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Introduction

The process of evaluating tree health and condition involves gathering information in the field, determining the significance of that information and producing a report of the findings. In producing and explaining the findings each report is designed to be readily understood and able to stand alone, with no further reference being required by the reader. To that end, each report contains the following sections:

- **Overview**; describing the events that precipitated the evaluation and identifying the subject, owner and location.
- **Tree Inspection**; containing an explanation of the field work techniques and methods and instruments used in analysis.
- **Observations**; providing site and tree specific information and commentary.
- **Conclusions**; giving an interpretation of the field work observations, testing and analysis, with recommendations for treatment.

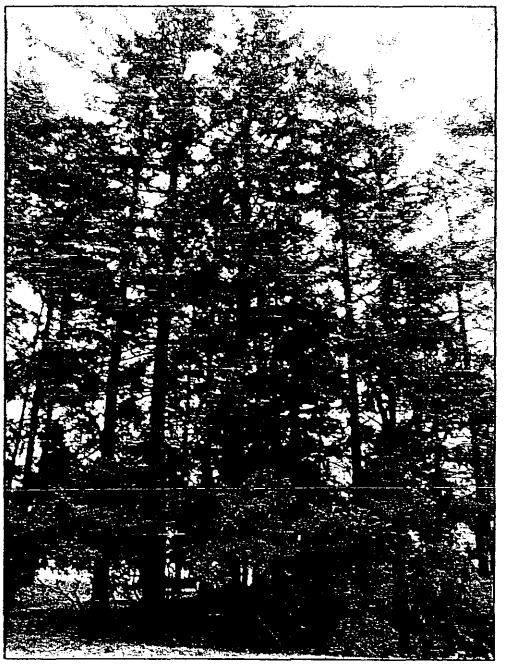
Overview

The process of developing the site at the Campfire Girls and Boys facility at 8511 15th NE in Seattle is underway. Prescott Homes is constructing the Maple Leaf Cottages on the site. Plans include the placement of the new homes in close proximity to a group of trees on the eastern periphery of the site. To evaluate the trees to assess health, structural condition and failure risk relative to the latest design, a Tree Inspection was recommended. The Inspection took place during the last week of February 2008.

During March of 2008 an additional site visit was made to make observations and carry out preliminary site preparation for the Tree Preservation Guidelines and Specifications; section which follows the Tree Inspection report.

Tree Inspection

To develop an accurate picture of tree health and condition, information must be gathered about the multiple, changeable, factors which influence tree vitality and stability. Vital, healthy tree growth is the result of a complex association of internal and external influences and to consider each tree as an isolated entity is to fall short in understanding the whole picture. As a practical matter, this information must be gathered and structured in the best way to communicate the results of the observations and to impart any recommendations for treatment.



Individual tree inspection begins at ground level; tree genus and species is determined and soil quality, rooting conditions, soil level, irrigation and drainage characteristics are observed. Soil is a living micro-system that relies on an active working relationship between structural and living organic components. The structural condition of the soil is most commonly adversely affected.

The quality of the soil may be assessed in its ability to contain and disperse available moisture and the level of soil compaction may be tested to evaluate the aeration capacity of the soil. Some soil types are easily compacted and although they are high in nutrient quantity, little of that nutrient quality is available to the growing tree. Compact soils also cause problems by restricting the trees ability to discharge the gasses produced as part of the growth cycle.

The visible parts of the tree, the trunk, branches and leaves live in balance with the unseen roots. Damage to the soil leads to inhibited root growth and causes a lack of vitality and decline within the tree as a whole. Soil compaction is commonly the result of heavy traffic in the root zone. The effects of soil compaction may not become apparent in the tree for decades following the initial compaction event.

If signs of stress are present, a soil test may be made to assess the fertility of the soil. Testing establishes the presence and degree of vital nutrients and micro-flora. Vital soil is essential to vital tree growth, the presence of nutrients and organisms within the soil mean that growth can continue. An imbalance of nutrients can cause poor vitality; often exhibited by leaf discoloration or lack of annual growth. Poor nutrition will slow growth and can diminish the trees natural defense mechanisms and expose the tree to disease.

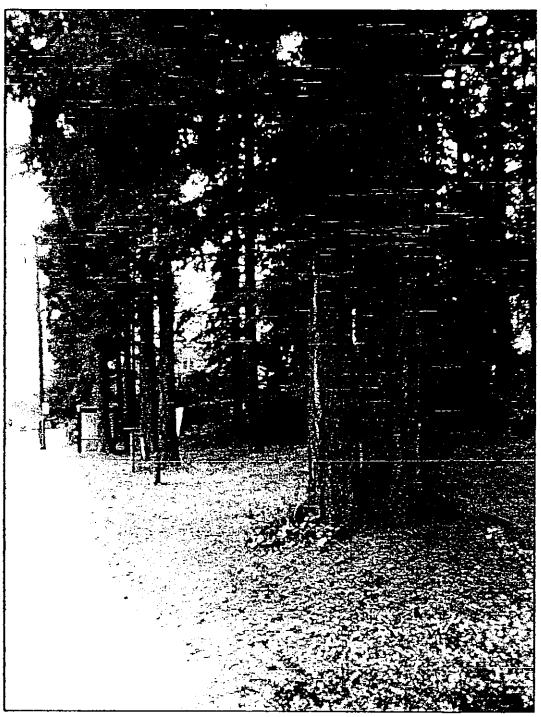
In nature, few tree species grow alone; the forest is their natural and protected setting. Whether native or introduced, irregardless of a trees origin, trees in a landscape setting demand special attention. Although bound by the genetic code of its predecessors each tree is also the product of its local environment in terms of health and stability.

Looking at the overall picture, the health of the soil, turf and other plants and trees can reveal the cause of disease, or indicate potential problems. The presence of certain species of fungus can indicate decay. Certain decay fungi

may destroy support tissues and leave conductive tissues unharmed. The tree may appear healthy and continue to grow until the internal decay outpaces the new outer growth.

A root crown examination may be necessary if root decay is suspected. By removing the soil at the base of the tree, the location, health and condition of the absorbing and support roots can be determined.

In the primary examination of the root crown and trunk a mallet is used to test for loose bark. Bark lifting can indicate dead or hollow areas and give signs of the presence of decay in the root crown zone and at the base of the trunk. The mallet may be used to "sound" for decay but has limited reliability. If decay is suspected the tree will be tested using the Resistograph. The Resistograph is an instrument that inserts a constant velocity probe into the suspect area of the tree. The resistance to the probe is graphed by the machine. The graph profile can tell a great deal about the internal character of the wood. Internal defects can be detected, cracks, hollows and early stage decay. The type of decay and its effect on the stability of the wood depends on the species of fungus involved. Soil and root tissue samples may be taken to determine the cause of disease by laboratory testing.

