

FOR FINAL REVIEW

The Knoxville-Knox County

Tree Conservation & Planting Plan

KNOXVILLE • KNOX COUNTY METROPOLITAN PLANNING COMMISSION

March 2007

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The Knoxville-Knox County

*Tree Conservation
& Planting Plan*

KNOXVILLE • KNOX COUNTY METROPOLITAN PLANNING COMMISSION

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Chapter 1:

Introduction

Trees provide significant benefits. They make our air better to breathe and the water of our streams and rivers cleaner. Trees cool a summer's day and enhance the value of property. They make neighborhoods better places to live.

These benefits are largely derived from the canopy of leaves and root systems that are created with tree growth. When trees are lost, the benefits are diminished. When forested areas are protected and planting programs are successful, the natural and economic environment is enhanced. Protecting and increasing the tree canopy is the central focus of this plan.

About 50 percent of Knox County's landscape is forested, or roughly 170,000 of the county's 337,000 acres. The Knox County Engineering and Public Works Department, working with American Forests, discovered that the rate in decline has been substantial. Their 2002 study found that 15,000 acres of moderate to heavily forested land (those areas where the canopy was 20 percent or greater) were lost between 1989 and 1999. In other words, over 4 percent of the county's significant forested area was lost. The satellite image (see Map 1: Remotely Sensed Ground Cover Classifications) provides a benchmark for how many forested and non-forested areas exist across the county. The forested ridges, mostly running from the northeast to southwest, are easy to pick out. Those are areas where the canopy is 50 percent or greater. The gray patterns, which have few trees, are highly urbanized and rapidly developing areas that include downtown and highway-oriented commercial and industrial sites.



The rural areas of the county, like this setting around House Mountain, are often heavily forested.

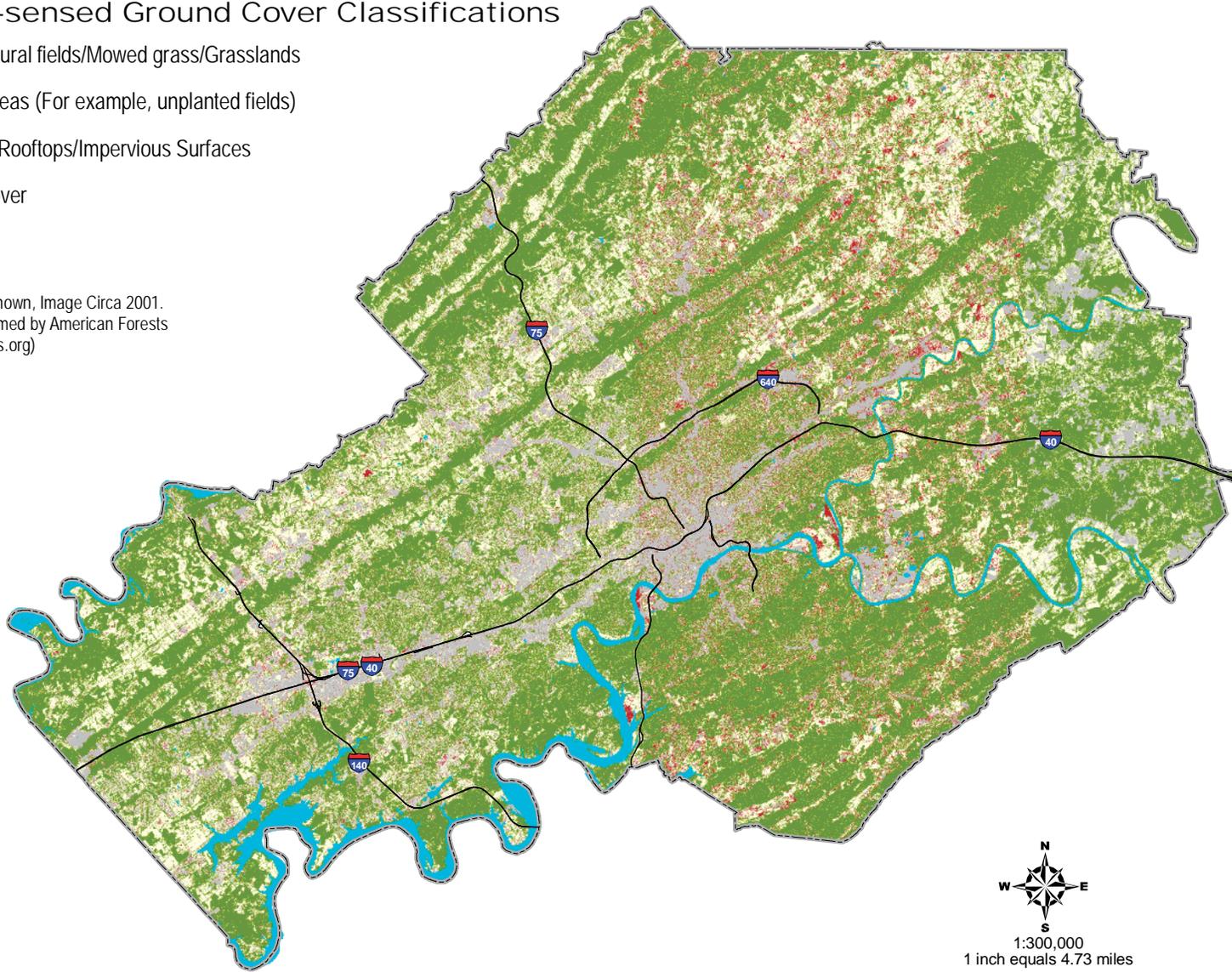
One bright spot in the American Forest study was the growth of trees in urban and agricultural areas where tree canopy increased by 9.8 percent between 1989 and 1999. This resulted in part from the city's annual tree planting programs, homeowners' desires for yard trees, and forest succession on agricultural land.

Map 1:

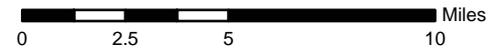
Remotely-sensed Ground Cover Classifications

-  Agricultural fields/Mowed grass/Grasslands
-  Bare areas (For example, unplanted fields)
-  Roads/Rooftops/Impervious Surfaces
-  Tree cover
-  Water

Source: Sensor Unknown, Image Circa 2001.
Classifications performed by American Forests
(www.americanforests.org)



1:300,000
1 inch equals 4.73 miles



SCOPE OF THE PLAN

This plan has been prepared to provide a framework for forest protection and to enhance the city and county landscape with tree planting programs. Specifically, the components are:

- Protection of key resources, including ridges and riparian areas
- Planting programs for specific types of development, including parking lots and buffers between residential and other land uses
- Planting programs on public grounds, particularly schools and park and library sites
- Tree conservation and landscape improvements along rural roads, local streets, cross-county arterials, and interstates
- Standards and practices for planting trees
- Programs that can be used to implement the plan

In part, this plan is a companion to Knoxville's Street Tree Master Plan, dating from 2002, in which the focus was the city's streetscape. The emphasis of this plan is geographically greater, with overall conservation and planting programs that can be used by the city or the county.



Tree planting with development, like the well-landscaped Deane Hill Centre, is another objective of this plan.



Knox County's forests play a significant role in providing better air.

BENEFITS OF TREES

Air Quality

A healthy urban forest is part of the formula in reducing air pollution. Trees remove carbon dioxide (CO₂), which is a major product of vehicle and other fossil fuel burning processes. This is important because CO₂ causes heat to build-up in our atmosphere (what many scientists refer to as the greenhouse effect). During photosynthesis, a tree transforms carbon dioxide into carbohydrates that are used in the tree's structure, while releasing oxygen back into the air. The carbon is also released as leaves fall and eventually enrich the soil. An acre of trees removes about 2.6 tons of carbon each year, or the equivalent of the carbon dioxide that is produced by an automobile driven about 26,000 miles per year.

Additionally, trees remove some particulate pollution (those less than 10 microns). Particulates result from burning fuel, with diesel being a major culprit. Particulate removal is particularly important because the

U.S. Environmental Protection Agency has found that Knox County and surrounding counties exceed particulate levels that are considered healthy. High levels of the small particulates can result in respiratory problems. Most particulates are too large to be absorbed by leaves and merely stick to them temporarily until wind or rain redistributes them. Ozone is another pollutant that is problematic in the region; high ozone levels have placed the Knox region on EPA's non-compliance list. While trees can remove ozone to some degree, they are also harmed by high concentrations of ozone. This is a concern because recent studies indicate that ozone tends to singe tree leaves, reducing their ability to remove the overabundance of CO₂ in the lower atmosphere. Maintaining existing forests and increasing the size and number of trees is a portion of the formula that can lead to better air.

Economic Well-being

Forested neighborhoods are found to be more desirable. Various studies have found that trees in neighborhoods can enhance property values by 5 to 15 percent, depending on the species and size of trees. Trees provide communities with a sense of identity. Such places as Sequoyah Hills, West Hills, Fountain City and Farragut are good local examples.



The forested parkways and trails of Fairfax County, Virginia have made its suburbs very popular places to live.

Cities with abundantly-wooded landscapes tend to attract businesses and keep residents. Their forested neighborhoods and business districts are part of their quality of life and keep them competitive in attracting new firms. Asheville, Charlotte, Raleigh, Minneapolis, Montgomery County, Maryland, and Fairfax County, Virginia have embraced tree protection and planting programs. They are good examples of places that “marry” environmental well being with economic growth.

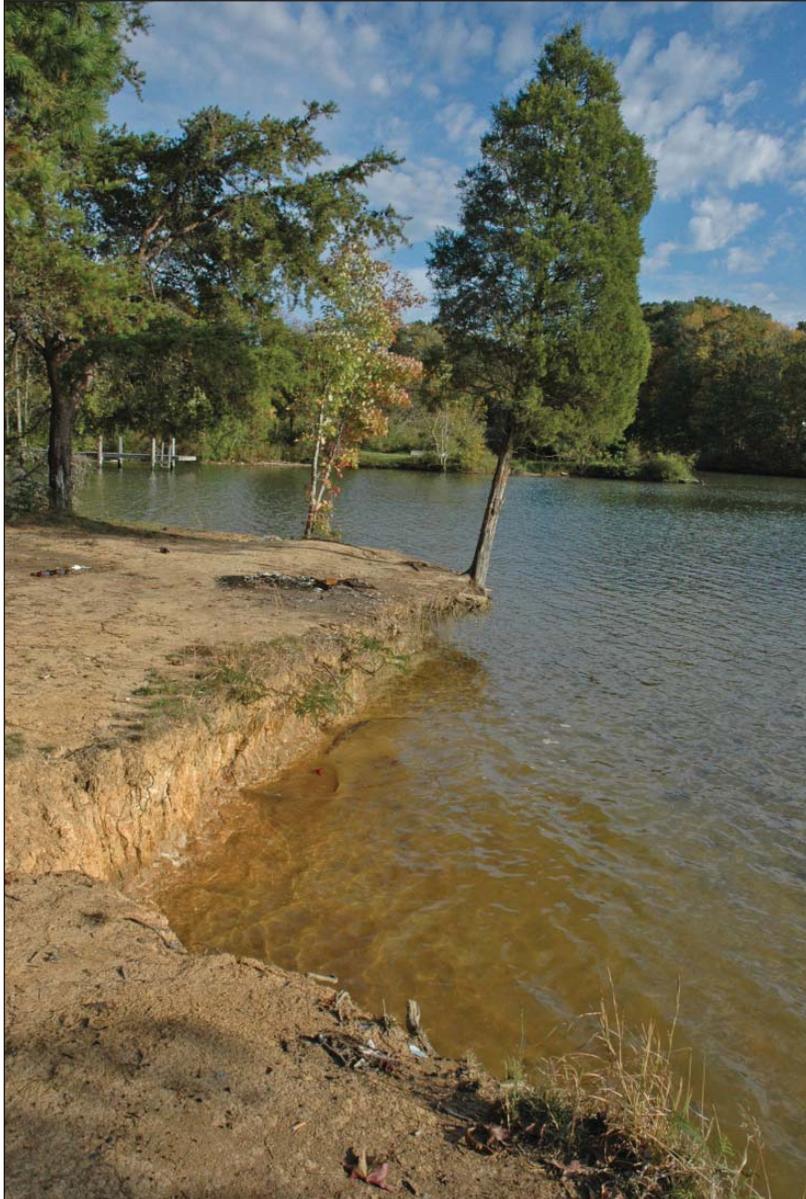
Physical and Psychological Well-being

Trees provide a beautiful sense of place. Various surveys, including those conducted in developing this plan, have shown that the vast majority of the population considers the beauty of trees to be very important. This directly relates to outdoor exercise. The number one recreation activity of Americans is walking for pleasure and health. With an aging population, the demand for sidewalks and walking paths has grown appreciably. City and county residents have expressed a desire for a setting of trees and separation from roadways as part of their walking experience.

Trees also have therapeutic values. When in or near a setting of trees, hospital patients recover from surgery faster and note less pain. Children with attention deficit disorder have been found to be able to more easily relax and learn in the solace of a wooded setting. Trees also block noise. While not as effective as sound barriers, the U.S. Department of Transportation has found that continuous rows of trees can mask highway noise by damping the sound of traffic.

Energy Conservation

Trees provide an evaporative cooling effect, lowering temperatures in cities. Areas with trees are typically 5 to 9 degrees Fahrenheit cooler than conventional strip commercial or downtown development. By lowering extreme temperatures, trees reduce the physical stress that people suffer in high heat. The savings in air conditioning costs can also be significant. The EPA and the U.S. Forest Service have shown that well-placed trees can reduce the costs associated with summer cooling by 10 to 50 percent.



Shoreline erosion increases when trees are lost, like this part of Melton Hill Lake.

Storm Water Control and Water Quality

Forested areas have the greatest capacity of any landscape to store rainfall and reduce the impacts of storm water, including flooding and erosion. In the Knox County-American Forest study, the storm water retention capacity of the county's forests was estimated to be more than 740 million cubic feet. Without the forested areas, the cost of building the infrastructure, such as storm drains and culverts, would be almost \$1.5 billion (based on construction costs estimated at two dollars per cubic foot).

Keeping natural forested systems in place has critical benefits in pollution control as well, especially sediment reduction. When rain falls on a forested area, the drops are deflected by leaves, lessening the impact of the storm on underlying soils. Ground cover and roots hold the soils in place, also reducing tendencies toward erosion. Trees and their associated ground cover near streams, rivers, and lakes also serve as a sponge, reducing the flow of pollutants such as yard and agricultural chemicals before they reach fresh water.

CITIZEN PARTICIPATION

MPC staff went to various neighborhood and community organization meetings to gather public input on tree conservation and planting issues. A survey was conducted at the meetings and through MPC's website. Over 400 responses were received. While the method was not scientific, the results indicate that a substantial portion of Knox County citizens who answered the survey support tree conservation and planting programs.

The following summary provides highlights of the survey.



Nearly all survey respondents strongly felt that trees along streams and rivers should be protected.

Over 90 percent of the respondents agreed or strongly agreed that:

- Trees that grow on ridges and hillsides should be protected
- Native trees, such as oaks, maples and dogwoods, are the most important species to plant
- Trees that grow near creeks and rivers should be protected
- More shade trees should be planted in and around parking lots
- Existing trees should be protected during development (even if costs are more)
- Trees should be planted when constructing or improving highways
- Trees inspire pride in neighborhoods and communities
- Citizens have a responsibility to protect trees and the environment

- More trees are needed to improve air and water quality
- Trees increase property values
- Trees attract visitors and businesses to the region

In looking at design issues, over 90 percent of the respondents noted:

- They feel more comfortable when walking on a sidewalk that is separated from a street with a grass strip and a row of trees than walking on a sidewalk that is next to a curb
- They disagree or strongly disagree with the statement that trees should not be planted in commercial areas because they block store signs

When asked about the need for new regulations and programs, over 90 percent of the respondents said that it is very important or important to:

- Protect mature trees in creating new residential subdivisions
- Protect or plant trees as buffers between very different land uses
- Protect or plant trees in developing commercial, office, and multifamily projects
- Create a county tree board or a city-county tree board to advise the mayors, County Commission, and City Council on tree conservation and planting

When asked if they would support public funding for the following, over 80 percent of the respondents felt that funding is needed for:

- Planting trees in public spaces such as school or library grounds, parks, and roadsides

- Hiring a college-trained professional, such as a forester, to manage tree planting and protection programs, including development plan review
- Hiring additional staff to monitor protection and planting during development

Citizens also provided insight into particular places where they felt trees should be planted. These include:

- Along the interstate system
- Shopping center parking lots
- Within rights-of-way, particularly next to sidewalks
- Specific county and Farragut-area parks: Anchor Park, Nicholas Ball Park, Maloney Road Park, Sterchi Park, and Watt Road Park
- Specific city park spaces: Caswell Park, Chilhowee Park, Cherokee Park, Christenberry Park (especially with native trees), Tyson Park, Victor Ashe Park, replacing dying trees at Lakeshore Park, James Agee Park, McCallie Park, Turkey Creek Greenway, Market Square and Krutch Park, and Sequoyah Hills Park
- Schools: Some respondents noted that almost all schools need more trees. Specifically, the following were mentioned: A.L. Lotts Elementary, Bluegrass Elementary, Brickey Elementary, Dogwood Elementary, Central High, Farragut Middle, Farragut High, Fulton High, Pleasant Ridge Elementary, Powell Middle, Sarah Moore Greene, Spring Hill Elementary, South Knoxville Elementary, West High, and West Valley Middle
- Libraries: Cedar Bluff and West Knox at Bearden
- Specific commercial areas: Rocky Hill, Broadway in Fountain City, Kingston Pike, Knoxville Center Mall, and Cumberland Avenue



West Valley Middle School is like many new schools where few trees have been planted.

Most respondents provided information on specific places where they felt trees and woodlands should be protected. These include:

- Ridges: Virtually every ridge was mentioned. Some were mentioned multiple times, including Sharp's, Beaver, Copper, and Black Oak Ridges. Also mentioned several times were the bluffs and ridges along Fort Loudoun Lake and the French Broad and Holston Rivers
- Streams and watersheds: along Fort Loudoun Lake, First, Second, Fourth, Ten Mile, Beaver, Bull Run, and Turkey Creeks
- Specific parts of the county: Bluff Point, Early Road, Keller Bend Road, Dutchtown Road, McCampbell Swamp, Alcoa Highway, and Pellissippi Parkway
- Along the interstate system

Other issues and opportunities that respondents identify as tree protection and planting issues were:

- Plant native species and provide diverse deciduous species (sourwood, sugar maple, tulip poplar, sassafras, beech, butternut, ash, deciduous magnolias, and redbud) as well as evergreens
- Remove invasive trees and plants
- Create public programs and demonstration plots
- No more Bradford pears; replace Bradfords with native trees
- Stop tree topping practices
- Improve utility trimming and cutting practices
- Develop a planting and best practices guide
- Work with neighborhood associations to plant trees
- Reforest older parts of the city and replace dying trees
- Protect rows of trees along roads
- Create and implement landscape plans as part of road improvement planning
- Improve the tree planting standards for parking lot development
- Create better tree protection ordinances

Developers noted the following issues about the cost of saving trees during site preparation and building:

- More expense and bureaucratic measures
- Potential difficulties in siting buildings to be constructed
- Limit the amount of bureaucracy by having a professional who can consult with developers and provide compromises for certain trees based on preservation objectives and economic feasibility
- Protection measures should be the same for the county as they are for the city



The vast majority of respondents want to see protection of forested areas and the wooded settings along many Knox County roads.

The citizen-based Knoxville Tree Board, which is composed of both Knoxville residents and residents of the unincorporated portions of the county, were also involved in developing some concepts in this plan. The board's planning committee worked with MPC staff in considering tree protection and planting programs that could be used by both local governments. The board also discussed the potential of expanding to become a city-county tree board, addressing conservation and planting issues county-wide.

Chapter 2:

Protecting and Enhancing Knoxville and Knox County's Forests

GUIDING PRINCIPLES

With input from citizens and the advice of urban foresters, engineers, and landscape architects, the following principles should guide forest protection and tree planting in Knoxville and Knox County:



Tree conservation was a major objective in this award-winning subdivision in Knox County's Choto area.

- Forest and tree conservation should be the first course of action in looking at the development of property, particularly given the years required for tree growth and the ongoing benefits that mature trees provide.
- A mix of native trees, both evergreen and deciduous, should be planted (including species that enhance wildlife habitat).
- A variety of species should be planted to avoid problems associated with blight and insect infestation.

