City of High Point

Urban Forest Management Plan

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"Creating Sustainability in the Urban Forest"

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Background and Purpose

The desire to improve current urban forestry program activities and encourage more tree-planting within the High Point Core City area has created much interest. This has in turn motivated the City to seek an analysis of its urban forest and urban forestry management program and develop a professional management plan to protect and enhance this resource. As in many American communities, city leaders and urban forest stakeholders in High Point question whether or not the current governmental structure, organizational values, and municipal resources are sufficient to support the rational and effective management of the urban forest. Therefore, the City of High Point has taken the proactive step of creating an Urban Forest Management Plan. This Plan intends to provide strategies, goals, policies, standards, and actions to protect, enhance, expand, and preserve the tree canopy for the benefit of the community. The Plan will help coordinate and improve the City's tree management in an equitable, economic and sustainable manner. Moreover, the Plan will be a valuable strategic planning tool and serve as a road map in recovering the loss of tree canopy. This Plan was systematically developed by a comprehensive review of existing City specifications and standards, analyzing inventory data and field observations, and by applying national arboricultural standards and best management practices. This is a customized Urban Forest Management Plan for the High Point Core City area based on local conditions, resources and priorities.

Vision

The High Point Urban Forest Management Plan is both a current management document and a long-term planning tool. Initially, the Plan will help coordinate and improve the Core City's tree management actions in an equitable, efficient and sustainable manner and focus on applying current arboricultural standards and practices to municipal tree care and planting efforts. In the long-term, the Plan will be a valuable strategic planning tool, serving as a road map to guide the growth and progress of the Core City's comprehensive urban forest management program.

The Urban Forest Management Plan takes its vision, in part, from the 2006 City of High Point *Guidelines and Standard Practices for Trees*, Core City Master Tree Planting Plan (derived from the recent inventory) and 2011 Work Plan for the High Point Urban Forestry Committee. All of the documents reflect the City's desire to retain a high quality of life by focusing on actions to increase the benefits and values of trees, and to improve the responsible management of High Point's urban forest. The Urban Forestry Committee, City staff, elected officials and citizens have this vision for the future of the City's urban forest:

Urban Forest Management Plan Vision Statement

The High Point Core City area will have a safe, healthy and diverse tree canopy by promoting tree preservation and planting within the City. With the use of professional urban forestry leadership and staff, appropriate policies, efficient management of City resources and public education and support, the City's future urban forest will be viewed as an important community asset. It will support and benefit all citywide programs, goals and mandates and the citizen's well-being. The urban forest will uniquely define the Core City's character and be a major factor in its continued livability.

Major Goals

The overarching goals of High Point's Urban Forest Management Plan are to guide the Core City's efforts to recover the loss of tree canopy and enhance all tree-related benefits by recommending strategies and actions to improve the City's urban forest management in an equitable, economic and sustainable manner. The Urban Forest Management Plan will achieve its goals by recommending strategies, goals, policies, standards and actions to protect, enhance, expand and preserve the tree canopy for the benefit of the community.

Through input from City staff and a detailed analysis of urban forestry conditions, five management goals emerged as priorities for High Point's Core City area:

1. Tree Planting and Increased Forest Canopy Cover

The lack of new and replacement tree planting on public and private properties in the Core City area will result in decreased forest canopy cover. Without an adequate canopy cover, this area of the City will not realize the many tangible and intangible benefits trees provide, and the character of the community will suffer.

2. Improved Tree Planting/Protection Policies

The City should review and improve ordinances, guidelines and policies regarding tree planting and tree and forest protection, and create or enact new policies as needed. These policies will serve as an official statement by the City regarding the importance and value of trees in the community.

3. Expanded Education and Public Relations

Citizens, businesses, City staff and leaders and developers need continued education and marketing targeted to increase their awareness of the benefits of trees. They need to be aware of the availability of City resources and the various ways they can become more involved in the urban forest management program and be a part of the solution.

4. Improved Funding

Critical to the program's success is adequate funding.

5. Improved Urban Forest Maintenance

Proper and timely tree maintenance is required to maximize tree benefits, increase service life, improve aesthetics and ensure public safety. Maintenance programs are critical to the survival, vitality and growth of existing trees and of newly planted trees.

Major Recommendations

The Urban Forest Management Plan presents recommendations in each major goal area and outlines programs and procedures for achieving success on small and large task items. The major recommendations for reaching the City's goals include:

1. Achieve an overall tree canopy cover of 40% by a combination of updating and implementing the High Point Core City Master Tree Planting Plan, revising current

policies, enacting new policies, creating incentives for private property owners to plant trees on private properties and ensuring there is adequate funding for tree planting and maintenance.

2. Improve City tree planting/protection policies by reviewing and amending, as needed, the City's existing development-related ordinances and guidelines.
3. Continue public and citizen urban forestry outreach efforts and create an educational program for elected officials and City employees. Market the urban forestry program with regular presentations at conferences and to local groups.
4. Support and seek new public and private funding sources to support a comprehensive urban forestry program.
5. Implement and expand various tree maintenance programs and conduct a complete public tree inventory every ten years using a tree data software program to manage the data. Train employees and use current and accepted best management practices and arboricultural standards.

Implementation

The recommendations made in this Plan are intended to be considered and implemented over a period of ten years. The results of the Plan's implementation, in relation to the overarching goal and final measurable result of achieving an average of 40% canopy cover for the Core City area, may take 20 years or more.

Trees are long-lived organisms. Planting trees today will provide benefits for future generations of City citizens. However, by having systematic tree planting and maintenance programs in place, and by having adequate funding, staffing, regulations and public education resources today, the future public tree population and overall urban forest will be expanded and sustainable. Using the analysis and recommendations of the Plan, the City's rights-of-way, parks, greenways and other public properties can be planted to increase canopy cover. New and existing residential and commercial developments can be required and encouraged to plant more trees. Using computer modeling programs, tree planting efforts can be measured to predict the levels of canopy cover in various areas. An acre of newly planted oak trees will not have a large collective canopy now, but in 20 years the change can be dramatic.

Benefits

High Point's urban forest is a municipal asset that appreciates over time because it is alive and growing, providing tangible and intangible benefits to the City and its citizens. Because of its significance to the environmental, social and economic well-being of the City, the urban forest should be professionally managed and protected to preserve trees now for all citizens and to expand canopy cover for future citizens.

1.0 Introduction

Municipal governments across the country have begun to understand the importance of their role in the proper management, control and protection of the natural environment. They now realize that in addition to serving the community by providing economic development, public safety, social services and other basic municipal programs, elected officials and municipal staff are now being challenged, and even mandated by state and federal government, to take the lead in solving

the problems of air pollution, water quality, storm water control, solid waste disposal, wildlife protection and other environmental issues.

The City of High Point realizes it must respond to a growing list of environmental concerns to protect the quality of life in their community while simultaneously ensuring growth and complying with environmental regulations. The urban forest within High Point may have once been considered only an aesthetic resource, but can now be looked to as a major component in the City's plan to comply with environmental regulations with continued development, and maintain a high quality of life. The City's 2011 Work Plan for the High Point Urban Forestry Committee contains several references to preserving and enhancing the community forest in High Point, including the recently conducted tree inventory from which the Core City Master Tree Planting Plan was developed. This comprehensive tree plan was developed in order to provide details for new tree plantings, with recommendations for streets and parks in the Core City area.

The desire to have an established tree planting program has created much interest and has further motivated the City to seek an updated analysis of its urban forest and urban forestry management program and develop a professional management plan to protect and enhance this resource. As in many American communities, city leaders and urban forest stakeholders in High Point question whether or not the current governmental structure, organizational values and municipal resources are sufficient to support the rational and effective management of the urban forest. Therefore, the City of High Point has taken the proactive step of creating an Urban Forest Management Plan. This Plan intends to provide strategies, goals, policies, standards and actions to protect, enhance, expand and preserve the tree canopy for the benefit of the community. The Plan will help coordinate and improve the City's tree management in an equitable, economic and sustainable manner. Moreover, the Plan will be a valuable strategic planning tool and serve as a road map in recovering the loss of and expanding the existing tree canopy. Definitions of many terms used within this Plan are found in Appendix A.

With initial professional guidance and assistance from Treefull Communities, LLC in developing the Plan, High Point's Urban Forestry Committee, City staff, elected officials and citizens should work together to facilitate the Plan. A summary of the objectives designed to reach the City's goals for facilitation of this Plan includes:

1. Review and update the City's current urban forestry data, planning policies, development regulations, construction standards, master tree plans and other useful documents and information.
2. Perform on-site surveys of public trees on streets, in parks, and other areas as needed or directed.
3. Conduct interviews with City personnel, elected officials, various commission members and other key stakeholders.

The recommendations made in this Plan are based on Urban Forest Best Management Practices and current arboricultural standards.

The urban forest, as a municipal asset, is as important to High Point's economic and political viability as are water and sewage facilities, transportation systems and community support

services. The quality and availability of all these assets are indicators of High Point's ability to encourage people to live and support businesses to prosper within the City limits.

The value of High Point's public and private urban forest can be calculated using several models and methodologies. All would indicate that trees provide significant benefits to the City's residents. Beyond simply dollars and cents, the City should increase and be actively engaged in urban forest management and public education for both philosophical and practical reasons. Like other cities, High Point is challenged to quickly dispel the persistent belief held by citizens, developers and staff that the City exists separate from nature rather than within it, and that the hillsides, forests and streams are individual features rather than a connected ecosystem. This belief has had enormous consequences for how High Point has developed thus far, and changes in this attitude will positively affect how the City plans its future; designs and builds roads, neighborhoods and commercial areas; addresses regulated environmental issues; and ultimately manages the urban forest. High Point's Urban Forest Management Plan is a starting point and guide for viewing and using the urban forest to accomplish the many goals of recent planning efforts, to secure a better future, and to maintain the charm, history and livability that are hallmarks of the Core City area.

1.1 Vision Statement of the Urban Forest Management Plan

High Point's Urban Forest Management Plan is both a current management document and a long-term planning tool. Initially, the Plan will help coordinate and improve the City's tree management actions in an equitable, efficient and sustainable manner and focus on applying current arboricultural standards and practices to municipal tree care and planting efforts. In the long term, the Plan will be a valuable strategic planning tool, serving as a road map to guide the growth and progress of the City's comprehensive urban forest management program.

The Urban Forest Management Plan takes its vision, in part, from the 2006 City of High Point *Guidelines and Standard Practices for Trees*, Core City Master Tree Planting Plan (derived from the recent inventory) and 2011 Work Plan for the High Point Urban Forestry Committee. All of the documents reflect the City's desire to retain a high quality of life by focusing on actions to increase the benefits and values of trees and to improve the responsible management of High Point's urban forest. The Urban Forestry Committee, City staff, elected officials and citizens have this vision for the future of the City's urban forest:

Urban Forest Management Plan Vision Statement

- The City of High Point will have a safe, healthy and diverse tree canopy by promoting tree preservation and planting within the Core City area.
- With the use of professional urban forestry leadership and staff, appropriate policies, efficient management of City resources and public education and support, the City's future urban forest will be viewed as an important community asset. It will support and benefit all citywide programs, goals and mandates and the citizen's well-being.
- The urban forest will uniquely define the Core City's character, and be a major factor in its continued vitality and livability.

1.2 History of High Point's Urban Forestry Program

In early 2003, members of the High Point City Council asked City staff to investigate the requirements for achieving Tree City USA designation. After gathering the initial information, staff started the process of drafting an urban forestry ordinance, which was reviewed by the Planning & Zoning Commission in October 2003 and then by the City Council in November 2003. The City's first official Arbor Day was celebrated on March 19, 2004 in anticipation of pursuing a possible Tree City USA designation. After months of deliberations about the best way to organize it, a final tree ordinance was adopted on October 21, 2004. Since that time, the City has received Tree City USA designation for seven consecutive years.

Implementation of the urban forestry program is overseen by an Urban Forestry Committee made up of representatives from the City's Electric, Parks & Recreation, Planning & Development, and Public Services Departments. The Committee, which started meeting in 2005, created the *Guidelines and Standard Practices for Trees* in January 2006 to help guide its decisions about trees. The tree guidelines only apply to trees located on city owned or controlled property, although private property owners are also encouraged to follow them in order to enhance the city's overall tree canopy. The Committee typically meets once a month to review any requests to plant, maintain, or remove trees on city property. Over the past several years, the Committee has been working to promote a variety of tree planting activities, including the "150 Trees for 150 Years" in celebration of the City's sesquicentennial, a Liberty Elm Tree Memorial in cooperation with the Boy Scouts, and the "Plant to Remember" Memorial Tree Program started in 2010.

The local Mid-Week Garden Club has been instrumental in advocating for urban forestry projects, and even regularly sends a liaison to the Urban Forestry Committee meetings, as well as helping organize the annual Arbor Day celebrations. In the future, there may be renewed efforts to establish an Urban Forestry Board made up of citizens appointed by the City Council, as was originally envisioned during development of the urban forestry ordinance.

1.3 Benefits and Values of the Urban Forest

1.3.1 General Benefits and Values

Collectively, the trees along streets, in parks and yards, by streams, on farms and in other open spaces make up High Point's urban forest system. Whether they are native, young saplings, newly planted landscape trees or mature shade and woodland trees, the whole forest canopy contributes to other efforts that strive to make the City a better, safer, more beautiful place to live, work and play. Trees play an important role in High Point, beyond providing people shade on a hot day, seasonal beauty or a place for wildlife to thrive. Trees can:

- Absorb and filter air pollution.
- Reduce energy consumption by shading homes and buildings.
- Moderate storm water flow and reduce flooding, prevent soil erosion and stabilize hillsides.
- Improve water quality by buffering ponds, streams and rivers from pollutants.
- Increase property values and help businesses attract customers and retain employees.

During the educational process which preceded the Tree Inventory (as a precursor to developing the Management Plan), citizens and key stakeholders clearly expressed their deep appreciation for the value of trees in the City.

1.3.2 High Point Tree Benefits and Values

The Economy

- Technically sound development will preserve natural beauty yet allow desired economic growth.
- Effective buffering and landscaping with natural materials and trees can enhance development projects and encourage longer visits by shoppers in retail areas.
- Development land values increase when trees are present.
- Homebuyer interest and homeowner satisfaction are increased when trees are preserved and major landscape elements are already established at the time of occupancy.
- Trees and open space increase property values, tax revenues, income levels, real estate sales turn-around rates, jobs, worker productivity, the recruitment of buyers and the number of customers in a given area and decrease unoccupied periods for apartment and commercial buildings.
- Including street trees in landscape design increases all property values.

Infrastructure

- Trees enhance transportation routes (sidewalks, streets and walking trails) by contributing beauty and functionality, such as shade and shelter.
- Trees absorb, filter and moderate air pollution from vehicles on transportation routes.
- Trees screen roads and walkways from other adjacent land uses, creating visual and noise buffers.
- Trees can reduce the amount of sediment that runs off developed and developing land.
- Trees efficiently serve the community as a biogenic utility and important infrastructure component by providing energy conservation, storm water mitigation and pollution moderation services even after accounting for planting and future maintenance costs.
- A comprehensive urban forestry program adhering to current industry standards and performing routine and preventive tree maintenance uses municipal funds more efficiently than a reactive-based management system.
- Proactive urban forestry management programs increase public safety and decrease municipal liability for tree risk situations.
- Trees make parks more desirable locations for recreational and leisure activities.
- Trees and forests offer educational and interpretive opportunities for park programs.

Community

- Individual mature trees on historic sites are markers and living witnesses of significant events and places.
- Trees and landscape are significant features of the City's lasting contributions to community design, such as roads, public buildings and parks.
- New tree planting can complement historic sites and preservation efforts.
- Trees balance the built environment within the natural world.

- Maintaining trees according to accepted industry standards can greatly improve a community‘s overall appearance.
- Planting trees along roadways can dramatically improve the streetscape.
- A diverse urban forest can protect a community‘s tree assets by reducing the risk of catastrophic losses from invasive pests.

2.0 Public Process

A crucial element in implementing the Urban Forest Management Plan will be soliciting information from key stakeholders and citizens of High Point. Stakeholder input will be used to assist the City in identifying opportunities, issues, actions and goals for implementation of the Plan. A stakeholders' public meeting should be scheduled for 2012, and interviews held with elected officials, City staff (Development Services and Public Services) and boards and commission members. Comments should be solicited through a comment period and through a questionnaire. A Project Overview Handout and the questionnaire should also be provided to stakeholders at interviews and public meetings.

2.1 Stakeholders' Public Meeting

In 2012, a meeting should be held to solicit input from the public. The meeting should be held after newspaper notices are published. After a brief introduction and presentation of the Management Plan issues, an opportunity will be provided for citizens to comment. Attendees should include members of the development community, local arborists, City Council members and other interested citizens. Each participant will be asked to complete a questionnaire and will be provided a Project Overview.

2.2 Interviews

To gather more insight about the City's current operations, issues and goals, interviews should be conducted with Urban Forestry Committee members, City staff and elected officials. Interviewed positions include: Mayor; Directors of the Electrical Services, Planning and Development, Public Services, and Parks and Recreation Departments. Although individual comments gathered during the personal interviews should be confidential, they will provide valuable information that can be used to facilitate the Plan.

2.3 Questionnaire

Participants of the public meeting and all City staff and elected officials that will be interviewed should be given questionnaires to provide additional feedback for the Plan. The questionnaire will be comprised of a set of general questions that will be asked of all participants and a group-specific set of questions for elected officials, City staff, members of boards and commissions and citizens and business owners.

3.0 Review and Update Existing Plans and Regulations

An important preliminary task to accomplish during implementation of the Urban Forest Management Plan is the review of existing plans, regulations and other documents that affect or are used in the management of High Point's urban forest. The following sections summarize

each plan and regulation to be reviewed, and in some instances, make appropriate recommendations and suggest action steps for the document.

3.1 Plans

3.1.1 Guidelines and Standard Practices for Trees

Originally prepared in 2006, High Point's Guidelines and Standard Practices for Trees have been a policy and technical-oriented document that establishes procedures for on-going tree maintenance and planting. The 2006 Guidelines and Standard Practices were approved by the Urban Forestry Committee in January 2006. Plans are currently underway by the Committee to update this document during 2012.

3.1.2 High Point Comprehensive Plan

This document, last updated in 2001, should include the following policy areas in the next update. Each of these areas includes topics that will individually and collectively help High Point achieve a better and balanced future by improving the management of the City's urban forest.

Policy Category: Economic Development

> **Policy** – The City should protect and enhance a high quality of life, image, cultural amenities and natural beauty as the most effective, long-term component of an economic development strategy.
>
> > **Action** – Continue to evaluate and amend development regulations to help ensure aesthetic quality in the area and preserve the natural beauty of the area.
> >
> > **Action** – Adopt analytically sound, technically based development regulations to preserve natural beauty.
> >
> > **Action** – Balance the benefits of economic development projects with special concern for environmental quality issues.
>
> **Policy** – New firms and expanding businesses that complement the natural resources and beauty of the region should be especially recruited and encouraged.

Policy Category: Commercial Development

> **Policy** – Effective buffering and/or landscaping should be provided where a large scale or automobile-oriented commercial or office use adjoins an existing planned residential use.

Policy Category: Industrial Development

> **Policy** – Industrial development should be located on land which is physically suitable and has unique location advantage for the industry. Advanced planning for the identification of such land should be encouraged.

Policy Category: Agricultural and Rural Development

Policy – Farms and woodlands should be recognized as an integral part of the planning area's open space system.

Action – Farms and woodland open spaces should be conserved through a comprehensive rural area conservation strategy, to include rural area density standards, tax incentives, conservation easements and other means. These areas should be considered in the planning for pedestrian ways, bikeways, greenways and other open space needs.

Policy – Agriculture, forestry and low-density residential activities should be the preferred land uses in rural areas. Urban level development should not be encouraged in rural areas.

Action – Employ the City's water and sewer extension policies to encourage a compact development pattern.

Policy Category: Downtown

Policy – A compatible design character for the downtown area should be identified, reinforced and supported to put forth a quality image and sense of place.

Action – Prepare an overall landscape strategy for the public right-of-way in coordination with private sector landscape treatments, e.g., street trees, planter boxes and planting beds.

Policy Category: Parks, Recreation and Open Space

Policy – In determining future sites for park, recreation and open space facilities, multiple objectives for natural area conservation, visual enhancement, promotion of cultural and historic preservation, watershed and flood prone area protection should be considered.

Action – Support efforts to establish public green spaces and parks in the downtown business district.

Policy – Land acquisition for new recreation sites in advance of need should be encouraged to achieve desirable locations at cost-effective levels.

Action – Consider the establishment of a land dedication provision or fees in lieu of land dedication in the City's development regulations. Coordinate such dedications fully with pedestrian, bikeway, or greenway space objectives.

Action – Prepare an information pamphlet identifying the tax advantages and process for making property and land easement donations.

Policy – Provision of open space and recreational facilities shall be encouraged in private developments and through intergovernmental and public/private partnerships.

Action – Employ a neighborhood planning process to identify neighborhood park and recreation needs.

Policy – The identification and appropriate development of a system of open space greenways within the planning area should be encouraged for both recreational and alternative transportation purposes. The use of natural corridors such as streams, floodplains, and secondarily, man-made corridors such as utility and transportation rights-of-way and easements should be emphasized.

Action – Prepare a greenways action plan with the full coordination, leadership and input of a Greenways Citizen Action Committee.

Policy Category: Environmental Quality

Policy – Development activities in the 100-year floodplain or near lakes or streams should be carefully controlled. If development must occur, low-intensity uses such as open space or recreation should be preferred.

Policy – Runoff and drainage from development activities should be of a quality and quantity as near to natural conditions as possible, with special emphasis given to critical watershed areas.

Policy – Development which preserves the natural features of the site, including existing topography, streams and significant trees and vegetation should be reflected in the City's Development Standards.

Action – Consider the use of innovative zoning techniques such as density bonuses and transfer of development rights in exchange for preservation of significant environmental features.

Policy – Recognizing the economic and environmental costs of commercial and residential storm water runoff, innovative storm water management techniques such as permeable sidewalks, driveways and parking areas should be encouraged.

Policy Category: Community Appearance

Policy – Measures to improve the effectiveness of grading, landscaping and buffering standards for new and existing developments should be encouraged.

Policy – The significance of street trees in providing visual relief, summer cooling, improved air quality and livability should be recognized through public policies and actions to encourage their planting and maintenance.

Action – Expand scope and effectiveness of the City's street tree planting program in close cooperation with student and citizen volunteer groups, power companies and other groups.

Action – Implement High Point's Core City Tree Planting Master Plan. Implement the Three-year Maintenance Plan as detailed in the Core City Tree Inventory Report and Analysis.

Policy Category: Community Character

Policy – The destruction of significant architectural, historic, scenic, natural and archaeological resources in the planning area should be discouraged.

Action – Continue to support and intensify the City's tree preservation standards. Evaluate the effectiveness of the tree regulations since their establishment and amend them as necessary.

3.1.3 Core City Master Tree Planting Plan

As a portion of the recent Core City Tree Inventory, additional data was collected in the form of 247 available planting spaces along designated streets and in some park areas of the Core City. These locations were recorded with GPS and mapped as with the remaining tree data. Each location was designated as small, medium or large in accordance with immediate surroundings and available space. In most cases, specific tree species (virtually all native) were carefully assigned for each of the spaces based on existing trees, fall color and size at maturity. For the spaces in which a tree species has not yet been assigned, further study will be conducted in order to select the best varieties for these locations.

These planting spaces have been compiled into the High Point Core City Master Tree Planting Plan, upon which a designated number of trees will be planted on an annual basis over a specified period of time. Tree planting will best occur in the identified spaces in late fall and winter, essentially from late November through February. The Plan is laid out so as to create ease of installation in regards to locating the sites, which were identified in a contiguous manner. It is very important to note that even though the street trees will be planted on City rights-of-way; there will always be a small number of residents who prefer not to have a tree located adjacent to their property, upon which their preferences are usually respected. For this reason, it will be necessary to contact each of these residents by letter approximately one month before the planting begins, informing them of the City's intentions. A reminder in the form of a door hanger should be installed at each residence about one week prior to planting time. The initial exact planting locations should be marked with paint and stakes. Any conflict with underground utilities should be addressed prior to planting and the stakes adjusted accordingly. Based on implementation in other communities, this system has proven very successful.

3.1.4 Core City Urban Forest Three-Year Maintenance Plan

This plan was also developed as a portion of the recent Tree Inventory. This Plan should be facilitated as directed in the Tree Inventory Report and Analysis and from that point the Routine Maintenance Cycle should be implemented.

3.1.5 Core City Plan

The Core City Plan was adopted in 2007 to guide development, redevelopment and revitalization of an 11 square mile area in High Point's core area. The plan identified ways to improve the physical, economic and social facets of the area, which includes most of the downtown commercial areas and surrounding urban neighborhoods. The plan identifies physical improvements to key streets, including the addition of street trees, landscaped medians, and

downtown streetscapes, as one of its primary goals. The plan's boundary was also used to define the extent of the recently completed High Point Core City Tree Inventory.

3.1.6 Community Growth Vision Statement

This vision statement, which was adopted around the same time as the Core City Plan, provides a foundation for more focused and detailed plans, policies and programs city-wide. The goals and objectives in the vision statement were determined during an extensive public participation process seeking consensus about the future of the community. Several of the objectives relate to trees, including preserving and linking open spaces and environmentally sensitive lands, enhancing existing neighborhood parks and recreational facilities, providing greenways where opportunities exist, and improving downtown streetscapes.

3.2 Regulations

The City of High Point has several existing regulations in its Development Ordinance regarding trees. Two sections deal with the planting and preservation of trees during certain development activities on private property, and one section involves the conservation of trees on public property.

3.2.1 Landscaping and Tree Preservation Requirements

Certain types of new or expanded building construction or changes in use require that landscaping be provided on the property. The size of the planting area and the number and size of trees are determined by the intensity of the proposed and existing adjacent uses. Landscaping design and maintenance standards are also included, such as those specific to parking lots. In addition, an appendix listing recommended plant species is found in the back of the Development Ordinance.

3.2.2 Watershed Protection

Within designated critical areas of water supply watersheds, the area immediately adjacent to a water body and fragile areas, such as wetlands and slopes of greater than 15%, must remain in a natural undisturbed condition, with only a few exceptions. Likewise, vegetation within stream buffers of a specified width measured on each side of all streams, lakes and ponds throughout the city must remain undisturbed.

3.2.3 City Tree Conservation

This section only applies to property that the City owns or controls through public rights-of-way or easements for public purposes. It includes provisions making topping and unauthorized removal or damage to trees a violation, and requiring that public trees be protected during construction. It sets up an Urban Forestry Committee to authorize planting, maintaining or removing trees on city owned or controlled property, with exceptions for public and private utilities maintaining infrastructure and City departments addressing public safety matters, as well as waivers during emergency situations. The Committee is also tasked with developing, adopting and maintaining guidelines and standard practices for trees.

4.0 Current Tree Management Structure

4.1 City Organization and Urban Forestry Management Responsibilities

The following is a breakdown of the roles of the Urban Forestry Committee and each of the City departments that are represented on it.

4.1.1 Urban Forestry Committee

The Urban Forestry Committee (UFC) is the primary body responsible for overseeing implementation of the City's urban forestry program. It is made up of representatives from the four departments that typically deal with trees. It meets once a month to review any requests for authorization to plant, maintain or remove trees on publicly owned or controlled property, and to discuss any other tree related issues. Tree programs, such as the "Plant to Remember" Memorial Tree Program, also originate from the UFC. In addition, it is responsible for updating the *Guidelines and Standard Practices for Trees*, organizing the annual Arbor Day event, and applying for Tree City USA designation every year.

4.1.2 Planning and Development Department

The Planning and Development Department is responsible for implementing the tree related regulations found in the City's Development Ordinance, including landscaping and tree preservation requirements, watershed protection, and city tree conservation. The representative from this department serves as chair of the Urban Forestry Committee.

4.1.3 Public Services Department

The Public Services Department is typically responsible for maintenance of trees located in street rights-of-way, along sidewalks, and in public easements such as sewer and storm-water easements, often using contractors. It is also involved in soil and erosion control measures, like verifying whether watershed protection buffers remain in an undisturbed, natural condition.

4.1.4 Parks and Recreation Department

The Parks and Recreation Department typically maintains trees up to approximately 15 feet in height located in parks, greenways and road medians. It is also involved in tree planting efforts in the City's parks and other facilities, and manages the Piedmont Environmental Center.

4.1.5 Electric Department

The City has its own municipal electric utility. Trees adjacent to electrical utilities and those in parks and road medians taller than 15 feet are typically maintained by the Electric Department. It hires a contractor on an annual basis to perform many of the line clearance activities.

4.1.6 Mayor and City Council

The City Council hears any appeals of decisions made by the Urban Forestry Committee. In addition, the Mayor and Council members often participate in tree related ceremonies, such as Arbor Day observances.

4.2 Analysis of Current Tree Management Structure

The City's current system utilizes a staff-level committee, although there were discussions originally about having a citizen appointed board to serve as a Tree Commission, or to have a Community Appearance Commission that would also handle tree related issues. The Urban Forestry Committee's annual work program currently includes an item to investigate how a future tree board might work. The City does not currently employ a certified arborist on staff.

4.2.1 Budget

The City's tree budget consists of tree related expenditures made by each of the departments that have a representative on the Urban Forestry Committee. The Committee itself does not have a budget. A budget line item was recently created to accept donations for the memorial tree program, but it is part of the Parks & Recreation Department budget. The tree guidelines recommend accepting in lieu fees for replacing trees that are removed, but there is no budget account to put the money in, so it has never been used. However, according to the most recent Tree City USA application submitted in December 2010, the City had total tree related expenditures of $293,050, although an additional $467,130 of electric line clearance work is not included in this total due to reporting requirements specific to the Tree City USA program. If that amount is included, the City had a total of $760,180 tree related expenditures in 2010.

4.2.2 Policy

While there are usually a handful of authorization requests each year, the Urban Forestry Committee has spent most of its time pursuing new programs and policies. The biggest undertaking was an inventory of all public trees in the Core City Area, which was conducted in spring 2011 with the help of volunteers. This will serve as a basis for building future capacity of the tree program. Another new program created recently was the "Plant to Remember" Memorial Tree Program. Possible programs to explore in the near future might include ways to increase public awareness about trees, such as a champion tree program. In addition, the City's *Guidelines and Standard Practices for Trees* are due to be updated, and a review of training practices might be conducted.

4.3 Management Structure Recommendations

To improve the management structure of the City's urban forest to the caliber that is advised in this Plan, it is highly recommended if not imperative that the City move swiftly towards a citizen appointed board to serve as Tree Commission, or alternatively a Community Appearance Commission. In addition, because High Point is one of the ten largest cities in North Carolina with a population in excess of 100,000, it will be highly advantageous to consider budgeting future funds in order to staff a full-time City Arborist or Urban Forester to administer the daily activities of an urban forest of this magnitude.

4.4 Reserved

5.0 Tree Inventory Analysis

5.1 Tree Inventory Analysis

At the request of the City of High Point, an inventory of trees on publicly owned or controlled property in the Core City area was conducted in April, May and June of 2011. In addition, several densely wooded areas were plot sampled in order to calculate an estimate of the number of trees in these areas. Although the goal was to complete a 100% count of all trees in the Core City, there were some areas that were not counted due to limits on time and resources, most notably the Blair Park Golf Course. The project was performed in order to evaluate the characteristics and condition of the Core City's trees and to develop a tree maintenance program based on the data collected. The species composition, size, health and current maintenance requirements were identified and evaluated. This information will provide the City of High Point with the opportunity to maximize the value and benefits of publicly owned trees and minimize the problems that can be associated with them.

Of the 4374 trees inventoried, 106 species comprise the High Point Core City Urban Forest. Crape Myrtle, Red Maple and Sweetgum are the most common species, consisting of 16.67, 8.48 and 7.57 percent of the total tree population, while Willow Oak ranks fourth at nearly seven percent. The Core City's community forest is exceptionally well diversified except for a disproportionately high number of Crape Myrtle trees.

The High Point Core City urban forest is in good condition overall, but with a substantial proportion of trees in fair condition as well. Currently there are 92 trees requiring removal and another 236 recommended for pruning. In order to develop some level of continuity following the current maintenance recommendations, a trained in-house employee or crew would best meet the present needs of the City. In this way, staff can become more efficient in controlling the development of potential hazard and liability situations and to limit, through regular and appropriate pruning methods, the occurrence of structural conditions that could prove costly to remedy in the long run. The use of an employee or crew that already works for the City could be trained for specific tasks, which would reduce the expense of contracting. However, some contracting may still be necessary, especially if the work requires the use of a bucket truck.

This inventory is maintained by one of the City's Senior Planners along with additional information that makes up High Point's urban forestry program.

5.2 Maintaining the Tree Inventory

High Point's Core City Tree Inventory should be updated on a regular basis to reflect new plantings, removals and maintenance procedures performed. An accurate inventory is the best way for the City to monitor the progress and cost-efficiency of its tree care operations. The primary benefit of an accurate tree inventory is that the community can budget, plan and anticipate tree-related problems and situations in the most cost-effective manner possible.

The best way to maintain the inventory is to commit to regular, routine data entry. The Planning staff could create a simple form for use in the field that contains similar data fields as the software program. This form can easily be used to record new plantings, work histories, changes in tree conditions and maintenance recommendations. On a daily, weekly or monthly basis, the

information collected should be entered into the inventory database. This task can be performed by the Senior Planner, administrative support staff or trained volunteers.

It is further recommended that a thorough inventory be performed every ten years or more frequently if rapid changes in the urban forest occur, such as severe storms, serious insect and disease problems, or a dramatic increase in new tree planting. Tree inventories should be organized by a Certified Arborist, or by the City's Senior Planner. Only a highly qualified professional should make the determinations of condition, safety risk and maintenance requirements. Volunteers may assist in the inventory process which will increase public awareness and ownership.

Recommendations

1. Complete a city-wide GIS based inventory of street trees and park trees in mowed and maintained areas while keeping the Core City Inventory up-to-date.
2. Commit to routine data entry.
3. Create a simple form for use in the field with inventory data fields.
4. Perform a thorough inventory of public trees every ten years or as needed.

