URBAN FORESTRY

A Manual for the State Forestry Agencies in the Southern Region

Unit: Site and Tree Selection

The Urban Forestry Manual is being developed by the USDA Forest Service, Southern Region and Southern Research Station, and the Southern Group of State Foresters as an educational tool for State forestry agency employees and others who work with communities on urban forestry. It can be used for self-guided learning, finding specific information on a topic and developing workshops and presentations. There are 16 units (chapters) in the Manual - at this time 9 units are on the web site (www.urbanforestrysouth.usda.gov). The other units will be added as they become available.

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Using this Manual

The Urban Forestry Manual provides the scientific, technical, and practical information needed to work with communities on urban forestry. There are 16 units (listed below) that address specific topics in the practice of urban forestry. These units have been developed as a series, each building upon the information in previous ones. The units may also be used individually to gain information about a specific topic.

Benefits and Costs of the Urban Forest is the first unit in the Urban Forestry Manual. This is an introduction to urban forestry and it explains why your work with communities and individuals in urban forestry is important. This unit also includes information about how to maximize the benefits and minimize the costs related to the urban forest.

The Role of the State Forestry Agency in Urban Forestry is an introduction to State forestry agencies' responsibilities and activities in urban forestry. It explains why partnerships are important to State forestry agencies activities in urban forestry. This unit also discusses the importance of working with communities and individuals.

Tree Biology is an introduction to how trees grow and live. It describes how trees are structured, how they function, and how they grow and develop. It also explains how the urban environment influences tree growth and development.

Dendrology is an introduction to identifying and understanding trees in the urban environment. It explains the classification of trees, naming trees and tree identification. This unit also includes information on how characteristics of the urban environment influence tree identification.

Urban Soils is an introduction to the role that soils play in the health of the urban forest. It explains what soil characteristics are important for healthy tree growth. This unit also includes information about common soil problems in urban areas.

Site and Tree Selection provides information on how to select a site and species to maximize the benefits and minimize the costs related to urban forestry. It explains what factors you need to consider when selecting a planting site, tree species, and tree stock. This unit also discusses how to match these factors to ensure healthy tree growth and development.

Tree Planting is a unit that will introduces factors to consider and techniques to implement when planting trees. It includes recommended guidelines for planting and post-planting. It also explains how to work with communities and individuals to successfully plant trees.

Tree Maintenance is an introduction to the importance of providing regular maintenance to the urban forest. The basic steps to preventative maintenance are discussed, such as fertilization, mulching, pruning and tree protection.

Tree Diagnosis and Treatment provides an introduction on how to diagnosis and treat tree health problems. This unit explains how your knowledge and application of diagnosis and treatment can improve the health of the urban forest. It also includes information on why it is important to prevent tree health problems.

Trees and Construction is an introduction to the relationship between construction activities and trees. It explains the importance of communication during the construction process. The focus is on the impact of construction activities on trees, the protection of trees during construction, and care for the tree before and after construction.

Hazard Trees is an introduction to the importance of recognizing a hazard tree. It gives a general overview on evaluating a target, site conditions and the tree. This unit also includes information on how to prevent and manage hazard trees.

Urban Wildlife is an introduction to the relationship between wildlife and the urban environment. It first defines urban wildlife and describes the needs of wildlife, such as food, water, cover and living space. Then it discusses wildlife habitat in urban areas and how wildlife adapts to urban habitat. It also includes information on how to encourage and discourage wildlife.

Urban Ecosystems is an introduction to the role that trees play within an urban ecosystem. It first defines an ecosystem and why it is important to understand ecosystems. Then is discusses ecological concepts, such as structure and function, that are important to understanding ecosystems. This unit also includes information on understanding challenges in the urban forest ecosystem.

Urban Forestry Planning and Management is an introduction to the importance of planning and managing the urban forest. It starts with a definition of an urban forest management plan and why they are important. Then it discusses the steps involved in developing a management plan. It also includes information on the different components in a management plan.

Urban Forestry and Public Policy is an introduction to understanding public policy and how it relates to urban forestry. It first describes the role that each level of government has in setting public policy related to urban forestry. Next it provides information on local government in more detail because this is where most urban forestry policy is created and implemented. The role that Tree Boards have with local government is also discussed. The final section reviews public policy tools that can be used to address urban forestry issues in a community.

Working with the Public is an introduction on how to effectively work with the public. It starts with tips on how to work together as a team and how to work with volunteers. Then it discusses the role of communication and education in working with the public. The unit also includes information on the importance of leadership in urban forestry.

Using Each Unit

Each unit in the Urban Forestry Manual is organized as follows:

Table of Contents
Lists major topics that are included in the unit.

Unit Overview
Presents goals and objectives for the unit.

Before You Begin
Consider how your current activities and experiences relate to this topic.

Content
Presents specific material about this subject under several headings.

Next?
Think about how you can use the information in your daily responsibilities and in developing your career in forestry.

For More Information
Lists other sources of information about this subject, as well as the literature cited in the unit.

Appendix
Some units have an appendix that may include checklists or other information.

In addition, each unit has two sections that will help you assess your learning of the information.

Checking Your Understanding
At the end of major sections in the unit, there are short-answer questions about the information you have read. After you have written the answers, you may compare your responses to the answers provided at the end of each unit.

Case Study
These are stories based on the real experiences. The questions at the end of the case study challenge you to use the information you learned to solve a problem similar to what you will be facing when working. You will be asked to analyze an actual urban forestry problem and prepare your solutions. There are no right or wrong answers -- only what you decide is the best course of action after considering all of the information.

Site and Tree Selection

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Overview

Guidelines for selecting the right planting site and tree are the focus of this unit. First, the reasons for planting a tree are discussed. Second, important factors to consider when selecting a planting site and some common types of urban planting sites are covered. Third, information is provided that will help in selecting the right tree for the site, which includes factors to consider when selecting a species and tree stock. This unit emphasizes the importance of planning when selecting a site and tree to avoid mistakes and future costs. It will also help you communicate more effectively with people in your community about selecting planting sites and finding the best types of trees for those sites.

Starlington Oaks

A Tale of Trees, Birds, and Downtown Streets
The residents of a small southern city were delighted by the Darlington oaks planted by the city's landscape department -- until a nearby group of starlings found them equally attractive. The trees protected the birds from predators and provided large amounts of roosting space. Since starlings form massive flocks during the winter, it was just what they needed.

After the starlings discovered the oaks, they descended on them each evening, to the human residents' dismay. Flocks of more than a hundred thousand birds created an unpleasant sound; in addition, the streets, sidewalks, and benches were covered with droppings.

Angry residents and business owners demanded action, and the landscape department tried to comply. Their attempts to drive the birds off included loud noises, explosives, and even water cannons. None of these efforts worked, although they all drew extensive media coverage that grew increasingly negative.

