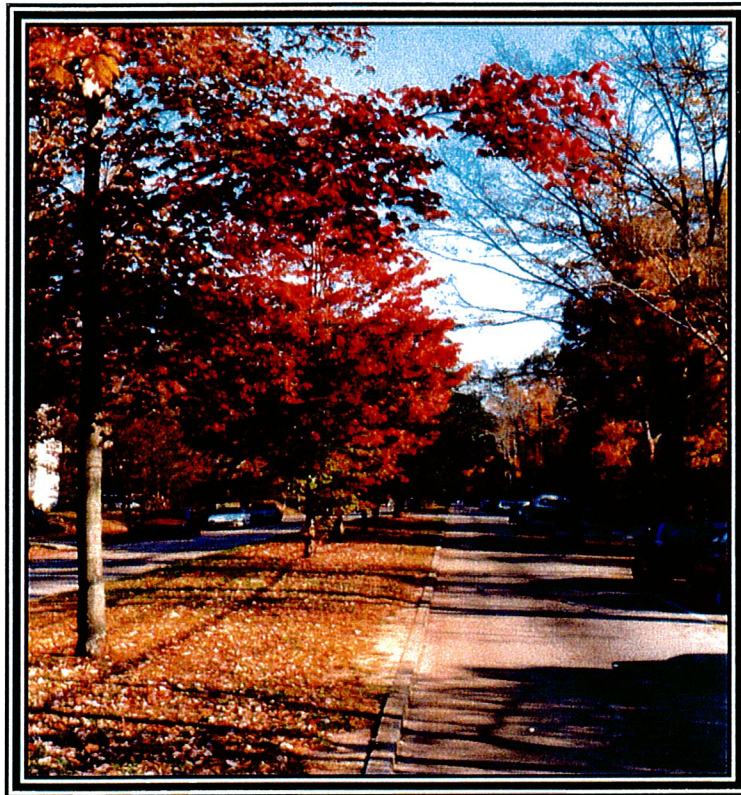


TOWN OF WAKE FOREST, NC

Community Tree Management Plan



Trees for a New Millennium

March 2000

This document's purpose is to serve as a guide to preserve and maintain an active community forestry program in Wake Forest, NC. It was produced in part through funding from an Urban & Community Forestry grant, a cooperative program, administered by the North Carolina Department of Environment and Natural Resources.



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PART I

Community Forestry in Wake Forest, North Carolina

Wake Forest enjoys a wealth of natural beauty amidst a pastoral setting in the piedmont section of North Carolina. The community is enhanced by these natural attributes and holds a history of protecting and preserving its natural and created amenities. Wake Forest's trees have always been a tremendous component of a vibrant quality of life and easygoing atmosphere. Trees in Wake Forest help create a town that is both safe for young and old as well as ecologically contributing to the surrounding environment.

The *benefits* of trees in Wake Forest help define the importance of establishing and maintaining a systematic program to manage this important resource. Trees can benefit urban environments by *modifying local climates and saving energy*. By properly placing trees around buildings, air conditioning costs can be reduced by as much as 30 percent. Trees are effective in *reducing air pollution* by trapping both solid and gaseous substances from the air and converting some of these gases into oxygen for us to breathe. *Noise pollution* can be reduced with trees and other vegetation by planting buffers or islands of trees to absorb unpleasant sounds. Trees help protect *soil and water quality* by reducing the impact of raindrops, resulting in less runoff and erosion. Tree roots help stabilize soils by holding soil particles together and thus supporting other vegetation.

Additionally, trees benefit us by improving our quality of life, increasing property values, improving wildlife habitat and adding beauty to our towns and cities. It is because of these benefits that a comprehensive plan to manage the urban forest becomes paramount. A comprehensive community tree management plan is critical for developing, sustaining and maintaining the community forest.

The goal of a community tree management plan is to provide the key information necessary for the systematic management of a community's urban tree resource. The intent for this plan is for it to become integrated into the Town's overall comprehensive planning efforts as they relate to public vegetation management.



Wake Forest Neighborhood Street Trees

Acknowledging the importance of its community trees, the Wake Forest Tree Board has been keenly aware of a need for this management plan. The Tree Board intends to take Wake Forest's Community Forestry program to new heights in the coming millennium by improving the number and variety of trees, by protecting tree health and by promoting a better public understanding of the role trees play in the community of Wake Forest.

Historic Perspectives of Wake Forest (*Town of Wake Forest Records*)

"The Forest district is one of the best neighborhoods in the state, with three schools, well-filled meeting houses for the Baptists and the Methodists, a doctor and a lawyer. The inhabitants, without exception I believe, are sober, moral, thriving in their circumstances, educated and intelligent"

Dr. Calvin Jones, MD 1832
Founder of Wake Forest Academy

Wake Forest began in the early 1800's, when it was home to what was to become Wake Forest College. Development was initiated in 1820 when Dr. Calvin Jones from New England purchased 615 acres in "Wake Forest Township" from Davis Battle. Dr. Jones built a two-story frame house in the center of the campus, which still survives today. In 1832 the site housed the "Wake Forest Academy for Boys", and in 1834 it

was sold to the North Carolina Baptist Convention to become the “Manual Labor Institute”.

The school grew rapidly and was renamed “Wake Forest College” in 1838. The Raleigh and Gaston Railroad, constructed along the eastern border of the school, was completed in 1840

With an increasing need for space and money, the college decided to divide the remainder of the Calvin Jones farm into lots and sell them for \$100 each. Eighty one-acre lots north of the campus and west of the railroad were put on the market in 1839. This area was later known as Faculty Avenue and today constitutes the greater portion of the Wake Forest Historic District.

Between 1880 and 1905, several businesses were established and commercial development grew with the relocation of the railroad to Wake Forest College. This growth caused the community to draft its first charter in 1909 and become the Town of Wake Forest.

And so these early days were a clear indication of the importance of Wake Forests’ location in proximity to Raleigh and the surrounding region. Growth and development has been a fact of life in the area since it’s establishment and with the more recent expansion of the Research Triangle Park (RTP) area, development continues to be a high priority for the Town’s planning professionals.



Historic Cedar Grove

In 1978 the Wake Forest Tree Board was established as an advisory group to the Wake Forest Board of Commissioners. Its mission revolves around managing the urban tree resources and landscaping in Wake Forest and preserving trees and vegetation when possible as the town faces rapid growth and development.

In 1990, the Tree Board commissioned an Urban Forestry Report detailing the condition of the community forest. The findings of the 1990 report necessitated the need for amendments to be made to the landscape standards. In 1993 these amendments were incorporated into the Town's Zoning Ordinance and from there a *Tree Preservation Steering Committee* was formed which concentrated on preserving and protecting trees during the development process. The goal of this steering committee was to foster working relationships between development interests and tree preservation interests so that the standards would be "user-friendly" and would not hinder development.

In July of 1997, the Town of Wake Forest Board of Commissioners approved the amendments (Article IV, Section 7, Landscape Standards) to the Zoning Ordinance as it stands today. One year later the Town developed An Illustrated Guide to the Landscape Standards of the Wake Forest Zoning Ordinance. A brief list of past projects of the Town of Wake Forest Urban Forestry program is found in the appendix.

The Present: The Year 2000

The Town of Wake Forest has been a Tree City USA since 1979 and has received the Growth Award for 6 straight years. Wake Forest is one of a few towns in North Carolina that has been an established Tree City for over 20 years.

The Wake Forest Tree Board actively pursues urban and community forestry grants. Receiving these grants in the past has enabled activities such as community tree plantings, landscaping ordinance updates, and Arbor Day celebrations. The Tree Board plays a vital role in the management and proliferation of Wake Forests' community trees through:

- General Funds of the Town of Wake Forest (Figure 1). This source of funding has been utilized for the operation of the tree board, newsletters, workshops, grant matching funds and the maintenance and care of the community forest and town entrances.
- Urban and Community Forestry Grants. This source of funding has been utilized for the creation of the Landscape Ordinance, Community Tree Management Plan, Arbor Day activities and other projects.
- Public Education and Information- A quarterly newsletter "The Community Forester", messages printed on utility bills, Town cable channel, workshops, tree seedling sales and "Green Medal Awards" are all used by the Tree Board to promote the community forestry program.
- Champion and Historic Trees Program- This program is designed to promote and preserve tree species in the area that are of historical importance and/or are an exceptional size that by virtue of their size are measured and declared Champions. This program is helpful in educating private property owners of the wonderful tree resource that they possess. The current list is found in the appendix.