5.3 Using Tree Benefit Models

Arboricultural research and technological advances in computer analysis are allowing municipalities to document the benefits of trees beyond aesthetics and real estate values. Tree benefit models use aerial and satellite imagery and tree inventory data to determine the levels and values of public health and safety and other benefits, such as air pollution reduction, storm-water mitigation and energy conservation. These benefit models conduct complex statistical analyses of ecosystem and environmental services that trees provide to a community. The reports and maps created can then be used for land-use planning, policy-making and urban forestry program evaluation.

There are tree benefit models now available for municipalities to use – the Urban Forestry Effects Model (i-Tree Eco) and the Street Tree Resource Analysis Tool for Urban Forest Managers (i-Tree Streets). These models were developed by the U.S. Forest Service and are now part of the i-Tree suite of urban forest management tools. These models have been extensively peer-reviewed for accuracy and are available for the City to use. The i-Tree suite of software tools help communities to identify and manage the structure, function and value of urban tree populations. Together, the suite provides a scientifically sound system for data collection, analysis and quantification of the benefits and costs of urban forest management.

5.3.1 i-Tree Eco

i-Tree Eco is a computer model that calculates the structure, environmental effects and values of the entire urban forest. The model is designed to use standardized field data from randomly located plots or complete inventories. i-Tree Eco results are compatible with ArcView™ for display in GIS systems.

The i-Tree Eco model is currently designed to provide accurate estimates of:

1. Urban forest structure (e.g., species composition, number of trees, tree density and tree health) analyzed by land-use type.
2. Pollution removed by the urban forest, and associated percent air quality improvement throughout a year. Pollution removal is calculated for ozone, sulfur dioxide, nitrogen dioxide, carbon monoxide and particulate matter (<10 microns).
3. Volatile organic compound emissions and the relative impact of tree species on net ozone and carbon monoxide formation throughout the year.
4. Total carbon stored and net carbon annually sequestered by the urban forest.
5. Effects of trees on building energy use and consequent effects on carbon dioxide emissions from power plants.
6. Compensatory value of the forest, as well as the value of air pollution removal and carbon storage and sequestration.
7. Tree pollen allergen index.
8. Potential impact of pests, such as Gypsy Moth, Emerald Ash Borer, or Asian Long-horned Beetle.

The i-Tree Eco software is in the public domain and available at no cost to all interested individuals and organizations through i-Tree. If the City wants to consider conducting its own i-Tree Eco project, be aware that the program requires specific types and amounts of data to accurately project the structure and benefits of urban vegetation. The validity of results from i-Tree Eco will depend on a large degree to how closely the City adheres to project setup and sampling protocols. More information can be found at www.itreetools.org.

5.3.2 i-Tree Streets

i-Tree Streets is a street tree management and analysis tool for urban forest managers who utilize simple tree inventory data to quantify the value of annual environmental and other benefits such as: energy conservation, air quality improvement, carbon dioxide reduction, storm-water control and property value increases. Uniquely, this model also considers management, maintenance and planting costs, and can, therefore, produce data on costs-benefits and management needs. Using simple, non-GIS based tree attribute data from sample plots to complete inventories and community specific information (e.g., program management costs, population and price of residential electricity), i-Tree Streets applies tree growth and benefits models to calculate:

1. Structure (i.e., species composition, extent and diversity).
2. Function (i.e., the environmental and aesthetic benefits trees afford the community).
3. Value (i.e., the annual monetary value of the benefits provided and costs accrued).
4. Management needs (i.e., evaluations of diversity, canopy cover, planting, pruning and removal needs).

i-Tree Streets produces a report consisting of graphs, charts and tables that managers can use to justify funding, create program enthusiasm and investment, and promote sound decision-making. In short, i-Tree Streets can assist managers and communities to answer the question as to whether the benefits of street trees outweigh their management costs.

i-Tree Streets differs from other urban forest analysis and tree benefit software models in many ways:

1. i-Tree Streets is designed for analyzing street tree populations, not the entire urban forest.
2. It is intended to be utilized as a planning tool, going beyond the reporting of benefits.
3. Costs of management, rather than benefits alone, are incorporated to provide a platform for strategic planning.
4. i-Tree Streets is not GIS-based; it requires only basic inventory data.
5. i-Tree Streets also is in the public domain and is available at no cost to communities.

5.3.3 Summary of Tree Benefit Models

Both i-Tree Eco and i-Tree Streets are benefit models that could assist High Point in supporting the growth of the urban forestry program, and aid the City in making the right management decisions at the right time. The availability of i-Tree Streets is also further justification for the City to convert the existing Core City Tree Inventory and eventually expand this survey of the City's tree to surrounding areas in order to document the value of street trees and justify management costs.

6.0 Urban Forestry Management Recommendations

6.1 Tree Risk Management

Situations where injury or property damage has occurred from falling trees are not isolated and are well documented in the media on a regular basis. Along with the potential for personal injury or property damage comes the probability of the responsible parties being held liable for any injuries or damages. Such lawsuits can and have resulted in costly judgments against the defendants. Public safety must be the primary concern in High Point. Tree removals and pruning are a vital part of safety risk mitigation. The general tree population in the Core City is in good to fair condition; however, there are large trees with varying degrees of risk factors existing in the scaffold limbs, trunks and roots.

Consideration must always be made of area usage and the threat of falling limbs or trees to persons and property when putting a pruning and removal plan into action. External indicators of increased risk trees, such as obvious root zone activity, decay fungi, or included bark require special attention to meet the public's safety needs. Trees that display decay fungi or obvious signs of wood decay should be carefully monitored and evaluated for safety concerns and risk management. Trees with poor structure, such as those with co-dominant leaders or multiple trunks, can pose a greater failure risk than trees with good structure. All City trees (especially trees in the large-size diameter class) with signs of decay and/or poor structure should be examined annually for signs of impending failure.

Criteria of Safety Risk Trees

1. A defective tree, or tree part, that poses a high risk of failure or fracture.
2. Presence of a target that could be struck by the tree (e.g., people or property).
3. Environmental hazards may increase the likelihood of tree failure (e.g., severe storms, strong winds, shallow or wet soils, or growing spaces that restrict root or crown development).

6.1.1 Priority Tree Maintenance

Initially, High Point should concentrate on reducing the potential risks associated with trees that have serious defects. In addition to the Core City survey, a complete inventory of street and park trees would identify associated hazards and provide a foundation for managing tree risk across the entire City.

6.1.2 Useful Life

The useful life of a public tree ends when the cost of maintenance is greater than the value added by the tree to the community. This can be due to either the decline of the tree's condition and increasing maintenance activities or to the costs of repairing damage caused by the tree's presence.

Decline generally starts when the tree has reached a point where it cannot withstand the stresses imposed by its environment. Restrictive growing space, disease, insects, mechanical injury, pollution and vandalism, among others, can cause stress. Although some species are more resistant to these urban stresses, all trees in urban settings will eventually decline, whether due to maturity, stress, or senescence. The pattern of decline generally begins with persistent limiting site factors that place the tree in a state of chronic stress. This weakens the tree's natural defenses, leaving it more susceptible to injury from pests or unusual weather, such as a single insect-induced defoliation or a late frost. When a tree is stressed, it has difficulty withstanding or combating the circumstance or recovering from such stress. As a result, the tree can become even more vulnerable to insects and disease that continue to reduce its vigor. Often, the first signs of a problem appear at this point. The age at which a tree reaches the end of its useful life differs by genus and species. Slow-growing trees, such as Northern Red Oak (Quercus rubra), are most valuable when they attain maturity. Fast-growing species, such as Red Maple (Acer rubrum), are most valuable as juvenile trees, because they provide benefits quickly and become expensive to maintain as they reach maturity.

The end of a tree's useful life can also be reached while the tree is still healthy if it is growing in a limited site. Useful life, in this instance, is the point at which the cost of related maintenance, such as the repair of hardscape damage, exceeds the value added by the tree. For example, a large, fast-growing tree used in a smaller tree lawn will cause hardscape damage at an early age and periodically throughout its lifetime. The useful life of this tree will be reached before it begins to decline. A smaller tree, on the other hand, would probably not exceed growing space dimensions at any point in its life. The end of its useful life would probably be reached only when it started to decline due to senescence. A smaller tree, as a result, would make better use of this example tree site.

6.1.3 Priority Tree Maintenance Summary

Treefull Communities strongly encourages the City of High Point to schedule all priority maintenance recommendations to occur in a timely manner to reduce potential safety risks. By doing so, the City will greatly lessen the potential of injury to citizens, damage to property and possible liability litigation. Although it would be impossible to expect the City to perform all needed maintenance activities immediately, an organized and systematic program will achieve

the required results in a timely manner and will demonstrate the City's sincere attempt to keep all of its streets and public spaces safe for its citizens.

The management of trees on streets, parks and other public settings can be challenging. Some tree failures can be predicted and some cannot. Although not all hazard trees can be detected, corrected, or eliminated at any given time, having trained personnel perform regular safety risk tree assessments and property inspections can help make public rights-of-way and public property reasonably safe while preserving the aesthetics and other benefits trees provide.

6.2 Mature Tree Care

The benefits and values of trees are maximized when trees reach maturity and become established in their growing location. To maintain this high level of benefits for a longer period, the City should commit to providing regular scheduled maintenance to its mature trees and prepare for non-routine arboricultural treatments as needed. A comprehensive mature tree care program primarily centers on routine or preventive pruning, and the ability to provide fertilization, irrigation, insect and disease control, and cabling and bracing when necessary.

6.2.1 Routine Pruning Program

Routine Pruning should occur on a cyclical basis for the entire tree population once all priority maintenance removal and pruning activities have been completed. Since the priority maintenance recommendations described above may be accomplished in the first two years, it is recommended that the routine pruning program described here be implemented beginning in the same years if funds exist for the work. If funds do not exist, the routine pruning program can begin after the priority tasks have been completed. This activity is extremely beneficial for the overall health and longevity of street and public space trees. Through routine pruning, potentially serious problems can be avoided because the trees can be closely inspected during these pruning cycles. Proper decisions can be made on declining trees, and any trees that become potential hazards can be managed appropriately before any serious incidents occur.

Small trees currently constitute a considerable portion of High Point's street and public space tree population. The City's personnel must recognize that as these small trees reach maturity, more work will be required to maintain a five-year pruning cycle. The City should develop an organized, documented approach to cyclical tree maintenance that can be easily managed by staff and properly trained volunteers, if budgetary issues are a concern.

Routine Pruning

This activity is extremely beneficial for the overall health and longevity of street and public space trees. Through routine pruning, potentially serious problems can be avoided because the trees can be closely inspected during these pruning cycles. Proper decisions can be made on declining trees, and any trees that become potential hazards can be managed appropriately before any serious incidents occur.

6.2.2 Small Growth-Habit Trees

Small Routine Pruning is recommended for mature, small growth habit trees, such as the Flowering Crabapples (Malus spp.), Callery Pears (Pyrus calleryana) and Flowering Dogwoods

(Cornus florida) in the City of High Point. These species are genetically small trees and usually attain a maximum height no greater than 25 to 30 feet, but like all urban trees, they require periodic pruning throughout their life span. The primary reason to periodically prune these small growth-habit species is to maintain overall health and vigor through the removal of dead, dying, or diseased branches, as well as branches that may be interfering with the growth of other major branches. By maintaining these trees through periodic small routine pruning, the potential for decay can be minimized and their vigor can be improved by retaining only strong, healthy branches. Small routine pruning can normally be accomplished from the ground with relatively inexpensive equipment. For this reason, it is recommended that the City organize a small tree care crew that would be able to easily perform this work with existing equipment. Based on the generally small size of the trees in this category, a crew of two properly trained personnel would be capable of accomplishing the work.

This crew would be responsible for the cyclical trimming of all mature, young trees, as well as training pruning of young and recently planted trees. Additionally, they can perform clearance-trimming work. This is known as crown raising (removal of lower tree limbs), and it will allow vehicles to safely pass on streets or pedestrians to walk on sidewalks. Furthermore, the clearing of limbs away from signs and traffic signals can also be accomplished.

There are also young trees of other species in High Point's urban forest. These trees normally require little in the way of training pruning, but inspections should be made to ensure that each tree does not have more than one leader or trunk. Occasionally, these trees will develop co-dominant leaders that, if not pruned to a single leader, result in a tree with poor structure. Other problems may include the likelihood of creating traffic clearance problems and increased susceptibility to storm damage.

6.2.3 Five-Year Cycle

It is suggested that a five-year cycle be implemented so that street trees are routinely pruned. As happens all too often in many cities, tree pruning consists of trimming by resident request or only if a hazardous situation exists. Routine pruning includes those trees requiring pruning on a cyclical basis to maintain tree form and health. Centralized pruning should be carried out, meaning that all trees in a City block are trimmed. A certain number of City streets (and blocks along those streets) and public spaces should be designated for each year's work in order to meet the annual routine pruning goal.

6.2.4 Fertilization

Mature trees should not be placed on a scheduled fertilization program without a documented need. If soil analyses show a distinct and serious nutrient deficiency, or if the tree's root system or growing area has been damaged or contaminated, then the time and expense of fertilization may be worthwhile to save the tree.

6.2.5 Irrigation

All trees need supplemental watering when there are drought conditions. Under these conditions, the City, volunteers and/or the abutting property owner should water mature and young trees. This supplemental irrigation can be accomplished for park and street trees with a water truck and hose and/or deep root watering lance, or with watering aids, such as the widely

used Treegator® Drip Irrigation Bags. Citizens and abutting business owners should be encouraged to water street trees frequently during the summer when drought conditions are present.

When trees are planted in tree wells, or are growing in restricted rooting areas, such as between streets and sidewalks, they are especially prone to not receiving enough water from rainfall. Additionally, if a tree's root system has been compromised or damaged by a construction project or accident, whether drought conditions are present or not, supplemental watering during the growing season may be a critical factor in the tree's long-term survival.

6.2.6 Insect and Disease Control

Generally, mature trees do not have significant insect and disease problems if they are healthy and well cared for. Some degree of insect infestation and disease incidence will always be present, as this is the norm for the natural world. However, trees in street and other highly urbanized settings can be predisposed to insect and disease problems since they are growing in unnatural and constrained environments. Therefore, it is prudent to include insect and disease monitoring as a routine part of a public tree inspection program. Monitoring will be discussed in more detail in Chapter 6.6, Future Risk Tree Management.

It is only when particularly damaging insects, such as Gypsy Moth and Emerald Ash Borer are detected, the levels of insect populations are extremely high, or when particularly virulent diseases are diagnosed, that action must be taken. The type and extent of action depends on the type and extent of the insect or disease problem.

Biological and synthetic chemical controls are available for most situations. Improved arboricultural knowledge and chemical application technology allows most treatments to be directed into the soil or into the tree, avoiding open, broadcast spraying of the crown, which in a public setting is usually not well-received.

6.2.7 Cabling and Bracing

Rather than remove or severely prune a mature tree if a structural defect is discovered, the use of structural support can reduce safety risks. Cabling and bracing are the two most common forms of structural support for trees. Other, less common forms of structural support are guying and propping. Structural support is infrequently recommended, but trees with special or historic significance can be spared from removal by using such techniques as cabling and bracing. Generally, this involves installing flexible cables or rigid rods to reduce the chances of failure of defective unions.

If the decision is made that a tree needs structural support, there are a few basic considerations. First, only use a Certified Arborist who is knowledgeable and experienced in this area. Ask about the important technical aspects of correct cabling and bracing: the strength and material of the hardware; the arrangement of the cables (e.g., simple, triangle, or box) or rods (e.g., single or multiple); and the location, type and size of the entries made into the tree. Be sure to specify in writing that "all work and materials shall be in accordance with ANSI, A300 Tree Care Standards (Part 3), 2005.

Primary Uses of Cabling and Bracing

1. Prevention to reduce the chance of failure on a healthy tree with structural weakness (e.g., a specimen oak in good condition but having large limbs with V-crotches).
2. Restoration to prolong the existence of a damaged tree (e.g., a large sugar maple that lost one of its leaders in a storm, leaving the others suddenly exposed and vulnerable to further damage).
3. Mitigation to reduce the hazard potential of a tree (e.g., a picturesque multi-stemmed hickory that towers over a picnic shelter).

6.3 Young Tree Care

Significant populations of the Core City's inventoried public trees are recently planted or young and with the Master Planting Plan in place, more new trees will be added to the City's urban forest. It is critical then to understand the proper maintenance techniques required to ensure the longest and safest service life of these trees. The major components of a young tree care program are pruning, mulching and watering.

6.3.1 Training Pruning Program

Training Pruning consists of the removal of dead, dying, diseased, interfering, conflicting and/or weak branches, as well as selective trimming to direct future branch growth on trees less than 20 feet in height. Although this type of pruning is termed training pruning, the word training truly pertains to young or recently planted trees. For these trees, training pruning is used to develop a strong structural architecture of branches so that future growth will lead to a healthy, structurally sound tree. Many young trees may have branch structure that can lead to potential problems as they grow, such as double leaders, many limbs attaching at the same point on the trunk, or crossing/interfering limbs. When trees are small, these problems can be remedied easily and inexpensively.

Training pruning can be accomplished from the ground with a minimum amount of equipment. If structural problems are not corrected while trees are young, they can lead to instances where branches are poorly attached and where decay can develop at the crossing points of interfering limbs. Trees with poor branching can become safety risks as they grow larger and could create potential liability for High Point in the near future.

All newly planted trees should receive their first training pruning within three years following planting. Training pruning should not be done when a tree is planted, because it is already under stress from transplanting and needs as much of its leaf canopy as possible in order to manufacture food and increase root growth for proper establishment in its new site. Only dead or broken branches should be removed at the time of planting, and during the next two years.

6.3.2 Three-Year Maintenance Cycle

Similar to the routine pruning program, the training pruning program would also be accomplished on a cyclical basis, but the work would be scheduled during a three-year cycle rather than the five-year cycle for the routine pruning of larger established trees. As mentioned above, newly planted trees should receive their first training pruning three years after planting. This work can be accomplished throughout the year. Since no bucket truck is required, City

employees can perform this work at any time. This type of work is also highly suitable for properly trained summer interns, part-time employees and/or volunteers.

6.3.3 Mulching

Mulching is more than an aesthetic treatment in the landscape. Trees that are properly mulched benefit from less drought stress and less cold damage, and tend to grow faster and be more vigorous. Mulch also helps prevent trunk and root damage from mechanical removal of grass and weeds.

Some trees in the Core City area were observed to have mechanical damage. These are both younger trees with injuries caused by lawn mowing equipment and mature trees with similar damage. This kind of stress on a tree can make it more susceptible to pest problems by providing access to internal wood tissue. There are certain insect pests specifically drawn to wounded trees, and if a tree is already stressed, the additional injury can substantially reduce the tree's ability to sustain defense and maintain growth. A less visible impact is the effect on roots; decay from trunk damage can spread into the root system.

It is recommended that all small-diameter trees be mulched regularly. Large-diameter trees can also be mulched where the mulch bed will not interfere with other uses of the area. Mulch can consist of a variety of materials, ranging from the more expensive, but aesthetically pleasing, shredded black hardwood bark, to no-cost rough wood chips. Either type is acceptable and provides the many benefits of mulch. Generally speaking, mulch is applied in a two to four-inch layer in a three-foot diameter circle around young trees and as far out as the dripline in mature trees. Mulch is placed in a saucer shape around the tree, meaning the outside edges are slightly higher than the inside, and it should never be placed directly against the trunk. Mulch is also usually applied once a year, as long as the two to four-inch depth is not exceeded.

Chemical herbicides used in conjunction with mulch is the most effective way of keeping unwanted grass and weeds from growing in the mulched area and near the tree. Many safe, non-restricted, post-emergent sprays, like Round-Up®, are available to kill weeds. Effective pre-emergent sprays, like Preen®, are available to prevent weeds from ever germinating. When these types of herbicides are used in combination with mulch, public trees will derive the benefits from mulch, avoid mechanical damage and be more attractive.

6.3.4 Watering

This maintenance task was discussed previously, but it is even more critical to water young trees during the first few years after planting as part of their routine care program. This task can be performed by City staff or contractors, but is one that is easily accomplished by volunteers and citizens. For example, the use of watering aids, such as the widely used Treegator® Drip Irrigation Bags, water-hoses and nearby homeowners willing to share their water, will allow volunteers and youth organizations to irrigate several blocks of newly planted trees in a single day.

6.3.5 Training of Personnel

Proper training for young tree structural pruning would be required for City personnel responsible for this task. Additionally, these workers would require an understanding of the

growth-habits of the various species being planted, as well as an understanding of tree anatomy and physiology. This training can be received through several sources, including International Society of Arboriculture Certified Arborists. The tremendous aesthetic and financial benefits to be gained in the years to come from proper pruning of young trees are a strong incentive for educating tree crew personnel concerning proper pruning techniques. The added knowledge gained by the individuals could augment the sense of professionalism in their jobs.

6.4 Tree Planting

Considering the ongoing land development and High Point's goal to increase canopy cover, tree planting should be a major goal for the City. Not considering private property, the streets, parks and other public areas offer ample opportunities for new tree planting. Therefore, it is important to make sure this goal is carried out in the most effective way possible. The trees planted now will have a great impact on the City's future character and livability.

6.4.1 Developing an Effective Tree Planting Program

Tree species and planting location designations are significant components of a municipal tree care program because of the long-term impact of these decisions. It is important to develop an overall planting strategy, initially concentrating on streets and blocks with the greatest need for improvement.

The success of a continuing tree planting program will be judged by the post-planting health of the trees and the amount of money spent on planting and maintaining the new trees. With a small amount of planning, healthy trees with greater life expectancies can be established with minimal initial investment and minor maintenance costs.

6.4.2 Tree Species Diversity

Tree plantings in historic districts and new developments add greatly to the aesthetic appeal of the City. However, species diversity in new plantings should be a primary concern. The dangers (e.g., disease and insects) of planting monocultures have proven to be devastating throughout the eastern and mid-western United States. The goal should be to maintain species diversity throughout the City such that no more than one species represents 10% and that no one genus comprises more than 20% of the total population.

6.4.3 Tree Species Selection

High Point is located in Zone 7 of the USDA Hardiness Zone Map, which identifies the climatic region where the average annual minimum temperature is between 0 and 10 degrees Fahrenheit. Tree species selected for planting in the City should be appropriate for this zone. In addition, species should be urban-tolerant, and rated as relatively free from insect pests and disease. In addition to considering site characteristics, such as availability of space, soil pH and irrigation, species-specific features must also be scrutinized. A major consideration for street trees is the amount of litter dropped by mature trees. Species, such as Willow (Salix spp.) have weak wood and typically drop many small branches during a growing season. Others, such as Sweetgum (Liquidambar styraciflua) drop high volumes of syncarps (fruits). In certain species, such as Ginkgo (Ginkgo biloba) and Osage-orange (Maclura pomifera), female trees produce offensive/large fruit; male trees, however, produce no fruit. Furthermore, a few species of trees,

including Black Locust (Robinia pseudoacacia), Hawthorn (Crataegus spp.) and Honeylocust (Gleditsia triacanthos) may have substantial thorns. These species should be avoided in high traffic areas. Seasonal color should also be considered when planning tree plantings. Flowering varieties are particularly welcome in the spring, and deciduous trees that display bright colors in autumn can add a great deal of interest to surrounding landscapes. Above all, tree species should be selected for their durability and low-maintenance characteristics. These attributes are highly dependent on site characteristics as well as species characteristics. Matching a species to its favored climatic and soil conditions is the most important task when planning for a low-maintenance landscape. Plants that are well matched to their environmental and site conditions are more likely to resist pathogens and insect pests, therefore, requiring less maintenance overall.

6.4.4 Tree Planting Process

As trees are purchased through local nurseries, the most important consideration should be species selection to increase species diversity throughout High Point. Once the appropriate trees have been selected for planting, the most important detail to ensure success is the preparation of the planting sites. Appendix C explains the proper method of excavating a planting hole. In general, the tree-planting holes should be relatively shallow (typically slightly less deep than the height of the root ball) and quite wide (three times the diameter of the root ball). Care should be taken so that the root collars of the new trees are at the same level or slightly higher than the surrounding soil grade.

In most situations, it is not recommended to add soil amendments to the planting holes, as this can lead to differences between texture and structure of soils inside the planting holes and the surrounding soil. Such differences can lead to either water being wicked away from or accumulating in the planting holes. Tree staking hardware should only be installed when necessary to keep trees from leaning (e.g., windy sites) or to prevent damage from pedestrians and/or vandals. Stakes should only be attached to trees with a loose, flexible material, and all staking material must be removed within one growing season.

6.4.5 Tree Mulching

Mulch should be applied to the surface of the soil around each newly planted tree. Mulch should never be piled up around the root collar (creating mulch volcanoes), but rather should be pulled away from the root collar. Mulch that buries the root collar provides shelter for insects, fungi, and mammals that could damage the tree. Mulch should be applied to an area three times the diameter of the root ball to a depth of two to four inches. Mulch not only suppresses competition from grass and weeds, but also provides a zone where turf maintenance is not needed, thereby keeping lawn mowers and string trimmers safely away and thus preventing mechanical damage. Mulch also helps to hold moisture in the surface of the soil where most of the feeder roots are to be established.

6.4.6 Tree Fertilization

Any fertilization process should not be thought of as feeding or energizing the trees; instead, arboricultural fertilizers should be understood as essentially replacing soil elements or minerals that are lacking or in short supply for a variety of reasons. Nutrients may be in adequate supply but be unavailable for uptake by the trees because of extreme pH conditions. Application of

fertilizer may not improve the situation until measures are taken to alter pH levels or to replace the trees with a species better suited for the existing soil conditions.

Fertilization may not be necessary for the first growing season unless specific nutrient deficiencies exist. At the beginning of the second growing season, fertilizers can be applied to the root zone. Nitrogen is usually the limiting nutrient for plant growth. Soil analysis, particularly when combined with a foliar analysis, can determine when other elements are in short supply. Slow-release fertilizers applied in autumn will help root growth and will still be available the following spring.

6.4.7 Tree Pruning

Assuming that the proper trees have been selected for each site, pruning young trees to improve branch structure is the most effective method of reducing maintenance costs as trees mature. At the time of planting, the only pruning that should be done is the removal of broken or dead branches. In the second growing season, minor pruning can be performed to remove branches with poor attachments. In subsequent years, selective pruning should be performed to achieve the proper spacing of branches. See Appendix C for more information on proper pruning techniques.

6.4.8 Tree Purchases

Tree prices, of course, vary based on the species selected, but many nurseries offer trees of 1.5 to three inches in caliper for $150 to $250 retail and $50 to $100 wholesale. As the City plants more trees annually, obtaining a good price for quality trees will become more important. Saving money on the cost per tree will allow a greater number of trees to be purchased.

A good working relationship with a local nursery is beneficial, but it is equally important that good prices and wide species availability be considered. It is recommended that High Point continue to explore local and regional sources for trees and discuss pricing with the current nursery source. Due to the requirement to work towards species diversity, it may be necessary to use several nurseries as sources for trees.

6.5 Master Tree Planting Plans and Designs

Given the goal of increasing High Point's canopy cover, it is important that City expand the current Core City Master Tree Planting Plan, especially if public opinion rates this management task as a high priority. Such a plan would detail the exact location of every available public tree planting site in High Point, provide information of the size and type of the growing space, indicate the presence of utilities and ultimately assign an appropriate species to that site. With this information collected and analyzed, and entered into the tree inventory database, a logical and citizen-responsive prioritization scheme can be developed to begin tree plantings throughout the City.

Often, the downtown and other business districts, such as the Core City Area are selected as high-priority areas to increase the attractiveness and functionality of the urban forest. Tree selection for business and shopping areas must take into consideration the need for shoppers to view storefronts, as well as the need to provide adequate shade. Tree canopies should be open, as in Thornless Honeylocust (Gleditsia triacanthos), and the branching habit must be high

enough to allow pedestrians to walk comfortably beneath the trees. Other options are tall, narrow-growing (fastigiate) species, such as Fastigiate European Hornbeam (Carpinus betulus 'Fastigiata') and many others. These trees can provide beauty, a look of uniformity and a formal appearance to the shopping district.

Tree plantings in residential areas can be selected to match the existing types of trees growing on each street (i.e., large growth-habit trees or flowering tree species) or can be selected to begin to develop a uniform look for a given street. To create unity, balance and beauty on a street, it is advantageous to plant the same species or species of similar form and size on both sides of the street, if possible. Keep species diversity in mind when developing any type of tree planting design. Often, in older neighborhoods, one side of the street has utility lines, which precludes the use of large trees.

The primary aesthetic role that street tree plantings can play in a residential neighborhood is to visually link individual homes into a unified scene. It is this unified quality that makes older neighborhoods with large mature trees so attractive in many communities. Either formal or informal planting schemes are appropriate for neighborhood streets. In most instances, medium or large trees, spaced so that their canopies overlap, are desirable. As always, a street tree-planting program must have the objective of species diversity in mind at all times.

Recommendations

1. Maintain species diversity throughout the City such that no one species represents more than ten percent and that no one genus comprises more than 20 percent of the total tree population.
2. Wherever possible, plant large growth-habit trees that provide shade, the greatest environmental and economic benefits, and that are aesthetically pleasing.
3. Expand the existing Core City Master Tree Planting Plan to include all streets and public properties.

6.6 Future Tree Risk Management

6.6.1 Disease and Insect Monitoring

Urban trees are inherently under stress because of many human-induced factors, primarily limited growing space in non-native, sub-standard soil. Basic elements that influence plant health include sufficient water, light and a proper balance of nutrients. Too much or too little of any of these environmental conditions may cause plant stress. Insect pests and diseases are opportunists that primarily target stressed trees, making urban trees particularly vulnerable. Sound management practices, a proactive monitoring program and education are the best tools to help mitigate these potential threats to the health of the urban forest.

The array of disease and insect pests that can threaten the health of forest and urban trees and their treatments are too numerous to completely encompass within the scope of this document. However, a basic discussion on the fundamentals of an Integrated Pest Management (IPM) program, and specifically monitoring, is covered in this section.

Fundamentals of an IPM program are:

1. Identification: The proper identification of trees and their existing and potentially harmful pests is necessary to successfully manage a pest outbreak or occurrence. Additionally, understanding each pest's life cycle is important for a positive diagnosis. Knowledge of beneficial and incidental (non-threatening) organisms also plays an important role in the identification and diagnostic process.
2. Monitoring: Proactive, regular monitoring for potential threats is perhaps the most important part of an IPM program. Monitoring for pest activity can be done using a variety of techniques, including visual inspection, and in some cases, use of specialized traps. Regular contact with state and local plant health care officials can help to focus monitoring efforts and increase awareness of emerging threats. In most cases, North Carolina's State Forester, university extension services, State Department of Agriculture, or U.S. Department of Agriculture's state office can provide support for suspicions of potential pest infestations.
3. Understanding the Economic Threshold Level: The economic threshold is the level in which the costs involved in managing a pest infestation overshadow the value that a tree or plant is providing. In an urban situation, the economic value of a tree can be tied to the benefits that a tree provides. These benefits include, but are not limited to, aesthetic, environmental and cultural benefits. This concept, on a general level, amounts to determining whether or not a tree is worth the costs of mitigating against a pest problem compared to its value to the community.
4. Selecting the Correct Treatment: Once a pest problem has been properly diagnosed and the decision has been made to treat the problem, selection of the correct treatment is the next step. Selecting treatment is a decision that requires a solid understanding of all the options, chemical or otherwise, for pest management material.
5. Proper Timing of Management Strategies: Once an appropriate treatment has been selected, it is important to carefully plan the timing and implementation to maximize effectiveness.
6. Recordkeeping: To facilitate future pest management decisions, accurate records should be kept concerning information on pests, treatments, locations, timing, weather conditions and any other useful information.
7. Evaluation: A successful IPM must be evaluated based on experience, successes and failures in order to focus efforts and resources for the future.

Factors Influencing the Success of a Disease and Insect Monitoring Program

- Public education and communication
- Cooperation and support from state and local agencies
- Structured system to report, investigate and diagnose suspected threats

6.6.2 Emergency Response

An integral part of urban forest management must include an established procedure for emergency response. Individual tree-related emergencies, such as tree failures and large limb failures, are usually isolated events that can be effectively handled by having an emergency protocol for hazardous trees.

Efficient tree emergency response should proceed in an organized manner to maximize safety and minimize costs. For large-scale storm events that result in substantial amounts of damage

and debris from trees, a formal tree emergency protocol should be in place, outlining emergency response steps, safety standards, debris removal plans, public communication means and contact lists. These steps are outlined in the Tree Emergency Manual for Public Officials, included in Appendix D.

Storm events, such as ice storms, high winds and destructive pest infestations, can result in overwhelming amounts of hazardous trees and debris that have immediate implications to public safety. Storm events often cannot be accurately predicted, and the post-storm management of the resulting hazards and debris can go from challenging to chaotic without an emergency response standard in place. Communities manage such catastrophes with varying degrees of efficiency and often rely on aid from state and federal government agencies to fund hazard reduction and debris removal. That aid depends significantly on the ability to estimate storm damage accurately and quickly. The newly developed software i-Tree Storm creates a new standard for assessing widespread storm damage in a simple, credible and efficient manner immediately after a severe storm. This assessment method is adaptable to various community types and sizes, and it provides information on the time and funds needed to mitigate storm damage. Paramount to an efficient and accurate damage assessment is the establishment of a pre-storm survey and the training of observers who will be called upon to perform the field assessments as the City mobilizes after a disaster.

Recommendations

1. Continually update the City's tree emergency response and recovery plan.
2. Establish a method to assess the costs of damage to trees after a storm event.

6.7 Tree Preservation

The following recommendations are suggestions for action-items to protect and enhance the existing public and private urban forest, since the very nature and location of these resources often cross public and private lines, and the presence or absence of them can greatly affect the community and surrounding area as well; and to establish new forest cover where it is needed. The recommendations range from a variety of planning and management tools to simple public education. They are suggested as realistic and practical goals for the City and citizens to achieve.

6.7.1 Tree Preservation Ordinances

Tree preservation ordinances expand on the general principles and goals of the simple tree ordinances by addressing larger issues, such as protection of trees on private property, protection of trees in critical areas (e.g., stream-banks and slopes) and protection of unique forest ecosystem areas. Several approaches can be used to define the preservation of trees within a development.