- Smaller tree species should be planted under or nearly under overhead utility lines to avoid conflicts with electrical and related wires; larger trees should be planted as a backdrop, away from wires.
- Invasive trees, kudzu, privet, and other exotic vegetation that threatens the health and appearance of Knoxville-Knox County's forests should be removed and replaced with native species.
- As annual tree planting programs are developed, efforts should be balanced among different communities, schools, and parks in each section of the county.

THE NEED FOR TREE PROTECTION PROGRAMS

In creating such programs, both protection and planting are necessary. On heavily wooded sites, some tree loss is inevitable as portions of the landscape must be cleared and graded prior to development, necessitating tree planting as a recovery measure. On sites with few trees, planting should be part of site development. Tree protection measures should address conservation and planting to realize the benefits outlined in this plan, including enhancement of aesthetic, economic, and environmental values.

There are situations where tree protection and planting programs are not greatly needed, including the development of single-family lots, which account for as much as 70 percent of land use in many Knox County communities. Homeowners generally protect or plant a variety of trees. The reforestation of Sequoyah Hills and West Hills are outstanding local examples where wooded landscapes were created on what was once primarily farmland. Cutting hazardous and

invasive trees, pruning or removing trees in utility easements, and such agricultural practices as timber harvesting, tree farming and nursery operations are other activities that should be self-regulated and are not addressed in this plan.

Basic programs are needed to address clearing as a part of site design, setting aside wooded areas and specimen trees, while incorporating space for buildings, roads and parking.

Certain forested areas should be given particular attention, including hillsides, ridges, and stream corridors. In addition, materials should be available to developers on how to protect trees, especially their root systems, during construction so that the trees can be enjoyed for future generations



An example of grading where almost all trees were removed



Even in late fall, the extent of tree conservation in White Oak subdivision is evident.

HILLSIDE AND RIDGE PROTECTION AND RESTORATION

Existing Conditions

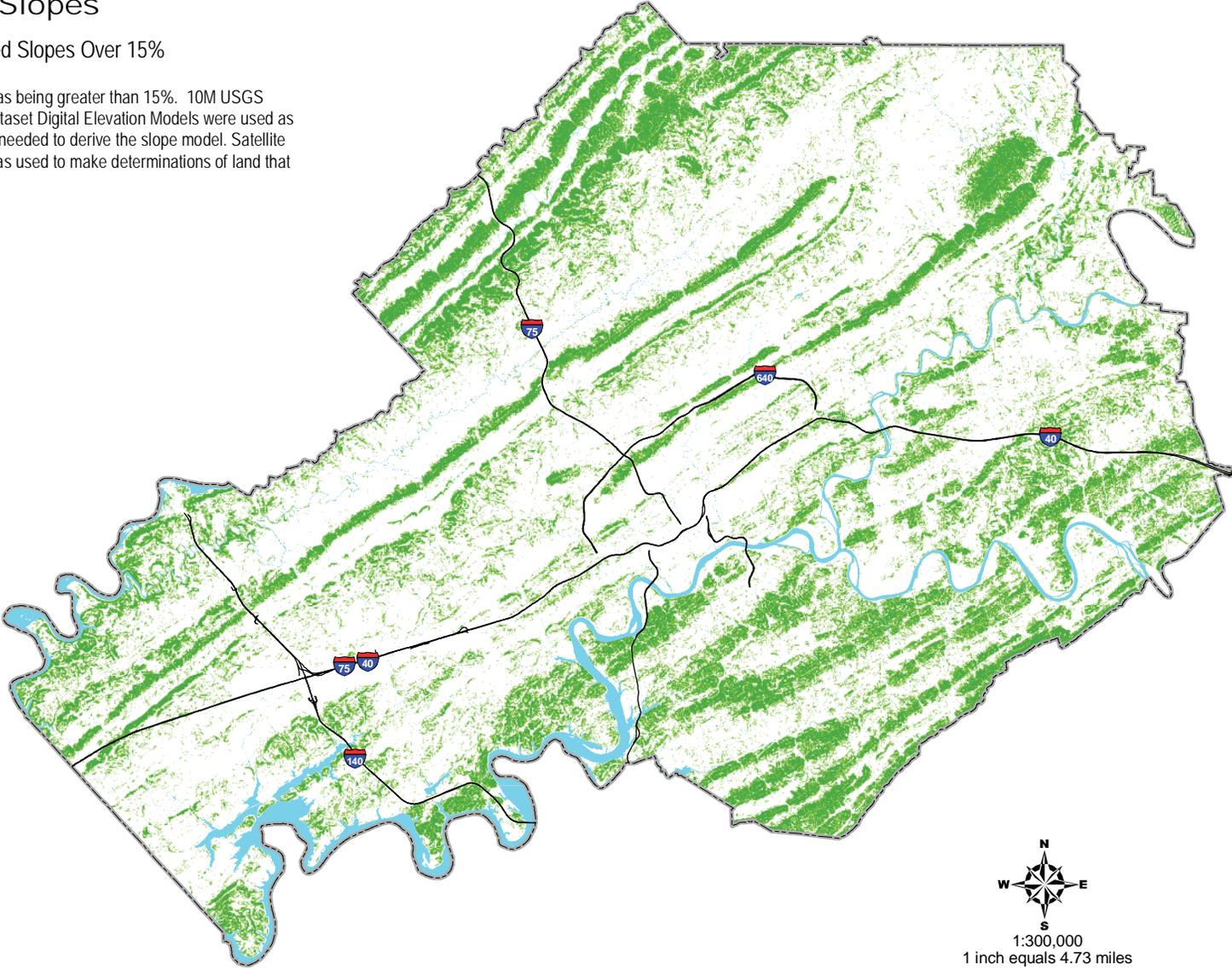
As can easily be seen on the opposite page, most of Knox County's forested lands lie on ridges and hillsides (Map 2: Forested Slopes). Unfortunately, there are very few existing regulations to protect these natural features, with the exception of occasional zoning cases where residential density is limited on steep slopes. Also lacking are tree restoration standards for denuded hillsides.

Ridges are impacted by both residential and commercial development. Although there are occasional severe slope cuts, residential development typically destroys lower portions of ridges. Years ago, large-lot development left most trees and woodlands undisturbed. More recently, with a diminishing land supply, residential development has been directed to hillier sites. Clearing and grading have been more pronounced beyond the lower portions of steep slopes.

Map 2: Forested Slopes

 Forested Slopes Over 15%

Slopes were defined as being greater than 15%. 10M USGS National Elevation Dataset Digital Elevation Models were used as the elevation surface needed to derive the slope model. Satellite imagery from 2001 was used to make determinations of land that was wooded.





The ridges of south Knox County, like Hall Mountain, help define the character of the region.

Many arterial roads radiate through gaps. Zoning for commercial growth often follows such roads, resulting in ridge cuts to accommodate retail development. Many of those sites have not been restored and are sources of erosion. Further ridgeline cuts should be limited and carefully regulated to lessen environmental damage.

Benefits

The Tennessee River Valley and surrounding mountains are a strong part of the regional identity and culture. The scenery is a part of our quality of life – the reason why so many people are happy to call Knoxville-Knox County home and are willing to relocate here.

Conservation of slopes provides significant property protection and environmental benefits. Proper regulation is essential to insure that the impacts of surface water runoff and landslides are avoided. Failure to do so can lead to expensive repairs and injury to persons and property. By minimizing disturbance, habitat is significantly protected because ridges run as extended corridors, offering ample space to sustain larger and migrating animals.

Protection Approaches

Various means can be used to conserve forested ridges.

- **Protecting Ridgetops:** North Carolina has the model approach; laws limit the height of buildings on ridges to maintain the mountaintop beauty of the Blue Ridge and Smokies.
- **Overlay Zoning for Residential Development:** Supplementary regulations can be added to residential zones to protect views and sensitive habitat. Design regulations may include limits on clearing, grading, and design, such as building up with a few stories as opposed to a rambling structure that requires greater clearing.
- **Clustering Houses:** Various sites such as the toe of a slope or flatter areas on rolling terrain are logical places for development. By consolidating the allowed housing density onto the most appropriate sites, forested slopes and other environmental assets can be protected. Planned residential zones and conservation (or cluster) subdivisions (see page 47) help accomplish these objectives.
- **Acquisition as Public or Quasi-Public Open Space:** Knoxville-Knox County in partnership with non-profit land trusts or the Legacy Park Foundation (established in 2006) should look for

opportunities to acquire and permanently set aside ridges as open space. Conservation easements can be a tool to realize this objective.



Slope protection is a major factor in maintaining water quality.

Slope Conservation and Restoration Principles

In restoring a site, new vegetation is critical so that roots can anchor soil. Dense groundcovers should be established soon after hillsides are cut to reduce stormwater runoff and erosion. Tree canopy should also be created to intercept and reduce the impact of stormwater and reclaim the aesthetic benefits that were lost. Appendix B: Slope Restoration lists appropriate species.

- Avoid clear cutting and limit soil exposure on slopes that are to be disturbed. Silt fences should be used during grading to reduce erosion.
- Protect existing native vegetation and trees from damage during construction, and replant disturbed slopes with native species along natural contours.
- Design structures in a manner that requires a minimum amount of alternation to the terrain.
- Limit building footprints and other impervious surfaces.
- During the site planning process, use such techniques as conservation subdivisions (see page 47) and planned residential development to cluster housing while dedicating ridgetop land and steep slopes as permanent open space.

RIPARIAN CORRIDORS

Riparian buffers are natural or restored areas along streams, rivers and lakes that are set aside for environmental and community-serving purposes. Healthy riparian forests provide substantial benefits:

- Water quality is enhanced as stream and lakeshore banks are protected and pollutants are removed.
- The habitats of fish, amphibians, birds, and mammals are protected, maintaining the native species that were here for thousands of years before man.
- Flood problems are reduced because the natural vegetation absorbs water and reduces the velocity of moving water.
- Public recreation opportunities are increased, including nature observation, trail systems, and park development.

Many riparian areas have been cleared for farming and development. The map on the following page (Map 3: Riparian Areas) depicts the extent of forested areas, agricultural, and impervious surfaces along



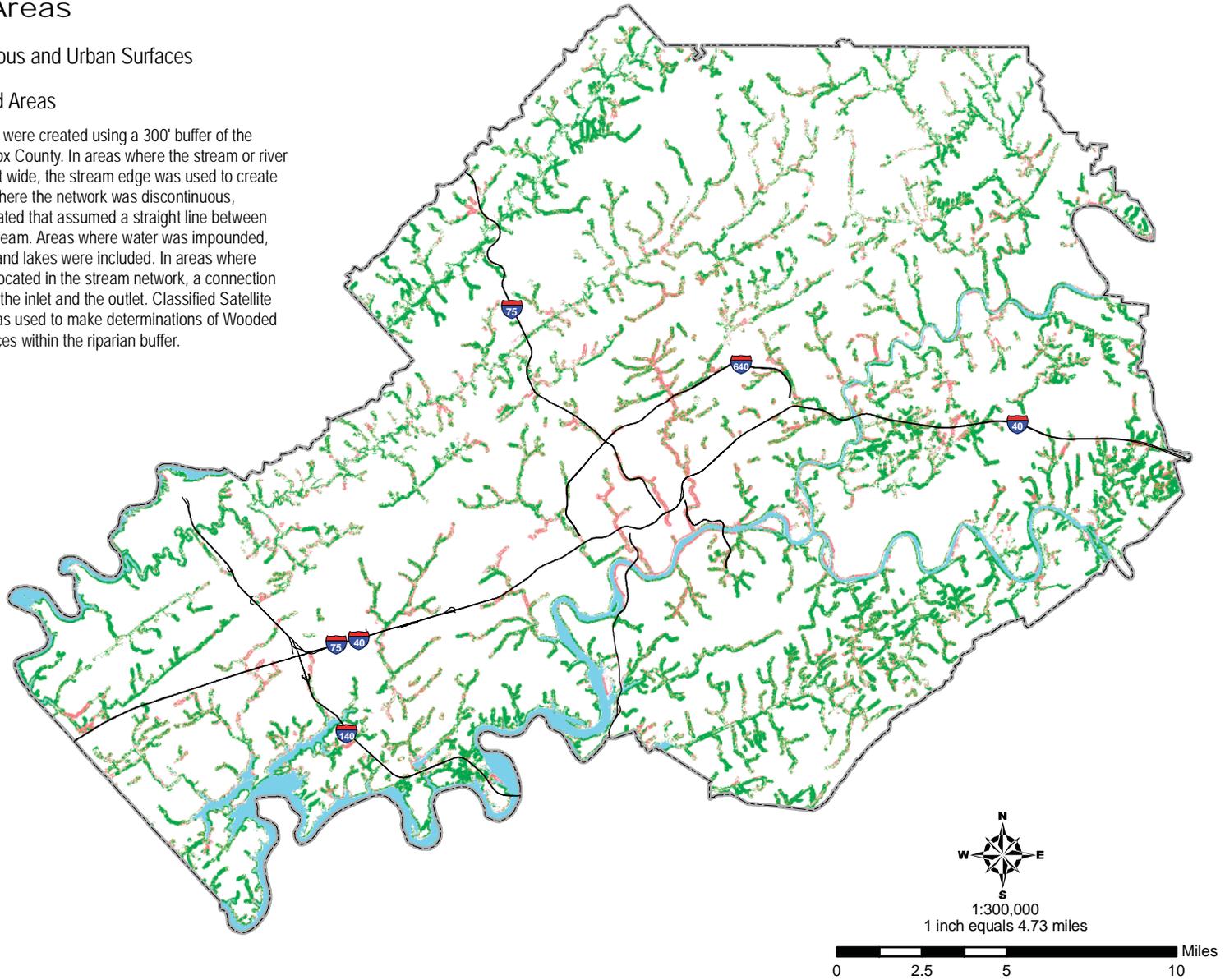
water features. In general, the least amount of riparian forest is along agricultural lands and newly developed subdivisions. The hillier portions of the county, such as those to the south and north, have the most extensive areas of riparian forest, which is an environmental benefit because the slopes are still intact and the negative impacts on water quality have been avoided.

In this streamside area, Halls High School students have removed invasive plants and are planting native trees.

Map 3: Riparian Areas

-  Impervious and Urban Surfaces
-  Wooded Areas

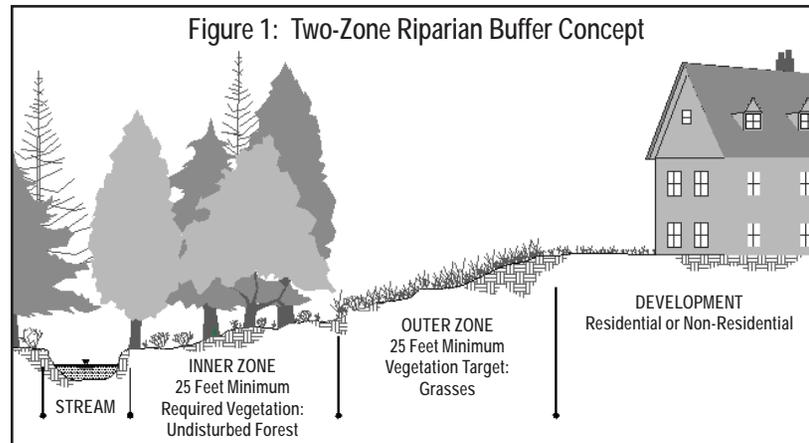
Riparian areas shown were created using a 300' buffer of the stream network in Knox County. In areas where the stream or river was more than 10 feet wide, the stream edge was used to create the buffer. In areas, where the network was discontinuous, connections were created that assumed a straight line between visible areas of the stream. Areas where water was impounded, such as small ponds and lakes were included. In areas where impoundments were located in the stream network, a connection was created between the inlet and the outlet. Classified Satellite Imagery from 2001 was used to make determinations of Wooded and Impervious surfaces within the riparian buffer.



Riparian Buffers

Knox County, like many cities and counties across the country, is in the process of creating standards for the conservation of woodlands and other natural features along the edges of streams, rivers and lakes. Several benefits are derived from the conservation of the riparian space, including:

- Water quality protection because stormwater is filtered
- Stream bank protection and soil conservation
- Flood protection as infiltration continues and development is avoided in flood plains
- Habitat protection for aquatic species and other wildlife
- Cost savings in waterway restoration and stormwater management.



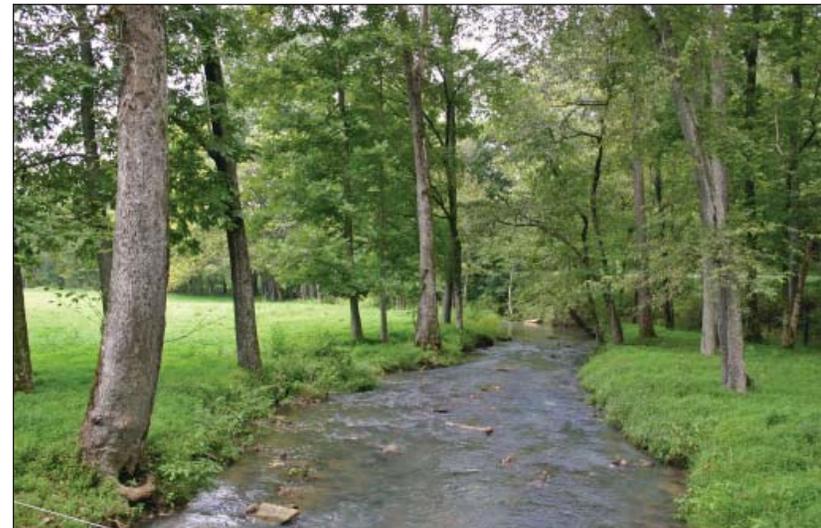
In general, a 50 foot wide buffer should be provided along each side of the stream. This riparian protection area can be divided into two zones.

Zone 1: This inner zone should have a minimum width of 25 feet, measured inland from the top of the bank of the channel. The edge of the stream is particularly important. Healthy forests in this area should be conserved. Native trees, shrubs and under-story plants should be planted if the area has been cleared. That combination of vegetation maintains cool water and provides the necessary debris and organisms to support aquatic life. A much greater area is encouraged to truly protect a wide range of habitat.

Zone 2: This outer zone, which should generally be 25 feet wide, can be disturbed, graded and re-vegetated with grass or other natural groundcover. The primary purpose of this area is to filter runoff as it flows over land from adjacent development, lawns or farms.

Principles

- **Maintain and Plant Native Trees, Shrubs, and Groundcover:** These are the best suited to enhance habitat.
- **Provide Continuous Forested Corridors:** This is necessary for wildlife migration, flood prevention, and water quality enhancement.
- **Establish a Diversity of Tree Species:** Avoid a monoculture that can be destroyed by disease or drought.
- **Remove Invasive Plants:** Such species as privet thrive in these wet environments and impair the growth of native plants.
- **Create a Natural Pattern of Forests Next to Stream and Make Provisions for Future Maintenance in Adjacent Zones:** For example, plant trees and shrubs in a pattern easy to mow around or otherwise maintain.



Much of Conner Creek is lined with woodlands.

Recommended Species

To Establish a Riparian Buffer:

- Cottonwood
- Box Elder
- Red Maple
- Ash (green)
- Red Osier Dogwood
- Gray Dogwood
- Silky Dogwood
- Sycamore

To Sustain a Mature Riparian Forest

- Swamp White Oak
- Pin Oak
- Black Walnut
- Silver Maple
- Hawthorn
- Rusty Blackhaw
- Maple Leaf Viburnum
- River Birch
- Water Oak
- Willow Oak
- Sugarberry
- Blackgum
- Green Ash
- Persimmon



Knox County's Cove at Concord Park is a good example of shaded walks, benches and picnic areas.

PARKS, LIBRARY AND SCHOOL GROUNDS

During the past decade, public investment in these basic community facilities has grown appreciably. New schools such as West Valley Middle and Hardin Valley Elementary are landmarks in the community. Northwest Sports Park and Sterchi Park are fine additions, meeting a variety of recreation needs. The Halls, Frank Leuthold, and Bonnie Kate libraries now serve rapidly growing communities. While community development has been admirable, landscaping and tree planting has not always kept pace with site preparation and construction.

