

# WAKE FOREST

## OPEN SPACE & GREENWAY PLAN

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# WAKE FOREST OPEN SPACE & GREENWAY PLAN

Prepared for:

Wake Forest Planning Department  
Wake Forest Parks & Recreation Department

Prepared by:

Greenways Incorporated

Open Space & Greenway Plan funded by:

Wake County  
Town of Wake Forest

January 2002

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# Acknowledgments

This Open Space and Greenways Plan study was made possible by the joint efforts of the Wake Forest Planning Department, the Wake Forest Parks and Recreation Department, and the efforts of local citizens. This public-private partnership represents the broad commitment by individual members of the Wake Forest community to work together to improve the quality of life for area citizens.

A special thank you is given to the persons listed below for their time, support and participation in the completion of this Plan.

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# Executive Summary

The Town of Wake Forest, a community that is poised for future progressive growth and development in the 21<sup>st</sup> Century, has prepared this Open Space and Greenways Master Plan in order to protect the natural and cultural resources that community residents value most. There are three principal goals of the plan: 1) identify parcels and corridors of land that are in need of protection and conservation measures; 2) establish a comprehensive approach that will link greenspace lands and corridors to residential, commercial, institutional and central business areas of the community; and 3) define a concise set of strategies for protecting and conserving these corridors and at the same time developing public use facilities that would provide residents with access to these lands and corridors.

By working towards the goals presented above, greenways and open space will serve to protect stream corridors and their floodplains from degradation due to land use development and poor land management practices. Greenways and open space will serve as valuable components of the park and recreation system, linking residents to popular outdoor resources, including neighborhood and community parks. Greenways will also serve as transportation routes for close-to-home and close-to-work travel, providing residents with a choice for how they complete short-distance trips.

Incorporating public participation was central to the process for producing this Plan. The community was actively engaged through meetings with stakeholders, Town staff, and the general public. Two evening open house type meetings were held to gather community input and display working maps of the community. The input and feedback received from the groups mentioned above were combined to craft the recommendations contained within this Plan. Also incorporated into the process was field research and GIS (Geographic Information System) analysis.

As a result of community meetings, staff and stakeholder comments it is recommended that the Town of Wake Forest supplement it's existing park system with the following parks and open space acquisitions. These acquisition recommendations are broadly defined within this plan to cover geographical areas of the community which were agreed upon throughout the participatory planning process.

## Purpose

## Process

## Key Recommendations

## Key Recommendations

- First - We envision future development of a “central park” between the downtown area and the new bypass.
- Second - There is a need to establish a community park in the east-central area of the community, and there is a possibility that this park could be jointly developed in partnership with Rolesville.
- Third - There was a desire on the part of local residents to have a future community park in the northwestern quadrant of the community.
- Fourth - The Town has been provided with an opportunity to develop a future park along the Neuse River at the intersection with Capital Boulevard.

It is envisioned that these future parks will serve multiple purposes; including active and passive recreation, protection of water quality, flood plain management, and environmental education.

Additionally, this Plan advocates for the protection and conservation of the primary streams of Wake Forest (Horse Creek, Richland Creek, Smith Creek, and Sanford Creek). Finally, it is important to conserve and protect the small town character of Wake Forest by enhancing the main community thoroughfares (US 1/ Capital Boulevard, Durham Road/Wait Avenue, and the new 98-bypass).

### Phasing

Because of the expense, private property issues, and comprehensive nature of this effort a phasing program is required for successful implementation. The Wake Forest Open Space and Greenway System can be broken down into two primary phases of future development in order to be executed in a manageable manner. Phase One focuses on two primary axes. The first focus is on the Smith Creek corridor that runs north-and-south. Wake Forest is experiencing rapid growth along this corridor and the positive impacts of implementing a greenway system would do much to preserve the character of this part of town as well as addressing environmental needs. The second axis in Phase One is the east/west corridor that follows Wait Avenue and Durham Road. The benefits of an east/west corridor are economic and cultural. By developing a bicycle and pedestrian connection through downtown, the greenway system accentuates the commercial center of town and the historic architecture and attractive charm of Wake Forest. Increasingly, US 1/Capital Boulevard is a frequent destination for shoppers. Connecting this area to the town center for cyclists and pedestrians will prove to be an insightful endeavor as the community continues to grow.

Phase Two of the greenway system will seek to expand the greenway system to other parts of the Wake Forest community. Phase Two will extend service to much of the downtown population by providing another north/south corridor along Richland Creek and another east/west corridor along Purnell Road. Additionally, Phase Two will extend eastward, connecting with Rolesville and begin to function as part of a regional, Wake County system.

## Funding

It is estimated that implementing the recommendations of the Phase One plan will cost \$4,019,000. The town will need to work in partnership with outside agents to fund greenway implementation. There are a variety of funding sources that Wake Forest can tap into for assistance in bringing the Open Space and Greenway system into being. The federal government funding source that holds the most promise for greenway funding is the Intermodal Surface Transportation Efficiency Act (ISTEA). Grant recipients are capable of receiving up to an 80 percent match for approved projects. Additional federal funding opportunities are available for community development, land and water conservation, and watershed protection – all of which are positively impacted by greenway development. The State of North Carolina also has a variety of funding source possibilities. Greenways and open space preservation meet the objectives established by a host state departments and divisions. Funding may be sought from programs administered by the Department of Transportation, Division of Parks and Recreation, Wildlife Resources Commission, Department of Corrections, and the Division of Water Resources. There are also funding options that can be pursued locally. Most notably there is money available from a Wake County Open Space Bond that passed in November of 2000. Applying for this money is competitive, but this Plan demonstrates that Wake Forest is prepared to receive funds for open space preservation. One possibility that would enable Wake Forest to raise funds for the greenway and open system would be to create a Wake Forest Greenway Trust Fund as a non-profit 501(c)(3) organization. The Trust Fund would be able to advocate, promote, and encourage greenway development, organize volunteers to assist with implementation and management, sponsor greenway events, and provide an outlet for donations intended specifically for greenway development projects.

# Chapter 1: Introduction

The Town of Wake Forest, a community that is poised for future progressive growth and development in the 21st Century, has prepared this Open Space and Greenways Master Plan in order to protect the natural and cultural resources that community residents value most. There are three principal goals of the plan: 1) to identify parcels and corridors of land that are in need of protection and conservation measures; 2) to establish a comprehensive approach that will link greenspace lands and corridors to residential, commercial, institutional and central business areas of the community; and 3) to define a concise set of strategies for protecting and conserving these corridors and at the same time developing public use facilities that would provide residents with access to these lands and corridors.

The goals for this plan, stated above, are in concert with the goals of other Wake Forest planning initiatives found in the Wake Forest Parks and Recreation Master Plan, Wake Forest Land Use Management Plan, and Land Development Plan. The following statements from these documents demonstrate the importance and concerted effort to protect open space and preserve greenways in Wake Forest.

- The historic and aesthetic aspects of the community are assets to be protected and preserved.
- Development should be compatible with the natural environment including the topography, soils, flood plains and wooded areas.
- Encourage conservation of energy and land resources through higher density development close to the Central Business District and in the appropriate districts.
- Maintain and protect privacy and quiet within residential areas.
- Prevent intrusion of conflicting or harmful land uses.
- Maintain the Central Business District as a viable commercial center, as a source of employment, a convenience and service center, a tax base, and a community focus.
- Provide parks and recreation facilities adequate for a comprehensive program.
- Acquire new park and open space land in accordance with the Parks and Recreation Master Plan.
- Acquire, develop and maintain a system of greenways and bikeways to preserve natural features and the aesthetic character of the Town.

## Purpose

## Consistency with Wake County Program

- Protect environmentally sensitive areas such as flood plains, steep slopes, and water supply watersheds by preventing development which would destroy those areas.
- Preserve open space for aesthetic and environmental purposes.
- Prevent development in areas subject to damage due to flooding or unstable soils.
- Preserve wooded areas by preventing development of flood plains and steeply sloped areas. Other development should be regulated to limit land clearing to the minimum necessary for development.
- Recreation areas and facilities shall be equitably distributed and conveniently located throughout the Town to provide opportunities for all.
- Provide diverse facilities and programs to meet the basic needs of children, teenagers and adults, recognizing the special needs of the elderly, the deprived, and the handicapped.
- A variety of land and water areas adequate in size and strategic in location for both active and passive leisure pursuits and for visual enhancement and conservation shall be provided.

If the goals of this program are met, Wake Forest will have achieved success in enhancing the small town character that is the hallmark of the community. Perhaps most importantly, protecting greenspace that is linked can support natural functions that are important in sustaining a high quality of life for residents of the community.

This Open Space Plan has been prepared to be consistent with a larger comprehensive Open Space Plan for Wake County. The County launched its open space planning efforts in 1999 to preserve natural and cultural landscapes. The County has encouraged and supported the preparation and adoption of municipal open space plans to ensure that there is continuity across jurisdictions. In order to comprehensively evaluate land in Wake County, each municipal government was asked to prepare its own open space plan. Because the character of the land within a municipal area helps define the character of a town, these individual assessments are viewed as critically important for the protection of resources and the way of life throughout the County. Further, the County adopted the following definition for open space to ensure a relationship between municipal plans and the county's open space program:

“Open space is a functional system of natural and cultural resources protected and maintained for the benefit of residents, businesses, and visitors.”

The County's Open Space Program began with a focus on four key watersheds within the County: Falls Lake, Neuse River, Swift Creek and Harris Lake. This initial plan was adopted by County government and has led to the passage of a \$15 million bond referendum and the establish-

ment of Partners for Open Space and the Environment (POSE). Wake County is currently engaged in a comprehensive open space planning effort that will tie together each of the twelve municipal plans.

As Wake County continues to grow in the 21st Century, it is hoped that these efforts of planning for the protection and conservation of open space will ensure that future generations will have access to the special landscapes and waterways that are unique to the County. Preserving and protecting these resources will also enhance the quality of life for future residents and ensure that Wake County is one of the great places to live, work and raise a family.

# Inventory of Existing Conditions

The roots of Wake Forest stretch back to the early 1800's and the purchase of 615 acres by Dr. Calvin Jones. In 1823, the site was home to the "Wake Forest Academy for Boys." In 1834, it was sold to the North Carolina Baptist Convention and became the "Manual Labor Institute." The school grew rapidly and, in 1838, was renamed "Wake Forest College."

The growing school had an increasing need for space and money and decided to divide the property into lots and sell them for \$100 each. Eighty one-acre lots north of the campus and west of the railroad were put on the market in 1839. This area was later known as Faculty Avenue and today constitutes the greater portion of the Wake Forest Historic District. The College was temporarily closed from 1862 to 1866 because of the Civil War.

When the Raleigh and Gaston Railroad station moved from Forestville to Wake Forest College, a substantial increase in the commercial development of Wake Forest was underway. And in 1909, the community drafted its first charter to become the Town of Wake Forest. Steady growth continued into the 1950's, when Wake Forest College was transferred to Winston-Salem, North Carolina, and the existing site was sold to its current occupant, the Southeastern Baptist Theological Seminary.

Wake Forest has continued to attract families and businesses. In recent years, the nearby Research Triangle Park (RTP) has experienced explosive growth. While the region sustains success with the arrival and advances of medical and high-technology firms, the accessibility and livability of Wake Forest assures it of maintaining a highly desirable quality of life.

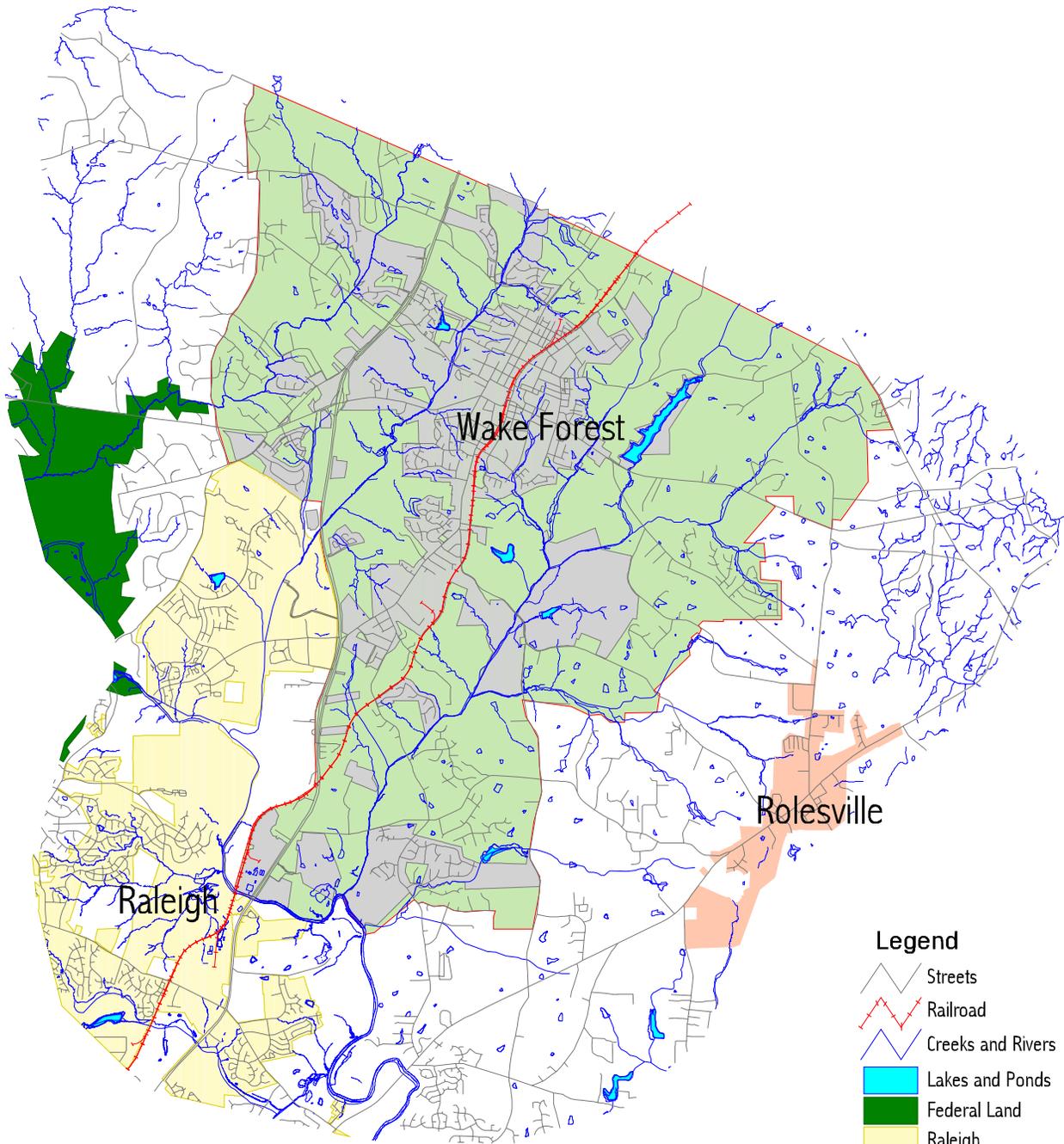
The study area, for this Open Space Plan, is defined principally by the Neuse River (to the south) and the Wake County / Franklin County Line (to the north). The western boundary runs south from the County line along Thomson Mill Road to Capital Boulevard and down to the Neuse River. The eastern edge of the study area generally follows Forestville Road north, along the north fork of Sanford Creek to the intersection of Averette Road and Highway 98, and north-northeast to the County line (see Figure 1 for the contract extents, as drawn, and its relationship to adjoining municipalities).

## History of Wake Forest

## Bounds of the Study Area

# Wake Forest, North Carolina

## Figure 1: Study Area



- Legend**
- Streets
  - Railroad
  - Creeks and Rivers
  - Lakes and Ponds
  - Federal Land
  - Raleigh
  - Rolesville
  - Wake Forest
  - Contract Extents

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Prepared:  
February 1, 2001

Data Sources:  
Wake County Planning GIS Dept.  
Wake Forest Planning Dept.



0.5 0 0.5 1 Miles

The topography of the study area can be characterized as rolling to hilly terrain. Major drainageways are bordered by steep slopes. The principal features in the study (Horse Creek, Richland Creek, and Smith Creek) lie in north-south running valleys. The Richland and Smith creeks flow south to the Neuse River. Horse Creek flows south to Falls Lake. A fourth stream, Tom's Creek, was also investigated, however, it is a much less prominent feature than the three streams mentioned above. The ridgelines between the valleys delineate the watershed units used in this analysis (see Figure 2: Landform). The town of Wake Forest is situated atop the ridge that divides the Richland Creek watershed from the Smith Creek watershed. Elevations within the study area range from approximately 220 to 440 feet above sea level. Rounded ridgetops give way to moderate slopes and level-out to relatively broad floodplains.

The soil types within the study area are characteristic of soils found on ridges and the sides of ridges. The study area primarily consists of Cecil association soils. Soils around Wake Forest tend to be deep and well-drained. Typically, they have a subsoil of firm, red clay, and surface layers tend to be sandy loam or gravelly sandy loam to clay loam.

In the lowlands, near stream courses, the soils are primarily of the Chewacla or Wehadkee associations. This area contains hydric and semi-hydric soils (waterlogged soils) typical of floodplains (see Figure 3: Flood Zones). The properties of these soils make development difficult due to greater engineering requirements and higher construction costs.

Vegetation, composed principally of overstory trees, understory trees, shrubs and groundcovers, is a critically important feature of the natural landscape. Vegetation filters pollutants from the air, surface and sub-surface waters; moderates local climates; offers relief from exposure to sun, wind and rain; and provides habitat for numerous species of wildlife. Wake Forest is predominantly forest-covered, featuring shagbark hickory (*Carya ovata*), white oak (*Quercus alba*), and river birch (*Betula nigra*). Understory vegetation is comprised primarily of greenbriar (*Smilax* spp.), sedge grass (*Carex* spp.), bull rush (*Juncus* spp.), native bamboo, and wool grass (*Scirpus cyperinus*). Along stream corridors, density is controlled by seasonal flooding, allowing for a relatively clear understory. The edge community is dominated by sweet gum (*Liquidambar styraciflua*) saplings, small cedars (*Cedrus* spp.), and sweet bay magnolia (*Magnolia virginiana*). Vacant farmlands are dominated by andropogon (Johnson's grass) and sumac (*Rhus* spp.).

Wetlands are typically defined by the presence of three unique, interrelated natural features: hydrology, hydric soils, and vegetation species. Wetlands are critical ecological systems because of their ability to filter pollutants from surface water, recharge underground aquifers, absorb floodwaters, and serve as habitat for a diverse variety of plant and animal life. Most wetlands are protected by Section 404 of the Federal Clean

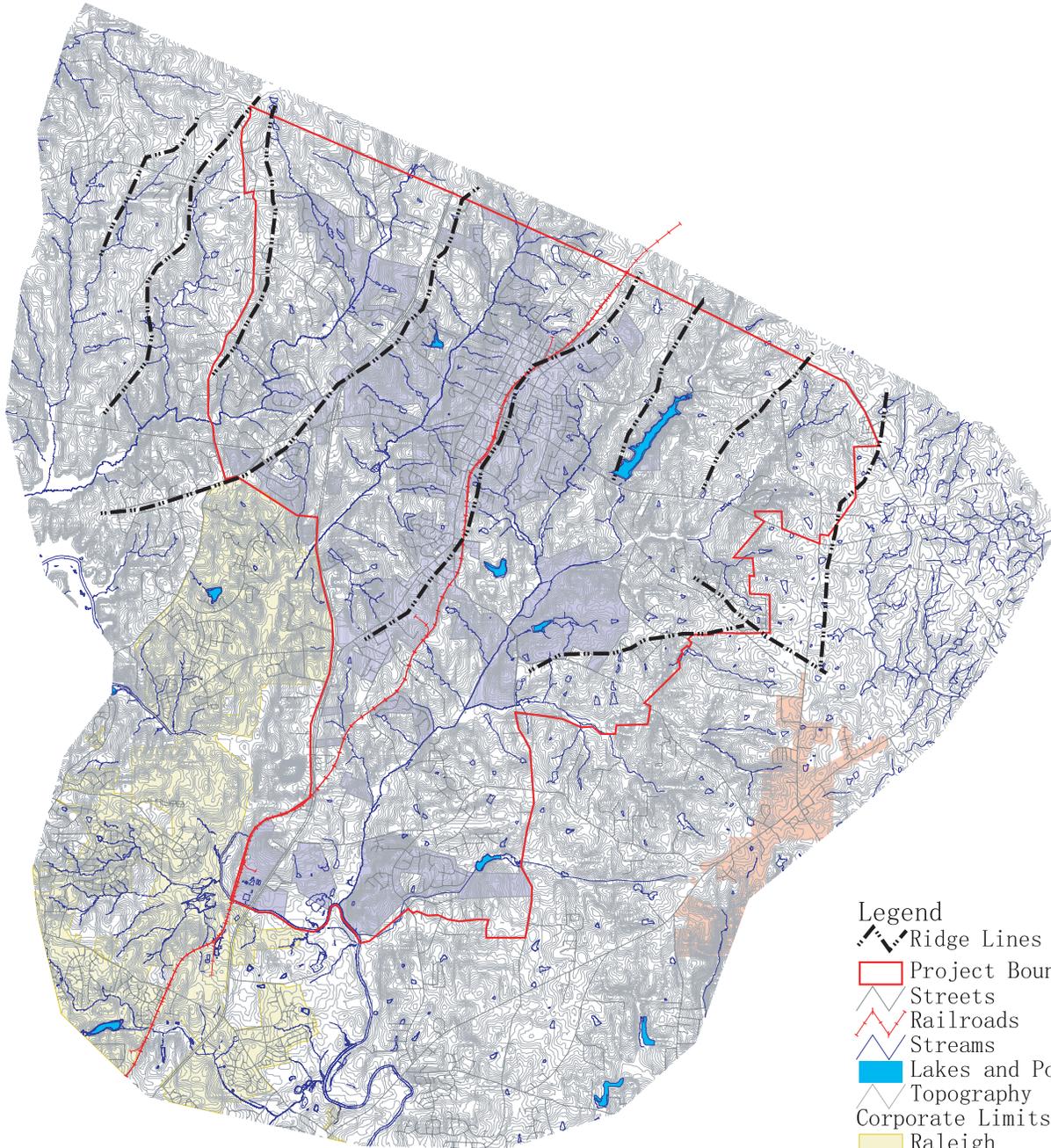
## Topography

## Soils

## Vegetation

# Wake Forest, North Carolina

## Figure 2: Land form



- Legend**
- Ridge Lines
  - Project Boundary
  - Streets
  - Railroads
  - Streams
  - Lakes and Ponds
  - Topography
  - Corporate Limits**
  - Raleigh
  - Rolesville
  - Wake Forest



Prepared:  
August 28, 2001

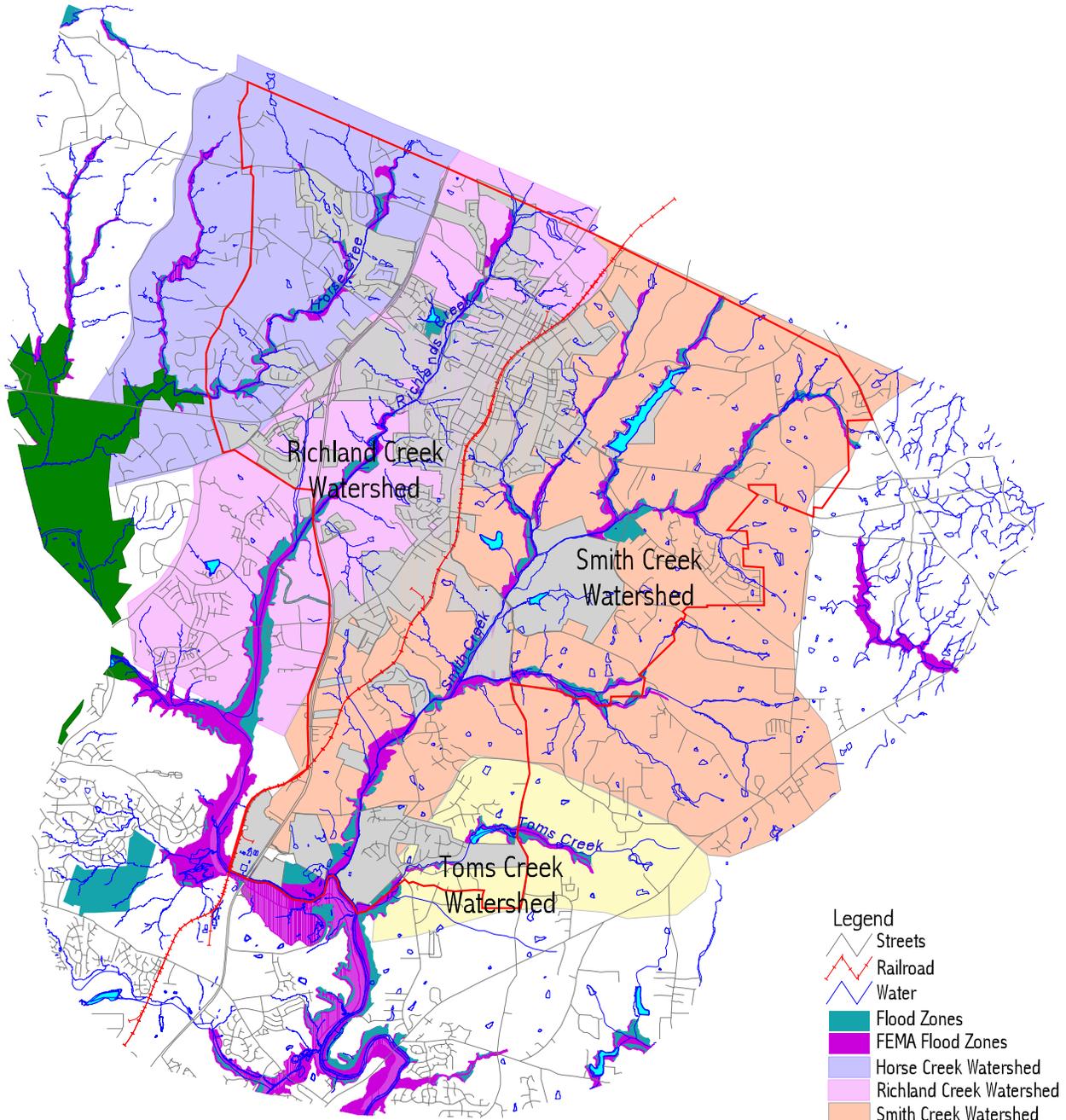
Data Sources:  
Wake County Planning GIS Dept.  
Wake Forest Planning Dept.



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# Wake Forest, North Carolina

## Figure 3: Flood Zones



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Prepared:  
February 1, 2001

Data Sources:  
Wake County Planning GIS Dept.  
Wake Forest Planning Dept.

- Legend**
- Streets
  - Railroad
  - Water
  - Flood Zones
  - FEMA Flood Zones
  - Horse Creek Watershed
  - Richland Creek Watershed
  - Smith Creek Watershed
  - Toms Creek Watershed
  - Contract Extents
  - Federal Land
  - Wake Forest



Water Act, which authorizes the U.S. Army Corps of Engineers to regulate the discharge of dredged and fill materials into waters of the United States, including wetlands (called “Jurisdictional Wetlands”).

The primary overstory wetland species are red maple (*Acer rubrum*), willow (*Salix* spp.), ironwood (*Carpinus caroliniana*) and river birch. The understory is principally composed of reeds, greenbriar, and small grasses. Due to the shade cast by overstory trees there is very little groundcover. However, along cleared corridors, such as sewer line easements, enough sunlight penetrates the canopy to support a carpet of rye grass, planted to stabilize the soil and permit access along the corridor.

## Wildlife Habitat

There are two broad categories of wildlife that are of concern to this planning effort: “interior” forest species wildlife and “edge” species wildlife. Most species of wildlife that inhabit urban areas are known as “edge” species. These mammals, birds, amphibians and insects have adapted to urbanized landscapes and have developed harmonious relationships with urban residents. However, “interior” species require undisturbed forest environments to survive and, because of the human population growth and resulting land development, have experienced significant habitat loss and population declines.

Habitats for rare and common “interior” and “edge” species exist in various forms throughout the Wake Forest area. Diverse habitats are typically connected by migration corridors that allow plant and animal species to move through the landscape. The migration corridors most important to the study area are along streams. The Wake Forest Open Space and Greenway Plan is concerned with both the remnants of “interior” forest species and the “edge” environments that exist within the floodplains of the study area. These resource areas are the most valuable for wildlife in that they provide a food source, water and shelter. Approximately, eighty percent of all wildlife depend on riparian corridors for survival. Therefore, the protection of floodplains is crucial to sustaining a diverse wildlife population in Wake Forest.

During site visits, evidence was found of beaver, squirrel and deer populations. Even a tiger salamander was discovered. Opossum and raccoons are expected to be in abundance. Bird species that one can expect to find within the study area include: black-capped chickadee, red-bellied woodpecker, northern cardinal, and barred owl.

## Population

The population of Wake Forest has increased steadily over the last two decades. In Wake County, the population grew from 429,876 in 1990 to 627,846 in 2000, an increase of forty-six percent. Within the municipal boundaries of Wake Forest, the population grew (by almost eighty-six percent) from 6,043 in 1990 to 11,227 in 1999. Population projections for Wake County indicate a 2019 population of 939,753. As the population continues to grow, the need for conservation of undeveloped lands, such as greenway corridors, will also continue to increase.

Infrastructure is the skeleton of a community and a critical determinant of future development. Infrastructure easements can play a significant role in the alignment of greenway facilities. Oftentimes, utility companies can be persuaded to grant surface easements for the construction of trails that can be used by the public as well as utility vehicles for easement maintenance.

In Wake Forest the available infrastructure data displays water and sewer lines (see Figure 4: Infrastructure). Most notable are the lengthy stretches of sewer lines in the floodplains of Richland Creek and Smith Creek. These facilities are of special interest to greenway planners because of their potential to link the community north-to-south. Also of interest, is the water line that runs from the west of Horse Creek, through downtown, and east to Rolesville. The water lines demonstrate opportunities for east-to-west connections, which are more difficult to identify in this community of north-south running topography. Another water line of particular interest is the line that runs along the ridge between Richland Creek and Smith Creek. Upland connections are most difficult to identify because the land along ridgelines is typically well-suited to development and road construction and overland areas are oftentimes already subdivided or developed. Using water utility easements as upland connections is an opportunity worth exploring.

It should be mentioned that publicly owned sewer and power easements are already being used by residents, throughout the study area, for hiking, horseback riding, and paintball competitions. Evidence of mountain biking can also be found within these easements.

Wake Forest is located in northern Wake County, the fastest growing County in North Carolina throughout the 1990's. Wake Forest's development pattern can be divided into three distinctive regions, defined by the ridgelines and streams (see Figure 5: Land Use). In general, residential development is occurring along the ridgelines, while lower elevations tend to be engaged in agricultural activities. The Wake Forest town center contains a high school, elementary school and the Southern Baptist Theologic Seminary, as well as the Wake Forest Historic District.

Farmland to the west is primarily utilized for tree farming and as pastureland. Likewise, the land around the Wake Forest Reservoir is zoned for forestry. Eastern agricultural activities primarily involve raising field crops and pastureland. Development in the eastern portion of Wake Forest, centered around Sanford and Smith Creeks, is shifting towards medium-density residential neighborhoods.

