Forest Management Plan
Sudden Valley Community Association

PREPARED FOR

Wilson Engineering
Bellingham, WA

Mayl 15, 2015

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Introduction

In April, 2014 American Forest Management, Inc. (AFM) was contacted by the Sudden Valley Community Association (SVCA) to conduct a forest health and management plan. That effort was postponed until February, 2015 when AFM was again contacted, this time by Wilson Engineering, Bellingham, Washington to conduct the same assessment but with an emphasis on the maintenance and improvement of water quality in Lake Whatcom with respect to run-off from SVCA. The following report summarizes that effort.

Executive Summary

1.) The Sudden Valley Residential Development comprises about 1,576 acres with about 7,000 residents. The development is unique in that it is set within a forested area where tree removal and trimming is regulated in order to preserve the environmental and aesthetic features of the site.

2.) Wilson Engineering of Bellingham Washington is conducting an analysis of and implementation supervision of surface water run-off into Lake Whatcom. The objective is to reduce and mitigate for naturally derived phosphorous delivery into the lake that serves as the water source for the City of Bellingham and environs.

3.) Wilson contracted with American Forest Management, Inc. of Kirkland, Washington to conduct a forest health assessment on community owned lands (SVCA) that includes an overview of the forest condition, timber harvest potential, hazard tree identification, fire risk, a review of tree removal and pruning guidelines and tree canopy restoration mitigation.

4.) The forested areas on SVCA lands include 304 distinct areas totaling 478 acres, identified as Management Units (MU's) on the 701 SVCA owned acres. These MU's are mostly in the form of narrow buffer strips, vacant lots, parks and larger undeveloped upland areas on steep ground south of the residential area as well as in a developed but currently unused campground site.

5.) AFM utilized an assessment procedure used regionally in urban forest areas known as the Forest Land Assessment Tool (FLAT) that visually ascribes 30 attributes to each MU including tree data, shrub and ground cover data and invasive species presence.

6.) The FLAT process resulted in a generally healthy forest assessment at SVCA with typical tree vitality and low invasive species presence.

7.) Timber harvest potential is limited by the close quarters in developed areas, steep unstable slopes in upland areas and/or previous removal of timber.

8.) The hazard tree identification process, hampered by lack of precise land ownership maps, resulted in locating twenty-eight trees or groups of trees assessed as imminent hazards to human or human developed structures that are recommended for removal. Hazard trees were identified that had visible significant defects (wood decay) and that are within reach of high use areas.

9.) The risk of wildfire at SVCA is present due mostly from the dense residential use that could spread into the natural forest environment. However, fire risk abatement is practiced in much of the area by removal of lower tree limbs, removal of tree debris, community education and the presence of robust interagency fire suppression capabilities in and nearby SVCA.

10.) SVCA has a written policy addressing tree removal and tree pruning practices and debris abatement. The policy is adequate but lacks tree replacement or mitigation plans. This report provides a brief summary of practices to address this item.

11.) Tree pruning and maintenance guidelines are provided as part of this report.

12.) Canopy restoration opportunities and mitigation areas are found at tree removal sites and the marina park area.

Figure 1

SVCA Vicinity Map

I. Current Forest Health and Condition

Overview and History of Sudden Valley

Sudden Valley is a community of about 7,000 residents on 1,576 acres on the southwest shore of Lake Whatcom in Whatcom County Washington. The lake is the water source for some 80,000 residents in the City of Bellingham area. Development of a former farm and forest area began in the late 1960s with construction of an 18-hole golf course and community infrastructure. Residential development has continued since that time, however some lots have been acquired by the community as being unbuildable or have reverted for other reasons. Community activities are regulated by written governing documents including Architectural Control Guidelines (ACC) which address home-site development and the preservation of environmental and aesthetic resources within the forested setting.

According to the ACC Guidelines at least 50-percent of each residential lot must remain in open space with no structural encroachment. Additional undisturbed areas are required to buffer sensitive areas around water features. Native vegetation, including trees is to be preserved to the greatest extent possible and tree and tree limb removal are governed by the guidelines. It is the unique setting, the health of the forest and the effect of forest changes on the environment and water quality that are the subject of this report. The focus herein is on Sudden Valley Community Association (SVCA) owned properties.

Community goals include the maintenance of healthy forests, to provide an aesthetically unique environment for the residents, to provide fire protection and to maintain and improve water quality in Lake Whatcom. AFM set about to assess the health of the forest, to identify individuals and groups of trees with potential to fail and cause harm, to assess wildfire risk, and to plan for vegetative mitigations.

Methodology

Wilson Engineering provided a **GIS** (electronic maps provided from Whatcom County) parcel layer for SVCA that contained a land-use / ownership designation for each tax parcel. This was used to determine the survey area. A high resolution, leaf off, **orthophoto** dated 2010 was also provided. The parcel layer has significant positional errors when compared with the orthophoto. (The parcel boundaries are not correct) A certain amount of interpolation is required to estimate where the project area boundaries fall on the imagery. No attempt was made to correct parcel boundaries.

The parcels that comprise the project area were dissolved using GIS to remove any interior parcel boundaries. The resulting map or management units, **(MU)** were then broken into smaller units or polygons based on forest canopy cover type as viewed on the orthophoto. They were assigned a land-cover type of forest, natural, landscape, hardscape, or water. The minimum size for an MU is typically 5 acres, unless the type is surrounded by distinct non-forest types or property boundaries. Significant and distinct non-forest areas may be delineated down to 0.1 acre. Many very small MUs were delineated in this process due to their separation by roads or other features. Each MU was assigned a unique identification number which was used to identify it during the field data collection phase. Please refer to the fold out map, back cover.

A total of 304 individual forested polygons on the 701 acre SVCA ownership were identified. Those polygons total 478 acres. Land cover designations are based on forest canopy cover. In summary, those areas with more than 25% canopy cover are considered forested. Natural areas have less than 25% cover and the other categories, water, landscape and hardscape are non-forest or are affected by human processes. Table 1, based on the 701 SVCA acres summarizes the forest cover findings.

The ownership is summarized in Table 1 by land class.

Table 1

Land Cover	
Forest	67%
Natural	1%
Water	4%
Landscape	28%
Hard scape	trace

Please refer to Addendum II, Forest Landscape Assessment Tool (FLAT). This manual developed by the Green Cities Research Alliance allows land managers to rapidly assess landscape conditions and prioritize activities in order to begin the process of forest restoration. The MUs were then inspected by forester/arborists and data was gathered with reference to forest health. Upon completion of the field survey, GIS data from the survey crew was merged, compiled, and edited. A threat matrix number was calculated based on canopy cover percentage and **invasive plant** ratings determined in the field for each map unit. The final Map Unit GIS dataset contains the spatial polygon data along with the entire associated field observations collected in the field.

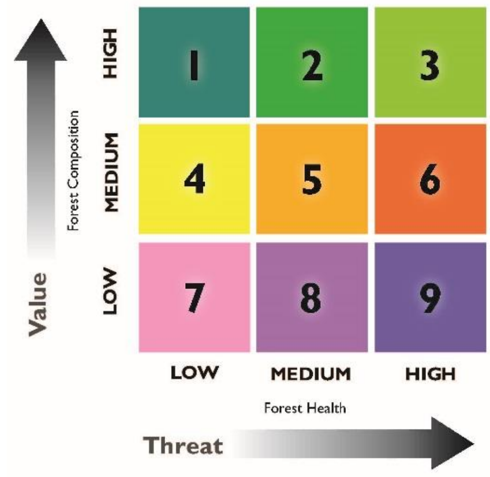
The field assessment includes identifying 30 attributes of each MU. In summary, those attributes include the primary, secondary and tertiary tree species, their size age and vigor. Then regenerating tree species are noted by species and size. Woody and herbaceous vegetation is briefly examined. Throughout the process, disease, insect and the presence of tree failure is noted. Once the data is collected, a Tree-iage Matrix is developed. Identifying and prioritizing areas in need of management is a key output of the FLAT process. Attributes assessed in the field are used to produce a qualitative value for two axes of a matrix. At SVCA, forest composition (y-axis) and forest threats (x-axis) were used. The matrix combines the attribute information to produce a classification value for each MU.

The result of the analysis is a “Tree-iage” table ranking the MUs on a scale of 1-9 from low to high priority for restoration activities. Forested areas, growing naturally without significant health or invasion by non-native species are graded low and those areas in poor health, with high percentages of hardwood trees and **non-native invasive species** rank high, meaning that corrective action should be taken to maintain forest health.

Identifying and prioritizing areas in need of management is a key output of the FLAT process. Attributes assessed in the field are used to produce a qualitative value for two axes of a matrix. At SVCA forest composition (y-axis) and forest threats (x-axis) were used. The matrix combines the attribute information to produce a classification value for each MU.

Figure 2

Triage Matrix



In the figure at the right, values 1-3 represent MUs with a tree composition that has high ecological value, and so are important to protect and maintain. Values 2 and 3 also represent the presence of a forest health threat and could be prioritized for restoration or maintenance. On the other end of the spectrum, a MU with a value of 9 has a high threat presence and a lower tree composition, and therefore may not be not be as high a priority for management actions.

How the results of the matrix analysis are used in subsequent land management decisions is up to each FLAT user. FLAT provides an ecological input for land management decision-making. The combination of field data collection, flow chart processing, and classification of MUs using the matrix can be used to prioritize future management actions and monitoring.

Summary of Findings

Addendum III contains the detail showing the attributes for each MU. The following table summarizes the SVCA forest overall.

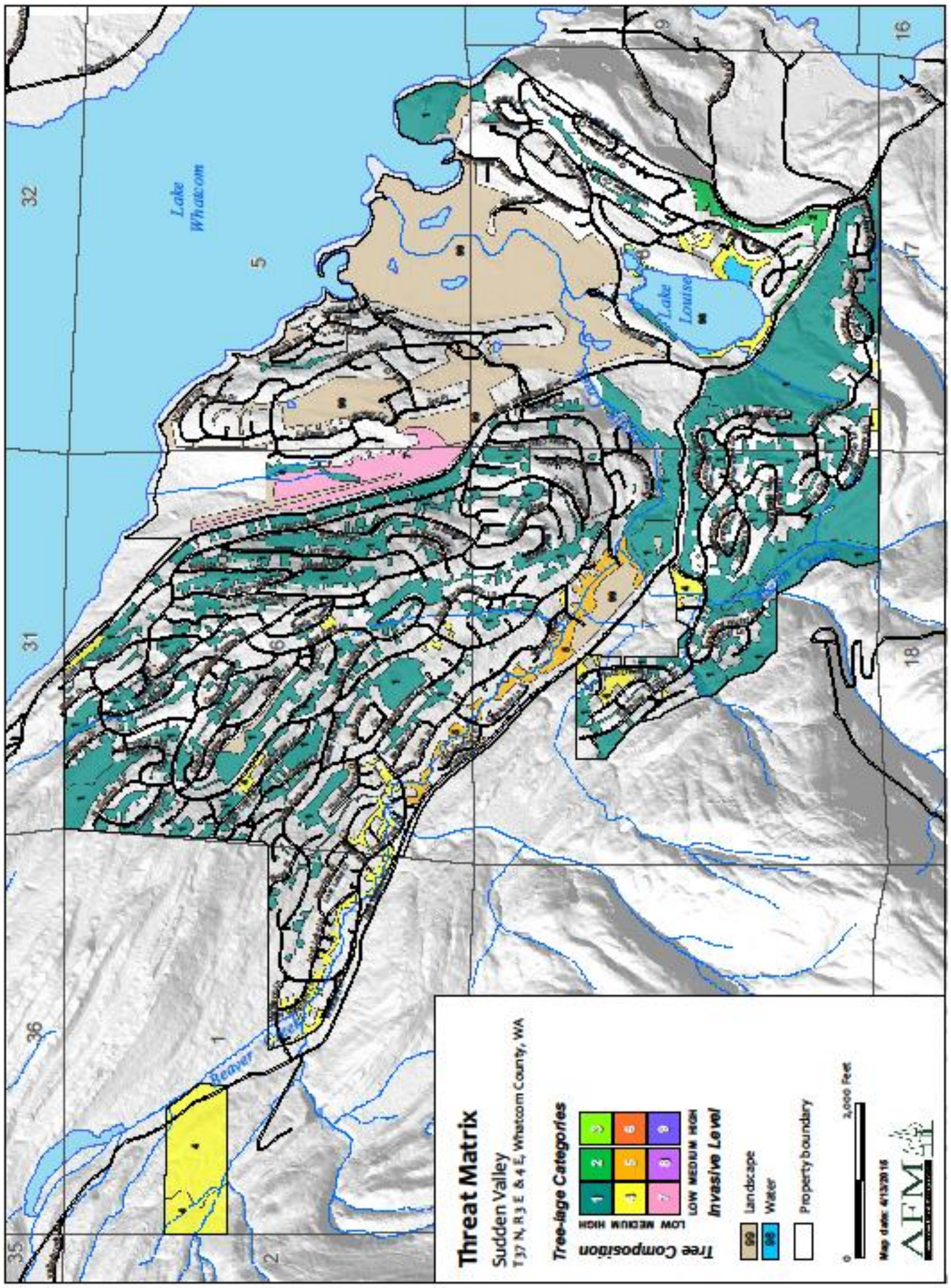
Table 2

SVCA Forest Summary							
Canopy Cover		Age Class		Size Class		Stocking	
Species		Years		Diameter inches		canopy cover	
Douglas-fir	46%	<29	8%	0-5"	5%	<10%	0%
Cedar	33%	30-49	3%	6-10"	12%	10-39%	0%
Alder	14%	50-99	87%	11-20"	51%	40-69%	18%
Cottonwood	5%	>99	2%	21"+	29%	>70%	82%
other	2%						

The forest areas are generally described as Douglas-fir and/or cedar, 50-99 years in age, ranging from 11-inches to well over 20-inches in diameter, well stocked with a canopy cover exceeding 70% closure 82-percent of the time. This describes a mature forest.

Figure 3

Threat Matrix



A larger version of this map is provided in the back cover. However in a nutshell, the natural processes of the SVCA forest are interrupted. The presence of the dense residential development, removal of small understory trees, removal of dead and dying trees, fire suppression, and debris removal as per

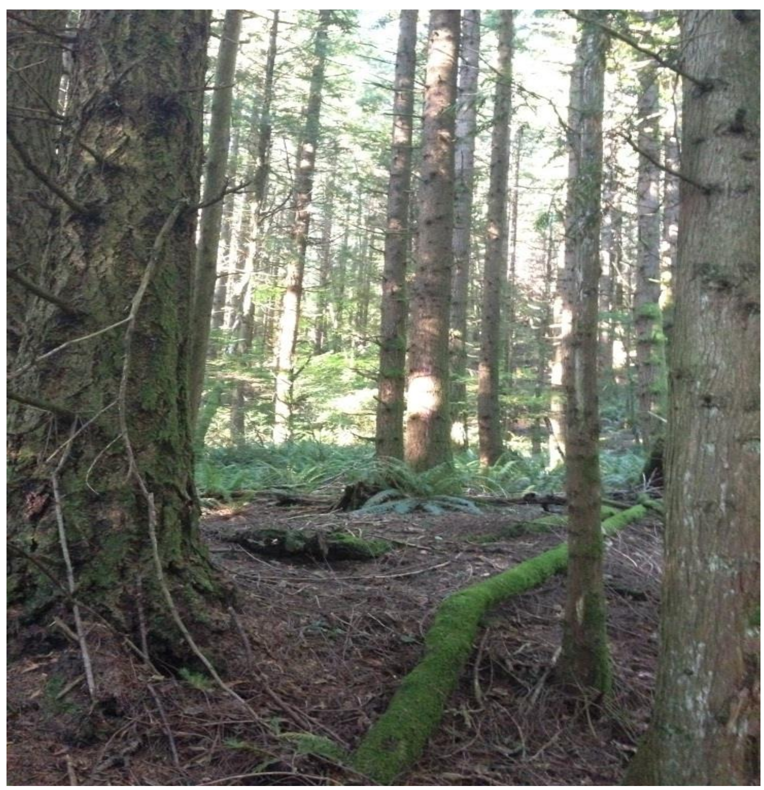
ACC guidelines have all disturbed natural processes. Exceptions occur in inner portions of the larger MUs such as #, 277, 278 and 283 which are largely undisturbed since timber harvest some 80 years ago. The forest composition, mostly Douglas-fir and western red cedar represent trees with the demonstrated the **vitality** found in many undisturbed forests, but **vigor** has been compromised by the environment at SVCA. At the same time there is very little indication of invasive species presence.

Without disturbance the SVCA forest would have continued on its course toward an "old growth" forest or late **seral stage** condition. Old-growth features include complex and diverse tree-related structures that provide diverse wildlife habitat that increases the bio-diversity of the forested ecosystem. The concept of diverse tree structure includes multi-layered canopies and canopy gaps, greatly varying tree heights and diameters, and diverse tree species and classes and sizes of woody debris. Old-growth forests tend to have large trees and standing dead trees, multi-layered canopies with gaps that result from the deaths of individual trees, and coarse woody debris on the forest floor. (Naturally Wood, British Columbia's Forest Diversity. British Columbia Forest Facts) With disturbance, for instance removal of dead limbs, hazard trees and woody shrubs, then the total components of the forest will not exist, rather we have only large trees. With no disturbance, the predominately Douglas-fir forest now existing would convert to western hemlock and western red cedar, shade tolerant species (Oregon Conservation Strategy. Oregon Fish and Wildlife). That process is now interrupted.

That said the FLAT assessment which relies heavily on conifer composition and invasive species presence to categorize forest health, finds a healthy but simple forest….just not a totally natural one.

Section III, Hazard Tree Summary which follows, points out how residential use affects the forest and the ensuing development of hazard tree situations and high risk conditions.

Late Seral Forest with multi-layer components (complex structure)



Typical managed-single layer forest (simple structure)

II. Forest Management Action Items

Suggested Actions

We found no items requiring urgent action with respect to forest health. Exceptions are noted in the Hazard Tree Summary which follows.

We were asked to consider timber harvest potentials aside from forest health tree removals. In particular we looked at the "Gate Five" area, MU # 283, and in the Austin Creek Area, MUs #277, 278 and 285 as well as MUs 120 and 122 at the Campground. The following Table summarizes our thoughts on these areas.

Table 3

Timber Harvest Potentials

MU	Harvest Comment
#283	Landslide Hazard Zone—Limited Access Above Lake Whatcom Blvd
#277, #278	Limited Access at Woodrush Ct and Loganberry Ct. –Sensitive areas above Austin Creek
#120	Difficult Access--- Sensitive Area above fish bearing stream
#122	Previous partial harvest for campground development

For these reasons we find no commercial timber harvest options compatible with the overall objectives of the SVCA.

Future Condition

The most striking statistic in Table 2, above is found in the Age Class Column where 89-percent of the trees at SVCA are 50 years or older. This generally reflects the vitality of the Douglas-fir and cedar components which can live hundreds of years. However, tree growth rate and vigor tend to decline after 50 years. The obvious conflict then is that as forest debris is removed, houses built and other man-caused activities take place, the forest does not continue on its natural path. Instead, the forest grows into a one dimensional stand and as it matures it causes additional problems with the residential use underneath.

With disturbance, for instance hazard tree removal and additional residential construction, mitigation replanting that we recommend in Section V will likely result in a second growth Douglas-fir and/or western red cedar forest. By the standards of the FLAT process, this is still a healthy forest—just different than a natural one.

III. Hazard Tree Summary

Methodology

The sheer numbers of trees as well as the difficulty in determining precise tree ownerships has hampered hazard tree identification on the SVCA property. We did identify twenty-eight trees or groups of trees as high risk hazards and those are marked with pink ribbon. (We note that upon re-inspection, some ribbons had been removed) In addition we identified groves of trees with significant defects and have indicated those on maps and in tables in Addendum IV and in the back cover. These areas would need on the ground property line identification in order to determine ownership.

Tree hazards include dead or dying trees, dead parts of live trees, or unstable live trees (due to structural defects or other factors) that are within striking distance of people or property (a target). Hazard trees are those with defects that have the potential to cause property damage, personal injury or fatality in the event of a failure. (Hazard Tree Guidelines for Forest Service Facilities. USDA Report #RO-12-01). In a nutshell, a tree with a defect (decay, mechanical failure, etc.) that is likely to cause failure of all or part of the tree that is within striking distance of a man made structure or human use area is a hazard.

The standard process for assessing risk is termed Visual Tree Assessment (VTA). This process is a visual inspection that looks for obvious indications of defect and targets.

The tree assessment process involves the examination of many factors:

- The **crown** of the tree is examined for current vigor. This is comprised of inspecting the crown (foliage, buds and branches) for color, density, form, and annual shoot growth, limb **dieback** and disease.

- The **bole** or main stem of the tree is inspected for decay, which includes cavities, wounds, fruiting bodies of decay (conks or mushrooms), seams, insects, bleeding, callus development, broken or dead tops, structural defects and unnatural leans. Structural defects include crooks, forks with V-shaped crotches, multiple attachments, and excessive sweep.

- The **root collar** and roots are inspected for the presence of decay, insects and/or damage, as well as if they have been injured, undermined or exposed, or original grade has been altered.

- The vicinity of human occupations or use, and potential property damage.

Inspection methods included examining the trees from ground level that may include binoculars and sounding trunks with a mallet. At SVCA, no invasive methods were utilized to assess defects in trees.

Defects are indicators of potential failure and can include mechanical (leaning trees, broken limbs, splintered trunks, heaving root systems) or the presence or disease that affect the structural integrity of wood (wood decaying fungus).

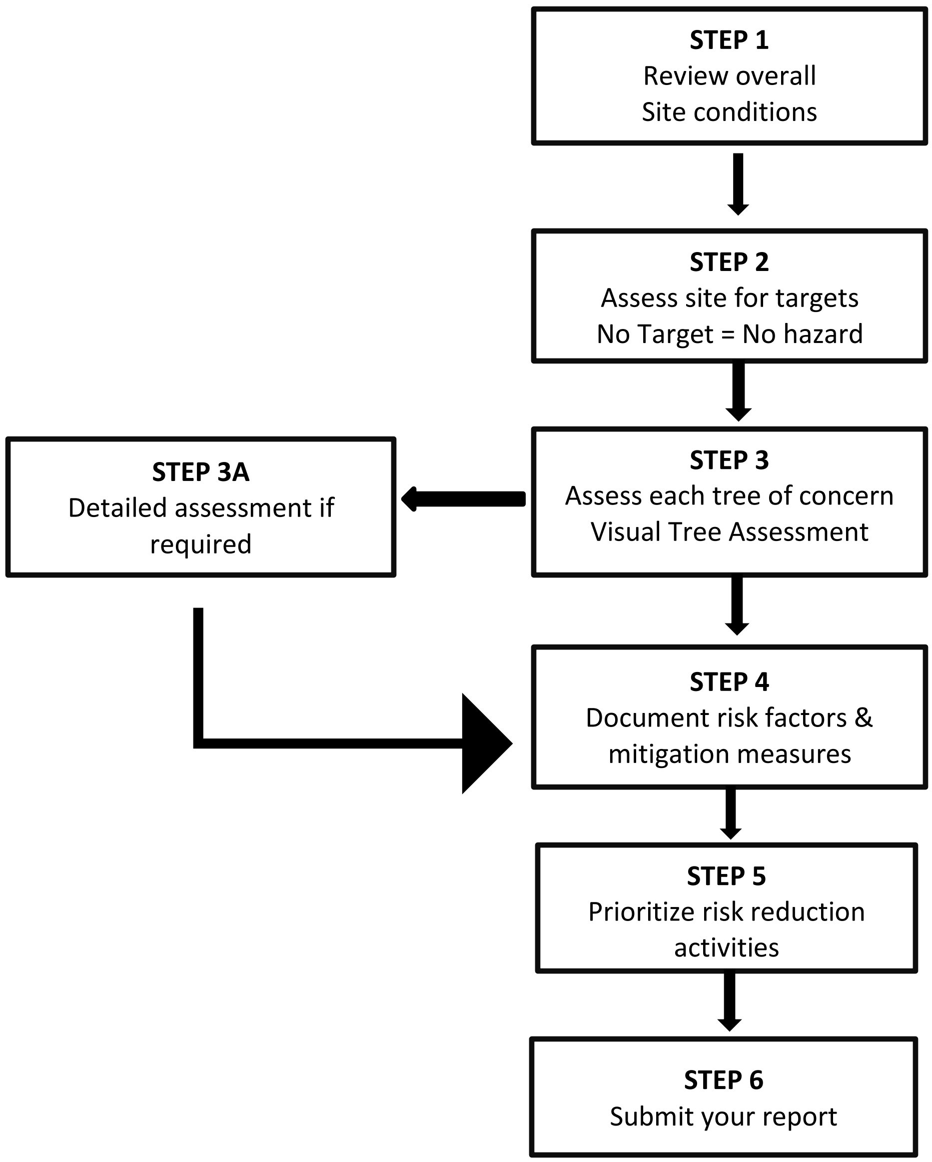
Risk Assessment

Tree Risk Assessment is a complex undertaking. It involves a stepwise process similar to that shown in the following flow chart. Risk is defined as "…the probability that an undesirable event will or will not occur. It is the product of the probability of the event taking place, the probability of being exposed to the event, and the probability of certain outcomes occurring if exposure did take place. Risk can be statistically quantified in a risk assessment. Acknowledgement for the foregoing to: (Dunster and Dunster in Tree Risk Assessment in Urban Areas and Urban/Rural Interface—Course Manual. PNW International Society of Arboriculture.)

Risk Assessment steps are demonstrated by the following Chart.

Figure 4

Tree Risk Assessment



Risk Assessment typically considers:

- The size of the tree component that might fail
- The probability of it failing
- The probability of a target being hit in the event of failure
- The damage/harm likely to result to the target.

Risk Assessment is undertaken to:

- Limit the amount of risk to people
- Limit the amount of risk to property
- Limit the amount of risk to tree owners
- Identify the highest risk trees
- Prescribe actions to reduce risk (Risk Management)

A hazard tree exists when the sum of the risk factors assessed equals or exceeds a predetermined threshold of risk. In its simplest terms, trees with defects and near targets are higher risk than healthy trees away from targets. Risk Assessment attempts to quantify risk even though the uncertainty factor requires judgement on the part of the assessor. The key concepts of assessing risk besides uncertainty are probability and significance. Risk assessment is not hard and fast—nor is the level of risk one would tolerate. Much of the risk assessment process is driven not only by biomechanics, but also by litigation. Importantly, risk assessment is dependent on that seen or predicted at the time of the assessment.

Risk Assessment is used to determine which trees are actively failing (extreme), which will fail soon (high) and which might fail soon (moderate). There are no guarantees in risk assessment and no "for sure" categories of safe or unsafe. Risk assessment is a subjective process, based on an understanding of biological and mechanical factors. The task of the risk manager (entity responsible for the tree) is to balance tree risk issues against economic, social, political and regulatory requirements.

