Town of Windsor, NC:

Comprehensive Bicycle & Pedestrian Plan

Adopted: July 12, 2018

HOLLAND CONSULTING PLANNERS

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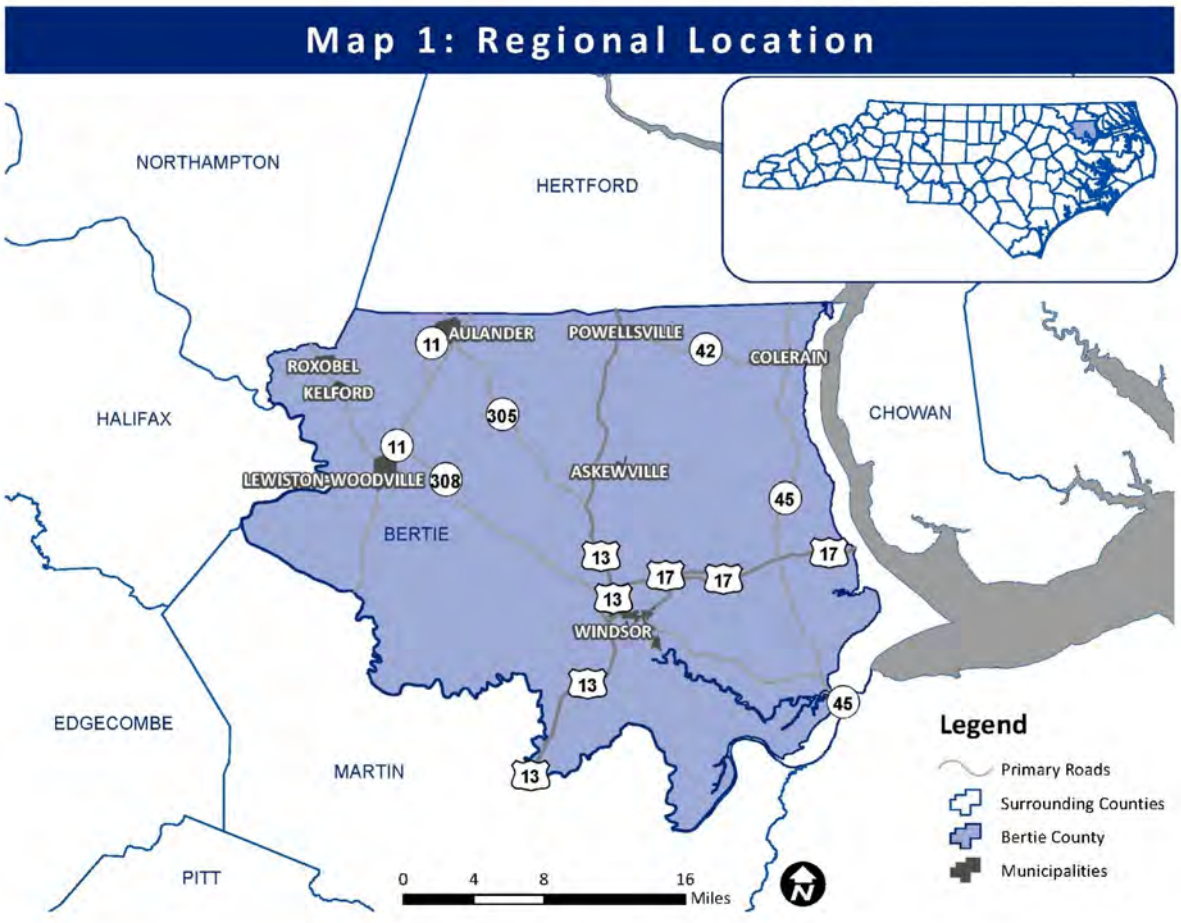
Section 1: Introduction

Purpose

The Windsor Comprehensive Bicycle and Pedestrian Plan addresses the needs of those individuals seeking to travel utilizing non-motorized transportation (bicycle and pedestrian facilities). This plan includes recommendations for the long-term development of a cohesive and comprehensive sidewalk network, intersection improvements, and other bicycle- and pedestrian-friendly improvements, which may foster the increasing number and use of bicycle and pedestrian facilities for the Town. The plan supports an educational and promotional initiative that will solidify Windsor as a bicycle- and pedestrian-friendly community. Emphasis is also placed on the link between active transportation activities, such as biking and walking, and related health outcomes.

The Town of Windsor is located in south-central Bertie County, North Carolina. Windsor is situated at approximately the midway point between Raleigh/Wake County, North Carolina, to the west and the North Carolina coast to the east. US Highways 17 and 13 are the major roads that regionally connect with the Town. Map 1 depicts the Town's regional location. Bertie County, with a high poverty rate (25.5%), is one of the most economically distressed counties in the state. It seems increasingly important that bicycle and pedestrian facilities be provided, particularly in lower income areas where vehicle ownership is low, which will promote a greater and safer number of bicycle and walking trips. Bicycle and pedestrian transportation is not superficial, but essential to many of the needs of Windsor's residents and meeting substantial challenges such as transportation, economic prosperity, health and longevity, quality of life, and community identity.



Planning Process

In April of 2015, Windsor was notified that it had been awarded a pedestrian planning grant from the NCDOT Bicycle and Planning Grant Initiative. The NCDOT Bicycle and Planning Grant Initiative encourages local governments to complete non-motorized transportation plans in an effort to increase facilities used by bicyclists and pedestrians. The initiative has assisted more than 150 communities across the state.

The planning process was initiated in July of 2016. A steering committee was established to guide the plan framework and ensure local concerns were included. Particular interest was placed on including individuals with a public health background. Several public meetings were held to solicit additional citizen input as it relates to increasing pedestrian infrastructure in the Town of Windsor. Once the plan was approved by the steering committee, NCDOT's Division of Bicycle and Pedestrian Transportation (DBPT) provided a thorough review to ensure all recommendations, policies, and programs were realistic and achievable.

A project specific website was to maintain all materials pertaining to Windsor's Comprehensive Bicycle and Pedestrian Plan. The website information was distributed via the Town website and the project steering committee. In addition, a community-wide survey focused on bicycle and pedestrian transportation options was established at the project's onset. The survey was designed to solicit feedback from citizens living and working in Windsor. Many concerns were identified, all of which have been summarized as a part of this process (refer to Section 3, Existing Conditions and Section 4, Recommendations). As mentioned previously, several public meetings were held to solicit further input and offer an opportunity for citizens to engage in the planning process.

Figure 1-1: Windsor Comprehensive Bicycle and Pedestrian Plan project website

During the first Steering Committee meeting, members were tasked with identifying the primary barriers to bicycle and pedestrian travel in Windsor – the most notable of which being safety and a lack of bicycle and pedestrian lanes and sidewalks.

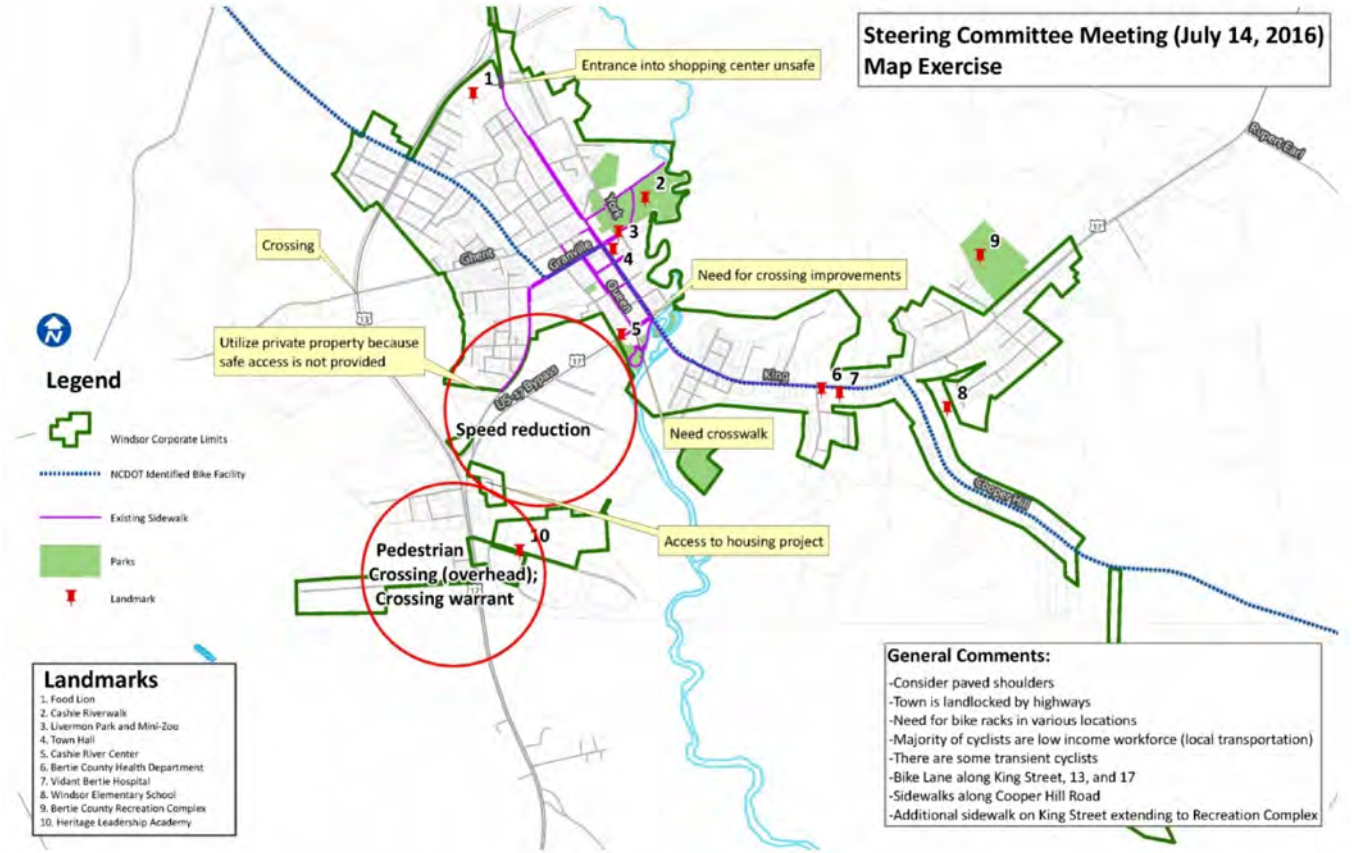


Figure 1-2: Steering Committee Meeting Map Exercise (July 14, 2016)

A Public Input Forum, held on August 23, 2016, allowed citizens of the community to further identify issues and areas of concern in a similar exercise as was administered during the first Steering Committee meeting. Many issues during this exercise coincided with issues identified during the committee meeting.

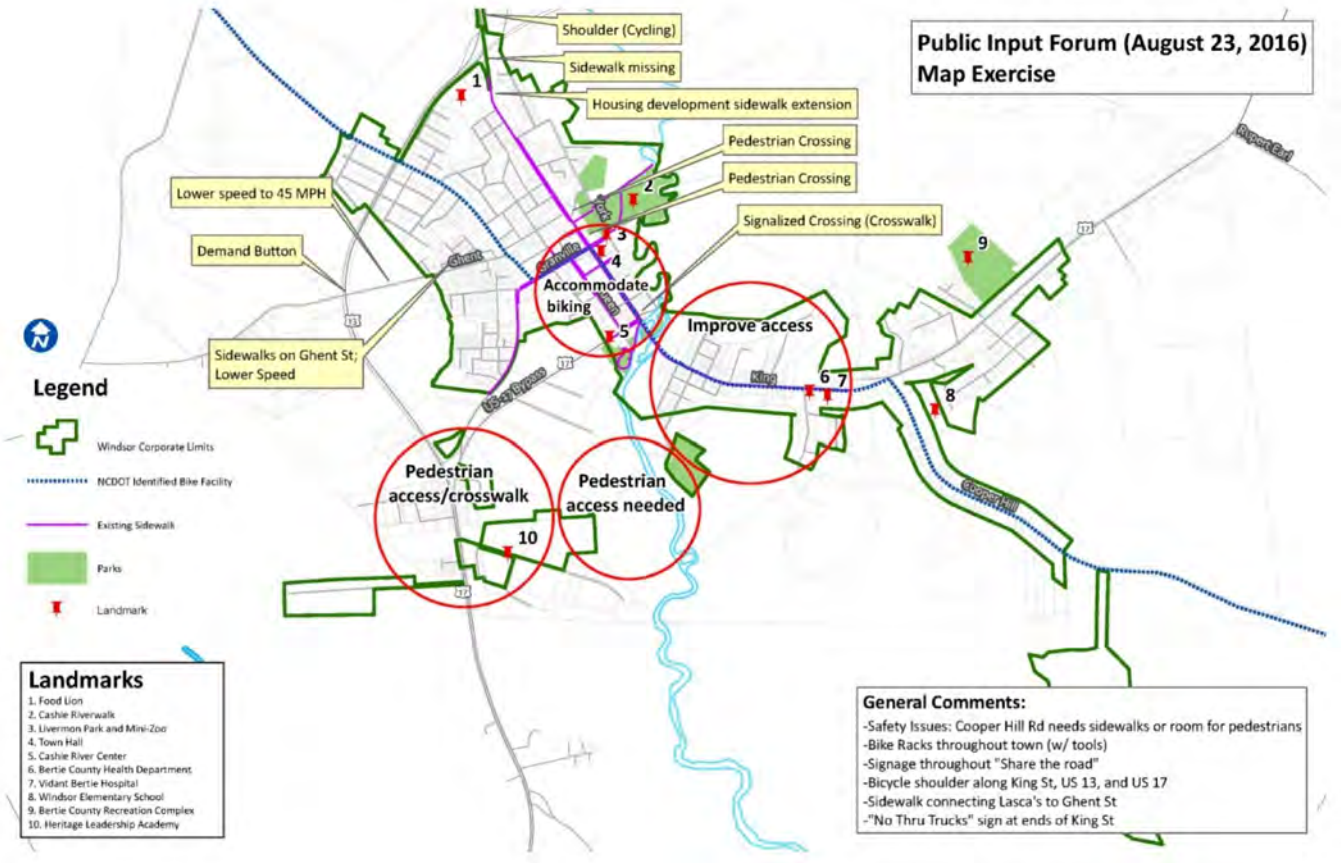


Figure 1-3: Public Input Forum Map Exercise (August 23, 2016)

The input provided from the steering committee and public input meeting were combined with data gathered from a community survey. These findings allowed for the prioritizing of intersections and areas of concern.

Vision and Goals

As part of the planning process, a vision statement and overarching goals were developed in concert with the Steering Committee.

Vision Statement

Windsor's vision is to develop a comprehensive and connected bicycle and pedestrian network that provides safe access to homes, schools, workplaces, park and recreational facilities, and other important destinations as part of an active community. We envision children biking or walking safely to school, seniors walking to nearby destinations, citizens moving safely in high traffic areas, and tourists moving about community and downtown areas easily on bike or foot.

Goals

- ❑ Improve bicycle and pedestrian safety and awareness throughout the Town.
- ❑ Increase the utilization of bicycle and pedestrian facilities as an alternative to motorized transportation.
- ❑ Increase the number of bicycle and pedestrian facilities: sidewalks, trails, crosswalks, pedestrian safety improvements at intersections, and other related amenities in the Town of Windsor.
- ❑ Improve the overall quality of life and public health of Windsor citizens.

Health Benefits of Walking

Historical Context of Planning & Public Health

In the 19th and early 20th centuries, architects and urban planners in cities across the United States helped defeat infectious diseases like cholera and tuberculosis by retrofitting buildings, streets, neighborhoods, clean water systems, and parks. In particular, buildings and streets were redesigned to increase air flow and provide daylight in an effort to combat bacteria. In the 21st century, planners and urban designers can again play a crucial role in combating the biggest public health epidemics of our time: obesity and related chronic diseases such as diabetes, heart disease, and some cancers. Today, an unhealthy diet and lack of physical activity are second only to tobacco use as the main cause of premature death in the United States.

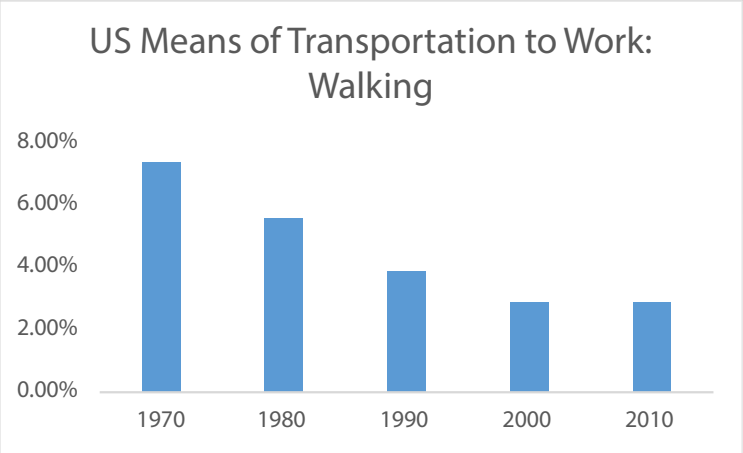
The Town of Windsor has worked diligently to improve recreational access to residents in an effort to improve public health. The recommendations outlined in this plan will further this effort and help promote the safe and efficient use of alternate modes of transportation.

Walking for Health

In the last hundred years, travel modes have shifted dramatically. Over the last forty years, little emphasis has been placed on the non-motorized forms of movement, often to the detriment of cyclists and pedestrians. In fact, it was not until 1998 that the Federal Highway Administration authored a guidance manual addressing the design of such facilities.[1]

Walking trips, particularly as a means of transportation to work, have experienced a dramatic decline in recent decades. From 1970 to 2010, the percentage of Americans walking to work declined by more than 60%. At the same time, the adult obesity rate increased by nearly 150% (see Figure4). An unintended consequence of our preference for automobile use is the ability to accomplish daily tasks without expending significant energy walking. Meeting the recommended daily exercise guidelines can be easily accomplished by such trips as running errands, walking to work, or walking for leisure. Yet, research shows that less than 10% of adults meet the recommended thirty minutes of exercise per day.[2]

[1] **FHWA.** *Improving Conditions for Bicyclists and Pedestrians.* Washington, DC: s.n., 1998.
[2] *Physical Activity in United States Measured by Accelerometer.* **Troiano, R, Berrigan, D and Dodd, K.** 2008, Medicine and Science in Sports Exercise, pp. 181-188.



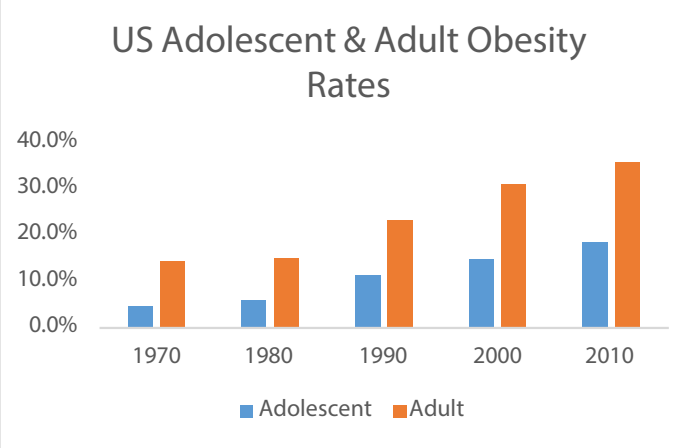


Figure 1-4: Population Walking to Work (Source: National Household Travel Survey) and US Adolescent & Adult Obesity Rates (Source: CDC).

The design of the built environment, influenced by our land use and transportation infrastructure, has much to do with the lack of exercise experienced in our daily travels. Over the past ten years, community officials have seen an increasing need to address health disparities through changes to the built environment. The emphasis on public health incorporated into this plan is a result of this evolving thought process. Figure 5 details the impact of active transportation use on health.

Figure 1-5: Potential Health Impacts of Pedestrian and Bicycle Infrastructure (Source: WalkBikeNC).

Changing Priorities

Efficient flow and speed of the private vehicle, the primary determinant of vehicular level of service, is often the only component considered in designing a particular roadway.[3] As a result, non-motorized travelers face difficulties due to a lack of facilities that provide for their safe and efficient movement. Yet, things are changing at the state level. NCDOT now fully supports the "Complete Streets" initiative, and health has been added to its mission statement. The "Complete Streets" initiative views streets as a "vital part of livable, attractive communities."

[3] **Institute of Transportation Engineers.** *Context Sensitive Solutions in Designing Major Urban Thoroughfares.* Washington, DC: s.n., 2006.

NCDOT Old Mission Statement:

- Connecting people and places safely and efficiently, with accountability and environmental sensitivity for North Carolina residents.

NCDOT New Mission Statement:

- Connecting people and places safely and efficiently, with accountability and environmental sensitivity to **enhance the economy, health, and well-being** of North Carolina.

Investments in transportation can either discourage or encourage use by non-motorized travelers. Research suggests that providing pedestrian infrastructure will, in fact, increase use and promote physical activity.[4] In the end, Windsor supports the need to enhance facilities for pedestrian use, to make walking an easier choice, and to combat the incidence of chronic disease and obesity.

Economic Benefits of Walking

There are many economic benefits of a walkable community. Preferences for walkable real estate, lower vehicle and fuel costs, and increased competitiveness for walkable commercial establishments are among the few. In recent years, Americans have begun to desire walkability as a factor when selecting a residence. Windsor, for example, has a downtown district with wide walkable sidewalks, local venues such as the Windsor Farmers' Market held at the Cashie River Center, the Livermon Park and Mini Zoo, and most recently, the Town has constructed and introduced to the community - tree house cabins overlooking the Cashie River.