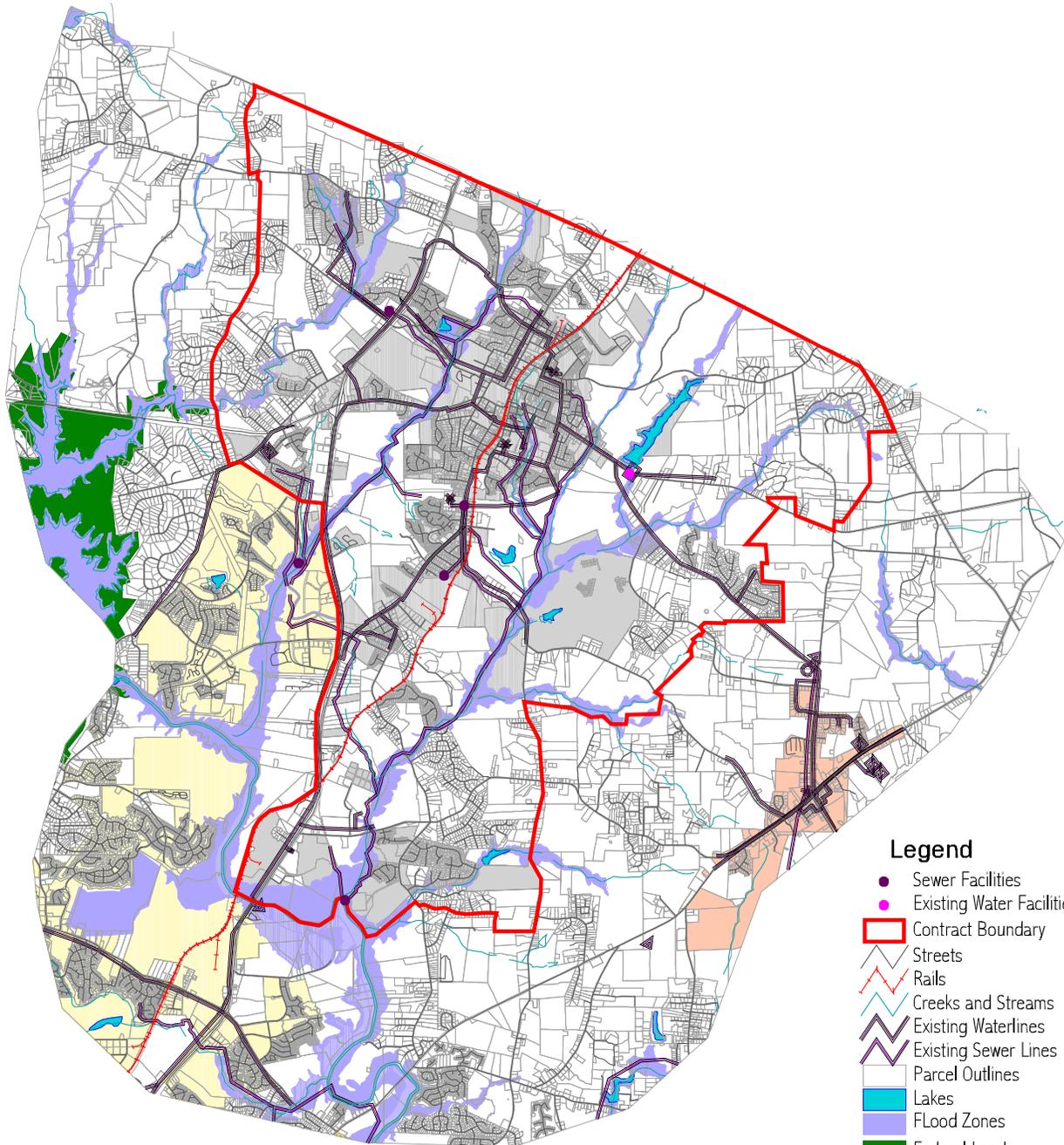
US Highway 1/Capital Boulevard runs north/south and divides much of the traditionally urban land use activities in Wake Forest. To the west of US Highway 1/Capital Boulevard, the land use tends to be large-scale commercial development. Land east of US Highway 1/Capital Boulevard

## Infrastructure

## Land Use

# Wake Forest, North Carolina

## Figure 4: Infrastructure



### Legend

- Sewer Facilities
- Existing Water Facilities
- Contract Boundary
- Streets
- Rails
- Creeks and Streams
- Existing Waterlines
- Existing Sewer Lines
- Parcel Outlines
- Lakes
- Flood Zones
- Federal Land
- Raleigh
- Rolesville
- Wake Forest

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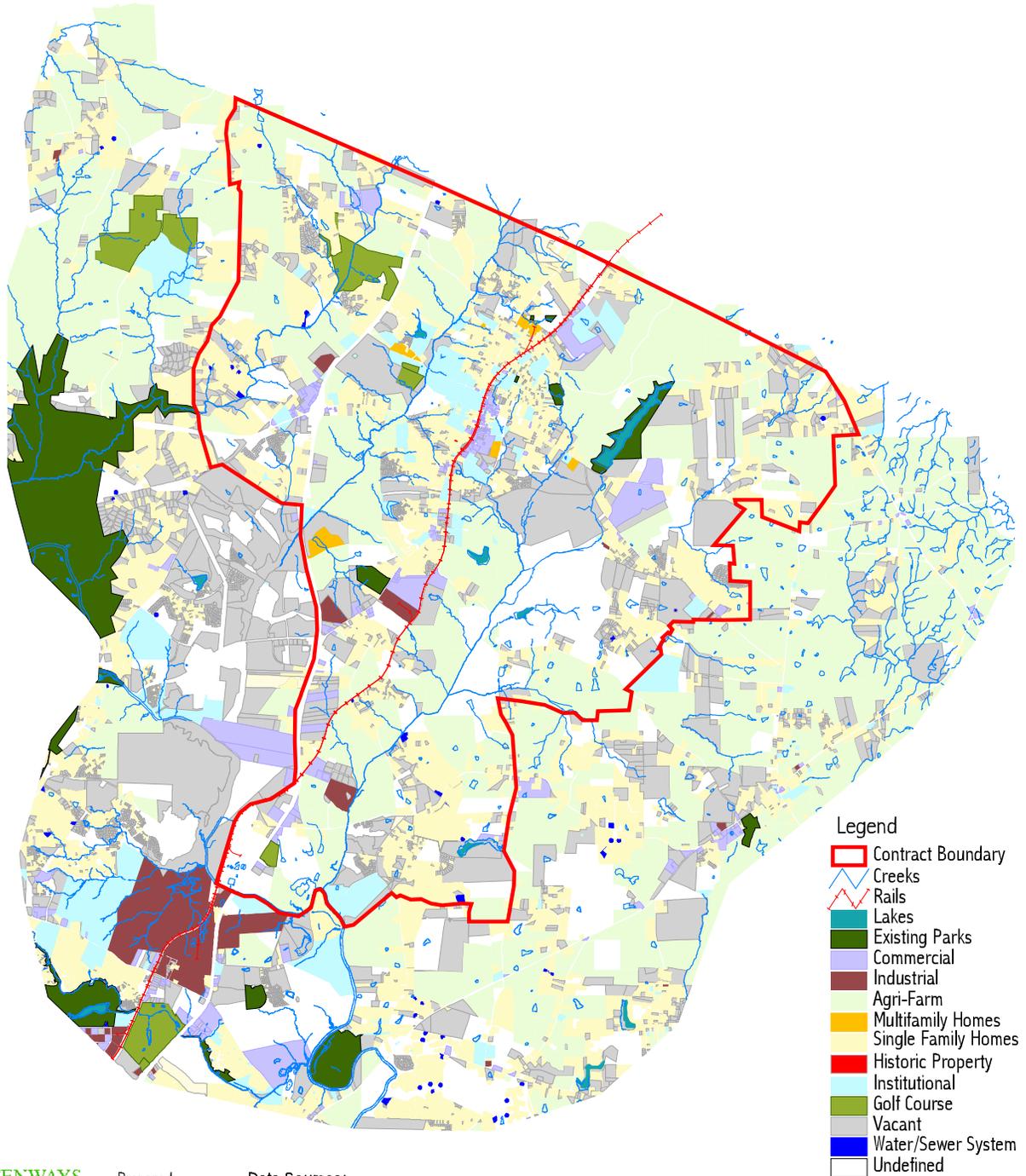
Data Sources:  
Wake County Planning GIS Dept.  
Wake Forest Planning Dept.



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# Wake Forest, North Carolina

## Figure 5: Land Use



**GREENWAYS**  
LANDSCAPE ARCHITECTURE  
10100 W. GREENWAY DRIVE, SUITE 100  
GREENSBORO, NC 27409

Prepared:  
 February 1, 2001

Data Sources:  
 Wake County Planning GIS Dept.  
 Wake Forest Planning Dept.  
 NCGIA Corporate Database



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is high density mixed-use. Most of the residential development pressure is coming from the southern portion of the study area as Raleigh continues to expand.

## Park and Recreation Lands

There are several opportunities for public recreation within and near the area of study (see Figure 6: Existing Open Space and Points of Interest). These places include a small plaza located at the center of Elm Street, the Southern Baptist Theologic Seminary campus, and the facilities at the elementary school. There are several small community parks within residential neighborhoods.

The western portion of the study area borders on the Falls Lake recreational area. This is a significant recreation area that provides outdoor activities such as fishing, canoeing and kayaking, and hiking. It is within a short driving distance from downtown Wake Forest. Two golf courses are located within the western portion of the study area. The Wake Forest Golf Club is a semi-private course that straddles Horse Creek. Paschal Golf Course, is a nine-hole public course located along Highway 98, west of downtown. To the east of downtown, there are recreational hiking trails at the Wake Forest Reservoir.

## Open Space/ Greenway Resources

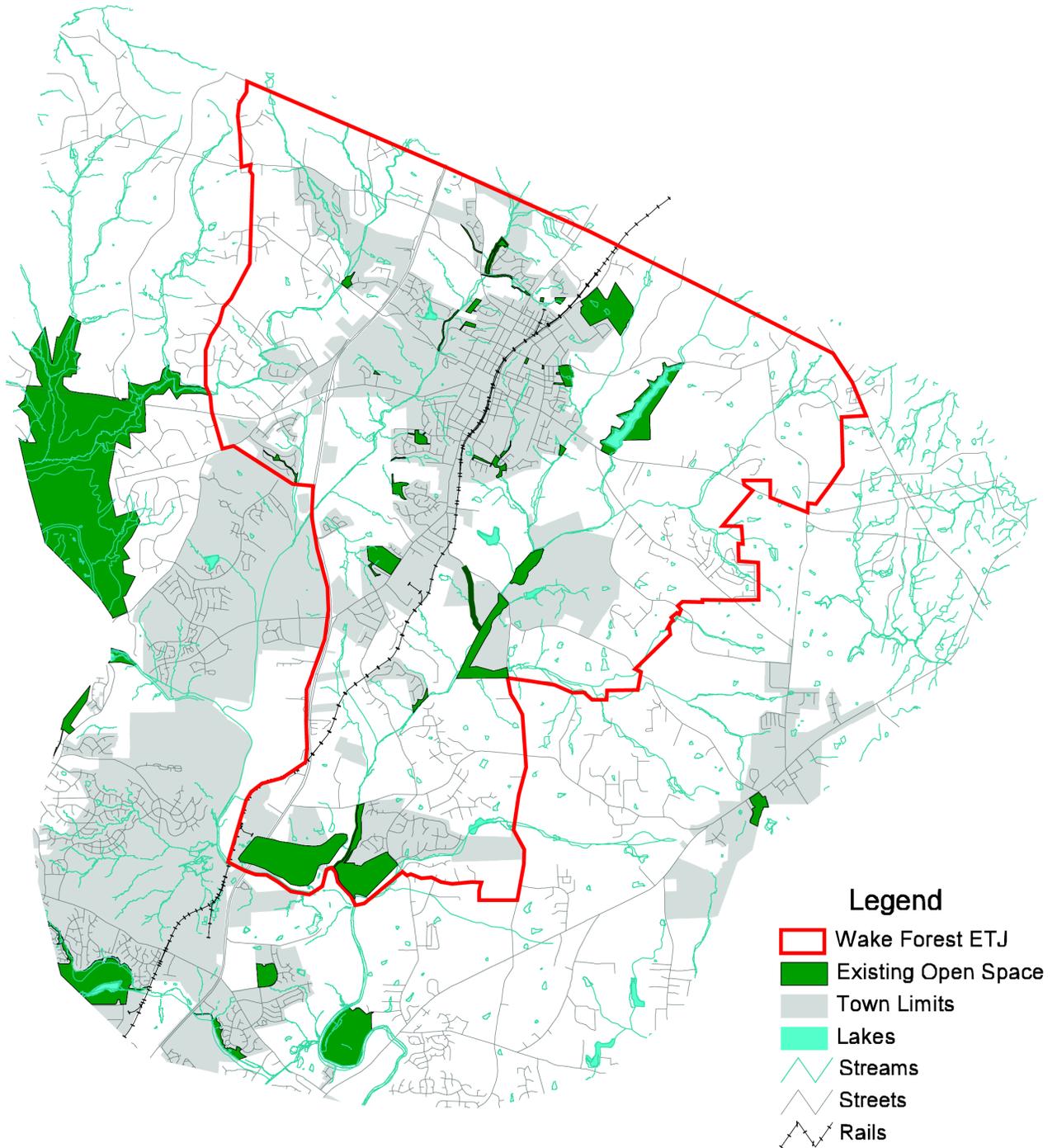
### Overview

The Town of Wake Forest has significant holdings in public land (see Figure 6: Publicly Owned Property). These land holdings are diverse in size and location. The parcels owned by the town are scaled appropriate to the surrounding land uses. Connectivity in the central area of Wake Forest, those neighborhoods most closely associated with downtown, will be a challenge. However, the locations and types of parcels already in public ownership provide opportunities to serve as destinations or as connecting pieces. The majority of parcels are smaller and located in more densely populated areas. Larger parcels are found east of town, in areas with greater agricultural activity. The western portion of the study area is decidedly lacking in publicly owned open space resources in comparison to the central and western portion of the Wake Forest ETJ. While the greatest development pressures are in the south (where residents can enjoy the amenities and charm of Wake Forest yet still remain within a reasonable commute of downtown Raleigh), the western portion of the study area is being identified as an attractive place to live. Residents west of Capital Boulevard enjoy a close proximity to the recreational amenities offered by Falls Lake, while maintaining reasonable connections to downtown Durham (via Highway 98) and Raleigh (via U.S. 1).

In addition to the publicly owned land resources it is necessary to mention the open space resources of Wake Forest in terms visual quality. Property does not have to be publicly owned for the public to enjoy the landscape. Wake Forest is considered a beautiful town not only because of the small town charm in its downtown building stock, but also due to the character of the surrounding landscape. The gently rolling terrain that separates the

# Wake Forest, North Carolina

## Figure 6: Open Space



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August 27, 2001

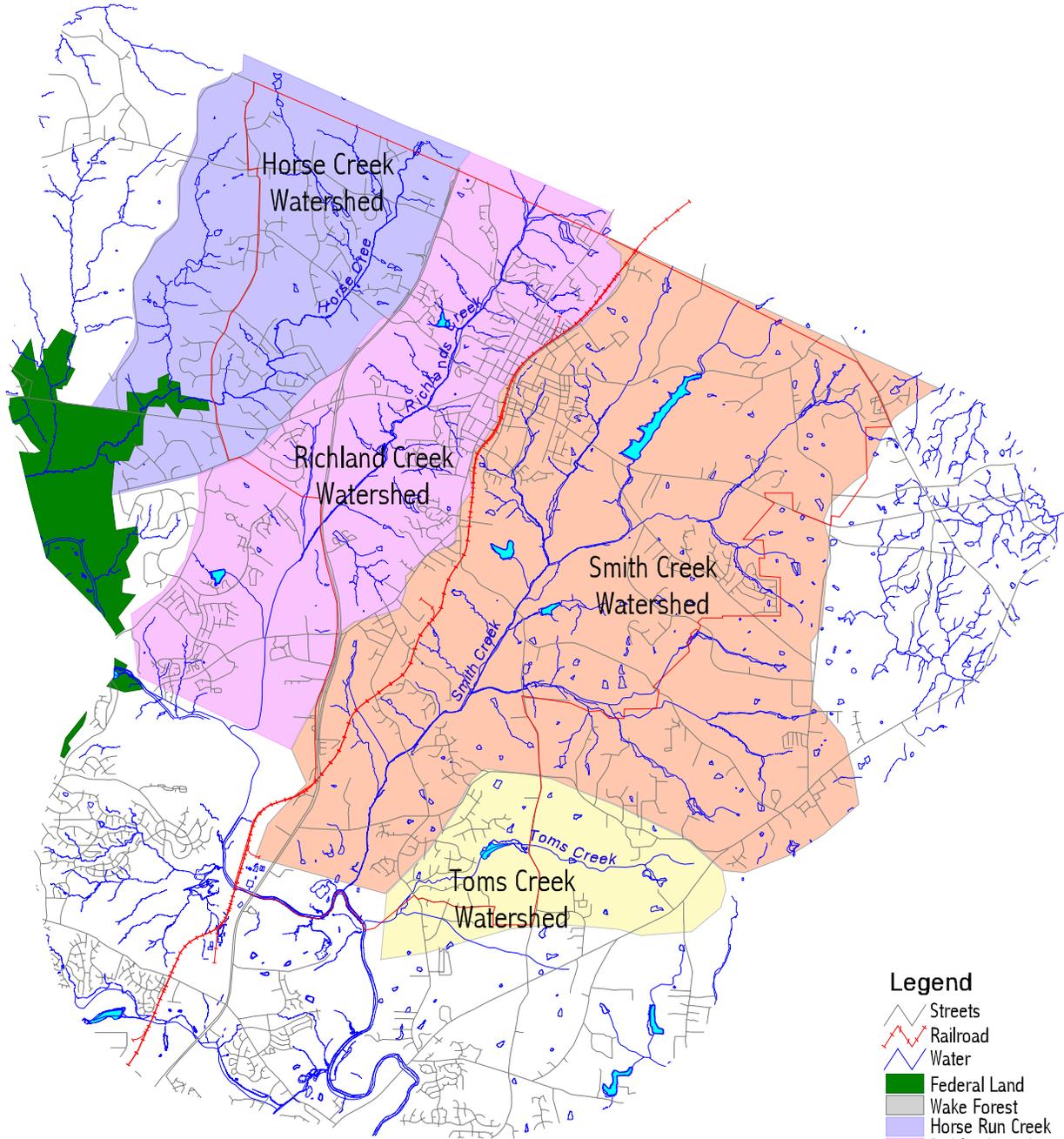
Data Sources:  
Wake County Planning GIS Dept.  
Wake Forest Planning Dept.



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# Wake Forest, North Carolina

## Figure 7: Watersheds



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February 1, 2001

Data Sources:  
Wake County Planning GIS Dept.  
Wake Forest Planning Dept.



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four primary watersheds of Wake Forest is a critical resource for the town. Residents enjoy the undeveloped open spaces composed of woodland, agricultural land, and stream corridors in a part of the county that was once considered rural, but is now becoming more suburbanized as residential neighborhoods and strip commercial facilities continue to develop. While development and economic activity will certainly continue to shape the community, it can be said that Wake Forest is rich in visually appealing open space. Open space is nicely distributed throughout the study area. Strategies to preserve this situation will be discussed later.

The study area has been divided into sub-areas of focus based upon watershed boundaries. These areas are the Smith and Sanford Creeks watershed, the Richland Creek watershed, the Horse Creek watershed, and Tom's Creek watershed (see Figure 7: Watersheds). Determining ecological health and the suitability for greenway facilities and improvements are the primary objectives when investigating the study area's open space resources. Site inspections focused upon stream corridors, flood plains, and public utility easements, as well as upland areas and ridgelines.

### Smith Creek and Sanford Creek Watershed

We begin a description of the Smith and Sanford Creeks watershed in the southern portion of the study area at the water treatment plant. The sewer easement extends north along the east side of Smith Creek. Wetlands occupy the west side. Good separation was observed between proposed and existing homes and the sewer line corridor. Trees and dense vegetation separate the private properties from the sewer line. A small power line runs along the east side of Smith Creek. Red oaks and pine were noted along the ridges while tulip poplar, red maple, and sycamore were identified in the lower, wetter areas. In many areas it was obvious that a trail would need to be slightly elevated in order to address the drainage issues. A Smith Creek spur was followed northeast towards the railroad tracks before turning due east to follow a high-voltage power easement. In the developing areas, generally poor sediment controls were observed.

It is apparent that any constructed trails would need to be sited as close to the toe of slopes as possible. Floodwater storage is the optimum use for areas that run from the toe to the creek. Conservation easements and/or fee simple ownership are advisable as the best method for preserving the creek flood zones and low areas.

An inspection of the reservoir trail system showed it to be small, poorly defined, and sporadically maintained. Vegetation reveals a second-growth pine upland forest of average condition. Posted signs indicate that neighboring land is owned by Andy Ammons (a significant developer in Wake County). Should he choose to develop this neighboring land, vegetated buffers will be needed to filter sediment and debris from any proposed development. Outflow from the reservoir crosses under Wait Avenue into a kudzu choked floodplain. No further investigation into this area was conducted.

## Watershed Areas





Off of Chalks Road lies a future, very-large development called the Heritage. A cursory investigation revealed an 18 hole golf course (that straddles Smith Creek) and lot layouts (presumably for larger homes). One area (south of the current development) showed promise for a high quality trail. Natural conditions were observed beside the creek. Development is expected to stop above the toe of the slope. A combination of hydric and non-hydric soils were found throughout the study area. Opportunities to skirt around the hydric soils needs to be explored.

## Richland Creek Watershed

The corridor survey began at the intersection of Richland Creek and Harris Road. Here the sewer easement runs through fenced pastureland along the east side of the creek. At the upper portion of the study area, the dense vegetation – primarily cedar and pine - provides an adequate visual buffer from nearby residences. Sandy, soft soils indicate a regular flood regimen. Evidence of stream health includes vegetated stream banks and very little suspended sediment. Bedload sediment primarily consists of coarse grained sands. This is sporadically (but not excessively) deposited as sandbars throughout the stream corridor. There are periodic points of stream bank degradation where the creek appears to be widening. Preserving the floodplain area will allow the stream to manage water velocity by providing room for the creek to increase its sinuosity, as necessary, to dissipate stream energy.



Travel along the sewer easement is swift. The corridor is approximately 15-20 feet wide and covered with a soft, dense layer of dormant rye grass. Daylight more easily penetrates the easement's thinner canopy. Near West Stadium Avenue the grade tapers leaving standing water in many places. Additionally, beaver dams are in place, further limiting drainage and saturating the land. On the north side of the stadium (at the end of West Juniper Avenue) lies an access road to the power and sewer utility corridors. This access road could be used as a trail connector to the high school while still serving as an access road for utility maintenance vehicles. Shortly past the access road, Richland Creek passes under Stadium Avenue. While engineering would be required, it appears feasible to run a greenway under the bridge and onto Paschal Golf Course. It should be noted that the existing bridge is in a deteriorating condition. If plans exist to replace the bridge in the near future, a greenway underpass should be incorporated into the design.



The Paschal Golf Course lies at the approximate midpoint of the Richland Creek corridor. The nine-hole golf course facility provides greenway opportunities and constraints. The primary constraints are private property issues (the course is owned by the Seminary College) and safety considerations. Most of a greenway/golf course conflict would be confined to negotiating the entry drive, parking lot/club house area, the #5 tee box and the #1 fairway. The power line corridor bisects the golf course, thus presenting a trail placement opportunity. However, after crossing the golf



course, the power line continues across the very busy Durham Road (Highway 98). It is possible to mitigate the vehicular/greenway-user conflicts at the five concrete culverts near the end of the first hole.

One possible greenway alignment through the golf course involves running the trail between Richland Creek and the golf course driveway, behind the fifth hole tee box, and over the creek (a ford exists at this point, but it would require significant improvements to serve as a greenway crossing). After crossing the creek, a trail could either continue along the power line corridor (until it intersects Highway 98) or along the west side of Richland Creek (through the woods) paralleling the first fairway. Richland Creek serves as a water hazard down the right side of the fairway, thus discouraging play along this side of the hole. Additionally, the woods along the west side of the creek are dense enough to provide some protection from wayward tee shots. Whether the trail follows the power line corridor or traverses through the woods, a connection to the five concrete box culverts (where Richland Creek passes under Highway 98) needs to be made.

Potential benefits to incorporating the golf course include an opportunity to improve the vegetative buffer between the entry drive and Richland Creek and the possible economic impact of greenway users frequenting the clubhouse as a resting place.

According to the 1993 USGS map, there is a “Sewage Disposal” area near the intersection of Richland Creek and Durham Road. More research needs to be done before facilities can be recommended at this place, however, the area appears to be a *former* sewage disposal area and has the space to host a trailhead facility. Included are a cleared corridor from Woodland Drive (in the Tyler Run Holding Ridge community) and a cleared space, approximately an acre in size, (the disposal area) behind property owned by the Saint Catherine of Sienna Roman Catholic Church.

After crossing under Highway 98, it appears easy to pick-up the power line corridor or the sewer line corridor all the way to Capital Boulevard (Highway 1). While Highway US-1 is not a suitable destination point and creating a trailhead would present problems, it may be possible, with County involvement, to cross under the highway and continue to the Neuse River.

## Horse Creek Watershed

The site visit began at the intersection of Horse Creek and Purnell Road. Few residential units were observed along the corridor down to Jenkins Road. Trees and thickets shade the entire floodplain. River birch and tulip poplar are the dominant species in the lower, wetter areas. The floodplain is very wide (approximately 300 feet) in some places. Pines are more prolific along the toe of slopes. Despite the rolling topography and thick vegetation, in some places Highway 1 can be heard from the stream’s edge.





Wildlife habitat along the stream looks good, however, the only evidence of aquatic life comes from beaver dams and tree cuts. Soft, sandy soils appear to be poorly suited to hosting a trail. In many areas a trail would need to be elevated in order to address the drainage issues. Further complicating a potential greenway route, Horse Creek passes through the Wake Forest Golf Club bisecting a couple of fairways. Here the stream is in a degraded condition with undercutting observed and no vegetated buffer between mowed, playable areas and the creek.

The Horse Creek segment between Jenkins Road and Thomson Mill Road was not walked. A roadside survey was conducted at all creek crossings. Research and direct observation indicate no significant changes in vegetation or soils along the corridor.



- At Jenkins Road: the Adobe Ranch (on the west side of Horse Creek) appears to be a sizable privately-owned property. Maps indicate that a significant portion of the west side of the creek is privately owned.

- At Kearney Road: an enormous corrugated steel culvert allows the road to span the creek. Slopes are covered with briars and riprap. The ridge slopes, above and below Kearney Road, appear to be steeper and the floodplain much narrower.

- At Crenshaw Drive: the drive dead-ends at a private lot. No attempts were made to access the stream.

- At Thomson Mill Road (the project terminus): three concrete culverts (approximately 15' high and 10' wide) allow the road to span the creek. Before the stream enters the culverts, the flood plain is wide and healthy on the south side. Below the culverts the stream narrows and turns sharply north. Considerable storm damage is evident.



Should a greenway plan be implemented along Horse Creek, trails would need to be constructed close to the toe of slopes. Soggy soils and dense vegetation made it apparent that the floodplain is effectively storing water. Conservation easements and/or fee simple ownership are advisable for the creek flood zones and low-lying areas. Where slopes are steeper and floodplains narrower, it will be substantially more difficult to construct trails and obtain access due to more complicated land ownership issues.

## Tom's Creek Watershed

Tom's Creek is the smallest of the four watersheds in the study area. However, at the junction of the study area boundary and Tom's Creek lies Brown's Lake - one the most significant water and scenic resources in the study area. The study area boundary at Forestville Road is the northeast-

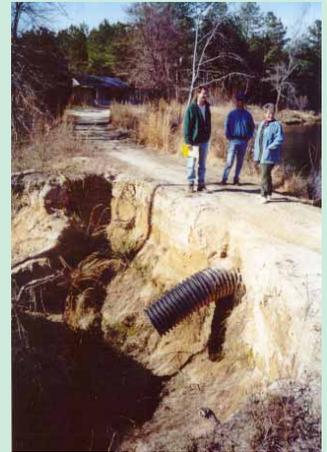


ern end of the creek. The creek flows in a southwest direction before terminating at the Neuse River. On both sides of Forestville Road are areas of marsh. Undoubtedly, the low turbidity and plant life are filtering pollutants and sediments from the upper reaches of the stream. Brown's Lake is directly below the marsh area west of Forestville Road. At the western end of the marsh is a dry-laid granite dam that served a mill approximately 150 years ago. There is a small break in the dam that creates an attractive waterfall into Brown's Lake.

Brown's Lake is approximately 13 acres. The lake is oblong, generally running east-to-west and sits beautifully between the wooded knolls on the north and south sides. A few single-family residences exist on the north side of the lake and a subdivision is proposed for the southeastern side of the lake. The lake is well buffered from most human impacts. The mature vegetation reduces the amount of sediments that would otherwise wash into the lake during storm events. However, there are ATV trails that have been carved through the woods, thus reducing the effectiveness of the existing vegetation. Although the lake is picturesque and the water appears clean, there is severe degradation to the dam at the northwestern end of the lake. Hurricane Fran (1996) caused significant damage to the Brown's Lake dam structure - exposing the outlet pipe, thus causing the lake to rely on the emergency overflow outlet to maintain the lake level. Below the emergency overflow outlet, significant damage is evident by the debris in the water channel, lack of healthy vegetation, and the exposed and eroding banks. The effects of the overflow channel are apparent by the sediment accumulation in the stream channel below. Also of concern is the outflow pipe (approximately 200 feet below the dam), that reportedly serves as the sewage outfall for a packaging plant sited above the lake.

Below Brown's Lake, Tom's Creek passes between the Saint Andrews Plantation subdivision to the north and the Saint Andrews subdivision to the south. Larger lots are situated on the south side of the stream with homes sited well away from the banks of Tom's Creek. Hurricane Fran caused a significant reduction in the number of mature trees that lined the stream banks. There are some efforts to replant where mature trees once existed. It is apparent by the maintained lawns that stretch to the edge of the stream, and the lack of vegetative buffering, that the current residents along the stream enjoy the unobstructed view of the creek. It is here, between the subdivisions, that the sedimentation is most evident.

The water is clear and relatively free of suspended solids. Sand bars are surprisingly frequent along the stream. It is likely that the emergency overflow channel, immediately below Brown's Lake, is eroding and that the shallow grade of Tom's Creek lacks the energy necessary to carry away the solids deposited during storm events. It is anticipated that sand bars will continue to grow and increase the sinuosity of Tom's Creek between Brown's Lake and Ligon Mill Road.





Below Ligon Mill Road is an emergent wetland that stretches down to the Neuse River. Here the soils are waterlogged and much of the standing timber is dead. The wetland is part of a 31 acre plot currently for sale. Approximately 17 acres are above the floodplain.

An access road borders the wetland, providing an excellent opportunity for an interpretive trail. The west side of the road is primarily covered in loblolly pine. The east side of the road features the wetland. Walking the road south to watch beavers, just above the point where Tom's Creek feeds into the Neuse River, is already an occasional practice for residents aware of the wildlife population along the Neuse.

# Chapter 3: Greenspace System Recommendations

It is necessary to say a word about the process of investigation before a discussion occurs concerning the greenspace system recommendations of Wake Forest. Both remote research and direct observation were used to analyze the existing Wake Forest Open Space condition. Combining the graphic representations (of isolated conditions) with the direct observation of actual conditions facilitates a more complete picture of the study area. By examining the study area through objective numbers and subjective experience, a more comprehensive understanding is achieved.

Remote research consisted of gathering background data from previous studies as well as recently produced data. Studies and reports made available to the consultant include the Parks and Recreation Master Plans (1986, updated 1990 and 1996), Land Development Plan (1985), the US 1 Corridor Plan (1999), the Inventory of the Natural Areas of Wake County (1987), the Capital Area Greenway Master Plan Update (1989), and North Carolina's 303(d) List (1998) of streams deficient in water quality by Clean Water Act standards. Additional data was gathered from websites maintained by the U.S. Census Bureau, the Neuse River Foundation, and other sites offering environmental and cultural information specific to Wake Forest. Finally, thematic maps were produced from Wake County Geographic Information Systems (GIS) data to graphically illustrate important conditions relative to geographic position. GIS applications are tools used to analyze spatial data and allow detailed geographic analysis. The strength of GIS applications is their ability to overlay separate layers of data and reveal patterns of interrelated landscape components.

