Protection and Care of the Urban Forest

NJDEP Division of Parks and Forestry

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Introduction

Our country is slowly becoming an urban nation where it is expected that, by the year 2000, three of every four Americans will be living in the concentration of homes in the urban areas. Although our suburbs are facing tremendous development and the metropolitan areas expanding at an estimated 3,000 acres per day, very little thought has been given to the land until recently. Rural land has been disappearing at an alarming rate, taking with it prime farmland and destroying unique scenic and historic areas. Lands and waters for recreation have been lost, marshes have been filled in for homes and industries, and once scenic rural forest lands now support subdivisions. It is imperative that we stop trying to change or destroy what Mother Nature has made to make it suit the human need. Rules and regulations have been enacted in many areas to protect the natural resources such as soil, air, and water, but very few regulations exist to protect another valuable resource: the trees and forests.

URBAN FORESTRY is the management of the vegetation in urban and urbanizing areas.

The urban forest, which comprises all the trees and associated vegetation within an urban area, consists of several areas. The street trees have probably received the most intensive management. The park system probably has the longest history of management, going back to managed "commons" and European community woodlots and forests. Only recently have the trees and vegetation on urban private lands, both residential and institutional, been actively considered part of the urban forest.

Urban societies' objectives for tree and forest land management vary greatly, usually dealing with the "in place" values of the trees.

Noise reduction, screening of unsightly views, and provision of natural beauty for urban people rank high in the objectives for growing trees in inner cities, as does providing a habitat for songbirds, squirrels, and other wildlife, especially in parks. Recreation sites are important and the form varies with location: playgrounds and open spaces predominate in the inner cities, while sites for picnicking, hiking, biking, horseback riding, and similar activities are more common in suburban areas. "Natural areas" for recreation, nature education, and research are also in demand and are needed within the urban areas.

Problems in growing trees to meet these objectives are many and varied. Soil treatments may be needed to insure survival and growth. Air or soil pollution, sometimes aided and abetted by disease or insects, may limit the choice of species or require remedial measures. Shade trees may need pruning to permit the passage of utility lines or vehicles, even though this may increase disease problems or lower esthetic values. Along streets of cities and towns, and in recreation areas and developments, trees may suffer injury to trunks or root systems that may require costly treatments which might have been prevented by proper planning. In suburban and developing areas, construction may damage residual tree stands.

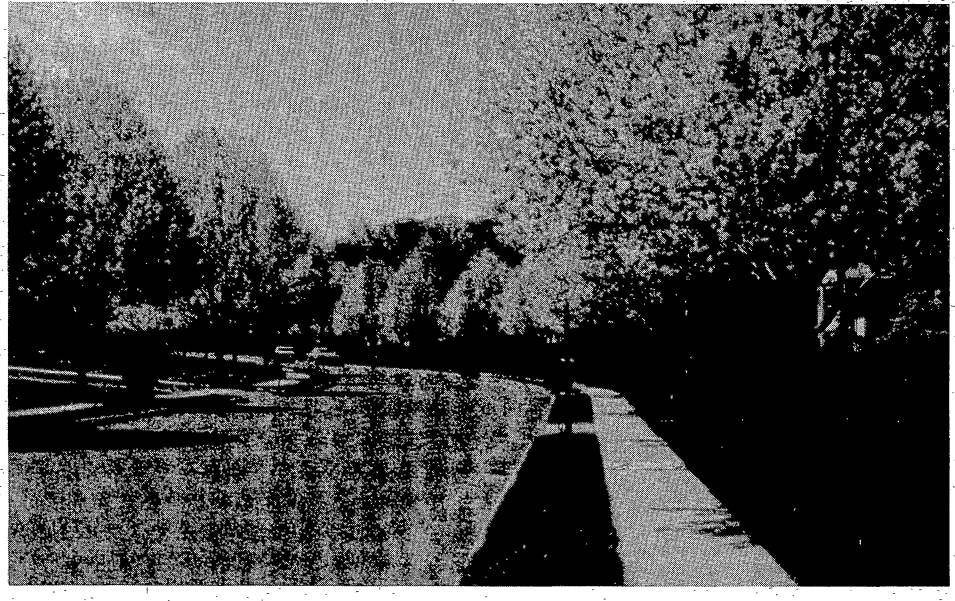
Management standards must be developed which meet both societies' objectives and the ecological requirements of desirable tree species, plant associations, or wildlife. City climate or other physical attributes of urban life may be controlled or ameliorated through management. Perhaps management will be dictated by the need to provide high-quality water for municipal water supplies, or to dispose of waste water and sludge in ways that groundwater supplies are not contaminated. One fact of urban forest management is clear--it must be "multiple-use", or rather "multiple-benefit", management.

Why Preserve Trees

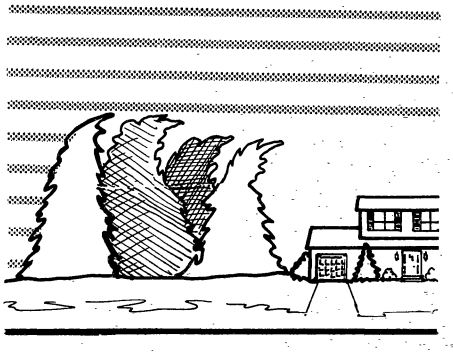
Woodlands and trees are beneficial to man and his environment in many ways. Trees modify local climatic conditions near or within their boundaries; create a feeling of privacy and seclusion; serve as recreational areas; and provide a reservoir of plants and animals that would otherwise be absent from an urban area.

Trees and woods improve the local climate by screening and shading the direct sun rays during the summer months, providing a more comfortable atmosphere with lower temperatures.

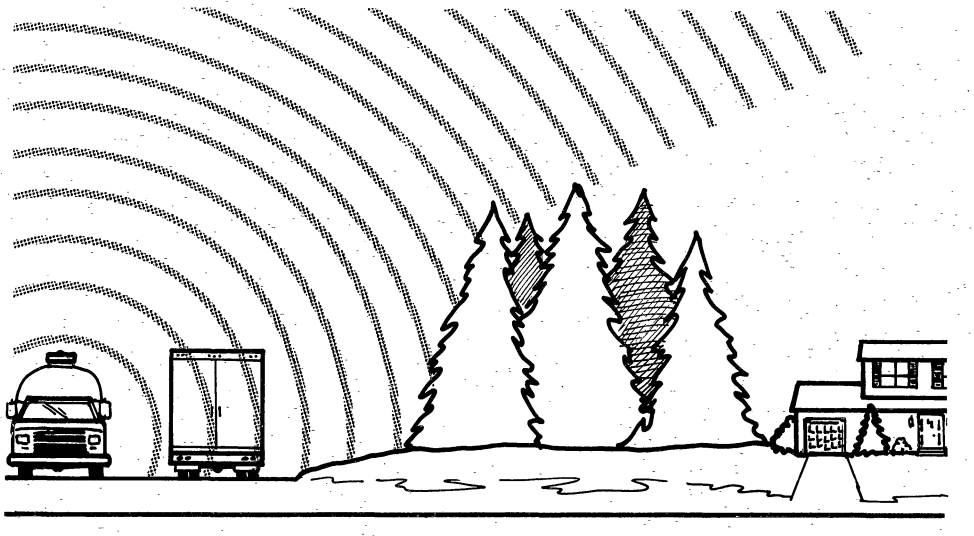
Trees and woods slow down surface runoff of rain because of the high moisture-holding capacity of the organic matter on the soil surface and the increased permeability of woodland soils caused by the abundant network of tree roots. Leaves of trees and other vegetation reduce the impact of the billions of hard-hitting raindrops. This, in turn, recharges the groundwater supply, usualy reduced by paving and construction.



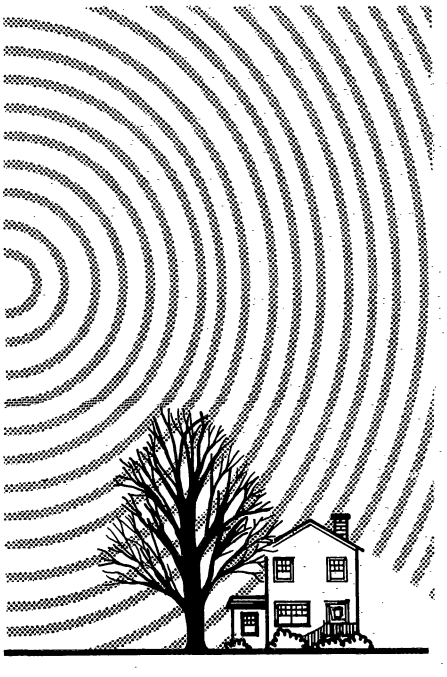
Wind Protection



Acoustical Control



Sun Control



A large percentage of the ground may be covered with houses, streets, driveways and parking lots that are impervious to rain, reducing the amount of water soaking into the soil.

Trees serve as physical screening of objects and unsightly scenes, increasing aesthetic values. The screening creates privacy. Trees may also serve as windbreaks in the winter months.

Trees and woods provide food and cover for urban wildlife which would otherwise be absent. How many people do not enjoy seeing rabbits, squirrels, or pheasants in their backyard? It is hard to attract birds to a feeder in the winter if trees and shrubs are not present for protection.

How do you place a dollar figure on the aesthetic effect of trees surrounding homes and businesses? It is quite difficult because some specimens are priceless. But aesthetics and beauty are the most important uses of trees in residential areas. A study by the U.S. Forest Service showed some interesting facts regarding trees and their relation to property values.

A parcel of ground was appraised with and without trees by a group of real estate appraisers. On the average the results indicated that trees contributed as much as 27 percent of the appraised land value. Of course, it is a matter of economics as to whether the cost of protecting the trees is more than what they are worth. But if the cost of protection is less than their addition to the property value, it is more profitable to leave the trees. For home developers, there is a quick lesson in these results. If the trees die as a result of the development of the site, then the money and time invested in protecting the trees was wasted.

In another such study, pictures of identical homes with and without trees were shown to local realtors for their appraisal. On the average, the trees can increase the value of property 10 percent. The value of trees to the property owner or developer and the community is far higher than these figures when the values of the environmental benefits that the trees provide are included.

General Tree Information

It is imperative that planners understand how open grown trees and forest trees grow, the classification of individual forest trees and stand types, and the factors that affect tree growth. Without this basic knowledge and understanding, time and money may be wasted in protecting trees.

Even though many trees may be left on the building site, oftentimes a high percentage of them are severely injured and may die as a result of the damages sustained by the builder or equipment operator. A basic understanding of how trees grow is required to illustrate how easily they can be damaged. The basic parts of a tree are:

1. the crown or branch system
2. the trunk
3. the root system

The leaves in the crown produce the principal food of the tree. During construction, this part of the tree is usually not damaged.

The tree trunk, for the most part, consists almost entirely of inactive cells. The heartwood in the center of the tree provides mostly structural support. The sapwood, or lighter wood near the outer edge or bark, is important for the transportation of food and water.

The most critical area, the cambium, is a very thin layer of cells located just inside the bark. This layer is the most delicate part of the trunk and it is the only part of the trunk that is actually alive. It is this layer that is responsible for the diameter growth of the trunk. Between the cambium and the outside bark is the inner bark, which is also very thin, and functions as the carrier of food from the leaves to the cambium and storage cells. The final part of the trunk is the outer bark that provides protection.

Damage occurs to the tree when the bark is skinned off or the trunk is gouged by equipment. If severe enough, such damage interrupts the flow of nutrients up and down the tree. Removal of all of the bark around the tree (girdling) will cause it to die. When the bark has been damaged or removed, insects and decay fungi can enter the tree. Small wounds may heal over in a

How a Tree Grows (Figure 1)

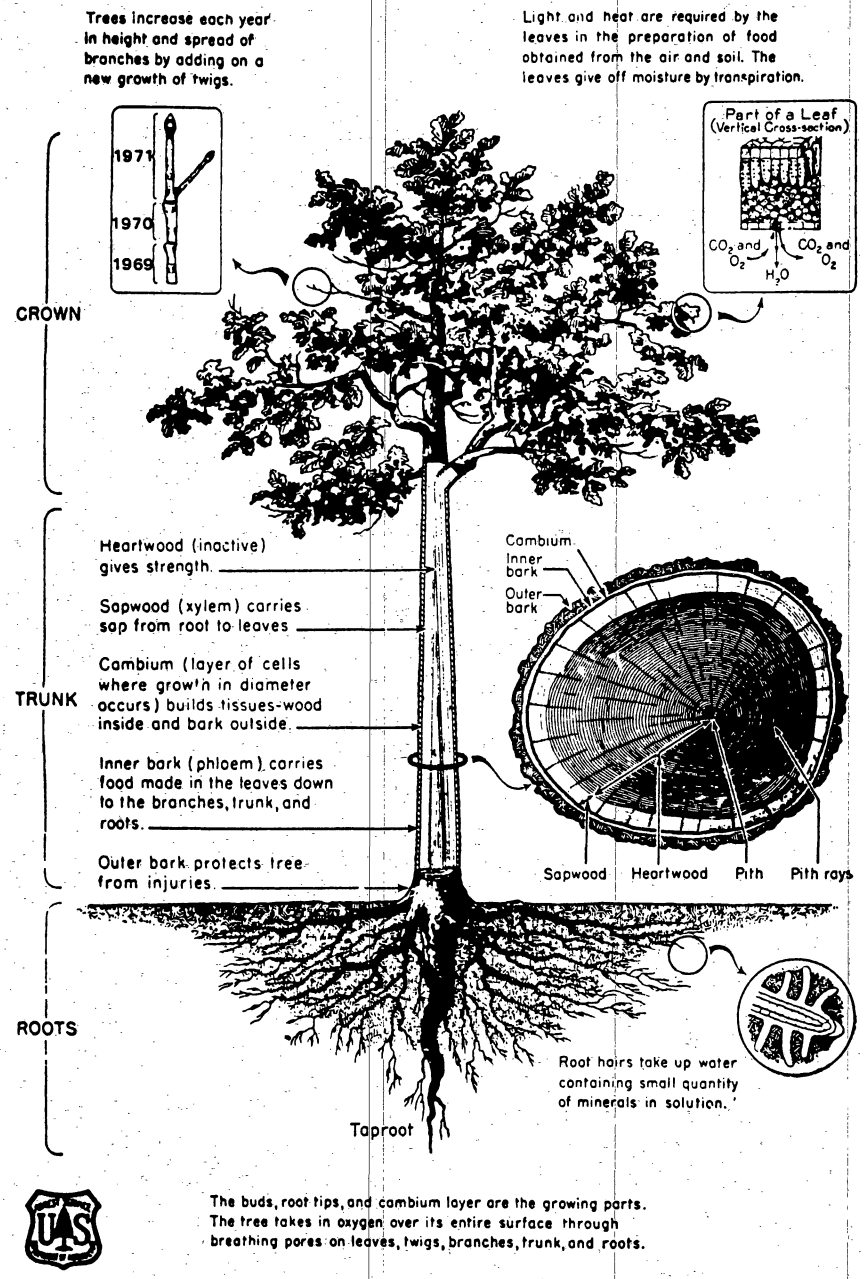


Figure 1 *Trees use soil nutrients, water, carbon dioxide, and sunlight to grow, and they give off oxygen as a byproduct.*

few years, but large wounds may never heal. The tree may continue to live, however, the unhealed damaged area will begin to decay, and in time the entire inside of the tree may become hollow. The tree may remain vigorous and grow very well even though hollow, but the internal structural support will have been greatly reduced, leading to the possibility of the trunk splitting or breaking off during windstorms or heavy accumulations of ice.

The root system of the tree acts as an anchor and also absorbs the water and nutrients the tree needs. The root system may be fiberous and shallow near the surface of the ground or the system may be deep with a main taproot growing downward, similar to a carrot. Smaller lateral roots grow from the taproot. Soil moisture and oxygen availability has much to do with how far down a root system will go. Large amounts of free moisture in the soil will tend to stop the downward growth, resulting in a normally deep-rooted tree having a fairly shallow root system.

Where the roots attach to the tree trunk, the roots are very large and are relatively few in number. Going out away from the tree, these large roots divide many times with the root size decreasing in diameter until at the very end of the root are found very fine strands called "root hairs." The root hairs are responsible for the absorption from the soil of water and nutrients the tree requires.

The root zone, or area under the tree where the majority of the roots are located, is defined as being the area from the trunk outward to the "drip line," or where the outer tips of the branches overhang the ground. Some root zones are smaller and some are larger, depending upon factors such as growing space, competition between trees, and soils.

Damage to the tree can occur if the feeder roots and associated root hairs in the root zone are damaged or killed. This can occur from soil compaction by equipment, suffocation by fill, and damage during excavation and grading. The tree can also be injured if the large roots near the trunk are severed, not allowing nutrients and water to flow from the smaller roots to the tree.

Shallow-rooted trees are damaged more by soil disturbances than those which are deep-rooted. The best precaution to take to avoid damage to either type is to eliminate all work under trees within the root zone area. If such work is necessary, us the lightest equipment possible and minimize its movements.

Development of a Tree

Trees growing in a forest situation grow physiologically the same as trees growing in open areas or as ornamentals, but they do exhibit different forms and produce only those amounts of roots and branches needed for their particular situation. The root and branch systems are generally more compact than for trees grown in the open because of competition from other trees. Associated with this competition is a need for sunlight. The trees, reaching for the sun, grow tall and straight and the lower branches gradually die from a lack of sunlight. The resultant tree is tall and slim with few branches on the lower trunk and the branch system adapted to the size of the opening it found in the tree tops.

Trees grown in the open, by comparison, are usually shorter and bushy because of an abundance of sunlight and from the lack of competition. These trees exhibit heavy limbs, sometimes low to the ground. The lack of competition results in the root systems being more extensive and wide - spreading.

Forest stands that are severely thinned during construction may cause problems later. The remaining trees, for example, may be damaged by the sudden exposure to full sunlight. The tops of thin barked trees may die because of direct sunlight. This effect is called sunscald. Also, after having been protected from the wind by surrounding trees for many years, the remaining trees may uproot in heavy winds because their root systems are not adapted to that kind of stress. Severe thinnings of woodlands should be avoided and unprotected trees should not be left standing near buildings where uprooting may cause serious damage.