Most assessment protocols are ordinal---factors that might lead to tree collapse and damage to humans or structures are assigned numbers. For instance the International Society of Arboriculture Tree Risk Rating System "scores" trees as summarized following.

Table 4

Risk Rating System

Size of Part			Potential to Fail			Target	
Score	Range		Score	Narrative		Score	Narrative
1	1-6"		1	Low		1	Low
2	6-18"		2	Medium		2	Medium
3	18-30"		3	High		3	High
4	>30"		4	Severe		4	Severe

Scores are totaled for each tree. Scores above 9 are considered "high risk" and those ranging toward 12 are those in imminent danger of failing.

At SVCA we focused on those trees totaling 9 and above recognizing that lower ranked trees could fail as well. (An interesting feature of the system is that although there are many more tree limbs in a forest under 6” in diameter, those limbs are ranked lower than large limbs even though the probability of failure is greater based solely on their frequency.)

Rather than describe each tree and target in detail, we simply noted the tree size and defect indicator with the understanding that targets were in obvious reach for each. The majority of the hazard trees we noted are over 18-inches in diameter, had a high to severe failure potential and had high to severe targets (ranges 9-12). We abbreviated the reporting procedures and developed the Hazard Tree Summary table in Addendum V.

Hazard trees were located and mapped using **GPS** tools. See Addendum V.

Summary of Findings

At SVCA we located twenty-eight hazard trees or small groups of trees defective and within striking distance of human activities or structures. We also noted several areas or groups of hazard trees where ownership was undetermined. The primary defects are root and bole decay as evidenced by fruiting bodies, known as **conks** and/or dead and declining tops and crowns. In Addendum V we have provided visual aids that describe the decay diseases found. Those major diseases are categorized as affecting either roots or the bole or stem of the trees. They are further categorized as white, brown or soft decays. In each case, the structural integrity of the wood is affected, decreasing the ability of the tree to stand. The most common fungi noted are those following.

Root Diseases:

Red-Brown Cubical Rot: Affects Douglas-fir by destroying the connective tissue **(lignin)** of root wood. It enters through root or lower stem wounds. It is often exacerbated by hoofed animals, root zone soil compaction. It affects the center of the tree (heartwood) first and trees infected may stand for many years. The fungal **conk** is found on the ground and looks somewhat like a cow-pie.

Laminated Root Rot (yellow ring rot): Affects Douglas-fir by destroying the cell walls **(cellulose)** of root wood and lower bole. It is typically transmitted tree to tree underground. Initial identification is often the appearance of a dead and dying tree top. Fungal conks are inconspicuous, often underground, when found look like a white mat. Identification is often made by the presence of thin tree crowns.

Armillaria Root Rot breaks down both the lignin and cellulose in plant tissue, particularly tree roots. It is often first noticed by thinning or dying tree crowns. The fungal fruiting body is sometimes called "honey mushroom".

Stem or bole diseases:

Red Ring Rot: Affects Douglas-fir by destroying the lignin in the bole or stem of the trees. It often lives in trees for many years without detection--- as it runs out of healthy wood to live on it produces a conk on the stem of the tree. The conk is shelf-like.

All of these diseases are exacerbated by stress--- changes in micro climate or root disturbance. Cultural control measures are limited generally to removal of the diseased trees and their stumps. Chemical fumigation has had limited results.

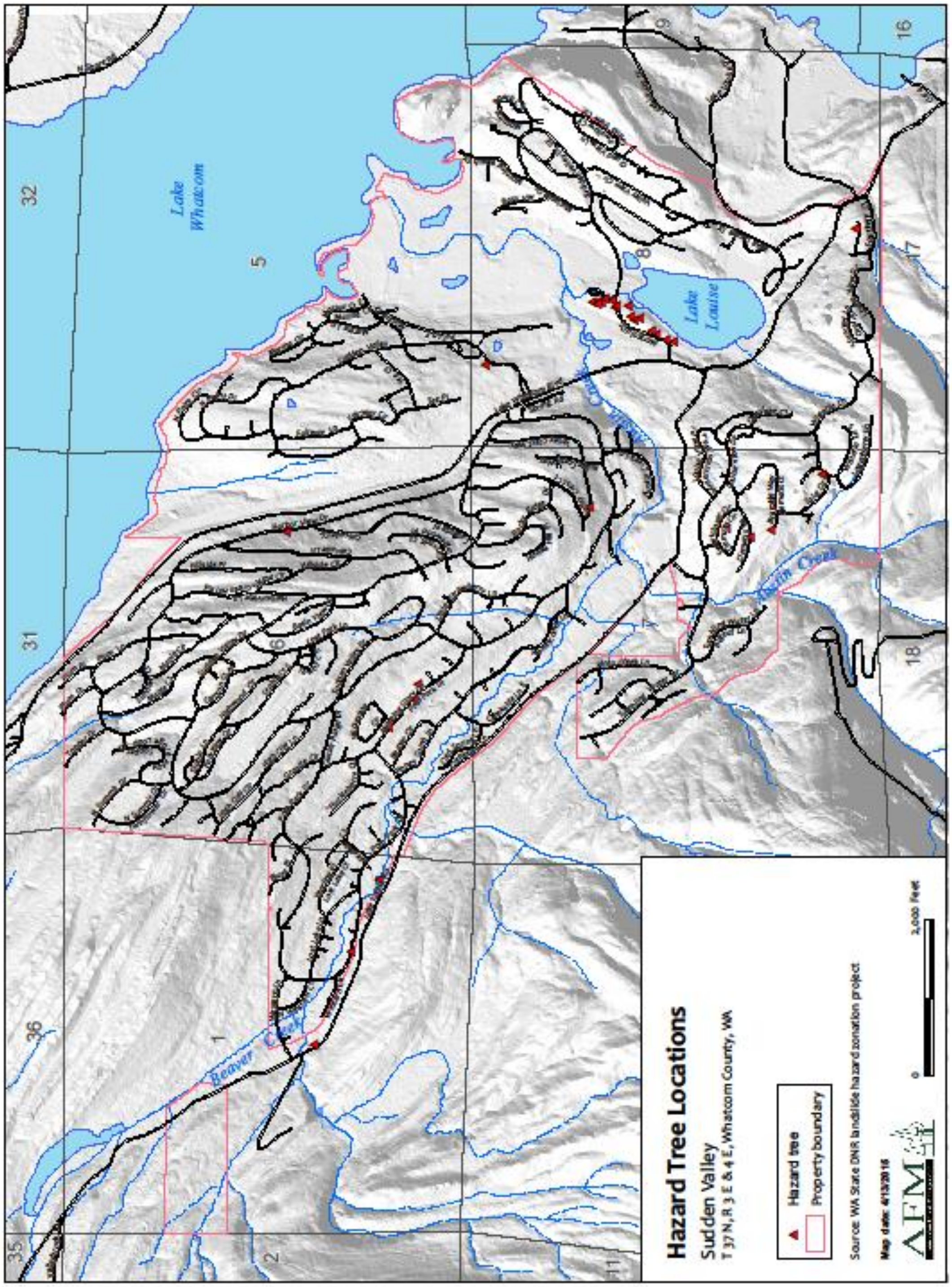
Action Items

As discussed, risk assessment includes an element of tolerance. An aggressive strategy at SVCA would reduce risk by removing all hazardous trees. A more passive strategy would take a wait and see approach, removing only those trees identified as imminent failure risks. As stated above, biomechanics and litigation play an important part in risk management.

The most prominent and highest risk trees are found around the parking lot at the Administration and Clubhouse area. Large trees with high amounts of decayed bole dominate the area. To a lesser extent we noted similar trees in the divider strip on Marigold Drive. Furthermore, trees on the northern end of Marigold are afflicted with root disease. We would take a less aggressive approach to the root diseased trees as these seem to stand for longer periods.

In any event, a yearly assessment of the noted hazard tree areas is highly recommended.

We noted the occurrence of obviously diseased trees, apparently on private ownership, throughout the developed area of Sudden Valley.


Hazard Tree Locations
Sudden Valley
T 37 N, R 3 E & 4 E, Whatcom County, WA
Hazard tree
Property boundary
Source: WA State DNR landslide hazard zonation project
2,000 Feet
Lake Whatcom
Lake Louise
Beaver Creek

IV. Tree Removal Guidelines

Current Regulations

SVCA Architectural Control Guidelines (ACC) section 14.10.1, Tree Removal and Limbing Criteria were reviewed. Guidelines adequately summarize the criteria that residents and SVCA may use to remove and maintain trees. However, the ACC does not provide guidance on tree replacement. It does not address the removal of trees in wetland, lake or stream buffer areas.

According to the Whatcom County Code, removal of hazard trees outside of regulated critical areas, shoreline management areas or protected native growth protection areas does not require a permit as long as the stump is left in place. Within regulated areas tree removal may be allowed with notification. (Whatcom County Code 16.16.235)

The Washington Department of Natural Resources (DNR) was contacted with respect to their jurisdictional authority regarding hazard tree removal. Generally, a defective tree within one and a half tree lengths of a target can be removed, regardless of whether or not the tree is within a regulated sensitive area. However, in non-forest areas, such as SV, DNR passes jurisdiction to Whatcom County.

Suggested Regulatory Modifications

One of the greater concerns at Sudden Valley is the maintenance of the forest cover in order to modify water runoff and phosphorous delivery into Lake Whatcom. According to Rhett Winter, PE, LEED, APND at Wilson Engineering, "The primary driver of phosphorus in runoff as it relates to forest canopy cover is with regard to the amount of runoff that is generated once the trees are removed. Forests are said to have less than 1% of the rainfall runoff from them. Once these trees are removed, the evapotranspiration, infiltration and uptake are eliminated or drastically reduced. Surface runoff increases to about 30% in urban environments. Two sources of phosphorus are the soil that is carried downstream due to erosion or other processes and and particulate vegetation (leaves, etc.). The forest condition attenuates much of the particulate vegetation and its function to reduce runoff and are the two main drivers to maximize canopy retention and the amount of phosphorus entering our surface waters."

Removal of trees at SVCA is inevitable in order to reduce the hazard risk from defective trees. Other activities including continued clearing for residential development will lead to tree removal as well. We are recommending that the loss of forest canopy be mitigated by planting suitable trees to replace that loss. Tree removal leading to forest gaps, but with no development (i.e. hazard trees) can be mitigated by planting at the same spot. We recommend shade tolerant species such as western red cedar that are generally not susceptible to Douglas-fir root diseases. In very wet areas, native willows should be considered.

V. Forest Health Improvement

Older trees are biologically different from younger trees. Trees slow in growth as they approach “old” age and become more vulnerable to disease, wind and other causes of death. It has been observed that older trees need greater energy stores and photosynthetic capacity to fend off disease or environmental changes. Urban (or suburban) trees are subjected to environmental forces including shade disruption, root compaction, root damage or simply root zone coverage. These disruptions lead to physical functionality losses and susceptibility to disease, primarily root and butt rots. Reduction of stress, damage or environmental degradation is essential to maintaining a healthy forest.

Development of a stable environment involves the minimizing of change and disturbance to the tree’s growing space, both above and below ground. An example of environmental change, for instance occurs when native plants that are naturally adapted to summer drought as is often experienced in the Pacific Northwest are subjected to irrigation. Root diseases can thrive in these damp environments.

Another stress factor is more obvious when one considers mechanical damage, chemical injury, low soil aeration (under asphalt for instance or the use of “engineered soils”) and nutrient deficiencies (when forest debris is removed without allowing natural decay on the ground).

Managing the forest in a residential setting obviously presents multiple challenges. On one hand, fire safety and appearance lead to debris removal which affects soil nutrition and surface water flow. Access for ingress and egress, fire safety (again) and house maintenance require pruning and root disturbance which affect the trees ability to produce and absorb nutrients and sunlight.

Tree health must consider the application of external treatments such as pruning, fertilizing, irrigation and debris removal against the natural processes required to keep a tree and its surrounding forest healthy. Tree death is generally attributed to multiple processes--- a single treatment or event may not be the ultimate cause of failure, but, and especially with older trees, a variety of stresses can accumulate to shorten the trees life span.

An unintended consequence occurs when trees in dense forest conditions are removed for whatever reason. In young forests, this typically promotes growth by providing greater root and crown space. However, in older forests, the trees do not respond as well, if at all due to increased stress, loss of support from neighboring trees or increased sunlight to the bole.

At Risk Areas

Areas at SVCA most at risk to tree failure are categorized as:

- Areas of greatest asphalt coverage over roots
    - The Club House and Marigold Avenue area
- Areas of greatest mechanical damage
    - The Club House and Marigold Avenue area
- Areas of recent house foundation construction

- Areas where soil moisture has changed
- Areas where trees are the oldest

Mitigation Actions

Mitigation actions to maintain forest health are generally those that return the environment to its natural vigorous state. They might include:

- Asphalt replacement with porous paving products—Use of engineered soils
- Expansion of building sites to reduce root disturbance (larger lots)
- Controlled water runoff—drainage of swales where conifer trees grow
- Erosion control—Use of biodegradable mats on exposed earth—planting shrubs and ground covers
- Removal of diseased trees and stumps to slow root disease transfer
- Chip and retain on site, forest debris (limbs, small trees, brush)

The other, and a primary focus of this report, is retention of the forest canopy whether or not at the same location as a removed tree; in other words, planting trees somewhere else on SVCA property. We have identified the following areas as canopy loss mitigation areas. An advantage of this procedure is that new trees and shrubs could be planted outside of root diseased soil areas.

- The location of removed hazard trees (assumes the likelihood that shady areas remain)
  - Suggest 3 6-foot tall western red cedar per removed tree
  - 1-gallon salal on 3' x 3' spacing
  - 1-gallon vine maple on 5' x 5' spacing
  - Other tree and shrub species as site-specific conditions suggest

- Marina Park Perimeter
  - Suggest 4-foot tall native willow on 6' x 6' spacing
  - 1-gallon spirea on 3'x3' spacing
  - 1-gallon Salmonberry on 3' x 3' spacing
  - 1-gallon slough sedge on 3' x 3' spacing

- Campground (Assumes land is to be restored, not used as campground)
  - Remove camping pads, underground utilities
  - Rip compacted soils
  - Plant shade tolerant tree and shrub species
    - Suggest 3 6-foot tall western red cedar per removed tree
    - 1-gallon salal on 3' x 3' spacing
    - 1-gallon vine maple on 5' x 5' spacing

- Beaver Creek Corridor
  - Suggest 3 6-foot tall western red cedar per removed tree
  - 1-gallon salal on 3' x 3' spacing
  - 1-gallon vine maple on 5' x 5' spacing
  - Other tree and shrub species as site-specific conditions suggest

All plantings should be protected from deer browse by use of bio-degradable netting. All plantings except those in the wetter areas should be hand watered for the first summer season.

VI. Fire Hazard Abatement

A. Community Fire Plan

The Sudden Valley Community is a dense residential area within a native forest. The properties rise up from near the lakes into the forest above at from 10-percent to nearly 70-percent slopes through a variety of forest fuel densities. This combination can provide a desirable pathway for fire into the forest. Of course extremely dry conditions can exacerbate the potential.

Fire History

Fire history in the forest is unknown but no evidence was noted during the field reconnaissance. A check with the Washington Department of Natural Resources and local fire departments (including the South Whatcom Fire Authority and the SVCA Fire Chief) found little or no incidence of fire on or near the properties in recent years.

Fire Risk

The Washington Department of Natural Resources has prepared a "Wildland Urban Interface (WUI) Communities at Risk for Fire" map. The map includes the Lake Whatcom Valley and specifically, Sudden Valley is identified as a "Landscape of Like Risk". Whatcom County Natural Hazards Mitigation Plan. Whatcom County Division of Emergency Management and Anchor QEA LLC., August 2011) A portion of the study, including maps is reproduced in Addendum V. The study undertook a Fire Vulnerability Assessment based on the following criteria:

- Spatial Characteristics
- Fuel Hazards
- Protection Capability
- Ignition Risk
- Fire History
- Catastrophic Fire Potential
- Values (Recreation, private property, forests, fish, etc.)
- Wildland-Urban Interface Hazards

The Lake Whatcom area, including Sudden Valley is identified as a "Community at Risk" but it is important to note the following points regarding fire risk at SVCA more distinctly describe the situation.

1. The majority of large wildfires occur east of the Cascade Crest. This is due to hotter and drier summers and fuel loads comprised of standing dead trees and shrubs under un-managed forests. Many of these trees and shrubs contain volatile oils that ignite easily. Eastern Washington forests are physically and biologically distinct from western Washington forests and are often un-even-aged, meaning tall and short trees grow nearby each other.

2. Those large fires were started in remote areas by lightening or are man-caused by campers in remote areas where quick suppression response does not exist. (I noted a lightning strike tree just east of Marigold Drive near Lake Louise, by the way---- it did not catch fire.)

3. The article points out the evidence of historic fires--- true, they occurred---- sometimes as a forest regeneration practice, sometimes due to intentional forestry practices that got away, and sometimes due to natural causes when modern fire suppression capabilities were not available.

4. At Sudden Valley the ground level shrubs are primarily herbaceous (full of non-flammable liquid) and are not particularly volatile. The tree spacing is dense, so lower limbs naturally fall off in the shade and/or are removed by pruning practices.

5. The Sudden Valley Community Fire Chief points out that risk is limited and there is little or no wildfire history in the community. A primary concern however, is access to homes particularly in the Gate Five neighborhood.

6. Finally (for now), the current weather cycle is affecting vegetative growth and climate, either in the short or long term, and is an unknown.

The WUI study suggests the following Mitigation Strategies:

1. Inter-Agency Cooperation
2. County-wide wildland fire prevention
3. WUI Communities at Risk

The South Whatcom Fire Authority includes the fire stations at Sudden Valley, Geneva, Chuckanut, Lake Samish and Yew Street. These local fire stations in cooperation with the Washington Department of Natural Resources form the Inter-Agency Cooperative that comprises the Sudden Valley fire Suppression network.

County-wide, fire prevention activities include:

1. Public Awareness Education
2. Press Releases
3. Education via media
4. Burn bans
5. Smokey Bear prevention programs
6. Inter-agency fire prevention teams

WUI Communities are encouraged to:

1. Join the Firewise Communities Program (www.firewise.org)
2. Conduct Firewise workshops
3. Increase homeowner awareness
4. Facilitate media involvement

Firewise education is important and the community should be made aware of precautions and hazards when it comes to fire prevention. I will encourage Sudden Valley to complete a Community Wildfire Protection Plan. The Washington Department of Natural Resources provides fire prevention training assistance to communities. See www.dnr.wa.gov.RecreationEducation/Topics/Prevention

Homeowner Fire Reduction Activities can include:

- Adherence to Building Codes
- Visible Address Signs

- Improving Fire Department Access
- Creating defensible space
    - Removal of vegetative debris on owned and non-owned property
    - Use of fire retardant building materials
- Firewise Landscaping
- Planting fire resistant plants (Oregon State University "Fire Resistant Plants for Home Landscapes)

Fire Resistant Plants Include

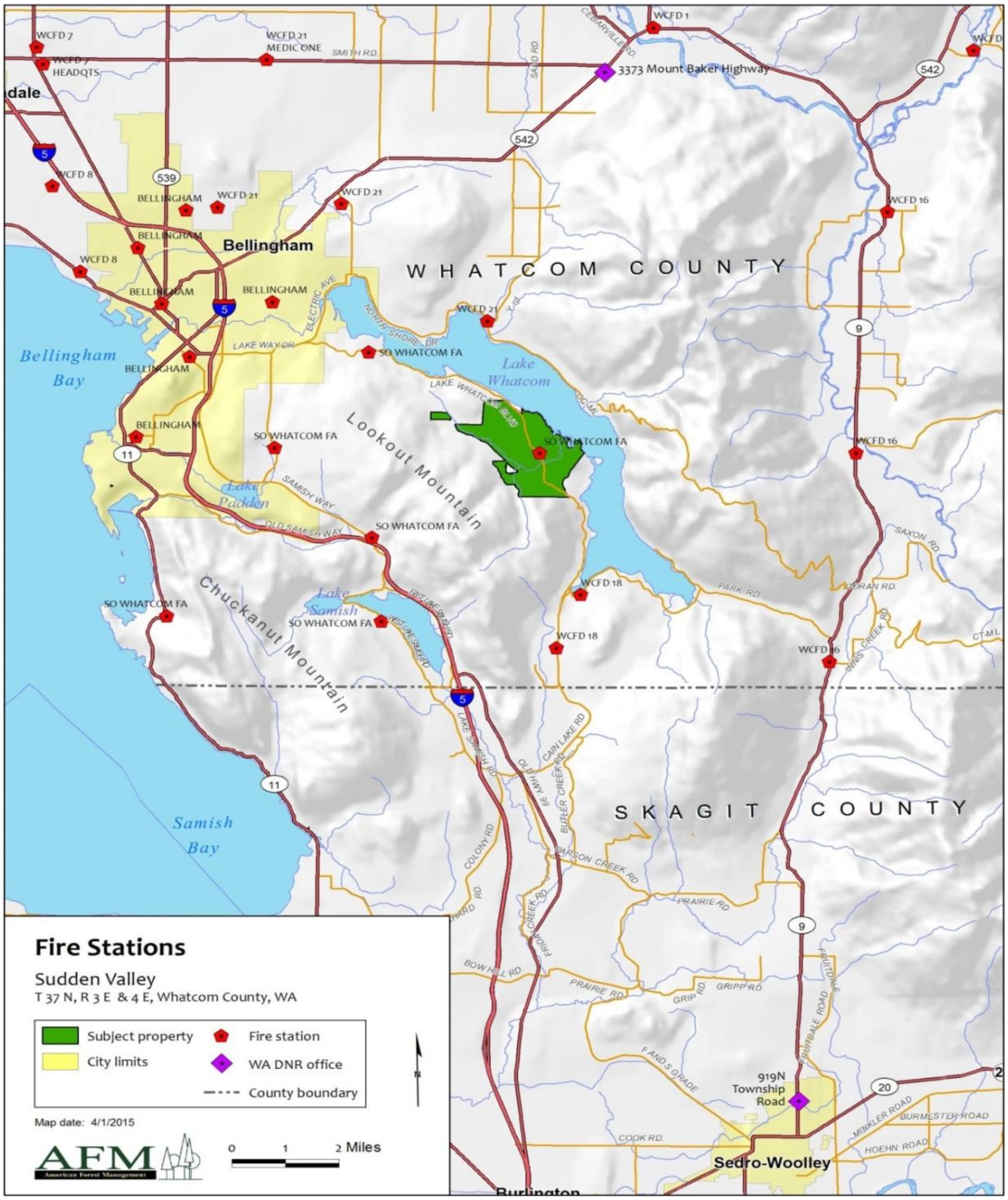
Table 5

Fire Resistant Plants

Pacific Rhododendron	Tall Oregon Grape
Vine Maple	Mock Orange
Big leaf Maple	Flowering Dogwood
Ice Plant	Wild Strawberry
Hosta	Salvia

Figure 6

Fire Suppression Facilities



VI. Tree Pruning Guidelines

SVCA is nestled within native forest. Trees typically and naturally self-prune. Branches and leaves lower down on the bole shed when they are no longer useful (due to shading) in the photosynthetic process. Eventually dead lower limbs fall off. Pruning lower limbs emulates that natural process, and if properly done is not a detriment to tree health. Various reports suggest that trees with 50-percent or more live green crown (crown coverage to total height) ratio are unaffected by pruning. Some sources consider a ratio down to 30-percent.

Pruning involves removing offending limbs; those that encroach living space, impede sight lines, contribute to debris fall. The resultant wound does not “heal” but rather seals when pitch and then new wood and bark grows over the cut. Trees tend to compartmentalize wounds--- that is, they seal off the cut internally to prevent the spread of disease from airborne pathogens. In its simplest form, pruning emulates natural limb discard—the difference being a natural discard begins with sealing off the limb connection at the bole, whereas mechanical pruning creates the wound, followed, hopefully by compartmentalization and sealing.

In a nutshell proper pruning includes:

- Making the pruning cut at the natural “collar” of the limb
- Avoiding cutting the limb flush with the bole
- Avoiding leaving “stubs” or branch remnants
- Not using paint or other sealants to cover the wound
    - These simply interfere with the trees natural sealing process

Pruning does not include topping or removal of the central upper bole of the tree. This practice, often seen is not recommended as trees will tend to recover by sending up limbs to emulate the lost stem. This results in a fast growing, poorly attached tree portion. Often several tops will form, all with poor or “knuckled) connections to the main stem.

SVCA is embarking on a street-side pruning program to enhance visibility, ease road maintenance issues and improve air flow around homes. We recommend maintenance training by an International Society of Arboriculture, Certified Arborist.

Addendum VI includes pruning guidelines developed by ANSI (American National Standards Institute) and a tree pruning guide developed by King County, the USDA Forest Service, The City of Seattle and Washington Department of Natural Resources.

Addenda

ADDENDUM I

GLOSSARY OF TERMS

Glossary of Terms

Bole:	The main stem or trunk of a tree
Conk:	The fruiting body of a fungus--- reproductive spores emanate from these.
Crown:	The live green portion of the tree including leaves and needles.
Dieback:	Dead limb tips
DBH:	Diameter in inches at 4.5 feet above ground level; the standard measure point for trees.
GIS:	Geographic Information System used to capture, store, manipulate and analyze spatial and geographic data.
Invasive Plant:	Plants not native to a particular area that tend to spread and cause l damage.
MU:	Map Unit or forest cover area distinguished by tree species, density and size.
Orthophotograph:	Aerial photograph corrected for distortion.
Root Collar:	The portion of the bole at ground level: often a rapidly tapering portion of the bole where roots connect.
Seral Stage:	Intermediate state in the ecological process, leading to old growth or climax forest

Scientific Names

Plants

Douglas-fir	*Psuedotsuga menziesii*
Western hemlock	*Tsuga heterophylla*
Western red cedar	*Thuja plicata*
Red alder	*Alnus rubra*
Bigleaf maple	*Acer macrophyllum*
Vine maple	*Acer circinatum*
Willow	*Salix sp.*
Pacific rhododendron	*Rhododendron macrophyllum*
Ice plant	*Aizoaceae sp.*
Hosta	*Hosta*
Tall Oregon Grape	*Mahonia aquifolium*
Mock Orange	*Philadelphus sp.*
Flowering Dogwood	*Cornus nuttali*
Wild Strawberry	*Fragaria virginiana*
Salvia	*Salvia sp.*

Fungus

Brown Cubical rot	*Phaeolus schweinitzii*
Laminated Root rot	*Phellinus sulphurascens*
Armillara Root rot	*Armillare solidipes*
Red Ring rot	*Fomitopsis pinicola*

Seral Stage: Intermediate state in the ecological process, leading to old-growth or climax forest.

Vigor: Refers to tree health and growth rate.