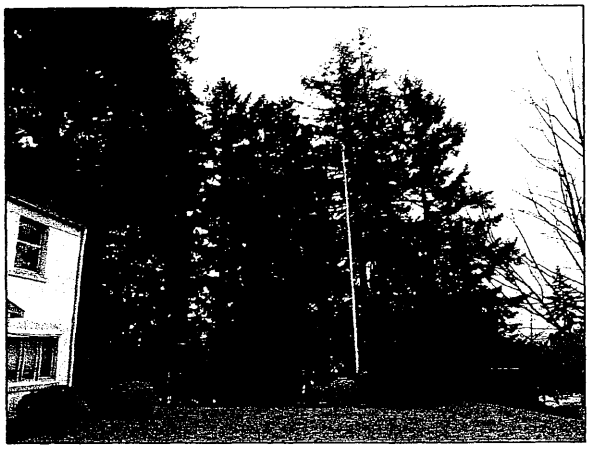


The inspection continues with an evaluation of the tree crown, first by eye or with the use of binoculars then, if necessary, by climbing into the canopy of the tree. The color, size and condition of the leaves, trunk, branches and twigs are assessed. The form and formation of all the trees components give information about health, vitality and structural strength. The crown density, the number of leaves on each stem, and past and current growth extension, indicate current health and reveal previous problems. Changes in growth rate in past growth may indicate prior disease or injury.

An evaluation of the general growth habit will reveal any problems related to vigor, or the genetic component of tree growth. Previous treatments such as pruning or cabling are observed, the quality of the work, and its effect on the tree. Any growth abnormalities are noted: weak limbs, discolored or missing bark, cracks or cavities in branches or trunks. Indications of disease are observed within the canopy of the tree, disease may be indicated by leaf blight, stem canker, fungal growth or insect and bird activity.

Trees produce adaptive growth to compensate for the stress related to growth and injury. The shape and formation of limbs and trunks can show the ability of the tree to compensate for weakness or indicate internal problems that may lead to limb or trunk breakage. The interpretation of these changes in form is part of a growing body of knowledge pioneered in Europe. The knowledge is not new but the application is: Dr. Claus Mattheck of the Karlsruhe Institute and colleagues, have developed a system of structural evaluation based on the principals of bio-engineering. I have chosen to use this approach to augment my own knowledge and experience.

Observations



Thirty-six trees were inspected in six species. The species include:

- Pacific Madrone (*Arbutus menziesii*)
- Douglas fir (*Pseudotsuga menziesii*)
- Western Hemlock (*Tsuga heterophylla*)
- Pacific Dogwood (*Comus nuttallii*)
- Western redcedar (*Thuja plicata*)
- Austrian Pine (*Pinus nigra*)

In general, the individual trees display a wide range in vitality and structural condition. The trees show good to poor vitality with some trees standing dead. Observations were made on each tree and are listed below with the tree numbers taken from the original survey and tree retention plan; as follows:

1. Douglas fir: Showing moderate vitality with some swelling at the base, trunk asymmetry and resinosis (resin flow on the trunk). The tree has been line-cleared and there are stubs and deadwood within the canopy.
2. Madrone: Good overall vitality with decay in the base from an old wound on the SW quadrant. There is surface rooting and the roots have developed on a rock wall.
3. Madrone: An immature tree with no significant problems.
4. Douglas fir: Shows good vitality with some resinosis, old wounds, deadwood in the canopy and stubs. Resonance testing led to a Resistograph test. *(results follow this section.)
5. Douglas fir: Showing good vitality and has grown in close proximity to tree number 4. Displays minor resinosis and some deadwood.

11. Douglas fir: Displays moderate vitality, slightly sheltered by location within the stand. There is some deadwood and broken limbs.
12. Douglas fir: High Crown, displays moderate vitality, slightly diminished by stand location; will be edge tree in new stand.
13. Hemlock: Dead tree.
14. Douglas fir: Moderate-poor vitality, dieback and suppressed.
15. Douglas fir: Moderate vitality with major asymmetry. The trunk is deviated and there are old wounds and deadwood.
16. Douglas fir: Moderate vitality with waisting at the base; old wounds and deadwood.
17. Douglas fir: Moderate vitality with some trunk swelling with old wounds, deadwood and stubs.
18. Douglas fir: Good vitality with resinosis. This tree was line cleared and there are stubs and deadwood.
19. Douglas fir: Showing moderate vitality; suppressed, old wounds, deadwood and major asymmetry.
20. Douglas fir: Good vitality with minor resinosis and deadwood.
21. Douglas fir: Shows good vitality; contains deadwood and stubs. The tree has been line-cleared.
22. Douglas fir: Moderate vitality, a sway in the trunk, resinosis and deadwood.
23. Douglas fir: With moderate vitality, deadwood, stubs and broken limbs. The tree has been line-cleared and holds the makings of a tree house.
24. Douglas fir: Shows good vitality with no significant problems.
25. Douglas fir: Poor vitality, suppressed. *Tested with the Resistograph.
26. Douglas fir: Moderate vitality, trunk asymmetry, a flat area on the SE quadrant, contains stubs and has been line-cleared.
40. Douglas fir: Good vitality with minor trunk asymmetry and deadwood.
41. Douglas fir: Good vitality with asymmetry in the crown, an old wound on the N. side, broken limbs, stubs and deadwood.

42. Douglas fir: Moderate – good vitality, deadwood, broken limbs and stubs with resinosis; there is waisting at the base. *Resistograph tested.
43. Western redcedar: Displaying good vitality with no significant problems.
44. Douglas fir: Good vitality, deadwood and stubs. This tree will be newly exposed with site clearing and considered the 'lynchpin tree'.
45. Douglas fir: Moderate - poor vitality with old wounds and trunk deviation.
46. Douglas fir: Moderate – poor vitality, old wounds, suppressed.
47. Douglas fir: Moderate vitality, previously topped, with deviated leaders and over-extended limbs.
48. Dogwood: Immature tree, some broken limbs, no significant problems.
49. Douglas fir: Moderate vitality, previously topped and deviated leader. Resonance sounding led to *Resistograph testing.
62. Dogwood: Immature tree with good vitality and no significant problems.
105. Austrian Pine: Displays moderate vitality with deadwood
106. Austrian Pine: Displays moderate vitality with minor deadwood.
107. Austrian Pine: Displays moderate vitality with minor deadwood.
108: Austrian Pine: Displays moderate vitality, co-dominance with inclusion, old wounds and dieback.

Resistograph Testing

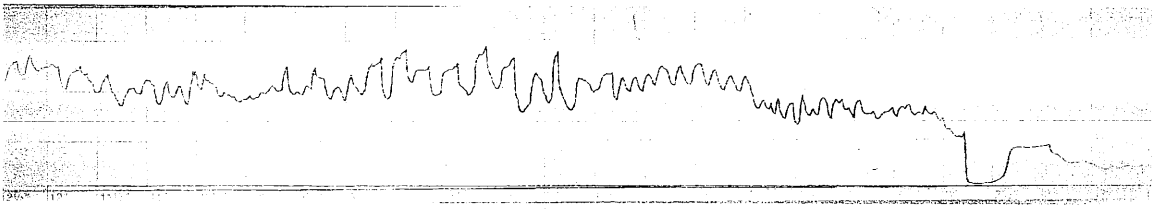
Where significant internal problems were suspected following resonance testing, trees were tested with the Resistograph. The Resistograph is an instrument, or rather a family of instruments, for detecting decay and defects in trees and timber. The instrument measures the resistance to a needle inserted into the wood under constant drive. In the M300 model, the constant drive is provided by either a crank and fly wheel or a battery driven electric motor, while the F400 relies on a battery driven motor alone. The M300 tests to a depth of 12" and the F400 to 16"in depth.