In addition to the remote research conducted in the office, field research was done to verify the conditions described in text and illustrated in maps, as well as to familiarize the consultant team with the distinct character of Wake Forest. Field visits included vegetation identification, observation of water quality and soil conditions, photo documentation, identification of greenway opportunities and constraints, examination of residential and industrial development patterns, and ecological health estimations. Consultant visits to the field verified the office research and will serve to authenticate subsequent recommendations.

Central to the Wake County Open Space Program is the concept of connectivity. For each of the municipal plans to function together successfully they must be completed with neighboring landscapes and municipali-

## Methodology

## Linkages

ties in mind. Wake Forest has cultural opportunities to connect to the City of Raleigh, Rolesville and Franklin County. Natural opportunities exist to connect to the Neuse River and Falls Lake - two premier water features in Wake County.

Wake Forest has a primary consideration of preserving its small town charm and quality of life enjoyed by its residents. Providing greenway linkages to the community will accentuate that character. Greenways and open space will provide buffers from adjacent landuses, preserve the character of the landscape and allow people to access Wake Forest via alternative, slower-paced modes of transportation.

## Greenspace Elements

### Targeted Open Space Acquisition

As a result of community meetings, staff and stakeholders comments it is recommended that the Town of Wake Forest supplement existing park systems with the following parks and open space acquisitions. These acquisition recommendations are broadly defined within this plan to cover geographical areas of the community which were agreed upon throughout the participatory planning process.

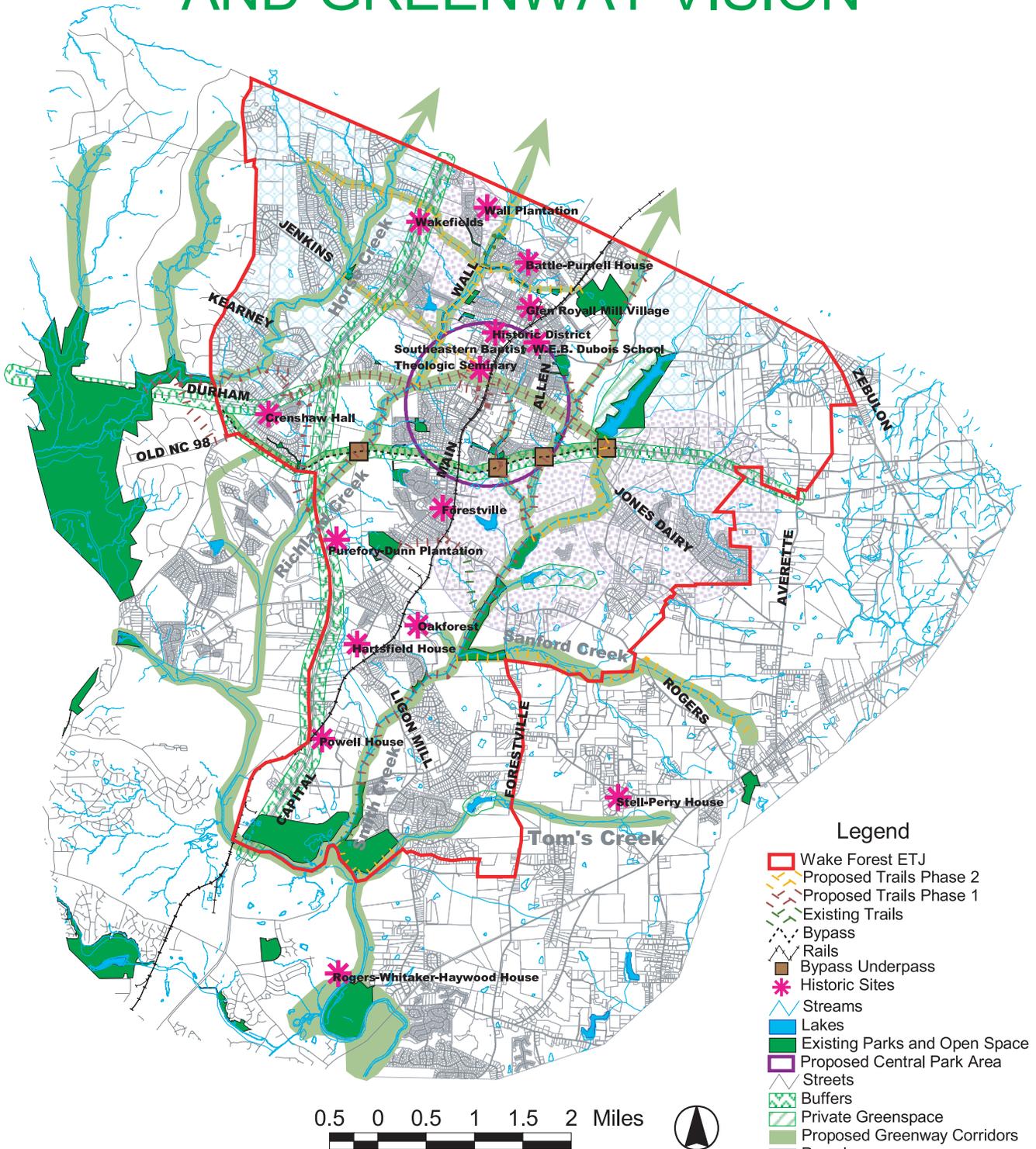
- First - We envision future development of a “central park” between the downtown area and the new bypass.
- Second - There is a need to establish a community park in the east-central area of the community, and there is a possibility that this park could be jointly developed in partnership with Rolesville.
- Third - There was a desire on the part of local residents to have a future community park in the northwestern quadrant of the community.
- Fourth - The Town has been provided with an opportunity to develop a future park along the Neuse River at the intersection with Capital Boulevard.

It is envisioned that these future parks will serve multiple purposes; including active and passive recreation, protection of water quality, flood plain management, and environmental education.

## Scenic Corridors

Wake Forest has two primary vehicular entry-ways into the community (Highway 98 and US Highway 1 /Capital Boulevard) and a significant thoroughfare coming on-line, soon (Highway 98 Bypass). Each of these corridors is significant for the first-impression that visitors receive as they enter Wake Forest. Many participants in the Open Space and Greenways Workshops have said that they place a high priority on the scenic value present along these roadways. Preserving open space and establishing buffers alongside these corridors will convey the small town charm that is one of Wake Forest’s greatest assets.

# WAKE FOREST OPEN SPACE AND GREENWAY VISION



- Legend**
- Wake Forest ETJ
  - Proposed Trails Phase 2
  - Proposed Trails Phase 1
  - Existing Trails
  - Bypass
  - Rails
  - Bypass Underpass
  - ★ Historic Sites
  - △ Streams
  - Lakes
  - Existing Parks and Open Space
  - Proposed Central Park Area
  - Streets
  - Buffers
  - Private Greenspace
  - Proposed Greenway Corridors
  - Parcels
  - Watershed
  - Future Open Space



**GREENWAYS**  
Wake County Planning GIS Dept.  
 Wake Forest Planning Dept.

Prepared:  
 October 4, 2001

Data Sources:  
 Wake County Planning GIS Dept.  
 Wake Forest Planning Dept.

## Greenway System Recommendations

### Highway 98 Corridor

The Highway 98 Corridor (or Durham Highway) is the oldest of the three major connectors. It is a significant access road for Falls Lake and a convenient west-side entry into Wake Forest. The roadway is starting to show the effects of Research Triangle growth as new housing developments radiate from Durham, Raleigh and Wake Forest. Protecting the scenic quality of Highway 98 is important to Wake Forest residents. While Wake Forest is certainly experiencing its share of growth the vegetated edges of Highway 98 are a reminder of Wake Forest's more rural days.

### US Highway 1 /Capital Boulevard Corridor

The US 1 corridor is one that has already received some attention to its visual quality. In 1999, the US 1 Corridor Plan was adopted. This plan focuses on the visual resources along the corridor that include the built and unbuilt environment. Preserving open space and establishing buffers along the corridor will be difficult because of the roadway's economic development. The highway is a major thoroughfare for commuters to and from Raleigh. Businesses will continue to target this corridor for the visual exposure to travelers and to serve commuters that require convenient shopping destinations. Despite the difficulty of preserving the scenic resources of US 1, it is a worthy effort because of the high volume of traffic that generates perceptions of Wake Forest from the windshield.

### Highway 98 Bypass Corridor

The Highway 98 Bypass is a concern and a relief for many Wake Forest residents. Many welcome the diversion of truck traffic, but fear a degradation of the landscape as a result of the construction. While the highway is designed to move traffic quickly around the downtown core, it does not have to be a highway of convenience, only. It will be important to buffer the sound and sight of the highway from adjacent neighborhoods. This will be welcomed by the residents and enjoyed by the commuting public. Again, today's vehicular society draws many of its perceptions through the windshield. The Highway 98 Bypass has the ability to preserve and communicate some of the charm that is inherent in the Wake Forest community. Preserving the native vegetation already within the corridor is a terrific start to doing just that.

### Overview

The future of open space and greenways in Wake Forest is envisioned as a system of outdoor spaces that function as healthy, protected ecosystems. Contiguity is critical to the concept of preserving open space in Wake Forest. The benefits of open space and greenways are maximized when they are linked together. Contiguous natural areas are better equipped to function as healthy, interrelated ecological systems. As such, they are more stable, provide more "edge" habitat for wildlife, and allow a place to retain its natural character.

Despite common public perceptions of open space and greenways, this plan does not view these outdoor resources solely as passive recreation areas. Rather, these natural resources should fulfill multiple objectives. Objectives should include progressive floodplain management, wildlife habitat, and improved water quality. Areas that are well-suited to host trails can provide passive recreation facilities, environmental education, and alternative transportation routes.

Recommendations for a system of open space and greenways in Wake Forest are based largely on community input that includes civic organizations, public agencies, and the general public. Corridors and open space locations were identified and presented in map form at meetings with Wake Forest staff, as well as meetings with interested parties, civic clubs, and public workshops. All public comments received from these meetings and workshops were incorporated into the recommendations for the open space and greenways system.

Proposed greenways are located along natural and human-made linear corridors that generally follow streams and roadways within the study limits. In this manner, greenways will fulfill objectives related to alternative transportation, natural resource conservation, water quality, and floodplain management, in addition to their function as recreational resources. Corridors were also selected to ensure development of a continuous system of greenways located throughout Wake Forest and extending to neighboring jurisdictions. It is expected that many Wake Forest neighborhoods will want to connect their greenway systems to the larger, municipal system. This is encouraged. However, it will be necessary for groups wishing to connect to the Wake Forest municipal system to seek permission from the Wake Forest Parks and Recreation Department. Efforts to join systems will require coordination between the Parks and Recreation Department and neighborhood associations. It must be clear to all parties that connecting to the Wake Forest municipal system does not transfer the neighborhood greenways responsibilities of safety, security, and/or maintenance to the Wake Forest Parks and Recreation Department.

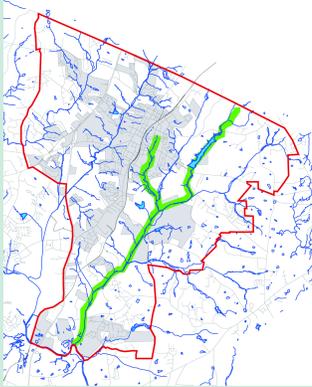
Proposed open space areas (as opposed to greenways) are not necessarily linear corridors. Open spaces identified in this plan are larger properties that contribute to the preservation of Wake Forest's natural character and its scenic beauty as well as perform ecological functions. In fact, open space preservation does not require public access or ownership in order to meet the desired objectives. Open space protection serves as a cultural resource and/or as an environmental resource. Opportunities to express the cultural and environmental resources in Wake Forest can be manifest in the creation of a central park feature. Such a facility could serve as a destination point and an organizing feature for the community and the greenway system.

The strength of executing the open space and greenways system recommendations will be in the contiguity of natural resources. However, it is not practical to consider the acquisition of properties and easements and



the development of facilities as a single unit. The following pages highlight individual segments of a contiguous system. The segments are described and the objectives for incorporation are discussed.

## Smith Creek



### Corridor Description:

Smith Creek is the major north-south greenway corridor proposed for Wake Forest. The corridor's endpoints are the Neuse River to the south and the Wake Forest reservoir (and beyond the Franklin County Line) to the north. The Smith Creek corridor is the longest feature within the study boundaries and under considerable development pressures. The primary land use along the proposed corridor is single-family residential and agricultural.

### Corridor Objectives:

This corridor can serve multiple objectives. Some trails along this corridor are designed and others are already built. Due to the increasing number of residential dwellings, new schools coming on-line, and the connection to downtown trails, the Smith Creek corridor has the greatest potential to be used as an alternate transportation routes. A greenway along Smith Creek will also serve to reduce flood damage that accompanies the increased impermeable surfaces of suburbanization. Also, this corridor has the potential to stir community interest in three ways: first, a greenway would serve as an axis between the Wake Forest reservoir and the Neuse River - highlighting Wake Forest water issues; second, a greenway would serve as a buffer between new neighborhoods that will develop as Wake Forest continues to grow; and third, a successful greenway project in this increasingly populated segment of Wake Forest will stimulate interest throughout the Wake Forest community. Because of the sizeable population that could be served by the Smith Creek greenway, trail facilities should be a Type 4 (Multi-Use Paved Trail). It may be necessary, however, for portions of the facility to be Type 2 (Limited Development Low-Impact Uses), in order to comply with Neuse River rules that require minimum disturbance of the land within 50-feet of surface waters.

## Richland Creek



### Corridor Description:

Richland Creek is the second longest stream in the study area. It shapes downtown by flanking it to the west. Downtown Wake Forest is situated atop the ridge that separates the Richland Creek and Smith Creek watersheds. Richland Creek flows from north to south, starting above the Wake County line, Richland Creek terminates at the Neuse River. Land use along Richland Creek is primarily single-family residential and agricultural.

### Corridor Objectives:

This corridor is well-suited to serve as a greenway corridor. In fact, it is probably the best-suited corridor based on current conditions. However, due to the pressures upon the rapidly developing Smith Creek corridor, more immediate actions to stay ahead of proposed developments there

requires that it should receive attention prior to the Richland Creek corridor. Richland Creek can function as a second north-south corridor that serves much of western Wake Forest. Securing the floodplain and conservation easements along the stream will protect water quality and wildlife habitat until funding is available to develop trails. It's position near the high school suggests that a future trail might be used by students to get to and from school. Also, connecting Wake Forest to the Neuse River, just below Falls Lake, should prove to be a popular recreational amenity. Trails developed within the Richland Creek corridor should be Type 4 (Multi-Use Paved Trails). Increasing numbers of residents along this corridor will warrant a durable facility that serves the western side of Wake Forest. It may be necessary, however, for portions of the facility to be Type 2 (Limited Development Low-Impact Uses), in order to comply with Neuse River rules that require minimum disturbance of the land within 50-feet of surface waters.

### Corridor Description:

Horse Creek is the western-most stream corridor in the study area. It is also the most healthy stream. The water in Horse Creek is clear and streambanks appear stable. The floodplain is wide and well-vegetated. Evidence suggests that the corridor supports a healthy wildlife population. The stream flows in a northeast to southwest direction before emptying into Falls Lake. Increasingly, Wake Forest is expanding westward and maintaining the health of the stream needs to be a priority.

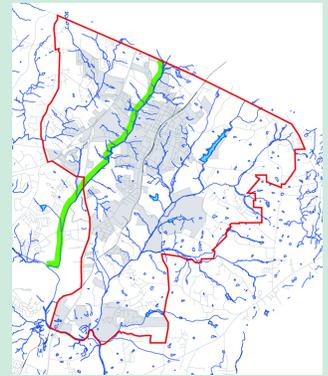
### Corridor Objectives:

The Horse Creek corridor is not well-suited to support a trail facility, at least not in a contiguous manner. Greenways in this corridor need to be Type 1 (No Facility Development) or Type 2 (Limited Development Low Impact Uses) to ensure that surfaces are porous and do not adversely effect the water absorbing functions of the floodplain soil. If facilities in this corridor are to be constructed, special care should be taken to ensure that Neuse River rules are strictly followed.

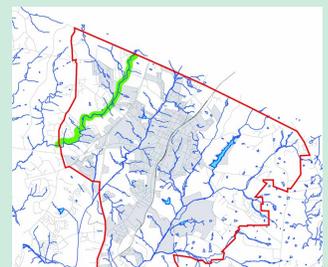
A major obstacle along the corridor is the Wake Forest Golf Club. Passage through or around this facility would be difficult to design with the necessary safety considerations addressed. Additionally, soil conditions along the upper portion of the stream would make trail construction difficult. The lower stretches of Horse Creek, within the study area and beyond, could someday provide a popular connection to Falls Lake. However, it is important to stress that the ecological health of the stream is its greatest strength and its contribution to the drinking water supply is its greatest service.

### Corridor Description:

Tom's Creek is the shortest stream corridor within the study area. The stream flows east to southwest from the Rolesville area to the Neuse River. The stream passes through residential neighborhoods and a large



## Horse Creek



## Tom's Creek



wetland before emptying into the Neuse River. The stream is listed as a 303(d) stream due to point source pollution, land development nonpoint source pollution, and urban runoff.

### Corridor Objectives:

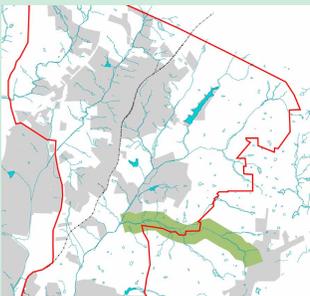
The greatest potential for this stream is its ability to connect Wake Forest to Rolesville thus contributing to a county-wide effort to link Wake County communities. There are sizeable wetlands associated with Brown's Lake at the eastern edge of the study boundary. The ecological functions of the wetlands, along with the cultural significance and beauty of the lake and granite dam, make this a significant corridor. However, Tom's Creek flows between residential communities that have expressed mixed feelings regarding the development of trail facilities. At the lower end of Tom's Creek there is a substantial wetland adjacent to property already owned by Wake Forest. While a trail here would be of limited benefit to much of the Wake Forest community, it could serve as an attractive destination to view wildlife, it could connect to trails along the Neuse River, and potentially link into a Smith Creek system. Trails being developed in this area should be Type 2 (Limited Development Low-Impact Uses) or Type 3 (Multi-Use Unpaved).



## Sanford Creek

### Corridor Description:

Sanford Creek is the easternmost stream corridor in the study area. The corridor's endpoints are Smith Creek and the Town of Rolesville. Sanford Creek is an opportunity to connect Wake Forest with Rolesville. Like Smith Creek, Sanford Creek is experiencing significant change due to residential development, particularly at its western end. The primary land use along the proposed corridor is single-family residential and agricultural.



### Corridor Objectives:

This corridor has the potential to serve multiple objectives. Due to the increasing number of residential dwellings, new schools coming on-line, and the connection to Rolesville - the Sanford Creek corridor has some potential to be used as an alternate transportation route. A greenway along Sanford Creek would also serve to reduce flood damage that accompanies the increased impermeable surfaces of suburbanization. Perhaps, the greatest contribution that the Sanford Creek corridor can make is connectivity. As mentioned earlier, the Wake County Open Space Program places a premium on connecting natural areas and communities. A Sanford Creek greenway would preserve wildlife habitat, contribute to water quality and stormwater management, and connect the communities of Wake Forest and Rolesville. Coordinating efforts between Wake Forest and the Town of Rolesville will add some complexity to the issue of trail development, but the connectivity rewards associated with it will be substantial. As long as compliance with the Neuse River rules is maintained, a Type 4 (Multi-Use Paved Trail) greenway will serve the users well.



# Chapter 4: Implementation Program

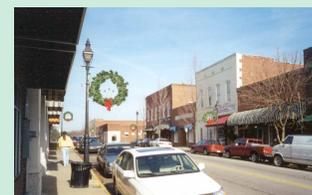
Because of the expense, private property issues, and comprehensive nature of this effort a phasing program is required for successful implementation. The Wake Forest Open Space and Greenway System can be broken down into two primary phases of future development in order to be executed in a manageable manner.

## Phase One

Phase One focuses on two primary axes. The first focus is on the Smith Creek axis. Smith Creek is a key north/south corridor that connects Wake Forest with the Neuse River. One day, this portion of the Neuse will host the Mountains-to-Sea Trail across North Carolina. It would be beneficial for Wake Forest to be prepared to tie into this trail for recreational and economic benefits. Additionally, communities are developing quickly along Smith Creek. The benefits that a greenway can bring to this area include: stormwater capacity that will be needed with the increased impervious surfaces that accompany development, a community recreation facility, and buffering adjacent neighborhoods and land uses. A Smith Creek greenway is capable of serving the community by branching to downtown (serving economic interests) and to recreation facilities (W.E.B Dubois School, Flaherty Park, and a future central park). Smith Creek is also the longest stream in Wake Forest (which presents a considerable challenge), and for this reason it has the potential to serve as an important community amenity. Finally, Wake Forest already owns considerable properties along Smith Creek, and despite its length, there are relatively few property owners that must be approached to gain access.

The second axis in Phase One is the east/west corridor that follows Wait Avenue and Durham Road. East/west connections are especially hard to identify in Wake Forest due to the north/south running ridges. This second axis would contrast the north/south axis, because it would primarily be an on-road system of pedestrian and bicycle facilities. While it does have potential recreation destinations at either end (Falls Lake to the west and the Wake Forest Reservoir to the east) it is considered important for its economic connections. Repeatedly, public comment made it known that the shopping center to the west of US 1/Capital Boulevard is a frequent destination. Having alternative transportation options to those retail facilities is important to the community - especially noted by the elderly.

## Phasing



Conversely, Wake Forest's downtown district is decidedly a pedestrian community. The traditional downtown storefronts rely on foot-traffic to attract patrons. Establishing a greenway through the heart of Wake Forest would no-doubt be a high profile amenity for Wake Forest.

## Phase Two

Phase Two of the greenway system will seek to expand the greenway system to other parts of the Wake Forest community. A greenway along Purnell Road and another along Richland Creek would effectively box-in much of the northern downtown population. Phase Two will also help establish a connection to Rolesville along Sanford Creek. This would require cooperation and coordination with the Town of Rolesville, and, undoubtedly, each town would benefit. Other aspects of Phase Two include extending Smith Creek to the Wake Forest Reservoir and establishing an on-road facility along Jenkins Road.

## Greenway Trail Types

Two important issues for the Town to consider while designing greenway facilities are the surface types of trails and the width of trails. These two variables will greatly effect the cost of installing and maintaining this system. When determining the width of greenways the Town should consider the safety of the user groups for which the trail will be built. We recommend a minimum trail width of 10' for any facility intended for bicycle use. This allows enough room for cyclists traveling in opposite directions to pass each other comfortably. An 8' minimum width is recommended for walking/jogging/hiking trails.

There are several different surface types that could be used to build the Wake Forest Greenway System. The following descriptions briefly explain some of the trail surface types that can be considered for this greenway system. See Appendix B: Design Guidelines for specifications.

The Wake Forest system includes five trail types. The selection of the appropriate type depends on anticipated use, topography, hydrology, existing road access and a host of other factors. The following typology of trails will assist in defining and designing future greenway projects. Construction methods for specific trail types may vary between areas in the region depending on local environmental conditions and user requirements.

### Type 1: No Facility Development

This designation applies to corridors containing environmentally sensitive areas, steep slopes, wetlands or other constraints that make trail facilities undesirable or impossible. The corridor will remain primarily in a natural state as human access will be extremely limited. Other functions for these corridors include floodplain management, water quality protection and conservation of important habitat for wildlife and plants. Preserving connections between wildlife habitat areas is also an important function of such corridors.

Environmentally sensitive areas may be further described as those that contain significant natural resources, remnant landscapes, and those that are unsuitable for development but offer natural resource potential. Sites with steep slopes, mature or virgin natural vegetation, ravines, wetlands and streamsides are typical of such locations in the MetroGreen project area. Resource quality is the primary determinant when it comes to selecting a site for preservation. Sites that exhibit unique natural resources or remnant landscapes of the region should be of the highest priority. Outlots and undevelopable/protected lands should be selected on the basis of enhancing the character of the community, protection of stream corridors, and providing linkages with other system components protecting natural systems and processes.

In these areas avoid actual trail development. Hikers are free to use wildlife trails, creeks and other natural features, however, no support facilities, signage or amenities are recommended.

## Type 2: Limited Development, Low-impact Uses

This designation applies to corridors containing environmentally sensitive features that limit the extent of greenway facility development. The corridor will remain primarily in a natural state, with gravel, or dirt trails (4 to 6 feet wide) for use by low impact user groups such as hikers or joggers. Trailhead facilities and other amenities (such as signage and picnic tables) will be limited. Boardwalks may be necessary to cross wetlands in these areas.

These areas are valuable to tie park components together to form a cohesive system. They also emphasize harmony with the natural environment while allowing more access than a Type 1 Trail. Type 2 Trails have a great deal in common with Type 1. Both preserve natural resources and mediate between larger habitat areas, open space, and corridors for wildlife. Corridor widths of 200 feet are considered optimal with 50 feet usually considered the minimum.

Type 2 Trails are designed to accommodate pedestrians and are not intended for cyclists or other wheeled users. These paths, often very narrow, sometimes follow strenuous routes and may limit access to all but the most mobile users. Construction of these trails consists of providing positive drainage for the trail tread and should not involve extensive removal of existing vegetation.

Boardwalk or wood surface trails are typically required when crossing wetlands or other poorly drained areas. While boardwalks can be considered multi-use trails, the surface tends to be slippery when wet. They are constructed of wooden planks or recycled material planks that form the top layer of the boardwalk. The recycled material has gained popularity in recent years since it lasts much longer than wood, especially in wet conditions. A number of low-impact support systems are also available that reduce the disturbance within wetland areas to the greatest extent possible.

### Type 3: Multi-Use, Unpaved Trail Development

This designation applies to greenway corridors located outside of areas which experience frequent flooding. Aggregate surface trails (10 feet minimum width) are appropriate for corridors outside the floodplain where anticipated use or the adjacent landscape dictates a more natural trail.

These trails are restricted to pedestrian and bicycle activity. Wheelchair users and persons with strollers can use unpaved trails if they are designed to ADA standards and surfaced with compacted limestone screenings or other hard, permeable surface, crushed stone. Trailhead facilities and other amenities (such as benches, signage and picnic tables) are appropriate with this type trail and will be developed as needed and where desirable.

While less expensive to install, unpaved trails typically require more frequent repairs. Careful consideration should be given to the amount of traffic the specific segment will generate since these surfaces tend to deteriorate with excessive use. Another important design issue is providing for proper drainage of aggregate trails. It is best if water is channeled beside the trail rather than allowing it to cross the surface. Materials that can be used to surface a Type 3 Trail include, soil cement, compacted limestone screenings, and crushed stone.

### Type 4: Multi-Use Paved Trail Development

This designation applies to corridors where high use is anticipated, that do not contain environmentally sensitive areas, will most likely be used as transportation routes, and are located within frequently flooded areas. The paved trails can be surfaced with asphalt or concrete (10 feet minimum) for use by several user groups, including bicyclists, joggers, wheelchair users and rollerbladers. Although asphalt is the most common paved surface used for greenway trails, concrete is best for areas experiencing frequent flooding. Trailhead facilities and other amenities will be developed as needed and where appropriate.

Typical pavement design for paved, off-road, multi-use trails should be based on specific loading and soil conditions found on site. They should be designed to accommodate maintenance and emergency vehicles in both width and loading.

Asphalt is a popular trail surface in the region. It is highly flexible, relatively inexpensive to lay and holds-up well over time. One concern with asphalt is the deterioration of trail edges. This condition can be reduced through the installation of geotextile fabric under an aggregate base and the provision of 2-foot shoulders. There are many cases in the metropolitan area, however, where asphalt is installed directly on compacted subgrade and performance is acceptable. It is important when omitting the aggregate base to pay close attention to subsurface conditions and drainage to insure a stable subgrade prior to paving.

The minimum width for a two-directional trail is 10 feet. Centerline stripes should be considered for paths that generate substantial amounts of traffic. Possible conflicts between user groups must also be considered during the design phase since cyclists often travel at higher speeds than other modes.

### Type 5: On-road (Sidewalks and Bikeways)

This trail type has perhaps the most variation of use and construction. This designation applies to corridors in urbanized or urbanizing areas where an off-road option is not possible, corridors function as connections between off-road trails and major origins and destinations and where different users have different needs: ie. recreational cyclists versus commuter cyclists. This category includes both sidewalks for pedestrian use and bikeways for cyclists. Bikeways can vary from 6-foot wide bicycle lanes (complete with pavement striping and signage) to 4-foot wide paved roadway shoulders to a 14-foot wide curb lane (to be shared by cyclists and motorists). Pedestrian scale lighting, street trees, benches and other amenities can be developed to encourage sidewalk use.

### Equestrian Trails

There is an active horse riding contingency in Wake Forest. They are particularly active in the area east of the reservoir, and have expressed an interest in developing equine trails. Equestrian trails need to be separated from facilities that are used by pedestrians and cyclists. Equestrian trails tend to prefer longer segments of trails to ride. Wake Forest may wish to explore the possibilities of a shared facility with the towns of Rolesville, Wendell, and Zebulon. This would enable the trail to span a greater distance, connect the different towns, and create an opportunity for the towns to share in the investment of a stand-alone equestrian trail or one that parallels a pedestrian and cyclist trail.

The following Action Plan for the Wake Forest Open Space and Greenways Plan describes the Plan's overall implementation strategy, identifies five objectives to accomplish that strategy and recommends 37 actions to accomplish those objectives.

Implementation of this plan requires the cooperative effort of a variety of public and private organizations, and involves implementation by land-owners and citizens, as well. It is the intent that this plan be fully implemented over the next 10-20 years. However, some of the long-range actions, principally those involving water quality, are complex and may take time to implement. Therefore, an important part of this plan's implementation will be identifying which actions should be initiated immediately and which should be pursued at a later date. The following outline fulfills this need by providing a priority for implementation for each action.

It is important to note, however, that many actions can be pursued simultaneously. The list is intended to provide general direction only, and long-range actions should be implemented if conditions are favorable.

## Summary Action Plan

## Short-Range Actions

(Initiated within the first five years of plan implementation)

- I.) Objective: Establish a greenway corridor and stream buffer zone for all major streams
  - A.) Initiate new land acquisitions for greenway preservation and trail development
  - B.) Initiate new conservation easements on selected properties
  - C.) Initiate acquisition/protection of vacant properties within the greenway boundary
  - D.) Increase public education and technical assistance to property owners
  - E.) Encourage protection of streamside trees and vegetation
- II.) Objective: Develop multi-purpose recreational trails
  - A.) Implement land trails along Smith Creek and Richland Creek
  - B.) Acquire property for regional trailheads and a water quality demonstration project
- III.) Objective: Improve water quality
  - A.) Implement buffers along stream corridors
  - B.) Acquire and/or protect parcels in water recharge areas
- IV.) Objective: Restore natural areas
  - A.) Implement restoration and demonstration projects
  - B.) Protect streambanks and complete streambank stabilization projects using environmentally friendly bioengineering techniques along creeks in areas which have the greatest erosion
- V.) Objective: Reduce flood damages
  - A.) Remove or relocate repetitively damaged structures from the floodway
  - B.) Limit construction in the floodway by increasing buffers along streams

## Long-Range Actions

(Initiated and/or completed within 10 years of plan adoption)

- I.) Objective: Develop a multi-purpose recreational trail
  - A.) Encourage coordination with developers on trail improvements opportunities
  - B.) Implement multiple use trailheads
  - C.) Implement signage program
  - D.) Install vegetative screening to shield selected land uses

- II.) Objective: Improve water quality
  - A.) Increase water quality public education and technical assistance program
  - B.) Work to minimize impervious surfaces and to improve infiltration
  - C.) Acquire, restore and/or construct wetlands
  - D.) Promote use of native vegetation
  - E.) Use wetland detention basin designs or retrofit existing basins
  - F.) Enforce erosion and sediment controls
  
- III.) Objective: Restore natural areas
  - A.) Actively manage riparian zones and natural areas to control non-native species
  
- IV.) Objective: Reduce flood damages
  - A.) Provide technical assistance to property owners to minimize impervious surfaces
  - B.) Conduct annual stream maintenance to maintain stream channel conveyance

# Appendix A: Summary of Public Input

The Wake Forest Open Space and Greenways Plan workshops were well-attended and productive. More than twenty people attended the first workshop held Wednesday, March 21, 2001, from 6:30 pm to 8:30 pm at the Wake Forest Town Hall. The second public meeting was held Monday, July 30, 2001, from 6:30 pm to 8:30, also at the Wake Forest Town Hall. Over thirty people attended the second workshop to contribute their knowledge of the region and to learn more about area efforts to preserve Wake County open space. The meetings attracted neighborhood residents, government officials, environmentalists, developers, historians, and other interested groups.