According to a study conducted by the National Association of Realtors, the presence of sidewalks and places to take walks are among the top community characteristics people consider important when deciding where to live.

In addition, bicycle- and pedestrian-friendly conditions improve the commercial and cultural vibrancy of communities according to the Policy on Geometric Cultural Vibrancy of Communities. According to the policy on Geometric Design of Highways and Streets, a primary roadway design guide used by transportation engineers, accommodations for non-motorized travel are vital to lively commercial districts:

> "Pedestrians are a part of every roadway environment, and attention must be paid to their presence in rural as well as urban areas…Because of the demands of vehicular traffic in congested urban areas, it is often extremely difficult to make adequate provisions for pedestrians. Yet this must be done, because pedestrians are the lifeblood of our urban areas, especially in the downtown and other retail areas. In general, the most successful shopping sections are those that provide the most comfort and pleasure for pedestrians."

Some commercial districts also find that walkability increases business activity. Studies have shown that non-motorized travelers spend far more money per acre of commercial land than motorists.

[4] *Associations of Perceived Social and Physical Environmental Supports with Physical Activity and Walking Behavior.* **Addy, C, Wilson, D and Kirkland, K.** 2004, American Journal of Public Health, pp. 440-443.

Among low-income residents, the cost of fuel and upkeep for a vehicle may create a financial burden that many will deem unnecessary. According to the Pedestrian and Bicycle Information Center (PBIC), of Chapel Hill, NC, the cost of operating a car for one year is slightly over $5,000, while walking is virtually free. In Windsor, over 18% of people in the occupied housing units in the Town have no vehicle available for private use compared to 9.6% for the county (2014 American Community Survey 5-year Estimates). The difficulty that the built environment has created for these residents is increasingly burdensome. Additional pedestrian-oriented facilities will aid those who need safe passage through the Town.

Through implementation of this plan, Windsor not only hopes to promote non-motorized transportation among citizens, but also visitors. The Town hopes that the overall recommendations in this plan will promote tourism by connecting many of the historical, cultural, and recreational assets the Town has to offer.

Environmental Benefits of Walking

Making a positive impact on the environment can be as easy as walking or biking one or two times a week rather than driving a car. The reduction of gasoline use in turn reduces the volume of pollutants in the air. Additional environmental impacts can be a reduction in the overall noise level in neighborhoods and better water quality due to a lessening of runoff from vehicles.

While sidewalks and street bike lanes are an integral part of the bicycle/pedestrian network, trails and greenways are also a contributor to the network. Greenways are beneficial in that they provide opportunities for protecting plant and animal species. In addition to this, greenways provide a natural buffer that helps protect streams, rivers and lakes, prevent soil erosion and filtering pollution caused by agricultural and road runoff.

Section 2: Community Profile

Introduction

The Community Profile section contains information related to demographic and Census-based statistics. Maps depicting various demographic data are a representation of the community and should not be viewed as an exact replica of existing conditions. The maps are displayed by modeling Census data within the corporate limits. The following maps and data are intended to educate key stakeholders, as well as the Steering Committee, about existing conditions throughout the Town of Windsor. This information will assist in the development of plan recommendations and proposed improvements.

Population

Windsor's population is scattered throughout the corporate limits, with the most densely populated areas located in close proximity to the downtown district (see Map 2). According to the 2010 Census, Windsor's total population was 3,630 persons (see Table 1).

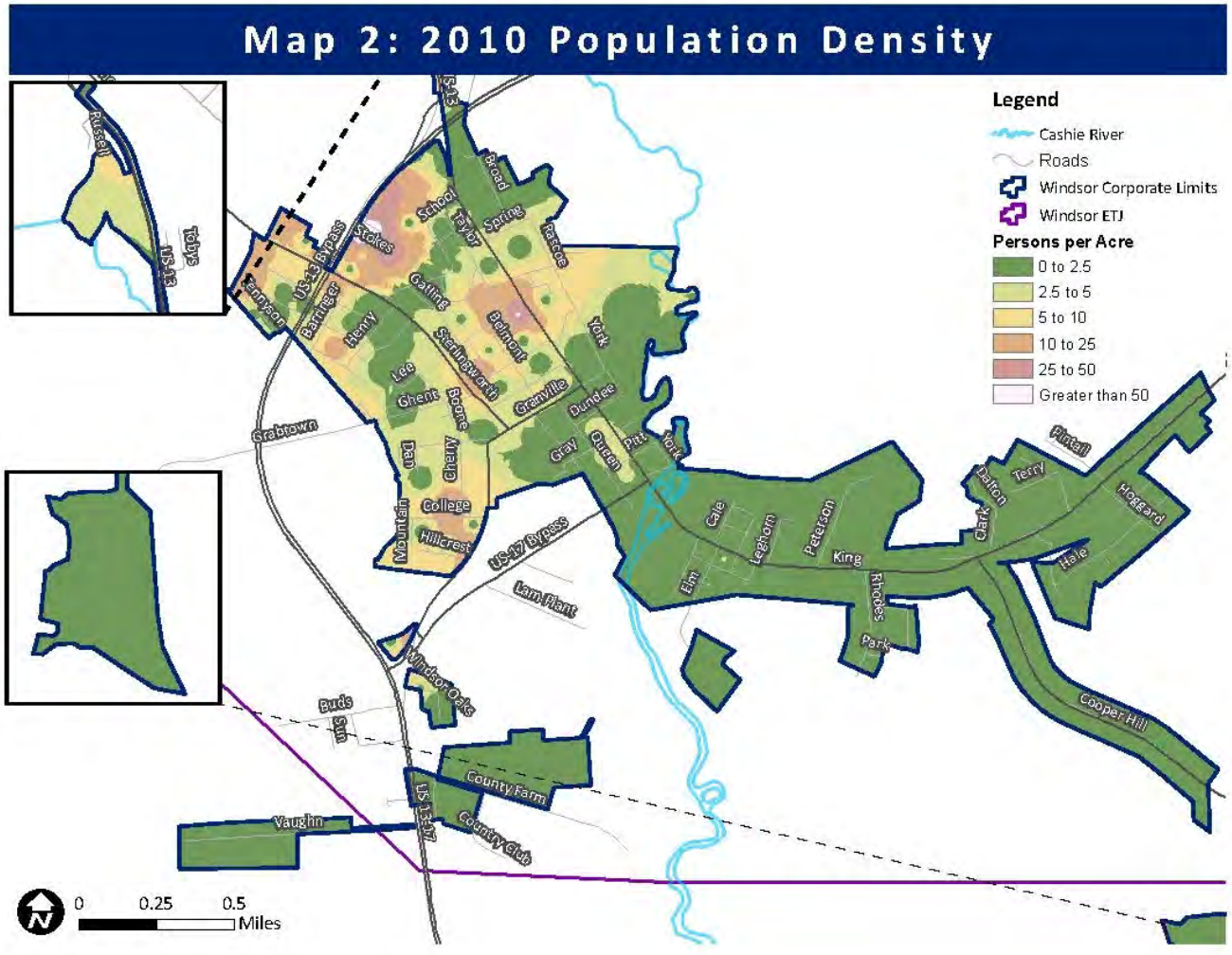
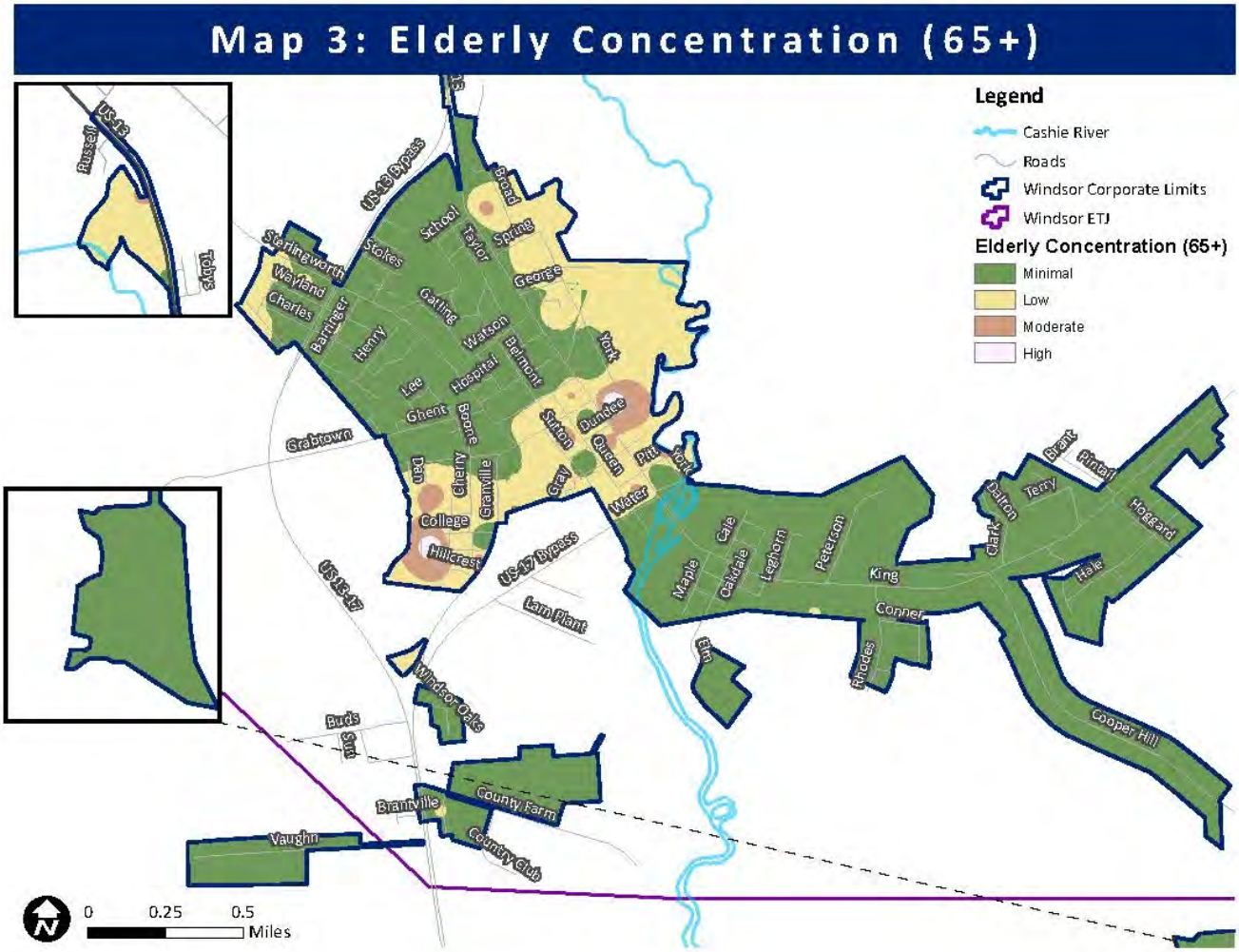


Table 1. Population Growth, 1990-2010				
	Windsor		North Carolina	
Population 1990-2010	**Number**	**% Change**	**Number**	**% Change**
1990 Population	2,209	--	6,626,118	--
2000 Population	2,283	3.3%	8,049,319	21.5%
2010 Population	3,630*	59.0%	9,535,483	18.5%
**It should be noted that a majority of the population increase between 2000 and 2010 results from the inclusion of the Bertie County Correctional Institution's inmate population into the municipal population.*				
Source: 1990, 2000, 2010 US Census and 2010-2014 American Community Survey.				

Population by Age

In terms of age, Windsor residents are younger (36.7 years) than the 2010 statewide median age figure of 37.3 years. Concentrations of elderly individuals (65+) within Windsor are located in two primarily residential areas near the downtown district (see Map 3). Some elderly individuals may experience difficulties with driving private vehicles and must rely on friends/family, transit, or walking to their destinations. Additionally, older individuals may experience mobility limitations and, therefore, need curb ramps, high visibility crosswalks, or other extra safety measures tailored to their needs.



Educational Attainment

The overall educational attainment of a given community can be a significant indicator in health concerns, economic mobility, and socioeconomic status. Table 2 provides a summary of educational attainment for the Town of Windsor from 2000 to 2010. In 2010, 76.0% of the town's population 25 years old or older had a high school diploma or higher. In addition, 42.5% had some college or a complete college education. Relative to many other rural communities, Windsor has a fairly well educated population.

Table 2. Educational Attainment, 2000 and 2010

	2000 Census	% of Total	2010 Census	% of Total
Less than 9th grade	205	13.4%	224	9.4%
9th to 12th grade, no diploma	309	20.3%	347	14.6%
High school graduate (includes equivalency)	426	27.9%	797	33.5%
Some college, no degree	220	14.4%	495	20.8%
Associate's degree	76	5.1%	119	5.0%
Bachelor's degree	201	13.1%	285	12.0%
Graduate or professional degree	89	5.8%	112	4.7%
Population 25 years and over	1,526	100.0%	2,379	100.0%

Source: US Census.

Income

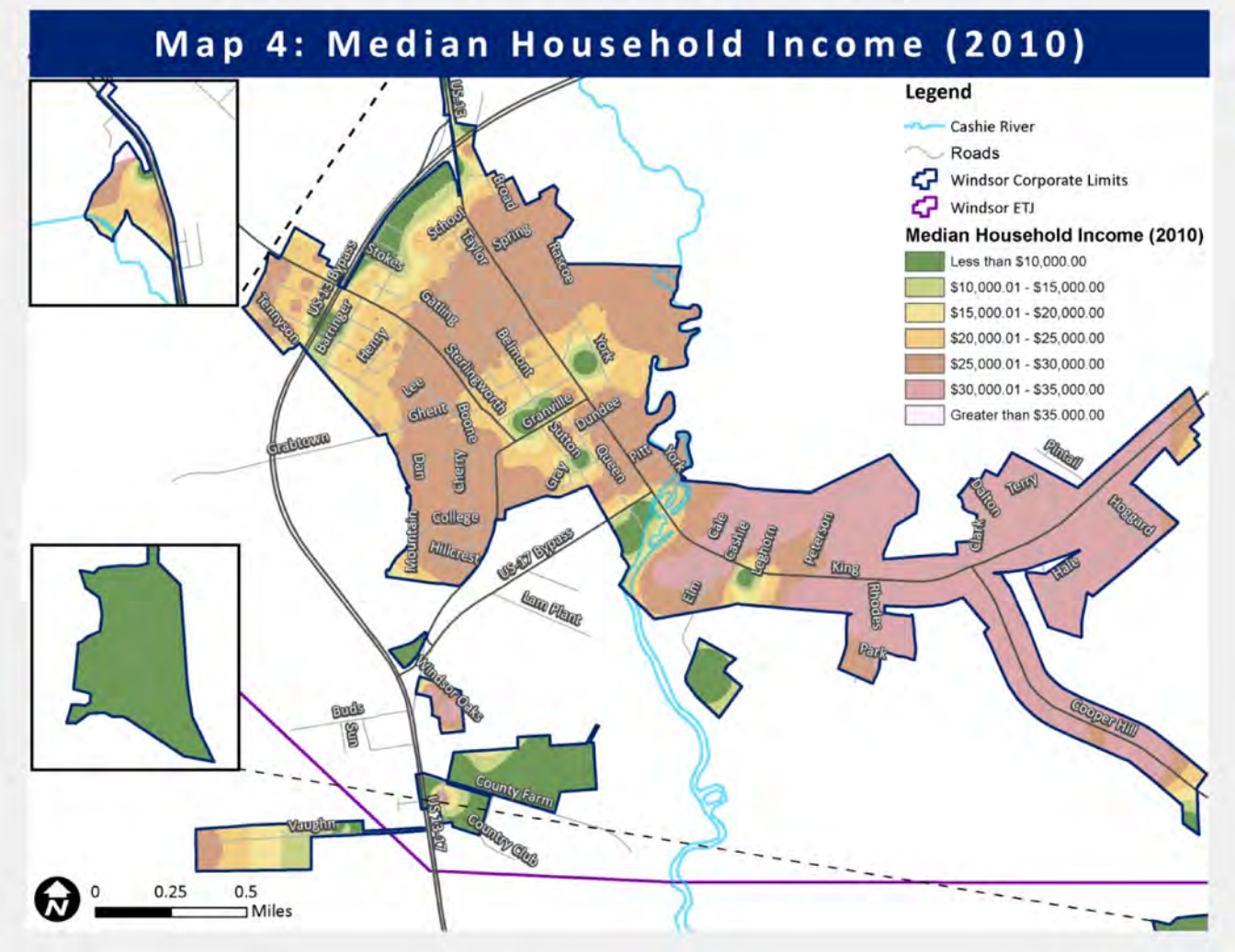
Income plays a significant role in the health outcomes of individuals. Countless studies have noted the correlation between low income and exposure to risk factors that can harm health. The median household income in Windsor is significantly lower than figures for the state. In North Carolina, the 2010 median income figure was $45,570 compared to $32,596 for Windsor.

Many households in Windsor live below the median income range for the state. In fact, for 2014, the percentage of persons below the poverty level for North Carolina was 15.5%, compared to Windsor's 22.9% (see Table 3 and Map 4).

Table 3. Median Household Income, 2000 and 2010

	Median Household Income		Persons Below Poverty Level	
Jurisdiction	**2000**	**2010**	**2000**	**2010**
Windsor	$25,256	$32,596	25.8%	22.9%
Bertie County	$25,177	$29,110	23.5%	23.3%
Chowan County	$30,928	$36,761	17.6%	17.4%
Halifax County	$26,459	$30,349	23.9%	23.8%
Hertford County	$26,422	$30,878	18.3%	24.1%
Martin County	$28,793	$34,766	20.2%	23.4%
Northampton County	$26,652	$30,578	21.3%	21.7%
Washington County	$28,865	$32,716	21.8%	24.8%
North Carolina	$39,184	$45,570	12.3%	15.5%

Source: US Census.

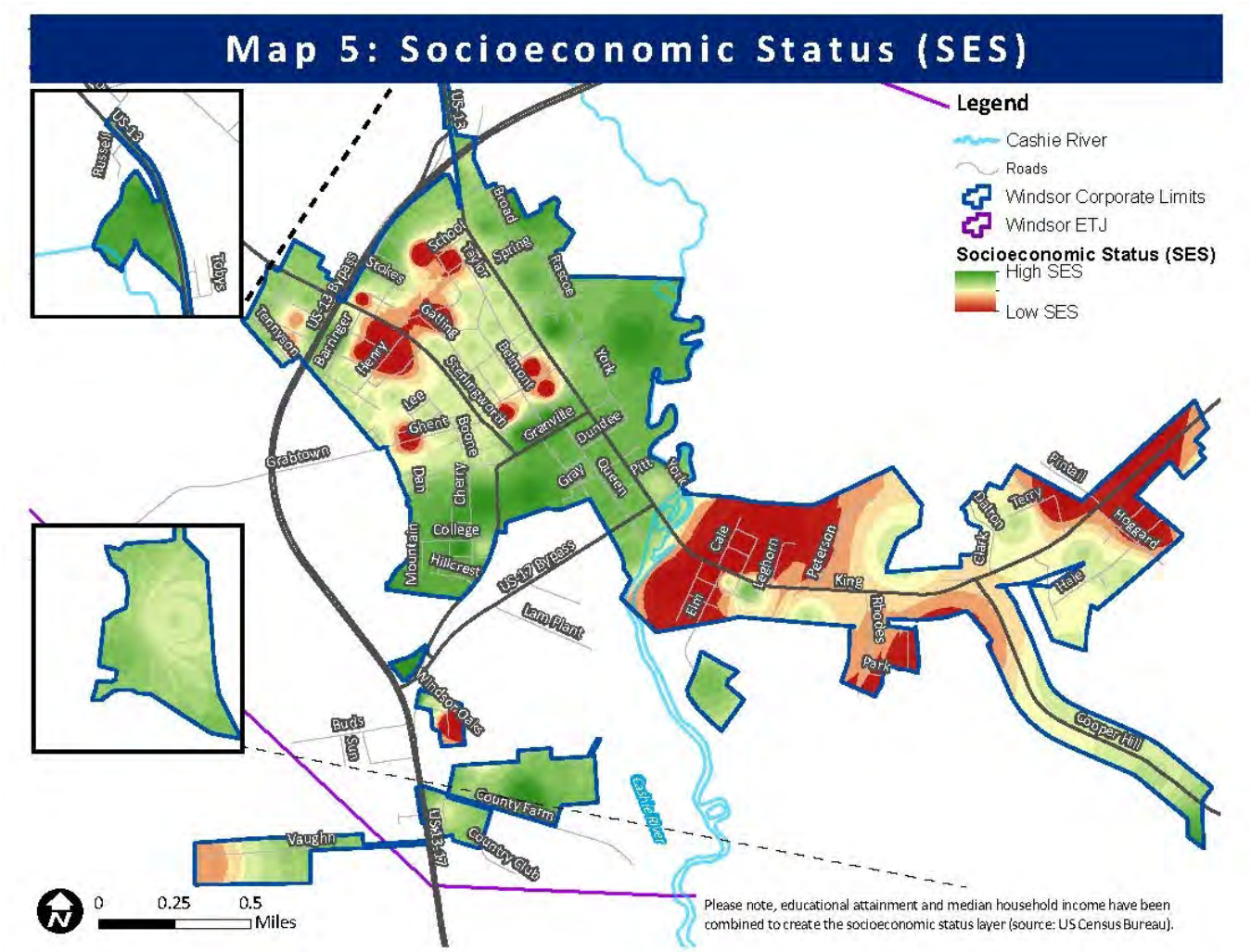


Socioeconomic Status

Many studies have attempted to provide a correlation between socioeconomic status and chronic disease. Obesity, whose leading contributors are poor nutrition and lack of physical activity, is the second leading cause of death in the United States and increases the risk factor for a number of chronic diseases.[5] In general, obesity tends to be a multi-faceted problem with no "one solution" to combating its occurrence. However, there are certain segments of the population that are more likely to be obese or face higher rates of chronic disease, as each are more prevalent in the low socioeconomic status (SES) segments of society. Investigations have shown similar results in urban, suburban, and rural communities. In addition, a childhood spent in poor social and economic conditions has been shown to lead to a less healthy adulthood. In both adolescent boys and girls, low SES and parental education levels were related to an unfavorable risk factor profile, indicating a need for early intervention in low SES communities.