The resistance to the needle tip is transferred through an "intelligent" satellite gearbox to a pointer on the top of the instrument that maps the result on a waterproof wax paper printout. Drilling resistance correlates to the physical

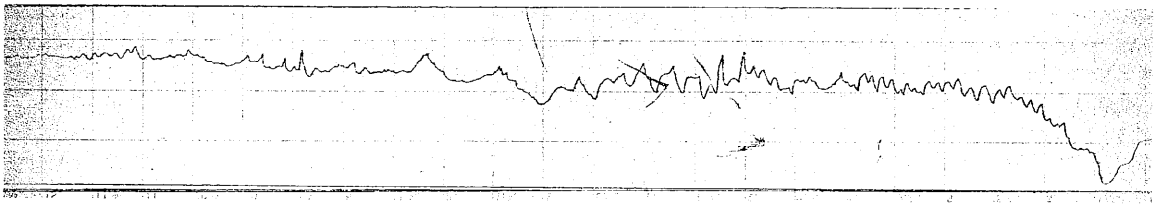
properties of the wood. Defects such as cracks areas of decay, hollows and to a certain extent tree ring structures can be detected and mapped. The resistance is mapped on a 1:1 scale on the wax paper, giving a clear graphical representation of the mechanical properties of the wood. The Resistograph utilizes a 3mm needle tip and a 1.5mm flexible needle that tends to "squeeze" between the fibres of the wood causing very little wounding.

Four trees were tested; the Resistograph charts are shown below and should be read from right to left; areas of lower strength are shown by a lower reading on the scale:

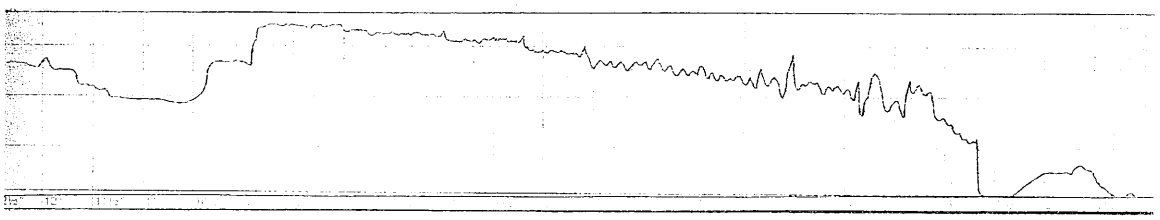
Tree 4 shows a profile of normal resistance to the probe to a depth of 12.5" where a small area of possible early decay is indicated.



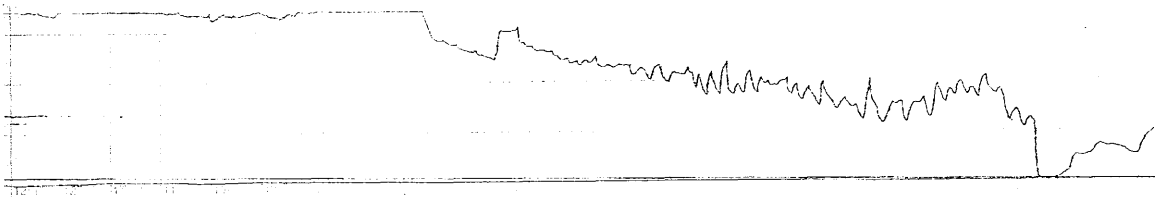
Tree 25 shows resistance in the normal range to 12.5" where early and intermediate decay is indicated.



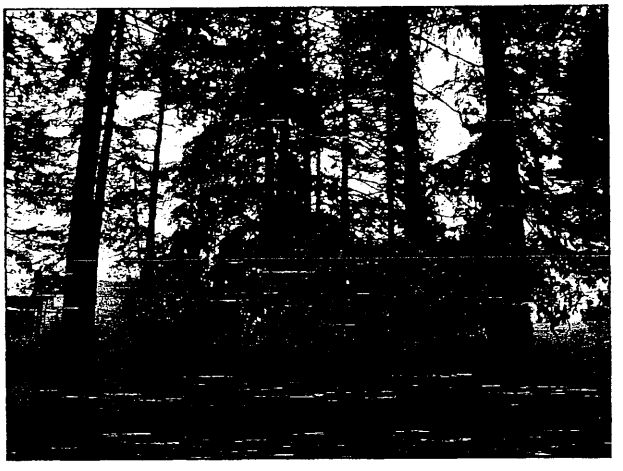
Tree 42 strong resistance is followed by an area of decay at 10"



Tree 49 shows a pattern of gathering resistance with depth. No decay or defect is indicated.



Conclusions



Design modifications have been made in an attempt to preserve the majority of the trees within the "native grove" on the eastern border of the campfire site. These trees have grown and developed over time in relatively close proximity to one another. As a consequence their, health, form and overall structural condition shows the influence of developing within a stand. Trees that develop in a stand have specific characteristics that separate them from trees that are open grown. Trees within the center of the stand typically carry their limbs high on a slender trunk. This growth formation is stable in an enclosed stand but highly unstable when newly exposed. In assessing the risk of failure of individual trees within a group the effect of changes in exposure must be assessed. Currently plans call for the removal of three trees on the windward edge of the stand and several trees on the leeward end of the group.

The proposed removals will alter the exposure of several trees but, given the composition of the stand, the current level of exposure and the terrain, a significant increase in the risk of failure is not expected. However; due to the predicted change in use of the area following the development of the site, action is recommended to reduce the hazard potential related to trees of particular concern. Tree 12 will become an edge tree following clearing; this tree has a high

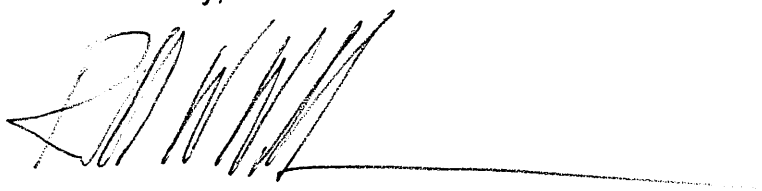
crown and will become borderline for retention. Tree 13 is standing dead and should be cut to the ground. Tree 14 has severe die-back and should be monitored for removal following clearing. Tree 45 and 46 will be located on the 'leading edge' of the stand. These trees show poor vitality and form, they are borderline for retention and should be monitored.

In general the trees would benefit from pruning. Pruning should remove deadwood, broken limbs and stubbed off limbs. Pruning will remove potential disease sites and allow better monitoring of ongoing tree health. Periodic monitoring by inspection is advised. Initially, the trees should be evaluated annually following the completion of the project. Pruning and Monitoring are addressed in the Tree Preservation Guidelines and Specifications section that follows.

Providing adequate tree protection measures are implemented, prior to, during, and after the completion of construction, the adverse effect on the trees will be minimal. Given that the trees have been subject to a circumstance of benign neglect in the past, the development of the site could serve to improve and enhance the overall condition of the trees with time.

I hope the preceding information proves useful. Please let me know if there are further questions.

Yours sincerely,



Robert W. Williams
Consulting Arborist, PN0176A

Maple Leaf Cottages Tree Preservation Guidelines and Specifications

Current design calls for the preservation of the majority of the trees within the grove area on the eastern part of the Camp Fire Site. To facilitate the successful preservation of these trees the following guidelines and specifications should be adopted in the pre-construction, construction and post-construction phases of the project.