Town of Wake Forest Tree Board

PROGRAM DESCRIPTION- *The Urban Forestry program provides for the care and maintenance of Wake Forest's Trees. The program is responsible for administering the Town's Tree Ordinance by overseeing the planting, removal and maintenance of trees and other vegetation located on public property and rights of way. The program is administered by a staff position and the Wake Forest Tree Board, established in 1978 as an advisory board to the Board of Commissioners. The program has continued to expand its include citizen participation and public education through community-wide landscaping projects and informative seminars.*

PROGRAM OBJECTIVES

- Maintain Tree City USA status and apply for the Tree City USA Growth Award.*
- Distribute tree seedlings to all elementary school students.*
- Educate the public through information workshops and newsletters.*
- Apply for, if available, the Urban and Community Forestry (UCF) Grant.*
- Plant trees and install landscaping on public property and rights-of-way.*
- Plan and implement annual programs for the Tree City USA and Arbor Day Celebration.*
- Actively involve the public in urban forestry through neighborhood tree-planting and educational projects.*
- Continue urban forest management programs, which includes pruning and removal, mulching, care and replacement of street trees, downtown landscaping, town entryways, and other previously implemented plantings.*
- Assist with the landscaping goals and implementation the US-1 Corridor Plan.*
- Continue a revolving fund for purchase of trees for resale at minimal cost to members of community who will agree to plant and maintain trees and focus on the community at large, encouraging older neighborhoods to replace old and damaged trees and to inspire new neighborhoods to establish a tree cover in their yards as well.*

Figure 1

Tree Resources - The 1990 urban forestry report found the tree population of Wake Forest to be approximately 3,700. Taylor & Knowles, Inc. researched town documents provided by the planning department. These documents consisted primarily of tree board monthly meeting minutes for years 1978 through 1999. The search of these records for the period of 1990 though 1999 revealed that since 1990 approximately 1060 new trees were planted. During this time period approximately 22 trees were removed from the population. Based on the findings of the 1990 report and a search of the records, the Town of Wake Forest community

forest population is approximately 4754. The town owns and manages 12 parks totaling 145.5 acres within the town which are located at the following locations:

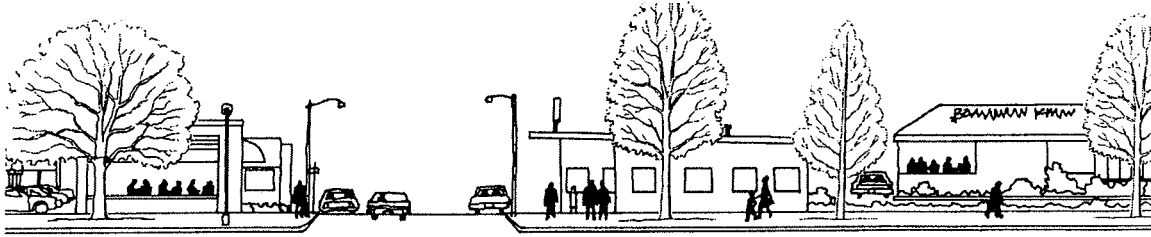
- Ailey M.Young Park, Juniper Ave.
- JB Flaherty Park, N. White Street
- HL Miller Park, Franklin Street
- Holding Park, Owen Ave.
- Kiwanis Park, Holding Ave.
- Plummer Park, Jones Wynd
- RH Forrest Park, Wingate Street
- Rock Springs Park, Rock Springs Rd.
- Taylor St. Park, N. Taylor Street
- Tyler Run Park, Pineview Drive
- WF-R Middle School Park, S. Main Street
- Olde Mill Stream Park, Barnford Mill Road

The Town's population has steadily increased since the 1930's and today reaches approximately 12,000 people. Annual growth has averaged about 7.5% annually since 1990 when the population was just over 5,800 residents. Wake Forest's land area within the town limits is 4,659 acres or 7.28 square miles. The crush of development that began during the early 1990's is likely to continue to increase the population of the town. The demand for space, infrastructure and urban development will place the towns' tree resources at greater risk.

SOILS - Most soils in the Wake Forest area are in the *Cecil Soil Association*. This association is defined as having gently sloping to steep, deep well-drained soils that have a subsoil of firm red clay; derived mostly from gneiss and schist. Some nearby soils are in the *Appling Association*, which are derived from granite, gneiss and schist.

The Community Forestry program in Wake Forest is currently active and growing. Recent and past grant programs and other cooperative ventures have benefited the residents of Wake Forest in a number of ways. A brief history of Wake Forest's Urban Forestry Program can be found in the appendix. In 1990, an Urban Forestry report was prepared which outlined the general state of the town's community forest. Today this report is somewhat outdated and new statistics need to be formulated.

The town has consistently improved its tree-planting program and has continued to look into new and innovative ways to get more tree planting activities off the ground.



Ann Christensen's "Unfolding Urban Landscape"

What's Ahead – The Future

The year is 2025; the Raleigh metropolitan area has engulfed field and forest in all directions. The US 540 "outer loop" is no longer the outer loop, but another tree-less thoroughfare for commuters to move about the city. Urban sprawl becomes an urban storm that sweeps the entire triangle area. But amid the rush of bulldozer and track hoe, one area stays green. In-fact over the years it has become even greener. This shining jewel, the emerald of the Triangle area is the Town of Wake Forest.

How did they do it?

When you ponder "The Future" of trees in Wake Forest, it must be thought of in terms of 100 years. How do we get there from here? How can what we do today, impact the next century? The future of trees in Wake Forest is as exciting and hopeful as ever. As the new millennium arrives one can't help but to look to town citizens, who at the turn of the past century, planted trees for future generations. The citizens have enjoyed and embraced a Town among the trees. The citizens of today are doing the same. In a small way, we all know that trees and the benefits that they provide will be even more valuable at the turn of the next century. The future is now. Getting from "here to there" can be best done taking small, well-planned steps. Recommendations for the management of the Town of Wake Forest's tree population can help shape the ecological and economical environment as we head into the next millennium.

PART II Management Recommendations

There are several principle recommendations that will allow the town to get from “here to there”. After research and meetings with tree board members and town staff it became apparent that there are two important tools missing. The town’s community forestry program is in great need of a town arborist and a comprehensive tree inventory needs to be conducted.

Town Arborist – The establishment and funding of a Town Arborist has many advantages in providing professional services to the community. This position may be classified as a full time staff position or these services may be contracted out to a professional arborist on a part time or full time basis. The Town Arborist can be the spokesperson on all matters concerning town tree resources. Specific duties of a Town Arborist are outlined in detail in the appendix section following.

A major task for the Town Arborist should be the inventory and recording of all town trees within the town’s jurisdiction. From the inventory, the arborist can make valuable decisions on how to proceed with planting schedules, tree removal priorities, pruning and other tree maintenance practices. The tree inventory can be completed using town staff, volunteers, students or consulting firms. The town tree inventory should address tree species, condition, location, maintenance, planting opportunities, infrastructure conflicts and other information relating to urban forest management.

Tree Inventory – Wake Forest’s community forest efforts could benefit greatly with the implementation of a comprehensive tree inventory. The Inventory should cover all trees located on town-owned property, street right of ways and other public property. There are several data collection methods and ways to manage the inventory data.

The data derived from a well-planned and executed inventory would give decision makers key information for the management of this important piece of Wake Forest’s infrastructure. An inventory and it’s information, coupled with the services of a town arborist, would allow Wake Forest to be prepared for future tree management issues. Information collected in an inventory typically should cover species, size, quantity, location by street address, maintenance needs, serial number, presence of utilities, potential planting

spaces and condition rating. This information can help in making decisions about tree maintenance needs, hazardous tree situations and tree planting target areas.

A comprehensive urban tree inventory can be used as a valuable information tool for various and diverse groups of people. The core of this type of project can allow a community to begin to be proactive with the management of its community forest rather than just reacting and picking up the pieces that fall.

The hiring of a town arborist and a complete inventory of all town tree resources should be a major goal for the Town's Urban Forestry program in the immediate years to come.

Tree Inventory System Planning (Morgan, R.) is a method for obtaining and organizing information about the number, condition, and distribution of urban trees. Information that is accurate, accessible, and simple is one of the best tools for making planning and management decisions. With tree inventory information, program resources can be allocated appropriately among the various tree management functions, work can be scheduled for maximum efficiency, and financial decision-makers can evaluate various work plan proposals by comparing expected results with projected budgets.

Several inventory systems have been developed by cities, universities, extension services, and consulting firms. They range from quick inexpensive survey methods that provide basic information to sophisticated, computerized systems that are integrated with daily tree care activities. All inventories share the same general goal—to provide information about the nature of the urban forest. Most inventories have several objectives. The simplest systems might provide information to support the establishment of a tree care budget, start a community tree program, or at least, initiate a tree advisory board. At this level, the desired information may be as simple as three estimates: the total number of trees, their average condition, and their monetary value.

Computerized systems may be used to justify and prepare annual budgets, organize daily work assignments, keep records on individual trees, aid long-range planning, and support management analyses. These types of inventory systems link day-to-day operations with long-range planning.

Diversity or monoculture in tree species replacement will usually be an issue in most communities. Species diversity stabilizes the urban forest and tends to reduce losses due to harmful insects or disease. While having similar maintenance requirements is a primary consideration in species selection, large-scale monocultures should be avoided. Diversity also offers the adjacent property owners some individuality. Again, citizen involvement is valuable in developing the rotation plan.