[5] *Actual causes of death in the United States, 2000*. **Mokdad AH, Marks JS, Stroup DF, Gerberding JL**, 2004, Journal of the American Medical Association, pp. 1238 - 1245.

To identify areas of Windsor that are considered low in socioeconomic status, GIS analysis was used (see Map 5). Census estimates for educational attainment and median household income levels were combined to locate these areas. Concentrations of low SES are mainly found east of the Cashie River. West of the river, there are some concentrations closer to the downtown district and a few locations near US Highway 17.



Mobility

Mobility is defined as the movement of people from place to place. For the purposes of this plan, demographics related to transportation modes to work and household vehicle availability are provided.

Means of Transportation to Work

According to the 2006-2010 American Community Survey (ACS), approximately 3.1% of Windsor residents walk to work (see Table 4). This figure is consistent with the statewide averages, but low for similar communities across the state. Approximately 71.8% of residents drove alone to their place of employment. Based on these figures, it appears that workers travel to employment centers outside of town or are reluctant to travel by foot or bicycle due to a lack of facilities.

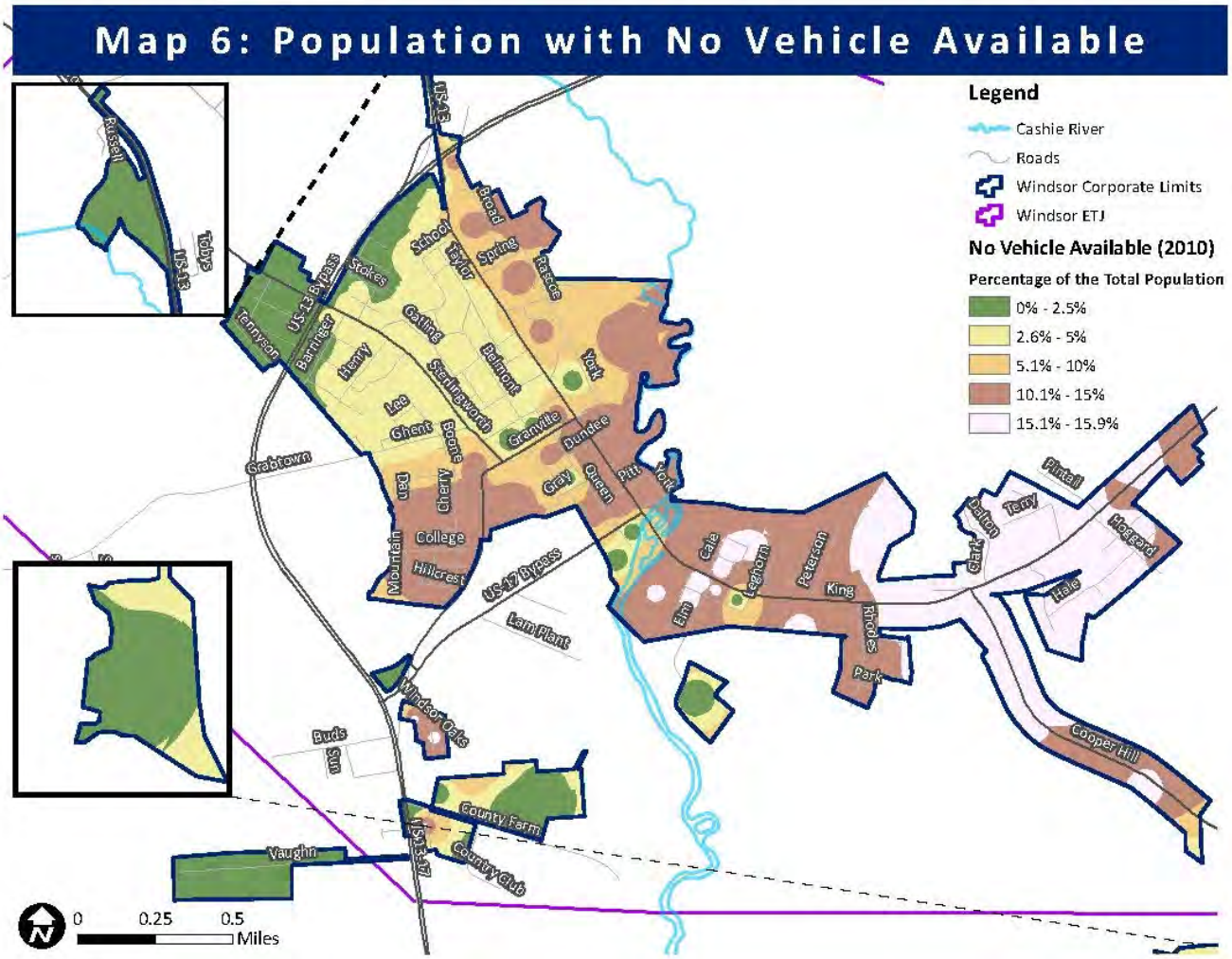
Table 4. Means of Transportation to Work, 2010		
	Number	% of Total
Drove alone	1,004	71.8%
Carpooled	336	24.0%
Public transportation (excluding taxicab)	0	0.0%
Taxicab, motorcycle or other means	0	0.0%
Bicycle	0	0.0%
Walked	44	3.1%
Worked at home	15	1.1%
Total	1,399	100.0%
Source: 2010-2014 American Community Survey.		

Household Vehicle Availability

Another measure of mobility is the availability of private vehicles for use. The Census Bureau also surveys occupied households to determine those that have vehicles available for use. In Windsor, 15.4% of occupied households do not have access to a private vehicle. That figure is over two times the statewide average of 6.5% (see Table 5). These residents must rely on friends, family, para-transit, or a non-motorized means (bicycling/walking) for transportation to work, medical facilities, or food outlets.

Neighborhoods along Cooper Hill Road and various areas east of the Cashie River along South King Street (see Map 6) have a high percentage of households without access to a vehicle. This finding is also consistent with the lower income areas of Windsor's corporate limits (shown on Map 4). Ultimately, residents of these areas must rely on some other means of transportation. Appropriate bicycle and pedestrian facilities can help fill this need.

Table 5. Vehicle Availability and Travel Time to Work, 2010						
	Windsor		**Bertie County**		**North Carolina**	
	Number	**%**	**Number**	**%**	**Number**	**%**
Occupied housing units	1,332	100.0%	8,160	100.0%	3,626,179	100.0%
No vehicles available	205	15.4%	828	10.1%	234,435	6.5%
1 or more vehicles	1,127	84.6%	7,332	89.8%	3,391,744	93.5%
Mean travel time to work	20.5 minutes		25.7 minutes		23.4 minutes	
Source: 2010 US Census and 2010-2014 American Community Survey.						



Public Transportation

Bertie County provides public transportation through the Choanoke Public Transportation Authority. The services offered are: (1) local services, provided Monday thru Friday for trips to local agencies, media appointments, community colleges, group, individual shopping trips, and older American nutrition sites; (2) out-of-area trips to Rocky Mount, provided three days each week on Monday, Wednesday, and Friday for medical appointments; and (3) in-area field trips, available on weekends and during non-peak hours on weekdays. It should be noted that paratransit services are provided on an as-needed basis and pickups are made at the resident's home.

Health Concerns

Because public health and the design of the built environment are intrinsically linked, particularly as it relates to the ability to navigate a community safely by foot, it is important to include some of the health issues experienced by the Windsor populace. Health statistics and data are most commonly collected at the county level. Bertie County, in which Windsor is located, has consistently ranked lower for health outcomes compared to other North Carolina counties.

In fact, Bertie County ranks 92nd overall for health outcomes and health factors in North Carolina. According to the Bertie County Community Health Assessment, this poor ranking is chiefly due to a very high mortality rate ranking of 97th and a high morbidity ranking of 83rd. The "best" rankings for Bertie County are in the health factors of clinical care and physical environment which are 66th and 62nd respectively.

Lack of physical activity and poor nutritional habits are major factors in health risks and poor health outcomes, including overweight, heart disease, stroke, high blood pressure, diabetes, and many other conditions. The North Carolina Child Health Report Card for 2011 reported only 31.2% of students ages 10-17 years, were physically active a total of 60 minutes or more per day on five days or more per week.

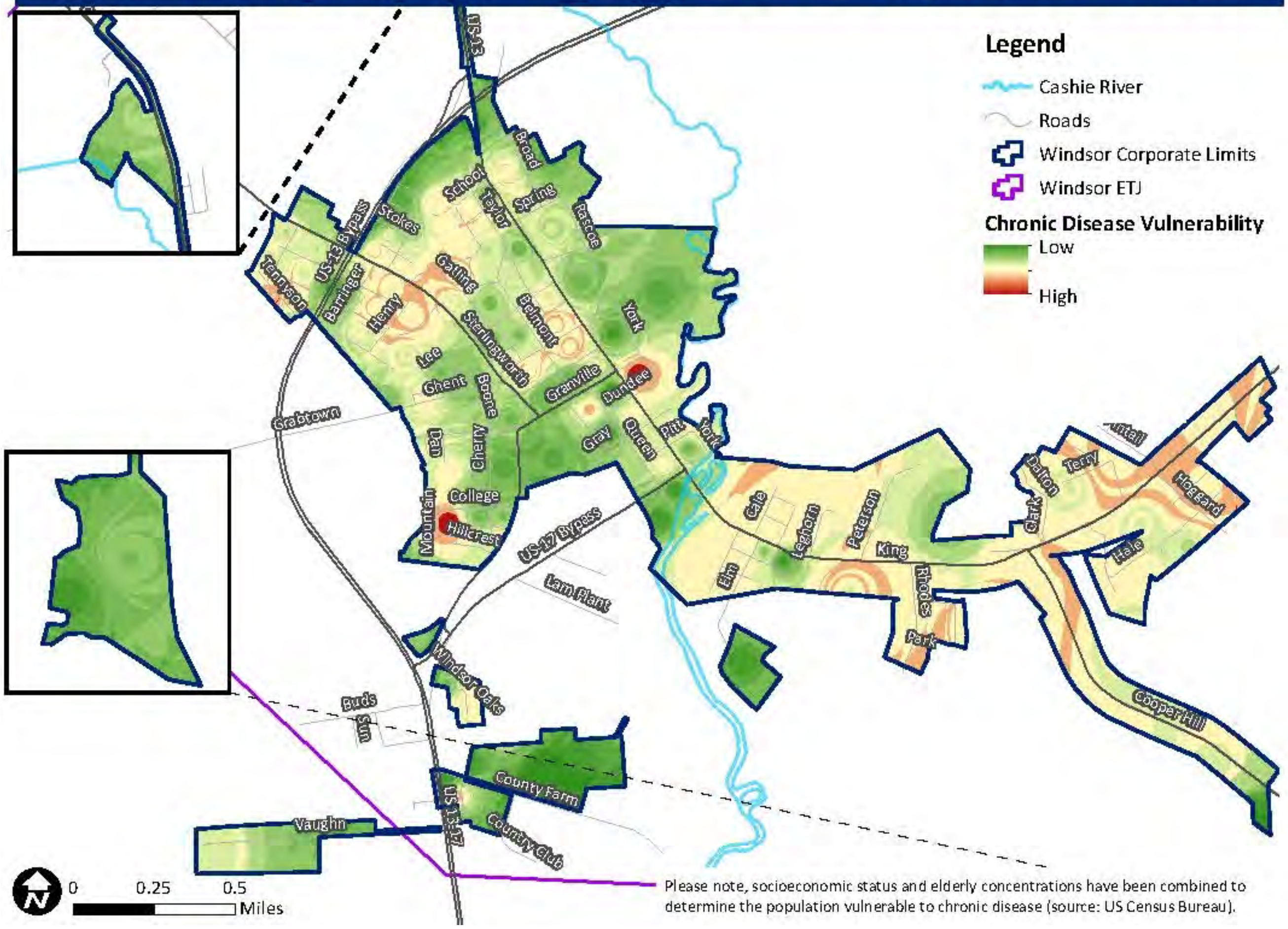
Targeting priority areas of obesity, tobacco prevention, encouraging physical activity and good nutrition, and making our parks and roadways safer can help make a positive impact on Bertie County.

Population Vulnerable to Chronic Disease

Whereas infectious diseases were the gravest health threats of an earlier era, the largest killers of our time have become chronic diseases such as heart disease and strokes, cancers, and diabetes, for which the leading risk factors are obesity, physical inactivity, poor diets, and smoking. According to the CDC, approximately 80% of adults in the United States over the age of 65 have at least one chronic condition, and 50% have at least two. As mentioned previously, low socioeconomic status households are also at a greater risk for chronic disease conditions. Combining the two demographics illustrates locations within Windsor that may have higher risks of chronic disease.

In order to prioritize investment in pedestrian infrastructure in an effort to combat chronic disease, it is important to spatially locate those areas that may be most vulnerable to chronic ailments. To do so, GIS analysis was used to combine socioeconomic status and concentrations of the elderly population (see Map 7). Map 7 shows the areas that are subject to multiple risk factors for chronic disease, as well as being most in need of safe, healthy transportation options. Incorporating walking and bicycling into everyday life helps with multiple disease risk factors, as well as allowing better access to daily needs, employment, care providers and social interaction for those most at risk. Many of the priority projects identified and described in Section 4 will serve the areas most at risk according to the map analysis, and help connect them with health transportation options, as well as safe routes to retail and service locations and other daily needs.

Map 7: Population Vulnerable to Chronic Disease



Please note, socioeconomic status and elderly concentrations have been combined to determine the population vulnerable to chronic disease (source: US Census Bureau).

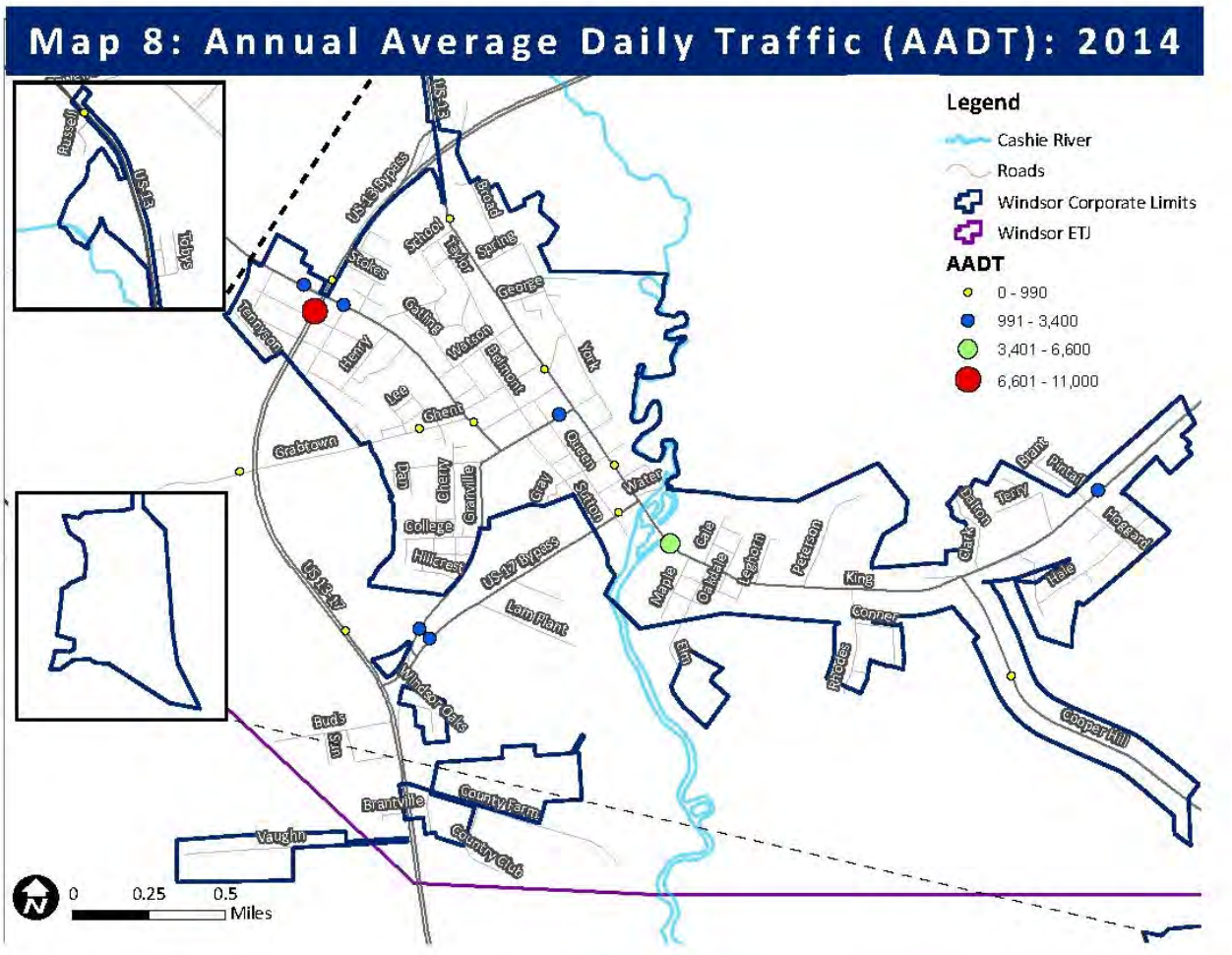
Section 3: Existing Conditions

Introduction

This section details existing conditions in Windsor's corporate limits. Specific details relating to the transportation network (motorized and non-motorized), pedestrian crashes, and existing plans/programs are included. Field work was conducted to analyze the bicycle and pedestrian network conditions, right-of-way constraints, crossing distances, perceived danger, and obstructions to bicycle and pedestrian travel. Please note that full-sized maps can be found in Appendix A.

Vehicular Roadway Network

Windsor is both wrapped by and bisected by US Highways 13 and 17. US 13 and 17 both serve as major north-south routes. The location of Windsor creates a strong presence of vehicular traffic that both surrounds and travels through the small town (see Map 8). Parts of US 13 occupy the same space as King Street, a primary route of transportation for Windsor residents. Closer to the downtown district, speed limits are substantially slower than that of the outlying limits of the town. Older streets in Windsor are mostly arranged in a modified grid, forming a highly connected network with short block lengths, particularly in the older core of town. These short block lengths and high intersectivity are helpful to pedestrian usage. The narrow, low-volume, low-speed local streets are compatible with a "shared street" situation, where people on bicycles, walking, and in cars can compatibly and safely share the same space. However, larger connecting streets such as Grabtown, King Street (NC 308) east of the Cashie, Cooper Hill Road, and Water Street/US 17 Bypass have much higher speeds and volumes, and are quire unsafe and uncomfortable for people on foot or riding bicycles. These streets also have a much lower degree of intersectivity, with long distances between intersections, where development takes the form of strip centers or short dead-end streets or driveways along the main road. This condition is much more difficult for pedestrians to navigate between origins and destinations. The outlying areas are still frequented by Windsor residents who patronize businesses that also tend to attract passersby. Though no pedestrian or bicycle facilities are made available to residents, the worn paths adjacent to the highway demonstrate a great need for such facilities.



Bicycle and Pedestrian Network

Windsor's pedestrian network consists of its sidewalks, intersection crossing locations (crosswalks, pedestrian signals), off-street multi-use paths and trails, and "shared space" in some low-volume, low-speed local streets. The availability of bicycle and pedestrian facilities is not unlike other small municipalities in North Carolina. Past priorities for the inclusion of sidewalks as a standard component of roadways did not exist. As a result, many town streets and roads were constructed without pedestrian facilities. An example of this lack of facilities is South King Street. The north side of the street has no sidewalks east or west of the bridge crossing the Cashie River and on the southern side, the sidewalk ends just east of the Vidant Bertie Hospital.

Another factor in the lack of a suitable network for bicycle and pedestrian access is that standards for new development are lacking requirements for suitable pathways to connect to the surrounding streets as well as provide for circulation within a multi-parcel development site. Development has occurred at the edges around Windsor mostly in two forms: shopping centers with multiple parcels, or single parcelization in a mostly linear strip pattern along roads leading out of town, with either short, dead-end streets or driveways accessing individual developed parcels, such as along Cooper Hill Road. These patterns are not conducive to active transportation, but they also serve vehicular transportation in a less than ideal way, putting tension between the conflicting priorities of parcel access and through-travel, and setting up multiple turning conflicts and potential for collisions due to stopping, turning, etc.

Figure 3-1: South King Street Sidewalk – Inset Looking West (Source: Google Maps).

The following section outlines Windsor's available bicycle and pedestrian facilities, destinations, crash data, and specific areas of concern.

Facilities

Windsor has slightly over seven (7) miles of sidewalks within the corporate limits. The majority of those facilities are located within downtown and its immediate vicinity (see Map 9). Sidewalks within the downtown area are located on both sides of the street, whereas sidewalks outside of the downtown area are typically provided on only one side of the street, diminishing completely the farther you travel from downtown.

No pedestrian signals are made available to pedestrians and bicyclists in Windsor. At various locations along King Street, there are crosswalks and bicycle/pedestrian facilities implemented to accommodate bicycle and pedestrian use.

At most intersections where sidewalks are available, curb ramps are present. These facilities allow for citizens with disabilities to navigate intersections safely.