Examples include:

1. Using a minimum basal area to ensure a minimum canopy cover for all land within the City
2. Establishing a maximum percentage of trees during construction
3. Requiring that the post-development forest be proportionally similar to the pre-development forest. For example, if 50% of the pre-development forest is mature trees

and 50% is saplings, then the post development forest should also consist of 50% mature trees and 50% saplings

Tree replacement guidelines may also be included in the ordinance. For example, some ordinances permit replacing 15, 2-inch diameter trees for the removal of 1, 30-inch diameter tree. This can become a complex procedure and may fail to mitigate the loss of a mature forest if there is not a mechanism to ensure the survival of these newly planted trees. In addition, it may be challenging to locate appropriate planting sites for large numbers of small trees.

Goals of Tree Preservation Ordinances

- Reducing tree loss during development
- Reducing damage to standing trees during construction
- Providing for replacement of trees lost during construction
- Planting trees where none occurred previously
- Maintaining preserved trees after construction is completed

6.7.2 Riparian Setbacks and Easements

Retaining undisturbed, forested land along sensitive resources, such as streams and rivers, provides additional measures of protection. Undisturbed vegetation along streams and rivers filters pollutants, abates flooding, moderates peak flows, allows for groundwater infiltration of storm-water, reduces erosion and sedimentation, stabilizes banks and provides habitat benefits. These areas may be protected by setbacks from the resource area similar to lot-line setbacks. Setbacks protect property owners by preventing construction too close to flood or erosion-prone areas that widen due to upstream development. Requiring riparian setbacks and easements prevents development of the most sensitive lands and promotes a reduction in flooding, erosion and water quality problems while creating more attractive, livable communities.

6.7.3 Conservation Development

Conventional development carves the landscape into a patchwork of disturbed (i.e., mowed, graded and paved) land. Conservation development or open space subdivisions are designed to create the same overall density while preserving 50% or more of the site in open space by grouping buildings together on smaller lots than would ordinarily be allowed under standard zoning or by having flexible side, rear and front yard setbacks. Critical areas of High Point's urban forest can be preserved and protected within the open spaces in conservation developments. To further promote conservation development, the City should consider the following:

- Educate local officials and the development community as to the value, public health and safety benefits, and mechanics of conservation development.
- Educate the public as to the benefits of and need for conservation development.
- Identify linked systems of resources to protect the areas for relatively dense development by comprehensive planning.

6.7.4 Conservation Easements and Donations

Often, property owners will willingly donate all or portions of their property to governments or non-profit organizations for forest and farmland preservation. Other than the outright donation of property, owners can also allow and approve conservation easements to be placed on their property. A conservation easement is a voluntary agreement that allows a landowner to permanently limit the type and amount of development on their property while retaining private ownership.

All parties concerned in transactions relating to conservation easements and land donations generally regard these actions positively. There is no taking by the government; the community benefits from the additional protected green-space; and the property owner can receive financial as well as non-financial benefits from the donation or easement transaction. The City should work cooperatively with local organizations to educate and encourage landowners to consider donating or placing conservation easements on their land to protect critical urban forests.

6.7.5 Creating a Tree Mitigation Site

Use of a tree mitigation site would be an asset to the City. A tree mitigation site is a specific piece of land, or multiple sites, where tree plantings can occur to replace trees that have been removed or damaged due to development elsewhere in the City. Typically, a mitigation site is on publicly owned land or land protected in perpetuity, generally with a conservation easement. The mitigation site would likely be managed by the City or other entity knowledgeable in forest management, urban forestry issues and tree care. The party responsible for tree removal or damage, funds the purchase, planting and long-term maintenance of the trees that are planted at the mitigation site property. Plantings along some of High Point's waterways would be ideal sites.

6.7.6 Historic Tree Designation

It seems to be human nature to want to know about the largest and oldest of trees. In addition to sheer beauty and majesty, the engineering challenges to maintain a large, complex tree structure is truly awesome. To attain great age and size requires the capture of huge amounts of much water, essential elements, food, as well as plenty of good luck. Society honors large specimen trees through state champion programs, native tree societies and advocacy groups.

Although large and old trees seem to be the answer to tree preservation, it should be geared toward the normal range of size and age for the area. The species of a tree should also be considered. For High Point, trees such as Loblolly Pine (Pinus taeda) and Black Locust (Robinia pseudoacacia) are subject to the harsh weather conditions, issues with saturated soils and other issues that classify them more of a hazard in an urban environment. Historic should be designated based on appropriate species, native versus non-native and useful life directly related to the size and species. I.e., an eight-inch diameter Flowering Dogwood (Cornus florida) based on size and age is more historic and useful than a 40-inch diameter Loblolly Pine (Pinus taeda).

6.7.7 Construction Damage and Tree Preservation

Trees are valuable assets. They clean the air, provide shade and wind protection, add aesthetic benefits, decrease cooling and heating costs, provide pollution control, provide storm-water

management benefits and increase property value. Unfortunately, when expansion occurs in the name of progress, trees are often compromised in the process. Attempts to save trees during the construction process are often doomed unless protective measures are carefully implemented prior to and strictly enforced during construction.

Trees are adversely affected both above and below ground by construction activities. To preserve trees during construction activities, every possible preservation technique must be implemented to minimize damage. The following information addresses the activities that damage trees during construction – trenching, soil compaction and soil clearing and grading. Scientists and arborists agree that the greatest percentage of tree roots are in the upper 12 to 18 inches of soil and extend well beyond the spread of the canopy. It is critical to protect the root zone during construction to preserve a tree.

Trenching

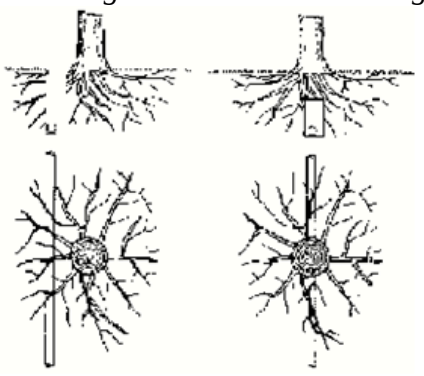
A trench dug without consideration can effectively and immediately sever a tree's root system by 50 percent or more. Construction equipment can injure a tree by tearing or breaking limbs and/or roots and by damaging the bark and wounding the trunk. Wounds created from these actions are permanent and can be fatal if extensive.

Trenching

Tunneling and Directional Boring

Whenever possible, trenching should be restricted to areas that will disturb the least amount of root systems. Where this cannot be achieved because of other site restrictions, tunneling or directional boring should be considered. These practices minimize tree damage by keeping root injury to a minimum.

Tunneling and Directional Boring



Soil Compaction

The most damaging effect of construction activity is soil compaction. Species tolerance to compaction varies, but most trees will suffer when the surrounding soil is compacted extensively. Soil compaction during construction is usually due to equipment and vehicles continually driving over the root zone and from construction supplies and materials being stored for long periods of time near trees. Compaction happens quickly and is difficult, if not impossible, to correct. Only seven passes of a small tractor over the same area is enough to change a porous soil consistency to one similar to concrete. To remedy this, fencing and off-limits areas should be established. If this cannot be accomplished, then a thick layer of unrefined (coarse) wood chips (12 to 18 inches deep) or sturdy geotextile materials can be temporarily laid over the driving area to reduce compaction.

Soil Compaction

Soil Clearing and Grading

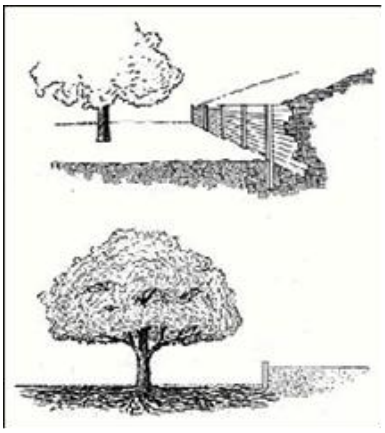
Soil grading and clearing can cause root loss, mechanical damage, soil compaction and stripping of soil nutrients. These detrimental effects of grading and clearing can be avoided by preserving a tree's root zone. Restricting construction activity in and near the root zone by erecting metal, plastic, or wood fencing is the most effective means of avoiding damage to roots, trunks and crowns.

Soil Clearing and Grading

Site Design Solutions

Site design solutions are available to achieve required grade changes and to retain trees. The project architect and/or engineer, working in conjunction with a qualified arborist, can help develop innovative solutions to construction activities and tree preservation.

Site Design Solutions



During construction, protective fencing should be placed at the critical root zone. A tree's critical root zone can be practically defined as the extent of the drip-line despite the fact that a tree's roots often extend two to three times beyond the drip-line. Ultimately, a Tree Preservation Plan should be developed specifically for all construction projects in the City that will affect desirable trees and forest tracts. A preservation plan must note that protective tree fencing shall be installed prior to any site work and that it be placed at or outside of the drip-line to ensure survivability of existing trees. It must also state that no site disturbing activities (e.g., cut, fill, parking, or material storage) shall take place inside the fenced area. Signs should be posted on the fencing to display all pertinent information, such as potential penalties, City contact information and other useful facts. Trees that are only slightly damaged may be restored to a healthy condition by pruning, watering, fertilizing, core aeration and/or radial trenching. Branches directly interfering with construction work should be properly pruned back. If a tree is severely injured, it should be removed. While trees that have been disrupted by construction activities may not be showing signs of damage or stress now, they may show signs of decline in the near future. Trees in construction zones can be damaged or killed by root severance, soil compaction, soil grading and/or construction materials (e.g., toxic leaks and spills).

Table 1. Symptoms and Signs of Construction Activity Damage

Tree Part	Symptoms and Signs of Damage
Crown	Slow growth rate, staghorns, and/or dieback
Leaves	Wilted, scorched, sparse, undersized, distorted, chlorotic, browning margins, premature autumn color, and/or premature drop
Trunk	Wounds, absent bark, crown rot, absence of buttress (root) flares, adventitious sprouting, suckering, and/or severe insect damage and disease
Branches	Dieback, slow growth rate, wounds, adventitious sprouting, and/or suckering
Fruits and flowers	Abnormally large crop, absence of fruit, and/or flowering out of season

Table 2. Major Construction Impacts and Methods to Minimize Damage

Impact to Tree	Construction Activity	Methods and Treatments to Minimize Damage
Root Loss	Stripping site of organic surface soil during mass grading	Restrict stripping of topsoil around trees. Any woody vegetation slated for removal and adjacent to preserved trees should be cut at ground level and not pulled out by equipment. This will prevent tree root injury.
	Lowering grade, scarifying, preparing subgrade for fills and/or structures	Use retaining walls with discontinuous footings to maintain natural grade as far as possible from trees. Excavate to finish grade by hand and cut exposed roots with a saw to avoid root wrenching and shattering by equipment, or cut with root pruning equipment. Spoil beyond cut face can be removed by equipment sitting outside the dripline of the tree.
	Subgrade preparation for pavement	Use paving materials requiring a minimum amount of excavation (*e.g.*, reinforced concrete instead of asphalt). Design traffic patterns to avoid heavy loads adjacent to trees (*i.e.*, heavy load bearing pavement requires thicker base material and subgrade compaction). Specify minimum subgrade compaction under pavement within dripline (*i.e.*, extra reinforcement in concrete or geotextile under asphalt may be needed).
	Excavation for footings, walls, and/or foundations	Design walls/structures with discontinuous footings/pier foundations. Excavate by hand. Avoid slab foundations/post and beam footings.
	Trenching for utilities and/or drainage	Coordinate utility trench locations with installation contractors. Consolidate utility trenches. Excavate trenches by hand in areas with roots larger than 2 inches in diameter. Tunnel under woody roots rather than cutting them.
Wounding Top of Tree	Injury from equipment	Fence trees to enclose low branches and protect trunk. Report all damage promptly so arborists can treat appropriately.
	Pruning for vertical clearance for buildings, traffic, and/or construction equipment	Prune to minimum height required prior to construction. Consider minimum height requirements of construction equipment and emergency vehicles over roads. An arborist, not construction personnel, should perform all pruning.
Unfavorable Conditions for Root Growth and/or Chronic Stress from Reduced Root Systems	Compacted soils	Fence off trees to keep traffic and storage out of root area. In areas of engineered fills, specify minimum compaction (usually 85%) if fill will not support a structure. Provide a storage yard and traffic areas for construction activity well away from trees. Protect soil surface from traffic compaction with thick mulch. Following construction, vertical mulch compacted areas. Install aeration vents.
	Spills and/or waste disposal (*e.g.*, paint, oil, fuel)	Post notices on fences prohibiting dumping and disposal of waste around trees. Require immediate cleanup of accidental spills.
	Soil sterilants (herbicides) applied under pavement	Use herbicides safe for use around existing vegetation and follow label directions.
	Impervious pavement over soil surface	Utilize pervious paving materials (*e.g.*, interlocking blocks set on sand). Install aeration vents in impervious paving.

Table 2. Major Construction Impacts and Methods to Minimize Damage (Continued)

Impact to Tree	Construction Activity	Methods and Treatments to Minimize Damage
Inadequate Soil Moisture	Rechannelization of stream flow, redirecting runoff, lowering water table, and/or lowering grade	In some cases, it may be possible to design systems to allow low flows through normal stream alignments and provide bypass into storm drains for peak flow conditions. Usually flood control and engineering specifications are not flexible where the possibility of flooding occurs. Provide supplemental irrigation in similar volumes and seasonal distribution as would normally occur.
Excess Soil Moisture	Underground flow backup, raising water table	Fills placed across drainage courses must have culverts placed at the bottom of the low flow so that water is not backed up before rising to the elevation of the culvert. Study the geotechnical report for groundwater characteristics to see that walls and fills will not intercept underground flow.
	Lack of surface drainage away from tree	Where surface grades are to be modified, make sure that water will flow away from the trunk (*i.e.*, that the trunk is not at the lowest point). If the tree is placed in a well, drainage must be provided from the bottom of the well.
	Compacted soils, irrigation of exotic landscapes	Compacted soils have few macropores and many micropores. Core vent to improve drainage. Some species cannot tolerate frequent irrigation required to maintain lawns, flowers, and other shallow-rooted plants. Avoid landscaping under those trees, or utilize plants that do not require irrigation.
Increased Exposure	Thinning stands, removal of undergrowth	Preserve species that perform poorly in single stands as groups or clusters of trees. Maintain the natural undergrowth.
	Reflected heat from surrounding hard surfaces	Minimize use of hard surfaces around trees. Monitor soil moisture needs where water use is expected to increase.
	Pruning	Avoid severe pruning where previously shaded bark would be exposed to sun. Where pruning is unavoidable, provide protection to bark from sun.

Recommendations

1. Develop a Tree Preservation Ordinance.
2. Enforce riparian setbacks and require easements.
3. Promote conservation development.
4. Promote and establish conservation easements and land donations.
5. Locate and prioritize potential reforestation areas.
6. Create a Tree Mitigation Site.
7. Implement an educational program with the Urban Forestry Committee taking the leadership role.
8. Require Tree Preservation Plans for all construction projects in the City that will affect desirable trees and forest tracts.
9. Redefine what truly defines a Historic and Significant Tree based on the appropriate species for the area and size in accordance with the species useful life.
10. Consider providing a Champion Tree designation for the community that truly defines a majestic tree and consider more extensive preservation standards for this type of designated tree.

6.8 Educational Tools

An important element of any successful urban forestry program in any community is education. Governments and non-profits alike can work together to educate and inform property owners on how to maintain their trees and forests, plant trees and engage in development projects in ways that protect existing forest tracts. The educational tools discussed in this section are proven approaches to protect urban and community forests. Implementing any of the recommendations previously described will require a substantial effort, and education and information dissemination are critical to the success of these efforts.

Implementing resource protection measures will require educating public officials and developers in designing, implementing and complying with the new requirements in a way that appropriately protects the resources while allowing use of the land. The measures discussed involve changing perceptions about many issues, including:

1. Natural resources provide public and private health and safety benefits and are mechanisms to reduce many problems.
2. Trees and forests are not just attractive areas for people and places for animals to live; they are High Point's natural heritage.
3. Natural resources can be protected through both regulation and guidance. Not all forest protection strategies have to be legislated. Incentives and education can greatly promote proper forest stewardship throughout the City and across Guilford, Forsyth, Randolph and Davidson Counties.
4. All activities have some level of impact on our natural resources, and High Point's residents have a personal responsibility to help protect these resources.

The Urban Forestry Committee should take a leadership role in the educational efforts in High Point. The Committee, as a non-partisan organization with its access to current and comprehensive forest data, is the natural and neutral agency to affect change. Education topics should range from the scientific data gathered on High Point's urban forest to more basic, consumer-oriented tree care, planting and benefits information. The educational efforts should be offered to the following persons and groups:

- City Planners
- Engineers
- Building Inspectors
- City Advisory Commissions
- Contractors/Subcontractors
- Home/Property Owners
- Homeowner Associations
- Foresters
- Citizen Groups
- City Council
- Utility Companies
- Realtors
- Developers
- Landscape Architects

Educational tools may include:

- Workshops and training seminars with community leaders, advisory groups, contractors, homebuilders and county and municipal staff

- Publications, including direct mailings, newsletters, forestry and arboricultural handouts, landmark, unique and historic tree brochures, special publications and articles for the local print media. All publications should be available in electronic format and included on the City's website.
- Awards and events to recognize contractors and governments who excel at tree preservation and reforestation, and a Big Tree Contest and Arbor Day events and programs.

7.0 Funding Sources

Urban forest management is a recognized function of the City of High Point and receives some dedicated funding. Although there are currently no dedicated urban forestry budgetary line items, various departmental funds are available and used for emergency tree maintenance, brush removal, landscape design work and limited tree planting.

With greater funding levels, the City could move from a reactive to a proactive management approach, provide greater services, and increase tree canopy coverage if the security of funds to sustain all activities, programs and initiatives are available. There are various funding mechanisms and sources the City can consider for supporting the increase of staff levels, public education efforts, tree protection, maintenance, planting activities and other components of a truly progressive, comprehensive urban forest management program.

7.1 Establish a High Point Tree Bank

A special account could be created to deposit funds from various sources, which are restricted for use by the urban forestry program. The funds in this account are managed by the City, subject to the annual budget process, and expenditures follow normal purchasing policies and procedures. This innovative funding mechanism does not rely on City general funds but, instead, on the collection and deposit of monies from various sources. Suggested sources include, but are not limited to, the following:

Damage Compensation – This source may not generate a great deal of money, but it is a legitimate and often under-pursued source of funds. When an automobile damages a public tree or when construction equipment destroys a group of public trees, the City should seek compensation for the landscape value of the tree(s). The City can rightly seek compensation for the total damages, including: the value of the tree(s); the cost of repair or clean-up and the cost of the administrative time used during the resolution of the situation. The receipt of $500 from a minor car accident to $5,000 for a major damage claim can add up over time. Generally, the compensation is collected from the insurance company of the person responsible for the damage or directly from the business that caused the damage to public trees. The compensation funds can be used to remedy the specific damage, or be used for other legitimate urban forestry functions throughout the City.

Permit and Plan Review and Inspection Fees – It is not uncommon for municipalities to require private developers and businesses to support the administrative time needed for proper and professional plan review and site inspection tasks. In light of the City's goal to protect and enhance the urban forest, charging specifically for the time and arboricultural expertise needed to approve permit applications, review plans and make site inspections might be a viable option to

support the salary and benefits of additional full or part-time urban forestry positions. The City may need to perform a job analysis to determine the time spent performing review and inspection tasks, and could investigate what other cities in the region, or of a similar size, are charging for such a task.

Developers Fees – In lieu of or in addition to new tree-related plan and inspection fees, and previously mentioned currently required expenses for tree preservation compliance, landscape installation and other zoning/subdivision regulation activities, developers could be required to pay a set amount to support High Point's overall urban forestry program. In effect, it would be a cost of doing business within the City limits. The fee could be a percentage of the total project cost, based on the number of housing units built, or based on the area of land being developed. The City's Planning Department may have better information upon which to base this fee. It is suggested that this fee would be paid and deposited in the Tree Bank before the project is approved.

Utility Company Fees – Non-municipal utility companies perform new construction, maintenance and repair work on an annual basis in the City. This work may affect the aboveground and belowground portions of public trees. It is prudent and reasonable to assess a fee to such utility companies when their work affects municipal trees. Utility companies with aerial facilities might be required to provide the City an anticipated annual work plan and maps with an appropriate fee attached to provide for inspection and monitoring. Any compensation for documented damage to public trees during utility work would be collected separately on a case-by-case basis, and the utility company should be responsible for the costs for any remediation necessary (e.g., pruning, fertilization, or temporary irrigation) above and beyond the fees and compensatory payment. The same conditions would apply for companies installing or maintaining underground utilities.

Private Donations/Corporate Sponsorships – High Point is fortunate to have generous citizens who care about the quality of life in the City. The Urban Forestry Committee could solicit citizens for private donations to support tree planting, tree care and public education activities. A major source of donations could be from businesses and corporations who wish to sponsor non-profit, environmental activities. All potential contributors should be reminded that any donations might be tax-deductible when they file their federal income tax return if their financial situation allows.

Fund-Raising Activities – With the support of volunteers, the City can hold various fund-raising events throughout the year. Popular large events include competitive and social runs and walks. Volunteers can staff food and drink booths at local fairs and festivals. Tree and High Point-related merchandise could be commissioned and sold. Restaurants can have special Tree Nights where a small percentage of the patron's bill is donated back to the City for tree planting. Even small efforts, such as school and church bake sales and yard sales, can be encouraged to raise funds for trees in the community.

Firewood/Mulch/Wood Sales – If City property can be sold, the wood waste from tree maintenance and storm damage repairs can be a source of funds for the Tree Bank. Other cities have been successful in selling split and un-split firewood, hardwood timber and rough wood chips to the general public and commercial businesses. Rather than pay for proper removal and disposal, cities sell these excess wood products. A new trend is when a significant or historic

public tree must be removed; the logs and useable wood are given to local craftsmen who then create furniture, sculpture and other collectibles from the wood. These are sold and all or portions of the proceeds are returned to the City.

Memorial and Honor Trees – High Point's tree planting program is currently partially funded and enhanced by a Memorial/Honor Tree Planting Program. Citizens at times of loss and at times of celebration often choose to plant a tree to remember special people and mark a special achievement. Cities across the country successfully use this funding technique not only for program support but also for generating good public relations for the urban forestry program. A prudent approach to implementing such a program is to set a level of funding that will not only purchase and plant a tree of a certain size, but that will also collect funds to pay for maintenance for three years.

Utility Bill Donations – The City bills property owners directly for water and sewer services. These municipal invoices could be a source for needed funds for the urban forestry program. A small fixed amount from $0.25 to $1.00 could be automatically added to each bill. The property owner would then have the option to voluntarily include it with their utility payment. Another option is to ask the bill payers to round the invoice amount up to a higher figure of their choice. Using this voluntary and painless funding mechanism can potentially raise thousands of dollars. Cooperation and coordination between the Utility Department and Finance Department will be necessary to implement this program.

7.2 Other Funding Tools

The following sources of revenue are not appropriate for inclusion in High Point's Tree Bank, but are each viable sources of funding for the comprehensive urban forestry program.

Increase the General Fund Allocation to the Urban Forestry Program – During future budgeting cycles, the City should consider increasing the financial resources available for urban forestry staff and functions and making a separate budget line-item for the urban forestry program.

Obtain Grants – As a municipality and a non-profit with existing support structures and staff, High Point is in a good position to apply for and receive grants to support urban forestry activities. The City has previously received grants for urban forestry projects, but with the investment in time and a person skilled in grant writing, there are likely multitudes of grant opportunities for High Point. These opportunities can be found with the State and Federal governments, non-profit organizations, large corporate and private business foundations and private charitable foundations. If High Point establishes a Tree Bank, there will be a ready source of matching funds to leverage even more grant dollars.

Promote the Federal Tax Incentive to Citizens – As a non-profit, the City of High Point is in a unique position to encourage citizens to directly pay for desired tree planting and tree maintenance on public property. The City should inform property owners abutting the public rights-of-way, parks, or other municipal properties that if they pay for City-approved, proper public tree planting or tree maintenance, then that effort and any related expenditures may qualify as a charitable deduction on their federal income tax return. Until the City's urban

forestry program is fully staffed, equipped and funded, this mechanism is a good public relations tool as well as a way to accomplish needed work.

8.0 Management Goals

The overarching goals of High Point's Urban Forest Management Plan is to guide the City's efforts to recover the loss of tree canopy and enhance all tree-related benefits by recommending strategies and actions to improve urban forest management in an equitable, economic and sustainable manner. The Urban Forest Management Plan seeks to initially be used along with the Core City Plan and will achieve its goals by recommending strategies, goals, policies, standards and actions to protect, enhance, expand and preserve the tree canopy for the benefit of the community.

Through input from City staff and a detailed analysis of urban forestry conditions, five management goals emerged as priorities for High Point:

1. Tree Planting and Increased Forest Canopy Cover
2. Improved Tree Planting/Protection Policies
3. Expanded Education and Public Relations
4. Improved Funding
5. Improved Urban Forest Maintenance

8.1 Major Goal Areas, Statements and Objectives

Achieving progress and success in the five major goal areas should be the City's priority in the next ten years. These major goals are summarized below.

Goal Area 1 — Tree Planting and Increased Forest Canopy Cover

Statement: High Point's canopy cover is steadily declining due to forest removal on private property and lack of new and replacement tree planting on public and private properties. Without an adequate forest canopy cover, High Point will not realize the many tangible and intangible benefits trees provide, and the character of the City will suffer.

Objectives:

1. Achieve an overall tree canopy cover of 40%.
2. Expand the Master Tree Planting Plan with prioritized areas, including, but not limited to, these public areas: streets, parks, pathways/trails, public buildings, greenways and waterways.
3. Ensure that all new tree planting is monitored to ensure species diversity and is performed using current arboricultural standards.
4. Seek to establish an adequate level of funding for tree planting through increased allocations from the general fund, grants, donations, fees and other sources.
5. Plant trees only if there is a maintenance program and adequate resources available to care for the trees.

Goal Area 2 — Improved Tree Planting/Protection Policies

Statement: The City should review and improve ordinances, guidelines and policies regarding tree planting and tree and forest protection, and create or enact new policies as needed. These policies will serve as an official statement by the City regarding the importance and value of trees in the community.

Objectives:

1. Review and revise the High Point Unified Development Ordinance to require a higher degree of accountability for developers to preserve existing forests and plant new trees. Consider changing the fee structure to support more professional arboricultural review, inspection, and emphasize the need for developers to replace trees or make significant payments to a newly established Tree Bank.
2. Revise the section of the Development Ordinance that references trees on public property. Include language that provides for a full accounting of tree value by collecting the appraised value of public trees that are damaged or removed without a permit. Require permits for any work on public property that may damage trees (including roots). Require all work on public trees to follow accepted industry standards.
3. Update the tree guidelines that serve as a technical guide to tree preservation and other arboricultural activities to ensure all current arboricultural and horticultural standards and practices are referenced and used.

Goal Area 3 — Expanded Education and Public Relations

Statement: Citizens, businesses, City staff and leaders, and developers need continued education and marketing targeted to increase their awareness of the benefits of trees. They need to be aware of the availability of City resources and the various ways they can become more involved in the urban forest management program and be a part of the solution.

Objectives:

1. Continue public and citizen urban forestry outreach efforts through a wide variety of media outlets, special events and publications to instill a sense of civic pride and gain more financial and political support for the urban forestry program.
2. Create a standardized educational program for orienting newly elected public officials to the City's urban forestry program, efforts and goals.
3. Promote internal educational opportunities by increasing professional interaction, coordination and communication between departments and staff regarding tree planting and maintenance principles and practices.
4. Market the urban forestry program and its successes outside of the City to the surrounding counties, state, region and the country. A widespread and heightened awareness of the quality of the urban forest and life in High Point promotes economic development, which, in turn, enhances the visibility and political stature of the program.

Goal Area 4 — Improved Funding

Statement: Critical to the program's success is adequate funding.

Objective:

1. Seek new and reallocated funding sources to support a comprehensive urban forestry program. A national average sets the minimum annual budget at $5 per capita.

Goal Area 5 — Improved Urban Forest Maintenance

Statement: Proper and timely tree maintenance is required to maximize tree benefits, increase service life, improve aesthetics and ensure public safety. Maintenance programs are critical to the survival, vitality and growth of existing trees and of newly planted trees.

Objectives:

1. Implement four tree maintenance programs — preventive maintenance on a 5-year cycle, routine maintenance on an as-needed or request basis, young or small tree maintenance, and an emergency response program.
2. Expand the current Core City Tree Inventory to a city-wide street and park tree inventory and complete a full update every ten years. Use a quality tree management software program to store the data, document maintenance work and costs, and create annual work plans.
3. Mandate the use of current and accepted best management practices and arboricultural work standards in all maintenance activities.
4. Adequately train City employees performing maintenance, encourage staff to become Certified Arborists, and hire contractors who perform work to the highest industry standards (Appendix E has information about contracting tree work).

9.0 Conclusion

High Point's natural resources have contributed greatly to the character of the City. Over the years, however, changing demographics, renewed interest and activity in attracting business, increasing residential development and new research on the benefits urban forests provide cities all pointed to the need for an evaluation of the current urban forest resources and management in High Point and creating a plan of action. The Urban Forest Management Plan is the resulting action plan and is based on major goals that collectively lead to creating a sustainable urban forestry program.

9.1 Management Goal Areas and Key Recommendations

The overarching goal of High Point's Urban Forest Management Plan is to guide the City's efforts to recover the loss of tree canopy and enhance all tree-related benefits by recommending strategies and actions to improve urban forest management in an equitable, economic and sustainable manner. The five Management Goal Areas are presented below with the key recommendations.

1. Tree Planting and Increased Forest Canopy Cover

High Point's canopy cover is steadily declining due to forest removal on private property and lack of new and replacement tree planting on public and private properties. Without an adequate forest canopy cover, High Point will not realize the many tangible and intangible benefits trees provide, and the character of the City will suffer.

Key Recommendations: Achieve an overall tree canopy cover of 40% by a combination of facilitating and expanding the Core City Master Tree Planting Plan, revising current policies, enacting new policies, creating incentives for private property owners to plant trees on private properties, and ensuring there is adequate funding for tree planting and maintenance.

2. Improved Tree Planting/Protection Policies

The City of High Point should review and improve ordinances, guidelines and policies regarding tree planting and tree and forest protection, and create or enact new policies as needed. These policies will serve as an official statement by the City regarding the importance and value of trees in the community.

Key Recommendations: Improve City policies by reviewing and amending, as needed, the Unified Development Ordinance, as well as updating and adopting a defensible Public Tree Ordinance; and incorporate urban forestry goals, programs and tasks with all other City plans.

3. Expanded Education and Public Relations

Citizens, businesses, City staff and leaders, and developers need continued education and marketing targeted to increase their awareness of the benefits of trees. They need to be aware of the availability of City resources and the various ways they can become more involved in the urban forest management program and be a part of the solution.

Key Recommendations: Continue public and citizen urban forestry outreach efforts, and educate elected officials and City employees on a regular basis.

4. Improved Funding

Critical to the program's success is adequate funding.

Key Recommendations: Seek new and reallocated funding sources to support a comprehensive urban forestry program.

5. Improved Urban Forest Maintenance

Proper and timely tree maintenance is required to maximize tree benefits, increase service life, improve aesthetics, and ensure public safety. Maintenance programs are critical to the survival, vitality and growth of existing and newly planted trees.

Key Recommendations: Implement and expand various tree maintenance programs, and conduct a complete public tree inventory every ten years using a tree data software program to manage the data.

9.2 Plan Implementation

It is hoped that High Point's Urban Forest Management Plan will be a working document that can be used by the City and the Urban Forestry Committee as a guide and reference source to achieve not only short and long-term urban forestry goals, but City goals as well. With this Plan, High Point has an important and critical tool to help form, grow and sustain an effective, progressive and comprehensive urban forestry program. The Plan will allow the Urban Forestry Committee, City staff and leaders, and the citizens to examine a number of urban forestry issues in terms of what is technically correct, organizationally feasible, and aesthetically complementary, as well as what is economically expedient.

The importance of comprehensive urban forestry management in High Point transcends the daily, operational maintenance routines and responsibilities; it stands to demonstrate the City's leadership and commitment to improving the environmental quality of life for its citizens. It demonstrates that owning and managing land not only grants privileges but also entails obligations.

High Point's urban forest is a municipal amenity that will appreciate over time because trees are alive and growing. They provide tangible and intangible benefits to the City and its citizens. Because of their significance to the environmental, social and economic well-being of the City, the urban forest should be professionally managed and protected to preserve them for all citizens and the future.

"People in cities need to have living things around them. The most common biblical metaphor for the spirit is the wind; and trees show us the wind. The state of a city's trees is what tells us if the special spirit of a city is alive and blowing."

Sara Ebenrect, "Measuring the Value of Trees,"

American Forests, July/August 1988

Appendices

A. Definitions

B. Tree Fertilization, Planting, Pruning and Removal Specifications

C. Tree Planting and Pruning Guidelines

D. Tree Emergency Manual for Public Officials

E. Contracting Tree Work

Appendix A
Definitions

Appendix A. Definitions

American National Standards Institute (ANSI) Standards

ANSI is a private, non-profit standards organization that serves as a facilitator for the standardization work of its members in the United States. It accredits standards developing organizations (SDOs) that meet a set of requirements and criteria governing the management of consensus standards development. Accredited SDOs can submit candidate documents to ANSI for consideration and approval as American National Standards (ANS). ANSI's goal is to promote and facilitate voluntary consensus standards and conformity assessment systems and maintain their integrity.

Basal Area

The basal area is the cross-section area of the stem or stems of a plant or of all plants in a stand, generally expressed as square units per unit area.

Cabling/Bracing

Cabling and bracing are processes that restore or improve the structural integrity of a tree that is worth preserving. Individual limbs or the entire tree may be cabled and braced. Fasteners are attached to the weakened limb and the main trunk. Using ropes or chains, tension is applied to the weakened limb. Heavy-duty cables are then prepared and attached to each fastener to provide the correct amount of support for the weakened limb.

Central Leader

The central leader is the topmost vertical stem extending from the trunk.

Certified Arborist

A *Certified Arborist* is an individual who has achieved a level of knowledge in the art and science of tree care through at least three years' experience and who has passed a comprehensive examination developed by some of the nation's leading experts on tree care. A *Certified Arborist* must also continue his/her education to maintain his/her certification. Therefore, he/she should be up-to-date on the latest techniques in arboriculture. Certification is not a measure of standards of practice. Certification can attest to the tree knowledge of an individual, but cannot guarantee or ensure quality performance.