Successful tree preservation requires foresight and planning. Trees can very easily be permanently damaged or destroyed during any part of the construction process. The following measures should be carried out in sequence:

1. **Site preparation prior to ground breaking.**
2. **Tree preparation prior to ground breaking.**
3. **Modified construction techniques.**
4. **Construction supervision.**
5. **Post construction follow up inspections.**

Site Preparation

The primary measure of protection will be to maintain the integrity of the stand of remaining trees following selective removals. The creation of a fenced Tree Protection Zone with limited access is specified along with measures to treat the area to optimize health and moisture management.

- Tree pruning should occur prior to the establishment of the protective fencing described below. Details of pruning are provided in the Tree Preparation Section. Several trees are scheduled to be removed on the north and south end of the grove. These removals should be carried out by a qualified Tree Service supervised by an ISA Certified Arborist. The trees should be removed in sections with the brush extracted to the roadside and chipped. Trunk wood should be moved off site without the use of heavy equipment. The core of each of the stumps should be ground. No excavation equipment should be used in stump removal and no heavy equipment to be used in the extraction of brush and wood.

- A six foot chain link fence with driven posts should be installed (see attachment A specification). A single access gate on the street (15th Ave NE) side should be installed in the northeast corner to allow maintenance access. The line of the fence has been staked using wooden markers with green paint and the attached plan has been illustrated to show the location of the fence. Continuous sheets of 8' plywood should be attached to the fence on the West side to form a barrier. The area within the barrier constitutes the Tree Protection Zone (TPZ) and access to the area within the fencing is strictly limited. Signs indicating Tree Protection Zone Access Restricted (see Attachment B) should be affixed to the fence at eye level at 20' intervals. The TPZ is located at the distance from the centerline of the tree to the nearest foundation or side-sewer placement. Some access for construction will be necessary (see site supervision).
- Noxious weeds and undesirable plants identified by the Landscape Architect should be grubbed out by hand within the TPZ. To aid in soil building, optimizing the health of the trees and in retaining moisture, the area should be mulched with a three inch deep layer of fertile mulch (see attachment C specification). Mulch should be applied to the entire area, avoiding piling the mulch immediately around the base of the trees and shrubs.

Tree Preparation

To preclude accidental damage and to optimize tree health, tree pruning is specified. An application of beneficial Mycorrhizae is specified to optimize root performance.

- General pruning: Pruning should remove major deadwood, broken limbs, crossing and duplicated growth. Pruning should be carried out by, or under the supervision of an ISA Certified Arborist to ANSI A300 specifications (see attachment D).
- Specific Pruning: Trees shown on the following form should be pruned to prevent damage when construction commences.

- Mycorrhizal application: An application of Mycorrhizae should be made to the root zones of the trees to optimize root performance (see attachment C specification).

Tree Number	DBH	Proximity to disturbance	Action or Treatment
4	24"	15' 3.5"W	Crown thinning to reduce weight and wind resistance. Lift lower limbs
5	32"	12' 9" W	Crown thinning to reduce weight and wind resistance. Lift lower limbs
41	36"	17' W	Crown thinning to reduce weight and wind resistance.
42	32"	19' 8.5" W	Crown thinning to reduce weight and wind resistance. Remove lower whorl and one limb on north side.
44	28"	18' 7" S	Crown thinning to reduce weight and wind resistance.
45	12"	9' W	Prune to lift lower limbs

Modified Construction Techniques

Special tools and techniques will be required in close proximity to the trees. These measures will be required for all work within the TPZ and will develop along with the project.

- Where excavation and grade change take place within Zone A (see attachment E diagram) air spade excavation may be required. The diagram in attachment E should be prominently displayed where it can be seen by contractors and employees. (I.e. the job trailer).
- Hand digging trenches may be necessary in the placement of side sewers within Zone A.

Construction Supervision

The Certified Arborist Construction Supervisor should be able to make on-site decisions to modify excavation and construction techniques.

- Where construction is to take place on the periphery of the Tree Protection Zones, Arborist site supervision is required.
- Assessment of ongoing impacts in communication with the site supervisor and construction personnel for the duration of the project.
- Non-compliance with the tree preservation guidelines and specifications by contractors during construction, which noncompliance causes the destruction of or significant damage to a tree in the TPZ, and which destruction or significant damage results in the need to remove the tree during or within three years of construction, shall result in a fine to the contractor of $15,000 per tree required to be removed.

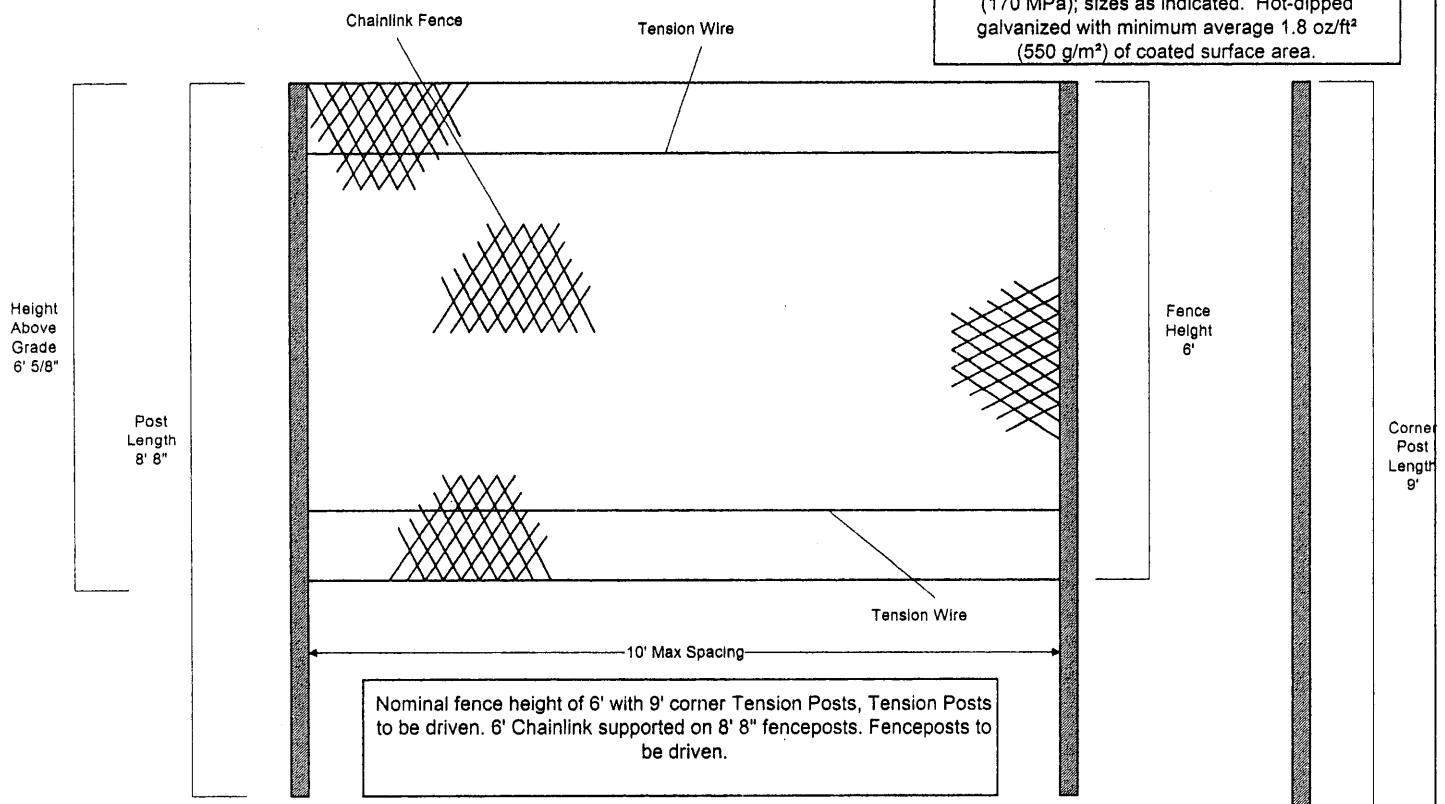
Post Construction follow-up

An inspection of the trees by the Consulting Arborist should take place annually over the transitional, three-year period:

- To evaluate the overall health, condition and structural stability of the trees.
- To assess the need for remedial measures to treat any unforeseen effects on the trees of the construction process.
- To establish a maintenance program for the new Homeowner's Association to ensure continued health and structural integrity of the preserved trees.
- Once established, the Homeowner's Association will be responsible for the implementation of the recommendations outlined in the maintenance program.

Attachment A

Tension and Fence Posts.
Steel pipe - Type I: ASTM F 1083, standard weight schedule 40; minimum yield strength of 25,000 psi (170 MPa); sizes as indicated. Hot-dipped galvanized with minimum average 1.8 oz/ft² (550 g/m²) of coated surface area.



Nominal fence height of 6' with 9' corner Tension Posts, Tension Posts to be driven. 6' Chainlink supported on 8' 8" fenceposts. Fenceposts to be driven.

Chain Link Fence.Galvanized wire : Zinc coated Wire, ASTM A 392 - 1.2oz/sf. [Wire Spec-A817-83, Class 1

Tension wire: Galvanized coated steel wire, 7 gauge, [0.177"(4.5 mm)] diameter wire with tensile strength of75,000psi (517 MPa).

Robert W. Williams. consulting arborist	Tree protection fencing dimensions and specifications.	By RWW	Scale Not to Scale
		Date 03 / 08	Other

Attachment B

Attachment C

FERTILE MULCH AMENDMENT
Description:

A. Fertile mulch shall be a mix of 1/3 composted biosolids and 2/3 composted organic material.
B. Fertile mulch shall be free of weed seed, sticks, roots, trash, and other foreign material.

Quality Assurance:

A. Biosolids shall be fully composted at an approved facility. *Approved*biosolid composting shall meet the requirements of the United States Environmental Protection Agency, Washington State Department of Ecology, and the state and local health departments.

B. Compost shall consist of composted yard debris or organic waste material and shall consist of 100% recycled content. In addition, the organic material shall have the following physical characteristics:

1. Shall be screened using a sieve with openings no smaller than 5/16 inch and no greater than 7/16 inch.

2. Shall pass a standard cress test for seed germination (90% germination compared to standard).

3. Shall have a pH from 5.5 to 7.5.

4. Shall have a maximum electrical conductivity of 3.0 ohms/cm.

5. Shall have a maximum carbon to nitrogen ration of 40:1.

6. Shall be certified by the Process to Further Reduce Pathogens (PFRP) guidelines for hot composting as established by the United States Environmental Protection Agency.

Acceptable products or sources are:

1. "Steerco"

2. "Growco"

3. "Fertil-Mulch"

MYCORRHIZAL APPLICATION

Mycorrhizal Applications Inc, BioGROW blend inoculum. Application should be made to the root systems of the trees via soil incorporation by injection. At a rate of 1 pound per 4,000 square ft.

Attachment D

American National Standard
for Tree Care Operations –

Tree, Shrub and Other Woody Plant Maintenance – Standard Practices

1 Scope, purpose, and application

1.1 Scope

This document presents performance standards for the care and maintenance of trees, shrubs, and other woody plants.

1.2 Purpose

It is intended as a guide for federal, state, municipal, and private authorities including property owners, property managers, and utilities in the drafting of their maintenance specifications and should be adopted by them in whole or in part.

1.3 Application

This standard is intended to apply to any person or entity engaged in the business, trade, or performance of repairing, maintaining, or preserving trees.

1.4 Implementation

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

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this American National Standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below.

ANSI Z60.1-1990, *Nursery stock*

ANSI Z133.1-1994, *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)]

3 Definitions

3.1 anvil-type pruning tool: Pruning tool that has a straight sharp blade that cuts against a flat metal cutting surface. (See *hook and blade-type pruning tool.*)

3.2 arborist: A professional who possesses the technical competence through experience and related training to provide for or supervise the management of trees and other woody plants in the residential, commercial, and public landscape.

3.3 boundary reaction zone: A separating boundary between wood present at the time of wounding and wood that continues to form after wounding.

3.4 branch: A secondary shoot or stem arising from one of the main axes (i.e., trunk or leader) of a tree or woody plant.

[1)] Available from U.S. Department of Labor, 200 Constitution Avenue, NW, Washington, DC 20210.

3.5 branch collar: Trunk tissue that forms around the base of a branch between the main stem and the branch or a branch and a lateral. As a branch decreases in vigor or begins to die, the branch collar becomes more pronounced.

3.6 branch bark ridge: Raised area of bark in the branch crotch that marks where the branch wood and trunk wood meet.

3.7 callus: Undifferentiated tissue formed by the cambium layer around a wound.

3.8 cambium: Dividing layer of cells that forms sapwood (xylem) to the inside and bark (phloem) to the outside.

3.9 climbing spurs: Sharp, pointed devices affixed to the climber's leg used to assist in climbing trees (also known as *gaffs, hooks, spurs, spikes, climbers*).

3.10 closure: The process of woundwood covering a cut or other tree injury.

3.11 crotch: The angle formed at the attachment between a branch and another branch, leader, or trunk of a woody plant.

3.12 crown: The leaves and branches of a tree or shrub; the upper portion of a tree from the lowest branch on the trunk to the top.

3.13 crown cleaning: The removal of dead, dying, diseased, crowded, weakly attached, low-vigor branches, and watersprouts from a tree's crown.

3.14 crown raising: The removal of the lower branches of a tree in order to provide clearance.

3.15 crown reduction: The reduction of the top, sides, or individual limbs by the means of removal of the leader or longest portion of a limb to a lateral no less than one-third of the total diameter of the original limb removing no more than one-quarter of the leaf surface.

3.16 crown thinning: The selective removal of branches to increase light penetration and air movement, and to reduce weight.

3.17 cut: The exposed wood area resulting from the removal of a branch or portion thereof.

3.18 decay: Degradation of woody tissue caused by biological organisms.

3.19 espalier pruning: A combination of cutting and training branches that are oriented in one plane, formally or informally arranged, and usually supported on a wall, fence, or trellis. The patterns can be simple or complex, but the cutting and training is precise. Ties should be replaced every few years to prevent girdling the branches at the attachment site.

3.20 facility: Equipment or structure used to deliver or provide protection for the delivery of an essential service such as electricity.

3.21 girdling roots: Roots located above- or belowground whose circular growth around the base of the trunk or over individual roots applies pressure to the bark area, ultimately restricting sap flow and trunk/root growth, frequently resulting in reduced vitality or stability of the plant.