There are multiple intersections of concern that contain longer pedestrian crossing distances, including the intersection of Granville and King Street, the intersection of Highway 17 (in close proximity to the Shell convenience store), and the intersection of Cooper Hill Road and South King Street. These intersections are ideal for pedestrian refuge islands which convert a single, long crossing into a 2-stage crossing so that

pedestrians can manage two shorter crossing stages that each deal with only one direction of traffic at a time, and enable the pedestrian or bicyclist to be exposed to danger for shorter periods of time. Existing crosswalks, pedestrian and bicycle facilities are depicted on Maps 11 and 12.

Sidewalk Conditions

Figures 3-2 and 3-3 illustrated that the downtown area provides plenty of space for pedestrians to patronize the establishments within the downtown corridor and nearby blocks.

Figure 3-2: Sidewalks in Downtown Windsor (King Street)

Figure 3-3: Sidewalks in Downtown Windsor (Granville Street)

Slightly farther from downtown, there is a diminishing amount of sidewalk area and related facilities (see Figures 3-4 and 3-5).

Figure 3-4: Deficient Sidewalk Infrastructure (N. York Street)

Figure 3-5: Deficient Sidewalk Infrastructure (S. King Street)

Figures 3-6 and 3-7 illustrate a lack of facilities and demand for facilities to be constructed. Figure 3-6 shows North King Street and the need for pedestrian and bicycle access into the shopping center while Figure 3-7 shows a worn dirt path adjacent to US Highway 17.

Figure 3-6: Pedestrian access needed along N. King Street near shopping center

Figure 3-7: Worn dirt path adjacent to US Highway 17

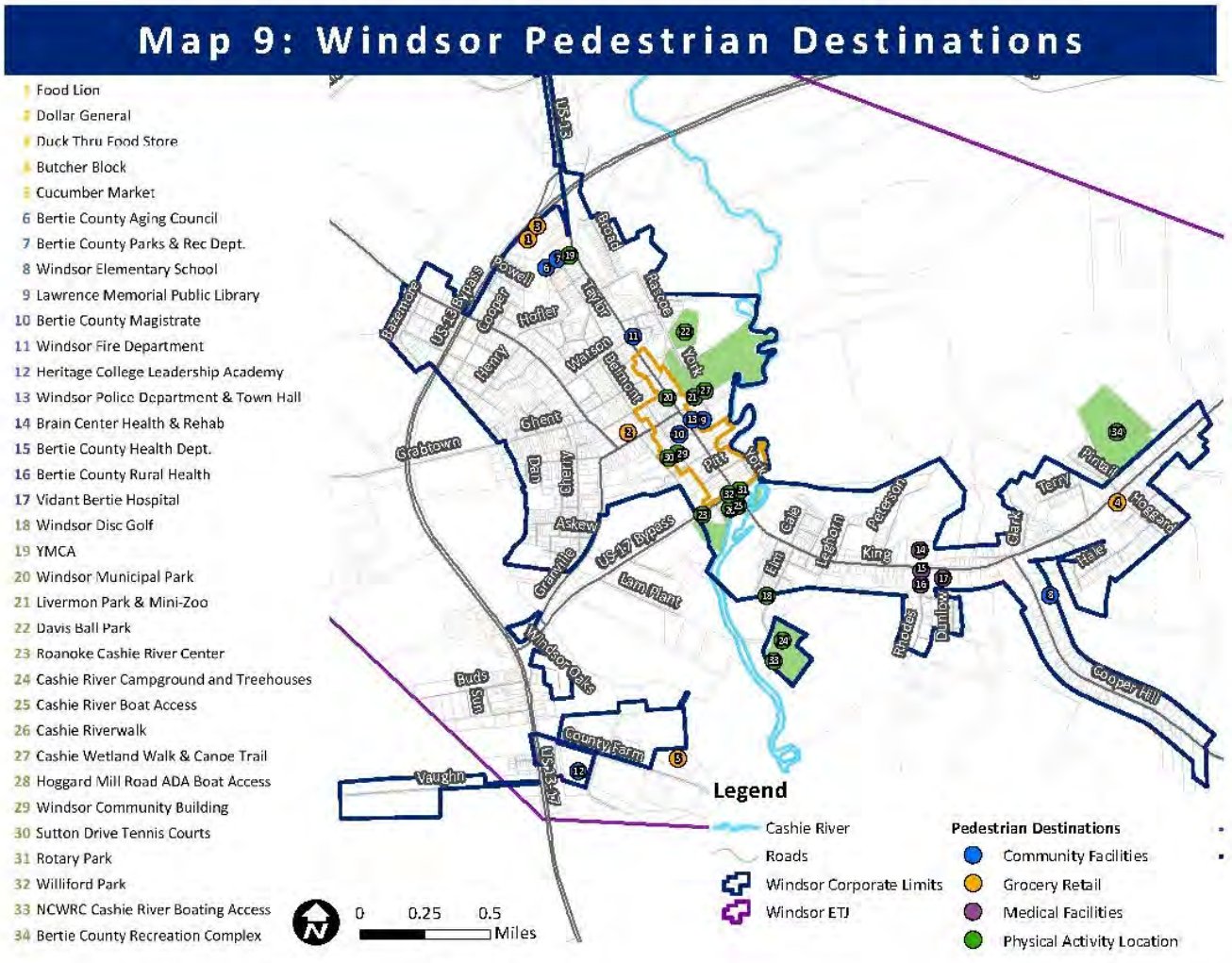
Figure 3-8 shows a lack of sidewalk on the north side of South King Street which could prove useful to the increased utilization of the Bertie County Recreation Complex. In addition to improved bicycle and pedestrian facilities leading to the recreation complex, it would be helpful to create a network of shared paths throughout the facility to promote walking and bicycle use.

Figure 3-8: South King Street near entrance to Bertie County Recreation Complex

Pedestrian Destinations

Pedestrian destinations or generators are locations where there is a demand for individuals to walk to a particular establishment. Each location is categorized as one of the following (see Map 9):

- Community Facilities – governmental/non-profit facilities such as the library, schools, and post office
- Grocery Retail – retail locations that provide food
- Medical Facilities – hospitals and clinics
- Physical Activity Location – parks and recreational areas



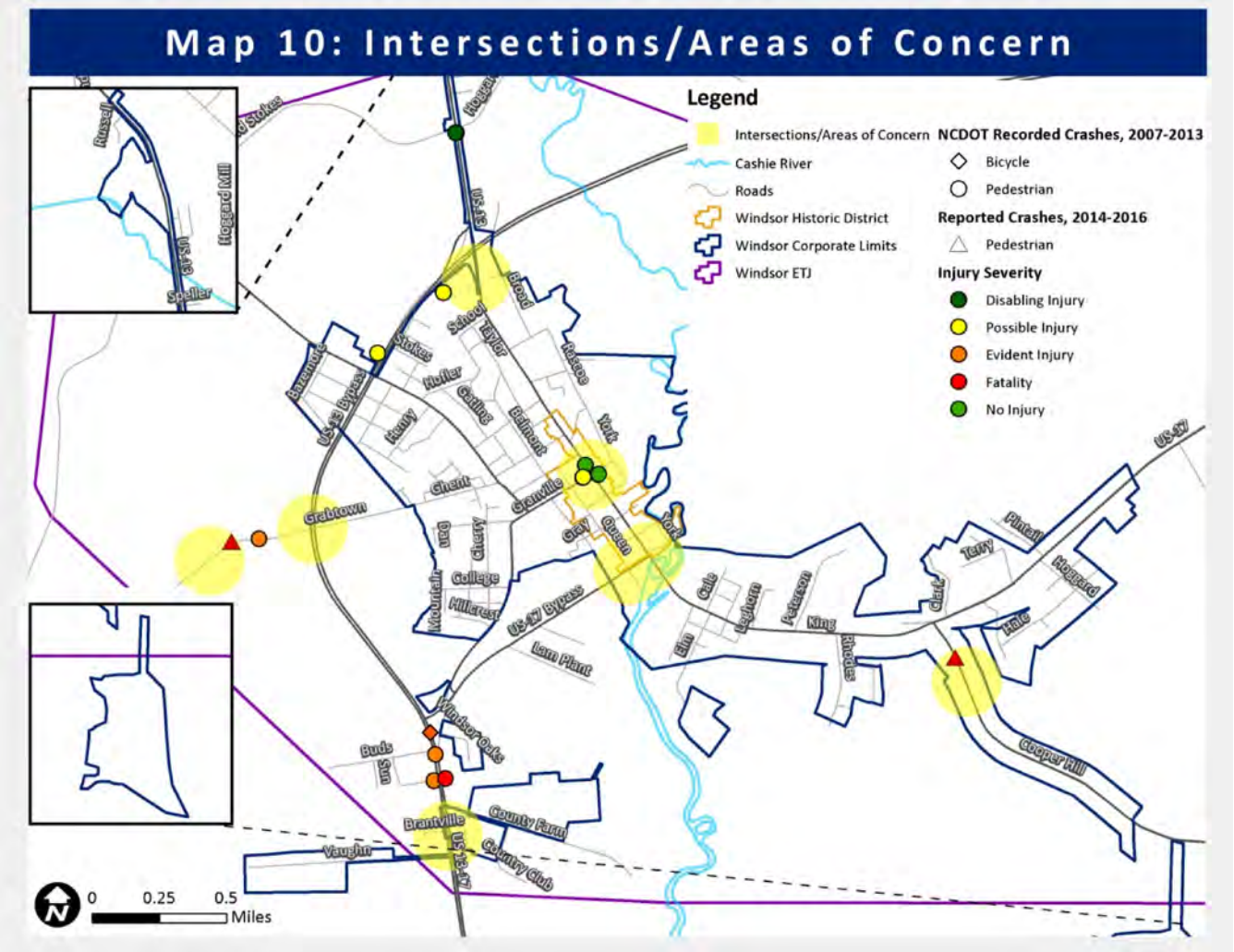
Community facilities attract pedestrians for various reasons. Schools, in particular, are a primary destination for the youth demographic. Studies have shown a reluctance of present-day parents to allow their children to walk to school—the primary reason being safety. According to the National Center for Safe Routes to Schools, approximately 48% of children walked or cycled to school in 1969. "Fast-forward" forty years and that statistic has seen a dramatic decline, with only 13% of children aged 5 to 14 years walking or cycling to school. Not unlike many other municipalities throughout North Carolina, the schools within the corporate limits lack adequate pedestrian facilities to allow for safe travel by foot.

Parks and recreation locations are scattered throughout Windsor's corporate limits. These vary in use depending on proximity to water or other natural resources.

Commercial facilities serve to attract pedestrians throughout the year. The Food Lion, located near US 17 at the northern area of the corporate limits, serves the town as the only full-service grocery store. This area attracts a high level of vehicular traffic (see Map 8) and access to the site can be problematic for pedestrians. Improved access has been specifically addressed as a recommendation resulting from this planning process.

Bicycle and Pedestrian Crashes

Bicycle and pedestrian crash data is collected by the NC Department of Transportation and UNC's Highway Research Center. From 2007-2016, there were twelve (12) total motor vehicle crashes involving pedestrians and one (1) motor vehicle crash related to biking.



Intersections and Areas of Concern

Eight (8) intersections have been selected for further study as part of the comprehensive bicycle and pedestrian plan. These intersections have been chosen based on feedback from the Steering Committee, gaps in the sidewalk network, the community survey, and the NCDOT and UNC Highway Research Center pedestrian crash data. Recommendations for improvement are included in Section 4 of this plan.

Many of the intersections chosen have high vehicular traffic volumes and lack dedicated bicycle and pedestrian facilities. In addition, many are located in close proximity to pedestrian destinations. Each intersection studied is listed below and shown on Map 10.

- King Street and Granville Street
- Grabtown Road and US Highway 13
- King Street entering Food Lion Shopping Center
- Queen Street and Water Street
- King Street and Water Street
- Grabtown Road (West of US Highway 13)
- Cooper Hill Road
- US-15 (Southern portion near National Guard Armory)

Pedestrian Network Strengths & Weaknesses

Strengths

As mentioned previously, Windsor's downtown core is considered a pedestrian-friendly environment (see Figure 3-2 and 3-3). Sidewalks downtown are generally functional and widths vary between 5 feet and 11 feet in the Central Business District and along King Street throughout the downtown district. It should be noted, however, that these widths do not support the functional travel zones for a Central Business District. Additionally, all existing curb ramps are not constructed to ADA standards. In addition to the downtown area, there are traditional neighborhoods in close proximity to the Central Business District. These neighborhoods have small block sizes, adding to the walkability of the area. Many streets in these neighborhoods, however, have a sidewalk on only one side or are completely without sidewalks.

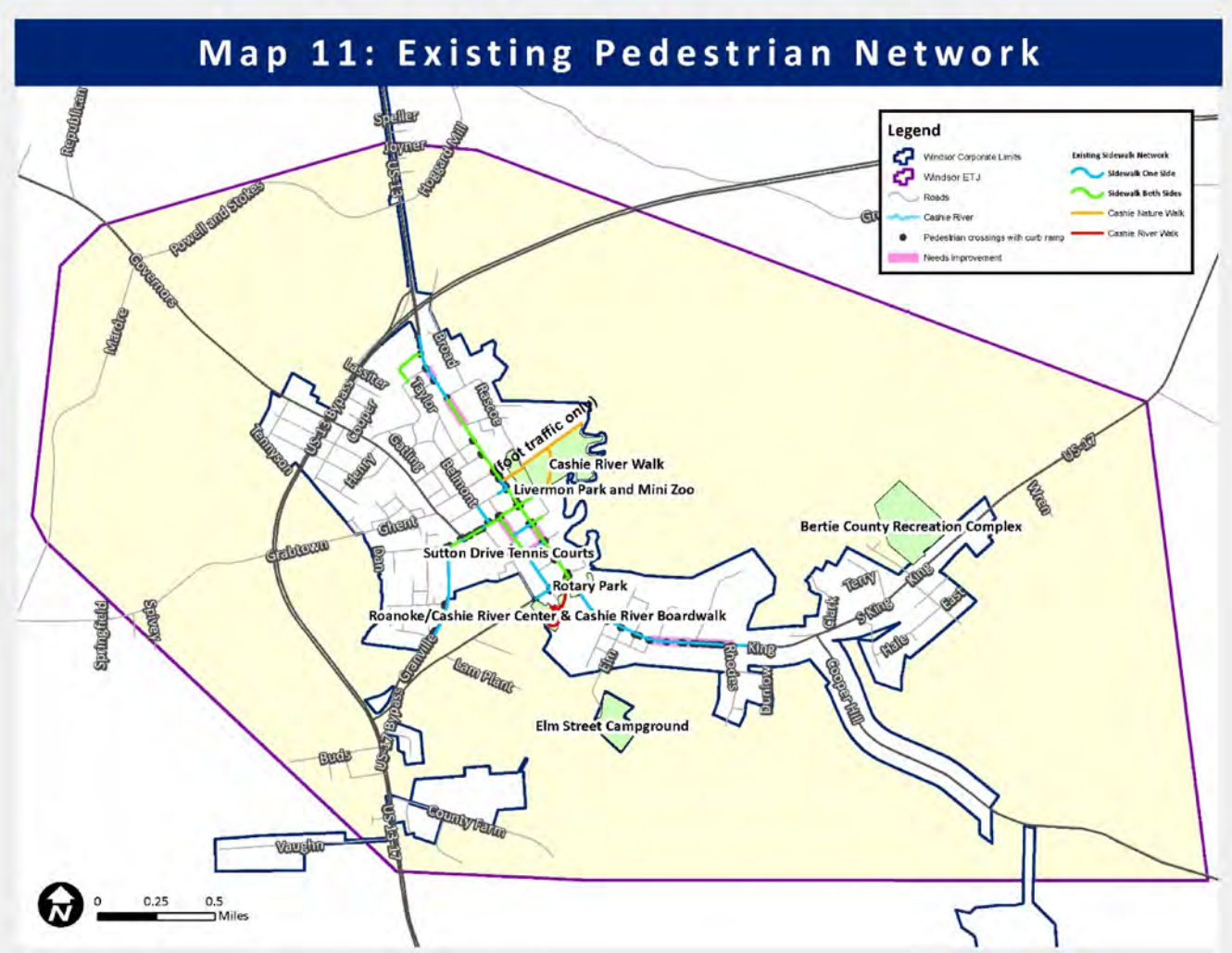
Weaknesses

Physical barriers to pedestrian travel include the presence of US Highway 13 and US Highway 17. In addition to the US Highway 13 Bypass enclosing Windsor from the west, US Highway 13 Business runs concurrently along North King Street and US Highway 17 runs concurrently along South King Street. Additionally, US Highway 13 and US Highway 17 also occupy South Granville Street and South Water Street, respectively, until US Highway 17 is absorbed and both streets become US Highway 13 Business.

There are slightly over seven (7) miles of sidewalk in Windsor compared to well over 300 miles of road within the corporate limits. Not all roads need the accompaniment of sidewalk improvement, but with just over 2% of the total mileage of roads outfitted with sidewalks, Windsor certainly has room for improvement. Particular areas of concern include the two-mile radius encompassing schools within the corporate limits. The only school lacking adequate pedestrian connections within a two-mile radius is the Windsor Elementary School. Additional locations of concern are the Food Lion shopping center which receives frequent traffic from both US Highway 13 and US Highway 17 in addition to daily traffic supplied by Windsor residents.

Constraints to sidewalk and multi-use path construction primarily include street trees and vegetation. In addition, several intersections will require retrofitting to provide crossing facilities for the multi-use path proposed in Section 4. Lighting is also a concern outside of the downtown area. The conditions of existing sidewalks vary throughout the town; however, maintenance is a continuing concern.

Map 11 illustrates Windsor's existing sidewalk network.



Existing Plans and Programs

Introduction

The Town of Windsor has a variety of existing plans that have helped to provide guidance to the Town with regard to transportation, economic development, health, parks and recreation, zoning, and land use. As these plans were developed, they allowed officials and residents the opportunity to provide input regarding a variety of topics. Listed below are just a few examples of existing plans that affect, or were created specifically for, the Town of Windsor. These are provided with a short summary describing how they are related in the shaping and creation of this Comprehensive Bicycle and Pedestrian Plan.

Rural Planning Organization (RPO) Regional Transportation Plan

An RPO serves as the designated transportation planners for many rural areas and are part of the transportation networks and economies of surrounding metropolitan and non-metropolitan regions. Often, transportation issues create a large undertaking for many municipalities and counties. Currently, the Bertie County Comprehensive Transportation Plan addresses county-wide issues surrounding the Town of Windsor

corporate limits. This plan does not specifically address multi-modal transportation improvements within the Town.

Bertie County Economic Development Plan

An Economic Development Plan is a tool an entity may utilize to study and prepare for future development and create guidelines regarding this development. The mission of the Bertie County Economic Development Plan is to "create an environment that supports new and existing businesses by upgrading and improving the infrastructure to promote tourism, entrepreneurism, and the integration of technology by utilizing existing community values and natural resources."

As walkability becomes an increasingly important factor in relation to the economic benefit of a town and the businesses within, this Comprehensive Bicycle and Pedestrian Plan may help guide the creation of a bicycle- and pedestrian-friendly network that showcases Windsor's assets and attracts visitors and potential residents. The Town has invested significantly in tourism and economic development in recent years. These efforts include development of Memorial Park, construction of the Windsor/Cashie River Treehouses, and improvements to the campground. Many of the recommendations in this plan are intended to provide better connectivity between these facilities and the Town's Central Business District.

Comprehensive Plan and Coastal Area Management Act (CAMA)

A comprehensive plan, an important tool for all municipalities, aids in determining the best course of action for the health, safety, and general welfare of its residents. These documents typically contain existing conditions, future demands, future land use, and implementation strategies.

Windsor's Comprehensive Plan encompasses a wide variety of topics including transportation, land use, and implementing strategies. Based on residents needs', in conjunction with existing transportation infrastructure, the comprehensive plan and the data it provides will help to guide and support the introduction of pedestrian and bicycle facilities.

As one of the twenty (20) counties that are a part of the Coastal Area Management Act (CAMA), Windsor's Comprehensive Plan also includes and complies with the Coastal Resources Commission's (CRC) planning requirements and Subchapter 15A NCAC 7B in accordance with the February 1, 2016, update.

Parks and Recreation Plan

Parks and recreational use areas are becoming increasingly important regarding the amenities people seek when searching for a home. Based on a variety of factors, parks and recreational areas – especially in Windsor – are placed at varying locations throughout the corporate limits and extraterritorial jurisdiction (ETJ).

This Comprehensive Bicycle and Pedestrian Plan will adopt some of the suggestions included in the Parks and Recreation Plan and ensure better connectivity to Windsor's parks and recreational assets.

Bertie County Community Health Assessment (2013)

The Bertie County Community Health Assessment provides information describing demographics, socioeconomic status, health resources, health statistics, and environment data which begins to discuss the built environment, grocery stores and the importance of access to these stores.

This assessment is important to the bicycle and pedestrian plan since, often, it provides a basis for identifying areas of need. The benefits of bicycle and pedestrian plans do not only lie in the potential for positive economic impacts and bicycle/pedestrian access, but also focuses to help reduce illnesses related to a sedentary lifestyle. The maps and data provided in this section were developed utilizing information from this assessment and have assisted in educating stakeholders during the development of this plan.

Existing Land Development Regulations

Over the last few years, Windsor has made a series of amendments to the Town's Unified Development Ordinance intended to improve the quality of development. The updated regulations require the installation of sidewalks, proper lighting, and the dedication of open space. Requirements vary based on land use type.

Existing Educational Programs

Currently, the Town provides two primary education programs regarding bicycle and pedestrian safety. The Town police department annually participates in National Night Out and also conducts presentations in local schools about the issue of bicycle safety and ensuring safe and ready pedestrian access to school sites. The recommendations outlined throughout this plan are intended to improve connectivity and access between the key community facilities outlined on Map 9. A variety of solutions will be utilized focused on affording both on- and off-road access to both pedestrians and cyclists.

