TOWN OF CHEEKTOWAGA

# AN URBAN FOREST MANAGEMENT PLAN

# acknowledgements

**An Urban Forest Management Plan for the Town of Cheektowaga, NY 2017**

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# contents

# executive summary

The purpose of this document is to aid the Town of Cheektowaga in maintaining and enhancing their urban forest with the mission of increasing the aesthetic, environmental and economic benefits provided by the urban forest. Town government as well as public engagement is essential to realize the vision of Cheektowaga's urban forest. With this in mind, the Town has developed a long-range urban forest management plan to guide the Towns' urban forest into the future.

This Plan reflects the current understanding of Cheektowaga's urban forest conditions and forest management needs. However, it is intended to be a living document that is regularly reviewed and updated.

A vigorous and engaged urban forestry program is critical to meeting Cheektowaga's mission and vision. In order to accomplish the mission five goals have been identified along with a means of measuring if those goals are achieved.

**Goal 1:** Improve efficiency in managing the urban forest

**Goal 2:** Conserve existing tree asset

**Goal 3:** Increase tree canopy and species diversity

**Goal 4:** Preparedness

**Goal 5:** Increase urban forestry awareness

While there may be some cross over in the objectives of the goals each goal targets a particular segment or user group when considering the urban forest as a whole.

- Improving efficiency in management is focused on the Town government and the interactions of various departments to develop relationships that benefit the urban forest.
- Conserving the tree asset focuses on maintenance activities and strives to develop a set of standards and best management practices that would be adhered to by both the Town, its contractors, developers and the public in general.
- Increasing tree canopy cover includes the long term objective of essentially doubling the tree canopy over twenty years, integrating forestry into stormwater management and promoting civic engagement in tree planting.
- Preparedness deals with two main issues that threaten the mission of the Town, both large storms and pest or disease outbreaks can decrease the aesthetic, environmental and economic benefits through the widespread loss of trees.
- Increasing awareness will be a critical goal to achieve. Without public understanding behind the reasoning for the other goals this plan will fail to succeed.

Trees do much more than beautify our parks and streets. They provide a wide range of important social, economic and environmental benefits. Although trees work hard every day - cleaning the air, storing carbon and providing habitat - they are rarely recognized or valued for the services they provide. This plan recommends maximizing the benefits of urban trees and educating policymakers and the public on these benefits. Trees that are nurtured within an urban environment produce benefits that far exceed the cost of planting and care during the trees' lifetime. This goals and objectives set forth within this plan can be used by the Town and property owners to aid in the selection of trees to plant and how to approach maintenance activities, thereby maximizing the benefits most relevant to the residents:

•Improved Air Quality •Stormwater Retention •Enhanced Public Health

•Biodiversity & Habitat Creation •Carbon Sequestration

•Support Local Economy

# community setting

Text...

# state of the urban forest

All trees within a municipality or community (on private and public lands) comprise the urban forest. This Management Plan is focused on the public portion of the forest, with the intention to persuade owners and managers of the private portion to join in a common effort to improve the quality of the urban forest as a whole.

Assessing the state of the urban forest is accomplished by an analysis of the species composition, age of the trees, their condition and stocking rate. The base data that was analyzed for this plan was an inventory of 16,302 existing street trees on town controlled right-of-ways. The inventory data was collected in summer 2013 by interns and represents a 'snapshot' in time as the data has not been updated. The tree inventory did not include potential planting locations or maintenance recommendations, therefore an analysis of the stocking rate or maintenance planning could not be performed.

## species composition

The current street tree population lacks diversity. Urban foresters and municipal arborists should use the following guidelines for tree diversity within their area of jurisdiction:

(1) no single species should represent more than 10% of the population,

(2) no single genus should represent more than 20% of the population,

(3) no single family should represent more than 30% of the population.

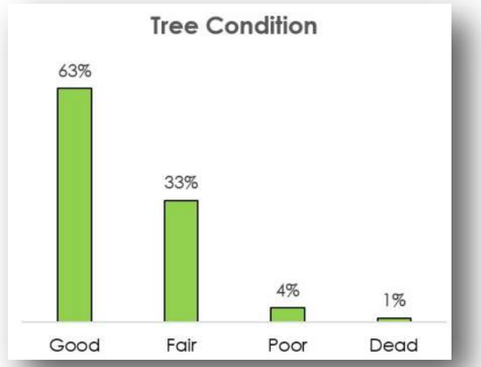
The genus Acer (Maple), which includes, but not limited to silver, red, sugar and hedge maples comprises approximately 57% of the street tree population. This percentage well exceeds the 20% guideline and demonstrates that the Town should endeavor to diversify its tree population.

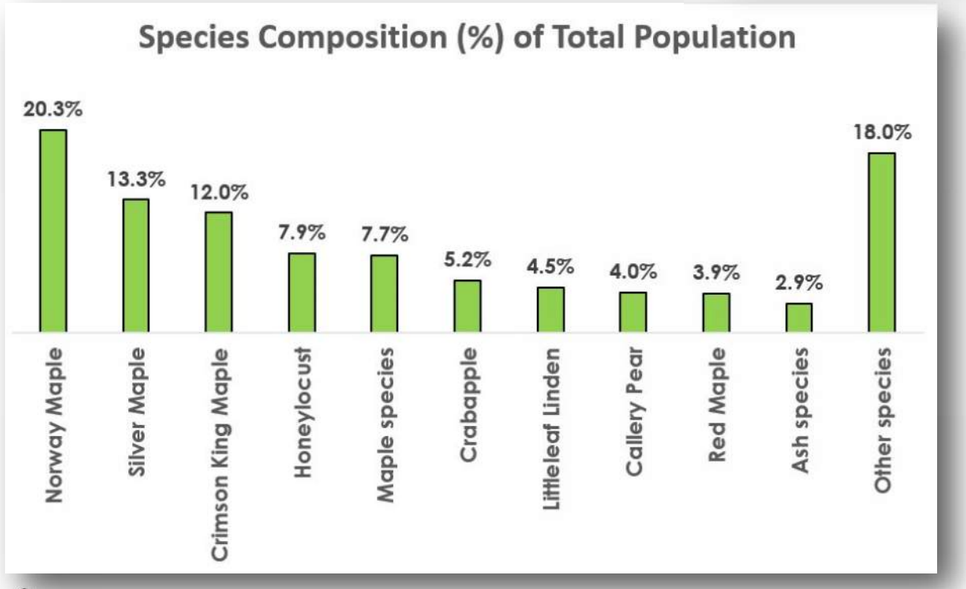
Species diversity is important to prevent the sudden loss of a large amount of the tree canopy at one time due a disease or insect. The Asian Long Horned Beetle feeds primarily on maple trees, but will also impact birch, common horsechestnut, elm, hackberry, London plane, mountain ash, poplar, aspen, and willow. If this insect should become established in the Town it could mean the loss of 62% of the current street tree population. As the Town plans future plantings, a variety of genus and species should be considered to ensure the diversity of the overall tree population continues.

## tree condition

The street tree population was determined to be 63% in Good condition and 33% in Fair condition.

The median estimated annual survival rate is 95%, the condition ratings collected in the town appear to indicate the health street tree population is on par with other studied communities.

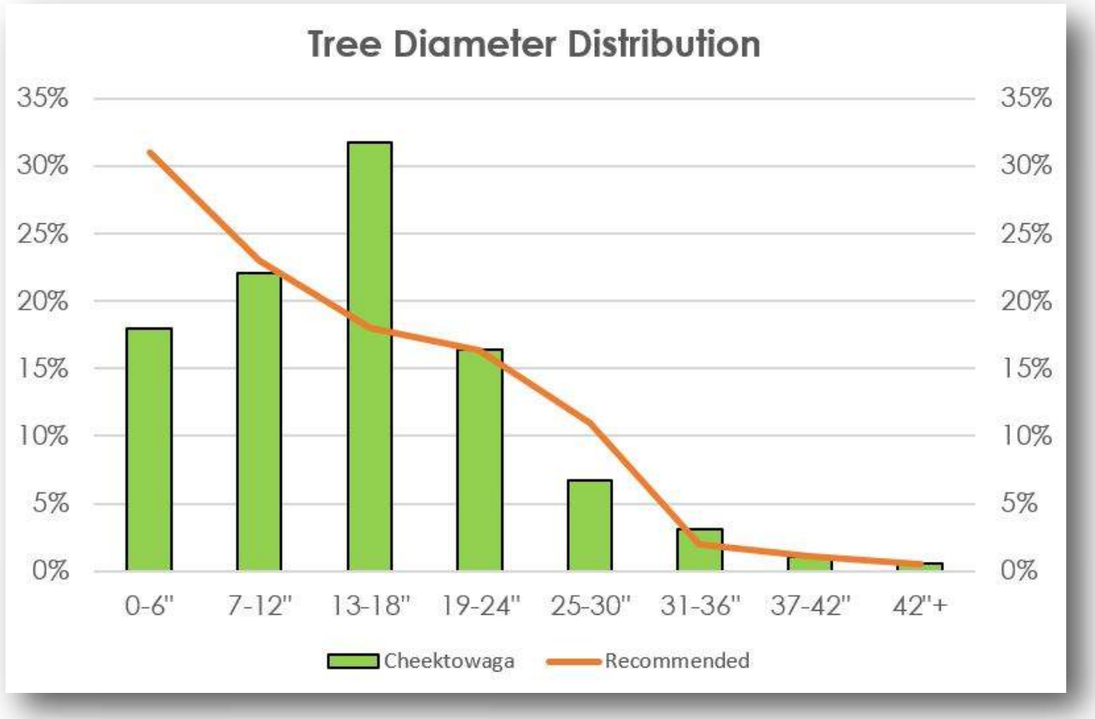


# state of the urban forest

## diameter distribution

Using size as a proxy for age, Richards identified an "ideal" distribution for municipal forests as having about 40% of the urban tree population in the smallest diameter classes. (Richards, N.A., 1983. Diversity and stability in a street tree population. *Urban Ecology*. 7: 159-171) As the Diameter Distribution table indicates, the Town has not engaged in an aggressive street tree planting program resulting in a "bell" curve of diameter distribution. The Town is encouraged to begin a an aggressive tree planting program to renew the resource as the larger or older trees decline and are removed. An urban forest that has a large percentage of young trees is one that supports the variety of values the urban forest provides as the population ages.




## benefits

The current tree canopy has a replacement cost of:

**$19million**

and is providing

**$2.1million**

in benefits each year.

# Town of Cheektowaga, NY

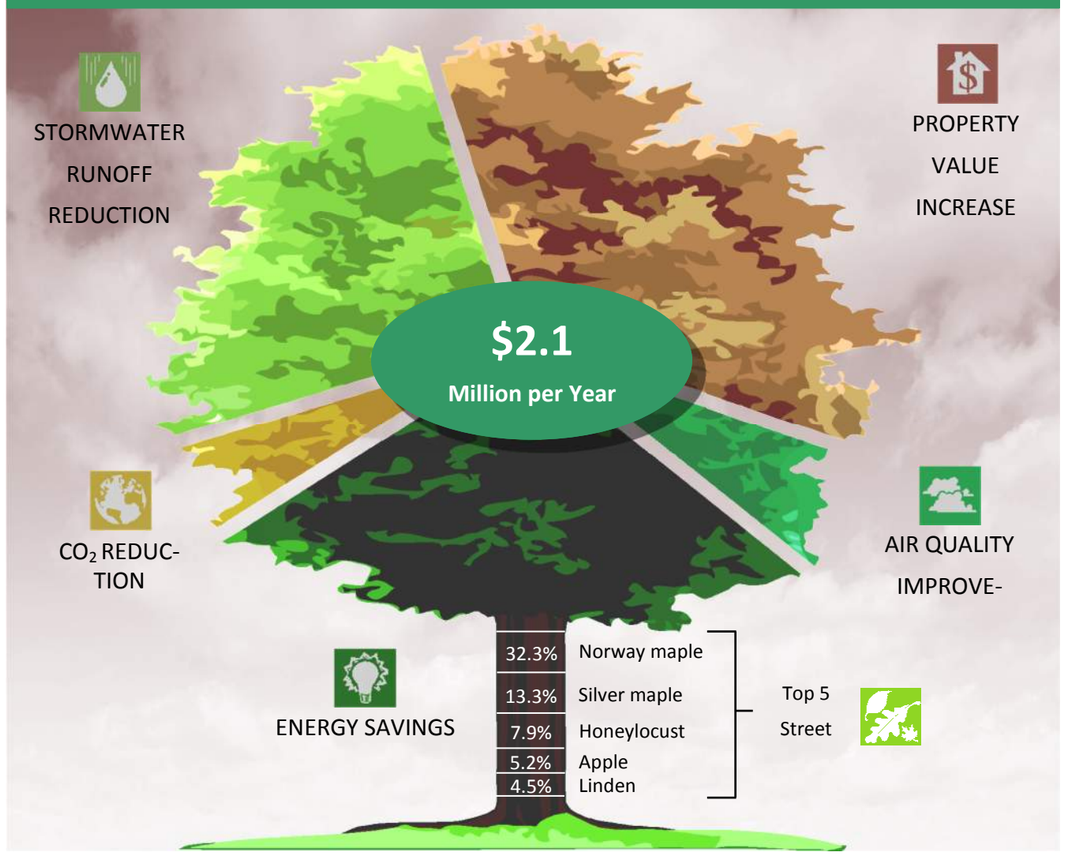
## Street Tree Benefits

**Town of Cheektowaga** street trees provide millions of dollars of environmental, economic and aesthetic benefits to the community. Over their lifetime, street tree benefits exceed the costs of planting and care, representing a 300 percent return on investment. Tree benefits increase over time highlighting the importance of not only planting trees, but of providing ongoing maintenance and protection. These benefits are a reminder of the

**Trees:**

- **Reduce stormwater runoff**
- **Lower summer air temperatures**
- **Reduce air pollution**
- **Reduce heating and cooling costs**
- **Reduce atmospheric carbon dioxide ($CO_2$)**

## Annually **Cheektowaga's** public street trees provide[1]...




## Trees Reduce Stormwater

Trees reduce peak stormwater runoff and associated pollutants entering local water bodies. Trees reduce stormwater volumes by intercepting a portion of rainfall, which evaporates and never reaches the ground. Tree roots also increase rainfall infiltration and storage in the soil. And tree canopies reduce soil erosion by diminishing the impact

**Street trees intercept 25 million gallons of water**

## Trees Reduce Atmospheric

Trees reduce atmospheric carbon by capturing and storing $CO_2$ as they grow. By reducing demand for heating and cooling, trees indirectly reduce $CO_2$ by avoiding power plant

**Street trees capture 3.6 million tons of atmospheric $CO_2$ per year. Annual savings including indirect costs are $22,490. Street trees also store approximately 75 million tons of atmospheric $CO_2$ for a total savings of**

## Trees Improve Air Quality

Trees improve air quality by trapping particulates, absorbing gaseous pollutants, and releasing oxygen. By cooling urban heat islands and shading parked cars, trees indirectly reduce ozone levels. The Environmental Protection Agency recognizes tree planting as an ozone reduction measure in

**Street trees remove 3,684 lbs. of particulate matter, 7,5190 lbs. of ozone, 1,228 lbs. of sulfur dioxide and 3,225 lbs. of nitrogen oxides annually. Total annual**

[1]Analysis was conducted using iTree Streets. iTree Streets is a street tree management and analysis tool for urban forest managers that uses tree inventory data to quantify the dollar value of annual environmental and aesthetic benefits. The iTree Suite is a free state-of-the-art peer reviewed software suite from the USDA Forest Service. www.itreetool.org.

## Trees Save Energy

Trees reduce the demand for energy to heat and cool buildings by providing shade, lowering summertime temperatures, and reducing windspeeds. Secondary

**Street trees save approximately 1,370 MWH of electricity and 503,365 Therms of natural gas annually**

## Trees Improve Property Values

Trees are the single strongest positive influence on scenic quality in our community! They increase the attractiveness of retail business areas. Studies found shoppers are willing to pay up to 11% more for goods and services in a well-landscaped business district. Trees increase property values. People will pay 3-7% more for properties with many trees. Trees foster safer and more sociable neighborhoods. Views of trees ease mental fatigue and stress, help concentration, reduce sickness, and provide settings for recreation and relaxation. Trees also help reduce noise, provide a refuge

**Street trees increase property values annually by**

## Diversity Improves Urban Forest

A diverse palette of trees helps guard against catastrophic loss to insects and diseases or environmental stresses. A general guideline for urban forest diversity is no more than

**Maple trees are over-represented on the streets. This jeopardizes $1,350,000 of the city's urban forest's benefits from pests such as and Asian longhorned beetle (ALB). Enlist the public to help increase Town of Cheektowaga's forest resilience by planting less common trees on their own property.**

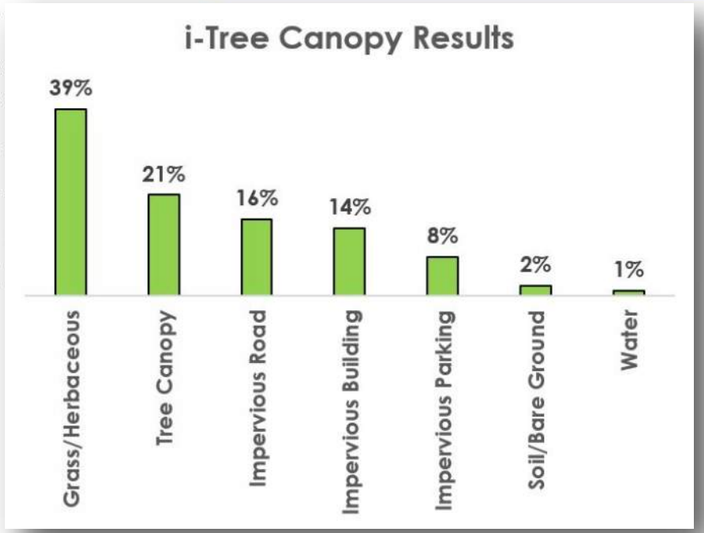
# i-Tree Canopy Analysis

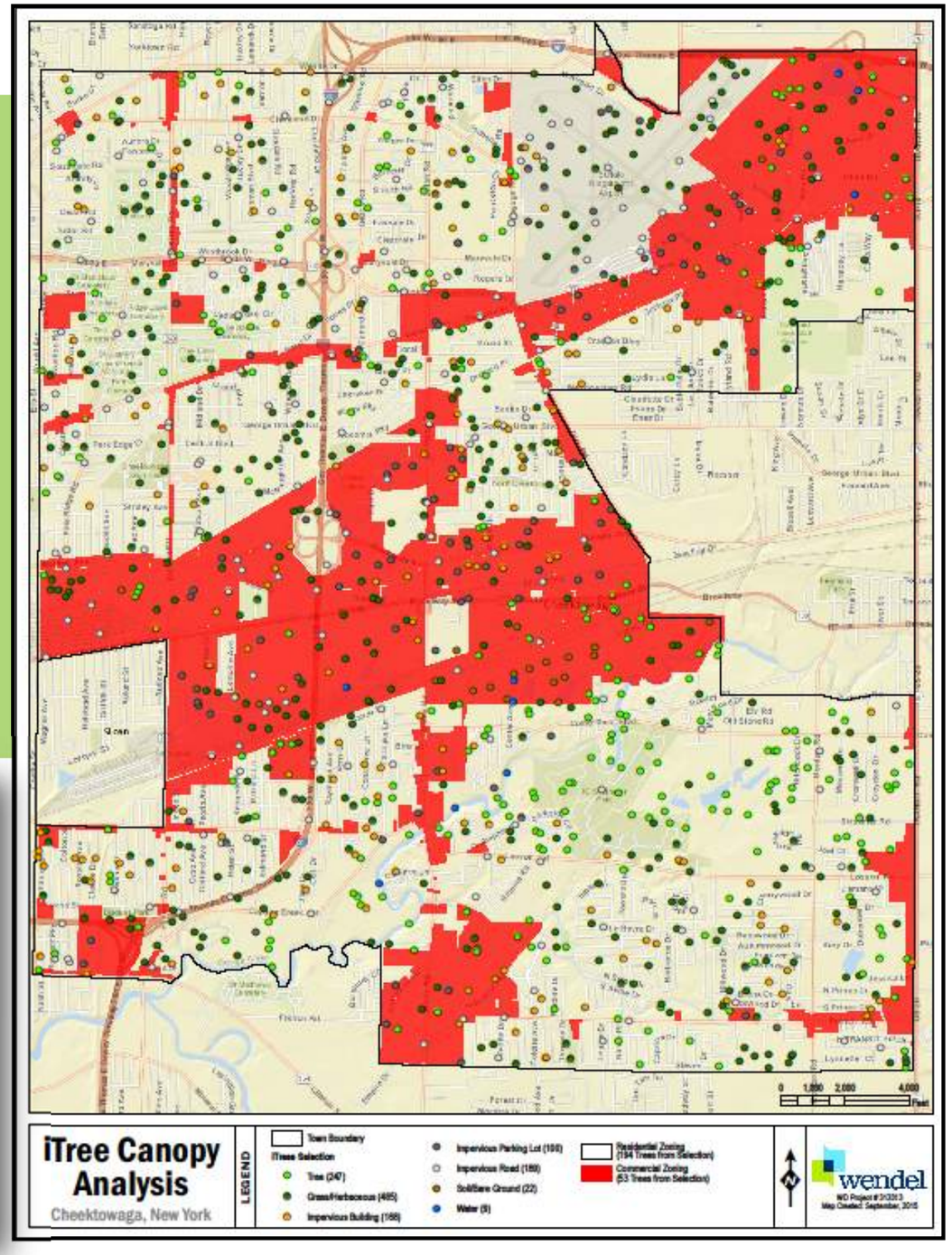
i-Tree Canopy offers a way for communities to statistically measure land cover types using aerial imagery. The most recent aerial imagery (2014) using Google Earth was used to determine land cover. Seven cover types were classified: tree canopy, grass/herbaceous, impervious road, impervious building, water, soil/bare ground and impervious parking lot.