Tree Classification

If a forest tree is to remain alive and vigorous, it must grow. To grow, it must continually have an increase in its growing space. It then follows that competition between trees will result and some trees will be eliminated, particularly those individual trees which are low in vigor or those that are genetically less suited to win the fight for survival under the particular environmental conditions that may exist. This is the process of natural selection and only the most hardy and vigorous trees will survive. During this process, four tree classes are recognized as the forest matures. Refer to Figure 2.

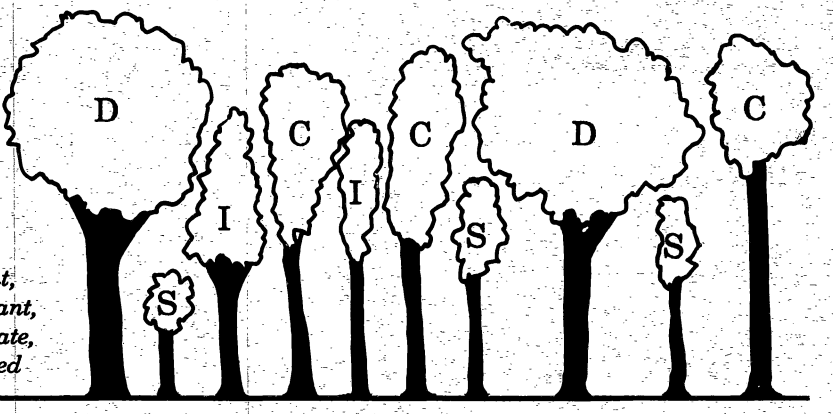


Figure 2
D=Dominant, C=Codominant, I=Intermediate, S=Suppressed

Dominant (D): This is a tree that is found in the main canopy or overstory and is usually one of the larger, healthy, and vigorous trees. It can be defined as having the top and sides of its crown or branch system exposed to the sun above the rest of the trees.

Codominant (C): This tree is second in size to the dominant and can be defined as a tree with its top and only part of the sides of the crown in the sunlight.

Intermediate (I): This tree is usually smaller than those in the previous two classes and has only the top of the crown in the sunlight. This tree is struggling to survive and unless more growing space is made available, it will decline in vigor and slow down in growth.

Suppressed (S): This tree is lacking sunlight and growing very slowly. The crown or top of the tree receives no direct sunlight at all. The tree is dying slowly and little can be done to make it increase in growth. After falling this far behind in competition, the suppressed tree usually will not respond to a thinning. It usually will not increase its growth rate.

When building in woodlots, it is important that as many as possible of the dominant and codominant trees be favored. Leaving intermediate and suppressed trees in key locations is also desirable. If the tree is lost, it will result in losing the investment made in saving it, and also result in an additional cost for its removal and replacement with a new tree.

Stand Types

Woodlands can be divided into different "stands" or groups of trees with the same characteristics. These stands can be separated by age class, species composition, tree size, or tree vigor. There is no standard size for any stand. Stand sizes vary widely from groups of only five or ten trees to stands of twenty to thirty acres. In relation to construction and the inevitable environmental disturbance that will occur, it is important to know that such divisions of woodlands do exist. The stands should be differentiated in the initial land planning stages because each one will react differently to environmental changes.

A stand of large mature or overmature trees will not tolerate heavy thinnings or the removal of many surrounding trees and

severe soil disturbance beneath them. Such changes may cause the tops of the trees to die back and may result in complete death of the tree. Trees of this size are "set in their ways" and will not usually survive severe environmental changes.

A stand of immature trees growing vigorously will generally tolerate heavier thinnings than older stands. Moderate thinnings in immature stands do not oridinarily have an adverse effect on the remaining trees. However, immature trees of some species such as oak, maple, beech, and tulip poplar may still be affected after a severe thinning. Being thin barked, the tree tops may die as a result of "sunscald" from the sun. Sunscald will cause a misshapped tree, but is not necessarily a lethal condition.

Stands of very young trees or saplings will tolerate the heaviest thinning because they are more vigorous and can better adapt to the environmental changes.

The Effects of Sun, Wind, Heat, Cold, Drought, Salt and Salt Spray

Sun: Leaves grown in the shade are thinner in cross section and less resistant to heat and water loss caused by the sun. When suddenly exposed to full sunlight after a heavy thinning, they are frequently unable to survive. If the entire branch is to survive, it must develop new leaves that will tolerate the new environmental conditions. If not, death of the limb will occur. Sunscald of thin barked trees such as maple, beech, and white pine will occur after heavy prunings or thinnings, as mentioned previously. Sunscald occurs during the winter and is apparently related to the rapid temperature changes of the layers of cells in the limb often resulting in death of the limb.

Full sunlight on tree trunks after a heavy thinning will stimulate buds in the bark to grow causing branching (epicormic) on the sides of the trees. The once clean, sleek tree trunks will have a "feathered" appearance. Feathering does not kill the tree, but it is unsightly.

The heating of forest soils when suddenly exposed will have a detrimental effect on the root system. An average temperature change of 2°F can cause mortality, especially in shallow-rooted trees.

Wind: Winds from a single direction will exert a strong influence upon the form and size of tree tops. After many years the tops will all lean in the same direction. Sway, caused by the wind, will influence the tree form by causing short trunks and excessive taper.

Wind is a major cause of breakage, windthrow and uprooting. As mentioned before, when woodlands are heavily thinned and single trees remain, not accustomed to wind and previously protected by other trees, the risk of the tree being uprooted or broken in high winds is extreme.

Windthrow is also a result of soil structure. The structure of some soils prevents trees from developing a strong holding root system. It is suggested that the characteristics of the types of soils in a development area be determined. Such information is available from the soil conservation districts of the State of New Jersey. (Appendix IX)

Heat: The effects of heat on trees are most apparent in certain areas, such as adjacent to buildings or near blacktop pavements. Radiated and convected heat can damage leaves and sometimes the trunk and branches. Blacktop pavements continue to produce heat at night, either by radiation or convection, and can contribute to leaf dehydration -- leaves may be "scorched" or burned at the tips (conifers) or on the margins (broad-leaved trees), and eventually turn brown. Bark of certain species of trees, such as beech which usually grow in shady locations, can suffer from sunscald, especially when trees are widely spaced. Small cracks form in areas of the bark, and this bark may die and form unsightly dead patches a few inches in diameter. These can develop into cankers which are associated with the presence of certain fungi or bacteria.

Cold: Most cases of winter injury related to cold can result, not from the cold alone, but from the failure of the shoot or xylem of the leaves themselves to conduct water. The effect has been called "frost drought." This is the common cause of browning or yellowing of conifer leaves in winter. Very often the effect is blamed on some soil problem. Burlap covers and windbreaks, as well as certain sprays that coat the leaf surface, may help prevent such injury.

Roots are generally more sensitive to freezing in winter than tops, although temperatures do not usually fall as low in the soil as in the air above. Some species are injured when there is little snow cover or natural mulching to act as insulation. The following spring, the above-ground parts may dry up and die with no other visible symptoms. Container-grown trees are especially susceptible to such damage.

In some urban areas where trees are exposed by wide spacing, it is fairly common that trunks crack

as a result of a combination of winter cold and radiant warming. When trees are deeply frozen, warming one side of the tree by the sun's rays can result in severe distortions and rupture of the wood and outlying bark. Cracks can also appear on twigs usually so small as not to be noticed. These are then invaded by fungi. Cold is not usually suspected as the cause.

Drought: "Drought" usually implies soil drought, but it may also be atmospheric drought, although the former is far more common. Effects of drought are sometimes obvious with some species like dogwood that wilt readily. Shallow-rooted shrubs commonly wilt in forests when subjected to severe drought. Mineral absorption is sometimes interfered with, and trees may show signs of iron deficiency (yellowing of young leaves) or nitrogen deficiency (yellowing of all leaves). In more severe cases, dieback and early leaf-fall are common.

Drought can cause cracks in branches and trunks. Cracks may be several feet long, parallel to the direction of longitudinal growth. They may resemble frost cracks, with which they are commonly confused. But drought crack is most common in summer. Trees suffering from drought often grew under very moist conditions, and then were subjected to soil and atmospheric drought.

Another result of drought, which is more subtle, is injury that may not be apparent at all. Trees subjected to drought undergo certain chemical changes that make them susceptible to attack by parasitic organisms. This is why it is important to water trees suffering from drought, if at all possible. When drought is combined with the effects of defoliation by leaf-feeding insects, the effects are even more pronounced, and subsequent invasion by parasites is even more likely. Application of fertilizers has been found beneficial for the recovery of defoliated trees.

Salt: Sand treated with salt for use on icy roads may damage trees. The salt is leached down into the roots and causes burning. Salt is frequently scattered over sidewalks in winter to melt ice or prevent water from freezing. When the salty solution finds its way to open soil near roots it can be very toxic. Sand, sawdust or other non toxic materials should be used in areas near tree and other plant roots. Trees within 30 feet of roads are usually affected, while trees beyond that distance are usually not affected. Salt injury appears as a marginal leaf scorch, early fall coloration and defoliation, dieback of twigs and branches and in severe cases death of the entire tree.

Salt Spray: Trees growing along the Atlantic coast are often injured by salt spray blown from the ocean. Most damage is confined to within a few miles of the coast.

Among the broad-leaved trees, elm, magnolia, Norway maple, sugar maple, tuliptree, and sourgum appear most susceptible to salt-water spray, whereas red oak and horsechestnut are very resistant. Among the evergreens, white pine, hemlock, junipers, and Scots pine are most harmed, whereas Japanese black pine, Colorado blue spruce, Austrian pine, holly, spruce and yew suffer least.

Removal of badly damaged trees and pruning of mildly affected ones are all that can be suggested.

Reconnaissance Before Land Clearing

There are many factors to be considered and evaluated during the planning of developments before the final plans are prepared. Together with such factors as the architecture, utilities, traffic flow and many others, the natural features of the site should also be evaluated. Information should be sought on the soils, slopes, flood plains, wildlife, and historic aspects of the site, as well as the vegetation present.

Individual trees, groups of trees, and wooded areas should be examined thoroughly and divided

into stands, if necessary, so that any unique or delicate areas can be protected.

By understanding the species of trees that are present, by knowing what their characteristics are and their levels of tolerance regarding environmental changes, intense development activity could possibly be shifted to the areas that will tolerate such disturbances. This is not to say that all trees or woodlands on a site can or should be protected. It is sometimes impossible to protect trees because of the nature of the development and construction required. Also, because of a tree's condition or even an entire woodland's condition, protecting the trees may be a waste of time and money if they are in such poor condition to begin with that they will not survive, even if left alone. Examples would be trees damaged and weakened by fire, insects, or diseases. In such a reconnaissance, a professional forester in a public or private service may be of invaluable assistance to the planner.

The reconnaissance before land clearing begins can mean the difference between an aesthetically pleasing development with natural vegetation or one not pleasing to look at because of dead or dying trees. Once clearing begins and damage to the trees occurs, it cannot be reversed if the damage is severe.

Courtesy of Van Nostrand Reinhold

Characteristics of Trees to be Protected

The following lists the criteria that should be evaluated before deciding to remove or protect a tree. It must be understood that all tree species have at least one characteristic that makes them unsuitable for some use. How the tree is to be used must be taken into consideration.

Tree Vigor :

Vigor is described best as the overall condition of the tree. Vigor is important because a tree of low vigor is more susceptible to damage by environmental changes than healthy trees. Trees of low vigor are also more susceptible to insect and disease attacks. Indications of poor vigor include the dying of the tips of branches and entire limbs, small annual twig growth, stunted leaf size, sparse foliage, and color of foliage. Avoid hollow and rotten trees, trees cracked or split, those oozing sap, trees with broken tops, and those leaning, crooked, or twisted.

Tree Age :

Very old, picturesque trees may be more aesthetically valuable than smaller, young trees, but they will also require more protection measures. If leaving a very old tree, be sure the tree is sound and healthy.

Species :

Many species of trees found in New Jersey woodlands are not suitable for shade tree uses around buildings. Avoid protecting trees that are short-lived, brittle, have soft wood, messy leaves or fruit, and those frequently attacked by insects and disease. (see Appendix II)

Resistant to Insects and Diseases :

Avoid leaving trees in highly visible areas or specimens that are frequent targets of insects and diseases. American elm, for example, will eventually be lost because of the Dutch elm disease. Cherry, another example, is a favorite host of the tent caterpillar which causes defoliation of the trees in early summer, constructing "tents" or webs, giving the tree an unsightly appearance (see page 25).

Tree Aesthetics :

Choose trees that are aesthetically pleasing, exhibiting good shape and form. Avoid leaning, twisted, crooked and misshapen specimens. An odd shaped tree or one of unusual form could add interest to the landscape if strategically located. Be sure, however, the tree is structurally sound and vigorous.

Spring and Autumn Coloration :

Species differ as to the color the leaves turn in the fall. Some are bright red, others orange and yellow. Some exhibit no autumn color at all, such as walnut, locust and sycamore. (see Appendix V)

Wildlife Benefits :

Favor trees that are preferred by wildlife for food, cover and nesting. A mixture of evergreens and hardwoods is very beneficial. Evergreen trees are important for cover during the winter months. The hardwoods, on the other hand, are more valuable for food.

Air Pollution Susceptibility:

Tree species vary immensely in this respect and even with different individuals of the same species because of their genetic makeup. Symptoms vary from browning on the edges of the leaves and needles, to stunting of growth, to death of the tree. (see Appendix IV)

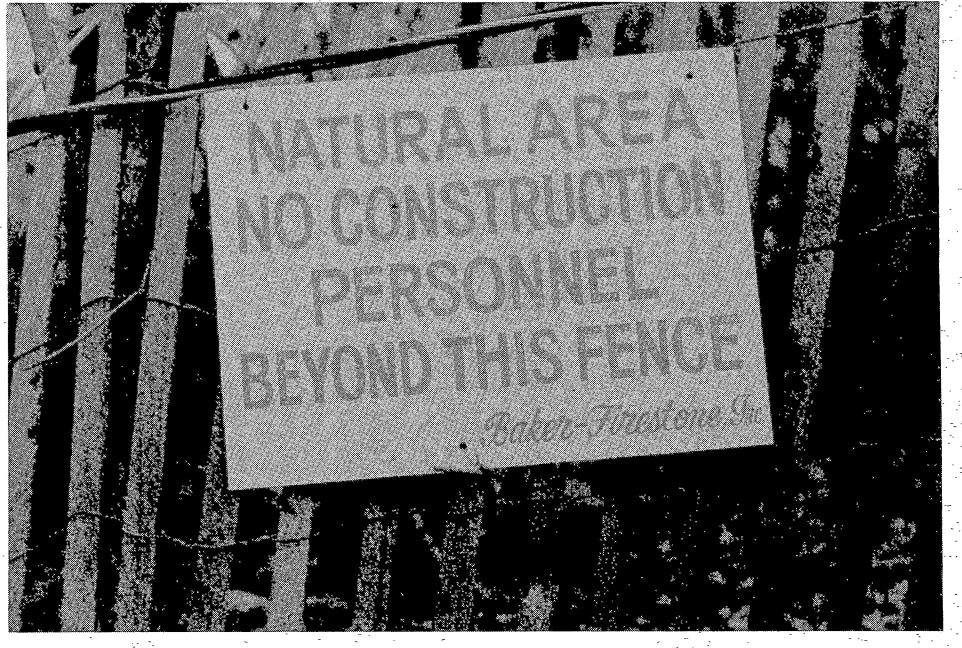
Species Longevity:

Favor trees whose life span is considerably long, such as oak, beech, and tulip poplar. Short-lived trees should be avoided for use as shade, lawn, or specimen trees. Some short-lived trees are attractive and have pleasing coloration in the spring or fall, and, in that respect, are suitable. However, be aware that the tree may not live for a long time. (see Appendix V)

Protection of Trees During Construction

After the trees on the building site have been completely evaluated, the undesirable trees should be removed before construction begins. Be careful not to damage the remaining trees. Experienced tree experts may be required for this task. If the trees to be removed are large enough, a local logger may be interested in purchasing the trees, providing a financial return. Experienced loggers can remove the trees without damage to those remaining. The remaining trees should then be protected from:

1. construction equipment
2. grade changes
3. excavations
4. final cleanup of the site.



With no protection, this can happen. Resulting in the death of the trees. (upper)

Post a sign to keep personnel and equipment from areas to be protected. (lower)

Protection from Construction Equipment

If the soil around the tree is not to be disturbed, the tree should be protected by fencing, roping, or flagging to prevent a surface damage and root damage from soil compaction by construction equipment. Include the entire root zone, the trunk and low hanging branches. Groups of trees can be protected by fencing, roping or flagging the entire area where they are located. Such protection measures are of no value if the equipment operators are not aware of their significance. (Fig. 3 &4)

All trees surrounding the immediate building site and access roads can be protected by wrapping the trunks with sections of snow fence or boards wired together. In the event the tree is hit, the trunk will be protected and hopefully the bark will not be scraped away. The trees should not be used for roping, cables, signs, or fencing, which can damage the bark. Nails and spikes should not be driven into trees.

Major grade changes may require an air supply to the roots. One method that can be used is installing a layer of gravel and stone and a system of drain tiles over the root system at the original grade level (Figure 5). The tiles are laid on the original grade and form a wagon wheel shape with the spokes of the wheel opening into a dry well built around the trunk. The dry well acts as the hub of the tile system and holds fill away from the tree trunk. For all trees, the dry well must be big enough to allow for tree growth.