Community Survey

A community survey was initiated in July 2016, to engage citizens and employees who utilize Windsor's bicycle and pedestrian networks. The survey was designed to identify issues relating to bicycle and pedestrian travel within the corporate limits. Most notably, more than 80% of respondents stated they would bike more often if more lanes, trails, and safe roadway crossings were provided. Other key findings are highlighted below:

- The majority of respondents were between the ages of 45 and 54 (43.75%).
- Over 90% of respondents stated Fitness or Recreation was one of the reasons they bike.
- "Personal Safety" was cited as the most significant hindrance to walking.
- "Lack of Bicycle Lanes" was cited as the most discouraging factor to biking.

The survey results can be found in their entirety in Appendix C.

Section 4: Recommendations

Introduction

Recommendations for improvements to Windsor's bicycle and pedestrian networks and greenways are included in this section. Supporting information, such as analysis of priority locations, areas of concern, and bicycle and/or shared-use path improvements and the Town of Windsor Parks and Recreation Master Plan are also included. All recommended facility improvements are included in Appendix B: Design Guidelines.

A combination of field work, committee input, and community survey results led to the creation of the network recommendations contained in this comprehensive pedestrian plan. To identify high priority projects, the committee was tasked with isolating intersections and other areas of concern based on Bicycle and Pedestrian Crash Data, and community and committee input. Project priority is defined within the summary table at the end of this section.

All recommendations in this section are a direct result of discussions with the Steering Committee, Town staff, and elected officials. The solutions provided are based on data available and standards in place when the document was drafted.

Areas of concern were identified at the onset of the planning process. Information for the areas of concern was gathered from the survey, public input, community input, and NCDOT Crash Data.

Pedestrian and Bicycle Network Recommendations

A primary focus of this plan is the identification of practical recommendations for improving bicycle and pedestrian travel options in Windsor. Recommendations are provided for sidewalks, bicycle accommodations, shared use paths, and crossing improvements. A detailed summary of bicycle and pedestrian facility improvements associated with Table 6 and 7 are provided in Appendix D of this plan.

Recommended Pedestrian Facilities

Proposed improvements to Windsor's sidewalk network are shown on Map 12. Curb ramp construction and improvements are also noted. Table 6 shows an estimated cost for approximately 1.81 miles of sidewalk. According to the Pedestrian and Bicycle Information Center, the average cost for a 5-foot wide concrete sidewalk with curb and gutter is a combined $53.00 per linear foot.

Table 6. Sidewalk Recommendations

Infrastructure Facility	Average Cost	Cost Unit	Proposed # of Units	Approximate Total
Concrete Sidewalk	$32	Linear Foot	51,819	$1,658,208
Curb & Gutter	$21	Linear Foot	51,819	$1,088,199
Estimated Total Project Cost				$2,746,407

Source: UNC Chapel Hill Highway Safety Research Center.

Map 12 – Recommended Pedestrian Improvements

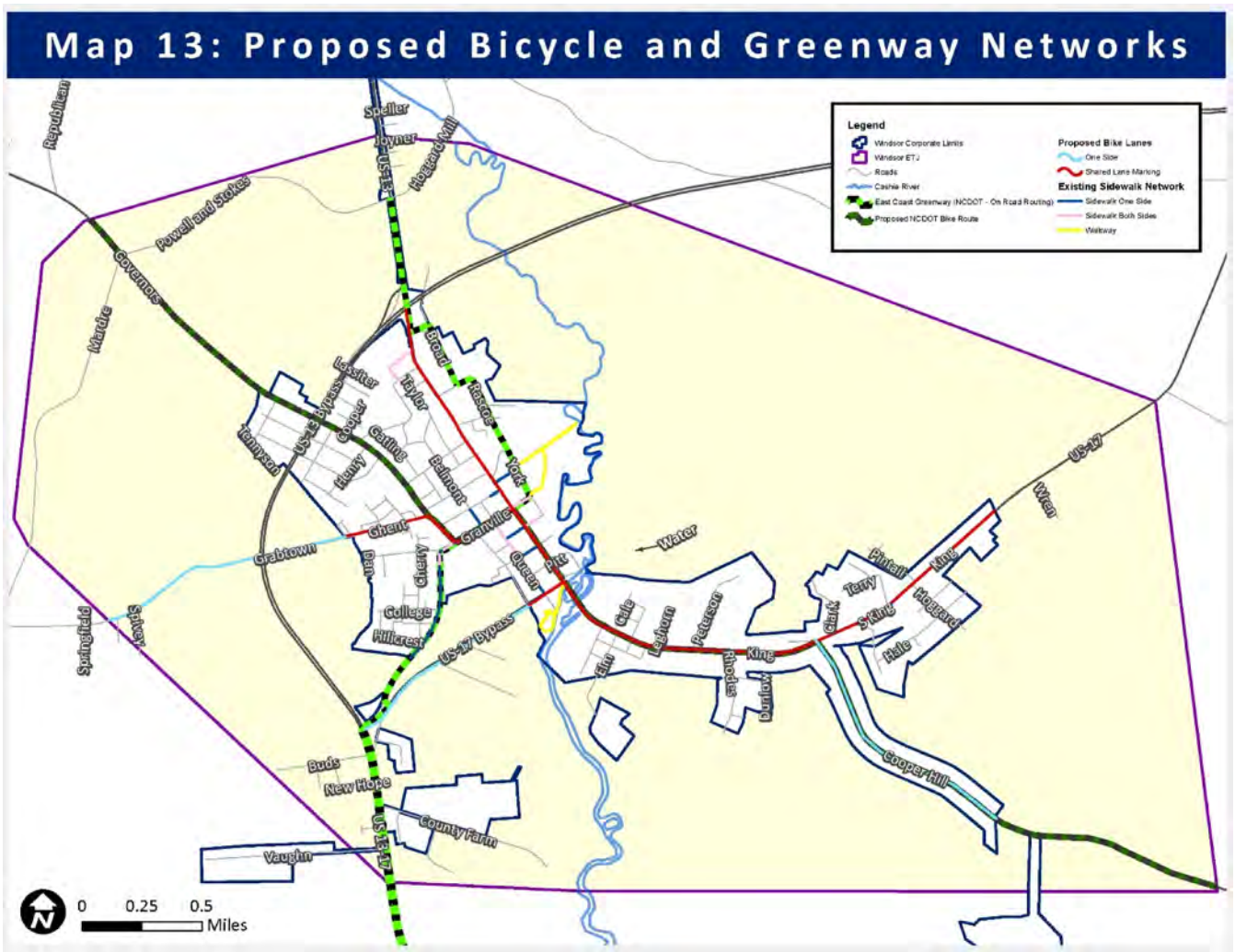
Recommended Bicycle and Greenway Facilities

Proposed bicycle improvements coincide in many places with suggested shared-use path recommendations. Depending on the availability of funds, a shared lane marking, bicycle accommodations/boulevard, or a shared-use path should be introduced in the designated areas marked on Map 13 according to the type of facility indicated on the map for each location. Additionally, Map 14 shows the locations of the detailed projects outlined in this chapter. Table 7 shows an estimated cost for approximately 7.3 miles of bicycle accommodations. Example cost breakdowns for both dedicated bicycle paths and shared lane are shown.

Table 7. Bicycle Infrastructure Recommendations

Infrastructure Facility	Average Cost	Cost Unit	Proposed # of Units	Approximate Total
Bicycle Lane	$21.54	Linear Feet	34,546	$744,120
Shared Lane/Bicycle Marking	$180	Each	20	$3,600
Estimated Total Project Cost				$747,720

Source: UNC Chapel Hill Highway Safety Research Center.



Insert Map 14 – Areas of Concern

Areas of Concern (Priority Projects)

The projects discussed and outlined under this section are a result of the planning process discussed earlier in this plan. A summary defining all proposed projects is provided in Appendix D of this plan. Map 14 provides the locations of all "priority projects" defined in this section.

For each area discussed in this section, recommendations are stated and accompanied by conceptual renderings. Each area will also be provided with the approximate cost of project construction.

The recommended elements provided in each rendering are indicated in the legend below.

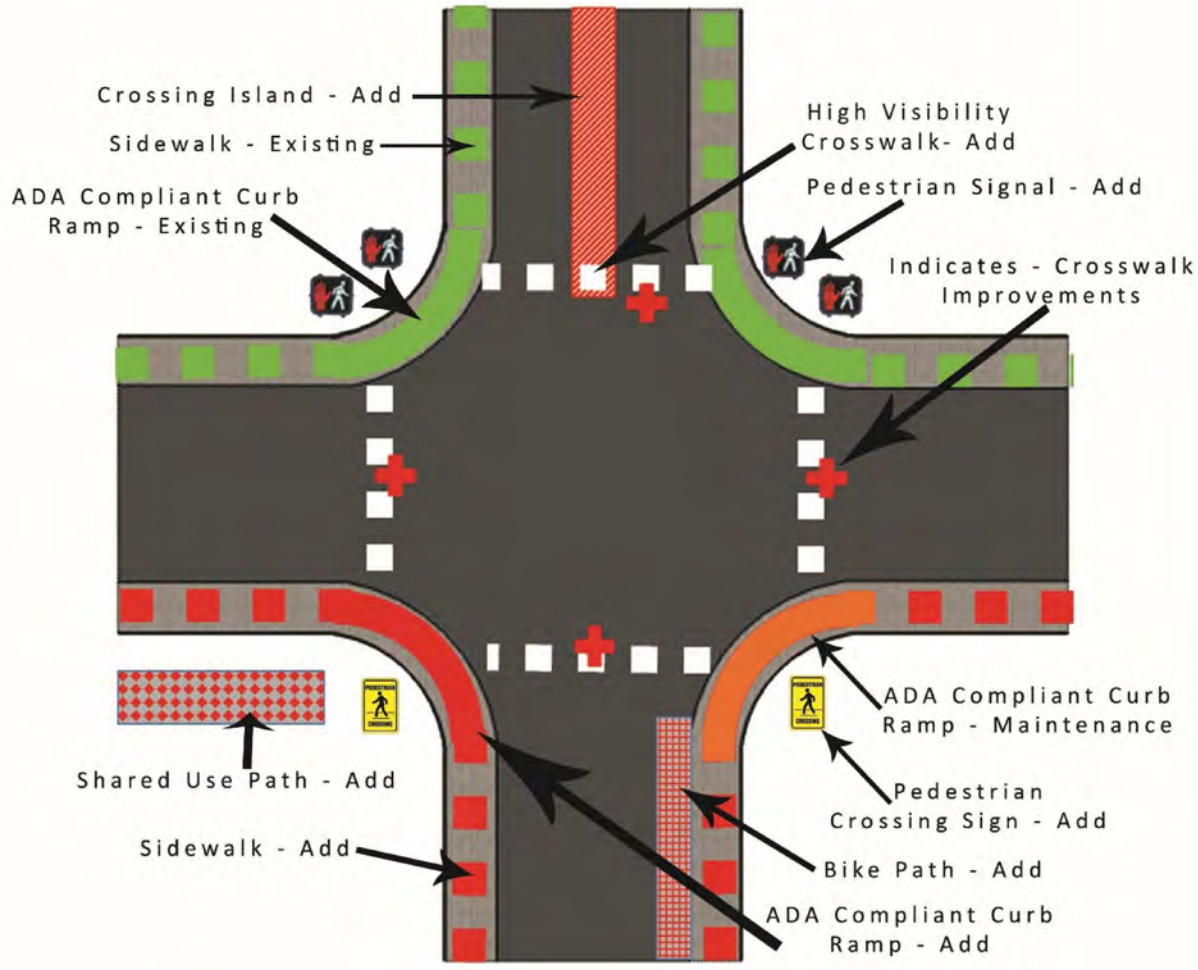


Figure 4-1: Recommendations Legend (Source: HCP).

Area 1: Cooper Hill Road

Cooper Hill Road, a mostly residential neighborhood containing Windsor Elementary School and a few churches, experienced a fatality in 2016. In addition to a dedicated non-vehicular path, it is recommended that a crosswalk be added to aid in crossing Cooper Hill Road (refer to Figure 4-4). A pedestrian refuge/island, striped crosswalk, and two (2) pedestrian crossing signs are suggested (see Figure 4-4) to increase safety for pedestrians or bicyclists in the vicinity of the school. The need for additional notification signals, pavement markings, and signage will be assessed during the formal design phase of the project. It should be noted that the proposed shared use path and pedestrian crossing will tie directly into facilities available at the school site.

Figure 4-2: Cooper Hill Road Looking Northeast – Before (Source: HCP).

Figure 4-3: Cooper Hill Road Looking Northeast – Proposed (Source: HCP).

Area 1: Existing Conditions

- 100 foot right-of-way with approximately 30 feet of paved traveled way.
- Travel speed of 25 mph reduced from 55 mph due to the school zone.
- Main entry corridor into the Town of Windsor.

Area 1: Constraints

- The proposed improvements involve construction of improvements that will be located within the NCDOT right-of-way.
- There are currently no other known constraints to the improvements recommended.

Area 1: Project Justification

- The Steering Committee, including the Active Routes to School Coordinator, identified this area as a significant need regarding accessibility and public safety to provide safe access to the Windsor Elementary School across Cooper Hill Road.
- The proposed improvements will not serve a substantial population; however, safe and ready access from Cooper Hill Road to Windsor Elementary School is needed to ensure the safety of students and visitors of the school facility.
- Currently, there is no crossing and the proposed improvements will tie into existing school pedestrian facilities. This will require further engineering during the project design phase.

Area 1: Issues Addressed (as identified in Appendix C Survey Results)

- Improved pedestrian access.
- Addition of safe crossing to public facilities.
- Installation of additional pedestrian and bicycling facilities.

Table 8. Cooper Hill Road Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
High-Visibility Crosswalk	$770	Each	1	$770
Pedestrian Crossing Sign	$360	Each	2	$720
Pedestrian Refuge/Island	$13,520	Each	1	$13,520
Estimated Total Project Cost				$15,010
Note: Overall bike path cost estimates are provided on page 4-2. Detailed estimates are provided in Appendix D. *Source: UNC Chapel Hill Highway Safety Research Center.*				

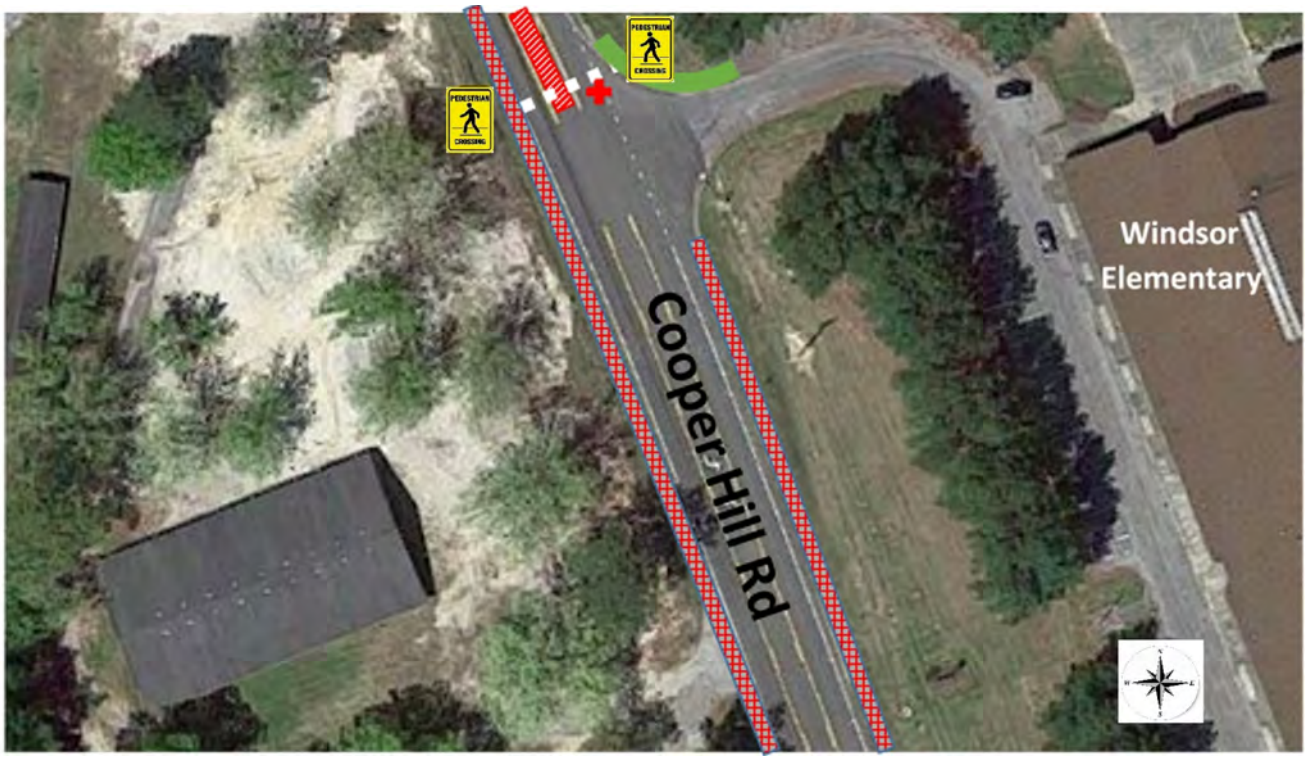
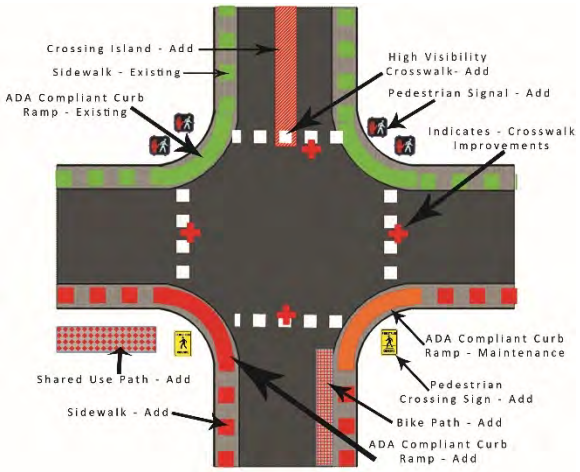


Figure 4-4: Cooper Hill Road – Satellite View and Proposed Elements (Source: Google Maps, HCP).



Area 2: Grabtown Road

Grabtown Road is the location of another fatality which happened in 2014. This road is outside the Town's corporate limits, but well within the extraterritorial jurisdiction (ETJ). To ensure the safety of residents of the Town, it is recommended that a path be placed along Grabtown Road on the southern side and partially along the northern side to provide connectivity to the intersection of Grabtown Road and US-13. Construction of a striped crosswalk accompanied by two (2) pedestrian crossing signs is encouraged to allow for safe passage across Grabtown Road.

Figure 4-5: Grabtown Road Looking North – Before (Source: Google Maps).

Figure 4-6: Grabtown Road Looking North – Proposed (Source: Google Maps, HCP).

Area 2: Existing Conditions

- This area is generally rural in nature; however, the proposed side path does traverse from Highway 17, a high speed corridor.
- The proposed project will terminate adjacent to the State Employees Credit Union (SECU) leaving the potential for further expansion in the future.

Area 2: Project Justification

- This project was recommended by the Steering Committee to provide pedestrian and bicycle access across US Highway 17.
- The Town will work with the SECU to tie the path into on-site pedestrian facilities.
- The project will also afford the expansion of the path further up the northern side of Grabtown Road as development occurs.

Area 2: Constraints

- The proposed project will tie into the crossing improvements outlined under Area #3.
- There are no significant constraints to project development except for the need to coordinate with the SECU to establish safe and efficient access to the commercial site from the proposed side path.

Area 2: Issues Addressed (as identified in Appendix C Survey Results)

- Improves pedestrian access to northern portions of the Town.
- Establishes safe pedestrian and bicycle crossing that also ties into the Area 3 crossing at US 13.
- Creates connectivity with downtown Windsor.

Table 9. Grabtown Road Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
High-Visibility Crosswalk	$770	Each	1	$770
Pedestrian Crossing Sign	$360	Each	2	$720
Estimated Total Project Cost				$1,490
Note: Overall bike path cost estimates are provided on page 4-2. Detailed estimates are provided in Appendix D. Source: UNC Chapel Hill Highway Safety Research Center.				