Based on survey of 1,200 randomly generated points throughout the Town, tree canopy cover is approximately 21%. In a publication by Dan Cray, eastern cities ideally need 40% tree canopy, taking into account all zones from commercial to residential.[1] A recent publication from the U.S. Forest Service shows New York State has an average of 38.2% canopy cover in urban areas.[2] By increasing the tree canopy, ecological benefits from trees are increased such as air quality, storm water reduction and increased property values.

**American Forests**, the oldest national nonprofit conservation organization in the United States, which aims to protect, restore and enhance the natural capital of trees and forests, has established the following canopy coverage recommendations:

- Average tree cover counting all zones 40%
- Suburban residential zones 50%
- Urban residential zones 25%
- Central business districts 15%




Cray, Dan. "Why Cities are Uprooting Trees." Time Magazine. (2007). Web.

http://www.nrs.fs.fed.us/data/urban/state/?state=NY

The largest category of ground cover was found to be Grass/ Herbaceous, representing approximately 39% of the town. These areas included cemeteries, parks, schools, agriculture or abandoned fields, right of ways managed by the town, privately owned yards and the Buffalo Niagara Airport. A majority of these areas are not under the control of the Town but through program incentives these open areas can be encouraged to include trees in the landscape.

Following in a close second to Grass/Herbaceous is a combination of Impervious Road, Impervious Parking lot and Impervious Building at a combined ground cover of 38%. Impervious areas can reduce or inhibit ground water recharge and infiltration by not allowing water to percolate into the ground. During rainstorms and through snow melt pollutants found on these surfaces can flow into storm drains and potentially overflow beyond capacity, the end result is pollutants end up in streams and lakes.

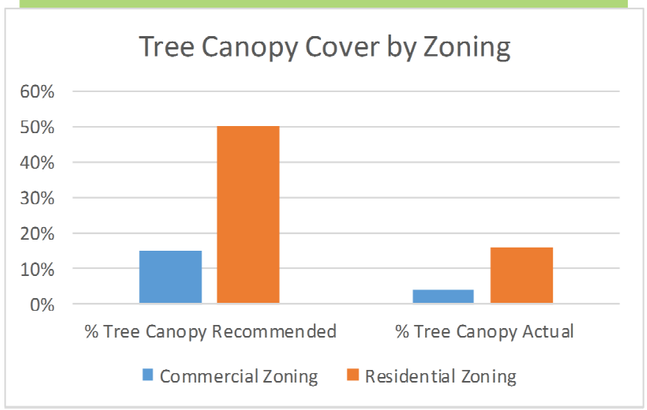
## i-Tree Canopy Analysis

The i-Tree Canopy data points were overlaid with current Town zoning maps.

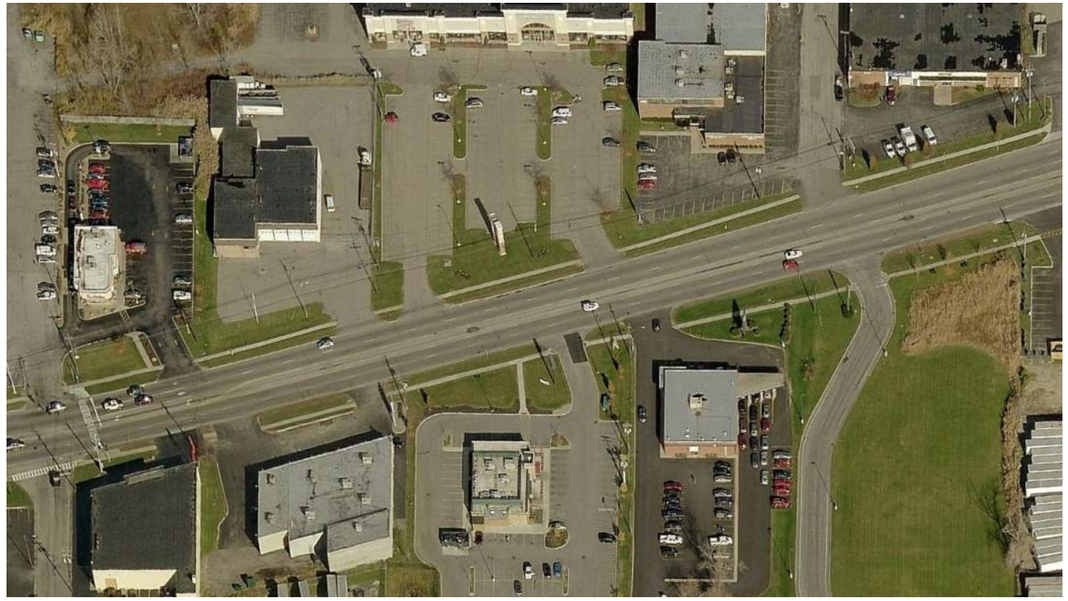
In the areas zoned for residential development the tree canopy cover was approximately 16%. American Forests recommends tree canopy cover in suburban residential development to achieve 50%.

In the areas zoned for commercial development the tree canopy cover was approximately 4%. American Forests recommends tree canopy cover in commercial development to achieve 15%.

Both the residential and commercial zoned areas are well below recommended levels.




*Typical Residential Streets in the Town of Cheektowaga* Photo D. Ulatowski



*Typical Commercial Street in the Town of Cheektowaga* Source: Bing Maps

# influences on the urban forest

## Natural influences

**Climate**:

Annual rainfall and temperature ranges of regional climates create environments for various tree species to thrive and others to fail.

Cheektowaga's temperate climate has an average rainfall of 40-inches per year and an average snowfall of 94-inches per year, which provides ample soil moisture for plant growth.

Cheektowaga's average temperature is 48-degrees F, the average high temperature is 80-degrees F and the average low temperature is 19-degrees F. This places the town in USDA Hardiness Zone 6A.

**Storms**:

Average wind speed of 10.3 MPH, Cheektowaga is one of the top 20% most windy cities in the U.S., 2 MPH higher than the national average. Winter is the windiest season with wind speeds reaching 12 MPH on average. Cheektowaga regularly experiences high wind events that damage trees. It is not uncommon for the region to experience wind gusts approaching 70 MPH several times during the year.

The region experienced an early snow storm, October 12, 2006, while many of the trees were still in full leaf. This storm damaged thousands of the town trees and cost millions of dollars to clean up.

**Insects and Diseases**:

Insect populations fluctuate depending on the weather. In most cases the damage to the trees does not warrant intervention and natural systems are allowed to control populations. Some pests do create nuisance problems for residents. Aphids drop sticky honeydew from trees onto cars, sidewalks and surfaces and the honeydew attracts yellow-jackets which can become more than just a nuisance. Control measures may be warranted and taken in the case where the insect poses a safety risk to the public, however pesticide application regulations make treating every pest prohibitive.

Common diseases that may be found in Cheektowaga's urban forest include: verticillium wilt, fire blight, anthracnose and tar spot. Common insects include: aphids, adelgids, scale, locust plant bug, bees and ants.

The discovery of Asian Longhorned Beetle (*Anoplophora glabripennis*) in New York City, Chicago, IL, Worchester, MA, and Toronto, ON is a concern for the Town's urban forest. The Asian longhorned beetle, or ALB, is an invasive insect that feeds on a wide variety of trees in the United States, eventually killing them.

Asian Longhorned Beetle, photo credit NYSDEC


Posing a current threat is the discovery of Emerald Ash Borer (*Agrilus planipennis*) throughout the town. Larvae feed in the phloem and outer sapwood of ash trees, producing galleries that eventually girdle and kill branches and entire trees within a few years.

Emerald Ash Borer,
photo credit US Forest Service

# influences on the urban forest

## Man-Made influences

While the favorable tree growing environments presented within our parks and larger open spaces at our facilities, street tree planting sites prove to be much more difficult for tree health and long term survival. Street trees must share the same space as utilities within the right-of-way. Utilities both overhead and underground present potential conflicts. Motor vehicles may inflict direct damage by colliding with trees, and vehicle exhaust provides additional stressors.

**De-icing compounds**:

De-icing compounds used on streets, parking lots, driveways and sidewalks in winter contain sodium chloride and/or calcium chloride. These chemicals are injurious to trees and plants. Injury occurs when de-icing compounds are deposited by spray or drift on dormant stems and buds of deciduous trees. Injury may also occur when excessive amounts of de-icing compounds accumulate in the root zone of these trees. Overmaturity and drought can intensify the problem of high salt levels. For example, prolonged drought interacts with soil salt to increase damage to trees. Also, as trees age they lose their ability to tolerate soil and salt related stresses.

**Construction**:

Construction is by far the most man-made influence on the urban forest. Tree damage and eventual death results from the cumulative effect of construction activities. Root cutting, soil compaction, grade changes, stockpiling of materials, extreme heat from equipment exhaust and paving operations and soil compaction all negatively effect the health of trees.

Utility work involving repairs or upgrades to underground water, gas, sanitary and storm services usually involves excavation adjacent to or within the critical root zones of street trees.

Tree pruning ahead of a road or utility construction project may reduce the chances of equipment hitting and damaging lower tree limbs.

# summary of key findings

## town street trees

- Over 16,000 inventoried street trees are managed by the Town
- 96% of the trees were found in either good or fair condition
- The most prevalent species is Norway Maple, which comprises of 20.3% of the inventory
- 54% of the inventory is in the 6-18 inch diameter class
- Street trees intercept approximately 25 million gallons of storm water annually
- Street trees are providing approximately $900,000 in energy savings annually
- The replacement value for the inventoried street trees is approximately $19.6 million

## town park trees

*Only the trees located within Cheektowaga Town Park have been inventoried. The Town must inventory its remaining parks to determine the health of the forest population within each park.

- The inventory contains 624 trees
- 82% of trees were found in either good or fair condition
- The most prevalent species is Spruce, which comprises 14.2% of the inventoried trees
- Apple comprises 13.9% of the inventoried trees
- 31% of the park trees are in the 6-18 inch diameter class
- Park trees intercept approximately 610,000 gallons of stormwater annually
- The replacement value for the inventoried parks trees is approximately $3.3 million
- Park trees are storing 1,657,000 lbs. of carbon

# goals and objectives

The town has set the following goals and objectives to aid in enhancing the urban tree canopy and increasing the environmental benefits for the community. It is recommended for the town to review the progress on these goals at least annually and perform a detailed review of progress when there is a change in administration.

## improve efficiency in managing the urban forest

- Develop an organizational chart for personnel responsibility
- Share services among departments to increase efficiency
- Develop an Urban Forestry Administration and Policy Plan
- Update and maintain tree inventory

## conserve existing tree asset

- Develop a tree maintenance manual
- Develop a rotational care program
- Actively seek funding for maintenance activities
- Review and update codes and related documents

## increase tree canopy cover and tree population diversity

- Plant with a purpose
- Develop annual planting plans
- Actively seek funding for planting
- Promote planting by private entities
- Explore Public/Private partnerships
- Incorporate Stormwater Management into urban forestry

## preparedness

- Develop an urban forest storm response plan
- Develop an exotic pest and disease response plan

## increase urban forestry awareness

- Develop educational programs and brochures
- Become a Tree City USA

Timelines for addressing the goals and objectives, as well as an evaluation system is outlined later in this document.

# improve efficiency in managing the urban forest

## Develop an organizational chart for personnel responsibility

### current conditions

Responsibility for the care of the Urban Forest is currently shared between four different departments. The decision making process is fractured and is assigned as follows:

**Highway** – Annual leaf /tree debris pick up and disposal, tree removals, limited trimming and limited tree plantings within town rights of way.

**Engineering** – Tree planting bid preparation, manage awarded planting contract/supervise contractor for compliance with bid specification. Tree removal bid preparation, manage awarded tree removal contract/ supervise contractor for compliance with bid specification. Urban Forest Grant preparation with Town's grant consultant.

**Facilities, Parks, Buildings & Grounds** - Tree maintenance/plantings within town parks and facilities, including all other vegetative management within town parks and town owned facilities.

**Building Inspections** – Enforce Chapter 229 of Town Code (Tree Preservation Law), NYS Property Maintenance Code and joint enforcement of Chapter 210 of Town Code (Streets and Sidewalks Law) with the Highway Superintendent.

### recommendations

Due to the fractured and overlapping nature of responsibilities across departments concerning the urban forest the Town should develop an organizational chart outlining roles, responsibilities and personnel.

It is further recommended the town either designate a single staff member or retain an urban forest consultant to make the decision making process more efficient. The responsibilities of this position or consultant would entail:

> Coordinate and communicate with the four departments on urban forest management and maintenance activities
>
> Conduct field inspections for service requests from the public for tree maintenance or planting
>
> Manage tree inventory data; including updating the inventory, recording service requests, and entering work history data
>
> Develop tree maintenance work plans and specifications, including; review of individual trees to be pruned or removed and inspecting work for contract compliance
>
> Develop tree planting plans and specifications; including selection and assessment of potential planting sites, selection of appropriate tree species, review of nursery stock and inspecting planting work for contract compliance
>
> Develop annual urban forestry budgets based on planning and projected maintenance work

## Share services across departments

### recommendations

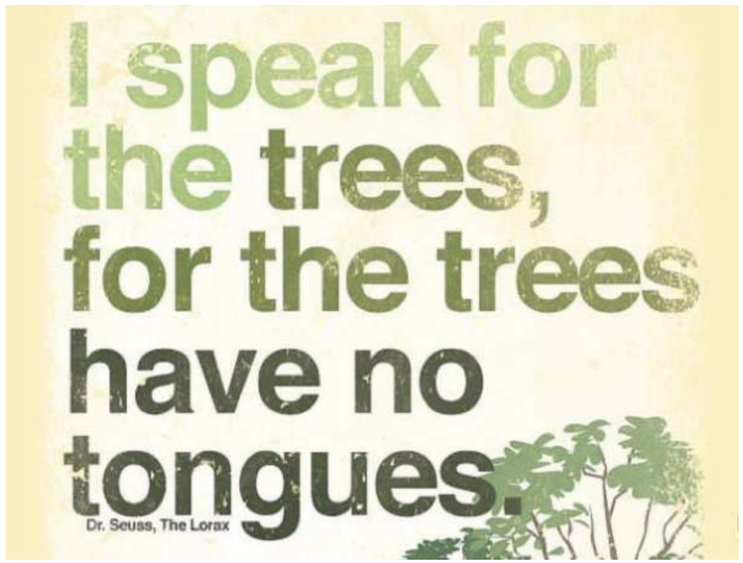
The Town is encouraged to explore opportunities to collaboratively utilize personnel, equipment and budget allocations across departments to achieve the goals and objectives set forth in this plan.

# improve efficiency in managing the urban forest

## Develop Urban Forest Administrative and Policy Document

### current conditions

The town does not have a stand alone document developed that defines how tree inspections are to carried out, how maintenance recommendations are determined, how planting spaces are determined or how funding for the for the Urban Forest is allocated.




### recommendations

The Town of Cheektowaga recognizes that a healthy urban forest is an integral part of the town infrastructure and essential for the wellbeing of residents and visitors alike. It is the Town's responsibility to protect, regulate and fund the tree planting, maintenance and removal on town-owned lands and public right-of-way in the most social, responsive, environmental and economic manner. It is recommended an administrative and policy document be developed that would ensure these principles are adhered to. This document should address, but not be limited to the following areas:

- Define how forestry services will be delivered
- Minimum qualifications for personnel performing tree inspections
- Tree protection requirements during construction
- Guidelines for performing tree risk assessments
- Guidelines or standards for determining tree maintenance, removal or planting recommendations
- Required protocols or procedures for inspecting work performed by contractors
- Annual budget guidance, internal and external funding sources
- Shade Tree Committee responsibilities and coordination

## Update and maintain existing tree inventory

### current conditions

A street tree inventory was completed in 2013 with sporadic updates.

### recommendations

The Town should perform an annual windshield survey to identify high risk trees. The tree inventory should then be updated accordingly.

The Town should perform a rotational update, including risk assessments if required, for the entire inventory. This update can be performed from a grid or sector approach with the intent to visit each tree location within six or seven years. A current inventory is required to efficiently plan urban forest management activities.

The Town should complete an inventory of existing trees within the parks and other town owned and maintained facilities.

The Town should collect potential planting spaces in the tree inventory.