Principles for Planting on Public Grounds

- Plant a mix of trees, including shade trees, evergreens, and small native trees like dogwoods and redbud, avoiding a monoculture that can be destroyed by plant disease.
- Use that mix of native trees to loosely frame the edges of playfields and ball fields, providing a setting that mimics natural surroundings.
- Plant shade trees near playgrounds, benches, and picnic tables, providing a more comfortable setting for hot summer days.
- Provide trees in the parking lots, generally at a distribution of one shade tree per 10 parking spaces.
- Remove invasive plants from park and school grounds, so that native trees are not “smothered” (see page 20 for list of invasives).
- Provide trees that support wildlife in the natural areas of school, library, and park grounds and along greenways.
- Do not plant nut and fruit bearing trees along paths, sidewalks, and parking areas. Such trees as sycamores, hickories, and walnuts can damage cars or cause people to slip.

Implementation Measures

The cost of tree and landscaping programs need not fall back on taxpayers. Cooperative programs between service and professional organizations, community and neighborhood groups, and non-profit agencies can go a long way in creating a beautiful landscape on park, school, and library grounds. Seed money for matching programs or distribution of trees through governmental agencies can also jump-start tree planting initiatives. Some specific measures are:

- The respective departments or boards should see that landscape plans are created and approved for each park, library, and school project
- The boards and staffs should create programs so that such organizations as community clubs, PTOs and scout groups can adopt a public ground and plant native trees. This includes “seed money” to provide trees to organizations with stipulations regarding species selection, proper planting, and maintenance.
- With the creation of the Legacy Park Foundation, some matching funds or trees could be earmarked for landscaping on the grounds of public facilities.

DETENTION BASIN PLANTING

Currently, Knoxville and Knox County have no requirements for landscaping detention basins, other than requiring a stand of grass. Well designed, landscaped detention areas can increase property value by creating a better appearance, while decreasing damage to property that might occur as a result of downstream flooding. They can also minimize erosion, help maintain water quality, and provide opportunities to create wildlife habitat.



The landscaping around the detention basin at the Knoxville/Knox County Animal Shelter turned a potential eyesore into a visual asset.

Principles

- Detention or retention areas should use natural topography and existing vegetation where possible.
- In addition to or as a replacement for existing vegetation, these areas should be landscaped. (Native trees and shrubs are appropriate along the outside edge of the basin. Riparian species, see page 16, are potential choices in these sites.)
- Landscaping should be planned in a way that screens the basin without interfering in the drainage functions.
- Basin or pond slopes should be planted with grass (but not mown) to prevent erosion.
- In residential areas, it is preferable to broaden the basin and integrate the facility into the subdivision as open space.
- In order to blend with natural terrain, a mix of native trees and shrubs should be planted around the cut slopes of the detention basin.
- Fill slopes should not be planted with trees since such slopes serve as the face of an earthen dam in detaining water, and root growth can undermine the strength of the fill.

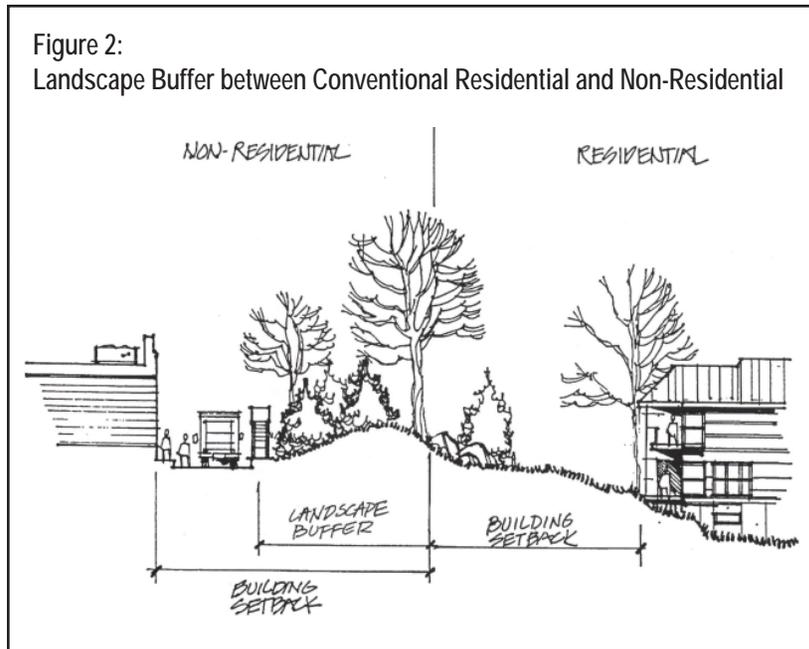
Recommended Plantings

For every 100 linear feet, the following minimum quantities, types, and sizes of plant material are recommended for landscaping the top edge of basins:

- 2 evergreen trees
(6-foot minimum height)
- 2 ornamental trees
(1 ½-inch caliper)
- 2 canopy trees
(2 ½-inch caliper)
- 10 shrubs
(24-inch minimum height)

PROTECTING NEIGHBORHOODS WITH LANDSCAPE BUFFERS

Figure 2:
Landscape Buffer between Conventional Residential and Non-Residential



A landscape buffer is a strip of land that should include trees and shrubbery to minimize impacts between very different land uses. Such buffers are also used to protect natural and historic resources. Currently, Knoxville and Knox County do not have specific regulations that outline where landscape buffers should be used. In limited circumstances, such as planned commercial zones, the Planning Commission will require buffers. However, even in those cases there are only general guidelines, and tree species selection is not addressed.

Optimally, there should be logical transitions in land uses (for example, retail uses at major intersections, gravitating to medium density housing or offices, and then to single family uses). However, where such transitions are not possible, landscape buffers can reduce negative impacts, including:

Unappealing Views: This generally occurs when adjacent neighbors would see a parking lot, storage and delivery facilities, large industrial or commercial buildings, or operational equipment.

Spill-over Lighting: This generally occurs when neighbors have unscreened views of parking lots and well-lit buildings. Issues include lighting design and location, angle of exterior building lighting, and the direction that automobile headlights shine.

Noise: These conflicts typically involve issues with delivery, refuse pick-up, traffic, and other business-related uses. While operational hours and decibel restrictions are major solutions, landscape buffers can help minimize impacts.

Principles

- A diverse number of predominantly native species should be used; at least 60 percent of the screening material should be native plants.
- Height of trees and shrubs at maturation should vary, creating a screen from ground level upward.
- The buffer needs to be designed as an effective screen year round.
- The required buffer width should be greater in relation to uses of high intensity and large scale.
- Its design should include the advantages that existing trees and topography can provide in screening the impacting use.
- Existing medium and large maturing shade and evergreen trees (greater than six inches in diameter at breast height) should be conserved as should small native trees like dogwoods and redbuds.
- In instances where space is limited, walls and landscaping should be used to create an effective screen.

Flexibility is needed in providing effective buffers because of differences in topography, types of land uses, and the dimensions of property. Several options are possible:



This landscape buffer in west Knox County provides a nice mix of evergreen and deciduous trees, separating office and residential development.

Live Screen Options establish a standard number of evergreen trees, flowering and shade trees, and shrubs per linear foot; for example (based on height at maturity), 4 large or medium-maturing evergreen trees, 2 small evergreen trees, 1 shade and 2 flowering trees, and 10 shrubs (capable of growing to a 5-foot height) per 100 linear feet. Staggering in natural patterns could also be a design standard.

Fence or Wall Options set standards for fence or wall height and accompanying landscaping. For example, a solid 6-foot high wall or fence with 2 evergreen trees, 2 flowering trees, and 5 large shrubs per 100 linear feet.

Berm Options set a standard for a berm and its accompanying vegetation (for example, a minimum 25-foot rear buffer yard with berming not to exceed 1:3 slope, 3 large evergreen trees, and 2 flowering trees per 100 linear feet, and sufficient evergreen shrubs to form a continuous screen within three years).

Recommended Species

Medium and Large Evergreen or Near-evergreen Trees

- Eastern Hemlock
- Eastern Red Cedar
- Laurel Oak
- Loblolly Pine
- Short Leaf Pine
- Virginia Pine
- White Pine
- Southern Magnolia
- White Fir
- Japanese Cryptomeria
- Leyland Cypress
- Cherry Laurel
- Western Red Cedar
- Canadian Hemlock
- Carolina Hemlock

Small Evergreen Trees

- American Holly
- Foster Holly
- Savannah Holly
- Sweet Bay Magnolia
- Little Gem Magnolia
- Star Magnolia
- Yaupon Holly

Evergreen Shrubs and Vines

(Native and non-native, typically growing to a height of 4 to 15 feet)

- Anise Bush
- Azaleas, native and hybrids
- Boxwood
- Camellia Japonica
- Cleyera
- Firethorn
- Fortune Tea Olive
- Flowering Quince
- English Laurel
- English Holly
- Glossy Abelia
- Japanese Yew
- Lusterleaf Holly
- Otto Lukeyn Laurel
- Rhododendron
- Winterberry Barberry
- Winterberry Holly
- Carolina Jessamine and Trumpet Honeysuckle (vines for fence planting)

INVASIVE PLANTS

Many parts of the county, including stream corridors, ridges, roadsides, and yards, are covered with thickets of invasive plants. Mimosa trees, honeysuckle, privet, and kudzu are common examples. Invasives are a severe threat to our forests because they replace native plants and imperil wildlife by diminishing the supply of nut and seed bearing plants. Stream corridors and roadsides are of particular concern because invasives tend to become established there first.



Kudzu causes havoc in reforestation and detracts from scenic areas, like the Bull Run watershed.

Also called exotic pest plants, they are incredibly adaptable, having the ability to thrive in a wide range of soil and water conditions, reproduce in large numbers, grow rapidly for extended portions of the year, and thwart many methods to eradicate them. Not all exotic plants are such pests. Over the last few centuries, we imported many variety of plants from Europe and Asia for ornamental, erosion control, or economic purposes, only to realize some grow unchecked across our countryside. They spread easily because many have high volumes of seeds that can be deposited by birds or spread by wind. Once established, their shoots and root systems become a prolific problem in their new locale.

Control Measures

Invasive control measures are not easy because these plants are so widespread and the public is so unfamiliar with the problem. Two basic management strategies are necessary:

- Avoid planting exotic species. Native Tennessee trees and plants should be selected by both public and private interests to meet their landscaping needs. The tables of recommended trees on pages 36, 37, and 38, are a good basis in selecting the right type of native tree.
- Remove invasive plants. Any large-scale eradication efforts should be coordinated to re-establish native species.

List of Invasive Plants

The following list of more common invasive plants should not be selected for planting and should be the target for removal.

Trees

- Tree-of-Heaven
- Silktree (Mimosa)
- Princess Tree (Paulownia)
- Chinaberry Tree
- Tallowtree (Popcorn Tree)
- Russian Olive
- White Poplar

Shrubs

- Silverthorn (Thorny Olive)
- Autumn Olive
- Chinese/European Privet
- Japanese/Glossy Privet
- Bush Honeysuckle
- Sacred Bamboo (Nandina)
- Multiflora Roses

Grasses

- Giant Reed
- Tall Fescue
- Cogon Grass
- Nepalese Brown Top
- Chinese Silver Grass
- Bamboos

Vines

- Oriental Bittersweet
- Climbing Yams
- Winter Creeper
- English Ivy
- Japanese Honeysuckle
- Kudzu
- Vincas (Periwinkles)
- Nonnative Wisterias

Chapter 3:

Streetscapes – Roads, Parking Lots, and Utilities

In this chapter, the overall “streetscape” is addressed. Streetscapes include tree planting and conservation in public rights-of-way and in the adjoining spaces, including, yards, parking lots, and utility corridors. To truly beautify and realize environmental benefits along roads and highways, it is prudent to look at the broader dimensions of these corridors. That approach is used in developing the following strategies and recommended programs.

STRATEGIES

Conserve Trees and Woodlands

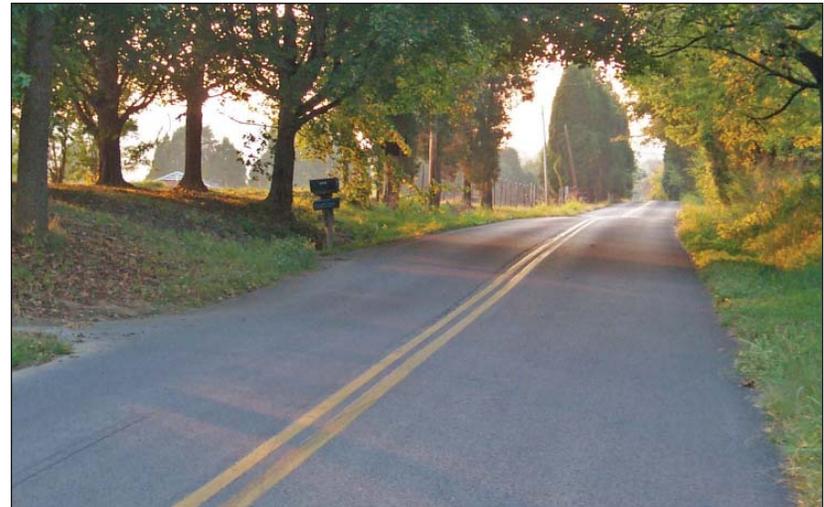
Many roads are lined by rows or pockets of trees. Occasionally, an unusually large shade tree, obviously a specimen planted or saved with early settlement, will adorn a rural yard. Such trees and woodlands are part of the county’s natural heritage. Because of their beauty and environmental benefits, they should be protected.

Plant within Rights-of-way

The width of rights-of-way (r-o-w) varies along public roads and highways. As long as the outside portion of the r-o-w is beyond the clear zone and there are no major utility conflicts, it should be used for tree planting. Several benefits result: improved air quality (carbon dioxide, ozone and particulate removal), stormwater runoff, absorption and shaded sidewalks.

Plant Trees in Medians

The county has done an admirable job in creating medians with many of their road improvements. The recently completed extensions to Callahan Road and Middlebrook Pike are good examples and provide



Conserving the beauty of our roadsides should be a basic strategy.

adequate space for landscaping. The city has an ongoing tree planting program for medians; Middlebrook Pike, James White Parkway, and North Broadway are examples where this has occurred. Appropriate trees should be selected in relation to the median width and traffic speed. As a general rule, larger-maturing trees like maples, oaks, and sycamores can be planted when the road is designed for slower traffic or the median is wide. Conversely, smaller-maturing trees like selected varieties of magnolia and crepe myrtle and native flowering trees can be good choices where the road is designed for higher speeds.

Replace Concrete-filled Medians with Trees and Ground Cover

This planting strategy has been widely used in Knoxville, reclaiming stretches of highway and transforming them into landscaped community gateways. Several roads outside the city, like Clinton Highway near Emory Road, would be good sites for such beautification and environmental enhancement.

Slopes along Roadsides

Forested hillsides particularly need to be protected to avoid erosion and accompanying water quality problems. Where slopes must be cut to accommodate a road or road expansion, reclamation with a combination of continuous groundcover and a mix of native trees should be a matter of public policy.

Rural and Suburban Yards

The right-of-way along many roads, especially in rural areas, is severely limited. Individual homeowners as well as community associations can beautify their landscape by planting trees. Rural yards are good targets for public-private planting programs. Residents can create a special character for their neighborhood by planting a similar mix of trees like



Median landscaping along Middlebrook Pike



A good example of a 'street yard' in north Knoxville

oaks, maples, and pines, with an understory of small flowering trees like dogwoods and redbuds. Various native species can be provided through non-profit or public sources such as East Tennessee Releaf to community groups, which can work together to plant them along a stretch of roadway.

Yards along Commercial Corridors

There are not many trees along commercial corridors and little consistency in landscaping. Those shortcomings detract from the county's natural beauty and provide limited environmental benefits. 'Street yards' (see above photo) that are planted with shade and native flowering trees are ideal spaces for tree planting. Trees and other landscaping should also be used to define entrances from the adjoining road.

Parking Lots

Basic standards should be adopted to save and provide trees when parking lots are developed and redeveloped. Along some highways it is difficult to discern where highway pavement ends and a parking lot emerges. Reclamation of selected portions of the asphalt, such as a few parking spaces, can have substantial aesthetic and environmental benefits. Parking lot beautification is also a means to employ competitive commercial design.



The tree-lined “Main Street”, Philips Place in Charlotte, North Carolina, is one of the South’s newest and most successful commercial enterprises.

In the case of property redevelopment, particularly commercial projects, trees and landscaping can make the old look much more inviting like well landscaped new development.

Plant Trees along Sidewalks

Some newer neighborhoods like Montgomery Cove have turned back the clock to a time when trees were routinely planted in the grass strips between the road and sidewalk. Survey respondents prefer to walk along a sidewalk that has separation from travel lanes. Two alternatives are recommended as desirable practices for neighborhood streets: 1) provide planting strips at least 6 feet wide to allow adequate space for root growth; or 2) provide a two- to three-foot grassy strip and plant trees in the adjoining yard space. Along thoroughfares and parkways, planting strips should be much wider to further separate pedestrians or bicyclists from faster moving traffic. Where space is limited or a higher design speed warrants, separation of trees from travel lanes may be necessary. Planting in the outside portion of the right-of-way or adjoining yards is a good solution. In fact, tree roots can grow substantially in that border area, allowing greater longevity. Certain trees are better to plant near sidewalks than others. Some trees, like sweet gums, walnuts and

hickories, should be avoided in that their hard fruit can be like ball bearings under foot.

Remove Invasive Plants

Privet, honeysuckle, mimosa, and kudzu are examples of invasives or exotics which blemish the appearance of many roads, and worse, destroy the natural plant community. A combination of public and non-profit efforts could go a long way in removing roadside invasives (see list of invasive plants, page 20).

Plant Small Native Trees near Utility Lines

Such trees as dogwood and redbud are appropriate species to plant under or nearly under utility lines. They do not grow high enough to compete with electrical lines, yet provide beautification along the street and avoid the pruning costs associated with tall trees.



Montgomery Cove subdivision



Virtually every section of Knox County has scenic roads that should be protected.

TRANSPORTATION CORRIDOR STRATEGIES

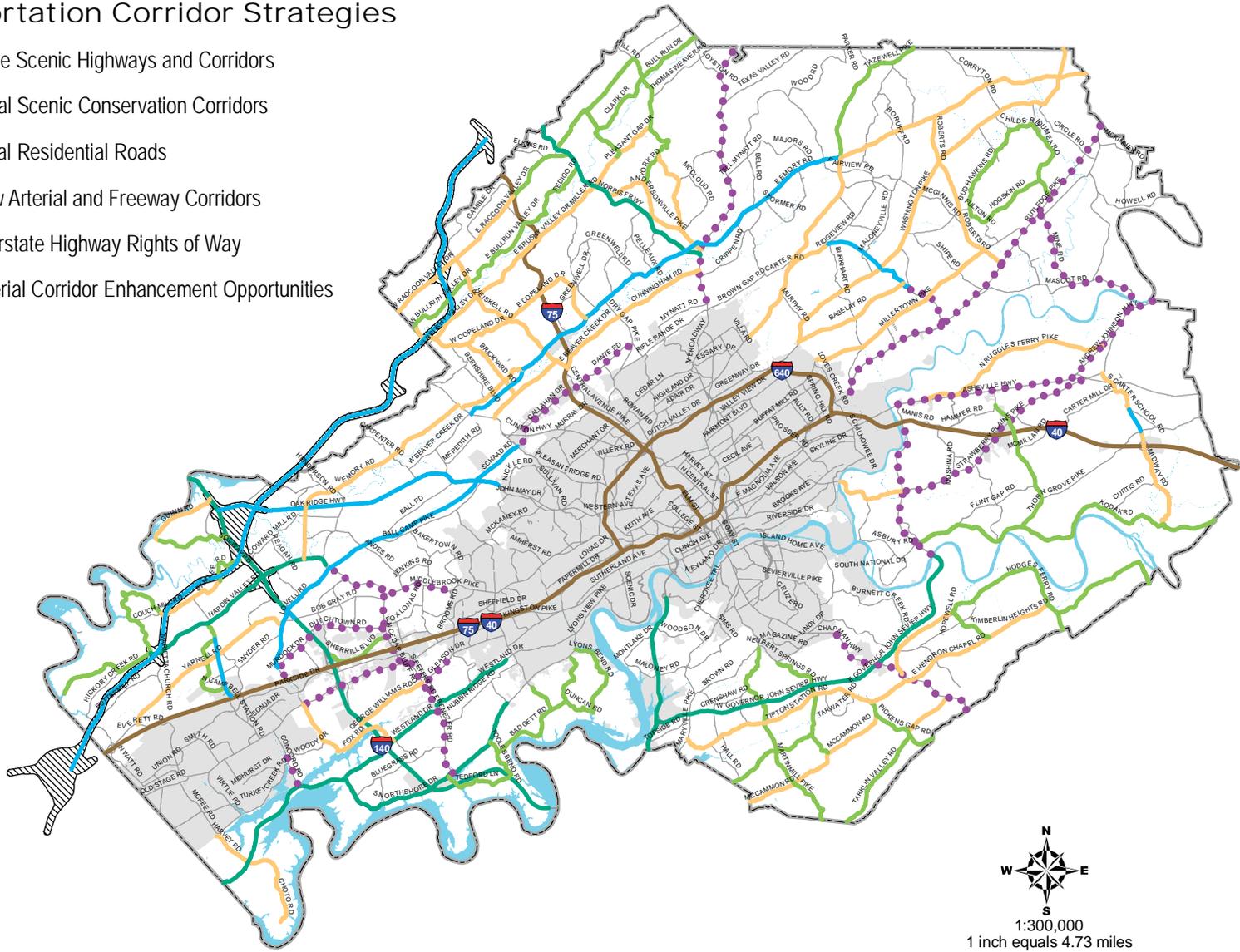
State Scenic Highways and Parkways

The state has recognized various scenic roads in Knox County. Particularly attractive examples include: Pellissippi Parkway north of Dutchtown Road; Northshore Drive as it runs along the lake; Norris Freeway; and Governor John Sevier Highway south of the French Broad River.