3.22 heading: Cutting a currently growing or one-year-old shoot back to a bud, or cutting an older branch or stem back to a stub or lateral branch not sufficiently large enough to assume the terminal role. Heading should rarely be used on mature trees.

3.23 heartwood: The inactive xylem (wood) toward the center of a stem or root that provides structural support.

3.24 hook and blade pruning tool: A hand pruner that has a curved, sharpened blade that overlaps a supporting hook; in contrast to an *anvil-type pruning tool.*

3.25 horizontal plane (palms): An imaginary level line that begins at the base of live frond petioles.

3.26 lateral: A branch or twig growing from a parent branch or stem.

3.27 leader: A dominant upright stem, usually the main trunk. There can be several leaders in one tree.

3.28 limb: Same as *branch*, but larger and more prominent.

3.29 lopping: See *heading.*

3.30 mycelium: Growth mass of fungus tissue found under bark or in rotted wood.

3.31 obstructing: To hinder, block, close off, or be in the way of; to hinder or retard a desired effect or shape.

3.32 parent branch or stem: The tree trunk; or a large limb from which lateral branches grow.

3.33 petiole: The stalk of a leaf.

3.34 phloem: Inner bark tissue through which primarily carbohydrates and other organic compounds move from regions of high concentration to low.

3.35 pollarding: Pollarding is a training system used on some large-growing deciduous trees that are severely headed annually or every few years to hold them to modest size or to give them and the landscape a formal appearance. Pollarding is not synonymous with topping, lopping, or stubbing. Pollarding is severely heading some and removing the other vigorous water sprouts back to a definite head or knob of latent buds at the branch ends.

3.36 precut or precutting: The two-step process to remove a branch before the finished cut is made so as to prevent splitting or bark tearing into the parent stem. The branch is first undercut, then cut from the top before the final cut.

3.37 pruning: Removal of plant parts.

3.38 qualified line clearance tree trimmer: A tree worker who, through related training and on-the-job experience is familiar with the techniques in line clearance and has demonstrated his/her ability in the performance of the special techniques involved. This qualified person may or may not be currently employed by a line clearance contractor.

3.39 qualified line clearance tree trimmer trainee: Any worker undergoing line-clearance tree trimming training, who, in the course of such training, is familiar with the techniques in line clearance and has demonstrated his/her ability in the performance of the special techniques involved. Such trainees shall be under the direct supervision of qualified personnel.

3.40 qualified person or personnel: Workers who, through related training, or on-the-job experience, or both, are familiar with the techniques and hazards of arboriculture work including training, trimming, maintaining, repairing, or removing trees, and the equipment used in such operations.

3.41 qualified tree worker, person, or personnel: A person(s) who, through related training and on-the-job experience, is familiar with the hazards of pruning, trimming, repairing, maintaining, or removing trees and with the equipment used in such operations, and has demonstrated ability in the performance of the special techniques involved.

3.42 qualified tree worker trainee: Any worker undergoing on-the-job training who, in the course of such training, is familiar with the hazards of pruning, trimming, repairing, maintaining, or removing trees, with the equipment used in such operations, and has demonstrated ability in the performance of the special techniques involved. Such trainees shall be under the direct supervision of qualified personnel.

3.43 remote/rural: Areas associated with very little human activity, land improvement, or development.

3.44 sapwood: The active xylem (wood) that stores water and carbohydrates, and transports water and nutrients; a wood layer of variable thickness found immediately inside the cambium, comprised of water-conducting vessels or tracheids and living plant cells.

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

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

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

3.48 stubbing: See *heading.*

3.49 target: A person, structure, or object that could sustain damage from the failure of a tree or portion of a tree.

3.50 terminal role: Branch that assumes the dominant vertical position on the top of a tree.

3.51 thinning: The removal of a lateral branch at its point of origin or the shortening of a branch or stem by cutting to a lateral large enough to assume the terminal role.

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

3.53 topping: See *heading.*

3.54 tracing: Shaping a wound by removing loose bark from in and around a wound.

3.55 urban/residential: Locations normally associated with human activity such as populated areas including public and private property.

3.56 utility: An entity that delivers a public service such as electricity or communication.

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

3.58 wound: The opening that is created any time the tree's protective bark covering is penetrated, cut, or removed, injuring or destroying living tissue. Pruning a live branch creates a wound, even when the cut is properly made.

3.59 woundwood: Differentiated woody tissue that forms after initial callus has formed around the margins of a wound. Wounds are closed primarily by woundwood.

3.60 xylem: Wood tissue; active xylem is called *sapwood*, inactive xylem is called *heartwood*.

3.61 young tree: A tree young in age or a newly installed tree.

4 Safety

4.1 Tree maintenance shall only be performed by qualified tree workers, 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.

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

Operations shall comply with applicable Occupational Safety and Health Administration (OSHA) standards (see clause 2), ANSI Z133.1, as well as state and local regulations.

5 Tree pruning

5.1 Purpose

The purpose of this clause is to provide specifications for tree pruning.

5.2 Pruning practices

5.2.1 Reasons for pruning

The reasons for tree pruning may include, but are not limited to, reducing hazards, maintaining or improving tree health and structure, improving aesthetics, or satisfying a specific need such as: removing diseased, dead, dying, decayed, interfering or obstructing branches; training young trees; utility line clearance; or specialty tasks as defined in this standard. Before pruning, the primary objective should be clearly defined. That objective should be accomplished in the manner most beneficial to the health of the tree.

Pruning practices for agricultural, horticultural production or silvicultural purposes are exempt from this standard.

5.2.2 When to prune

To obtain the defined objective, the growth cycles of individual species as well as the type of pruning to be performed should be considered.

5.2.3 Tree inspection

Before beginning work and while work is being performed, a qualified person shall visually inspect each tree. If a condition is observed that requires additional attention, this condition should be brought to the attention of an immediate supervisor or the person responsible for authorizing the work.

5.2.4 Tools and equipment

5.2.4.1 Pruning tools used in making pruning cuts shall be kept adequately sharpened to result in final cuts with a smooth surface and firmly attached remaining adjacent bark.

5.2.4.2 Hook and blade pruning tools should be used; not anvil-type pruning tools.

5.2.4.3 Climbing spurs should not be used when climbing trees, except as specified elsewhere in this standard. Climbing spur use is permissible on tree removals and in emergencies such as aerial rescue.

5.2.4.4 Equipment and work practices that damage bark, cambium, live palm tissue, or any combination of these, should be avoided.

5.2.5 Pruning cuts

5.2.5.1 A thinning cut should be the preferred type of cut to make.

5.2.5.2 A thinning cut shall consist of the removal of a lateral branch at its point of origin or the shortening of a branch or stem by cutting to a lateral large enough to assume the terminal role.

5.2.5.3 A heading cut should rarely be used on mature trees, yet may be appropriate for

specific purposes such as, but not limited to, training young trees; pollarding, shaping terminal flowering trees, storm damage repair, etc.

5.2.5.4 A heading cut should consist of cutting a currently growing or one-year-old shoot back to a bud, or cutting an older branch or stem back to a stub or lateral branch not sufficiently large enough to assume the terminal role.