After three years, the oaks were pruned almost to stumps in an effort to make them less attractive to the birds. It worked; but the trees were no longer as attractive to the residents either.

We first knew you a feeble plant which wanted a little earth whereon to grow. We gave it to you; and afterward, when we could have trod you under our feet, we watered and protected you; and now you have grown to be a mighty tree, whose top reaches the clouds, and whose branches over spread the whole land.
Red Jacket (Sagoyewatha) Statement [c. 1792]

Before You Begin

This unit provides information useful in answering questions when you work with individuals or groups in the community to select a site and tree to plant. Think about how you can use this information in your work.

- What are some of the reasons trees are planted in your community?

- What are some of the common site characteristics you have found when planting trees in your area?

- What species are often recommended for planting in your community? Why are these trees often suggested?

On a separate piece of paper describe the urban forestry work you currently know about and how this work is a part of your job.

Asking the Right Questions

There are three important questions to ask before planting a tree.

- What is the purpose of the tree?
- What are the characteristics of the planting site?
- What are the characteristics of the tree?

Asking these questions before planting a tree can help insure the tree has the best chance for healthy growth, development, and survival. Planning ahead will also help to maximize the benefits while minimizing the costs associated with the tree. Some of the costs that can be minimized by proper site and tree selection include maintenance, removal, infrastructure repair, and liability.

Helping people to answer these three questions will help insure the growth of a healthy urban forest, prevent tree health problems, and minimize costs. There are a number of ways to assist communities in selecting the right tree and the right site (table 1).

Table 1. Examples of ways to provide site and tree selection assistance and potential recipients

Technical/Educational Assistance	Planning Assistance	Community Assistance
• Site selection • Tree selection • Unique planting sites • Planting requirements • Identification of healthy tree stock • Construction site evaluations • Tree inventories • Benefits and costs • Workshops and presentations	• Construction site planning • Soil management • Land-use management plans • Urban forestry management and planning • Urban wildlife management • Urban habitat management • Urban landscape programs	• Tree Boards • Individual homeowners • Business owners • Related professionals • Utility companies • Policy makers and elected officials

Why Plant a Tree?

The first question to ask when selecting a tree or group of trees for a given site is, what is the purpose of their being planted? Trees can serve various functions, and the list of "job descriptions" of trees in an urban environment is long. In some cases, their job may be to provide privacy or to screen an unpleasant site such as a landfill from public view; in other cases, people may want trees just for their shade or as adornments for their yards. Sometimes trees are used to direct pedestrian or automobile traffic. Communities may want trees to help prevent erosion, reduce storm-water runoff, and improve air and water quality. Some (but not all) functions of urban trees are listed below. At the end of this unit there is a *Tree Function Checklist* that can be copied and used as needed.

- Provide shade
- Provide seasonal color, flowers, and fruit
- Serve as a landscape accent
- Increase property values
- Decrease energy costs
- Improve air quality
- Reduce storm-water runoff
- Decrease soil erosion
- Improve water quality
- Create wildlife habitat
- Increase plant diversity
- Reduce wind speed
- Increase community pride
- Increase recreational opportunities
- Improve health and well-being
- Reduce noise levels
- Reduce glare
- Create buffer zones
- Provide screening
- Provide privacy
- Assist with pedestrian and traffic flow
- Enhance architecture design

Refer to the "Benefits and Costs of the Urban Forests" unit for more information on benefits of trees.

What are the Site Factors?

Knowing the characteristics of the planting site will help you determine whether the site will support healthy tree growth and development. The *Site Factors Checklist*, at the end of this unit, may be useful when evaluating site conditions. Some of the important site conditions to consider include:

- Soil characteristics
- Environmental conditions
- Planting space
- Site location
- Existing vegetation
- Land ownership and regulations
- Social influences
- Maintenance requirements

Numerous problems can be prevented just by checking the site conditions before selecting a species and planting.

Soil Characteristics

Soil conditions are among the most critical site considerations for tree growth and survival. The *Urban Soils* unit describes how to identify and test soil and ways to prevent and solve soil problems at a planting site. Specific problems can be identified by having soil tested at a laboratory. Some of the soil characteristics to consider when selecting a site are:

Soil texture

Soil texture influences soil fertility and the way air and water move through the soil. Find out the soil texture at the site.

- Heavy clay soil typically has poor aeration and drainage but high fertility.
- Sandy soil typically has good aeration and drainage, but poor water retention and fertility.
- Loamy soil typically has good aeration, drainage, water retention, and fertility.

Soil interfaces are abrupt changes in the texture that interrupt the normal movement of water in the soil. These changes can be caused by a variety of activities, such as erosion, mudslides, and the addition of fill soil, bricks and concrete.

Soil compaction

Because compacted soils are a major cause of tree decline in urban areas, this factor needs to be checked. Are there signs of compacted soil, such as hardness, standing water,

or poor plant growth? If the soil is compacted the site may have poor soil structure, aeration, and drainage. A bulk-density test of the soil reveals the amount of compaction.

Construction activities can cause soil compaction.

Soil moisture and drainage
Soil moisture is influenced by various factors, such as soil texture and structure, precipitation patterns, hardpan, and soil interfaces. Poorly timed irrigation systems can also cause soil moisture problems.

- High soil moisture and drainage problems
  A simple way to test for drainage and compaction problems is to dig a 12 x 12-inch hole and fill it with water. If all the water drains away in one hour, drainage is good. If the water takes several hours to drain, drainage is fair. If water is in the hole for more than one day, drainage is poor or there is a high water table (Gilman 1997).
- Low soil moisture
  Causes of low soil moisture include high temperature, drought, or high salt content in the soil.

Soil nutrients, fertility, and pH
Since leaves and other tree litter are usually raked and not left on the ground to decompose, the soil may lack necessary nutrients and fertility may be low. Construction activities, such as removal of topsoil and cement wash out areas (where cement trucks wash their shoots with water), may also alter soil nutrient availability. Sometimes soil color is a clue to nutrient levels in soil. It is usually a good idea to send a soil sample to a laboratory to test the pH and nutrient levels.

Soil temperature
The temperature of the soil influences root growth by controlling the rate of chemical and biological processes. Temperature extremes can freeze or dry out roots. If the site is in a paved area, such as a parking lot, or is a container, soil temperatures may be higher than normal. Adding mulch to the planting area is one way to help maintain adequate soil temperature.

Soil contamination
Soil contamination may kill the roots. Does it look as if the soil has been contaminated by construction activities, chemical spills, excessive use of herbicides, or other disturbance? An unusual soil color or odd smell may indicate chemical contamination at the site.

Salt
Salt greatly influences tree physiology because it binds with important nutrients the tree needs, thus prohibiting the tree from absorbing those nutrients. Salt also absorbs water in the soil that the tree needs. Is the site located near the coast or near roads that are salted to melt snow and ice? Selecting a species tolerant to salt is usually recommended for these sites.