The objectives of the state's Scenic Byways Program are to limit the height of buildings and prohibit billboards and junkyards within 1,000 feet of the designated highways. Although the law does not address landscaping and tree protection, Knox County could make significant aesthetic improvements by creating conservation and planting programs.

Map 4:
Transportation Corridor Strategies

- State Scenic Highways and Corridors
- Local Scenic Conservation Corridors
- Rural Residential Roads
- New Arterial and Freeway Corridors
- Interstate Highway Rights of Way
- Arterial Corridor Enhancement Opportunities



0 2.5 5 10 Miles



Northshore Drive, a State-designated scenic highway, contains landscapes that should be preserved.



Scenic Corridors: Additional landscaping can enhance such thoroughfares as Hardin Valley Road.

Local Scenic Conservation Corridors

In addition to state-designated routes, various county roads have scenic, tree-lined landscapes that should be conserved. Sparsely landscaped areas along these roads should be enhanced by planting a mix of native deciduous and evergreen trees. Views of agricultural land should be protected; trees along fence rows and similar limited plantings are appropriate in defining farm landscapes.

Rural Residential Corridors

For many years, rural roads provided access to widely separated farms. Over time, houses were developed on large lots lining these roads. Native trees should be planted along these roads, reclaiming a wooded landscape and providing water quality, wildlife, and energy-saving benefits.

New Arterial and Freeway Corridors

Landscaping within medians and tree planting to the outside of rights-of-way should be undertaken at the time of road development. Where slopes must be cut, they should be reclaimed with native species that will complement the East Tennessee landscape.

Interstate Highway Rights-of-way

In order to enhance Knoxville and Knox County's image and landscape, reduce maintenance costs, and provide additional environmental benefits, the outside portions of rights-of-way and interchanges should be landscaped using a variety of native trees, shrubs, wildflowers, and grasses.

Arterial Corridor Enhancement

Some of the harshest environments in terms of glare, summer heat, water pollution, and lack of beauty are sections of commercial corridors. However, other arterial corridors have great potential for landscape enhancement, such as Asheville Highway and Rutledge Pike. Public and private planting programs, including trees in roadside and yard open spaces as well as better parking lot landscaping are primary improvements that should be pursued.

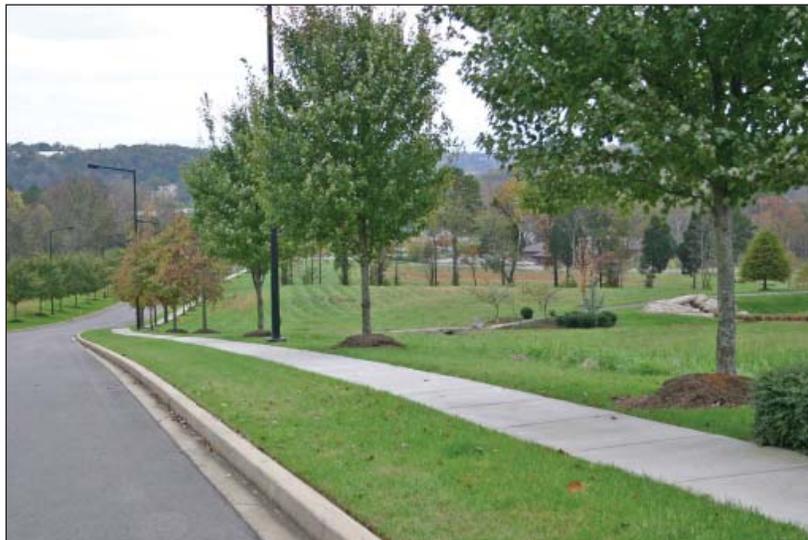
NOTE:

Some trees are likely to be lost with road widening projects. Funds should be set aside to plant a variety of native species with future road expansion projects. (see Chapter 5: Implementation, page 49, Transportation Corridor Landscape Programs)

SPACING AND PROPORTION PRINCIPLES

The pattern of trees along roadways should be roughly symmetrical, and in most cases, should mimic the region's natural landscape. Tall-maturing trees on one side of a road should be matched with similar planted species on the opposite side of a road. Specifically, the following points should guide roadside tree planting:

- When planting trees along parkways, curvilinear suburban roads, or near interchanges, use a variety of shade, evergreen, and small flowering trees in informal patterns that are like the natural East Tennessee landscape.
- Smaller trees like sourwood, hawthorn or dogwood can be planted among shade trees, especially in informal settings along rural or suburban roads, freeways, and parkways.
- In choosing a mix of trees along roads, use species that will have similar proportions when they grow to maturity.
- When utility lines are on one side of a road, plant smaller-maturing trees near the lines and larger-maturing trees as a backdrop; plant or conserve larger-maturing trees on the opposite side of the road.



Trees planted to the outside of sidewalks provide adequate growing space and safety.

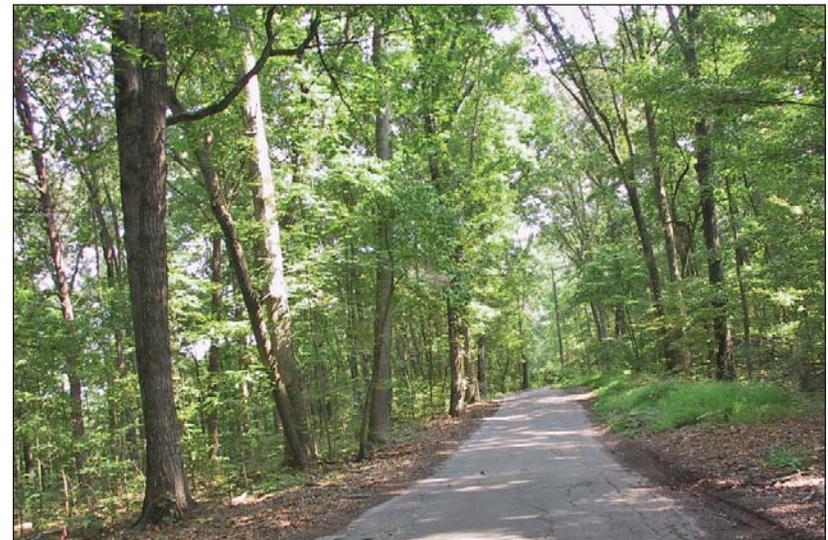
TRAFFIC ENGINEERING CONSIDERATIONS

Trees and Clear Zone Constraints

A 'clear zone' is an area of roadside free of fixed objects in order to reduce both the potential and severity of accidents. Guidance on appropriate clear zone distances is found in the Roadside Design Guide manual produced by the American Association of State Highway and Transportation Officials (AASHTO). Although the document is intended only as a 'guide' and not as a standard or design policy, it does present the most current and best practices regarding roadside safety.

Recommended roadside design criteria relating to the clear zone are outlined below:

Distance: An adequate clear zone is based on three criteria: traffic volume, design speed, and slope next to a roadside. Clear zone distances can range from 7 feet for low-volume, low-speed roadways with gentle side slopes to greater than 30 feet for high-volume, high-speed roadways with steeper side slopes. The clear zone distance is measured from the



As mixed forests mature along county roads, a proportional 'cathedral effect' results.

edge of the driving lane, which is not necessarily the edge of pavement if on-street parking or bicycle lanes are present.

Curbs: These are not typically considered to be barriers.

Types of Vegetation Allowed: The Roadside Design Guide notes that any single tree with a trunk diameter of greater than 5 inches is considered a fixed object. In addition, a group of shrubs or small trees that are close together can be assumed to have the same effect as a single larger tree.



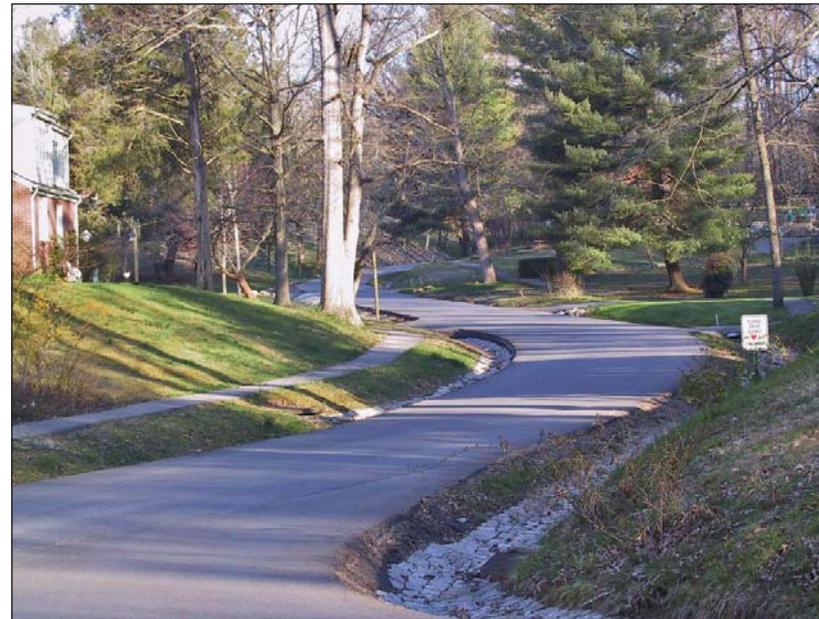
Protection, such as these natural-appearing barriers in the Smokies, may be needed to preserve trees and protect drivers along some roads.

Safety Barriers: There may be situations, particularly where there are higher design speeds, where barriers should be considered. Local engineering departments and the Tennessee Department of Transportation should be consulted in finding an acceptable method in preserving trees. A barrier such as a guardrail should only be considered if it will reduce the severity of potential accidents, since the barrier itself can be considered a roadside hazard, particularly at its terminal end. Aesthetically pleasing barriers should be used. Any proposed

barrier must have passed several Federal Highway Administration test procedures in order to be considered crash-worthy. Potential barriers that have aesthetic merit include: (1) the dual cable barriers used along the interstate medians in South Carolina (their ‘transparency’ permits views of the landscaping); and (2) wooden barriers that are used by the National Park Service along its parkways.

Sight Distance

A major consideration when proposing additional landscaping and trees along a roadside is maintaining adequate sight distances. The most critical areas are intersecting roadways where drivers must be able to see each other clearly as well as any pedestrians or other road users. A visual clear zone must be established (often referred to as a “sight-triangle”) at all intersections, and that area must be kept free of obstructions.



At this intersection, sight distance is not compromised because trees were planted further away from the intersection.

TREES AND ROAD DESIGN CONSIDERATIONS

Provisions for tree planting and conservation along roads and highways should be made with respect to lane width, design speed, utility, and sidewalk locations and related factors. The Knoxville Street Tree Master Plan, available online at www.knoxmpc.org, also provides guidelines for tree planting along the city's street system. The following design criteria are adapted for suburban and rural circumstances.

Lanes and 'Trails'

These are relatively short streets in suburban residential areas. The side roads of Sequoyah Hills and Forest Hills are good examples. They are an ideal design for establishing a forest in very low-density neighborhoods.

Features:

- Street Width: 20 feet with curb and gutter or extruded curb and informal parking designated on street
- Planting Strips: 6-foot minimum if street trees are to be provided
- Sidewalks: 5 feet on at least one side with a minimum of a 2-foot separation from the travel lane
- Design Speed: 20 mph
- Posted Speed: 20 mph
- Requires a minimum 44-foot right-of-way
- Drainage: Curb and gutter or drainage swales in very low density areas
- Generally two to six blocks long



One of the "trails" in Forest Hills



A residential road in a subdivision with street trees and a separated sidewalk

Local Roads and Residential Streets

The basic residential road in low density subdivisions should include street trees or yard trees and a separated sidewalk. Concrete sidewalks are very expensive. In low density residential areas, a sidewalk on one side of the street will usually meet the needs of pedestrians. Some streets are designed in a more traditional fashion and include sidewalks and planting strips.

Features:

- Street Width: 26 feet with curb and gutter or extruded curb and informal parking
- Planting Strips: 6-foot minimum with trees; or 2-foot minimum when the emphasis is on yard tree planting
- Sidewalks: 5 feet on each side
- Design Speed: 25 mph
- Posted Speed: 25 mph
- Requires a 50-foot right-of-way
- Drainage: Curb and gutter or extruded curb
- Generally two to six blocks long



A typical avenue in Kentlands, Maryland, a New Urban community

Avenues

Because the following features are related to New Urban development, like the future Northshore Town Center, there are few streets in Knox County that currently meet this classification. These are not your typical Knox County avenues. These streets should be developed to link a higher intensity mix of land uses to nearby neighborhoods. The land uses next to avenues include a mix of residential, office, and commercial uses, and can have a vertical mix of those uses within buildings.

Features:

- Street Width: 1 or 2 lanes on both sides of median with on-street parking; 18 feet if no parking or curb and gutter
- Median Width: varies with design, traffic volume and entrance points
- Travel Lanes: 11 to 12 feet
- Maximum: 2 travel lanes
- Bike Lanes and Planting Strips: 6 feet
- Sidewalks: 5 to 8 feet depending upon intensity of adjoining land use
- Design Speed: 30 mph (maximum)
- Posted Speed: 25-30 mph
- Right-of-way: Depends upon width of design features
- Drainage: Curb and gutter or extruded curb



This arterial road in Maryville includes landscaped medians and separated sidewalks.

Boulevards and Similar Cross-county Roads

Designed with medians, these roads are developed to provide connections through parts of the county. The design of Middlebrook Pike partially realizes the following design features. Adjoining land uses can be varied, including residential, commercial, office, and institutional uses.

Features:

- Lanes: 11 feet with striped parking and bike lanes
- Maximum of 4 travel lanes
- Median Width: varies with design, traffic volume and entrance points
- Planting Strips: 6 to 11 feet
- Sidewalks or Multi-purpose Trail: 5-foot minimum width sidewalks, if warranted on both sides of the boulevard; alternatively, a 10-foot or greater width multi-purpose trail may be preferable on one side of the road, especially where greater separation is needed under limited r-o-w situations and the intensity of adjoining land use is not significant.
- Design Speed: 40 mph (maximum)
- Posted Speed: 30-35 mph
- Right-of-way: Depends upon the width of design features
- Drainage: Curb and gutter



An artist's rendering of a parkway that is designed to blend with the terrain

Parkways

Designed to protect or enhance the natural landscape, parkways provide access through significantly large areas of the county or through parts of a region. They are designed to blend with the terrain.

Features:

- Travel Lanes: 11-12 feet
- Median Width: 30 feet is recommended minimum
- Design Speed: 50 mph (maximum)
- Posted Speed: 45 mph (maximum)
- Right-of-way: depends upon width of design features
- Drainage: swales allowed, or curb and gutter
- Multi-use Trails (walking, jogging, and biking): 10-14 feet, well separated from travel lanes
- Planting Strips: 7-20 feet
- 6-foot minimum paved shoulder on high-speed parkway (greater than 45 mph: typical section has shoulder with ditches)

PARKING LOT LANDSCAPING

Currently, Knox County does not have a provision for tree planting in parking lots. (Note: In a few zoning districts, like Planned Commercial, landscape plans are required. However, there are no specific standards such as the number of trees that should be planted.) While some developers have provided shade trees and landscaping in relation to parking lots, it is common to see vast areas of parking lot asphalt, especially along commercial corridors. Parking lot landscaping is beneficial for reasons that are discussed below.

Economic Benefits

Commercial, office, and multifamily developments are greatly enhanced by shade trees. Consumers want a pleasant place to shop, work, and reside. Developers of several new commercial and office projects have put a premium on planting and saving trees. Trees in commercial and office settings provide a more seamless transition between the places where we do business and the places we live. That type of setting adds value to properties. In fact, neighborhood property values increase by as much as 15 percent in wooded settings.



An employee parking area at Bush Brothers and Company corporate headquarters



The 'street yard' and parking lot tree plantings at the Turkey Creek development

Environmental Benefits

Trees reduce water run-off and the heat of asphalt paving. On a hot summer day, surface temperatures in unshaded parking lots can reach 140°. When a rainstorm occurs, run-off to nearby streams can virtually cook aquatic life. Shade trees can reduce that effect and filter stormwater, thereby reducing water temperatures, pollutants and flooding problems.

Principles

In designing parking lots, there are various principles in planting trees that should be followed to realize the benefits, including:



Willow oaks are fast-growing and adaptive for parking areas.

Entrances and Aisles

Trees and landscaping can provide a clear entrance to the property and direct attention toward the most significant buildings.

Planting Islands

These spaces are located at the end of parking rows, defining access points to each row, and at intermediate points, providing space for an even distribution of trees. Islands between rows are a traffic safety measure; drivers cannot speed across a lot and endanger others.

Number and Distribution of Trees

An even canopy is significant by providing a pleasant place to park and achieving environmental benefits. Typical standards include one shade tree for 8 to 10 parking spaces or one shade tree within 60 feet of each parking space.

Species

Large-maturing shade trees are most beneficial. A variety of species should be planted to avoid disease problems. Certain trees should be excluded; for instance, sweetgum, hickory, and walnut trees shed nuts that can dent cars or be like ball bearings underfoot. Other trees such as white pine and magnolias should be planted in places where their low evergreen branches will not block a driver's view of intersections or aisle entrances. Lists of appropriate species are presented in Chapter 4.



Huntersville, North Carolina: An example of a parking lot with roughly, one tree per 10 parking spaces

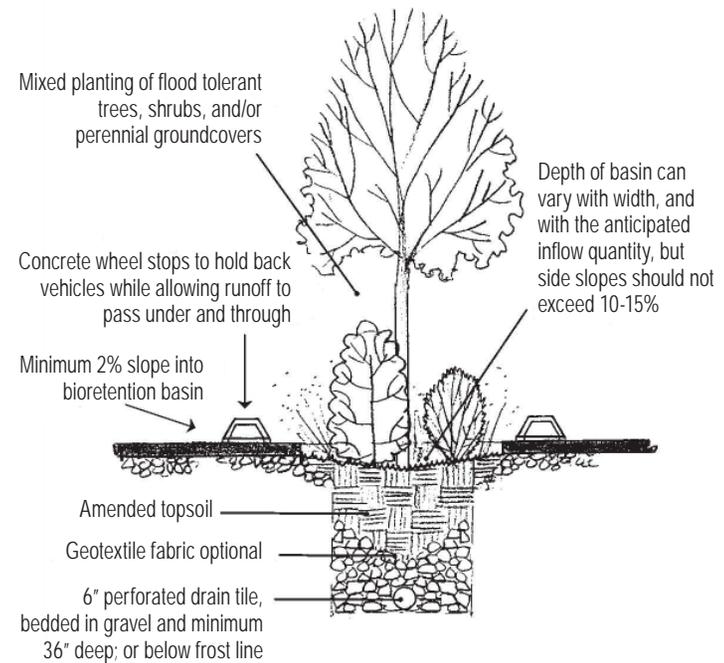
Planting Space

Parking lots present brutal conditions for tree growth. Good soil and adequate volume of soil are needed for the roots to grow properly. A soil volume of 2 to 3 cubic feet is needed for every one square foot of tree canopy. To provide that area, end islands should run the entire length of parking rows. Intermediate planting islands within rows are ideally designed to span two parking spaces. Some recently developed techniques provide opportunities to plant trees in smaller spaces by using amended soils under asphalt and concrete. In all instances tree trunks must be protected from vehicle bumpers by curbs, bollards, or similar devices.