5.2.5.5 When removing a lateral branch at its point of origin on the trunk or parent limb, the final cut shall be made in branch tissue close to the trunk or parent limb, without cutting into the branch bark ridge or collar, or leaving a stub. (See figure 1.)

5.2.5.6 When removing a leader or length of a branch, the angle of the cut should bisect the angle between the branch bark ridge and an imaginary line perpendicular to the leader being removed. (See figure 2.)

5.2.5.7 When removing a dead branch, the final cut shall be made just outside the collar of live tissue. If the collar has grown out along the branch stub, only the dead stub should be removed. The live collar shall remain intact and uninjured.

5.2.5.8 To prevent damage to the parent limb when removing a branch with a narrow branch attachment, the final cut should be made from the bottom of the branch up. (See figure 3.)

5.2.5.9 Cut limbs shall be removed from the crown upon completion of the pruning, or at times when the tree would be left unattended or at the end of the work day.

5.2.6 Wound treatment

5.2.6.1 Wound dressings and tree paints should not be used to cover pruning wounds, except when specified for disease, borer, mistletoe, sprout control, or cosmetic reasons. If wound dressings or paints are used for cosmetic or other reasons, then materials nontoxic to the cambium layer shall be used, and only a light coating shall be applied to the wound surface.

5.2.6.2 When repairing bark wounds, only damaged or loose bark should be removed, disturbing a minimal amount of live tissue.

5.2.6.3 Cavities shall not be filled or treated if the boundary reaction zones would be disturbed.

5.3 Mature tree pruning

5.3.1 General

The following specifications should be used with pruning objectives.

5.3.1.1 Pruning cuts shall be made in accordance with 5.2.5.

5.3.1.2 Tree branches shall be removed in such a manner so as not to cause damage to other parts of the tree or to other plants or property. Branches too large to support with one hand shall be precut to avoid splitting or tearing of the bark. (See figure 1.) Where necessary, ropes or other equipment should be used to lower large branches or portions of branches to the ground.

5.3.1.3 When a branch is cut back to a lateral, not more than one-fourth of its leaf surface should be removed. The lateral remaining should be large enough to assume the terminal role.

5.3.1.4 Not more than one-fourth of the foliage on a mature tree should be removed within a growing season.

5.3.1.5 Upon completion of pruning a mature tree, one-half of the foliage should remain evenly distributed in the lower two-thirds of the crown and individual limbs.

5.3.2 Size specifications

A minimum or maximum diameter of branches to be removed should be specified to establish the extent of pruning, such as: the removal of branches 3 in (7.5 cm) in diameter and greater, or; the removal of branches 2 in (5 cm) in diameter and greater, etc.

5.3.3 Pruning objectives

Pruning objectives should be established prior to beginning any pruning operation.

5.3.3.1 Hazard reduction pruning

Hazard reduction pruning is recommended when the primary objective is to reduce the danger to a specific target caused by visibly defined hazards in a tree. Hazard reduction pruning should consist of one or more of the maintenance pruning types.

5.3.3.2 Maintenance pruning

Maintenance pruning is recommended when the primary objective is to maintain or improve tree

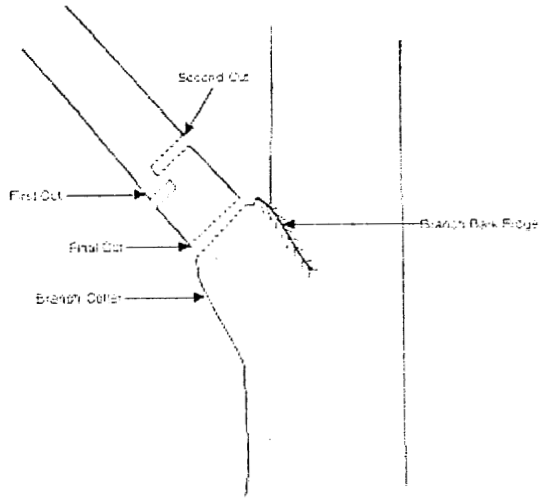


Figure 1 – Removing a large lateral branch requires two preliminary cuts before the final cut

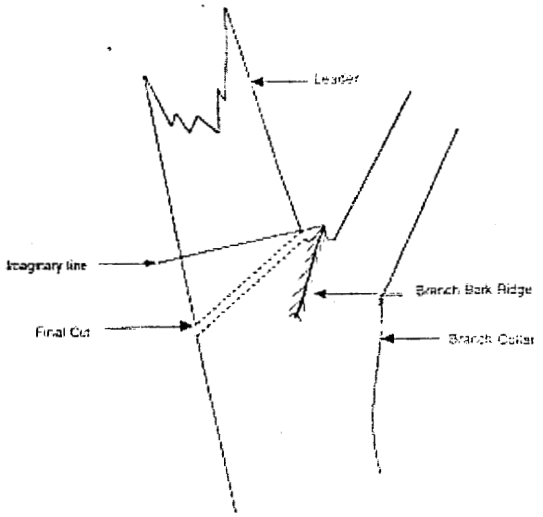


Figure 2 – When cutting back to a lateral, bisect the angle between the branch bark ridge and an imaginary line perpendicular to the leader or the branch being removed

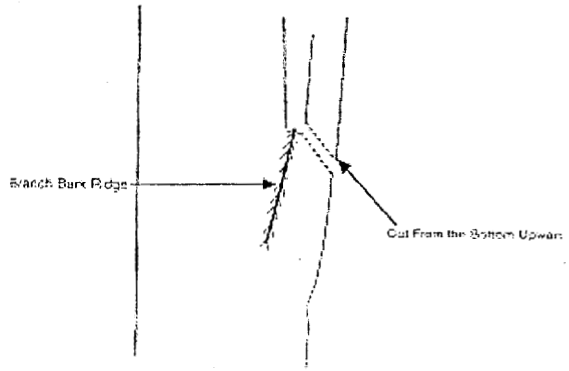


Figure 3 – When removing a branch with a narrow branch attachment, cut from the bottom upward

health and structure, and includes hazard reduction pruning. Maintenance pruning should consist of one or more of the following pruning types:

a) *Crown cleaning:* Crown cleaning shall consist of the selective removal of one or more of the following items: dead, dying, diseased, weak branches and watersprouts from a tree's crown;

b) *Crown thinning:* Crown thinning shall consist of the selective removal of branches to increase light penetration, air movement, and reduce weight;

c) *Crown raising:* Crown raising shall consist of the removal of the lower branches of a tree in order to provide clearance;

d) *Crown reduction (crown shaping):* Crown reduction reduces the height and/or spread of a tree. Consideration should be given to the ability of a species to sustain this type of pruning;

e) *Vista pruning:* Vista pruning is selective thinning of framework limbs or specific areas of the crown to allow a specific view of an object from a predetermined point;

f) *Crown restoration:* Crown restoration pruning should improve the structure, form, and appearance of trees that have been severely headed, vandalized, or storm damaged.

5.4 Young tree pruning

5.4.1 At planting

When a young tree is planted, dead, broken, and split branches should be removed. A central trunk or leader or well-spaced multiple trunks or leaders (as most appropriate for the species and specimen) should be developed by removing competing leaders and removing, heading, or thinning laterals on vigorously growing branches that compete with the selected leader(s). Branches should be retained on the lower trunk to increase taper.