Environmental Conditions

To ensure the tree will grow and develop to maturity, it is essential to evaluate the environmental conditions at the site.

Light patterns
Consider the amount of sunlight, shade, and artificial light at the site, including the duration and directness of sunlight. How often is the tree in full sunlight or shade? Are there buildings or other trees shading the site? Are there artificial lights shining on the tree all night? Is there reflective light from buildings, streets and other structures? Light patterns can even change the dormancy and growth patterns of a tree. Visiting the site at different times of the day and season will help determine the light patterns and help in choosing a species appropriate to those conditions.

Buildings can shade trees.

Temperature extremes
It is important to know if a species can survive the temperature extremes at the planting site. The average minimum temperature can be determined from hardiness zone maps. Urban areas are usually warmer than rural ones because of the "heat island" effect, but

site-specific factors can cause even greater extremes. For example, trees planted next to a black asphalt road will have much hotter conditions and will probably need more water than those planted in the middle of a park or yard. Some sites are subject to early and late frost, such as ridgetops, large open spaces, low areas, and frost pockets.

Contact the Cooperative Extension Service or your local nursery for more information on hardiness zones.

Precipitation patterns
Precipitation patterns directly influence site conditions. How much rainfall does the site typically receive? When are the dry months? Is there a history of long periods of rain that can waterlog the soil? Snow and ice increases the weight on the branches and may break branches and cause other injuries. Select a species adapted to the precipitation patterns at the site.

Wind patterns
Strong winds may blow down trees and snap trunks and limbs. Constant winds increase the trees' need for water because of increased transpiration. Buildings in downtown areas can create a wind-tunnel effect and increase the wind speed in those locations. Are wind storms, tornadoes, or hurricanes common in the area? Sites exposed to strong winds should have adequate soil volume for good root development, and the tree species should have a structure and branch attachment that can tolerate windy conditions.

Refer to the "Tree Biology" unit for more information on branch attachment.

Air quality
Air quality problems vary depending on the location of the site, the size of the urban area, the kind of local industry, and the climate and weather patterns. Air pollution may damage foliage and impair photosynthesis. Is the planting site near a major road with large quantities of exhaust fumes? If major industrial polluters are located nearby, what are the chemical components of the pollutants? Some species can better tolerate specific pollutants than others. Is there anything about the local climate that contributes to or reduces air pollution, such as an inversion layer or constant winds?

Contact the U. S. Environmental Protection Agency for information on air pollution in your area.

Planting Space

Too often the amount of space a tree needs for growth of branches and roots is not fully considered. Imagine what the tree will look like when it matures and look for any potential problems with paved areas, structures, or utility lines. Gilman's (1997) planting

space guidelines are listed in table 2. Coder (1996b) states that the following factors need to be considered when determining size of tree planting area: current tree diameter, annual growth, tree life span, and management objectives; he also recommends a 5-step process for determining size of the tree planting area.

Refer to the publication "Tree Planting Area Size: Futuring Resource Availability and Identifying Constraints" for more information on Coder's (1996b) 5-step process.

Table 2. Planting space guidelines (adapted from Gilman 1997)

Size of planting site		Choose this size tree
Size of planting site(square feet)	Minimum width of planting site	Maximum tree size at maturity
Less than 100 sq. ft	3 to 4 feet	Small (less than 30 feet tall)
100 to 200 sq. ft	4 to 6 feet	Medium (30 to 50 feet tall)
More than 200 sq. ft	greater than 6 feet	Large (taller than 50 feet)

Site Location

The site location offers clues on potential stresses that may impact tree health and maintenance. For example, a tree located on a downtown sidewalk will probably require more maintenance than one located in a park. Sites where there is pedestrian and vehicular traffic require special attention.

Streets, sidewalks, and other paved areas

If the site is located near a street, sidewalk, bike path, or other paved area several site factors must be considered.

- Pedestrian and vehicular areas
  For any site near where pedestrians or vehicles travel, tree species selection is critical. Species with thorns or prickly foliage or soft, messy fruit should be avoided. Trees with drooping branches will require frequent pruning. For public safety, it is always important that traffic lights, signs, and intersections not be obstructed by trees. Select a species tolerant to high salt levels in the soil if the site is located near a road where de-icing salts are used. Is the site located where the tree can be damaged by vehicles?
- Conflicts with roots and pavement
  Tree roots may grow under asphalt or cement pavement, which can cause the pavement to crack and buckle. Some communities have tried using root barriers and root training to avoid root-pavement conflict. There are different types of root

barriers, from cylinders to herbicide strips that are placed in the planting site. They are designed to physically deflect the roots away from the pavement. In some cases they do prevent root growth near sidewalks, but they may also limit tree growth. Root training is an option that uses chemical and physical barriers, deep fertilization, and irrigation or aeration structures to improve the soil conditions in the deeper soil horizons. If the barriers are successful, the roots will grow deeper, avoiding surface problems such as cracked sidewalks.

Sometimes there are conflicts with tree roots and pavement.

Structures

Trees need to be far enough away from buildings to allow for proper crown and root development (Gilman 1997). Trees that grow large, such as oaks, should be planted at least 15 feet from a building. Small and medium-sized trees may be planted closer to the building, but regular pruning may be required (Gilman 1997).

Utility lines

Utility lines for water, sewer, phone, electric, or cable may cause problems for trees. When selecting a site check for underground or above-ground lines that might interfere with the future growth of the tree.

- Above-ground utility lines
  If the site has above-ground utility lines, select a small species that will top out at least 5 feet below the wire, or select a species with a narrow crown and place it so it will not grow into the utility line (Gilman 1994).
- Below-ground utility lines
  The planting site should be located at least 12 feet from a major underground utility line for large trees (Gilman 1994). A common misconception about tree roots is that they actively grow into sewer and water lines. Roots will follow a path of least resistance and only grow into sewer and water lines that are broken.

Contact the local utility company to find out how to have all underground utility lines marked on the site.

Site activities
The type of activities, past, current, and future, on the site can help determine if this is a good planting site. Has construction occurred on the site that may have changed soil conditions? How many people or vehicles use the area around the site? Are there safety concerns, such as personal welfare or property damage? Does the tree need to be protected from compaction, vandalism, and injuries? Find out if there are any legal restrictions on how the property is used.

This type of information can usually be determined by visiting the site and talking with people who are familiar with it. The owner of the site or the local planning department are good resources for finding out about future plans.

Someone who is familiar with the site is a great resource for collecting site history.

Existing Vegetation
The existing vegetation at a site may reveal the current condition of the site. Is the vegetation healthy? How many different species are there? Could some of the species compete with each other? Are there any signs of insect and disease problems? Is there evidence of pesticide or herbicide applications? If the roots of the existing trees are visible above ground, expect the soil to be compacted or eroded. Existing natural vegetation also suggests species suitability, especially if native plants are being considered for planting.