Management planning for replacement trees must ensure the long-range maintenance for these replacement trees. Young trees require considerable care, such as watering, fertilizing, insect and disease control, and regularly scheduled pruning (see *Action Plan*). Any plan must ensure long-range maintenance to protect the investment of public funds in replanting. For example, scheduled trimming of young trees reduces the need for expensive corrective pruning of mature trees.

Additional Management Recommendations

Public Education & Awareness Programs – The town currently has several programs and projects in place that augment the dissemination of information pertaining to trees. *The Community Forester* newsletter is an excellent vehicle for communicating the town's position on tree-related matters. This newsletter could be used to publish parts of this plan to share with town residents as well as the continued use of the newsletter to inform residents of tree program activities.

The town is currently studying the development of a Web Page. This project would not only give residents another convenient source of information, but could also be used to facilitate tree work request, schedule chat forums, email newsletter subscriptions, provide tree links to other urban forestry and horticulture sites, town staff contact information, project updates, activity announcements and other sources to communicate the goals and objectives of the community forestry program.

The use of public television media can also be an effective and low cost way to project information about the program. Public service announcements about Arbor Day activities, tree care workshops and educational classes can be developed to communicate these programs.

The Town should of course continue to grow in the area of its Tree City USA designation. Wake Forest's status in this program is one of national significance as it is one of the older Tree City USA's in the country.

Tree Pruning Guidelines – Using the International Society of Arboriculture's *Tree Pruning Guidelines*, the town should develop a tree-pruning guide for residents, contractors, utility personnel and others who prune trees in town. Other guides are available through the US Forest Service, The National Arborists Association, The National Arbor Day Foundation and the NC State University Extension Service. The proper pruning of trees, especially young landscape trees, can be done by virtually anyone if proper training is available. A pruning guide could be a simple, low cost pamphlet funded by the Tree Board budget, USDA grant programs or perhaps a cooperative effort with the State Extension Service and/or the NC Urban Forest Council for use in any NC community. The town could oversee the distribution of the guide through: new resident information packets, mailings with town utility bills, Arbor Day activity events, the town's web page and other community events that the town government has sponsorship in.

Administration

The Town of Wake Forest municipal government is responsible for the day-to-day implementation of the town's community forestry program. This responsibility lies within the Planning, Public Works and Parks Maintenance departments. There is a shared responsibility between these departments with the town's Tree Board overseeing tree removal and planting activities. Additionally, the Tree Board organizes public awareness programs aimed at galvanizing residents of Wake Forest into volunteer planting projects, Arbor Day ceremonies, community tree workshops and other public awareness campaigns. The Tree Board functions as an advisory board to the Town. It makes recommendations concerning tree species, maintenance and public involvement and works actively with the Town Planning Department in researching grants and contributions and hearing property owner appeals.

There are a number of other groups and entities in Wake Forest and throughout the state, which could have an impact on the town's tree resource. The following known groups and clubs are potential sources for involvement in Wake Forest's forestry program:

American Legion	American Forests
NC Div.of Forest Resources	Community Council
National Arbor Day Foundation	Business Community
The National Tree Trust	Garden Clubs
Boy Scouts/Girl Scouts	Kiwanis Club
Daughters of the Am. Revolution	Jaycees
Fourth of July Committee	Masonic Lodge 282
Wake Forest Public Library	Optimist Club
Historic District Commission	Lions Club
NC Urban Forestry Council	Rotary Club
Keep America Beautiful	Tri-Area Ministries
N.Wake Senior Citizens Assoc.	Women's Club
Sons of Confederate Veterans	Wake Forest Singles
Wake Forest Cultural Arts	YMCA
Indian Princess Guide Program	

PART III

Action Plan & Activities

Tree Planting

In recent years the Town of Wake Forest has planted an average of 200 trees per year. As the town's growth accelerates with the growth of the greater Raleigh metropolitan area, the need for tree plantings will continue.

A goal of a community tree management plan is to create and promote diversity in a community's street tree population. When selecting trees for a specific site, architectural features of the neighborhood and scale of the surrounding buildings should be considered. Sizes, shapes, colors and forms of trees should compliment the surroundings. Trees that grow large and have large canopies are usually suited best near larger buildings and homes. In areas of smaller buildings and features, plant selection should reflect the building scale. When selecting trees and other plants, refer to the *American National Standards Institute* (ANSI) #Z60.1; American Standard for Nursery Stock. **Bid specifications for trees for street plantings should specify the height to which the tree should be free of branching. Height of branching should bear a relationship to the size and kind of tree, also, so that the crown of the tree will be in good balance with the trunk as the tree grows (ANSI Z60.1).**

Street trees do not have to fill all available spaces. Private properties landscaped with a variety of trees and shrubs between the home and street may not need more. Decisions on whether or not to plant in these spaces should be based on discussions with the town staff, tree board and the property owner.

Types of Planting Stock

Trees are available in several types of stock including: Bare Root, Container Grown, Balled and Burlapped (B & B), and Machine Transplants (Tree Spade). There are distinct advantages and disadvantages to each of these types of plant stock.

Bare Root trees are usually planted in the winter months. They are easy to handle and less costly than other types. This type of stock is generally used when smaller diameter trees (less than one inch caliper) are specified and can be planted immediately. Because the roots are "bare" they tend to dry out quickly and therefore adequate moisture must be present within the root system at all times. Bare root trees are relatively inexpensive to ship and should arrive packed in a moss type material to retain moisture.

Container grown trees are one of the most popular types of stock in the industry and are recommended for this project due to the limited growing area. Generally, the container trees have a higher cost than other types but the survival rates are often better due to the fact that all of the root system comes with tree. They are easy to handle, even the larger size containers can be handled with out the special equipment needed for balled and burlapped trees. The root system in container trees should be inspected carefully. Any circling roots could cause girdling problems later in the tree's life. If the tree has become to big for the container and the roots are circling or growing out of the container's drain holes, these roots should be pruned using sharp pruners and clean cuts. Container trees can be planted anytime of the year, but care should be taken when transporting them during hot weather to avoid excessive desiccation.

Balled and burlap (B & B) type stock is generally used for larger nursery trees (2 inch caliper and larger). B & B is less expensive than container stock but harder to handle than both bare root and containerized. Usually the trees are dug with the roots contained in the soil ball, which is held with burlap and a wire basket. Because of the large soil ball, the stock is extremely heavy and most of the time requires the use of heavy equipment (loaders, cranes, backhoe etc) to unload and plant. B & B trees should be planted while they are dormant.

Site Factors

Site factors that will affect placement include proximity to driveways, signs and intersections, clearance from overhead and underground utilities and placement of other trees. When necessary, the tree board should consult with a certified arborist or urban forester to determine if a tree might be a safety hazard. As a general rule, no tree should be planted within 35 feet of a major intersection. Other rules of thumb include no tree planting within 10 feet of a driveway, within 10 feet of a light pole or within 10 feet of a fireplug.

Handling Trees

Trees should be handled with great care during the transporting process. Protection from drying winds is a must, especially if green foliage is present. If desired, anti-desiccants may be applied to the foliage to help alleviate water loss through the leaves. It is also beneficial to water down the crown and root ball, and cover with a tarp before transporting.



The Wake Weekly/JIMMY ALLEN

A touch of red

Harold White, Kevin McGinley and Jason Hicks plant a row of cherry trees in the median of North Main Street in Wake Forest on March 19, giving the town a bit of the spring-time flair found in Washington, D.C. The tree plantings are part of the town's urban tree renewal. Twenty-one cherry trees were planted along the street that has been described as a park for walkers. In addition to the cherry trees, six ginkgo trees were planted along the street.

Proper Planting

Handle the tree by the root ball only. Do not lift or move the tree by the trunk as this may damage the root ball. The soil ball should remain moist at all times. If planting B & B stock, the wire basket may be used to lift the tree. Exercise care when loading trees into front-end loaders. Some sort of

padding on the tractor bucket edges will help in preventing damage to the tree's trunk and bark.

Preparing the Site

In cases where drainage may be a problem, considerations should be given to the addition of underground drains or planting on earthen berms.

Prepare the planting site by digging a hole at least two times the width of the root ball and approximately the same depth as the root ball height. The larger (width) the hole, the better chance the tree's roots will have in growing into the backfilled soil. It is important to keep in mind that root establishment on newly planted trees is critical to long term survival. Trees planted too deep may cause root problems, so ensure that the soil is firm at the bottom of the hole so that the tree does not settle. When planting bare rootstock, the hole only needs to be as deep as the root/trunk flare. Scarify the sides of the hole to loosen up the soil and allow for better root penetration into the existing soil.

Once the site has been prepared, you are ready to set the tree and backfill. Prune any dead, broken branches or circling roots with clean, sharp pruning tools. Carefully place the tree in the hole by lifting the root ball into place. Remove all twine, rope, wire, or other material circling the trunk. Trees with wire baskets should have the top rung removed. Fold any burlap back down into the hole. If synthetic bags or burlap is used, the entire bag must be removed. It is important that natural burlap be completely buried once it is rolled back into the hole. Exposed burlap above the soil line will draw moisture from the root area out into the atmosphere.