# conserve existing tree canopy

## Develop tree maintenance manual

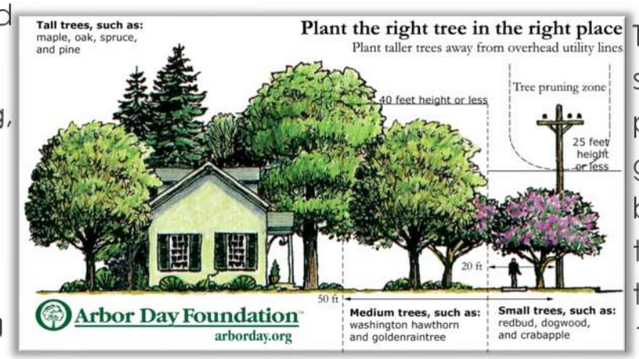
### current conditions

The town's maintenance program can be best described as reactive rather than proactive. Planting, tree maintenance and tree removals are performed by both in-house staff and contractors. The town does not have a document that specifies the correct standards of practice for tree planting and the care of trees.

### recommendation

The town should develop a tree maintenance or tree care manual that specifies the correct standards of practice for tree planting, maintenance and removal. This publication should serve as an arboricultural specifications manual and include, at a minimum, the following sections:

1. Introduction, including purpose of manual, implementation of standards and adopted policies
2. Recommended Planting Standards
    a. Selecting right tree/right place
    b. Requirements for plant stock
    c. Planting procedures; specification and detail
    d. Care for new trees; watering, pruning, mulching
3. Tree Maintenance (Pruning)
    a. Selecting qualified personnel
    b. Summary of regulations, no tree topping
    c. Approved pruning standards such as International Society of Arboriculture's (ISA) tree pruning guidelines and/or those in the ANSI A300 pruning standards and the Z133.1 safety standards
4. Tree Removal Standards
5. Tree protection during construction
    a. Sidewalk construction and repair
    b. Trenching and tunneling
    c. Materials storage
6. How to obtain a tree work permit
7. Recommended street tree species list




## Develop a rotational care program

### current conditions

The town currently performs pruning on individual trees that have been identified either from a service request or a staff member mentioning a potential risk condition. While this approach to maintenance is not beneficial to the entire tree population, it is necessary to address priority concerns in a timely manner.

### recommendation

The town should develop a rotational or cyclical tree pruning schedule. Periodic tree pruning reduces tree related risks such as potential storm damage and promotes vigorous growth and good tree structure. While all of the trees within the town need to be pruned it is not practical to prune all of the trees at the same time. It is recommended to develop a schedule that would rotate throughout the town and prune all of the existing trees within a 7-10 year cycle.

# conserve existing tree canopy

## Review and update codes and related documents

### current conditions

A review of the Town Code did uncover several chapters that impact tree care and maintenance. Chapter 229: Trees, establishes standards limiting the removal and ensuring the replacement of trees sufficient to safeguard the ecological and aesthetic environment necessary for a healthy community. However, five other Chapters (174: Parks, 187: Public Improvements, 209: Stormwater Management and Erosion Sediment Control, 210: Streets and Sidewalks and 260: Zoning) also contain standards regarding trees that are not cohesive with Chapter 229: Trees. During the course of developing this Management Plan the town has addressed many discrepancies within the Town Code and has strengthened them and received approval from the Town Board for the changes.

### recommendations

> Assess the codes every four years or when a  new supervisor is elected.
>
> ANSI standards are updated every 5 years and should be considered during the towns review.
>
> The Site Planning and Design Guidelines should provide the same guidance for tree selection, planting, protection and maintenance as is used for public trees.
>
> Chapter 229 should be amended to include the protection and care of the tree canopy and strengthen fines and procedures for violations

# increase tree canopy cover and tree population diversity

## Plant with a purpose

### current conditions

The town does not conduct an annual tree planting. Street tree planting projects are intermittent and have historically taken place when grant funding has been secured. The locations selected for planting typically are in response from a resident requesting a tree be planted, so planting locations are scattered throughout the town and are primarily in residential areas.

### recommendations

In order for the town to achieve the goal of increasing tree canopy cover a pro-active planting program will be required. The current tree canopy cover was estimated to be 21% town wide with a desire to achieve tree canopy cover of 40% as recommended by American Forests. Several tasks are identified to establish the planting program:

1. Identify potential street tree planting sites. The street tree inventory did not initially collect planting sites. The town should complete the inventory in order to assess the potential of adding trees within the right-of-way. These planting sites are under town control and street tree plantings do offer aesthetic, environmental and economic benefits. It is assumed, from an analysis of aerial photos and comparing similar sized towns that do have complete street tree inventories, that there may be as many as 10,000 to 15,000 potential planting locations within the right-of-ways in the town.
2. Establish an annual budget amount specifically for tree planting.
3. Incorporate tree planting as an asset in the Capital Improvement Program and the Storm Water Program.
4. Pursue grant funding for tree planting.
5. Develop annual planting plans that are focused and achievable. Utilize a grid or sector based plan to geographically concentrate annual plantings to ease the required care during the establishment period.

6. Select and plant the largest growing tree that the planting location can support. Avoid planting ornamental trees in large tree lawns that do not have overhead utilities or other growing space limitations.
7. Utilize the recommended tree species list developed in the tree maintenance manual to diversify the tree population.
8. Develop a tree establishment plan, including irrigation, mulching, removal of tree support system and training pruning. Adhere to the plan.

# increase tree canopy cover and tree population diversity

## Actively seek funding for planting

### current conditions

Grants for tree planting funding are typically applied for. Due to overall town budget reductions and the recent inconsistency in availability of grant funding it has proved difficult for the town to establish an annual budget line item amount specifically for tree planting. Generally within the annual budget there is funding identified for trees, occasionally defined as tree planting or tree maintenance, but mostly left as undefined.

### recommendations

With the goal of increasing tree canopy by 20% over the course of 20-years the town will need to establish a dedicated capital budget line item amount that accommodates the number of trees needed to plant and establish annually.

Actively seek out and apply for state and federal funding as applicable as well as actively seek out funding from non-governmental sources such as local, regional and national foundations, industry, and corporations.

Secure funds generated by tree work permit applications, fines and contractor buyouts.

## Promote planting by private entities

### current conditions

Zoning code, Chapter 260-51 Landscaping Regulations does not specifically require trees to be included as part of development, but does state "the primary emphasis of the landscape treatment shall be on trees."

The town currently does not actively promote or offer incentives to residents or commercial entities to plant trees on their properties.

### recommendations

It is recommended to amend the Landscaping Regulations to require tree planting as part of development. Tree planting can be focused in three specific areas related to a development project. The following is sample language to be considered:

**Interior Landscape:** Any development, with exceptions, shall include the installation of one shade tree for every 1,000 square feet of non-paved and non-built area on the site.

**Parking Lot Landscape:** At least one shade tree shall be installed for every 20 parking spaces, and distributed so that no parking space is more than 150 feet from a tree.

**Street Trees:** A minimum of one street tree shall be installed on the adjacent public right-of-way for each 30 feet of frontage. Street trees shall be installed in accordance with the Town's Tree Maintenance Manual. The Town may provide alternative planting locations within a right-of-way or public parks when installation cannot be accommodated in the immediate adjacent right-of-way due to feature conflicts with the placement of a required tree. An exception to this requirement may include the required number of street trees already exist and are in a healthy condition.

# increase tree canopy cover and tree population diversity

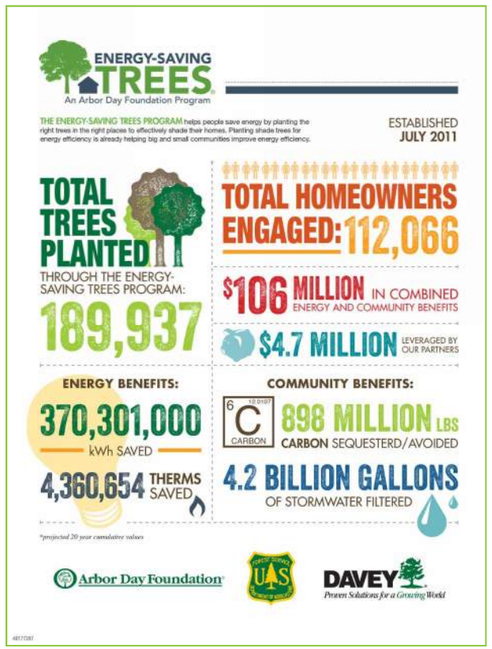
## Explore public-private partnerships

### current conditions

A portion of the town is serviced by National Grid for electrical service. National Grid does offer incentives for planting "The Right Tree in the Right Place". The town can be reimbursed for planting appropriate trees underneath National Grid's overhead utilities.

### recommendations

The town should be seeking reimbursements from National Grid for planting appropriate tree species under their utilities through the 10,000 Trees and Growing grant program.




Explore the Energy-Saving Trees Program offered by Arbor Day Foundation. This is a program that partners utility companies, municipalities and other organizations to provide residents with free trees. This program is an innovative way to encourage home owners to plant trees that will effectively shade their homes and reduce summertime peak energy demand. The program offers opportunities for public relations and significant environmental contributions.

Many communities are already working in partnership with local non-profit organizations to both stretch and supplement municipal resources. This is not a new concept in urban forestry and public-private partnerships have been proven to be effective as illustrated in the following examples:

> **Pittsburgh**: Tree Pittsburgh and The Western Pennsylvania Conservancy are the primary non-profit partners helping to supplement the City's Forestry Division budget through tree purchase and planting programs and a volunteer stewardship program for young tree maintenance.
>
> **Indianapolis:** The non-profit Keep Indianapolis Beautiful (KIB) is partnering with the City of Indianapolis to plant 100,000 trees. KIB's agreement with the city to manage tree planting has been in place since 2011. KIB installs the trees and provides care for the first 3–5 years after installation.
>
> **Washington, D.C.:** Casey Trees is a Washington, D.C. non-profit started in 2002 with the goal of restoring and protecting urban tree canopy in the city. The organization supports D.C.'s municipal urban forestry department by planting trees on public and private lands not serviced by the city. Each year, the city plants over 2,500 trees with the end goal of achieving 40% canopy by 2032.

The example organizations were founded out of citizen concern for the health of their respective urban forests and environmental conditions. In 2006 Re-TreeWNY was founded to aid in tree planting effort across Western New York, but this organization currently only operates in the City of Buffalo.

Cheektowaga is encouraged to identify either a philanthropic individual or corporate entity that may be interested in establishing a beneficial relationship with the town with the mission of restoring the tree canopy through tree planting, education and advocacy.

# increase tree canopy cover and tree population diversity

## Incorporate urban forestry practices into the Town's storm-water management plan

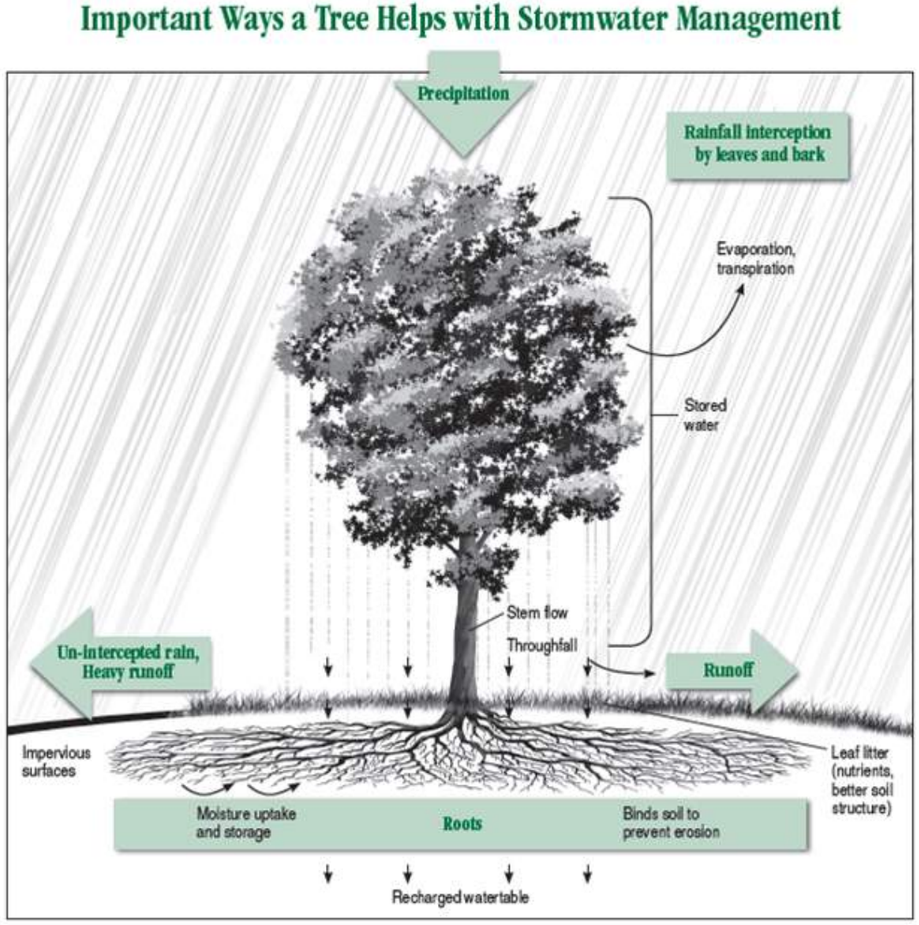
In a natural or forested setting, trees control stormwater runoff and protect surface waters from sediment and nutrient loading. In an urban setting, trees reduce the amount of runoff that enters stormwater and sewer systems. Working like a reservoir, trees control stormwater at the source and reduce the peak of a rain event. According to the National Tree Benefit Calculator, www.treebenefits.com/calculator, a single, mature silver maple can intercept several thousand gallons of stormwater per year. It does this by:

> Intercepting and holding rain on leaves, branches and bark
> Increasing infiltration and storage of rainwater through its root system
> Reducing soil erosion by slowing rainfall before it strikes the soil

Water bodies in urban areas that receive stormwater runoff are often threatened by pollution. Rain flushes salt, oil, gasoline and other contaminants directly into bodies of water, creating imbalance to their aquatic ecosystems. Rain events can also cause sanitary sewers and storm systems to overflow, dumping untreated sewage into our streams, rivers and eventually lakes.

According to the USDA Forest Service Center for Watershed Protection, stormwater runoff is the number one factor in the decline of urban streams and decreasing urban water quality. Regarding trees and stormwater, the Center has reached these conclusions:

- Watershed health is linked to the amount of forest in the watershed and its distribution.
- Increased tree cover and tree size result in reduced total runoff rates (for example, 10% tree cover results in 2–5% reduced runoff).
- Tree canopy has a greater effect on small storm events than on large storm events.
- Effects on runoff are greatest when urban trees are large and well established.
- Trees and stormwater management infrastructure can coexist if planned and designed from the start




ArborDay.org

# increase tree canopy cover and tree population diversity

## Incorporate urban forestry practices into the Town's storm-water management plan

### current conditions

Cheektowaga does have separate sanitary and storm sewer systems. The Town maintains 263 miles of sanitary sewer pipe and 150 miles of storm sewer pipe. During peak rainfall events the existing sanitary sewer can not handle the volume of rainwater due to inflow and infiltration. In these cases overflow pumps are utilized to re-direct water into the storm sewer system. The New York State Department of Environmental Conservation requires communities with excess inflow and infiltration to invest in reduction remedies such as disconnecting sump pumps from sanitary sewers and repairing leaky pipes. It has been estimated to cost $1 billion to build additional sewer infrastructure to provide capacity during larger rain events.

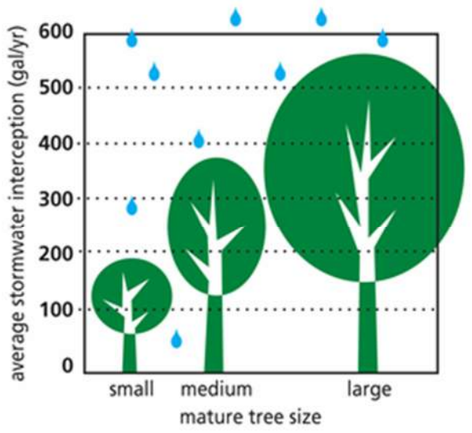
By intercepting rainfall and controlling runoff at the source, trees can reduce the extent of the problem. This is important as there is a significant quantity of impervious surface in the Town. The i-Tree Canopy Analysis that was completed as part of this plan indicates that 38% of the ground surface of the town is considered to be impervious, including roads, parking lots and buildings. Consider a 1-inch rainfall on just the impervious surfaces in the town equates to approximately 210-million gallons of stormwater that will need to managed.

The Town needs to improve its methods of managing stormwater. Urban forestry practices that combine planning, engineering and arboriculture can greatly mitigate the damage caused by urban runoff. Significantly increasing tree canopy and reducing impervious surfaces are methods that should be used in combination to have a meaningful impact.

Tree planting schemes that are designed and engineered with tree as a consideration will produce trees that grow to their maximum potential, expanding the canopy and provide the greatest stormwater reduction benefit, as well as other environmental and economic benefits.

Trees are not typically considered part of stormwater management systems or infrastructure, they are considered 'landscaping'. When the town is making a determination to plant or remove a tree it should be considering the tree as part of the stormwater infrastructure, and analyze if the decision is a benefit or detriment to the stormwater system.

***The larger the tree, the more stormwater it can manage.***




www.portlandoregon.gov

### recommendations

Trees should be considered a part of the stormwater infrastructure and be included in any stormwater construction project.

All stormwater plans should have urban forestry as a component.

The town should target tree planting and canopy expansion based on stormwater benefits. Focus on planting locations adjacent to impervious surfaces, such as roads and parking lots.

Where growing space limitations allow, select large growing trees to decrease peak stormwater flows.

Encourage and assist homeowners to plant large growing shade trees to reduce stormwater peak flows.

# preparedness

## Develop urban forest storm response plan

### current conditions

The Town of Cheektowaga Office of Emergency Services (OES) was created in 1981. The main responsibility of the office is to conduct a hazard analysis of the Town and then develop a plan and resources to handle a hazard or emergency. In 2006 the Town of Cheektowaga Community Emergency Response Team (CERT) was formed and currently has 72 members on the team.

Currently there is no defined or coordinated plan in place that defines who and how to respond in the event of a larger, town-wide tree related emergency such as a wind, ice or snow storm.

### recommendations

An urban forest emergency response plan is required to deal effectively and efficiently with the emergencies caused by infrequent storm events. When trees fail they can impede emergency response, cause structural damage and impede access to critical infrastructure facilities. A plan detailing procedures for tree related emergencies should be developed and maintained. The plan should integrate urban forest management into emergency management and contain two levels of detail.

**Vegetative Management:** Is a broad look at planning, operations and response. Within this

section of the plan critical infrastructure, and the potential for vegetative damage, should be identified. Debris management plans and protocols, including staging areas and methods to identify potential high debris areas, are to be defined. Standard evaluations for removal of a tree are defined.

In a time of crisis it is imperative to have a plan for timely, immediate response and to address emergencies systematically. Tree emergencies can be prioritized in order of most urgent:

> Life and Safety: trees blocking streets or access to critical infrastructure, trees on structures or vehicles with trapped occupants.
>
> Property Preservation: trees on homes, structures or vehicles.
>
> Quality of Life: trees blocking sidewalks, lawns or located in parks.

**Tree Risk:** After the initial response has been completed a detailed evaluation of the urban forest should be carried out. This section of the plan would define how maintenance recommendations would be made for individual trees, and the minimum qualifications of the personnel providing these recommendations.