At the workshops, participants were encouraged to make notations and draw potential trail routes directly on Wake Forest maps produced for the workshops (see figures A-1 and A-2). Comment forms were also available for people to leave written comments and answer questions about their open space and passive recreation area needs. Also, Wake Forest staff and Greenways Incorporated personnel were on-hand to answer questions and listen to citizen comments.

Attention focused on the four Wake Forest stream corridors: Horse Creek, Richland Creek, Smith Creek and Tom's Creek. The streams flow north to south and are the primary source of wildlife habitat for Wake Forest. Participants were also interested in east-west connections, specifically greenways that would bridge Capital Boulevard. Public input received at the first workshop was incorporated graphically into the working map for the second workshop.

In addition to the workshops, efforts were made to reach out to community groups. On April 5, 2001, the Wake Forest Women's Club meeting was attended (see figure A-3). A brief presentation was given about the benefits of open space planning, the Wake Forest planning process, and the Wake County Open Space Program. Comments focused on the new 98-bypass, open spaces where some of the women played as children, and connections to shopping areas.

Also, a meeting was held with Andy and Jan Ammons to discuss activities in the development community. The conversation focused on the growth patterns of Wake Forest and, specifically, the new Heritage development in eastern Wake Forest.

## Workshop Overview









Of the approximately 60 public workshop visitors, a total of 30 completed comment forms were returned. These comment forms were designed to encourage workshop participation and allow people to comment privately, if they chose to do so. The figures below represent the results from the returned forms.

## What should be accomplished by Open Space preservation?

- 70% Acquire more land for public uses
- 73% Clean the water that flows in the stream corridors
- 80% Link neighborhoods to the existing park systems
- 60% Interpret the unique history of the landscapes of Wake Forest
- 53% Acquire more land for improving water quality of the area streams
- 70% Build a trail system along stream corridors
- 60% Improve access to surrounding urban, suburban, and rural areas

## What activities are you most likely to do in a Greenway?

- 87% Walk along a stream corridor
- 60% Ride a bike for fitness and fun
- 10% Ride a horse on a trail
- 63% Picnic with friends or family
- 43% Volunteer to plant native trees and other vegetation near the stream buffers
- 47% Volunteer to help with clean up of public lands along the corridor
- 50% Learn about the environment and history of the stream corridor from interpretive signs

## Who should manage and care for Open Space and Greenways?

- 33% The community of Wake Forest
- 10% Wake County
- 0% The State of North Carolina
- 37% A Partnership of Public and Private Organizations
- 0% Private Sector Organizations and Landowners
- 20% No response

## Do you support using public funds for the preservation of Open Space?

- 83% Yes
- 0% No
- 3% Not certain at this time
- 7% No response



Additional comments were included on some of the forms. A representative sample of the comments are printed below:

- More recreational space for the youth of Wake Forest.
- Particularly interested in equestrian access/use to trails. Lots of riders in WF and surrounding area.
- Encourage developers to dedicate passage ways for trails as developments are proposed/approved. Coordinate w/ County and surrounding towns to interconnect trails/systems.
- After living in urban areas all over the country including 15 years in LA, we have come to treasure open areas in developed areas. So will other potential residents & business owners.
- Walk to and from community resources inclusive of public commercial and residential property for actual usage.
- No immediate visual access from the greenway to the major traffic corridors (i.e. buffers).

# Design Guidelines

The design development guidelines featured in this Appendix have been tailored to meet the specific facility development needs of the Wake Forest Open Space and Greenway System. The purpose of these guidelines is to assist the Town and its partnering organizations in developing open space and greenway facilities.

These guidelines provide a variety of trail facility and ecological system restoration concepts and ideas. These guidelines are not a substitute for a more thorough examination and detailed landscape architectural and engineering evaluation of each project segment. These guidelines serve as minimum standards for greenway facility development. The Town disclaims any liability for the use, appropriateness and accuracy of these guidelines as they apply to a specific project.

The following resource materials have been used in the preparation of these guidelines:

- Adherence to national design standards for off-road trails and greenway facilities, as defined by the American Association of State Highway Transportation Officials (AASHTO), the Americans with Disabilities Act, Designing Sidewalks and Trails for Access: Part 2 and the Manual on Uniform Traffic Control Devices.

For more in-depth information and design development standards, the following publications should be consulted:

Greenways: A Guide to Planning, Design and Development  
Published by Island Press, 1993  
Authors: Charles A. Flink and Robert Searns  
For more information visit [www.greenways.com](http://www.greenways.com)

Trails for the Twenty-First Century  
Published by Island Press, 2001  
Authors: Charles A. Flink, Robert Searns and Kristine Olka  
For more information visit [www.greenways.com](http://www.greenways.com)

## Description

## Resources

## Additional Resources

### Guide to the Development of Bicycle Facilities

Updated in 2000 by the American Association of State Highway Transportation Officials (AASHTO). Available from FHWA or AASHTO. [www.aashto.org/bookstore/abs.html](http://www.aashto.org/bookstore/abs.html)

### Manual on Uniform Traffic Control Devices (MUTCD)

Published by the U. S. Department of Transportation, Washington, DC

### Universal Access to Outdoor Recreation: A Design Guide

Published by PLAE, Inc., Berkeley, CA, 1993

### Designing Sidewalks and Trails for Access: Part Two - Best Practices Design Guide

Published by U.S. Department of Transportation, Washington, DC, 2001

In all cases, the recommended guidelines in this report meet or exceed national standards. Should these national standards be revised in the future and result in discrepancies with this chapter, the national standards should prevail for all design decisions.

Other useful web sites for information include:

Rails-to-Trails Conservancy - [www.railtrails.org](http://www.railtrails.org)

National Park Service - [www.nps.org](http://www.nps.org)

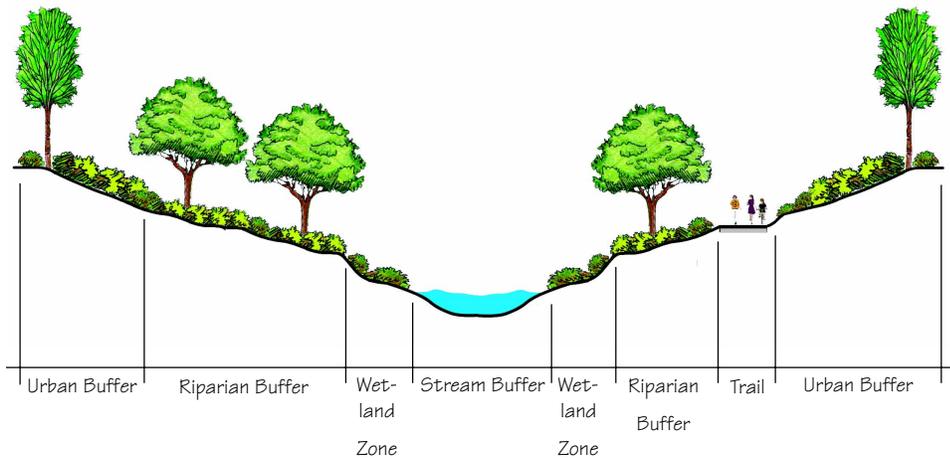
U.S. Department of Transportation - [www.walkinginfo.org](http://www.walkinginfo.org) and  
[www.bicyclinginfo.org](http://www.bicyclinginfo.org)

Trails and Greenways Clearinghouse -  
[www.trailsandgreenways.org](http://www.trailsandgreenways.org)

National Bicycle and Pedestrian Clearinghouse -  
[www.bikefed.org/clear.htm](http://www.bikefed.org/clear.htm)

Greenways Incorporated - [www.greenways.com](http://www.greenways.com)

## Stream Corridor Buffer



Riparian buffers serve many functions. They filter stormwater pollutants, help moderate stream flow, stabilize streambanks, moderate stream temperature, and provide aquatic and terrestrial habitat. The Neuse Nutrient Sensitive Waters (NSW) rules require that new developments maintain an existing 50-foot vegetated buffer on both sides of all intermittent and perennial streams, lakes and ponds within the Neuse River Basin. Approximately 85 percent of Wake County lies within the Neuse River Basin. For the purpose of the rules, a waterbody exists if the feature is present on either the most recent version of the soil map or 7.5 minute quadrangle topographic map prepared by USGS. The required buffers consist of two zones: a 30-foot undisturbed zone adjacent to each side of the waterbody, and a vegetated zone that extends from the outer edge of the 30 foot zone for a distance of at least 20-feet.

Buffers are required in water supply watersheds throughout the state as part of the Water Supply Watershed Management Program. The Division of Water Quality manages the program through oversight of local ordinances and monitoring of land use activities. Local water supply watershed programs must be approved by the NC Environmental Management Commission (EMC). The program requires local governments to adopt land use controls that include buffer protection. For low-density development, 30-foot buffers are required along perennial streams, and 100-foot buffers are required for high-density development. There are five major water supply watersheds within Wake County: Falls Lake, Jordan Lake, Wake Forest Reservoir, Swift Creek, and Little River. In addition, a small portion of the County near Fuquay-Varina drains to the Cape Fear River, which is used as a water supply by Lillington.

Stream buffers within Wake County should be established to protect water quality and animal habitat. For the purpose of greenway facility development, a minimum of 50-foot wide buffer (150-foot preferred) as measured from the top of streambank is required in order to mitigate the damaging effects of flooding from storms, filter pollutants from overland flow and develop appropriately sized greenway trail facilities.

Wake County has applied the Neuse River Basin 50-foot buffer throughout the county. (Please see the attached Neuse River Buffer Rules.) Some of the municipalities within the county (Wake Forest, Apex, Cary and Morrisville) have placed additional buffers up to 100-feet on their streams, according to their order.

Instead of using this conventional method of prescriptive buffers, stream buffers should be a varied width according to ecological features of the watershed. Each buffer width will be site specific, depending on the following characteristics of the stream, riparian buffer and watershed:

- Slope
- Soil
- Hydrology
- Vegetation
- Water Quality
- Impervious Surface

The appropriate width for a variety of characteristic combinations will be discussed more in depth in the Wake County-wide Open Space and Greenways Plan.

## Corridor Planting

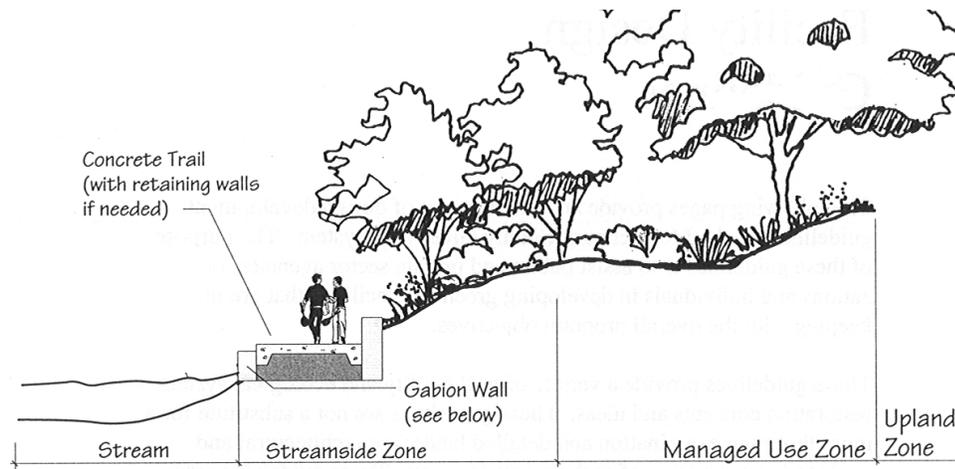
Some basic guides for planting in corridors is as follows:

- Efforts should be made to eliminate non-native invasive species, such as privet (*Ligustrum sinense*) from corridors.
- Native overstory and understory trees/shrubs should be re-planted where vegetation is removed or harmed due to construction of parks, trails, etc. in greenway corridors or open space.
- Fallen trees should not be removed unless they obstruct trails or present danger. Otherwise, they should be left to decay naturally.
- Evergreens, conifers (pines) and deciduous trees should all be used proportionally.
- Mast producing trees and shrubs with berries should be utilized for wildlife food whenever possible.
- Flowering trees and shrubs can be used to draw attention to important intersections and entrances.
- Evergreen shade trees are needed near seating areas and picnic tables.
- Evergreen shrubs, such as wax myrtle, can help separate public areas from private residences.

# Types of Trail Treads

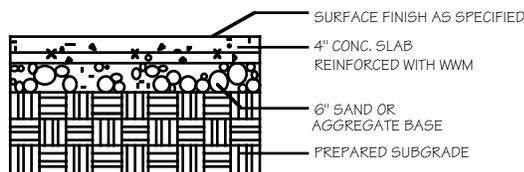
## Creekside Trail Tread

Creekside trails are located only in urban areas, where right-of-way constraints and channelized streams restrict trail development to the floodway. Creekside trails are designed to accommodate walkers, bicyclists, rollerbladers, and joggers. These multi-use trails are typically positioned directly adjacent to the stream channel and are therefore subject to frequent flooding. These trails require hard-paved surfaces of concrete to withstand high-velocity stream flows. Retaining walls or other structural elements may also be required for stable construction and to protect the trail from erosion and flood damage.



### Typical Multi-Use Creekside Trail Cross Section

Creekside trails should be a minimum of 10'-wide for multi-use trails. The installation of railings, benches, signage, and trash receptacles that could obstruct flow during storm events, should be carefully considered. Creekside trails must be designed and installed in a manner that minimizes their effect on flood waters and protects the amenities from flood damage. The use of retaining walls as seat walls is one way in which non-obtrusive amenities can be included on this type of trail facility. Special consideration should be paid to mitigating the impacts of trail construction on the natural environment.

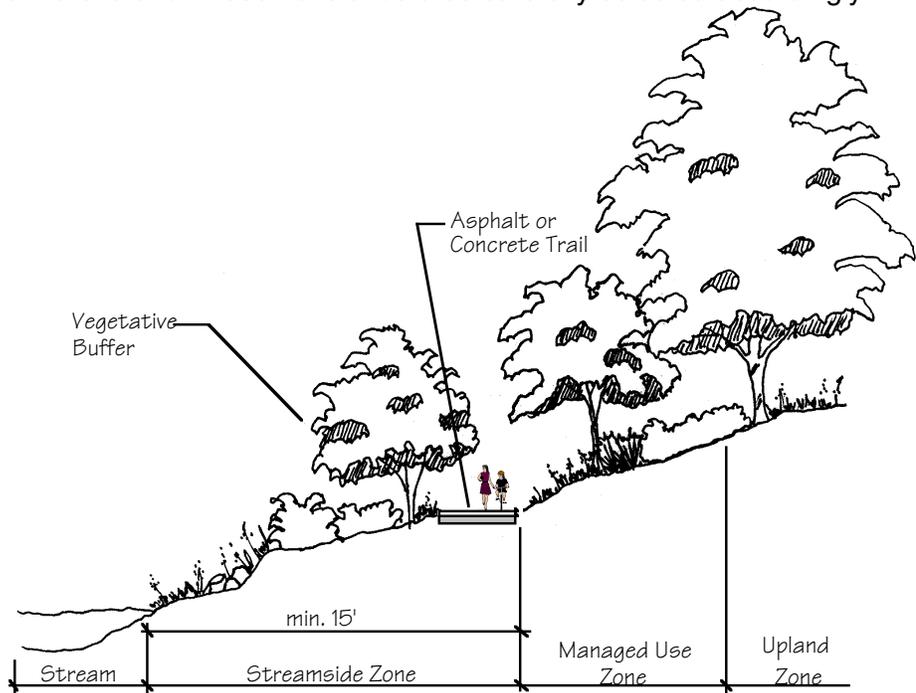


### Paving Cross Section

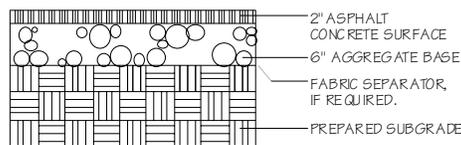
## Floodway Trail Tread

Multi-use trails within the floodway are designed to accommodate a variety of users including walkers, joggers, cyclists, and rollerbladers. These multi-use trails are typically positioned within the floodway but not directly adjacent to streams. Some vegetative buffer between the stream and trail should be left intact. Like the streamside trails, trails within the floodway are subject to periodic flooding, however, not as frequently. These trails require paved surfaces of either asphalt or concrete depending on frequency of flooding and expected velocity of flow. A proper trail foundation is important and will increase the longevity of the trail. No soft shoulder should be constructed due to flood considerations. Special consideration should be given to the mitigation of negative impacts from trail development on the natural stream environment.

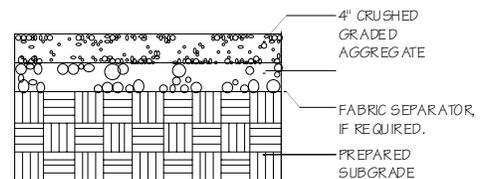
Multi-use trails within the floodway should be built with a minimum width of 10 feet. All elements of the trail including the trail tread, railings, benches, and trash receptacles will be periodically flooded. The design and materials for these trails should be carefully selected accordingly.



**Typical Multi-Use Trail Cross Section  
(Within the Floodway)**



**Asphalt Paving on Aggregate Base**



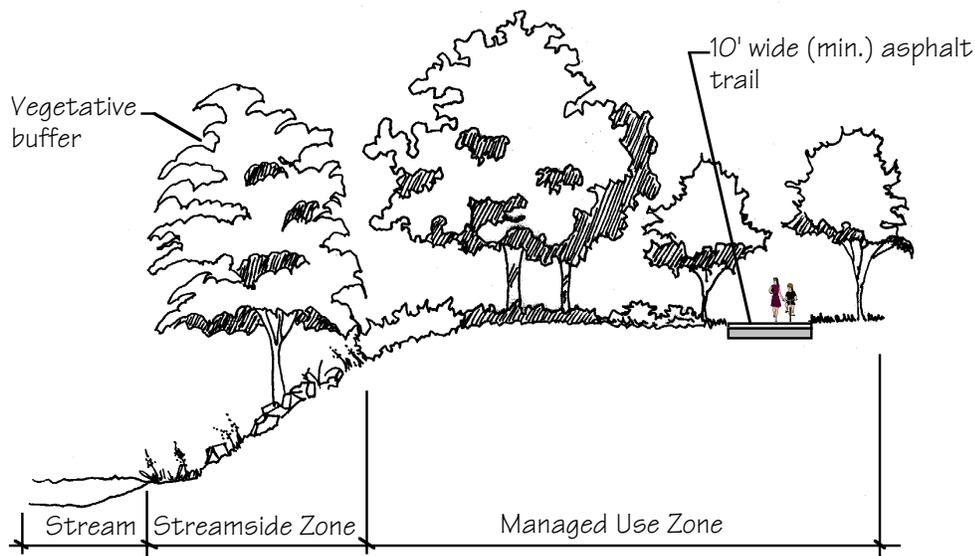
**Gravel Paving on Aggregate Base**

### Paving Cross Section

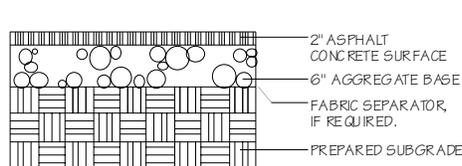
## Floodplain Trail Tread

Multi-use trails within the floodplain are designed to accommodate a variety of users including walkers, joggers, cyclists, and in-line skaters. These multi-use trails are typically positioned outside the floodway but within the floodplain. Significant vegetative buffers between the stream and trail should be left in tact. Multi-use trails within the floodplain are subject to occasional flooding during large storm events. It is recommended that these trails be built with paved asphalt, however an aggregate stone surface may be adequate in some locations.

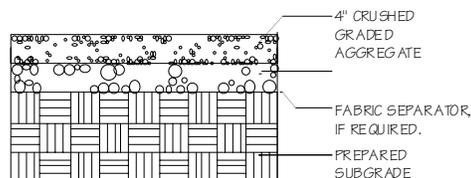
Multi-use trails within the floodplain should be built to a minimum width of 10', although 12' to 14' is preferred. The graphics below illustrate two suitable pavement cross sections that can be used to build multi-use trails within the floodplain.



**Typical Multi-Use Trail Cross Section  
(Within the Floodplain)**



Asphalt Paving on Aggregate Base

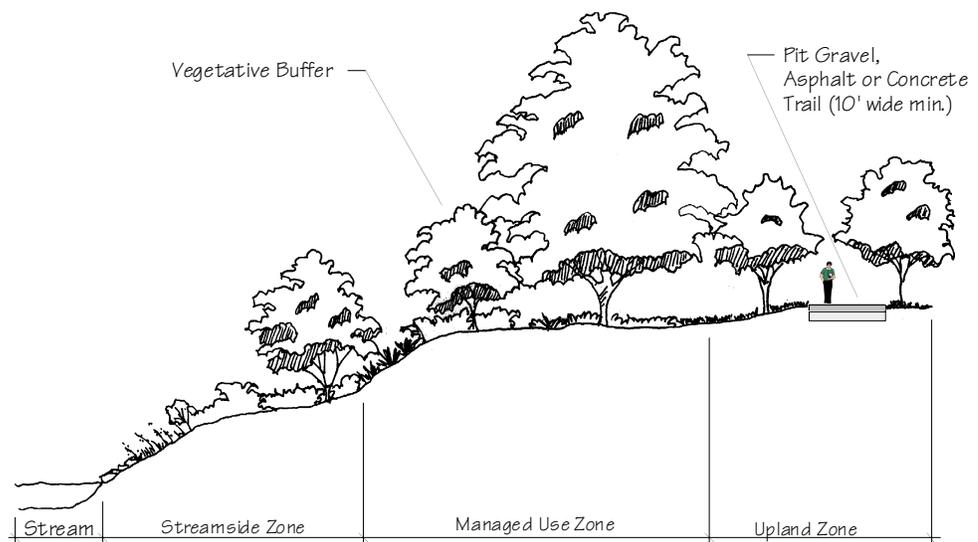


Gravel Paving on Aggregate Base

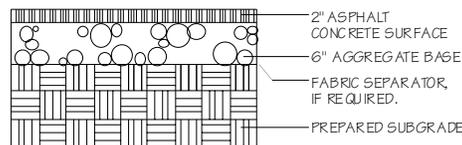
## Paving Cross Section

## Upland Trail Tread

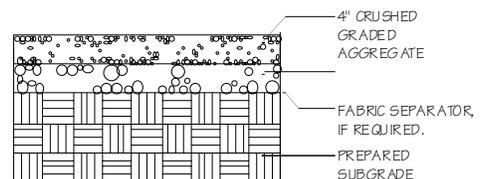
Upland multi-use trails are designed to accommodate a variety of users including walkers, joggers, cyclists and in-line skaters. These upland multi-use trails are typically positioned completely outside designated floodplains. Significant vegetative buffer between any streams and the trail should be left in tact. It is recommended that these trails be built with paved asphalt or aggregate stone, depending on the preference of local user groups. Upland multi-use trails should be built to a minimum width of 10', though 12' is preferred.



## Upland Trail Cross Section



Asphalt Paving on Aggregate Base



Gravel Paving on Aggregate Base

## Paving Cross Section

## Footpath/Hiking Trail

Footpaths or hiking trails are designed to accommodate pedestrians and are not intended for cyclists or other wheeled users. These natural surface trails typically make use of dirt, rock, soil, forest litter, pine mulch and other native materials for the trail surface. Preparation varies from machine-worked surfaces to those worn only by usage. This is the most appropriate surface for ecologically sensitive areas.

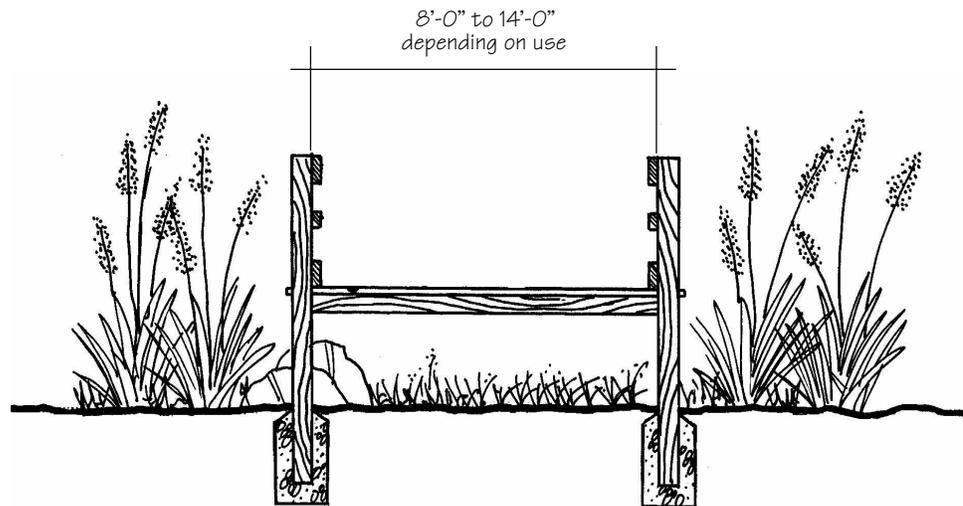


### Footpath Cross Section

These pathways, often very narrow, sometimes follow strenuous routes and may limit access to all but skilled users. Construction of these trails mainly consists of providing positive drainage for the trail tread and should not involve extensive removal of existing vegetation. Timbers may be used for steps along steep slopes. These trails vary in width from 3 feet to 6 feet and vertical clearance should be maintained at 9 feet. These trails are most commonly found within the streamside zone.

## Boardwalk Trail Tread

Boardwalks, or wood surface trails, are typically required when crossing wetlands or poorly-drained areas. While boardwalks can be considered multi-use trails, the surface tends to be slippery when wet and not best suited for wheeled users. Boardwalks intended for use by bikes, pedestrians, in-line skaters and others should be a minimum of 14 feet wide. However, boardwalk trails limited to pedestrian use can be as narrow as 8 feet. If maintenance vehicles use the boardwalk for maintenance access, it should be a minimum of 14 feet.



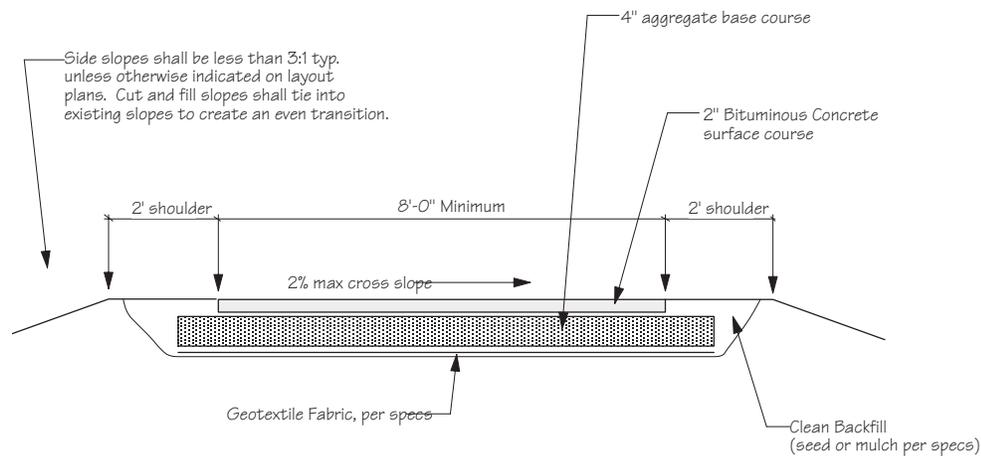
## Boardwalk Cross Section

Wood surfaced trails are usually composed of sawn wooden planks or lumber that forms the top layer of a bridge, boardwalk or deck. The most commonly used woods for trail surfacing are exposure- and decay-resistant species such as pine, redwood, fir, larch, cedar, hemlock and spruce. Wood is a preferred surface type for special applications because of its strength and comparative weight, its aesthetic appeal and its versatility. Synthetic wood, manufactured from recycled plastics, is now available for use as a substitute in conventional outdoor wood construction. While these products are more expensive than wood lumber, recycled plastic lumber lasts much longer, does not splinter or warp and will not discolor.

## Paved Multi-Use Trail

Typical pavement design for paved, off-road, multi-use trails should be based upon the specific loading and soil conditions for each project. These trails, typically composed of asphalt or concrete, should be designed to withstand the loading requirements of occasional maintenance and emergency vehicles. In areas prone to frequent flooding, it is recommended that concrete be used because of its excellent durability.

One important concern for asphalt, multi-use trails is the deterioration of trail edges. Installation of a geotextile fabric beneath a layer of aggregate base course (ABC) can help to maintain the edge of a trail. It is important to provide a 2'-wide graded shoulder to prevent trail edges from crumbling.



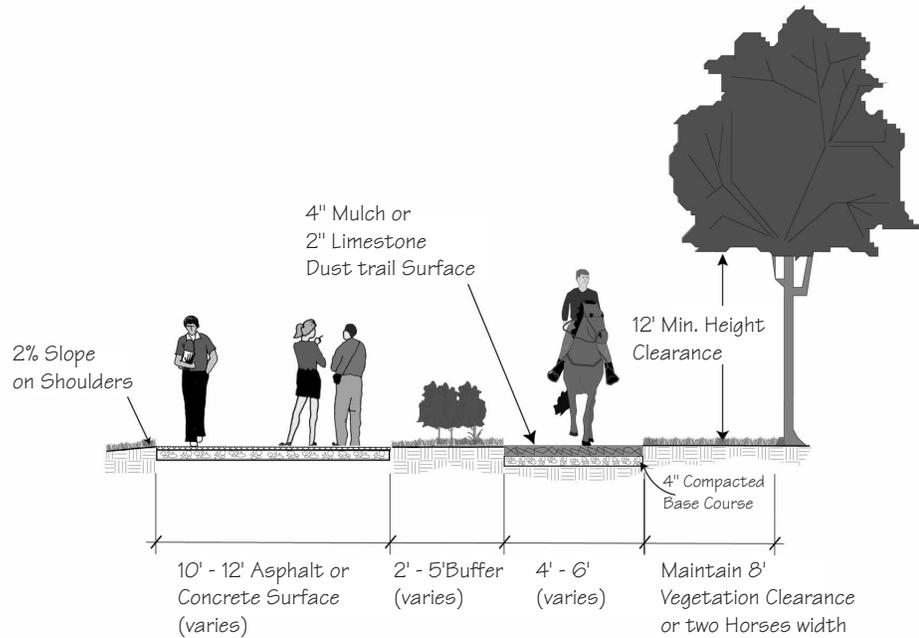
## Multi-Use Trail Cross Section

The minimum width for two-directional trails is 10', however 12'-14' widths are preferred where heavy traffic is expected. Centerline stripes should be considered for paths that generate substantial amounts of pedestrian traffic. Possible conflicts between user groups must be considered during the design phase, as cyclists often travel at a faster speed than other users. Radii minimums should also be considered depending on the different user groups.