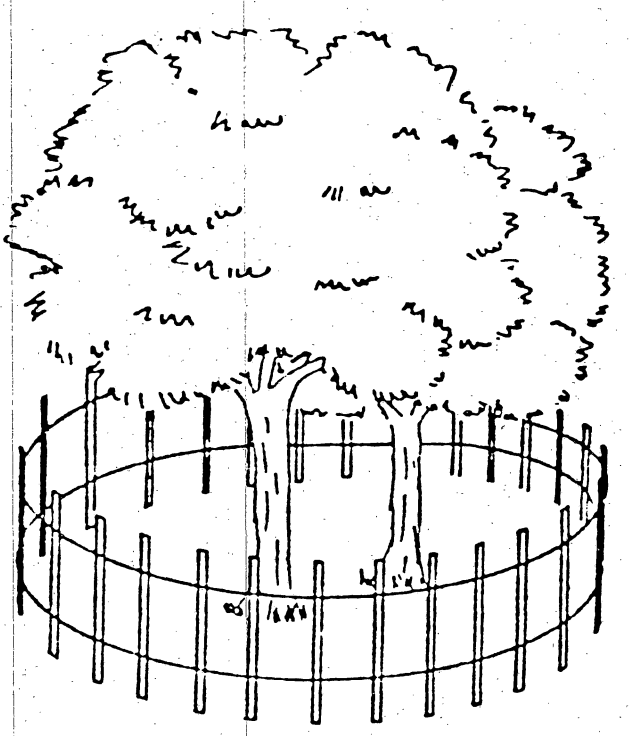


Figure 3 *Correct fencing for tree protection*

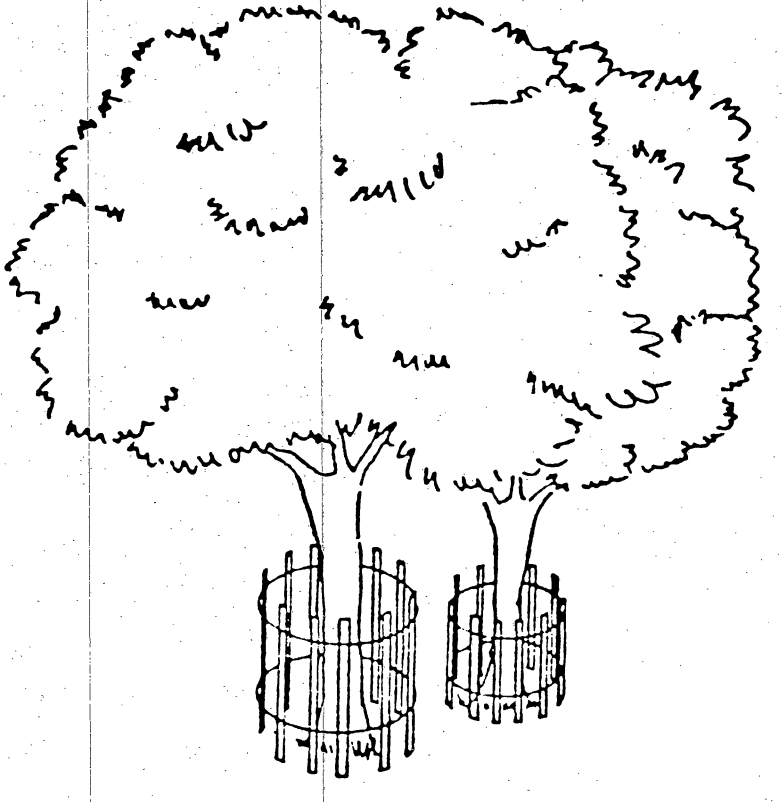


Figure 4 *Incorrect fencing for tree protection*

Bell tiles may be necessary, placed vertically over the roots and connected to the wagon wheel, to provide additional air and water circulation.

This system must be designed for each tree individually and must fit the contour of the land so that it drains water away from the tree trunk. It is expensive and recommended only for specimen trees. It must be mentioned that it is not a foolproof method. In such instances where large amounts of fill are required, and the survival of the tree is questionable, it may be better to remove the tree and replace it with another after construction.

Protection from Grade Changes

Tree roots need air, water, and land minerals in sufficient amounts to survive and, in turn, keep the tree alive. However, when changing the soil grade, placing fill on top of the root systems, or removing soil when lowering the grade, the tree has difficulty obtaining its normal supply of nutrients. The tree may be critically damaged or even killed.

Raising the Grade :

Fill added around the base of trees covers the roots and may actually smother the trees by preventing air and water from reaching the roots. Minor fills of 6 inches in depth or less will probably not seriously harm most species of trees if the fill is porous and high in organic matter. Heavy non-porous clay fills are undesirable. This 6 inch figure is only a guide and should be used as such. It is not a guarantee that the tree will survive.

The installation of a wall or well around the tree trunk to protect it from fill only prevents the fill materials from damaging the bark. The value of such wells is questionable. On smaller trees of good vigor, they may provide adequate protection, but on large, mature trees, or where excessive amounts of fill are required, such a practice, without also taking other precautions, may be useless and a waste of time and money.

Lowering the Grade :

Protecting a tree from grade lowering is less complicated that when raising the grade. Damage to the tree will depend on the amount of grading done.

Severe grading will either damage or remove the feeder roots of the tree located in the upper part of the soil. Damage will be worse on shallow rooted trees, such as maple and beech. Large scale grading around the tree can change the soil water table, leading to tree death. Protection can be achieved by terracing the grade. If space is available, the tree may be unharmed if it is left on a gently sloping mound.

Another way to protect a tree from lowering of a grade is to build a retaining wall between it and the lower grade. (Figure 6) This is an effective way to save a tree on almost any grade. The retaining wall must be placed as far from the trunk as possible because the roots will spread out to drip line of the tree.

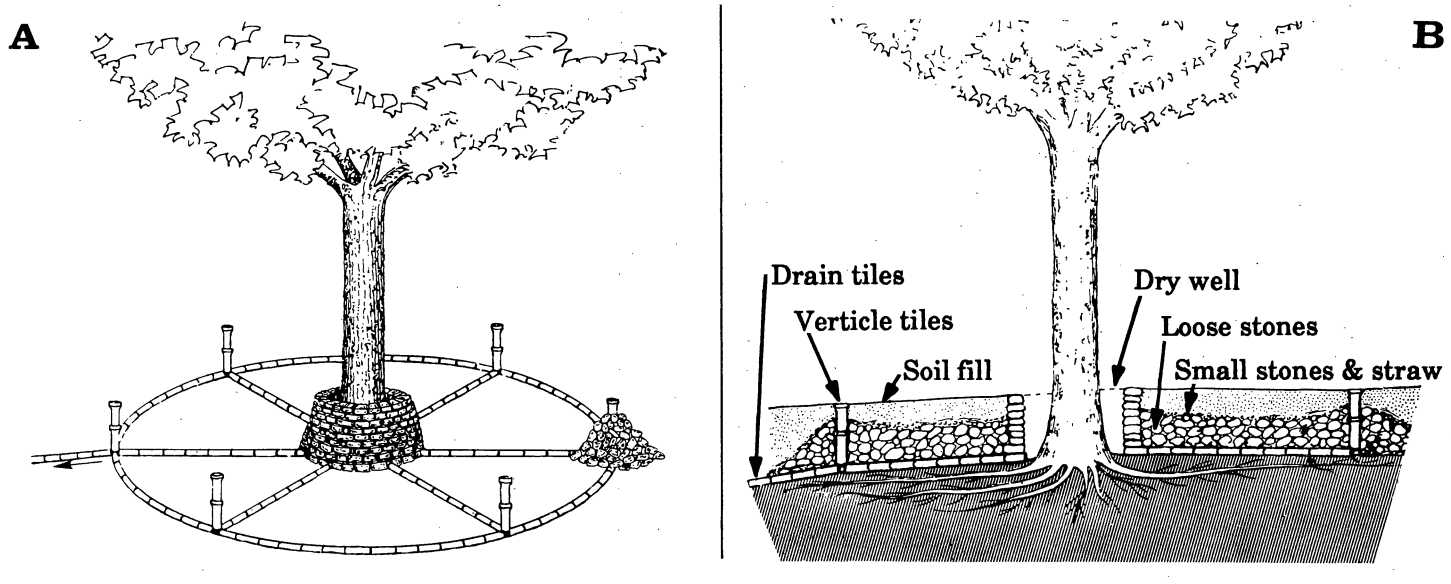


Figure 5 *A tile system protects a tree from a raised grade.*

A. *The tile is laid out on the original grade, leading from a dry well around the tree trunk.*

B. *The tile system is covered with small stones to allow air to circulate over the root area.*

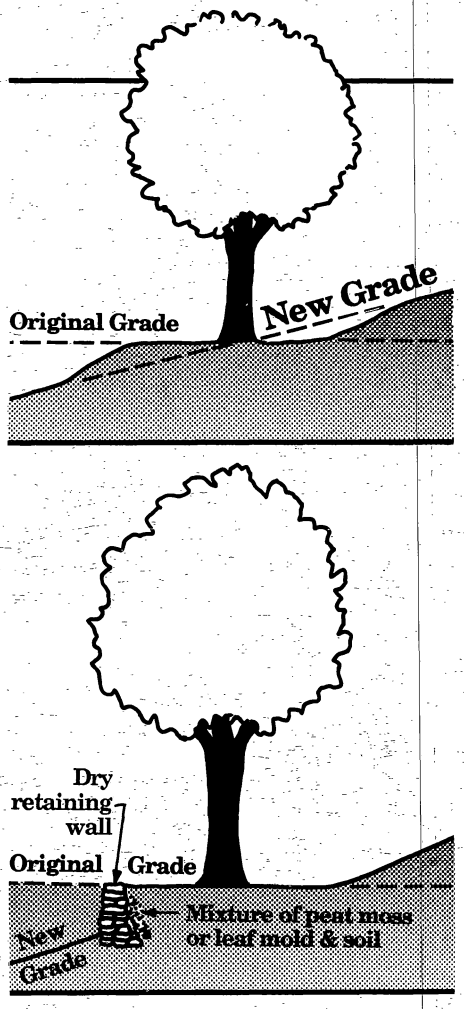


Figure 6 A retaining wall protects a tree from a lowered grade.

Protection from Excavations

Excavations for pipelines may cause considerable damage if the trenches are dug next to the trees. Trenches dug close to the trunk may sever as much as 45 percent of the roots, a practice that severely damages and kills trees. Severing a large number of roots will also make the tree susceptible to uprooting in heavy winds. If possible, the trenches should bypass the root area. If this is impossible, the next best thing is to tunnel under the trees. Tuneling can be accomplished by a power auger (Figure 7). The procedure may be expensive, and should be used only where specimen trees are concerned.

If the trenches must be dug past the side of a tree, follow these guidelines:

1. Cut as few roots as possible and try to go under the large main roots.

2. If the roots have to be cut, cut them cleanly with the proper tools.

3. Paint the cut ends with a tree wound dressing or orange shellac.

4. Backfill the trench as soon as possible. Do not leave the roots exposed to air for any length of time. (Figure 7)

Utilities should be tunneled beneath tree roots. The drawing at the left of the line show trenching that would probably kill the tree. Drawings at right shown how tunneling under the tree will preserve many of the important feeder roots.

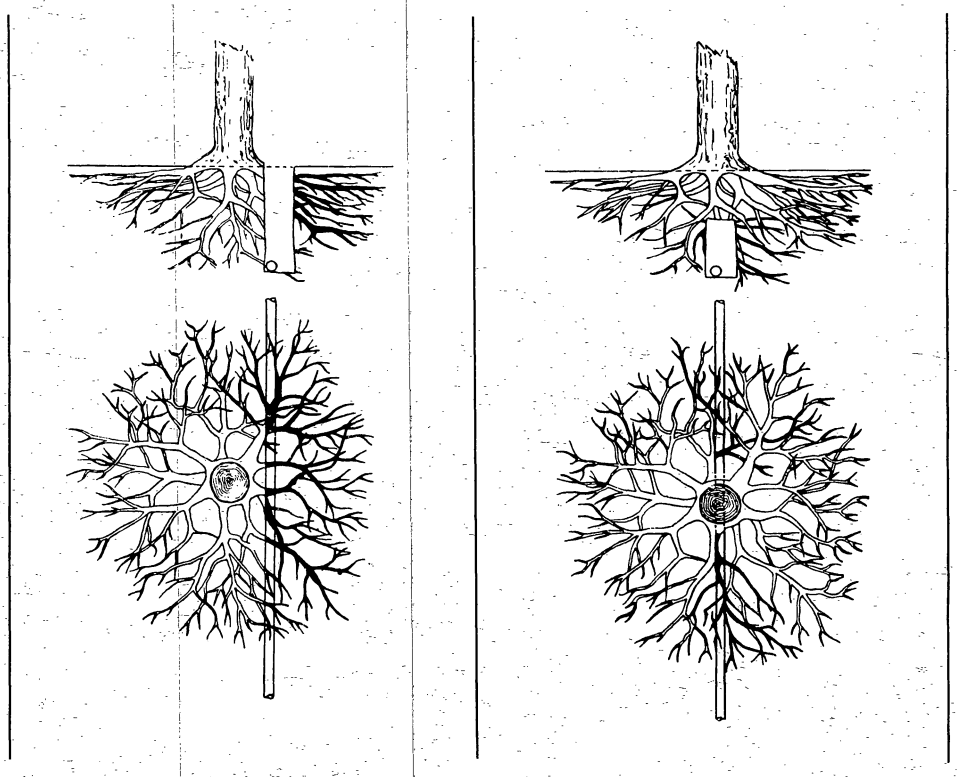


Figure 7 Tunnel beneath both root systems. Drawings at left show trenching that would possibly kill the tree. Drawings at right show how tunneling under the tree will preserve many of the important, feeder roots.

Protection During Cleanup

This can be a critical time for tree damage to occur as everyone will be in a hurry to leave the site. Have all debris hauled away.

In situations where moderate to severe damage is done to the root system, measures should be undertaken to help the tree recover. These include proper fertilization and pruning. Fertilization can easily be done and will help the tree to return to a vigorous condition. Refer to the section on fertilization on page 18.

When the roots have been damaged or severed, there may not be a sufficient amount remaining to support the number of branches and leaves in the tree crown. It is recommended that a corresponding percentage of limbs also be removed to equalize the roots and crown. Refer to the next section for proper pruning practices.

Tree Pruning

There are many reasons why trees should be pruned. The amount of attention given pruning may determine how long a tree will remain healthy and beautiful. Pruning should be done to *(1)* remove any dead, diseased or insect-infested parts to keep the rest of the tree healthy, *(2)* reduce the density of the tree, allowing more air and light to reach the center of the top, *(3)* correct defects and help the tree recover its vigor after root damage has occurred, *(4)* eliminate safety hazards in residential areas or *(5)* improve the overall appearance of the tree, being careful not to change its shape severely from its natural form. Trees severely pruned often result in a misshappen tree or one of unnatural form and it may be advisable to replace them.

Seasons for Pruning :

Deciduous trees, or those that lose their leaves in autumn may be pruned in any season. Pruning during summer lets you visualize the effect of the pruning while they have their leaves. Dead limbs can also be found easier. But the best time to prune for health is in the dormant period, especially near the end of the period. If possible, avoid pruning at the time of leaf formation and leaf shedding

Most needle-leaf evergreens may be pruned in late fall, winter and early spring. Pines should only be pruned in late spring and pruning should be confined to new growth. Late summer shearing may stimulate the plant to produce new growth that may be susceptible to winter injury if it is not hardened off before cold weather arrives.

Pruning Techniques :

Pruning should start with the removal of dead, diseased or insect infested limbs since it is very important these be removed to keep the tree healthy. Cut the wood back to a healthy crotch so healthy tissue is available for healing the wound. If disease infected, cut at least three inches below the sight of infection. Always prune back to a healthy lateral branch or to a healthy bud. If neither is available, cut the limb just beyond or outside the branch collar.

Next remove any interfering branches that rub together. Injury to the bark by rubbing will provide an entrance for decay fungi.

Narrow "V" shaped crotches are generally weaker than wide angle crotches and should be removed before the branches become heavy enought to split the crotch. Removal can best be accomplished by undercutting the branch on the lower side and several inches above the crotch. The second cut is then made above the first from the top of the branch. Finally a third cut is made to remove the stub and slants down from the joined limbs to below the crotch (Figure 8).

If, when pruned, a tree with a narrow "V" shaped crotch will result in a misshapen tree or the tree will be overly heavy on one side, the two branches may be cabled together to prevent their splitting apart instead of pruning. Cabling must be done by a qualified tree expert.

To prevent the stripping of bark from the tree when pruning, "stub" cut all branches too large to be supported by hand (Figure 9). This requires three cuts-the first is made on the limb 1 or 2 feet out from the trunk. Saw upward from the bottom about halfway through the limb until the wood starts to pinch the saw blade. The second is made a few inches farther out on the limb and cut downward from the top until the limb is severed. Finally, cut off the stub, but do not remove the protective branch collar. Leave no bark or wood at the top of the cut and make it as smooth as possible. If not removed, this short stub will die and provide a point of entry for decay fungi and insects.

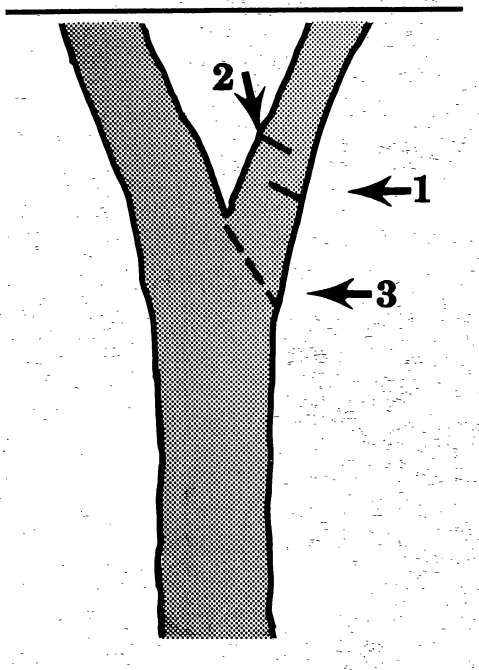


***Figure 8** Pruning of a "V" crotch*

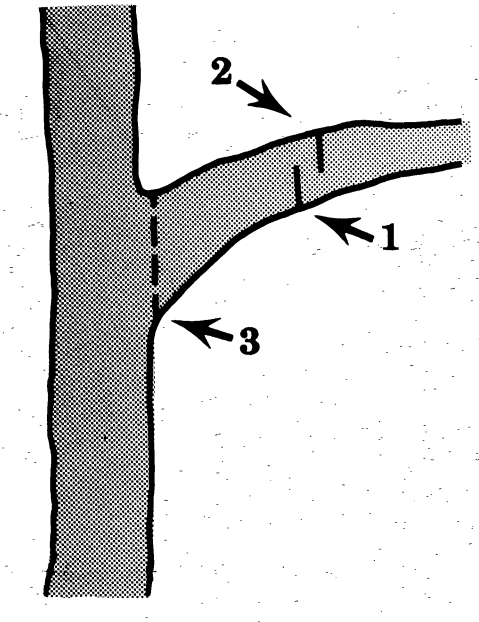


***Figure 9** Removal of large branches*

Some species of trees, such as oak and pine, characteristically have one main trunk. Prune these trees when young so they form only a single trunk. "Suckers" or additional sprouts at the base of the trunk should be removed; otherwise, they may form a secondary leader and consequently, a second trunk. Suckers sometimes sprout on diseased trees or those under stress, and do so because the other limbs are not doing their job. On some trees such as elm, cherry, crabapple and serviceberry, this is a normal occurrence and may not be a sign of damage or disease.

