Mulching Trees

What is that?

- Mulching refers to the placement of any material on the ground around plants.
- Mulches can be divided into organic and inorganic materials.
- Organic mulches break down over time and become part of the soil, inorganic ones do not.

What good is it?

- There are so many benefits to mulching trees, it is hard to even count them.
- Almost all mulches make significant contributions:
  protect trunk from mowers, weedwhackers, etc.
  conserve soil moisture
  impede weed growth
  reduce soil erosion
  restrict soil cracking
  limit salt build-up
- Most organic mulches add further features:
  protect the roots from traffic
  cut down soil compaction
  improve soil fertility & structure
  moderate soil temperatures
- A "green mulch" such as pachysandra or vinca also brings many of these benefits, although it will compete with the tree to some extent for water and nutrients.
- When possible, do not grow grass beneath trees, especially young trees, because it is highly competetive against them and will restrict their growth.
- And, oh yes, all mulch looks good.

What problems can mulch cause?

- Except for needing to be renewed now and then, mulches give very few problems.
- Avoid fresh organic mulches, i.e., those that have not been leached or composted. They often 1) deplete soil nitrogen, especially if small in size and thickly applied, and 2) can be toxic, especially mulch made of conifer (cedar, for example) sawdust and bark.
- Many mulches, if put on too thick or against the trunk, actually tend to increase stress, disease and insect troubles, especially on poorly drained clay soils.
- Geotextile fabrics can lead to higher temperatures, and it is hard to get weeds out of them. If you use them, be sure to cut slits for air and water movement.
- Black plastic and peat moss should be avoided altogether as tree mulch.

What is the best mulch to use?

- There is no single best mulch, but organic mulches such as partially composted bark, branches, and leaves are much better for the tree and often cheaper as well.

How do you put it on?

- To the tree's dripline, if possible. Remember, the dripline moves out as trees grow.
- No higher than the heel of your hand. Anything from 2-6" will benefit the tree, though 4" has proven optimal.
- Not against the trunk. The mulch should look like a donut when you are through.

Staking Trees

What is this about?

- Staking is a technique used to protect, anchor, and support recently transplanted trees.

Do I need to stake trees?

- Not usually. Most young trees can stand unsupported, and will be stronger without stakes.
- Staking actually delays the creation of a strong tree.
- Trunk movement signals the lower trunk and roots to produce increased growth. A better trunk taper and root system results.
- Research shows that bare-root trees can stand unstaked as well as B&B or containerized ones.

When is staking recommended?

- There are certain situations where staking can be advisable:
  very large tree size
  fall-planted evergreens
  high wind conditions
  very weak trunk
  high population pressure

What are the potential drawbacks of staking?

- Poor trunk development at the base of the tree.
- Increased trunk caliper near the support ties, which produces a negative trunk taper and restricts the vascular tissue conducting water, nutrients, and sugars.
- Wounding or girdling from ties too tight against the trunk, especially when they are left on too long.. concentrated pressure from narrow ties (e.g. elastic webbing, wire, or even wire through a hose) will crush or cut through the bark.
- More wind throw and wind damage later, particularly when the tree is staked rigidly.

  most susceptible are shallow-rooted evergreens and trees with a large "sail."

What are the current recommendations?

- Don't stake if you don't have to.
- Consider alternative methods of staking.

- Remove stakes and ties within 1 year, or use degradable materials.
- Use flexible ties with a broad, smooth surface.
- If vandalism is a consideration: instead of staking, try planting larger caliper trees, or encircling the tree with heavy posts, wire, or metal grill work.
- If protecting from mowers and foot traffic: sink three 4' stakes halfway into the ground, 15" or so from the tree, and run a line between them to make a triangle.
- If follow-up maintenance within 1 year is unlikely: use 2" x 2" pine stakes, and UV degradable ties. The stakes and ties will fall off by themselves.
- If staking because the trunk is too weak: place the ties 6" above the lowest point where, when you hold the trunk, the top will still return upright after being bent to the side.

Pruning Overview

The pruning of trees is probably the most noticeable and important of all tree maintenance practices. Thoughtful pruning produces a structurally sound tree that can better withstand the conditions found in the urban environment. Trees are pruned principally to preserve their health and to prevent damage to human life and property.

