Pacific Forestry Centre, Victoria, BC (250) 363-0600

- To enroll in a *Wildlife/Danger Tree Assessor's Course* Module - contact University of Northern British Columbia, Dept. of Continuing Education, Prince George, BC (250) 960-5982. http://www.unbc.ca/continuingstudies

- To find out about the *Wildlife Tree* Program in British Columbia, see the Wildlife Tree Committee of BC website at http://www.for.gov.bc.ca/hfp/values/wildlife/WLT/