Land Ownership and Regulations
It is always important to find out if the site is located on public or private property. For both private and public locations it is critical to find out the relevant zoning ordinances and other laws and policies that apply to the site. Some local tree ordinances may prohibit planting certain species of trees because they encourage exotic pests or are a nuisance to the people around them.

Find out what regulations a community has related to site and tree selection.

Social Influences
People's perceptions and feelings about trees must be taken into account when selecting a site and species. In some cases factors that influence public opinion have a historical basis; in other cases they may develop through an effort to promote civic pride or economic development. Communities may prefer a particular tree or be averse to another

one because of the color of the flower or local tradition. Social influences to consider include culture, history, local identity, and safety issues. Local tree boards, garden clubs, civic clubs, and other organizations are good resources for finding out about social influences in the community.

Are there any social influences related to trees in the communities that you work with?

Maintenance Requirements

Too often trees are forgotten and not maintained after being planted. A tree requires proper care, especially in the early stages of its development, to prevent health problems. Are there adequate resources to maintain the tree?

- Is there someone or an organization responsible for maintenance?
- Are there resources, such as labor and equipment, to provide for watering, mulching, pruning, fertilization, protection, and other maintenance needs? Are there strategies to protect the tree from injuries?
- What are the qualifications of the personnel maintaining the trees? Do they have the necessary training and skills?

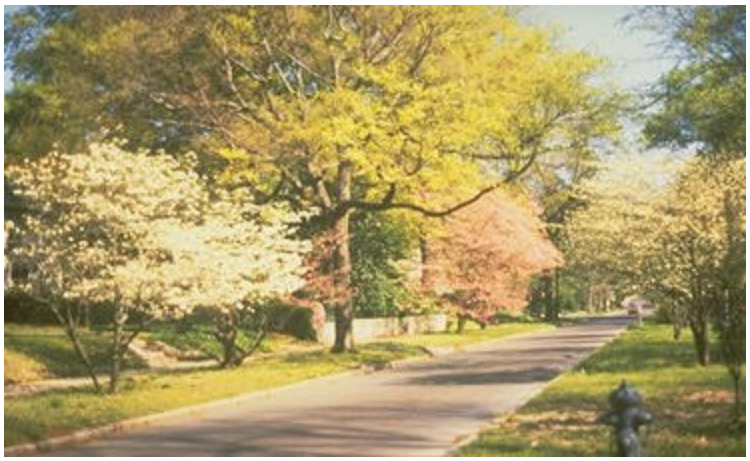
Types of Planting Sites

Several types of planting sites are unique to urban areas, including street lawn, tree pit, roadway, planter, and cluster planting. These sites may require special considerations when selecting a species and choosing a proper planting technique.

There are a variety of places to plant trees, such as residential and business yards, parking lots, empty lots, highway medians, parks, and courtyards between buildings.

Street Lawn

The street lawn, also known as the tree lawn, is the space between the curb and the sidewalk. Depending upon on the mature size of the planted tree, the street lawn should be at least 3 feet wide. If there is a choice, a street lawn is preferred to a tree pit because the street lawn has a continuous strip of soil. Do some checking before planting in a street lawn because of the potential conflicts with pavement, utilities, and local highway department guidelines.



Street lawns are one option for planting public trees.

Tree or Planting Pit

Tree or planting pits are small areas of soil within a sidewalk, parking lot, or other paved area. They are common in urban areas because often this is the only space available for planting trees. They also offer the advantage of softening the hardscape in urban areas. Trees planted in tree pits usually require special attention because of the unique growing conditions at the site (table 3).

Table 3. Factors to consider when planting in a tree pit

Factors	Description
Environmental stresses	In pits, trees are exposed to various stresses, such as drought or over watering, extreme temperatures, and wind. Because of these stresses, trees in pits often have a short life span. Regular maintenance and monitoring can help lengthen the life span of these trees.
Drainage and aeration	Drainage in the tree pit is critical. Normal drainage is disrupted when the backfill in the tree pit is different texture than the existing soil, such as sand on top of clay, or the bottom of the tree pit is compacted soil or rock.
Soil volume	There needs to be enough soil in the tree pit to support the growth of the tree. The volume of soil needed depends on the size of the tree. For trees up to 4 1/2 inches in diameter the tree pit is usually 3 feet deep. The pit should be at least 3 feet wide for a small tree and 6 feet wide for a large tree. If the pit does not have enough soil for the size of tree, the pit should be enlarged if possible by interconnecting tree pits or using adjacent lawn space or storm drain inlets. The larger the tree pit, the less chance there will be for tree root problems and better the chance for successful establishment of the tree.
Maintenance	Trees planted in pits require regular maintenance and monitoring because of the site peculiar conditions. Placing a cover or grate over the tree pit protects the soil from compaction.
Root control	Various root-control techniques may need to be used, such as root training or installing root barriers.
Hazards	Some of the hazards associated with tree pits include tree failure and reduced sight distance.

Tree pits are sometimes the only places available for planting trees in downtown and commerical areas.

Roadway

Tree plantings in the median and on the sides of the roads provide many benefits such as intercepting dust and particulate matter; reducing glare, noise, wind, and erosion; visually separating opposite lanes of traffic; and reducing mowing costs. However, trees near roadways can be damaged by vehicles, lawnmowers, string trimmers, herbicides, and de-icing salts.

Knowing the soil conditions near a roadway is essential to selecting a site. Drainage problems are common because the sites usually have disturbed soil that has been placed on top of compacted soil. It is also common to find construction rubble from road projects in the soil. Planning helps to avoid future problems with the trees and the pavement.

The State department of transportation usually has specific guidelines for plantings near roadways, such as species selection, planting distance from pavement, and distance between trees. It is important to work with them, especially during the planning phase.

Planter

Planters or containers are an option for sites where it is impossible to plant because of poor soil, lack of soil, underground utilities, or other factors. Planters can also be used for architectural design purposes. Tree planters come in various shapes and sizes and are made of plastic, wood, cement, or other composite materials. They should have thick walls, be light color, and be at least 18 inches deep with an adequate drainage hole. Factors to consider when using a planter are listed in table 4.

Table 4. Factors to consider when using a planter

Factors	Description
High maintenance requirements	Trees in planters need to be monitored frequently. Water requirements in the summer are critical. A container tree can die if it is not watered every one or two days.
Poor drainage	Drainage can be a problem. Water movement is limited in containerized soils, which can cause water logging. There can also be a buildup of fertilizer salts because there is limited leaching of dissolved nutrients from the soil.
Limited root space	Most containers do not provide enough room for adequate root development so selecting the proper size container for the species is important.
Temperature sensitivity	During cold weather the roots may freeze, or the container may crack and break. This is usually not a problem if the container is insulated or in warmer climates.
Short life span	Due to these stresses and limited growth space, trees in containers typically have a short life span.