There are three types of pruning that can be applied to street trees. They are: Hazard Reduction Pruning (HRP); Crown Reduction Pruning (CRP); and Crown Raising. Each are important components of a balanced urban forest management program.

Procedure

Although you will not be trimming trees as part of the inventory, you will be asked to make a determination of the pruning needs of each tree that you survey. The following section briefly outlines the reasons for pruning an urban tree.

Pruning for Health

Broken, dead, or diseased branches are pruned to prevent pathogenic organisms from penetrating into adjacent parts of the tree and reduce inoculum for spread to other trees. Live branches are removed to permit penetration of sunlight and circulation of air through the canopy. Proper pruning of the tree crown can reduce wind resistance and help prevent beakage.

Pruning for Appearance

Pruning may be used to maintain or restore the characteristics of the crown. Occasionally it is desirable to keep normally large-growing shade or ornamental trees within restricted boundaries often found in urban areas.

Pruning for Safety

Dead, Split and broken branches are a constant hazard to human life and property. Danger from falling limbs is always greatest in trees along city streets and in public parks. Low-hanging live branches must be removed to a height of 8-18 feet when they interfere with pedestrian and vehicular traffic. Branches that obscure clear vision of warning signs, traffic signals, or other traffic also must be removed. Hazard reduction pruning shall consist of the removal of dead, diseased, obstruction, split and/or broken branches 2 inches in diameter or greater. In addition, limbs susceptible to failure from the weight of heavy foliar masses should be thinned.

Trees are pruned to prevent them from interfering with energized electrical lines. Branches touching lines can interrupt service and wind-thrown limbs can knock down electrical and telephone lines.

The following Pruning Classes are to be used to classify the pruning requirements of the trees that you will be inspecting during the inventory. Please use them as your guide to rate the needs of the trees that you will be surveying.

Crown Reduction Pruning includes the reduction of the top, sides or individual limbs of the tree. This type of pruning is commonly associated with pruning away from buildings, structures, or away from overhead utility wires.

Crown Raising is used to provide clearance for pedestrian and vehicular traffic. The lower limbs of the street tree are removed to provide clearance. Limbs above the sidewalks shall be no lower than 8 feet, and limbs above the road shall be no lower than 18 feet. This will provide safety and sufficient clearance for both the tree, the citizen, and any traffic.

Urban Tree Maintenance

Watering

Adequate water is the most important factor for survival and future growth of newly planted trees. Young trees need at least ten gallons of water a week, including rainfall, during their active growing season. While some cities now own watering trucks to maintain new plantings, city residents can easily assist by watering young trees with an ordinary garden hose set at low pressure. Watering once a week for about one half hour – more during periods of drought – can be very important for the future growth of new trees. Early morning or evening watering is preferred.

Keys to Good Pruning

1. Prune early in life of the tree so pruning wounds are small and so growth goes where you want it.
2. Begin your visual inspection at the top of the tree and work downward.
3. Identify the best leader and lateral branches (scaffold limbs) before you begin pruning and remove defective parts before pruning for form.
4. Don't worry about protecting pruning cuts. For aesthetics, you may feel better painting larger wounds with a neutral-color tree paint, but the evidence is that it does not prevent or reduce decay
5. Keep your tools sharp. One hand pruning shears with curved blades work best on young trees.
6. Make safety a number one priority. For high branches use a pole pruner. Some, like the one pictured, have both a saw and shears on the same tool. A major job on a big tree should be done by a professional arborist.
7. When you prune back to the trunk or a larger limb, branches too small to have formed a collar (swollen area at base) should be cut close. Otherwise, follow the rules of good pruning of larger limbs by cutting just outside the branch ridge and collar and at a slight down-and-outward angle (so as not to injure the collar). Do not leave a protruding stub.

When simply shortening a small branch, make the cut at a lateral bud or another lateral branch (referred to as a "head" or "headback" pruning). Favor a bud that will produce a branch that will grow in a desired direction (usually outward). The cut should be sharp and clean, and made at a slight angle about ¼ inch beyond the bud.