Asphalt is a hard surface material that is popular for a variety of rural, suburban and urban trails. It is composed of asphalt cement and graded aggregate stone. It is a flexible pavement and can be installed on virtually any slope.

Concrete surfaces are capable of withstanding the most powerful environmental forces. They hold up well against the erosive action of water, root intrusion and subgrade deficiencies such as soft soils. Most often, concrete is used for intensive urban applications. Of all surface types, it is the strongest and has the lowest maintenance requirement, if it is properly installed.

## Dual Trail Tread



### Typical Equestrian and Pedestrian Trail Cross Section

Dual tread trails are suggested on multi-use trail systems where different users travel at different speeds, such as equestrians and walkers. If hard surfacing is being used on the multi-use trail, a softer, 5-foot-wide tread for horses should be considered. Mulch, dirt, stabilized dirt or limestone dust can be used. Hard surfaces, such as concrete and asphalt are undesirable for equestrians because they can injure horses' hooves. Granular stone may also present problems because it can get stuck in horse hooves.

Vertical clearance for equestrians should be at least 10 feet, with a horizontal clearance of at least 5 feet. Low-hanging tree limbs should be cut flush with the trunk. Leaves, branches and other protrusions that could injure the horse, rider or gear should be removed. Within the tread, stumps, large rocks and other debris should be cleared. Sight distances for equestrians, who usually travel between 4 and 6 miles per hour, should be at least 100'.

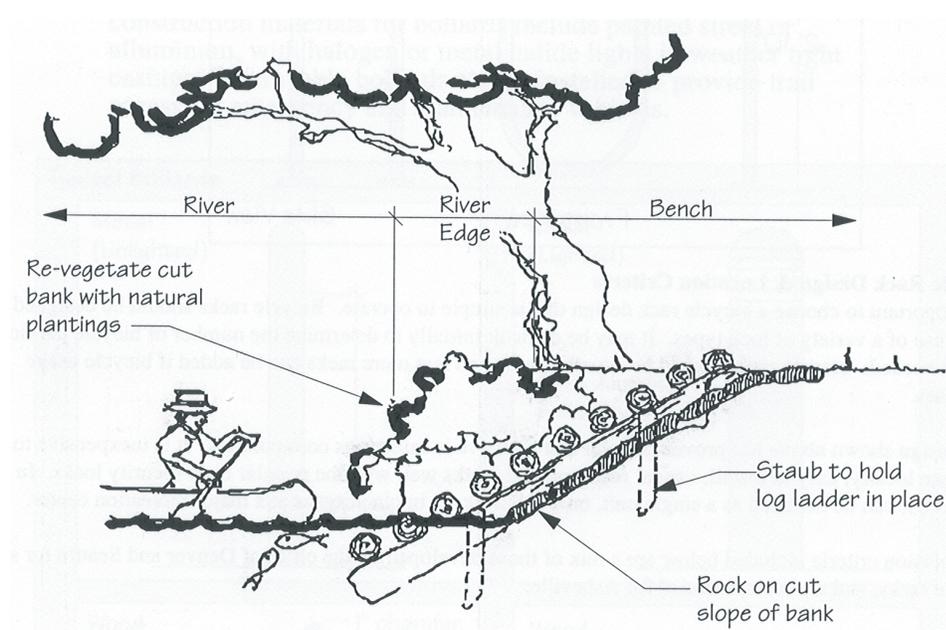
Dual treads may also be required for mountain biking trails.

## Water Based Trail

This designation applies to those rivers and streams that can successfully accommodate and/or which are designated to support canoeing, kayaking and boating. Water based trails can be designated with features and facilities that make this activity more enjoyable for residents, including signage systems, improved rapids, safety systems, and access points. Rental outfits could be established at put in/take out points.



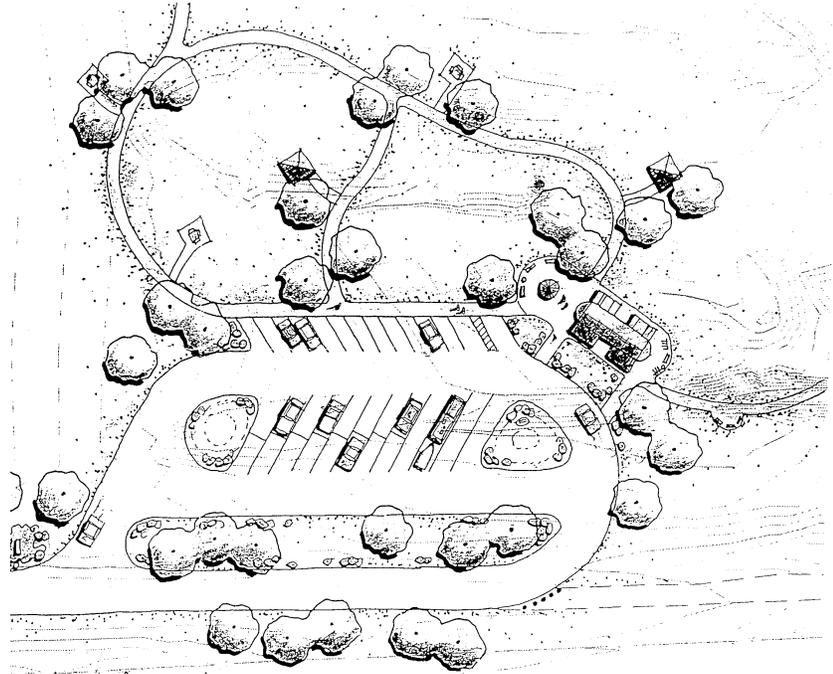
Example of a Water Based Trail in Use



Small Boat Access

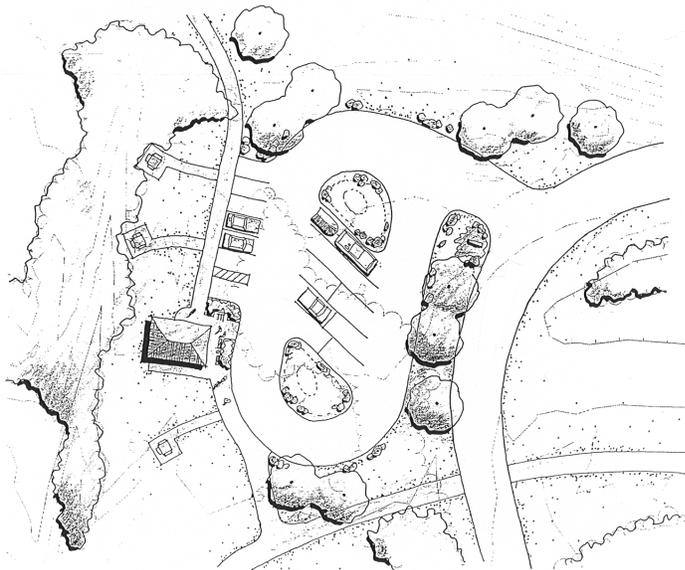
# Trailheads

## Major and Minor Trailheads



**Typical Major Trailhead Plan View**

Trailheads should be installed throughout the greenway system to give the public access. A “trailhead” is a point of formal public entry into the greenway system that may provide certain related public facilities such as parking, restrooms, drinking fountains, trail signage, etc. Major trailheads and minor trail heads are suggested. Major trailheads should be located in significant areas. An exhibition building or an interpretive exhibit may be incorporated, along with restrooms, water fountains, picnic tables, parking, signage, etc. Minor trailheads can be used to connect a smaller number of people to surrounding trails, open space, parks, etc.



**Typical Minor Trailhead Plan View**

## Restrooms

Public amenities, such as phones, restrooms, etc., shall be located and concentrated at the confluence of vehicular and pedestrian traffic. ADA accessible restrooms should be placed at major trail access points in order to accommodate trail users. Where possible, other uses should be incorporated into the structure, such as storage for maintenance equipment. These structures should be located adjacent to thoroughfares for security, maintenance and access to utility hookups. They should also make use of natural light and ventilation as much as possible.



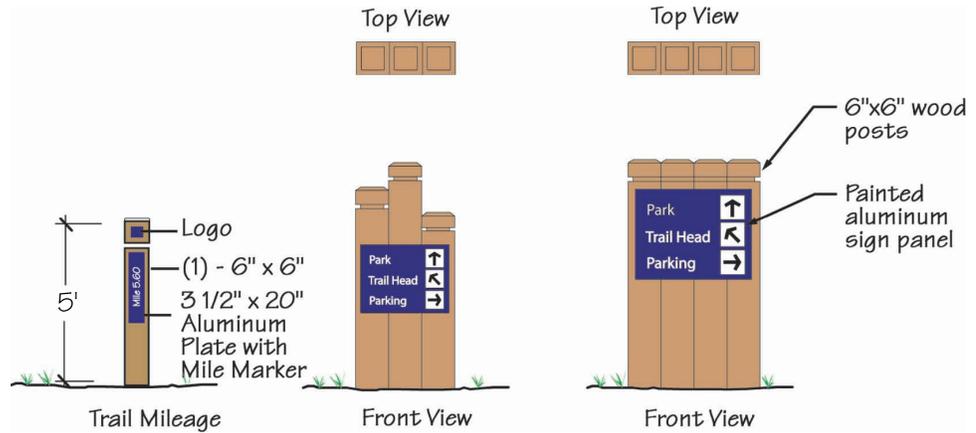
## Typical Restrooms



## Waterless Restroom Option

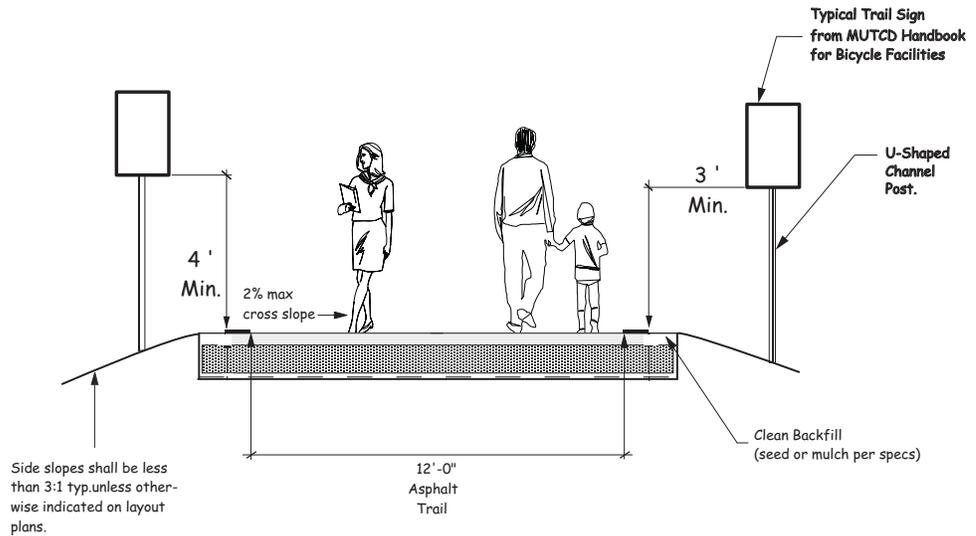
# Signage Details

## Directional Signage



## Signage Examples

### Typical Trail Signage Location

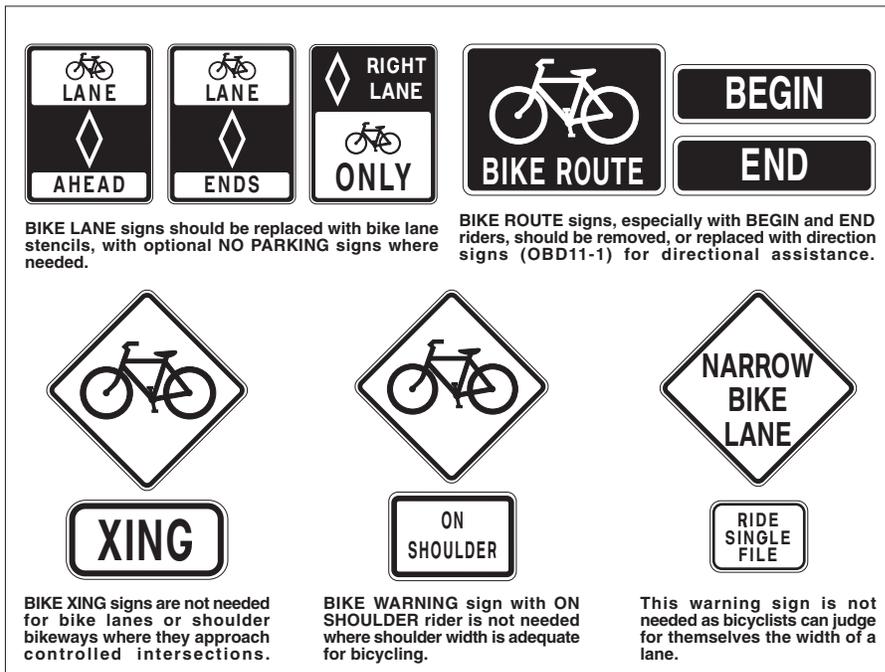


### Typical Signage Location

## DOT Bike Signage

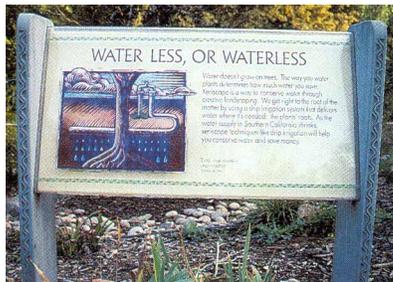
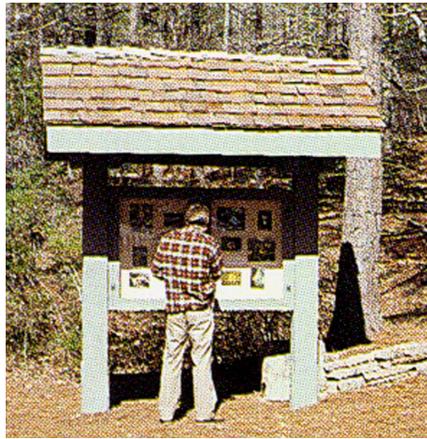
The MUTCD specifies standard signage for bicycle lanes. According to section 9B-8, the R3-16 sign should be used in advance of the beginning of a designated bicycle lane to call attention to the lane and to the possible presence of bicycles. The MCTUD requires that the diamond lane symbol be used with both the R3-16 and R3-17 signs.

According to Section 9B-11 of the MUTCD, the R7-9 R7-9a signs can be used along streets where motorists are likely to park or frequently pull into the bike lane.



### Signage Examples

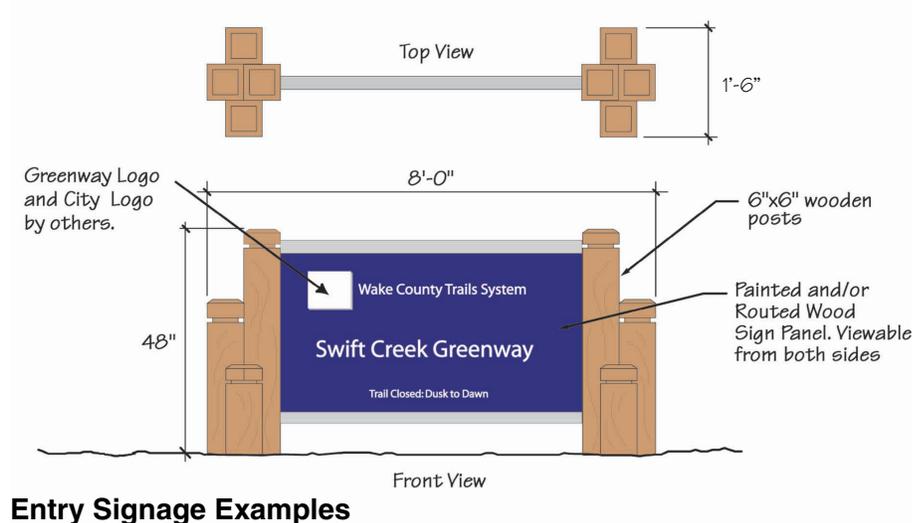
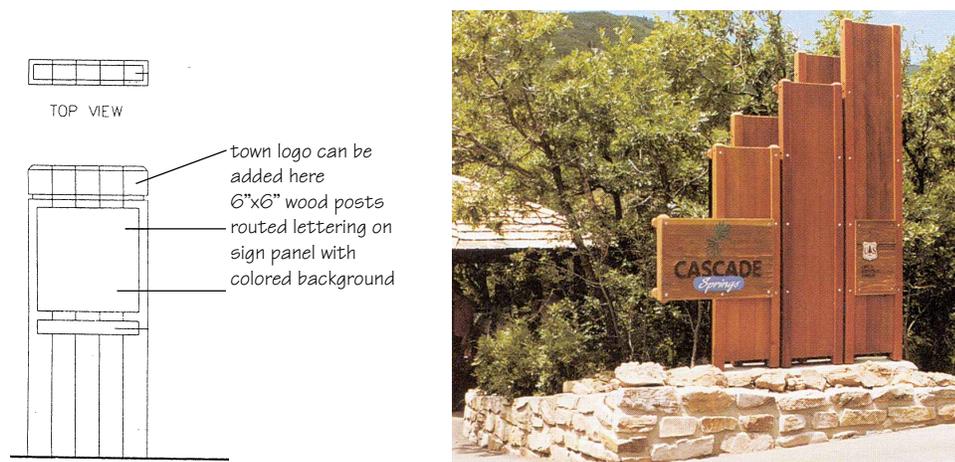
## Interpretive Signage



## Signage Examples

## Entry Signage

Proper trail identification at trail terminal point and major intersections is important in the development of a comprehensive trail network. A system of signage is important throughout Wake County to ensure that information is provided to trail users regarding the safe and appropriate use of all facilities. Greenway entry signage may also include mileage to provide users with a reference as to how far he or she has traveled, and the remaining distance to specific destinations.

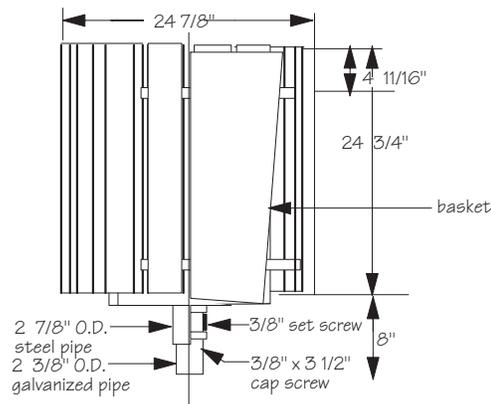
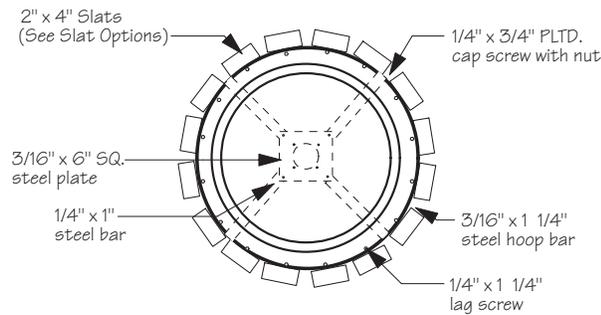


## Entry Signage Examples

# Site Furnishings Details

## Trash Receptacles

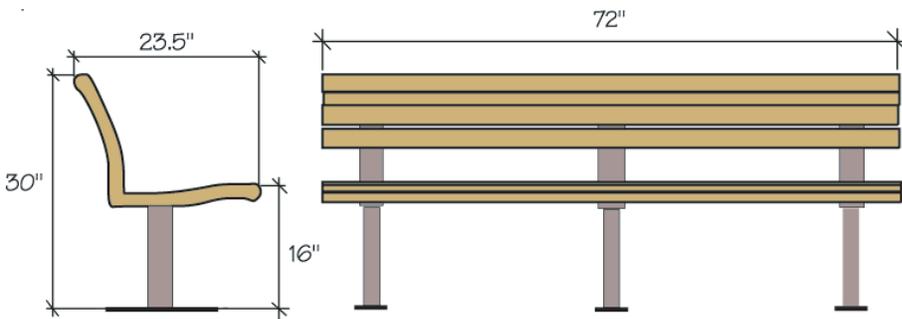
Trash containers are necessary along all trails. They can be attractive as well as functional and should be selected based on the amount of trash expected, overall maintenance program of the trail, and types of users. Trash cans need to be accessible to both trail users and maintenance personnel. At a minimum, 22-gallon or 32-gallon containers should be located at each entranceway and at each bench seating area. They should be set back three feet from the edge of the trail. The location of additional trash cans will depend upon the location of concessions, facilities adjacent to the trail and areas where trail users tend to congregate.



**Typical Trash Receptacle Detail**

## Benches

Benches along trails allow users to rest, congregate or contemplate. Trail benches should comfortably accommodate the average adult. They should be located at the primary and secondary entrances to the trail and at regular intervals, and should be set back three feet from the trail edge. The graphics below illustrate a bench that can be manufactured using recycled plastic lumber or conventional treated wood lumber. The prefabricated plastic lumber units cost more initially but last longer and require little or no maintenance.

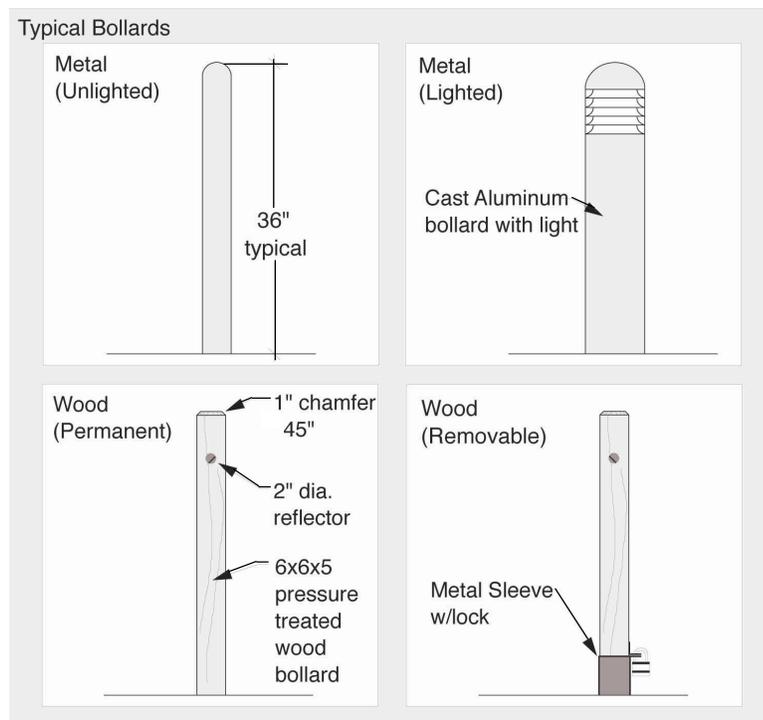


### Typical Bench Detail



## Bollards

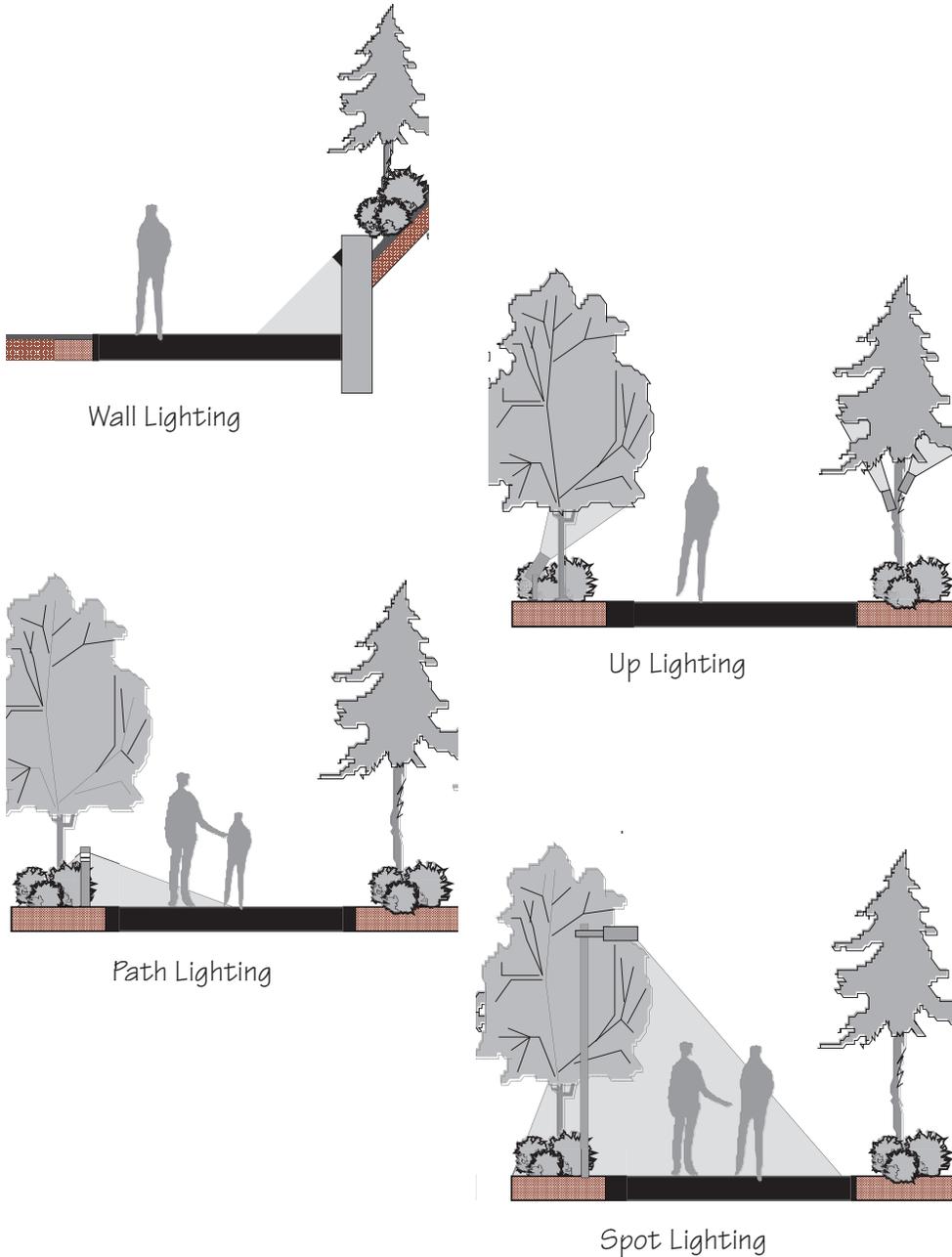
Bollards are intended to provide separation between vehicles and trail users. They are available in a variety of shapes, sizes, and colors and come with a variety of features. Lighted bollards are intended to provide visitors with minimum levels of safety and security along trails which are open after dark. Bollards should be chosen according to the specific needs of the site and should be similar in style to the surrounding elements. Typical construction materials for bollards include painted steel or aluminum, with halogen or metal halide lights in weather tight casings. Removable bollards can be installed to provide trail access for emergency and maintenance vehicles. The graphic below illustrates several typical bollard examples.



**Typical Bollard Details**

## Trail Lighting

Particularly during winter months when trips to and from work are made in the dark, adequate lighting can make the difference in a person's choice to bicycle or walk. However, due to liability and security concerns, many off-road bicycle paths are closed at night, and therefore unlit. Lighting for multi-use trails should be considered on a case-by-case basis in areas where 24-hour activity is expected (such as college campuses or downtown areas), with full consideration of the maintenance commitment lighting requires.

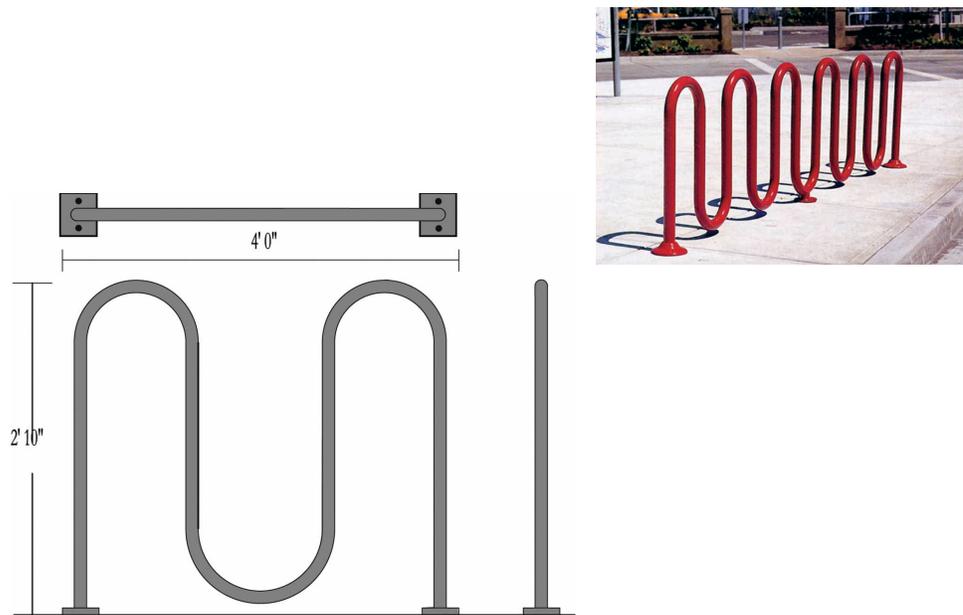


### Various Lighting Types

## Bike Rack

It is important to choose a bicycle rack design that is simple for cyclists to operate. Bicycle racks should be designed to allow use of a variety of lock types. It may be difficult initially to determine the number of bicycle parking spaces needed. Therefore, bike racks should be situated on-site so that more can be added if bicycle usage increases.

The design shown below has proven popular and effective in numerous communities. It is inexpensive to fabricate locally, easy to install, vandal resistant and works well with popular high-security locks. In addition, it can be installed as a single unit, on a sidewalk, or in quantity, at major recreation nodes.



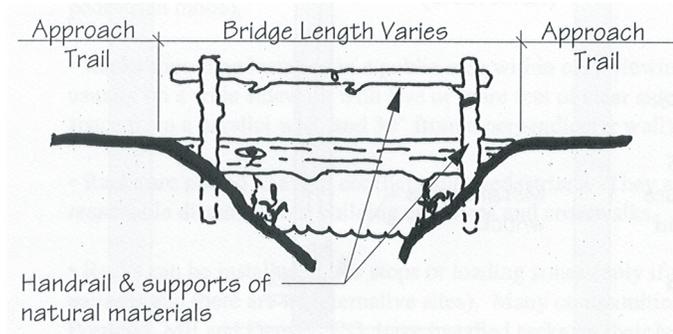
### Typical Bike Rack

#### Location Criteria:

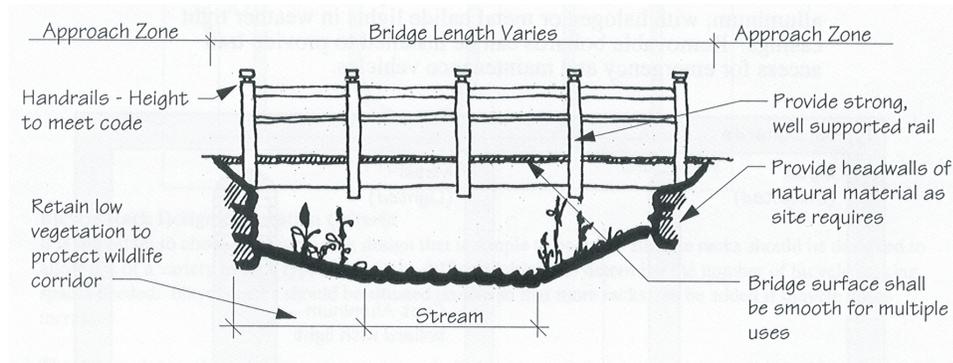
- Racks should be located within 50' of building entrances (where bicyclists would naturally transition into pedestrian mode).
- Racks should be installed in a public area within easy viewing distance from a main pedestrian walkway, usually on a wide sidewalk with five or more feet of clear sidewalk space remaining (a minimum of 24" clear space from a parallel wall and 30" from a perpendicular wall).
- Racks are placed to avoid conflicts with pedestrians. They are usually installed near the curb and at a reasonable distance from the building entrances and crosswalks.
- Racks can be installed at bus stops or at loading zones (only if they do not interfere with boarding or loading patterns and there are no alternatives). Bike racks on busses also facilitate bike-on-transit travel.