Backfill

When backfilling around the newly planted tree, it is usually best to use the existing native soil, which was taken from the hole. Amending the backfill has seldom proven to be beneficial, unless it is an extremely poor native soil. If amendments are used, they should be mixed into the soil evenly, at a rate of 40 - 50% added volume. Fertilizer should not be added or used as an amendment. If planting bare rootstock, set the tree and work the soil in among the roots so as to fill in all air pockets. The soil should support the roots, not compact them. Fill in around the root ball, but not

on top of the ball, itself. Using one foot, gently tamp the backfill mix and fill with remaining soil until full.

Next, construct a water basin around the root ball to facilitate directing water to the root area. Completely water in the new tree, and check for soil settling. If the tree settles below the original grade, raise the tree. For container and B&B stock, lift the root ball from beneath with the support of a shovel. Bare root trees can be gently lifted by the trunk to the desired height.

Staking

Although staking is a popular landscape practice, it is seldom needed. Trees, which are top heavy or in a high wind location, should be supported to prevent blowovers. Should you suspect the tree needs support, stake in the following manner:

Drive stakes into firm ground outside the root ball straight into the ground. The tie material should be 2" to 3" and encircle the trunk below the first branches. Although widely used, a wire inserted through a garden hose is not recommended. This can cause girdling of the trunk in windy situations. Keep in mind that support staking is temporary and should be removed as soon as the tree has established roots to hold it upright (no more than one year). If wind is not a problem and protective staking is desired, stakes can be placed around the tree with no ties around the trunk. Vandalism and equipment around trees may warrant this type of staking.

Tree Maintenance

Pruning- Many of the trees growing along the town's streets are in need of some pruning. Much of the recommended pruning on the larger trees is of a safety nature. All pruning and tree removal operations should comply with the *American National Standards Institute* (ANSI) #Z133.1 and #A300 standards. Pruning should be performed with the concept that it is a primary technique for preventing and reducing hazardous situations. All trees require periodic pruning. It is a practice that invigorates growth when done correctly. It improves plant health and appearance and helps form structure in young trees. It is in essence an efficient, conserving practice.

There are specific reasons to prune trees. Pruning is not some random maintenance practice that is done just for scheduling purposes. The reasons stated below are some examples of why we prune:

- Elimination of dead wood
- Removal of structurally unsound branches
- Reduction of wind resistance
- Reduction of weight in dense crowns
- Opening up of the plant to more sunlight
- Removal of interfering branches with structures or other branches.
- Utility pruning.

This list is not all-inclusive. Some pruning is done for plant size reduction, directional pruning, and fruit and flower production.

It is extremely important to prune trees in the way, which will result in the enhancement of the natural growth habit. Study trees in their natural form. See how they grow. Many conifers are pyramidal when young and become broad as they mature. Learn the different growth patterns of trees and prune to maintain these natural forms.

There are two types of pruning cuts:

1. Thinning or natural pruning which removes the branch at the union with the trunk.



Proper limb removal

2. Lateral or drop crotch pruning which is used to reduce the size of trees, to re-direct growth, or repair storm damaged trees. Trees, which have been “topped”, can also be restored to some extent by using drop crotch pruning cuts

Pruning Young Or Newly Planted Trees

The main objective in pruning young trees is to generate a branching framework for the tree to develop into a structurally sound plant. It is important to maintain a strong central leader in shade trees and prune to develop scaffold branches. That is, those branches which will be permanent, strong, and healthy. Be sure to prune so that half of the foliage remains on the lower two-thirds of the entire tree. This standard helps trunks develop taper which is important to the structure and future tree health.

First prune out any dead, diseased or broken branches or those branches, which grow from root sprouts or suckers. Next look to maintain six to ten inch spacing between the main scaffold branches. The branches, which are selected, should have strong crotches/unions. Remove any branches that have included bark. Maintain this scaffold spacing as the tree grows and matures.

On young and or newly planted trees **DO NOT**:

- Cut branches just to compensate for "root loss".
- Remove lower branches unless absolutely necessary.
- Prune newly planted trees until they are established, usually two to four years after planting (unless dead, broken, or diseased branches).

Five years after planting, lightly thin out the crown and maintain scaffold spacing. Continue this type of pruning every five years.

Pruning Standards

The main objective in pruning mature trees is to remove those portions of the tree, which are not contributing to the whole tree system. Pruning large, mature trees is specialized, professional work. Proper and adequate training is necessary.

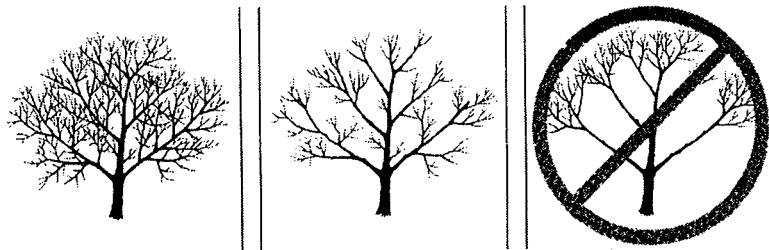
Ideally, mature trees should be pruned every four to six years depending upon the species' growth rate and the tree maintenance budget. At a minimum, hazardous limbs and trees should be removed for safety as soon as possible.

Thinning mature trees should be done judiciously where no more than twenty-five percent of the crown is removed at any one pruning cycle. The National Arborist Association (NAA) and the International Society of Arboriculture have established industry wide accepted sets of standards for different classes of pruning shade trees. In general they are:

Crown Cleaning is the removal of dead, dying, diseased, crowded, weakly attached, and low vigor branches and water sprouts for the tree crown.

Crown Thinning includes crown cleaning and the selective removal of branches to increase light penetration and air movement into the crown. Greater light and air movement stimulates and maintains interior foliage, which improves branch taper and strength. Thinning reduces the wind-sail effect of the crown and the weight of heavy limbs. Thinning the crown can emphasize the structural beauty of the trunk and branches, as well as improve the growth of plants beneath the tree by increasing the light penetration.

When thinning the crown of mature trees, no more than one -quarter of the foliage should be removed. At least one-half of the remaining foliage should grow from the branches that originate in the lower two-thirds of the tree. Removing laterals from a branch requires a similar approach.



Thinning

Gilman, Brown.

Try to retain inner laterals and leave the same distribution of foliage along the branch. Trees and branches pruned in this way have stress loads more evenly distributed. Removing the inside lateral branches also produces an effect known as “lion’s-tailing”. By removing all the inner foliage, weight is moved to the ends of the branches, which may cause the branch structure to weaken and limbs to break. Greater light penetration may cause sunburned branches and stimulate water sprouts.

Crown Reduction, also known as drop-crotching, decreases the height and spread of a tree. Thinning cuts will maintain the structural integrity and natural form of a tree, and delay the time when it will need to be pruned again.

Crown Restoration improves the structure and appearance of trees that have been topped or severely pruned using heading cuts. Select one to three main branch stubs that will grow to reform a more natural looking crown. Thinning or even heading may be required to match the weight of the new branches with the strength of their attachment. Restoration may require several prunings over a number of years.

Crown Raising provides clearance for buildings, vehicles, pedestrians, and vistas by removing lower branches. It is important to maintain at least one-half of the tree's foliage on branches that originate in the lower two-thirds of the crown. This ensures a well-formed, tapered structure and uniformly distributed stress load. When pruning for view, it is better to open "windows" through the foliage of the tree, rather than severely raising or reducing the crown.

Time of Year to Prune

If a hazardous situation exists, prune out hazards as soon as possible. If possible, avoid major pruning operations while trees are entering or leaving their dormancy period. Shade trees can be pruned anytime of the year. Summer flowering trees such as Japanese Pagodatree or Crape Myrtle should be pruned in late winter. Spring flowering trees should be pruned just after their bloom period. Evergreens can be pinched in spring to develop "bushier" growth habits.

Generally, pruning should be performed by trained personnel who have an understanding of basic tree biology. Pruning should be performed for a specific purpose (i.e., dead wood, hazard removal, structural training etc). If pruning is initiated when the tree is young, hazards can be controlled better as the tree matures. Don't flush cut branches. Don't top trees. Don't leave stubs. Don't injure the branch collar.

FERTILIZATION

Trees and other landscape plants need sixteen essential elements for healthy growth. They are divided into two groups based on the needed quantity for the plant. Macronutrients are those, which are needed, in larger

quantities. Those elements include: Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, and Sulfur. Micronutrients are those, which are needed, in small amounts. These elements include: Iron, Manganese, Boron, Copper, Zinc, Molybdenum, and Chlorine. Carbon, Hydrogen, and Oxygen are the other three elements needed and are found naturally in the air.