5.4.2 During the first three years after planting

A strong scaffold branch structure should be developed by selecting the primary scaffold branches. To improve the scaffold structure, branches that are crossing, have included bark, or interfere with the scaffold branches should be removed. Scaffold branches should be properly spaced. For deciduous shade trees that will reach or exceed 40 ft (12 m) in height at maturity, the recommended spacing between primary scaffold branches is approximately 18 in (46 cm). For smaller species, 6 to 8 in (15 to 20 cm) would be adequate.

5.4.3 Between four and six years after planting

The development of a good, structurally sound scaffold branch system should be continued by selective thinning of or on branches and removing dead, interfering, split, and broken branches. Large-growing branches with narrow angles of attachment shall be removed from the trunk or canopy. Lower branches shall be pruned (crown raising) so as not to interfere with human needs where appropriate.

5.5 Specialty training systems

5.5.1 Espalier

Espalier pruning is a combination of cutting and training branches that are oriented in one plane; formally or informally arranged; and usually supported on a wall, fence, or trellis. The patterns can be simple or complex but the cutting and training is precise. Ties should be replaced every few years to prevent girdling the branches at the attachment site.

5.5.2 Pollarding

Pollarding is a training system used on some large-growing deciduous trees that are severely headed annually or every few years to hold them to modest size or to give them and the landscape a formal appearance. Pollarding is not synonymous with topping, lopping, or stubbing. Pollarding is severely heading some and removing the other vigorous water sprouts back to a definite head or knob of latent buds at the branch ends.

5.6 Palm pruning

5.6.1 Palm pruning should be performed when fronds, fruit, or loose petioles may create a dangerous condition.

5.6.1.1 Live healthy fronds, initiating at an angle of 45° or greater from the horizontal plane, should not be removed.

5.6.1.2 Fronds removed should be severed close to the petiole base without damaging living trunk tissue.

5.6.1.3 Palm peeling (shaving) should consist of the removal of the dead frond bases only, at the point they make contact with the trunk without damaging living trunk tissue.

5.7 Utility pruning

5.7.1 General

The purpose of utility pruning is to remove branches in order to prevent the loss of service, prevent damage to equipment, avoid impairment and uphold the intended usage of the facility/utility space.

5.7.1.1 Only a qualified line clearance tree trimmer or qualified line clearance tree trimmer trainee should be assigned to line clearance work in accordance with ANSI Z133.1, 29 CFR 1910.331 – 335, 29 CFR 1910.268, or 29 CFR 1910.269.

5.7.1.2 Utility pruning operations are exempt from requirements in 5.2.3.

5.7.2 Utility crown reduction pruning

5.7.2.1 Urban/residential environment

5.7.2.1.1 Cuts should be made in accordance with 5.2.5 and 5.2.6.

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

5.7.2.1.3 Trees directly under and growing into the facility/utility 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.

5.7.2.1.4 Trees growing along the side and growing into or toward the facility/utility space should be pruned by removing entire branches. Branches that, when cut, will produce sprouts that would grow into facilities and/or utility space should be removed.

5.7.2.1.5 Branches should be cut to laterals or the parent branch and not at a preestablished clearing limit.

5.7.2.2 Remote/rural environment

5.7.2.2.1 Climbing spurs

Climbing spurs may be used when limbs are more than throw line distance apart, or when the bark is thick enough to prevent damage to the cambium, or there are no other practical means of climbing the tree.

5.7.2.2.2 Remote locations

Utilities must often maintain facilities/corridors at remote locations. In such locations, it may be appropriate to use mechanical pruning equipment.

5.7.2.2.3 Mechanical pruning

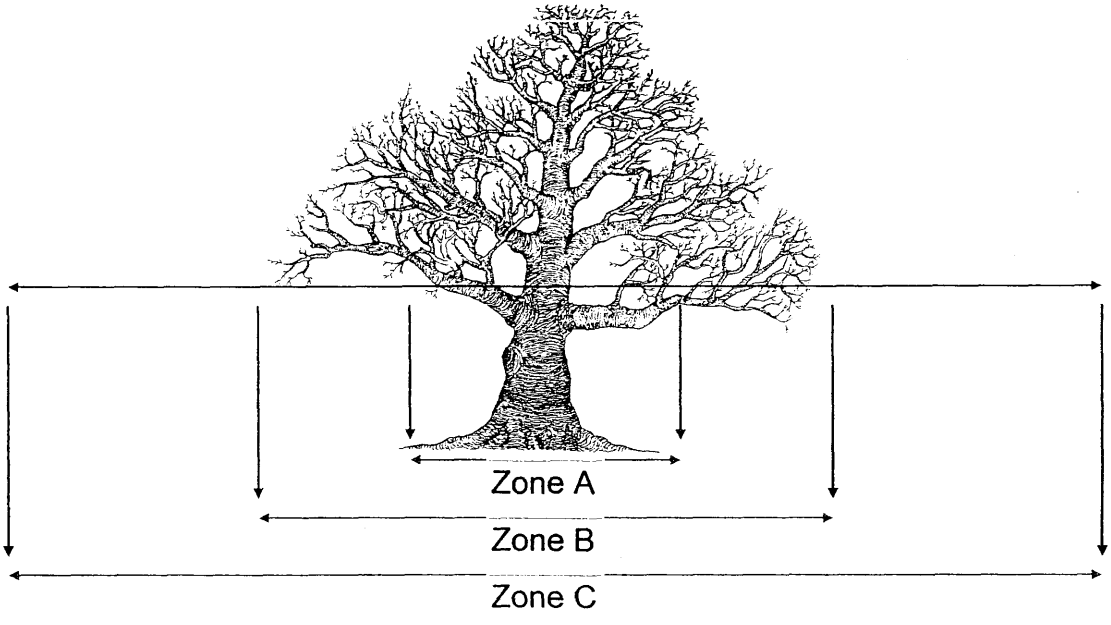
Cuts should be made close to the main stem, outside of the branch bark ridge and branch collar. Precautions should be taken to avoid stripping or tearing of bark or excessive wounding.

5.7.3 Emergency service restoration

During a utility declared emergency, utilities must restore service 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.

Attachment E Zones of Construction Impact Zones on existing trees

Recommendations to limit Construction Damage



ZONE A. Half the area of Zone B. (Half the area from the trunk to the dripline.)

ZONE B. The area from the trunk to the dripline. (The edge of the canopy).

ZONE C. Twice the area of Zone B and represents the extent of the absorbing root system.

Zone A

No heavy equipment traffic.
No stacking of materials or supplies.
Any roots above 1" should be cut clean back to laterals where possible.
Severance of roots over 2" in diameter prohibited.
Hand digging required to 3' depth.
Tunneling required below 3' depth.
No grade changes.

No disturbance allowed without site specific arborist recommendation and approval.

Zone B

No heavy equipment traffic on roots.
No stacking of materials.
Apply 6" layer of wood chip mulch.
No severance of roots over 4" in diameter.
Hand digging or hand guided trencher.
Limit trench width.
Any roots above 1" should be cut clean back to laterals where possible.
Minimize grade change

6' Chainlink fence around perimeter.

Zone C.

Apply 1' layer of wood-chip mulch.
Open trenching allowed with heavy equipment.
Minimize trench width.
All roots severed above 1" in diameter must be cut clean back to laterals where possible.

General Recommendations:

Minimize heavy traffic on native soils throughout the site.
Flag or mark exposed roots and overhanging limbs.