Codominant Leader and Stems

Codominant leaders and stems is a tree condition that occurs when two or more branches, trunks, or leaders of approximately the same size originate in close proximity to one another.

Condition Rating

Rating tree condition involves looking at the tree crown, foliage, trunk, and root characteristics. The condition of each tree is rated according to the following categories:

Excellent

Trees in this class are judged to be exceptional trees possessing the best qualities of their species. They have excellent form and very minor maintenance problems. There are virtually no dead branches, deformities, or nutritional problems. These trees are in an acceptable location and can be expected to achieve a full mature shape and life expectancy.

Good

Trees in this class are judged to be desirable and with proper maintenance can be returned to an excellent classification. They may be interfering with utility lines, planted in an overcrowded location, or have minor insect, pathogen, or nutritional deficiencies.

Fair

Most trees in this category have some or all of the following problems: large dead limbs with as much as one-half of the tree already dead, large cavities in the trunk, major deformities, girdling roots, obvious insect, pathogen, or nutritional problems. Immediate maintenance and proper care may be able to save the tree.

Poor

Trees in this group are in a degraded condition with irreversible problems. They have over 50% dead branches, drastic deformities, and severe insect, pathogen, or nutritional problems. They will have to be removed as soon as possible.

Dead

Trees in this category are either already dead or in such poor condition that removal is required. These trees have over 90% dead branches and have completely succumbed to either insects, pathogens, or nutritional deficiencies. It is important to conduct the installation tree inventory after spring growth has begun. This ensures that a dormant tree is not misidentified as dead.

Coniferous

Coniferous trees are those that are in or related to any order (Coniferales) of mostly evergreen trees and shrubs including forms (as pines) with true cones and others (as yews) with an arillate fruit.

Conservation Easement

A conservation easement is a restriction placed on a piece of property to protect its associated resources. Conservation easements protect land for future generations while allowing owners to retain many private property rights and to live on and use their land, at the same time potentially providing them with tax benefits.

Critical Root Zone

The critical root zone is the soil area around a tree where the roots are located that provides stability and a significant uptake of moisture.

Cultivar

A cultivar is a race or variety of a plant that has been created or selected intentionally and maintained through cultivation.

Diameter at Breast Height (DBH)

The DBH is the internationally accepted method of measuring tree diameter. Measurements are taken on the trunk of the tree 4.5 feet from the ground.

Deciduous

Deciduous trees or other plants lose their leaves at some time during the year and stay leafless during the cold season.

Double Leader

A double leader occurs when two stems compete as leading stems on a tree.

Genus

Genus is a taxonomic category ranking below a family and above a species and generally consisting of a group of species exhibiting similar characteristics. In taxonomic nomenclature, the genus name is used, either alone or followed by a Latin adjective or epithet, to form the name of a species.

Geographic Information Systems (GIS)

GIS is a technology that is used to view and analyze data from a geographic perspective. The technology is a piece of an organization's overall information system framework.
GIS links location to information (such as people to addresses, buildings to parcels, or streets within a network) and layers that information to give you a better understanding of how it all interrelates. You choose what layers to combine based on your purpose.

Global Positioning Systems (GPS)

GPS is a system of earth-orbiting satellites that make it possible for people with ground receivers to pinpoint their geographic location.

Grow Space

A tree's grow space is the room needed for a plant's leaves and roots to grow.

Growth Habit

The growth habit of a tree describes its growth form, comprising its size, shape, texture, and orientation.

Integrated Pest Management

Integrated pest management is an approach that relies primarily on non-chemical means (such as controlling climate, food sources, and building entry points) to prevent and manage pest infestation.

Low-impact Development (LID)

Low-impact development is a more environmentally sensitive approach to developing land and managing stormwater runoff. The main objective of low impact development is to help protect aquatic resources, water quality, and the natural hydrology of a watershed as development takes place.

Maintenance Rating

Tree maintenance requirements can be categorized in one of six categories:

Removal—High Priority

Trees categorized as high-priority removals should be removed as soon as possible as their condition and location present risks to persons or property.

Removal—Low Priority

Low-priority removals should be scheduled and accomplished when resources are available after high-priority removals have been accomplished. These trees are generally located away from population areas and facilities.

Pruning—Immediate Priority

Like high-priority removal, trees in the immediate pruning category present safety risks to persons or property. Trees in this category are characterized by dangerous broken branches and large deadwood. Pruning should be accomplished as soon as resources are available. All trees in this category should be examined closely during trimming operations for decay or severe dieback. If, upon closer inspection, these trees are severely decayed, they should be removed.

Pruning—High Priority

Trees requiring high-priority pruning should be attended to as quickly as scheduling will allow, starting with those presenting the greatest safety risks. These trees, like the immediate priority pruning category, have broken branches and areas of deadwood. The dead areas, however, do not present an immediate safety hazard to persons or property. All trees in this category should be examined closely during trimming operations for decay or severe dieback. If, upon closer inspection, these trees are severely decayed, they should be removed.

Routine Pruning

All other trees, except young and recent plantings, fall into the routine pruning category. They require removal of dead, dying, diseased, or obviously weak, heavy, or hazardous branches, and deadwood. Routine, ongoing pruning should be scheduled and programmed to ensure all tree pruning is accomplished on a minimum cycle of five to seven years. It is important to remember that low priority problems can become high priority if they are neglected for an extended period of time. Thinning of tree canopies to reduce crossing or unnecessary branches should be accomplished routinely. This reduces the potential for wind and ice-induced branch breakage and increases sunlight and air circulation within the crown. Thinning of tree canopies reduces substantially the incidence of insect and disease related problems.

Training Pruning

Trees in this category are generally young, recent plantings. Minimum maintenance includes trimming root and trunk suckers, deadwood, crossing, diseased, or weak branches, and staking improvement or removal. Trees in this category need to be scheduled for maintenance and not neglected. Generally, young trees should be pruned to reflect their species' natural growth pattern or to a single leader or a strong central leader to promote the development of strong scaffold limbs. Certain species do not develop single leaders; therefore, the strongest leaders should be selected and allowed to shape the tree canopy. It is important to remember that minor problems can become major if they are neglected for an extended period of time.

Monoculture

A monoculture is a single, homogenous culture of species lacking diversity across a population or area.

Native Species

A native species is one which naturally exists at a given location or in a particular ecosystem, *i.e.*, it has not been moved there by humans.

Non-native Species

Species that occur outside of their native ranges in a given place as a result of actions by humans are non-native species.

Over-mature

Trees or stands past the mature stage are over-mature.

Residential Cluster Development

Residential cluster development is a means of permanently protecting open space, rural character, and important environmental resources in new housing developments, while still providing homeowners with good housing and landowners with the opportunity to develop their property.

Right-of-Way

The right-of-way is a strip of land over which facilities, such as highways, railroads, or power lines, are built.

Risk Tree

A risk tree has structural defects likely to cause failure of all or part of the tree, which could strike a target.

Routine/Preventive Maintenance

Routine/preventive maintenance work is planned and performed on a routine basis to maintain and preserve the condition of trees.

Species

Species is a fundamental category of taxonomic classification, ranking below a genus or subgenus and consisting of related organisms capable of interbreeding. An organism belonging to such a category, represented in binomial nomenclature by an uncapitalized Latin adjective or noun following a capitalized genus name.

Stocking Level

The number of trees in an area as compared to the desirable number of trees for best results, such as maximum wood production.

Tax Increment District (TID)

A TID uses property and/or sales tax revenues in a designated area to enable private development to occur.

Traffic Calming Device

Traffic calming devices are used to calm traffic on residential streets to enhance neighborhood livability. Some examples of these devices are speed humps, stop signs, crosswalks, traffic signals, and enforcing speed limits.

Transplanting

Trees within the urban forest may be affected as the result of proposed construction. In these cases, the choices are to remove or transplant the tree. Trees in good condition under 20 centimeters DBH should be transplanted if expertise, equipment, and funding are available. The long-term benefits of transplanting a quality tree usually outweigh the transplanting costs. Transplanting can be accomplished using a tree spade or by back-hoe and chain. A large, protected root ball and immediate replanting greatly improves transplant success. This will lessen transplant shock and dehydration greatly enhancing survival rates. In most regions, transplanting is most successful when performed in the fall. Transplanted trees must receive constant attention for at least six months or more depending on the season and climate. Extra irrigation, root

stimulators, special fertilizers, and expert pruning contribute to the success and survival of a transplanted tree.

Tree Bank

A tree bank is a special account created to deposit funds from various sources, which are restricted for use by the urban forestry program. The funds in this account are managed by the City, subject to the annual budget process, and expenditures follow normal purchasing policies and procedures.

Tree Mitigation Site

A tree mitigation site is typically a publicly owned property, such as a school or public park, or a site permanently protected with a conservation easement where a developer can donate and plant the required trees when it is not feasible to plant the required trees within their site's project area.

Urban Forest Canopy Cover

The urban forest canopy cover is a measurement of how much of an urban area is covered by the leaves in the crown of its trees. Communities use this measure to set tree planting goals to ensure green infrastructure is maintained at minimum thresholds, even as the community continues to develop.

Appendix B

Tree Fertilization, Planting, Pruning, Removal Specifications

CITY-WIDE STREET TREE PLANTING SPECIFICATIONS
CITY OF _____, _____

I. Scope of Work

To provide all supervision, material, labor, equipment, service operations, and expertise required to deliver, locate, plant, and guarantee for one year, street trees in the City of _____as specified herein. Contractor has responsibility to:

A) Furnish, transport, and plant trees;

B) Reserve workspace along streets;

C) Excavate in-place soil, plant, and backfill with topsoil approved by City Administrator;

D) Furnish and place mulch;

E) Remove excess material and clean up site;

F) Guarantee trees for one year and make appropriate replacement planting;

G) Keep work site safe at all times; and

H) Any work incidental to above.

II. Definitions

A) Reference is any other specifications or standards means the latest revision in effect on date of invitation to bid. This set of specifications governs when disagreement with a reference specification occurs.

B) Specified means specified in the invitation to bid and/or order or contract.

C) ANSI Z60.1-Standards are American Standard for Nursery Stock.

D) City Administrator is the city's representative that will administer the technical aspects of this tree planting contract. The City Administrator for this contract is:

_____

E) Contractor is a company that earns the majority of its annual revenue from planting or maintaining trees and/or shrubbery. Contractor must possess an I.S.A. Certified Arborist License or Certified Landscapers License or Certificate.

III. Materials Specifications

Mention of any product name neither constitutes an endorsement of that product nor excludes the use of similar products meeting specifications.

A) Nursery Stock - All trees healthy, vigorous, and well-grown, showing evidence of proper root and top pruning, single-trunked, high-branched specimens suitable for use along streets. All trees 1-3/4 inch caliper unless otherwise noted. All trees grown at least one year in a currently active nursery having same climatic conditions as the City of _____. All trees meet ANSI Z60.1-standards for top grade. Label attached to each tree at nursery indicating botanical name and common name. City Administrator will mark trees in the nursery and has final approval of species or variety used and nursery from which trees are obtained.

B) Root balls and burlap - All trees balled and burlapped with ball shape and size conforming to ANSI Z60.1 standards. Root flare will be easily visible on root balls. Only rottable burlap and rottable rope permitted. Root balls adequately protected at all times from sun, heat, freezing, and drying. City Administrator will reject any cracked or manufactured root balls.

C) Mulch - Year-old rough wood chips created by local tree service companies during brush chipping operations.

IV. Work Procedures

A) Source of supply - Contractor submits to City Administrator, within ten (10) days after receipt of notice of award of contract, complete and detailed information concerning the source of supply for each item of plant material specified in the planting list.

B) Tree location - All planting sites will be identified and marked by the City Administrator before planting begins. The appropriate utilities services will be notified of planting site locations by Contractor immediately after contract has been awarded. Contractor will also be responsible for notifying the appropriate utility authority prior to digging. Contractor will be responsible for any damage to utilities during the planting process. Sites will be marked by a white flag in the grass area and also with a white mark painted on the curb. All trees will be centered between curb and sidewalk, at least two feet from curb line unless otherwise specified by the City Administrator.

C) Delivery - Trees shall be transported and handled with adequate protection. Trees shall be covered with burlap or tarpaulin during transit or transported in a closed truck to prevent drying out of the tree. Trees in leaf shall be sprayed before shipping with "Wiltpruf" or other anti-desiccant approved by the City Administrator.

D) Temporary storage - Root balls of trees not immediately planted after delivery must be adequately protected by mulch or heeling-in and watering until planting occurs. Contractor assumes all risk and expense of temporary storage.

E) Planting holes - Holes may be dug by hand, backhoe, tree spade, or other approved equipment at specified location. An auger is not considered approved equipment. Walls of the planting hole shall be dug so that they are properly sloped and sufficiently loosened to remove the glazing effects of the digging. The planting hole shall be elliptical in shape with the top diameter two times that of the ball. The bottom of the hole shall be rough, flat, and deep enough to have the plant at its original planting depth or slightly higher. Holes shall be ground only on the day the tree is planted. Contractor is responsible to ensure all holes are safe until planted and covered with mulch.

F) Precautions during digging - When underground utilities are encountered, Contractor immediately calls the controlling agency or company and the City of _____. The Contractor, at his expense, restores to original condition all structures, facilities, and other property damaged by his company's work.

G) Surplus excavation - Removed and disposed of by Contractor at his own expense.

H) Planting - Allowed only between the dates of _____ and _____. Planting is only allowed when the soil is not frozen. Balled and burlapped trees are set on tamped backfill, placing tree at same depth as in nursery or up to two (2) inches higher than that level. Planting height may be adjusted if unusual site situations are encountered after approval by City Administrator. Burlap should be pulled back one-third the depth of the root ball and rope or twine should be cut from trunk. Trees with forked top oriented with forked limbs shall be pointed parallel to street and not toward street. Planting is not allowed on days when temperatures fall below 30° F.

I) Root pruning - Ends of broken or damaged roots more than 1/4 inch in diameter should be pruned with a clean cut, removing only injured portion.

J) Backfilling - Planting holes shall be backfilled with approved topsoil. Mix soil amendments in mixture prior to filling the hole to prevent stratification. Incorporate a transplant inoculant that contains water-absorbing material such as polymers, root stimulants, and endo- and ecto-mycorrhizal fungi into the backfill. Backfill sides of the tree hole halfway with soil mixture and tamp as the hole is being filled. Cut and remove all rope, twine, burlap, and wires from the top half of the soil ball. Wire baskets should be cut and removed to a two-inch depth below the soil line. Burlap should be pulled back with one-half of the soil ball exposed after plants are properly placed in the planting hole. Shape backfill and mulch in a water ring to facilitate watering.

K) Top pruning and wound treatment - Pruning to make trees shapely and typical of species shall be done according to recognized horticultural standards and instructions of the City Administrator. Accidental damage during planting not great enough to warrant branch removal or tree replacement should be promptly traced according to recognized horticultural practices. Pruning paint is not necessary.

L) Mulching - Place rough wood chips loosely around trees within 24 hours after planting to uniform depth of no more than four (4) inches and to a diameter of three (3) feet where possible.

M) Extra holes - Excess or improperly located planting holes are to be immediately backfilled and seeded with Kentucky Bluegrass, and covered with two (2) inches of straw, at Contractor's expense.

N) Watering - Thoroughly water to settle backfill when one-half of backfill is in place and again after all backfill is placed. It is highly recommended that watering continue through the first growing season to increase chances of survival after planting.

O) Wrapping - Trees are not wrapped unless specified by the City Administrator. If wrapping is required, trunk and wrapping shall be treated with a 20 percent Lindane and water spray. Wrapping is crinkle-draft tree wrapping paper tied with rottable twine.

P) Productivity - Production schedule beginning and ending dates will be agreed upon in writing between the Contractor and the City Administrator.

Q) Supervision - Contractor is required to consult with the City Administrator concerning details and scheduling of all work. Contractor shall have a competent person in charge of work at all times to whom the City Administrator may issue directions and who is authorized to accept and act upon such directives. Supervisor calls the City Administrator before each day's work begins to provide work locations by street.

R) Public relations - An information sheet shall be supplied by the City Administrator to Contractor for distribution to property owner.

V. Substitutions

If a species or variety is used as a substitute with the approval of the City Administrator, the per tree price paid by the City is the lowest of:

A) The per tree price of the species or variety originally bid on; or

B) The lowest bid price for the substitute species or variety if it is specified elsewhere in this contract.

VI. Inspections

A) Nursery inspection - The City Administrator, at its discretion, will inspect and mark nursery stock purchased under this contract before digging.

B) Agency inspection - Federal, state, and other authorities inspect all trees before removal from nursery, as required by local law. Required certificates declaring trees free of all diseases and insects shall accompany each order or shipment of trees.

C) Planting inspection - The City Administrator, at its discretion, inspects progress of planting or temporarily stored trees to review the progress of the work and condition of trees.

D) Guarantee period inspection - The City Administrator inspects planting work to verify completion and begin guarantee period. Contractor requests this inspection in writing at least ten (10) days before its scheduled date. After inspection, the City Administrator notifies Contractor in writing of date of beginning of guarantee period or of deficiencies to correct before guarantee period begins.

E) Correction inspection - Two months before end of guarantee period, the City Administrator inspects work and notifies Contractor of replacement and other corrections required to make work acceptable.

F) Final inspection - At end of guarantee period, City Administrator inspects trees to determine final acceptance. Contractor requests this inspection in writing at least ten (10) days before the scheduled date.

G) Stock inspections - The City Administrator reserves right to inspect trees before they are removed from delivery truck at work site. Delivery truck driver or other agent or Contractor should call the City Administrator's office before leaving for work site each day to facilitate these on-truck inspections.

H) Other inspections - City Administrator reserves right to inspect on-site work at any time without notice. Contractor calls City Administrator on morning of each working day to provide work location.

VII. Guarantee

Contractor guarantees that all trees remain alive and healthy until the end of a one-(1) year guarantee period. Contractor replaces, as specified, and at his expense, any dead trees and any trees, that in the opinion of the City Administrator, have become unhealthy or unsightly or have lost their natural shape due to dead branches, improper pruning or maintenance, or any other cause due to the Contractor's negligence, or weather conditions. Contractor straightens any leaning trees, bearing the entire cost.

VIII. Rejection

Contractor disposes of any tree rejected by the City Administrator at the Contractor's expense.

IX. Items

Each entry (Street name, estimated number of trees and species) within each section is considered a separate item. The City Administrator reserves the right to delete any item or items because of an inability to obtain specified trees or other reasonable cause.

TREE REMOVAL AND PRUNING SPECIFICATIONS CITY OF _____, _____

I. Scope of Work

To provide all labor, supervision, equipment, services, and expertise necessary to perform urban forestry maintenance work in the City of _____as specified herein. Since this work is of a potentially dangerous nature, and requires special expertise, it is to be performed by a contractor that derives a majority of its annual income from arboricultural work and whose employees are highly trained and skilled in all phases of tree service work. Contractors must have been in business for at least five years. The City will require proof of Contractor's involvement in tree service work. The contractor has the responsibility to:

A. Remove or prune designated trees.

B. Reserve work space along streets.

C. Grind out stump when tree is to be removed.

D. Remove excess material and clean up site.

E. Guarantee that specifications be met.

F. Keep work site safe at all times.

II. Definitions

A. **Reference:** Reference to any other specifications or standards means the latest revision in effect on date of invitation to bid. This set of specifications governs when disagreement with a reference specification occurs.

B. **Specified:** Means specified in the invitation to bid

C. **ANSI Z-133:** American Standard of Tree Worker Safety.

D. **ANSI A300:** Standard Practices for Trees, Shrubs, and Other Woody Plant Maintenance

E. **City Administrator:** The City's representative that will administer the technical aspects of this tree pruning and removal contract. The City administrator for this contract is: _____

F. **Contractor:** A company that earns the majority of its annual revenue for pruning, removing, or maintaining trees and/or shrubbery. Contractor must possess an I.S.A. Certified Arborist License.

III. Work Procedures

A. **Equipment:** All bidders must have in their possession or available to them by formal agreement at the time of bidding: trucks, devices, chippers, hand tools, aerial and other equipment and supplies which are necessary to perform the work as outlined in these specifications. The City may inspect such equipment or agreements prior to the awarding of a contract.

B. **Tree Location:** Work limited to trees located on all public rights-of-way and City-owned property. All work under this contract shall be assigned by supplying the Contractor with a list of trees that have been marked with blue paint for priority pruning or red paint if tree is to be removed. All other trees on list are to be pruned for vehicular and pedestrian traffic. The City reserves the right to change, add, or delete areas or quantities to be pruned or removed as it deems to be in its best interest. Pruning and removal operations will commence no later than thirty (30) days after the contract has been awarded and will be completed no later than 90 days after work has begun. The Contractor will be responsible for notifying the appropriate utility authority before removing trees growing in the utility wires. Contractor will be responsible for any damage to utilities during the removal or pruning process.

C. **Public Relations:** An information sheet will be sent by the City Administrator to the property owners.

D. **Supervision:** Contractor consults with the City concerning details of scheduling of all work. Contractor has a competent person in charge of his work at all times to whom the City may issue directives and who shall accept and act upon such directives, and who reads, speaks, and writes English competently. Failure for the supervisor to act on said directives shall be sufficient cause to give notice that the Contractor is in default of contract unless such directives would create potential personal injury of safety hazards. The City requires a certified arborist on the job site, and requires the arborist's certification number in this bid.

E. **Inspections:** The City is called at #_____before 8:30 a.m. on mornings of each working day and told exact location of that day's work. The City inspects work at its discretion and is requested by letter, five days in advance of the completion of this contract, to provide a final inspection.

F. **Tree Damage:** Climbing irons, spurs, or spikes are not used on trees to be pruned. Any tree damage caused by contractor is repaired immediately at no additional expense to the satisfaction of the City Administrator. Trees damaged beyond repair, as judged by the City Administrator, are removed at no expense to the City and replaced by a tree of size and species designated by the City Administrator at no additional expense to the City or the dollar value of such damaged trees, as determined by the City Administrator, is deducted from the monies owed the Contractor.

G: **Pruning Specifications:** Conforms to latest revision of standards of National Arborist Association, ANSI A300. All cuts shall be made as close as possible to the trunk or parent limb, without cutting into the branch collar or leaving a protruding stub. Bark at the edge of all pruning cuts should remain firmly attached. All branches too large to support with one hand shall be precut to avoid splitting or tearing of the bark. Where necessary, ropes or other equipment should be used to lower large branches or stubs to the ground. Treatment of cuts and wounds with wound dressing or paints has not been shown to be effective in preventing or reducing decay and is not generally recommended for this reason. Wound dressing over infected wood may stimulate the decay process. If wounds are painted for cosmetic or other reasons, then material non-toxic to the cambium layer of meristematic tissue must be used.

Care must be taken to apply a thin coating of material only to exposed wood.

Old injuries are to be inspected. Those not closing properly and where the callus growth is not already completely established should be bark traced if the bark appears loose or damaged. Such tracing shall not penetrate the xylem (sapwood), and margins shall be kept rounded.

Equipment that will damage the bark and cambium layer should not be used on or in the trees. For example, the use of climbing spurs (hooks or irons) is not an acceptable work practice for pruning operations on live trees. Sharp tools shall be used so that clean cuts will be made at all times.

All cut limbs shall be removed from the crown upon completion of the pruning. Clean-up of branches, logs, or any other debris resulting from any tree pruning shall be promptly and properly accomplished. The work area shall be kept safe at all times until the clean-up operation is completed. Under no condition shall the accumulation of brush, branches, logs, or other debris be allowed upon a public property in such a manner as to result in a public hazard.

Trees impeding vehicle or pedestrian traffic should be raised up a least 13 feet over streets and 8 feet over sidewalks. Trees obstructing control devices (stop signs, yield signs, and traffic lights) should be trimmed to allow for adequate visibility.

H. **Removal Specifications:** Removals will include topping and other operations necessary to safely remove the assigned trees. No trees or trunks are felled onto pavement. Work includes removal of basal sprout and brush and weeds within three feet of the trunk. The tree stump will be ground out to a depth of six (6) inches below the normal surface level including all surface roots. Immediately after grinding each stump, the grindings must be removed from the work area. Adjacent sidewalks, lawns, streets, and gutters will be cleaned. Backfill consisting of clean earthen soil should be used to fill the cavity, free of debris, to normal ground level and seeded with an approved seeding mix. Do not backfill with wood chips. All labor, supervision, equipment, materials, and supplies necessary for the execution of this work must be provided for by the contractor at no additional cost to the city. All debris disposal must be provided by the contractor at no additional cost to the city. The chosen contractor will be required to follow the ANSI Z-133 Standards for tree worker safety. If a contractor is not aware of these standards, copies can be provided by the City of _____.

I. **Traffic Control:** Is total responsibility of Contractor and is coordinated with the proper department of the City of _____.

The contractor shall be solely responsible for pedestrian and vehicular safety and control within the work site and shall provide the necessary warning devices, barricades, and personnel needed to give safety, protection, and warning to persons and vehicular traffic within the area.

Blocking of public streets shall not be permitted unless prior arrangements have been made with the City and is coordinated with the appropriate departments. Traffic control is the responsibility of the Contractor and shall be accomplished in conformance with State, County, and Local highway construction codes.

J. **Utility Agencies:** Are contacted by Contractor any time assistance is needed to work safely around overhead or underground installations. The City provides a list of principal contacts and telephone numbers for public and private utility organizations.

Tree trimming and removal operations may be conducted in areas where overhead electric, telephone, and cable television facilities exist. The Contractor shall protect all utilities from damage, shall immediately contact the appropriate utility if damage should occur, and shall be responsible for all claims for damage due to his operations.

The Contractor shall make arrangements with the utility for removal of all necessary limbs and branches that may conflict with or create a personal injury hazard in conducting the operations of this contract. If the Contractor has properly contacted the utility in sufficient time to arrange for the required work by the utility, delays encountered by the Contractor in waiting for the utility to complete its work will not be the responsibility of the Contractor.

K. **Safety:** Work conforms to the latest revision of American National Standards Institute Standard Z-133.1 (Safety Requirement for Pruning, Trimming, Repairing, Maintaining, Removing Trees, and for Cutting Brush).

At the time a contract is entered into, the Contractor shall certify in writing to the City that all Contractor's employees working on this job are either 'Qualified Line Clearance Tree Trimmers' or 'Qualified Line Clearance Tree Trimmer Trainees', as defined in the above ANSI Z-133.1 Standards.

L. **Clean Up:** Clean-up procedures are completed within two hours after debris have been placed around the site of each tree requiring pruning or removal. The work site is left equal to or cleaner than pre-work conditions. Tree parts dropped or lowered from trees are kept off private property.

It shall be the responsibility of the Contractor to remove and dispose in a proper and acceptable manner all logs, brush, and debris resulting from the tree maintenance operations. Wood may be left for residents, but that not taken must be disposed.

M. **Damages:** Done by the Contractor to any person or property, public or private, are the total responsibility of the Contractor and are repaired or compensated for by the Contractor to the satisfaction of both injured party and the City at no cost to the City.

N. **Insurance:** Contractor shall be fully insured as specified and shall be completely covered by State Workers' Compensation during the life of this contract. The Contractor shall have liability insurance in the amount of $1,000,000.00 for each occurrence and shall name the City as an additional insured on its policy for the work being performed in the City of _____.

O. **Payments:** Partial billings are acceptable, but not more frequently than every two weeks. Payment is made according to actual number of stumps removed. Ten percent (10%) of each invoice is withheld until Contractor's work is completed to the satisfaction of the City. Billing for work along any street may not be made until Contractor completes all work on that street. At the discretion of the city, one-half of the ten percent (10%) retainer may be held until spring if enough snow is on the ground that a proper inspection of sites cannot be conducted. When an inspection is done and the Contractor, as directed by the City, corrects any problem that may occur, the remainder of the retainer will be paid.

P. **Working Hours:** The Contractor will schedule work between the hours of 7:00 a.m. and 6:00 p.m. Monday through Friday unless authorized by the City to do otherwise.

Q. **Subcontracts:** The Contractor will not be allowed to subcontract work under this contract unless written approval is granted by the City. The Subcontractor, as approved, shall be bound by the conditions of the contract between the City and the Contractor. The authorization of a Subcontractor is to perform in accordance with all terms of the contract and specifications. All directions given to the Subcontractor in the field shall bind the Contractors as if the notice had been given directly to the Contractor.

R. **Execution of Contract:** The successful Bidder shall, within five (5) calendar days of the mailing of written notice of selection as the successful bidder, enter into contract with the City on forms included within the bidding documents for the performance of work awarded him and shall simultaneously provide the appropriate bonds, indemnities, and insurance required hereunder.

The contract, when executed, shall be deemed to include the entire agreement between the parties; the Contractor shall not base any claim for modification of the contract upon any prior representation or promises made by representatives of the City, or other persons.

S. **Discontinuance of Work:** Any practice obviously hazardous as determined by the City shall be immediately discontinued by the Contractor upon receipt of either written or oral notice to discontinue such practice.

T. **Observance of Laws, Ordinances, and Regulations:** The Contractor, at all times during the term of this contract, shall observe and abide by all Federal, State, and Local laws which in any way affect the conduct of the work and shall comply with all decrees and orders of courts and competent jurisdiction. The Contractor shall comply fully and completely with any and all applicable State and Federal Statutes, rules, and regulations as they relate to hiring, wages, and other applicable conditions of employment.

U. **Supervision:** This contract will be under the direct supervision of the City or its authorized representatives. Any alteration or modifications of the work performed under this contract shall be made only in written agreement between the Contractor and the City-authorized representative and shall be made prior to commencement of the altered or modified work. No claims for extra work or materials shall be allowed unless covered by written agreement.

V. **Bidding Specification and Contractual Terms:** Tree maintenance work done under the direction of this contract shall be bid on forms as provided by the City.

W. **References:** Municipal tree pruning and removal experience is required. The bidder will provide a list of municipal governments that it has serviced in the past five years with a contact person listed.

X. **Award:** For a bid to be considered, prices must be quoted for the entire pruning and removal project.

Y. **Contract Termination:** The City shall have the right to terminate a contract or a part thereof before the work is completed in the event:

i. Previous unknown circumstances arise making it desirable in the public interest to void the contract;

ii. The Contractor is not adequately complying with the specifications;

iii. Proper arboricultural techniques are not being followed after warning notification by the City or its authorized representatives;

iv. The Contractor refuses, neglects, or fails to supply properly trained or skilled supervisory personnel and/or workers or proper equipment of the specified quality and quantity;

v. The Contractor in the judgment of the City is unnecessarily or willfully delaying the performance and completion of the work;

vi. The Contractor refuses to proceed with work when as directed by the City; or

vii. The Contractor abandons the work.

Z. **Indemnification:** I, the Contractor, agree to indemnify, hold harmless, and defend the City from and against any and all loss, damage, or expense which the City may suffer or for which the City may be liable by reason of any injury (including death) or damage to any property arising out of negligence on the part of the Contractor in the execution of the work to be performed hereunder.

This indemnity provision shall not apply in cases where the Contractor has not been provided with timely notice, nor shall the Contractor be liable to the City for any settlement of any complaint affected without the prior written consent of the Contractor. This indemnity provision also specifically does not apply to loss, damage, or expense arising out of contact with the City's trees by persons (other than employees of the Contractor engaged in the work contemplated by this agreement) who are around such trees.

STUMP REMOVAL SPECIFICATIONS FOR DEPARTMENT OF PUBLIC SERVICE CITY OF _____, _____

I. Scope of Work

To provide all labor, supervision, equipment, services, and expertise necessary for grinding of stumps, disposal of grindings and debris, and backfilling of stump holes in the City of _____ as specified herein. Since the work is potentially dangerous, and requires special expertise, it is to be performed by a Contractor that derives a majority of its annual income from arboricultural work and whose employees are highly trained and skilled in all phases of tree service work. Contractors must have been in business for at least five years. The City may require proof of the Contractor's involvement in tree service work.

The Contractor has the responsibility to:

A. Reserve work space along streets;

B. Grind out designated stumps;

C. Remove excess material and clean up the work site;

D. Guarantee the specifications will be met; and

E. Keep work site safe at all times.

All bidders must have in their possession or available to them by formal agreement at the time of bidding: trucks, stump grinders, hand tools, and other equipment and supplies that are necessary to perform the work as outlined in these specifications.

II. Location

Work is limited to stumps located on all public rights-of-way and City-owned property. All work under this contract shall be assigned by supplying the Contractor with a list of stumps that have been marked with the diameter of the stump.

The City reserves the right to change, add, or delete areas or quantities of stumps to be removed as it deems necessary. Stumping operations will commence no later than five (5) days after the contract has been awarded and will be completed no later than _____.

III. Supervision

Contractor consults with the City concerning details of scheduling of all work. Contractor has a competent person in charge of his work at all times to whom the City may issue directives and who shall accept and act upon such directives, and who reads, speaks, and writes English competently.

Failure for the supervisor to act on said directives shall be sufficient cause to give notice that the Contractor is in default of contract unless such directives would create potential personal injury of safety hazards. The City requires a certified arborist on the job site, and requires the arborist's certification number in this bid.

IV. Inspections

The City is called at #_____before 8:30 a.m. on mornings of each working day and told exact location of that day's work. The City inspects work at its discretion and is requested by letter, five days in advance of the completion of this contract, to provide a final inspection.

V. Stump Grinding

The tree stumps will be ground out to a depth of six (6) inches below the normal surface level including all surface roots. Immediately after grinding each stump, the grindings must be removed from the work area. Adjacent sidewalks, lawns, streets, and gutters will be cleaned. Holes are not to be left open overnight. Backfill consisting of clean earthen soil should be used to fill in the cavity, free of debris, to four (4) inches above the existing lawn grade surrounding the stump site (to allow for settling) and seeded with an approved seeding mix. Do not backfill with wood chips.

All labor, supervision, equipment, material, and supplies necessary for the execution of the work must be provided for by the Contractor at no additional cost to the City. All debris disposal must be provided by the Contractor at no additional cost to the City.

The chosen Contractor will be required to follow the ANSI Z-133 Standards for tree worker safety. If a Contractor is not aware of these standards, copies can be provided by the City of _____.

VI. Traffic Control

Is total responsibility of Contractor and is coordinated with the proper department of the City of _____.

The Contractor shall be solely responsible for pedestrian and vehicular safety and control within the work site and shall provide the necessary warning devices, barricades, and personnel needed to give safety, protection, and warning to persons and vehicular traffic within the area.