Soil pH is a measure of acidity or alkalinity. Ideal soil pH is in the 6.0 - 6.5 range. When soil pH is within this range, most of the essential elements become available to the plant for uptake. Some elements like iron and magnesium become "bound up" or unavailable when soil pH falls outside of this ideal range. Often this is the case when plants exhibit a chlorotic condition. The addition and incorporation of sulfur or lime to the soil area can raise or lower pH to the desired level.

Soil Samples

Because soil pH is so important, soil samples should be taken to determine what the pH level is and what elements are sufficient or insufficient. Based on the results of the soil samples, fertilizer practices and recommendations can be made. Sometimes soil pH is sufficient for nutrient availability and sufficient amounts of nutrients are present in the soil but the plant still exhibits low vigor. Nutrient uptake may be hindered by soil compaction, root damage, low oxygenated soils, or poor drainage. It is essential to correct the problems first (see problem/solution section). Because nitrogen is needed in large amounts, is easily leached from the soil, and easily used by plants, we usually focus our fertilizer efforts on the application of nitrogen products.

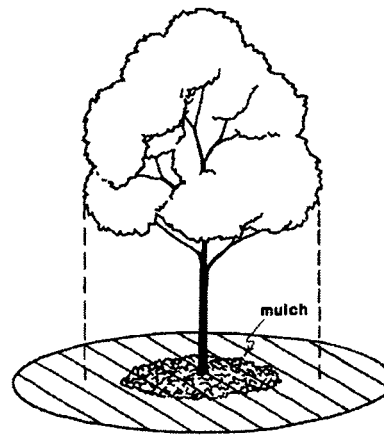
Time of Year to Fertilize

Winter and early spring are generally the best times of the year to apply fertilizer, but especially before new leaves emerge. If fertilizers are applied to the root zone in the winter, the roots will store these nutrients for spring leaf-out.

Avoid fertilizer applications in the hot summer months as this practice may burn foliage and if applied in the late summer, the fertilizer could cause a late flush of growth which may be susceptible to an early frost. It is best to wait one year after planting to fertilize new trees.

Application Methods

Surface Application - Fertilizer applied (usually granular forms) to the soil surface under the drip line of the tree. It is usually best to go out just beyond the drip line (fertilization zone) to cover roots in this area also. Do not use weed and feed type products under the drip line of desirable trees and other plants. Care must be taken not to overlap when applying.



Fertilization Zone

Gilman, Brown

If there is turf grass with the drip line area, most of the fertilizer will be used by the turf. If this is the case, the drill hole application may be more beneficial

Drill Hole Application - Holes are augured into the soil under the tree's drip line down to a depth of about twelve to eighteen inches. The fertilizer is then mixed with a carrier such as sand, peat moss, or compost and poured into the drilled holes. A two to four inch diameter auger is usually used to drill the holes. The holes should be drilled in a grid type pattern to cover the entire root zone area. The drill hole method puts the fertilizer in direct contact with the root zone as well as provides an aeration benefit.

Liquid Injection Application- Is beneficial in that soluble fertilizer is readily available for plant take up immediately. Special equipment is usually needed to deliver the solution out into the root area underground. Again, a grid type pattern is used to distribute the fertilizer evenly. Liquid

injections can also be done with the soil needle type injections. These applications are hose end type soil needles, which are hand pushed into the soil and soluble fertilizer, can be dissolved as water passes through a cartridge on top of the soil needle. Soil needles are relatively inexpensive, but more time consuming due to low water pressure. For small applications, this may be appropriate as it would not be advantageous for larger applications.

Foliar Spray Applications - This is a temporary quick fix that will supply nutrients for up take by the tree's leaves. Nitrogen or iron is usually applied for quick green up in instances where small amounts of fertilizer are needed. Spray equipment is needed to apply foliar fertilizers with pressure requirements of 100-200 psi. If foliage shows chlorotic conditions, a more permanent solution should be considered for long-term tree health.

Fertilizer Products

There are many kinds of fertilizer products and much of what determines which ones to use should be based on results of the soil sample test results. Certain products such as chelated iron are used to lower high pH soils in order for other elements to be available to the plant.

In general, slow release complete fertilizers are best because they allow elements to be released into the soil for the plant over an extended period of time. Again, depending upon soil test results, micronutrients may be beneficial for some soils, which are lacking in iron, zinc, boron, or magnesium.

Rates of application also vary depending on what is needed and application method. Some rates are based on pounds/foot of crown radius while others are based on pounds/square inch of tree trunk. It is paramount that label directions be followed strictly and that too much is not applied. This could be much more damaging than not fertilizing at all. General use fertilizers like 10-10-10 or 16-4-8 are usually sufficient, readily available and safe to apply.

MYCORRHIZAL FUNGI

Mycorrhizal fungi are an important part of plant growth in the natural environment. They provide an essential bridge between a plant's feeder roots and the soil surrounding the roots. Mycorrhiza means, "fungus-root" and works as a

partner with roots in the uptake of water and nutrients. In natural forest environments, mycorrhiza exists in abundance. However in urban and disturbed soils, they are virtually non-existent. The addition of mycorrhiza products into soils can be extremely beneficial for plant health and vigor. Products may be soil injected, combined with granular fertilizers, or applied sub-surface within the rhizosphere (root zone environment) of plant material.

WATER MANAGEMENT

Trees in forested areas are normally receiving adequate moisture from natural rainfall. Edge trees, specimen trees, and those in developed sites will probably require some supplemental watering in times of little or no rainfall. Soil moisture is an extremely important factor, especially when trying to establish newly planted trees.

Deciduous trees, if planted in the dormant season will need to be watered in at planting time. In most scenarios, this will be adequate until spring leaf out. Broadleaf evergreens and conifers continue to transpire and lose water throughout the winter months. Therefore, soil moisture needs to be monitored year round. Container grown nursery stock will tend to dry out quicker than B & B stock and must be considered in watering schedules.

In general, newly planted trees will need supplemental watering for the first one to two years after planting. To determine if a tree needs water, use the following " Ribbon" method:

1. Dig down four to six inches into the root area with your hand and collect a handful of soil.
2. With your thumb and index finger squeeze the soil by rolling your thumb over your index finger.
3. If the soil forms a ribbon on your thumb, the soil moisture is adequate. If the soil crumbles, water is needed and if water visibly squeezes from the soil, there may be too much soil moisture.

MULCHING PRACTICES

The use of organic mulch on trees provides many benefits. The most obvious benefits are:

- Moisture retention
- Weed suppression
- Aesthetic benefits
- Soil temperature modification (cooling effect)
- Removes competition from surrounding turf grasses
- Keeps equipment away from trunk/cambium
- Improves soil structure

Ideally, mulch should be applied over the root system of trees to a depth of two to four inches. This thickness should be maintained over the years by replenishing on an annual basis. As the root system expands outward radially, the mulch area should follow.

The type of material to be used for mulch should be decided upon based on availability, cost, ease of transport and application, and aesthetics. It is important to use organic materials in order to receive the benefits previously discussed.

PEST CONTROL

Monitoring of trees and shrubs is an extremely important practice in preventing and controlling pest problems. Both integrated pest management (IPM) and plant health care (PHC) programs stress the importance of the monitoring process. Maintaining plant vigor and keeping trees healthy keep pest problems kept to a minimum.

Pest population thresholds should be established to determine when treatments are necessary. By using an integrated approach (resistant varieties of plants, biological controls, botanical pesticides, cultural practices to improve and maintain vigor, and close monitoring programs) an environmentally sensitive pest control program can be established.

Poisonous chemicals should only be used when necessary and the old practice of blanket preventative sprays should be

seriously scrutinized. If town staff do not have the necessary diagnostic skills and equipment, the county extension service and the State Forestry Commission have local offices that can provide this information.

Pests are secondary problems by nature. Usually pests are attracted to trees with low vigor and under a state of stress. The root cause of the stress problem should be corrected for long-term solutions. Obviously, pest problems present on specimen trees will take higher priority than forest or natural area vegetation. Some things to look for in association with pest problems are:

- Actual physical presence of insects
- Stunted plant growth
- Wilted, curled, or distorted leaves
- Unusual leaf color
- Cracks or holes in bark and/or branches
- Mushrooms or other fruiting bodies
- Galls or other distorted twig growth patterns

Other Types of Tree Maintenance (Morgan, R)

Cabling and bracing is warranted only when special trees require such expensive measures to preserve their health or safety. A list of these trees should be established to dictate periodic inspections for possible repairs and adjustments.

Emergency treatments may be needed when mechanical damage occurs, as when bark is knocked off trees by vehicles or equipment. A Certified Arborist should prescribe treatments.

Aeration practices can help tree root growth and improve soil structure by creating pore spaces in the soil to supply roots with air as well as water. Some soils may start out well aerated, but through actions of pedestrians, vehicles, and even water, pore spaces are compressed. Soil compaction is far easier to prevent than it is to repair. Preventative measures include limiting pedestrian and vehicular access, and mulching exposed soil to minimize compaction caused by the impact of rain or irrigation water. If planting into a site with poor aeration, first rip or deep plow the soil, replace the soil with a suitable material, or try selecting trees with a tolerance for low oxygen soils.