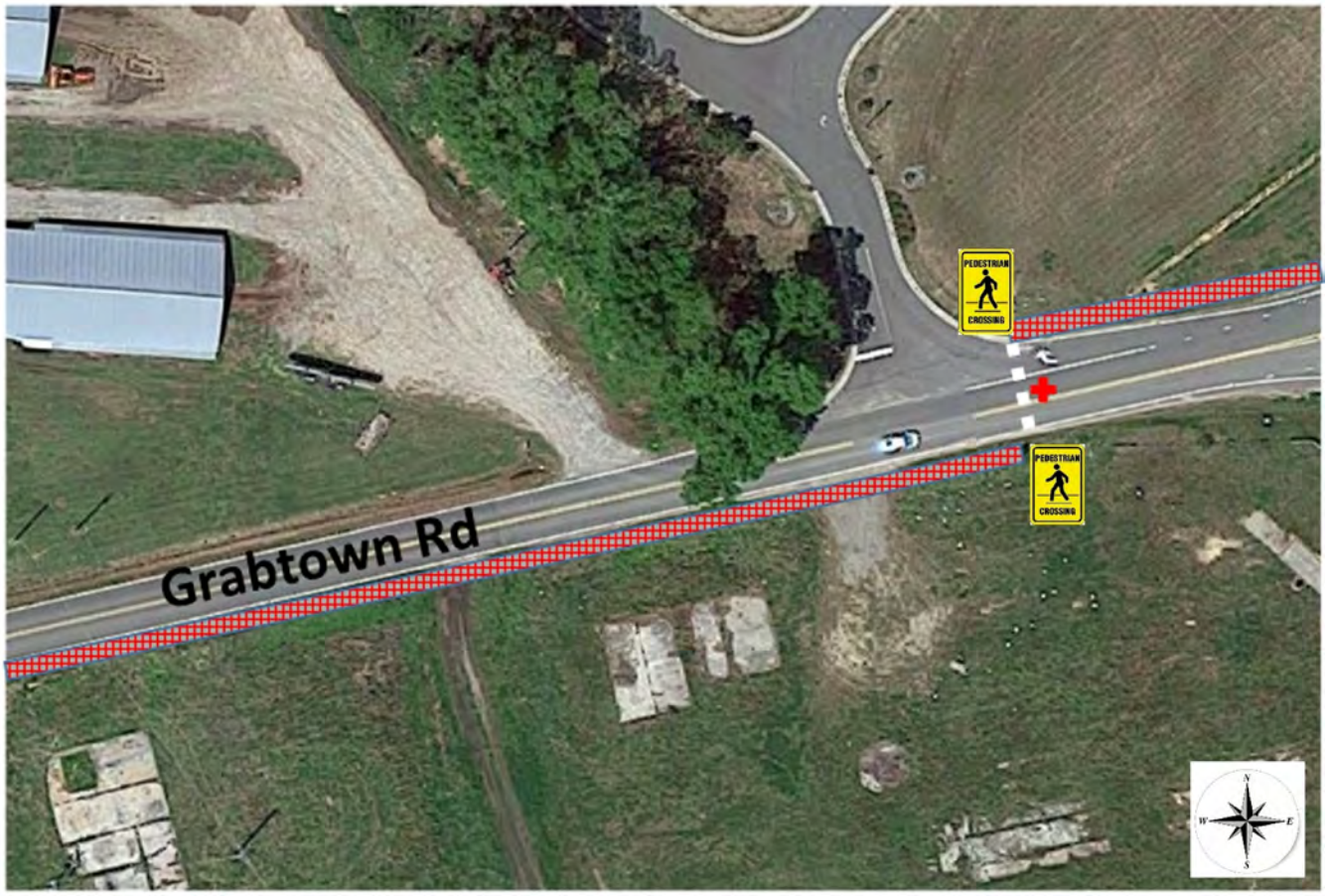
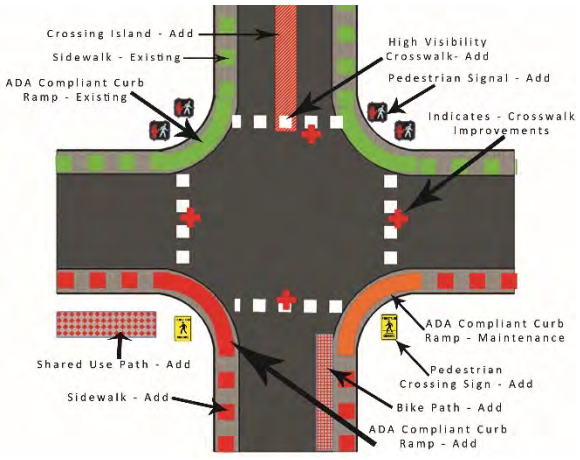


Figure 4-7: Grabtown Road – Satellite View and Proposed Elements (Source: Google Maps, HCP).



Area 3: Grabtown Road & US-13

The intersection of Grabtown Road and US-13 was mentioned numerous times throughout the planning process. Crossing at this intersection proves to be a difficult task for all modes of transportation, especially non-vehicular. Cars travel along this corridor at 45 MPH or greater. This high traffic/speed area suggests there should be elements placed to allow safe bicycle and pedestrian crossing.

In addition to paths (see Map 12, page 4-3) that provide for consistent access and connectivity, the introduction of high visibility crosswalks spanning Ghent Street and US-13 is also recommended. To complement these bicycle- and pedestrian-friendly elements, pedestrian islands/refuges and pedestrian crossing signals should be constructed.

Figure 4-8: Grabtown Road & US 13 Looking West – Before (Source: Google Maps).

Figure 4-9: Grabtown Road & US 13 Looking West – Proposed (Source: Google Maps, HCP).

Area 3: Existing Conditions

- This project will provide safe crossing access to allow pedestrians and cyclists to safely travel across the busy NC Highway 17 corridor.
- The crossing is located at a high speed intersection involving NC Highway 17 (four lanes) and Ghent Street (two lane Connector Street).
- The proposed side path traverses along the right side of Ghent Street which is characterized by farmland and single-family residential homes with associated curb-cuts.

Area 3: Project Justification

- This project will provide access to US Highway 17 along Ghent Street and enable safe crossing of US 17 as development continues to occur along this corridor.
- The improvements outlined under Areas #2 and #3 are intended to be coordinated in an effort to provide access to this portion of Town where future commercial and residential development are anticipated.

Area 3: Constraints

- The most significant constraints to development regarding this project will be coordination with the SECU regarding a connection to their existing facilities.
- Development of this project will also require coordination with the Area #2 priority project.
- It should be noted that development of this project will require additional engineering and design considerations.

Area 3: Issues Addressed
(as identified in Appendix C Survey Results)

- Improves pedestrian access to northern portions of the Town.
- Establishes safe bicycle and pedestrian crossing that ties into the Area 2 improvements previously discussed.
- Creates connectivity with downtown Windsor.

Table 10. Grabtown Road & US 13 Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
High-Visibility Crosswalk	$2,540	Each	4	$10,160
Pedestrian Crossing Signal	$1,480	Each	6	$8,880
Pedestrian Refuge/Island	$13,520	Each	2	$27,040
Estimated Total Project Cost				$46,080
NOTE: Overall bike path cost estimates are provided on page 4-2. Detailed estimates are provided in Appendix D. Source: UNC Chapel Hill Highway Safety Research Center.				

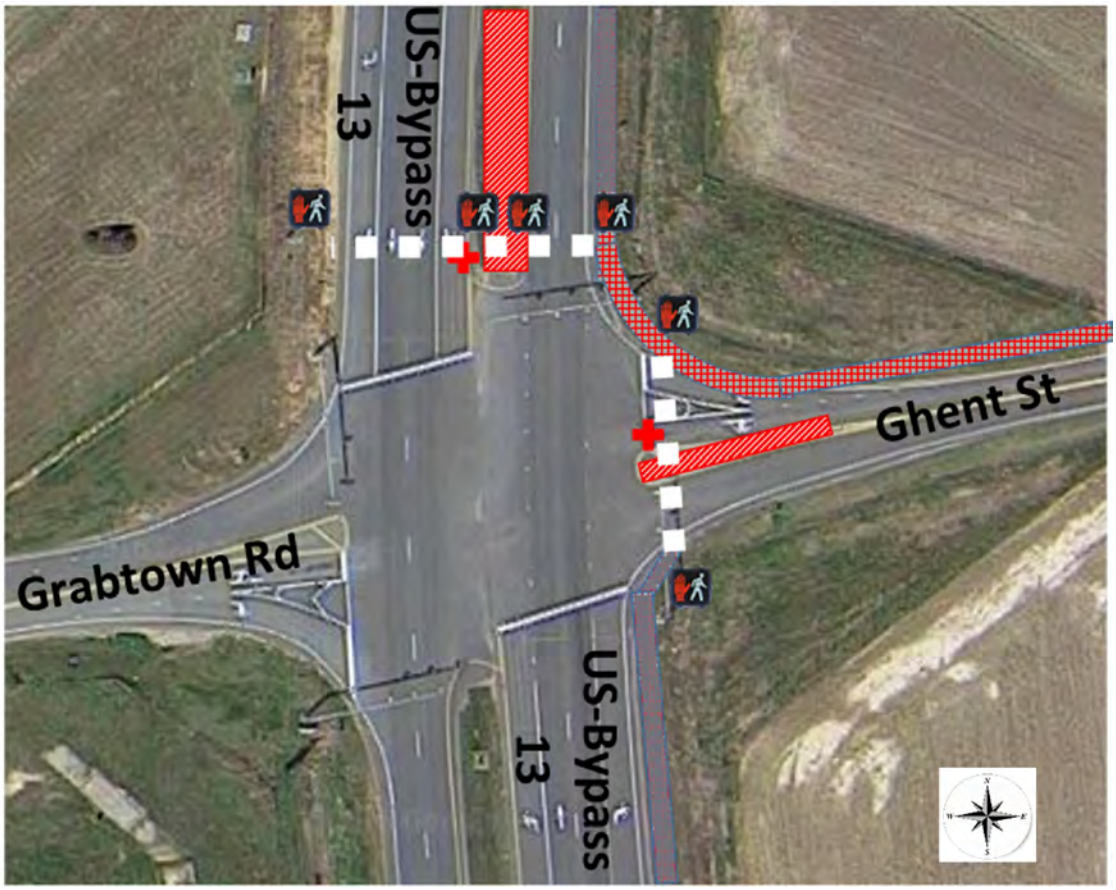
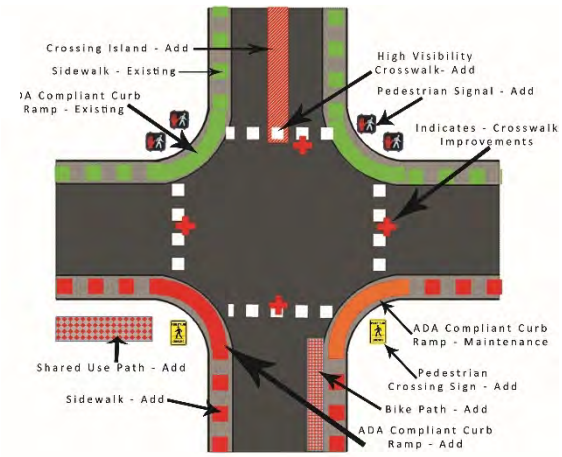


Figure 4-10: Grabtown Road & US 13 – Satellite View and Proposed Elements (Source: Google Maps, HCP).



Area 4: King Street and Granville Street

King Street and Granville Street meet in the heart of downtown Windsor. Sidewalks are located throughout the central business district and provide access to a majority of business storefront locations. To accompany this pedestrian-friendly atmosphere, striped crosswalks and pedestrian crossing signals should be placed on all sides of this intersection. Additionally, maintenance on sidewalk is suggested to address ADA compliance and to extend the pedestrian refuge into the intersection (bulb-out). This effort could potentially be addressed in concert with a planned repaving project. Regardless, detailed planning and engineering will be required to ensure proper treatment.

Figure 4-11: King Street & Granville Street Looking East – Before (Source: HCP).

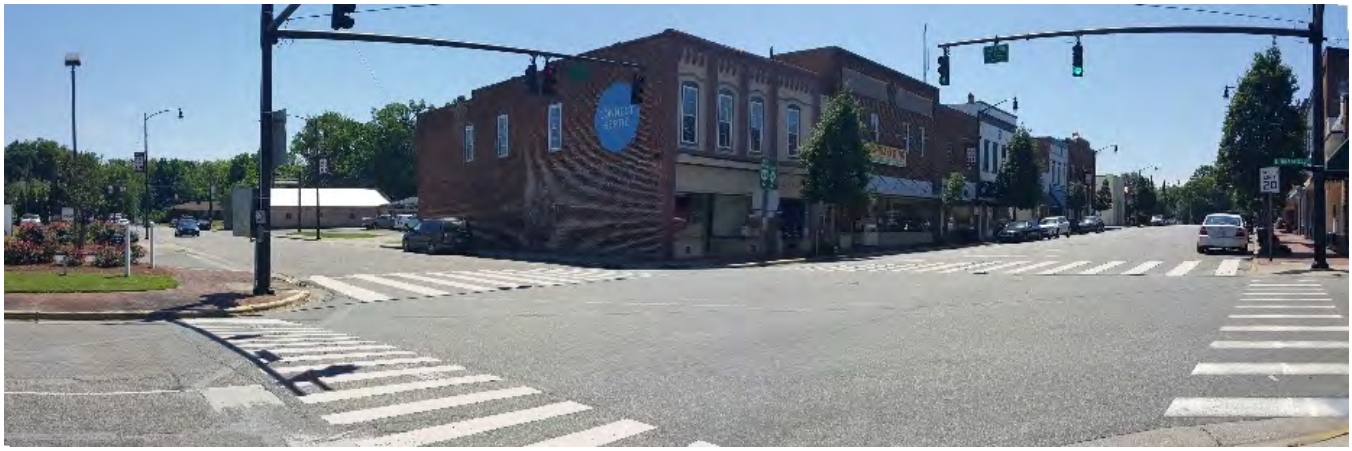


Figure 4-12: King Street & Granville Street Looking East – Proposed (Source: HCP).

Area 4: Existing Conditions

- This proposed project is centrally located within Windsor's Central Business District.
- The intersection of King Street and Granville Street is a key gathering point in the CBD and is in dire need of non-motorized access improvements.
- Engineered curb ramps and cross walks with signals are proposed at all four corners of this intersection.
- Additionally, curb ramps and crossings are also proposed along King Street and Granville Street as indicated on Map 4.

Area 4: Project Justification

- This project as well as the other crossing improvements are intended to improve pedestrian connectivity and access within the Windsor CBD.
- Currently, these facilities are limited.
- In addition to crossing improvements, on-road bicycle facilities are also being proposed.

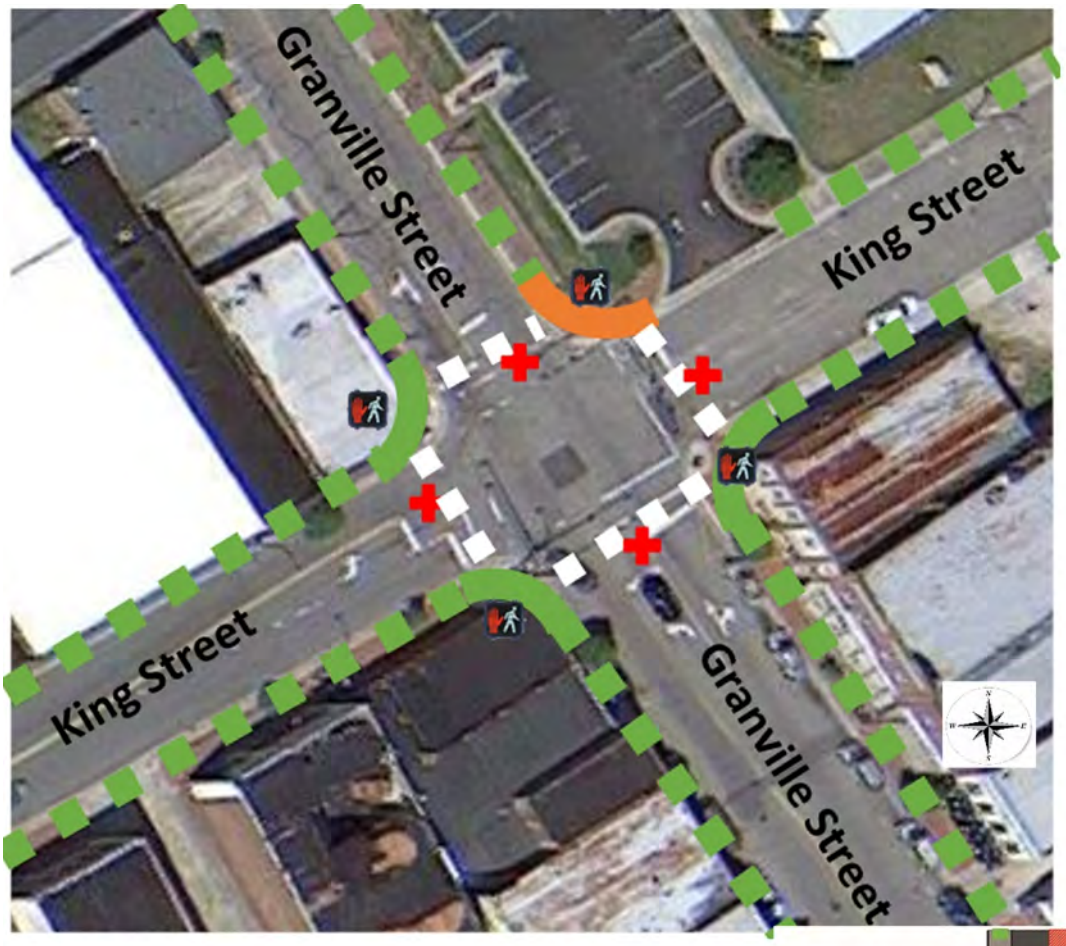
Area 4: Constraints

- There are no known constraints to completing these improvements, aside from funding.
- The downtown improvements will be considered very high priority and addressed through general funding and NCDOT.

Area 4: Issues Addressed (as identified in Appendix C Survey Results)

- Improves walkability downtown.
- Improves pedestrian safety.
- Ties into the overall pedestrian/shared use network outlined throughout the plan.

Table 11. King Street & Granville Street Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
High-Visibility Crosswalk	$770	Each	4	$3,080
Pedestrian Crossing Signal	$1,480	Each	8	$11,840
ADA Compliant Curb Ramp	$810*	Each	1	$810
Estimated Total Project Cost				$15,730
** Cost shown is new construction. Cost variation expected based on necessary materials.*				
Source: UNC Chapel Hill Highway Safety Research Center.				



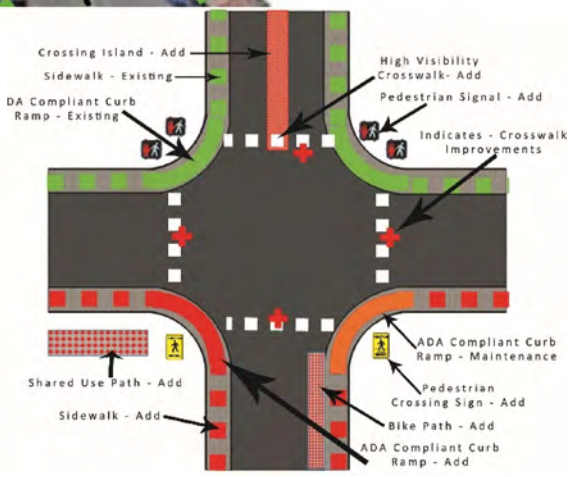


Figure 4-13: King Street & Granville Street – Satellite View and Proposed Elements (Source: Google Maps, HCP).

Area 5: King Street & Water Street

The intersection of South King Street and Water Street requires safe passage for pedestrians crossing South King Street and there is currently no safe passage in place. Additionally, the closest crosswalks to this location are at King Street and Granville Street, three (3) blocks northwest, and to the south, at the far side of the King Street bridge over the Cashie River. Along all NCDOT right-of-way, public safety signage will be installed per NCDOT design guidelines.

Figure 4-14: King Street & Water Street Looking East – Before (Source: Google Maps).

Figure 4-15: King Street & Water Street Looking East – Proposed (Source: Google Maps).

Area 5: Existing Conditions

- This project is also located within the Town's Central Business District.
- The intersection at East Water Street and South King Street is characterized by downtown residential development with curb-cuts and sidewalks on both sides of the street.
- Opposite the proposed crosswalk is the King Street bridge which crosses the Cashie River and there is an existing crosswalk traversing East Water Street along King Street.

Area 5: Project Justification

- This project will provide connectivity to downtown from portions of Town east of the Cashie River.
- These areas include many of the Town's recreational amenities including the Elm Street Campground, Frisbee golf course, Rotary Park, and Treehouse Cabins.
- The proposed crosswalk will tie into the existing East Water Street crossing which establishes a pedestrian crossing of the King Street Bridge.

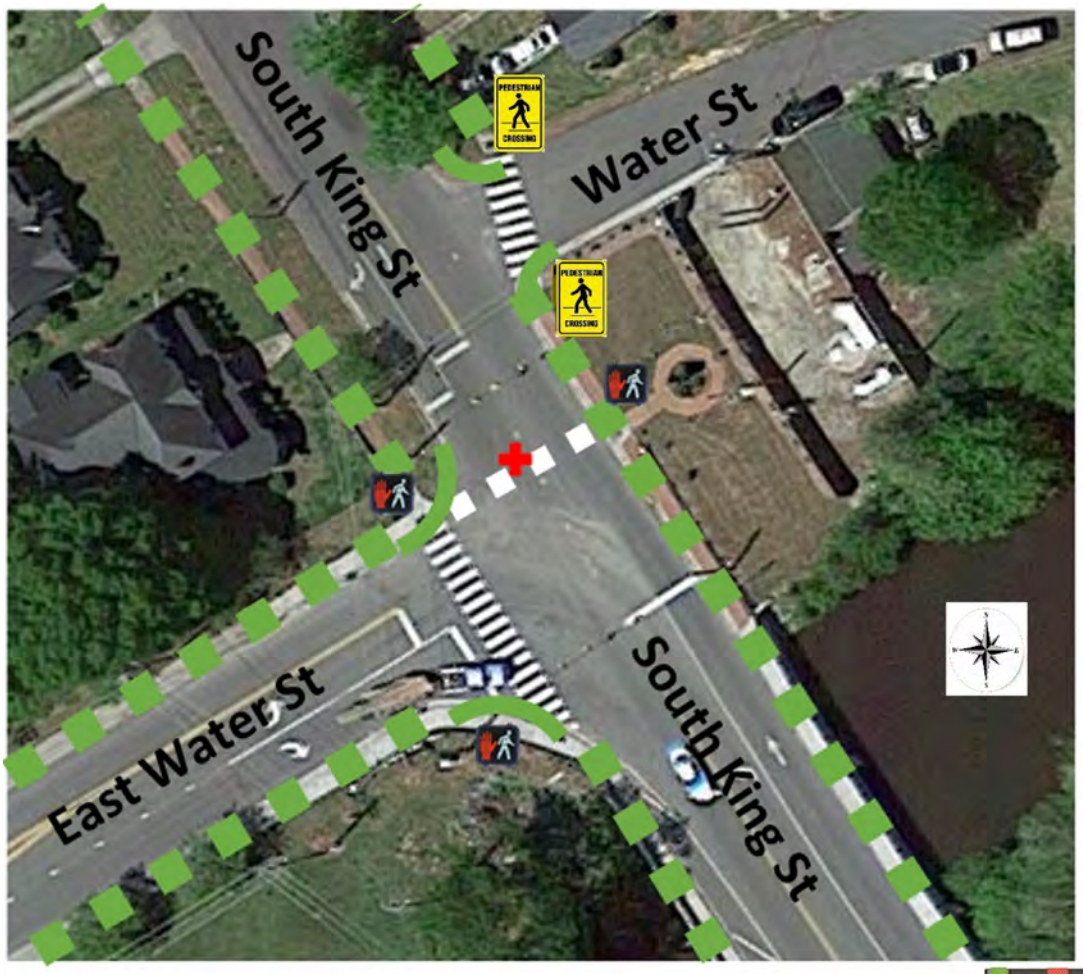
Area 5: Constraints

- This project involves minimal engineering and design, and no acquisition or construction, with the exception of establishing ADA compliant curb ramps on both sides of the crosswalk.