Vitality: Refers to tree life and suitability

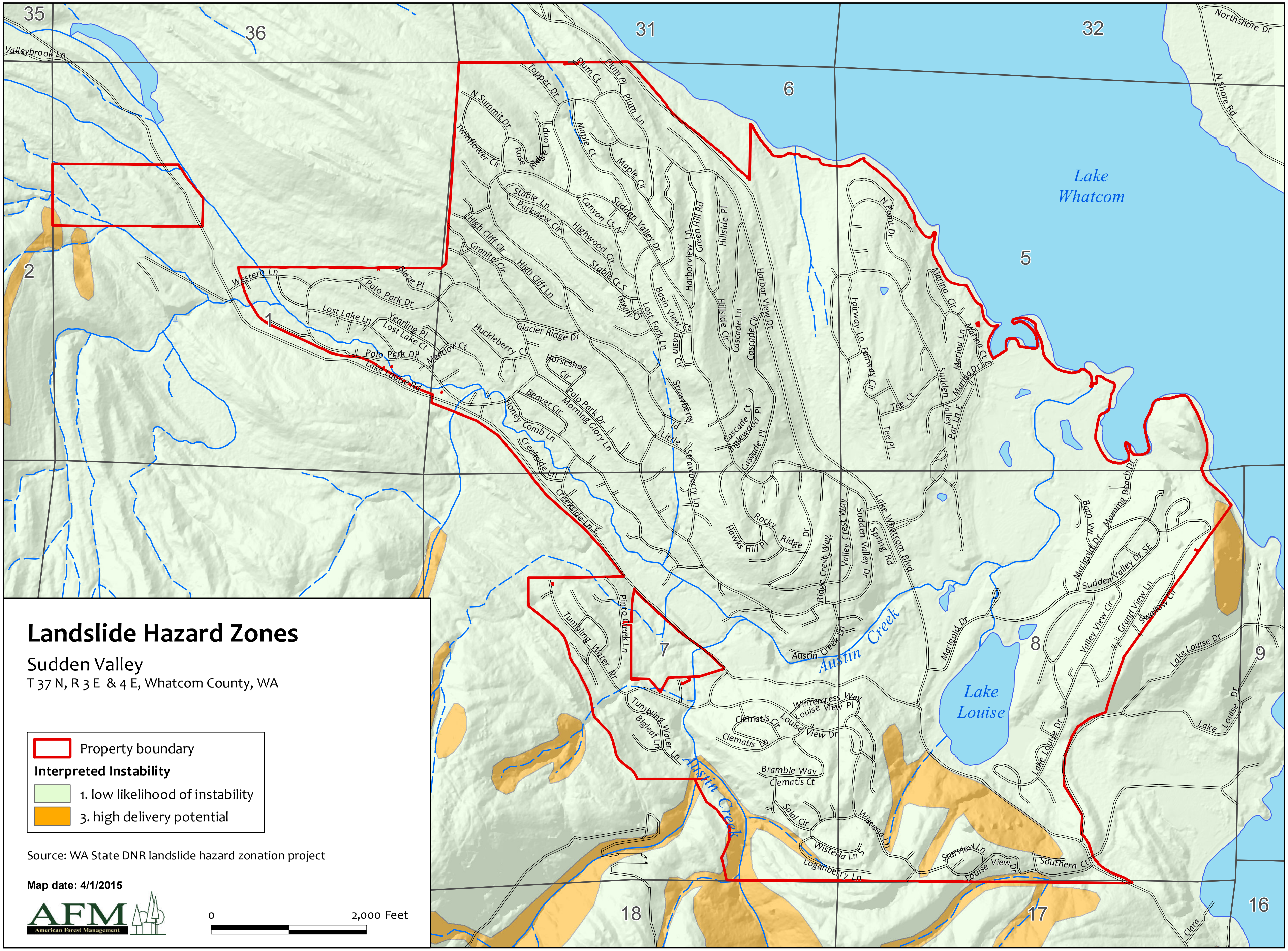
Scientific Names

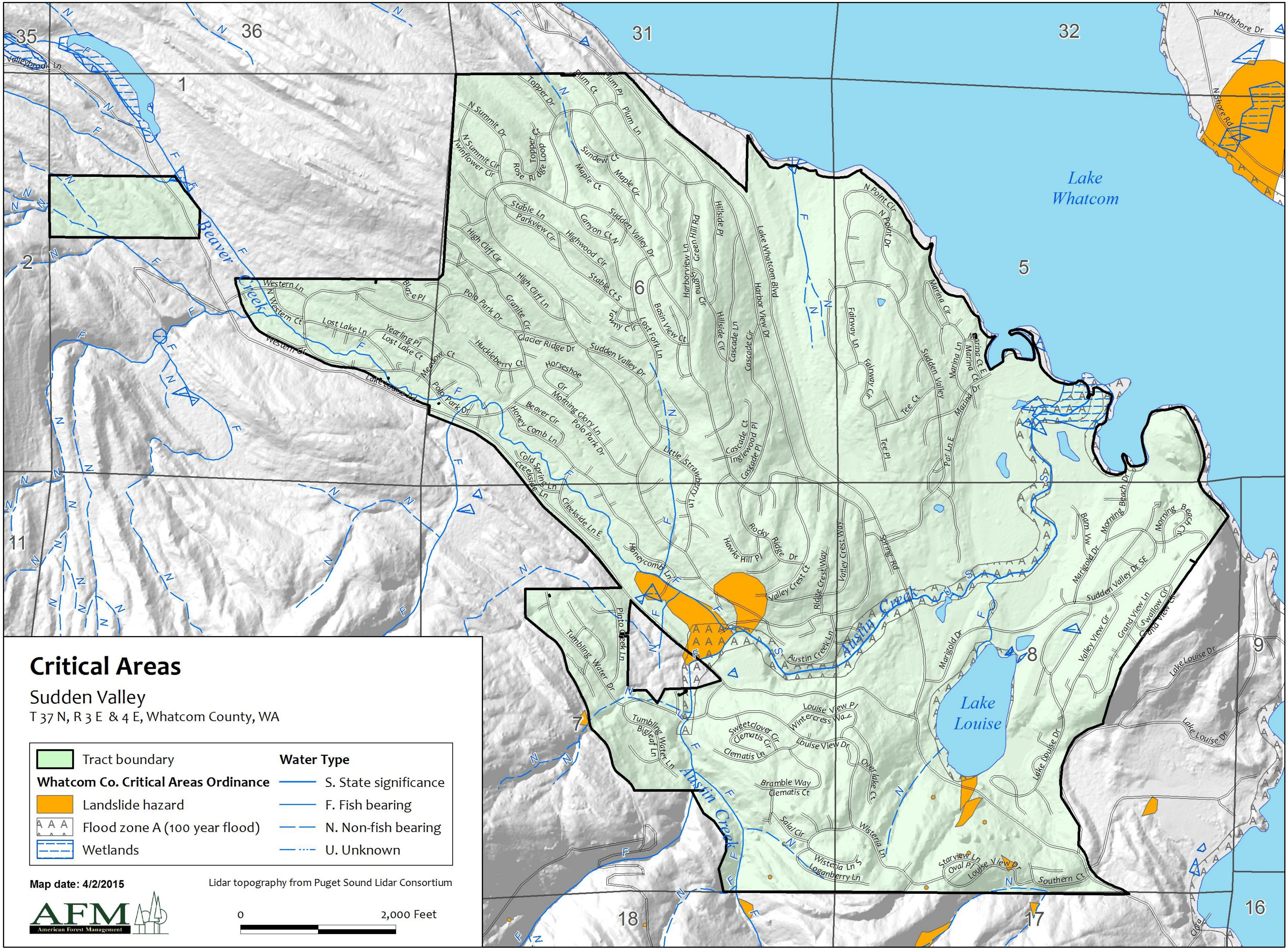
Douglas-fir:	*Pseudotsuga menziesii*
Western red cedar:	*Thuja plicata*
Western hemlock:	*Tsuga heterophylla*
Red alder:	*Alnus rubra*
Bigleaf maple:	*Acer macrophyllum*

ADDENDUM II

SVCA MAPS

See also Back Cover


Landslide Hazard Zones
Sudden Valley
T 37 N, R 3 E & 4 E, Whatcom County, WA
Property boundary
Interpreted Instability
1. low likelihood of instability
3. high delivery potential
Source: WA State DNR landslide hazard zonation project
Map date: 4/1/2015
AFM
American Forest Management
0
2,000 Feet
Lake Whatcom
Lake Louise
Austin Creek
35
36
31
32
2
1
6
5
7
8
9
18
17
16
Valleybrook Ln
Northshore Dr
N Shore Rd
Lake Louise Rd
Western Ln
Polo Park Dr
Lost Lake Ln
Lake Whatcom Blvd
Sudden Valley Dr
Harbor View Dr
Lake Louise Dr
Marigold Dr
Creekside Ln E
Tumbling Water Dr
Pinto Creek Ln
Southern Ct



Critical Areas
Sudden Valley
T 37 N, R 3 E & 4 E, Whatcom County, WA
Tract boundary
Whatcom Co. Critical Areas Ordinance
Landslide hazard
Flood zone A (100 year flood)
Wetlands
Water Type
S. State significance
F. Fish bearing
N. Non-fish bearing
U. Unknown
Map date: 4/2/2015
Lidar topography from Puget Sound Lidar Consortium
0
2,000 Feet
AFM
American Forest Management
Lake Whatcom
Lake Louise
Beaver Creek
Austin Creek
Lake Whatcom Blvd
Sudden Valley Dr
Northshore Dr
N Shore Rd
Lake Louise Dr
Spring Rd
35
36
31
32
1
2
5
6
7
8
9
11
16
17
18

ADDENDUM III

FLAT Hazard Assessment Method

FLAT Forest Assessment Data

The following data attributes are to be collected using the Forest Landscape Assessment Tool for the 2014 forest assessment and 20-year plan update. Attributes were chosen that provide forest characteristics most relevant for setting restoration priorities for forested and natural area parks owned and managed by Kirkland Parks and Community Services.

Data Attribute	Data Field	Explanation/Criteria
Site Name	SITE NAME	GIS identifier
Management Unit Number	HMU_NO	GIS identifier
Date of data collection	DATE	
Assessors initials	CREW	
Land Cover	LANDCOV	
Forested	FOR	≥ 25% forest canopy
Natural Area	NAT	< 25% forest canopy
Open Water	WAT	no woody vegetation
Hardscape	HS	buildings, parking
Landscaped	LS	landscaped, mechanically maintained
Habitat Type	HABITAT	
Conifer forest	CONIFER	Overstory dominated by conifer trees; upland site; dry soils
Conifer deciduous mixed	CONDECMIX	More than 30% of the overstory is dominated by both conifer and deciduous trees.
Deciduous	DECID	Overstory more than 30% dominated by deciduous trees
Madrone conifer mixed	MADCON	Both Madrone and conifer trees each make up more than 30% of the overstory
Madrone deciduous mixed	MADDEC	Both Madrone and deciduous trees each make up more than 30% of the overstory
Conifer Riparian Forest	RIPCON	Greater than 25% tree canopy with stream as dominant influence; more than 30% conifer
Deciduous Riparian Forest	RIPDEC	Greater than 25% tree canopy with stream as dominant influence; more than 30% deciduous
Conifer-deciduous Mixed Riparian Forest	RIPCONDEC	Greater than 25% tree canopy with stream as dominant influence; more than 30% conifer and deciduous
Madrone-conifer Mixed Riparian Forest	RIPMADCON	Greater than 25% tree canopy with stream as dominant influence; more than 30% madrone and conifer
Madrone-deciduous mixed Riparian Forest	RIPMADDEC	Greater than 25% tree canopy with stream as dominant influence; more than 30% madrone and deciduous
Riparian Shrubland	RIPSHRUB	Less than 25% tree canopy; dominated by shrubs with stream as dominant influence
Riparian meadow/ grassland	RIPMEAD	Less than 25% tree canopy; unmaintained grass and/or herbs; stream as dominant influence
Conifer-deciduous mixed Forested Wetland	FORWETCON	More than 30% of trees growing in standing water or saturated soils or more than 30% of area have small wetlands present entirely beneath overhanging forest canopy; more than 30% of trees are conifers and deciduous trees

Data Attribute	Data Field	Explanation/Criteria
Deciduous Forested Wetland	FOREWETDEC	More than 30% of trees growing in standing water or saturated soils or more than 30% of area have small wetlands present entirely beneath overhanging forest canopy; more than 30% of trees are deciduous
Emergent wetland	EMERGWET	Herbaceous plants growing in standing water or saturated soils; less than 25% tree cover; grass and/or herbs
Scrub-shrub wetland	SCRUBWET	less than 10% overstory canopy, and dominated by shrubs or regenerating trees growing in standing water or saturated soils
Open Woodland	OPENWOOD	10%-25% tree with unmaintained grass, shrubs or both
Shrubland	SHRUBLAN	Less than 10% overstory tree canopy and dominated by upland shrubs or regenerating trees (ie. blackberry, scotch broom, etc.)
Grassland-meadow	GRASS	Less than 10% tree canopy with unmaintained grass and/or herbs
Age Class	AGECLASS	
category 1	1	0-29 years
category 2	2	30-49 years
category 3	3	50-99 years
category 4	4	100 + years
Overstory Species	OVR1_SPC	overstory species, most abundant dominant or codominant >20ft in height
Overstory Size	OVR1_SIZE	overstory DBH size class
category 1	1	0 -5" DBH
category 2	2	6 - 10" DBH
category 3	3	11 - 20" DBH
category 4	4	21"+ DBH
Second Overstory Species	OVR2_SPC	2nd overstory species, in order of abundance codominant > 20ft in height
Second Overstory Size	OVR2_SIZE	Overstory DBH size class, see size class chart above
Third Overstory Species	OVR3_SPC	3rd overstory species, if present, in order of abundance codominant > 20ft in height
Third Overstory Size	OVR3_SIZE	Overstory DBH size class, see size class chart above
Canopy Cover	CANOPYCOV	Canopy cover estimate, as viewed directly above
category 0	0	Less than 10% canopy cover
category 1	1	10 - 39% canopy cover
category 2	2	40 - 69% canopy cover
category 3	3	70% + canopy cover
Management Unit Composition	HMU_CMP	
High Composition	H	> 50% conifer/madrone; <u>or</u> ≤50% conifer/madrone with no capacity for restoration (includes wetlands)

Data Attribute	Data Field	Explanation/Criteria
Medium Composition	M	1-50% conifer/madrone with capacity to support restoration to H; or <25% native cover with capacity to restore up to 50% conifer
Low Composition	L	< 25% native cover with capacity for full restoration planting; or no conifer/madrone with capacity for full restoration
Low Vigor	LOW VIGOR	Conifer: Live Crown ≤40%, Y or N; Hardwood decline: Top Dieback or Snags ≥ 5%, Y or N
Mechanical Tree Failure	FAILURE	Mechanical Tree Failure in ≥ 1% of MU , Y or N (ex. wind throw, landslide)
Root Rot	ROOT ROT	Root Rot Pockets present, Y or N
Mistletoe	MISTLETOE	Mistletoe present, Y or N
Bare Soil	BARE SOIL	≥1% Bare Soil present from recent disturbance, erosion, etc. Y or N
Other	OTHER	Present in ≥ 1% of MU , Y or N (*note in comments*)
Regeneration Species	RGN1_SPC	Regeneration species <5" DBH, in order of abundance;
Second Regeneration Species	RGN2_SPC	Regeneration species <5" DBH, in order of abundance
Regeneration Stocking Class	RGN_TPA	
category 1	1	0-49 TPA (> 30 ft. spacing)
category 2	2	50-149 TPA (between 30 and 16 ft. spacing)
category 3	3	150+ TPA (< 16 ft. spacing)
Plantable Space	PLANTABLE	Suitable growing space for restoration planting? Y or N
Native Shrubs and Herbs Species	GRD1_SPC	Native shrubs and herbs, most abundant
Native Shrubs and Herbs Species	GRD2_SPC	Second native shrubs and herbs in order of abundance
Native Shrubs and Herbs Species	GRD3_SPC	Third native shrubs and herbs in order of abundance
Invasive Species	INV1_SPC	Non-native species, most abundant
Invasive Species	INV2_SPC	Second non-native species in order of abundance
Invasive Species	INV3_SPC	Third non-native species in order of abundance
Invasive Species	INV4_SPC	Fourth non-native species in order of abundance
Invasive Species	INV5_SPC	Fifth non-native species in order of abundance
Total Invasive Cover	INVCOV	Total Invasive Cover
High cover	H	> 50%
Medium cover	M	5% - 50%
Low cover	L	<5%
Notes	NOTES	Unique site conditions and other dominant trees present

ADDENDUM IV

FOREST HEALTH SUMMARY BY MANAGEMENT UNIT

MU_NO	ACRE	LANDCOV	AGE_CLASS	OVR1_SPC	OVR1_SIZE	OVR2_SPC	OVR2_SIZE	OVR3_SPC	OVR3_SIZE	STOCKING	MU_CMP	OW_VIGOI	FAILURE	ROOT_ROT	BARE_SOIL	RGN1_SPC	RGN2_SPC	RGN_TPA	PLANTABLE	GRD1_SPC	GRD2_SPC	GRD3_SPC	INV1_SPC	INV_COV	THREATMT
101	7.3	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	ACMA	1	N	POMU	RUSP	VAPA		L	1
102	5.6	FOR	3	THPL	3	ALRU	2	PSME	3	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	RUSP	MANE		L	1
103	3.7	FOR	3	THPL	3	ACMA	2	PSME	3	2	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE	TEGR	GERO	L	1
104	0.1	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
105	0.2	FOR	3	THPL	4	ALRU	2		<Null>	2	H	N	N	N	N	THPL	TSHE	1	Y	POMU	RUSP		ILAQ	L	1
106	1.2	NAT	1	ALRU	1		<Null>		<Null>	0	M	N	N	N	N	ALRU	PSME	3	N	POMU	GASH	MANE		L	4
107	4.0	FOR	3	PSME	4	THPL	3	ALRU	2	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	GASH	MANE		L	1
108	0.6	FOR	2	ALRU	2	THPL	2	PSME	3	2	H	N	N	N	N	THPL	ALRU	2	N	POMU	LYAM	GASH		L	1
109	1.9	FOR	2	THPL	3	PSME	3	TSHE	2	2	H	N	N	N	N	THPL	TSHE	2	Y	POMU	MANE	RUSP		L	1
110	2.2	FOR	3	THPL	3	PSME	3	TSHE	2	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE	VAPA		L	1
111	2.8	FOR	3	THPL	3	ACMA	2	PSME	3	2	H	N	N	N	N	THPL	ACMA	1	N	POMU	TEGR	ACCI		L	1
112	2.7	FOR	3	THPL	3	ALRU	2	PSME	3	2	H	N	N	N	N	THPL	ALRU	2	N	POMU	ACCI	TEGR	RUDI	L	1
113	0.4	FOR	3	THPL	3	PSME	3	THPL	2	3	H	N	N	N	N	THPL	TSHE	1	N	GASH	POMU	MANE		L	1
114	1.5	FOR	2	ALRU	2	THPL	2	TSHE	2	2	H	N	N	N	N	ALRU	THPL	1	N	POMU	RUSP	VAPA		L	1
115	0.6	FOR	3	THPL	4	PSME	4	ACMA	4	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE			L	1
116	0.5	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
117	0.2	FOR	3	THPL	3	PSME	3	THPL	2	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP	MANE		L	1
118	0.8	FOR	3	ALRU	2	THPL	2	ACMA	2	2	H	N	N	N	N	THPL	ALRU	2	N	POMU	GRASS			L	1
119	0.3	FOR	3	THPL	3	ACMA	3	ALRU	2	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	OECE	RUSP		L	1
120	9.2	FOR	3	ALRU	3	ACMA	3	TSHE	3	2	M	N	N	N	N	THPL		1	N	THPL	ACCI	MANE		L	4
121	0.2	FOR	3	THPL	4	PSME	4	ACMA	2	3	H	N	N	N	N	TSHE	ACMA	1	N	POMU	MANE			L	1
122	24.5	FOR	3	THPL	3	PSME	3	TSHE	3	2	M	N	N	N	Y	THPL		1	Y	THPL	ACCI	MANE		L	4
123	1.9	FOR	3	THPL	3	ACMA	3	PSME	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP			L	1
124	3.2	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
125	1.2	FOR	3	PSME	4	THPL	3	ALRU	2	2	H	N	N	N	N	ALRU	THPL	1	Y	POMU	MANE	VAPA		L	1
126	0.4	FOR	3	THPL	3	PSME	3	ACMA	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE			L	1
127	10.7	FOR	3	PSME	3	THPL	2	ALMP	3	3	H	N	N	N	N	THPL		1	N	THPL	RUSP	RUSP	RUDI	L	1
128	0.7	FOR	4	THPL	4	ALRU	2	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU				L	1
129	4.3	FOR	3	THPL	3	PSME	3	ACMA	3	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	RUSP	MANE		L	1
130	0.1	FOR	3	THPL	3	ACMA	3	ALRU	3	2	H	N	N	N	N	THPL		1	N	POMU	RUSP			L	1
131	0.0	FOR	4	THPL	4	ALRU	2	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP			L	1
132	5.2	FOR	3	THPL	3	PSME	3	ALRU	2	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE	RUSP		L	1
133	7.0	FOR	2	ALRU	2	THPL	2	PSME	2	2	H	N	N	N	N	ALRU	THPL	2	N	RUSP	POMU	GRASS		L	1
134	2.6	FOR	3	THPL	3	ALRU	2	PSME	2	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	VAPA	RUSP		L	1
135	0.1	FOR	3	THPL	3	ACMA	2	PSME	3	2	H	N	N	N	N	THPL	ACMA	1	N	POMU	TEGR	ACCI		L	1
136	4.8	FOR	3	PSME	3	TSHE	3	THPL	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	OECE	RUSP		L	1
137	0.6	FOR	4	THPL	4	PSME	4	TSHE	2	3	H	N	N	N	N	THPL	PSME	1	N	POMU	MANE	OECE	RUDI	L	1
138	23.2	FOR	1	POBA	3	ALRU	1	THPL	1	3	L	N	N	N	N	THPL		1	N	THPL	POMU	POMU	RUDI	L	7
139	4.4	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
140	0.1	FOR	4	THPL	4		<Null>		<Null>	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA			L	1
141	0.3	FOR	3	THPL	3	PSME	3	TSHE	2	3	H	N	N	N	N	THPL	ALRU	2	N	POMU	RUSP	MANE		L	1
142	0.0	FOR	4	THPL	4	ALRU	2		<Null>	3	H	N	N	N	N	THPL	TSHE	1	N	POMU				L	1
143	0.1	FOR	3	THPL	4	PSME	3		<Null>	3	H	N	N	N	N	THPL		1	N	VAPA	POMU	MANE		L	1
144	0.9	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	RUSP	ACCI		L	1
145	0.1	FOR	3	THPL	3	PSME	4	ALRU	2	3	H	N	N	N	N	THPL	ALRU	1	Y	POMU				L	1
146	0.1	FOR	3	THPL	3	PSME	3	ALRU	2	3	H	N	N	N	N	THPL		1	N	POMU	MANE			L	1
147	0.0	FOR	3	THPL	3	ALRU	2		<Null>	3	H	N	N	Y	N	THPL		1	N	POMU	RUSP			M	2
148	1.2	FOR	3	PSME	3	THPL	3	ALRU	2	3	H	N	N	N	N	THPL		1	N	GASH	POMU	MANE		L	1
149	0.3	FOR	3	PSME	3	THPL	3	ALRU	2	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	MANE	ACCI	GERO	L	1
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152	0.3	FOR	4	THPL	3	PSME	4	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU				L	1
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155	0.3	FOR	3	THPL	4	PSME	3	ACMA	3	3	H	N	N	N	N	THPL	ACMA	1	N	POMU	TEGR	MANE		L	1
156	0.4	FOR	3	THPL	3	PSME	3	TSHE	2	3	H	N	N	N	N	THPL	TSHE	1	N	POMU			GERO	L	1
157	0.2	FOR	4	THPL	3	PSME	4	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU				L	1
158	1.5	FOR	3	THPL	4	ALRU	2	ACMA	3	2	M	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP	GRASS		L	4
159	0.7	FOR	3	THPL	3	PSME	4	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE	GASH	GERO	L	1
160	0.2	FOR	3	THPL	4	ALRU	2	ACMA	3	2	M	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP	GRASS		L	4
161	0.1	FOR	3	PSME	4	THPL	2	ACMA	2	3	H	N	N	N	N	THPL		1	N	MANE	POMU	GASH		L	1
162	8.5	FOR	4	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	RUSP		L	1
163	1.8	FOR	3	THPL	4	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	Y	POMU	MANE	GASH		L	1
164	0.3	FOR	3	PSME	4	TSHE	3	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	ILAQ	L	1
165	5.1	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE	VAPA		L	1
166	1.1	FOR	2	ALRU	2	POBA	3	THPL	3	2	H	N	N	N	N	ALRU	THPL	1	N	POMU	RUSP			L	1
167	7.3	FOR	3	ALRU	2	THPL	4	TSHE	3	3	M	N	N	N	N	THPL	TSHE	1	N	RUSP	POMU	OECE	PHAR	L	4