Mechanical aeration is possible, but at best, it's a temporary solution. Physically separating soil particles merely buys time until the pore spaces cave in again. An auger or high-pressure water probe breaks up soil particles that have been pressed tightly together. Surface penetrations should be eight to ten inches deep, two to three feet apart and extend up to one-fourth of the radius beyond the drip line of the tree. Openings should be made away from the trunk and main roots to avoid injury to the tree. Aeration may also be improved by adding an organic mulch to the soil surface.

Tree Removals

Tree and stump removals are performed for several reasons. Tree inventory data can supply a set of criteria to guide tree removal decisions. Safety is probably the most important reason and considering public liability, this becomes ample justification for removing a tree. Trees could be removed to prevent the spread of disease, insects or vegetation that may be harmful to the environment. Finally, aesthetics may dictate removing a particular tree. Trees that have been severely topped over the course of a number of years or trees exposed to other drastic pruning practices may not be aesthetically pleasing to the community. When removing trees consider the following guidelines.

Stumps are defined as the lower portion of a tree - up to a maximum height of four feet - that remains after foliage, limbs, branches, and the upper part of the trunk have been cut off.

The stump removal area is generally between the sidewalk and the curb, or between the curb and the curb if growing in a median strip. For trees planted in an open space, the area of stump removal is that which causes the surface of the ground to be higher than the existing grade. Roots within the stump area should be taken out as deep as 24 inches below the finished grade. This is especially true of roots that are exposed at grade and those adjacent to or growing over a curb or sidewalk. All exposed surface roots beyond the stump area should be removed to a depth of 12 inches below grade. Soil that has been displaced by deeper roots should be leveled to the existing grade.

The hole or depression resulting from the removal work should be filled with topsoil. Do not use chips, leaves, brush, sawdust or tree debris as filler. This organic matter would eventually decompose allowing the soil to settle. Because any type of soil will settle a little over the first several months, additional soil of the same quality should be added. The entire area should be made level with the existing grade.

Cleanup involves removing all soil, leaves, twigs, or trash resulting from the work. Remove debris daily to approved disposal sites. Explore opportunities to utilize the waste wood for lumber, arts and crafts, firewood, mulch, or compost. Damage to property resulting from this work should be repaired within a reasonable time. Before starting work at a new site, survey the condition of the area, including adjacent properties. During cleanup, survey the area again to identify damage caused by tree work.

Tree Replacements

A street tree that is removed should be replaced within one year except in a case where it is advisable not to replant. In situations where the planting density is at a level that is optimal, replacement may not be needed, in fact it may help to not replant in these instances. A replacement tree should be biologically and architecturally appropriate for the planting site including size, shape and variety. Changes in adjacent landscaping or development or prevalent insect or disease problems may discourage replacing with the same species or cultivar.

Safety should be a major deciding factor in replacing street trees. Trees planted too close to roadways, intersections, fire hydrants, driveways, or signs should be avoided as it may create a hazard (see section on planting).

APPENDIX

Sample Job Description - Town Arborist

Town of Wake Forest Urban Forestry Program: Grant Assisted Projects (1991 - present)

Document: Preserving Trees During Construction (Morgan, Robin)

Champion/Historic Tree List

References

**JOB DESCRIPTION
TOWN ARBORIST**

JOB PURPOSE: This is highly responsible work in the management of Town tree programs and enforcement of Town Tree Ordinances.

CLASSIFICATION STANDARDS: The single position allocated to this class reports to the Town Planner and works under general supervision. The work in this class is distinguished from other classes by its emphasis on Urban Forestry and Horticultural projects. The incumbent will be responsible for the planting and maintenance of trees on Town property with a high degree of hands-on involvement.

ESSENTIAL JOB FUNCTIONS: Oversees the Town Urban Forestry Plan that establishes guidelines and requirements for the recognition and preservation of areas of forestation within the Town limits and annexation reserve area. Responsible for establishing and maintaining a streetscape plan with tree planting and maintenance guidelines for vehicular corridors.

Prepares an annual tree planting plan and directs the planning and prioritization of tree work within the Town.

Oversees the Urban Forestry Plan as well as the tree selection, placement, and planting in the Town Parks, right-of-ways and Greenbelt areas.

Reviews, revises and enforces, with the assistance of the Town Planning staff, the Tree and Landscape Ordinance in accordance with a current proven and effective Tree Ordinance.

Serves as liaison to Town departments in coordinating activities related to the Urban Forestry Plan and tree service work of the Town.

Establishes and maintains various records and files including data on the Town tree inventory, service requests and work histories.

Establishes and maintains effective working relationships with Town officials, co-workers, contractors, architects, engineers, commercial nurseries, state forestry officials, and the general public.

Works with appropriate utility companies to inspect sites to determine proper course of action for tree removal, trimming and protection.

Will inspect diseased and hazardous trees to identify the proper corrective action needed.

Refers to Town Ordinances, technical manuals, guidebooks, city maps, textbooks, and other documents in performing assigned job duties.

Will research and write, with the assistance of the Town staff, a City Tree Ordinance that will be separate from the existing Town of Wake Forest Tree Ordinance. Will staff a Tree Board that will facilitate with the "Tree City" Status and all other Forestry related items. \

OTHER JOB FUNCTIONS:

Plans and conducts public education programs on the Town's Tree Ordinance; provides information, explanations, and makes presentations to the public, and community groups.

Responds to emergency calls in circumstances of disasters, inclement weather, accidents and others requiring immediate action in removing trees and limbs.

Assists the Public Works Department and the Parks and Recreation Department in tree servicing, where required.

Provides Forestry education to the Town staff and citizenry.

Will work to coordinate the Town's Tree City USA status designation as well as to set up and be in charge of Arbor Day events.

Stays abreast of current nationwide trend and methods pertaining to trees.

Attends local, state and nationwide seminars and conventions for educational requirements associated with the various certifications required.

May attend meetings after regular business hours.

May require lifting and carrying objects of moderate weight.

Performs routine clerical duties including typing, copying and filing correspondence, memos and forms.

MINIMUM QUALIFICATIONS:

Graduation from an accredited four year college or university with major course work in urban forestry, landscape architecture, horticulture or a closely related field and one (1) year experience in Urban Forestry, or an equivalent combination of education and experience.

SPECIAL REQUISITES: Valid Motor Vehicle Operator's License. A Pesticide Applicator Certification License is required within 6 months of employment and incumbent must maintain that certification throughout employment with the Town of Wake Forest. Must be willing to become certified as an arborist with the International Society of Arboriculture (ISA) within one (1) year of employment.

SELECTION FACTORS:

Knowledge of municipal and state Urban Forestry plans.

Knowledge of basic pesticide storage and usage.

Thorough knowledge of laws, ordinances, regulations, and statutes governing trees and forestry.

Ability to communicate effectively, both orally and in writing.

Ability to develop long-term programs and to evaluate work accomplishments.

Ability to plan, direct and supervise the work of others.

Ability to make effective presentations in a group or individual setting.

Ability to work effectively with elected officials, department heads, representatives of other agencies, Town employees, contractors, architects, engineers, and the public.

Town of Wake Forest Urban Forestry Program: Grant Assisted Projects (1991 - present)

<u>Year</u>	<u>Grant Description</u>	<u>Tree Planting Location(s)</u>	<u>Amount</u>
2000	Adoption of the Community Tree Management Plan	N/A	\$9,835.00
1999	20 th Consecutive Tree City USA Celebration which included a Series of events, Arbor Day Ceremony, Workshops, tree plantings, etc.	Wake Forest Town Hall	\$6,900.00
1998	Production of "An Illustrated Guide to the Landscape Standards of the Wake Forest Zoning Ordinance." A user friendly set of Regulations to ensure that the ordinance is easier to understand and useful to citizens and the development of the community.	N/A	\$10,000.00
1997	Phase 3 of a community-wide reforestation/beautification effort designed to promote volunteerism and to educate the public about good urban forestry practices.	Historic Forestville Area	\$10,000.00
1996	Phase 2B of a community-wide reforestation/beautification effort designed to promote volunteerism and to educate the public about good urban forestry practices.	Northeast area of Town	\$8,000.00
1995	Phase 2 of a community-wide reforestation/beautification effort designed to promote volunteerism and to educate the public about good urban forestry practices.	Northeast area of Town	\$10,000.00
1994	Master planning and initial planting phase of a community wide planting program that will enhance the tree cover of the Town's older neighborhoods and provide educational information to area residents to ensure the urban forest's long-term care and maintenance.	Mill Village Area	\$7,834.00
1993	Downtown Wake Forest Beautification Plan	Wake Forest Downtown	\$11,114.00
1992	A partnership between the Town and the WF-Rolesville Highschool and Middle School in designing, planting, maintaining, and studying landscaping.	N/A	\$6,940.00
1991	Tree plantings at Wake Forest Parks	Tyler Run Park & Ailey Young Park	\$32,640.00

PRESERVING TREES DURING CONSTRUCTION (Morgan, R.)