# preparedness

## Develop an exotic pest and disease response plan

### current conditions

Exotic and invasive pests are plants, animals, insects, or diseases that are typically imported or released accidentally from other regions of the world. In their native lands, these species often have natural predators and other controls to keep populations and ecosystem damage at low, manageable levels. However, when introduced here without natural checks and balances, their populations increase dramatically and they can severely affect trees and ecosystems. The effects of invasive pests and diseases are directly correlated to a reduction in the quality of structural and functional urban forest benefits. Our global economy has set the stage for an increasing number of threats each year as more and more goods are shipped to the United States from overseas. Adding to the threat, Cheektowaga is the location of the Buffalo Niagara International Airport, where over 4-million passengers pass through each year from points around the globe.

Currently there is no Town specific response plan or guidelines in place for responding to exotic pests and diseases that may be introduced, established and spread within the town. While the safeguarding of our natural resources is performed primarily by USDA-APHIS, NYS-A&M and NYS-DEC, the party that is required to take action is typically the local municipality. The possibility of a plant health emergency is never far away.

Oak leaves infested with Oak Wilt, Photo USDA Forest Service

While historic pest problems typically occur one at a time, Cheektowaga is faced with several real threats from exotic or invasive pests and diseases. Currently Emerald Ash Borer (EAB) is present within the Town and across most of NYS. Asian Longhorned Beetle (ALB) is another destructive borer that attacks a wide range of hardwood trees, primarily maple. While ALB has not been discovered in Cheektowaga, it has been discovered in NYS and Ontario, CA. ALB is considered a high-risk pest by the USDA. Oak Wilt is a destructive fungus lethal to trees in the red oak group. While not discovered in the town is has been confirmed in NYS. While treatments exist, they require early diagnosis and treatment to be successful.

### recommendations

> Identify the highest level exotic pest threats and develop strategies for monitoring, control, removals and replanting. Strategies should include methods to secure funding to prevent or address existing and future pest issues. Determine thresholds for action.
>
> Utilize existing street tree inventory data to monitor public street trees for high-priority pest threats.
>
> Develop educational materials including brochures, web pages, workshops and educational sessions to educate town staff, stakeholders and the general public.
>
> Create or partner with existing citizen watch programs to assist with early detection of exotic pests and diseases.
>
> Offer homeowner incentives to address invasive species on private property.
>
> Develop codes that define what the Town's capacity is for new diseases or insect detections.

# increase urban forestry awareness

## Develop educational programs and brochures

### current conditions

The town, through the Youth & Recreational Services Department, offers a summer program for teenagers to learn basic tree care.

Reinstein Woods Nature Preserve & Environmental Education, a 290-acre NYS Department of Environmental Conservation facility located within the town offer a variety of educational opportunities with focus on forests and wildlife.

### recommendations

In order to establish community-wide understanding and valuing of trees as a community asset several opportunities have been identified to reach the public through outreach, education, and engagement.

**Establish a learning tree farm**: Several communities have developed small learning tree farms (outdoor learning labs) in which participants, typically teenagers, are actively engaged in learning the biology of trees, how to propagate, transplant, maintain and care for trees. Several tasks have been identified.

- Determine who will operate the program.
- Determine a funding source or potential public-private partnerships.
- Identify property or location for the program.
- Develop learning objectives and outline curriculum.
- Define service leaning projects.

**Develop brochures**: As the town plants street trees a brochure should be left at the residence. This brochure can describe the type of tree that has been planted, how large (or small) it will grow, flower color, leaf color in summer and fall and other informative facts. The brochure should also include basic instructions as to how the resident help with the establishment of the tree through regular watering, keeping much and soil away from the trunk and preventing damage from lawn equipment.

**Engagement**: Develop a tree stewardship program similar to the CommuniTree Steward program in the cities of Buffalo and Syracuse, NY. While these programs are operated by Cornell Cooperative Extension in their respective counties, the funding for the program in Erie County is through the Buffalo Green Fund and is restricted in its application. The CommuniTree Steward program is a five-part classroom and in-field training series that teaches residents to care for juvenile trees. Instructors for the classes would be professionals in the fields of arboriculture and biology. Upon completion the attendee completes a service project in their own neighborhood, such as planting trees or pruning small trees.

**Education**: Develop a series short courses or educational sessions. Reach out to the green industry including landscape contractors, arborists, commercial growers, and garden centers/nurseries to aid in programs. Offer programming on basic tree care, how select an arborist, and similar topics.


Professor Pricklethorn educating elementary school children about the benefits of trees

# increase urban forestry awareness

## Become a Tree City USA

### current conditions

The town does not hold the Tree City USA designation.

### recommendation

It is recommended Cheektowaga achieve the Tree City USA designation.

Tree City USA is a program sponsored by The National Arbor Day Foundation in cooperation with the USDA Forest Service and the state forestry agencies. It provides direction, technical assistance, public attention, and national recognition for urban and community forestry programs.

Meeting the four standards for becoming a Tree City USA provides initial direction for an urban or community forestry program. The standards help get a community started toward annual, systematic management of its tree resources, ensuring an achievable tree management plan and program. The four standards are:

- A Tree Board or Department
- A Tree Care Ordinance
- A Community Forestry Program with an Annual Budget of at Least $2 Per Capita
- An Arbor Day Observance and Proclamation

Being a Tree City USA helps present the kind of image that most citizens want to have for the place they live or conduct business. The Tree City USA signs at community entrances tell visitors that here is a community that cares about its environment. It is also an indication to prospective businesses that the quality of life may be better here.

Gaining and retaining Tree City USA recognition is an award to the tree workers, managers, volunteers, tree board members and others who work on behalf of better care of a community's trees. Non-involved citizens, too, often share a sense of pride that theirs is a Tree City USA. This may translate to better care of trees on private property or a willingness to volunteer in the future .

Preference is sometimes given to Tree City USA communities over other communities when allocations of grant money are made for trees or forestry programs.

Arbor Day tree planting at Cayuga Heights Elementary School, photo D Ulatowski

Presentation of the Tree City USA award and the celebration of Arbor Day offer excellent publicity opportunities. This results not only in satisfaction for the individuals involved and their families, but also provides one more way to reach large numbers of people with information about tree care .

# plan timelines and evaluations

The following pages include timelines for the goals and objects as well as a means for measuring accomplishment. While some of the goals, such as increasing tree canopy cover to a desired 40% cover, have a substantial time horizon it is recommended that progress is reviewed on an annual basis. For each goal a letter 'grade' has been assigned which encompasses the objectives related to the goal.

## Goal 1 - improve efficiency in managing the urban forest

| Timeline for objectives | |
|---|---|
| Develop organizational chart for personnel responsibility | 1 year |
| Share services among departments | 2 years |
| Develop UF Administration and Policy Plan | 3 years |
| Update existing tree inventory | 7 years |

### grading for improving efficiency

A. Organization chart complete, staff understands their role and job descriptions encompassing tree work; Services are being coordinated and shared on a regular basis; Administrative document is complete; and Tree inventory is being systematically updated.

B. Organization chart complete, staff understands their role and job descriptions encompassing tree work; framework for Shared Services is being developed; Administrative document is in progress; and Tree inventory is being systematically updated.

C. Organization chart complete, staff understands their role and job descriptions encompassing tree work; and Tree inventory is being systematically updated.

D. No objectives have been started or completed.

## Goal 2 - conserve existing tree asset

| Timeline for objectives | |
|---|---|
| Review and update codes and related documents; occurs annually | |
| Actively seek funding for tree maintenance; occurs annually | |
| Develop tree maintenance manual | 1 year |
| Develop rotational tree care program | 3 years |

### grading for conserving existing trees

A. Codes and related documents are reviewed and amendments (if applicable) are complete; Tree maintenance funds are identified in the town budget; Tree maintenance manual is complete; Rotational tree care is being performed.

B. Codes and related documents are reviewed; Tree maintenance funds are identified in the town budget; Tree maintenance manual is in progress; Rotational tree care program is being developed.

C. Codes and related documents are reviewed; Tree maintenance manual is in progress.

D. No objectives have been started or completed.

# plan timelines and evaluations

## Goal 3 - increase tree canopy cover and population diversity

| Timeline for objectives | |
|---|---|
| Plant with a Purpose | |
| • Update tree inventory to include planting locations | 6 years |
| • Annual planting targets developed for next 20 years | 3 years |
| • 40% tree canopy cover | 20 years |
| Actively seek funding for planting; occurs annually | |
| Promote planting by private entities, Code changes | 3 years |
| Develop public-private partnership | 6 years |

### grading for increasing tree canopy cover

A. Annual planting 'plans' complete; Tree planting identified in Capital Budget with support from Council for foreseeable future; Annual plantings taking place to increase canopy cover; Grant funding secured; Private planting incentivized; Non-profit partnership identified.

B. Annual planting 'plans' in progress; Tree planting identified in Capital Budget with support from Council; Annual plantings taking place to increase canopy cover; Grant funding actively sought and applications submitted; Incentives for private planting in progress; Non-profit partnership explored.

C. Annual planting 'plans' in progress; Annual plantings taking place to increase canopy cover; Grant funding actively sought.

D. No objectives have been started or completed.

## Goal 4 - preparedness

| Timeline for objectives | |
|---|---|
| Develop UF storm response plan | 2 years |
| Develop pest and disease management plan | 3 years |

### grading for preparedness

A. Both plans are complete.

B. Both plans are in progress.

C. One of the plans is in progress.

D. No plans have been started.

## Goal 5 - increase urban forestry awareness

| Timeline for objectives | |
|---|---|
| Develop brochures | 1 year |
| Develop basic educational programming | 3 years |
| Develop tree stewardship program | 3 years |
| Develop learning tree farm | 2 years |
| Become a Tree City USA | 4 years |

### grading for awareness

A. All objectives are in progress and at least three completed.

B. At least three objectives are in progress and at least one completed.

C. At least three objectives are in progress.

D. No objectives have been started or completed.

# appendices

## Town of Cheektowaga Recommended Tree List

The recommended tree list has been developed after a review of several factors.

First is species diversity. The known or inventoried tree population indicates 57% of the trees are in the genus *Acer* (Maple). Guidelines are to limit a single genus to 20% of the overall population, therefore further planting of *Acer* is not advised. It was also observed that the population of *Gleditsia triacanthos* (Honeylocust) is approximately 8%. Guidelines are to limit a single species to 10% of the overall population, therefore further planting of *Gleditsia triacanthos* should be limited.

The second factor considered is site conditions. The species selected have been shown to perform better than others when considering aerial salt spray and poor soil conditions common with right-of-way plantings. Selections also considered variability in pH, soil moisture and the USDA hardiness zone.

The third factor considered was the physical size of the planting space in terms of the width of the tree lawn, proximity to structures and presence of overhead utilities. The tree list has been categorized into large growing trees, medium growing trees and small growing trees. It is recommended when selecting a tree for a particular planting site that the species selected is the largest growing tree that the site can accommodate, providing the maximum benefit possible over the lifespan of the tree.

The following tree lists are recommendations and should not be considered 'complete', but as a starting point for selecting appropriate species given particular site conditions. The tree list should be reviewed and updated as the tree inventory is updated.

**Large Growing Trees:**

Typically over 50-feet height at maturity, tree lawn should be at least 6-feet wide, do not plant where overhead utilities are present.

| **Botanical Name** | **Common Name** |
|---|---|
| Alnus glutinosa | Black Alder |
| Celtis occidentalis | Common Hackberry |
| Corylus colurna | Turkish Filbert |
| Eucommia ulmoides | Hardy Rubber Tree |
| Ginkgo biloba 'Magyar' | Magyar Ginkgo |
| Ginkgo biloba 'Princeton Sentry' | Princeton Sentry Ginkgo |
| Gleditsia triacanthos f. inermis 'Shademaster' | Shademaster Honeylocust |
| Gleditsia triacanthos f. inermis 'Skycole' | Skyline Honeylocust |
| Gymnocladus dioicus 'Espresso' | Espresso Kentucky Coffeetree |
| Metasequoia glyptostroboides | Dawn Redwood |
| Nyssa sylvatica | Black Tupelo |
| Platanus x acerifolia 'Bloodgood' | Bloodgood London Planetree |
| Platanus x acerifolia 'Morton Circle' | Exclamation London Planetree |
| Quercus bicolor | Swamp White Oak |
| Quercus imbricaria | Shingle Oak |
| Quercus macrocarpa | Bur Oak |
| Quercus robur 'Pyramich' | Skymaster Oak |
| Quercus rubra | Northern Red Oak |
| Styphnolobium japonicum 'Regent' | Regent Scholar Tree |
| Tilia x flavenscens 'Glenleven' | Glenleven Linden |
| Ulmus davidiana var. japonica 'Morton' | Accolade Elm |
| Ulmus japonica x wilsoniana 'Morton Red Tip' | Danada Charm Elm |
| Ulmus *'Homestead'* | Homestead Elm |
| Ulmus *'Morton Glossy'* | Triumph Elm |
| Zelkova serrata 'Village Green' | Village Green Zelkova |

**Medium Growing Trees:**

Typically between 30 to 50-feet height at maturity, tree lawn should be at least 5-feet wide, do not plant where overhead utilities are present.

| Botanical Name | Common Name |
|---|---|
| Aesculus x carnea 'Fort McNair' | Fort McNair Horsechestnut |
| Betula nigra 'Heritage' | Heritage River Birch |
| Cercidiphyllum japonicum | Katsura Tree |
| Cladrastis kentukea | American Yellowwood |
| Halesia carolina 'Arnold Pink' | Arnold Pink Silverbell |
| Koelreuteria paniculata | Goldenraintree |
| Liquidambar stryraciflua 'Moraine' | American Sweetgum |
| Ostrya virginiana | American Hophornbeam |
| Phellodendron amurense 'Macho' | Macho Amur Cork Tree |
| Prunus sargentii 'Columnaris' | Columnar Sargent Cherry |
| Quercus robur x bicolor 'Long' | Regal Prince Oak |
| Sorbus alnifolia | Korean Mountain-Ash |
| Tilia tomentosa 'Sterling' | Sterling Linden |

Katsura Tree

American Yellowwood

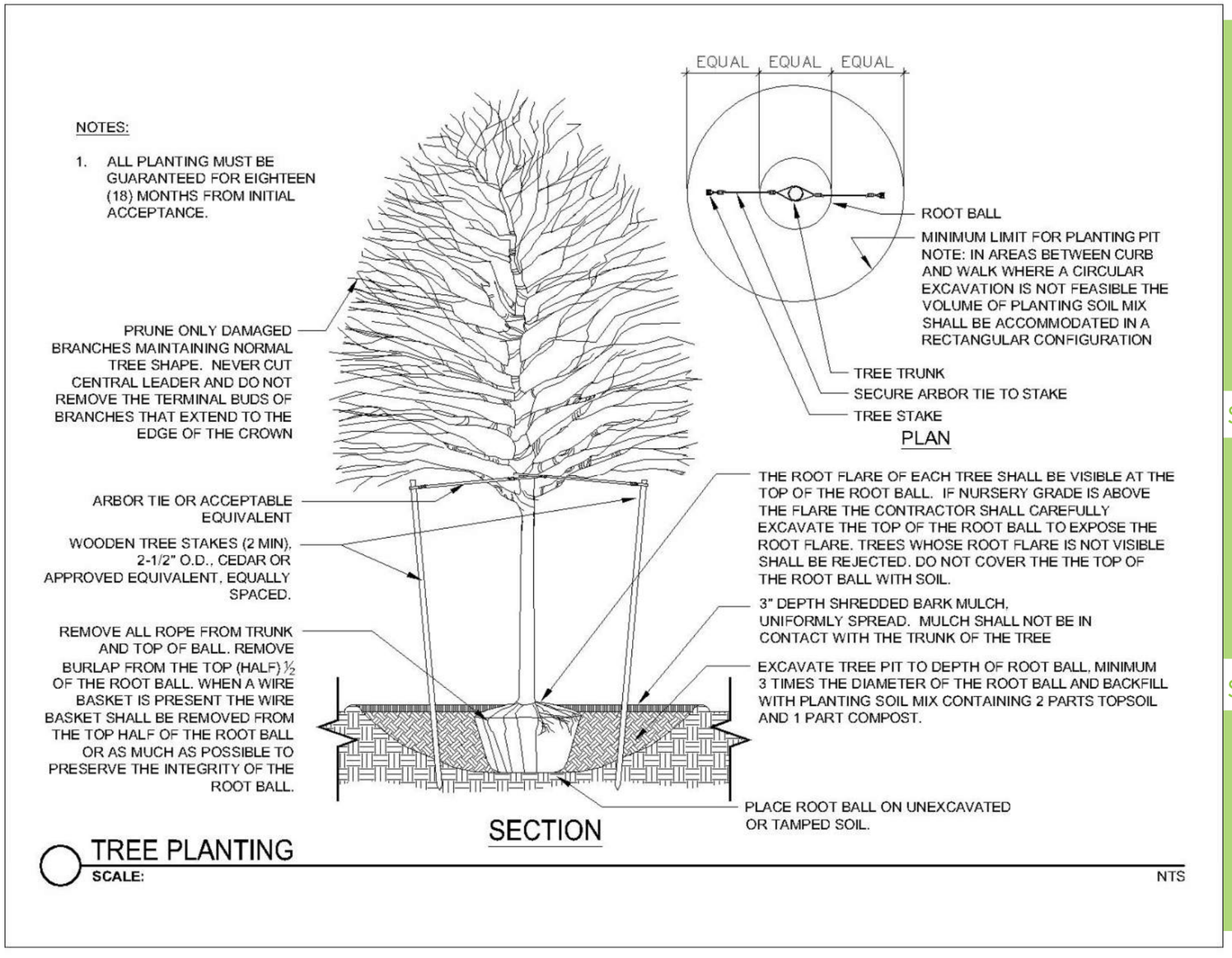
**Small Growing Trees:**

Typically under 30-feet height at maturity, tree lawn should be at least 3-feet wide, can be planted where overhead utilities are present.

| Botanical Name | Common Name |
|---|---|
| Amelanchier x grandiflora 'Autumn Brilliance' | Autumn Brilliance Serviceberry |
| Amelanchier x grandiflora 'Robin Hill' | Robin Hill Serviceberry |
| Amelanchier laevis 'JFS-Arb' | Spring Flurry Serviceberry |
| Cercis canadensis | Redbud |
| Cornus x 'Rutdan' | Celestial Dogwood |
| Chionanthus retusus 'Tokyo Tower' | Tokyo Tower Fringe Tree |
| Maackia amurensis | Amur Maackia |
| Malus 'Adirondack' | Adirondack Crabapple |
| Malus 'Schmidtcutleaf' | Golden Raindrops Crabapple |
| Malus 'Harvest Gold' | Harvest Gold Crabapple |
| Malus 'Rejzam' | Rejoice Crabapple |
| Parrotia persica 'Vanessa' | Vanessa Parrotia |
| Prunus sargentii 'Pink Flair' | Pink Flair Sargent Cherry |
| Sorbus x thuringiaca 'Fastigiata' | Columnar Oakleaf Mountain-Ash |
| Syringa reticulata 'Ivory Silk' | Ivory Silk Japanese Tree Lilac |
| Zelkova serrata 'Schmidtlow' | Wireless Zelkova |

Spring Flurry Serviceberry


Redbud




## tree placement guidelines

- 30’ minimum between trees
- 15’ minimum distance from utility/light poles, and fire hydrants
- 45’ minimum from intersection with signal
- 35’ minimum from all other intersections
- 5’ minimum from driveway curb cut
- 3’ minimum from utility boxes