Tree planters are one way to incorporate trees into areas that are difficult to landscape.

Cluster Planting

Cluster plantings, clumping, open-space planting, and urban tree islands are different names for planting groups of trees in a large space. In some areas this may be a better option than planting small trees in tree pits. Cluster plantings provide many benefits, such as reduced maintenance costs, shelter from weather extremes, and increased life spans for the trees. However, since the trees are located close together, insects and disease can move quickly from tree to tree. Overcrowding may also become a problem. Proper species selection is critical to avoid these problems.

Checking Your Understanding of Site Factors

On a separate sheet of paper, briefly answer each of the following questions:

1.What are the three main questions that need to be asked before selecting a site and tree for planting?

2.Soil is one of the most important factors to consider in selecting a planting site. What soil conditions should you take into account when selecting a species for a particular site?

3.What are some of the other factors, that need to be considered when selecting a planting site in an urban location?

4.What are three types of planting sites discussed in this unit? What are the most common problems associated with each?

Answers are at the end of the unit.

What Is the Right Tree?

Another question to ask before planting a tree is what tree will best satisfy the reasons for planting it and be suitable for the location where it is being planted. Trees vary greatly in the purposes they can fulfill and in their tolerance to the different conditions found at any one site. To select the right tree for the right site, both tree species and type of tree stock need to be considered.

Selecting a Tree Species

Trees may experience different types of stress and respond to stress in different ways (Coder 1996a). Some tree species can tolerate stress, such as poor soils and adverse environmental conditions, better than other species. Many of the same questions asked about the site also need to be asked about the species of tree. The *Selecting a Species Checklist* at the end of the unit can be used as a reference tool.

Future costs, such as pruning, insect and disease control, and repairing infrastructure damage, should be considered in selecting a tree.

Growth Factors

Several factors related to growth should to be considered when selecting a species.

Mature size and form

The mature size and form of the tree crown and root system are important because of potential interference with utility lines, pavement, structures, and signs. For example, it would be best to select a small or medium-size tree for a site located under a utility line.

Plant keys, listed in the "Dendrology" unit, can be used to determine mature tree size and form.

Growth rate

The reason for planting a tree may make the growth rate important in selecting the species. A fast growth is important for trees planted for shade or screening. However, some fast-growing species have weak wood and are prone to breakage. This makes the tree susceptible to storm damage and other hazards. Growth rate may affect how well the species compartmentalizes injuries.

Branching pattern

Alternate branching patterns are strongest and, therefore, preferable (figure 1). Some species grow this way naturally, and others can be trained to do this with early pruning.

The branching pattern is important when selecting at tree for a site that is subject to strong winds and storms.

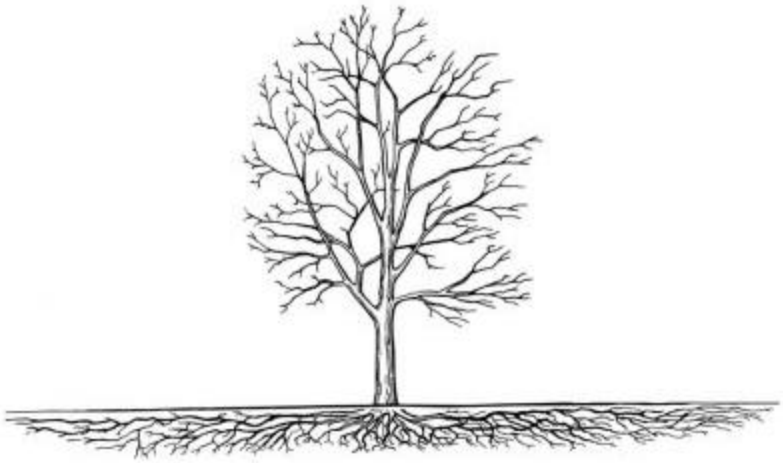


Figure 1. Alternative branching patterns are the strongest. (Illustration by Gene Wright)

Leaves
Most hardwoods are without leaves in the winter while evergreens have needles all year long. This is important when planting a tree to reduce energy costs for a building. There are positive and negative considerations about the leaves of different species, including fall color, thorns, or prickly foliage.

Flowers, fruits, seeds, and bark texture
Often a species is selected for the flowers, fruits, or seeds that it bears, or the texture of its bark. It is important to know the type of flower, fruit, and seed the tree produces, and how often this cycle occurs. The flowers, fruits, and seeds may be a source of beauty or food, or they may cause problems because of the litter, smell, or seeds they produce. This is especially true if the tree is near a sidewalk or road.

Soil Requirements

Each species of tree has different soil requirements but may adapt to a range of soil conditions. Some species can tolerate wet or compacted soils, while others are more drought tolerant. Species may also have different soil pH requirements and need different amounts of nutrients for healthy growth. If soil conditions are less than optimum for a specific species, it may be best to select either another site for the tree or another species for that site.

The web site "Urban Trees: Site Assessment, Selection for Stress Tolerance, Planting" is a good resource for list of tree species tolerant to different conditions.

Other Environmental Factors

Several environmental factors need to be considered when selecting a species. Future changes in the environment will also impact the growth and vitality of the trees planted.

Hardiness zone adaptation

Tree species have different tolerances to cold. Knowing the hardiness range for a species will help determine if it can survive the temperature extremes of winter at the site.

Wind and storm damage

For sites where wind and storm damage are a concern, a species with strong branch attachment and wood strength should be chosen. The species also needs a strong root system that will support it under these conditions.

Light requirements

Select a species that can tolerate the light conditions at the site (Gilman 1997).

- Sun-loving trees need at least 6 hours of direct sun.
- Partial shade or partial sun trees need 3-6 hours of sun.
- Shade-loving trees need less than 3 hours of direct sun each day or filtered sun.

Pollution tolerance

If air quality is a problem, the species should be tolerant to the type of pollutants that are in the area.

Insect and disease resistance

Insects and diseases should be considered in selecting a tree. The species selected should be resistant to those insects and diseases common in the area. Exotic species may not be tolerant to local insects and disease. Also, when planting exotic species consider the possibility of introducing insects or diseases damaging to native plants.

Fire resistance

Some species are more susceptible to fire than others. This is especially important in the urban-rural interface where homes and other structures are located near vegetation that burns easily. One option is to remove flammable vegetation and plant fire-resistant vegetation.

Maintenance Requirements

Some species of trees require more maintenance, including pruning, watering, fertilizing, and mulching, than other species. The maintenance requirements for a tree should match the resources, including time and money, available to care for the tree. Low maintenance trees may tend to live longer and stay healthy.

Types of Tree Stock

Trees are usually sold as seedlings, bare rooted, in containers, balled and in burlap (B&B), or as fabric bag stock. Trees may also be transplanted from one location to another. Factors to consider when selecting type of tree stock include site conditions and location, time of year, cost, and size of the tree. Each type of tree stock has its own advantages and disadvantages which are listed in tables 5, 6, 7, 8, 9 and 10.