Blocking of public streets shall not be permitted unless prior arrangements have been made with the City and is coordinated with the appropriate departments. Traffic control is the responsibility of the Contractor and shall be accomplished in conformance with State, County, and Local highway construction codes.

VII. Utility Agencies

Are contacted by Contractor any time assistance is needed to work safely around overhead or underground installations. The City provides list of principal contacts and telephone numbers for public and private utility organizations.

The Contractor shall protect all utilities from damage, shall immediately contact the appropriate utility if damage should occur, and shall be responsible for all claims for damage due to his operations. It is left to the Contractor's discretion to notify the appropriate utility authority before stump removal begins. If the Contractor has properly contacted the utility in sufficient time to arrange for the required work by the utility, delays encountered by the Contractor in waiting for the utility to complete its work will not be the responsibility of the Contractor.

VIII. Damages

Done by the Contractor to any person or property, public or private, are the total responsibility of the Contractor and are repaired or compensated for by the Contractor to the satisfaction of both injured party and the City at no cost to the City.

IX. Insurance

Contractor shall be fully insured as specified and shall be completely covered by State Workers' Compensation during the life of this contract. The Contractor shall have liability insurance in the amount of $1,000,000.00 for each occurrence and shall name the City as an additional insured on its policy for the work being performed in the City of _____.

X. Payments

Partial billings are acceptable, not more frequently than every two weeks. Payment is made according to actual number of stumps removed. Ten percent (10%) of each invoice is withheld until Contractor's work is completed to the satisfaction of the City. Billing for work along any street may not be made until Contractor completes all work on that street. At the discretion of the city, one-half of the ten percent (10%) retainer may be held until spring if enough snow is on the ground that a proper inspection of sites cannot be conducted. When an inspection is done and the Contractor, as directed by the City, corrects any problem that may occur, the remainder of the retainer will be paid.

XI. Working Hours

The Contractor will schedule work between the hours of 7:00 a.m. and 6:00 p.m. Monday through Friday unless authorized by the City to do otherwise.

XII. Subcontracts

The Contractor will not be allowed to subcontract work under this contract unless written approval is granted by the City. The Subcontractor, as approved, shall be bound by the conditions of the contract between the City and the Contractor. The authorization of a Subcontractor is to perform in accordance with all terms of the contract and specifications. All directions given to the Subcontractor in the field shall bind the Contractors as if the notice had been given directly to the Contractor.

XIII. Execution of Contract

The successful Bidder shall, within five (5) calendar days of the mailing of written notice of selection as the successful bidder, enter into contract with the City on forms included within the bidding documents for the performance of work awarded him and shall simultaneously provide the appropriate bonds, indemnities, and insurance required hereunder. The contract, when executed, shall be deemed to include the entire agreement between the parties; the Contractor shall not base any claim for modification of the contract upon any prior representation or promises made by representatives of the City, or other persons.

XIV. Discontinuance of Work

Any practice obviously hazardous as determined by the City shall be immediately discontinued by the Contractor upon receipt of either written or oral notice to discontinue such practice.

XV. Observance of Laws, Ordinances, and Regulations

The Contractor, at all times during the term of this contract, shall observe and abide by all Federal, State, and Local laws which in any way affect the conduct of the work and shall comply with all decrees and orders of courts and competent jurisdiction. The Contractor shall comply fully and completely with any and all applicable State and Federal Statutes, rules, and regulations as they relate to hiring, wages, and other applicable conditions of employment.

XVI. Supervision

This contract will be under the direct supervision of the City or its authorized representatives. Any alteration or modifications of the work performed under this contract shall be made only in written agreement between the Contractor and the City-authorized representative and shall be made prior to commencement of the altered or modified work. No claims for extra work or materials shall be allowed unless covered by written agreement.

XVII. Bidding Specification and Contractual Terms

Stump work done under the direction of this contract shall be bid on forms as provided by the City.

XVIII. Award

For a bid to be considered, prices must be quoted for the entire stump removal project.

XIX. Contract Termination

The City shall have the right to terminate a contract or a part thereof before the work is completed in the event:

A. Previous unknown circumstances arise making it desirable in the public interest to void the contract;

B. The Contractor is not adequately complying with the specifications;

C. Proper arboricultural techniques are not being followed after warning notification by the City or its authorized representatives;

D. The Contractor refuses, neglects, or fails to supply properly trained or skilled supervisory personnel and/or workers or proper equipment of the specified quality and quantity;

E. The Contractor in the judgment of the City is unnecessarily or willfully delaying the performance and completion of the work;

F. The Contractor refuses to proceed with work when as directed by the City; or

G. The Contractor abandons the work.

XX. Indemnification

I, the Contractor, agree to indemnify, hold harmless, and defend the City from and against any and all loss, damage, or expense which the City may suffer or for which the City may be liable by reason of any injury (including death) or damage to any property arising out of negligence on the part of the Contractor in the execution of the work to be performed hereunder.

This indemnity provision shall not apply in cases where the Contractor has not been provided with timely notice, nor shall the Contractor be liable to the City for any settlement of any complaint affected without the prior written consent of the Contractor. This indemnity provision also specifically does not apply to loss, damage, or expense arising out of contact with the City's stumps by persons (other than employees of the Contractor engaged in the work contemplated by this agreement) who are around such stumps.

CITY WIDE STREET TREE FERTILIZATION SPECIFICATIONS

CITY OF _____, _____

I. Scope of Work

To provide all supervision, material, labor, equipment, service operations, and expertise required to fertilize street trees in the City of _____as specified herein. Contractor has responsibility to:

A) Furnish, transport, and apply water-soluble fertilizer;

B) Reserve work space along streets;

C) Use hydraulic sprayer and soil probe or lance at 100-200 PSI;

D) Remove excess material and clean up site;

E) Keep work site safe at all times; and

F) Any work incidental to above.

II. Material Specifications

Section A: Types of Fertilizer to be Used

1. Inorganic Fertilizer (Chemical) - Is that derived from chemical sources. These nutrients are readily available in the soil and are rapidly soluble, with a short residual period.
2. Soluble Fertilizer - Is mixed with water and applied in liquid form. Soluble fertilizers may be applied via the deep root feeding method. Soluble fertilizers are usually inorganic and readily available. Materials with a limited solubility that dissolve slowly are often listed on fertilizer labels as water-insoluble nitrogen (WIN).

Section B: Fertilizer Analysis

1. Established Plantings - use fertilizers with N-P-K ratios of 3-1-2 or 3-1-1 for best response. These formulations may have slight variations.
2. Inorganic (water-soluble) nitrogen should be supplemented with synthetic or organic nitrogen (WIN) for the slow availability characteristics of the insoluble form of the material.

Section C: Rates of Application

1. For optimum plant growth, apply 4-6 lbs. of actual nitrogen per 1,000 sq. ft. every two years.
2. Diameter at Breast Height (DBH) - Measure the trunk diameter at 4.5 feet above grade. Generally for optimum growth, apply 1/4 lb. actual nitrogen per inch DBH to trees under 6 inches in diameter. The rate can be increased to 1/2 lb. N per inch DBH for most trees over 6 inches DBH. The majority of the trees to be fertilized in this project will be 2 - 4 inch DBH. Using a 3-inch DBH tree and fertilizing with 1/4 lb. actual N per inch DBH would require 4.2 lbs of an 18-5-11 complete fertilizer:

   3 inches (dia) x 0.25 lb/inch (rate) = 0.75 lb. (amount of N).

   0.75 lb. (amount of N) / 0.18 (%N in 18-5-11) = 4.166 lbs of 18-5-11.

3. Liquid application - Diluted fertilizer solutions should be applied at the rate recommended by the manufacturer according to operating pressure and flow rate of the equipment to be used. Apply sufficient liquid mixture to supply the required rate of fertilizer as determined by the surface area of DBH method. It is suggested that one apply 150 gallons to each 2,000 sq. ft. of surface area. Inject approximately 1/2 gallon of fertilizer solution per injection at 2.5 ft. spacings.

Section D: Timing of Fertilizer Applications

Early spring before bud break is the recommended time for fertilizing. Fertilizing should not be done after leaves have fully expanded.

Section E: Method of Fertilizer Application

Liquid Injection - Injections using a soil probe or lance should be 2.5 feet apart, and 6-12 inches deep for trees. Begin lance injection 2-3 feet from the tree trunk and work out about 8 feet beyond the trunk or to the sidewalk or other hardscape obstacle, which ever is farthest. Use a hydraulic sprayer at 100-200 lbs. pressure and soil lance designed for liquid fertilizer with a manual shut-off valve and three or four horizontal discharge holes at 90 degrees in its point. Inject one-half a gallon of fertilizer solution into each hole. The addition of water to dry soil as occurs during the liquid injection process is an excellent side-benefit.

Section F: Additional Guidelines

1. Undesirable tree species that could be found on tree lawns or on public rights-of-way should not be fertilized. These are: silver maple, boxelder, alder, birch, catalpa, redbud, Russian-olive, osage-orange, apple, mulberry, poplar, cottonwood, cherry plum, black cherry, black locust, sassafras, willow, and elm.
2. Be aware that overfertilizing small trees such as flowering crabapple can result in excessive succulent growth. Succulent growth is more prone to fireblight symptoms on susceptible plants such as pear, crabapple, and mountain ash.
3. Fertilize in moist soils - Fertilizer should always be applied in moist soils to enhance fertilizer uptake and reduce fertilizer injury to plants and aid in soil injection treatment. If soils are not moist, irrigation should precede fertilization to moisten the plant root zone area. The liquid injection method of fertilizing trees will help moisten the soil in the root zone while applying desired nutrients.
4. Fertilizing Excessively Wet Soils - Avoid fertilizing trees growing in soil that is excessively wet. The roots in wet soil are often damaged from lack of oxygen caused by the accumulation of toxic gases. Adding fertilizer in any form may contribute to root injury.
5. Read the Label - Read the entire label of any fertilizer product before application and apply per label recommendations.

Appendix C
Tree Planting and Pruning Guidelines

Planting Guidelines

The following guidelines to tree planting will help reduce transplanting shock and ensure that trees adapt to the new site. Keep in mind that spring and fall are the best times of the year to plant trees, but some trees do better when transplanted in spring rather than fall, and vice versa. Check with your nursery when planning tree-planting operations.

Site Conditions

A frequent cause of new tree failure is poor acclimation to site conditions. This includes not only the planting site, but also the climate conditions at the nursery and the similarity in the new tree location. For example, a tree raised in a nursery farther south than the planting site may have more difficulty in adapting than a tree grown in more similar climate conditions. Furthermore, the soil conditions of the site (pH, moisture, oxygen, and nutrient availability) should be sufficient to meet the specific requirements of the tree. It is more cost-effective to choose the right tree for a site than to modify the site after the tree has been planted or to have high maintenance costs because a poorly established tree is unhealthy.

Tree Selection

In addition to selecting trees that are tolerant of existing site conditions, select trees that show normal growth and are free of serious insect and disease problems. The trees should exhibit good vitality, appearing undamaged with a healthy root mass. Trees should have good leaf color, annual twig growth, and bud appearance. Careful nursery selection is essential.

Single-stemmed trees should not have the appearance of clumped foliage arising from the same point on the stem. Such a condition, while providing an initial tree form, will ultimately cause branching problems, such as weak crotches, and should be avoided. Trees with good potential for lower maintenance when mature will have a scaffold or ladder appearance with branch angles greater than forty-five degrees. Some trees have this form naturally, while others need to be pruned when young to encourage such form.

Stock Type

Trees are delivered from the nursery in one of three states of preparation: balled-and-burlapped trees, with soil surrounding the root system; bare-root trees, without soil; and containerized trees, generally grown in the container in which they are delivered.

Bare-root is the least expensive and allows roots to be in contact with the native soil. However, care must be taken to keep the roots protected and moist before planting, as the fine roots can dry rapidly.

Balled-and-burlapped tree roots are slower to dry out than bare-root trees, as the roots are inside a soil ball. However, the burlap may cover dead or poorly pruned roots and should be inspected before planting. The type of soil surrounding the roots should not be too different from the soil on the site or the tree roots may not extend sufficiently into the surrounding soil from the root ball. In such a case, the backfill soil should be amended to provide a transition between the two types of soil.

Container-grown trees have an undisturbed root system and can be planted with the intact root system. If the tree has been in the container for too long; however, the tree may be pot-bound with the roots encircling the inside perimeter of the pot. The roots should be sliced or partially separated in order to improve the ability of the tree to extend the roots into the surrounding soil.

Tree Planting

The tree should be planted to the same depth or slightly higher than it was growing at the nursery. A high mound should be avoided as the soil can dry out quickly in the summer and freeze in the winter.

The hole should be dug shallow and wide. It should not be any deeper than the root ball but should be a wide hole, allowing for amendments, if necessary, or for loosening heavy clay soil to allow for improved oxygen availability and root penetration.

The backfill soil should be added gradually and watered carefully to settle the soil but not to saturate it. Balled-and-burlapped trees should have any untreated burlap pulled away from the top of the root ball and cut away| not buried| so that none of the burlap is exposed at the soil surface. Otherwise, the burlap can wick moisture away from the roots of the freshly planted tree.

Tree Staking

Stakes should only be used to support trees on windy sites or for smaller trees with weak trunks. The stakes should be placed before the backfill is added to avoid damaging any large roots. A stake is meant to provide a temporary support and should be removed within a year to allow the tree to develop trunk strength and to limit the potential for physical damage from the stakes and support ties.

Wooden stakes, metal pipe, fence stakes, and metal reinforcing bars may all be used for support. Anything used for a tie should have a flat, smooth surface and be somewhat elastic to allow for slight movement for the tree. Suitable materials include rubber strips or webbing and belting. Wire covered with hose or tubing **should not** be used.

Tree Irrigation

Because a newly transplanted tree may have lost much of its root system, watering is critical for successful establishment. Initial watering at planting should be followed with weekly watering, particularly during dry periods. A newly planted tree will benefit from at least an inch of water a week.

Mulching

Newly planted trees respond well to mulch placed around the tree. This reduces initial root competition with turf and limits the possibility of physical damage by mowers. These factors contribute to the health of the trees and increase the likelihood of survival.

The mulch should **not** be piled (mulch 'volcanoes') around the tree and should not actually touch the tree trunk. No more than a 2- to 3-inch depth of mulch should be added, with it being no more than ½ inch deep closest to the tree.

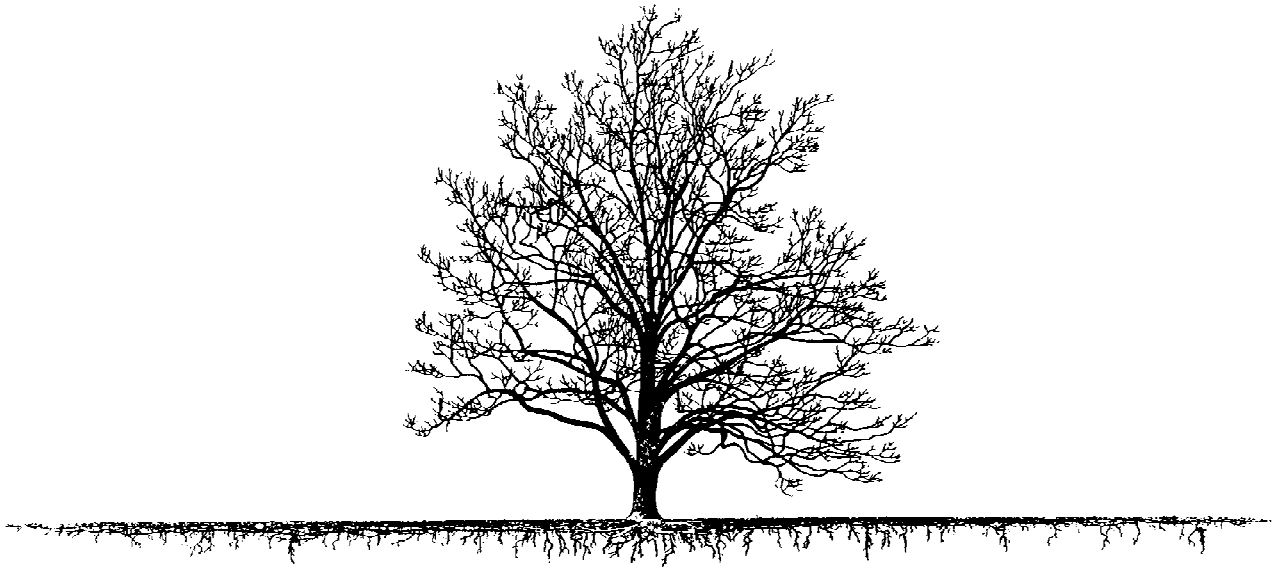
Pruning

When planting a tree, only dead or broken branches should be removed. All living branches should be left on the tree to help promote tree establishment. Once the tree has been established on the site, training pruning can be done to promote good branching patterns, but no more than 1/4 of the branches should be removed at any one time.

Fertilizing

Fertilizer is not generally necessary at the time of planting and, indeed, if placed improperly in the planting hole can injure roots. The addition of nitrogen, in a slow-release form, however, can benefit a newly planted tree, and it may be efficient to apply at the time of planting.

Tree Pruning Guidelines



Introduction

Pruning consists of *selectively* removing branches (living and dead) from woody plants, ranging from pinching off a bud at the end of a twig to removing large limbs.

Proper pruning benefits trees, shrubs, and vines, and the associates of woody plants (including humans). Pruning branches can be one of the most beneficial or the most damaging practices arborists do to trees.

A basic principle of pruning is that the removal of any live stems, branches, twigs, and buds affects growth of the plant. Proper pruning prevents and corrects defective form that could result in branch or stem failure. Thus, knowledge of plant biology is essential for the correct methods of pruning.

Most tree species evolved in competitive forest communities. Consequently, trees developed efficient branching systems to capture the energy of available light for photosynthesis.

Woody plants also evolved the ability to get rid of inefficient energy resources by *shedding* shaded branches (cladaptosis). A branch is naturally shed from its base. As natural shedding occurs, the wood tissue around the branch core within the stem protects against decay. Proper limb removal cuts imitate natural branch shedding (natural target pruning).

Many people equate woody plant pruning to amputation, but there should be no fear of wise and careful use of pruning equipment. A properly pruned tree, shrub, or vine is a combination of art, science, and skill.

Tree surgeons should adhere to industry pruning standards. In the arboriculture industry, the current standard approved by the ISA and the NAA is *The American National Standards Institute* (ANSI) A300 issued in 1995.

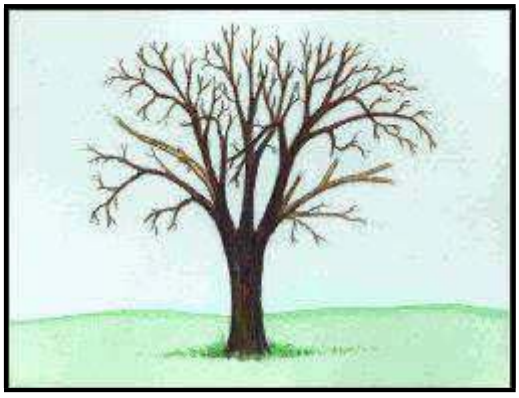
Reasons for Pruning

The first rule in pruning is **do not cut without a reason**. Too often arborists tend to over prune to meet client expectations. Proper pruning is an effort to *direct* new growth rather than 'control' growth.

Most pruning cuts are of a *preventive* or a *corrective* nature to be beneficial to woody plant health.

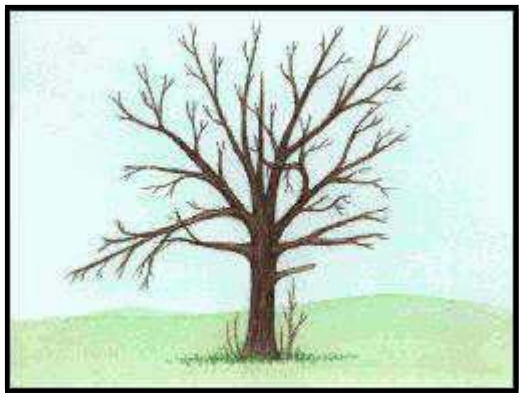
Health

- *Sanitation* by removing dead, broken, decayed, diseased or insect-infested wood (crown cleaning).
- *Thinning* to improve penetration of light and air, and to reduce wind resistance and potential storm damage.
- Reduction of the number of poorly attached *epicormic branches.*
- *Girdling root* removal.
- Correct and/or redirect *structural growth* that may cause future problems (weak crotches, branches growing out of proportion, etc.).



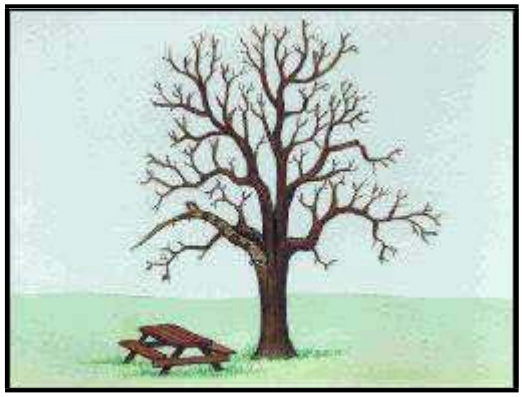
Appearance

- Shape for aesthetic purpose, natural forms, growth habit (training).
- Influence flowering, fruiting, promotion of shoots, canes, bark color.
- Direct new growth and/or correct improper prior pruning (crown restoration).



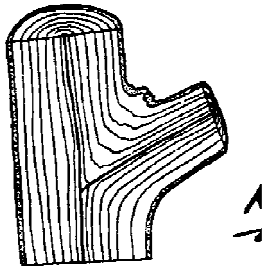
Convenience or Safety of Property and People

- Correct or modify storm-damaged, neglected, or poorly pruned woody plants.
- Identify and remove potential hazard limbs, stems, and deadwood (hazard reduction pruning).
- Line clearance (directional pruning).
- Raise or lower obstructive canopies over or near roads, sidewalks, playgrounds, buildings, pools, satellite dishes, etc. by removing interfering limbs (crown reduction and/or crown raising).
- Provide access to more light for understory plants and turf (crown thinning).
- Vista pruning (alter crowns to allow views of something beyond tree screens).



Pruning Methods and Techniques

Branch Attachment to Stems



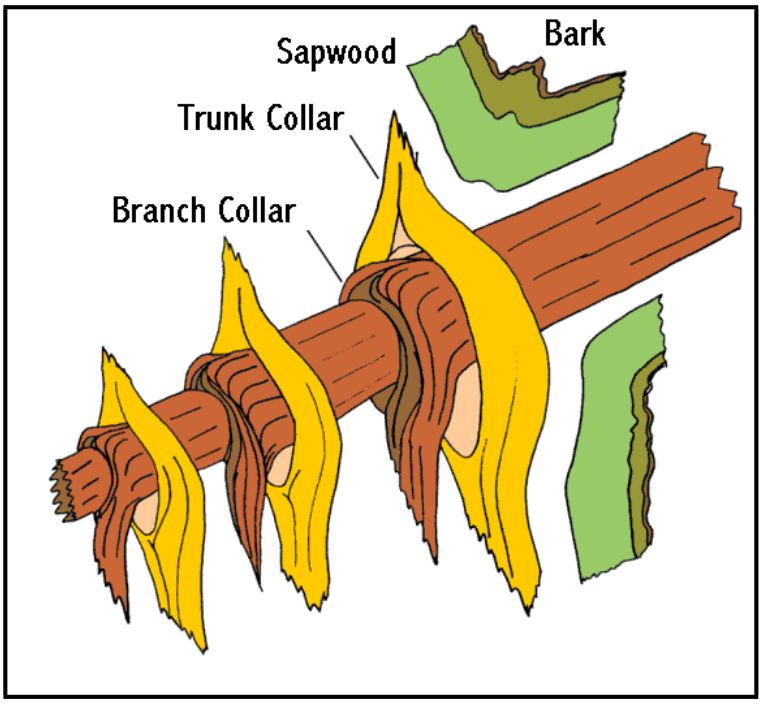
New branch tissues generated by the vascular cambium usually start growth before trunk tissues. As current-year branch tissue develops from branch ends toward the trunk, it turns abruptly downward at the branch base to form a *collar.*

Trunk branch tissues grow later and form a trunk collar over the branch collar (trunk collars and branch collars are collectively called the *branch collar*).

The collar is where wood and bark of the branch and the trunk come together, like an overlapping tissue 'switching zone'. All true branches on woody plants have branch collars.

The *branch bark ridge* (BBR) is raised bark developing in the branch crotch and shows the angle of the branch core in the tree.

If a branch dies or is removed, the trunk collar continues to grow over the thin belt of branch tissue below the collar junction. The wood core of the branch is walled off (compartmentalized) in the trunk.



Proper Pruning Cuts (Natural Target Pruning)

Location of *branch bark ridges* and *branch collars* determines the location of a pruning cut. Cuts must be made *outside* of the branch bark ridge, angling away from the trunk outward as close as possible to the collar.

- There is no set or standard angle for a proper collar cut.
- The proper angle depends on the shape of the collar.
- Conifers often have flat collars where a straight cut close to the collar is correct.
- Sometimes the angle of the cut will necessitate an *upstroke* cut with a handsaw or chainsaw.

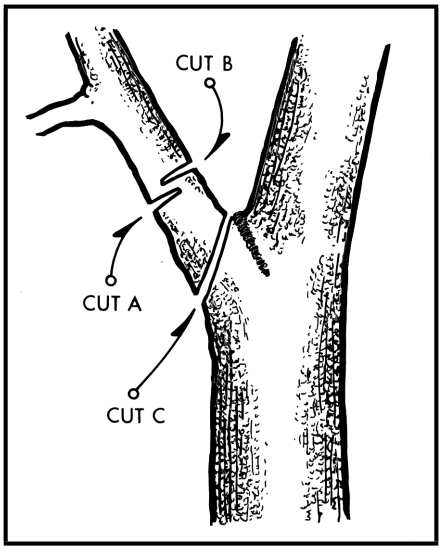
Do not cut into the collar to stimulate callus production and rapid closure. Although closure is desirable for appearance, such a cut promotes decay and future hazards. Never put a pruning tool behind the branch bark ridge.

Whether a branch collar is obvious or not, the position of the final or finish cut should:

- Minimize the branch stub that is an entryway for decay fungi.
- Retain the natural decay protection present in the branch core. The intact branch collar is the first line of defense in preventing decay within the trunk.
- Minimize the overall size of the pruning wound and direct damage to the stem.

Always **stub cut** the branch first. Limbs that cannot be controlled must be removed using at least **three** cuts. Roping of limbs may be necessary to prevent damage to other parts of the tree if they cannot be controlled by hand.

1. The first cut (Cut A) **undercuts** the limb one or two feet out from the parent branch or trunk. A properly made undercut will eliminate the chance of the branch 'peeling' or tearing bark as it is removed.
2. The second cut (Cut B) is the **top cut** which is usually made slightly further out on the limb than the undercut. This allows the limb to drop smoothly when the weight is released.
3. The third cut (Cut C) or **finish cut** is to remove the stub.



Each finish cut should be made carefully, outside of the branch bark ridge and the evident collar, leaving a smooth surface with no jagged edges or torn bark.

There are some situations where the cambium dies back beneath a branch collar after a correct cut:

- The trunk collar did not join the branch collar directly below the branch. Sunken spots under branches are a sign of this condition.
- Winter cuts may result in undercollar dieback.
- Problem tends to increase with size of branches removed.

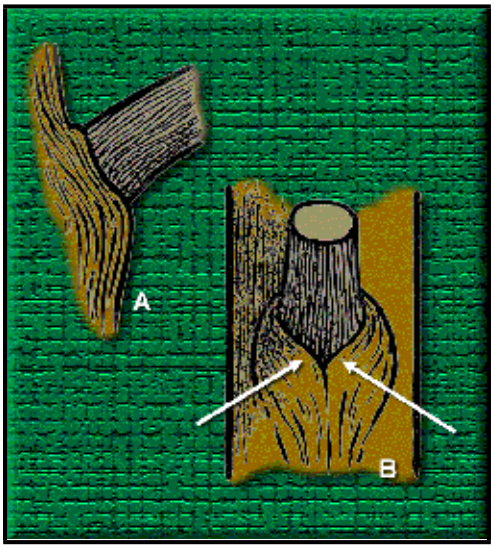
Callus and Woundwood

Callus is undifferentiated meristematic tissue that forms at wound margins from the cambium.

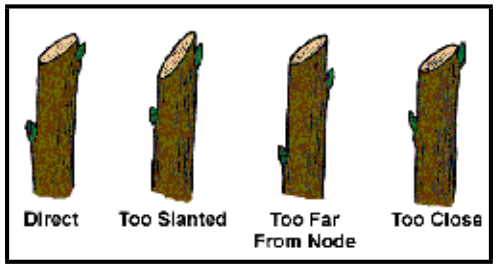
Callus differentiates into *woundwood* over time. Woundwood is 'new wood' and has the different cell components of periderm, cambium, phloem, and xylem.

A *complete* ring of callus and subsequent woundwood will develop around and eventually over proper cuts. Woundwood forms only to the sides of improper cuts (flush cuts), which means the collar and branch protection zone is damaged and the trunk is wounded.

A proper pruning cut results in a smaller wound area, and more rapid callus and woundwood movement over the wound. Cuts on dead limbs that have trunk collars moving up the dead branch wood must also be made just outside of the evident collar.



- Appropriate only for small woody plants or one- to two-year-old branches (twigs, branchlets) on trees.
- Cut back to a bud (lateral bud) or lateral branchlet, slanting at a 45° angle above the bud *node* on alternately arranged branches and stems.
- Two or more buds at a node (opposite, whorled) require a *transverse* cut just above the bud tips or a 45° angle cut, removing one of the buds and leaving the other(s) to elongate in a desired direction.
- Cut 1/8" higher above the bud tips when pruning in cold weather to prevent winter injury to the bud (tissue around a winter cut is more vulnerable to desiccation).



- Leaving a majority of *inward* facing buds produces growth towards center.

- Leaving a majority of *outward* facing buds results in more open growth.

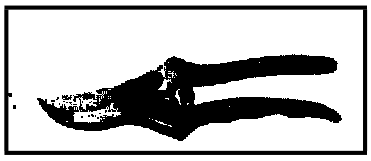
Pruning Tools

Use **well-sharpened** tools for both your safety and to help reduce tearing of wood and cambial tissues. Wear specified protective equipment.

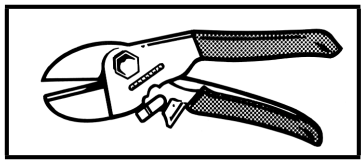
Pruning Shears

Hand shears, secateurs, hand pruners, one-hand shears:

- Remove branches, stems up to 1/2" diameter.
- By-pass (hook and blade, scissors, drop-forge, curve blade): make closer cuts than anvil-type.



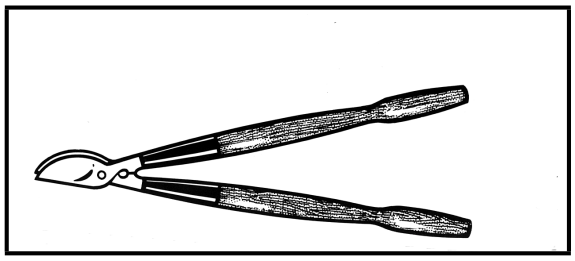
- Anvil (straight-blade): good for only soft-tissued wood; will crush harder wood (inappropriate per A300 standards).



Lopping shears

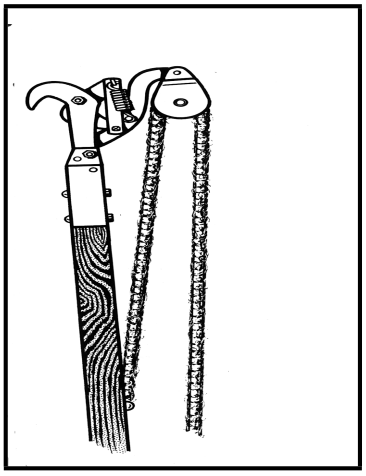
Two-hand shears:

- Remove branches, stems up to 1-3/4" diameter.
- Most useful in rejuvenation.
- By-pass, hook and blade, etc.
- Anvil, straight-blade.
- Ratcheting.



Pole Pruners

- Wood and insulated poles (round and squared).
- Cut like by-pass shears.
- Important to keep blade side in toward the cut.



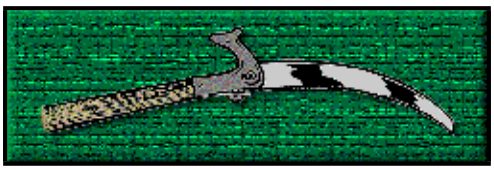
Cut at the outer side of the branch bark ridge at a slightly outward angle so as not to injure or remove the branch collar. Hook the pruner head around the limb to be cut with the blade side against the lateral branch or stem to remain. The arborist must be in a safe working position and the pruner handle positioned so the blade will not jam in the wood. You should not cut off a limb directly above yourself if there is any chance that it could fall and hit you.

Change your working position before completing the cut; place the hook so you have a straight pull on the rope and the lever arm can move far enough to complete the cut. An experienced tree surgeon can give a limb a flip with the side of the pruner head, just as the cut is completed, so that the limb will fall in the desired direction.

Saws

Pole saws:

- Hook cast onto pole-head.
- Wood poles (round and squared).
- Insulated poles (foam core).
- Difficult to make clean, accurate cuts.



Fine-tooth saw blades (more points per inch):

- On folding, rigid, and grip handles.
- *Needlepoint* teeth.
- Razor-tooth, Japanese, or *tri-edge*-style teeth (*Fanno*™ 1311, *Felco*™, *Corona*™); narrow, curved blades facilitate getting into tight spots.

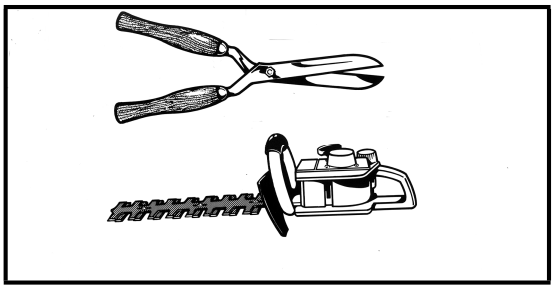
Arborist saws cut on the *pull* stroke:

- Speed saws.
- Raker and gullet saws.
- Needle-tooth saws Fanno™ series.
- Scabbards, blade lengths.
- Pole saw blades now available with tri-edge teeth.