Mature trees provide many benefits to development sites. They enhance the aesthetic character of the area, give scale to the new buildings, provide shade, give a look of maturity to the landscape, and provide habitat to wildlife. It may be possible to retain trees with minimum forethought. However, preserving specimens that will survive and perform well in the new environment requires thorough planning, careful implementation, and adequate maintenance.

Effective tree protection is a long process. First, evaluate the trees to determine which specimens are suitable for preservation. Next, work with the planners and engineers to design improvements so those suitable trees are preserved. Then, monitor construction around the trees to see that the trees are not injured. Finally, routinely evaluate the trees to identify maintenance needs.

Identifying trees to be protected

Deciding which trees to preserve and designing development around them often seems like a "chicken or the egg" problem. The trees suitable for preservation must be identified before designing around them. On the other hand, the design strongly influences the selection of trees to be preserved.

One way out of this dilemma involves a preliminary evaluation of the trees to determine those that are suitable for preservation. Compare that information with conceptual site plans. Identify the trees suitable for saving, and modify the site plan to accommodate the desirable trees. Finally, work out the details of grading and preservation for trees that will remain.

In most cases the costs to preserve trees are significant. Costs accrue because the land dedicated for tree preservation is unavailable for building, structures, and techniques to minimize damage to trees require extra design and construction attention, and affected trees must be maintained to support long-term health. These costs will be borne by the public, whether through increased taxes to pay for trees in public rights-of-way, higher homeowner association dues, greater commercial rents, higher home prices or direct payment for maintenance. Trees should be selected carefully, keeping their value and contribution to the new environment in mind.

In determining which trees are to be preserved, four factors must be considered:

1. Suitability of the species to the new land use
2. Tree health and structural stability
3. Species tolerance to changes in environment
4. Level of maintenance that will be provided following impact

Species suitability

The suitability of the species to the location and use of the site are important factors in determining whether to save a tree or not. For example, species that normally grow along streams, such as willow and alder, would perform poorly in a parking lot.

The tree should survive in the new landscape for a considerable length of time to warrant the cost and effort of protection. Oaks that can be expected survive for many decades have a greater value than a mature acacia that many only live for a few years.

Tree health

Young, vigorous, healthy trees are the best candidates for protection, because they grow new tissue quickly and adapt readily to new environments. However, it is large, old trees that are most often the focus of preservation. Of course, it is possible to preserve old trees as long as they are healthy, but younger ones may give the best return on investment.

Vigorous trees usually have full canopies and healthy leaves. Three conditions indicate poor tree health:

1. Leaves are small and pale for the species
2. Some of the branches are dead
3. Most of the foliage arises from short twigs along the major limbs known as epicorm growth

Trees with large cavities or other structural weaknesses are not good candidates for preservation, unless pruning, cabling or bracing can alleviate the problems.

Tolerance to changes in environment

The ability of the tree to tolerate injury and changes in the environment is another important factor to consider. Trees that regenerate roots quickly and have adaptations to control water loss seem to be better able to tolerate construction impacts.

Environmental changes can cause tree decline even when the tree is not directly injured. Significant changes in water table levels or rechannelization of streams or runoff can seriously weaken or kill trees. Road fills placed over streambeds can raise water levels upstream. It is important to consider large-scale alterations in the overall ecology of the area, as well as the specific changes that will occur next to trees.

Trees stressed by construction require considerable maintenance to prevent loss of vigor and attack by harmful insects and diseases. Irrigation, fertilization, pest and disease control, and pruning are all aspects of this maintenance.

Responsibilities for maintenance of affected trees should be established early in the planning phase. If the trees will not be maintained, it is important to minimize stresses to the trees that would affect tree health.

PREPARING A TREE LOCATION MAP

A tree location map is critical to successful preservation. Use a topographic map showing vegetation lines as a base. Early in the design, process locates the trunks approximately. Later, the engineer's survey can pinpoint the locations and show the base elevation of the trunks. The engineer should project the centerline of the tree when plotting locations. An indication of the drip line for each tree would also be helpful. On 20-scale or larger maps, plot the circumference of the trunk for larger trees.

Be sure that the tree locations show on all building site plans. Number the trees on the map so that all discussions address specific trees. It is helpful to have a corresponding numbered tag attached to the tree, as well.

ASSESSING POTENTIAL IMPACTS TO TREES

Evaluate the development plans around the trees to estimate the potential impact. This requires skill in reading plans and understanding of construction procedures. The following plans and specifications should be reviewed:

1. Topography and tree survey plan
2. Grading plan and specifications
3. Plot or development plan
4. Utilities placement and depth
5. Drainage plan
6. Geotechnical survey

The plans will provide information on the depth of cuts, fills, utilities, subdrains, and other excavations, as well as their distance from trees. The geotechnical survey describes the soil profile. It also specifies the compaction and over-excavation required under structures, pavements and fills.

To better visualize the changes that will occur next to trees, draw cross-sectional views showing existing and future grades, and all improvements. Based on the geotechnical requirements, the amount of soil work could also be estimated and recorded on the drawing.

SOIL ALTERATIONS DURING CONSTRUCTION

Soil favorable for root growth is a mixture of mineral particles, organic matter, air, and water. About half of the volume of the soil is pore space containing varying amounts of water and air. To soil engineers pore spaces are known as voids. Although an asset to plant growth, voids reduce a soil's values as structural material. To stabilize the soil, engineers compact it to remove as many of the void as possible.

Compacting soils for construction involves removing the soil to a specified depth, mixing the soil with water, and replacing the soil in thin lifts (usually six to eight inches thick). Heavy equipment, designed to maximize the compaction, drives repeatedly over each lift. This activity hurts tree roots by first cutting them, and then by breaking down the soil structure.

LOCATION OF TREE ROOTS

To protect tree roots from damage, it is important to know where to look for them. Although root systems are often depicted as mirror images of the tops, they usually cover a much larger area. Roots can extend far beyond the drip line, as much as two to three times the diameter of the crown. The major portion of the absorbing roots system of a mature tree is within the top three feet of soil, and most of the fine roots that arise from larger horizontal roots near the trunk of the tree. Sinker roots aid in water and nutrient absorption from deeper layers aerated soil during times of drought.

Root patterns also are affected by topography and characteristics of the soil of substrate. Trees on slopes tend to have more roots on the downhill side. Roots of trees along streams will parallel the bank.

Developing a site is seldom possible without hurting tree roots to some extent. Even preliminary grading, stripping the site of debris and organic laden topsoil, can cause significant root damage. It is commonly thought that a healthy tree tolerates removal of one-third of its roots. Most guidelines for tree preservation advise holding construction and grading outside of the drip line. However, based on a typical root structure, even that restriction could lead to removal of over the roots of half the tree. As land value rise, there is more pressure to encroach within the drip line to gain usable space.

Several variables affect a tree's ability to tolerate encroachment, including the health, species, root structure, and environmental factors. The type of construction that will occur and how it will be executed are equally important factors. For example, construction of a concrete sidewalk on natural grade requires about six inches of excavation. This would cause less injury than an asphalt road requiring at least twelve inches of excavation. A road with water and sewer improvements along the curb—usually in trenches four to six feet deep—must be held farther away from trees than one with on improvements.

Of work must be done close to trees, extra care can minimize the damage. For example, lowering the grade two feet at a distance fifteen feet from the trunk of a tree that forms sinker roots may be possible. But it would require that the excavation be done by hand and the roots cut clearly with a saw, rather than with equipment that rips and shatters roots.

Evaluating the potential of trees to survive and adapt to the new environment must be made on a tree-by-tree basis. The evaluation involves estimating the percentage of root loss, the potential of the tree to tolerate immediate water stress, and the ability of the tree to produce new roots.

TREE PRESERVATION TECHNIQUES

PRESERVING TREES IN GROUPS

Whenever possible, preserve trees in-groups so that relatively large areas can be set aside of native vegetation. These areas serve as green belts or open space. In forest situations the amount of thinning the trees will tolerate depends on the size, age, and species present. Mixed forest stands, which contain conifers and hardwoods of different ages and sizes, should be preserved in large blocks (at least 60 feet wide). On the other hand, single oaks growing in the open can often be preserved effectively.

If only a small amount of land can be dedicated to tree preservation, it may be better to allot a larger area around the few best specimens than to attempt saving a greater number of trees that would sustain heavy damage.

SITE PREPARATION AND CLEARING SPECIFICATIONS

Clearly, identify the trees to be preserved on all plans. Flag and fence them in the field. When next to trees that will remain, trees to be removed should be cut rather than pushed over with equipment. This avoids possible root damage to remaining trees.



Tree Protection Zone

Specify no stripping of topsoil or grubbing of understory in tree preservation zones.

Locate storage for equipment and materials, access roads to the site, and traffic patterns within the site well away from trees to avoid unnecessary root injury and soil compaction. These areas should be identified on the site plans.