Seedlings

Seedlings may be either potted or bare-root and are usually 1 to 2 years old.

Table 5. Advantages and disadvantages of using seedlings

Advantages	Disadvantages
• Light weight and easy to transport • Easy to do large scale plantings • Least transplant shock • Least expensive	• Susceptible to damage from lawn mowers, string trimmers, animals, and pedestrians • Small in size

Bare-Root Trees

Bare-root trees are grown in the field. There is no root ball because the soil is removed from the roots (figure 2). If the trees must be stored, the exposed roots should be covered with mulch or organic litter and kept moist. Bare-root trees are usually small, less than 2 inches in diameter.

Figure 2. Bare-root trees should have a well-developed root system. (Illustration by Gene Wright)

Table 6. Advantages and disadvantages of using bare-root trees

Advantages	Disadvantages
• Smaller and lighter than ball and burlap or container trees • Tend to be inexpensive • Easy to ship and transplant because they are lightweight, but roots need to be protected • No kinked, girdled, or circling roots because they are grown in the field • No soil interface problems because the roots are bare	• Sensitive to changes in temperature, especially freezing • Roots should be kept moist at all times • Many of the fine roots are damaged • Should only be planted in the spring or fall

Container-Grown Trees

Container-grown trees are usually grown above ground in a container filled with lightweight, artificial soil or planting mix. Since the soil in the container is different from the planting site, root development may be restricted to the original dimensions of the container once the tree is planted. Another common problem with container- grown trees is circling, girdling, and matted roots (figure 3).

- Circling roots occur around the edge of the rootball inside the container. Trees grown in containers with vertical side ribs or copper-treated insides may have fewer problems with circling roots.
- Girdling roots are easily spotted at the top of the root crown where they ring and cover smaller roots. As they grow around the tree stem and other roots, these roots restrict water and nutrient movement in the trees. They can also cause the tree to be poorly anchored in the soil.
- Matted roots are small fibrous roots that form a dense web-like mass around the rootball, which may limit root growth.

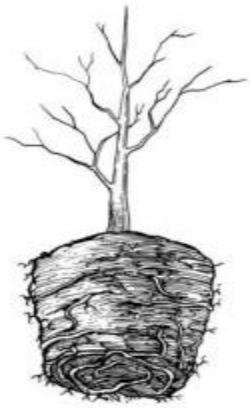


Figure 3. Container-grown trees may have circling, girdling or matted roots. (Illustration by Gene Wright)

Table 7. Advantages and disadvantages of using container-grown trees

Advantages	Disadvantages
• Can be transplanted any time of year • Easier to handle than ball and burlap trees because they are lightweight • Can be stored if watered frequently and protected from extreme temperatures and exposure • No root loss due to digging during transplanting • Larger than seedlings and bare-root trees	• Often have circling, girdling, and matted roots. • Need to be watered frequently. The small container sizes and type of soil used in the container often cause the soils to dry out.

Ball and Burlap (B&B) Trees

Ball and burlap trees are grown in the field at the nursery. When removed from the field, they are dug out with soil remaining around a portion of the roots. This root ball is then wrapped in a natural fabric, such as burlap, or synthetic material, and placed in a wire basket or wrapped in string (figure 4). Should be planted in the spring or fall.

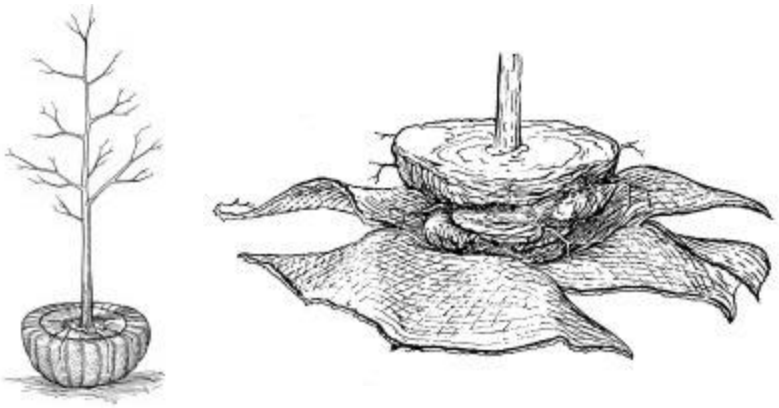


Figure 4. Wrappings and wire baskets must be removed from ball and burlap trees to avoid root development problems. (Illustration by Gene Wright)

Table 8. Advantages and disadvantages of using ball and burlap trees

Advantages	Disadvantages
• Better chance of survival than bare-root trees • Usually larger than bare-root trees	• Root loss when tree removed from nursery • Fabric and basket may be difficult to remove • May be difficult to handle due to weight of the root ball • If soil in the root ball is different from the planting site, soil drainage problems may develop.

Fabric Bag Trees

Trees are grown in the nursery, below-ground, in a non-biodegradable bag that is supposed to promote fibrous root growth.

Table 9. Advantages and disadvantages of using fabric bags

Advantages	Disadvantages
• Reduced loss of roots at the nursery • A more fibrous root system • A smaller root ball may make them easier to handle than container or B&B stock • Circling roots are not as common as in container trees.	• May require staking if crowded growing conditions in the nursery weakened the trunk. • Difficult to remove the fabric bag

Transplanted Trees

There are times when trees need to be transplanted from one location to another, for example mature trees that need to be relocated.

Table 10. Advantages and disadvantages of transplanting trees

Advantages	Disadvantages
• Option to save large trees that would be destroyed if not removed from a site • Creation of "instant" landscapes • Preservation of trees of special significance, such as historical trees	• Highest maintenance requirements of all tree stock • Expensive • High water requirements • May result in severe health problems or even loss of the tree if transplanted incorrectly or at the wrong time of year. • More than 90% of the root system may be lost in the transplanting process.

Selecting Tree Stock

Selecting a "good" tree that is healthy, attractive, and has the individual characteristics needed for the site can prevent numerous problems (figure 5). The publication, *American Standards for Nursery Stock*, by the American Association of Nurserymen, has specific information on how to select tree stock. General characteristics to consider are the tree's appearance and the source of the tree stock. Use the *Selecting Tree Stock Checklist* at the end of the unit as a reference tool.

Figure 5. Characteristics of healthy, high quality tree - good taper on trunk, well developed leader, healthy bark, good branch spacing and distribution, and healthy fibrous roots. (Illustration by Gene Wright)

General Appearance

- A healthy, well balanced crown
- No signs of insect or disease damage

Trunk, Branches, and Bark

- Straight, single trunk is best
- Trunk centered and firmly attached to rootball
- Evenly distributed branches with wide angle of branch attachment
- No severe pruning cuts, scars, swollen or sunken areas, or wounds
- No insect or disease damage, such as borer holes
- No paint on wounds or cuts
- Usually smooth bark with no cracks, splits, or sunken areas
- Bright green underneath top layer of bark

Scratch a twig with your thumbnail to check color underneath the bark.