## site requirements for street trees

- Tree pits shall have at least 35 sq. ft. opening
- Trees to be planted at grade, no raised planters
- Structural soil may be used under pavements
- Do not use tree grates

## street tree standards

- Street grade trees per ANSI Z60.1, current edition
- No damage to trunk or leaders
- No girdling roots
- Strong central leader, no co-dominant stems

# tree condition rating criteria

## good

- Healthy and vigorous growth
- Minimal to no mechanical damage to trunk and large branches
- Insect or disease injury present, but within threshold
- Form is characteristic of species
- May require crown raising or crown reduction pruning for clearance requirements

## poor

- Tree in a general state of decline
- Mechanical damage to trunk and/or large branches present
- Insect or disease injury present that requires treatment, beyond threshold
- May require renovation pruning
- Tree risk may be reduced through pruning

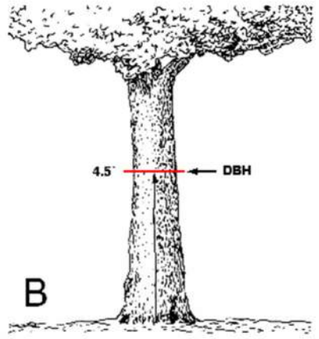
## fair

- Average health and vigor for species
- New growth may be less than average
- May lack desirable form for species
- Minor mechanical damage to trunk or large branches
- Insect or disease injury present that requires treatment, beyond threshold
- May require crown cleaning pruning

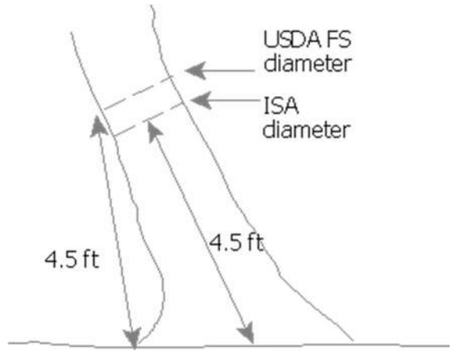
## dead

- Tree is dead or death is imminent within two years

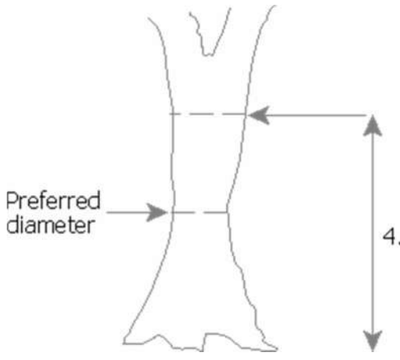
# how to measure DBH



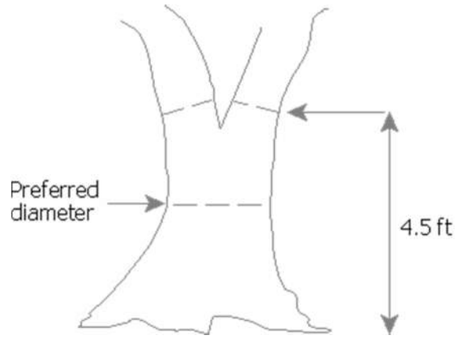

A tree is measured at 4.5 feet from the ground on the trunk of the tree, called Diameter Breast Height or DBH.  A Biltmore stick, or diameter tape may be used to



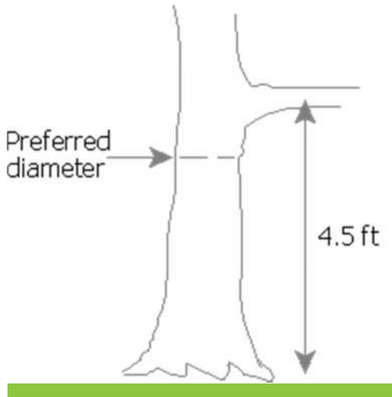

Leaning tree. There are several commonly accepted ways to find the DBH height. The US Forest Service measures 4.5 ft. up the stem in the direction of the lean. Some references (e.g., ISA) say to measure 4.5 ft. from the midpoint of the lean. The US Forest Service method is probably less prone to error and more readily repeatable by different observers.



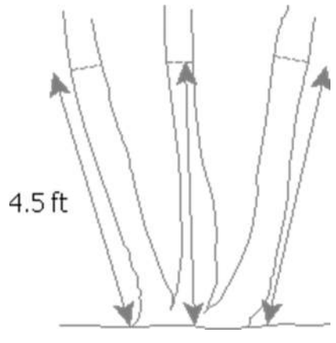

If the tree tapers in such a way that the diameter at a point below 4.5 ft. is actually smaller than the diameter at 4.5 ft. measure diameter at the smallest point.




Tree forks below DBH or near DBH. The measurement is recorded at the narrowest part of the main stem below the fork.




If the tree has branches or bumps which interfere with DBH measurement, measure DBH below the branch or bump. The concept is to measure the diameter that would be closest to the expected DBH if branches or other irregularities were not present.




Tree splits into several trunks close to ground level. Measure DBH of each trunk separately. The DBH for the tree is found by taking the square root of the sum of all stem DBHs.

# pruning guidelines

Pruning is one of the most important and visible management actions used on woody vegetation in the urban environment. Proper pruning is a wise investment that can extend the useful life of trees, improving their safety and adding significantly to the values they provide. Conversely, improper pruning can irreparably damage a tree, significantly detracting from its value and possibly making it hazardous. These pruning guidelines should be used to make informed decisions as to whether pruning is necessary based on overall objectives and to improve understanding of tree health and maintenance needs

The practices set forth in these guidelines are consistent with the pruning guidelines and Best Management Practices adopted by the International Society of Arboriculture, the American National Standard for Tree Care Operations – Tree, Shrub, and Other Woody Plant Maintenance-Standard Practices (ANSI.A300-1995), the U S  Forest Service, and the National Arbor Day Foundation.

## Why prune trees?

Trees, having evolved in forests where they must compete for available light, developed a natural ability to shed limbs. For trees in an street, park or landscape setting this natural process of branch development and shedding can pose a risk to people and property. These trees may require pruning. Pruning branches can be one of the most beneficial practices performed to trees, significantly improving their health, structure and aesthetic quality. Conversely, improper pruning can hasten the demise of a tree and cause damage which will remain present throughout the life of the tree.

## Reasons to prune

Health  Safety  Aesthetics

**Pruning for Health**: This involves removing diseased or insect-infested wood, thinning the crown to increase airflow which will reduce some pest problems, and removing crossing and rubbing branches. Pruning can best be used to encourage trees to develop a strong structure and reduce the likelihood of damage during severe weather. Removing broken or damaged limbs encourages wound closure.

**Pruning for Safety:** This involves removing branches that could fail and cause injury or property damage, removing branches that interfere with traffic sight lines and removing branches that may be in conflict with utility lines. Safety pruning resulting from site line or utility conflicts can largely be avoided by selecting appropriate tree species that will not grow beyond the space available.

**Pruning for Aesthetics:** This involves enhancing the natural form and character of trees or stimulating flower production. Pruning for form can be important for open grown trees that do very little self pruning. In some cases aesthetic pruning may be performed to enhance views, which may be a reasonable option as long as the structure and health of the tree can be preserved.

## Pruning Goals

Pruning should only be undertaken with a specific goal in mind. Before any pruning project is started, the goal or outcome should be defined. In many cases you may have more than one goal in mind for the pruning. Examples of pruning goals include:

- Reduce risk of failure
- Provide clearance for street, sidewalk, building or utility*
- Reduce wind resistance
- Maintain health
- Improve aesthetics
- Tree planting
- Sidewalk/driveway repair

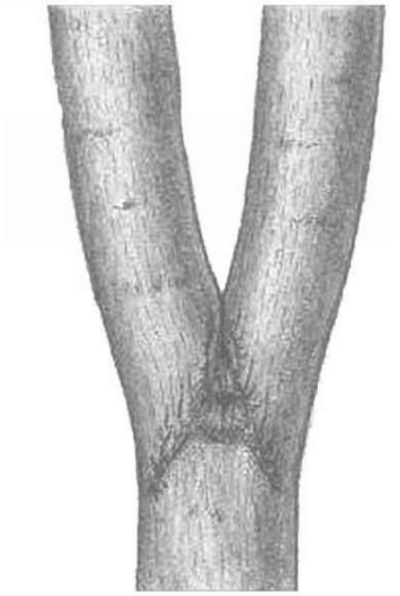
* Only Qualified Line Clearance Tree Trimmers can prune within 10-feet of any electrical conductor. Assume all overhead wires are energized.

## Pruning Techniques

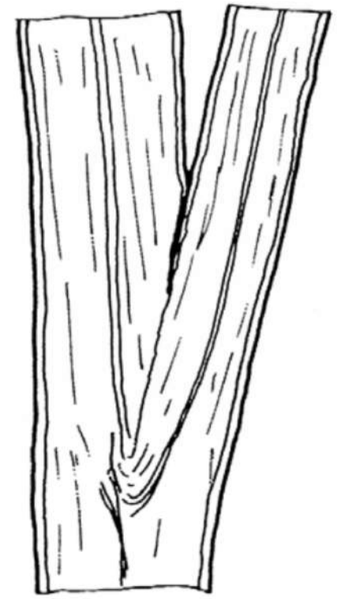
Once your goal(s) has been defined the next step is to determine which pruning technique(s) will be employed to achieve the goal. In most case several different techniques can be employed. For example to reduce the risk of failure several techniques could be used; crown cleaning, crown thinning, crown raising or crown reduction. In the case of maintaining health you may use structural pruning, crown cleaning or restoration pruning, or any combination of the above.

**Structural pruning of young trees:** Structural pruning principles are primarily used when pruning young trees. Properly trained young trees will develop into structurally strong trees that should require little corrective pruning as they mature. One of the best means to reduce tree risk and future maintenance costs is to choose good quality tree stock and perform proper structural pruning early in the trees life.

Although species dependent, many trees will develop co-dominant branches. These branches are a direct extension of the stem. It is best if one of these branches if removed when the tree is young.



Example of co-dominant branches

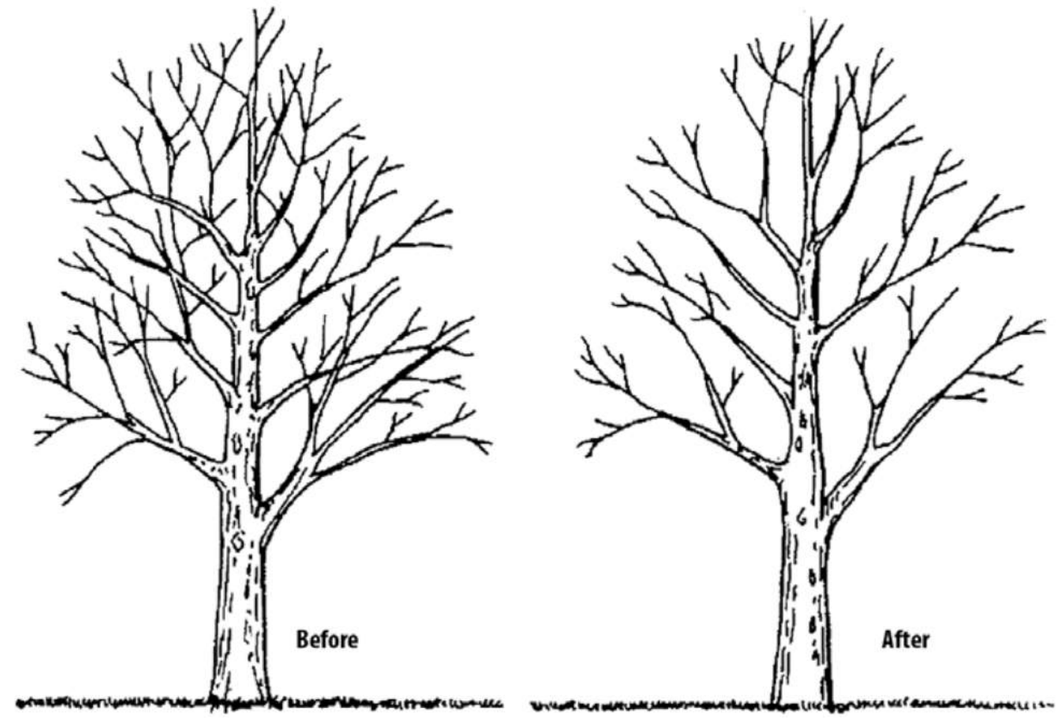


Example of included bark

Branches with narrow angles of attachment and co-dominant branches tend to fail at the point of attachment if there is included bark. Included bark is bark that becomes enclosed in the crotch of the branch union as the branches develop and grow in diameter. This condition weakens the branch attachment, making the tree more prone to loading and storm damage.

**Crown Cleaning:** Virtually all trees benefit from periodic crown cleaning. This is the removal of defective limbs including those that are dead, dying, diseased, rubbing and structurally unsound (decayed). Cleaning reduces the risk of branch failure, improves tree health and enhances tree appearance by removing limbs that are unsightly, unhealthy and unsound.

Although removal of healthy branches is technically "thinning", selective removal of watersprouts is included in the cleaning technique.

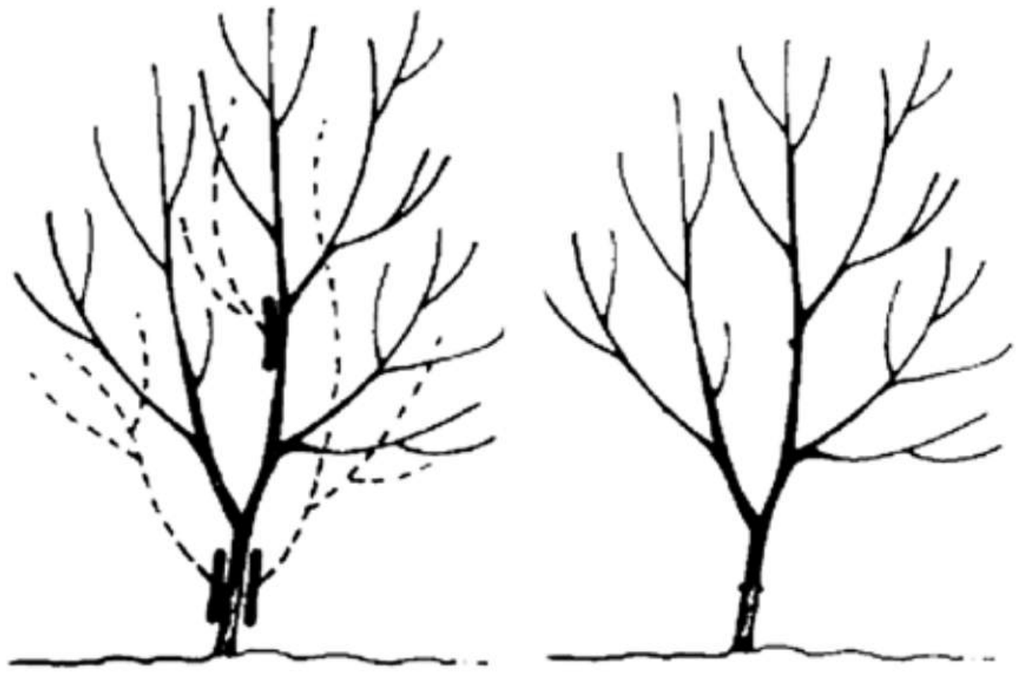



Example of crown cleaning

**Crown Thinning**: Crown thinning is the removal of live, healthy branches on trees with dense crowns. This improves light penetration and air movement, and decreases wind resistance, thus reducing potential pest infestations and reducing the risk of storm or wing damage. Thinning can also be used to reduce weight of individual limbs and to slow the growth rate on vigorous limbs.

Proper thinning involves removal of branches at their point of origin or back to appropriate lateral branches.

Thinning does not normally influence the size or shape of the tree and should result in an even distribution of branches on individual limbs. Removal of only interior branches can create the effect known as lion-tailing which displaces weight and wind resistance to the ends of the branches which may result in weakened branch structure and failure.

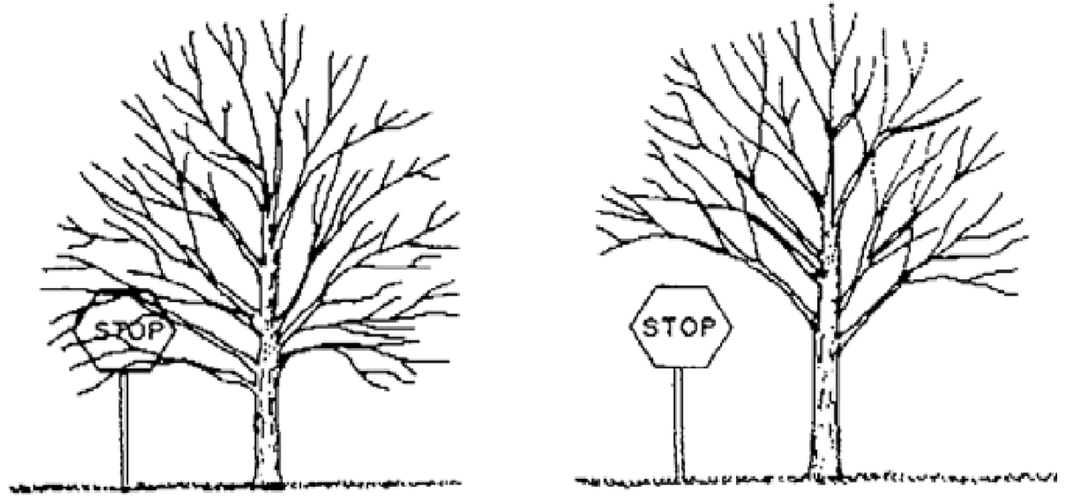


Example of crown thinning

**Crown Raising:** Crown raising is the removal of the lower branches of a tree in order to provide clearance for pedestrian or vehicular traffic, or to remove visual obstructions to traffic control devices.

Crown raising should be performed on young or medium aged trees, before lower interfering limbs grow to a large diameter resulting in large pruning wounds. Young and medium aged trees also tend to close wounds better than older trees. Large wounds on older trees may not close which can lead to decay on the main stem. Lower limbs on young trees should remain as long as possible to create and maintain trunk taper.

A common practice on younger trees to avoid removing lower branches is to perform reduction cuts to suppress growth. These shortened branches can be removed later to raise the crown as needed.