The interior branches of the trees can be pruned to let more light and air circulate through the trees. This permits better coverage with spray material for insect control. Avoid opening the crown too much as "sunscald" may occur, killing the outer ends of many of the branches, especially those not used to growing in full sunlight.

To thicken the crowns of pine trees, prune off the new young growth while it is still soft. This encourages the development of numerous small branches.

If severe pruning is required on pines or other evergreens, remove the whole limb. Avoid pruning branches to needleless stubs, as they seldom develop new foliage.

Old Trees and Groves :

Many old trees are sunscalded if they are heavily pruned or if they were part of a forest and their companion trees are cut down. To prevent sunscald, prune only part of the tree top in any one year. Thin old forests and groves by cutting down unwanted trees over a period of years rather than all at one time.

One other pruning practice, pollarding or dehorning, is sometimes used on old trees. This is the cutting off of the top of the tree, leaving only the major limbs. These limbs then are expected to produce a new crown.

Pollarding is recommended only for unusual circumstances, and is satisfactory on only a few trees. Trees pruned in this manner have an unpleasing appearance until they grow new tops. Examples of trees that can tolerate this type of severe pruning are silver maple, poplars, willows and sycamore. Because of the large pruning cuts that will result, decay of the larger branches may result unless protected.

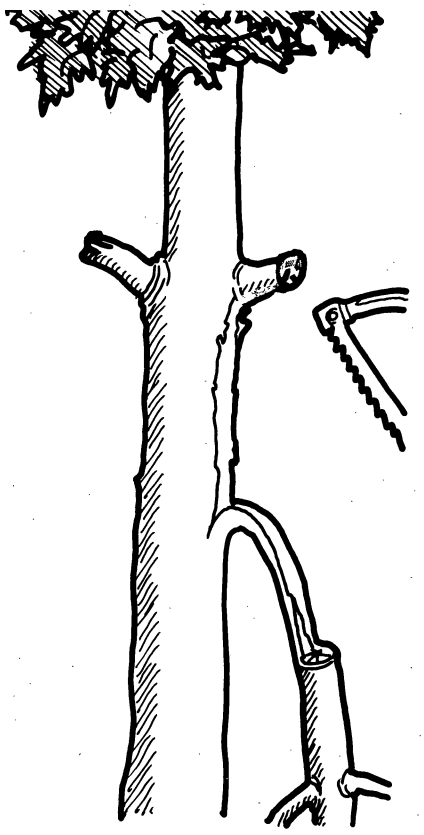
Care of Pruning Wounds :

The treatment of pruning cuts and wounds on trees is the subject of considerable research. The materials currently recommended as tree wound dressings are being challenged to show that they benefit neither rapid wound healing or fungus exclusion. Tests with a variety of tree species and tree wound dressings indicate that currently available dressings do not shorten the time required for healing, and may in fact promote subsequent decay.

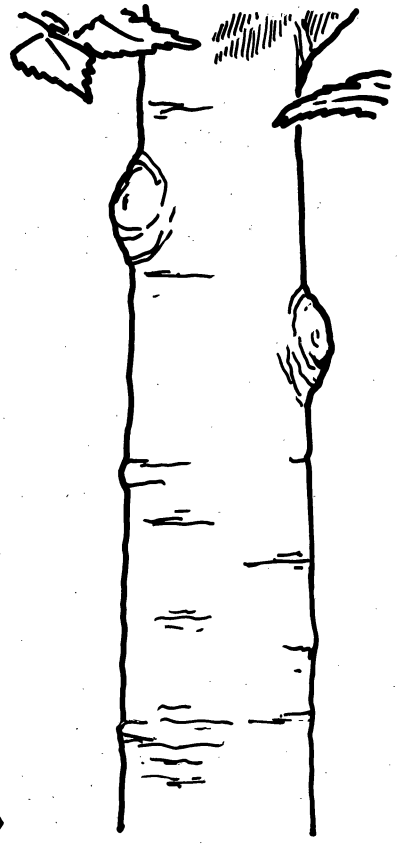
Pruning Errors :

Everything discussed so far concerns what to do. There are certain things which should not be done because of their adverse effects on trees.

A lot of research has been done on pruning and their is now a concensus that has revealed valuable information. In a



Improper pruning does more harm than good.



Proper pruning helps assure long-lived, healthy trees.

nutshell - Do not cut branches flush with the trunk. Do not remove the callus or branch collars. Do not paint the cuts. And finally never leave short stubs when you make a cut. Remaining stubs do not heal over quickly and make an ideal opening for insects and diseases. Pruning should be done as much as possible with a hand pruning saw or shears.

Recognizing the need for pruning early is important since the smaller the branch when pruned, the quicker it will heal.

Repairing Tree Injuries

Tree injuries should be treated as soon as possible after the damage occurs in order to keep the tree from becoming unsightly or dangerous, and possibly to save it from dying. Injuries exposing wood or killing the bark will allow disease and decay organisms to enter the tree. All wounds should be protected until they heal.

Bark Injuries :

If the bark has been crushed or knocked from the tree, follow the guidelines below for its treatment.

Cut away all damaged bark and remove any scraps of bark in the wound area, making cuts as shallow as possible. For fastest healing, shape the edge of the wound as nearly as possible to the shape of an ellipse (Figure 10). Make all margins round - no pointed tips, and do not enlarge the wound any more than necessary. Finally, remove all splintered wood from the exposed area.

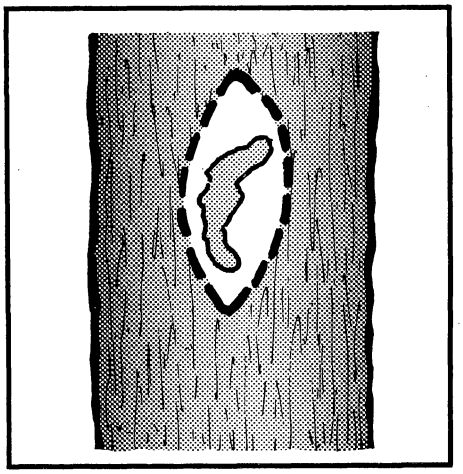


Figure 10 *Trim damaged bark areas as illustrated by the dashed lines.*

Lightning Damage :

Usually, you cannot tell how badly a tree is damaged by lightning until a year or so after the tree has been struck. The extent to which a tree has been damaged depends entirely upon the size of the charge it received. Trees that seem to be badly damaged may live while others apparently only mildly injured may die. All shattered parts of the tree and dangerous hanging limbs should be removed. The wounded areas should be pruned and trimmed to form a clean edge to promote healing.

Split Trunks and Crotches :

Split trunks, crotches, limbs, or branches often can be mended by restoring the damaged part to its original position, and holding it there permanently. This can be done by inserting bolts or threaded screw rods through the damaged parts and then supporting damaged parts with cables and toggle bolts. The use of this type of equipment requires skill and experience and should be done only by a competent tree expert.

Uprooted Trees :

Smaller and medium sized trees partly or wholly uprooted sometimes may be saved by prompt action. Cover the exposed roots immediately to be sure that they do not dry out. Cover the roots with burlap, mud or anything that will keep the root system wet. Before returning the tree to its original position, prune off any badly damaged roots. The tree then can be pushed into place by using a bulldozer, block and tackle, winch, etc. But, wherever pressure is applied to the tree, be sure it is padded so no injury is sustained to the bark. Spraying the tree with an antidessicant or antiwilting preparation after being returned to its original position may help the tree recover if it was in foliage when it was blown over. These preparations reduce water loss through the leaves. The tree should then be watered during droughts until new roots have formed.

When the tree is restored to its original position, install guy wires to hold it in place. Guy wires should be inserted through sections of rubber hosekeep the wire from cutting into the bark of the tree. Installation of turnbuckles on the guy wires can be used to increase or decrease wire tension. Remove the wires in one or two years. Do not leave them in place where they start to cut into the bark and interfere with growth.

Caution :

Big trees can be dangerous to prune and work in. Large limbs are very heavy and if such a limb gets out of hand, it may cause extensive property damage, or it may injure a nearby worker or bystander. One misstep while climbing a tall tree, loss of balance, or misplaced confidence can cause a tree worker to fall to his death.

For greatest safety, engage professional arborists or tree experts to do work that requires removal of large limbs or climbing in tall trees. Be sure these commercial tree workers are insured against personal injury and property damage.

Tree Fertilization

Trees require adequate supplies of nutrients for growth. The resistance of trees to insect and disease attacks is partly governed by tree vigor. Therefore, maintenance of vigorous tree growth is suggested to help prevent insect and disease establishment. Tree vigor can be maintained by fertilization. It is not uncommon for a soil nutrient excess or deficiency to affect tree growth adversely. But, without an extensive soil and plant tissue analysis performed by a competent expert, such nutritional problems are difficult to determine or correct.

It is not always possible to diagnose the actual cause of nutritional problems due to the many interactions in the soil. If a complete analysis is performed, a soils expert can consider such factors as soil type, pH and nutrient levels and recommend ways to correct the problem. Unfortunately, these analyses are not easily available to the homeowner.

Tree fertilization is not only important in maintaining vigor of trees on established lawns and park lands, but is also very necessary to maintain tree vigor in new developments where disturbance of the soil, grading, installation or pipe lines, etc., have disturbed the tree roots and may have caused undue stress on the tree. Fertilization can be accomplished by using a complete commercial fertilizer with an analysis such as 5-10-10 or 5-10-5 with a slow release nitrogen source, and at least 50 percent organic. It is advisable not to use a fertilizer which is high in nitrogen.

Nitrogen will stimulate the top of the tree to grow, but may actually increase tree problems because root development is not adequately stimulated. In most situations, it is advisable to use a complete low nitrogen fertilizer. This will maintain adequate root growth and development while moderately stimulating the top to grow.

It is important to caution against the use of fertilizers that contain weed killers, since these will injure the tree and may possibly cause its death.

Trees can be fertilized in several ways. The punch-bar method can be used which involves punching holes in the ground 12 to 18 inches deep all around the area underneath the tree (Figure 11). The holes should be scattered throughout this area, extending from the drip line or the outer branches (Figure 12) of the tree to within 3 feet of the trunk. The fertilizer is then deposited in the holes and the hole is closed.

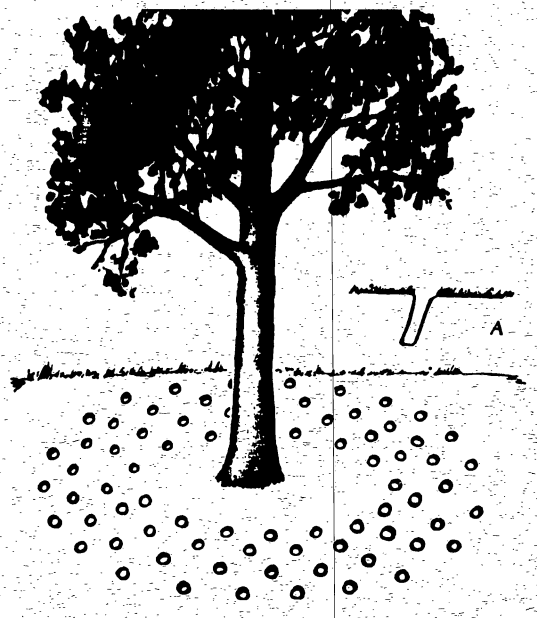


***Figure 11** Fertilization of shade trees, showing the location of the wholes to which fertilizers are added. The wholes should be 18 inches deep, about 2 feet apart, and slanted toward the tree, as shown in diagram A.*

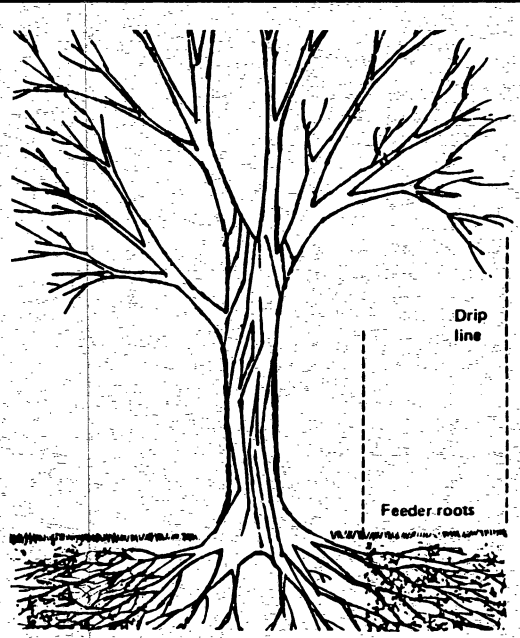


***Figure 12** Fertilizer must reach the feeder roots which extend out to the ends of the braches (Drip line), and some times beyond.*

Another method of fertilization is broadcast fertilization on top of the ground. This can be done on areas that have been graded or on wooded areas where there is no grass present. Applying fertilizer in this manner on grass, if applied too heavily or not raked in and watered, will burn the grass. One problem of this second method is that much of the fertilizer never reaches the tree roots because the grass utilizes it.

Most fertilizer elements remain where they are placed and do not move through the soil readily. When surface application of fertilizer is done for several years, the tree will tend to develop roots near the soil surface. Surface roots such as these interfere with grass mowing. During dry conditions, shallow-rooted trees suffer more than deep-routed trees. Fertilization such as this around normally shallow-rooted trees only increases these problems. Other methods of fertilizing trees are as follows:

1. Compressed air and feeding needles:

Pipes or needles are inserted into the soil around the tree and dry or liquid fertilizer is forced into the ground. Some types of these needles are available to home owners and attach to the garden hose.

2. Tree spikes:

Available commercially to home owners, they consist of spikes of prepackaged fertilizer that are pounded into the ground around the tree, the number used depends on the tree size. Rain, sprinklers and soil moisture dissolve the fertilizer. This is the easiest method, however, it localizes the fertilizer.

3. Foliage feeding:

The fertilizer is mixed with water and sprayed on the foliage. Not all fertilizers can be used in this manner. Caution must be exerted to be sure a particular fertilizer is safe for this use. Be sure to read the manufacturer's label.

4. Tree Injection:

This method is only used in certain instances for specific problems and should be done only by a competent tree expert. If done incorrectly, damage to the tree will result.

When using the punch-bar method, it is recommended that fertilizer be applied at the rate of 2 pounds of fertilizer per inch of diameter of the tree trunk at breast height, or 4´ feet above the ground. Or, if broadcasting fertilizer beneath the trees, it should be applied at the rate of 30 pounds per 1,000 square feet. The fertilizer should not be placed within 3 feet of tree trunks in order to avoid serious damage to the root collar.

The trees should be fertilized in the early spring as soon as the ground thaws. Do not wait until late summer to fertilize as it may cause the tree to sprout new growth, and if not hardened off before winter arrives, these new shoots will be killed by the winter weather. Late fall applications may also be considered but should not be made until all possibility of top growth is past and the tree is dormant. If in doubt, fertilize in the spring.

Additional comments concerning fertilization are as follows:

1. Late fall fertilization is suggested for beech and white oak, since spring fertilization may injure these two species. The condition and reasons for this are not known at this time.

2. If the broadcast method is selected, it should not be done in the fall since it will run off during the winter. This technique is for spring application only.

3. If the tree is severely weakened, apply only one half of the recommended amount in the early spring, the other one-half, in the early summer.

4. If a portion of the root system is covered by pavement, driveway, sidewalk, etc., apply a correspondingly smaller amount of fertilizer in the soil area that can be treated.

Tree Planting

Selecting the Right Tree

When you plant a tree, you also plant for shade, for shape or background, for screening, or for color. The use that you intend for your tree, and the location in which you plant it, should guide you in its selection.

1. Hardiness: Consider the environment in which the tree will grow. Consider factors such as the climate, the soil type, soil moisture, and air pollution problems. Hardiness does not mean only winter's cold, but also how the tree will react to the summer's heat. Trees native to northern climates easily withstand southern winters but may not survive the heat of the southern summer. Be sure that the trees are reliably hardy in your area and have been tested. Commercial nurseries should be able to provide you with this information.

Determine the soil type in which you are going to plant. Find out such characteristics as the pH level (acidity level), structure of the soil, soil fertility, and the amount of the moisture the soil will hold.

Consider the amount of moisture in the soil. Do not choose a tree that will live only in dry soil and plant it in a swampy area and vice versa.

Find out, if possible, the types of air pollutants that may be in the vicinity of your tree-planting area and choose a tree which is not susceptible to such pollutants. There are some trees which will grow in very polluted air, and there are others which are extremely suscep tible to even the slightest bit of air pollution.

Finally, choose trees on the amount of human damage they will tolerate. Many city trees or development trees must compete with automobiles, pedestrians, lawn mowers, sewer lines, and utility lines.

2. Form: Consider whether the mature form of the tree is appropriate for its intended use. A broad-spreading and low-hanging tree may be ideal for a park or yard, but would be unsatisfactory along a driveway. A slim, upright tree may be perfect for lining driveways, but it may be little value in providing shade for a picnic area or patio. If you are not familiar with the mature form of trees under consideration, study illustrations of them in books or in nursery catalogs.

Enough room for growth? Not quite. Any maintainance cost? You bet.