Hedge Shears

Clippers/trimmers:

- Manual (sometimes called 'pruning' shears)



- Powered (electric, gasoline)
- Cut off growth ‘in line’ with no regard for node locations or branch bark ridges.
- Provide time and labor savings at expense of overall plant health.
- Dull blades compound problems and make you work harder!

Crown Thinning and Cleaning

A proper thinning cut removes a branch at its point of attachment, or back to a lateral branch large enough to assume a terminal role.

Learn to foresee the need for removing live branches while they are small. Avoid large cuts. Direction can be influenced by removal of short portions of growth or even by removal of individual buds.

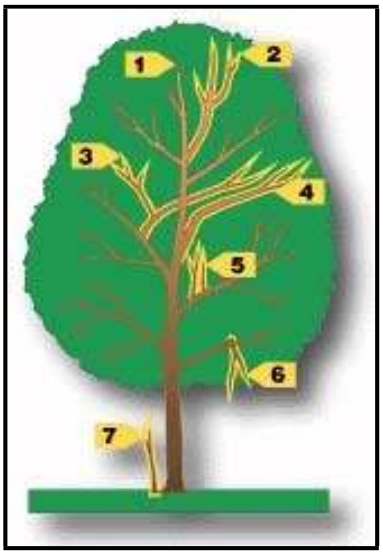
Thinning of lower branches can ‘raise’ a limb. If, after crown raising, the remaining leaf material is insufficient for limb size, consider complete removal. The client's opinion is important.

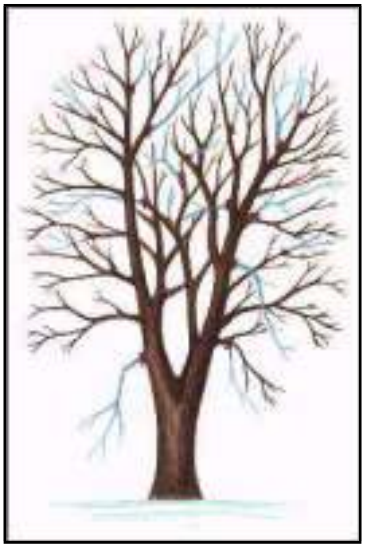
Never perform excessive thinning, which is stressful, especially on thin-barked or young trees prone to sunscald.

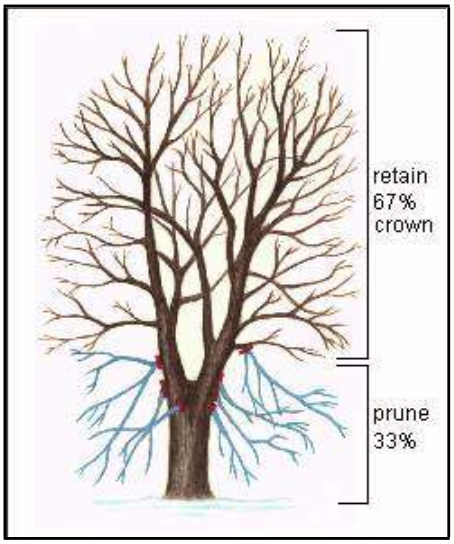
Avoid removing more than 1/4 of the live branches on a tree. Older or overmature trees should have an absolute minimum of living branches removed.

Always avoid ‘skinning’ or ‘hollowing' out the center of a tree's canopy. The majority of thinning cuts should be made along the outer crown. Proper thinning requires a good deal of limb-walking and deft use of a pole-pruner when and where aerial lifts are not used.

When thinning laterals from a limb, maintain well-spaced inner branches to achieve more distribution of foliage along the branch.

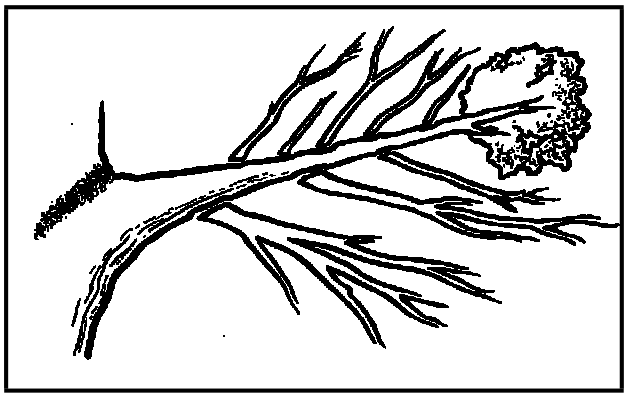






Caution must be taken to avoid creating an effect known as *lion-tailing*:

- Caused by removing all of the inner laterals and foliage.
- Displaces foliar weight to the ends of the branches.
- May result in sunburned bark tissue, renewed and excessive epicormic branches, weakened branch structure and breakage.
- Wind whippage.



Lion-tailing

Removal of Diseased or Insect-Infested Branches

Sanitation or 'eradicative' pruning (crown cleaning):

- Cut out diseased limbs back to collars, appropriate lateral branches, or a scaffold branch at least one foot below infected portion.
- Disinfect tools *during or after* pruning diseased branches with bleach solution (1 part bleach to 10 parts water) or Lysol.
- Do not use any form of alcohol to sterilize pruning tools *during* the work. Use alcohol to disinfect auger-bits, injection tees, or pruning tools *after* the job, especially plants with wetwood or fireblight bacterial infections.

Removal of Weak, Rubbing, or Competing Stems

Remove, if possible, but avoid large holes in the canopy.

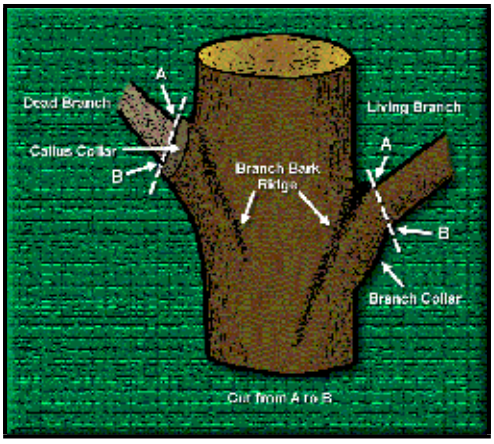
The life of large limbs, weakened by decay or cracks, can often be extended by "shortening" or weight removal using highly selective thinning cuts. Cabling and/or rigid bracing may be required to secure limbs or codominant stems if removal is not possible.

Deadwood Removal

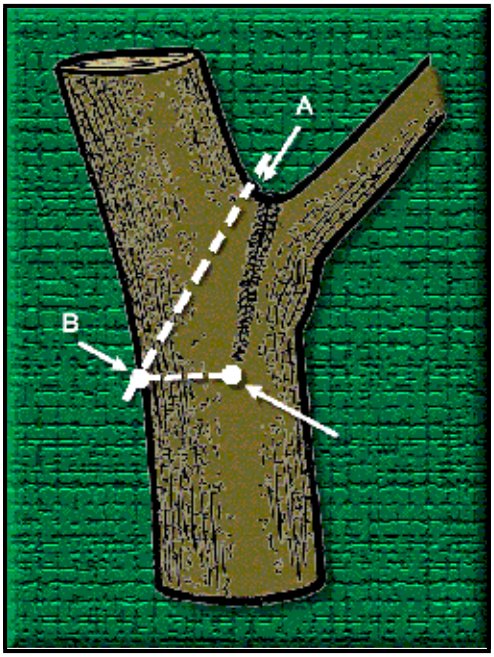
Sanitation and hazard reduction pruning:

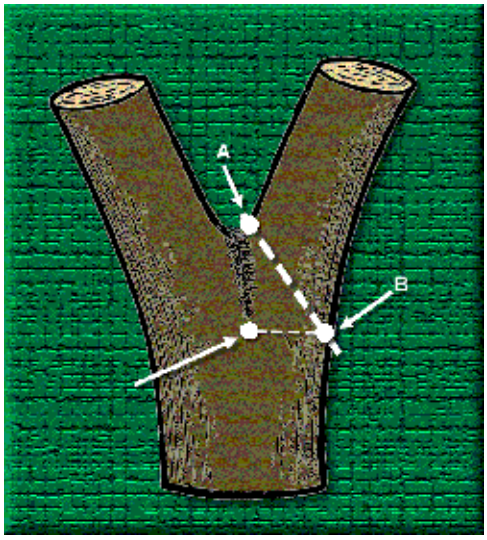
- Dead branches and stubs are an energy source (cellulose, glucose).
- Decay fungi.
- Boring insects.

Again, do not remove the branch collar around dead branches. Cut as close as possible to the collar of good wood surrounding the branch base.



Locate Target Points





Codominant Stem or Branch Removal

Always *stub cut* the stem to be removed, and then make the *finish* cut with care.

Some defect (discoloration) will develop in the remnant stem 'core' in the main stem:

- Usually not attached like a true branch with protective collar.
- Barrier zone should develop and confine defect if correct cut is performed.

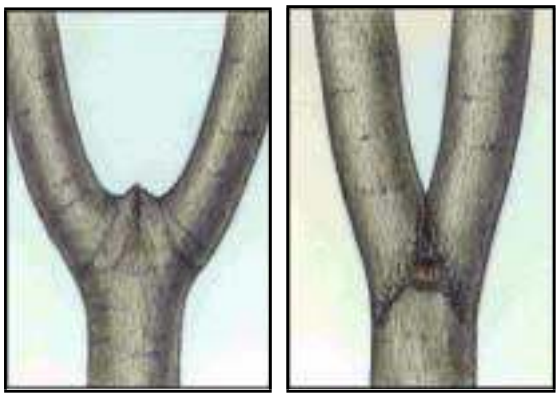
Never remove both stems!

When the bark plates on the stem bark ridge turn upward, the union of the stems is usually *strong.*

When the bark between the stems turns inward, the union of the stems is *weak.*

It is the *union* of the stems or upright branches more than the *angle* that determines whether attachment is weak or strong.

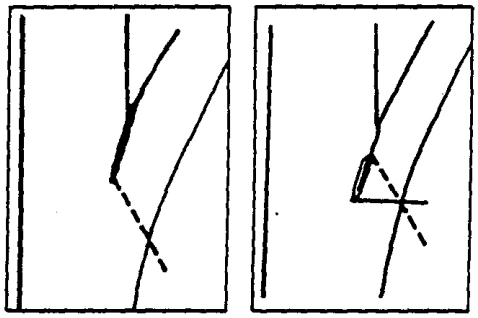
The stems have *included bark* squeezed or embedded *between* them.



Remedies:

To *remove*, stub cut the stem first and then cut where the dotted line is with care; avoid cutting into the remaining stem.

If the saw cannot complete this cut, tap a small wedge into the kerf and cut the remainder of the wood with a flat chisel and mallet.



To *strengthen* stem on older trees, a cable can be attached; place at a point approximately two-thirds of the distance from the crotch to the ends of the stems.

When a cable is used to strengthen stems, the cable and hardware must be checked regularly. When the risk of stem fracture becomes high, the weaker stem should be removed.

There are four general classes of pruning. Classes 1, 2, and 3 are classified as maintenance pruning, which is recommended when the primary objective is to maintain or improve tree health and structure, including hazard reduction pruning:

- Class #1 - *Fine Pruning*: consists of the removal of dead, dying, diseased, interfering, objectionable, and weak branches (crown cleaning), as well as selective thinning to lessen wind resistance. Some deadwood up to ½ inch in diameter may remain within the main leaf area where it is not practical to remove such. Girdling roots will be monitored and removed where possible.

- Class #2 - *Medium Pruning*: consists of the removal of dead, dying, diseased, interfering, objectionable, and weak branches (crown cleaning). Some deadwood up to one inch in diameter may remain within the leaf canopy.
- Class #3 - *Hazard reduction*: pruning is recommended when the primary objective is to reduce the danger to a specific target, caused by visibly defined hazards in a tree, by removing dead, diseased, or obviously weak branches two inches in diameter or greater.
- Class #4 - *Crown Reduction Pruning*: consists of reducing canopy tops, sides, under branches, or individual limbs at appropriate lateral limbs and stems for purposes of clearance of storm damage repair. Some crown reduction pruning incorporates hazard reduction pruning.

Epicormic Branches

Epicormic branches may be needed to fill in the canopy where trees have been excessively thinned or storm damage has occurred (crown restoration).

Epicormic branches (shoots, watersprouts, suckers) arise from two types of "buds":

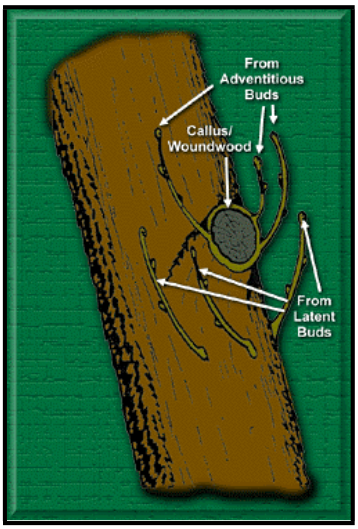
- Adventitious buds.
- Latent (dormant) buds or meristematic points.

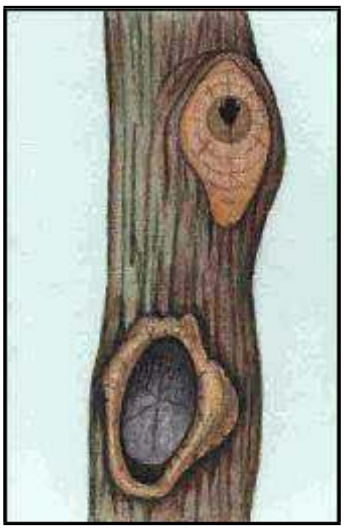
Adventitious epicormics come from meristematic tissue generated anew by the cambium. Most adventitious buds develop from callus tissues moving over a wound, or from root tissue.

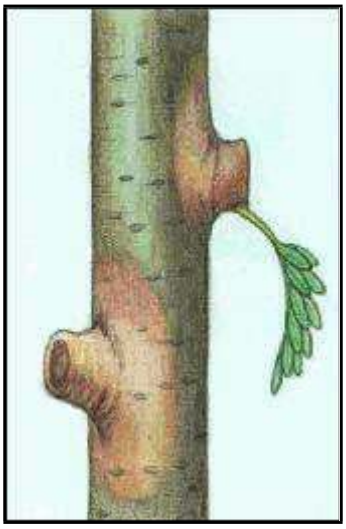
Latent (dormant) buds or *meristematic points* are formed at an earlier time in the life of a woody plant but do not 'release' or grow. Latent buds are 'carried along' in rays in the cambial zone year after year, as the tree increases girth, and are usually released upon injury or stress. Epicormic sprouts from latent meristematic points are often found in the vicinity of pruning cuts, usually below the wound.

Epicormic branches are *stimulated* on a much larger scale by winter or early spring pruning rather than by late spring-summer pruning (desirable in shrub renewal or rejuvenation).

A *watersprout* is an epicormic branch growing from branch and stem parts, or above a graft union.







A *sucker* is an epicormic branch growing from root tissue or <u>below</u> a graft union.

Apical Dominance and Control

Woody plant natural shapes, forms, or habits are governed by species' inherent (genetic) determination of:

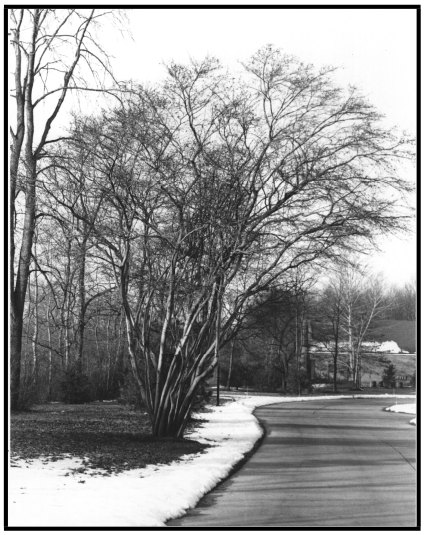
- Leaf and flower bud locations.
- Bud-break patterns along stems.
- Branching angles.
- How buds and branches elongate.

Apical dominance = terminal bud(s) suppress lateral buds along an elongating shoot

Excurrent and *decurrent* branching patterns:

- Decurrent woody plants have overall weak apical control, but strong apical dominance while shoots are elongating.
- Random-branching excurrent plants have weak apical dominance and overall strong apical control.
- Whorl-branching excurrent trees have both strong apical dominance and control.

Decurrent



Excurrent

Plant growth regulators are substances that enhance or alter the growth and development process of a plant. In most cases, these chemicals either increase or decrease normal growth, flowering, and/or fruiting of plants.

Selective growth control and/or branch release by natural growth regulators:

- Auxins
- Abscisic acid (ABA)
- Cytokinins
- Gibberellins (gibberellic acid = GA)
- Ethylene

Branch terminals – auxin source
Roots – cytokinin source

Low auxin = axillary bud release,
High cytokinin energy storage drain

High auxin = bud suppression,
Low cytokinin initiate new roots

Plant growth regulators are substances that enhance or alter the growth and development process of a plant. In most cases, these chemicals either increase or decrease normal growth, flowering, and/or fruiting of plants.

Utility arborists use synthetic growth regulators to *control* the growth of trees and other vegetation beneath utility lines. Growth *inhibitors* can be:

- Sprayed on the foliage.
- Painted on pruning wounds.
- Banded on the bark.
- Soil applied.
- Injected into trees.

Antigibberellins are growth regulators that counter the effects of naturally occurring *cell-elongation* hormones (gibberellin). Ideal formulations are being sought that would minimize phytotoxicity while reducing utilities' pruning expenses.

Another use of growth inhibitors is to suppress epicormic branch production on trees:

- Not yet widely used by arborists.
- Must be applied annually.
- Client concern over the use of chemicals.
- Applicator safety concerns.
- Epicormic branch growth can be minimized with proper cuts.
- Retarded woundwood development.

Painting of Cuts

Proper cuts negate the "need" for wound dressings. Wound dressings will not *prevent* decay; wound dressings have been evaluated to often *promote* wood decay or cause cambium damage.

Cuts or wounds in certain species during the growing season may attract insects that carry diseases or allow fungus invasion. Native oaks or elms and European elms should be pruned during dormant periods in regions where wilt disease conditions are known to exist.

If pruned in summer, pruning wounds on wilt-susceptible oaks and elms should be treated with a wound dressing.

Pruning Phenology

The ideal or optimal times to prune most woody plants are:

- Late in the dormant season.
- After leaves are fully formed and expanded.

Client concerns with excessive *sap flow* (birches, maples):

- Avoid pruning during height of sap flow (just before growing season) if possible.
- Sap flow may be unsightly but does not cause definite injury.
- Prune immediately after leaves are fully expanded if client cannot be convinced.

Avoid pruning birches after leaf expansion, as the wounds may be attractive to boring insects.

Dead, broken, or weak limbs may be removed at any time with little effect, except in wilt-susceptible oaks and elms.

Pruning before the spring leaf bud-break period can enhance stimulated growth and rapid wound closure. Pruning during the period after leaf expansion will result in suppressed growth and maximum 'dwarfing'.

Avoid pruning those woody plants undergoing bud break and early leaf expansion, especially in the period where bark 'slips' (cambial development of unlignified wood).

Flowering can be reduced or enhanced by pruning at the appropriate time of the year. Woody plants that bloom on current season's growth ('summer-flowering' such as crapemyrtle or butterfly-bush) are best pruned to enhance flowering:

- During the dormant season.
- Just prior to or immediately after leaf expansion.
- In late summer (post-bloom).

Plants that bloom on last season's wood ('spring-flowering') should be pruned *just after bloom.*

- Fruit trees are often pruned during the dormant season to enhance structure and distribute fruiting wood, and after bloom to thin fruit-load.

Pruning Selection

Ideal pruning technique begins with planting the right tree in the right place (PHC selection).

Maintaining tree size or allowing for limited crown growth is possible with a regular pruning schedule begun early in the tree's life.

- Consider the extent of mature branches and crown.
- Select good stock with proper growth form.
- Imagine how form will continue to develop; there is no way to turn a large tree back into a small tree.
- Don't expect to improve form with future prunings.

Avoid obtaining saplings with included bark; the stem union becomes weaker rather than stronger as the plant grows. Failure of one or both stems of the fork frequently occurs when the tree is mature, especially during snow and ice storms (loading events).

Structural Pruning

Structural pruning principles are used when training young woody plants or working with a tree that has not been pruned in many years. Properly trained shrubs and young trees will develop into structurally strong plants that should require little corrective pruning as they mature.

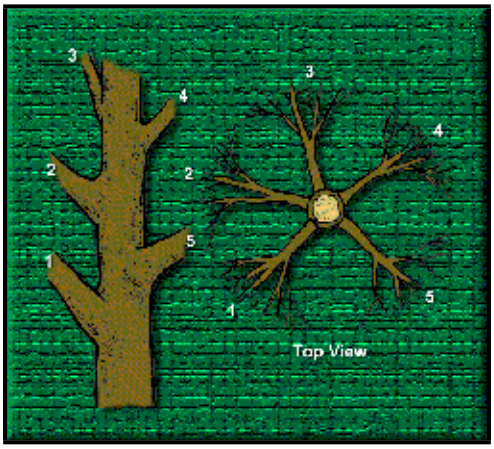
Trees that will be large at maturity should have a sturdy, tapered trunk, with well-spaced branches smaller in diameter than the trunk.

If two branches develop from apical buds at the tip of the same stem, they will form *codominant* branches or, eventually, codominant stems. Each codominant branch is a direct extension of the stem. It is best if one is removed when the tree is young.

Branches with narrow angles of attachment and codominant branches may tend to break if there is *included bark* that gets enclosed inside the crotch as the two branches develop girth and length.

The relative *size* of a branch in relation to the trunk is usually more important for strength of branch attachment than is the *angle* of attachment. Scaffold branches' diameters should not be more than 1/2 the stem or trunk diameter.

Select main branches to give *radial distribution*. Discourage branches growing directly over another unless spaced well apart.



On large-growing trees, except whorl-branching conifers, branches that are more than 1/3 the diameter of the trunk in size should be well spaced along the trunk (at least 18 inches apart).

Maintain one-half the foliage on branches arising in the lower 2/3 of younger trees.

- Increases trunk taper.
- More uniformly distributes weight and wind stress along the trunk.

This rule of thumb also holds true for an individual limb:

- Leave lower and inside branches along the limb.
- Limb can develop taper and strength.
- Stress and weight can be evenly distributed along the length.

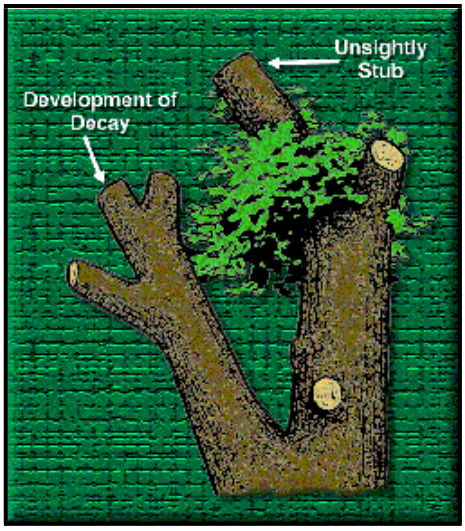
The height of the lowest scaffold branch will depend on the intended function of the tree: screen an unsightly view, provide a windbreak, shade a patio, installed as a walkway or street tree.

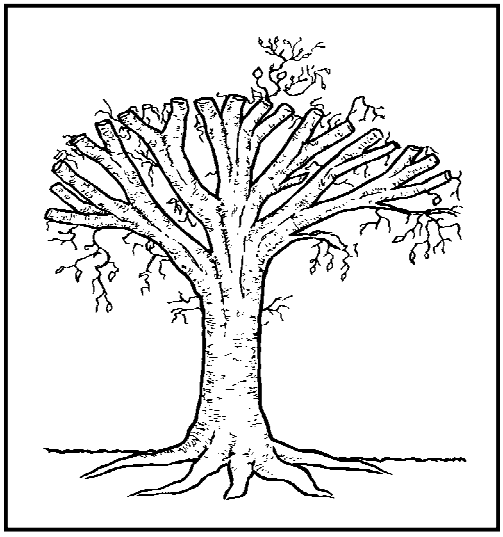
Pruning at Planting

For years, the conventional wisdom was that trees should be severely pruned at time of transplant to compensate for root loss and to "balance" the crown with the root system (especially bareroot trees). This practice has since been discovered to prolong *transplant shock.*

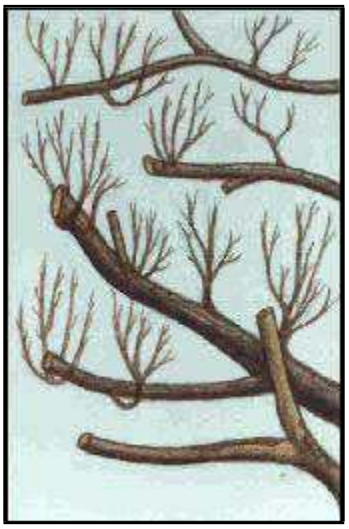
- Transplant pruning should be limited to removal of dead, broken, diseased, or interfering branches.
- Leave small shoots along the trunk for later removal.
- Protect the trunk from 'sunburn'.
- Aid in development of proper trunk taper.
- Leave as many terminal buds as possible.
- Stimulate root growth triggered by hormones in these buds.

Topping, Tipping, and Roundover

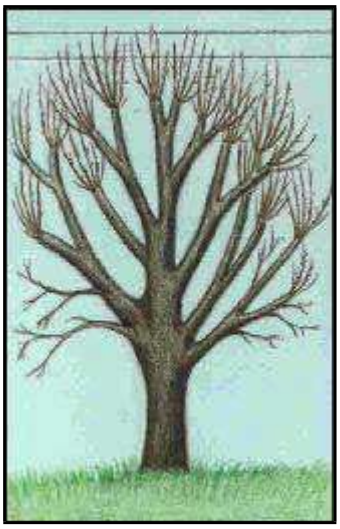




Topping: cutting vertical branches and stems back to inadequate nodes (heading) or to internodes (stubbing).



Tipping: heading side or horizontal branches to stubs or weak laterals.



Roundover: topping + tipping.

Many people have the misconception that cutting or heading the main branches of a tree back to stubs to 'reduce the height' is the proper way to prune.

Apparently, a short tree is thought to be safer and healthier than a tall tree regardless of how the result is attained. Heading back to stubs or inadequate laterals permanently disfigures and weakens a tree. Topping is one of the worst things humans do to trees.

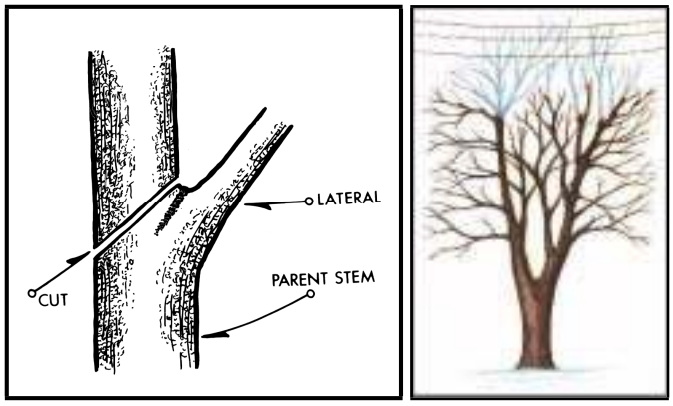
The International Society of Arboriculture (ISA) and the National Arborist Association (NAA) consider heading-back to stubs an unacceptable arboricultural practice. Modern pruning standards do not include heading-back as any sort of a recommended technique.

- Topping removes a major portion of a tree's leaves that are necessary for the production of carbohydrates.
- Stimulation of epicormic branches at or just below an internodal stub cut causes a topped tree to grow back to its original height faster and denser than a properly pruned tree. The sprouts are weakly attached and easily broken off in storms.
- Bark within the canopy can become scalded by sudden exposure to direct sunlight.
- Stubs attract wood-boring insects and sustain wood decay organisms.
- Topping, tipping, and roundover cuts permanently disfigure a tree.

Crown Reduction, Restoration, and Raising

If the height or width of a tree has to be reduced because of storm damage or interference with structures or utility lines, it is performed correctly by a method called *crown reduction* or *drop-crotch* pruning (NAA Class IV Crown Reduction). This procedure involves the removal of a main leader, scaffold, or branch at its point of attachment with a lateral branch large enough to assume a terminal or leader role.

The final cut should begin or end somewhat *parallel* to the remaining lateral branch and offset slightly above the branch bark ridge (without cutting into the bark ridge). The remaining lateral branch must be at least one-half to one-third the diameter of the branch or leader that is being removed.



If a tree has been topped previously and now has epicormic sprouts, *crown restoration* can improve its structure and appearance. Decayed, rotting stubs and tipped branches are cut back to appropriate laterals or entirely removed. One to three sprouts on main branch stubs are retained to become permanent branches and reform a more natural appearing crown. Selected epicormic branches may need to be thinned to a lateral to control length and ensure adequate attachment for the size of the sprout. Restoration usually requires several prunings over a number of years.

Trees in urban and landscape settings may need to have lower limbs removed. *Crown raising* or elevating removes the lower branches of a tree in order to provide clearance for buildings, vehicles, pedestrians, and vistas. Excessive removal of lower limbs should be avoided so that the development of trunk taper is not affected and structural stability is maintained.

Definitions of Arboricultural Terms

Anvil-Type Pruning Tool – Pruning tool that has a straight sharp blade that cuts against a flat metal cutting surface (see *hook and blade-type pruning tool*).

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

Boundary Reaction Zone – A separating boundary between wood present at the time of wounding and wood that continues to form after wounding.

Branch – A secondary shoot or stem arising from one of the main axes (i.e. trunk or leader) of a tree or woody plant.

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

Branch Bark Ridge – Raised area of bark in the branch crotch that marks where the branch wood and trunk wood meet.

Callus – Undifferentiated tissue formed by the cambium layer around a wound.

Cambium – Dividing layer of cells that forms sapwood (xylem) to the inside and bark (phloem) to the outside.

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

Closure – The process of woundwood covering a cut or other tree injury.

Crotch – The angle formed at the attachment between a branch and another branch, leader, or trunk of a woody plant.

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

Crown Cleaning – The removal of dead, dying, diseased, crowded, weakly attached, low-vigor branches, and watersprouts from a tree's crown.

Crown Raising – The removal of the lower branches of a tree in order to provide clearance.

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

Crown Thinning – The selective removal of branches to increase light penetration and air movement, and to reduce weight.

Cut – The exposed wood area resulting from the removal of a branch or portion thereof.

Decay – Degradation of woody tissue caused by biological organisms.

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

Facility – Equipment or structure used to deliver or provide protection for the delivery of an essential service such as electricity.

Girdling Roots – Roots located above or below ground whose circular growth around the base of the trunk or over individual roots applies pressure to the bark area, ultimately restricting sap flow and trunk/root growth. Frequently results in reduced vitality or stability of the plant.

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

Heartwood – The inactive xylem (wood) toward the center of a stem or root that provides structural support.

Hook and Blade Pruning Tool – A hand pruner that has a curved, sharpened blade that overlaps a supporting hook (in contrast to *an anvil-type pruning tool*).

Horizontal Plane (palms) – An imaginary level line that begins at the base of live frond petioles.

Lateral – A branch or twig growing from a parent branch or stem.

Leader – A dominant upright stem, usually the main trunk. There can be several leaders in one tree.

Limb – Same as *Branch,* but larger and more prominent.

Lopping – See *Heading.*

Mycellum – Growth mass of fungus tissue found under bark or in rotted wood.

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

Parent Branch or Stem – The tree trunk or a large limb from which lateral branches grow.

Petiole – The stalk of a leaf.

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

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

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

Pruning – Removal of plant parts.

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

Qualified Line Clearance Tree Trimmer Trainee – Any worker undergoing line-clearance tree trimming training, who, in the course of such training, is familiar with the techniques in line clearance and has demonstrated his/her ability in the performance of the special techniques involved. Such trainees shall be under the direct supervision of qualified personnel.

Qualified Person or Personnel – Workers who, through related training or on-the-job experience, or both, are familiar with the techniques and hazards of arboriculture work including training, trimming, maintaining, repairing, or removing trees, and the equipment used in such operations.

Qualified Tree Worker, Person, or Personnel – A person who, through related training and on-the-job experience, is familiar with the hazards of pruning, trimming, repairing, maintaining, or removing trees and with the equipment used in such operations and has demonstrated ability in the performance of the special techniques involved.

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

Remote/Rural – Areas associated with very little human activity, land improvement, or development.

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

Shall – As used in this standard, denotes a mandatory requirement.

Should – As used in this standard, denotes an advisory recommendation.

Stub – An undesirable short length of a branch remaining after a break or incorrect pruning cut is made.

Stubbing – See *Heading.*

Target – A person, structure, or object that could sustain damage from the failure of a tree or portion of a tree.

Terminal Role – Branch that assumes the dominant vertical position on the top of a tree.

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

Throwline – A small, lightweight line with a weighted end used to position a climber's rope in a tree.

Topping – See *Heading.*

Tracing – Shaping a wound by removing loose bark from in and around a wound.

Urban/Residential – Locations normally associated with human activity such as populated areas including public and private property.

Utility – An entity that delivers a public service such as electricity or communication.