## Bridges

Bridges are an important element of almost any trail project. The type and size of bridges can vary widely depending on the trail type and specific site requirements. Some bridges often used for multi-use trails include suspension bridges, prefabricated span bridges and simple log bridges. When determining a bridge design for multi-use trails, it is important to consider emergency and maintenance vehicle access. Bridges intended for occasional vehicular use must be designed to handle up to 10,000 pound loads safely and at least 14'-wide to allow for vehicle passage.



## Foot Bridge



## Urban Trail Bridge



## Span Bridge

Note: Prefabricated span bridges are ordered directly from the manufacturer. Approximate cost is \$100/foot. For examples and quotes, see [www.steadfastbridge.com](http://www.steadfastbridge.com).

## On Road Facilities

### Underpass

Trail underpasses and overpasses can be used to avoid undesirable at-grade intersections of trails and freeways or high volume arterial highways. Neither should be used frequently in suburban, fringe or rural areas. Underpasses typically utilize existing overhead roadway bridges adjacent to a stream or culverts under the roadway that are large enough to accommodate trail users. There are several key issues that must be addressed in the design of the roadway underpass:

1. The vertical clearance of the underpass must be at least 10 feet
2. The width of the underpass must be at least 12 feet
3. Proper drainage must be established to avoid pooling of stormwater inside the underpass
4. It is recommended that underpasses be lighted for safety



Roadway underpasses that utilize box culverts can sometimes be installed as part of a roadway improvement or construction project at a greatly reduced cost.

## Overpass

Trail overpasses can be used in high traffic volume areas where underpasses are not possible. Overpass options include sidewalks on bridges, freestanding pedestrian/bike bridges or lanes attached to an existing bridge. AASHTO requires that bridges be a minimum of 36 inches, but prefers that they are at least as wide as the trail. Forty-two inch high railing is also required. A fenced cover, as shown below, provides a safer environment over highways and busy streets. The NCDOT should be referenced for height requirements, which vary depending on the type of road. ADA should also be referenced for ramp requirements. It is important to remember that pedestrians and cyclists will opt not to use an overpass or an underpass if it takes more than twice the time as crossing the street at-grade. For this reason, at-grade fencing should be considered in some instances .



Typical Roadway Bridge with Sidewalk

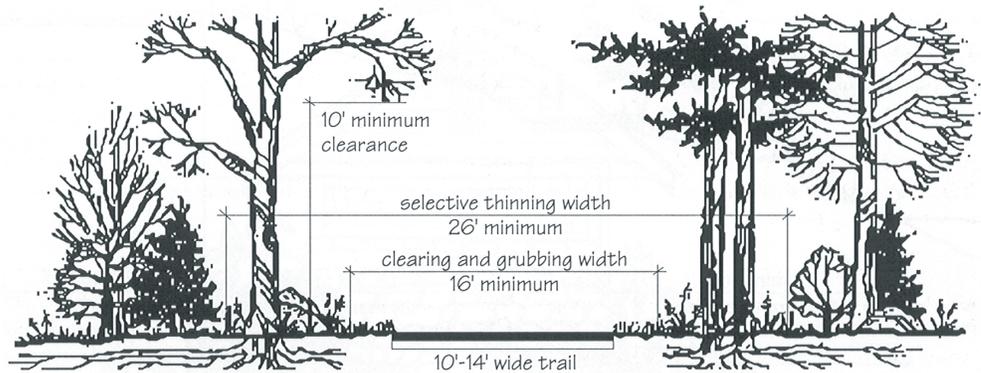


## Miscellaneous Trail Details

### Vegetative Clearing

Vegetative clearing refers to the amount of vegetation removal that is required for various levels of trail development. The amount of vegetative clearing required for any one trail will depend on the type of trail being developed. While footpaths or hiking trails require little or no vegetation removal, paved pathways may require significantly more.

Single-tread, multi-use trails are the most common trail type in the nation. These trails vary in width, can accommodate a wide variety of users and are especially popular in urban areas. While the vegetative clearing needed for these trails varies with the width of the trail, the graphic below outlines typical requirements.

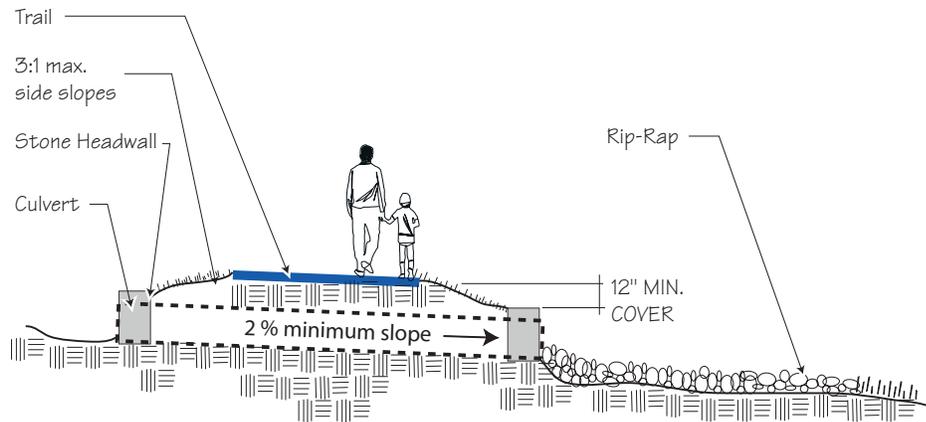


### Typical Tree Trimming Distances

Clearing and grubbing consists of tree, shrub and stump removal. The minimum width for clearing and grubbing of a 14'-wide trail is 16 feet (2'-wide shoulders). Selective thinning includes removal of underbrush and limbs to create open pockets within a forest canopy. Selective thinning increases sight lines and distances and enhances the safety of the trail user. Selective thinning does not include the removal of the forest canopy.

## Trail Culvert

Proper installation of trail culverts is important to ensure proper stormwater runoff drainage, trail user safety and longevity of the trail surface. Pipe length, diameter and material specifications will vary depending on specific site needs. Two materials typically used for trail culverts are reinforced concrete pipe (typically required when the trail is within NCDOT Right of Way), and High Density Polyethylene (HDPE) recycled plastic pipe. Plastic pipes are typically less expensive on a per foot basis. Outlet protection varies per site needs and in some cases a flow spreader may be required at the outlet location. Rock check dams can be placed after the outlet to slow and filter drainage. The graphic below outlines proper installation parameters for greenway trail culverts.

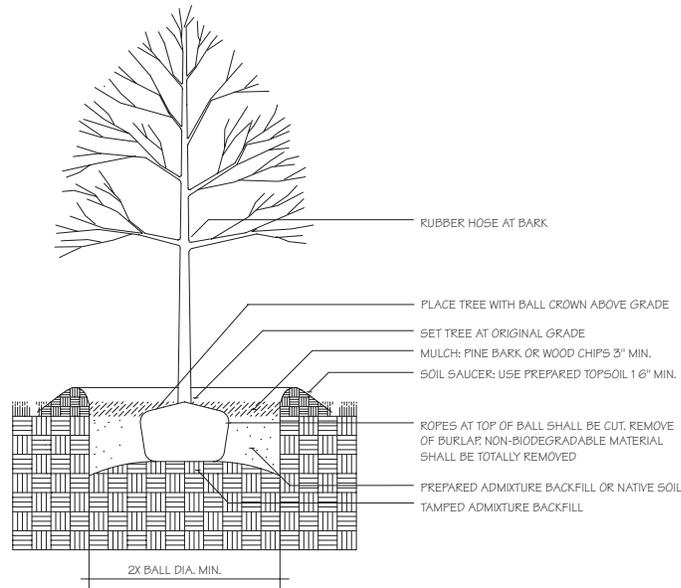


**Culvert Placement Cross Section**

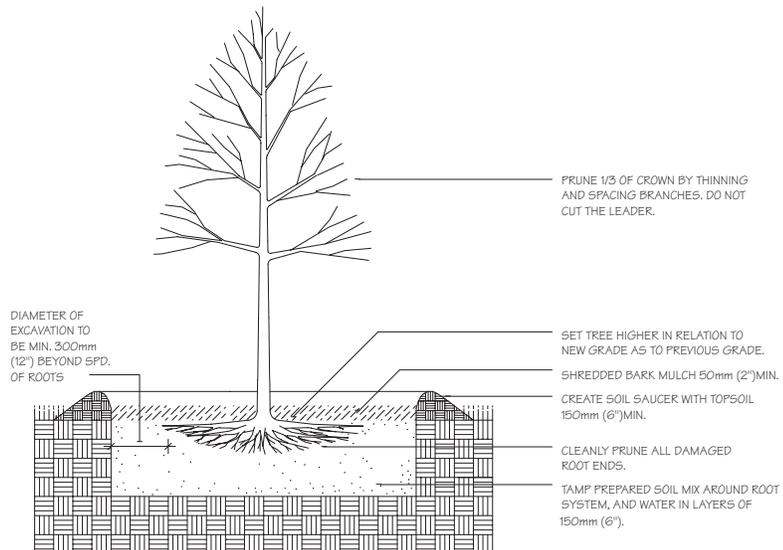
# Planting Details

## Tree Plantings

Trees are important to greenways and trails for both aesthetic and environmental reasons. Not only do they contribute to the appearance of a trail, their shade cools the environment for trail users and provides habitat for birds and wildlife. Trees also help keep streams healthy by providing shade (which regulates the temperature), filtering pollutants in storm runoff and adding leaf litter to feed small insects and fish. When choosing trees and shrubs for greenway corridors, it is recommended that indigenous and well-adapted species be used. This will reduce the need for chemical and water applications as a part of long term maintenance. The following graphics represent common installation practices used for several different types of plant material.



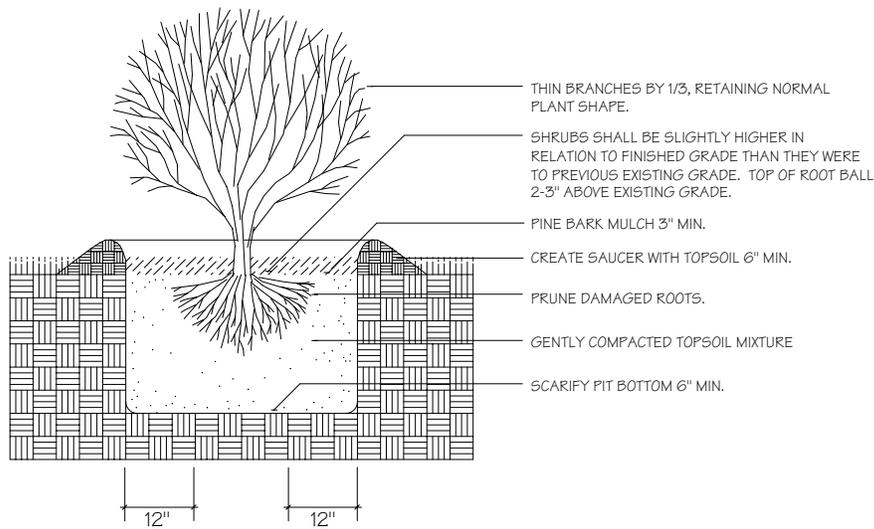
**Ball and Burlap Tree Planting Detail**



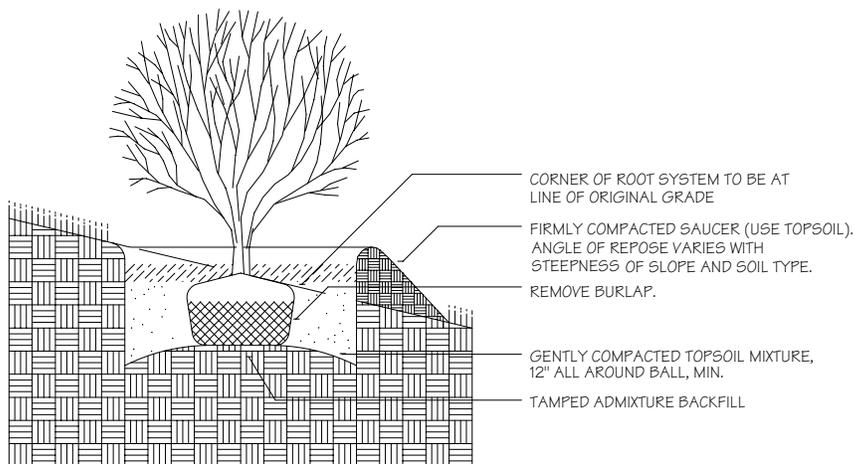
**Bare Root Tree Planting Detail**

## Shrub Plantings

The amount of planting needed will vary depending on the project. While some projects will require little or no planting, other projects may require it for vegetative screening, habitat restoration, erosion control or aesthetics. The graphics below illustrate planting techniques for two types of shrub material (ball & burlap and bare root) which can be used.



### Shrub Planting Detail



### Ball and Burlap Shrub Planting Detail

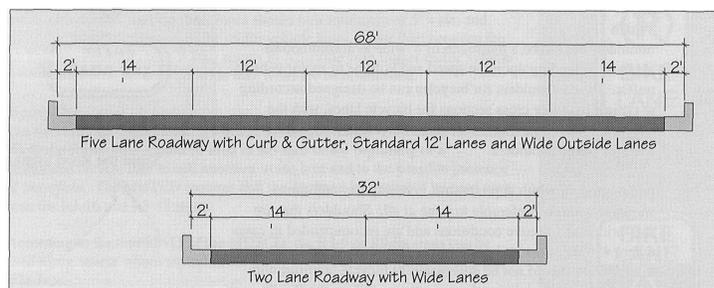
## Bike Considerations

### Bike Considerations - Wide Curb Lanes

There are three types of on-road bicycle facilities: wide curb lanes, bike lanes and paved shoulders. Wide curb lanes, or outside lanes, are wider than the standard 12' travel lane and can provide more space for cyclists and easier passing for motorists. Under most conditions, automobiles and bicycles can coexist in a 14' wide curb lane, without the need for the motorist to move into the next adjacent lane.

#### Location and Width

Wide curb lanes best accommodate advanced cyclists, as these riders are more comfortable operating directly in traffic. The wide curb lane is always the furthest right-hand lane, and should optimally be 14'-16' wide, not including the gutter pan (curb lanes that are wider than 16' are not recommended). Wide curb lanes are not required to have curb and gutter. In order to achieve the extra space needed for a 14' wide outside lane, the roadway may either be physically widened or restriped to reduce the lane width of inner lanes and increase the width of outer lanes. Re-striping proposals should be reviewed by a transportation engineer to ensure adequate safety for the motorists as well as bicyclists.



#### Signage

There is no special “wide curb lane” sign, however on high volume urban arterials, the designer may choose to install “Share the Road” warning signs (standard bicycle warning plate with a subplate stating SHARE THE ROAD).

#### Intersection Design

When the curb lanes approach intersections with turning lanes, the 14' wide lane should continue through the intersection as the outside through-lane.

#### Design Issues

**Acceptance:** Bicycle programs in numerous communities have found that less experienced bicyclists seldom see a difference when wide curb lanes are provided. Therefore, if the desired outcome is greater numbers of bicyclists or a visible “pro bicycle” statement, this option will not satisfy the need.

**Traffic:** Wider curb travel lanes may tend to increase motorist speeds. Whether a marginal increase in speeds is important in a particular situation should be a subject for analysis.

## Bike Considerations - Bike Lanes

Bicycle lanes in Wake County should conform to the standards in AASHTO's Guide for the Development of Bicycle Facilities (2000). Bicycle lanes are an on-road type of facility. They should not be separated from other motor vehicle lanes by curbs, parking lanes, or other obstructions. General standards for width, striping, and intersections are provided below.

### Location and Use

Bicycle lanes serve the needs of experienced and inexperienced bicyclists in urban and suburban areas, providing them with their own travel lane. Bicycle lanes are always located on both sides of the road (except when they are constructed on one-way streets). By this design, cyclists are encouraged to follow the rules of the road, which require them to travel in the same direction as adjacent motor vehicle traffic.

### Width

The minimum width of bike lanes should be 4', exclusive of the gutter pan. On roads with parallel parking, bike lanes should be a minimum of 5' wide, and should be installed adjacent to the motor vehicle lanes, rather than between the parking lane and the curb. Along streets in Wake County with higher motor vehicle speeds and traffic volumes, 6' wide bike lanes are recommended.

### Signage

The MUTCD specifies standard signage for bicycle lanes. According to section 9B-8, the R3-16 sign should be used in advance of the beginning of a designated bicycle lane to call attention to the lane and to the possible presence of bicyclists. The MUTCD requires that the diamond lane symbol be used with both the R3-16 and R3-17 signs. (See page 16 for signage examples.)

According to Section 9B-11 of the MUTCD, the R7-9 or R7-9a signs can be used along streets where motorists are likely to park or frequently pull into the bike lane.

### Striping

Bicycle lane stripes should be solid, 6"-wide white lines. Care should be taken to use pavement striping that is skid resistant. Bicycle-shaped pavement symbols and directional arrows should be placed in the bicycle lane to clarify its use. Pavement letters that spell "ONLY BIKE" are also highly recommended. Symbols should be installed at regular intervals, immediately after intersections, and at areas where bicycle lanes begin. Bike lane striping at intersections is challenging. Traffic has a tendency to mix at intersections: motorists who are turning right must cross paths with cyclists who wish to continue straight, and cyclists who wish to turn left must cross into left-hand turn lanes. Several intersection striping patterns are provided by AASHTO's Guide for the Development of Bicycle Facilities (2000) and the MUTCD.

## Bike Route

A bicycle route is a “suggested way” for a cyclist to get from a point of origin to a destination. Bike routes do not necessarily require physical improvements in order to accommodate bicyclists, given that they meet minimum safety criteria in their present condition (see below). Bike routes can be preferable for a number of reasons including directness, scenery, less congestion and lower speed limits.

### Location and Use

Bicycle routes may be used by all types of cyclists. In urban areas bike routes are most often designated on residential streets with low traffic volumes, and are typically used to direct cyclists to a destination within the community, or to provide a through-route for bicyclists. In rural areas, bike routes are most often designated on roadways that are popular touring routes for recreational cyclists, or long-distance commuting routes for advanced cyclists.

### Safety Criteria

A street does not necessary have to be physically widened in order to be designated as a bicycle route. A road with standard 12' wide lanes can be designated as a bike route with the appropriate signage, given that each condition below is met:

- In its present state (or with planned improvements), the roadway sufficiently accommodates cyclists. The evaluation should take into account roadway width and traffic volumes. Candidate bike routes should have good sight distances and adequate pavement conditions. In addition, traffic should not regularly exceed posted speed limits.
- All bicycle hazards have been removed from the roadway or otherwise remedied, including unsafe drainage grates and angled railroad crossings.
- The bicycle route is designated as one segment within an interconnected system of bicycle facilities.

Bicycle route signage should be used according to the standards in the MUTCD, which provides several choices in styles. Bicycle route signs should be placed at all areas where new traffic enters the roadway. The distance between signs should not be greater than two miles. In urban areas, it is helpful to include directional arrows and captions that indicate nearby destinations, particularly at intersections.

## Bike Pavement

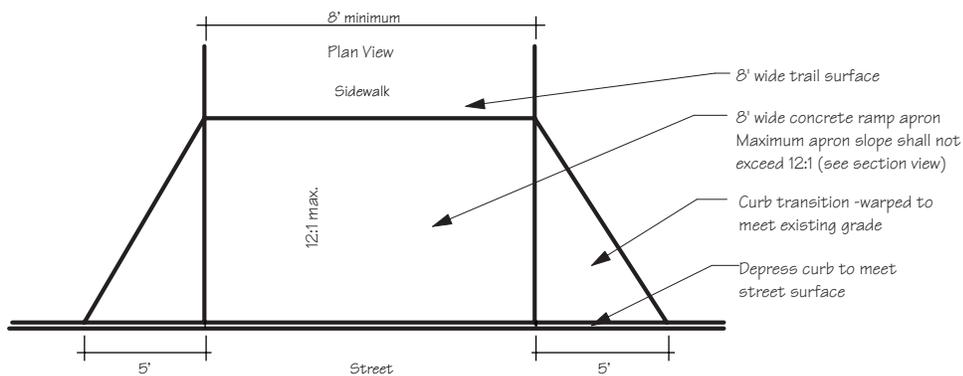
Bike lane pavement and sub-base should always have the same depth and quality as the adjacent roadway. Bike lanes are not required to have a curb and gutter.

Every effort should be made to provide a smooth and even surface for bicycles, particularly for designated bicycle routes and lanes. Bicycles are much more vulnerable to surface irregularities than motor vehicles, because they rely on very narrow, highly pressurized wheel with no suspension. A simple pothole that might cause a slight jarring to the passengers of a car can cause a serious crash for a cyclist.

Potholes aren't the only surface hazard for cyclist. Bumps, corrugations, seams, rumble strips, unraveled pavement and bridge expansion joints can cause bicyclists to lose their balance. In addition, temporary roadway construction zones often include surface hazards such as milled pavements and sudden pavement changes. Temporary signage can be used to warn bicyclist of upcoming irregularities.

When paved shoulders or bicycle lanes are added to the edge of the existing roadway, a resulting seam between the two can be hazardous to bicyclists. One solution is to install 10' wide strips of asphalt, partially overlapping the existing motor vehicles lanes.

Pavement with large aggregates can also put additional stress on the mechanical parts of road bikes, especially for distance riders. Smooth pavement is preferred to avoid accidents due to the loss and/or looseness of bike parts.

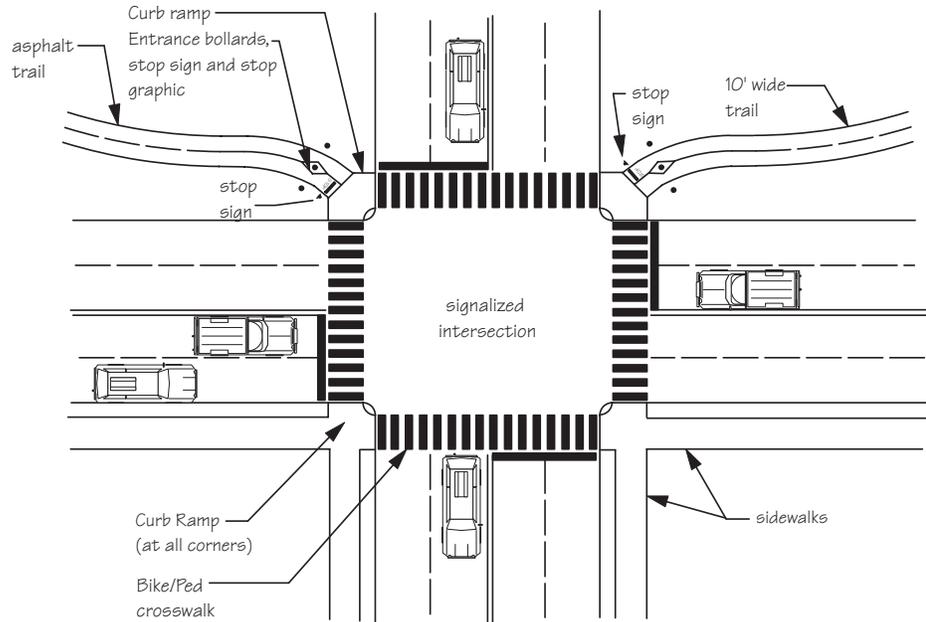


### Bike Curb Ramp Plan View

## Bike Intersections

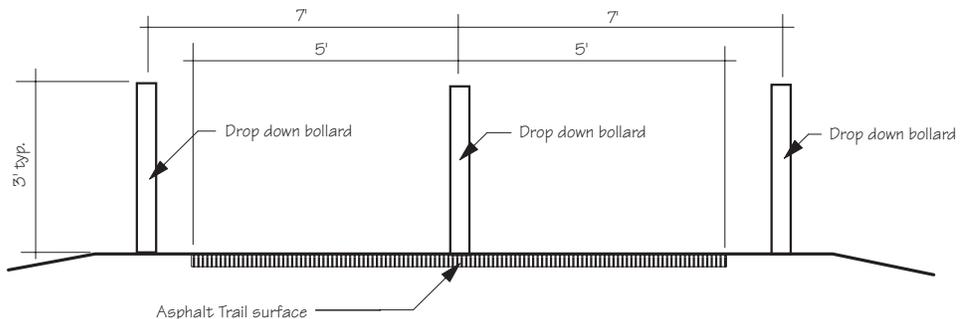
Trail/Roadway intersections can become dangerous conflict areas if not carefully designed. For at-grade intersections, there are usually several design objectives:

1. Site the crossing area at a logical and visible location.
2. Warn motorists of the upcoming crossing.
3. Maintain visibility between trail users and motorists.
4. Inform trail users of the upcoming intersection.



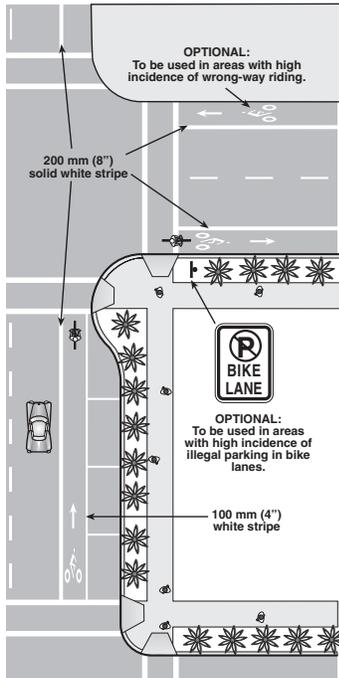
**Typical Signalized Intersection Plan View**

Intersections and approaches should be on relatively flat grades. In particular, the bicyclist should not be required to stop at the bottom of the hill. If the intersection is more than 75 feet from the curb to curb, it is preferable to provide a center median refuge area, per ADA (Americans with Disabilities Act) or ANSI (American National Standards Institute) standards. If crossing traffic is expected to be heavy, it may be necessary to provide a traffic signal that responds to bicycles and/or can be pedestrian activated.

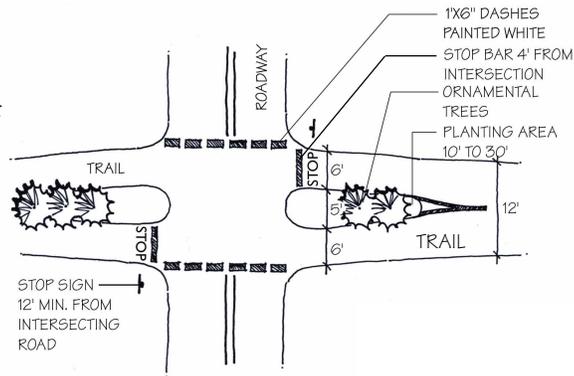


**Typical Bollard Placement**

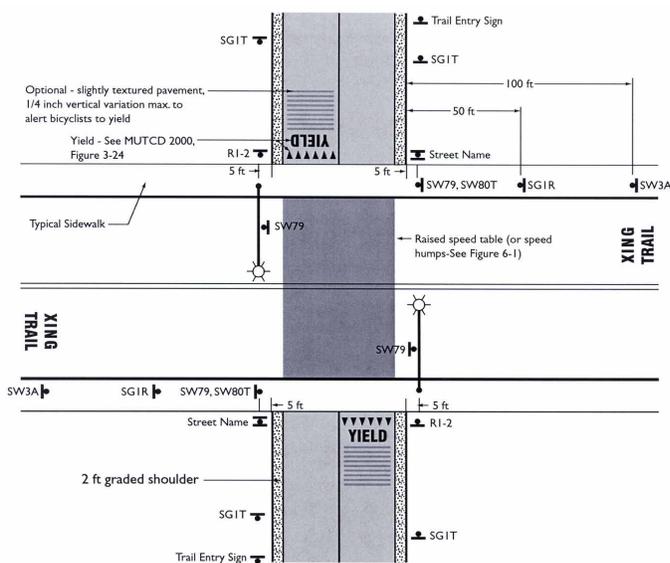
# Bike Intersections



**Typical Intersection Signage Layout Plan View**



**Typical Perpendicular Trail and Road Intersection**



**Typical Trail Crossing at Local Street (from Contra Costa County Trail Design Guidelines)**

## Sidewalk Considerations

### Sidewalk Considerations

Sidewalks are a critical component of this Open Space and Greenways Plan. They not only encourage walking, but they also improve the safety of pedestrians. An individual's decision to walk is as much a factor of convenience as it is the perceived quality of the experience. Pedestrian facilities should be designed with the following factors in mind:

#### **Sufficient width**

Sidewalks should accommodate anticipated volumes based on adjacent land uses, and should at a minimum allow for two adults to walk abreast (min. 5 feet, prefer 6 feet).

#### **Protection from traffic**

High volume and/or high speed (greater than 35 mph) motor vehicle traffic creates dangerous and uncomfortable conditions for pedestrians. Physical (and perceptual) separation can be achieved through a combination of methods: a grassy planting strip with trees, a raised planter, bicycle lanes, on-street parallel parking, etc.

#### **Street trees**

Street trees are an essential element in a high quality pedestrian environment. Not only do they provide shade, they also give a sense of enclosure to the sidewalk environment which enhances the pedestrian's sense of a protected environment.

#### **Pedestrian-scaled design**

Large highway-scale signage reinforces the general notion that pedestrians are out of place. Signage should be designed to be seen by the pedestrian. Street lighting should likewise be scaled to the level of the pedestrian (14 feet tall), rather than providing light poles that are more appropriate on high-speed freeways.

#### **Continuity**

Pedestrian facilities are often discontinuous, particularly when private developers are not encouraged to link on-site pedestrian facilities to adjacent developments and nearby sidewalks or street corners. New development should be designed to encourage pedestrian access from nearby streets. Existing gaps in the system should be placed on a prioritized list for new sidewalk construction.

#### **Clearances**

Vertical clearance above sidewalks for landscaping, trees, signs and similar obstructions should be at least 10 feet. In commercial areas and the downtown, the vertical clearance for awnings should be 10 feet. The vertical clearance for building overhangs which cover the majority of the sidewalk should be 12 feet.

### **Conformance with national standards**

Sidewalk design should be consistent with Americans with Disabilities Act requirements and/or ANSI requirements. Specific guidance is provided by the Architectural and Transportation Barriers Compliance Board's American's with Disabilities Act Accessibility Guidelines.

### **Sidewalk Obstacles**

Street furniture and utility poles create obstacles to pedestrian travel when located directly on the sidewalk. At a minimum, there should be 36 inches of sidewalk width to allow wheelchairs to pass. Where possible, utilities should be relocated so as not to block the sidewalk. Benches should not be sited directly on the sidewalk, but set back at least 3 feet. The design of new intersections or re-design of existing intersections presents an opportunity to improve pedestrian circulation. Street furniture located near intersections can block sight lines. In general, the designer should consider the impact on sight distance for all features located in the vicinity of roadway intersections.

### **Sidewalk pavement design**

Sidewalks and roadside pathways should be constructed of a solid, debris-free surface. Regardless of the type of surface chosen, it must be designed to withstand adequate load requirements. Pavement depth should reflect site specific soil conditions but never be less than 4.5 inches. Brick and concrete pavers are popular materials for more decorative sidewalks. The use of stylized surfaces is encouraged, however they must be installed properly or they will deteriorate more rapidly.