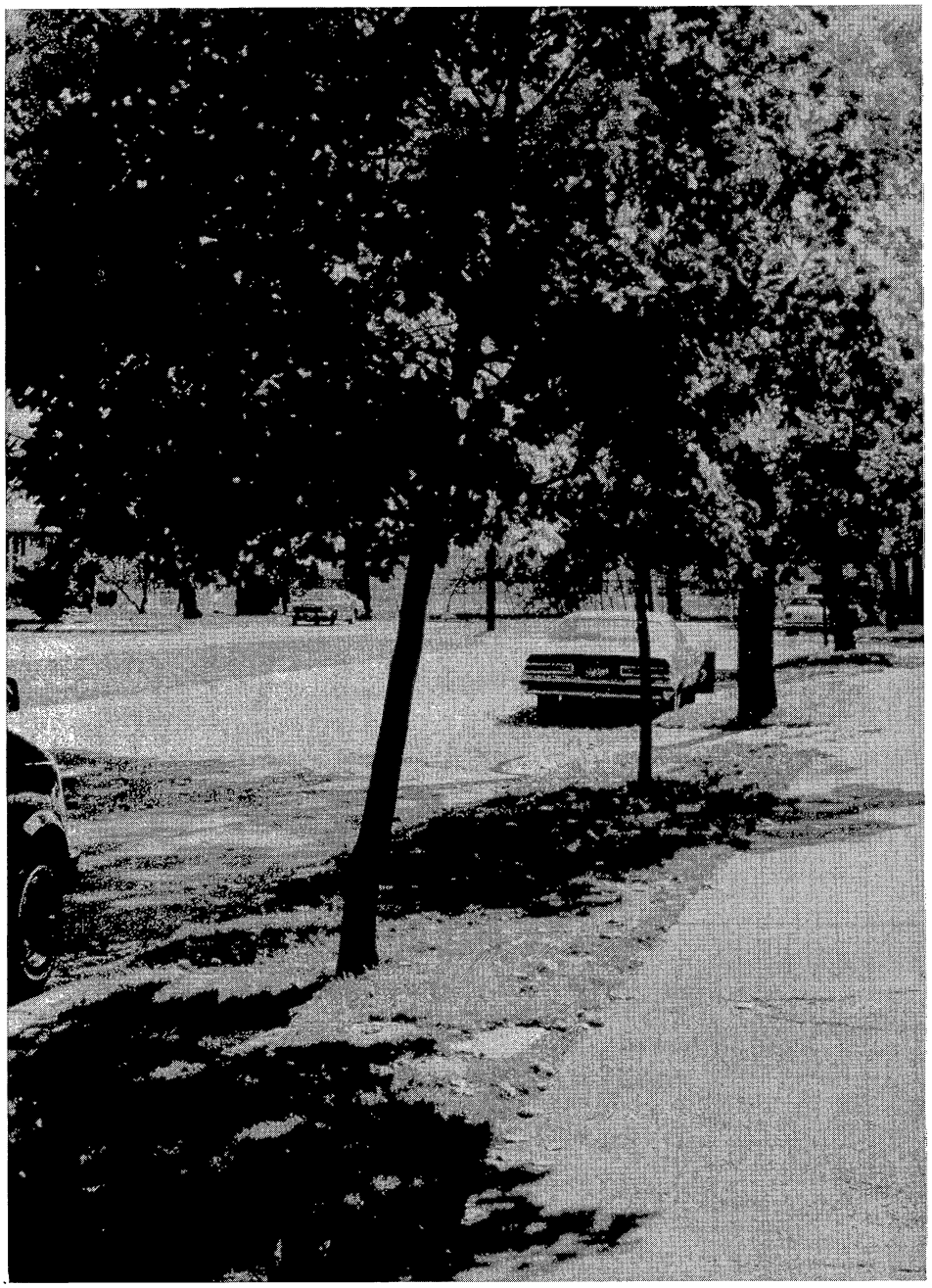
3. Size: Be sure you know the size of the tree at maturity - before it is planted. The 6-foot tall evergreen that looks so attractive as an ornamental near a house can grow to a height of 70 feet and have a spread of 40 feet. Select a tree that will not interfere with overhead telephone or power lines. Be sure that the tree, when mature, will not overhang buildings and cause maintenance problems.

4. Space: The area in which you plant the tree should be big enough to sustain a mature tree. For planting between a sidewalk and the street, at least 4 feet square must be available for a tree. If less than 3 feet, it may be advisable not to plant. Very large trees will at times lift the sidewalk and lift the street pavement with their roots if not enough room is given so they can grow.

5. Longevity: Determine how long the tree will live. Some trees will reach maturity quickly and then decline. Despite what many people believe, trees do not live forever. You have to decide whether you are planting a tree for future generations or for yourself to enjoy.

6. Undesirable characteristics: It is difficult to find a tree that has no undesirable characteristics. There are some traits that make a tree unsuited for any use. The American elm is an example. This tree is susceptible to the Dutch elm disease which makes this tree a poor risk for New Jersey. Avoid planting trees such as white mulberry and the female Gingko which produce fruits that are so objectionable that these two species may be considered garbage trees.

7. Location: The precise location of the planting should be considered. Is the soil wet with a high water table, or is it sandy and



excessively dry ? Sometimes the one condition can be changed by drainage and the other by adding soil, but often it is wiser to select a species that will be suited to the prevailing soil condition.

*8. **Purpose:*** The purpose of the tree is an important consideration. Some trees are designed for light shade that will provide some comfort from glare, but allows a lawn or flowering plants to thrive. Trees chosen to form a screen to hide an unpleasant view might well be an evergreen species, either coniferous or broadleaved. Deciduous trees may be chosen for heavy shade in the summer but an abundance of light in the winter. Showy flowering trees may be needed to brighten a drab landscape, and both spring and summer flowering species are available.

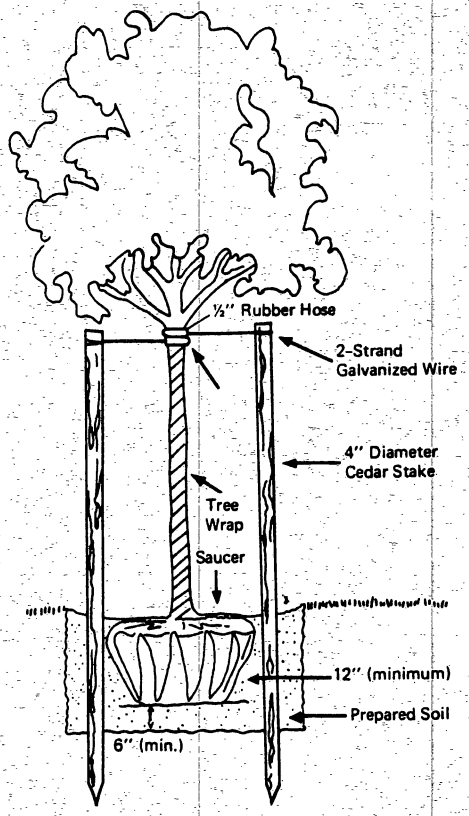
*9. **Damage:*** Possible damage to the tree by disease, insects, or injury is especially important to consider if the tree is to have a long life with minimum maintenance. Air pollution, road salt,natural-gas leaks, and overhead wires also should be considered. Where these factors are most prevalent, few or no trees survive; but a number of species have weak wood that requires heavy clean-up problems after storms and disrupt utility service and highway traffic. These species should be avoided, particularly since many of the stronger species will grow rapidly in a well-prepared site that is irrigated and fertilized as needed. Proper pruning of trees will eliminate weak crotches and other sources of structural weakness.

Some trees have traits that are nuisances. Oaks, hickory, horsechestnut, crabapples, all have fruits that attract children who may use them for throwing. Sweetgum and black walnut produce fruit that are nuisances on lawns. Poplar and mimosa produce an abundance of seeds that sprout in lawns and flower beds. You must match the tree's characteristics with its intended use and decide if they are compatible.

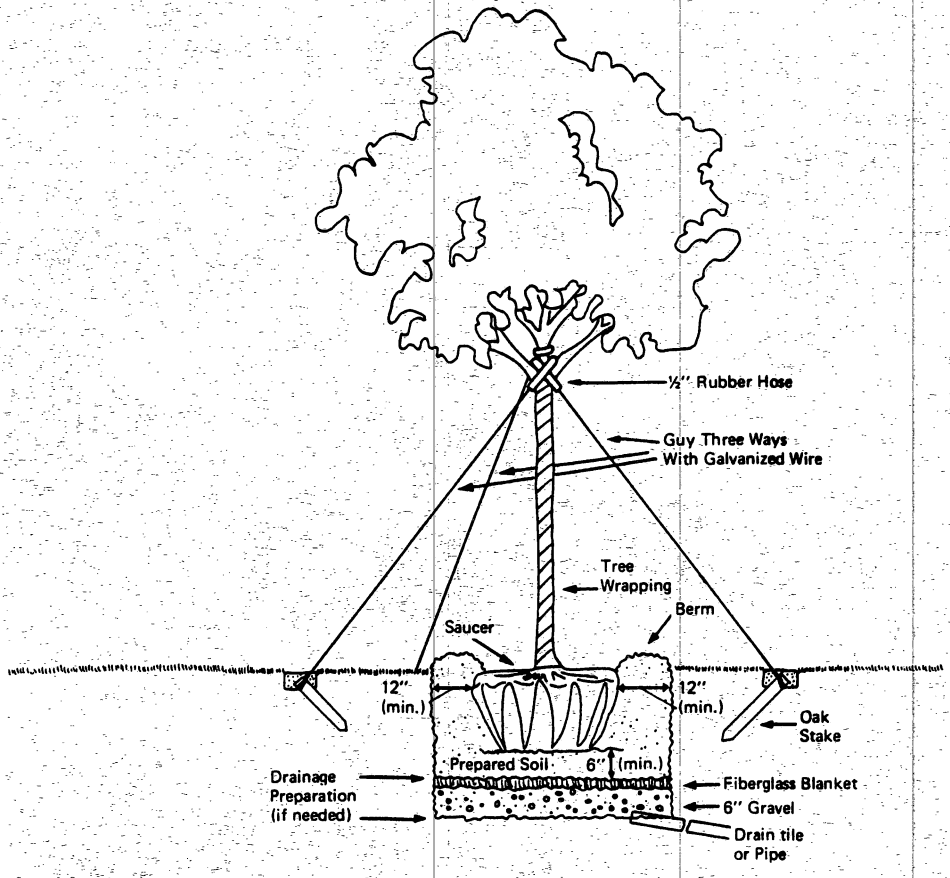
Steps in Tree Planting

Trees are relatively easy to plant and their survival can be almost guaran- teed if the proper steps are taken and care is exercised during the planting (see Appendix III).

*1. **Digging the planting hole:*** It is necessary to make the hole deep and wide enough to accommodate the roots of the tree whether the tree is planted with bare roots or balled and burlapped. The hole should be dug 1 to 2 feet wider and 6 to 12 inches deeper than the root spread of the ball to allow for ample room. Be sure that the hole is clean of any rocks, sticks, or trash. Deposit the



Support: *(see next page) Details of planting and supporting a tree, at right. Method of supporting larger trees planted in open areas with guy wires, illustrated below.*



soil well away from the hole and remove any sticks or stones that may be mixed in with it. If the soil is poor, it may be advisable to replace it with topsoil from another site.

2. Preparation of the soil: Most soils will have to be modified before replaced in the hole around the tree. This can be done by mixing into the topsoil by volume, one part of peat, well rotted sawdust or leaf mold. This will help improve the structure and water-holding capacity of the soil. Adjusting the soil pH may be important when preparing the soil for planting. A soil test done earlier will indicate if the soil pH needs adjusting. Lime and fertilizer can be applied before the tree is planted by mixing them into the topsoil.

Be careful not to mix in dry fertilizer when plantingbare-rooted trees. Damage to the tree will result if the fertilizer touches the roots.

3. Setting the tree in the hole: Before placing the tree in the hole, partially fill the hole with prepared soil so that the tree will sit at the same depth or slightly deeper than it stood at the nursery. The ground level should be about the same level as the top of the ball. After placing the tree in the hole, be sure it is sitting straight and not slanting. The container or burlap around bare-rooted, container-grown trees should be removed before the tree is placed in the hole. For balled and burlapped trees, the burlap should be left on the ball.

After placed in the hole, the strings on the ball should be cut and the burlap rolled back off the ball. If you intend to stake the tree instead of guying it after the tree is planted, drive in the stakes before backfilling the hole.

Begin filling the hole with prepared soil, compacting it slightly with your hand or foot as you go. Avoid

excessive packing or tamping as it may restrict soil aeration and even kill the tree. If the soil is wet, avoid compaction of the soil. After the hole is two-thirds full, add water. After the water has drained away, finish filling the hole with soil. Using mulch on top of the soil will help the soil to retain its moisture and it will also help reduce the amount of weeds that will grow. Complete the planting by forming a ridge with soil around the top of the planting hole to act as a dish to hold water. This will help retain rain water and will aid in watering.

*4. **Support:*** In some cases, newly planted trees should either be staked or supported by guy wires. Stakes can be used as support by driving them into the planting hole before backfilling, one on either side of the tree. The stakes should extend to about the first whirl of branches. The tree can be attached to the stakes by means of a single loop of rope or wire run through a piece of old garden hose to keep the wire from damaging the tree.

Trees can also be supported by guy wires. Generally, three guy wires are used and spaced equally around the tree. This is done by placing the wire in a piece of hose around the tree at a branch crotch and extending the other end of the wire to a stake driven into the ground at an angle. Guy wires and stakes should remain snug to be sure the tree does not shift in positon or uproot in heavy winds. A turnbuckle on each guy wire can be used to keep it snug but not extremely tight. Tree wrap, support stakes, and guy wires should be left in position for at least one year.

*5. **Watering:*** On newly planted trees or transplanted trees, watering is extremely important to prevent the tree from drying out. This, of course, depends upon the soil moisture and the amount of rainfall received. As a general rule, newly planted trees should be watered at least once a week. In very porous or sandy soil, more frequent watering may be required. On heavy or clay soils, water less frequently.

Periods of hot, humid, summer weather causes rapid loss of water in newly planted trees. This may cause a tree to die. To help protect trees that are newly planted and especially those recently transplanted, an antidesicant or antiwilting solution can be sprayed on the trees to prevent their drying out. These solutions are available at local garden centers and nurseries.

Transplanting Desirable Trees

There are many reasons why trees should be transplanted, some which include: *(1)* growing in too crowded conditions, *(2)* too much or too little shade, *(3)* valuable tree is in the way of construction, or *(4)* tree would be more appealing in another location. Almost any size tree can be transplanted, except very large ones. To insure success, tree experts or nurserymen should be engaged for the transplanting. For large trees, their services are a must.

Smaller trees can be moved by the layman with a basic understanding of the process. Trees can be moved either by hand-digging or with a mechanical tree digger. The mechanical tree digger is run hydraulically from a tractor or truck. This is a fast and easy way to move many trees. Hand-digging can be employed when moving a few small trees or shrubs.

When to Transplant

The best time to transplant is when the plants are dormant in early spring or after they have become dormant in fall. Transplanting in the spring should be done before the buds start to grow on deciduous trees. Transplanting of deciduous trees in the fall should be done after the leaves have turned color and dropped. Evergreens can be transplanted later in the spring and earlier in the.

Transplanting during the summer months is possible; however, extra care is needed to make sure the roots and rootball are kept moist. A great deal of water will be lost through the leaves because of the high summer temperatures. It is advisable to spray the trees with a nonwilting solution which cover the leaves and reduces the moisture loss.

How to Transplant

Trees can be transplanted with a rootball or with bare roots. The layman, however, will achieve better success with the former and the following discussion will deal with that method:

1. Tie a piece of rope or twine to one of the lower branches of the tree and wrap the rope around the tree toward the top compacting all the branches. Be sure all the main branches have been enclosed to avoid damage to them during the moving. Secure the other end of the rope to the top of the tree. Be careful not to break the branches while wrapping.

2. Before starting to dig, move out one foot from the trunk for each inch of trunk diameter.

3. Dig with the back of the spade toward the plant to avoid prying up uncut roots forming more or less of

a trench around the tree. After the rootball is cut, trim and shape it into a desirable size, then undercut the rootball.

4. After the rootball is loose, tip the tree and the ball and tuck a roll of burlap under it. Then tip the ball in the opposite direction and unroll and pull the burlap under the ball.

5. Wrap the burlap around the rootball and pin it together with nails or small sticks. Further secure the burlap by repeatedly winding cord or a small rope around the rootball. Do not lift the plant by its trunk or branches. Lift small plants by the rootball and larger ones by prying up with two spades to remove the plant from the hole.

If the tree cannot be planted shortly after digging, keep the plant in a shaded area out of the hot sun. Be sure to keep it well watered. To replant the tree, follow the planting recommendations in the previous section.

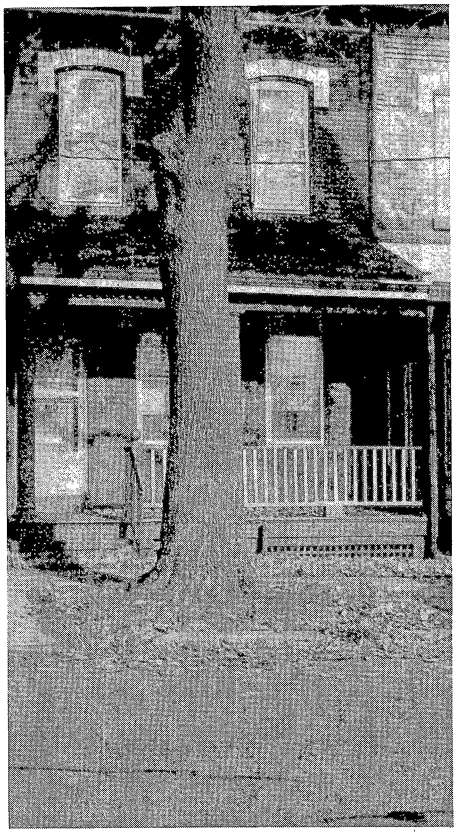
Considerations for Street Planting

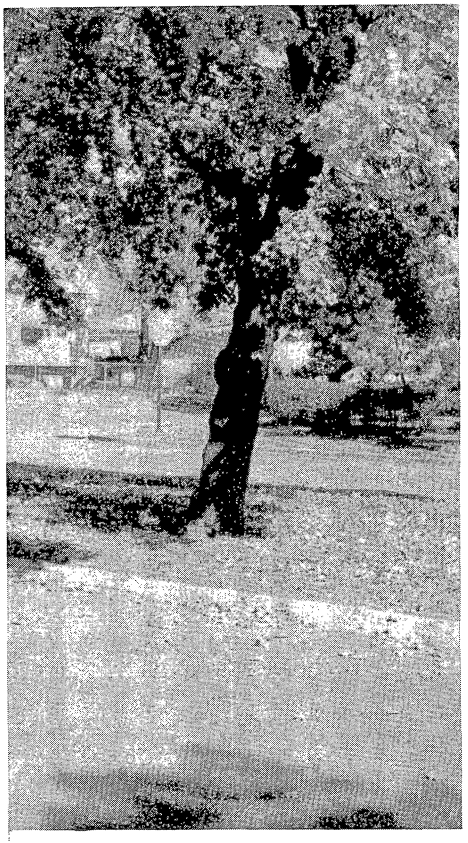
Essential Tree Qualities

When trees are planted along streets, they must be able to thrive in adverse environmental conditions. Street trees should have certain qualities to withstand such conditions.