168	0.1	FOR	3	THPL	4	PSME	4	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	RUSP	POMU	OECE	PHAR	L	1
169	5.8	FOR	3	PSME	4	THPL	3	ALRU	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	GASH	ACCI		L	1
170	0.8	FOR	3	PSME	4	TSHE	3	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	ILAQ	L	1
171	1.4	FOR	3	THDL	3	THPL	3	TSHE	2	3	H	N	N	N	N	THPL		1	N	THPL				L	1
172	0.1	FOR	3	THPL	4	PSME	4	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	RUSP	POMU	OECE	PHAR	L	1
173	2.6	FOR	3	PSME	3	THPL	2	ALMP	3	3	H	N	N	N	N	THPL		<Null>	N	THPL	RUSP	RUSP	RUDI	L	1
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175	0.8	FOR	3	PSME	4	TSHE	3	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	ILAQ	L	1
176	0.8	FOR	3	PSME	4	TSHE	3	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	ILAQ	L	1
177	0.1	FOR	3	THPL	4	TSHE	4	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	RUSP	ACCI	ILAQ	L	1
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181	2.9	FOR	3	TSHE	3	THPL	3	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	ACCI	RUSP		L	1
182	0.1	FOR	3	THPL	4	TSHE	4	ALRU	2	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	RUSP	ACCI	ILAQ	L	1
183	0.4	FOR	3	PSME	4	THPL	3		<Null>	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP			L	1
184	0.6	FOR	3	PSME	4	TSHE	3	THPL	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	OECE		L	1
186	1.7	FOR	3	ALRU	2	PSME	4	TSHE	3	3	M	N	N	N	N	THPL	TSHE	1	N	RUSP	POMU	OECE	PHAR	L	4
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190	0.6	FOR	3	ALRU	2	PSME	3	THPL	3	2	M	N	N	N	N	THPL	ALRU	1	N	POMU	MANE	GASH		L	4
191	0.2	FOR	3	TSHE	2	THPL	3	PSME	4	3	H	N	N	N	N	TSHE	THPL	1	N	POMU				L	1
192	0.2	FOR	3	PSME	3	THPL	3		<Null>	2	H	N	N	N	N	THPL	TSHE	1	N	MANE	VAPA	POMU		L	1
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196	1.2	FOR	3	THPL	3	TSHE	3	ACMA	3	2	H	N	N	N	N	THPL	TSHE	1	Y	POMU	RUSP	OECE		L	1
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200	0.1	FOR	3	THPL	4		<Null>		<Null>	2	H	N	N	N	N			<Null>	N	RUSP	POMU	GRASS		L	1
201	0.1	FOR	3	THPL	3	ALRU	2		<Null>	2	M	N	N	N	N	THPL	ALRU	1	N	POMU	RUSP	GRASS		L	4
202	0.1	FOR	3	PSME	4	THPL	3	TSHE	3	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	RUSP	VAPA		L	1
203	0.0	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
204	0.2	FOR	3	PSME	3	THPL	2	ALMP	3	3	H	N	N	N	N	THPL		1	N	THPL	RUSP	RUSP	RUDI	L	1
205	0.2	FOR	3	PSME	4	THPL	4	ACMA	3	3	H	N	N	N	N	THPL		1	N	POMU	MANE	VAPA		L	1
206	0.5	FOR	3	PSME	4	THPL	3	ALRU	2	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE			L	1
207	1.1	FOR	4	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	RUSP		L	1
208	0.0	FOR	3	THDL	3	THPL	3	TSHE	2	3	H	N	N	N	N	THPL		1	N	THPL				L	1
209	0.0	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
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211	0.1	FOR	3	THPL	3	TSHE	3	PSME	3	2	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	RUSP		L	1
212	13.4	FOR	3	PSME	3	THPL	3	PSME	4	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	RUSP		L	1
213	0.4	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	MANE	RUSP		L	1
214	3.2	FOR	3	PSME	4	THPL	4	ALRU	3	3	H	N	Y	Y	N	TSHE	THPL	1	N	POMU	RUSP	ACCI	CYSC	L	1
215	0.1	FOR	3	THPL	3	PSME	4	THPL	4	3	H	N	N	N	N	THPL	ALRU	1	N	POMU	VAPA			L	1
216	0.2	FOR	3	ACMA	3	ALRU	2	THPL	3	2	M	N	N	N	N	THPL	ALRU	1	Y	POMU	OECE	RUSP	GERO	L	4
217	0.2	FOR	3	PSME	3	THPL	3	ACMA	3	3	H	N	N	N	N	THPL		1	Y	POMU	MANE			L	1
218	19.5	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>							99
219	3.6	FOR	3	ALRU	2	TSHE	3	THPL	4	3	M	N	N	N	N	TSHE	ALRU	1	N	RUSP	POMU	ACCI	HEHE	M	5
220	13.8	FOR	3	THPL	3	TSHE	3	PSME	4	3	H	Y	N	N	N	THPL	TSHE	1	N	POMU	GASH		RUDI	L	1
221	1.7	FOR	3	PSME	3	THPL	2	ALMP	3	3	H	N	N	N	N	THPL		1	N	THPL	RUSP	RUSP	RUDI	L	1
222	0.6	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	ACCI		L	1
223	0.2	FOR	3	ALRU	2	TAPC	4	PSME	4	2	M	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	4
224	0.3	FOR	3	ALRU	2	TAPC	4	PSME	4	2	M	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	4
225	0.3	FOR	3	ALRU	2	THPL	4	TSHE	3	3	M	N	N	N	N	THPL	TSHE	1	N	RUSP	POMU	OECE	PHAR	L	4
226	0.2	FOR	3	PSME	4	TSHE	4	THPL	4	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	1
227	3.2	FOR	3	PSME	4	TSHE	4	THPL	4	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	1
228	13.2	FOR	3	ALRU	2	TSHE	3	THPL	4	3	M	N	N	N	N	TSHE	ALRU	1	N	RUSP	POMU	ACCI	HEHE	M	5
229	0.2	FOR	3	PSME	4	TSHE	4	THPL	4	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	1
230	3.9	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	RUSP	PRLA	L	1
231	0.1	FOR	3	PSME	4	TSHE	4	THPL	4	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	1
232	1.2	FOR	3	THPL	3	TSHE	3	ACMA	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP	ACCI		L	1
233	2.6	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	RUSP	MANE		L	1
234	0.1	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE	1	N	POMU	VAPA	RUSP	PRLA	L	1
235	0.1	FOR	3	PSME	4	TSHE	4	THPL	4	3	H	N	N	N	N	TSHE	THPL	1	N	POMU	MANE	RUSP	HEHE	L	1
236	0.2	FOR	3	THPL	4	PSME	2		<Null>	3	H	N	N	N	N	THPL		1	N	POMU	ACCI			L	1

237	0.0	FOR	3	PSME	3	THPL	3		<Null>	3	H	N	N	N	N			<Null>		N	POMU	VAPA		RUDI	L	1
238	0.1	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1
239	0.3	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>								99
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241	2.5	FOR	3	THPL	3	ACMA	2	TSHE	3	3	H	N	N	N	N	THPL			1	N	POMU	VAPA		HEHE	L	1
242	0.3	FOR	3	THPL	4	PSME	4	ALRU	2	3	H	N	N	N	N	TSHE	THPL		1	N	RUSP	POMU	OECE	PHAR	L	1
243	2.3	FOR	3	THPL	3	PSME	3		<Null>	3	H	N	N	N	N	THPL			1	N	POMU				L	1
244	0.5	FOR	3	PSME	3	THPL	3	PSME	4	3	H	N	N	N	N	THPL	TSHE		1	N	POMU	VAPA	RUSP		L	1
245	0.0	FOR	3	THPL	3	PSME	3		<Null>	3	H	N	N	N	N	THPL			1	N	POMU				L	1
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247	0.2	FOR	3	ACMA	3	ALRU	2	THPL	3	2	M	N	N	N	N	THPL	ALRU		1	Y	POMU	OECE	RUSP	GERO	L	4
248	8.6	LS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>								99
249	0.8	FOR	3	TSHE	3	ALRU	3		<Null>	2	M	N	N	N	N	TSHE			1	N	POMU	RUSP	ACCI		L	4
250	2.5	FOR	3	PSME	4	THPL	4	ALRU	2	3	H	N	N	N	N	TSHE			1	N	POMU	RUSP			L	1
251	0.2	FOR	3	THPL	3	PSME	3	TSHE	3	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1
252	0.0	FOR	3	THPL	3	PSME	4		<Null>	3	H	N	N	N	N	THPL			1	N	POMU				L	1
253	0.1	FOR	3	THPL	3	ALRU	2		<Null>	2	H	N	N	N	N	THPL			1	N	RUSP	POMU	ACCI		L	1
254	2.4	FOR	3	PSME	4	THPL	4	ALRU	2	3	H	N	N	N	N	TSHE			1	N	POMU	RUSP	ACCI		L	1
255	0.1	FOR	3	PSME	3	THPL	3	PSME	4	3	H	N	N	N	N	THPL	TSHE		1	N	POMU	VAPA	RUSP		L	1
256	2.0	FOR	3	THPL	3	ACMA	2	TSHE	3	3	H	N	N	N	N	THPL			1	N				RUDI	L	1
257	2.2	FOR	3	ALRU	2	THPL	4	TSHE	3	2	M	N	N	N	N	TSHE			1	Y	RUSP	POMU	ACCI		L	4
258	15.8	FOR	3	PSME	4	THPL	3	TSHE	3	3	H	N	N	N	N	THPL			1	N	POMU	ACCI	RUSP		L	1
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260	0.2	FOR	3	PSME	4	THPL	3	TSHE	3	3	H	N	N	N	N	DITB			1	N	POMU	ACCI	RUSP		L	1
261	0.4	FOR	3	THPL	3	ACMA	2	PSME	4	2	M	N	Y	N	N	THPL			1	N	OPHO	URDI	POMU		L	4
262	0.2	FOR	3	PSME	4	THPL	3	TSHE	3	3	H	N	N	N	N	TSHE			1	N	POMU	RUSP			L	1
263	8.0	NAT	1	ALRU	1	ACMA	1	THPL	3	2	M	N	N	N	N	ALRU		<Null>		N	RUSP	TYLA	GRASS	RUDI	L	4
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267	0.2	FOR	3	PSME	4	THPL	3	ALRU	2	3	H	N	N	N	N	TSHE			1	N	POMU	RUSP			L	1
268	0.3	FOR	3	TSHE	3	ALRU	2	PSME	4	3	H	N	N	N	N	TSHE			1	N	POMU	RUSP			L	1
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270	0.4	FOR	3	PSME	4	THPL	3		<Null>	3	H	N	N	N	N	THPL			2	N	POMU	MANE			L	1
271	1.5	FOR	3	PSME	4	ALRU	2		<Null>	3	H	N	N	N	N	TSHE			1	N					L	1
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274	2.4	FOR	1	ALRU	1	THPL	4		<Null>	3	M	N	N	N	N	THPL			1	N	RUSP	POMU			L	4
275	9.8	FOR	3	PSME	4	ALRU	2	THPL	3	2	H	N	N	N	N	TSHE	THPL		1	N	POMU	RUSP	MANE	RUDI	L	1
276	1.3	FOR	3	THPL	3	ACMA	2	ALRU	2	2	M	N	N	N	N	THPL	ALRU		1	N	POMU			RUDI	L	4
277	10.9	FOR	3	PSME	4	THPL	3	<Null>	<Null>	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1
278	28.8	FOR	3	PSME	4	TSHE	3	THPL	3	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1
279	7.4	FOR	3	THPL	3	TSHE	3	PSME	4	3	H	N	N	N	N	THPL			1	N	POMU	GASH		RUDI	M	2
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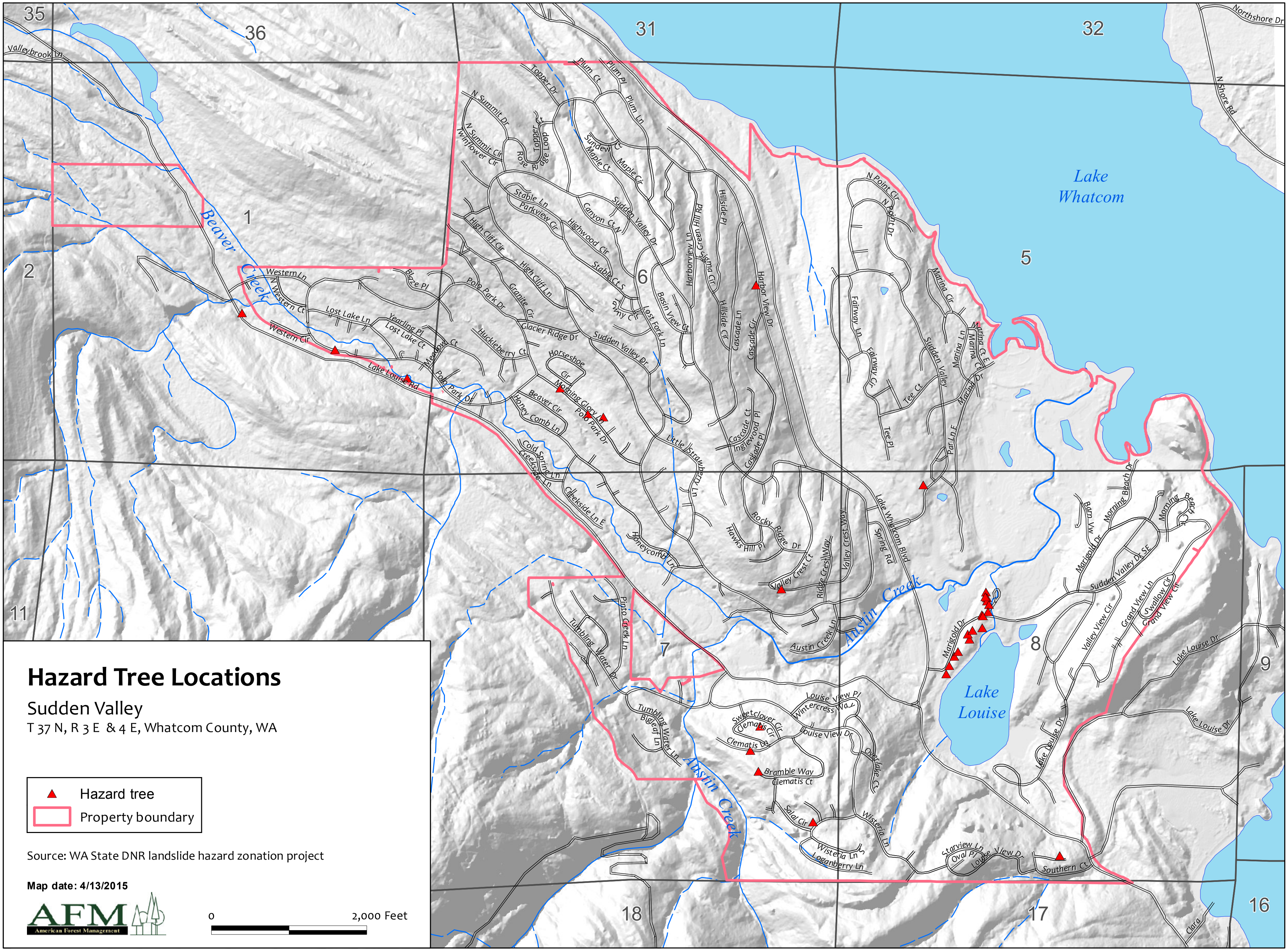
283	49.9	FOR	3	PSME	4	TSHE	4	THPL	4	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1
284	0.8	FOR	3	PSME	4	TSHE	4		<Null>	3	H	N	N	N	N			<Null>		N	POMU	RUSP	ACCI		L	1
285	12.5	FOR	3	PSME	4	TSHE	3	THPL	3	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1
286	0.2	HS	<Null>		<Null>		<Null>		<Null>	<Null>								<Null>								99
287	0.4	FOR	3	PSME	4	TSHE	3	ACMA	4	3	H	N	N	N	N	TSHE			1	N	POMU	MANE	VAPA		L	1
288	0.4	FOR	3	PSME	4	TSHE	3		<Null>	3	H	N	N	Y	N	TSHE			1	N	POMU	MANE	VAPA		L	1
289	0.2	FOR	3	TSHE	4	ALRU	2	THPL	4	3	H	N	N	N	N	TSHE			1	N	POMU	MANE			L	1
290	8.0	FOR	3	PSME	4	TSHE	3	ALRU	2	3	H	N	N	N	N	TSHE			1	N	POMU	RUSP	VAPA	ILAQ	L	1
291	2.3	FOR	3	PSME	4	TSHE	3	THPL	3	3	H	N	N	Y	N	TSHE			1	N	POMU	RUSP	SACA		L	1
292	0.3	FOR	3	PSME	4	TSHE	3		<Null>	3	H	N	N	N	N	TSHE			1	N	POMU	VAPA			L	1
293	0.1	FOR	3	PSME	4		<Null>		<Null>	3	H	N	N	N	N	THPL	PSME		2	N	MANE	POMU			L	1
294	3.6	FOR	3	THPL	4	PSME	4	TSHE	3	3	H	N	N	N	N	THPL	PSME		1	N	POMU	MANE	OPHO		L	1
295	0.4	FOR	3	PSME	4	THPL	3	TSHE	3	3	H	N	N	N	N	THPL	TSHE		1	N	POMU	MANE	VAPA		L	1
296	0.8	FOR	3	PSME	4	THPL	3	TSHE	3	3	H	N	N	N	N	TSHE			1	N	POMU	MANE	RUSP		L	1
297	0.0	FOR	3	PSME	4	THPL	3		<Null>	3	H	N	N	N	N			<Null>		N	POMU				L	1
298	7.1	FOR	3	THPL	3	PSME	4	TSHE	3	3	H	N	N	N	N	THPL	TSHE		1	N	POMU	RUSP			L	1
299	0.1	FOR	3	PSME	4	THPL	3		<Null>	3	H	N	N	N	N			<Null>		N	POMU				L	1
300	0.9	FOR	3	PSME	4	TSHE	3	THPL	3	3	H	N	N	N	N	PSME	TSHE		3	N	POMU				L	1
301	0.6	FOR	3	PSME	4	THPL	3	ACMA	3	2	M	N	N	N	N			<Null>		N	RUSP	POMU	VAPA		L	4
302	0.3	FOR	3	PSME	4	ACMA	4	THPL	3	3	H	N	N	N	N	THPL	TSHE		1	N	POMU	VAPA	RUSP		L	1
303	0.2	FOR	3	ACMA	4	THPL	4	PSME	4	2	M	N	Y	N	N	THPL	TSHE		1	N	POMU	RUSP			L	4
304	10.9	FOR	3	THPL	3	TSHE	3	<Null>	<Null>	3	H	N	N	N	N	THPL			1	N	THPL	ACCI	MANE		L	1

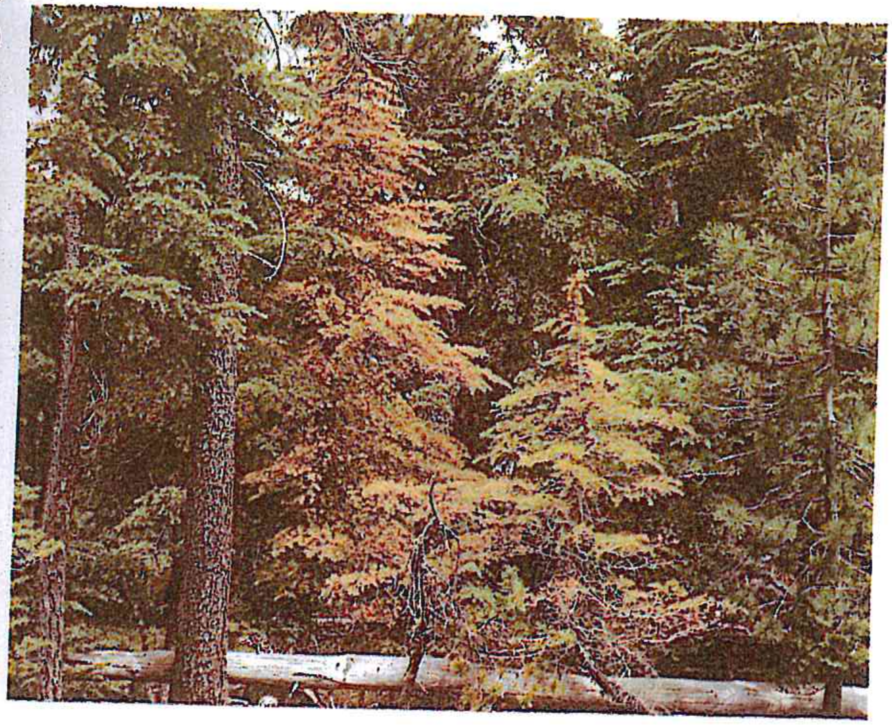
ADDENDUM V

HAZARD TREE SUMMARY

SVCA Preliminary Hazard Tree List

Identifier	Latitude	Longtitude	Description	Indicator	Target
Placemark 21	48.70809	-122.33932	Cluster of D fir and Hem	MU 387	Clematis Drive residences
Placemark 27	48.71025	-122.32924	Cluster of D fir and Hem	Decay indicators	Marigold
Placemark 6	48.71265	-122.32722	28" D fir	F. pini conks	Clubhouse and Parking lot
Placemark 22	48.70724	-122.33983	Cluster of 6 or more D fir	Root disease	Clematis Drive residences
Placemark 29	48.71118	-122.32817	22" D fir	lean	Marigold Dirve
Placemark 7	48.71253	-122.32724	28" D fir	F. pini conks	Clubhouse and Parking lot
Placemark 20	48.70472	-122.33648	28" D fir	Root Disease	Reidences on Salal Cir.
Placemark 31	48.72134	-122.36203	16" hemlock	Dead	Polo Park Roadway
Placemark 9	48.71204	-122.32752	25" D fir and 10" Hemlock	Dying -root disease	Clubhouse parking lot
Placemark 24	48.72366	-122.33958	P. sulphuracens	root rot pocket	Residences on Harborview
Placemark 13	48.70355	-122.32331	50" D ir	F.pini conks	residence and roadway on Southern Ct.
Place mark 3	48.71251	-122.3245	Several D fir	P. Sweinitzii Conks	Marigold Dirve
Placemark 11	48.71137	-122.32826	24" Hemlock	P. hartigii	Marigold Drive and Condos
Placemark 19	48.71241	-122.32711	D fir	F pini conks	Clubhouse and Parking lot
Placemark 26	48.71059	-122.32895	Several D fir and Hem	Root and bole decay	residences on Morning Glory
Placemark 15	48.70995	-122.3294	Several D fir	Probable root disease	South end Marigold
Placemark 5	48.71268	-122.32732	30" D fir	F. pini conks	Clubhouse and Parking lot
H1	48.72264	-122.367	2 red alder 16", 14"	Dead tops	Hang over L.Louise Rd
Placemark 28	48.71075	-122.32876	Several D fir and Hem	Multiple indicators	Residences around MU 284
Placemark 12	48.71662	-122.33065	50" D fir	F pini conks	Rotunda Parking lot
Placemark 23	48.70651	-122.33939	Multiple D fir	P.sulphuracens	Bramble Way residence
Placemark 16	48.72001	-122.35002	Cluster of 8 30-50" D fir	Root and bole decay	Morning Glory Drive Residences
Placemark 30	48.71294	-122.33819	22" D fir	Dead	Road way on Valley Crest
Placemark 8	48.71215	-122.32718	14" D fir	Dead	Clubhouse and Parking lot
H2	48.72034	-122.35818	18" red alder	Dead top	Hangs over L.Louise Rd
Placemark 10	48.71201	-122.32744	28" D fir	F. pini conks	Clubhouse parking lot
Placemark 18	48.71899	-122.34772	22" hemlock	"widow maker"	In Beaver Ridge Park
Placemark 25	48.7115	-122.32799	15" D fir	Dead	Marigold Dirve


Hazard Tree Locations
Sudden Valley
T 37 N, R 3 E & 4 E, Whatcom County, WA
Hazard tree
Property boundary
Source: WA State DNR landslide hazard zonation project
Map date: 4/13/2015
AFM
American Forest Management
0
2,000 Feet
Lake Whatcom
Lake Louise
Beaver Creek
Austin Creek
35
36
31
32
1
2
5
6
7
8
9
11
16
17
18
Sudden Valley Dr
Lake Whatcom Blvd
Lake Louise Rd
Lake Louise Dr
Harbor View Dr
Marigold Dr
Polo Park Dr
Southern Ct



Field Guide to the Common Diseases and Insect Pests of Oregon and Washington Conifers

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R6-NR-FID-PR-01-06

Root Diseases

Root diseases commonly found in Oregon and Washington are caused by several species of fungi and one Oomycete. Some root disease pathogens are favored by conditions associated with low tree vigor. Others are able to cause infection regardless of tree vigor. Some are quite host specific, while others have large host lists. Susceptibility to root diseases may also vary with host age or with geographic location.

Root diseases are often difficult to detect because of the subtle nature of their effects. Trees tend to die slowly, especially when older. Mortality may occur in centers or pockets or as individual dead trees scattered through a stand.

Tree and Root Disease Interactions

The predominant mode of spread for most root disease pathogens occurs underground when the roots of susceptible uninfected trees directly contact infected roots of diseased trees. Spore spread, insect vectors, short distance growth of fungi through the soil, or movement of infection propagules in soil or water may be involved in some cases.

Root disease pathogens may kill the cambium, decay root wood, plug water conducting tissue, or cause some combination of these effects. Tree death may be a direct result of root disease infection or may occur when trees with decayed roots fall or are predisposed to bark beetle attack.

Many root diseases are considered to be diseases of the site; inoculum may remain viable in the wood of infected roots or in the soil for many years or even decades.

Patterns of Damage

Within a stand

Several stages of tree decline and death usually occur in root disease pockets (Figs. 30a-e). Older dead trees are often broken off at the stem or near ground-line (Fig. 30c). Recent mortality is frequently mixed with trees exhibiting crown symptoms such as chlorosis, reduced growth, and presence of distress cone crops (Figs. 30k-o). Downed trees often occur in a "jackstraw" pattern (Figs. 30c, f). Large structural roots of downed trees may be partially or totally decayed leaving a "root ball" (Fig. 30g). Mortality may be associated with cut stumps (Fig. 30h) or be concentrated along roadsides and skid trails. Within pockets, brush species may be abundant and conifer regeneration

may occur (Fig. 30a). The pattern of mortality may be "doughnutlike," a slowly expanding circle with symptomatic trees at the margin of the pocket and the oldest mortality at the center or, more likely, the pattern may be "amoeboid," with stages of mortality and infection relatively mixed in small pockets or lobes in the stand.

Scattered individual tree mortality is typical for some site and root disease combinations. Root disease of this nature often goes undetected because of its subtlety. Scattered mortality may also be found in combination with distinct pockets on some sites.

Some root disease conditions are recognized because of the absence of trees rather than obvious current mortality. The lack of adequate regeneration around stumps may result from root disease.

Root disease symptoms may not be visible until trees reach the age where their root systems are able to contact inoculum. It may take up to 15 years before root disease effects are visible in plantations. While stands remain young, root disease signatures may be limited to scattered mortality or relatively small non-stocked pockets associated with stumps or snags remaining from the previous stand (Fig. 30d).

Bark beetle activity is often an indicator of root disease since bark beetles infest disease-weakened trees preferentially. It is important to examine trees for indicators of root disease when investigating areas where bark beetles are or have been active.

Within a tree

Aboveground symptoms of root disease include decreased growth, crown deterioration, and chlorosis (yellowing) (Table 4, pp. 68-69; Figs. 30j-m). Needles fade in color from bright green to pale green to yellow to red. Crowns of some small root-diseased trees or trees infested by bark beetles rapidly fade to reddish brown. Needles fade or are lost from infected trees over their entire crowns; the pattern of loss is usually from inside to outside and from bottom to top, but this may be quite subtle. Shortened terminal growth and smaller-than-normal needles often are symptoms of root disease. A sharp demarcation between dead and dying needles and bright healthy needles within a crown is not symptomatic of root diseases.

Many root diseased trees produce "stress" or "distress" cone crops (Figs. 30n, o). Cones may be produced earlier in the tree's life than normal, generally are smaller, and have fewer viable seeds than otherwise healthy cones.