### **Sidewalk width and setback guidelines**

It is important to note that there are some areas that warrant wider sidewalks. For example, sidewalks in and around local universities and colleges must accommodate a much higher volume of pedestrians and, therefore, warrant additional width. The recommendations below are based upon standards used by other pedestrian-friendly communities in the U.S. Following the recommendations below ensures that basic needs of pedestrians are addressed in developing areas. In existing residential and commercial areas that lack sidewalks, new sidewalk construction (independent of new development) should occur first in locations that demonstrate the most need.

#### **Sidewalks on local streets in residential areas:**

Five-foot wide sidewalks are recommended on at least one side of the street, with a 5 foot wide planting strip. The planting strip may need to be slightly wider to accommodate the roots of street trees, if they are included in the design. Sidewalks are not necessary on cul-de-sacs that are less than 500 feet in length.

**Sidewalks on collector streets in residential and commercial areas:**

Five-foot wide sidewalks are recommended on both sides of the street. However, one option may be to install a 6 foot wide sidewalk on the side of the street that generates the most activity. A 7 foot wide planting strip is recommended.

**Sidewalks on arterial streets in residential and commercial areas:**

Six foot sidewalks are recommended on both sides of the street, with an 8' wide planting strip.

**Sidewalks on streets within 2000' of schools:**

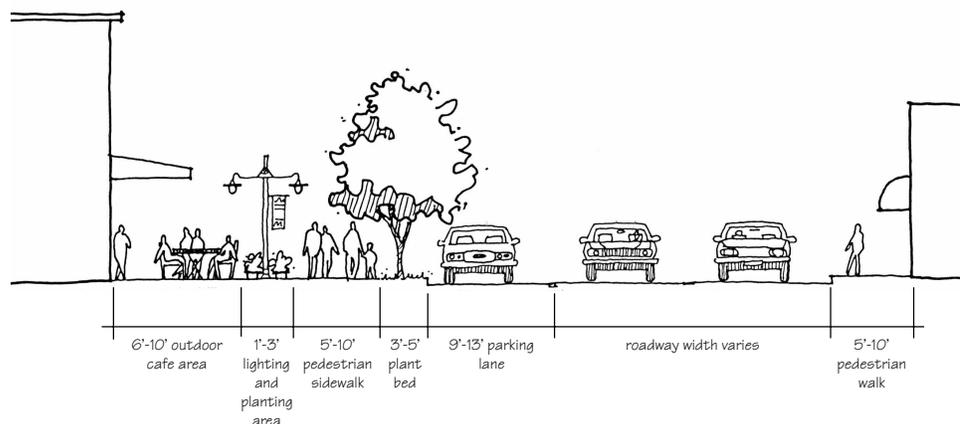
Width and setback should be based on the specific roadway type as described above. For all roadway types, however, sidewalks should be installed on both sides of the road, and should include well-marked crosswalks and school crossing signs.

**Sidewalks on streets with no curb and gutter**

Sidewalks located immediately adjacent to “ribbon pavement” (pavement with no curb and gutter) are not recommended. However, if no other solution is possible, sidewalks adjacent to ribbon pavement have a much greater setback requirement, depending on roadway conditions. Engineers should consult the AASHTO [Policy on Geometric Design of Highways and Streets](#) for more specific guidelines.

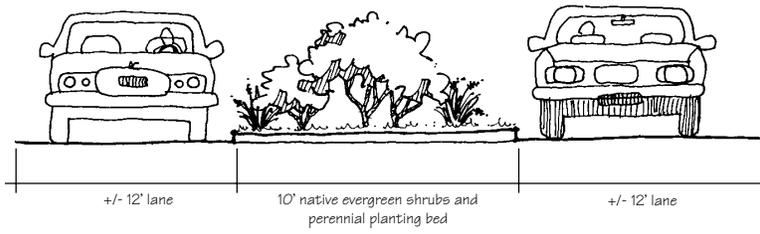
**Sidewalks in rural areas**

In most rural areas, the low volume of pedestrians does not warrant sidewalk construction. In most cases, 4'-6' wide paved shoulders can provide an adequate area for pedestrians to walk on rural roadways, while also serving the needs of bicyclists. Exceptions should be made in areas where isolated developments such as schools, ballparks or housing communities create more pedestrian use. For example, motorists might regularly park along a rural road to access a nearby ballpark. A sidewalk may be warranted in this circumstance so that the pedestrians can walk separately from traffic. Sidewalks in rural areas should be provided at a width based on anticipated or real volume of pedestrians, with 5' being the minimum width.

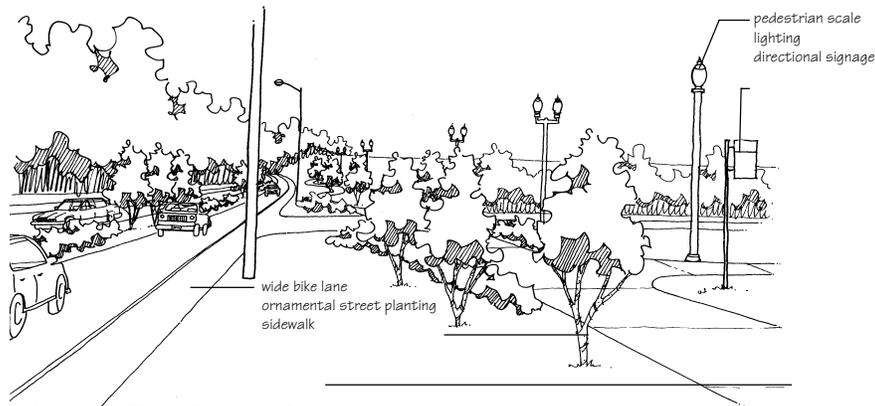


**Typical Street Section**

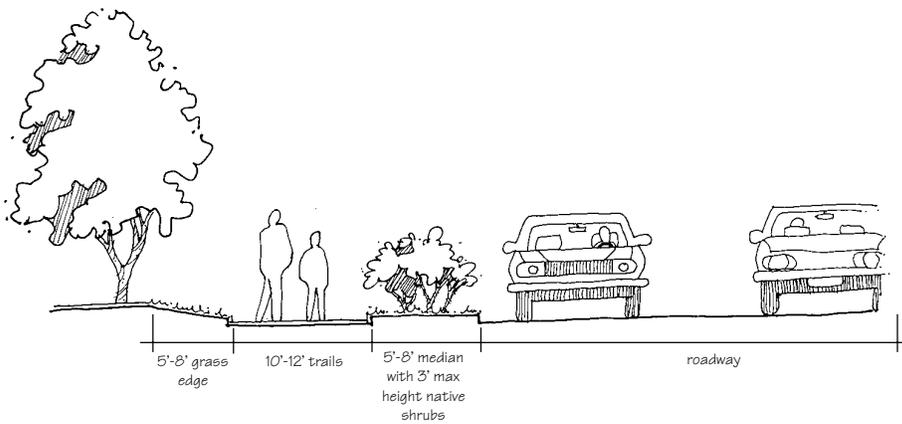
## Roadside Treatments



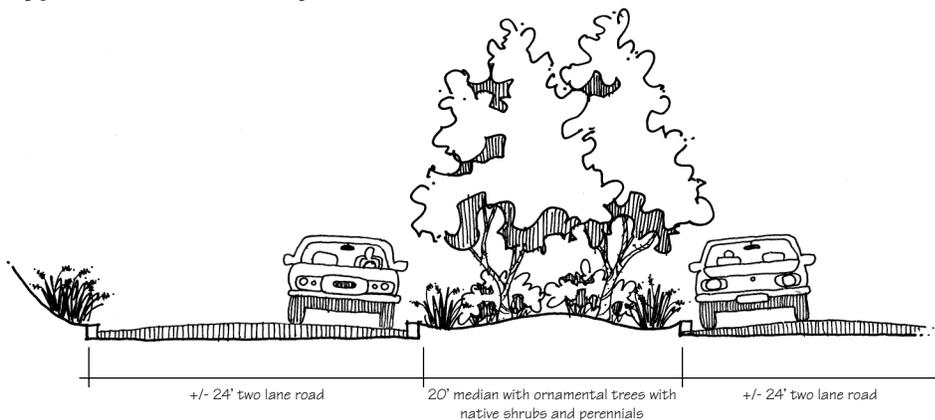
## Typical Median Shrub Planting



## Typical Scenic Road Corridor



## Typical Road with Adjacent Sidewalk



## Typical Median Planting

# Roadside Treatments

## Neuse Buffer Rules

	Exempt	Allowable	Allowable with Mitigation	Prohibited
<b>Airport facilities:</b>				
Airport facilities that impact equal to or less than 150 linear feet or one-third of an acre of riparian buffer		●		
Airport facilities that impact greater than 150 linear feet or one-third of an acre of riparian buffer			●	
Archaeological activities	●			
Bridges		●		
Dam maintenance activities	●			
<b>Drainage ditches, roadside ditches and stormwater outfalls through riparian buffers:</b>				
Existing drainage ditches, roadside ditches, and stormwater outfalls provided that they are managed to minimize the sediment, nutrients and other pollution that convey to waterbodies	●			
New drainage ditches, roadside ditches and stormwater outfalls provided that a stormwater management facility is installed to control nitrogen and attenuate flow before the conveyance discharges through the riparian buffer		●		
New drainage ditches, roadside ditches and stormwater outfalls that do not provide control for nitrogen before discharging through the riparian buffer				●
Excavation of the streambed in order to bring it to the same elevation as the invert of a ditch				●
Drainage of a pond in a natural drainage way provided that a new riparian buffer that meets the requirements of Items (4) and (5) is established adjacent to the new channel	●			
<b>Driveway crossings:</b>				
Driveway crossings on single family residential lots that disturb equal to or less than 25 linear feet or 2,500 square feet of riparian buffer	●			
Driveway crossings on single family residential lots that disturb greater than 25 linear feet or 2,500 square feet of riparian buffer		●		
In a subdivision that cumulatively disturb equal to or less than 150 linear feet or one-third of an acre of riparian buffer		●		
In a subdivision that cumulatively disturb greater than 150 linear feet or one-third of an acre or riparian buffer			●	
Fences provided that disturbance is minimized and installation does not result in removal of forest vegetation	●			
Forest harvesting - see Item (11) of this Rule				
<b>Fertilizer application:</b>				
One-time fertilizer application to establish replanted vegetation	●			
Ongoing fertilizer application				●

Grading and revegetation in Zone 2 only provided that diffuse flow and the health of existing vegetation in Zone 1 is not compromised and disturbed areas are stabilized	●			
Greenway trails		●		
Historic preservation	●			
Landfills				●
Mining activities:				
Mining activities that are covered by the Mining Act provided that new riparian buffers that meet the requirements of Items (4) and (5) are established adjacent to the relocated channels		●		
Mining activities that are not covered by the Mining Act OR where new riparian buffers that meet the requirements or Items (4) and (5) are not established adjacent to the relocated channels			●	
Non-electric utility lines:				
Impacts other than perpendicular crossings in Zone 2 only		●		
Impacts other than perpendicular crossings in Zone 1			●	
Perpendicular crossings that disturb equal to or less than 40 linear feet of riparian buffer	●			
On-site sanitary sewage systems - new ones that use ground absorption				●
Overhead electric utility lines:				
Impacts other than perpendicular crossings in Zone 2 only	●			
Impacts other than perpendicular crossings in Zone 1 <sup>1,2</sup>	●			
Perpendicular crossings that disturb equal to or less than 150 linear feet of riparian buffer <sup>1</sup>	●			
Perpendicular crossings that disturb greater than 150 linear feet of riparian buffer <sup>1,2</sup>		●		
Periodic maintenance of modified natural streams such as canals and a grassed travelway on one side of the surface water when alternative forms of maintenance access are not practical		●		
Playground equipment:				
Playground equipment on single family lots provided that installation and use does not result in removal of vegetation	●			
Playground equipment installed on lands other than single-family lots or that requires removal of vegetation		●		

<sup>1</sup> Provided that, in Zone 1, all of the following BMPs for overhead utility lines are used. If all of these BMPs are not used, then the overhead utility lines shall require a no practical alternatives evaluation by the Division.

- A minimum zone of 10 feet wide immediately adjacent to the waterbody shall be managed such that only vegetation that poses a hazard or has the potential to grow tall enough to interfere with the line is removed.

- Woody vegetation shall be cleared by hand. No land grubbing or grading is allowed.
- Vegetative root systems shall be left intact to maintain the integrity of the soil. Stumps shall remain where trees are cut.
- Rip rap shall not be used unless it is necessary to stabilize a tower.
- No fertilizer shall be used other than a one-time application to re-establish vegetation.
- Construction activities shall minimize the removal of woody vegetation, the extent of the disturbed area, and the time in which areas remain in a disturbed state.
- Active measures shall be taken after construction and during routine maintenance to ensure diffuse flow of stormwater through the buffer.
- In wetlands, mats shall be utilized to minimize soil disturbance.

<sup>2</sup> Provided that poles or towers shall not be installed within 10 feet of a water body unless the Division completes a no practical alternatives evaluation.

Ponds in natural drainage ways:				
New ponds provided that a riparian buffer that meets the requirements of Items (4) and (5) is established adjacent to the pond		●		
New ponds where a riparian buffer that meets the requirements of Items (4) and (5) is NOT established adjacent to the pond			●	
Protection of existing structures and facilities when this requires additional disturbance of the riparian buffer or the stream channel		●		
Railroad crossings:				
Railroad crossings that impact equal to or less than 150 linear feet or one-third of an acre of riparian buffer		●		
Railroad crossings that impact greater than 150 linear feet or one-third of an acre of riparian buffer			●	
Removal of previous fill or debris provided that diffuse flow is maintained and any vegetation removed is restored	●			
Road crossings:				
Road crossings that impact equal to or less than 150 linear feet or one-third of an acre of riparian buffer		●		
Road crossings that impact greater than 150 linear feet or one-third of an acre of riparian buffer			●	
Stormwater management ponds:				
New stormwater management ponds provided that a riparian buffer that meets the requirements of Items (4) and (5) is established adjacent to the pond		●		
New stormwater management ponds where a riparian buffer that meets the requirements of Items (4) and (5) is NOT established adjacent to the pond			●	

Stormwater management ponds:				
New stormwater management ponds provided that a riparian buffer that meets the requirements of Items (4) and (5) is established adjacent to the pond		●		
New stormwater management ponds where a riparian buffer that meets the requirements of Items (4) and (5) is NOT established adjacent to the pond			●	
Scientific studies and stream gauging	●			
Stream restoration	●			
Streambank stabilization		●		
Temporary roads:				
Temporary roads that disturb less than or equal to 2,500 square feet provided that vegetation is restored within six months	●			
Temporary roads that disturb greater than 2,500 square feet provided that vegetation is restored within six months		●		
Temporary sediment and erosion control devices:				
In Zone 2 only provided that the vegetation in Zone 1 is not compromised and that discharge is released as diffuse flow in accordance with Item (5)	●			
In Zones 1 and 2 to control impacts associated with uses approved by the Division or that have received a variance provided that sediment and erosion control for upland areas is addressed to the maximum extent practical outside the buffer		●		
In-stream temporary erosion and sediment control measures for work within a stream channel	●			
Underground electric utility lines:				
Impacts other than perpendicular crossings in Zone 2 only	●			
Impacts other than perpendicular crossings in Zone 1 <sup>3</sup>	●			
Perpendicular crossings that disturb less than or equal to 40 linear feet of riparian buffer <sup>3</sup>	●			
Perpendicular crossings that disturb greater than 40 linear feet of riparian buffer <sup>3</sup>		●		
Vegetation management:				
Emergency fire control measures provided that topography is restored	●			
Periodic mowing and harvesting of plant products in Zone 2 only	●			
Planting vegetation to enhance the riparian buffer	●			
Pruning forest vegetation provided that the health and function of the forest vegetation is not compromised	●			
Removal of individual trees which are in danger of causing damage to dwellings, other structures or human life	●			
Removal or poison ivy	●			
Removal of understory nuisance vegetation as defined in: Smith, Cherri L. 1998. Exotic Plant Guidelines. Department of Environment and Natural Resources. Division of Parks and Recreation. Raleigh, NC. Guideline #30	●			

- <sup>3</sup> Provided that, in Zone 1, all of the following BMPs for underground utility lines are used. If all of these BMPs are not used, then the underground utility line shall require a no practical alternatives evaluation by the Division.
- Woody vegetation shall be cleared by hand. No land grubbing or grading is allowed.
  - Vegetative root systems shall be left intact to maintain the integrity of the soil. Stumps shall remain, except in the trench, where trees are cut.
  - Underground cables shall be installed by vibratory plow or trenching.
  - The trench shall be backfilled with the excavated soil material immediately following cable installation.
  - No fertilizer shall be used other than a one-time application to re-establish vegetation.
  - Construction activities shall minimize the removal of woody vegetation, the extent of the disturbed area, and the time in which areas remain in a disturbed state.
  - Active measures shall be taken after construction and during routine maintenance to ensure diffuse flow of stormwater through the buffer.
  - In wetlands, mats shall be utilized to minimize soil disturbance.

Water dependent structures as defined in 15A NCAC 2B .0202		●		
Water supply reservoirs:				
New reservoirs provided that a riparian buffer that meets the requirements of Items (4) and (5) is established adjacent to the reservoir		●		
New reservoirs where a riparian buffer that meets the requirements of Items (4) and (5) is NOT established adjacent to the reservoir			●	
Water wells	●			
Wetland restoration	●			

# Appendix C: Estimated Costs

## Cost Estimates

Itemized below are some rough cost estimates that could be associated with trail development for the Wake Forest greenway system. These costs are divided into major elements of the project. These prices are based on North Carolina greenway averages for similar projects currently in operation throughout the state and assume that the Town will employ professional contractors appropriate to build the project. Greenways Incorporated offers these estimates as a guide to future decision making and cannot guarantee their accuracy.

Because the greenways can be built using a variety of different trail widths, materials, and surfaces, the costs for installation can vary widely. Volunteer labor and donations of materials can help to significantly lower the price of trail installation. A representative sample of costs (in 2001 dollars) associated with trail types follows.

### Greenways with No Facility Development (Type 1):

<b>Vegetation</b>	<b>Unit cost</b>
Trees (3" caliper)	\$ 350 each
Shrubs (3 gallon)	\$ 25 each

\*Costs include plant and installation.

### Streambank Stabilization (Bioengineering)

\$ 25 - 75 / lin. foot
\$ 45 - 60 / lin. foot (ave.)

### Greenways with Limited Facility Development (Type 2):

<b>Trail Treads</b>	<b>Unit cost</b>
4-foot Bare Earth Hiking/Mtn. Bike Trail	\$ 2 / lin. foot
10-foot Wood Deck/Boardwalk Trail	\$ 150 / lin. foot

\*Costs include site preparation, clearing, grading, and mobilization.

### Signage

Information Signs	\$ 250 each
Direction Signs	\$ 250 each
Warning Signs	\$ 250 each
Mile Markers	\$ 50 each

**Greenways with Multi-Use Unpaved Trail Facility  
Development (Type 3):**

<b>Trail Treads</b>	<b>Unit cost</b>
10-foot Aggregate/Stone Trail	\$ 12 / lin. foot
10-foot Wood Deck/Boardwalk Trail	\$ 150 / lin. foot

**Signage**

Information Signs	\$ 250 each
Direction Signs	\$ 250 each
Warning Signs	\$ 250 each
Mile Markers	\$ 50 each

**Furniture/Furnishings**

Benches	\$ 600 each
Trash Receptacles	\$ 200 each
Security Bollards	\$ 250 each
Bicycle Racks	\$ 550 each
Fencing (Board-on-Board)	\$ 20 / lin. foot
Gates	\$ 750 each
911 Emergency Phones (w/ infrastructure)	\$ 800 each
911 Emergency Phones (w/o infrastructure)	\$ 3,500 each
Pre-fabricated Steel Bridges	\$ 1,000 / lin. foot

**Greenways with Multi-Use Paved Trail Facility  
Development (Type 4):**

<b>Trail Treads</b>	<b>Unit cost</b>
10-foot Asphalt Multi-Purpose Trail	\$ 50 / lin. foot
10-foot Concrete Multi-Purpose Trail	\$ 75 / lin. foot
10-foot Wood Deck/Boardwalk Trail	\$ 150 / lin. foot

**Signage**

Information Signs	\$ 250 each
Direction Signs	\$ 250 each
Warning Signs	\$ 250 each
Mile Markers	\$ 50 each

**Furniture/Furnishings**

Benches	\$ 600 each
Trash Receptacles	\$ 200 each
Security Bollards	\$ 250 each
Bicycle Racks	\$ 550 each
Fencing (Board-on-Board)	\$ 20 / lin. foot
Gates	\$ 750 each
911 Emergency Phones (w/ infrastructure)	\$ 800 each
911 Emergency Phones (w/o infrastructure)	\$ 3,500 each
Pre-fabricated Steel Bridges	\$ 1,000 / lin. foot

On-road trail construction is especially difficult to assess without knowledge of the existing Wake Forest sidewalk system. Simple striping for bike lanes is relatively inexpensive while road widening and sidewalk construction are considerably more expensive. For these reasons the estimate cost of on-road facilities was placed at \$20 per linear foot.

The following estimate for developing the Wake Forest Greenway trail system has been prepared based on the itemized costs above.

Phase I (as delineated on the Wake Forest Vision Map) trails are estimated to take 5-to-10 years to complete. These include approximately 14.78 miles of off-road trail and 5.72 miles of on-road trail. It is estimated that two-thirds of the off-road trail will require an asphalt or concrete surface.

• Natural surface trail (25,750 linear ft. @ \$12.00 per /ft.)	\$309,000
• Paved asphalt trail (52,278 linear ft. @ \$50.00 per /ft.)	\$2,614,000
• On-road trail (30,217 linear ft. @ \$20.00 per /ft.)	\$605,000
• Signage allowance (1 sign per 1,000 linear ft. @ \$250 each)	\$108,000
• Furniture allowance (\$2,000 per mile of trail - off-road only)	\$29,000
• Design fees and Construction Documentation (@ 15% of Total Cost)	\$354,000
• Total Cost	\$4,019,000

Phase II trails are estimated to take 10-to-20 years to complete. These include approximately 9.06 miles of off-road trail and 4.19 miles of on-road trail. It is estimated that two-thirds of the off-road trail will require an asphalt or concrete surface.

• Natural surface trail (16,281 linear ft. @ \$12.00 per /ft.)	\$195,000
• Paved asphalt trail (31,572 linear ft. @ \$50.00 per /ft.)	\$1,579,000
• On-road trail (22,119 linear ft. @ \$20.00 per /ft.)	\$442,000
• Signage allowance (1 sign per 1,000 linear ft. @ \$250 each)	\$18,000
• Furniture allowance (\$2,000 per mile of trail)	\$26,000
• Design fees and Construction Documentation (@ 15% of Total Cost)	\$221,000
• Total Cost	\$2,481,000

The following maintenance costs are provided as a guide to establishing a budget for the operation, maintenance and management of each trail segment within the greenway system. These costs are derived from national industry averages and have not been adjusted to reflect unique labor, material and cost issues specific to Wake Forest.

## Facility Maintenance Costs

It may be possible to lower the cost of maintaining one mile of paved trail through the development of an Adopt-a-Greenway Program. Volunteers have been proven effective in performing some of the routine maintenance activities that are listed below. Savings of 50% of the estimated cost per mile defined below are possible through a coordinated and well-run Adopt-a-Greenway Program, and some of these costs are already being covered along highways, roads and parks and other areas.

### Typical Maintenance Costs (for a 1-mile paved trail)

Drainage and storm channel maintenance (4 x / year)	\$ 500
Sweeping/blowing debris off trail tread (20 x / year)	\$ 1,200
Pick-up and removal of trash (20 x./ year)	\$ 1,200
Weed control and vegetation management (10 x / year)	\$ 1,000
Mowing of 3-ft grass safe zone along trail (20 x / year)	\$ 1,200
Minor repairs to trail furniture / safety features	\$ 500
Maintenance supplies for work crews	\$ 300
Equipment fuel and repairs	<u>\$ 600</u>
<b>Total Maintenance Costs per Mile of Paved Trail</b>	<b>\$ 6,500</b>
 Re-surfacing of paved trail tread (20-year cycle)	 \$ 50 / lin. foot

# Appendix D: Funding Sources

Some Federal programs offer financial aid for projects that aim to improve community infrastructure, transportation, housing and recreation. Some of the Federal programs that could be used to support the development of Wake Forest open space and greenways include:

## The Intermodal Surface Transportation Efficiency Act (ISTEA)

The primary source of federal funding for greenways is through the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA). This money is targeted at greenway projects that serve a transportation purpose, and is administered through the state Department of Transportation. All funded projects must meet certain design standards set forth by the state, which may add to the cost of the project. Therefore, this funding source should be investigated carefully before an application is completed. There are many sections of the Act that support the development of bicycle and pedestrian transportation corridors. Those sections that may be of particular interest to Wake Forest include:

- **Section 1302: Symms National Recreational Trails Fund Act (NRTFA)**

A component of ISTEA, the NRTFA is a funding source that assists with the development of non-motorized and motorized trails. The Act uses Highway Trust Fund fees from non-highway recreation fuel used by off-road vehicles and camping equipment. States can grant funds to private and public sector organizations. NRTFA projects are 80 percent federally funded, grant recipients must provide a 20 percent match. Projects funded must be consistent with the Statewide Comprehensive Outdoor Recreation Plan.

## Surface Transportation Program (STP) Funds

These funds can be used for bicycle and pedestrian facility construction or non-construction projects such as brochures, public service announcements, and route maps related to bicycle safety. The projects must involve bicycle and pedestrian transportation and must be part of the Long Range Transportation Plan.

## Federal Government Funding Sources

- **STP Transportation Enhancements Program**

Ten percent of North Carolina's annual STP funds are available for transportation enhancements, which include projects such as scenic byways, historic transportation preservation, landscaping and the development of bicycle and pedestrian facilities. These funds are available to all cities and counties in the state. There are several key requirements that projects must meet in order to receive these funds. Contact the State Bicycle and Pedestrian Coordinator for more information.

**Community Development Block Grant Program**

The U.S. Department of Housing and Urban Development (HUD) offers financial grants to communities for neighborhood revitalization, economic development, and improvements to community facilities and services, especially in low and moderate-income areas. Several communities have used HUD funds to develop greenways, including the Boscobel Heights' "Safe Walk" Greenway in Nashville, TN.

**Land and Water Conservation Fund (LWCF) Grants**

This Federal funding source was established in 1965 to provide "close-to-home" parks and recreation opportunities to residents throughout the United States. Money for the fund comes from the sale or lease of nonrenewable resources, primarily federal offshore oil and gas leases along with surplus federal land sales. LWCF grants can be used by communities to build a variety of park and recreation facilities, including trails and greenways.

LWCF funds are distributed by the National Park Service to the states annually. Communities must match LWCF grants with 50 percent of the local project costs through in-kind services or cash. All projects funded by LWCF grants must be used exclusively for recreation purposes, in perpetuity.

**Watershed Protection and Flood Prevention (Small Watersheds) Grants**

The USDA Natural Resource Conservation Service (NRCS) provides funding to state and local agencies or nonprofit organizations authorized to carry out, maintain and operate watershed improvements involving less than 250,000 acres. The NRCS provides financial and technical assistance to eligible projects to improve watershed protection, flood prevention, sedimentation control, public water-based fish and wildlife enhancements and recreation planning. The NRCS requires a 50 percent local match for public recreation, and fish and wildlife projects.

**Urban and Community Forestry Assistance Program**

The USDA provides small grants of up to \$10,000 to communities for the purchase of trees to plant along city streets, greenways and parks. To qualify for this program, a community must pledge to develop a street-tree inventory; a municipal tree ordinance; a tree commission, committee or department; and an urban forestry-management plan.

## Small Business Tree Planting Program

The Small Business Administration provides small grants of up to \$10,000 to purchase trees for planting along streets and within parks or greenways. Grants are used to develop contracts with local businesses for the planting.

## Design Arts Program

The National Endowment for the Arts provides grants to states and local agencies, individuals and nonprofit organizations for projects that incorporate urban design, historic preservation, planning, architecture, landscape architecture and other community improvement activities, including greenway development. Grants to organizations and agencies must be matched by a 50 percent local contribution. Agencies can receive up to \$50,000.

## North Carolina Department of Transportation (NCDOT)

NCDOT is the state agency that administers federal funding from the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991. Along with the federal requirements for this money, NCDOT has application policies and procedures. Contact the state Bicycle and Pedestrian Coordinator for more details.

## North Carolina Division of Parks and Recreation

The state Division of Parks and Recreation currently offers limited funding for greenway projects. The Adopt-a-Trail program provides funding (approximately \$135,000 annually) to trail projects, with priority given to volunteer groups. There is also a state trails program that offers technical assistance in the planning, design and maintenance of trails.

## North Carolina Wildlife Resources Commission

The Commission, through small grants, annually funds projects that increase wildlife habitat or improve public access and education related to wildlife. This money can be used for interpretive signage on local wildlife habitat along greenways.

## North Carolina Department of Corrections

Low security prison labor can be used to construct and maintain greenways. Amenities such as picnic tables, signs and benches can be constructed using prison labor. An example of where this has been successful is in Guilford County, where prisoners regularly maintain the Bicentennial Greenway.

## North Carolina Division of Water Resources

Greenway projects involving stream restoration or recreation can receive money from the Water Resources Development Grant Program, administered by the Division of Water Resources.

# State Funding Sources

## Local Funding Sources

- **PL 566—Watershed Protection and Flood Prevention Act**

Local communities can receive funding for greenway projects that incorporate flood prevention and watershed protection through this Act.

### Local Private-Sector Funding

Local industries and private businesses may agree to provide support for development of Wake Forest open space and greenways through:

- donations of cash to a specific greenway segment or open space parcel;
- donations of services by large corporations to reduce the cost of greenway implementation, including equipment and labor to construct and install elements of greenways;
- reductions in the cost of materials purchased from local businesses which support open space preservation/greenway implementation and can supply essential products for facility development.

One example of a successful endeavor of this type is the Swift Creek Recycled Greenway in Cary, NC. A total of \$40,000 in donated construction materials and labor made this trail an award-winning demonstration project. This method of raising funds requires a great deal of staff coordination. (Note: Some materials used in the “recycled trail” were considered waste materials by local industries!)

### Greenway Sponsors

A sponsorship program for greenway amenities allows for smaller donations to be received both from individuals and businesses. The program must be well planned and organized, with design standards and associated costs established for each amenity. Project elements which may be funded can include wayside exhibits, benches, trash receptacles, entry signage, and picnic areas.

### Volunteer Work

Community volunteers may help construct open space or greenway facilities, as well as conduct fund-raisers. Individual volunteers can be recruited, as well as those from local organizations such as church groups, civic groups, scout troops, and environmental groups.

A case in point is Cheyenne, Wyoming’s volunteer greenway program. The Greater Cheyenne Greenway has motivated an impressive amount of community support and volunteer work. The program had to insist that volunteers wait to begin landscaping the trail until construction is completed. A manual for greenway volunteers was developed in 1994 to guide and regulate volunteer work. The manual includes a description of appropriate volunteer efforts, request forms, waiver and release forms, and a

completion form (that asks volunteers to summarize their accomplishments). Written guidelines are also provided for volunteer work in 100-year floodplains.

To better organize volunteer activity, Cheyenne developed an “Adopt-a-Spot” program. Participants who adopt a segment of trail are responsible for periodic trash pickup, but can also install landscaping, prune trail-side vegetation, develop wildlife enhancement projects, and install site amenities. All improvements must be consistent with the Greenway Development Plan and must be approved by the local Greenway Coordinator. Adopt-a-Spot volunteers are allowed to display their names on a small sign along the adopted section of greenway.