When to Prune

When to prune depends on a large extent on why you prune. Light pruning and the removal of dead wood can be done anytime. Otherwise, here are some guidelines, but recognizing that individual species may differ.

Winter – Pruning during dormancy is the most common practice. It results in a vigourous burst of new growth in the spring and should be used if that is the desired effect. It is usually best to wait until the coldest part of the winter has passed. Some species, such as maples, walnuts and birches, may "bleed" when the sap begins to flow. This is not harmful and will cease when the tree leafs out.

Summer – To direct the growth by slowing the branches you don't want; or to slow or "dwarf" the development of a tree or branch, pruning should be done soon after seasonal growth is complete. The reason for the slowing effect is that you reduce the total leaf surface, thereby reducing the amount of food manufactured and sent to the roots for their development and next year's growth of the crown. Another reason to prune in the summer is for corrective purposes. Defective limbs can be seen more easily, or limbs that hang down to far under the weight of the leaves. Fall – Because decay fungi spread their spores profusely in the fall and healing of wounds seems to be slower on fall cuts, this is a good time to leave your pruning tools in storage.

Flowering Trees – If your purpose for pruning is to enhance flowering: 1. For trees and shrubs that bloom in the summer or fall on CURRENT years growth (e.g. crape myrtle), prune in winter: 2. For trees that bloom in spring from buds on one-year-old wood (e.g. dogwood and flowering fruit trees), prune when their flowers fade

Pruning for Form

The objective in pruning for form is to help shape a tree that is aesthetically pleasing and serves well in the space it is to occupy. After pruning with strength in mind, look for ways to help shape the most desirable tree.

Thinning and Spacing – Most trees benefit from thinning; removing a portion of the limbs that compete for space and light. Evenly spaced laterals, 8-12 inches apart in the young tree, is a good rule of thumb to help assure an ideal "ladder" at maturity.

Function – Try to imagine what the tree will look like when it is larger. If a limb is headed toward trouble (the house, walkway, sign, etc), remove as early as possible in the life of the tree. Closure of the wound will be more complete when the limb is small, and it is less trouble and expense. Remember, limbs do not move upward as a tree grows in height

Double Leaders – Protect the leader from competition. In trees with co-dominant leaders, remove the one with a crook or other defects, or that creates a lop-sided appearance.

In-growers, Protruders, and Crown Ratio – When a crown is dense, look for limbs that turn inward, and those that extend beyond the "natural" outline of the crown. Prune at the trunk or down to an appropriate lateral branch. Over-pruning can damage or even kill your tree. Always maintain at least 2/3 of the tree as the live crown.

Pruning for Strength

The first guide to pruning a young shade tree is to have a clear understanding about what pruning can do for the tree – and you. For example, we know to prune modestly – if at all – when transplanting a new tree. An immediate objective must be to strengthen and expand the root system which is usually reduced by 80-90 percent during transplanting. To meet this objective, as much as possible of the leaf surface (the tree's food factories) is left intact. Only damaged or dead limbs should be removed. After the first year, pruning should begin in earnest. Pruning with strength as the objective is the best way to avoid weak branches later on, and to prevent expensive corrections that will otherwise become necessary.

What to look for:

Branch Angles and Size – Narrow angles signal a point of future weakness, whether in the trunk or the crown. The reason is that as the two branches grow, neither has sufficient space to add the wood needed for strength. Instead, they grow against each other: the effect is similar to hammering in a wedge. To prevent this and the expensive problems that are sure to follow, simply remove one of the two branches. For strength, the ideal branching angle approximates 10 or 2 o'clock. Lateral branches should be no more than ½ to ¾ the diameter of the trunk. As the trunk grows it will strengthen the joint by adding wood around the branch – like a dowel in a chair leg.

Watersprouts and Suckers – These "parasite" sprouts can occur at the base or inside the crown. They are rapidly growing, weakly attached, and upright. Usually they use more energy than they return to the tree. It is best to remove them as soon as possible when it is obvious they are vigorous sprouts.

Rubbing Branches – Branches that rub result in wounds, decay, and notches. Remove one of the offending branches.