Another symptom of root disease may be production of excessive resin flow or "basal resinosis" in the lower portion of the stem and at the root collar (Fig. 30i). In certain species, brown leachate, a watery resin-flow that emerges from and soaks the bark, may be visible on stems (Fig. 32a).

Signs of Occurrence

On the tree

Root disease symptoms may be confused with those caused by local wind events, sucking or defoliating insects, nutrient deficiencies or other impacts to root systems. To determine if root diseases are involved in tree decline or death, roots and root collars of dead or declining trees should be examined for diagnostic stains, decays, or fruiting structures (Table 4, pp. 68-69). This may involve excavation of roots on several sides of a tree, removal of bark, and chopping into the root wood. Stumps may also need to be examined in the same manner. Timing may be critical. For some root diseases, important indicators may disappear within a few years after trees have died.

Distinguishing Root Disease Pathogens

Diagnostic features

While a few of the root diseases may be accurately identified by a single diagnostic feature, it is often necessary to use combinations of distinguishing features in order to make an accurate identification for others (Table 4). It is also possible to have more than one root disease present at a time on a given tree.

Host preferences

The host may also help identify the root disease pathogens. Several root diseases have wide host ranges while others are quite host specific (Table 5, pp. 70-71). For those with wide host ranges, the likelihood of identifying root disease pathogens is higher on moderately and severely damaged tree species than on those hosts that are seldom damaged. Host preference may also differ by locality.

Root Disease Severity Rating

During stand examinations and inventories, individual trees are often given a root disease severity rating based on diagnostic decay or tree reaction in combination with the presence or lack of crown symptoms. The following rating scale is used throughout the Pacific Northwest:

Severity 1: A live tree within 30 feet of known root disease.

Severity 2: A live tree with diagnostic decay or tree reaction without crown symptoms.

Severity 3: A live tree with diagnostic decay, other root disease indicators and a symptomatic crown OR a dead tree with diagnostic decay or root disease indicators.

References: 31, 33, 34, 37, 55, 61, 67, 75, 83

Figure 30a—Hardwood shrubs often fill in openings where root diseases have killed groups of conifers.

Figure 30b—Several stages of tree decline and death, often in close proximity, are typical stand-level symptoms of root disease.

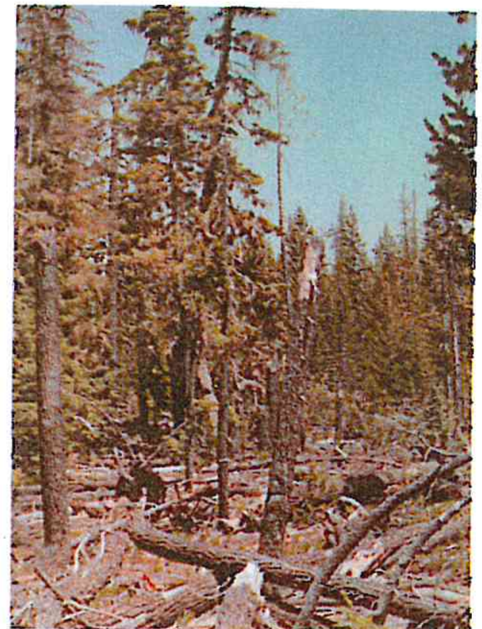


Figure 30c—Root disease centers frequently have substantial accumulations of down wood.

Figure 30d—Root disease mortality is usually not evident in plantations until trees are 10 to 20 years old.

Figure 30e—Several stages of tree decline and death caused by root disease.

Figure 30f—Down wood in root disease pockets is usually oriented in a random or "jackstraw" pattern.

Figure 30g—All large roots of this tree have been decayed by a root pathogen resulting in formation of a "root ball."

Figure 30h—Stumps often serve as foci for root disease centers.

Figure 30i—Resin flow at the base of a tree (basal resinosis) is often a symptom of root disease.

Figure 30j and k—Yellow (chlorotic) foliage is a common root disease symptom.

Figure 30ℓ and m—Foliage on root diseased trees may be sparse as well as chlorotic.

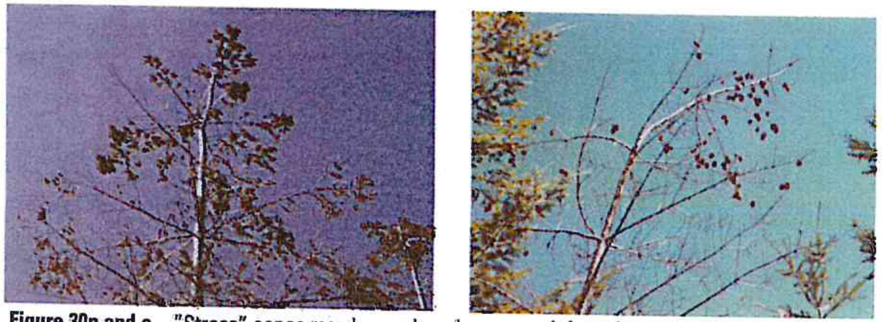


Figure 30n and o—"Stress" cones may be produced on young infected trees.

Table 4—Symptoms and signs of five important forest tree root diseases in Oregon and Washington.[1]

Symptoms and Signs	Laminated root rot	Armillaria root disease	Annosus root disease	Black stain root disease	Port-Orford-cedar root disease
Reduced height growth	√	√	√	√	
Chlorotic foliage	√	√	√	√	√
Slow loss of foliage	√	√	√	√	
Distress cones	√	√	√	√	
Slow crown decline	√	√	√	√	
Rapid tree death[2]				√	√
Dead tree, no foliage loss[2]					√
Abundant basal resin flow		√		√	
Cinnamon stain in inner bark					√
Black stain in sapwood				√	
Roots rotted	√	√	√		
Windthrown live trees	√		√		
Insect galleries under bark	√	√	√	√	√
Fleshy golden yellow mushrooms on tree base		√			

Table 4—Symptoms and signs of five important forest tree root diseases in Oregon and Washington (cont.).[1]

Symptoms and Signs	Laminated root rot	Armillaria root disease	Annosus root disease	Black stain root disease	Port-Orford-cedar root disease
Thick mycelial fans		√			
Rhizomorphs		√			
Leathery conks			√		
Setal hyphae	√				
Ectotrophic mycelium	√				
Creamy leathery pustules on roots			√		
Laminated decay with pits and setal hyphae	√				
Laminated decay with pits on one side of sheet			√		
Yellow stringy decay, papery when dry		√			
White stringy decay			√		

[1] Table modified after Hadfield et al. 1986.

[2] Young trees with root disease may die rapidly with foliage intact.

Table 5– Relative susceptibility of conifers in Oregon and Washington to damage by five common root diseases.[1]

Hosts	Laminated root rot	Armillaria root disease	Annosus root disease	Black stain root disease	Port-Orford-cedar root disease
Douglas-fir Westside	1[2]	2[3]	3	1	4
Douglas-fir Eastside	1	1	3	3	4
Ponderosa pine	3	2	2	3	4
Jeffrey pine	3	2	2	3	4
Lodgepole pine	3	2	2	3	4
Knobcone pine	3	2	3	3	4
Western white pine	3	2	3	3	4
Sugar pine	3	2	3	3	4
Whitebark pine	3	3	3	4	4
Grand fir	1	1	1	4	4
White fir	1	1	1	4	4
Noble fir	2	2	2	4	4
Pacific silver fir	2	2	1	4	4
Subalpine fir	2	2	2	4	4
Shasta red fir	2	2	2	4	4
Western hemlock	2	2	2[4]	3	4
Mountain hemlock	1	2	1	3	4
Western larch	2	3	3	4	4

Table 5–Relative susceptibility of conifers in Oregon and Washington to damage by five common root diseases (cont.).[1]

Hosts	Laminated root rot	Armillaria root disease	Annosus root disease	Black stain root disease	Port-Orford-cedar root disease
Subalpine larch	3	3	3	4	4
Engelmann spruce	2	2	3	4	4
Sitka spruce	3	2	3	4	4
Brewer spruce	3	2	3	4	4
Western redcedar	4[5]	2	3	4	4
Incense-cedar	4	3	3	4	4
Port-Orford-cedar	4	3	3	4	1
Pacific yew	3	3	4	4	2

[1] Table modified after Hadfield et al. 1986.
[2] 1 = severly damaged
2 = moderately damaged
3 = seldom damaged
4 = not damaged
[3] Westside Douglas-fir is moderately damaged up to age 25 to 30, susceptibility then decreases.
[4] Western hemlock is not severely damaged until it exceeds 150-years-old.
[5] Western redcedar east of the Cascade Mountains may have butt rot caused by laminated root rot.

ANNOSUS ROOT DISEASE

Pathogen: *Heterobasidion annosum* (Fr.) Bref. *(Fomes annosus)*

Hosts: Most conifers. Susceptibility and damage vary greatly by tree species and location.

Distribution and Damage: *H. annosum* is found throughout Oregon and Washington. It causes severe root and butt decay, tree mortality, and growth loss. Grand fir and white fir east of the Cascades and in southwestern Oregon and ponderosa pine and associated western juniper on drier sites east of the Cascades are frequently infected and often killed. In some locations east of the Cascades, Douglas-fir may be severely damaged. Other pine species are killed on rare occasions. Substantial butt rot can occur in older true firs, spruces, and hemlocks; regeneration of these species may be killed. Bark beetles are commonly found associated with trees infected with *H. annosum*.

Identification: Annosus root disease is difficult to detect; many infected trees do not show aboveground symptoms. Dead and dying trees with stained roots are often found adjacent to stumps with typical *H. annosum* decay and conks. On pine sites, substantial openings where regeneration is dead or missing are often centered on large (greater than 45 cm (18 in) diameter) pine stumps.

Fruiting bodies of *H. annosum* occur inside hollows in stumps, on the wood/bark interface of stumps, or in the root crotches below the duff (Figs. 31a-d). Conks are perennial with woody or leathery dark to chestnut-brown upper surfaces, white poreless margins, and creamy-white undersurfaces with small, rounded, regular pores (Fig. 31c). "Button conks," small cream-colored, "popcornlike" pustules of corky fungal tissue (pores visible), are sometimes found on the root collars of infected seedlings or within stumps (Fig. 31d). Incipient decay is a light brown to reddish stain in outer heartwood of lower stems and roots; wood is firm. In advanced decay, small elongated white pockets coalesce to form a white stringy to laminate decay (Figs. 31e, f). Small black flecks are often seen (Fig. 31e). Elongated pits occur on only one side of the laminae (Fig. 31g).

Agents Producing Similar Symptoms and Signs: Annosus root disease may be confused with other root diseases. *H. annosum* has distinctive fruiting bodies and the laminated decay has no associated setal hyphae. Its decay may be confused with decay caused by *Echinodontium tinctorium*, *Perenniporia subacida*, or *Ganoderma tsugae*.

Severity: Most damage occurs in eastside fir stands that have been entered for harvest one or more times and in entered pine stands in dry plant associations. *H. annosum* causes substantial amounts of decay and associated stem breakage in older mountain hemlock and western hemlock stands.

References: 1, 31, 56, 67

- *Diagnostic fruiting bodies.*
- *Laminated decay without setal hyphae.*
- *Check for bark beetles!*

Figure 31a—*Heterobasidion annosum* fruiting bodies are often found inside of stumps.

Figure 31b—Woody, shelflike conks have dark upper surfaces and a white to cream-colored margin.

Figure 31d—Conks may also occur under the duff or in root crotches of affected trees. Small "popcorn" or "button" conks are shown.

Figure 31f—In advanced stages, *H. annosum* can delaminate wood.

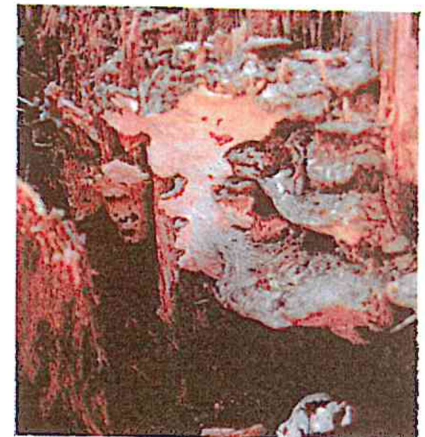


Figure 31c—Pore layers of *H. annosum* fruiting bodies are white to cream-colored with small, somewhat rounded pores.

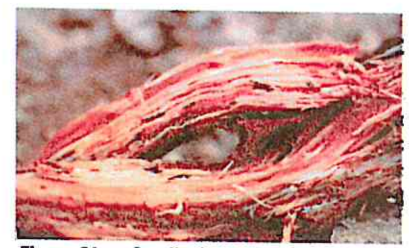


Figure 31e—Small, elongated white pockets of *H. annosum* decay coalesce to form a white spongy decay interspersed with black flecks.

Figure 31g—Delaminated wood may be pitted on one side. No setal hyphae are present.

ARMILLARIA ROOT DISEASE

Pathogen: *Armillaria ostoyae* (Romagnesi) Herinck

Hosts: All conifers. Susceptibility and damage vary by location.

Distribution and Damage: *A. ostoyae* is found throughout Oregon and Washington. On highly susceptible hosts, the fungus causes severe root and butt decay, growth loss, and mortality. In general, grand fir, and white fir east of the Cascades are most susceptible. They are readily infected and killed. In northwestern Washington, Douglas-fir is readily killed. In south-central Washington, ponderosa pine is often infected and can be severely impacted. In Oregon west of the Cascades Mountains crest, the disease is most common in Douglas-fir plantations less than 30 years old or where conditions occur that stress individual trees such as poor planting, planting of off-site stock, soil displacement, or soil compaction. White fir and Shasta red fir on compacted soils or in previously salvaged areas, and off-site ponderosa pine are readily killed in southwestern Oregon. In general, western larch, incense-cedar, Alaska yellow-cedar and Port-Orford-cedar are resistant. In local situations, other species or species combinations may be affected. This disease needs to be evaluated on a site by site basis since the host preference and virulence may differ significantly in nearby areas. Bark beetles often attack *A. ostoyae*-infected trees.

Identification: Aboveground symptoms of Armillaria root disease are typical of those for all root diseases. Heavy resin flow and soaking at the base of trees is commonly associated with this disease (Figs. 30i, 32a). White mycelial sheets, often shaped like fans, form between the wood and bark and take the place of the cambium of lower stems and roots (Figs. 32b, c). Fans are thick and peel away from wood or inner bark like "latex paint" (Fig. 32d). Fans often leave an impression on the bark after they disintegrate (Fig. 32e). Incipient decay is water-soaked wood with small straw-colored flecks; advanced decay is a wet, yellow, stringy rot (Fig. 32f). Rhizomorphs, black to reddish-brown shoestrings of fungal mycelia, form on roots and under bark. Golden-brown "honey-colored" mushrooms may be produced at the base of infected trees and stumps in late summer and fall (Fig. 32g).

Caution: Other species of Armillaria occur as saprophytes and are often found on stumps, severely weakened trees, or suppression-related mortality. To distinguish *A. ostoyae* from these, look for tree reaction, such as resin flow and soaking, and for mycelial fans that are thick and substantial and that often extend above the root collar.

Agents Producing Similar Symptoms and Signs: Armillaria root disease may be confused with other root diseases. The white mycelium is often confused with that of *Perenniporia subacida*. Thick mycelial fans present between the bark and wood (not within the wood itself) are diagnostic of *A. ostoyae*. Roots of bark beetle-infested trees should be examined for the presence of the fungus. Fruiting bodies may be confused with those of *Pholiota* species.

Severity: Armillaria root disease can be very severe locally. The disease may create large openings where highly susceptible species never attain large size.

References: 31, 69, 83

- *Thick white/cream mycelial fans.*
- *Tree reaction such as basal resinosis.*
- *Look for bark beetles!*

Figure 32a—Resin soaking at the bases of trees is often a symptom of Armillaria root disease.

Figure 32b—Removing bark reveals a white to cream-colored mycelial fan.

Figure 32c—Mycelial fans are found between the bark and the wood.

Figure 32d—Mycelial fans of *A. ostoyae* are thick and often can be peeled off of wood like coats of dried latex paint.

Figure 32e—As they get older and begin to deteriorate, mycelial fans may leave impressions in the bark.

Figure 32f—Advanced decay of *A. ostoyae* is a wet, yellow, stringy rot.

Figure 32g—*A. ostoyae* produces mushrooms in the fall.

LAMINATED ROOT ROT

Pathogen: *Phellinus weirii* (Murr.) Gilb.

Hosts: All conifers. Susceptibility and damage vary by species.

Distribution and Damage: In Oregon, *P. weirii* is present on and west of the Cascade Mountains crest, and north of the Crooked River on the east side of the Cascades. It is found throughout the forested portions of Washington. The fungus causes severe root and butt decay, growth loss and mortality. Douglas-fir, mountain hemlock, grand fir, and white fir are readily infected and often killed. Western hemlock, western larch, Pacific silver fir, subalpine fir, noble fir, Shasta red fir, Engelmann spruce and Sitka spruce are often infected but rarely killed. These species frequently exhibit butt decay. Lodgepole pine, ponderosa pine, Jeffrey pine, western white pine, sugar pine, whitebark pine, and western redcedar are seldom infected and almost never killed. Incense-cedar, Port-Orford-cedar, and Alaska yellow-cedar are almost never infected. Bark beetles often attack *P. weirii*-infected trees.

Identification: Aboveground symptoms are typical of those caused by most root diseases. Down trees with "root balls" and trees broken at or near ground level are common in laminated root rot pockets (Fig. 34e). Incipient decay is a brown to reddish-brown stain seen most often in sapwood (Fig. 34f). Stain is often crescent shaped or semicircular in cross-section (Fig. 34f). Advanced decay is a laminated yellow pocket rot (Figs. 34a, b). Wood separates at the growth rings with small, regular, elliptical pits on both sides of the laminae (Figs. 34a, b). Rusty-red, whiskery fungal hyphae called "setal hyphae" occur between layers of decayed wood (Fig. 34b). Setal hyphae may coalesce to form mats of reddish-brown "velvet." White, buff-colored to grayish ectotrophic mycelium can be found on the bark surface of roots, particularly on younger trees or younger portions of roots (Fig. 34c). On large roots with thick bark, ectotrophic mycelium can be found within bark crevices (Fig. 34d). Gray-brown to cinnamon-brown flat fruiting bodies may be found on the undersides of windthrown infected trees; they are infrequently observed and are of limited use for diagnosis.

Agents Producing Similar Symptoms and Signs: Laminated root rot may be confused with other root diseases, delaminating decays, or red ring rot. Setal hyphae combined with pitted, delaminated wood are diagnostic of *P. weirii*.

Severity: Laminated root rot frequently creates substantial-sized openings in stands where highly susceptible species such as Douglas-fir, white fir, grand fir, and mountain hemlock never attain large size. The disease is particularly severe on and west of the Cascade Mountain crest in Oregon and Washington, and in the Oregon Coast range.

References: 31, 34, 55, 75

- *Laminated decay with pits on both sides of laminae.*
- *Presence of setal hyphae.*
- *Ectotrophic mycelia on root bark or within bark fissures.*
- *Look for bark beetles!*

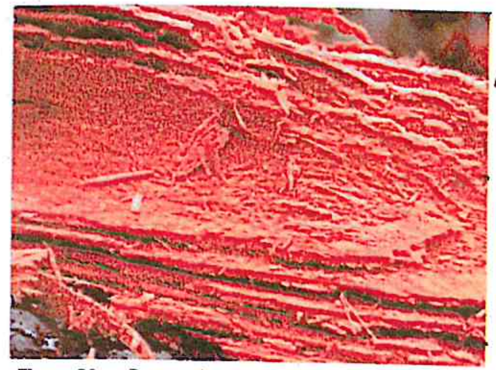


Figure 34a—Decayed wood separates at the annual rings like the pages of a book.

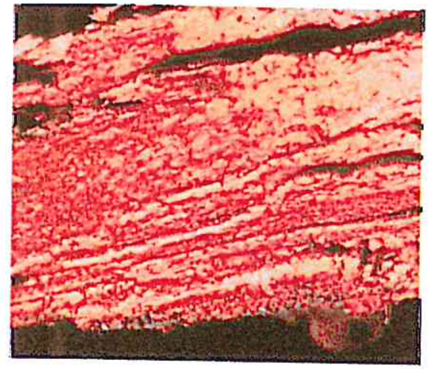


Figure 34b—*P. weirii* decays small holes or pits in the wood. Reddish-brown whiskery setal hyphae are found between wood sheets.

Figure 34c—Buff, cream, or pinkish ectotrophic mycelia grow on root surfaces.

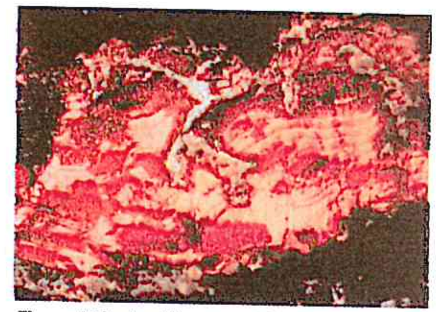


Figure 34d—In older trees with thick bark, ectotrophic mycelium may be found in bark crevices instead of on the bark surface.

Figure 34e—Physical decay of roots results in windthrown trees exhibiting "root balls."

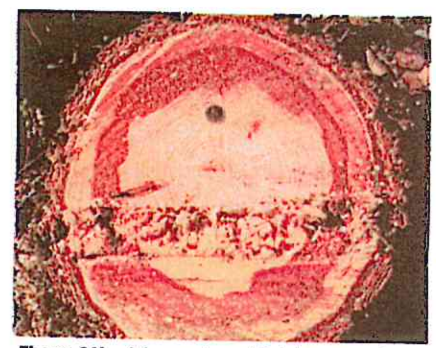


Figure 34f—A brown to reddish-brown stain indicating decay may be visible on stump surfaces of recently-cut infected trees.

Stem Decays

(HEART ROTS and SAP ROTS)

Stem decays are caused by hundreds of species of basidiomycetous fungi that invade and decompose the wood of trees. Many of these fungi decay only the nonliving heartwood portion of living trees while others decay heartwood and sapwood of dead trees, decay sapwood only, deteriorate wood in use, or decompose slash, roots, and organic matter in the soil. Decays change wood structure in such a fashion that excavations can be more easily made by cavity nesting birds and mammals (Fig. 39a). Decays also render timber unmerchantable, reduce wood quality, and predispose trees to windthrow and breakage (Fig. 39b).

As a rule, heartwood-rotting fungi, also known as heart rots, do not penetrate sound trees but require an opening into the heartwood through which they invade. Any opening into the heartwood or exposure of dead sapwood next to heartwood is a potential site for decay fungi to become established. Wounds caused by fire, weather, animals, or human activities are common points of entry for decay fungi. Natural openings in trees, such as branch stubs, open knots, and dead branches, also provide means of entrance. Some decay fungi enter the tree through injured roots or through basal fire scars. Others kill the root wood before entering the heartwood.

Several systems have been devised to classify decay fungi. The most useful classification concepts are based on 1) the type of decay, and 2) the characteristics of the fungal fruiting bodies also known as the sporophores or conks (Fig. 39c).

In the first classification scheme, two general types of decays are recognized: brown rots and white rots. Brown rots develop as a result of the selective utilization of carbohydrates (primarily cellulose) by the causal fungi, leaving behind the brownish lignin component of the wood. Brown rotted wood is usually dry and fragile; it tends to crumble readily or break apart into cubes. Most brown rots form solid columns of decay, while a few form pockets. Fungi that attack both the carbohydrate and lignin components of the wood produce white rots. They may form in pockets or be stringy or spongy.

The second classification system used to identify the decay fungi is based on characteristics of the fruiting bodies. These spore-producing bodies vary in form from fleshy mushrooms to woody brackets. Color, texture, and the nature of the spore-producing surface are examples of the characteristics used to identify the species. Some decay fungi produce annual sporophores; others are perennial. Some are able to fruit on trees after they are harvested.

Decay fungi often go unnoticed. Incipient decay may be very difficult to detect. While some incipient decays can be seen as distinct color changes in wood, others are much less obvious or virtually invisible. If conks are present, they are usually good indicators of decay; however, small but viable conks may escape casual inspection. Annual conks may not be apparent during certain times of the year. Woody conks are easily knocked off during harvest and transport.

References: 1, 6

Figure 39a—Decay fungi change wood structure making excavation of trees by primary cavity nesters easier.

Figure 39b—Decay causes hazards by increasing the likelihood of tree windthrow and breakage.

Figure 39c—Decays are most often identified by their characteristic fungal fruiting structures.

BROWN CRUMBLY ROT

Pathogen: *Fomitopsis pinicola* (Swartz:Fr.) Karst "red belt fungus"

Hosts: The host list is large and includes most western conifers, especially pines, true firs, Douglas-fir, western hemlock, western larch, spruce, incense-cedar, and western redcedar.

Distribution and Damage: *F. pinicola* is found throughout Oregon and Washington. The fungus causes a brown cubical rot and is one of the most common wood rot organisms in coniferous forests in western North America. It mainly decomposes dead and down timber, however, it may also cause heart rot in living trees, particularly in Alaska. *F. pinicola* causes decay in living true firs that is associated with large open bole swellings caused by dwarf mistletoe. The fungus is very important as a slash rotter. It also causes deterioration of recently-killed standing trees, down trees, and stored logs.

Identification: Fruiting bodies are commonly associated with this decay. They are leathery to woody, perennial, bracket-shaped structures that, when young, appear as white, round, fungal masses. As they mature, the upper surfaces turn dark gray to black, the fresh lower pore surfaces remain white to creamy, and conspicuous reddish margins, the "red belts," develop between the two surfaces (Figs. 40a-c). Fruiting bodies are commonly seen on dead and fallen conifers. They range from 10 to 46 cm (4 to 16 in) in width.

The decay develops rapidly in the sapwood and then progresses to the heartwood. In its early stages, it may appear as a faint yellow-brown to brown stain. As it advances, the decayed wood becomes light reddish brown and forms a crumbly mass broken into rough, rather small cubes (Fig. 40d). Small patches of lighter colored wood may give a mottled appearance on the ends of logs.

Non-resinous mycelial felts form in the shrinkage cracks in decayed wood. On a relative scale, these felts are thicker than those associated with similar rots, but not as thick as those formed by *Fomitopsis officinalis*.

Agents Producing Similar Symptoms and Signs: Many other fungi cause brown rot. The fruiting body distinguishes this fungus.

Severity: *F. pinicola* occurs on dead trees, logs, stumps and dead portions of living trees. It is a very significant recycler of wood. It can cause economic losses when it decays dead trees scheduled for salvage or logs in storage.

References: 1

- *Brown cubical decay.*
- *Bracket-shaped conks with reddish margin and white pore layer.*

Figure 40a—The often-distinct reddish-brown margin gives the fungus its common name "red-belt."

Figure 40b—A dark upper surface, reddish-brown margin, and creamy white pore layer distinguish this very commonly occurring conk.