### “Buy-a-Foot” Programs

“Buy-a-Foot” programs have been successful in raising funds and awareness for trail and greenway projects within North Carolina. Under local initiatives, citizens are encouraged to purchase one linear foot of the greenway by donating the cost of construction. An excellent example of a successful endeavor is the High Point Greenway “Buy-a-Foot” campaign, in which linear greenway “feet” were sold at a cost of \$25/foot. Those who donated were given a greenway T-shirt and a certificate. This project provided over \$5,000 in funds.

Many communities have solicited funding from a variety of private foundations and other conservation-minded benefactors.

### Walking Magazine Trail Restoration Fund

Walking Magazine, hoping to encourage more volunteer efforts among trail users, established this fund for the restoration of urban, suburban or rural walking trails. The magazine provides small grants, generally from \$200 to \$500, to help walking clubs and other groups purchase trail maintenance equipment or supplies.

### Coors Pure Water 2000 Grants

Coors Brewing Company and its affiliated distributors provide funding and in-kind services to grassroots organizations that are working to solve local, regional and national water-related problems. Coors provides grants, ranging from a few hundred dollars to \$50,000, for projects such as river cleanups, aquatic habitat improvements, water quality monitoring, wetlands protection, pollution prevention, water education efforts, ground-water protection, water conservation and fisheries.

### World Wildlife Fund Innovative Grants Program

This organization awards small grants to local, regional and statewide nonprofit organizations to help implement innovative strategies for the conservation of natural resources. Grants are offered to support projects which:

## Private Foundations and Corporations

1. Conserve wetlands;
2. Protect endangered species;
3. Preserve migratory birds;
4. Conserve coastal resources; and
5. Establish and sustain protected natural areas.

Innovation grants can help pay for the administrative costs for projects including planning, technical assistance, legal and other costs to facilitate the acquisition of critical lands; retaining consultants and other experts; and preparing visual presentations and brochures or other conservation activities. The maximum award for a single grant is \$10,000.

### **Establish a Greenway Trust Fund**

It may be beneficial to create a Wake Forest Greenway Trust Fund as a non-profit 501 (c)3 organization. The Trust Fund would advocate, promote, and encourage greenway development; organize volunteers to assist with implementation and management; sponsor or co-sponsor greenway events; and provide an outlet for donations that intended specifically for greenway development projects.

# Appendix E: Operations, Maintenance and Management

Operating, maintaining and managing a system of open space and greenways in Wake Forest will require a coordinated effort among all Town departments, private sector organizations and individuals. The following text defines key aspects of Open Space and Greenway System management, beginning with a discussion of a governance structure for the system, followed by definition of operational policies, facility management, land management, safety and security, trail user rules and regulations, an emergency response plan, and risk management program.

For a successful Open Space and Greenway System to be developed it is critical for the players to understand their role in supporting and managing the system.

## Role of Wake Forest

The Wake Forest Open Space and Greenway System will be developed and managed by the Town and its departments. Listed below and on the following pages are the key departments and organizations that will play a role in this implementation.

## Role of Parks and Recreation Department

As the primary developer of greenways, the Parks and Recreation Department is the most prominent participant in the Open Space and Greenway Plan. The Department will be responsible for the design, management and maintenance of the greenway system. The Parks and Recreation Department will need to work closely with the Planning Department in the siting of greenways.

## Role of the Planning Department

The Planning Department should provide support for the Open Space and Greenway Plan and assistance with future implementation of the system. This can be accomplished by defining future greenways within related planning efforts; utilizing the rezoning process to encourage dedication of lands, including sidewalks and bicycle facilities for the Open Space and Greenway System; and planning transportation improvements in coordination with greenways.

## Overview

## Governance Structure

## Role of Private Sector

### Role of Public Utilities Department and Water Resources Department

The Public Utilities Department and Water Resources Department are important players in the implementation strategy for the Open Space and Greenway System. The Departments manage the systems of sanitary and stormwater sewers which offers enormous potential for shared use with greenway development objectives. For the expansion and development of new sanitary sewer lines, the Water Resources Department should consider the use of a joint-use easement document during right-of-way negotiations to acquire subsurface and surface rights from willing sellers. Additionally, Public Utilities stormwater management objectives can be enhanced through the development of the Open Space and Greenway System through the use of funds obtained from federal and state grants. The Departments could function as greenway developers in partnership with the Parks and Recreation Department.

### Role of Department of Police Services

The Department of Police Services should assist the Parks and Recreation Department with patrolling and law enforcement for Open Space and Greenway System lands and facilities.

The private sector throughout Wake Forest is the primary beneficiary of the Wake Forest Open Space and Greenway System. As such, private organizations, businesses and individuals can and should play an important role in the development and management of the system. Private sector groups and businesses can sponsor implementation projects for open space and greenways as a partner of the Town. These groups can also help to maintain open space and greenway lands through cooperative management agreements with the Town.

### Role of Local Businesses and Corporations

Wake Forest businesses and corporations might choose to sponsor a segment of greenway for development or maintenance. Businesses and corporations can work with the Parks and Recreation Department to give money, materials, products and labor toward the development of a greenway facility. Businesses can also consider installing facilities, such as bike racks or lockers, benches, and signage that links their operations to the Open Space and Greenway System.

### Role of Civic Organizations

Local civic groups and organizations, including the Junior League, Boy Scouts and Girl Scouts, Women's Club, Chamber of Commerce, garden clubs, YMCA, Kiwanis and Rotary Clubs, to name a few, can be participants in the Wake Forest Open Space and Greenway System. These organizations can play a vital role in building sections of greenway trails, maintaining and managing greenway lands and facilities, and co-hosting events that raise money for the Open Space and Greenway System.

There are many ways in which civic organizations can participate in the development of the Open Space and Greenway System. The most appropriate involvement can be determined by matching the goals and objectives of each organization to the needs of the greenway program.

### Role of Individual Citizens

Local residents who are interested in the development of Wake Forest's Open Space Greenway System can participate by agreeing to donate their time, labor, and expertise to the Parks and Recreation Department. Residents might choose to partner with a friend or form a local neighborhood group that adopts a section of greenway for maintenance and management purposes. As an adopt-a-greenway organization, individuals might help pick-up trash, plant flowers and trees, care for newly planted vegetation and serve as additional "eyes and ears" for safety and security on open space and greenway lands. All volunteer efforts would be recognized by the Parks and Recreation Department through a community-wide program.

Over the course of time, Wake Forest will encounter a variety of issues that are important to the successful management and operation of the Open Space and Greenway System. The following operational policies are defined to assist the Town in responding to typical greenway implementation issues. More specific problems and issues may arise during the long-term development of the system that result in additional policies being considered and adopted.

The protection of stream corridors from urban encroachment is essential in order to permit stream channels and their floodplains to perform natural infrastructure functions. Stream corridors are best protected by first delineating the landscape boundaries of the 100-year (regulatory) floodplain and then by encouraging landowners to engage in land stewardship practices that limit encroachment and preserve the native landscape.

This section of the Plan defines land acquisition procedures that can be used to conserve, protect, and preserve the stream corridors of Wake Forest. This Plan recommends a voluntary land acquisition program for protecting the streams and floodplains of the Town. The text in this section offers a menu of tools that landowners, land conservation organizations and local government can use to establish the physical boundaries of the Open Space and Greenway System. In the event that certain parcels of land within the floodplain are considered vital to the overall efforts of the Open Space and Greenway System, mechanisms defined herein enable Wake Forest to purchase or negotiate for the dedication of certain property rights. Dedication should be negotiated in a manner that is consistent with local, state and Federal laws that permit and govern such action.

## Open Space and Greenways Operations

### Land Acquisition Procedures

## Methods for Acquisition of Land Through Management

Management is a method of conserving the resources of a specific greenway parcel through either an established set of policies called Management Plans, or through negotiated agreements or easements with private property owners.

### Management Plans

Management plans are prepared for Town-owned greenway lands. Management plans should identify valuable resources; determine compatible uses for the parcel; determine administrative needs of the parcel, such as maintenance, security and funding requirements; and recommend short-term and long-term action plans for the treatment and protection of the resources.

## Easements

Land management agreements in which Wake Forest receives less than full interest in a parcel of land in order to protect a valuable resource. The purpose of these agreements is to establish legally binding contracts or a mutual understanding of the specific use, treatment and protection that these greenway lands will receive. Property owners who grant easements retain all rights to the property except those which have been granted by the easement. The property owner is responsible for all taxes associated with the property, less the value of the easement granted. Easements are generally restricted to certain portions of property, although in certain cases an easement can be applied to an entire parcel of land. Easements are transferable through title transactions, thus the easement remains in effect in perpetuity. Three types of greenway easements are:

### Conservation Easements

This type of easement generally establishes permanent limits on the use and development of land to protect the natural resources of that land. Dedicated conservation easements can qualify for both federal income tax deductions and state tax credits. Tax deductions are allowed by the Federal government for donations of certain conservation easements. The donations may reduce the donor's taxable income.

### Preservation Easements

This type of easement is intended to protect the historical integrity of a structure or important elements of the landscape by sound management practices. Preservation easements may qualify for the same federal income tax deductions and state tax credits as conservation easements.

### Public Access Easements

Right of public access easements provide the general public with the right to access and use a specific parcel of property. Both conservation easements and preservation easements may contain clauses for the right of public access and still be eligible for tax incentives.

## Methods for Acquisition of Greenways Through Regulation

The second method of protecting stream corridor/greenways is through government regulation. Regulation is defined as the government's ability to control the use and development of land through legislative powers. The following types of development ordinances are regulatory tools that can meet the challenges of projected suburban growth and development and, at the same time, conserve and protect greenway resources.

### Dedication/Density Transfers

Also known as incentive zoning, this mechanism allows greenways to be dedicated for density transfers on the development of a property. The potential for improving or subdividing part or all of a parcel of real property, as permitted under land use development laws, can be expressed in dwelling unit equivalents or other measures of development density or intensity. Known as density transfers, these dwelling unit equivalents may be relocated to other portions of the same parcel or to contiguous land that is part of a common development plan. Dedicated density transfers can also be conveyed to subsequent holders if properly noted in transfer deeds.

### Negotiated Dedications

The Town may ask a landowner to enter into negotiations for certain parcels of land that are deemed beneficial to the protection and preservation of specific stream corridors. The Town may ask for the dedication of land for greenways when landowners subdivide property (a minimum size would be determined). Such dedications would be proportionate to the relationship between the impact of the subdivision on community services and the percentage of land required for dedication - as defined by the US Supreme Court in *Dolan v Tigard*.

### Recreation Facility Fee

The Town of Wake Forest has in-place a Recreation Facility Fee ordinance to offset the costs of additional or expanded recreational facilities generated by residential growth. Funds generated from this Fee are to be used to meet the increased demand for recreation facilities as the community grows. This money can be used to for greenway and open space acquisition and improvement costs.

### Reservation of Land

A reservation of land does not involve any transfer of property rights but simply constitutes an obligation to keep property free from development for a stated period of time. Reservations are normally subject to a specified period of time, such as 6 or 12 months. At the end of this period, if an agreement has not already been reached to transfer certain property rights, the reservation expires.

## Methods for Protection of Greenways through Acquisition

### Buffer/Transition Zones

This mechanism recognizes the problem of reconciling different, potentially incompatible land uses by preserving greenways that function as buffers or transition zones between uses. Care must be taken to ensure that use of this mechanism is reasonable and will not destroy the value of a property.

### Overlay Zones

An overlay zone and its regulations are established in addition to the zoning classification and regulations already in place.

### Subdivision Exactions

An exaction is a condition of development approval that requires a developer to provide or contribute to the financing of public facilities at their own expense. For example, a developer may be required to build a greenway on-site as a condition of developing a certain number of units because the development will create need for new parks or will harm existing parks due to overuse. The mechanism can be used to protect or preserve a greenway which is then dedicated to the Town. Consideration should be given to including greenway development in future exaction programs.

The third method of protecting stream corridor/greenways is through the acquisition of property. A variety of methods can be used to acquire property for greenway purposes.

### Donation/Tax Incentives

A governmental body, public agency or qualified conservation organization agrees to receive full title or a conservation easement to a parcel of land at no cost or at a “bargain sale” rate. The donor is eligible to receive a federal tax deduction of up to 30 to 50 percent of their adjusted gross income. Additionally, North Carolina offers a tax credit up to 25 percent of the property’s fair market value (up to \$5000). Any portion of the fair market value not used for tax credits may be deducted as a charitable contribution. Also, property owners may be able to avoid inheritance taxes, capital gains taxes and recurring property taxes.

### Fee Simple Purchase

This is a common method of acquisition where a local government agency or private greenway manager purchases property outright. Fee simple ownership conveys full title to the land and the entire “bundle” of property rights including the right to possess land, to exclude others, to use land and to alienate or sell land.

## Easement Purchase

This mechanism is the fee simple purchase of an easement. Full title to the land is not purchased, only those rights granted in the easement agreement. Therefore the easement purchase price is less than full title value.

## Purchase/Lease Back

A local government agency or private greenway organization can purchase a piece of land and then lease it back to the seller for a specified period of time. The lease may contain restrictions regarding the use and development of the property.

## Bargain Sale

A property owner can sell property at a price less than the appraised fair market value of the land. Sometimes the seller can derive the same benefits as if the property were donated. Bargain Sale is attractive to sellers when the seller wants cash for the property, the seller paid a low cash price and thus is not liable for high capital gains tax, and/or the seller has a fairly high current income and could benefit from a donation of the property as an income tax deduction.

## Option/First Right of Refusal

A local government agency or private organization establishes an agreement with a public agency or private property owner to provide the right of first refusal on a parcel of land that is scheduled to be sold. This form of agreement can be used in conjunction with other techniques, such as an easement, to protect the land in the short term. An option would provide the agency with sufficient time to obtain capital to purchase the property or successfully negotiate some other means of conserving the greenway resource.

## Purchase of Development Rights

A voluntary Purchase of Development Rights (PDR) involves purchasing the development rights from a private property owner at a fair market value. The landowner retains all ownership rights under current use, but exchanges the rights to develop the property for cash payment.

## Condemnation

The practice of condemning private land for use as greenways is viewed as a last resort policy. Using condemnation to acquire property or property rights can be avoided if private and public support for the Greenway Program is present. Condemnation is seldom used for the purpose of dealing with an unwilling property owner. In most cases, condemnation for greenway purposes has been exercised when there has been absentee property ownership, when title to the property is not clear, or when it becomes apparent that obtaining the consent for purchase will be difficult

because there are numerous heirs located in other parts of the United States, or in different countries. The community must exercise caution in using Eminent Domain.

It is recommended that the right of eminent domain for a specific property be exercised by the community only if all of the following conditions exist:

- a) that the property is valued by the community as an environmentally sensitive parcel of land, significant natural resource, or critical parcel of land, and as such has been defined by the community as an irreplaceable property;
- b) that written scientific justification for the community's claim that the property possesses such value should be prepared and offered to the property owner;
- c) that all efforts to negotiate with the property owner for the management, regulation and acquisition of the property have been exhausted and that the property owner has been given reasonable and fair offers for compensation and has rejected all offers;
- d) that due to the ownership of the property, the timeframe for negotiating the acquisition of the property will be unreasonable, and in the interest of pursuing a cost effective method for acquiring the property, the community has deemed it necessary to exercise the right of eminent domain.

## Right of Public Access and Use of Trail Lands

The general public should have access to and use of those greenway lands that support public use (i.e. trail development), and that are owned by Wake Forest or on land that the Town has secured the right of public access and use. All access and use is governed by existing Town policies and should also be governed by a Greenway Trail Ordinance. The use of all trails is limited to non-motorized uses, including hiking, bicycling, running, jogging, wheelchair use, skateboarding, in-line skating (rollerblading), equestrian use, mountain biking, and other uses that are determined to be compatible with the Town's greenway trails.

## Naming of Greenways

Greenways are named for the significant natural features that are found within the corridor. Greenways can also be named after an individual or individuals if these persons are truly distinguished within the community, or if these persons have contributed a gift equal to more than 50% of the value of greenway development within that corridor segment.

## Fencing and Vegetative Screening

Wake Forest should work with each landowner on an individual basis to determine if fencing and screening is required and appropriate. The Town may agree to fund the installation of a fence or vegetative screen; however, it should be the responsibility of the adjacent property owner to maintain the fence or vegetative screen in perpetuity, including the full replacement of such fence or screen in the event of failure or deterioration due to any circumstances.

An Adopt-a-Greenway Program should be established by Wake Forest to encourage community groups, families, businesses, school groups, civic clubs and other organizations to join in managing the Open Space and Greenway System. Wake Forest should implement this program for every greenway corridor in the system, and work closely with local organizations to ensure that these groups manage and maintain trails in a manner that is consistent with Town objectives. The Town should develop written agreements for each Adopt-a-Greenway entity and keep a current record of this agreement on file. Adopt-a-Greenway entities will be assigned a specific section of the Open Space and Greenway System, defined by location or milepost. The activities of each organization should be monitored by the Town or its designee. Agreements for management can be amended or terminated at any time by either party, giving 30 days written notice.

Management Agreements will be established between Wake Forest and specific public or private organizations wishing to assist with the management of designated segments of the Open Space and Greenway System. The objective of these agreements is to define areas of maintenance and management that are compatible with existing land management activities, especially where greenways intersects with public or private properties and/or rights-of-way. Management agreements spell out specific duties, responsibilities and activities of Wake Forest and public or private organization that wishes to assist with management activities. They can be amended or terminated at any time by either party, giving 30 days written notice.

Wake Forest can use cross access agreements to permit private landowners that have property on both sides of a greenway corridor access to and use of a greenway corridor to facilitate operation and land use activities.

Cross access agreements are based on case law of the United States and specific experiences from other greenway trail systems throughout the United States. Adjacent landowners generally have the right to use the access at any time. However, access cannot block the right-of-way for trail users, other than for temporary measures such as permitting livestock to cross, or transporting equipment. Adjacent landowners are responsible for acts or omissions that would cause injury to a third party using the trail. If a landowner must move products, materials, livestock or equipment across the trail on a regular basis, appropriate signage should be installed to warn users of the trail to yield for such activities.

Crossing of abandoned or active rail lines, utility corridors and/or roads and highways will require the execution of agreements with companies, local, state or federal agencies and organizations that own the rights-of-way. These crossings must provide clearly controlled, recognized, and

## Adopt-a-Greenway Program

## Management Agreements

## Cross Access Agreements

## Greenway Facility Management

defined intersections in which the user will be warned of the location. In accordance with the American Association of State Highway Transportation Officials (AASHTO) and the Manual on Uniform Traffic Control Devices (MUTCD), the crossing will be signed with appropriate regulatory, warning and information signs.

Greenway facilities shall be maintained in a manner that promotes safe use. All trail facilities should be managed by Wake Forest or its designee. Trail maintenance should include the removal of debris, trash, litter, obnoxious and unsafe man-made structures, and other foreign matter so as to be safe for public use. Trailheads, points of public access, rest areas and other activity areas should be maintained in a clean and usable condition at all times. The primary concern regarding maintenance should always be public safety.

All trail surfaces should be maintained in a safe and usable manner at all times. Rough edges, severe bumps or depressions, cracked or uneven pavement, gullies, rills and washed out treads should be repaired immediately. Volunteer vegetation occurring in the tread of the trail should be removed in such a manner so that the trail surface is maintained as a continuous, even and clean surface.

## Land Management

Property owned or used by Wake Forest for the Open Space and Greenway System shall be maintained in a condition that promotes safety and security for greenway users and adjacent property owners. To the extent possible, the property shall also be maintained in a manner that enables the corridor to fulfill multiple functions (i.e. passive recreation, alternative transportation, stormwater management and habitat for wildlife). Property that is owned or managed by other entities should be managed and maintained in accordance with the policies of that public body responsible for the affected parcel.

Private lands and neighborhood groups wanting to connect to the Wake Forest system will need to seek permission from the Wake Forest Parks and Recreation Department. Efforts to connect to the system will require the approval of the Department that will be decided on a case-by-case basis. Development expenses will not be covered by the Wake Forest Parks and Recreation Department. Connecting to the Wake Forest municipal system does not relieve neighborhood greenways management bodies of their responsibilities of safety, security, and/or maintenance.

Vegetation adjacent to trails shall be managed as necessary to maintain clear and open lines of sight along the edge of the trail, and eliminate potential hazards that could occur due to natural growth, severe weather or other unacceptable conditions. To promote safe use of any greenway trail, all vegetation should be clear cut to a minimum distance of three (3) feet from each edge of a trail. Selective clearing of vegetation should be conducted within a zone that is defined as being between three (3) to ten (10) feet from each edge of a trail. At any point along a trail, a user should

have a clear, unobstructed view, along the centerline of a trail, 300 feet ahead and behind his/her position. The only exception to this policy should be where terrain or curves in a trail serve as the limiting factor.

Wake Forest or their designated agent should be responsible for the cutting and removal of vegetation. Removal of vegetation by an individual or entity other than the Town of Wake Forest or its designee shall be deemed unlawful and subject to fines and/or prosecution.

It may also be necessary for Wake Forest to conduct wildlife management programs on lands that are publicly owned. This shall be accomplished in a manner that is in keeping with accepted laws, professional practices and/or recommended strategies that are provided to Wake Forest by wildlife management experts.

In order to provide a standard of care that offers reasonable and ordinary safety measures, Wake Forest shall cooperatively develop and implement a Safety and Security Program for the Open Space and Greenway System. This program will consist of well-defined safety and security policies; the identification of trail management, law enforcement, emergency and fire protection agencies; the proper posting, notification and education of the trail user policies; and a system that offers timely response to the public for issue or problems that are related to safety and security. The safety and security of the Open Space and Greenway System will need to be coordinated with local law enforcement officials, local neighborhood watch associations, and Adopt-a-Greenway organizations.

Important components of the safety and security program include the following. Wake Forest should:

- 1) Work with law enforcement agencies to establish a Greenway Safety and Security Committee that can meet periodically to discuss management of the Open Space and Greenway System.
- 2) Prepare a Greenway Safety Manual and distribute this to management agencies and post it at all major trailheads.
- 3) Post User Rules and Regulations at all public access points to greenway trails.
- 4) Work with the management agencies to develop Trail Emergency Procedures.
- 5) Prepare a Safety Checklist for the Open Space and Greenway System, and utilize it monthly during field inspection of greenway facilities.
- 6) Prepare a Greenway User Response Form for complaints and complements and provide copies at all trailheads.
- 7) Work with management agencies to develop a system for accident reporting analysis.
- 8) Conduct a regular Maintenance and Inspection Program, and share the results of these investigations with all management agencies.

## Safety and Security

## User Rules and Regulations

- 9) Coordinate other Public Information Programs that provide information about greenway events and activities that Town residents can participate in.
- 10) Have an ongoing evaluation of greenway program objectives.

Trails within greenway corridors shall be operated like all other parks within Wake Forest open for public use from sunrise to sunset, 365 days a year, except as specifically designated. Individuals who are found to be using unlighted facilities after dusk and before dawn should be deemed in violation of these hours of operation and treated as trespassers. Where trails are lighted for nighttime use, the rules established within the Trail Ordinance should govern permitted uses and activities.

Wake Forest shall enforce trespassing laws as defined under North Carolina General Statutes for publicly owned lands and facilities.

Wake Forest should always discourage the general public from using any segment of a greenway trail that is under construction. Trail segments should not be considered officially opened for public use until such time as a formal dedication ceremony and official opening has been completed. Individuals who use greenway segments that are under construction, without written permission from the Town should be deemed in violation of this access and use policy and treated as a trespasser.

### Trail Ordinance

Multi-use conflict is a national problem for community and regional Open Space and Greenway Systems. Typically, conflicts are caused by overuse of a greenway trail, however, other factors may be problematic including poorly designed and engineered trail alignments, inappropriate user behavior, or inadequate facility capacity. The most effective conflict resolution plan is a well-conceived safety program that provides the individual user with a Code of Conduct for the greenway trail, sometimes called a Trail Ordinance. Several communities across the United States have adopted progressive trail ordinances to govern public use and keep trails safe for all users. The following Rules and Regulations are recommended for the Wake Forest Greenway System. These rules should be displayed both on brochures and information signs throughout the Open Space and Greenway System.

- 1) **Be Courteous:** All Trail users, including bicyclists, joggers, walkers, wheelchairs, skateboarders and skaters, should be respectful of other users regardless of their mode of travel, speed, or level of skill. Never spook animals; this can be dangerous for you and other users. Respect the privacy of adjacent landowners! No trespassing allowed from trails, remain on trails at all times.
- 2) **Keep Right:** Always stay to the right as you use the Trail, or stay in the lane that has been designated for your user group. The exception to this rule occurs when you need to pass another user.

- 3) **Pass on the Left:** Pass others going in your direction on their left. Look ahead and behind to make sure that your lane is clear before you pull out and around the other user. Pass with ample separation. Do not move back to the right until you have safely gained distance and speed on the other user. Faster traffic should always yield to slower on-coming traffic.
- 4) **Give Audible Signal When Passing:** All users should give a clear warning signal before passing. This signal may be produced by voice, bell or soft horn. Voice signals might include "Passing on your left!" or "Cyclist on your left!" Always be courteous when providing the audible signal - profanity is unwarranted and unappreciated.
- 5) **Be Predictable:** Travel in a consistent and predictable manner. Always look behind before changing position on the Trail, regardless of your mode of travel.
- 6) **Control Your Bicycle:** Lack of attention, even for a second, can cause disaster - always stay alert! Maintain a safe and legal speed at all times.
- 7) **Do not Block the Trail:** When in a group, including your pets, use no more than half the trail, so as not to block the flow of other users. If your group is approached by users from both directions, form a single line or stop and move to the far right edge of the Trail to allow safe passage by these users.
- 8) **Yield when Entering or Crossing Trails:** When entering or crossing the Trail at an uncontrolled intersection, yield to traffic already using the other trail.
- 9) **Do not Use this Trail Under the Influence of Alcohol or Drugs:** It is illegal to use this Trail if you have consumed alcohol in excess of the statutory limits, or if you have consumed illegal drugs. Persons who use a prescribed medication should check with their doctor or pharmacist to ensure that it will not impair their ability to safely operate a bicycle or other wheeled vehicle.
- 10) **Clean-up Your Litter:** Please keep this Trail clean and neat for other users to enjoy. Do not leave glass, paper, cans or any other debris on or near the Trail. Please clean up after your pets. Pack out what you bring in - and remember to always recycle your trash.
- 11) **Keep Pets on Leashes:** All pets must be kept on secure and tethered leashes. Keep pets off of adjacent private property. Failure to do so will result in a fine.
- 12) **Prohibition on Camp Fires:** Fires, for any purpose, are prohibited within the Trails System. Any person caught lighting a fire for any purpose will be prosecuted to the fullest extent of the law.

In order to effectively patrol the Open Space and Greenway System and respond to the potential for fire, flash floods and other natural or human-caused disasters, Wake Forest shall adopt a greenway emergency response plan. This plan defines a cooperative law enforcement strategy for greenways based on services required and those that are typically

## Emergency Response Plan

## Risk Management Plan

provided by police, sheriff, fire and EMS agencies. Specifically, all trails should be provided with an address system that denotes specific locations along the length of a trail corridor. A site plan that illustrates points of access to each trail corridor should be produced and kept on file and provided to each agency. Trails in flash flood areas shall be appropriately signed to warn users. Each trail should be designed to permit access for law enforcement, fire and EMS agencies and vehicles that are not in excess of 6.5 tons gross vehicle weight. Typically, inter-governmental agreements are executed for this. A system of cellular-type emergency phone should be located in remote sections of the system, providing users with access to the area 911 Emergency System. All emergency phone should be placed above the flood elevation to ensure long term usage.

The emergency response plan should also define the agencies that should respond to 911 calls, and provide easy to understand routing plans and access points for emergency vehicles. For long distance trails, access points for emergency and maintenance vehicles should be located at reasonable distances from trailheads (approximately every 2-3 miles). Local hospitals should be notified of these routes so that they may also be familiar with the size and scope of the project. The entire Open Space and Greenway System should be designed and develop to support a minimum gross vehicle weight of 6.5 tons.

The purpose of a Risk Management Plan is to increase safety for the users of the Wake Forest Open Space and Greenway System and reduce the potential for accidents to occur within the system or on lands adjacent to the system. While it is impossible to guarantee that all risk will be eliminated by a Risk Management Plan, implementation of a plan is in fact a critical step to reduce liability and improve safety. A Risk Management Plan establishes a methodology for greenway management that is based on current tort liability and case law in the United States related to the development, operation and management of public use greenway lands and facilities.

The ultimate responsibility for managing the Open Space and Greenway System, as defined within this Plan, rests with Wake Forest. The Risk Management Plan has as its major goals:

- 1) Risk Identification: determining where risk (threat to safety or potential loss) exists within the corridor.
- 2) Risk Evaluation: conducting appropriate examination of areas defined as a risk and determining the factors that contribute to risk.
- 3) Risk Treatment: defining and implementing an appropriate solution to the area of risk in accordance with one of the four options:
  - a) Risk avoidance: prohibiting use of a risk area.
  - b) Risk reduction: limit use of area and repair risk area immediately.

- c) Risk retention: obtain waivers from all potential users of the risk area.
- d) Risk transfer: transfer risk area (property) to an agency better suited to manage the area.

The following sixteen step plan should be implemented by Wake Forest to establish a Risk Management Plan for the Wake Forest Open Space and Greenway System.

- 1) Develop a policy statement about risk management.
- 2) Conduct a needs assessment for the greenway program.
- 3) Determine goals and objectives for risk management - what are acceptable and not acceptable management levels.
- 4) Develop specifications for site and facility development.
- 5) Establish a clear and concise program for risk management.
- 6) Define supervision and responsibility for risk management.
- 7) Define appropriate rules and regulations that govern the use of the trail system.
- 8) Conduct routine/systematic inspections and investigations of the trail system.
- 9) Develop an accident reporting and analysis system.
- 10) Establish procedures for handling emergencies.
- 11) Develop appropriate releases, waivers and agreements for use and management.
- 12) Identify best methods for insuring against risk.
- 13) Develop a comprehensive in-service training program for employees of the Town.
- 14) Implement a public relations program that can effectively describe the risk management program and activities.
- 15) Conduct periodic reviews of the Risk Management Plan by outside agents to ensure that the Plan is up to date.
- 16) Maintain good legal and insurance representation.

The design, development, management, and operation of the Wake Forest Open Space and Greenway System must be carefully and accurately executed in order to provide a resource that protects the health and welfare of the public. Liability may occur when a facility has been under-designed to handle its intended volume of use; when management of the facility is poor; or when unexpected accidents occur because the trail manager failed to recognize the possibilities of a potentially hazardous situation. To reduce the possibility and exposure to liability, the Town should have in operation the following measures prior to opening the first segment of greenway:

- 1) a thorough Maintenance Program that provides the appropriate duty or level of care to greenway users;
- 2) a Risk Management Plan that appropriately covers all aspects of the Open Space and Greenway System, and as necessary adjacent landowners;

## Liability

- 3) a comprehensive working knowledge of public use laws and recent case history applicable in North Carolina.

Wake Forest's existing program may be adequate to protect the Town government from financial loss that might occur through the development and operation of the Open Space and Greenway System. Trails are no greater liability to the Town than park and recreation, sidewalk or urban open space resources. The Town should review its current policy and check coverages to be certain that all aspects of its policies are up to date.

Wake Forest should exercise reasonable care in the design and construction of all greenway facilities to reduce hazardous, public nuisance and life threatening situations. In fact, it is very difficult to find any case law in the United States where an adjacent property owner has been sued because a trail user strayed onto the adjacent private property and fell victim to an accident that was caused by the adjacent landowner. Some landowners have claimed that their insurance rates will go up because of the presence of a trail abutting their property. Once again, there is no case history among insurance companies to support this claim — provided the landowner has not gone out of their way to create an attractive nuisance and lure trail users onto their property.

It is also important that a fee not be charged to use any portion of the Open Space and Greenway System, because typically this may impact the way in which the recreational use statutes in North Carolina apply to the use of the system. A voluntary donation applied to the Open Space and Greenway System will generally not affect the recreational use statute.