Healthy Leaves

- Green to dark green leaf color depending on the species and season
- No insect or pesticide damage, such as bare spots or discoloration

Roots

- Healthy, white roots with evenly distributed lateral growth
- Avoid buying a tree with circling or matted roots. However, if the tree has circling roots, cut them in several places to prevent them from becoming girdling roots. For matted roots, making two or three vertical slices into the rootball with a sharp knife, or loosen the roots carefully by hand.
- Girdling roots are detrimental to the long-term health of the tree and should be avoided when buying a tree.

Source of Tree Stock

Tree stock survives best if it is planted in the same climate and soil conditions in which it was originally grown. Find out where the tree was grown when purchasing stock for planting. For example, a tree grown in a Texas nursery may not adapt well to a site in Virginia.

Checking Your Understanding of Tree Selection

On a separate sheet of paper, briefly answer the following questions.

1.What are the six growth habits of trees you need to consider when selecting a tree species for an urban location?

2.Most types of tree stock have some characteristics that inhibit maintaining a healthy root system. What are the problems you need to look for when selecting tree stock?

3.What are three characteristics of a healthy root system and three characteristics of a well-developing trunk and branch system to look for when selecting tree stock?

4.What role do people play in the selection of trees in an urban area?

Answers are at the end of the unit.

Case Study

Don't Touch that Tree!

Wes coordinates the power company's routine cycle for trimming trees on the electrical transmission circuit. His contract crews are working in an historic section of town that he knows well. The neighborhood, in which many of the people have lived for 20 or more years, has an abundance of stately, old trees. These give the area a great deal of character and charm, but Wes knows that tree interference with utility lines is the number one cause of the frequent power interruptions in the neighborhood. He also worries about children climbing trees that may be in contact with live wires.

One of Wes' crews finds a gnarled pecan tree that has grown into the overhead power lines. The crew wants to take the tree down because, even though it has been drastically pruned in the past, new suckers continue to grow into the lines. The homeowner, Mrs. Welch, sees the crew and tells them, "You're not going to touch that tree!". Wes meets with her, and explains that the upper branches of the tree are in direct contact with the power line. This hampers normal inspection and routine repair, violates both federal and state laws that require a minimum clearance for power lines, and poses a safety risk to the public. Mrs. Welch remains adamant that she does not want the tree taken down, but accepts his suggestion to have a forester from the Forestry Commission look at the tree.

Wes asks his friend Victor with the local Forestry Commission for assistance. Wes tells Victor the power company will replace the pecan tree with another tree if Mrs. Welch agrees. Victor makes an appointment with her for the following day. Not being as familiar with the neighborhood as Wes, Victor decides to drive through it this afternoon. He finds the streets lined with large shade trees that form a comforting green canopy over the streets and yards. The problem tree is one of three pecan trees in Mrs. Welch's front yard, and there are two other hardwoods as well. Well-tended flowers grow across the front of the house. He begins to understand Mrs. Welch's reaction to the suggestion of removing the tree. Now he must decide the best way to solve the problem when he meets with her tomorrow.

You and Mrs. Welch and the Pecan Tree

You are the forester that has made the appointment to talk with Mrs. Welch. On a separate page, answer the challenge questions below, telling how you will handle this situation.

- Knowing that Mrs. Welch is upset about this pecan tree, how will you approach your meeting with her?
- What is the first thing that you will do or talk about?
- What options can you present to her to solve the problem?
- What purpose does the tree serve?
- What are the important site factors you need to observe?
- What species characteristics do you need to look for in the tree that will replace this one if she agrees?

After you have answered the challenge questions, read the rest of the story to compare your solutions with what really happened.

The Rest of the Story

Decisions, Decisions

Victor knew the situation was delicate and so he wanted to approach Mrs. Welch and the tree problem carefully. Meeting the next day, he found her eager to talk about the pecan tree. She had strong emotional feelings about saving the tree. Victor knew this was not the time to discuss options and decided to listen, letting her do most of the talking. He learned she had lived in this house for 25 years. She was unhappy with past trimming practices, which she thought had caused the present problem. She hoped the tree could be saved. Victor told her the tree would live, but he thought the more important question was "would it be safe?" He stressed that as long as the tree was there it would create problems with the utility wires. He provided some brochures that illustrating potential problems, with diagrams and information about the relevant laws.

He explained there were three options. One, leave the tree and let the power company continue to trim it every few years. Second, remove it. Third, remove it and replace it with a species that would not grow into the wires. He asked her to think about these alternatives and left additional brochures on tree selection.

The following week, when Victor called Mrs. Welch, she had decided to remove the tree. He offered his help in selecting a replacement. On this visit, they spent a great deal of time in the yard talking about various alternatives for the new tree. There were several factors to consider. She wanted a tree to provide shade in the summer like the others in her yard, and to fit into the look and character of the neighborhood. The tree, of course, had to meet both the practical and legal requirements for utility lines and public safety. Being near the street might also affect the growth of a new tree. During the primary growing season the yard would have a lot of shade, although drainage did not seem to be a problem. However, Victor did suggest it would be a good idea to have the soil tested for bulk density and for nutrient content. The pecan tree had a well-developed root system that had been able to overcome any problems that had developed over the many years it had grown there. Making sure the soil was not compacted and had the right nutrients available would help a new tree become established more easily. Victor knew he needed to consider the branching pattern and eventual height of the tree. Mrs. Welch also wanted a fast-growing tree to return her front yard to normal as soon as possible. He suggested several different species for her to consider. After some more thought, Mrs. Welch agreed to have the power company remove the pecan tree and replace it with one that she and Victor had chosen.

Two Tales to Compare

- Did you decide to approach Mrs. Welch in the same way Victor had? Why or why not?
- Were the options you presented the same, or did you have others?
- Did you take the same legal, site, and species factors into consideration as Victor did?
- Did you see other factors that should have been considered?
- Do you agree with the actual outcome? Why or why not?

Next?

This unit has provided basic information about site and tree selection. Use this page to write your own action plan for putting this knowledge into practice in your job. The notes you made at the beginning of the unit may be useful in deciding some of the important points. Answering these questions can assist you in planning your own professional development.

- How will you be able to use this information about site and tree selection in your job?

- What other sources will you use to learn more about tree selection in your area?

- What have you learned that you can use to help others in your community make good decisions in selecting the sites and species to plant in your area?

- What other steps will you take to further improve your skills and how may this benefit you in your job?