Area 5: Issues Addressed (as identified in Appendix C Survey Results)

- Improves pedestrian access into downtown.
- Establishes linkage to Town's recreational facilities on the east side of Town.

Table 12. King Street & Water Street Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
High-Visibility Crosswalk	$770	Each	1	$770
Pedestrian Crossing Signal	$1,480	Each	3	$4,440
Pedestrian Crossing Sign	$360	Each	2	$720
Estimated Total Project Cost				$5,930
Source: UNC Chapel Hill Highway Safety Research Center.				



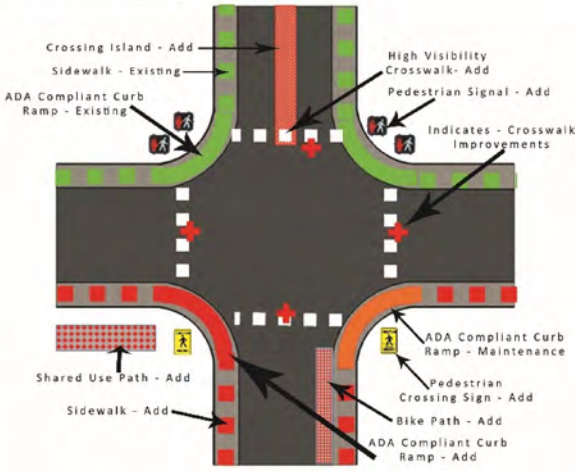


Figure 4-16: King Street and Water Street – Satellite View and Proposed Elements (Source: Google Maps, HCP).

Area 6: King Street at Food Lion Shopping Center

The sidewalk which extends along two-thirds of King Street ends at the entrance to the Food Lion Shopping Center (refer to Map 11). There is no shoulder available to access the shopping center due to thickly planted landscape shrubbery growing on the embankment (see Figure 4-18). This shopping center contains retail and service businesses, as well as the Food Lion grocery store. Food Lion is the only full-service grocery store within Windsor's corporate limits and should have safer access from King Street.

Figure 4-17: King Street Intersection near Bojangles Restaurant (Source: HCP).

To ensure there is safe access to the shopping center, the construction of a pedestrian- and bicycle-friendly path is recommended. The proposed path would begin at the existing sidewalk on the southern side of North King Street, and traverse up a hill to the bottom right corner of the Bojangles Restaurant parking lot. The specific design and location of this path will be determined through the planning and design phase of the project. Easement acquisition would be necessary from Parcel 6802489291. It is necessary that this path abide by ADA guidelines.

Figure 4-19 shows eight (8) feet of elevation change from sidewalk to parking lot. To meet ADA requirements, the slope of the proposed path should be no more than 1 inch:12inches with a 5 square-foot level pad at every 30-foot span, minimum. The proposed path should be approximately 96 feet long with at least three 5 square-foot level pads.

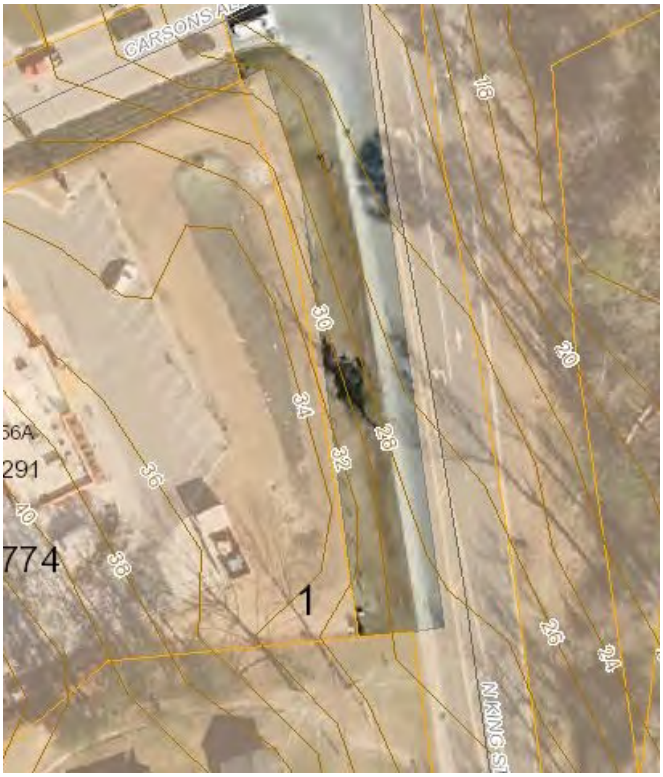


Figure 4-18: King Street Near Shopping Center – Topography (Source: Google Maps).

Area 6: Existing Conditions

- This project is located at what could be considered the busiest and most poorly suited site/location regarding bike and pedestrian access throughout Windsor.
- The proposed improvements are intended to provide for safe travel and access to and from the Food Lion shopping center from downtown Windsor leading towards the US 13 bypass.
- The King Street corridor in this area is characterized by residential development with an existing sidewalk along the western side of King Street.

Area 6: Constraints

- There are several design and construction challenges associated with this project.
- Development of the overall project will require close coordination with NCDOT, Bojangles, and the management company overseeing maintenance of the shopping center.
- Figure 4-20 provides a basic concept of how the project will be laid out. This project will require extensive engineering and design that will rely upon project funding.
- In addition to determining the appropriate design and location of the pedestrian access on the proposed parcel, the Town will have to coordinate with Bojangles to acquire property for design and construction of the proposed path.
- Upon installation of the path, the Town will have to establish a solution for tying the improvements outlined in Figure 4-20 into existing pedestrian facilities located on site. All improvements will be designed for ADA compliance, including on site modifications necessary on the shopping center life.

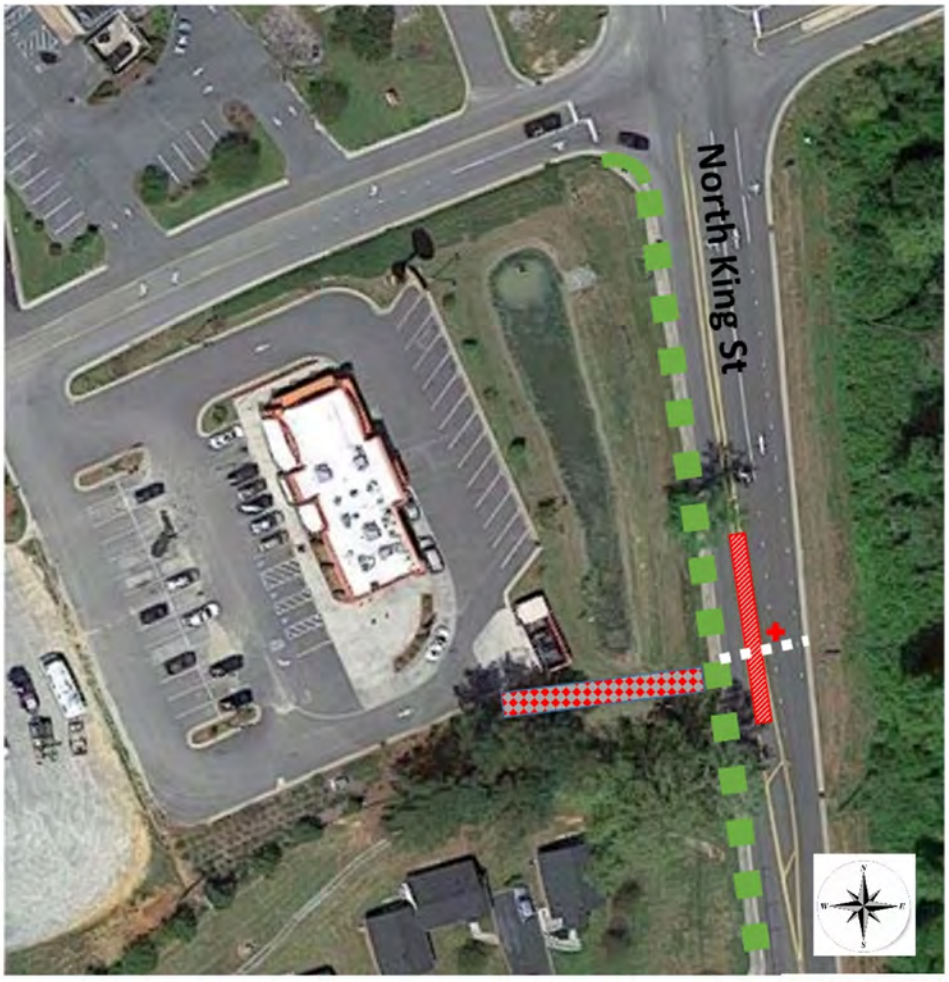
Area 6: Project Justification

- The proposed improvements are intended to establish safe access to the Food Lion shopping center along the western side of King Street heading northwest toward the US 13 bypass.
- Currently, pedestrians and cyclists are required to access the shopping center via the vehicular access driveways which put these users at risk due to the poor access design, as well as the presence of the US 13 bypass access ramps located along King Street adjacent to the site.
- The proposed improvements should address these issues and result in a much safer environment for both pedestrians and cyclists.

Area 6: Issues Addressed (as identified in Appendix C Survey Results)

- Proposed facility reduces the risk and exposure of pedestrians to automobile traffic.
- Improves pedestrian access to principal retail outlined within Town.
- Affords ADA compliant accessibility to the Food Lion Shopping Center.

Table 13. King Street at Food Lion Shopping Center Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
Multi-use Trail – Paved	$481,140	Mile	0.021	$10,104
Cut & Fill (Soil Leveling)	*	Each	*	*
Estimated Total Project Cost				$10,104*
**Cut & fill (soil leveling) to be determined.* *Source: UNC Chapel Hill Highway Safety Research Center.*				



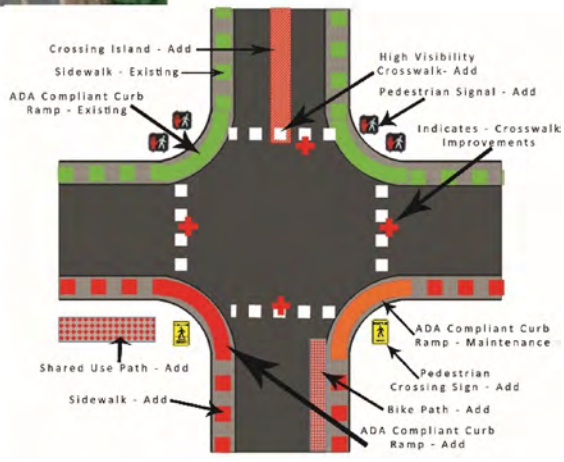


Figure 4-19: King Street at Shopping Center – Satellite View and Proposed Elements (Source: Google Maps, HCP).

Area 7: Queen Street & Water Street

It is recommended that a striped crosswalk be installed at the intersection of Queen Street and Water Street. A pedestrian crossing sign should be placed at both ends to ensure additional visibility for vehicle users.

Figure 4-20: Queen Street & Water Street Looking Northeast – Before (Source: Google Maps).

Figure 4-21: Queen Street & Water Street Looking Northeast – Proposed (Source: Google Maps, HCP).

Area 7: Existing Conditions

- This project is also located within the Town's Central Business District.
- The intersection at East Water Street and South King Street is characterized by downtown residential development with curb-cuts and sidewalks on both sides of the street.
- Opposite the proposed crosswalk is the King Street bridge which crosses the Cashie River and there is an existing crosswalk traversing East Water Street along King Street.

Area 7: Project Justification

- This project will provide connectivity to downtown from portions of Town east of the Cashie River.
- These areas include many of the Town's recreational amenities including the Elm Street Campground, Frisbee golf course, Rotary Park, and Treehouse Cabins.
- The proposed crosswalk will tie into the existing East Water Street crossing which establishes a pedestrian crossing of the King Street Bridge.

Area 7: Constraints

- This project involves minimal engineering and design, and no acquisition or construction, with the exception of establishing ADA compliant curb ramps on both sides of the crosswalk.

Area 7: Issues Addressed (as identified in Appendix C Survey Results)

- Establishes connectivity to Riverfront Park along South Queen Street.
- Establishes connection between downtown, Riverfront Park, and the Town's recreational facilities on the eastern side of Town.

Table 14. Queen Street and Water Street Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
High-Visibility Crosswalk	$770	Each	1	$770
Pedestrian Crossing Sign	$360	Each	2	$720
Estimated Total Project Cost				$1,490
Source: UNC Chapel Hill Highway Safety Research Center.				

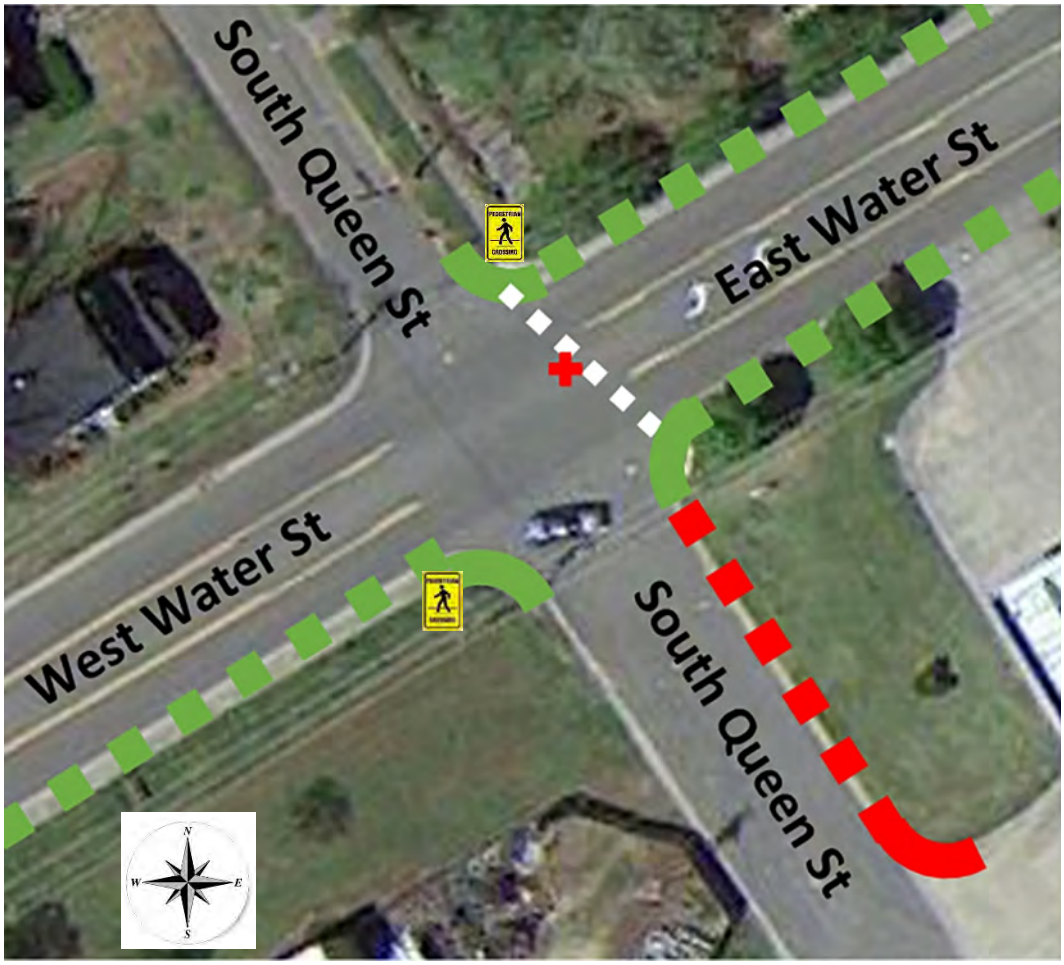
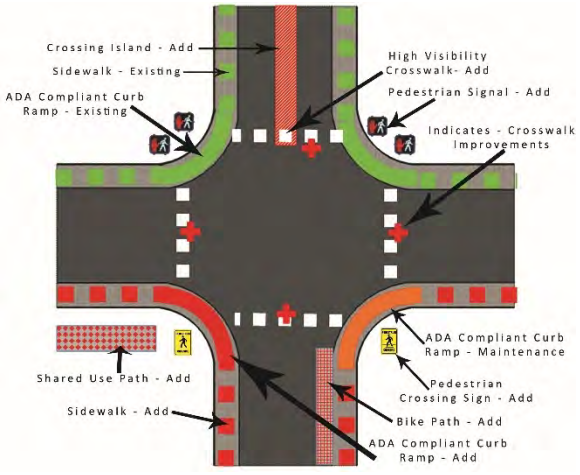


Figure 4-22: Queen Street & Water Street – Satellite View and Proposed Elements (Source: Google Maps, HCP).



Area 8: US Highway 17

The Steering Committee clearly identified this area as a need; however, there are many constraints to development. These constraints as well as project justification are provided below. This project has limited preliminary design and no formal budget figures. The reason for this fact is that further project development and research beyond the scope of this plan will be required to establish an appropriate solution. A general conceptual idea of the need for crossing improvements is provided in Figure 4-25. This figure is intended to simply provide a general overview and concept.

Figure 4-23: US Highway 17 Looking West – Before (Source: Google Maps).

Figure 4-24: US Highway 17 Looking West – Proposed (Source: Google Maps, HCP).

Refer to Map 13 for specific projection location.

Area 8: Existing Conditions

- This project is located along the US 17 bypass, a four lane highway segment with speeds ranging from 55 miles per hour down to 45 mph.
- Development along this corridor is principally commercial in nature, with single-family residences sporadically located.
- The local convenience store serving the area, the ABC store, and Heritage Academy are all located along this stretch.
- Portions of this project are located within the Town's ETJ.

Area 8: Project Justification

- As discussed in Section 3 of the plan, this portion of Town has been particularly problematic for pedestrians.
- Currently, the proposed project serves a fairly limited population and number of businesses.
- As development and land use trends continue to shift, various means and opportunities to address this need will materialize.

Area 8: Constraints

- There are a number of constraints that will prove problematic regarding project development and design.
- As noted, this project is located in an area where land use characteristics and trends may shift to better accommodate pedestrians and cyclists.
- The issues identified can be addressed under current conditions; however, extensive planning, design, and acquisition efforts must be undertaken.

Area 8: Issues Addressed (as identified in Appendix C Survey Results)

- Establishes safe and accessible pedestrian facilities.
- Addresses safety needs in an area where several fatalities have occurred in recent years.