Stormwater Control Measures

Leaving open spaces for tree growth helps absorb runoff. In addition to planting islands, bio-retention areas can be designed to absorb and filter runoff. These naturally planted areas can exist as parking row dividers or as points at the edges of a lot. Often, they can replace curbs, gutters, and full blown detention basins to filter grease, oil, metals, and other typical pollutant runoff. As shown in Figure 3, drain tile and specially prepared soils are needed. Trees which can adapt to these conditions include red maple, river birch, white ash, green ash, eastern red cedar, black gum, sycamore, London plane tree, black locust, bald cypress, sweet gum, and various oaks, including red, willow, bur, pin, scarlet, and swamp white oak. Heavy nut-bearing species are more appropriate in bio-retention basins that are established at the edge of parking areas.

Figure 3: Cross Section of Parking Lot “Wetland Island”



TREES AND UTILITIES

The other major dimension of streetscapes are utilities, especially overhead power lines. Trees and utilities can coexist with careful planning. The following factors are important:

- Tall trees should be located at least 50 feet from power lines. These trees, which provide beneficial shade in summer and wind protection in winter, include oaks, maples, sycamores, and pines.
- Medium trees should be at least 20 feet from power lines. This group includes sourwoods and thornless honey locusts.
- Short trees that will not grow more than 25 feet high can be planted beneath power lines. These include dogwoods and redbuds.

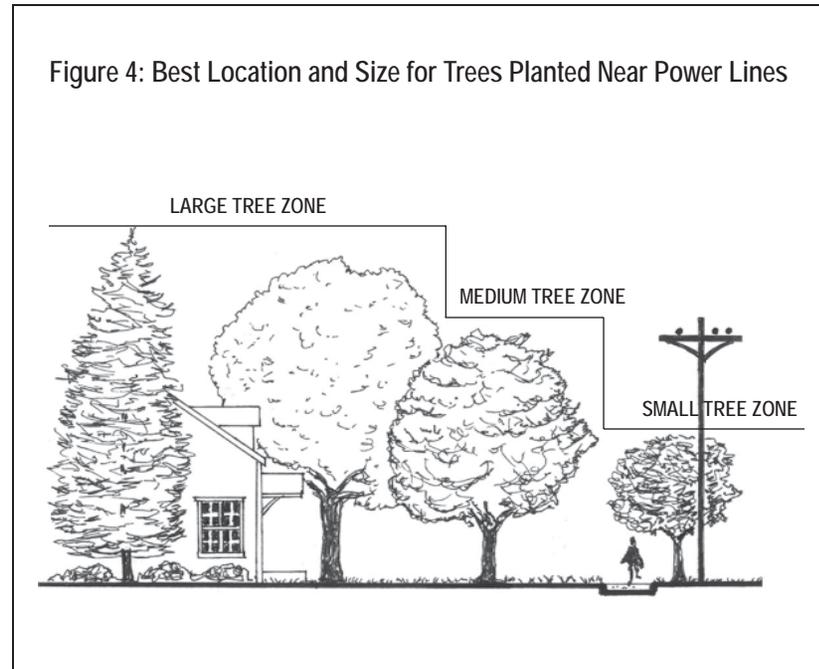
For a complete list of size-appropriate trees, see Chapter 4.

Existing trees that are too close to power lines may need periodic pruning. Proper pruning practices (not tree topping) are outlined by the National Arbor Day Foundation's Tree Line USA program, which recognizes utilities throughout the country using best practices for urban forestry. Locally, the Knoxville Utilities Board is a Tree Line USA utility. Other utilities should pursue the designation. Information, including an application and educational bulletins, is available at www.arborday.org.

Street lights are another utility to consider. Trees should be planted far enough away to avoid blocking the lights. Pruning will occasionally be needed to avoid limb, leaf, and lighting conflicts. In some situations, pedestrian-level lighting can work well beneath the limbs of large trees.

Tree roots can be badly damaged when trenches are cut for underground utilities. At a minimum, utility lines and pipes should be grouped in a single trench. The best method, however, is to tunnel through the root zones with boring equipment. In some cases, the value of the tree justifies hand excavation, digging beneath any roots larger than two inches in diameter.

Figure 4: Best Location and Size for Trees Planted Near Power Lines



Belle Meade, Tennessee: A good solution with small trees planted under the utility lines in the median and large trees in adjacent yards

Chapter 4:

Recommended Trees, Planting Practices & Design Considerations



Most small-maturing trees, like dogwoods, should be planted among shade trees.

This chapter is focused upon the recommended trees that should be planted in various circumstances. City, county and MPC staff are occasionally asked what trees are appropriate for planting near houses, along roadways or sidewalks, in parks or in parking lots. Many of the answers to such questions are contained in the following pages and tables.

RECOMMENDED TREES

The recommended tree lists on the following pages revolve around a wide range of native species, including such large-maturing trees as white oak and sycamores to flowering, under-story trees like sourwood and dogwood. In view of the fact that only half of Knox County is

covered with a significant amount of trees, there are many opportunities to expand the urban forest.

Large Tree Group: *Mature height generally more than 50 feet*

Almost all the trees in this group are native species. The use of native plants is important for a number of reasons. Native trees are significant in sustaining habitats because birds, insects and mammals use native trees to fulfill their biological needs. These large trees create canopy and make a major impact in creating an urban-suburban forest and park-like settings, especially in providing shade along streets and sidewalks. Large-maturing species should be the first choice in most tree planting programs.

Some large trees have severe limitations in some circumstances. Messy fruit, thorny branches, hard nuts that make walking difficult, root systems that tear up sidewalks and drains, or intolerance to urban conditions are among the limitations. Care must be taken in selecting places for such trees as buckeyes, chestnuts, hickories, walnuts, honey locusts and black locusts.

Medium Tree Group: *Mature height generally 30 to 50 feet*

While this group contains many native trees, a variety of ornamental species is also included in the tables. Trees on this list can be used in many situations, including such places as road medians and public grounds.

Small Tree Group: *Mature height generally less than 30 feet*

This list includes many of the native flowering trees that brighten Knox County's landscape every Spring, including dogwood, redbud and

LARGE TREE GROUP Mature Height More than 50'	Table 1: LARGE TREE SPECIES RECOMMENDATIONS						
	Interchanges/ Grade Separations	Medians	Parking Lots or Similar 'Hardscape'	Near Sidewalks	Under Utility Lines	Visibility Concern Areas**	Yards
Green Ash*	YES	YES	YES	YES	NO	YES	YES
American Basswood (Linden)*	YES	YES	YES	YES	NO	YES	YES
White Basswood (Linden)	YES	YES	YES	YES	NO	YES	YES
American Beech*	YES	YES	NO ^B	NO ^B	NO	YES	YES
European Beech	YES	YES	NO ^B	NO ^B	NO	YES	YES
Blackgum*	YES	YES	NO	NO	NO	YES	YES
Yellow Buckeye	YES	NO	NO	NO	NO	YES	YES
Bald Cypress*	YES	YES	NO	NO	NO	YES	YES
American Elm	YES	YES	YES ^C	YES ^C	NO	YES	YES
Hackberry*	YES	YES	NO	NO	NO	YES	YES
European Hornbeam	YES	YES	YES	NO	NO	NO	YES
Ginkgo	YES	YES	NO ^D	NO	NO	YES	YES ^E
Red Maple*	YES	YES	YES	YES	NO	YES	YES
Sugar Maple*	YES	YES	YES	YES	NO	YES	YES
Bur Oak	YES	YES	NO ^B	NO ^B	NO	YES	YES
Chestnut Oak*	YES	YES	YES	YES	NO	YES	YES
Chinkapin Oak*	YES	YES	NO ^B	NO ^B	NO	YES	YES
English Oak	YES	YES	YES	YES	NO	YES	YES
Northern Red Oak*	YES	YES	YES	YES	NO	YES	YES
Sawtooth Oak	YES	YES	YES	YES	NO	YES	YES
Scarlet Oak*	YES	YES	YES	YES	NO	YES	YES
Shumard Oak*	YES	YES	YES	YES	NO	YES	YES
Southern Red Oak*	YES	YES	YES	YES	NO	YES	YES
White Oak*	YES	YES	YES	YES	NO	YES	YES
Willow Oak*	YES	YES	YES	YES	NO	YES	YES
Loblolly Pine*	YES	NO	NO	NO	NO	NO	YES
Pitch Pine	YES	YES ^A	NO	NO	NO	NO	YES
Shortleaf Pine*	YES	YES ^A	NO	NO	NO	NO	YES
White Pine*	YES	YES ^A	NO	NO	NO	NO	YES
London Planetree/Sycamore* ^F	YES	YES	NO	NO	NO	YES	NO
Tulip Poplar*	YES	YES	YES	YES	NO	YES	YES
Dawn Redwood	YES	YES ^A	NO	NO	NO	NO	YES
Sweetgum*	YES	YES	NO ^B	NO ^B	NO	YES	YES
Black Cherry*	NO	NO	NO	NO	NO	NO	YES
Virginia Pine*	NO	YES ^A	YES	NO	NO	NO	YES
Laurel Oak	YES	YES	NO	YES	NO	NO	YES
Winged Elm	YES	YES	YES	NO	NO	NO	YES
Eastern Hemlock	NO	NO	NO	NO	NO	NO	YES

* Native to south central United States

**Tree placement and maintenance procedures should be respectful of sight distance

A. If site does not obstruct visibility and median width is acceptable

B. Large nuts can cause difficulties under foot

C. If hybrid, disease-resistant variety is used

D. Because of slow-growing nature and 'stick-like' appearance

E. Male trees, only

F. Two different species; both can produce pollen, causing allergies

MEDIUM TREE GROUP Mature Height 30' - 50'	Table 2: MEDIUM TREE SPECIES RECOMMENDATIONS						
	Interchanges/ Grade Separations	Medians	Parking Lots or Similar 'Hardscape'	Near Sidewalks	Under Utility Lines	Visibility Concern Areas**	Yards
Arborvitae*	YES	YES	YES	NO	NO	NO	YES
River Birch*	YES	YES	NO	NO	NO	YES	YES
Catalpa*	YES	YES	NO	NO	NO	NO	YES
Atlantic White Cedar	YES	YES ^A	YES ^B	NO	NO	NO	YES
Deodar Cedar	YES	YES ^A	YES ^B	NO	NO	NO	YES
Eastern Red Cedar*	YES	YES ^A	YES ^B	NO	NO	NO	YES
Kentucky Coffeetree	YES	YES	NO	NO	NO	YES	YES
Amur Cork Tree	YES	YES	YES	YES	NO	YES	YES
Cryptomeria	YES	YES	YES ^B	NO	NO	NO	YES
Lace-bark Elm	YES	YES	YES	YES	NO	YES	YES
Smooth Leaf Elm	YES	YES	YES	YES	NO	YES	YES
Eastern Hemlock*	YES	YES ^A	YES ^B	NO	NO	NO	YES
American Holly*	YES	YES	YES ^B	NO	NO	NO	YES
Thornless Honeylocust	YES	YES	YES	YES	NO	YES	YES
American Hornbeam*	YES	YES	YES	NO	NO	YES	YES
Eastern Hophornbeam*	YES	YES	YES	NO	NO	YES	YES
Little-leaf Linden*	YES	YES	YES	YES	NO	YES	YES
Silver Linden*	YES	YES	YES	YES	NO	YES	YES
Black Locust*	YES	YES	YES	NO	NO	YES	YES
Southern Magnolia*	YES	YES ^A	NO	YES	NO	NO	YES
Sweetbay Magnolia*	YES	YES	YES ^B	YES	NO	NO	YES
Hedge Maple	YES	YES	YES	YES	NO	YES	YES
Trident Maple	YES	YES	YES	YES	NO	YES	YES
Austrian Pine	YES	YES ^A	YES ^B	NO	NO	NO	YES
Japanese Red Pine	YES	YES	YES	NO	NO	NO	YES
Chinese Pistache	YES	YES	YES	YES	NO	YES	YES
Sassafras*	YES	YES	NO	YES	NO	YES	YES
Sourwood*	YES	YES	NO	YES	NO	YES	YES
Colorado Blue Spruce	YES	YES ^A	YES ^B	NO	NO	NO	YES
White Spruce	YES	YES	YES ^B	NO	NO	NO	YES
Weeping Willow ^C	YES	NO	NO	NO	NO	NO	YES
Yellowwood*	YES	YES	YES	YES	NO	YES	YES
Zelkova	YES	YES	YES	YES	NO	YES	YES

* Native to south central United States

**Tree placement and maintenance procedures should be respectful of sight distance

A. Avoid planting where there are breaks in median for turning across travel lanes. Plant where a screen from on-coming car headlights is needed.

B. Use at edges of parking lots for border or buffering purposes. Do not use in islands or medians of parking lots.

C. Avoid near septic systems and similar problem areas.

SMALL TREE GROUP Mature Height Less than 30'	Table 3: SMALL TREE SPECIES RECOMMENDATIONS						
	Interchanges/ Grade Separations	Medians	Parking Lots or Similar 'Hardscape'	Near Sidewalks	Under Utility Lines	Visibility Concern Areas**	Yards
Blackhaw*	YES	YES	YES ^A	NO	YES	YES ^B	YES
Rusty Blackhaw*	YES	YES	YES ^A	NO	YES	YES ^B	YES
Red Buckeye*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Carolina Buckthorn*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Oriental Cherries	YES	YES	YES ^A	NO	YES	YES ^B	YES
Carolina Cherrylaurel*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Flowering Crabapple ^C	YES	YES	YES ^A	NO	YES	YES ^B	YES
Crepe Myrtle	YES	YES	YES ^A	YES	YES	YES ^B	YES
Flowering Dogwood*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Kousa Dogwood*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Pagoda Dogwood	YES	YES	YES ^A	YES	YES	YES ^B	YES
Autumn Flametree	YES	YES	YES ^A	YES	YES	YES ^B	YES
American Fringetree*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Chinese Fringetree	YES	YES	YES ^A	YES	YES	YES ^B	YES
Golden Raintree	YES	YES	YES ^A	YES	YES	YES ^B	YES
Cockspur Hawthorn	YES	YES	YES ^A	YES	YES	YES ^B	YES
Foster Holly	YES	YES	YES ^A	YES	YES	YES ^B	YES
Amur Maple	YES	YES	YES ^A	YES	YES	YES ^B	YES
Japanese Maple	YES	YES	YES ^A	YES	YES	YES ^B	YES
Pawpaw*	YES	YES	YES ^A	NO	YES	YES ^B	YES
Eastern Redbud*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Service Berry*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Carolina Silverbell*	YES	YES	YES ^A	YES	YES	YES ^B	YES
European Smoketree	YES	YES	YES ^A	YES	YES	YES ^B	YES
American Smoketree*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Sourwood*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Mountain Stewartia	YES	YES	YES ^A	YES	YES	YES ^B	YES
Witch-hazel*	YES	YES	YES ^A	YES	YES	YES ^B	YES
Southern Crabapple	YES	YES	YES ^A	NO	YES	YES ^B	YES
Hawthorns ^D	YES	YES	YES ^A	NO	YES	YES ^B	YES

* Native to south central United States

**Tree placement and maintenance procedures should be respectful of sight distance

A. Should not be used for more than 25% of parking lot trees. Do not use in parking lot islands. May be used in parking lot medians

B. If properly trimmed. Some species will need to be pruned in their early years to allow space for pedestrian traffic; additional trimming may be needed.

C. Note that Flowering Crabapple and Red Cedar should not be planted near each other because of potential cedar apple rust disease.

D. Examples include Washington and Wintering Hawthorns



A combination of large evergreen and deciduous trees soften the edge of industrial buildings, like the Nissan Automotive Plant in Smyrna, Tennessee.

flowering cherry. Also included in the list are a variety of ornamental trees that are known to survive well in the region. The smaller trees should be typically planted along with larger, deciduous trees. This is recommended for two reasons: they serve to complement the taller trees on the landscape and they sometimes need the shade of other trees so they are not roasted in hot, dry conditions.

PLANTING CONSIDERATIONS

New research on trees has changed the traditional method of planting, where a hole was dug slightly deeper and wider than the rootball or container. Scientists now recognize that tree roots are naturally shallow and wide spreading, with the majority found in the top 12 inches of soil.

Balled or Containerized Trees

Choose a sunny location for most species. Some trees, like American beech, sugar maple, and dogwood, can tolerate various amounts of

shade. Handle the tree by the rootball, not by the trunk or branches. Avoid planting species that will grow tall beneath utility lines.

Keep the rootball moist and the tree in the shade until it is time to plant. Burlap should be loosened at the top or removed completely.

Dig a hole no deeper than the rootball, but much wider — at least twice as wide, but three to five times is best — so the roots can spread quickly into the loosened adjoining soil and anchor the tree against winds and storms.

Fill the hole with the soil that was dug up unless it is heavy with clay. Too much clay in the hole acts like a giant barrier, forcing the tree's roots to circle round and round and never break through the sides to new soil. If the soil does have a lot of clay, amend it with compost, aged manure, or peat. Do not use sand, which can bind with clay to create a rock-hard cement-like mixture.

Figure 5. Basic Considerations When Planting a Tree

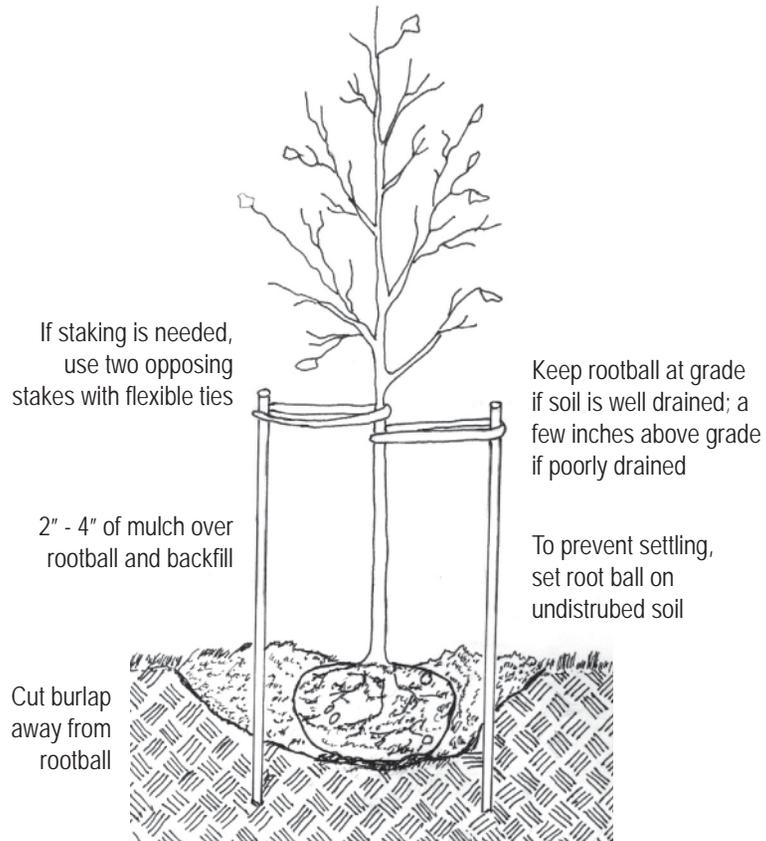
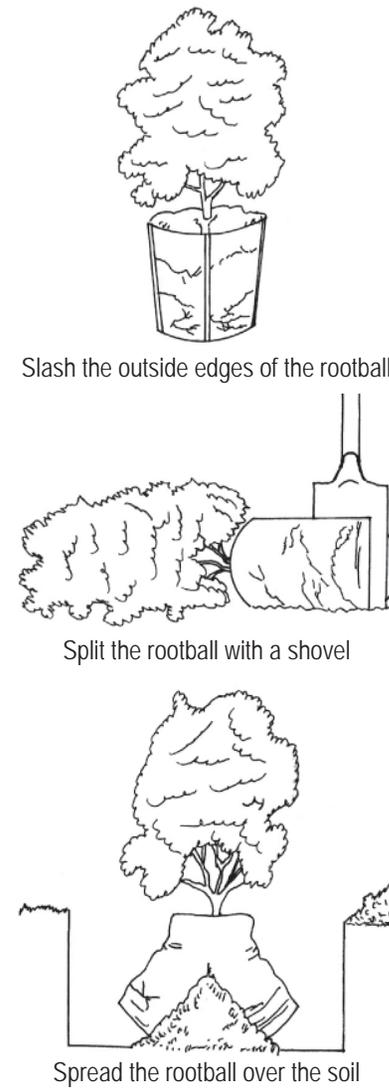


Figure 6. Measures to Avoid Circling Tree Roots





Amended soil should be added when planting trees on sites with clay soils.