Temporary Branches – Branches below the lowest permanent branch can protect young bark from injury from the sun and add taper and strength to the trunk. Particularly in lawn plantings where lower limbs do not block passage or tempt vandals, the limbs may be left for 3-4 years after planting. Then remove over the next 2-3 years, beginning with the larger temporaries. Don't let the temporary branches become large and vigorous.

Center of Gravity – Young trees deformed by wind may be corrected by pruning. Move the tree's center of gravity to a point more central over the trunk by cutting back the leader and laterals on the downwind side for direction of lean to more upright branches.

Hazard Tree Identification

There are many trees in our environment that people don't realize are accidents waiting to happen. Many of these trees can be a threat to someone's life or property. A hazard tree is a tree that is structurally weakened so that all or parts of it are likely to fall. It is very important that hazard trees are not overlooked because of the public liability involved.

It is during high winds, snow, and ice storms that a tree's structural support is very important. Much of the time disease, insect, or structural defects cause trees to fail during these storm conditions. If the disease, insect, or structural problem was taken care of the tree failure could be prevented.

Many times the tree can look very healthy but most of the trees makeup is of dead supporting wood. The only layer that is growing and living is directly under the bark, called the cambium. If internal decay is present most of the trees structural support is lost.

Trees become hazardous in four ways: (1) internal decay in the trunk or large branches (2) cankers and canker rots (3) cut roots and root decay and (4) weak forks in the trunk and/or large branches.

Procedure

During the conduction of the inventory, you will be asked to identify any hazard trees that you may along the town's streets. It is very important that you are able to identify trees that are hazardous and present a threat to the safety of the people and property. Therefore it is suggested that you carefully review the following information, so that you will become familiar with the causes and signs of the hazard trees.

During the inventory process, if you encounter trees that you have a question about to whether they are a hazard or not , note these trees on the hazard sheets or PDA device, so that they can be visited by a Certified Arborist, who can more closely examine the tree.

Cavities, Wounds, and Decay

Shade trees are under the constant stress of our society and as a result are constantly being wounded. These wounds are mainly caused from construction, automobiles, bicycles, lawnmowers, snowplows, and vandalists. Most of these wounds are small and close quickly but some are quite severe and require attention in order to close properly. Wounds or cavities from injury that are not treated properly can lead to heavy decay resulting in a hazard tree, this decay can be external or internal.

Cankers

Cankers are localized dead areas on the bark that develop from microorganisms. Cankers kill the cambium so that the tree cannot close the wound. A healthy tree can bend and sway with the wind without breaking, but a tree infested with cankers does not have much flexibility and can break at the canker face.

Canopy Density

A healthy and vigorous tree will have a full crown (healthy branching and leaf pattern) with few dead branches. Detection of dead sections in the tree crown can mean that the tree is under certain stress and could be in rapid decline. It is important to examine the branches and leaves of the overall tree to look for dead sections or declining sections which could result in hazardous trees.

Root Failure

Anything that alters the root system can put the tree in danger. Root decay and severing or cutting any portion of the root system are two factors that decrease a root systems ability to support the tree. Soil erosion, drought, gas leaks, fill, flooding, soil compaction, or paving over the roots can kill roots too. Some root rot microorganisms kill certain tree species before the tree has been weakened enough to fall. However, many root rots cause living trees to fall. Trees with root rot fungi often have visible fruiting structures of the fungus on the lower trunk. Trees that grow on ground with a high water table or near a body of water have shallow root systems and can be hazard trees.

Weak Branches or Forks

One disadvantage of trees in a landscape situation is the wide crown growth which results in the development of large weak branches. When a branch or fork forms, depending upon the tree species or variety there is likely to be a 45-90 degree between the trunk and the branch. However if this angle is much narrower (less than 40 degrees) not much supporting wood will form on the inside of the angle because of the pressure exerted during growth from both sides of the fork. This makes the fork structurally weak. As the stems weight continues to increase the weak fork will usually split at this junction, often resulting in the failure of a branch or even a large portion of the crown.

A weak fork may not split completely at first, but may only open a fissure that can be invaded by microorganisms. The resulting decay further weakens the fork and hastens it's failure.