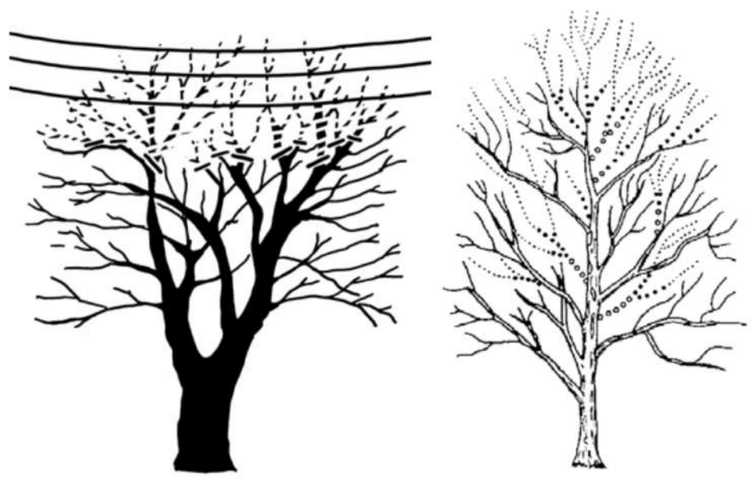



Example of crown raising for stop sign clearance

**Crown Reduction**: is needed on trees or individual limbs that are growing close to buildings, other trees, or utility wires. Crown reduction is not topping. Reduction may also be necessary to prevent or correct storm damage and to shorten errant branches to provide a more desirable shape. This type of pruning involves reducing the height or spread of the crown or individual limbs. Certain species such as beech and sugar maple respond poorly to reductions so consideration must be given to the ability of the species to tolerate this procedure.

When reducing a leader or branch cut back to a lateral branch that is large enough to assume dominance. The size of the remaining lateral is not specified since it varies with tree species and tree condition. Typically, a lateral one-third the diameter of the parent limb is selected. If the lateral is smaller, the limb will either dieback or sprout profusely. The remaining lateral should be growing in a direction that will maintain a desirable shape and not interfere with objects within the pruning cycle.

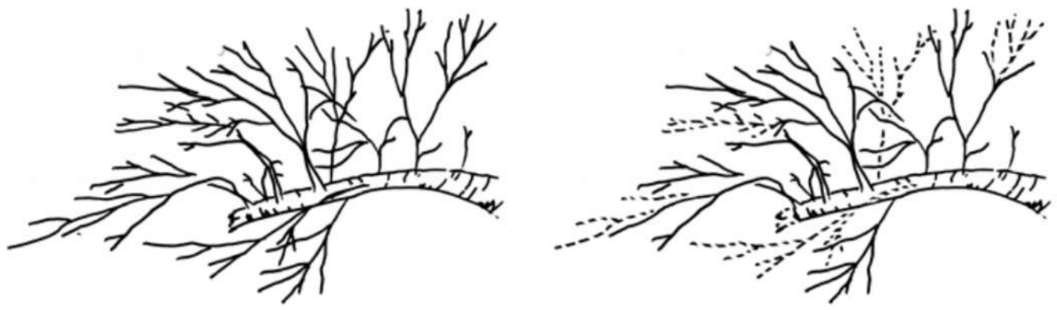
Crown reduction pruning can control tree size to a certain degree, but it no substitute for matching the correct tree species to the site conditions when planting, "Right Tree-Right Place".



Examples of crown reduction pruning

**Crown Restoration:** Crown restoration pruning is performed to improve the structure, form and appearance of trees that have been topped, vandalized or storm damaged. The success of restoration pruning depends on the ability of the tree to compartmentalize decay, the extent and location of damage, and the skill of the tree care worker attempting the restoration. Restoring a tree to a sustainable structure usually requires a number of prunings over a period of years as new dominant branches take time to form. Not all damaged trees are candidates for restoration, it may not be possible to restructure a tree and removal may be required.

The process of crown restoration can be combination of crown cleaning, crown thinning and crown reduction depending on the severity of damage. Removal of dead or broken limbs and stubs should be performed first. If the tree has been topped or broken limbs are present there will most likely be epicormics growth that will require thinning to allow more dominant limbs to grow. Sometimes these limbs will need to be reduced to a proper lateral, drop crotch pruning. When selecting branches to remain on the tree consideration shall be given to how the limbs are attached.



Example of thinning epicormic growth as part of restoration pruning

**Root Pruning**: Root pruning is the selective removal of tree roots. It is performed when conflicts between tree roots and infrastructure, such as sidewalks, driveways or underground utilities are identified.

When trees are root pruned there is always a risk of tree failure. Tree species, age, size, vigor, existing defects and site conditions are factors that must be analyzed prior to performing root pruning. Mature trees are less tolerant of root pruning than young trees. Trees with defects or in poor condition are not good candidates for root pruning.

The preferred method is to utilize an air-spade to expose the roots for identification and ease of making clean cuts. Hand digging may be performed to expose the roots, however there is the risk of causing more damage than necessary to the roots. Root pruning should be performed with a clean, sharp saw.

Root pruning should not be made with an axe, excavator bucket or ditch excavating machine as these tools tend to shatter and splinter roots which leads to decay.

Ideally roots should be pruned a distance of five times the diameter breast height (DBH). For example, if the tree is 12-inches in diameter the root pruning should be made no closer than 60-inches to the trunk. The closer to the trunk the root pruning occurs the greater the negative effect on the tree. Severing more than 25% of a trees root system is generally fatal to the tree.

Examples of crown reduction pruning

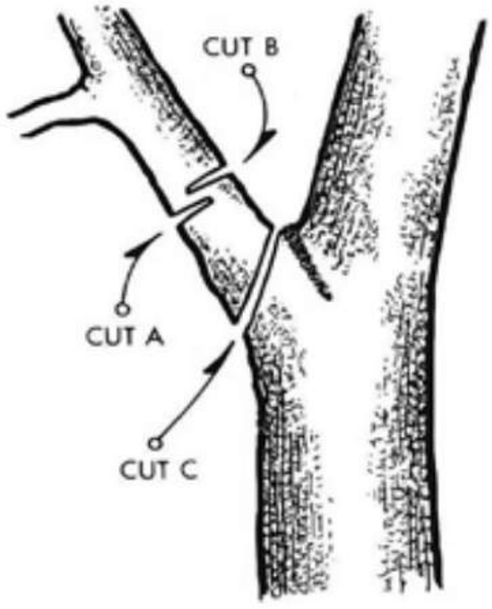
## Proper Pruning Practices

**Pruning Cuts:** Correctly removing a branch from a tree involves having the basic understanding of plant physiology how a tree responds to being wounded. Each cut should be made carefully, at the correct location, leaving a smooth surface with no jagged edges or tears into the bark. The correct anatomical location for a pruning cut is just beyond the branch collar, this is known as natural target pruning.

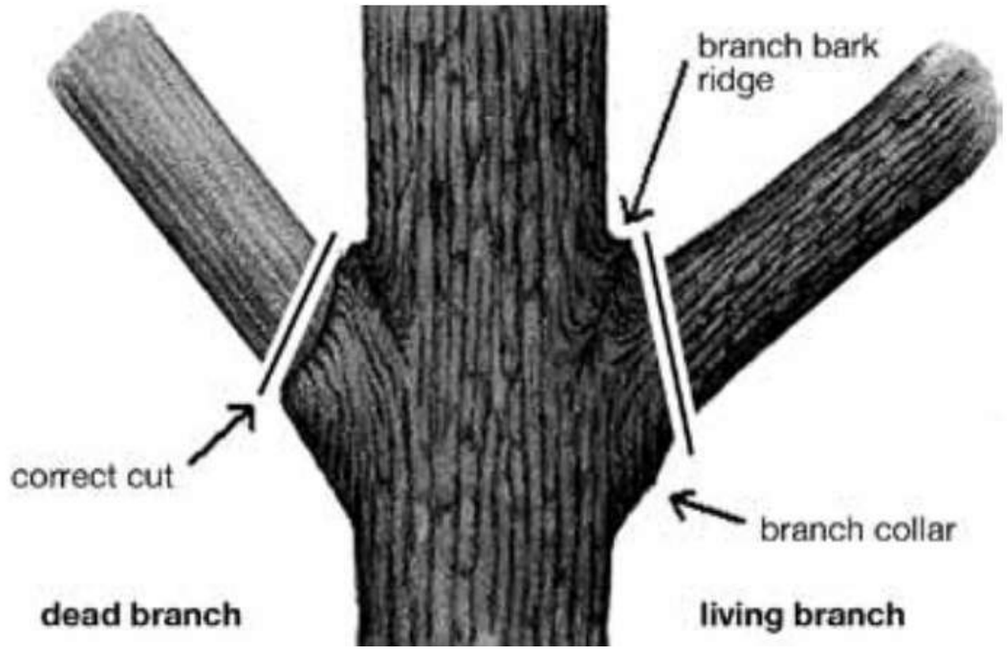
Large limbs should be removed using the three step method. The first cut undercuts the limb, this cut should eliminate the chance of the limb peeling or tearing the bark as it is removed. The second cut is the top cut made lightly further out on the limb, this allows the limb to drop when the weight is released. The final cut is to remove the remaining stub, this cut is made just outside of the branch collar and branch bark ridge.

Before making any pruning cut remember these basic concepts:

- Each cut has the potential to change the tree forever
- Removal of branches and limbs affects the trees ability gather sunlight for 'food' production
- Large limb removal can impact form and geometry, affecting stability
- Inconsiderate removal of branches can result in tree decline




Three Step Pruning Cut




**Pruning Dose:** A key principle is the pruning dose, or amount of live tissue mass removed during any one pruning. Pruning dose will depend on previous pruning cycles and pruning objectives. If extensive pruning is required then consider phasing the pruning over several cycles over a period of months or years.

Removing dead, damaged or dying tree parts do not factor into the live tissue mass being removed. The following are general guidelines for pruning dose, or maximum percentage of live foliage to be removed at one pruning, based on the development stage of the tree:

- Young, newly established trees - maximum 50%
- Medium aged trees - maximum 25%
- Mature trees - maximum 10%

## Proper Pruning Practices

**When to Prune:** There is much discussion and research on the best time to prune trees. Most of the time, pruning doesn't occur until there is a problem. However, timing depends on tree health, environmental conditions, season, desired effects, and purpose. Regardless of the need, always take into consideration the outcomes of the pruning action and what is best, long-term, for the tree. Prune trees when young to enhance growth and structure. Prune mature trees on an as-needed basis to insure safety and to improve structure and necessary clearance

Trees may be pruned at any time of the year, except when the wood is frozen. Pruning in late winter or early spring, just before the new growth emerges, is good timing for many trees. This leaves wound tissue exposed for a shorter period of time before sealing begins. Also, with no leaves on the trees, branching structure is more visible, helping with the decision-making process on pruning cuts. Minimize any pruning in late summer or early fall, because that can promote a late flush of new growth more susceptible to cold damage or can delay dormancy on species such as elms and maples. Also, reconsider any pruning activity if the tree is stressed from drought

Always consider that any arboricultural practice should not spread pathogens in the process. Proper timing of pruning can reduce spread of certain diseases. Dormant pruning, while trees are not actively growing, may be a good maintenance option on trees where pathogens such as oak wilt may be spread. Avoid pruning until late fall or dormancy, if disease is a problem. Spring or summer pruning increases chances for spread and infection of bacterial diseases such as fireblight. Prune crabapples, ornamental pears, and hawthorns in late February through March if these diseases are an issue

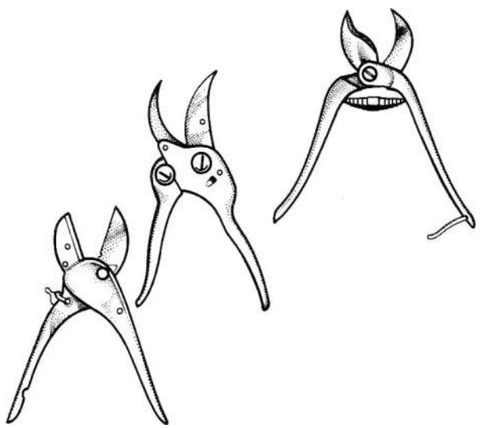
Certain species, maples, birches, ironwood, and beech are sometimes labeled as "bleeders" and can discharge a great deal of sap through pruning wounds in the spring. This is the result of converting large amounts of starch to sugars and the flow of water from the soil into the tree creating positive pressure. The bleeding is not a reason for alarm from a health perspective. However, it can be unsightly and messy. Pruning these species later in the spring can reduce the oozing. If pruning dead branches for these species the pruning work can be completed anytime of the year.

**Painting or covering of pruning wounds:** This practice is no longer widely recommended except in the case of elm or oak if pruning into live tissue is required to take place between Memorial Day and Labor Day. Wound dressings have been used to help reduce the spread of Oak Wilt and Dutch Elm Disease. The wound dressing helps to prevent the insect vectors of these diseases from having access to the wounded tissue. Studies have shown that wound dressings can be non-beneficial to trees and in some cases phytotoxic.

### Pruning Tips for Better Trees:

- Start training trees with pruning when they are young and newly established
- Minimize the number of live branches removed at any one time
- Use proper cuts, watch for the branch collar and branch bark ridge
- Pruning dose should be determined by overall tree health
- Reduce live tissue pruning during periods of drought
- Remove smaller branches rather than larger branches
- Prune when trees are biologically active to expedite wound sealing
- Do not use wound dressing, except to prevent disease spread
- Do not top trees for any reason

# pruning tools



## Pruning Shears

Are used to remove branches and stems up to 1/2" diameter.

## Lopping Shears

Two handed shears, remove stems and branches up to 1 3/4" diameter.

The long handles let you reach far and exert high leverage with minimal exertion.

## Pole Saws

Can be either mechanical or manual.  Allows user to trim branches that are within arms reach of the user.  The diameter of the branch to be removed is limited  only by the capability of the blade.

## Small Hand Saws

The small size and curved blade of these saws make them ideal for pruning branches that are too big for loppers and too small for a power saw.

**Cleaning of equipment**

Diseases and spores can be spread from one plant to another through pruning devices.  Basic cleaning isn't enough to keep the tools from spreading disease throughout your community. After working on a diseased plant it is recommended to sanitize the tools with a full-strength household disinfectant or a solution of 1 part bleach or pine oil cleaner and 3 parts water. Tools should be dry before moving on to the next plant.

# glossary

Appendix F

**Abiotic disorder:** plant malady caused by nonliving, environmental, or man-made agents

**Absorbing roots:** fine, fibrous roots that take up water and minerals. Most absorbing roots are within the top 12 inches (30 centimeters) of soil.

**Absorption:** taking up. Contrast with adsorption

**Access route:** defined entrance and exit route for a property during construction, tree work, or landscape operations.

**Acid:** having a pH less than 7.0. Contrast with alkaline.

**Acidity:** state or quality of being acid. Contrast with alkalinity. See pH.

**Acute**: disorder or disease that occurs suddenly or over a short period of time. Contrast with chronic.

**Adaptability:** genetic ability of plants and other living organisms to adjust or acclimate to different environments.

**Adsorption:** adhesion on contact of the molecules of gases, dissolved substances, or liquids to the surface of solids or liquids with which they are in contact. Contrast with absorption.

**Adventitious:** arising from parts of the root or stem and having no connection to apical meristems.

**Adventitious bud:** bud arising from a place other than a leaf axil or shoot tip, usually as a result of hormonal triggers.

**Adventitious roots:** roots arising from roots or stems and having no connection to apical meristems.

**Aeration:** provision of air to the soil to alleviate soil compaction and improve its structure.

**Aeration system:** set of holes or trenches created in the tree

**Aerial device (aerial lift device):** truck with booms and a bucket for elevating a worker to the proximity of a tree

**Aerial rescue** - method of bringing an injured worker down from a tree or aerial lift device.

**Aesthetic** — pleasing to the senses, visually or otherwise. Artistic.

**Aggregate** - close cluster or mix of small particles of soil and/or organic matter of varying size that are bonded together; sand, gravel, or small rocks in soil; and/or sand, gravel, or small rocks used under paved surfaces. Also clusters of flowers or fruits that appear as a single unit. Also individual tree crowns that form a canopy.

**Alternate** — pertaining to bud or leaf arrangement, one leaf or bud at each node, situated at alternating positions along the stem. In this arrangement, the leaves are not directly across from each other. Contrast with opposite and whorled.

**Alternate host** - one of a number of separate obligate hosts to the different life stages of certain pathogens, such as rusts, which must alternate between hosts.

**ANSI** - acronym for American National Standards Institute.

**ANSI A300** — in the United States, industry-developed, national consensus standards of practice for tree care.

**ANSI Z133.1** — in the United States, industry-developed, national consensus safety standards of practice for tree care.

**ANSI Z60.1** - In the United States, industry-developed, national consensus standards for nursery stock.

**Anthracnose** - group of fungal diseases of trees that affect the leaves, stems, flowers, or fruit, causing spotting, blotching, or necrosis.

**Antitranspirant** — substance applied to the foliage of plants to reduce water loss (transpiration).

**Appraisal** - (1) placing a monetary value on a tree, other plant, other landscaping, including hardscape, or an entire property. (2) a report stating an opinion of appraised value. (3) particularly outside the United States, an evaluation of nonmonetary landscape or plant characteristics.

**Arboriculture** — practice and study of the care of trees and other woody plants in the landscape.

**Arborist** - professional who possesses the technical competence gained through experience and related training to provide for or supervise the management of trees and other woody plants in residential, commercial, and public landscapes

**Back cut** - cut made on a tree trunk or branch, opposite from and to-

ward the notch, face cut, or undercut, to complete felling or branch removal. Contrast with bore cut.

**Backfill**—1) soil or amended soil used to fill the hole when planting a tree. (2) soil, common fill, aggregates, or contaminants in various combinations put back into an excavation. May not be hospitable for tree root growth and function.

**Bacteria**—single-celled organisms having a cell wall but no organized nucleus. A few species are plant pathogens.

**Balled and burlapped (B&B)** - tree or other plant dug and removed from the ground for re-planting, with the roots and soil wrapped in burlap or a burlaplike fabric. Contrast with bare root, container grown, containerized, and in-ground fabric-bag grown.

**Bare root**—tree or other plant removed from the ground for re-planting without soil around the roots. Contrast with balled and burlapped, container grown, containerized, and in-ground fabric-bag grown.

**Bark**—protective outer covering of branches and stems that arises from the cork cambium or cambium.

**Bark tracing**—cutting away torn or injured bark to leave a smooth edge.

**Barrier zone** - chemically defended tissue formed by the still-living cambium, after a tree is wounded or invaded by pathogens, to inhibit the spread of decay into new annual growth rings. Wall 4 in the CODIT model. Contrast with reaction zone.

**Basal bark application**— application of herbicides, usually mixed with penetrating oil, to the lowest 12 to 18 inches (30 to 45 centimeters) of the main stem(s) of unwanted vegetation.

**Best management practices (BMP)** - best-available, industry-recognized courses of action, in consideration of the benefits and limitations, based on scientific research and current knowledge.

**Biodegradable**—capable of being broken down by natural, organic processes and reabsorbed into the environment.

**Biological control** - method of managing plant pests or weeds through the use of natural predators, parasites, or pathogens.

**Biotic**— pertaining to living organisms.

**Biotic disorder**— disorder caused by an infectious living agent.

**Bleeding** - (1) flow of sap from plant wounds, injuries, or pathogen invasion. (2) flow of blood from a human or animal wound.

**Blight**— any disease or disorder, regardless of the causal agent, that kills young plant tissues.

**Bole**— main trunk of a tree below the branches, usually used in reference to a tall tree whose first branch is high off the ground.

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

**Bore cut** - using the tip of a chain saw to cut into or through the middle of a piece of wood. Back-cut technique in which the hinge is established by plunge cutting through the stem, then cutting back away from the hinge. Plunge cut. Contrast with back cut.

**Bracing**— installation of metal rods through portions of a tree for supplemental support.

**Branch**—stem arising from a larger stem. A subdominant stem. Pith in true branches has no connection to the parent stem.