Water the tree immediately to provide moisture and settle the soil — avoid packing down the dirt unless it is very fine sand. Mulch is a good idea, but spread it no thicker than three to four inches and do not pile it up against the tree trunk.

Depending on the season and the amount of rainfall, watering will be necessary. The goal is to get the root system large enough for the tree to survive on natural rainfall.

Bare Root Seedlings

Bare root trees should be planted as quickly as possible. Remove any packing materials and soak the roots in water for three to six hours. Some experts recommend dipping a bare root seedling into a water-absorbent polymer gel before planting, or mixing this gel (available from nurseries) into the backfill soil. Dig a wide, shallow hole that will

allow the tree to stand at the same depth as it did in the nursery. Leave a cone-shaped mound of dirt at the bottom of the hole to encourage roots to grow downward and outward. Continue with the same instructions for planting a containerized tree, but water more generously every day for up to 10 days before tapering off.

Staking and Fertilizing

For most trees, staking is not recommended. If the tree trunk is not sturdy, however, use two stakes, one on either side of the tree, for the first year only.

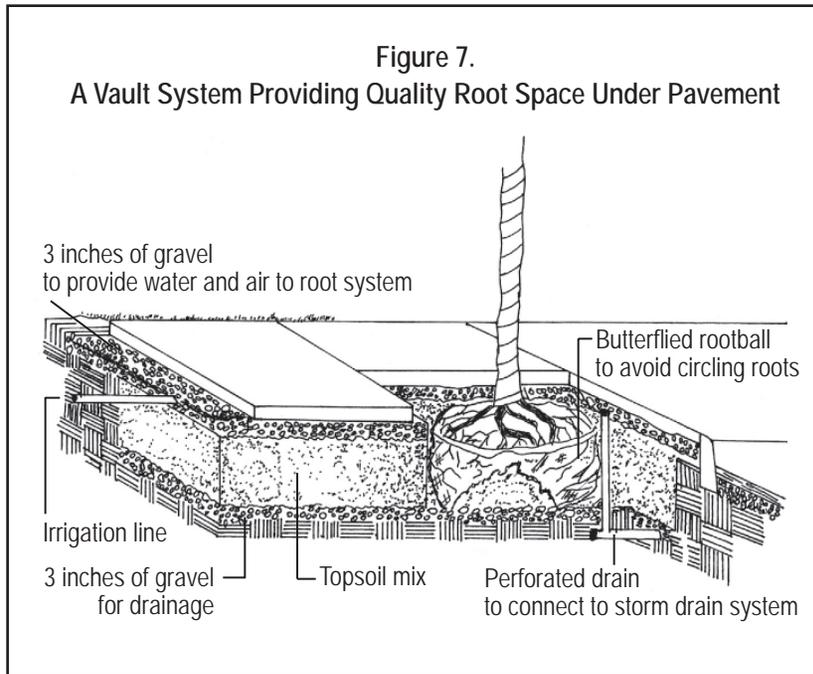
Avoid fertilizing a tree until late spring of the second year following planting.

Soil and Space

For trees to survive to maturity, the focus needs to be on the soil and the planting space around the tree. Sufficient amounts of good soil are needed to store and convey water and nutrients to the roots. In developing roads, sidewalks, building sites and parking areas, the good soils are typically removed during grading. Special attention has to be given to reintroducing good soils for trees to be planted.

- In usual circumstances, the soil surrounding the plant pit will allow for root penetration. In such circumstances backfill with the old topsoil, a mix of the old topsoil and other organic material, or new topsoil.
- Where there is surrounding clay, the planting pit needs to be large and filled with equal volumes of the original soil, compost or organic matter and sand.
- When creating planting pits in sidewalks, parking areas and similar “hardscape,” a minimum of 2 feet of fill (a maximum of 3 feet) is necessary, including (by weight) less than 27 percent clay, at least 50 percent of 1-millimeter sand and 5 percent organic matter (which is 20-35 percent organic matter by volume).

Figure 7.
A Vault System Providing Quality Root Space Under Pavement



Another approach in such areas is the use of “structural soil” that is composed of a mixture of angular crushed stone, soil and an adhesive that maintain pores within the mix for root growth and water and air infiltration.

The critical need is to create enough space when planting trees so that their root system can spread.

- The general area requirements recommended for each class of trees to survive to maturity are as follows:

Small Tree Group = 100 square feet
 Medium Tree Group = 225 square feet
 Large Tree Group = 400 square feet

A Time for Planting

Generally, late October to mid-December and March to May are recommended. Fall planting must be undertaken before soils become so cold that roots do not have a chance to grow. Spring planting should be undertaken before leaf or flower buds open. Extension agents, nursery personnel or similar professionals should be consulted with regard to the planting characteristics of individual species.

TREE MAINTENANCE

Watering

Newly planted trees need watering on a regular basis. For the first week after planting, lightly water the tree several times. The second week, water every other day; then, taper off to once a week. Once the tree is well established, water only during times of drought or mid-summer heat. A good soaking is better than a few casual sprinklings.

Mulching

A layer of mulch slows water from evaporating out of the soil. Most organic materials — leaves, bark, wood chips — are good, and compost is excellent. Spread it no thicker than three to four inches and do not pile it up against the tree trunk.

Pruning

After a couple of years, a transplanted tree will have grown enough to consider pruning. Remove:

- Dead or dying branches (these invite attack by insects and disease)
- Crossed branches (cut off the one that has the least structural benefit to the tree’s crown)
- Branches that form a poor union, generally a too tightly angled “V” (these branches are likely to break off as the tree grows)

The best time to prune is at the end of winter, before the growing season.

Injury

String trimmers are especially dangerous to newly planted trees. It is best to hand weed around young trees or carefully use a herbicide.



Bush Brothers and Company: Designers were able to save trees by protecting their root system and trunks during development.

SAVING TREES DURING CONSTRUCTION

It is easy to see when construction practices have damaged the trunks and branches of trees. But serious damage — the kind that kills trees — is almost always root damage. Roots go well beyond the drip line; they extend in a radius twice the height of the tree. There are three activities that kill most trees:

1. Builders cut roots by trenching or digging near the drip lines of trees. When roots are cut, trees become dehydrated and start to die at the top of the crown.
2. Trucks or heavy equipment compact the soil around trees and smother the roots.
3. Altering the grade around trees often exposes roots and causes loss of structural support, leaving trees subject to wind damage. Dumping excavation fill around trees can smother roots just like soil compaction.

Preserving trees on a building site requires careful planning. First, identify the trees most suitable for saving and erect sturdy, temporary fencing around their drip line prior to clearing. Do not change the grading around the trees. Group any utilities in a single trench or better yet, use boring equipment to tunnel through the root zones. In some cases, the value of the tree justifies hand excavation for utility lines.

In general, a healthy tree will survive if at least 60 percent of its roots remain unaffected by construction. A good rule is to allow one foot of protective radius for every one inch of tree diameter, especially for narrow trees like poplars, cedars, and tightly grouped stands.

Sometimes driveways, sidewalks, and utilities can be relocated slightly to protect existing trees. At other times, a boardwalk can be built to reduce traffic in the area. Building materials should not be stored near desired trees, nor should equipment be washed down in the



By protecting roots during construction, large trees can be saved, even for commercial settings.

vicinity. Trees are very sensitive to chemicals such as concrete washout, petroleum, and paint. Also, be careful when installing irrigation systems; trenching may cut tree roots, and too much moisture may cause roots to rot.

While critical decisions are made during the design stage, follow-through makes or breaks a project. Surveyors, well diggers, excavators, and truck drivers are usually the first to arrive on a site, and their cooperation and understanding of tree preservation techniques is crucial. Ideally, a site supervisor should work in conjunction with an arborist. The cost of hiring an arborist depends on the house and scope of project. The service can run from \$200 for a plan review and site visit to \$2,000 for a full consulting service.

To Help Trees Survive Construction Activity

- Focus on saving trees in masses (minimum area, 50 feet by 50 feet)
- Do not change the grade near a tree. Grading increases erosion, removes rich topsoil, and may damage roots that are typically concentrated in the uppermost 18-36 inches of soil.
- Do not compact the soil near a tree by driving construction equipment on it, storing heavy materials on it, or piling up fill dirt.
- Do not contaminate the soil with cement mixes, paint, asphalt, and other materials.
- Do not dig utility trenches within the tree's root zone
- Do not damage the trunk and limbs with cranes
- Do not use heavy equipment around trees when smoothing out land for lawns

The best way to address these concerns is to erect protective fencing around the tree during construction. An urban forester or landscape architect can help with special techniques such as utility tunnels, dry wells, and retaining walls.

Sensitive Species

Some trees are more sensitive to construction activities than others. The following points should be considered in relation to certain types of trees.

- Some trees have a particularly hard time surviving root disturbances, including soil compaction as well as physical injuries. These species include dogwood, sassafras, tupelo, white oak, northern pin oak, black oak, cherry, and most nut trees.
- Green ash are slow to recover from wounds at the base of the trunk, and northern red oak can become diseased from the slightest wound to the roots or trunk.
- Pine trees are especially susceptible to wind. If they are left newly isolated after surrounding land is cleared, their tall, narrow trunks can snap in half during storms. As a rule, pines are best preserved in groupings.

Chapter 5:

Implementation

Several programs, involving city and county governments, private interests (such as the Home Builders Association), neighborhood groups and public service organizations, are necessary to implement this plan.

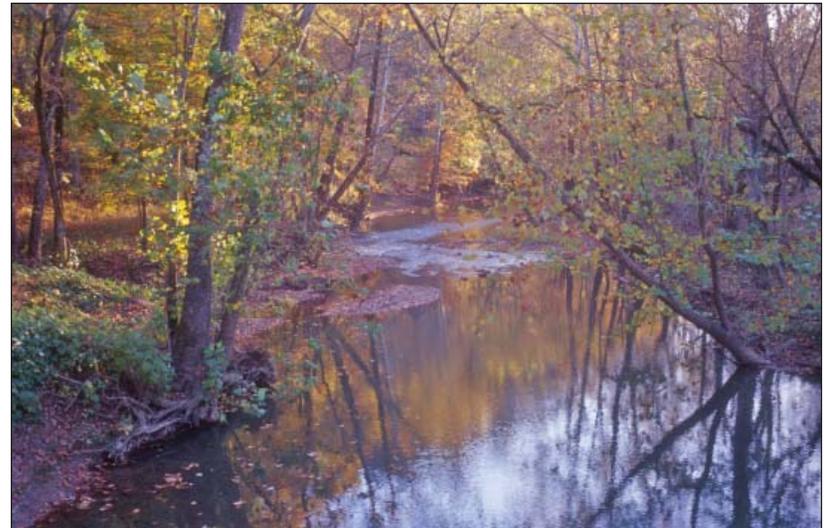
The components of the implementation program include:

- Creation of a county (or city-county) tree board
- Planting trees with public projects
- Budgeting for tree planting
- Public educational programs
- Creation of a Knox Tree Foundation

These points are further outlined in this section.

CREATION OF A COUNTY OR CITY-COUNTY TREE BOARD

While a separate county tree board is possible, the common interests of the city and county to protect the environment and foster more beautiful communities suggest the potential for a city-county tree board. Several places (like Athens-Clark County, Georgia) can serve as models for such a board. The City Tree Board's membership includes people who live within and outside the incorporated city area; additional members from the unincorporated area are recommended. Costs of administering the board require staff support at meetings and the involvement of ex-officio members, such as engineering, water quality, park and planning professionals to serve in advisory capacities. The board itself should be composed of a cross-section of interests, including such professionals as landscape architects, foresters, homebuilders and other developers, educators and interested citizens.



Protection of forested stream corridors is an asset to water quality.

The duties of the board would be:

- To work with city and county officials in creating tree planting programs for public spaces, including parks, school grounds and other civic grounds
- To develop roadside beautification programs
- To recommend annual tree planting priorities
- To advise elected officials on tree planting and protection programs

Several programs should be explored by the new board, including:

Tree Planting Brochures or Similar Publications: Distribute pamphlets that outline in sufficient detail the planting practices and species of trees that should be planted when trees are lost during site development, including an appropriate mix of native shade, evergreen, and small flowering trees.

Innovative Development Techniques: Create the means in land development to encourage tree protection. For instance, forested areas could be saved within subdivisions by allowing trade-offs in lot size and road width for the conservation of permanent open space. Conservation subdivisions are one means to retain forested land.

Tree Protection Programs: Improve ways to conserve trees with development, avoiding clear-cutting while retaining woodlands and large specimen trees.



Innovative designs techniques could include new standards for “skinny” streets and narrow one-way pairs.



Parking lot standards, such as the Town of Farragut’s, also address landscaping around buildings.

Parking Lot Design: Develop standards for planting trees in lots, including distribution of trees within the rows of parking. Standards are also needed for the ratio of the number of trees to the parking area, appropriate species, and provisions for landscaping at the edges of buildings.

Ridge, Hillside and Stream Corridor Protection: Explore the means to address clearing and reforestation. Continue the work of the County’s Site Planning Roundtable to address these concerns.

Utility Company Operations: In response to citizen concerns, work with the utility companies to create tree trimming practices that are aesthetically pleasing and root protection practices that do not damage trees. One of the first objectives of a new tree board should be to further develop pruning practice guidelines and work with all utilities to achieve *Tree Line USA* designations through the National Arbor Day Foundation.



In this illustration of a conservation subdivision, smaller, clustered lots are used to save woodlands, a neighborhood park and portions of a farm.

CONSERVATION SUBDIVISION

Working together through the Site Planning Roundtable, developers and staff from Knox County Engineering and MPC have recognized the potential value of conservation subdivisions. The values revolve around lower costs in land development and protection of environmental resources. These types of subdivisions support the same number of houses as conventional developments, but the houses are built on smaller lots in order to set aside significant natural areas, including forests, ridges, farms, and stream corridors.

Developers benefit from both cost reduction and marketing. Houses are clustered on the portions of the site that are most suitable for development, like well drained, relatively level areas. The formula for a conservation subdivision is usually based on the number of residential units that could be built under existing zoning and translated into

open space protection by reducing lot size. For example, on a 100-acre tract, a developer could reduce average lot size from 10,000 square feet to 6,000 square feet, and after accounting for the reduced road system, could set aside roughly 30 acres of open space. In turn, developers can save significantly by reducing site preparation, water, sewer, and road costs. A very marketable product results in which high quality homes are built in a natural setting with less property to maintain. The conservation subdivision track record shows that home buyers are willing to pay a premium to be next to open space for both environmental and quality of life benefits.

The open space that is set aside can be protected in a variety of ways: through the homeowners association, a local government's park department or foundation, or a conservation organization. A conservation easement should be recorded to protect the land in



perpetuity. Knoxville and Knox County could also use conservation subdivisions as a means for establishing a system of public and privately-controlled open space. Such systems reduce stormwater problems, provide wildlife corridors, and can link schools and parks.

A KNOX TREE FOUNDATION

The local governments, Knox County and the City of Knoxville, should jointly work with non-profit organizations and private interests to create a tree foundation. A tree foundation would be a primary means to:

- Combine the resources of neighborhoods, businesses, and government to purchase, plant, and maintain trees.
- Create tree planting programs, including memorial, graduation, and other gift programs, that can be offered to recognize a loved one or a milestone event.
- Sponsor tree planting on public grounds and space such as roadways, parks, and school grounds.

Another function of a tree foundation might be assisting public officials with field review to see that tree conservation and planting were properly completed in the course of development. Houston's tree foundation works with city staff to verify that trees were planted and survived. This cooperative program helps reduce government costs and keeps citizens actively involved in the beautification of their communities.

Most of America's larger cities have such organizations. Trees Atlanta (www.treesatlanta.org), the Nashville Tree Foundation (www.nashvilletreefoundation.org) and the Tree Trust of Minnesota's Twin Cities (www.treetrust.org) are fine examples. Some foundations such as Atlanta's have a full-time staff. Others, such as Nashville-Davidson County's, are coordinated through voluntary efforts.

A Knox Tree Foundation would be a significant legacy to benefit future generations.

COMMUNITY TREE PROGRAMS

Trees need to be placed in the hands of neighborhood and community groups for planting. This greatly reduces the cost of public planting and provides community pride as trees mature. Several programs are recommended:

East Tennessee ReLEAF

This organization recently has been started through the East Tennessee Community Design Center. Its primary operation will be to accept rescued native plants for distribution to community organizations. The ReLEAF center will be established on an 11-acre site near Loraine Street. In addition to saving plants, educational programs will be established, including demonstration gardens and invasive plant removal.

Grass Roots to Tree Roots

The county should begin a companion program to the city's in which native trees are given to neighborhood or community groups to plant in parks, on school and library grounds, and along roads. In operating this



The grounds of many schools, like Hardin Valley Elementary, could be enhanced with additional trees.

program, a planting and maintenance agreement should be created so that neighborhood associations care for the trees.

Seasonal Arbor Programs

The basis for such programs is already in place in several communities. For instance, in the Beaver Creek watershed, Powell and Halls High School students and teachers have worked with UT's Water Resources Center and AmeriCorps to remove invasive species and plant trees along the creek. Such programs should be fostered throughout Knox County.

Invasive Plant Removal Teams

Invasive plants such as privet, mimosa, and princess tree are so widespread across the county that virtually every measure of control should be fostered. Roadside invasives should be destroyed as part of right-of-way maintenance practices. Collaborative efforts are needed to address other circumstances. A few examples serve as models: The University of Tennessee's Native Plant class and the Isaac Walton League have been instrumental in removing invasives along streams, and the Knoxville Chapter of the Ornithological Society has adopted Sharp's Ridge and taken on removal there. The county is fortunate to

have members of the Tennessee Exotic Pest Plant Council to advise on mechanical and chemical ways to kill invasives.

TRANSPORTATION CORRIDOR LANDSCAPE PROGRAMS

Tree planting programs should be initiated along portions of major thoroughfares in Knoxville and Knox County. The city's Street Tree Master Plan provides an outline of critical highway-oriented corridors where trees should be planted. Chapter 3 of this plan is the county's companion street planting program. A two-part program should be fostered:

- In developing road improvement programs, landscape plans should be created to plant trees as part of the construction project. Use the services of a landscape architect or similarly qualified professional to develop the plan and work with the County Engineering and Public Works Department in its design and implementation.
- Where recent road improvements have been made, appropriate native trees should be planted in rights-of way. As part of the annual county budget, create funding for tree planting for specific areas.



The median space of Callahan Drive could be enhanced with tree planting.

Priorities regarding future road projects should include tree conservation, landscaping, and tree planting in conjunction with the following projects: Alcoa Highway, Emory Road (both east and west of I-75), the Knoxville Regional Parkway, James White Parkway, Lovell Road, Mall Road/Washington Pike improvements, Schaad Road extension, and Western Avenue (to Schaad Road).

Recommended street and highways for tree planting enhancement include Asheville Highway, Callahan Drive, Clinton Highway, Dutchtown Road, Ebenezer/Peter's Road, Governor John Sevier Highway (particularly between Strawberry Plains Pike and the river), Hardin Valley Road, Rutledge Pike, and Strawberry Plains Pike.

FUNDING AND TREE SUPPLY SOURCES

In developing annual tree-planting budgets, the following organizations and agencies may be a source for trees or landscape plan assistance:

- The Arbor Day Foundation (www.arborday.com)
- The Tennessee Department of Agriculture, Division of Forestry
- The U.S. Department of Agriculture's programs on riparian and habitat restoration
- The U.S. Department of Transportation, particularly through the Safe, Accountable, Flexible, Efficient Transportation Equity Act funds (SAFETEA-LU): potentially for corridor improvements and air pollution mitigation
- National Tree Trust (www.nationaltreetrust.org)
- U.S. Fish and Wildlife Service, especially its Partners for Fish and Wildlife program that helps restore wetlands, streams, grasslands, and forested areas to benefit wildlife
- The Tennessee Valley Authority, which provides seedlings for riparian restoration in partnership with AmeriCorps and local high schools (www.tva.gov/river/landandshore/stabilization)

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Appendix A:

A City/County Tree Board Ordinance — Draft

The following resolution and ordinance have been drafted for consideration in creating a Knoxville/Knox County Tree Board as proposed in Chapter 5 of this plan. If the county desires to create its own Tree Board the provisions of these drafts would be applicable. It is imperative that the representatives on the Board be drawn from a wide variety of interests, including landscape architecture, forestry, real estate, the Home Builders' Association and neighborhood/community organizations.