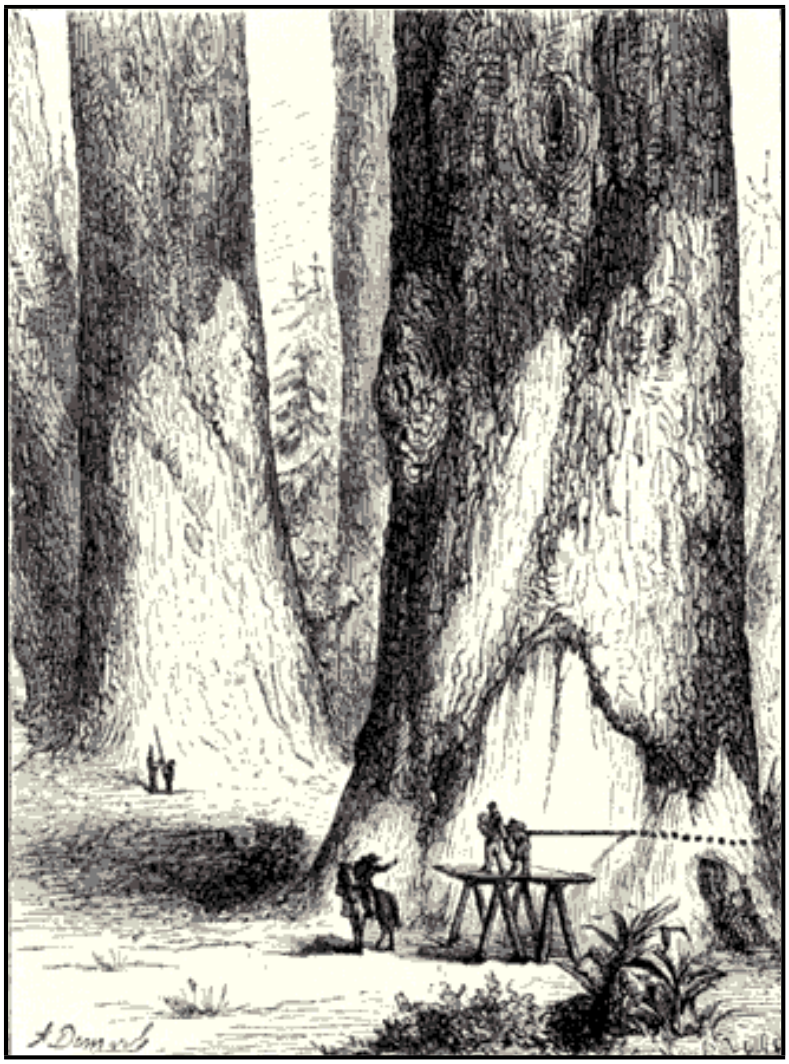
Utility Space – The physical area occupied by the utility's facilities and the additional space required ensuring its operation.

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

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

Xylem – Wood tissue; active xylem is called *sapwood* and inactive xylem is called *heartwood.*

Young Tree – A tree young in age or a newly installed tree.

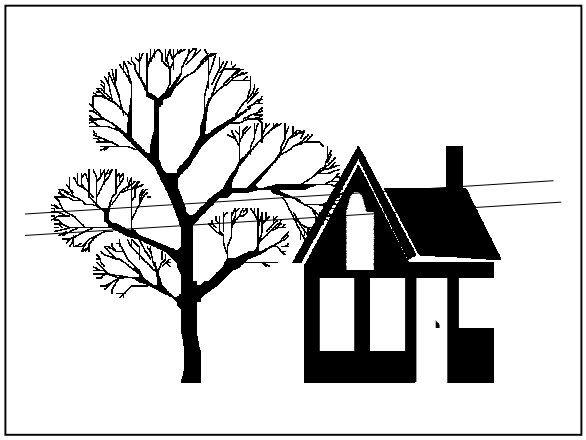


Appendix D
Tree Emergency Manual for Public Officials

TREE EMERGENCY MANUAL

for

Public Officials



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August 2000

Table of Contents

INTRODUCTION

This *Emergency Tree Manual* is designed to be a practical short **guide** to managing disastrous tree damage, accompanied by a set of critical documents and standards called the *Tree Emergency Compendium*. Its focus is upon urban forests in the public realm, where questions of safety and cost are critical, and its target audience is public tree managers. To facilitate access to and speed through the document, it has been written in outline form. For more detail or explanation, readers are referred to publications listed under Printed Resources.

The *Manual* and the *Compendium* will be stored at the USDA Forest Service's Northeast Center for Urban and Community Forestry in Amherst MA, at offices of participating state urban and community forestry coordinators, and at the FEMA Region 1 and Region 2 offices in Boston and New York. Both documents will also be posted on the web site of the Northeast Center for Urban and Community Forestry, where they will be updated periodically as needed.

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This document was produced by personnel of the Community Forestry Education Project, located at Cornell Cooperative Extension of Monroe County, 249 Highland Ave, Rochester NY 14620-3036. Primary responsibility lies with Jerry Bond, Community Forester, whose work was made much easier by the creative and unfailing support of Frances Tucker, Program Assistant.

PROJECT COOPERATORS

- USDA Forest Service, Northeastern Area
- USDA Forest Service, Northeast Center for Urban and Community Forestry
- Cornell University, Cornell Cooperative Extension
- State of Maine, Department of Conservation
- State of New Hampshire, Division of Forests and Lands, Urban Forestry Center
- State of Vermont, Agency of Natural Resources, Division of Forests
- State of New York, Department of Environmental Conservation

EXPLANATIONS OF SYMBOLS USED IN THIS TEXT

Indicates that a document referred to in the text is included in the companion volume, the *Tree Emergency Compendium*.

→ G — Indicates that a technical term underlined in the text is defined in the Glossary at the end of this document.

ACKNOWLEDGMENTS

Various hands contributed to this work. It began as a request from the state urban and community forestry coordinators of New York and New England after a disastrous 1998 ice storm to Dave Bloniarz of the USDA Northeast Center for Urban and Community Forestry in Amherst MA. That request was itself an attempt to respond to emergency needs in the field and at FEMA offices. Without the initial concept and ongoing support of the state coordinators, this document would never have appeared.

The basis and benchmark was laid by *Storms over the urban forest* (2nd ed., 1994) by John Andresen and Lisa Burban. That carefully written classic provided the inspiration for this *Manual.* Resources have been updated from that book, with special attention paid to web-based materials and computer applications, since much has emerged in those realms since the earlier text was written.

Contributors to this manual are: Dave Bloniarz (Northeast Center for Urban and Community Forestry in Amherst MA), Tish Carr (urban and community forestry coordinator, Maine), J. B. Cullen (urban and community forestry coordinator, New Hampshire), Jim Donovan (FEMA, Region 1), Peter Frank (urban and community forestry coordinator, New York), Doug Long (DPW Superintendent, Albion NY), Chris J. Luley (Davey Resource Group), Andy Pleninger (former City Forester, Rochester NY), Steve Sinclair (urban and community forestry coordinator, Vermont), Sue Sisinni (USDA Forest Service Research Unit in Syracuse NY), and Warren Spinner (City Arborist, Burlington VT).

ILLUSTRATIONS

Unless otherwise indicated, images of trees are taken from the collection of the Community Forestry Education Project. Contributors include Dr. Alex Shigo (Shigo & Trees, Associates, Durham NH), Press-Republican (Plattsburgh NY) and the Democrat and Chronicle (Rochester NY).

Source: Mike Dowd, The Press-Republican (Plattsburgh NY)

THE PROBLEM

View down a street in Plattsburgh NY after the ice storm of January 1998. The important questions after such a disaster are what to do, and how do it. Later come questions such as how to recover, and how to minimize damage in the future.

I. EMERGENCY RESPONSE

A. First steps

Basic Point: Tree emergency response should proceed in an orderly and prepared manner for maximum safety and minimum cost.

„ **Locate and consult Emergency Plans, Debris Removal Plan, and Contact Lists**.

„ **Identify live electric wires** in, on, or under trees. Block public access to them, and report them to appropriate utility officials.
Only trained arborists should work around live wires, and the work should conform to ANSI standards Z133.1 and A300.
OSHA 1910.269 and other safety standards may also be relevant.
Resources: Contact offices of ANSI, OSHA, and FEMA.

„ **Response Phase I, "Debris clearance"** (FEMA 1999)*
Clear priority traffic lanes and culverts, beginning with main routes, roads to hospitals, etc.
Push debris simply to the side in this first phase, without attempting at removal or disposal.
Clear at least one lane on each arterial, major highway, and secondary road as soon as possible.
Open major walkways to provide access to critical buildings, as well as other locations you think important under emergency conditions.

Source: Press-Republican (Plattsburgh NY) staff photo

Rig with a long-armed rotary saw clearing a country road during Phase I response after an ice storm in northern New York during early January 1998.

*References in parentheses and smaller font are listed in detail at the end of this document under "Resources"

„ **Response Phase II, "Debris removal and disposal"** (FEMA 1999)

Use established routes and methods for clearing tree debris. Hopefully, these were already set up before the disaster; if not, try adopting routes used for trash pickup or snow removal.

In larger communities, it is often easiest to set up temporary collection points (malls, playgrounds, etc.) around the community, then clear those after things calm down.

Debris removal is usually reported as the most difficult tree disaster problem for communities and individuals.

In general, removal of debris from public property is eligible for FEMA assistance (FEMA 1999) when a Federal Disaster has been declared and when it constitutes an immediate threat to life, public safety, or improved property. See II B, below.

B. Communication

Basic Point: Communication is critical to surviving disasters. If you do not actively manage information during tree emergencies, things have a way of quickly getting out of hand and complicating your work.

„ **Set up clear communication channels among emergency agencies and personnel.**

„ **Establish and publicize a phone number and staff person for public contact.**

„ **Work with the media early and often.**

Take the time to get accurate information out--it will be well spent.

Be frank about the extent of damage and the estimated time needed for recovery.

Useful tree disaster media releases can be downloaded from the web at http://www.arborday.org/storm Here is one example from that site:

Trees & Storms: Others Have Recovered

Trees are often like good friends-not fully appreciated until they are gone or hurt. So, to anyone who anguished when a favorite tree was severely damaged in the recent storm, here's encouragement from The National Arbor Day Foundation and foresters in other cities: Don't despair-given time, the community's trees can come back.

"Trees are amazingly resilient," says John Rosenow, president of The National Arbor Day Foundation. "It may take several years, but many of the trees damaged by a storm will recover as they grow."

Rosenow also notes that damaged trees may need human assistance in the recovery process. "They need our help and our patience, and they need our care. The experience of other communities has shown that with proper care of damaged trees and planting of new trees to replace those toppled or mortally wounded by a storm, once-devastated neighborhoods can come back."

In one Miami neighborhood, more than 1,600 homes were destroyed, and photos taken immediately after the storm show most trees down or severely damaged. But five years after Hurricane Andrew, the powers of recovery from both human and tree loss were amazingly evident in follow-up newspaper stories. The homes had been rebuilt, the surviving trees had regrown and were in full leaf, and life had returned to normal. Eliot Kleinberg, writing for the Palm Beach Post, summed up the recovery in his community in these words: "The birds have returned. The trees have grown back. The walls are back up. Unless you look closely, you might never know."

„ **Deliver important messages to the community:**

Stay safe (watch for hangers, leaning trees, downed wires, chainsaw injury, etc.). → G

Stay calm--it may not be as bad as it seems, and panic only makes it worse.

Get help from arborists who are insured and, if possible, certified or registered. → G

Take your time in deciding tree removals, as long as no hazard is present. → G

„ **Indicate how the public can help:**

Placing debris at the curbside
Keeping debris away from fire hydrants and valves
Segregating recyclable and flammable materials
Resource: FEMA 1999

„ **Emphasize the need for careful professional damage assessment.**

People often tend to become radical about trees after a disaster, wanting either to "kill" or to "save" them all, and they need to hear voices of reason from officials.
Trees can recover from substantial damage, and what looks awful at first to an amateur may be judged as much less serious by an experienced professional.

C. Records

Basic Point: It will be infinitely easier later if you start your paperwork at the beginning, and keep it up as you go along. It is very hard to recreate records after an emergency.

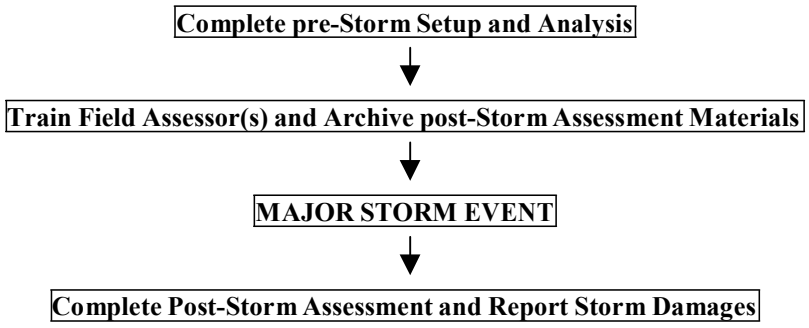
„ **Complete an accurate damage assessment, and estimate associated costs**

Use any method that will give you quick and reliable results. If your community is large, sample a random selection of streets that makes up at least 2% of street miles.
Accurate damage assessment is vastly easier if you already have a pre-storm survey in place.
You will need an accurate damage assessment for local officials, as well as for state and other emergency officials.
Estimate hours of labor and equipment that will be required for:

- ƒ standing tree removals
- ƒ hazard pruning
- ƒ debris removal

Multiply hours by costs to obtain job cost, or determine a lump sum for the job if relevant.
Resource: FEMA 1999, Bloniarz et al *Initial*

Overview: Storm Damage Assessment Protocol



Source: Bloniarz et al *Initial*

„ **Maintain good records from the beginning**

Keep track of date, personnel, job, equipment, location, and hours.
Basic FEMA forms can be found inside the back cover of this manual.
Others forms available on the FEMA web site (http://www.fema.gov), or in the *Applicant Handbook* for public assistance available from your regional FEMA office.

D. Survey of immediate threats

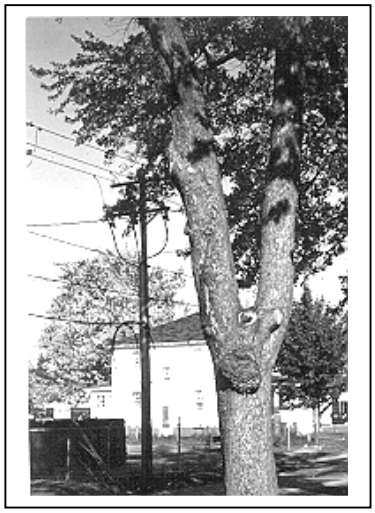
Basic Point: In addition to clearing trees and limbs on the ground, you need to examine and manage those that are still upright from the standpoint of public safety.

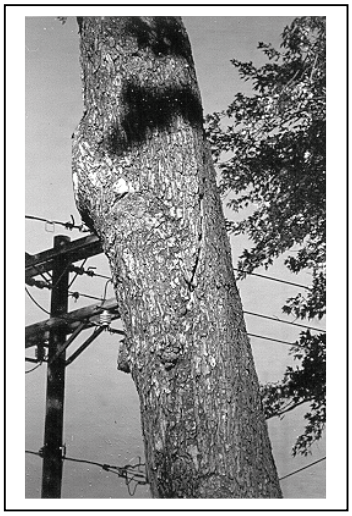
„ **Identify immediate threats**, and make Priority 1 (danger of immediate failure) decisions about removals and pruning.

„ **Determine Priority 1 Removal**

Systematically search for public trees that are:

- *uprooted*
- *split in half*
- *undermined*





This silver maple leader over a busy city street was split by rotational forces during a windstorm. It took binoculars to spot the crack. Once seen, it makes the tree an obvious Priority 1 Removal.

Select such trees for immediate removal if they have a building, sidewalk, major electric wires, road, or other important structure as a likely target.

Distribute work orders for the immediate removal of these hazardous trees.

„ **Determine Priority 1 Pruning**

Systematically conduct high priority pruning street by street, taking out limbs over 2" in diameter that are *hanging, broken*, or *cracked.*

Select these trees for immediate pruning if they have a building, sidewalk, electric wire, road, or other important structure as a likely target.

Contracting out the work for these steps is often easy and cost-effective. This frees up staff for other emergency needs.

„ **Hire professionals** whose work matches standards (ANSI A300) and whose costs are appropriate to the work. Include the phrase :"all work to be carried out according to ANSI A300 standards."

Let professionals know you are aware of the standards before they start.

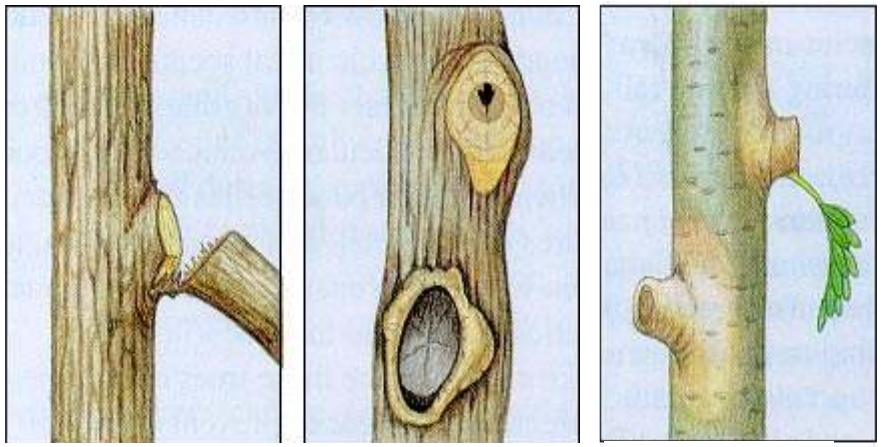
Expect a reasonable markup for emergency work, but try to keep it under 20-25%.

„ **Inspect the work** before you sign off on payment.

Look for *errors*:

→ G

- ƒ rips, flush cuts, and stubs (see below)
- ƒ cuts through the branch collar or branch ridge
- ƒ cuts back to a lateral branch that is too small (< 1/3 main branch diameter)
- ƒ follow-through cuts into healthy wood



Source: USDA, 1995, *How to prune trees*

Look for *omissions*:

- ƒ dead branches > 2", both attached and free
- ƒ cracked limbs
- ƒ trees with a new lean

Follow standard contract procedures when errors and omissions are found

„ **Estimate % crown loss**

Be sure not to confuse overall "% crown missing" (which includes earlier loss, pruning, etc.) from "% crown loss" caused by the event that led to your tree emergency

There is a good correlation between the amount of crown a tree loses and its survivability

- ƒ With 50% or less crown loss, a tree has a good chance of surviving
- ƒ With 50-75% crown loss, many trees will still survive, though with varying degrees of internal decay and growth suppression
- ƒ **Over 75% crown loss means trees generally have a low chance of survival**

The further outward the breaks occur, the less decay will occur

Weaker trees are less likely to survive than stronger trees

In declared Disaster Areas, FEMA usually covers removals of street trees above 50% crown loss where the tree's death is imminent and the dead trunk would become a threat to life, public safety, and/or improved property.

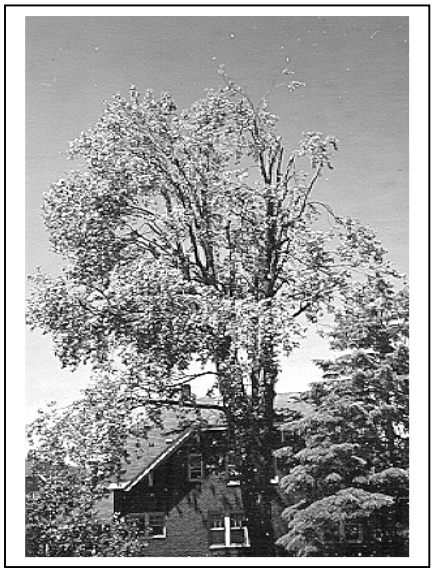
Resource: USDA FS 1998

„ **Vigorous and healthy individuals may recover in spite of crown loss > 75%**

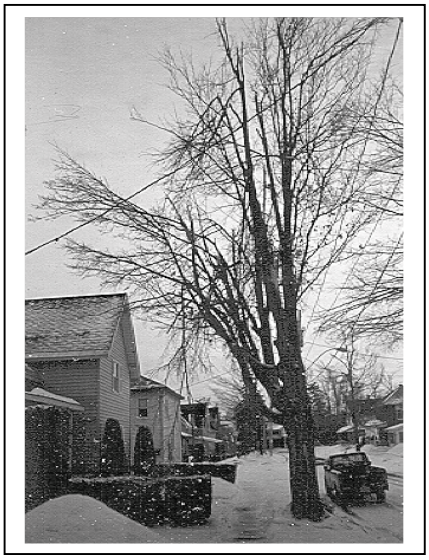
If there is no hazard situation, and if you can wait from a budget standpoint, postpone making removal decisions on vigorous healthy trees for a couple of years, to see how recovery progresses.

For instance, individual green ash, Callery pear, and honey locust trees have been known to recover well from complete or nearly complete canopy loss in urban locations.

,, **These images will help you estimate % crown loss in deciduous trees.**



This silver maple lost only about 20% of its crown. Depending on other health factors, it should recover well.



It is harder to estimate % crown loss in the winter on deciduous trees. This sugar maple lost about 30% , below the critical level.

Here, the easiest way to estimate loss is to add up loss in each half of the crown. The total is probably near 65% (40 left + 25 right) on this sugar maple.

This young (11" DBH) green ash in a park resprouted a full crown in the 8 years after it lost 90% in an ice storm. Most trees can not tolerate such loss, and will die.

II. AFTER THE DUST SETTLES

A. Assessment and Planning

Basic Point: Once the immediate tree emergency has been remedied, you will need to turn to long-term decisions and actions.

„ **Inventory/Survey**

Make a survey of the complete forest.

If you already have a survey or inventory, you need to revise it now:

- *f* to update data
- *f* to establish damage, safety problems, work, and cost

„ **Tree Inspection:** systematically inspect each tree for *maintenance needs* and *site information*.

For speed, you will probably want to conduct a windshield survey, but recognize that it takes a ground survey to see and evaluate more subtle problems such as decay.

Maintenance needs include pruning, removal, cabling, mulching, etc.

Site information includes presence of wires, width of planting area, soil texture, etc.

Include potential *planting sites*, if not already noted in your inventory. Check local criteria for planting sites, including spacing from other trees and traffic objects.

„ **Policies.** This is a good time to get in place—or review—standard tree documents such as:

up-to-date *specifications* for selecting, buying, planting, pruning, and removal

a Tree Ordinance

Resource: Bernhardt and Swiecki 1991, on the web at http://www2.champaign.isa-arbor.com/tree-ord/ordintro.htm, and the "Sample Brief Tree Ordinance" at www.cce.cornell.edu/monroe/cfep

„ **Education.** Work again with the media, now that you have a plan.

Publicize your next actions and decisions. People get most upset when they do not know what is going to happen, or when.

Notify homeowners from now on before doing work on any public tree they might consider "theirs". Use letters, postcards, door hangers, or any other means that works.

Get out good information on replanting and tree care. For example, excellent consumer brochures are available from the International Society of Arboriculture.

B. Working with FEMA and other reimbursement sources

Basic Point: A little bit of care and attention on the front end can save a lot of pain on the back end!

„ **Records, records, records! Know what is needed, and keep track of it <u>from the start</u>.**

„ **To be eligible for FEMA reimbursement, work must be:**

overtime

required as the result of a major disaster event

located within a designated disaster area

the legal responsibility of an eligible applicant

„ **Understand the "disaster area" declaration process** (Resource: Andresen/Burban 1994, pp. 61-65)

Initial emergency response occurs at the local level.

Local officials can decide to contact their State Emergency Management Agency (SEMA) for assistance.

SEMA determines whether the affected area should be declared a disaster by the Governor.

The governor can request that the situation be declared a "major disaster" by the President.

If approved, the Federal Emergency Management Agency names a Federal Coordinating Officer who oversees the determination of what type of relief is needed.

Local, state, and federal representatives work together to develop the Damage Survey Report, which provides an estimated budget.

Tree removal and pruning in natural forest systems are excluded from FEMA reimbursement, unless the trees directly impact public safety of persons using a maintained public facility.

Hazard mitigation funding is also possible to reduce future damage, though it is much more limited.

„ **Inform yourself about reimbursement requirements:**

Get a copy of your state's Emergency materials.

Understand FEMA and its role (current info on the web at www.fema.gov/about/)

Get a copy of FEMA's *Applicant Handbook* (FEMA 323).

- Interactive application forms that can be filled out on the computer are available on the web at http://www.fema.gov/r-n-r/pa/appfrm1.htm
- Directions for those forms can be found in the *Applicant Handbook,* and on the same web site as the forms.

Find out what will be reimbursed before you contract out work.

- Public tree removal necessitated by a disaster in a declared area is usually reimbursed, stump grinding is not unless a clear threat to life and public safety can be identified.
- Tree replacement is usually not covered by federal and state emergency management offices, unless it is a component of an otherwise eligible FEMA project.
- **Only overtime emergency labor is eligible** for FEMA reimbursement**.**

„ **Individual tree valuation may become necessary** in some instances for establishing the value of a specimen tree.

Tree valuation is difficult and often disputed, and for this reason is best carried out by a certified or registered consulting arborist trained and experienced in the technique.

There are two standard guidelines for doing this (ISA):

- *Trunk formula method:* used for large trees
- *Replacement cost method:* used for smaller, replaceable trees

Resource: ISA, *Guide for Plant Appraisal*

Appraised Value = Basic Value x Condition x Location

where

Basic Value = Replacement Cost + (Basic Price x [TA_A - TA_R] x Species)

Source: ISA Guide

General formulas for deriving a guideline value for a specimen tree according to the "Trunk Formula Method"

C. Reducing delayed threats to public safety

Basic Point: Disasters weaken surviving trees, leaving future safety and cost questions.

- **Priority 2 Removal.** Priority 2 trees have no danger of immediate death and failure, but they are expected to decline and fail over the next 5-10 years**.** *Making decisions about Priority 2 Removals is probably the hardest and most controversial step in managing a storm-damaged forest.*

  Decide which trees should come down now to remove a likely source of future hazards, and to be more cost-effective. Use your inventory/survey to set priorities.

  Consider factors such as safety, looks, neighborhood effect, cost, age, vigor, crown loss, balance, heartwood damage, and species.

  Good candidates for Priority 2 removal:
  - low-vigor trees with 50% or more of the crown destroyed or heavily damaged, especially when the loss is mostly on one side → G
  - trees with leaders broken back into the trunk
  - split or tipped trees that were not removed as Priority 1

  FEMA usually does not reimburse communities for non-hazardous tree removal.

  Consider closely those trees that have a high hazard potential by virtue of species. In the Northeast, these typically include:
  - basswood (American linden)
  - black locust
  - willows
  - boxelder (ash-leaf maple)
  - silver maple
  - cottonwood, quaking aspen, and other poplars
  - tree-of-heaven

This old sugar maple lost about 75% of its crown in an ice storm, and has a restricted rooting volume between the street and a new sidewalk. Sugar maple is a species that is unable to resprout lost crown. Finally, its failure would impact the busy street intersection, as well as significant utility fixtures. For these reasons, this tree is a Priority 2 Removal candidate.

Get help if possible, using knowledgeable tree professionals who have little or no monetary stake in the outcome. Check with your state forestry or Cooperative Extension office for suggestions.

„ **Priority 2 Pruning.**

Use your inventory to locate trees with a high hazard rating that need to be pruned.

Prune off stubs or broken branches, and begin rotational maintenance pruning to reduce future hazards. FEMA usually does *not* pay for non-hazardous pruning. → G

Identify vigorous trees that will need crown restoration.

- ƒ Hold off any restoration work until the tree has resumed normal growth.
- ƒ When many sprouts emerge after severe loss, it often helps to select a new scaffold limb structure by reducing competing limbs to the strongest.

Many communities have found it often more cost-effective to clean and repair Priority 2 trees than to remove them and replant.

„ **Delayed storm response**

After winter storms, be ready for new failures of split trunks and limbs when leaves come out in the spring. The leaf surfaces catch extra air and rain, increasing the load on the damaged tree parts.

Trees flooded when they are actively growing (especially just after the first flush of growth) will often have their roots weakened or killed, rendering them susceptible to later incidents of insects, disease, and windthrow.

All storm-damaged trees are weakened trees, and significant problems routinely emerge much later.

A radial shake in a linden that had gone through a severe ice storm, showing tri-part rupture through bark and wood on the outer surface. The radial shake weakens the limb, making it susceptible to later failure.

Source: Miller 1991

D. Recovery and reforestation

Basic Point: Tree loss means the community itself has lost value because of factors such as reduced cooling, less air purification, and lower attractiveness. It is in the community's best long-term interests to promote recovery and reforestation.

,, Trees have means to recover after disasters, because they have been dealing with natural disturbances (storms, fires, floods, insect plagues, etc.) since they first arose.

All tree species have innate means to control the decay that comes with damage.

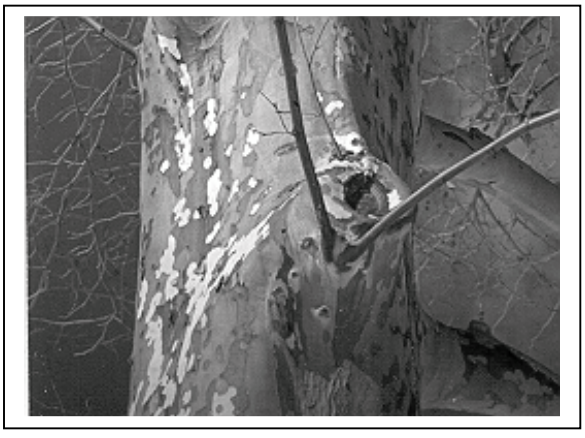
- ƒ Trees produce chemicals through photosynthesis that kill fungi. The healthier the tree is, the greater its capacity to produce these chemicals. → G
- ƒ Trees also change the physical structure of cells surrounding the decay, making it harder for the fungus to digest and grow through them.
- ƒ Combining these techniques, trees can build internal barriers to the expansion of decay in a process called "compartmentalization."
- ƒ The larger and deeper the wound, the greater the extent of decay. Also, trees cannot compartmentalize decay associated with the loss of their main stem.

Deciduous trees have another means of recovery: the ability to resprout lost crown.

- ƒ Buds in older wood that had been suppressed while the crown was healthy are released for growth.
- ƒ Younger, healthier trees on good growing sites will usually respond best.
- ƒ Some species (e.g., green ash) are very good at resprouting lost crowns, others (e.g., sugar maple) are not.
- ƒ The energy to resprout lost crown comes from starch that had been made and stored in previous growing seasons.

The length of time required for recovery depends on many factors, but forests often return to normal appearance within 5-10 years.

The loss of starch for containing decay and resprouting lost crown leaves the tree vulnerable, however, and long term decline may set in without many external symptoms at first.



On this London plane can be seen signs of a deciduous tree's responses to loss of crown, 8 years after a severe ice storm. The swollen ring of woundwood indicates compartmentalization of decay, and the shoots indicate attempts to sprout new foliage.
There are great differences in trees' abilities to compartmentalize decay and to resprout lost crown.

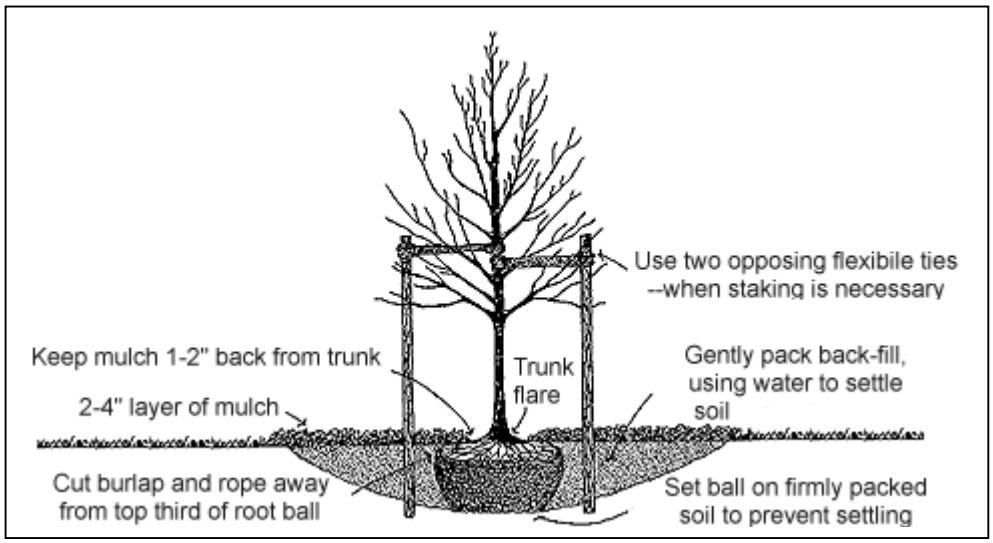
„ **Develop a restoration plan** that will become the reference document for the future.

„ **Seek out replanting funds** from private and public funds while memories are fresh.

Possibilities include local businesses, charity organizations, individuals, nurseries, green professionals, etc.

Contact the office of your state (urban and community forestry coordinator for other sources.
Resource : Tree City Bulletin #34, "How to Fund Urban Forestry."

■ **Set up and use purchasing and planting specifications** for standard use.



Source: ISA, "New Tree Planting"

„ **Have good selection criteria** in place.

Check with your state urban and community forestry coordinator or Cooperative Extension office.
Resources: Bassuk 1998, Reynolds and Boivin, 1994.

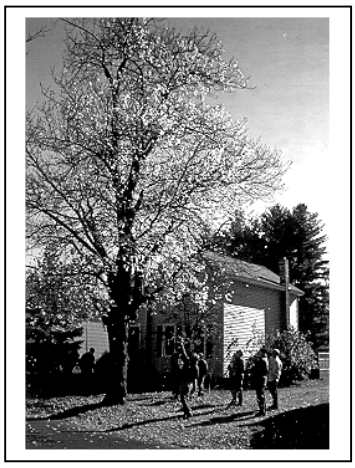
„ **Establish a Tree Commission**

Include concerned citizens as well as tree management personnel.

Use them for help in areas such as:

- basic tree inventory and assessment information
- tree selection
- keeping track of species diversity
- matching tree species to site
- relations with homeowners.

Resource: Lipkis and Lipkis, "The Simple Act of Planting a Tree"



Tree Commission members assessing a decayed horsechestnut in the village Right-Of-Way.

III. GETTING READY FOR THE NEXT ONE

A. Emergency Plan

Basic Point: You don't want to wait until disaster strikes again to figure out your best way of dealing with tree emergencies.

„ **Establish tasks** and assign responsibilities: figure out exactly what will need to be done, and who will do it. Basic task list for a medium-sized community might include (adapted from Andresen and Burban, 1994):

Tree pruning and removal
Public alley clearance
Phone contact for public service calls
Communications with other local officials/offices
Location of equipment, fuel, generators, etc.
Search for additional equipment and assistance
Brush removal from private property
Debris disposal
Record keeping
Damage assessment
Emergency response evaluation.

„ **Determine small management work units with priority routes,** and maintain
trees in the Right-Of-Way
relevant private trees (for example: any trees that would fall in the road)

„ **Identify tree professionals** who are knowledgeable and reliable.
Get prices for labor and equipment now, so that later you can figure out how great the markup for emergency work is.
The larger the amount of debris, the more equipment you will need to remove it. Businesses like construction or timber companies will be a likely source.