The tree must be hardy and capable to withstand unfavorable conditions. It must be able to tolerate a limited area, poor soil, and urban conditions of summer heat and drought, smoke and dust.

The tree should be straight and of good natural form. It should be in good health and vigor (see Appendix V).





Essential Site Qualities

Even though a good tree is planted, it may not survive if planted on the wrong site.

The "street lawn" or area between the sidewalk and street should be at least 4 feet wide. Avoid planting trees that when mature, the trunk will become as wide or wider than the street lawn. This causes parking problems, uprooted sidewalks and pavements, and eventual removal of the tree.

With more and more utilities being required to be placed underground, the planting area will have to be considered more closely. It would be desirable to have a 20-foot easement for planting along the street.

Avoid planting trees that get very large if utility lines are above them or if buildings are close by where the limbs would interfere. Before planting, evaluate the planting site for the size tree required at maturity.

Be sure the soil type and its characteristics have been evaluated so the proper tree can be planted. The soil should be tested; this can be done through the county agricultural extension service.

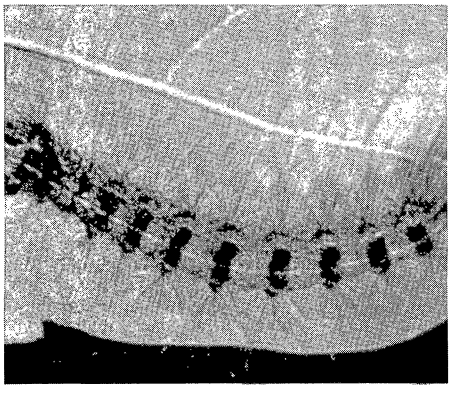
The recommended minimum size should be 1-3/4-2 inch diameter tree for initial planting. This size is good for street planting and, usually, deters vandalism.

An excellent reference regarding street trees is titled ***TREES FOR NEW JERSEY STREETS*** and is available at a small cost from the:
New Jersey Federation of Shade Tree Commissions
Cook College
Box 231, (Blake Hall)
Rutgers, The State University
New Brunswick, New Jersey 08903.

Protection Against Insects and Diseases

Trees in an urban setting are subjected to an array of problems that indirectly affect their survival. Through soil compaction and excavation, air and soil pollution, and construction, man creates changes that affect tree vigor. An insect or disease agent may detect decreased vigor of the trees, and attacks are initiated.

Insects, diseases, and other organisms can injure or kill trees, but their incidence is difficult to predict. Attack by these pests varies from year to year, being affected by such factors as tree and pest species, geographic location, and weather conditions. Many pests found on urban trees have parasites, predators, or diseases that exert some level of biological control. But even so, chemical controls are widely used at present because they offer the quickest remedial treatment. Natural controls should be encouraged whenever possible. Proper selection of a treatment or combination of treatments that is compatible with natural or silvicultural control is called integrated control. Applying such control over an extensive area (township, city, or park), monitoring the important factors (populations of insect pest, mites disease, parasites, and predators), and establishing the economic or damage thresholds above which control procedures are invoked make up integrated pest management. While such management is used in the production of food crops, it has received little attention in the protection of urban trees.



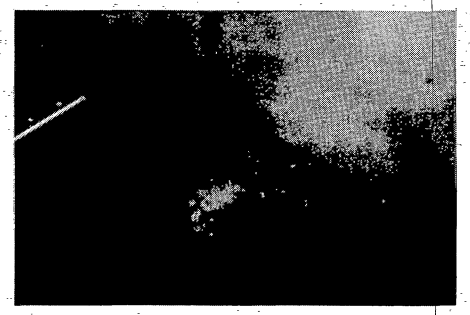
Proper selection of tree species is extremely important in pest management, whether a large number of the same species (possibly approaching monoculture) or a diversity of species (mixed culture) is used.

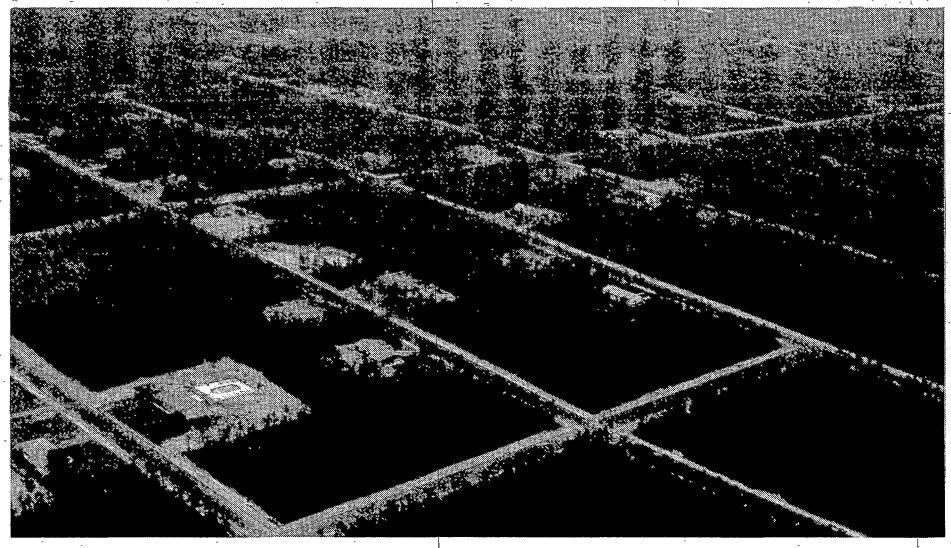
There are advantages to monoculture: uniformity of shape, size, and texture, and comparable requirements for spraying, shaping, fertilizing, or other maintenance. However, past experience with monoculture, such as the American elm, is a sufficient reminder that it can result in massive problems. When a disease, or insect strikes, the number and proximity of susceptible trees favor an outbreak. Because trees can be relatively long-lived and are costly to remove and replace, mixed culture is often more desirable than monoculture. The lower likelihood of major losses tends to make diverse plantings more stable.

Proper diagnosis of pest problems is essential. Most pests have a critical period during which control is maximized, but the period may vary from year to year, depending on the weather, pest, and host. Therefore, before attempting control, current recommendations should be obtained from such agencies as the Cooperative Extension Service (County Agent or Rutgers State University Extension Specialist), N.J. Bureau of Forest Management, and the N.J. Department of Agriculture's Entomologist or Pathologist.

Gypsy Moth have severly defoliated millions of aces of trees in the Northeastern United States. The caterpillar favors oak, birch, willow and poplar, but also will attack pine, spruce and other evergreen and hardwood trees.

The tent caterpillar defoliates trees, particularly fruit trees, in early summer, giving the tree an unsightly appearance.





Forest Fire Protection

Urban-Wildland Interface is a juxtaposition of urban suburban type development and wildland fuels. Land pressure, improved transportation, more leisure time, and an increased desire to escape the noise and pollution of the states urban areas has resulted in a proliferation of wildland residential subdivisions and developments. The majority of these areas have been planned and built without due consideration for forest fire protection. This is now recognized as one of the largest single fire prevention problems in the 50 states. New Jersey is no exception. This problem exists throughout the rural areas of the State but is particularly acute in the Pine Barrens region of South Jersey, which has one of the most hazardous and fastest spreading fuel type in the country.

The potential for wildfire disaster in New Jersey has been dramatically illustrated in years past. Large conflagrations occurred in 1930, 1954, 1963 and more recently in 1971 and 1977. The most notable was the weekend of April 20-22, 1963, when a series of forest fires consumed 190,000 acres, destroying 186 homes and 197 outbuildings. Thousands were forced to flee and entire communities were evacuated. Seven people were killed and the total estimated financial loss to improved property was 8.5 million dollars.

When this tragedy occurred, the South Jersey region was still largely undeveloped. However, since that time, development has progressed at an accelerated rate, and there has been a tremendous increase in property values. The results of a similar series of conflagrations today, would be staggering, not only to individual homeowners, but a severe economic blow to the communities affected. Development has slowed or stopped in some areas due to the Pinelands Act, but has continued in others. Most with little or no regard to the danger of wildfires.

Local authorities should be aware of the fire related problems associated with wildland developments. Until recently, the only legal means to correct problems in wildland subdivisions was through local ordinances. In many areas this is still the case. The problem has been recognized in the Pinelands Comprehensive Management Plan and Minimal Standards adopted. However, standards only apply to new developments of 25 units or more and do not affect lesser sized subdivisions, or what is already there. Community leaders and planners are encouraged to review the Bureau of Forest Fire Management's guidelines and adopt its principals in the form of local ordinances and building codes. The Bureau also has a brochure entitled ***"Protect Your Home From Wildfire"*** designed to advise individual homeowners of appropriate fire safety standards for homes in forested areas. The primary objective of this literature is to protect life and property from wildfire conflagrations which may threaten established or prospective developments.

For additional information on forest fire management, or the Urban-Wildland Interface problem, contact:
N.J. Bureau of Forest Fire Management
501 East State Street
Station Plaza # 5
CN-404
Trenton, NJ 08625
or call: (609) 292-2979

Evaluating Shade Trees

In determining the monetary value of shade and ornamental trees, four basic factors must be considered: kind, size, condition, and location.

The advice of a professional must be sought in this field to determine these four standards. These standards have been widely adopted and are recognized by insurance companies, the courts, and in some cases, the Internal Revenue Service.

Courtesy of Van Nostrand Reinhold

1. The kind of tree (or its classification): Not all species and varieties of trees are of equal value. The same kind of tree may have different values in different parts of the country. Trees must be chosen for their utility and adaptability. Trees which are hardy, durable, highly adaptable, and free from objectionable characteristics are worth the most. They do not require much maintenance and have sturdy, well-shaped branches and pleasing foliage.

2. Tree size: Tree size can be designated in several ways such as the diameter of the trunk, the area of a cross section of the trunk, the height, the branch spread, or a combination of all or a part of these measurements.

3. Condition of the tree: Very few shade trees are perfect specimens. As trees become larger and older, they very often become defective in one or several ways. Obviously, a healthy, well-maintained tree will have a higher value than one that is in poor condition. When appraising the condition of a tree, it is judged how nearly it resembles a perfect specimen.

4. Location of the tree: There are functional considerations as well as aesthetic. The tree may be acting as a windbreak or visual screen. It may be providing important shade for cooling of a home. The tree may also be the focal point in the landscape.

It is very important that a professional be consulted when evaluating a shade or ornamental tree. Only then will an accurate description and evaluation be made.

Utilization of Urban Wood Wastes

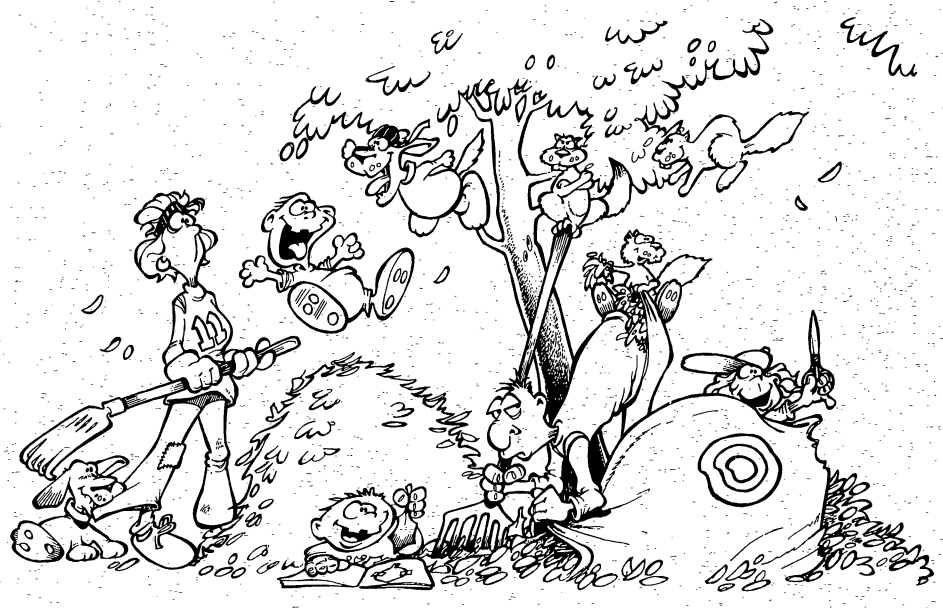
Several things can happen to tree material developed from clearing forested land for construction.

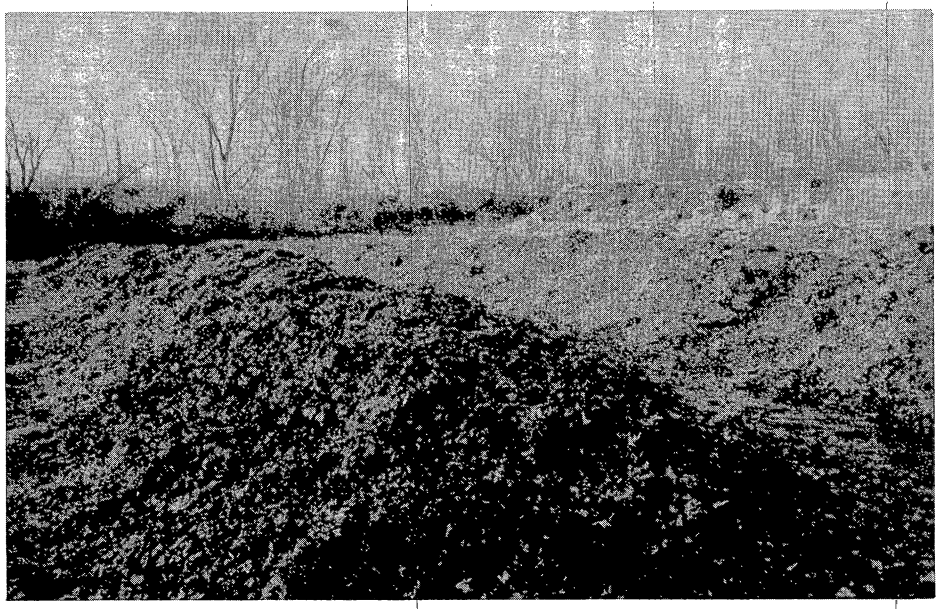
1. The material can be designated to landfills at a cost to the producer.

2. The material can be marketed in a round wood form to various outlets including firewood dealers, pulp mills, sawmills, and veneer buyers in New Jersey and neighboring states.

3. The woody material can be reduced to a chip form and marketed to pulp mills, landscaping companies, nurseries, wood residue dealers, industrial wood energy, sludge composting facilities, and other demand sources.

Any combination of these three alternatives are possible in most instances. Marketability and utilization of this type of resource material depends on a good number of variables including of course, the type, quality and quantity of raw material involved. Also equipment available and expertise of the contractor play a big part in getting this material into a marketable form. Delivery capabilities are an important consideration. In any event, there





Utilization of leaves can create thousands of cubic yards of compost and mulch for town use, residents and for sale

are a multitude of market possiblities for forest resource materials developed during land clearing for construction. Specific information on companies having a demand for various types of forest material is available from the Bureau of Forest Management's Forest Products Utilization and Marketing staff on request.

Firewood from tree removals can be in the hundreds of cords and given free to residents of your town.

Product	General Description	Average Value Range Delivered to Processor	Uses
Veneer	White oak, Red oak, White ash, Walnut, Cherry, Paulownia 14" small end diameter 8'3" and longer, free of visible defects	$800-$2,000/MBF	Wall paneling Furniture, Wood overlays, Doors, & Decorative Plywood.
Sawtimber 14" + DBH	Mixed hardwoods	$150-$300/MBF	Grade Lumber, Container products, Primary and Secondary wood products.
Piling	Hardwoods & Softwoods 10"-16" Butt diameter Straight & clear 15' and longer	$25-$60/Linear foot	All wood docking and Pier construction.
Furnace Poles	Hardwoods, preferably Gum and Oak 10"-16" Butt diameter 25' and longer	$19/Ton	Copper refining.
Cedar	Cedar logs 8" dbh & Tree lengths	$80-$130/Cord	Fencing, Decoys, Posts, Landscape ties, Mantels, Carving blocks, Shingles, Siding, and Lumber products.
Wood Chips	Whole Tree Chips	$24+/Ton Pine $17+/Ton Hardwood	Landscape mulch, Sludge composting medium, Paper manufacturing, Wood energy and Roofing products.
Firewood	24" Unsplit	$50-$80/Cord	Residential wood energy.
Pulpwood	Hardwoods & Softwoods 4"-8" diameter 4' lengths	$17/Ton Pine $10.50/Ton Hardwood	Paper and Roofing products.

The New Jersey Bureau of Forest Management has encouraged municipalities in New Jersey to enact a tree harvesting ordinance were those municipalities have many privately owned woodlots. Some well meaning municipalities have done so in the past, but the tree harvesting ordinance tends to be unrealistically restrictive and often discourages proper forest management. The N.J. Bureau of Forest Management encourages a tree harvesting ordinance that permits forest management under the direction of a professional forester. The following ordinance has been developed by the Bureau of Forest Management as a model and guide for municipalities. For further information contact the New Jersey Bureau of Forest Management Regional offices (appendix VIII).