RESOLUTION:

WHEREAS, the health, safety and general welfare of the public and the conservation of the natural resources of Knoxville/Knox County necessitate the implementation of regulations to guide the planting, maintenance and removal of shade and ornamental trees on public property and rights-of-way and

WHEREAS, the forested areas of Knox County are diminishing, have fewer trees remaining to transform carbon dioxide of vehicular and industrial emissions into oxygen, resulting in air quality degradation and

WHEREAS, the removal of forest canopy from urban and suburban areas of Knox County and its replacement with more intensive land uses exacts real costs upon infrastructure including storm water facilities which must be borne by all citizens of the community and

WHEREAS, well-managed city/county forest resources provide benefits to all the citizens of the community with respect to air quality,

water quality, storm water management, temperature amelioration, community aesthetics and general quality of life and increase commercial and residential property values and

WHEREAS, these benefits are crucial to the long-term health, benefit, welfare, and safety of the citizens of Knox County and the City of Knoxville and

WHEREAS, this tree protection ordinance is one part of a dedicated and integrated planning process dealing with land use, impacts of impervious surface, urban hydrology and water quality, air quality, soil erosion, transportation, noise abatement, and wildlife habitat and

WHEREAS, the Knoxville City Council/Knox County Commission finds that it is in the best interest of the public to provide standards and requirements for the conservation, protection and replacement of trees on public property for aesthetic, environmental and health benefits;

NOW, THEREFORE, be it ordained by the Knoxville City Council/Knox County Commission that the Code of Ordinances be amended to add this Article "Public Forest Protection and Planting Ordinance" as follows:

Section 1. Purpose and Intent

- A. It is the purpose of this ordinance to promote and protect public health, safety and general welfare by regulating the conservation, planting, maintenance and removal of trees on public property and rights-of-way in Knox County/City of Knoxville.
- B. It is the intent of the Knox County Commission/Knoxville City Council that the provisions of the ordinance shall apply to public property to promote:
1. The conservation, planting and maintenance of desirable trees; and
 2. The removal of unhealthy, dead or invasive plants
 3. The protection of area residents and visitors from personal injury and property damage and Knox County/City of Knoxville from property damage that is caused or threatened by improper planting, maintenance, or removal of trees in public areas and rights-of-way.

Section 2. Definitions

Administrator: The designee who is responsible for the administration of the provisions of this ordinance.

Note:

There are several alternatives for the administration of this ordinance.

1. *If the county adopts a separate ordinance, the Director of Parks and Recreation Department or the Director of the Engineering and Public Works Department are possible; or*
2. *If a city-county tree board is established, the administration could be co-sponsored through similar departments of the city and county, or through a metropolitan organization established for such purposes.*

Critical Root Zone: That area of tree roots around the tree measured to be no less than 1.5 feet in radius for every inch of trunk diameter measured 4 feet above the ground.

Street Trees: Street trees are herein defined as trees, shrubs, bushes, and all other woody vegetation within all rights-of-way of all streets, roads and thorough fares.

Topping: Topping is defined as the severe cutting back of tree limbs to stubs larger than three (3) inches in diameter within the tree's crown to such a degree so as to remove the normal canopy and disfigure the tree.

Park and Public Trees: Park and Public Trees are herein defined as trees, shrubs, bushes and all other vegetation in public parks and on public property such as school and library grounds to which the public has free access.

Section 3. Public Tree Protection and Care

A. Except as herein after provided, no person except a public utility shall cut, prune, injure or remove any living tree on or in a public right-of-way, park, ground or other public property; or cut or disturb or interfere in any way with the roots of any tree on public property; or spray with any chemical insecticide or herbicide or other oils or whitewash any tree on public property; or place any wire, rope, sign, poster, barricade, or other fixture on a tree or tree guard on public property; or injure, misuse or remove any device placed to protect any such tree;

1. No person shall pile building material or other material, about any tree, plant or shrub in a street in any manner that will in any way injure such tree, plant or shrub.
2. No person shall pave or place gravel, soil or other such material within twelve (12) feet of any tree on public property, unless approved by the county/city administrator.
3. No person shall dump, pour or spill any oil, herbicide, insecticide or other deleterious matter upon any tree or tree space in any street or within the critical root zone of any tree, or keep or maintain upon any street, any receptacle from which oil or

herbicide, pesticide or other deleterious matter leaks or drips, or said material onto any parking or concrete gutter so as to injure any tree on any public property.

4. No person shall use the rights-of-way, parks, sidewalks, or public places to dump grass clippings, tree trimmings, rocks or refuse of any nature.
5. No person shall decorate a public tree or place advertising matter, posters or political placards on trees or in public properties.

Section 4. Notification and Penalties

- A. Any person who shall injure, damage or destroy any public tree situated within public rights-of-way, park or other public property shall promptly notify the County/City Administrator of such fact and shall, within such reasonable time as specified by the County/City Administrator, repair or replace the same to the satisfaction of the County/City Administrator.
- B. Should the person fail or refuse to repair or replace the damaged or destroyed trees or plants within such reasonable time, the County/City Administrator shall do or cause to be done the necessary repairing or replacement, and the costs of this work shall be recovered from the person responsible for the damage or destruction by, a proper action of law. In any such action, *The Guide for Establishing Values of Trees and Other Plants*, published by the Council of Trees and Landscape Appraisers, current edition, shall form the basis for establishing any monetary damages due for damage or destruction to the tree. In addition, the County/City may recover for any other damages or losses to which it is entitled by law.

Section 5. County/City Requirements

The County/City shall have the right to plant, prune, maintain and remove trees, plants and shrubs within the rights-of-way of all streets, parks, squares, and public grounds, as may be necessary to insure public safety or to preserve or enhance the symmetry and beauty of such public grounds. All tree work taking place on public property being conducted by contractors, sub-contractors, or county/city employees will conform to International Society of Arboriculture and ANSI 300 and Z-133 arboricultural standards for tree work.

Additionally, it shall be unlawful as a normal practice for any person, firm, or government entity/department to top any street tree, park tree, or other tree on public property. Trees severely damaged by storms or other causes, or certain trees under utility wires or other obstructions where other pruning practices are impractical may be exempted from this provision of this ordinance by receipt of written notification from the Administrator for each instance allowing such actions.

It shall be unlawful for any entity, utility, citizen, tree care company or government to trench, cut, grade, clear, or fill within the critical root zone of any public tree without the expressed written consent of the Administrator.

Section 6. Duties of the Administrator

It shall be the expressed duty of the Administrator, when necessary, to issue permits, inspect tree work, require certain tree work to be preformed, and enforce provisions of this ordinance.

Section 7. Private Landowner Responsibilities and Rights

Every owner of any tree overhanging any street or right of way within the city shall prune the branches so that such branches shall not substantially obstruct the view of any street intersection and so that there shall be a clear space of thirteen (13) feet above street surface

or eight (8) feet above the sidewalk surface. Said owners shall remove all dead, diseased or dangerous trees, or broken or decayed limbs that constitute a menace to the safety of the public. The county/city shall have the right to prune any tree or shrub on private property when it interferes with visibility of any traffic control device or sign or line of sight. Nothing in this ordinance is intended to prohibit the planting of street trees by adjacent property owners providing that the selection and location and planting of said trees is in accordance with specifications of this ordinance and with prior approval of the Administrator.

Section 8. Creation and Establishment of a Knox County/City of Knoxville Tree Board

There is hereby created and established a Knox County/City of Knoxville Tree Board which shall consist of 20 members, 10 residents of the unincorporated portions of the county and 10 members from the City of Knoxville who shall be appointed by the respective mayors. The term of the 10 board members to be appointed by each mayor shall be 3 years except that the term of half of the members appointed to the first board shall be for only one year and the term of other half of the members of the first board shall be for two years. In the event that a vacancy shall occur during the term of any member, his successor shall be appointed for the unexpired portion of the term. Members of the board shall serve without compensation. Additionally, the board shall be served by representatives of KUB and one other utility. Ex-official staff should include a representative of each engineering/public service department, the Metropolitan Planning Commission, and each parks department. Such staff shall render information and advise the board; however, they have no vote in matters brought before the board.

A. Tree Board Duties and Responsibilities

1. It shall be the responsibility of the Board to study and develop and update annually, specifications for the care, conservation, pruning, planting, and replanting of publicly owned trees and shrubs in parks, along streets, and in other public areas. This

shall be published as a *Best Practices Manual*, updated annually and presented to the Knox County Commission/Knoxville City Council.

2. The Board, when requested by the County Commissioner or City Council, shall consider, investigate, make findings, and make recommendations upon any special matter or question coming within the scope of its work.
3. The Board may also advise the mayors, County Commission and City Council on other tree protection and planting programs, recommending standards and programs to protect forest and trees within Knox County and the City of Knoxville.
4. The Board shall have the responsibility to recommend special districts be created by the County Commission or City Council, such as downtown, historic or neighborhood preservation districts, and scenic or special highway corridors to conserve and plant trees to enhance the landscape of those districts.
5. The Board shall choose its own officers, make its own by laws, and keep a record of its proceedings. A majority of the members shall be a quorum for the transaction of business.

B. Development of Arboricultural Specifications

The Knox County/Knoxville Tree Board shall develop and maintain arboricultural specifications for tree care and replacement as follows:

1. A list of desirable trees for planting along streets in three size classes based on mature height: small (under 30 feet), medium (30 to 50 feet), and large (more than 50 feet). The Tree Board will also create lists of trees not suitable for planting; a list of invasive plants which should be removed from public properties and rights-of-way.

2. The distance trees may be planted from curbs or curb lines and sidewalks will be in accordance with the three (3) species size classes listed in the arboricultural specifications. No trees may be planted closer to any local streets, curb or sidewalk than the following: small trees, two (2) feet; medium trees, four (4) feet; and large trees, six (6) feet. Specifications for planting in relation to thoroughfares shall be created in respect to recognized highway engineering standards.
3. No street tree shall be planted within thirty-five (35) feet of any local street corner, except on city property measured from the point of nearest intersecting curbs or curb lines. No street tree shall be planted within ten (10) feet of any fire hydrant.
4. No tree, other than those particularly designated for planting under overhead lines by the Tree Board, shall be planted under or within ten (10) feet of a line drawn vertically below any overhead utility wire or any recorded utility right-of-way of a greater width. Trees planted within twenty (20) feet must be of a small species listed in the arboricultural specifications developed by the Tree Board.
5. The Tree Board must review a utility tree trimming policy prior to any trimming by the utility company to assure current arboricultural specifications are followed.
6. All stumps of street and park trees shall be removed below the surface of the ground so that the top of the stump shall not project above the surface of the ground where necessary to provide for public safety.

C. Public Education:

It shall be the responsibility of the Knox County/Knoxville Tree Board to undertake a public Arbor Day planting activity and develop and/or secure and distribute tree care and tree benefit information as part of a county wide educational program.

Section 9. Permit and Bond

It shall be unlawful for any person or firm to engage in the business or occupation of pruning, treating, or removing street or park trees or tree within a public right-of-way within the city without first applying for and procuring a permit. No permit shall be required for electric utilities and their agents and contractors or city employee doing such work in the pursuit of their public service endeavors.

Before any permit shall be issued for any tree work on public property, each applicant shall first file evidence of possession of liability insurance in the minimum amounts of \$_____ for bodily injury and \$_____ for property damage indemnifying the city, or any person injured or damaged resulting from the pursuit of such endeavors, as herein described.

Section 10. Penalties for Violations

Any person violating any provision of this ordinance shall be, upon conviction or a plea of guilty, subject to a fine not to exceed \$_____ per offense plus restitution for damages to public trees and property.

Section 11. Emergency Action

It may become necessary, from time to time for emergency crews to prune or remove trees to provide for public safety or restore phone or electrical service. Such an action may be conducted by government, emergency or utility crews without permit so as to allow immediate action to prevent damage or correct a condition which may pose a hazard to life or property. The administrator shall be notified of any such action within 24 hours of the action being initiated, by the entity taking such action, for each instance of action.

Section 12. Indemnification

Nothing contained in this ordinance shall be deemed to impose any liability upon the city, its officers or employees, nor to relieve the owner of any private property from the duty to keep any tree, shrub or plant upon any street tree area on his property or under his control in such condition as to prevent it from constituting a hazard or an impediment to travel or vision upon any public property or right of way or public place within the city.

Section 13. Appeals

Any action of the Administrator may be appealed to and heard by the respective Knox County or City of Knoxville Board of Appeals. An appeal must be filed within __ calendar days after the decision of the Administrator. The appeal shall be in writing and shall be filed with the respective County/City Clerk for placement on the Board of Appeals agenda. The appeal shall clearly specify the reasons for which a hearing is requested. After a hearing, the Board of Appeals shall render its decision, which shall be final unless appealed to the Knox County Commission or Knoxville City Council. To be effective, an appeal must be in writing, state the reasons for the appeal, and must be filed with the appropriate Clerk within __ calendar days after notice of the decision of the Board of Appeals is mailed to the applicant. The decision of the Knox County Commission/Knoxville City Council shall be final.

Section 14. Severability

Should any part or provision of this ordinance be declared by a court of the competent jurisdiction to be invalid, the same shall not affect the validity of the ordinance as a whole or any part thereof other than part held to be invalid.

Appendix B:

Slope Restoration

This appendix has been written to address the difficult problem of re-establishing forest cover when steep hillsides have been graded or cleared. A number of factors must be taken into account:

- As the slope is graded, the topsoil (the A Horizon soil) should be moved to an area where it can be protected during the course of development and placed back on the slope following completion of the project. This is needed because the soil chemistry would otherwise be drastically changed and the more acidic lower-levels of soil will not support a wide variety of trees.
- Groundcover, such as grass or Crown Vetch, will be needed to prevent erosion on the slopes.
- The aspect of the slope, the direction in which the hillside faces, is another critical concern. North and east facing slopes tend to hold more moisture than south and west exposures.
- The trees that are to be planted first can be looked upon as pioneering species.

Recommended Pioneering Tree Species

For North and East Facing Slopes

- American Beech
- Carolina Buckthorn
- Golden Raintree
- Flowering Crabapple
- Hackberry
- Thornless Honeylocust
- Red Maple
- Chestnut Oak
- Chinkapin Oak
- Sawtooth Oak
- Loblolly Pine
- Pitch Pine
- Shortleaf Pine
- Virginia Pine
- White Pine
- Southern Crabapple
- Sourwood
- Tulip Poplar

For South and East Facing Slopes

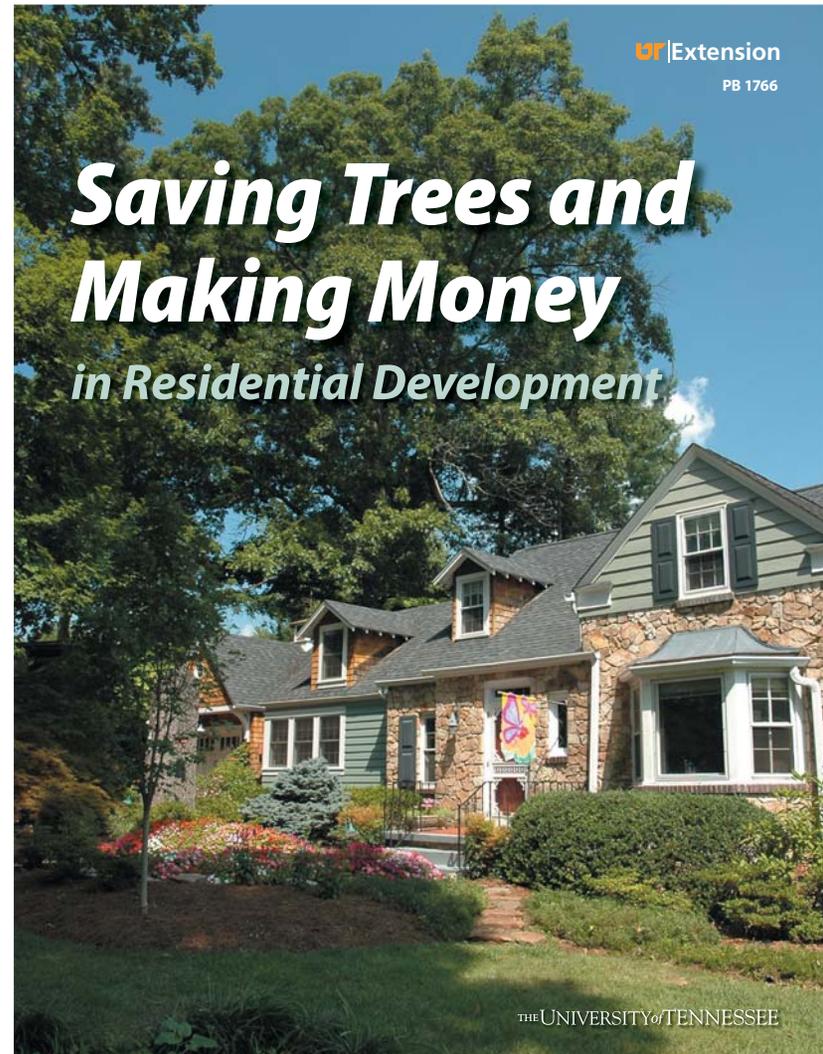
- Loblolly Pine
- Pitch Pine
- Shortleaf Pine
- Virginia Pine
- White Pine

Once the pioneer species are established (generally during a 10 to 20 year period), succession to native hardwoods will take place (a process that will take decades).

Appendix C:

Saving Trees and Making Money in Residential Development

MPC staff presented an earlier draft of this plan to the Home Builders Association in the fall of 2005. The Association felt that one of the basic needs was a brochure or similar guide on how to protect trees and what trees should be planted. Such a guide has been written by University of Tennessee Associate Professor of Plant Sciences, Garry Menendez, who serves on the Knoxville Tree Board. What follows is the text of a brochure that is available through UT's Agricultural Extension at www.utextension.utk.edu/publications/pbfiles/PB1766.pdf.



Saving Trees and Making Money in Residential Development

Garry Menendez, Associate Professor
Plant Sciences

We all know it. Saving trees during construction is not easy.

It's a common sight in developments that are 3 – 5 years old. A homeowner had initially purchased a property for its wooded and natural aesthetic appeal and thinks he or she has succeeded in preserving this beauty. When the home is finished and the nearby trees still cast shade, the owner considers the trees to be past the critical stage. It isn't until after the interior is furnished and the lawn is established that the homeowner soon notices he or she is picking up a few more fallen branches in

the yard than is customary. Eventually, the owner looks up and sees the tree in serious decline (usually dieback along the ends of the branches).

As a professional in the housing or construction field, you can have a major impact on how site-sensitive your company is perceived to be by the practices you employ. Preserving existing vegetation does indeed take time and thought, but it can also increase your profit. "Trees are aesthetically pleasing and are well known to increase real estate values by as much as 15 percent."¹

The Economics of Vegetation

Given the finite amount of land that is available for construction, developers often feel pressure to maximize the usability of a property by completely clearing the site. Initially, this may appear to be a viable approach. Many builders and developers interpret real estate solely as dollars acquired per square foot, but two

case studies by the National Association of Home Builders examined smart growth issues that clearly illustrate the relationship

of site-sensitive design and profit.² Also, consider these statistics regarding the value of vegetation prior to developing a site plan:

1. The average base value for a 10-inch diameter tree is \$1729. A tree with a 30-inch diameter has an average base value of \$15,554. (These values are adjusted based on species, location in relation to the house and condition. See section on "What Is a Tree Worth" for formula).³
2. "Quality of product ratings" was 30 percent higher in shopping districts with trees rather than those with barren sidewalks.⁴
3. Studies have shown that wooded areas add \$5,000 to \$10,000 to the value of a residential lot. The added value is higher where wooded areas are adjacent to other protected areas of woodlands.⁵
4. According to other research, prices for products sold in a well-landscaped district compared to the same products in a "no-tree" district were 12 percent higher.⁶
5. Healthy, mature trees add an average of 10 percent to a property's value.⁷
6. In one study, 83 percent of realtors believe that mature trees can have a "strong or moderate impact" on the salability of

homes listed for less than \$150,000. On homes valued at more than \$250,000, this perception increases to 98 percent.⁸

These are just a few of the economic benefits of adding and/or preserving trees on a property. Other benefits include savings in both heating and cooling costs (using deciduous trees to cast shade in summer while still allowing solar radiation to warm the structure in winter), improving air quality through pollution absorption, improved water quality via less runoff, and the often difficult-to-measure quality of life improvement that comes from living in such a setting.