PROTECTING TREES FROM FILL

Few trees can tolerate having filled soil placed over their trunks. Furthermore, the soil work involved in placing a fill causes root damage and creates an environment unfavorable for new root development. The following treatments can minimize adverse effects of fill:

Hold fill away from the tree with a retaining wall designed with a discontinuous footing. Unless the fill will support a structure, ask the soil engineer to specify the minimum soil compaction (usually about 85%). If fill will be imported, provide specifications for the chemical characteristics of the soil, so those trees will not be harmed by toxic conditions, such as high salts. Engineering specifications usually cover only the physical properties of the soil. For fill covering large portions of the roots, consider installing an aeration system on natural grade before placing the fill. If the potential for soil subsidence is a problem, air vents can be installed through the fill into natural grade after construction is completed.

LOWERING THE GRADE

Obviously, root damage occurs when soil is stripped away to lower the grade. Here are a few ways to minimize the damage that occurs:

Keep cuts as far from trees as possible by installing retaining walls. If the cut is greater than three feet, a continuous footing can be used because few roots are encountered below that depth. For shallow cuts, use discontinuous footings to minimize root injury. Excavate by hand at the cut face, cutting the exposed roots cleanly with a saw. Once the trench has been dug to the depth of the finish grade a backhoe can be used to pull away the soil. The backhoe should sit outside the drip line and remove the soil to finish grade.

PAVING

Paving inflicts more extension root damage than might be expected. Because it is often considered a structure, pavement requires soil compaction similar to buildings. Excavation must be deep enough to accommodate the compacted sub grade, the base material, and the pavement itself. To minimize damage caused by paving:

Maintain an area of several feet around the base of the trunk free of all pavements. Mulch the soil surface.

Use paving materials that allow water to penetrate, such as interlocking bricks on sand, where possible over the root zone of trees. Avoid excavation into the root zone by placing base material and pavement on natural grade, making the level of the pavement higher than the tree flair. Make sure water will not collect in the well surrounding the tree. Install aeration vents in impervious pavement.

UTILITIES AND STREET IMPROVEMENTS

Underground utilities are often overlooked as a possible cause of root injury. Water and sewer main lines are usually placed just inside the curb and gutter during road construction.

Depth requirements vary, but four to six feet deep is typical. Contractors connect buildings to utility lines and take the shortest and straightest path, unless otherwise instructed. These connections are usually placed in trenches three feet deep. Consider the following methods to minimize damage from installation utilities:

Place notices on tree protection fences informing workers to prevent encroachment by routing all trenches around trees. Trench by hand when digging close to trees, so the woody roots can be bridged, or tunnel under tree roots.
Curve trenches for street improvements towards the middle of the road or move them to the other side of the street.

POST-CONSTRUCTION SITE REASSESSMENT

Once construction is complete and the site clean, the tree care professional begins to direct maintenance. Others chose the remaining trees in the development process, and the reasons for selecting them may not be known. If protection measures were applied, they may be hidden. Therefore, before post-construction maintenance can begin, the tree care professional must re-assess the condition of the site.

Begin by determining the condition of the trees and sites. Safety, value to the property, and the changes of remaining vigorous are all factors worth considering. The maintenance prescription should compensate for construction damage, restricting surfaces, impacts of fill, and interference with the trees.

Trees stressed by construction must be carefully maintained to avoid loss of vigor or attack by harmful insects and diseases. They require special attention to irrigation, fertilization, pruning, and pest control. In extreme cases, improper preservation techniques or severe construction damage could prompt heavy pruning—or even removal of the whole tree. To determine the need for and the practicality of restoring a site severely changed by construction, the tree manager should draw on information from building plans as well as the designers and contractors involved in construction.

Damage or modification to the aboveground portion of the trees is easy to detect. Impacts to the roots and soil are more common, but generally difficult to uncover. These impacts are too often overlooked. Be sure to consider all factors affecting tree health, before developing maintenance.

TECHNICAL VS VALUE DECISION

Tree management frequently offers several alternatives for action, and weighing them can be difficult. The dilemma often arises from trying to balance two types of considerations. Some factors can be measured, such as size, shape, condition, health, and cost. Others are intangible values, such as beauty, history, attitude, and aesthetics. Urban forestry professionals often find themselves balancing tangible factors against intangible ones. For example, preserving existing trees during development must often be compared to the value of the trees and their changes of surviving construction. Communities often require a developer to spend hundreds of dollars preserving a tree that becomes damaged. It is worth

less than the cost to preserve it, and then it dies a year or two after the project is completed. There is no formula for arriving at the best solution. Only professional judgment honed by experience and tempered with public input, can make these decisions.

LIABILITY

Trees pose some unique liability problems. While most trees cause few problems, there are occasions where problems can be significant and should be avoided if possible. Liability problems can be best avoided by clearly assigning responsibility for a tree's care. Visual clearance for traffic signals must be maintained. Dead wood or hazardous trees on public property must be removed. And, property damage resulting from trees such as broken sidewalks must be repaired.

Scheduled tree maintenance programs limit liability to some extent by minimizing the number of dangerous situations that develop. Such a program can also maximize the benefits from trees by educating people, regulating tree care activities, and providing some central organization to undertake this task.

A number of communities have attempted to pass liability for trees to adjacent property owners, while the stated purpose of this action is to eliminate the community's ability for trees, it cannot be accomplished in this manner. At most, the property owner shares liability with the local government.

COORDINATION

As a community resource, trees may come under the jurisdiction of various groups. Although often overlooked, one task for urban forestry programs is coordinating the activities of others. Coordination is needed in three situations: public/public, public/private, and private/private.

Public/public-Any public tree care agency is regularly faced with adverse effects from other public agencies who have responsibilities for things such as sewer systems, street right of ways, and overhead utility lines. This is also true of different departments within the same public agency. Lack of attention to the work of others can be so damaging that it may outweigh the good work done by the urban forestry program. It is essential that one department coordinate all tree-related activities on public property, if the tree resources are to be protected. Since the tree care programs in most areas suffer from a lack of funds, it helps to establish good informal working relationships with other groups. In one city, the department of public works, which removed a number of trees in order to widen a city street, decided to replant new trees as part of the project. They did this based solely on the encouragement of the forestry department. The neighborhood was delighted with the result.

Public/private- this is probably the most typical situations many municipalities. Coordination often comes in the form of a permit system. Any tree work, such as pruning, planting, and applying pesticides, requires a permit. Such a system coordinates the activities of homeowners, businesses, tree care contractors, utility companies, and developers. Some cities even extend this regulation to private property by requiring a permit to remove any

tree over a certain size, usually four to six inches diameter. Since it affects the largest percentage of the urban forest, public/private coordination will have the greatest benefits.

Private/private-This type of effort addresses what private property owners do their trees. It is difficult to play as direct a role as in the previous two examples, but it still worth considering. Private/private coordination fills the remaining pieces of the urban forest, and allows a comprehensive approach to management.



Private Tree Maintenance

Public education campaigns can stress the value of trees to the community, their contribution to property values, environmental benefits, and economic contributions. Other topics could be more technical: proper tree care procedures, choosing a reputable tree care company, and minimizing the liability.

This role is more “facilitation” than the direct regulation or coordination mentioned earlier. Either a public agency or a private non-profit group, such as Tree People in Los Angeles, California, could play this role. A number of communities in British Columbia, Oregon, Washington, and California cultivate community spirit to encourage private individuals to preserve historic and otherwise significant trees.

Remember that maintaining and preserving the urban forest for future generations is a big job—more than one person can do alone. Success will require cooperation and coordination among many people. The more people involved the more successful the effort will be.

Champion/Historic Trees in Wake Forest, North Carolina

1. Willow Oak, *Quercus phellos* – Champion/Historic
607 N. Main St.
Elizabeth Holden
2. Water Oaks, *Quercus nigra* – Historical
S.E. Seminary
318 Durham Rd.
Southeastern Baptist Theological Seminary
3. White Oak, *Quercus alba* – Historical
531 S. Main St.
David M. Smoot
4. Pecan, *Carya illinoensis* – Historical
531 S. Main St.
David M. Smoot
5. Redcedar, *Juniperus virginiana* – Historical, Landmark
Wake Forest College Birthplace
Susan Brinkly, Wake Forest Birthplace Museum
Wake Forest College Birthplace Museum
6. White Oak, *Quercus alba* – Meritorious
4140 Burlington Mill Rd.
C. Roland Young
7. Tree of Heaven, *Ailanthus sp.* – Champion
725 Mill St.
Amy Pierce
8. White Oak, *Quercus alba* – Champion
546 N. Main St.
Elizabeth and Robert Ford
9. Southern Magnolia, *Magnolia grandiflora* – Historical
S.E. Seminary Campus
318 Durham Rd.
SE Baptist Theological Seminary
10. Ginkgo, *Ginkgo biloba* – Historical
546 N. Main St.
Elizabeth and Robert Ford

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