Model Tree Harvesting Ordinance for Municipalities

Ordinance To Regulate And Control The Harvesting Of Trees Be It Ordained by the Municipal Council of the Municipality of _____ in the County of _____ as follows:

Section 1. Introduction :

The Municipal Council of the Municipality of _____ does herein decide and find the woodlands are an important cultural, ecological, scenic, and economic resource. Proper management of this resource will insure its maintenance for all forest benefits, i.e., watershed protection, wildlife habitat, recreational aspects, aesthetics, and result in greater economic returns for harvested timber. The current yield of timber in the woodlands is below the region's potential because of wildlife, excessive cutting, and poor management.

The woodlands must be preserved, protected, enhanced, and maintained. A forestry program is intended to meet these objectives by providing opportunities for the continuing uses of the Township's forest resources which are compatible with the maintenance of the environment. This can be accomplished by the improvement of the forests through the application of sound management practices.

Section 2. Definitions:

Tree: A woody plant that has the potential to reach a height of at least 10 feet, has a single stem, and has a definite crown shape.

Forestry: The profession embracing the science, business and art of creating, conserving and managing forests and forestlands for the continuing use of their resources.

Section 3. Exceptions:

Excepted From This Ordinance Shall Be:

a. Any tree located on a parcel of land one acre or less in size on which a residence has been constructed.

b. Any tree growing on property actually being used as a nursery, garden center, Christmas tree plantation, or an orchard.

c. Any tree growing on land being used for sanitary landfill.

d. Any tree to be cut for personal use by the Owner.

e. Any tree growing on a public right-of-way.

f. Any dead, diseased, or other tree that is likely to endanger life or property.

Section 4. Permit:

Any landowner desiring to cut, remove, or harvest any tree for commercial purposes shall apply to the duly appointed officer of the Municipality of _____ for a permit application and shall include the following information:

a. A Harvesting Plan, which details the harvesting practices proposed to be employed, including, but not limited to, the following:
- *(1)* location and size of tracts
- *(2)* owners name and address;
- *(3)* map of the property showing wetlands, types of vegetation cover, area to be harvested receiving waters, location of stream crossings and alternatives, location of skid trails location of access roads and landings, cutting boundaries, and size of filter or buffer strips.
- *(4)* description of area to be harvested should include: acerage, general soil types and erodibility, range of percent of slope, timber quality and age (forest type, species age, DBH, height, volume and reproduction), and understory;
- *(5)* description of timber to be harvested (number of trees, species, diameter class and volume);
- *(6)* description of regeneration plans, and
- *(7)* description of intermediate management practices to be applied during or after harvesting

Section 5. Management:

Forest vegetation represents a unique and financially valuable part of the essential character of the Municipality. If properly managed, forests represent significant economic opportunities to their owners while perpetuating the overall ecological value of the Municipality. This ordinance encourages commercial forestry that will maximize forest land values and provide for the long-term economic and environmental integrity of the Municipality. Forestry shall be authorized throughout the Municipality of _____ provided:

a. That access to land proposed for harvesting:
- *(1)* follows previously established roads and trails to maximum extent practical;
- *(2)* avoids wetland areas except as are absolutely necessary to harvest wetland species or to gain access to the harvesting site; and
- *(3)* avoids crossing streams with high and unstable banks and those with approaching slopes exceeding 10% where alternative crossings exist.

b. That all activities during and after harvesting are carried out in a manner to avoid damage to stream banks and bottoms, erosion, and degradation of water quality, including the following:

- *(1)* stream banks at crossings shall be stabilized during and after harvesting;
- *(2)* culverts and bridges shall be temporary in nature;
- *(3)* trees which serve to stabilize stream banks shall be retained; other trees shall be felled to avoid stream banks where practical and winched off such banks where felling occurs;

(4) a 25-foot vegetated buffer along streams, ponds and marshes shall be maintained;
(5) the use of active and intermittent stream channels for skidding of logs shall be prohibited;
(6) skidding shall not occur within 25 feet of streams, ponds, lakes, and marshes, except for necessary crossings;
(7) accessways for forestry activities shall be located at least 100 feet from streams, ponds, lakes, and marshes, where practical;
(8) landings shall be located in well drained areas where practical and at least 200 feet from ponds, lakes, marshes;
(9) filter strips shall be located between: harvested areas, landings, and skid trails; and streams, ponds, lakes, marshes;
(10) water diversion devices shall be installed as necessary to control erosion;
(11) keep roads and skid trails out of wet and poorly drained spots; and
(12) plan carefully for the protection of slopes exceeding 30 percent.

c. Landowner shall notify the Municipality when harvesting is to commence once application is approved.

d. That only those trees which have been selected for harvesting are cut; that all trees are cut to the base; and all practical steps are taken to minimize damage to undesignated trees.

e. That at the conclusion of any harvesting operation:
(1) all areas disturbed for access, processing, moving or loading trees shall be regraded to approximate natural slopes and that water diversion devices are installed as necessary in order to avoid erosion;
(2) all accessways shall be closed and devices installed, such as poles, pilings or beams that will preclude use of the accessway;
(3) bare ground areas shall be stabilized with vegetation where necessary;
(4) all debris shall be removed from streams;
(5) all non-vegetative refuse shall be collected; and
(6) all hanging trees shall be removed.

f. That harvesting and reforestation activities shall ensure the regeneration of the harvested forest and;

g. That harvesting and reforestation in Atlantic white-cedar and hardwood swamps is conducted in the following manner:
(1) Atlantic white-cedar will be clearcut and slash will be managed to create site conditions favorable to regeneration of Atlantic white-cedar;
(2) reforestation to ensure Atlantic white-cedar regeneration will involve control of competitive hardwood species;
(3) existing streams shall be cutting boundaries where practical;
(4) harvesting methods employed shall be those which minimize environmental damage including the use of winches, corduroy roads, and helicopters; and
(5) harvesting will occur to the greatest extent practical during dry periods or when the ground is frozen.

h. That proposed activity does not involve the drainage or filling of wetlands.

Section 6. Compliance:

Work shall be performed in compliance with the submitted harvesting plan and shall adhere to the standards in ***Section 5*** of this ordinance. Any change will require the submission of a new or revised harvesting plan. The permit shall be valid for a period not to exceed two years.

Section 7. Penalty:

A stop work order shall be issued by the designated Township official if noncompliance with the submitted harvesting plan is evident or if there is nonadherence to the standards in ***Section 5.*** The stop work order will remain in effect until the Township has determined, that resuming work will not violate the conditions of the submitted harvesting plan.

Section 8. Fees:

A fee schedule will be determined to adequately cover the administrative costs of this ordinance. The fee shall be included with the permit application.

Section 9. Violations:

Any person violating any provisions of this ordinance shall be subject to a fine not exceeding Five Hundred Dollars **($500),** or imprisonment for thirty **(30)** days, or both, in the discretion of the judge of the Municipal Court of the Municipality of _____.

Section 10.

This ordinance shall take effect as provided by law after its final passage and publication.

Urban Tree Inventory System

An urban tree inventory system is a method of obtaining data about urban trees and organizing it into usable information. The basic information would include the number, condition and distribution of urban trees, but other kinds of data may be included. Municipalities wanting to start or improve a community tree program need this information for planning and management decisions. Various inventory systems have been developed. They range from simple survey methods that provide basic information quickly and inexpensively to sophisticated computerized systems that are integrated with daily tree care activities.

Prior to instituting an inventory system, a municipality should carefully consider exactly what information is needed. It would be adviseable for the municipality to consult an expert whose experience can be invaluable in avoiding many pitfalls.

The objectives of an inventory system should determine the nature of the components, but in practice the amount of available funding is also a limiting factor. In any case, inventories should state what kind of information is needed, and for what purpose. Results from the simplest system might be used to persuade local government to establish a tree care budget, start a community tree program, or at least initiate a shade tree commission.

Whatever the objectives of an inventory system are, they should be defined before the system is designed or implemented. An inventory conducted without thorough planning can be very wasteful.

Tree City USA

The National Arbor Day Foundation, in cooperation with the U.S. Forest Service, the National Association of State Foresters, the U.S. Conference of Mayors, and the National League of Cities, is prepared to recognize towns and cities all over New Jersey who meet the standards of the ***Tree City USA*** program.

When you think about it, every community in New Jersey is a mini forest. All you have to do is fly from one place to another and you can see that. In many instances, however, on closer observation, you discover that the "forest" isn't being managed as well as it could be. Trees are planted haphazardly. Dead trees aren't being removed. New trees are not being planted or cared for. Generally, about half of all the trees are on public property...along streets, in parks and around public buildings. It is important, therefore, that an ongoing community forestry program is initiated.

Tree City USA has been designed to recognize those communities that are effectively managing their tree resources. Just as important, it is geared to encourage the implementation of a local tree management program based on the ***Tree City USA*** standards through the professional leadership of the State Forester.

Public Law 92-288 of 1972 gives the state forester authority and responsibility for providing technical services for the "protection, improvement and

establishment of trees and shrubs in urban areas, communities and open spaces."

The New Jersey Bureau of Forest Management has developed an excellent urban and community forestry assistance program. Contacts may be made with any of the Regional Forestry Offices in Appendix VIII.

A quick check with the city forester or the Mayor's office will tell you whether your community is meeting the standards and therefore is eligible for ***Tree City USA*** recognition. It could be that you need only have a formal Arbor Day observance or the current local forestry program has to be a little better defined to become eligible. On the other hand, your community may have to make a concerted effort to get an effective management program underway and ***Tree City*** standards and guidelines will help provide direction.

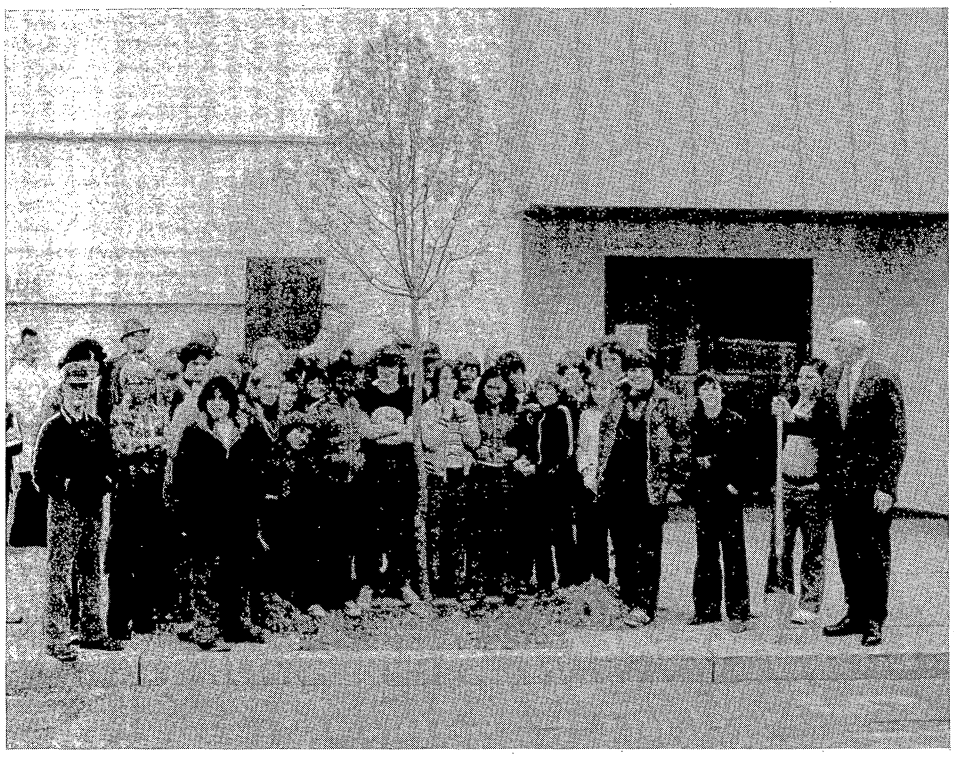
A word about the standards. They are designed for a ***Tree City USA*** award to be made to the community that has a workable program in urban/community forestry. The award is not simply for pretty trees, but also for the program that makes them pretty. The standards ***1*** and ***2*** provide for an urban/community forestry program structure in a town or city. Standard ***3*** requires the program to have demonstrated success based on the judgement of the State Forester's office. Standard ***4,*** the actual Arbor Day observance helps create a new awareness and appreciation of trees among all the residents of the community.

State forestry personnel will evaluate applications from individual cities and forward such evaluations to the National ***Tree City USA*** committee no later than ***December 31*** of each calendar year. Communities that will receive the award will be notified before February 15 by either the Arbor Day Foundation or the State Forester.

It is suggested that the actual ***Tree City USA*** Award be presented during your annual Arbor Day celebration.

Because ***Tree City USA*** is an ongoing community improvement program, your community can and should reapply for ***Tree City USA*** designation each year.

Once a community has received recognition and has met the standards, it can contact the State Forester at the end of each calendar year and apply for continued recognition. Communities are encouraged to continue to develop their urban forestry program beyond the standards set forth. For further information contact the New Jersey Bureau of Forest Management, Regional offices (appendix VIII).



Everyone can get involved in your towns Arbor Day celebration.

APPENDIX I

Trees Common to New Jersey Woodlands

Scientific Name	Common Name
Acer negundo	boxelder
Acer pensylvanicum	stripe maple
Acer platanoides	Norway maple
Acer rubrum	red maple
Acer saccharum	sugar maple
Acer saccharinum	silver maple
Ailanthus altissima	tree of heaven
Amelanchier arborea	service berry
Betula alleghaniensis	yellow birch
Betula lenta	black birch
Betula nigra	river birch
Betula papyrifera	white birch
Betula populifolia	gray birch
Carpinus caroliniana	American hornbeam
Carya cordiformis	bitternut hickory
Carya glabra	pignut hickory
Carya ovata	shagbark hickory
Carya tomentosa	mockernut hickory
Castanea dentata	American chestnut
Celtis occidentalis	hackberry
Chamaecyparis thyoides	Atlantic white-cedar
Cornus florida	dogwood
Diospyros virginiana	persimmon
Fagus grandifolia	American beech
Fraxinus americana	white ash
Fraxinus nigra	black ash
Fraxinus pennsylvanica	green ash
Gleditsia triacanthos	honey locust
Juglans cinerea	butternut
Junglans nigra	black walnut
Juniperus virginiana	eastern red cedar
Larix laricina	tamarack
Liquidambar styraciflua	sweet gum
Liriodendron tulipifera	yellow poplar
Magnolia acuminata	Cucumber magnolia
Morus rubra	red mulberry
Nyssa sylvatica	black gum
Ostrya virginiana	eastern hophornbeam
Picea abies	Norway spruce
Pinus echinata	shortleaf pine
Pinus resinosa	red pine
Pinus rigida	pitch pine
Pinus strobus	white pine
Pinus sylvestris	Scotch pine
Pinus virginiana	Virginia pine
Platanus occidentalis	sycamore
Populus grandidentata	bigtooth aspen

Scientific Name	Common Name
Populus tremuloides	quaking aspen
Prunus pennsylvanica	pin cherry
Prunus serotina	black cherry
Quercus alba	white oak
Quercus bicolor	swamp white oak
Quercus coccinea	scarlet oak
Quercus falcata	southern red oak
Quercus palustris	pin oak
Quercus phellos	willow oak
Quercus prinus	chestnut oak
Quercus rubra	red oak
Quercus stellata	post oak
Quercus velutina	black oak
Robinia pseudoacacia	black locust
Salix nigra	black weeping willow
Sassafras albidum	sassafras
Tilia americana	American basswood
Tsuga canadensis	eastern hemlock
Ulmus americana	American elm
Ulmus rubra	slippery bark elm

APPENDIX II

Undesirable Characteristics of Some Native Shade Trees

all hickories	-large nuts, nuisance for lawn care
black walnut	-large nuts, loses leaves early in fall, last to leaf out in spring, no fall color, nuisance for lawn care.
butternut	-large nuts, no fall color
American chestnut	-short-lived because of chestnut blight, usually does not reach tree size
Osage orange	-very large seed balls, bushy
silver maple	-susceptible to various insects and diseases, very weak branches
pitch pine	-poor form
sassafras	-usually has poor form, weak branches
all aspen	-short-lived, soft wood
black willow	-root problems in sewers, not attractive
all cherries	-poor form, attracts tent caterpillars in spring
paulownia	-short-lived, messy, soft wood, no fall color
elms	-susceptible to Dutch elm disease
black locust	-thorny, messy, poor form, weak branches
red mulberry	-messy fruit
boxelder	-messy, attracts boxelder beetles
virginia pine	-poor form, short-lived
pin oak	-dead branches on lower crown are maintenance problem
scarlet oak	-same as pin oak though not as bad
gray birch	-not long-lived
honey locust	-thorny, large seed pods
Tree of Heaven	-not long-lived, soft wood, easily damaged, messy, no coloration

APPENDIX III

Transplanting Characteristics of Various Ornamental Trees

Relatively Easy

Common Name	Scientific Name
Ailanthus	Ailanthus altissima
Apple	Malus sp.
Ash	Fraxinus sp.
Buckeye (horse chestnut)	Aesculus sp.
Catalpa	Catalpa sp.
Elm	Ulmus sp.
Ginkgo	Ginkgo biloba
Hackberry	Celtis occidentalis
Hawthorn	Crataegus sp.
Honeylocust	Gleditsia tricanthos
Maple	Acer sp.
Mountain-ash	Sorbus americana
Osage orange	Maclura pomifera
Paulownia	Paulownia tomentosa
Pear	Pyrus communis
Pin oak	Quercus palustris
Poplar	Populus sp.
Redgum (light soils)	Liquidambar stryaciflua
Sycamore	Platanus sp.
Willow	Salix sp.