Detection of Living Hazard Trees

Most tree failures could be prevented if efforts were focused on early detection. Recognizing the symptoms of the most common examples of internal decay, cankers, root rots and weak forks must be detected early in order to prevent further problems. If any construction is done near trees the trees should be watched carefully after the construction to detect any decline in the tree. Overall careful observation and early detection can eliminate many of your hazard tree problems.

What about Balance?

Leaning or lopsided trees present more of a hazard than those growing vertically, but if a tree has always been growing off center, it is generally not considered a risk. However, any sudden lean indicates breakage or weakening of support roots and should be cause for alarm and immediate action.

A Checklist for Preventing Hazardous Trees

Inspect your trees carefully several times each year and in all seasons. Annually, have a qualified Arborist inspect your trees and provide you with a written report.

Avoid planting brittle species where falling limbs could injure people or property. Some examples: Silver Maple, Lombardy Poplar, Willows, Boxelder

Training Prune trees when they are young, and regularly thereafter.

Use correct pruning methods, always making the pruning cut outside the branch collar.

Don't allow trees to be topped!

Always plant the right tree in the right place. For example, avoid planting large growing trees under power lines, or too close to your house. Also make sure the species selected matches the soil and other site characteristics.
Water deeply during dry periods, slowly applying at least 1" on water.

Erect barriers around or slightly beyond the dripline if trees during construction. Insist that these root protection measures be honored by construction workers.

Consider cabling or bracing weak forks or branches in older trees of high value. This is work for a professional arborist.

Do not plant trees with narrowly-forked stems

Where a high value tree may be suspected of developing into a hazard, use landscaping to keep people at a safe distance. This may require techniques such as re-routing walks, moving patio furniture, or planting shrubs and hedges as barriers to foot traffic.

Silver maple leader with diagonal crack

Training Young Community Trees

What does that mean?

- Training means pruning young trees for form during the first few years of their existence.
- Good nursery stock already has had quite a bit of training by the time it reaches the market. In fact, that is an important trait to look for when you buy.

Why is it done?

- Trees are trained
  to direct growth
  to correct structural weakness
  to adapt the tree to its human environment
- In the long run, a trained tree will be stronger, healthier, safer--and cheaper to maintain.
- Early training is better because the extent of infection from wounding depends greatly upon 1) the size of the wound, and 2) the age of the tree. In general, the smaller the wound and the younger the tree, the less decay will result.

How is it done?

- Select a single central leader if the young tree does not have one, and prune out any competitors. One central leader, or stem, is almost always preferable in street trees.
  Some species (such as many conifers) usually produce a single leader and need no training, others (such as sugar maple) often produce multiple leaders and need quite a bit; most species are in the middle, and do well with moderate training.
- Select what will be the lowest permanent ("scaffold") branch, and prune out nearby competitors. Choose a branch that 1) is vigorous, and 2) has the right clearance.
  Remember that once a branch is formed at a given level, it never gets any higher.
- Select and prune for other scaffolding branches.
  Choose vigorous branches less than half the size of the central leader that are
  well spaced apart (at least 18" for large trees)
  well distributed around the trunk.
- Finally, make temporary branches by cutting back branches you will not be keeping that are below or between the scaffolding branches.
  do not remove these branches for now, just reduce them to a few buds
  the leaves on temporary branches produce food for the young tree, and protect the young bark from the sun; they can be removed later when shaded out.
  Don't take off more than 25% of the leaves and buds at any one time.

When is it done?

- Prune nothing the first growing season after planting except broken, rubbing, or misshapen branches. The transplanted tree needs all its leaves to reestablish its roots.
- Many communities schedule the first training for the third year after planting, a time when remulching can also be done
- Most species are best trained in late winter, though badly resprouting species (such as lindens or crabapples) are better pruned soon after leaves have fully expanded.

TREE ROOT DAMAGE

Why does this topic matter?

- **The survival of urban trees depends critically on the health of the roots.**
- **Roots and shoots are linked** through a kind of circulatory system: what hurts the one, hurts the other.
- Roots supply water and nutrients to the shoots, and get back sugar and other compounds they need to grow and survive.
- Roots also store food, synthesize needed compounds, and provide support.
- Most tree roots lie in the top 6-18" of the soil, and usually extend well beyond the canopy edge. About 1 of every 5 species (e.g., red oak) typically has a "heartroot" structure, with roots going deeper. Very few species are actually taprooted. The actual root structure of a particular tree is highly influenced by local site conditions.