What is a Tree Worth?

Tree appraisers use a basic formula when calculating what a tree with greater than 12 inch caliper is worth. While there are some variations, this is the basic formula:

Value of Tree = Size (cross-section trunk area in square inches or $3.14 \times \text{radius squared}$) x Value per square inch x Condition x Location.⁹

For an 18-inch diameter Willow Oak in good condition and located on a residential lot, the calculation is as follows:

$$254 \text{ sq. in. } (3.14 \times 9 \text{ squared}) \times \$22 \times 95\% \times 80\% = \$3185^{10}$$

A mature tree (one that is larger in stature, greater than 24 inches in diameter and possesses a sizeable canopy) can often have an appraised value of between

\$1,000 and \$10,000.¹¹ Always consult with a certified arborist for more information regarding tree appraisal values.

Deciding What to Keep

In a perfect world, development and tree preservation would co-exist with no sacrifices to either. In residential situations, buyers of homes sometimes pressure builders to save trees that simply do not stand a chance of surviving past 3 – 5 years. It is best to be honest and tell them that with the footprint of the home they have chosen, mature trees within close proximity of construction or soil disturbance (approximately 20 feet) cannot be saved without the construction of retaining walls or other means of grade alteration. While they may not want to hear this initially, you may back up your claim by providing them with an estimate of costs to remove tree(s) early in the construction process and an estimate of what it may cost to remove the same tree(s) after all construction is complete. If they mention a competitor's promise to save large trees, you may advise them that they would be wise to visit a 3 – 5 year-old development that same builder has completed and look up in the canopy of vegetation to note the amount of decline or die-back in some of those "saved" trees.

Not all trees can or should be saved. Smaller, more vigorous trees with a strong leader may be much more beneficial in the

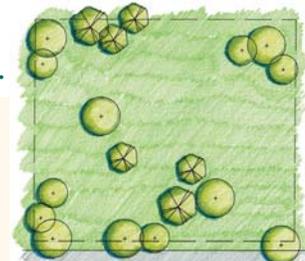


Figure 1. Typical residential lot with several existing trees.

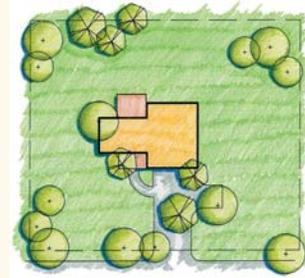


Figure 2. Constructing a home on the property with little thought given to existing vegetation.

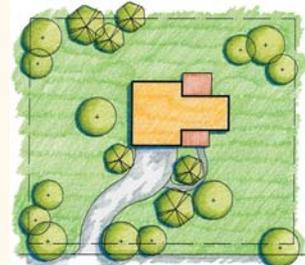


Figure 3. By mirroring the floorplan and repositioning house slightly, all trees could be saved in this scenario.



A common approach to development is to implement predesigned site plans with minimal regard to existing vegetation.

long term than an older, more mature tree that sits in a high-risk zone. You may also mention to a buyer that some very marginal trees (those that look unstable or spindly with poor branching structure) may be better replaced with younger trees that display attractive foliage at a more appreciated eye level. Ultimately, a property should possess both diversity of species and maturity of vegetation.

When deciding which trees to keep during new construction, a balanced and well-thought-out approach may prove to be the most profitable. For example, if well-established trees can be preserved through alternative site-design practices, the money invested in the extra time and ef-

fort it takes to do so might easily be regained in a higher selling price for a more attractive lot. Building up rather than out (multi-story vs. single-floor design) provides the same amount of usable floor space while making less of an impact on a site.

How to Protect Trees During Construction

The four major causes of decline and eventual death of trees during and after construction are compaction of soil, cutting and

filling within the root-zone, physical or mechanical injury and trenching in the root zone. While some trees are more sensitive than others, a general rule is to not add any soil over the root zone of a tree.



This dozer filling is an example of detrimental grading.

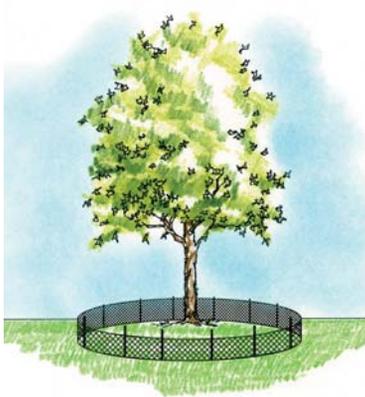


Figure 4. Protective silt fence located beyond tree's dripline.

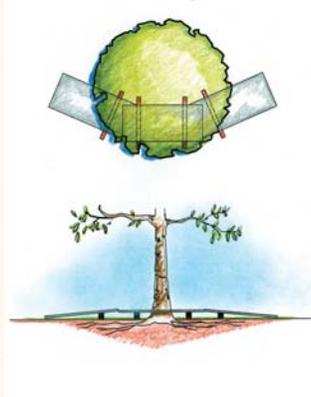


Figure 5. Temporary root zone bridge constructed of cross-ties and steel plates to prevent compaction.

Compaction

Compaction occurs when construction equipment (even standard-sized trucks) makes multiple trips or is stored on the ground over the tree root-zone for an extended period of time. This can also occur with the addition of soils or construction materials.

To protect a tree from this hazard, construct a temporary fence around the entire perimeter of a tree's drip line and let all contractors and sub-contractors know that this is off limits to all equipment and disposal of anything other than clean water. Since the bulk of a tree's roots are a mat of finely meshed feeder roots that fan out well beyond the drip line of a tree and occur primarily within the top 12 inches of soil, this protective zone may extend well beyond the drip line.

Detrimental Grading

Altering the amount of soil within a tree's root zone either by adding or removing that which was there prior to construction can cause a tree to die a slow death. Additional soils can lead to compaction and prohibit the flow of water and oxygen to the roots. Removing soil from this area exposes roots, which will cause them to dry out, also prohibiting this exchange. Existing contours on grading plans should be unaltered in a protected tree's root zone.

Trenching

When routing underground utilities, it is critical to avoid any trenching within the drip line of trees to be preserved. There are many special tools available today to help. If the utilities to be buried are fairly minimal in size, air excavation (a tool that uses compressed air to blow soil away from roots) may work well. Most irrigation and utility construction companies possess tunneling or auguring devices that can be used to literally bore a tunnel beneath the critical zone in which trees' roots grow.

Installing such high-impact elements as drain fields is another issue. The amount of trenching needed to accommodate these will eventually kill any tree in this area. Therefore, it is best to remove any affected large trees at the time of construction, while the costs will be relatively small compared to post-construction removal.

Being creative with construction practices can go far in saving a large tree. Using a post and lenti system to build over a portion of a tree's roots may allow soil to remain relatively undisturbed. Therefore, the roots are able to get oxygen and water. Although roots in this zone may not receive any water, as long as this area is less than 25 percent of the total root mass and the remainder has access to water, this tree may stand a much higher chance of survival than if trenching for a foundation had occurred.

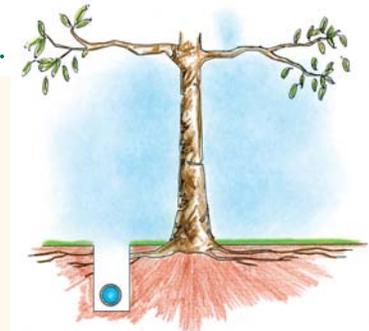


Figure 6. Traditional trenching devastates a tree's root system.

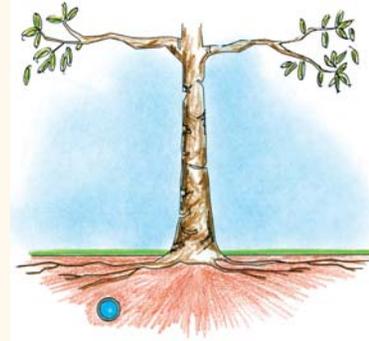


Figure 7. Boring beneath root zone saves tree's root system.

Mechanical Injury

Mechanical injury occurs when construction equipment bumps and scrapes tree trunks or damages and breaks branches. This is probably one of the most avoidable of all practices. Project managers and contractors may simply construct the high-visibility plastic fencing mentioned earlier around trees to be protected. Any undesirable understory brush within the drip line of the tree should be removed by hand, rather than using machinery, to avoid soil compaction and mechanical injury. The larger the area fenced off, the better. Although a tree's roots are often equal to the mass of its canopy, it may be difficult to preserve 100 percent of this area and still perform any construction. A rule of thumb is to fence 1 foot of radius per inch caliper (for a 12-inch tree, a 12-foot radius or 24-foot diameter circle is marked and fenced).

Post-Development Replanting

After a property has been developed and has stabilized, it is time to plan(t) for the future. The benefits of planting trees are lengthy, but there is an important question to ask: How much of your site-planting work will be around for your grandchildren to enjoy? There are two classifications of trees to consider. The first is the smaller, flowering, decorative trees, which are very popular. They are attractive,

relatively inexpensive and non-threatening but offer little in the way of shade and longevity. The second category includes some species that are often classified as "legacy trees." These are shade trees that are typically slower growing but stronger and much longer-lived. Since they will be around for a long time, placement is critical.

If a lot size allows, larger-growing trees should be planted at least 20 feet away from structures. Choose strong trees with good branching habits and of the appropriate foliage texture.

Large-leaved trees such as Sycamore and Tulip Poplar will be better off planted in a setting where they may be permitted to drop their leaves without having to be collected. Smaller-leaved trees such as Willow Oak or Dawn Redwood produce relatively little debris when fall arrives and are less of a threat to clog gutters and drain inlets.

An abbreviated list of trees to consider planting in the Southeast is shown below. Do not plant trees that will grow large under utilities or in areas where they may potentially block park-

Recommended Legacy Trees

Common Name	Scientific Name
Scarlet Oak	<i>Quercus coccinea</i>
American Linden	<i>Tilia americana</i>
Tulip Poplar	<i>Liriodendron tulipifera</i>
Swamp White Oak	<i>Quercus bicolor</i>
Bald Cypress	<i>Taxodium distichum</i>
Ginkgo (male)*	<i>Ginkgo biloba (male)</i>
Autumn Blaze Maple	<i>Acer x freemanii</i>
Sugar Maple	<i>Acer saccharum</i>
Black Gum	<i>Nyssa sylvatica</i>
Willow Oak	<i>Quercus phellos</i>
White Ash	<i>Fraxinus americana</i>
	"Rose Hill" or "Autumn Purple"
Japanese Zelkova*	<i>Zelkova serrata</i>
Lacebark Elm*	<i>Ulmus parvifolia</i>

* Non-native species that are not invasive

ing lot lighting from illuminating dark, higher-risk zones. With regard to care, select trees that are self-sustaining in the environment after a couple years of watering. If irrigation is needed to keep a tree alive, it shouldn't be considered in the first place. For a complete list of native trees, contact the Tennessee Valley Authority (TVA) and ask for the publication, "Native Plants of the Tennessee Valley" (no. 5 in Riparian Restoration

Fact Sheet Series – www.tva.gov/river/landandshore/stabilization/plantsearch.htm.

Our landscapes are far from static. They will always change and hopefully mature. Developers, builders and realtors with an appreciation and respect for land and the landscape will be in high demand as the general public's knowledge of ecology and environment increases. Being attuned to natural ele-

ments and knowledgeable about beneficial landscape practices can result in higher profits, while also earning one the reputation of being an individual or company who cares about much more than just dollars per square foot.

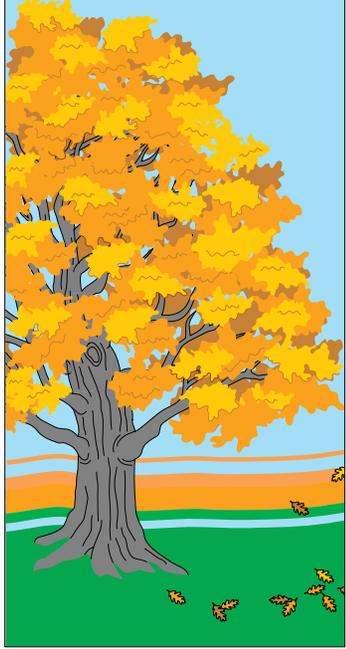
Resources:

- 1 National Association of Home Builders – NAHBNET issue summary, February 1990.
- 2 "Smart Growth Case Study: Newport" and "Smart Growth Case Study: The Preserve at Hunter's Lake" www.nahb.org/generic.aspx?genericContentID=437
- 3 "Growing Greener Cities, A Tree Planting Handbook" (Global Releaf, Living Plants Press, Los Angeles, 1992).
- 4 Washington Community Forest Council. "TreeLink 1999.
- 5 The Maryland-National Capital Park and Planning Commission, Prince George's County Planning Department.
- 6 Research performed by Kathy Wolf. www.treesforyou.org
- 7 USDA Forest Service
- 8 American Forests, Arbor National Mortgage
- 9 [Guide for Plant Appraisals](#), authored by the Council of Tree and Landscape Appraisers (CLTA).
- 10 [Guide for Plant Appraisals](#), authored by the Council of Tree and Landscape Appraisers (CLTA).
- 11 Council of Tree and Landscape Appraisers

Appendix D:

Planting Trees: A Guide for Homeowners

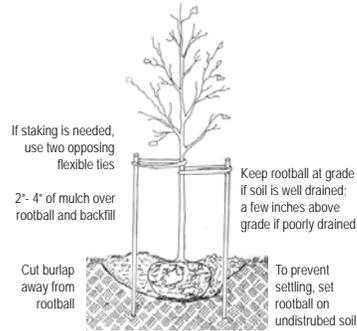
This pamphlet was created to encourage proper tree planting practices and to realize the goal of using native species in landscaping yards, road sides and public grounds.

<p>Pruning: After a couple of years, a transplanted tree will have grown enough to consider pruning. Remove:</p> <ul style="list-style-type: none"> • Dead or dying branches (these invite attack by insects and disease) • Crossed branches (cut off the one that has the least structural benefit to the tree's crown) • Branches that form a poor union, generally a too tightly angled "V" (these branches are likely to break off as the tree grows) <p>The best time to prune is at the end of winter, just before the growing season.</p> <p>PLANTING A MIX OF TREES A variety of native trees should be used in landscaping a yard. Native species are generally drought and disease resistant and their fruit, such as nuts and berries, supports the birds and mammals of our region.</p> <p>In selecting trees from the following list, keep in mind the locations where you would like to plant them. Large maturing trees should be planted away from houses, utility lines and sidewalks as their roots and limbs could cause problems in the future. Small maturing trees, like dogwoods and redbuds, should be planted as under-story species, adding seasonal color to the landscape.</p> <p>Evergreen trees should be planted where they will block winter wind, if your lot is exposed to chilly breezes. Shade trees should be selected for south and west facing sides of the house. Both these measures will reduce energy costs.</p> <p>Recommended Trees for Yards LARGE (usually growing 50 feet or more in height)</p> <ul style="list-style-type: none"> • Green Ash • American Basswood (Linden) • American Beech • Blackgum • American Heritage Elm • Red Maple • Sugar Maple • Chestnut Oak • Chinquapin Oak • Northern Red Oak • Scarlet Oak • Red Oak • White Oak • Willow Oak 	<ul style="list-style-type: none"> • Loblolly Pine • Shortleaf Pine • White Pine • Sycamore • Tulip Poplar • Sweetgum • Black Walnut • Black Cherry • Virginia Pine <p>MEDIUM (usually growing 30 to 50 feet in height)</p> <ul style="list-style-type: none"> • Arborvitae • River Birch • Catalpa • Eastern Red Cedar • Eastern Hemlock • American Holly • American Hornbeam • Black Locust • Southern Magnolia • Sweetbay Magnolia • Sassafras • Sourwood <p>SMALL (usually growing less than 30 feet in height)</p> <ul style="list-style-type: none"> • Blackhaw • Red Buckeye • Carolina Buckthorn • Carolina Cherrylaural • Flowering Dogwood • American Fringetree • Pawpaw • Eastern Redbud • Service Berry • American Smoketree • Witch Hazel <div data-bbox="1228 1185 1354 1347" style="text-align: center;"> <p>KNOXVILLE-KNOX COUNTY M P C METROPOLITAN P L A N N I N G C O M M I S S I O N T E N N E S S E E</p> <p>Suite 403 • City County Building 400 Main Street Knoxville, Tennessee 37902 8 8 8 • 2 1 5 • 2 5 0 0 F A X • 2 1 5 • 2 0 8 8 www.knoxmpc.org</p> </div> <p>This brochure was partially funded by the US Department of Agriculture Forest Service and the Tennessee Department of Agriculture Division of Forestry.</p>	<div data-bbox="1533 511 1879 544" style="text-align: center;"> <p>A HOMEOWNER'S GUIDE</p> </div> <div data-bbox="1533 568 1879 755" style="text-align: center;"> <h1>Planting Trees</h1> </div> 
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TREE PLANTING BASICS

New research on trees has changed the traditional method of planting, where a hole was dug slightly deeper and wider than the rootball or container. Scientists now recognize that tree roots are naturally shallow and wide spreading, with the majority found in the top 18 inches of soil.

Figure 1. Basic Considerations in Planting a Tree



Planting Balled or Containerized Trees:
Choose a sunny location for most species. Some trees, like American beech, sugar maple, and dogwood, can tolerate various amounts of shade. Handle the tree by the rootball, not by the trunk or branches. Avoid planting species that will grow tall beneath utility lines.

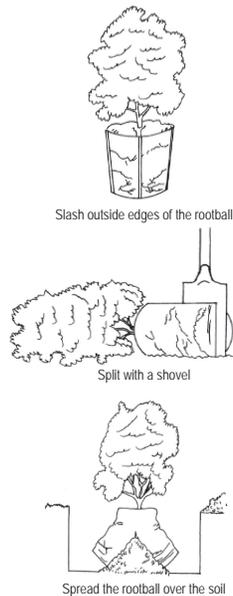
Keep the rootball moist and the tree in the shade until it is time to plant. Burlap should be loosened at the top or removed completely. Containers should be removed. Check the rootball; if roots have circled within the ball or container, follow the procedures in Figure 2. This will allow roots to spread out as the tree grows.

Dig a hole no deeper than the rootball, but much wider – at least twice as wide, but three to five times is best – so the

roots can spread quickly into the loosened adjoining soil and anchor the tree against winds and storms.

Sufficient amounts of good soil are needed to store and convey water and nutrients to the roots. Fill the hole with the soil that was dug up unless it is heavy with clay. Too much clay in the hole acts like a giant pot, forcing the tree's roots to circle round and round and never break through the sides to new soil. If the soil does have a lot of clay, amend it with compost, aged manure, or peat. Do not use sand, which can bind with clay to create a rock-hard cement-like mixture.

Figure 2. Measures to Avoid Circling Roots



Planting Bare-Root Seedlings:



Bare root trees should be planted as quickly as possible. Remove any packing materials and soak the roots in water for three to six hours. Some experts recommend dipping a bare root seedling into a water-absorbent polymer gel before planting, or mixing this gel (available from nurseries) into the backfill soil.

Dig a wide, shallow hole that will allow the tree to stand at the same depth as it did in the nursery. Leave a cone-shaped mound of dirt at the bottom of the hole to encourage roots to grow downward and outward. Continue with the same instructions for planting a containerized tree, but water more generously every day for up to 10 days before tapering off.

A TIME FOR PLANTING

Generally, late October to mid-December and March to May are the best times to plant trees. Fall planting must be undertaken before soils become so cold that roots do not have a chance to grow. Spring planting should be undertaken before leaf or flower buds open. Extension agents, nursery personnel or similar professionals should be consulted about the planting characteristics of individual species.

MAINTAINING TREES

Watering:

A newly planted tree needs watering on a regular basis. For the first week after planting, lightly water the tree daily. In the second week, water every other day, then taper off to once a week. Once the tree is well established, water only during times of drought or mid-summer heat. A good soaking is better than a few casual sprinklings.

Staking and Fertilizing:

For most trees, staking is not recommended. If the tree trunk is not sturdy, however, use two stakes, one on either side of the tree, for the first year only. Avoid fertilizing a tree until late spring of the second year following planting.

Mulching:

A layer of mulch slows water from evaporating out of the soil. Most organic materials – leaves, bark, wood chips – are good, and compost is excellent. Spread it no thicker than three to four inches and do not pile it up against the tree trunk.

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