Relatively Difficult and/or Slow to Recover

Common Name	Scientific Name
Beech	Fagus grandifolia
Birch	Betula sp.
Blackgum	Nyssa sylvatica
Blue beech	Carpinus caroliniana
Cherry	Prunus sp.
Coffee tree	Gymnocladus dioicus
Conifers	Pinaceae
Dogwood	Cornus sp.
Holly	Ilex opaca
Hophornbeam	Ostrya virginiana
Laburnum	Laburnum sp.
Magnolia	Magnolia sp.
Oak	Quercus (most sp.)
Persimmon	Diopyros virginiana
Redbud	Cercis canadensis
Redgum (heavy soils)	Liquidambar styraciflua

Relatively Difficult and/or Slow to Recover

Common Name	Scientific Name
Russian olive	Elaeagnus angustifolia
Sassafras	Sassafras albidum
Serviceberry	Amelanchier canadensis
Sourwood	Oxydendrum arboreum
Walnut	Junglans sp.
Yellow-poplar	Liriodendron tulipifera
Yellowwood	Cladrastis lutea

APPENDIX IV

Effects of Air Pollution

	Symptoms	Sensitive Trees	Tolerant Trees
Sulphur dioxide	Needle tip burn white pine. Reddish brown discoloration of needle tip. Broad leaves exhibit yellow coloration between green veins	Ash Aspen Birch Blackberry White pine Jack pine Yellow poplar	Black gum Boxelder Dogwood Juniper Maple Spruce
Ozone	Needle tips dies in conifers. Premature defoliation. Patches brown and yellow throughout leaf margin in decidious plants. Flecks of dead white-to-tan on upper leaf surfaces	Ash Honey locust White oak White pine Yellow poplar White birch	Black walnut Gray dogwood Maple Red oak Spruce
Fluorides	Tip necrosis in confiers. Broad leaf trees, tip and margin fades in color. Tissue dies. Reddish bands form.	Boxelder Scotch pine White pine Willow White birch	American elm Dogwood Sweet gum Sycamore
Ammonia	Spruce needles become black. White oak exhibits interveined bleaching.	Spruces White oak	

APPENDIX V

TREE CHARACTERISTICS

	Mature Height-Feet	Mature Trunk Dia. Inches	Fall Colors	Soil pH	Root System	Longevity	Shade Tolerance	Growth	Remarks
White Ash	80	36	Purple to Yellow	N-B	D-S	M	M	M-R	Grows in most soils, little care needed, good shade tree
Quaking Aspen	60	18	Yellow	N	S	S	I	R	Soft wood, short lived, weak
Amercian Birch	90	28	Golden Bronze	N	S	L	T	S	Valuable game food, good shade tree
Sweet Birch	60	20	Yellow	N	D	M	M	M	Not good for shade, moderate salt tolerance
Black Cherry	60	24	Reddish	N	M-D	M	M	R	Good wildlife food, spring flowers attractive, attracts tent caterpillar
Pin Cherry	50	20	Reddish	N	1-D	S	I	R	Good wildlife food, spring flowers attractive, attracts tent caterpillar
Flowering Dogwood	35	12	Scarlet	N	D	S	V-T	V-S	Good ornamental, attractive flowers and fall coloration, doesn't like wet soils
Black Gum	60	24	Brilliant Scarlet-Org.	N	M	M	M	M	Good autumn color, unattractive form, poor drainage
Eastern Hemlock	70	26	None	A-N	S	L	V-T	S	Beautiful ornamental, susceptible to insect problems, likes moist soil
Hickories	80	24	Yel-Orange	N	D	L	T	S	Good wildlife species, nuts are nuisance during lawn care
Honeylocust	60	18	None	N	D	M	M	R	Thorns, dirty, unattractive, good salt tolerance
Black Locust	80	24	None	N	S	M	I	R	Unattractive, dirty, good salt tolerance
Norway Maple	80	24	Yellow	N	S	M	M	R	Dense shade, hard to grow grass beneath, disease prone
Red Maple	70	20	Red-Scarlet and Yellow	N	S	M	M	M	Weak wood, wind damaged, good shade, excellent fall coloration
Sugar Maple	80	30	Yellow	A-N	D	L	V-T	M	Low salt tolerance
Silver Maple	80	24	Poor	N	S	M	M	R	Not good for street or home use, soft wood, brittle, disease prone
Black Oak	70	26	Red	A-N	D	L	M	M	Fair shade tree, lower brances fall
Red Oak	75	30	Red	N	D	L	I	R	Transplants easily, good street tree, good salt tolerance
White Oak	100	36	Purplish Red	A-N	D	L	I	S	Not good street tree, good salt tolerance
Eastern white pine	100	30	None	A-N	MD	L	M	R	Attractive, good conifer, good screen, salt prone
Eastern red cedar	50	18	None	B	D	M	I	S	Good ornamental, moderate salt tolerance
Sassafras	50	20	Scarlet-Red	N	S	S	T	S	Soft wood, attractive color
Sycamore	120	36	None	N	S	M	I	R	Tends to defoliate in mid-summer.
Tulip poplar	100	30	Yellow	N	D	L	I	R	Largest native tree, brittle
Black Walnut	90	24	None	N	D	L	I	R	Valuable wood, dirty, poor salt tolerance
Black Willow	40	14	Yellowish	N	S	S	I	R	Unattractive, soft wood
Black Pine	25	8	None	A-N	MD	M	M	R	Grows almost anywhere, not a street tree

KEY: Soil pH — (N) Neutral, (A) Acid, (B) Basic
Root System — (S) Shallow, (D) Deep, (M) Medium
Longevity — (L) Long, (M) Medium, (S) Short
Tolerance — (VT) Very Tolerant, (T) Tolerant, (M) Medium, (I) Intolerant
Growth — (R) Rapid, (M) Medium, (S) Slow

APPENDIX VI

Weights, Heat Values, and Heat Equivalents of Other Fuels for Selected Green and Air-dry Woods Commonly Found in New Jersey.

Species	Weight Lbs./Cord		Tons/Cord Ratio		Potential Heat/Cord (Million BTU)	Available Heat/Cord (Million BTU)	Heat Equivalent of Other Fuels			
	Green	Air-Dry	Green	Air-Dry			No. 2 Fuel Oil (gallons)	Natural Gas (Therm)	Electricity Kilowatt Hr.	Pa. Coal Ton
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Black Locust	4640	4192	2.32	2.10	29.18	16.03	164	200	4,696	1.00
Hickory	5120	4072	2.56	2.04	28.34	15.59	159	194	4,567	0.97
White Oak	5040	3776	2.52	1.89	26.28	14.45	148	180	4,233	0.90
Red Oak	5120	3536	2.55	1.77	24.61	13.54	138	169	3,967	0.84
Beech	4320	3504	2.16	1.75	24.39	13.41	137	167	3,929	0.83
White Ash	3840	3472	1.92	1.74	24.16	13.29	136	166	3,893	0.83
Sugar Maple	4480	3408	2.24	1.70	23.72	13.05	133	163	3,823	0.81
Black Cherry	3600	2928	1.80	1.46	20.38	11.31	115	141	3,313	0.70
Amer. Elm	4320	2872	2.15	1.44	19.99	11.09	113	139	3,249	0.69
Sweetgum	4400	2872	2.20	1.44	19.99	11.09	113	139	3,249	0.69
Sycamore	4160	2872	2.08	1.44	19.99	11.09	113	139	3,249	0.69
Red Maple	4000	2752	2.00	1.38	19.15	10.53	107	132	3,085	0.65
Yellow Poplar	3680	2456	1.84	1.22	17.09	9.40	96	117	2,754	0.58
Willow	4000	2216	2.00	1.11	15.42	8.48	86	106	2,484	0.53
Aspen	3440	2216	1.72	1.11	15.42	8.48	86	106	2,484	0.53
Basswood	3360	1984	1.68	.99	13.80	7.59	77	94	2,223	0.47
Pitch Pine	4160	3040	2.08	1.52	22.98	12.64	128	158	3,704	0.79
Hemlock	4000	2400	2.00	1.20	18.14	9.98	101	124	2,924	0.62
White Pine	2880	2104	1.44	1.05	15.91	8.75	89	109	2,564	0.54

APPENDIX VII

ORNAMENTAL TREES AND THEIR VALUE TO WILDLIFE

PLANT SPECIES		TYPE OF WILDLIFE													
		GAME ANIMALS			GAME BIRDS				SONGBIRDS						
COMMON NAME	SCIENTIFIC NAME	DEER	RABBIT	GRAY SQUIRREL	TURKEY	RUFFED GROUSE	BOBWHITE QUAIL	RING-NECK PHEASANT	EASTERN BLUEBIRD	AMERICAN ROBIN	MOURNING DOVE	CARDINAL	AMERICAN GOLDFINCH	BLUE JAY	MOCKING-BIRD
Maple	Acer Sp.	F	F	F,C,N		F				C,N	C		F,C,N		
Serviceberry	Amelanchier arbroea	F				F			F	F		F		F	F
Birch	Betula Sp.	F				F					C				
American Hornbeam	Carpinus caroliniana	F		F	F	F									
Hickory	Carya Sp.			F,C,N							C				
Common Hackberry	Celtis occidentalis				F				F	F					F,C
Flowering Dogwood	Cornus florida	F	F	F,C,N	F	F	F		F	F,N		F			F,C
Persimmon	Diospyros virginiana				F		F			F					
Amercian Beech	Fagus grandifolia	F		F,C,N	F	F					C			F	
White Ash	Faxinus americana	F	F	C,N	F		F				C	F			
American Holly	Ilex opaca	F	C		F,C		C		F	F,C,N	C	C,N			F,C,N
Black Walnut	Juglans nigra			F,C,N											
Eastern Larch	Larix laricina									C,N				C,N	
Yellow Poplar	Liriodendron tulipfera			C,N								F	F		
Crabapple	Malus sp.	F	F					F	C,N	F,C,N	C,N	N		C,N	C

F — Food C — Cover N — Nesting

APPENDIX VII (Continued)

ORNAMENTAL TREES AND THEIR VALUE TO WILDLIFE

PLANT SPECIES		TYPE OF WILDLIFE													
		GAME ANIMALS			GAME BIRDS				SONGBIRDS						
COMMON NAME	SCIENTIFIC NAME	DEER	RABBIT	GRAY SQUIRREL	TURKEY	RUFFED GROUSE	BOBWHITE QUAIL	RING-NECK PHEASANT	EASTERN BLUEBIRD	AMERICAN ROBIN	MOURNING DOVE	CARDINAL	AMERICAN GOLDFINCH	BLUE JAY	MOCKING-BIRD
Mulberry	Morus Sp.			C	F		F		F	F,C		F		F	F,C
Black Gum	Nyssa sylvatica	F		C	F		F		F	F,C					F,C
Hophornbeam	Ostrya virginiana	F													
Spruce	Picea Sp.	F	C		C		C			C,N	C,N		C	C,N	C
Pitch Pine	Pinus rigida		C		C		F,C			C,N	C,N				
Eastern White Pine	Pinus strobus	F			C					C,N	N		F	C,N	
Aspen	Populus Sp.	F	F			F,C									
Black Cherry	Prunus serotina	F	F	F,C,N		F	F	F	F	F,C		F	F	F	F,C
Oak	Quercus Sp.	F		F,C,N	F,C	F,C	F	F				F	F	F	
Willow	Salix Sp.	F				F									
Mountain Ash	Sorbus Sp.					F			F	F					
Eastern Hemlock	Tsuga canadensis	F			C	C				C,N	C,N			C,N	
Elm	Ulmus Sp.	F		F,C	F	C		F		N			F		
Hawthorn	Crataegus Sp.	F	F		F	F				F,C,N		C,N		N	F,C,N
Sweet Gum	Liquidambar styraciflua			F,C			F								

F — Food C — Cover N — Nesting

APPENDIX VIII

Forestry Assistance is Available at the Following State Offices

N.J. Bureau of Forest Management
501 East State Street
Station Plaza #5
4th Floor
CN-404
Trenton, NJ 08625
Office Phone - (609) 292-2531

N.J. Bureau of Forest Management, Region A
RD #1, Box 999
Franklin, NJ 07416
Office Phone - (201) 827-1325

N.J. Bureau of Forest Management, Region B
Lebanon State Forest
P.O. Box 239
New Lisbon, NJ 08064
Office Phone - (609) 726-1548

N.J. Bureau of Forest Management, Region C
561 Atlantic Avenue
Mays Landing, NJ 08330
Office Phone - (609) 625-1124

N.J. Bureau of Forest Management, Region D
State Nursery
RD 2, Box 41
Jackson, NJ 08527
Office Phone - (201) 928-0029

APPENDIX IX

Soil Conservation Districts in New Jersey

Name	Address	Telephone No.
Bergen SCD	327 East Ridgewood Avenue Paramus, NJ 07652	201-261-4407
Burlington SCD	Cramer Building Rt. 38, Mt. Holly, NJ 08060	609-267-7410
Camden SCD	Municipal Building 59 S. White Horse Pike Berlin, NJ 08009	609-767-6299
Cape May-Atlantic SCD	Atlantic Co. Office Bldg. 1200 W. Harding Highway Mays Landing, NJ 08330	609-625-9400
Cumberland SCD	P.O. Box 5148, Rt. 77 Seabrook, NJ 08302	609-451-2144
Freehold SCD (Mon. & Midsex. Co.)	211 Freehold Road Manalapan, NJ 07726	201-446-2300
Gloucester SCD	P.O. Box 507 Glassboro, NJ 08028	609-881-8323
Hudson, Essex & Passaic SCD	571 Bloomfield Avenue Verona, NJ 07044	201-239-1886 or 239-1939
Hunterdon SCD	4 Gauntt Place Flemington, NJ 08822	201-782-3915
Mercer SCD	930 Spruce Street Trenton, NJ 08648	609-989-6847
Morris SCD	Court House Morristown, NJ 07960 (Location-W. Hanover Ave.)	201-285-2953

Name	Address	Telephone No.
Ocean SCD	Ocean County Agri. Center 6 Mott Place CN-2191 Toms River, NJ 08753	201-244-7048
Salem SCD	1000 East, Rt. 40, Box 47 Woodstown, NJ 08098	609-769-1124
Somerset-Union SCD	308 Milltown Rd. Somerset County 4-H Center Bridgewater, NJ 08807	201-526-2701
Sussex SCD	330 Route 206 South Newton, NJ 07860	201-383-7315
Warren SCD	Stiger Street Hackettstown, NJ 07840	201-852-2579

State Soil Conservation Committee

CN - 330, Rm 203
Trenton, NJ 08625
Office Phone - 609-292-5540

APPENDIX X

Certified Tree Experts

A list of Certified Tree Experts is on file with the Bureau of Tree Experts in the New Jersey Department of Environmental Protection, Bureau of Forest Management. These arborists have been examined by the Bureau of Tree Experts under terms of the Tree Experts Act, Public Laws of 1940, Chapter 100, amended by L. 1983, C. 324 and have been found qualified to practice as Certified Tree Experts.

Approved Foresters

A list of Approved Foresters and services offered can be obtained by contacting the New Jersey Department of Environmental Protection, Bureau of Forest Management, Regional Offices.

New Jersey Shade Tree Federation

The New Jersey Shade Tree Federation was organized as a service association to promote municipal, county and park tree planting and maintenance. Further information regarding the Federation's services can be obtained by contacting:

New Jersey Shade Tree Federation
Cook College
Blake Hall, Box 231
New Brunswick, NJ 08903
Office Phone - 201-246-3210

Glossary

Arboriculture. The cultivation i.e. growing and tending, of trees and shrubs, individually or in small groups.
Blight. Any disease, or a pest, associated with an often rapid wilting and dieback of foliage, flowers, and even shoots.
Board Foot. A method of timber measurement. The amount of timber equivalent to a piece of 1 x 1 foot and 1 inch thick.
Cambium. Growing layer between the xylem and pholem.
Conifer. Needle-leaved trees, softwood. The most important order of the Gymnospermae, bearing cones.
Decidious. Perennial plants that are normally leafless for some time during the year
Dehorning. Involves the drastic cutting back of the larger limbs of a tree.
Diameter Breast Ht. (DBH). Diameter of standing trees measured at a point 4-1/2 feet above the ground.
Drip Line. Area where the outer tips of the branches overhang the ground.
Epicormic Branching. A shoot arising spontaneously from a bud on the stem or on a branch of woody plants
Frost Crack. Radial splitting along the grain in the stem and branches of a tree, as a result of internal stresses set up by low temperatures. Such cracks may be open to surface or internal only.
Girdling. Making more or less continuous incisions around a living stem, through at least both bark and cambium, generally with the object of felling the tree.
Hardening Off. Generally, the natural process of adaptation by plants to cold or drought.
Hardpan. Any hard and/or compacted layer in the soil.
Hardwoods. Conventional term for the timber of broad-leaved trees, and the trees themselves, belonging to the botanical group Angiosperma
Heartwood. The inner layers of wood which, in the growing tree, have ceased to contain living cells.
Organic Matter. Matter derived from living organisms.
Ornamental. A plant cultivated for its beauty rather than for use.
Pathogen. A specific cause (as a bacterium or virus) of disease.
pH. A notation designating acidity and alkalinity. A pH of 7 indicates neutrality; higher values indicate alkalinity and lower values acidity.
Phloem. A vascular tissue of higher plants that transports dissolved food material, contains sieve tubes, and lies mostly external to the cambium.
Pith. A central stand of spongy tissue in the stems of most vascular plants that function chiefly in storage.
Pollarding. Cutting back the crown of a tree with the object of producing a close head of shoots.
Pulpwood. Wood cut and prepared primarily for manufacture of paper and paper by-products.
Root Zone. A loose term for that part of the soil invaded by plant roots.
Sapling. A loose term for a young tree no longer a seedling but not yet pole size.
Sapwood. The outer layers of wood which, in the growing tree, contain living cells and reserve materials. Generally lighter in color.
Sawtimber. Trees fit to yield a log suitable in size and quality for producing sawn timber.
Silviculture. Art of producing and tending a forest.
Softwoods. A conventional term for both the timber and the trees belonging to the botanical group Gymnospermae.
Sunscald. Localized injury to bark and cambium, caused by a sudden increase in exposure of a stem or branch to high temperatures from intense sunlight.
Taproot. The main descending root of a plant which gives off small lateral roots.
Thinning. A felling made in an immature stand of trees in order to accelerate diameter growth and improve the average form of the trees that remain.
Timber Stand Improvement (TSI). Cuttings made to improve the composition, condition, and growth rate of a forest stand.
Tree Crown. The upper part of a tree or other woody plant, carrying the main branch system and foliage.
Veneer. A thin sheet of wood produced by slicing.
Water Table. The upper limit of the ground wholly saturated with water.

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