Figure 40c—The underside of the conk has a creamy-white pore layer.

Figure 40d—The fungus decays heartwood and sapwood. Advanced decay is a brown crumbly rot.

BROWN CUBICAL ROT

Pathogen: *Laetiporus sulphureus* (Bull.:Fr.) Murrill "sulfur fungus," "chicken of the woods"

Hosts: Douglas-fir, true firs, pines, hemlocks, spruces, larch, and western redcedar.

Distribution and Damage: *L. sulphureus* causes a brown cubical rot in a variety of conifers in the Pacific Northwest, especially in true firs. It is very common in dead trees or dead portions of trees and is often seen on stumps and logs.

Identification: The conks are quite conspicuous. They appear in the late summer or fall on wounds at or near the base of living trees, on stumps, and on fallen logs. They are annual, clustered, shelflike conks that are soft, fleshy, and brilliant orange to red orange (Fig. 41a). When fresh the pore surface is bright sulfur yellow. Older fruiting bodies become hard, brittle, and chalky white.

The fungus decomposes cellulose in the heartwood and occasionally sapwood, causing a brown cubical rot. Hidden decay is usually present but detectable only microscopically. The earliest detectable stage is a light brown stain. In advanced decay the wood breaks down into medium-sized reddish-brown cubes (Fig. 41b). Cracks between cubes are often completely filled with nonresinous white mycelial felts. Decay is most common in the butts of trees.

Agents Producing Similar Symptoms and Signs: Many other fungi cause brown rots. Decay is similar to that caused by *Fomitopsis officinalis*. The fruiting body distinguishes *L. sulphureus*.

Severity: *L. sulphureus* is often seen but not usually considered a major heart rot or slash decayer of conifers.

References: 1

- *Orange-yellow fruiting body.*
- *Brown cubical decay.*

Figure 41a—Its bright colors make *Laetiporus sulphureus* one of the most spectacular decay fungi.

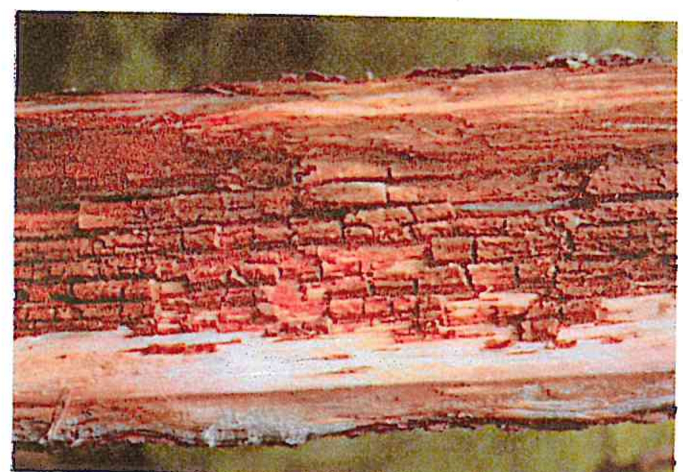


Figure 41b—*L. sulphureus* causes a brown cubical rot.

BROWN TRUNK ROT

Pathogen: *Fomitopsis officinalis* (Vill.:Fr.) Bond. & Sing. "quinine fungus"

Hosts: Douglas-fir, pines, western larch, spruces, and hemlocks; it is found occasionally on true firs.

Distribution and Damage: *F. officinalis* is found throughout Oregon and Washington. The fungus is most closely associated with old-growth conifers and is especially common in trees with old broken tops. Its incidence in second-growth forests is not well known but appears to be low.

Identification: Fruiting bodies are not common. When present they are hard, perennial, hoof shaped, and chalky white to grayish with ridged and cracked surfaces (Figs. 43a, b). Conks range in size from several centimeters (2 in) to more than 0.6 m (2 ft) long and may become long and cylindrical after several years. They develop at branch stubs or on wounds. Conk interiors are soft and white and have a bitter flavor if tasted, hence the common name "quinine fungus."

The decay is often difficult to detect in its early stages. Incipient decay color varies by host species. In Douglas-fir, discoloration is ordinarily absent, but is purplish in color when present. In ponderosa pine, incipient decay is commonly red brown or brown. On other hosts it is light yellow to red brown. In advanced stages, the wood breaks down into a crumbly mass of yellow-brown to reddish-brown cubical chunks (Figs. 43e, f).

Thick white to cream-colored mycelial felts are common in the shrinkage cracks between the cubes in advanced decay (Figs. 43c, d). Felts may be up to 5 mm (3/16 in) thick and can cover large areas in continuous sheets. Felts have a characteristic bitter taste and are associated with resinous pockets or resinous crusty areas.

The fungus is more frequently encountered in the upper parts of trees; it is found less commonly in the butt portion.

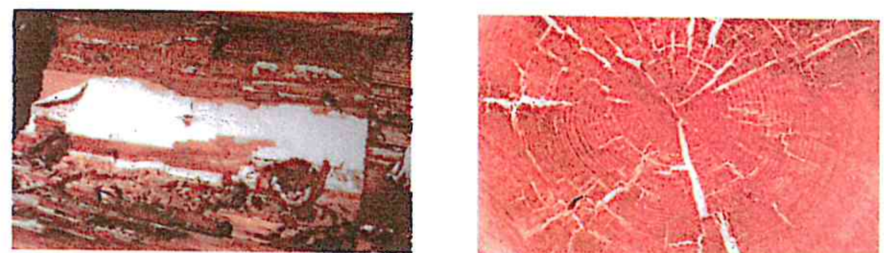
Agents Producing Similar Symptoms and Signs: Many other fungi cause brown rot. The decay caused by *F. officinalis* is most often confused with that of *Fomitopsis pinicola*, *Laetiporus sulphureus*, or *Phaeolus schweinitzii*. The fruiting body distinguishes this fungus.

Severity: *F. officinalis* is an important decay organism in old-growth conifers. The presence of a single conk indicates extensive decay.

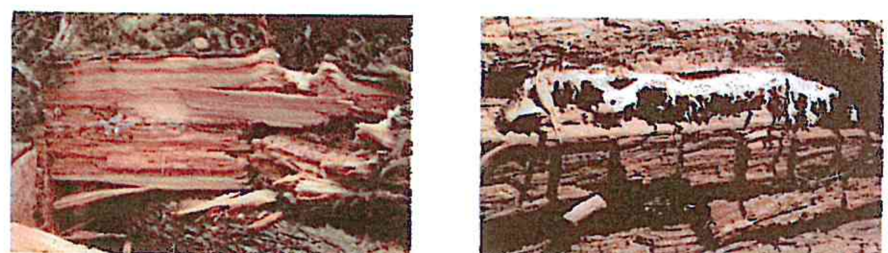
References: 1

- *White to gray chalky, hoof shaped conks.*
- *Thick, bitter-tasting mycelial felts between wood cubes.*
- *Cubical decay.*

Figures 43a and b—*F. officinalis* conks are white to gray in color, hoof shaped, and chalky with a ridged or cracked surface.



Figures 43c and d—Thick mycelial felts develop in the shrinkage cracks of the decayed wood.



Figures 43e and f—The decay caused by *F. officinalis* is yellow brown to reddish brown and cubical.

PENCIL ROT of WESTERN REDCEDAR

Pathogen: *Postia sericiomollis* (Romell) Jülich

Host: Western redcedar.

Distribution and Damage: *P. sericiomollis* occurs throughout the range of its host. It is the most common heartrot of western redcedar and causes a severe butt and lower bole decay.

Identification: Fruiting bodies are annual, thin, flat, white crusts with shallow round pores. They are infrequently observed, hence their use as an indicator of decay is limited. They may occasionally be seen on the ends of logs or on slash.

In the early stages of decay the wood is firm but discolored, appearing as yellow-brown pockets or columns. Advanced decay is a typical brown cubical pocket rot (Figs. 47a-c). The surface of the wood cubes may be covered with a thin white mycelium. In the lower bole, decay may be columnar or coalesce into a solid mass. Higher in the bole, decay usually occurs in long pockets.

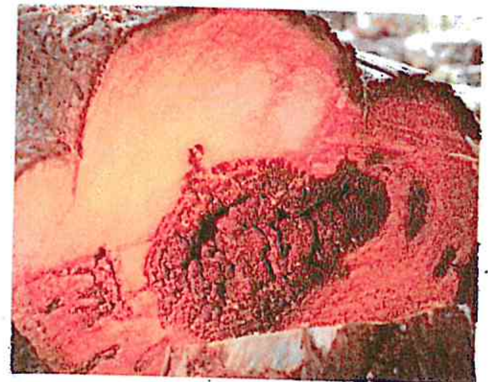
Infected trees may have a sunken or flattened area of decayed wood covered with bark called a "dry side" or "dry face" (Fig. 47d). Dry faces may extend as high as 14 m (45 ft) up the stem. The edge of the dry face may appear folded or callused.

Agents Producing Similar Symptoms and Signs: Pencil rot may be confused with brown cubical butt rot caused by *Phaeolus schweinitzii*, which does occasionally occur in western redcedar. *P. schweinitzii* is more often associated with a large central column of decay whereas *P. sericiomollis* more often occurs in pockets or rings. This distinction may be clearer higher on the stem.

Severity: Pencil rot causes a severe stem decay of western redcedar.

References: General

- *Brown cubical columnar decay.*
- *Flattened "dry face" on boles of western redcedar.*



Figures 47a and b—Advanced decay of *P. sericiomollis* in western redcedar.

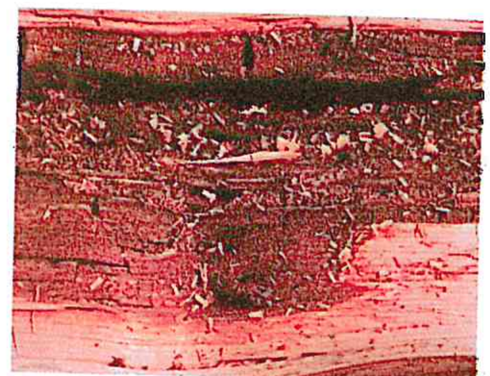


Figure 47c—Decay occurs in irregular large patches up to several feet in length throughout the stem.

Figure 47d—*P. sericiomollis* decay may be hidden in trees but is often associated with a dry face or dry side.

RED RING ROT or WHITE SPECK

Pathogen: *Phellinus pini* (Thore:Fr.) A. Ames "ring-scale fungus"

Hosts: Douglas-fir, western larch, pines, hemlocks, spruces, true firs, western redcedar, and rarely incense-cedar.

Distribution and Damage: *P. pini* is found throughout Oregon and Washington. It causes a cellulose and lignin-destroying white pocket rot in the heartwood. The decay occasionally enters living sapwood. Conks occur higher on trees in older stands; larger conks usually indicate more decay. The fungus is not a primary invader of dead wood and quickly dies out in cut lumber; decay does not continue in wood in service. *P. pini*'s impacts are most severe in the southern portions of the region, in older stands, in pure stands, on steep slopes, and on shallow soils.

Identification: Fruiting bodies occur on tree boles (Figs. 48a, b). They are perennial, hoof shaped to bracketlike, and produced on the stem at branch stubs and knots. They range in size from 5 to 25 cm (2 to 10 in) in width. The upper surface of each conk is rough, dark gray to brownish-black and concentrically furrowed (Figs. 48c, d). The interior and lower surface is cinnamon brown (Figs. 48c, d). Pores are irregular in shape (daedaloid), not round. Swollen knots filled with fungal tissue (punk knots) may be present on stems. Stems may be slightly flattened or "dished out" in areas associated with conks and punk knots.

Incipient decay of *P. pini* is usually reddish in color, but this varies with host species. It is usually red purple in Douglas-fir, light purplish gray in spruce, pink to reddish in pines, and colorless in cedar. Advanced decay occurs as few to many spindle-shaped white pockets with firm wood in between, hence one of the common names, "white speck" (Fig. 48e). Pockets may coalesce and in the latest stages may form distinct rings or crescents resulting in "red ring rot" (Fig. 48f). Zone lines are sometimes produced.

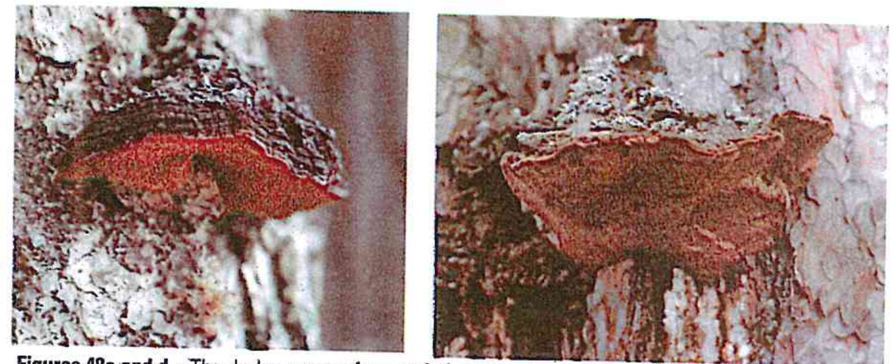
Agents Producing Similar Symptoms and Signs: Incipient decay caused by *P. pini* may be confused with incipient decay of *Echinodontium tinctorium*. In later stages, decay may be confused with other white pocket rots such as those caused by *Hericium abietis* or *Inonotus tomentosus*. *P. pini* conks are diagnostic.

Severity: In western North America, *P. pini* is considered to be the most common and widespread heart rot organism.

References: 1

- *Dark, rough fruiting bodies with cinnamon-brown pores.*
- *Rings or arcs of reddish stain or white pocket rot in log ends.*

Figures 48a and b—*P. pini* forms shelflike conks on many conifer species.



Figures 48c and d—The dark upper surface and cinnamon-brown pore surfaces distinguish the fruiting bodies of *P. pini*.

Figure 48e—Close-up of the decay showing white pockets separated by sound wood.

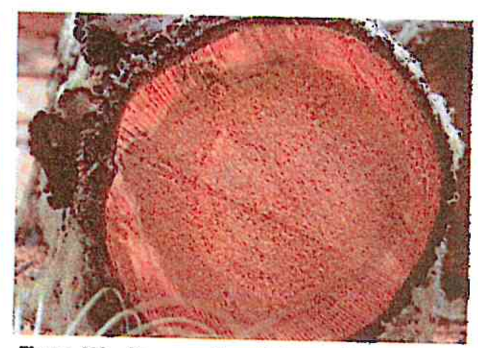


Figure 48f—Cross-section of decayed tree showing the reason for the common name of red ring rot.

SCHWEINITZII ROOT AND BUTT ROT

Pathogen: *Phaeolus schweinitzii* (Fr.) Pat. "cow-pie fungus," "velvet top fungus"

Hosts: Most frequently found on Douglas-fir. Other common hosts include western larch, Engelmann spruce, Sitka spruce, lodgepole pine, ponderosa pine, Jeffrey pine, western white pine, and sugar pine. It is occasionally found on western redcedar, western hemlock, mountain hemlock, grand fir, white fir, Pacific silver fir, noble fir, Shasta red fir and subalpine fir.

Distribution and Damage: *P. schweinitzii* is found throughout Washington and Oregon. The fungus causes a severe root and butt decay of older trees. Wind breakage above the groundline is the most common result of decay. Douglas-fir beetles and *Armillaria* spp. often attack *P. schweinitzii*-infected Douglas-firs. *P. schweinitzii* may directly cause Douglas-fir mortality; however this occurs only rarely in Washington and Oregon.

Identification: Fruiting bodies are the most reliable sign of this disease. Large annual mushroomlike conks occur on the ground near or growing from the bases of infected trees. Conks may also occur on the lower 3 m (10 ft) of stems (Fig. 51c). Fruiting bodies growing on trees usually emerge from wounds, cracks, and fire scars. Conks appear in the late summer and fall. They are velvety in texture and reddish brown, greenish brown, or yellow brown, often with a yellow edge (Fig. 51a). As they age, they become dark brown and brittle, and resemble cow droppings (Fig. 51b). The conks are circular with depressed centers and taper to short, thick stalks. Those growing directly on stems may be bracket shaped. Fruiting bodies may develop on living trees, dead trees, logs, and stumps.

Early decay is light green to light brown, with firm wood. Advanced decay is a light brown cubical rot aging to dark brown cubical decay with resinous white mycelial sheets in the shrinkage cracks (Figs. 51e, f). Decay is confined to the heartwood and usually found in the roots and butts of the host. Infected trees may have pronounced butt swells or "jugbutts" (Fig. 51d).

Agents Producing Similar Symptoms and Signs: *P. schweinitzii*-caused decay may be confused with that caused by *Fomitopsis pinicola*, *Fomitopsis officinalis*, *Laetiporus sulphureus*, or *Postia sericiomollis*. The fruiting body is diagnostic.

Severity: Schweinitzii root and butt rot occurs frequently in older stands. Decay is usually confined to the lower portions of infected trees; fruiting bodies emerging from the bole indicate higher levels of decay. Windthrow and breakage are commonly associated with this fungus.

References: 1, 31

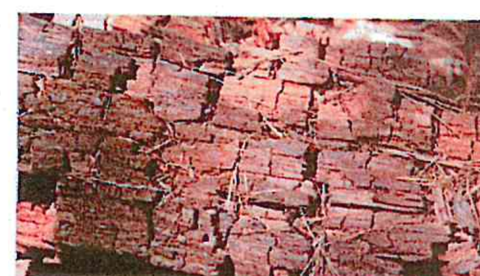
- *Distinct velvet top or "cow-pie" fruiting bodies on or near the ground.*
- *Swollen lower bole or "jugbutt."*

Figure 51a—Mushroomlike fruiting bodies of *P. schweinitzii* form in late summer and fall and are velvety when fresh.

Figure 51b—As fruiting bodies age, they become brittle and dark.

Figure 51c—Fruiting bodies are most frequently found on the ground emerging from roots or at the bases of infected trees. They may also be found on lower boles as shown here.

Figure 51d—"Jugbutt" on older Douglas-fir due to Schweinitzii root and butt rot.

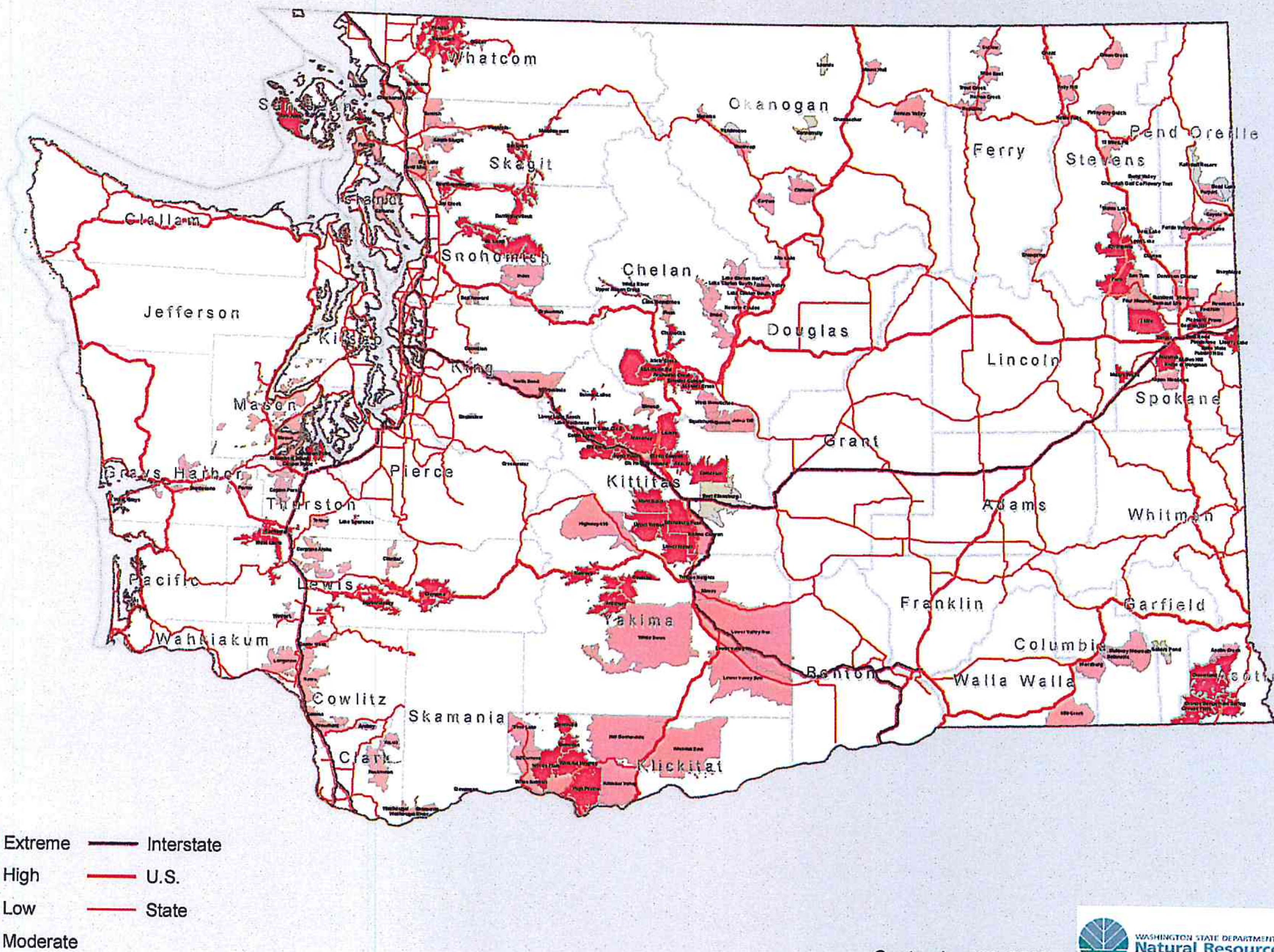


Figures 51e and f—Advanced decay of *P. schweinitzii* is a brown cubical rot.

ADDENDUM VI

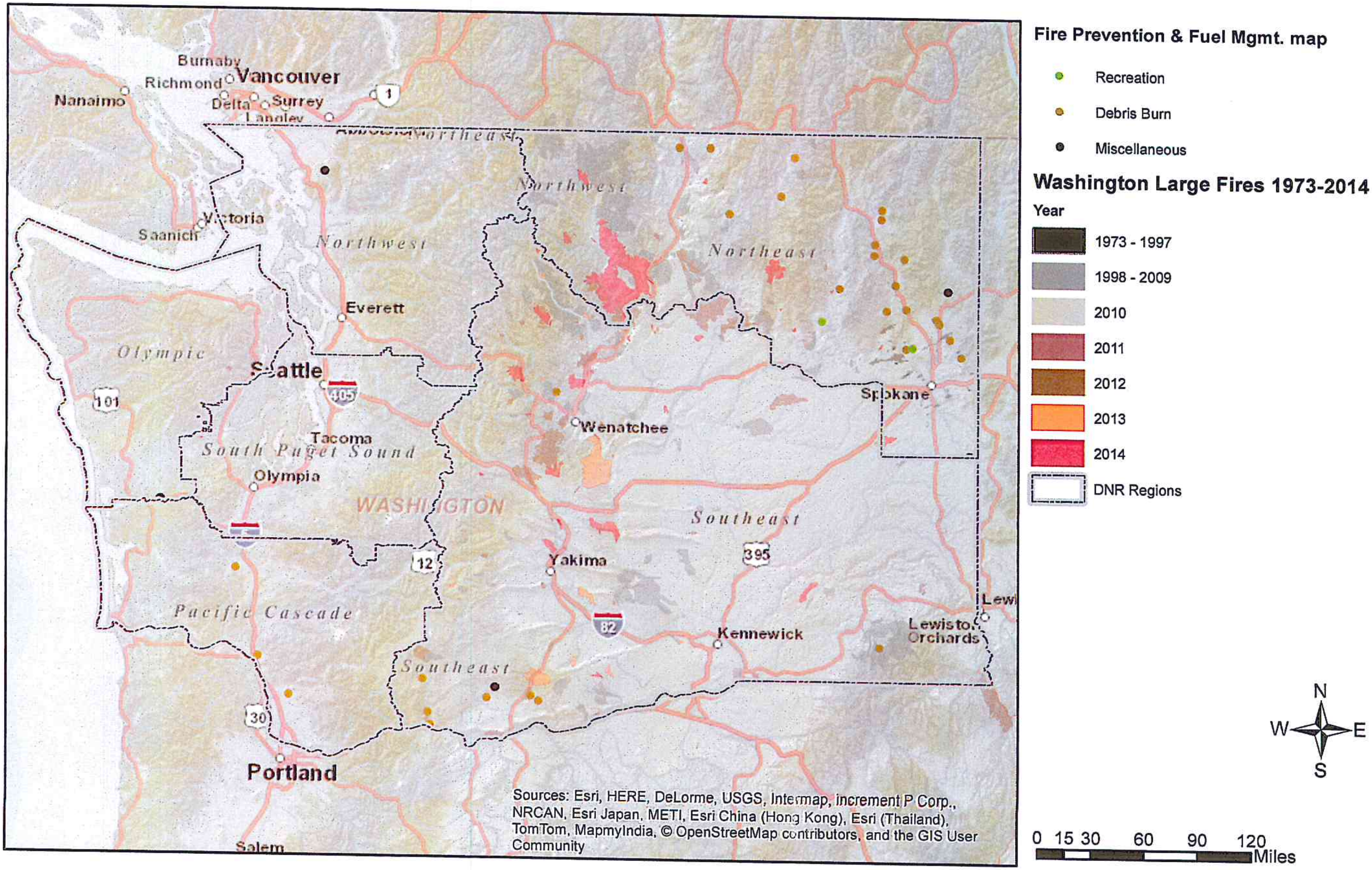
FIRE RISK

Wildland Urban Interface Communities at Risk for Fire



September 18, 2007

WASHINGTON STATE DEPARTMENT OF Natural Resources



Fire Prevention & Fuel Mgmt. map
Recreation
Debris Burn
Miscellaneous
Washington Large Fires 1973-2014
Year
1973 - 1997
1998 - 2009
2010
2011
2012
2013
2014
DNR Regions
0 15 30 60 90 120 Miles
N
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W
E
Northwest
Northeast
South Puget Sound
Olympic
Pacific Cascade
Southeast
WASHINGTON
Vancouver
Burnaby
Richmond
Nanaimo
Delta
Surrey
Victoria
Saanich
Everett
Tacoma
Olympia
Wenatchee
Yakima
Kennewick
Spokane
Portland
Salem
Lewiston Orchards
101
405
12
395
82
30
1
Sources: Esri, HERE, DeLorme, USGS, Intermap, increment P Corp., NRCAN, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