When does damage happen?

- **When something cuts the roots, stops them from growing, or prevents them from breathing, it causes damage and threatens the life of the tree.**

- Common urban activities that often damage roots include:
  - building construction
  - road widening
  - utilities repair
  - sidewalk replacement
  - lawn parking
  - patio or paving installation
  - grade change
  - stockpiling materials on the ground

- Damage to the root system can often be detected from discoloration, reduced size, or death of part or all of the tree's crown.

How do these acts hurt the tree?

- **Loss of support.** When the big buttress roots are cut close to the tree, the tree has no support on that side and is prone to windfall.
- **Loss of water.** Cutting the roots that supply water makes the tree vulnerable to drought, and also to pests that attack water-stressed trees.
- **Loss of nutrients.** Roots must grow to take up many nutrients**,** and when the soil is compacted by traffic or other loads, roots are unable to penetrate it.
- **Loss of food**. Roots, like people, must be able to breathe to use the food they get from the leaves. When roots are smothered, they die from starvation.

How can the roots be protected?

- Fence off the ground underneath the tree's crown *before* construction begins. If traffic must go through that area, first put down 6-12" of gravel or coarse mulch.
- Work with your utility company to tunnel under tree roots, when appropriate.
- When replacing sidewalks, lay them around (or up and over) the roots of older trees.
- Don't raise the soil grade over roots more than a few inches without special precautions.
- Set paving blocks in sand, and don't mortar them together.
- Mulch wide and 2-6" deep, especially younger trees trying to establish their roots.

Girdling Root

What is that?

- A girdling root is one that circles the base of a tree at or just below the surface.
- Gridling roots can also girdle other roots, but without harm.
- The most commonly affected species are maples, lindens, and ashes.

Is it serious?

- The threat of a girdling root depends on two major factors:
  the size of the root
  the amount of circumference affected
- The expansion of the root and the stem squeezes them against each other, interfering with the transport of water, nutrients, sugars, and other necessary compounds.
- The resulting damage to the tree reduces vigor, and often leads eventually to whole stem failure.

How do you know if there is a girdling root?

- The only sure sign is to see a root circling the main stem at or just below the soil surface.
  probe the soil at the tree base with a stiff wire to see if a circling root lies under the surface
  excavate the soil at the tree base to reveal any underground girdling roots
- Common symptoms include
  one side of the trunk flattened
  marginal and/or tip scorching on the leaves
  crown discoloration or dieback
- Many of these symptoms can be caused by other factors such as root damage, flooding, or wilt diseases.

What can be done about girdling roots?

- Prevention:
  carefully inspect the root system at the time of transplantation
  bend roots away from the stem before backfilling
  cut any roots (shaped like a "J") that curl back around the stem
- Treatment:
  use a saw or chisel to sever the girdling root, especially if the tree has a significant target
  reduce stress on the tree recovering from the removal of a girdling root

Evaluation of Trunk Cavities

What does that mean?

- **You need an explicit and reasonable policy when deciding what to do about a tree that is hollow.**

Why is it important?

- **Trees with cavities = trees with decay. Because the defect is on the inside, it is harder to see and judge the danger from the outside.**
- A reasonable policy can't be based on emotion. Extreme opinions such as "It's a beautiful tree, leave it alone!" or "It's a rotten tree, cut it down!" just cause more trouble.
- The happy medium is a policy that has two goals:
  to protect trees from unnecessary removal
  to protect people and property from unnecessary harm

What do I need to know to make a reasonable decision?