**Branch bark ridge** - raised strip of bark at the top of a branch union, where the growth and expansion of the trunk or parent stem and adjoining branch push the bark into a ridge.

**Branch collar**— area where a branch joins another branch or trunk that is created by the overlapping vascular tissues from both the branch and the trunk. Typically enlarged at the base of the branch.

**Branch union**—point where a branch originates from the trunk or another branch. Fork. Crotch

**Branch protection zone**— chemically and physically modified tissue within the trunk or parent branch at the base of a smaller, subordinate branch that retards the spread of discoloration and decay from the subordinate stem into the trunk or parent branch.

**Broadcast fertilization** - application of fertilizer over the soil surface. Contrast with drill-hole fertilization and liquid fertilization.

**Brown rot**—fungal wood rot characterized by the breakdown of cellulose. Contrast with soft rot and white rot.

**Brownout**— term describing the brown appearance of dead foliage, usually following the application of herbicide.

**Bud**— small lateral or terminal protuberance on the stem of a plant that may develop into a flower or shoot. Undeveloped flower or shoot containing a meristematic growing point.

**Bud trace**— vascular connection extending from the base of latent buds inward to near the pith. Grows in length with each annual increment and appears as a thin, continuous line when viewed in longitudinal section.

**Burl (burr)** - an abnormal swelling of a tree trunk characterized by swirling wood grain and meristematic tissue. Wood with these structures is prized for woodworking. Contrast with gall.

**Burlap** - (1) strong, coarsely woven cloth made from fibers of jute, flax, or hemp. (2) a burlaplike fabric made of synthetic fibers. Both are used for containing soil in a root ball. See balled and burlapped.

**Butt rot**—decay of the lower trunk, trunk flare, or buttress roots. See crown rot.

**Buttress roots**—roots at the trunk base that help support the tree and equalize mechanical stress

**Cabling**—installation of steel or synthetic cable in a tree to provide supplemental support to weak branches or crotches.

**Callus**—undifferentiated tissue formed by the cambium, usually as the result of wounding. Contrast with woundwood.

**Cambium**—thin layer(s) of meristematic cells that give rise (outward) to the phloem and (inward) to the xylem, increasing stem and root diameter.

**Canker**—localized diseased area on stems, roots, and branches. Often shrunken and discolored.

**Canopy**—collective branches and foliage of a tree or group of trees

**Cavity**— open or closed hollow within a tree stem, usually associated with decay.

**Central leader**— main stem of a tree, particularly of an excurrent specimen.

**Chemical injury**— plant tissue damage caused by pesticides (insecticides, fungicides, herbicides, plant growth regulators) or other chemicals.

**Chlorosis** - whitish or yellowish leaf discoloration caused by lack of chlorophyll. Often caused by nutrient deficiency.

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

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

**Codominant branches/codominant stems**— forked branches nearly the same size in diameter, arising from a common junction and lacking a normal branch union.

**Compartmentalization**— natural defense process in trees by which chemical and physical boundaries are created that act to limit the spread of disease and decay organisms.

**Conk**— fruiting body or nonfruiting body (sterile conk) of a fungus. Often associated with decay

**Container grown**— tree or other plant that has been grown in a container. Contrast with balled and burlapped, bare root, containerized, and in-ground fabric bag-grown.

**Compression wood**— reaction wood in woody plants that develops on the underside of branches or leaning trunks. Compression wood is important in load bearing in conifers.

**Conifer**— cone-bearing tree or other plant that has its seeds in a structure called a cone.

**Containerized**—field-grown plant placed into a container for a time and then sold as a potted plant. Term does not include a plant initially grown in a container. Contrast with balled and burlapped, bare root, container grown, and in-ground fabric bag-grown.

**Controlled release fertilizer** - slow-release or slowly soluble form of fertilizer.

**Cost of cure**—method used to appraise the monetary value of tree and landscape losses based on the treatment needed to return the property to a reasonable approximation of its original condition.

**Cracks**—narrow breaks or fissures in stems or branches. If severe, may result in tree or branch failure.

**Critical root zone (CRZ)** - area of soil around a tree where the majority of the roots are located and that provide stability as well as uptake of water and minerals. CRZ determination is sometimes based on the drip line or a multiple of dbh, but because root growth is often asymmetric due to site conditions, on-site investigation is preferred.

**Crook**—abrupt bend in a branch or trunk.

**Cross section**—section perpendicular to the axis of longitudinal growth.

**Crotch**—(1) (noun) branch union or fork. (2) (verb) to place a line through a branch union.

**Crown**—upper part of a tree, measured from the lowest branch, including all the branches and foliage.

**Crown cleaning**—in pruning, the selective removal of dead, dying, diseased, and broken branches from the tree crown.

**Crown raising**— in pruning, the selective removal of lower limbs from a tree crown to provide clearance. Raising. Lifting.

**Crown reduction**— method of reducing the height and/or spread of a tree crown by making appropriate pruning cuts. Reduction.

**Crown restoration**— method of restoring the natural growth habit of a tree that has been topped or damaged in any other way.

**Crown rot**— disease or decay at the base of a tree or root crown. See butt rot.

**Crown thinning**— in pruning, the selective removal of live branches to reduce crown density.

**Cultivar**—cultivated variety of a plant. Cannot be reproduced without human assistance. Usually propagated asexually (cloned). Compare to variety.

**Cultural control**— method of controlling plant pests by providing a growing environment favorable to the host plant and/or unfavorable to the pest. See Plant Health Care and Integrated Pest Management.

**DBH**—acronym for tree diameter at breast height. Measured at 1.4 meters (4.5 feet) above ground

**Deadwooding**—removing dead and dying branches from a tree. Outdated term for crown cleaning.

**Decay**—(1) (noun) an area of wood that is undergoing decomposition. (2) (verb) decomposition of organic tissues by fungi or bacteria.

**Deciduous**—tree or other plant that sheds all of its leaves according to a genetically scheduled cycle as impacted by climate factors (usually during the cold season in temperate zones). Contrast with evergreen.

**Decline**— gradually diminishing health or condition of a tree.

**Decurrent**— rounded or spreading growth habit of the tree crown. Contrast with excurrent.

**Deficiency**— pertaining to plant nutrition, lack or insufficient quantity of a required element.

**Defoliation**— loss of leaves from a tree or other plant by biological or mechanical means.

**Diagnosis**—process of identifying a disorder by analyzing signs, symptoms, site conditions, patterns, climate, cultural history, and other factors to determine the causative agent(s).

**Dieback**— condition in which the branches in the tree crown die from the tips toward the center.

**Disease**— condition that impairs the performance of one or more vital functions. Usually associated with infectious agents.

**Disorder**—abnormal condition that impairs the performance of one or more vital functions. Usually associated with noninfectious agents.

**Downy mildew**—white, fungal-like growth that develops during wet periods, usually on the underside of a leaf.

**Drill-hole fertilization**—applying fertilizer by drilling holes in the soil within the root zone. Contrast with broadcast fertilization and liquid fertilization.

**Drip irrigation**— method of minimizing evaporation and runoff by apply-

ing small amounts of water through small emitters.

**Drip line**— imaginary line defined by the branch spread of a single plant or group of plants.

**Drop cut branch**— removal technique consisting of an undercut and then a top cut, usually made farther out on the branch, or with a chain saw, directly over the undercut.

**Drop zone**— predetermined area where cut branches or wood sections will be dropped or lowered from a tree.

**Easement**— legal interest in real property that conveys use or partial use, but not ownership, of a portion of an owner

**Ecosystem**— complex system of living organisms and their abiotic environment

**Engineered fill**— material used as a construction base that is different from the surrounding soil profile and has a known compaction rate or load-bearing capacity.

**Eradication**— total removal of a species from a particular area. May refer to pathogens or insect pests or to unwanted plants.

**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.

**Evapotranspiration (ET)** - loss of water by evaporation from the soil surface and transpiration by plants.

**Evergreen** —tree or other plant that does not shed all of its foliage annually. Contrast with deciduous.

**Excurrent**—tree growth habit characterized by a central leader and a pyramidal crown. Contrast with decurrent.

**Exfoliating**—peeling off in shreds or layers.

**Exotic species**—not native or indigenous to a region. May be invasive. Contrast with introduced species, native species, and naturalized species.

**Family**—taxonomic group under the order level and above the genus level.

**Flagging** —(1) symptom in which leaves on a branch wilt and may ultimately turn brown without falling from the shoot. (2) growth form of trees growing in strong winds, characterized by the branches growing toward the downwind side. (3) colored tape used to mark trees or surveying points.

**Forestry:** management of forests using silvicultural treatments, to provide a variety of forest benefits including timber, aesthetics, wildlife habitat, and/or recreational opportunities.

**Frass**—fecal material and/or wood shavings produced by insects.

**Fruiting body**—reproductive structure of a fungus. The presence of certain species may indicate decay in a tree. See conk.

**Fungicides**—chemical compounds that are toxic to fungi.

**Fungus (pl. fungi)** - group of organisms from the kingdom Fungi, including yeasts, molds, mushrooms, and smuts. Typically multicellular, saprophytic, or parasitic and lacking vascular tissue and chlorophyll. Reproduces by spores borne in fruiting bodies.

**Gall**—abnormal swelling of plant tissues caused by gall wasps, mites, nematodes, and various insects and less commonly by fungi or bacteria. Contrast with burl.

**Genus**—taxonomic group, composed of species having similar fundamental traits. Botanical classification under the family level and above the specific epithet level.

**Geotextile fabric**—synthetic fabric used in landscaping and in landscape or road construction applications as a barrier under mulch or pavement to reduce weed germination and growth, as a filter to reduce infiltration of fine soil into drainage or aeration structures (including tiles or pipes), as a barrier to separate and prevent infiltration of fill or paving layers (e.g., to prevent gravel paving from infiltrating a tree root zone), and/or to spread the load of a paving or fill layer and reduce compaction of an underlying layer. Geotextiles generally allow for the passage of water and for gaseous exchange but will be limited by the material placed above

**Girdling**—restriction or destruction of the vascular system within a root, stem, or branch that causes an inhibition of the flow of water and photosynthates in the phloem.

**Girdling root**—root that encircles all or part of the trunk of a tree or other roots and constricts the vascular tissue and inhibits secondary growth and the movement of water and photosynthates.

**Grade**—(1) (noun) surface level of the ground. (2) (noun) the slope, or percentage of change, in the surface level of the ground; important for drainage and for the safe operation of equipment. (3) (verb) to change or groom the surface level or contours of the ground. (4) (noun and verb) quality determination for nursery stock.

**Grading phase** - of site development that provides a site with intended grades (contours, elevations, and slopes). Involves cutting and filling. See mass grading.

**Grading plan**—sheet of a complete set of development plans that depicts both original and finished (changed) grades. Essential information in developing tree conservation or preservation plans.

**Graft**—to join together tissues from the same or different plants in order to combine desirable characteristics or to effect a repair (bridge graft).

**Graft union**— junction between root stock and scion wood. Often evident by a thickening of the trunk at the union.

**Gravitational water**—water that drains from the larger soil macropores due to the force of gravity. Compare to available water, field capacity, permanent wilting point, and saturation point.

**Groundwater**—water naturally stored underground in aquifers or that flows through and saturates soil and rock, supplying springs and wells.

**Growth rate**—speed at which something grows.

**Growth rings**—rings of xylem that are visible in a cross section of the stem, branches, and roots of some trees. In temperate zones, the rings typically represent one year of growth and are sometimes referred to as annual rings

**Hanger**—broken or cut branch that is hanging in a tree.

**Hardened off**—plant tissue that is acclimated to the cold or a new environment.

**Hardiness**—genetically determined ability of a plant to survive low temperatures.

**Hardpan** - compacted soil layer nearly impervious to water, air, and roots.

**Hazard**—situation, condition, or thing that may be dangerous. (1) in tree management, a tree or tree part that is likely to fail and cause damage or injury, and the likelihood exceeds an acceptable level of risk. (2) in tree care or forestry operations, the presence of a condition or situation that may cause harm or injury to workers.

**Hazard assessment**—systematic process of identifying hazards. See risk assessment.

**Heading (heading back)** - cutting a shoot back to a bud or cutting branches back to buds, stubs, or lateral branches not large enough to assume apical dominance. Cutting an older branch or stem back to a stub in order to meet a structural objective.

**Heart rot**—any of several types of fungal decay of tree heartwood, often beginning with infected wounds in the living portions of wood tissue.

**Heartwood**—wood that is altered (inward) from sapwood and provides chemical defense against decay-causing organisms and continues to provide structural strength to the trunk. Trees may or may not have heartwood. Contrast with sapwood.

**Honeydew**- sugary substance secreted by certain insects, including aphids and some scale insects, when feeding on plants.

**Heat tolerance**—ability of a plant to endure high temperatures.

**Herbicides**—chemical compounds that kill vegetation.

**Horticultural oils**—highly refined petroleum oils that may be applied to plants to smother certain insects and other pests by disrupting their respiration.

**Horticulture**—art and science of growing, handling, and processing fruits, vegetables, and ornamental plants.

**Host**—living organism from which a parasite obtains nutrition.

**In-ground fabric** - bag grown trees and shrubs field grown in fabric bags, commonly called grow bags. Contrast with balled and burlapped, bare root, container grown, and containerized.

**Included bark**—bark that becomes embedded in a crotch (union) between branch and trunk or between codominant stems. Causes a weak structure.

**Increment borer**—device used to take core samples from trees to determine age or detect problems, such as decay.

**Infectious**—capable of being spread to plants from other plants or organisms.

**Infiltration**—(1) downward entry of water into the soil. Contrast with percolation. (2) entry of fine particles into drainage or aeration systems; can lead to system clogging and failure. (3) downward entry of materials from one soil or fill layer to another, as when a gravel road surface mixes with underlying soil.

**Infiltration rate**—speed at which water penetrates the soil.

Insect growth regulators—substances, man-made or naturally occurring in insects, that affect growth and development of insects.

**Insecticidal soaps** soap - based pesticides approved for application to plants to kill insects and certain mites by disrupting the cell membranes.

**Insecticides**—substances toxic to insects.

**Integrated Pest Management (IPM)** - method of controlling plant pests by combining biological, cultural, mechanical, physical, and/or chemical management strategies.

**Integrated Vegetation Management (IVM)** - system of managing plant communities in which compatible and incompatible vegetation are identified, action thresholds are considered, control methods are evaluated, and selected control(s) are implemented to achieve a specific objective. Choice of control methods is based on effectiveness, environmental impact, site characteristics, safety, security, and economics.

**Introduced species**—organisms not native to a region. Contrast with exotic species, native species, and naturalized species.

**Invasive species**—non-native organisms likely to spread, disrupting the natural balance of an ecosystem.

**Lateral**—a branch or twig growing from a parent branch or stem.

**Leader**—primary terminal shoot or trunk of a tree. Large, usually upright stem. A stem that dominates a portion of the crown by suppressing lateral branches.

**Liability**—something for which one is responsible. Legal responsibility.

**Lion tailing** - poor pruning practice in which an excessive number of branches are thinned from the inside and lower part of specific limbs or a tree crown, leaving mostly terminal foliage. Results in poor branch taper, poor wind load distribution, and a higher risk of branch failure.

**Liquid fertilization** - applying liquid formulations of fertilizer by injection into the root zone of a tree or by application to soil surface or to foliage. Contrast with broadcast fertilization and drill-hole fertilization.

**Live crown ratio**—ratio of the height of the crown containing live foliage to the overall height of the tree

**Macroinfusion**—technique to introduce substances directly into the xylem of a tree to treat or prevent diseases, disorders, or pest problems through a relatively large-diameter hole in the trunk or a cut root.

**Macroinjection**—trunk injection technique that requires a relatively large-diameter hole in the trunk.

**Macronutrient**—essential element that is required by plants in relatively large quantities. Contrast with micronutrient.

**Macropore**—relatively large space between soil particles that is usually air filled and allows for water movement and root penetration. Contrast with micropore.

**Mature height**—maximum height that a plant is likely to reach if the conditions of the planting site are favorable.

**Microinjection**—trunk injection technique using a small-diameter trunk penetration to introduce chemicals directly into the xylem.

**Micronutrient**—essential element that is required by plants in relatively small quantities. Contrast with macronutrient.

**Mites**—small, often minute, arthropods in the order Acarina of the class Arachnida that may feed on plants, other mites, or small insects.

**Mitigation**—in tree risk management, reducing, alleviating, or minimizing

risk of harm (damage or injury).

**Monitoring**—keeping a close watch. Performing regular checks or inspections.

**Mulch**—material that is spread or sometimes sprayed on the soil surface to reduce weed growth, to retain soil moisture and moderate temperature extremes, to reduce compaction from pedestrian or vehicle traffic or to prevent damage from lawn-maintenance equipment, to reduce erosion or soil splattering onto adjacent surfaces, to improve soil quality through its eventual decomposition, and/or to improve aesthetic appearance of the landscape. Mulch can be composed of chipped, ground, or shredded organic material such as bark, wood, or recycled paper; unmodified organic material such as seed hulls; organic fiber blankets or mats; or inorganic material such as plastic sheeting.

**Mycellum**—growth mass of fungus tissue found under bark o in rotted wood.

**Mycorrhizae**—symbiotic association between certain fungi and the roots of a plant.

**Native species**—plants indigenous to a region. Naturally occurring and not introduced by man. Contrast with exotic species, introduced species, and naturalized species.

**Natural enemy**—predator, parasite, or pathogen that targets an organism

**Naturalized species**—non-native species that has become established in a region and propagates without human assistance. Contrast with exotic species, introduced species, and native species.

**Necrosis**—localized death of tissue in a living organism.

**Nematode**—microscopic roundworm. Many are beneficial organisms, but some feed on plant tissues and may cause disease or damage.

**Nomenclature**—scientific naming system for living organisms. Scientific names are Latin (or Latinized forms of other languages) and written in italics, the genus first (always starting with capital letter), followed by the specific epithet (species, always starting with lowercase letter, e.g., Quercus alba).





**Opposite** - pertaining to leaf or branch arrangement, leaves or branches situated two at each node, across from each other on the stem. Contrast with alternate and whorled.

**Order**—taxonomic group below the class level but above the family level.

**Organic fertilizer** - fertilizer derived from plants or animals. Contrast with inorganic fertilizer.

**Organic layer**—layer of organic matter at the soil surface.

**Organic matter**—material derived from the growth (and death) of living organisms. The organic components of soil. See compost, green mulch, humus, mulch.

**OSHA**—(1) in the United States, the legislative Occupational Safety and Health Act dealing with health and safety in the workplace. (2) in the United States, the Occupational Safety and Health Administration, which administers the act. (3) in Canada, the Occupational Health and Safety Administration (OHSA).

**Pathogen**—causal agent of disease. Usually refers to microorganisms

**Percolation**—movement of water through the soil. Contrast with infiltration.

**Pest**—organism (including, but not limited to, weeds, insects, or fungi) that is damaging, noxious, or a nuisance.

**Pest resistance**—in plants, the tendency to withstand or to not develop certain pest problems.

**Pest resurgence**—increase in the population of a pest following a reduction in the population of natural predators or parasites of that pest. Usually the result of a nonspecific pesticide or unfavorable environmental condition.