„ **Collect emergency documents** and place copies in central locations. Possible inclusions:
List of tasks and responsibilities
List of priority routes to clear
List of emergency officials
FEMA rules and regulations
Chain of command and organizational chart
List of other emergency telephone numbers (utilities, etc.)
List of reputable tree professionals
Tree care pruning standards (ANSI A300, Part 1)
Safety announcements
Public releases on safety and other topics.

B. Inventory

Basic Point: The better you manage and maintain trees, the less damage they will suffer.

„ Inventories of public trees have multiple benefits:

Making and defending budgets is much easier with hard data.

Work orders, annual costs, and tree histories can be quickly produced.

Homeowners are happier when an inventory is in place. They seem glad that somebody actually knows about "their" tree.

By including potential planting sites in your inventory, you can figure out your stocking rate, plan your budget, and find locations for planting. → G

Funding requests to emergency agencies will usually be processed more quickly, and requests for reimbursement will be easier to justify.

Computerized inventories are easiest to maintain and use.

Buy a professional program, or use an off-the-shelf spreadsheet such as Excel™

Resource: recent review of professional programs on the web at http://willow.ncfes.umn.edu/pubs/urbanforestry/streettree/toc.htm.

Free basic inventory templates based on Excel™ and Access™ are downloadable from the web (http://www.cce.cornell.edu/monroe/cfep), or check with your state urban and community forestry coordinator's office.

„ If an inventory is not possible, at least make sure that you:

have a system of annual inspection for needs and hazards

use a reliable method of evaluation

keep good records of complaints, decisions, and actions.

Example: Simple Inventory (using Excel™)

DBH = diameter at breast height; Cond = condition (5=excellent, 1=dead);
HazEv = hazard evaluation rating (3=no hazard, 12 = highest hazard);
Remv = remove; Remv/Trim codes: 0=None, 1=Required, 2=Optional

Trees Sorted by Address

Address	*Species*	*DBH*	*Cond*	*HazEv*	*Remv*	*Trim*	*Comments*
Bell St.							
21 Bigelow Side N	Sugar Maple	28	3	6	1		Clean
21 Bigelow Side S	Sugar Maple	28	4	3	2		Raise
3 Bell	Norway Maple	14	4	3	0		
5 Bell S	Green Ash	23	3	5	0		
5 Bell N	Sugar Maple	21	3	9	1		Decay btw leaders

Trees Sorted by Hazard Potential

Address	*Species*	*DBH*	*Cond*	***HazEv***	*Remv*	*Trim*	*Comments*
5 Bell N	Sugar Maple	21	3	**9**	2		Decay btw leaders
21 Bigelow Side N	Sugar Maple	28	3	**6**	0		Clean
5 Bell S	Green Ash	23	3	**5**	2		
21 Bigelow Side S	Sugar Maple	28	4	**3**	0		Raise
3 Bell	Norway Maple	14	4	**3**	0		

„ A useful option is to determine **hazard potential** for your trees, using a consistent rating system. → G
Here is one well-tested simple formula for hazard potential developed by tree professionals in conjunction with the International Society of Arboricultue:

HAZARD POTENTIAL = failure possibility + part size + target rating

Each category on the right side is assigned by field examiners a number between 1 and 4, the higher numbers being more serious. The tree's hazard potential is the sum of those numbers.

Resource: Matheny/Clark 1994.

This hazard potential has little meaning all by itself, but gains value in comparison with other trees in the same area. It is a method to direct your resources toward the most dangerous trees.

Action on trees with a hazard rating higher than 8 or 9 is often considered obligatory, and the trees are usually put on more frequent inspection as well.

Good hazard evaluation depends on trained and experienced observers, and on consistency. For these reasons, it is best done by professionals.

If you conduct the hazard survey yourself and are not a tree professional, be as consistent as you can in applying the rating system.

Here is **an example** of a sugar maple on a country road with the top half dead:

Hazard Rating:

Failure possibility	4	(dead wood is non-negotiable)
Part size	3	(dead wood is about 24" in diameter)
Target rating	1	(occasional use road)
TOTAL	**8**	

C. Mitigation: How to Limit the Damage Potential

Basic Point: what you do now--and the way you do it--will strongly impact how much damage you will have and how well your forest will survive in the next disaster.

■ Tree Selection

Require site analysis before selection, so limitations are known before a tree goes into the ground. Try to plant the "right tree for the right place." → G

Resource: site analysis form in Bassuk,1998

Adjust the size of tree to the width of the tree lawn. In the long run, the health of an urban tree will depend its having an appropriate rooting volume for its size.

Avoid planting large-growing trees under power lines. You can train young trees around wires, but they will always have to be pruned, setting them up for weakness and failure.

Establish a list of acceptable species, using materials from your state urban and community forestry coordinator or Cooperative Extension . Do not plant species known to fail.

Boxelder often fails during storms without any apparent damage or decay.
This one went down in a 1998 ice storm.

Aim for species diversity to limit damage from any one kind of disaster. One common guideline states that any one species (e.g., sugar maple) should be limited to 10% of the forest, and any one genus (e.g., all maples) to 20%. → G

Limit use of nuisance species (e.g., cottonwood) and species known to be invasive in your area (e.g., Norway maple).

Buy high quality stock:

- no defects or pests,
- good crown and root structure

Resource: "Buying High-Quality Trees", on the web at http://www2.champaign.isa-arbor.com/consumer/buying.html

„ Planting

Dig shallow and wide holes. Make sure root ball sits on undisturbed soil, and that root flare is at soil grade, so roots don't suffocate or drown. → G

Check for girdling roots, and prune them to promote outward growth. → G

Don't stake unless necessary, and then only with wide, soft ties.

Place organic mulch 2-6" deep out to the dripline (but not against trunk), and renew it when it decomposes. → G

Guard the young trunk with a recommended method (such as mulch and hardware cloth) to prevent damage to young tree from string trimmers, lawn mowers, etc.
Resource: Reynolds and Ossenbruggen 1993.

„ Pruning and Removals

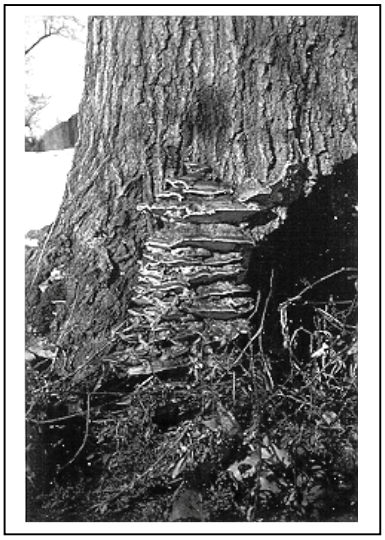
Prune young trees for strength and form (= "training"), starting a few years after planting. → G

- ƒ Training is particularly important for species that tend to produce codominant stems.

Resource "Pruning Young Trees" on the web at http://www2.champaign.isaarbor.com/consumer/young.html

Carry out the pruning and removals indicated by hazard potential on your inventory.

- ƒ Make annual inspections, and remove the riskiest trees as your budget permits.
- ƒ Larger trees with indications of butt rot (hollow buttress roots, mushrooms on the base, etc.) must be evaluated carefully. → G



This red oak in a park was diagnosed to have extensive butt decay but, because it had no reasonable target, was left standing. Six months later, it toppled over in a severe windstorm, revealing the extent of dead and rotted roots.

Make sure proper pruning cuts are made at proper times. Remember that decay routinely follows cutting, and that it will be less serious with:

- ƒ *better cuts, smaller exposed surfaces*
- ƒ *faster wound sealing, younger trees*

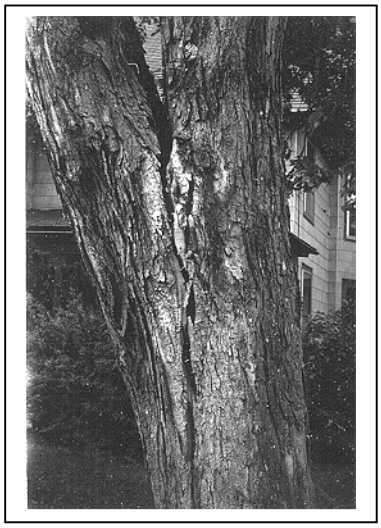
Resource "How to Prune Trees" (USDA, 1995).

On the right side of this tree is a flush cut painted with a creosote-based material. This technique is now known to be harmful to the tree.
A proper cut is indicated on the left side with a dotted line; nothing should be applied to the cut surface afterwards in most cases.

Source: adapted from a slide by Alex Shigo in the set "TLC for City Trees"

Pay attention to codominant stems on larger trees: they commonly fail in windstorms.

- The time to remove codominant stems is when the trees are young, because they can recover very well at that time.
- Removing a codominant stem on a large tree can cause as many problems as it solves, and should only be done when no other solution is possible and the target is serious.



The codominant stems on this red maple failed in a windstorm, leaving this crack on both sides of the trunk**. Such a tree is already in failure, and requires immediate action.** The best mitigation strategy would have been to remove one of the stems as early in the life of the tree as possible, cutting at an angle and avoiding wounding the branch ridge through the middle of the union.

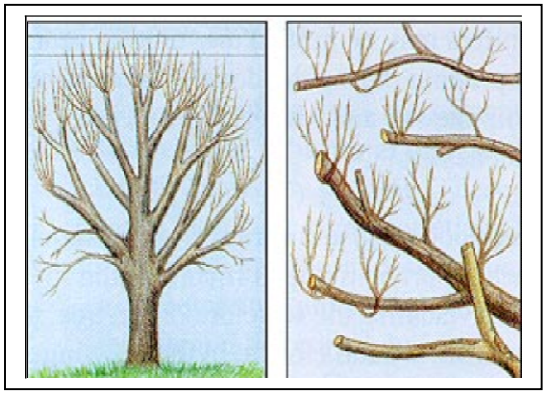
Avoid (if you can) cutting live wood in the spring between between bud break and full leaf expansion, **and in the early fall** when decay fungi are dispersing their spores. → G

Establish maintenance pruning on a rotational basis. Maintained forests suffer less damage and cause less harm in disasters than those that are not maintained. → G

Resource: "Community Maintenance Pruning" on the web at www.cce.cornell.edu/monroe/cfep.

Do not top or tip trees. This only causes more problems, and creates weaker trees. → G

Resource: "Why Topping Hurts Trees" on the web at http://www2.champaign.isa-arbor.com/consumer/topping.html



Topping (left) and tipping

Source: USDA, 1995, *How to prune trees*

„ Roots

Promote the health of the root zone as much as possible. This may include keeping a 2-6" layer of organic mulch underneath the crown, installing fencing, or planting other woody and herbaceous plants with the tree.

Protecting the roots and their soil environment is the best long-term investment in the health of the tree.

Resource: Shigo, "Troubles."

A large mulched zone around a tree set into turf. Such a separation of grass and trees leads in the long run to healthier, safer, and less costly trees.

Source: the slide set "Tree Anatomy Below Ground" by Alex Shigo

Keep grass away from the root system, especially around young trees. Grass competes well against trees, and limits growth above and below ground.

Provide slow-release fertilizer to young trees in the early fall or early spring. Young trees have been shown to benefit especially from a small amount of additional nitrogen—check for details on amounts and methods with your local Cooperative Extension office. → G

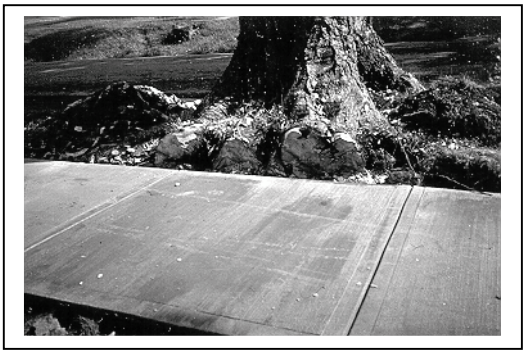
Resource: ANSI A300 fertilization standards.

Consider tunneling instead of trenching when installing underground utilities.

Avoid grade changes over mature tree roots, since the additional soil will suffocate them.

Avoid cutting the large buttress roots that flare out from tree bases. One common example occurs during sidewalk repair, and alternatives should be considered where possible.

Resource: "Trees and Sidewalks" on the web at www.cce.cornell.edu/monroe/cfep



Large sugar maple with buttress roots cut for new sidewalk. When buttress roots are cut on a tree of this age and species on such a site, it will often die in 3-5 years or suffer from windthrow.

IV. RESOURCES

A. Printed resources

General

„ Albers, Mike, et al. 1993. *How to detect, assess and correct hazard trees in recreational areas.* St. Paul MN: Minnesota DNR.

„ Andresen, John, and Lisa Burban. 1994. *Storms over the urban forest. Planning, responding, and regreening -- a community guide to natural disaster relief.* 2nd ed. Illinois: Division of Forest Resources. On the web at http://willow.ncfes.umn.edu/sotuf/sotuf.htm.

„ ANSI. 1995. *A300 American National Standard for Tree Care Operations. Tree, shrub, and other woody plant maintenance --standard practices.* New York: ANSI.

„ ANSI. 1998. *A300 (Part 2) American National Standard for Tree Care Operations. Tree, shrub, and other woody plant maintenance --standard practices fertilization).* New York: ANSI.

„ ANSI. 1994. *Z133.1 American National Standard for Tree Care Operations. Pruning, trimming, repairing, maintaining, and removing trees and cutting brush safely.* New York: ANSI.

„ Bloniarz, David, Ryan, H. Dennis, Luley, Christopher, and David Hawkins. [In Press] *An Initial storm damage procedure for urban and community forests.* Naples NY: Davey Resource Group.

„ Capon, Brian. 1990. *Botany for gardeners.* Portland OR: Timber Press.

„ Chaney, William. 1996. "How trees grow." *Tree Care Industry*. April, pp. 28-36.

„ Elmendorff, William F., and Henry D. Gerhold. 1996. *A Guide for municipal tree commissions*. Mechanicsburg PA: Pennsylvania Forestry Association.

„ Hanson, Trish, and E. Bradford Walker. 1996. *Field guide to common insect pests of urban trees in the northeast*. Waterbury VT: Department of Forests, Parks and Recreation. Order off the web at http://www.state.vt.us/anr/fpr/forestry/pubs/pest.html

„ Hauer, Richard J., et al. 1994. *Trees and ice storms: the development of ice storm-resistant populations.* Special Publication 94-1. Champaign IL: Illinois Dept. of Forestry. On the web: http://www.ag.uiuc.edu/~vista/abstracts/aicestorm.html

„ Hayes, Ed. 1998. *Risk assessment guidelines for hazard trees, "An Easy to Use Field Guide."* St. Paul MN: Minnesota DNR.

„ ISA. 1995. *Guidelines to tree pruning*. Savoy IL: ISA.

„ Kozlowski, T. T. 1985. "Soil aeration, flooding, and tree growth." *Journal of Arboriculture*. 11 (3), pp. 85-96.

„ Matheny, Nelda, and James Clark. 1994. *A Photographic guide to the evaluation of hazard trees in urban areas.* 2nd ed. Champaign, IL: ISA.

„ -----. 1993. *A handbook of hazard tree evaluation for utility arborists*. Champaign IL: ISA.

„ Nowak, D. J.; Rowntree, R. A.; McPherson, E. G.; Sisinni, S. M.; Kerkmann, E. R.; Stevens, J. C. 1996. "Measuring and analyzing urban tree cover." *Landscape and Urban Planning* 36: 49-57.

„ Shigo, Alex. [N.d.] *Tree Basics*. Durham, NH: Shigo and Trees, Associates.

„ USDA Forest Service. 1995. *How to prune trees.* NA-FR-01-95. On the web at http://willow.ncfes.umn.edu/ht_prune/prun001.htm

„ Watson, Gary, and E. B. Himelick. 1997. *Principles and practice of planting trees and shrubs*. Champaign IL: ISA.

Emergency response

„ Council of Tree & Landscape Appraisers. 2000. *Guide for plant appraisal*. 9th ed. Champaign IL: ISA.

„ Fazio, J. R., ed. [N.d.]. *When a storm strikes*. Tree City Bulletin No. 2. Nebraska City NE: National Arbor Day Foundation.

„ FEMA. 1999. *Public assistance: debris removal guide*. On the web at http://www.fema.gov/r-n-r/pa/dmgtoc.htm

„ Semrau, A. 1993. "Helping Trees Weather Nature." *Urban Forests*, Vol. 13, No. 1, pages 12-17. On the web at http://willow.ncfes.umn.edu/sotuf/chapter_4/appendix_d/appendixd.htm

„ USDA. 1998. *How to determine percent live crown loss in hardwoods before leaf-out.* Ice Storm Information Sheet #1. Durham NH: Forest Service. On the web at http://www.fs.fed.us/na/icestorm/Infoshts.html

After the dust settles

„ Bassuk, Nina. 1998. *Urban trees: site assessment selection for stress tolerance planting*. Ithaca NY: Urban Horticulture Institute, Cornell.

„ Bernhardt, E., and T. J. Swiecki. 1991. *Guidelines for developing and evaluating tree ordinances*. Sacramento, CA: Urban Forestry Program, California Department of Forestry and Fire Protection. On the web at http://www2.champaign.isa-arbor.com/tree-ord/ordintro.htm

„ Lipkis, Andy and Katie. 1990. "The Simple Act of Planting a Tree." Los Angeles CA: Tarcher. On the web at http://treelink.org/ .

„ Mattheck, Klaus. 1994. *Body language of trees.* Research for Amenity Trees No. 4. London: The Stationary Office.

„ Miller, Kenneth. 1991. *Investigation of internal stress damage from ice storm.* Kent OH: ACRT. On the web at http://www.acrtinc.com/Ice_storm/index.html.

„ Reynolds, Mary K., and Raymond Boivin. 1994. *Selecting trees for urban landscape ecosystems.* Concord NH: State of New Hampshire, Department of Resources and Economic Development.

„ Reynolds, Mary K., and H. Sharon Ossenbruggen. 1993. *Planting trees for communities. Checklist for success*. Concord NH: Department of Resources and Economic Development, Division of Forests and Lands.

„ Shigo, Alex. "How Trees Survive." *Tree Care Industry*. Volume VII, Number 2-Febuary. On the web at http://www.chesco.com/~treeman/SHIGO/SURVIVE.html

„ Smith, Kevin, and Walter Shortle. 1998. *A first look at tree decay*. NA-PR-02-98. Durham NH: USDA NE.

„ USDA Forest Service. [N.d.]. *Flooding and its effects on trees*. On the web at http://willow.ncfes.umn.edu/flood/table.htm

Getting ready for the next one

„ Fazio, J. R., ed. [N.d.]. *How to conduct a street tree inventory*. Tree City Bulletin No. 23. Nebraska City NE: National Arbor Day Foundation.

„ Shigo, Alex. 1996. "Troubles in the Rhizosphere." *Tree Care Industry.* Volume VII, Number 10 - October. On the web at http://www.chesco.com/~treeman/SHIGO/RHIZO.html

„ Miller, Robert W. 1998. *Urban forestry: planning and managing urban greenspaces*. 2nd ed. Upper Saddle River, NJ: Prentice Hall.

„ Shigo, Alex. 1986. *A new tree biology.* Durham, NH: Shigo and Trees, Associates.

B. Videos

- Clemson University, Department of Forest Resources. *Managing trees for public safety*. 3 tapes: "The Administrator's Responsibility," "The Role of Landscape Maintenance Personnel," "An Arborist's Guide." 65 mins total. Available from the International Society of Arboriculture.
- Illinois Arborist Association, et al. [N.d.] *Root injury and tree health*. 91/2 mins. Available from the International Society of Arboriculture.
- USDA Forest Service. [N.d.] *Evaluating trees for hazards.* 39 mins. Available from the American Forestry Association, or the International Society of Arboriculture.
- National Arborist Association, and the International Society of Arboriculture. [N.d.] *Pruning standards and techniques for the 21st century*.

C. Emergency and Urban/Community Forestry Web Sites

- http://www.isa-arbor.com/ The International Society of Arboriculture
- http://www.asca-consultants.org/ The American Society of Consulting Arborists
- http://www.treelink.org/ The National Urban and Community Forestry Advisory Committee
- http://www.willow.ncfes.umn.edu/ The USDA Forest Service in Minnesota, includes a "Hazard Tree Page"
- http://www.natlarb.com/ The National Arborist Association
- http://www.arborday.org/ The National Arborday Foundation's home page
- http://www.amfor.org/ The American Forests home page
- http://www.aces.uiuc.edu/~eden/resources.html The Extension Disaster Education Network
- http://www.fema.gov The home page for the Federal Emergency Management Agency. Regional offices (Boston, New York, etc.) are linked to the site.
- http://www.umass.edu/urbantree/ Northeast Center for Urban and Community Forestry Amherst MA.
- See "Emergency Contacts" (cover insert) for your state urban and community forestry web site.

D. Useful Addresses for Additional Resources

In addition to local FEMA, state urban and community forestry coordinator, and Cooperative Extension offices listed on the cover insert, here are some further places where you can obtain useful resources:

American National Standards Institute (ANSI)
11 West 42nd Street
New York, NY 10036

International Society of Arboriculture
PO Box 3129
Champaign IL 61826-3129

Northeast Center for Urban and Community Forestry
Department of Forestry & Wildlife
Holdsworth Center
University of Massachusetts
Amherst, MA 01003-4210

E. The Tree Emergency Compendium

*The **Tree Emergency Compendium** can be obtained from your state urban and community forestry coordinator (see front cover insert). It is also available on the web at the web site of the USDA Forest Service, Northeast Center for Urban & Community Forestry (*http://www.umass.edu/urbantree/*). It contains the following resource documents for tree emergency use:*

I. Emergency Response

- „ "A300 Tree Care Standards"
- „ "How to Determine Percent Live Crown loss in Hardwoods Before Leaf-Out"
- „ "How to Prune Trees"
- „ "In the Storm's Wake"
- „ "Safety Tips for Preventing Injury"
- „ "Watch Out for Scam Artists Posing as Arborists"

II. After the Dust Settles

- „ "A First Look at Tree Decay"
- „ "Buying High-Quality Trees"
- „ "Can these trees be saved?"
- „ "Flooding and its Effects on Trees"
- „ "Helping Trees Recover From Ice Storms"
- „ "Mulching Trees"
- „ "Native Tree Species"
- „ "Planting Trees for Communities"
- „ "Rating System for Tree Hazard Potential"
- „ "Risk Assessment Guidelines for Hazard Trees"
- „ "Setback Planting"
- „ "Site Assessment Checklist"
- „ "Staking Trees"
- „ "Underwire Trees"

III. Getting Ready for the Next One

- „ "Agency Planning Worksheet"
- „ "Community Maintenance Pruning"
- „ "Evaluation of Trunk Cavities"
- „ "Helping Trees Recover From Ice Storms"
- „ "How to Recognize Hazardous Defects in Trees"
- „ "Predicting Limb Breakage"
- „ "Pruning Young Trees"
- „ "Sample Brief Tree Ordinance"
- „ "Trees and Sidewalks"
- „ "Why Topping Hurts Trees"

IV. Other resources and useful information

V. GLOSSARY

Borer

A borer is any sort of insect that bores into wood, including moths, beetles, sawflies, horntails, and flies. Most of the damage is done when they are in the larval ("grub") stage. A common example is the bronze birch borer that can kill a susceptible tree within a few years.

Branch collar

At a branch's point of attachment, there is usually a swollen area where branch tissue and main stem tissue overlap. This collar contains the tree's primary defense mechanism against decay when the branch loses vigor or dies. In pruning, it is important that this collar be left intact.

Bud break

Bud break is the moment in the spring that the scales of a bud first open and shoot elongation begins. The exact time of bud break varies by species, plant health, and weather.

Butt rot

When decay fungi (see below) attack the part of a tree where the trunk meets the roots, it is commonly termed butt rot. It is a very dangerous form of tree decay, since it leads to failure of the whole tree but is often difficult to detect without special means.

Buttress root

This term applies to the large thickened roots that flare out from the trunk to the ground and form the upper part of the root crown. They provide much of the stability of a tree, and are the major path for water nutrients to the upper tree.

Certified arborist

The term "certified arborist" usually refers to someone who has fulfilled the requirements of the International Society of Arboriculture, which include a rigorous and long examination. Continuing education on an annual basis is required to retain certification. Some states have their own certification program as well.

Consulting arborist, registered

A registered consulting arborist has satisfied the requirements for technical education and experience set by the American Society of Consulting Arborists. They can bring a comprehensive and objective viewpoint to the diagnosis, appraisal, and evaluation of tree issues.

Codominant stems

Double or twin leaders of similar diameter that meet in a "V" union at their base. Such narrow unions commonly develop on opposite budded trees (such as maples) and some other species or cultivars (such as Bradford pear). They tend to fail during storms, especially when associated with decay, and dealing with them before serious storm events is good practice.

Crown

The crown is used here as a synonym of "canopy," and includes all the smaller branches, leaves, and fruiting structures that form the upper and outer part of the tree. It is one of the main parts of the tree, along with the roots, trunk, and scaffold branches. The crown's condition—leaf color or size, twig vigor, etc.—is a good indication of the overall health of the tree, although it says little about its stability (its ability to remain standing).

Crown cleaning

This term refers to the removal of dead wood above a certain minimum diameter (often 2"). One of the standard pruning types.

Crown raising

You raise the crown when you remove limbs that reach down below a certain minimum such as 8' (over sidewalks) or 14' (over roads). One of the standard pruning types.

Crown restoration

After crown loss in a disaster or in radical pruning, trees often release many new shoots from one location. With crown restoration, these new shoots are reduced to a few in order to produce a stronger crown and more natural shape. One of the standard pruning types.

Decay fungi

Most fungi are able to break down dead wood, but a few are actually parasitic and can attack living wood. They digest the wood of the tree, leading to strength loss and eventual failure of the tree part. They attack branches, roots, and any wounded part, and range from visible decay of the growth layer ("canker") to hidden decay of the roots. When decay has advanced, mushrooms appear as the fruiting body of the fungus. Decayed wood typically appears brown and crumbly or white and stringy.

Defect

Any tree factor that affects its health or stability negatively is a defect. Examples include chlorotic leaves, cut roots, wounded trunk, decayed branch wounds, codominant stems (see above), etc. Tree evaluation depends upon the careful detection and analysis of defects.

Dripline

A tree's dripline is the imaginary line around the edge of the crown projected on the ground. The outline of the canopy shadow when the sun is exactly overhead is a good approximation. It is used as an estimate of the extent of a tree's root system for things like tree protection or root fertilization, although in many situations the actual roots extend much further away from the trunk.

Flush cut

A way of pruning off branches that takes off the branch and its branch collar (see above) so that the cut is flush to the trunk. It used to be done for looks and health, and was once much recommended and practiced. It is now known to be detrimental to the tree's ability to limit the resulting decay.

Girdling root

When a root curls around the trunk base instead of growing outward away from the tree, it is called a girdling root. As it becomes larger over the years, it can cut off the flow of sugars down from the leaves to the roots. The roots will die, and the tree then lacks both water and support from that direction.

Hanger

Any dead piece of wood that is broken and hanging up in the crown, whether still attached or not. This obvious yet common defect poses a hazard to traffic or objects below.

Hazard potential/hazard rating

The hazard potential of a tree is a measure of its threat to an urban population. Methods to evaluate it usually examine the tree's potential to failure, the size of the part that might fail, and the relative significance of potential targets below.

Hazard tree

A hazard tree is one that in the judgment of an evaluator poses a significant threat to a significant target. Examples include a tree with a large dead branch over a street

Leader

A leader is a large, dominant, and more or less upright limb attached to the trunk. In some species, there is only a single or central leader, in others, there may be several.

Low-vigor trees

Vigor refers here to the average rate of growth of a tree, which can vary by species, age, site, and weather. When a tree has reduced growth, it often has a reduced ability to make sugar and to resist pests. Vigor can be measured directly with an increment borer, which takes a small core of wood directly out of the tree. A good non-invasive field estimate can often be made by looking at the annual growth increments of terminal twigs; anything consistently under 2" usually indicates low vigor.

Maintenance pruning

Maintenance pruning refers to the practice of maintaining tree structure, form, and appearance by periodic pruning visits. It is safer and more cost-effective to conduct maintenance pruning for an urban forest than to manage it by simply responding to reported problems.

Pest

A pest is any insect or disease that adversely affects the health or appearance of a plant. It is important to separate serious pests, such as borers, from cosmetic pests, such as galls.

Photosynthesis

Any plant that has chlorophyll can produce sugar and other chemicals from water and carbon dioxide in the presence of light. The reverse of photosynthesis is respiration (see below). The plant's photosynthetic rate is closely connected to its growth and health.

Pruning types

Six categories of pruning are defined in the ANSI A300 standards for hazard or maintenance pruning. These "pruning types" include crown raising, crown cleaning, crown thinning, crown reduction, vista pruning, and crown restoration. Using such standard terms brings clarity and responsibility to tree care.

Respiration

Sugars are consumed by plants as by animals: oxygen is taken in, and carbon dioxide is released. Trees need a certain level of respiration to maintain their health, and even more to be able to grow. If oxygen is cut off from respiring plant parts, such as when soil is heaped over small roots, they suffocate and die.

Root flare

When tree roots experience stress, they are strengthened. Trees undergo great stress from wind and gravity where the trunk meets the roots, and the result is a root thickening that produces a flare. The lack of a flare on an open-grown tree often indicates serious root problems, and should be evaluated carefully.

Rotational pruning

It is a common practice to conduct maintenance pruning (see above) in larger urban forests by dividing the forest into management units, and rotating the pruning to a different unit or group of units each year. This has been shown to be a very cost-effective way to manage public trees.

Scaffold branch

Scaffold branches are the large limbs that define the overall structure of the crown. They include leaders and large lateral limbs on many hardwoods, the central leader alone on many softwoods.

Site analysis

Many factors influence whether a tree will be able to grow successfully on a given site, and it is important to analyze them if the future forest is to be healthy and strong. These factors include: soil pH and soil texture (ratio of sand, silt, and clay), rooting volume, presence of utilities, heat load, soil moisture, etc.

Slow-release fertilizer

A slow-release fertilizer uses a method to make a small amount of its nutrients available to the plant over a long period of time. It has been shown that young trees particularly benefit from such a technique, because extra nitrogen is available whenever they need it.

Species diversity

The best defense against pests and disasters lies in having species diversity, or a mix of species, in the urban forest. Forests that contain predominantly one species (such as American elm), or one genus (such as maples) are much more susceptible to harm than those have a variety.

Stocking rate

This number is found by dividing the number of existing trees by the number of possible trees (= # of planting sites, whether filled or not). Expressed as a percentage, it can be used to estimate the degree of historic commitment to public trees, as well as to indicate the potential for growth.

Target pruning/Lateral pruning/Directional pruning

A tree's growth can be directed away from a target such as a building or wire by pruning to a sufficiently large lateral branch pointing away from the target. Fewer cuts have to be made, and pruning visits are reduced. If the trunk or limb is simply headed back without attention to where the cuts are made, resprouting will be encouraged on hardwoods and even more work will be produced.

Topping

When many branches are simply pruned back indiscriminately to reduce the height of a tree, it is called topping. Topping produces many new sprouts and introduces multiples wounds for decay fungi, and is therefore harmful to the tree. It also produces disfigured trees.

Training

Training is the pruning of young hardwood trees for strength and beauty. Well-spaced limbs with strong unions result from proper training. It is also the best method of taking care of codominant stems (see above), since one of the stems can be removed while the tree is young and can recover quickly.

Appendix E
Contracting Tree Work

Contacting Tree Work

Tree care companies can be utilized to perform work beyond the capabilities of municipal manpower and equipment. Some of the advantages of using contracted crews to do tree work are:

- Does not require an increase in municipality personnel or re-training of existing personnel.
- Does not require large capital expenditures on equipment.
- Allows for greater flexibility in scheduling tree care operations.
- Allows the amount of work performed on an annual basis to be adjusted based on available municipality budget, without laying off municipality personnel.

A municipality can most cost-effectively contract tree work by:

Scheduling work in the winter months – This is traditionally the slow season for tree care companies. Companies may offer reduced rates (10% to 20%) for off-season work to keep their employees on the payroll.

Performing work on a project basis – In this way, the tree care company is guaranteed a certain dollar volume of work, and the municipality is guaranteed specific work rates. Tree companies may offer a reduced rate (5% to 15%) for fixed-volume business.

Contracting of Tree Care on a Project Basis

To secure the best possible prices, Treefull Communities recommends contracting on a project-by-project basis. Projects can include work on an individual tree or work on a group of trees, based on either the type of maintenance to be performed or by location of work. In the first example, all of the removals can be identified as a project, and bids can be solicited for the performance of the removals alone within a specific time frame. Ideally, bids for work should be on a per tree basis by diameter class. In the second example, the maintenance for all trees on several streets can be identified as a single project and bids solicited for the entire project. There are many variations of this concept for contracting tree care, and the Municipality can select the method that best suits its requirements. Project planning should focus on the efficient use of workers and equipment by the selected contractor. This will aid the Municipality in obtaining the best pricing for tree care projects.

It is important to consider more than just pricing when selecting a tree care contractor. Contractors should be required to post performance bonds on projects over a certain dollar amount; should show proof of adequate general liability and workers' compensation insurance; should be able to demonstrate sufficient ability to perform the work as specified; should hold all necessary licenses, such as pesticide application certification; and should be able to provide references to past work that is similar to the work specified for the project. In addition, the Municipality should maintain awareness of any public relations problems involving the contractor's work procedures, equipment, and personnel appearance. Such problems or potential problems should be remedied as soon as possible.

Recommendations for Contractor Crew Inspection

When inspecting contractor tree crew operations, the Municipality should make sure the crews follow the guidelines set forth in contract specifications for the work being performed. These specifications should be developed and approved by the Municipality to ensure quality performance by contractors. Following these guidelines should result in improved pruning procedures and safe work practices. The inspection process should ensure that the contractual procedures are followed. Examples include:

Climbing crews do not use climbing spikes except for tree removals.

- Work operations are properly protected with traffic cones, pedestrian barriers, and flaggers to prevent injury to crew personnel and the general public, and to prevent damage to adjacent property.
- All pruning cuts are made according to specifications. Pollarding, framing, or rounding over is not acceptable practice.