- **Does the tree have a likely target?**
  Even a "bad" tree is *not* a hazard tree if it has no significant target to hit.
  Remove a tree with a large cavity when it has a stationary target that is constantly occupied like a house.
- **What kind of tree is it?**
  Different species have different mechanical strengths and decay strategies.
  Be more cautious with species of high hazard potential such as silver maple, cottonwood and other poplars, willow, basswood, boxelder, black locust, and tree-of-heaven.
- **What is the tree's condition?**
  Look for good overall balance, a full and normal crown, and at least 4" annual shoot extension.
  A declining and leaning hollow tree is much riskier than a vigorous and upright one.
- **How extensive is the rot?**
  Traditional methods include "sounding" (hitting the trunk) and probing a hole. Both are good techniques for finding the largest cavity, and to get a rough idea of its size.
  A more scientific but still low-cost method is to drill with a 3/16" long-shafted bit a few places around the trunk at the most likely point of failure. Measure how far up the bit you are when resistance drops, the shavings become discolored, or nothing more comes out.
  A precise record of resistance patterns can be had with new equipment such as the Resistograph®, though they are quite expensive.
  Research shows that **a cavity is unlikely to make a tree fail at the spot measured if there is 1" or more of sound wood per 6" of diameter** -- i.e., average sound wood thickness ¸ trunk diameter = 0.15 or more. This guideline has good scientific support for trees under 40" in diameter.
  Tall trees with a large canopy and on an exposed site require a higher ratio of sound wood to diameter.

How can I save a tree with internal rot?

- **You can't.** You can try to slow its decline, but you can't stop the decay.
- The best--and cheapest--intervention is usually to help the tree do its own work of containing the decay. Supply weekly water during dry spells and provide 2-6" of organic mulch.
- Fertilization will usually not help much, although aerating the soil to promote root growth often benefits older trees.

Predicting Limb Breakage

What does that mean?

- **Predicting limb breakage means learning to see and interpret the external signs that a limb is likely to fail.**
- Some failures can not be predicted, and some predictions will not be right. And even in predictable cases it is impossible to say exactly when failure will occur. But a sound policy follows "best guesses" based on years of careful field observations.
- As used here, a "limb" is bigger than 3-4" in diameter (=branch), at least somewhat horizontal, and attached to a larger leader or trunk.

What are some of the symptoms to look for?

- *Symptom*: limb without bark, missing or dead leaves in crown
  Problem: limb death
- *Symptom*: small or misshapen leaves, or early color in one spot of the crown
  Problem: limb decline
- *Symptom*: wounds with holes or cavities, esp. on the stress-bearing side or when lined up one above the other
  Problem: internal decay column, hollow limb
- *Symptom*: "dogleg" (sharp turn) in a limb at the point where there is an old wound
  Problem: decayed stress point
- *Symptom*: tuft of leaves at end ("lion's tail"), or great limb length (e.g., in silver maple)
  Problem: unusually high mechanical load
- *Symptom*: long cracks along the length of a limb, esp. serious when on both sides
  Problem: delamination of internal layers, separation of the beams
- *Symptom*: diameter over 15" in a hazard species, esp. if limb is larger than central leader
  Problem: limb weight beyond the normal wood strength of the species
- *Symptom*: woody plants in a union (crotch), swelling around or seepage from the union
  Problem: included bark, internal decay, weak attachment of limbs

What should I do if I see these symptoms?

- **Investigate the fundamental problem.** Remember that these symptoms may have causes elsewhere in the tree (e.g., in the butt or roots) or earlier in its history (e.g., lightning strike).

- **Evaluate the target.** What will the limb hit if it falls, and how serious would that be? If a large limb threatens people or property, you should probably remove it.
- **Identify the species.** A symptomatic limb on a weak-wooded species (such as silver maple, black willow, boxelder or cottonwood) is more dangerous than on a strong-wooded species (such as white oak, sugar maple, or shagbark hickory).
- **Get an aerial inspection when useful**. It is often difficult to tell the extent of a defect from the ground, even with binoculars.
- **Make sure a correct cut is done at the correct time,** usually taking it back to the collar on the leader. Limbs get pretty big, so the wound will close slowly if at all, and you want to minimize infection in any way possible.
- **Don't remove more than 1/4 of the crown**. Besides, if that many limbs are suspect, you should probably consider removal as a more cost-effective alternative.

How to PreserveTrees During Construction

Why is this topic important?

- The urban forest makes city living healthier and more pleasant:
  it removes the greenhouse gas carbon dioxide from the air
  it cleanses the air of a range of pollutants
  it moderates air temperature , reducing air conditioning and heating energy use
  it increases property and commercial values
  it instills a sense of well-being and connects people to nature
- Large healthy trees carry out these functions particulary well, but are often the most sensitive to construction damage and can not be quickly or easily replaced.
- Development and construction constitute the most serious threat to these benefits of the urban forest.