**Pesticide**—any chemical used to control or kill unwanted pests such as weeds, insects, or fungi.

**pH**—unit of measure that describes the alkalinity or acidity of a solution. Negative log of the hydrogen ion concentration. Measured on a scale from 0 to 14. Greater than 7 is alkaline, less than 7 is acid, and 7 is neutral (pure water). See acidity and alkalinity.

**Phloem**—plant vascular tissue that transports photosynthates and growth regulators. Situated on the inside of the bark, just outside the cambium. Is bidirectional (transports up and down). Contrast with xylem.

**Plant growth regulator**—compound effective in small quantities that affects the growth and/or development of plants. May be naturally produced (hormone) or synthetic. See plant hormone.

**Plant Health Care (PHC)** - comprehensive program to manage the health, structure, and appearance of plants in the landscape.

**Plant hormone**—substance produced by a plant that, in low concentrations, affects physiological processes such as growth and development, often at a distance from the substance point of origin. See plant growth regulator.

**Planting specifications**—detailed plans and statements of particular procedures, requirements, and standards for planting.

**Pole pruner**—long-handled tool used to make scissorslike, small pruning cuts that cannot be reached with hand tools.

**Pole saw** long— handled tool with a pruning saw on the end.

**Pollarding**—specialty pruning technique in which a tree with a large-maturing form is kept relatively short. Starting on a young tree, internodal cuts are made at a chosen height, resulting in the development of callus knobs at the cut height. Requires regular (usually annual) removal of the sprouts arising from the cuts.

**Powdery mildew**—any of various fungi of the genus Erysiphe producing powdery conidia that appear as a white, fuzzy coating on the upper leaf surfaces, often causing distortion of the leaf.

**Pruning**—removing branches (or occasionally roots) from a tree or other plant using approved practices, to achieve a specified objective.

**Pruning cycle**—in utility and municipal arboriculture, the time scheduled between pruning events that is established as a guideline for providing reasonable clearance between trees and conductors.

**Radial trenching**—technique for aerating the soil around a tree by removing and replacing soil (which may be amended) in trenches made in a spokelike pattern (radially from the trunk) in the root zone to improve conditions for root growth. Contrast with horizontal boring, trenching, and tunneling.

**Raising**—selective pruning to provide vertical clearance. See crown raising.

**Reaction wood**—wood formed in leaning or crooked stems or on lower or upper sides of branches as a means of counteracting the effects of gravity. See compression wood and tension wood.

**Reduction**—pruning to decrease height and/or spread of a branch or crown. See drop-crotch pruning.

**Reduction cut**—pruning cut that reduces the length of a branch or stem back to a lateral branch large enough to assume apical dominance.

**Replacement cost method (RCM)** - method to appraise the monetary value of trees considered replaceable with nursery or field-grown stock. Based on the cost of replacement with the same or a comparable species of the same size and in the same place, subject to depreciation for various factors. Contrast with trunk formula method.

**Resistance**—(1) in plants, the tendency to withstand, or to not develop, certain pest (including disease) problems; pest resistance. (2) in insects, the ability to withstand certain insecticides; survival of just a few genetically resistant insects that reproduce can lead to populations that are resistant. (3) in other pests, the ability to withstand certain pesticides.

**Resistant varieties**—plant varieties that are tolerant of, or not susceptible to, certain disease or pest problems or abiotic disorders.

**Resistograph**—brand name of a device consisting of a specialized microdrill bit that drills into trees and graphs density differences that are used to detect decay.

**Restoration**—(1) pruning to improve the structure, form, and appearance of trees that have been improperly trimmed, vandalized, or damaged. (2) management and planting to restore altered or damaged ecosystems or landscapes.

**Right-of-Way (ROW)** - defined area of land, usually a linear strip, reserved for the passage of traffic (paths and roadways) or the construction, maintenance, and operation of various above-ground or underground

utilities. ROW users may be owners (public and private roadways are common examples) or may be granted easement rights by the owners (utility corridors are common examples).

**Risk**—likelihood or probability that something will happen. Usually associated with negative consequences. In tree management, the likelihood that a tree or tree part will fail and cause injury or damage.

**Risk assessment**—process of evaluating what unexpected things could happen, how likely it is, and what the likely outcomes are. In tree management, the systematic process to determine the level of risk posed by a tree, tree part, or group of trees.

**Risk management** - systematic application of management policies, procedures, and practices for identifying, evaluating, treating, monitoring, and communicating risk.

**Root ball**—soil containing all (e.g., containerized) or a portion (e.g., B&B) of the roots that are moved with a plant when it is planted or transplanted.

**Root barrier**—membranes or sheets installed vertically in the soil to limit or direct the growth of tree roots.

**Root bound**—condition in which plant roots are overcrowded in a container or site and root growth is restricted.

**Root collar**—flared area at the tree trunk base where the roots and trunk come together.

**Root collar/root crown excavation**—process of removing soil to expose and assess the root collar (root crown) of a tree.

**Root crown**—area where the main roots join the plant stem, usually at or near ground level. Root collar.

**Root graft**—natural union of two roots, either from the same plant or two different plants. Can result in disease transmission.

**Root hairs**—modified epidermal cells of a root that absorb the majority of water and minerals.

**Root protection area (RPA)** - area of tree root zone to be protected from construction damage, the size of which is based on the size of the tree or trees to be protected.

**Root protection zone**—surface area of tree root concentration to be protected from construction damage, usually soil compaction damage. Best accomplished by fencing off the entire root protection zone.

**Root pruning**—(1) in transplanting, the process of pre-digging a root ball to increase the density of root development within the final root ball. (2) in tree conservation and preservation, the process of pre-cutting roots behind the line of a planned excavation to prevent tearing and splintering of remaining roots. (3) in tree disease management, severing tree roots to prevent disease transmission through root grafts.

**Root stock**—root or part of tree used for plant propagation by grafting to scion wood.

**Root zone**—(1) horizon or layer within the soil profile where roots exist. (2) volume of soil containing tree roots. (3) horizontal spread of tree roots from the trunk. Typically the root zone of a tree extends well beyond the drip line.

**Rust**—disease caused by a certain group of fungi and characterized by reddish brown spots on the foliage and/or the formation of stem galls.

**Sanitation**—cultural practice of removing dead, infested, or diseased plant parts to reduce the spread of insects or disease.

**Sapwood**—the active xylem 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.

**Saturation point**—point at which a soil or an aquifer will no longer absorb any amount of water without losing an equal amount. Compare to available water, field capacity, gravitational water, and permanent wilting point

**Scaffold**—1) pertaining to tree architecture or form, a strong and properly spaced arrangement, framework, or system of branches throughout the crown. (2) a work platform, which may be stationary or moving.

**Scaffold branches** - permanent or structural branches that form the scaffold architecture or structure of a tree.

**Secondary pest**—insect or other pest problem that develops on a plant

stressed and weakened by another factor. See secondary disorder.

**Secondary pest outbreak**– Increase in a secondary pest population following a reduction in the population of natural predators or parasite s.

**Selective herbicides**—herbicides that are effective only on specific plant types (e.g., broadleaves, grasses) or species.

**Shear**—(1) (noun) in mechanics, the movement or failure of materials, especially laminar material such as wood, by sliding side by side. (2) (noun) a tool used to cut small-diameter plant material, including secateurs and snips, as well as long-bladed hand tools and power tools used to cut hedges. (3) (verb) to cut; often used to describe cutting foliage or stems to a single plane, as in a hedge.

**Sign**—physical evidence of a causal agent (e.g., insect eggs, borer hole, frass). Contrast with symptom.

**Silviculture**—study and practice of the maintenance and growth of forests.

**Sinker roots**—downward-growing roots that provide anchorage and take up water and minerals. Especially useful during periods of drought.

**Site analysis**—(1) consideration or evaluation of the conditions, restrictions, and environment of a planting site. (2) consideration or evaluation of a construction or development site requiring a tree conservation or preservation plan.

**Site considerations**—factors that must be taken into account when assessing a site for planting, tree conservation, or preservation or for any operation.

**Skeletonized**- leaf-feeding damage caused by insects (skeletonizers), characterized by the loss of tissue between the leaf veins.

**Slow-release fertilizer** - fertilizer that is at least 50 percent water-insoluble nitrogen (WIN). Rate of release may vary depending upon soil moisture and temperature. Contrast with quick-release fertilizer.

**Slowly soluble fertilizer** - fertilizer formulation that is slowly hydrolyzed in the soil.

**Soft rot**—decay of plant tissues characterized by the breakdown of tissues within the cell walls.

**Soil analysis**—analysis of soil to determine pH, mineral composition, structure, salinity, and other characteristics.

**Soil auger**—(1) device for removing cores of soil for inspecting or testing. (2) device (drill bit) used to drill holes in the soil for vertical mulching or for the drill-hole method of fertilizing.

**Soil compaction**—compression of the soil, often as a result of vehicle or heavy-equipment traffic, that breaks down soil aggregates and reduces soil volume and total pore space, especially macropore space.

**Soil-drench application**—method of applying chemicals (usually herbicides or tree growth regulators) to trees through the soil. Normally done by excavating a shallow trench in the soil around the base of the trunk and pouring the compound into the trench.

**Species**—taxonomic group of organisms composed of individuals of the same genus that can reproduce among themselves and have similar offspring.

**Staking**—supporting a tree with stakes and ties. Usually used in reference to newly planted trees.

**Stem**—woody structure bearing foliage and buds that gives rise to other stems (branches).

**Structural defects** — any naturally occurring or secondary conditions such as cavities, poor branch attachments, cracks, or decayed wood in the trunk, crown, or roots of a tree that may contribute to structural failure.

**Structural pruning**—pruning to establish a strong arrangement or system of scaffold branches.

**Structural roots**—large, woody, tree roots that anchor and support the trunk and crown. Roots characterized by secondary thickening and relatively large diameter, giving form to the root system and functioning in anchorage and support.

**Structural Soil**—pavement substrate that can be compacted to meet engineering specifications yet remains penetrable by tree roots in the urban environment. Composed of angular crushed stone, clay loam, and hydrogel mixed in a weight ratio of 100:20:0.03. Developed at the Urban

Horticulture Institute, Cornell University, Ithaca, NY.

**Stub**—portion of a branch or stem remaining after a stub cut, branch breakage, or branch death

**Stub cuts**—improper pruning cuts made too far outside the branch bark ridge or branch collar that leave branch tissue attached to the stem.

**Stump**—base part of a tree that remains standing after the tree has been felled.

**Stump grinder**—piece of power equipment used to remove tree stumps by grinding away the solid wood. Stump machine. Stumper.

Stunting growth — reduction of organisms, specifically plants or plant parts.

**Sub-opposite**—leaf arrangement in which leaves are nearly opposite, but are slightly alternate, with one bud slightly below the one opposite.

**Subordinate**—(1) (verb) prune to reduce the size and ensuing growth of a branch in relation to other branches or leaders. (2) (adjective) dominated by other trees, branches, or parts; suppressed.

**Subsurface application**—placement of fertilizer or other material below the soil surface.

**Sucker**—shoot arising from the roots. Contrast with watersprout.

**Sunburn**—injury to bark and cambium caused by a combination of excessive light and heat and insufficient soil moisture.

**Sunscald** injury - to bark tissues on the trunk and branches caused by rapid changes in temperature, especially on warm days and cool nights in winter.

**Surface application**—placement of fertilizer or other material on the ground surface. Broadcast.

Surface water—water that sits or flows above the earth, including lakes, oceans, rivers, and streams. Contrast with groundwater.

**Symbiosis (symbiotic)** - association of two different types of living organisms that is often, but not always, beneficial to each.

**Symptom**—plant reaction to a disease or disorder (e.g., wilting, dieback). Contrast with sign.

**Systemic** - (1) substance that moves throughout an organism after it is absorbed. (2) any condition, disease, disorder, or pest that affects the entire organism.

**Tannins**—organic substances produced by trees. Believed to be involved in a tree

**Tap root**—central, vertical root growing directly below the main stem or trunk that may or may not persist into plant maturity.

**Taper**—change in diameter over the length of trunks, branches, and roots.

**Target**—(1) person, object, or structure that could be harmed (damaged or injured) by a tree or tree part in the event of failure. (2) location of target pruning.

**Target (or natural) pruning** - process of branch removal to achieve a specified goal in which the pruning cuts are made at nodes and in relation to the positions of the branch collar and branch bark ridge.

**Target canker**—type of perennial canker that gains its name from the appearance caused by concentric rings, each of which represents a year

**Taxonomic group**—any of several hierarchic levels in the classification of living organisms.

**Taxonomy**—science that studies the description, denomination, and classification of living organisms based on their similarities and differences. Contrast with anatomy, morphology, and physiology.

**Temporary branches**—in structural pruning of young trees, branches (generally the lower branches) that are left in place or subordinated but will be removed later in forming the permanent scaffold framework of a tree. Contrast with permanent branches.

**Tension**—in mechanics, the action of forces to stretch or pull apart any material or substance. Contrast with compression.

**Tension stress**—stretching force put on a tree limb. Can pose a potential hazard.

**Tension wood**—in broadleaved trees, reaction wood that forms on the upper side of branches or the trunks of leaning trees. Contrast with compression wood.

**Thinning** in pruning— the selective removal of live branches to provide light or air penetration through the tree or to lighten the weight of the remaining branches.

**Thresholds**—(1) in Integrated Pest Management, pest-population levels requiring action. (2) in hazard assessment, risk assessment, and risk management, levels or risk requiring action.

**Topping**—inappropriate pruning technique to reduce tree size. Cutting back a tree to a predetermined crown limit, often at internodes.

**Topping cut**—hinge cut used when removing the top from a tree in the tree removal process.

**Topsoil**—surface layer of soil that may be rich in nutrients from decaying plants and bacterial material, often removed when lots are graded in preparation for construction or development.

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

**Transpiration**—water vapor loss through the stomata of leaves.

**Transplant shock**—plant stress following transplant; characterized by reduced growth, wilting, dropping foliage, or death.

**Transplanting**—moving a plant to a new location.

**Tree**—woody perennial usually having one dominant trunk and a mature height greater than 5 meters (16 feet).

**Tree growth regulator (TGR)** - chemical that can be applied to trees that slows terminal growth by reducing cell elongation.

**Tree island**—enclosed planting bed surrounding a tree, often within a paved area or adjacent to a street.

**Tree protection zone (TPZ)** - defined area within which certain activities are prohibited or restricted to prevent or minimize potential injury to designated trees, especially during construction or development.

**Tree protection zone barrier (TPZB)** - various devices, including fencing, berms, or signs, installed to limit access to tree protection zones (or similarly designated areas) during construction, development, or site disturbance.

**Tree shelter**—tube placed around a tree seedling for protection and growth enhancement.

**Tree spade**—mechanical equipment to dig, transport, and replant trees with a sufficiently large volume of roots and soil.

**Tree value**—(1) appraised, monetary value placed on a tree. (2) non-monetary benefit(s) of a tree.

**Tree well** — wall constructed around a tree to protect the trunk by maintaining the original grade between the trunk and the wall when the grade is raised by filling outside and behind the wall.

**Tree wrap**—material used to wrap the trunks of newly planted or transplanted trees or to protect thin-barked mature trees when they are newly exposed to the sun. See sunburn.

**Trenching**—linear, open excavation, often used to install utilities or structural footings. Can cause tree root damage. Contrast with horizontal boring, tunneling, and radial trenching

**Trunk flare**—transition zone from trunk to roots where the trunk expands into the buttress or structural roots. Root flare.

**Trunk formula method (TFM)** - method to appraise the monetary value of trees considered too large to be replaced with nursery or field-grown stock. Based on developing a representative unit cost for replacement with the same or a comparable species of the same size and in the same place, subject to depreciation for various factors. Contrast with replacement cost method.

**Trunk injection**—technique to introduce substances directly into the xylem of a tree to treat or prevent diseases, disorders, or pest problems.

**Tunneling**—digging, often with special machinery and shoring or other supports, below the surface of the ground without an open trench. Alternative for installation of underground utilities that avoids cutting of tree roots or damage to hardscape or existing utilities. Contrast with horizontal boring, trenching, and tunneling.

**Twig**—small, woody branch, stem, or shoot.

**Undercut**—cut on the underside of a branch or stem being removed to prevent unwanted tearing as the part being removed falls.

**Urban forestry**—management of naturally occurring and planted trees and associated plants in urban areas

**Utility**—(1) an entity in the public (government) or private (company) sector that provides services including communications such as telephone, data, and CATV; electrical generation, transmission, and distribution; flood control; gas, steam, or other energy transmission and distribution; sewage collection, transmission, and treatment; transportation, including railroads; and water collection or pumping, treatment, and distribution. (2) the facilities associated with any particular utility. (3) an economic concept considered in the appraisal of monetary value; the ability to satisfy human desires, needs, and wants; the quality of usefulness.

**Utility arboriculture**—branch or service line of arboriculture that provides services to utilities. Often requires specialized equipment and training of workers. Often subject to standards of practice

**Utility line-clearance pruning**—selective removal of vegetation, especially tree branches, that could affect electric supply lines or other utility facilities.

**Utility pruning**—pruning around or near utility facilities with the object of maintaining safe and reliable utility service.

**Vascular discoloration**—darkening of the vascular tissues of woody plants in response to disease.

**Vascular tissue**—tissue that conducts water or nutrients.

**Vector**—(1) in pathology, biotic or abiotic agent that transmits a pathogen. (2) in mechanics or rigging, quantity that has both a magnitude and a direction (e.g., force); see acceleration and velocity.

**Vegetation management** — management and control of vegetation to achieve established goals and objectives.

**Vertical mulching** — an aeration or fertilization technique. Drilling vertical holes in the soil and filling them with materials to improve aeration.

**Virus**—ultramicroscopic, infectious agent (piece of nucleic acid) that can reproduce only in living cells of other organisms. Can cause disease.

**Vista pruning**—selective pruning to enable a view from a predetermined point.

**Vitality**—overall health. Ability of a plant to deal effectively with stress.

**Watersprout**—upright, epicormic shoot arising from the trunk or branches of a plant above the root graft or soil line. Incorrectly called a sucker. Contrast with sucker.

**White rot**—fungal decay of wood in which both cellulose and lignin are broken down. Contrast with brown rot and soft rot.

**Whorled** — leaves, twigs, or branches arranged in a circle around a point on the stem. Contrast with alternate and opposite.

**Wilt**—(1) (noun) loss of turgor and subsequent drooping of leaves and young stems; a symptom. (2) (noun) infectious disease caused by a particular agent on a particular host or range of hosts. (3) (verb) to lose turgor or to wilt

**Windthrow**—tree failure due to uprooting caused by wind.

**Winter kill**—injury from cold winter temperatures.

**Wire basket**—type of metal basket used to support the root ball of a balled-and-burlapped tree or a tree dug with a tree spade.

**Witch**—plant disorder characterized by a shortening of the internodes and a proliferation of terminal shoots forming a dense, brushlike mass of twigs.

**Work plan**—predetermined, orderly means for job completion.

**Work zone**—defined area of a job site, marked with caution signs and/or cones, where potential hazards exist and safety measures are in place to avoid accidents.

**Wound dressing**—compound applied to tree wounds or pruning cuts.

**Woundwood**—lignified, differentiated tissues produced on woody plants as a response to wounding. Contrast with callus.

**Xylem**—main water- and mineral-conducting (unidirectional, up only) tissue in trees and other plants. Provides structural support. Arises (inward) from the cambium and becomes wood after lignifying. Contrast with phloem.