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Checking Your Answers

Checking Your Answers about Site Factors

1. What are the three main questions that need to be asked before selecting a site and tree for planting?

- What will be the function or purpose of the tree?
- What site factors need to be considered?
- What tree selection factors need to be considered?

2. Soil is one of the most important factors to consider in selecting a planting site. What soil conditions should you take into account when selecting a tree for a particular site?

Soil texture, compaction, moisture, and drainage are important characteristics to consider when selecting a planting site for an urban location. The volume of soil available at a planting site is also crucial to the type of tree that is planted. Urban soils may contain contaminants and impurities from building materials, pesticides, and other sources. Testing the soil is always a good idea.

3. What are some of the other factors that need to be considered when selecting a planting site in an urban location?

- Environmental conditions, such as light patterns, temperature extremes, precipitation patterns, wind patterns, and air quality.
- Planting space
- Site location components, such as streets, sidewalks, structures, utilities, and site activities
- Existing vegetation
- Land ownership and regulations
- Social influences
- Maintenance requirements

4. What are three types of planting sites discussed in this unit? What are the most common problems associated with each?

- Street or tree lawns
- Tree or planting pit
- Roadways
- Planters
- Cluster planting

Soil conditions -- the quality and the volume of soil available for the tree's growth – often present the greatest challenge to face in urban planting. Drainage and aeration problems,

limited space for root growth, and possible soil contamination require special consideration when selecting a species for planting. Regular maintenance and monitoring will help improve the growth of trees in these urban planting sites.

Checking Your Answers for Tree Selection

1.What are the growth habits of trees you need to consider when selecting a tree species for an urban location?

The site conditions of an urban location, as well as the purpose of the tree, will influence the species that you select for planting. The growth patterns of the tree to consider include:

- Mature size and form of canopy and root system
- Rate of growth
- Branching pattern

Other characteristics of the tree, such as kind of leaves, litter from fruits and nuts, thorns, and maintenance requirements, are also selection factors.

2. Most types of tree stock have some characteristics that inhibit maintaining a healthy root system. What are the problems you need to look for when selecting tree stock?

There may be problems with the root system in most types of tree stock that you need to look for when selecting tree stock. In bare-root trees, including seedlings, many of the fine roots may be damaged or lost when the tree is removed from the ground, or they may dry out while waiting to be planted. The roots of container-grown trees may be kinked, circled, or matted, and may not have the space to develop properly. Grow-bag trees also may have circling roots. The fine roots of ball and burlap trees are better protected from drying than those of bare-root trees, but it is still possible that B&B trees may lose much of their original root system when removed from the ground. Large trees that are moved from one location to another are at the greatest risk for loss of roots when they are transplanted, often losing as much as 90% of their system.

3. What are three characteristics of a healthy root system and three characteristics of a well-developing trunk and branch system to look for when selecting tree stock?

Tree stock roots should be:

- white and firm in appearance
- evenly distributed around the trunk
- growing away from the trunk, not around or girdling the trunk.
- showing fibrous root development, but should not be dense or matted

The trunk and branches of tree stock should have:

- single, straight trunk.
- trunk firmly attached to the root ball.
- balanced growth pattern of branches around the trunk
- branches with wide angle of attachment
- no insect or disease damage
- no severe cuts or wounds in the wood
- bark that is not cracked or split.
- bright green color under the top layer of bark.

4. What role do people play in the selection of trees in an urban area?

People are the most constant factor in an urban area and a primary consideration when selecting a tree for several reasons. When they participate in the planting and caring for trees in their communities, they actively contribute to the health and survival of the urban forest. Many people view the trees in their yards and their neighborhoods as an important part of their lives. The likes and dislikes, opinions and feelings of these people are important. Communities may see trees as one way of creating an urban identity and as an economic benefit.

Appendix – Tree Function Checklist

Tree Function Checklist	
• Provides shade • Provides seasonal color, flowers, or fruit • Serves as a landscape accent • Increases property values • Decreases energy costs • Improves air quality • Reduces storm-water runoff • Decreases soil erosion • Improves water quality • Creates wildlife habitat • Increases plant diversity	• Reduces wind speed • Increases community pride • Increases recreational opportunities • Improves health and well-being • Reduces noise • Reduces glare • Creates buffer zones • Provides screening • Provides privacy • Assists with pedestrian and traffic flow • Enhances architecture design

Appendix – Site Factor Checklist

Site Factor Checklist	
Soil characteristics • Texture • Compaction • Moisture and drainage • Nutrients, soil fertility, and pH • Temperature • Contamination • Salt **Light patterns** • Sunlight • Shade • Artificial light • Reflective light **Temperature extremes** • USDA Hardiness Zones • Climatic extremes • Location factors that influence temperature extremes • Exposure **Precipitation patterns** • Amount of rainfall • Flooding • Drought • Snow, ice, or hail **Wind patterns** • Constant winds • Strong winds • Storms • Wind tunnel **Air quality** • Automobiles • Industry • Climatic variables	**Planting space** • Size of planting site • Maximum tree size at maturity • Minimum width of planting site **Site location** • Streets, sidewalks, paved areas • Structures • Utility lines • Activities **Existing vegetation** • Health • Number of species • Competition potential • Insects or disease **Land ownership and regulations** • Public or private property • Local tree or landscape ordinances • Local regulations - zoning, ordinances **Social influences** • Culture • History • Local identify • Safety issues • Vandalism **Maintenance requirements** • Responsible person or organization • Resources for maintenance and protection • Qualifications of personnel

Appendix – Selecting a Species Checklist

Selecting a Species Checklist	
Species growth factors • Mature size and form • Growth rate • Branching pattern • Leaves • Fruits, flowers, seeds, and bark texture **Species maintenance requirements** • Pruning • Watering • Fertilizing • Mulching • Leaves and litter	**Environmental factors** • Species requirements for hardiness zone and temperature extremes • Species ability to withstand wind and storm damage (branch structure and wood strength) • Species requirements for light (sun loving, partial shade or sun, or shade loving) • Species tolerance to air pollution • Species resistance to insects and disease • Species resistance to fire **Soil requirements** • Species requirements for soil conditions

Appendix – Selecting Tree Stock Checklist

Selecting Tree Stock Checklist	
General appearance • Healthy crown • Good vigor with no signs of stress, insects, or disease **Trunk and branches** • Straight, single trunk • Trunk in the center of the rootball. • Trunk firmly attached to the rootball • Branches evenly distributed, without clustering • No severe pruning cuts, scars, swollen or sunken areas • No insect damage, such as borer holes • No paint on wounds or cuts **Healthy leaves** • Leaves green to dark green, depending upon species and season • No discoloration, spots, or other damage	**Bark** • Smooth bark with no cracks, splits, or sunken areas. • Bark bright green underneath **Roots** • Healthy white roots • No circling roots • No girdling roots • No matted roots **Plant material source** • Climate and soil conditions at nursery • No internal girdling or kinked roots in root ball