What harm can construction cause?

- The worst damage occurs underground, where it is invisible until its aboveground effects become apparent.
- Underground damage includes:
  compacting the soil so roots cannot breathe and water cannot percolate
  killing roots and soil organisms through dumping or spilling toxic substances
  severing roots, especially those greater than about 1" in diameter, compromising tree health and stability
- Although more obvious, aboveground damage is usually only serious when it affects large trunk areas or large branches.

How can preservation be done?

- Be proactive. Don't wait until construction starts to start taking steps to preserve trees. It is much easier to prevent damage than to correct it.
- Recognize that both construction and preservation need space. These competing demands need to be resolved as fairly as possible, usually in.collaboration with a project's architects, engineers, and/or builders.
- Establish a root protection zone with strong fencing placed a correct distance from the trunk. The distance varies by species and soil, but out to a tree's dripline is a minimum, with greater distances for narrow crowns or sensitive species like sugar maple.

- Use formal agreements with strong penalties attached. This is the best approach for individuals as well as for communties.

Which trees should you preserve?

- There is little point in putting in time, cost and effort into preserving a tree in poor condition.
- An evaluation of the trees on a potential construction site is recommended, with the following considerations:
  The tree's crown should have the density, color, and foliage normal for its species and age.
  The tree should be mechanically stable, and not pose a serious risk to forseeable targets.
  Avoid preserving species that are unsuitable for the site. Important factors to consider include:
  growth rate
  pest susceptibility
  lifespan
  invasiveness

- Since health, stability, and suitability are not obvious traits, you will usually need a professional for this task.

HOW TO KILL A TREE STUMP

What is this about?

- **You often can't kill a tree just by cutting it down.**
- Sprouting from the stump or the roots is a fundamental strategy by trees (and even more by shrubs) for survival and reproduction.
- In a natural setting, sprouting is an effective guard against the repeated loss of stems--e.g., through deer browsing of seedlings, or destruction by fire of mature trunks.

Why is it important?

- **In urban settings, stump sprouts are a significant maintenance problem. It can be onerous to remove young sprouts, and hazardous to let them grow.**
- Young stump sprouts must be removed annually by mechanical or chemical means. If the stump is cut at ground level, sprouts can be controlled by mowing.
- If allowed to grow, such sprouts routinely produce multiple large trunks leaning away from each other that can pose a hazard later.

Which common urban species cause the most trouble?

- Cottonwood and other poplars, boxelder and the "soft" maples, lindens, tree-of-heaven, willow, beech, red oak, crabapples and other trees in the rose family, and green ash.
- Some species (like black locust) pose particular problems because of their ability to sprout from roots, even well away from a tree whose stump has been ground out.

What mechanical means are effective in urban settings?

- **Stump removal.** Grinding out the stump and large roots sharply reduces basal sprouting.
- **Accelerated decay.** Cut at soil level, drill holes, add slow-release fertilizer, and mound with soil.

What about chemical means?

- **Growth regulators.** Some forms of 2,4-D have proven effective when applied during the later part of the growing season by "frilling" (squirting into fresh trunk cuts), "cut-stumping" (painting or spraying on fresh stumps), or injection. Multiple applications may be required. Follow label directions.
- **Phloem-transported compounds.** Concentrated glyphosate-based herbicides are very effective during the later part of the growing season when applied by frilling, cut-stumping, or injection. Follow label directions. Phloem-transported compounds sometimes pass to other nearby trees--especially when same species--through root grafts ("backflash"), so be careful.
- **Other compounds** (such as triclopyr, for example) have also been show to work well when applied by frilling, cut-stumping, or injection.

PLEASE NOTE: Follow manufacturer's directions. Consult the appropriate state office for registered pesticides that are labeled in your region for use on woody plants. All pesticides are subject to varying restrictions. Furthermore, changes in pesticide regulation occur constantly and human errors are still possible.

Muliple sprouts from an oak stump (Source: http://www.extension.umn.edu/distribution/naturalresources/components/3474-20.htm