Fire Prevention & Fuel Management Mapping System

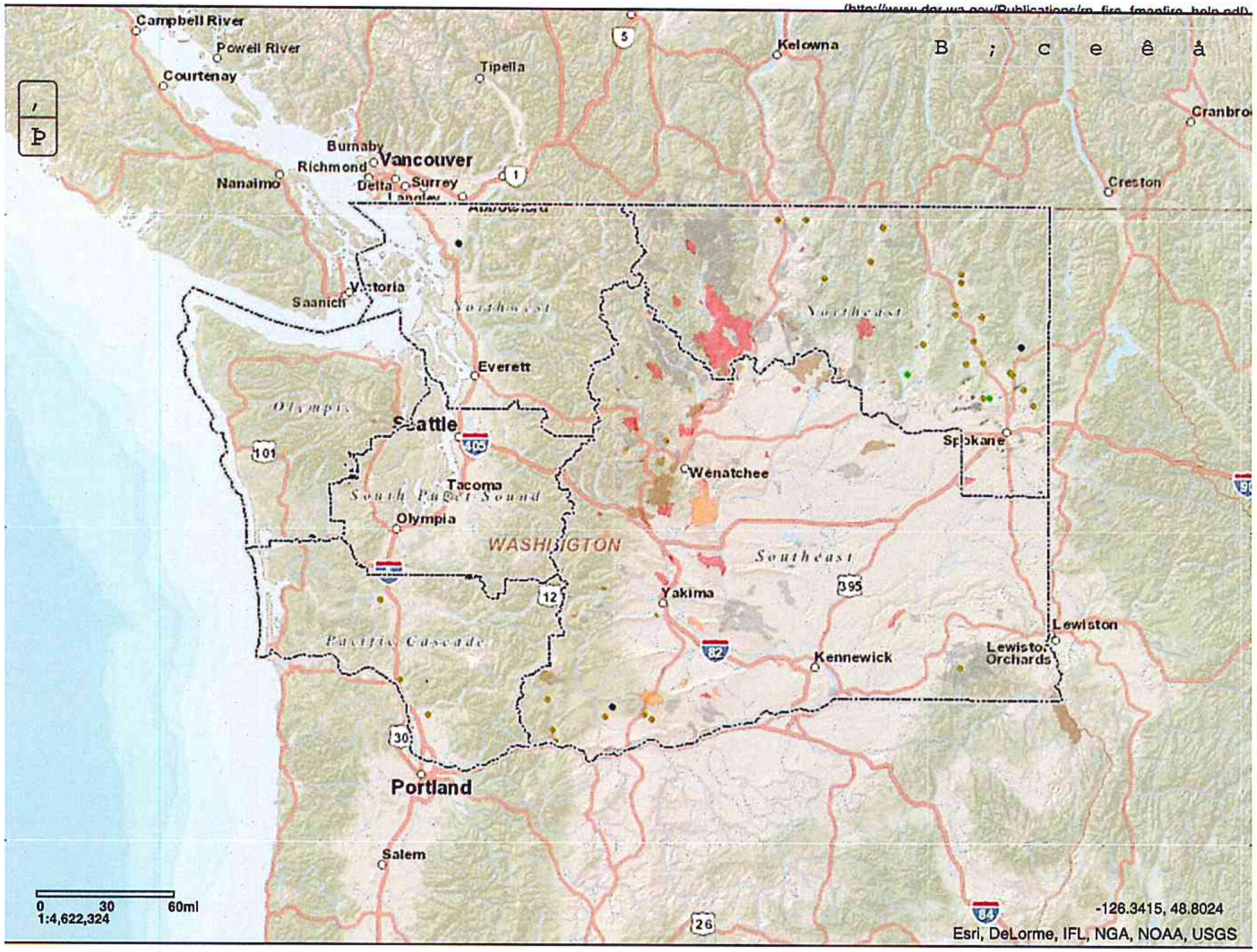
Washington State Department of Natural Resources (http://www.dnr.wa.gov)

Home (http://www.dnr.wa.gov/RecreationEducation/FirePreventionAssistance/Pages/Home.aspx) Contact Us About the Viewer Download Data (http://fortress.wa.gov/dnr/app1/dataweb/dmmatrix.html) Help

Data | Active (4) | Legend

Search for Layers

Wildfire & Prevention
Forest Health
Smoke Management
Forest Inventory
Topography
Soils
People & Places
Administrative Boundaries
Basemap



Wildland Fires

Definitions

Structure fire is a fire of natural or human-caused origin that results in the uncontrolled destruction of homes, businesses, and other structures in populated, urban or suburban areas.
Wildland fire is a fire of natural or human-caused origin that results in the uncontrolled destruction of forests, field crops and grasslands.

Wildland urban interface is a fire of natural of human-caused origin that occurs in, or near, forest or grassland areas, where isolated homes, subdivisions, and small communities are also located.

Background Information

Wildland fire is a serious and growing hazard over much of the United States, posing a great threat to life and property, particularly when it moves from forest or rangeland into developed areas. However, wildland fire is also a natural process, and its suppression is now recognized to have created a larger fire hazard, as live and dead vegetation accumulates in areas where fire has been excluded. In addition, the absence of fire has altered or disrupted the cycle of natural plant succession and wildlife habitat in many areas. Consequently, United States land management agencies are committed to finding ways, such as prescribed burning, to reintroduce fire into natural ecosystems, while recognizing that firefighting and suppression are still important. USGS conducts fire-related research to meet the varied needs of the fire management community and to understand the role of fire in the landscape; this research includes fire management support, studies of post-fire effects, and a wide range of studies on fire history and ecology.

History

Washington State has experienced several disastrous fire seasons in recent years. In 1994, a series of dry lightning strikes started numerous fires in the north-central portion of the state, with major fires occurring in or near Lake Chelan, Entiat, and Leavenworth. During the fire seasons of 2001 and 2002, lightning again caused numerous fires in Washington and Oregon.

In some cases, two or more fires merged together, overwhelming resources and creating fires so large and complex that some were not fully extinguished until cooler, damp autumn weather moved into the region.

Vulnerability Assessment

Should a large wildland or wildland-urban interface fire occur in Whatcom County, the effects of such an event would not be limited to loss of valuable timber, wildlife and habitat, or recreational areas. The loss of large amounts of timber on steep slopes would increase the risk of landslides and mudslides during the winter months and the depositing of large amounts of mud and debris in streams and river channels could threaten valuable fish habitat for many years. In addition, the loss of timber would severely impact the watershed of the Skagit River and could drastically increase the vulnerability to flooding for many years.

WDNR, Northwest Region, has conducted a region-wide wildland fire hazard assessment utilizing the following method:

1. Risk Assessment and Mitigation Strategies (RAMS) was developed for fire managers to be an all-inclusive approach to analyzing wildland fire and related risks. It considers the effects of fire on unit ecosystems by taking a coordinated approach to planning at a landscape level. The steps involved in this process include the following:

    A. Identification of spatial compartments for assessment purposes:
        i. Whatcom County (county # 37) was subdivided into three risk assessment compartments based on Industrial Fire Precaution Level (IFPL) Shutdown Zones. Zone 653 represents the islands and tidal lowlands; Zone 656 represents the interior lowlands (roughly the Interstate 5 corridor); and Zone 658 represents the uplands to the Cascade Crest (roughly 1,500 feet elevation and above). Whatcom County risk assessment compartments are numbered using the county number (37) combined with the shutdown zone number. Using this scheme, the three risk assessment compartments within Whatcom County are numbered 37653, 37656 and 37658.

    B. Assessment of significant issues within each compartment, which are related to:
        i. Fuels Hazards – The assessment of fuel hazards deals with identifying areas of like fire behavior based on fuel and topography. Given a normal fire season, how intense (as measured by flame length) would a fire burn? Under average fire season conditions, fire intensity is largely a product of fuel and topography.
        ii. Protection Capability – Determining fire protection capability for the purpose of this assessment involves estimating the actual response times for initial attack forces and how complex the actual suppression action may be once they arrive because of access, fuel profile, existence of natural or human-made barriers to fire spread, presence of structures, and predicted fire behavior.
            a. Initial Attack Capability – actual time of first suppression resource
            b. Suppression Complexity – access, fuel conditions, structure density, and so forth

iii. Ignition Risk – Ignition risk evaluation will be completed for each compartment. Ignition risks are defined as those human activities or natural events which have the potential to result in an ignition. Wherever there are concentrations of people or activity, the potential for a human-caused ignition exists. After assessing the risks within an area, it is helpful to look at historical fires to validate the risk assessment. Historical fires alone, however, are not an accurate reflection of the risks within a given area. The objective of this effort is to determine the degree of risk within given areas.
   a. Compartment Ignition Risk is based on:
      - Population Density
      - Power Lines – distribution as well as transmission
      - Industrial Operations – timber sale, construction project, fire use, mining, and so forth
      - Recreation – dispersed, developed, OHV, hunting, fishing
      - Flammables
      - Other – fireworks, children, shooting, incendiary, cultural, power equipment
      - Railroads
      - Transportation Systems – state, federal, public access
      - Commercial Development – camps, resorts, businesses, schools

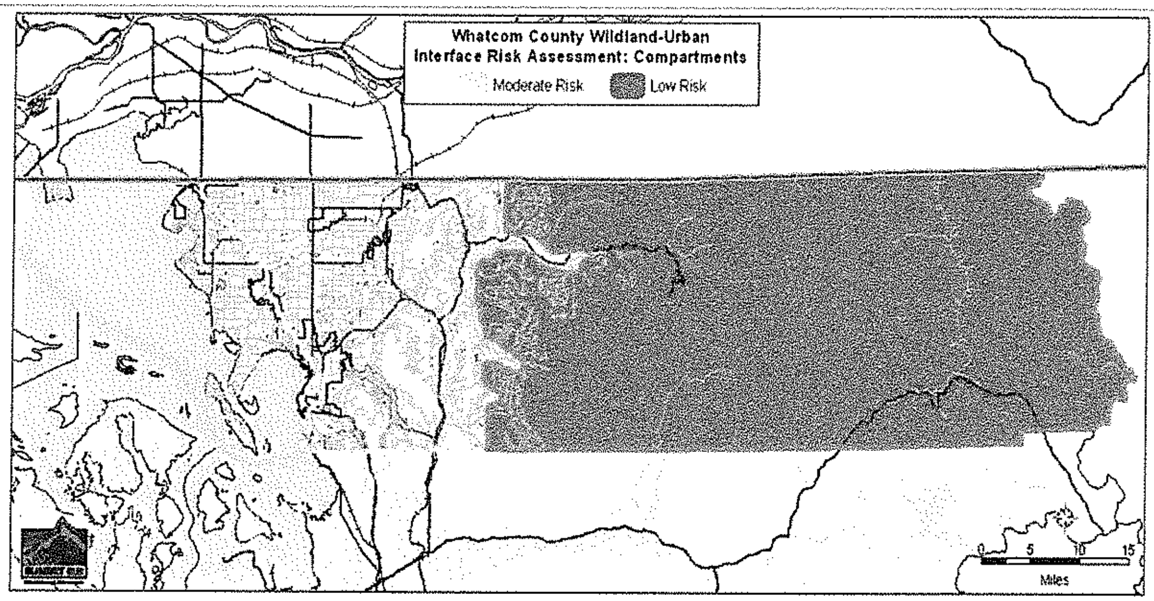
iv. Fire History – Fire history will be completed for each compartment to reflect:
   a. Fire location
   b. Cause
   c. Average annual acres burned
   d. Average annual number of fire by cause

v. Catastrophic Fire Potential – An evaluation of fire history reflects the potential for an event to occur. An example is if large damaging fires occur every 20 years and it has been 18 years since the last occurrence, this would reflect a priority for fire prevention management actions.
   a. Evaluate large fire history
   b. What are the odds of a stand replacement type fire occurrence in that compartment?
      - Unlikely
      - Possible
      - Likely

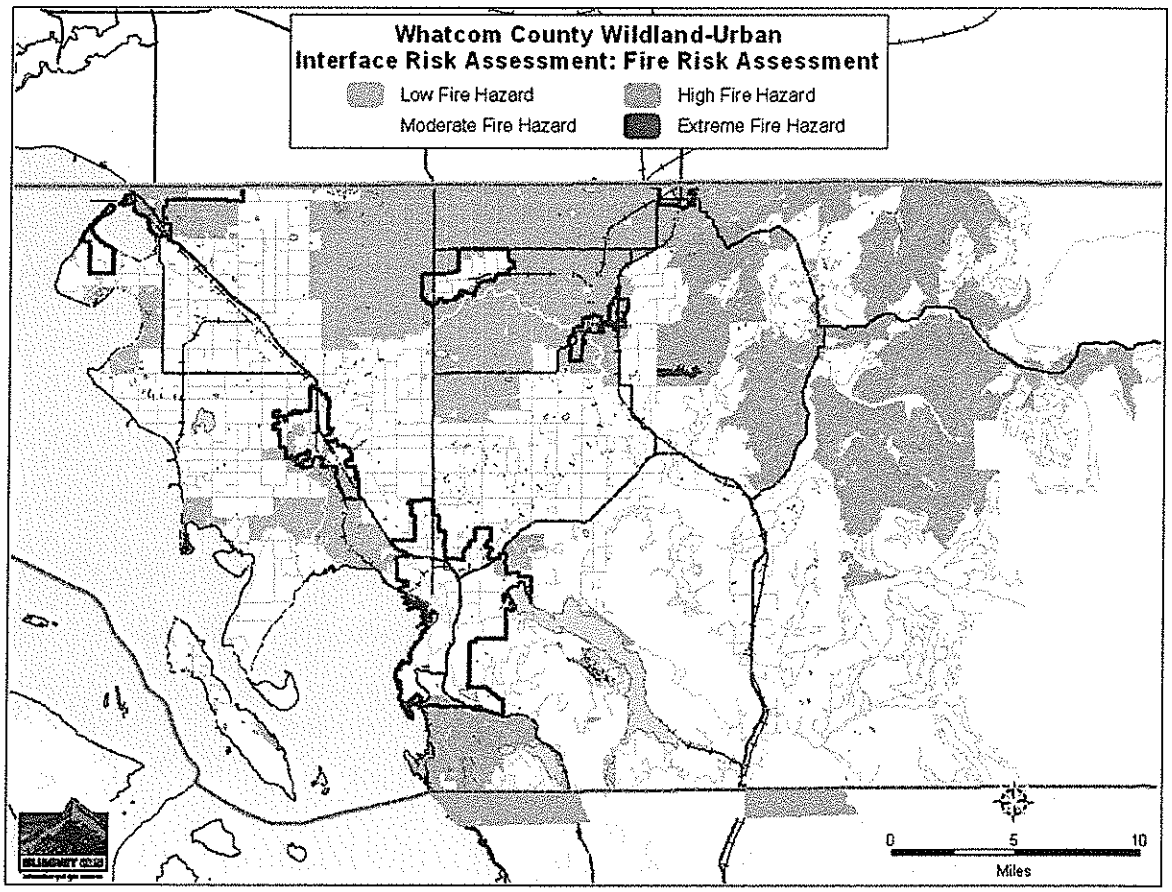
vi. Values – Values are defined as natural or developed areas where loss or destruction by fire would be unacceptable. The value elements include:
   a. Recreation – undeveloped/developed
   b. Administrative sites
   c. Wildlife/Fisheries – habitat existing
   d. Range Use
   e. Watershed
   f. Timber/Woodland
   g. Plantations
   h. Private Property

i. Cultural Resources
j. Special Interest Areas
k. Visual Resources
l. Threatened and Endangered Species
m. Soils
n. Airshed
o. Other Necessary Elements

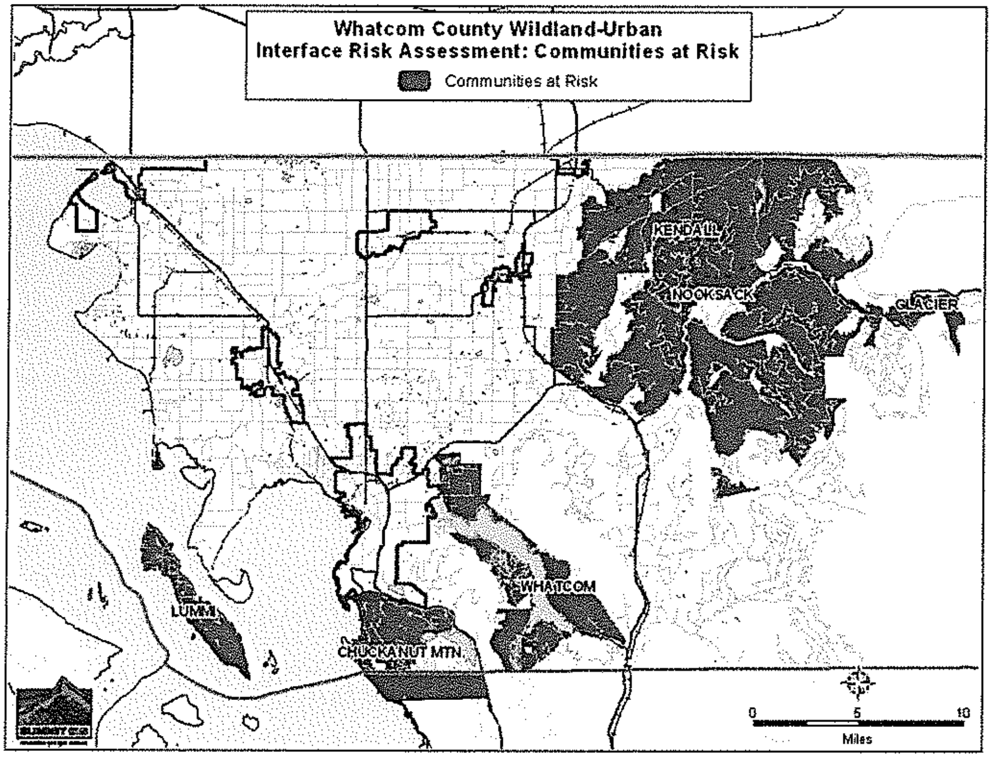
This evaluation process provides the basis for determining the *Whatcom County Wildland-Urban Interface Fire Risk Assessment Compartments* map. Additional information regarding the results of this process can be found in Appendix D, which contains excerpts from the RAMS Assessment.



RAMS risk assessment compartments were further broken down to identify Wildland-Urban Interface Hazards. Using 2000 Census data, individual areas were identified in the Wildland-Urban Interface and assessed using the National Fire Protection Association (NFPA) 299, Wildfire Hazard Assessment. The results of this assessment are depicted in the *Whatcom County Wildland-Urban Interface: Fire Risk Assessment* map.



The NFPA 299 was further refined, to reflect Whatcom County Fire Manager's input, producing a map that reflects Landscapes of Like Risk (Communities at Risk). Areas that received a high to extreme risk ranking were grouped into landscapes and named. The result is depicted in the following map. These areas of Whatcom County are at highest risk of catastrophic loss to a Wildland fire.



Mitigation Strategies

In cooperation with fire managers from WDNR, NW Region, three mitigation strategies were developed to address Whatcom County's fire hazards:

1. Inter-Agency Cooperation
2. County-wide Wildland Fire Prevention
3. WUI (Wildland/Urban Interface) Communities at Risk

Inter-Agency Cooperation

Inter-agency cooperation is the key to a successful wildland fire mitigation strategy. In the case of wildland fire risk mitigation, continued development and enhancement of support between fire protection agencies will be emphasized. Participation in the NW Region Wildland Fire Local Coordinating Group will continue and support of Local Coordination group activities will be a priority. Support of those activities proclaimed by the governor's office in relation to wildland fire prevention, such as Wildfire Awareness Week, should be made a priority.

County-Wide Wildland Fire Prevention
In the RAMS Compartments, where the wildland fire risk has been assessed at moderate, multi-agency cooperative fire prevention activities will occur during the summer months addressing the following:

1. Public awareness of current fire danger
2. Press releases
3. Media opportunities for fire prevention news articles
4. Radio and TV spots, as needed
5. Use of burn bans during periods of high fire danger
6. Use of Smokey Bear fire prevention programs targeting age-specific audiences during periods of extreme fire danger, or during significant wildland fire events
7. Consideration of mobilizing Washington State Inter-agency fire prevention teams
8. Use of other fire prevention tactics and strategies, as needed, and as conditions warrant

Wildland/Urban Interface (WUI) Communities at Risk
As a result of efforts conducted by WDNR, the following list of Landscapes of Like Risk were established.

1. Lake Whatcom – Sudden Valley, in the lake Whatcom watershed, is currently participating in the mitigation strategies set forth in this Plan
2. Nooksack
3. Glacier
4. Lummi Island – Lummi Island Scenic Estates, a community on Lummi Island, has received national recognition for their mitigation activities under the Firewise Communities/USA program
5. Kendall

In addition to CWPP recommendations, communities located in the Landscapes of Like Risk should consider the following mitigation strategies:

1. Use of the Firewise Communities program (www.firewise.org)

2. Conduct Firewise workshops

3. Increase homeowner awareness

4. Facilitate community involvement and support

5. Facilitate media involvement

6. Use the Firewise Communities/USA program (www.firewise.org/usa) to:

   a. Facilitate Community involvement and support
   b. Provide a course of action for community mitigation
   c. Nationally recognize achievement

Becoming a Recognized Firewise Community/USA®

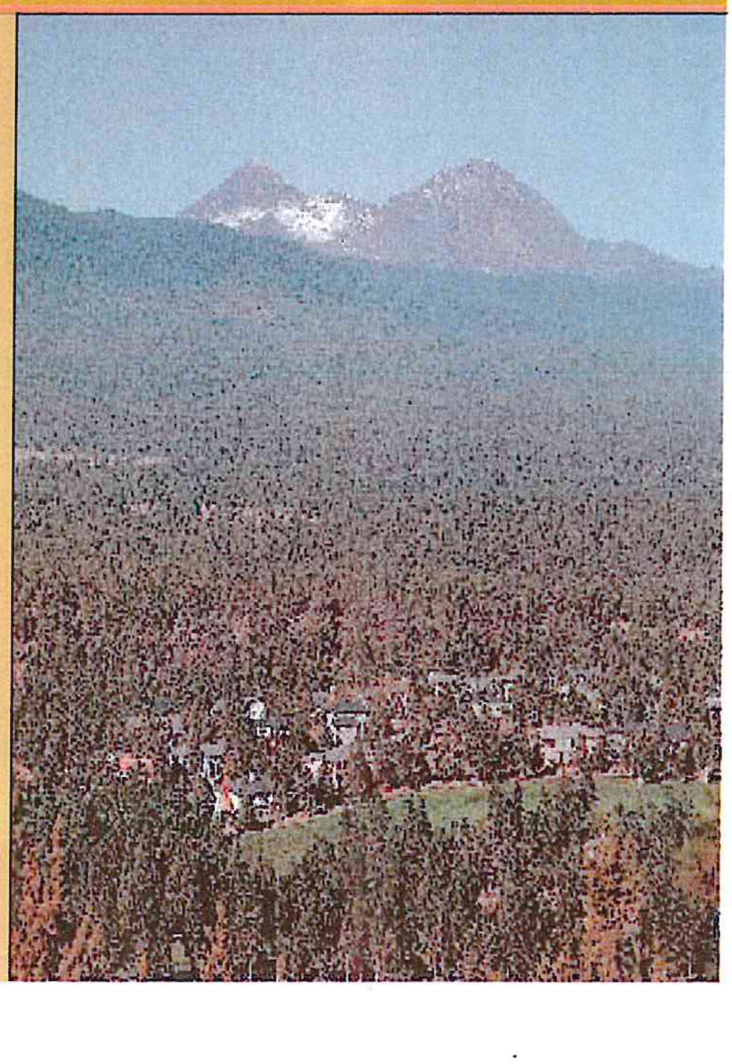
What is Firewise Communities/USA®?

How Can My Community Become A Recognized Firewise Community?

What are the Recognition Criteria?

What is the Home Ignition Zone and Why is it so Important?

What are the Benefits of Being a Firewise Community?



Living with Wildfire

Whether you've lived in the wildland/urban interface for years, or are purchasing or renting your dream home away from the hectic pace of city life, you may be concerned about wildfire. Living where wildfires can occur poses a risk to your property and loved ones — but it is possible to live compatibly with this natural event. Read on to learn more about how your participation in the Firewise Communities/USA Recognition Program can make you and your home safer.

What is Firewise Communities/USA® ?

Citizen involvement is the cornerstone of the Firewise Communities/USA® Recognition Program. If you are a homeowner or community resident whose home is located in a region susceptible to wildfires, this brochure will offer you relevant information on how you can help your community to become Firewise. As participants in the Program, you and your neighbors will learn how to decrease the risk of losing your homes and to best protect yourselves in the event of wildfire.

Within wildland/urban interface areas, firefighters lack the resources to defend every home that is threatened during extreme wildfires. However, communities whose residents take steps to reduce their vulnerability have a greater chance of surviving a wildfire. Firewise Communities/USA offers residents in fire-prone areas a unique opportunity to implement Firewise practices specially tailored to individual and community needs. You and your neighbors will gain useful knowledge and skills to prepare for a wildfire before it occurs, while also helping you maintain an acceptable level of fire readiness. Firewise homes and communities allow fire fighters to concentrate on fighting the wildfire – which ultimately saves more homes and lives. What's more, even a few preventive actions can prove critical, because when adequately prepared, homes have often survived a wildfire *without* the intervention of the fire department.

The Program draws on a community's spirit, its resolve, and its willingness to take responsibility for reducing wildfire risks by providing the resources needed to achieve both a high level of protection against wildland/urban interface fire and ecosystem balance. The Program utilizes the following three-legged template:

- *Wildland fire staff from federal, state or local agencies provide a community with information about living with wildfire with mitigation information tailored to your specific community or region.*

- *With the assistance of wildland fire staff, you and your neighbors assess wildfire risks around you and devise a cooperative network of other homeowners, agencies, and organizations.*

- *You and your neighbors identify and implement local solutions.*

How Can My Community Become A Recognized Firewise Community?

Ultimately, it all begins with you. Becoming Firewise takes time and coordination with your neighbors and others, but getting started is actually quite straightforward. The Firewise Communities/USA standards offer flexibility in creating the most appropriate plan and actions for your community. You will find that the effort expended reaps many rewards.

Following these steps, your community will be on its way toward becoming Firewise.

1) *Contact Firewise* — A community representative (you or another interested member of your community) completes an on-line request for contact by a Firewise representative on the Firewise Communities/USA web site, *www.firewise.org/usa.*

2) *Site Visit* — At an agreed-upon time, your state's Firewise Communities/USA liaison, a specialist in wildland/urban interface (WUI) fire, will visit your area and assess the proposed site. The visit is coordinated with local fire officials.

3) *Community Representatives* — At the same time, your community "spark plug" (again, this could be you) recruits community representatives to create a multi-disciplined Firewise board or committee. This group should include homeowners and fire professionals but may also include planners, land managers, urban foresters and members of other interest groups. Be aware that the development of the Firewise Community plan may take up to six months.

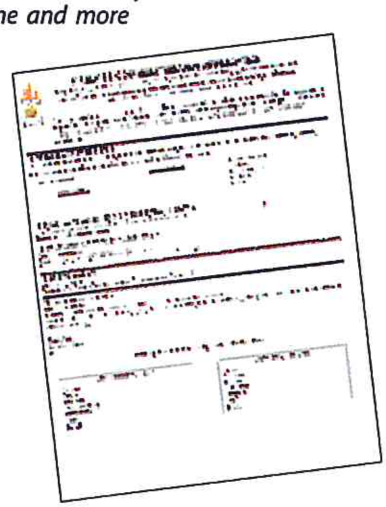
4) *Assessment & Evaluation* — Upon completing a site assessment and evaluation of the community's wildfire readiness, the WUI specialist schedules a meeting with your local Firewise board to present the assessment for review and acceptance by the board. If accepted, the process continues; if not, it is terminated.

5) *Moving Forward/Creating A Plan* — Your local Firewise board develops area-specific solutions to its WUI fire issues based on the WUI specialist's report. All members of the Firewise board must concur with the final plan. The recommendations are presented to and approved by the WUI specialist. The specialist may work with your community to seek project implementation funds, if needed.

6) *Implement Solutions* — Local solutions are implemented following a schedule designed by your Firewise group, who will be responsible for maintaining the program into the future.

7) *Apply for Recognition* — Firewise Communities/USA recognition status is achieved after your community submits its application form along with a completed Firewise community plan and Firewise event documentation to your state's Firewise liaison. *The application form is available online and more information on Firewise Recognition Criteria is on Page 5.*

8) *Renewing Your Recognition Status* — Annual renewal of your recognition is completed by submitting documentation of your community's continued participation to the state Firewise liaison. *This can be easily accomplished with the on-line form.*



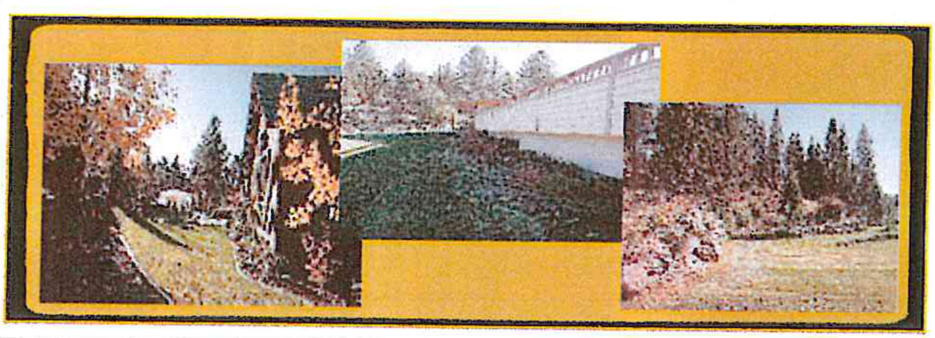
www.firewise.org/usa

What are the Recognition Criteria?

Neighborhoods, subdivisions, and small towns in fire-prone areas of the United States can earn Firewise Communities/USA Recognition status by creating dedicated local Firewise task forces and by implementing Firewise principles tailored to their specific community needs. This nationwide initiative recognizes communities for taking action to protect people and properties from the risk of fire in the wildland/urban interface. Communities create their programs themselves with cooperative assistance from local fire staff and state forestry agencies.

Fire-prone communities earn Firewise Communities/USA recognition status by meeting the following criteria:

- Enlisting a wildland/urban interface specialist to complete an assessment and create a plan that identifies locally agreed-upon solutions that the community can implement.
- Sponsoring a local Firewise task force, committee, commission or department which maintains the Firewise Community program and tracks its progress or status.
- Observing a Firewise Communities/USA Day each year that is dedicated to a local Firewise project.
- Investing a minimum of $2.00 annually per capita in local Firewise Communities/USA efforts. (Work by municipal employees or volunteers using municipal and other equipment can be included, as can state/federal grants dedicated to that purpose.)
- Submitting an annual report to Firewise Communities/USA, documenting continuing compliance with the program.



What is the Home Ignition Zone and *Why is it so Important?*

The Home Ignition Zone is the key to preparing your home for wildfire readiness. Your home ignition zone – including the condition of the house and its immediate surroundings within 100 to 200 feet and other structures such as garages, decks, porches, or fences that come in contact with the house – is what determines your home's susceptibility to ignition during a wildfire. "The more you can eliminate the things that can lead a wildfire to your home, the more likely your home will survive," notes Judith Leraas Cook, project manager of the Firewise Communities/USA Recognition Program. She offers some simple steps for evaluating your home ignition zone and making it a deterrent to the progress of the fire:

- Clear the build up of pine needles and leaves from the base of the house and any connecting structures which could otherwise ignite the home's siding.
- Create a three-foot, fire-free area on all sides of your home.
- Clear gutters of leaves and debris.

- Trim any limbs on trees hanging over the house.
- "Limb up" trees around the house by removing lower limbs that are 10 to 15 feet from the ground.
- Use metal flashing at all connection points of structures, such as wooden fences attached to the house.
- Clear trees and shrubs of dead material and keep them pruned. Space trees and shrubs far enough apart to slow the spread of an approaching wildfire.
- Regularly care for your property to keep it free of all dead leaves and needles.
- Choose deciduous trees, rather than evergreens, when planting close to your home. Sap from evergreens is good fuel for fire. Deciduous plants burn more slowly.

• Install glass skylights. Plastic melts during a fire.

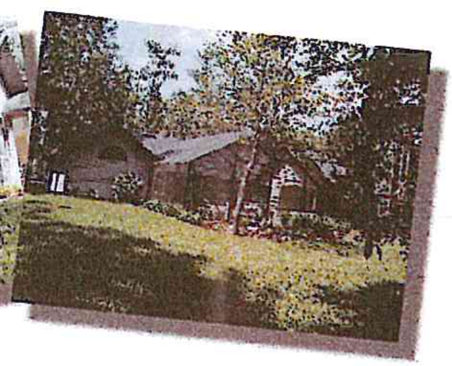
• Store firewood well away from your house, particularly during fire-season.

• Remove excess vegetation along roads and remove chipped wood immediately after cutting.

• Use non-flammable (Class A) roofing materials.

• Plant native wildflowers and fire-resistant plants; keep lawns green and irrigated as they serve as good fire breaks, as do rock gardens and xeriscapes.

• Remember that wide driveways, non-flammable walkways and other pathways can slow or stop the spread of a wildfire.



The national Firewise Communities program is an interagency program designed to encourage local solutions for wildfire safety by involving homeowners, community leaders, planners, developers, firefighters, and others in the effort to protect people and property from the risk of wildfire. The Firewise Communities program is sponsored by the National Wildfire Coordinating Group's Wildland/Urban Interface Working Team, a consortium of wildland fire agencies that includes the USDA Forest Service, the Department of the Interior, the Federal Emergency Management Agency, the International Association of Fire Chiefs, the National Emergency Management Association, the US Fire Administration, the National Association of State Fire Marshals, the National Fire Protection Association, and state forestry organizations. For more information, visit www.firewise.org.

What are the Benefits of Being a Firewise Community?

While the benefits can vary, there are a number of positive outcomes experienced by communities that become members of the Firewise Communities/USA Recognition Program. Being "Firewise":

- Creates defensible space that prevents fires from advancing and endangering homes and lives.
- Improves property value while reducing risk of loss.
- Improves community relationships with local fire staff, since firefighters can concentrate their efforts on fighting wildfires rather than devoting often limited resources to protecting homes – which may ultimately be lost if the fire can't be contained.
- Encourages good neighbors, since the more homes within a community that adopt "Firewise" practices, the greater the impact on reducing the heat and speed of the fire.
- Offers peace of mind, knowing that your home is prepared to survive a wildfire in the event one should occur.

Where Can I Get More Information about Firewise Communities/USA?

*For more information on the Firewise Communities/USA Recognition Program, visit **www.firewise.org/usa** or contact your state forestry agency.*

FWC10406

ADDENDUM VII

PRUNING GUIDELINES

ANSI®
A300 (Part 1)-2001
Revision of
ANSI A300-1995

American National Standard
for Tree Care Operations –

Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices *(Pruning)*

Secretariat

National Arborist Association, Inc.

Approved May 22, 2001

American National Standards Institute, Inc.
Headquarters:
1819 L Street, NW
Sixth Floor
Washington, DC 20036
New York Office:
25 West 43rd Street
Fourth Floor
New York, NY 10036

Contents

American National Standard for Tree Care Operations –

Tree, Shrub, and Other Woody Plant Maintenance – Standard Practices *(Pruning)*

1 ANSI A300 standards

1.1 Scope

ANSI A300 standards present performance standards for the care and maintenance of trees, shrubs, and other woody plants.

1.2 Purpose

ANSI A300 standards are intended as guides for federal, state, municipal and private authorities including property owners, property managers, and utilities in the drafting of their maintenance specifications.

1.3 Application

ANSI A300 standards shall apply to any person or entity engaged in the business, trade, or performance of repairing, maintaining, or preserving trees, shrubs, or other woody plants.

1.4 Implementation

Specifications for tree maintenance should be written and administered by an arborist.

2 Part 1 – Pruning standards

2.1 Purpose

The purpose of this document is to provide standards for developing specifications for tree pruning.

2.2 Reasons for pruning

The reasons for tree pruning may include, but are not limited to, reducing risk, maintaining or improving tree health and structure, improving aesthetics, or satisfying a specific need. Pruning practices for agricultural, horticultural production, or silvicultural purposes are exempt from this standard.

2.3 Safety

2.3.1 Tree maintenance shall be performed only by arborists or arborist trainees who, through related training or on-the-job experience, or both, are familiar with the practices and hazards of arboriculture and the equipment used in such operations.

2.3.2 This standard shall not take precedence over arboricultural safe work practices.

2.3.3 Operations shall comply with applicable Occupational Safety and Health Administration (OSHA) standards, ANSI Z133.1, as well as state and local regulations.

3 Normative references

The following standards contain provisions, which, through reference in the text, constitute provisions of this American National Standard. All standards are subject to revision, and parties to agreements based on this American National Standard shall apply the most recent edition of the standards indicated below.

ANSI Z60.1, *Nursery stock*

ANSI Z133.1, *Tree care operations - Pruning, trimming, repairing, maintaining, and removing trees, and cutting brush - Safety requirements*

29 CFR 1910, General industry [1)]

29 CFR 1910.268, Telecommunications [1)]

29 CFR 1910.269, Electric power generation, transmission, and distribution [1)]

29 CFR 1910.331 - 335, Electrical safety-related work practices [1)]

4 Definitions

4.1 anvil-type pruning tool: A pruning tool that branches. Lion's tailing is not an acceptable pruning practice (5.5.7).

4.28 **mechanical pruning:** A utility pruning technique where large-scale power equipment is used to cut back branches (5.9.2.2).

4.29 **parent branch or stem:** A tree trunk, limb, or prominent branch from which shoots or stems grow.

4.30 **peeling:** *For palms:* The removal of only the dead frond bases at the point they make contact with the trunk without damaging living trunk tissue. (syn.: shaving)

4.31 **petiole:** A stalk of a leaf or frond.

4.32 **phloem:** Inner bark conducting tissues that transport organic substances, primarily carbohydrates, from leaves and stems to other parts of the plant.

4.33 **pollarding:** The maintenance of a tree by making internodal cuts to reduce the size of a young tree, followed by the annual removal of shoot growth at its point of origin (5.7.3).

4.34 **pruning:** The selective removal of plant parts to meet specific goals and objectives.

4.35 **qualified line-clearance arborist:** An individual who, through related training and on-the-job experience, is familiar with the equipment and hazards in line clearance and has demonstrated the ability to perform the special techniques involved. This individual may or may not be currently employed by a line-clearance contractor.

4.36 **qualified line-clearance arborist trainee:** An individual undergoing line-clearance training and who, in the course of such training, is familiar with the hazards and equipment involved in line clearance and has demonstrated ability in the performance of the special techniques involved. This individual shall be under the direct supervision of a qualified line-clearance arborist.

4.37 **raising:** Selective pruning to provide vertical clearance (5.6.3).

4.38 **reduction:** Selective pruning to decrease height and/or spread (5.6.4).

4.39 **remote/rural areas:** Locations associated with very little human activity, land improvement, or development.

4.40 **restoration:** Selective pruning to improve the structure, form, and appearance of trees that have been severely headed, vandalized, or damaged (5.7.4).

4.41 **shall:** As used in this standard, denotes a mandatory requirement.

4.42 **should:** As used in this standard, denotes an advisory recommendation.

4.43 **stub:** An undesirable short length of a branch remaining after a break or incorrect pruning cut is made.

4.44 **thinning:** Selective pruning to reduce density of live branches (5.6.2).

4.45 **throwline:** A small, lightweight line with a weighted end used to position a climber's rope in a tree.

4.46 **topping:** The reduction of a tree's size using heading cuts that shorten limbs or branches back to a predetermined crown limit. Topping is not an acceptable pruning practice (5.5.7).

4.47 **tracing:** The removal of loose, damaged tissue from in and around the wound.

4.48 **urban/residential areas:** Locations, such as populated areas including public and private property, that are normally associated with human activity.

4.49 **utility:** An entity that delivers a public service, such as electricity or communications.

4.50 **utility space:** The physical area occupied by a utility's facilities and the additional space required to ensure its operation.

4.51 **vista pruning:** Selective pruning to allow a specific view (5.7.5).

4.52 **watersprouts:** New stems originating from epicormic buds. (syn.: epicormic shoots)

4.53 **wound:** An opening that is created when the bark of a live branch or stem is penetrated, cut, or removed.

5.6.1.2 Size range of parts to be removed shall be specified.

5.6.2 Thin: Thinning shall consist of selective pruning to reduce density of live branches.

5.6.2.1 Thinning should result in an even distribution of branches on individual limbs and throughout the crown.

5.6.2.2 Not more than 25 percent of the crown should be removed within an annual growing season.

5.6.2.3 Location of parts to be removed shall be specified.

5.6.2.4 Percentage of foliage and size range of parts to be removed shall be specified.

5.6.3 Raise: Raising shall consist of selective pruning to provide vertical clearance.

5.6.3.1 Vertical clearance should be specified.

5.6.3.2 Location and size range of parts to be removed should be specified.

5.6.4 Reduce: Reduction shall consist of selective pruning to decrease height and/or spread.

5.6.4.1 Consideration shall be given to the ability of a species to tolerate this type of pruning.

5.6.4.2 Location of parts to be removed and clearance should be specified.

5.6.4.3 Size range of parts should be specified.

5.7 Specialty pruning

Consideration shall be given to the ability of a species to tolerate specialty pruning, using one or more pruning types (5.6).

5.7.1 Young trees

5.7.1.1 The reasons for young tree pruning may include, but are not limited to, reducing risk, maintaining or improving tree health and structure, improving aesthetics, or satisfying a specific need.

5.7.1.2 Young trees that will not tolerate repetitive pruning and have the potential to outgrow their space should be considered for relocation or removal.

5.7.1.3 At planting

5.7.1.3.1 Pruning should be limited to cleaning (5.6.1).

5.7.1.3.2 Branches should be retained on the lower trunk.

5.7.1.4 Once established

5.7.1.4.1 Cleaning should be performed (5.6.1).

5.7.1.4.2 Rubbing and poorly attached branches should be removed.

5.7.1.4.3 A central leader or leader(s) as appropriate should be developed.

5.7.1.4.4 A strong, properly spaced scaffold branch structure should be selected and maintained.

5.7.1.4.5 Interfering branches should be reduced or removed.

5.7.2 Espalier

5.7.2.1 Branches that extend outside the desired plane of growth shall be pruned or tied back.

5.7.2.2 Ties should be replaced as needed to prevent girdling the branches at the attachment site.

5.7.3 Pollarding

5.7.3.1 Consideration shall be given to the ability of the individual tree to respond to pollarding.

5.7.3.2 Management plans shall be made prior to the start of the pollarding process for routine removal of watersprouts.

5.7.3.3 Internodal cuts shall be made at specific locations to start the pollarding process. After the initial cuts are made, no additional internodal cut shall be made.

5.7.3.4 Watersprouts growing from the cut ends of branches (knuckles) should be removed annually during the dormant season.

with a narrow angle of attachment should be made from the bottom of the branch to prevent damage to the parent limb (see Figure 5.3.7).

5.9.2.1.2 A minimum number of pruning cuts should be made to accomplish the purpose of facility/utility pruning. The natural structure of the tree should be considered.

5.9.2.1.3 Trees directly under and growing into facility/utility spaces should be removed or pruned. Such pruning should be done by removing entire branches or by removing branches that have laterals growing into (or once pruned, will grow into) the facility/utility space.

5.9.2.1.4 Trees growing next to, and into or toward facility/utility spaces should be pruned by reducing branches to laterals (5.3.3) to direct growth away from the utility space or by removing entire branches. Branches that, when cut, will produce watersprouts that would grow into facilities and/or utility space should be removed.

5.9.2.1.5 Branches should be cut to laterals or the parent branch and not at a pre-established clearing limit. If clearance limits are established, pruning cuts should be made at laterals or parent branches outside the specified clearance zone.

5.9.2.2 Rural/remote locations – mechanical pruning

Cuts should be made close to the main stem, outside of the branch bark ridge and branch collar. Precautions should be taken to avoid stripping or tearing of bark or excessive wounding.

5.9.3 Emergency service restoration

During a utility-declared emergency, service must be restored as quickly as possible in accordance with ANSI Z133.1, 29 CFR 1910.331 – 335, 29 CFR 1910.268, or 29 CFR 1910.269. At such times it may be necessary, because of safety and the urgency of service restoration, to deviate from the use of proper pruning techniques as defined in this standard. Following the emergency, corrective pruning should be done as necessary.

Tree Pruning

Introduction

This pruning guide is designed for beginning tree pruners and is written for the Puget Sound region of the Pacific Northwest (United States). Please use this to help you and your friends and neighbors understand correct pruning techniques. This guide is written in English, and is being translated into other languages, and was made possible by funding from the USDA Forest Service and the King County Department of Natural Resources.

Depending upon where you live, you may be required to get a permit for tree pruning and removal. These requirements vary from city to city, borough, county, state, and country. Please consult your local agriculture or forestry bureau for more information.

The City of Seattle requires a permit for removal of street trees or to hire a professional to prune. Permits are also required for pruning and removal of trees in critical areas (wetlands or steep slopes). For information, telephone **206.684.5008** or go to: **http://www.seattle.gov/transportation/forestry.htm**

Guidelines for When to Prune

* Prune to remove broken branches or to get street and sidewalk clearance anytime.
* Prune fruit trees when they are in winter dormancy before the buds swell or, in the summer.
* Prune willow and poplar trees late in the summer.
* Prune elm trees in the Pacific Northwest only between October 15th and April 15th (while leaves are off the tree) to minimize damage from the elm leaf borer and Dutch Elm Disease.
* Prune birch, beech and maple trees after a hard frost to lessen sap flow.

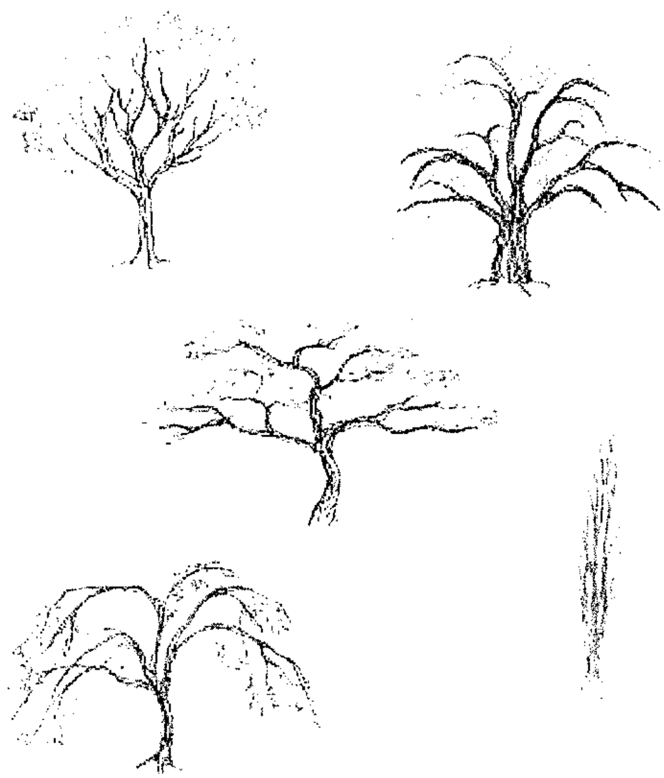
Why Prune Trees?

* Prune to increase visibility and provide clearance for pedestrians and vehicles. In Seattle, street tree branches must provide 8 feet of clearance over the sidewalk and 14 feet above the street at the curb.
* Prune to allow for light penetration or to frame a view.
* Prune to remove broken, diseased, or dead branches and suckers from the roots or root collar.
* Prune to direct growth and improve the structure in young trees.
* To increase fruit production.
* Prune trees to encourage and direct growth and accentuate a tree's beauty, not to inhibit growth.

By properly removing branches, we make sure that trees will mature to their natural shapes and preserve their natural beauty, vigor, and health. A little careful pruning early can protect your tree from branches breaking or becoming too crowded as the tree grows.

Most pruning involves removing a few lower branches and when done correctly, trees require less pruning as they mature. Good pruning never changes the shape of the tree.

Examples of the natural shape and form of trees

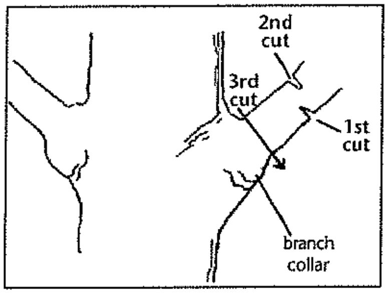


Natural Target Pruning - Learn Where and How to Make Pruning Cuts

By using the three step method when pruning, trees will respond by quickly closing over pruning cuts, remaining healthy, and looking nice. Branches are actually made from their own wood which is held onto the trunk by yearly wrappings of new growth. The branch collar is where the branch wood and the trunk wood meet. Making the pruning cut just outside this collar is important for tree health.

The angle of your pruning cut should expose the least amount of surface area. Use the three cut method to ensure that the bark does not tear as the branch falls away, causing a bigger injury to the trunk.

Three Cut Method for Removing Large Branches

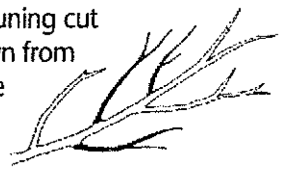


Use the three cut method to remove branches larger than ¾ inch or 2 centimeters. On narrow angled branch attachments, you may have to cut entirely from the outside upwards.

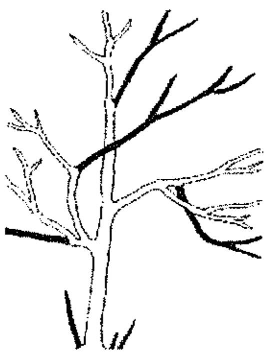
Types of Pruning Cuts

Thinning Cuts

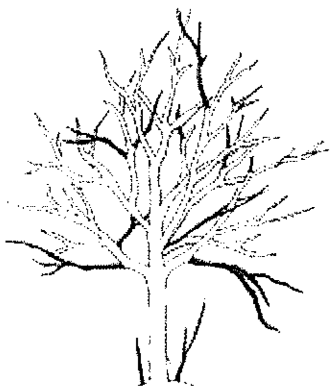
Thinning cuts are better for the health of a tree. Remove an entire branch by making a good pruning cut where the branch would have grown from a bud on another branch or the tree trunk. Thinning cuts are used to open or raise the tree canopy and can also be used to remove select branches to improve views.



Note: Thinning removes an entire branch back to another branch or to the trunk of the tree.



pruned small tree

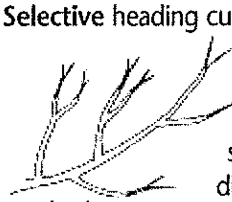


pruned older tree

Note: Do not remove more than 25% of the canopy of the tree in one growing season or over a five year period otherwise you stimulate sprouts that grow quickly and are unhealthy and unsightly and could be unsafe.

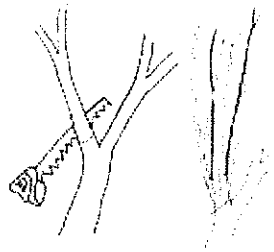
Heading Cuts

Selective heading cuts are used to shorten the branch and change its direction of growth. Prune the branch just above a bud that points in the desired direction or to a side branch that is at least half the diameter of what you are removing.



selective heading cuts

Making a **non selective** heading cut removes a branch that leaves a stub and open end that can either take a long time to cover with bark or be a point of entry for disease. These cuts are hardest on a tree and usually result in a quick regrowth of lots of shoots.

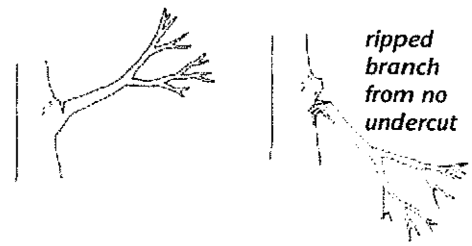


non selective heading cut results in lots of sprouts

Note: Head cuts are only used to change the direction of growth when a thinning cut will remove too much wood. Always cut above a bud facing the direction of the desired new growth.

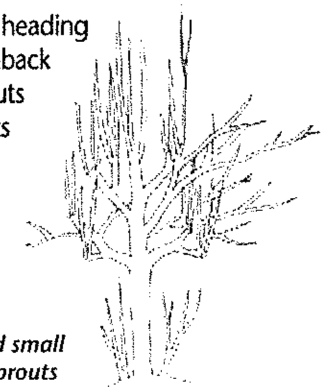
Good Tips to Avoid Bad Pruning

Use the 3 cut method to shorten branches before removal. This will prevent the branch from damaging the trunk as it falls to the ground, as shown in drawings below.



Do Not Top Trees!

Topping cuts are a non selective heading cut that causes the branch to dieback or form weak, rapid, bushy sprouts that are unsightly. If these sprouts are allowed to grow, they can become unsafe from being so heavy and yet just attached to the outer bark.



regrowth of topped small tree with lots of sprouts

Trees give us so much
Please keep them healthy and safe!

Reproduction encouraged! This Tree Pruning Guide was made possible by a grant from the King County Department of Natural Resources and Parks and funds from the USDA Forest Service and Washington Department of Natural Resources, with other assistance from the City of Seattle, awarded through the Natural Resource Stewardship Network. Assistance was also provided from PlantAmnesty, the University of Nevada Cooperative Extension, Forestry students at the University of Washington, and students in the Wilderness Inner-city Leadership Development program.

It is intended to help more people understand how to prune trees. If you have concerns with the translation, please email **trees@seattle.gov** or telephone **206.684.5008.**

King County
Department of Natural Resources and Parks
Water and Land Resources Division
City of Seattle
Natural Resources