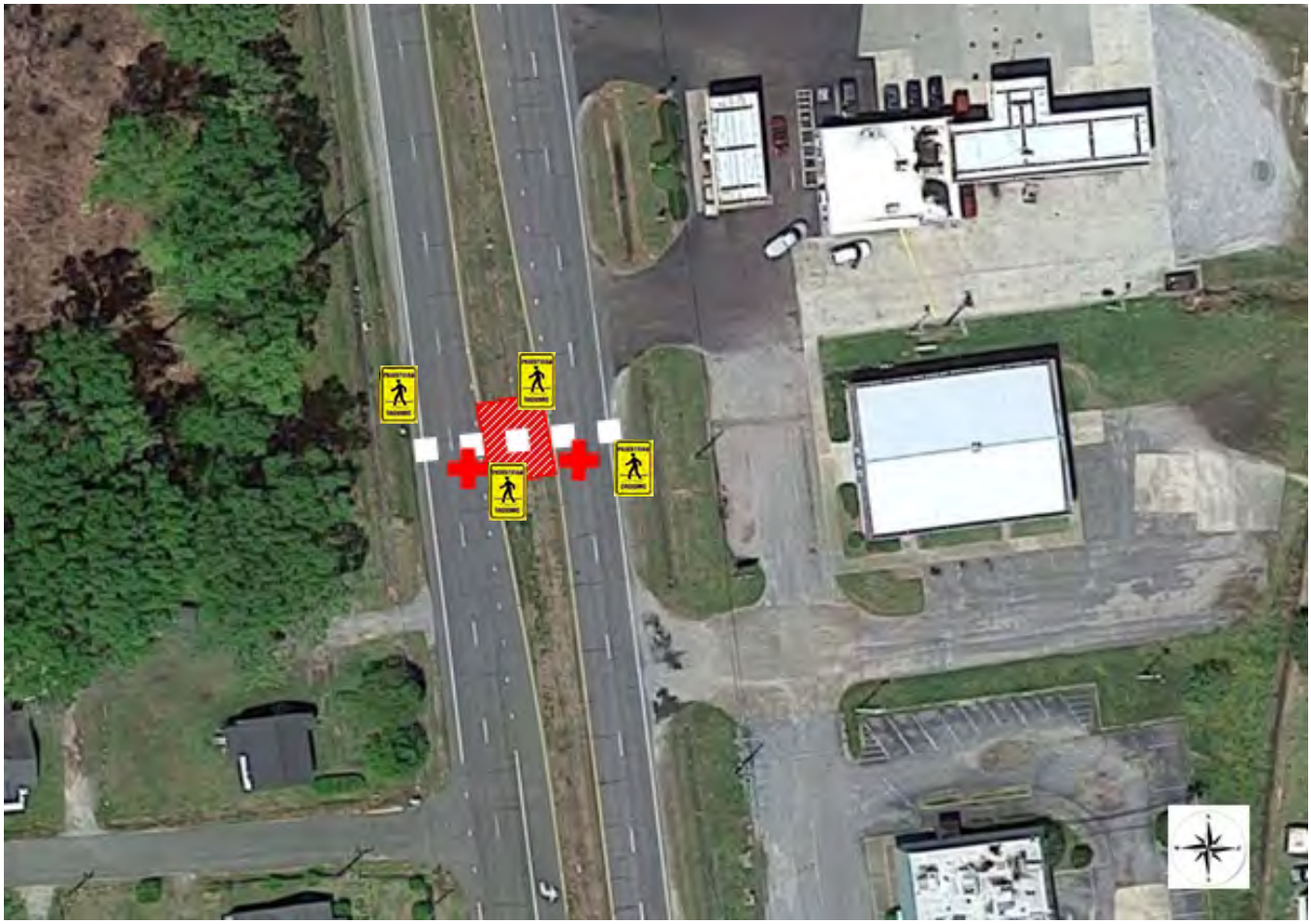
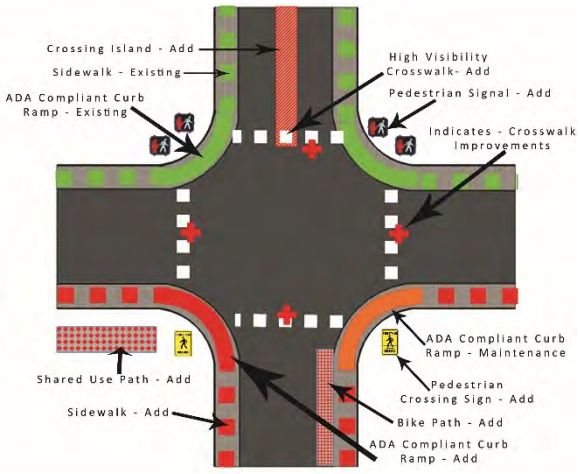


Figure 4-25: US Highway 17 – Satellite View and Proposed Elements (Source: Google Maps, HCP).



Area 9: King Street and Spring Street

Contributing to the safety of pedestrians and bicyclists at the entrance to the Food Lion shopping center, this intersection will be the point where users can cross from the northern side of King Street to the southern side using a crosswalk. This intersection is a stopping point to the existing sidewalk along the northern side of King Street thus becomes an obvious point to introduce a sidewalk.

Figure 4-26: King Street & Spring Street Looking Northwest – Before (Source: Google Maps).

Figure 4-27: King Street & Spring Street Looking Northwest – Proposed (Source: Google Maps, HCP).

Area 9: Existing Conditions

- This portion of King Street is characterized by single-family residential development, a majority of which have curb-cuts to accommodate off-street parking.
- Traffic speeds are 25 mph along this corridor and sidewalks of varying widths are provided on both sides of King Street.
- This plan proposes that some accommodation be made for cyclists; however, these improvements are intended to improve pedestrian access.

Area 9: Project Justification

- The King/Spring Street improvements are intended to coordinate with the proposed access projects defined under Area #8.
- Providing safe signalized access across King Street will establish coordinated and ADA accessible facilities enabling Town residents to access the Food Lion shopping center from downtown Windsor.

Area 9: Constraints

- There are no significant constraints to the establishment of the proposed crosswalk.
- Other options for the location of this crosswalk exist; however, the Steering Committee determined that this appeared to be the safest crossing point due to reduced right-of-way widths and travel speeds.

Area 9: Issues Addressed (as identified in Appendix C Survey Results)

- Provides crossing facility that ties into proposed shopping center access (Area 6).
- Improves overall connectivity within and adjacent to the Town's Central Business District.

Table 15. King Street and Spring Street Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
Striped Crosswalk	$770	Each	1	$770
ADA Compliant Curb Ramp	$810	Each	1	$810
Pedestrian Crossing Signal	$1,480	Each	2	$2,960
Estimated Total Project Cost				$4,540
Source: UNC Chapel Hill Highway Safety Research Center.				

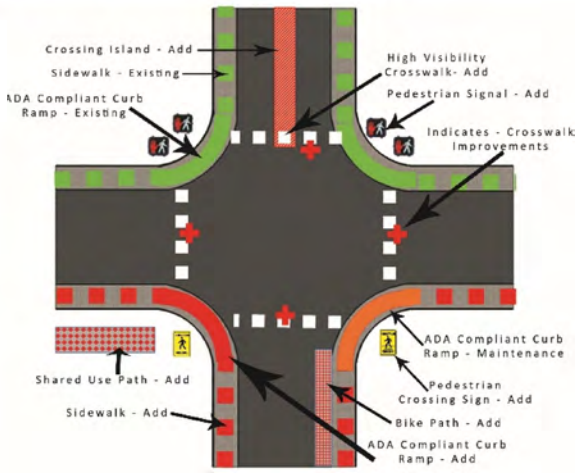


Figure 4-28: King Street & Spring Street – Satellite View and Proposed Elements (Source: Google Maps).

Area 10: Greenways/Shared Use Path

Greenways provide alternate travel choices for residents of Windsor. The proposed greenway facility will provide access from several of the Town's key recreational and tourist amenities and attractions. These include the Town's Frisbee golf course, the Elm Street Campground, the Windsor Treehouse Cabins, and the NC Wildlife Commission Public Boat Ramp. Currently, Elm Street Campground is accessible only by vehicle. The location of the campground and associated facilities on the east side of town limits its accessibility to downtown and other retail options. Providing an off-street multi-use path/greenway connecting the campground, wildlife ramp, and Frisbee golf course to Windsor's downtown would provide both an amenity and an active transportation option for residents and visitors. Greenways and/or shared use paths are off-road alternative transportation choices intended to provide multi-modal transit options for citizens and visitors. Not only will the proposed shared use path provide connections to the facilities listed above, but will also work towards establishing a comprehensive and cohesive pedestrian and cycling transportation network in concert with the other improvements defined in this plan.

The proposed greenway is approximately 2,680 feet in length. The greenway would be constructed as a ten-foot (10') wide asphalt multi-use path. The proposed greenway would utilize several parcels purchased as part of the Hurricane Floyd buyout program as part of the right-of-way for the greenway.

The proposed facility would connect to the sidewalk to the south side of King Street, just east of the King Street bridge.

Figure 4-29: Greenway/Shared Use Path Looking South Adjacent to West Maple Street (see Map 13) – Before (Source: Town of Windsor Parks and Recreation Master Plan, HCP).

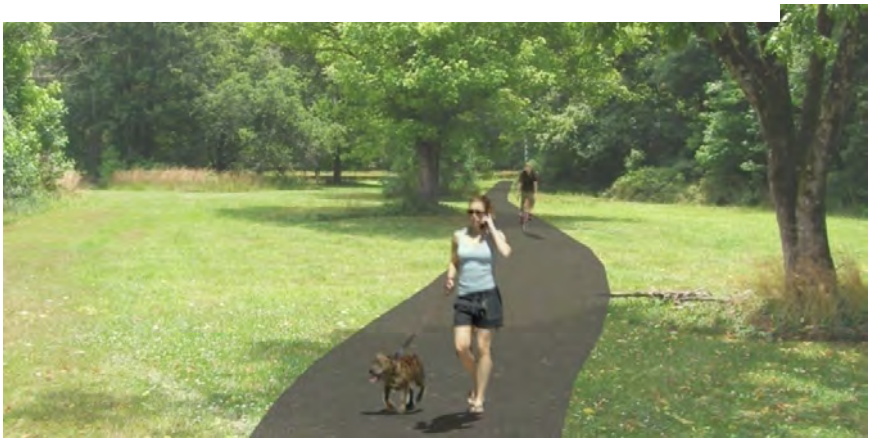


Figure 4-30: Greenway/Shared Use Path Looking South Adjacent to West Maple Street – Proposed (Source: Town of Windsor Parks and Recreation Master Plan, HCP).

Area 10: Existing Conditions

- This proposed greenway is situated in a portion of Town that is prone to flooding and characterized by single-family residential development.
- A majority of the properties involved were acquired through the Hurricane Floyd HMGP Buyout Process.
- This project must tie into existing crossing improvements associated with the King Street bridge.
- An appropriate solution for these improvements must be determined through a more comprehensive planning and design process.

Area 10: Project Justification

- This project has been discussed since the immediate impacts of Hurricane Floyd on the Town of Windsor were realized.
- Since Hurricane Floyd and the three other substantial flooding events in 2015 and Hurricane Matthew in 2016, discussions regarding the benefits of these improvements have been further discussed.
- The proposed greenway/shared use path will work towards the establishment of a comprehensive pedestrian/cycling network throughout the Town of Windsor.

Area 10: Constraints

- A significant portion of this project does not present any issues or problems regarding development and design.
- The project will require acquisition of right-of-way between E. Maple Street and the King Street bridge. Cost estimates for acquisition have not been provided.
- This project will require coordination with NCDOT regarding a tie in between the proposed greenway/shared use path and the King Street bridge crossing.

Area 10: Issues Addressed (as identified in Appendix C Survey Results)

- Provides recreational opportunity and access for residents and visitors.
- Assists with the Town's economic development program by tying into the Town's campground, Frisbee golf course, and treehouse cabins.
- Provides a multi-modal transport option tying together the eastern and western portions of Windsor.

Table 16. Greenway/Shared Use Path Estimates				
Infrastructure Facility	**Average Cost**	**Cost Unit**	**Proposed # of Units**	**Approximate Total**
Multi-Use Trail – Paved	$481,140	Mile	0.51	$245,381
Estimated Total Project Cost				$245,381
NOTE: The facility improvements and cost associated with this project are not included in the summary outlined in Tables 6 & 7 and Appendix D.				
Source: UNC Chapel Hill Highway Safety Research Center.				

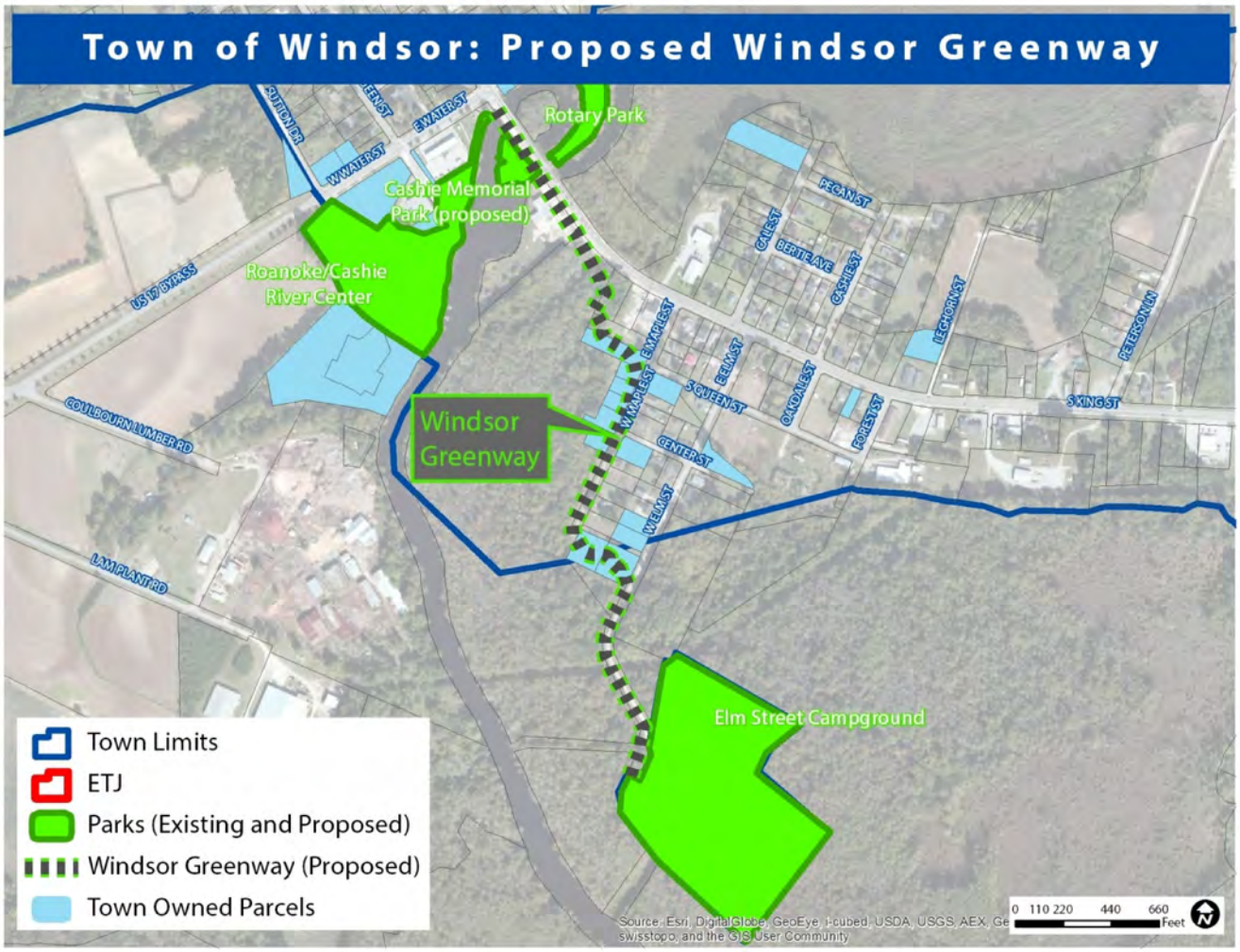


Figure 4-31: Proposed Windsor Greenway (Source: Town of Windsor Parks and Recreation Master Plan, HCP).

Area 11: King Street Redesign

There is ripe opportunity to redesign King Street for greatly improved transportation facilities, following the example of West Jefferson, NC, where Highway Division 11 worked with the town to dramatically improve the downtown streetscape with pavement markings, paint/hard structure curb extensions, and other improvements to better configure the street for downtown placemaking. The pilot project in West Jefferson was completed with paint and other temporary/inexpensive components before the hardscaping could be attempted.

Downtown sidewalks along King Street are among the most frequently used pedestrian facilities in Town; however, at about 10' width, the sidewalks are barely or not quite wide enough to provide a fully functional three-zone downtown sidewalk. A fully functional downtown sidewalk width includes space for a storefront zone, a passage zone, and curbside/utility zone. Curb to curb, the width of King Street downtown is plenty generous (about 48' between Dundee and Granville, and about 40' south of Dundee). This distance allows for the existing 6-8' wide parking lanes on both sides, and two travel lanes that are 17' wide (excessively wide). The average daily traffic on King Street is less than 1,000 vehicles per day, so there is tremendous opportunity to use the excess road width for placemaking and prosperity.

To better use the excessive extra pavement width on King Street, the 17' travel lanes could be reduced in width to 11-12' and this would gain 10 to 12 feet that could be used to install bike lanes, or it could potentially be used to expand the sidewalk width and install curb extensions. This would add room for additional street trees, merchandise display, outdoor dining, public seating, and other uses and improvements suitable to a downtown setting.

Another possibility is that the existing parallel parking spaces could be considered for reconfiguration as back-in angled parking, which will increase the parking supply, improve safety and vision of bikes, pedestrians, and other vehicles, allow easier parking maneuvers, allow easier loading of both cargo and children's car seats, and direct disembarking children safety behind open car doors to the sidewalk rather than the street. Additional information about back-in angled parking can be found at the following website: http://www.pedbikeinfo.org/data/faq_details.cfm?id=3974.

Accessibility for Cyclists

Sharing the road with bicyclists and pedestrians helps to ensure that all residents remain safe during times of travel, regardless of the mode of transportation. Figures 4-33 and 4-34 illustrate how simple it is to accommodate for alternate transportation modes. The stretch of road in the images is Water Street near downtown Windsor. A common entrance into the town from US Highway 17, this corridor is also one of the main arterial roadways from the center of town to the outlying commercial and residential areas.

Additional design resources can be found in Appendix A: Design Guidelines.

Figure 4-32: Water Street – Before (Source: Google Maps).

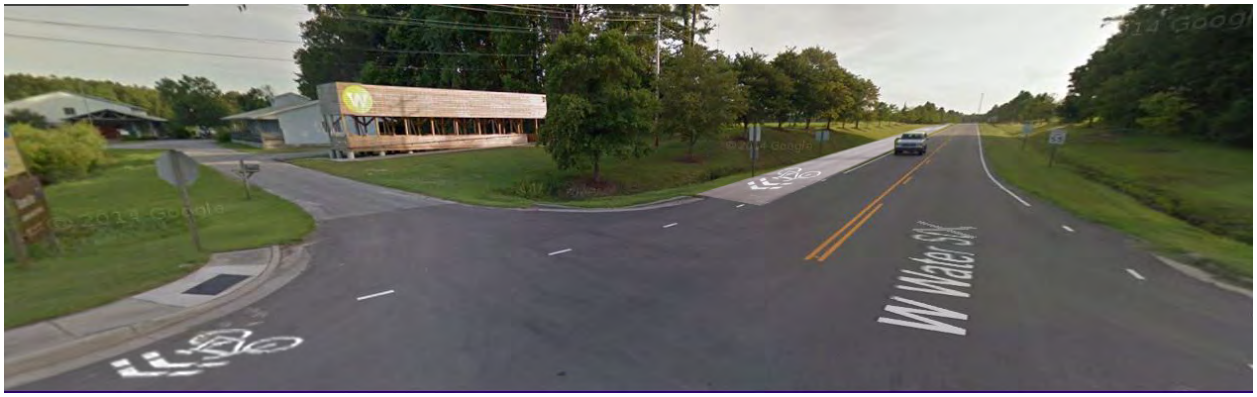


Figure 4-33: Water Street – Proposed (Source: Google Maps, HCP).

Accessibility for Greenways/Shared Use Paths

Accommodating all members of the community is an important aspect that should be practiced during the introduction of bicycle- and pedestrian-friendly facilities and infrastructure. Multi-use trails should comply with the provisions set forth in the Americans with Disabilities Act Accessibility Guidelines (ADAAG). Universal design principles should also be applied to all connections to the multi-use trail, including parking lots, neighborhood connectors, adjoining roadways, and adjoining facilities (rest stops, buildings, restrooms, etc.).

Cross slopes on shared-use paths should not exceed 2%. Running grades should be kept to a minimum to provide for maximum accessibility. Every effort should be made to ensure running grades are kept within ADA guidelines on shared-use paths. In limited circumstances where achieving these grades would be prohibitively expensive or would denigrate a unique natural environment, exceptions can be made to running grade requirements. Making such an exception does not eliminate the responsibility to meet ADA guidelines on all other aspects of trail design.

The following steps should be taken to mitigate steeper grades in these situations:

- Provide flat landings with benches to enable trail users to stop and rest if necessary;
- Provide handrails on the sides of the trail;
- Widen the trail to allow more space for slower users;
- Provide an alternative accessible route and use signage to direct people with physical disabilities to the route.

Steeper downgrades are not recommended at roadway intersection approaches. Every effort should be made to keep intersection approaches at or below a 5% slope in order to reduce the possibility of a bicyclist or other wheeled user losing control and crashing into the intersections.

Section 5: Policies and Programs

Introduction

This chapter of Windsor's Comprehensive Bicycle & Pedestrian Plan includes a general set of policy recommendations that will enable the town to become more bicycle- and pedestrian-friendly over time. Specifically, policies are provided to enhance enforcement, encourage use, and make roadways safe for non-motorized travel. Lastly, funding sources and recent changes to the NCDOT funding formula are summarized as it relates to pedestrian oriented projects.

Enforcement Recommendations

Under North Carolina law, pedestrians have the right-of-way at all intersections and driveways. However, pedestrians must act responsibly, using pedestrian signals where they are available. When crossing the road at any other point than a marked or unmarked crosswalk or when walking along or upon a highway, a pedestrian has a statutory duty to yield the right-of-way to all vehicles on the roadway. It is the duty of pedestrians to look before starting across a highway, and in the exercise of reasonable care for their own safety, to keep a timely lookout for approaching motor vehicle traffic. On roadways where there is no sidewalk, pedestrians should always walk facing traffic. To encourage a safer network for pedestrian travel, motorist enforcement should be a top priority.

Often times, the pedestrian and motorist view one another as a conflicting user. Through enforcement and education, the goal should be for each respective user to respect and recognize each other within the public right-of-way. Common issues creating a real and perceived danger for pedestrians include motorist speeding, a failure to yield within crosswalks, right-turning vehicles not looking both ways, etc. Windsor's police department can take targeted steps to enhance safety for pedestrians. Particular steps to enhance enforcement for the benefit of the pedestrian include the following:

- Enforcing the speed limit on high volume roadways with pedestrian traffic. Example roads include King Street, US Highway 13, US Highway 17 and US Highway 17 Bypass, Grabtown Road, and Cooper Hill Road.
- Work with the school system to train crossing guards. This task may be accomplished through the NCDOT Crossing Guard Training Program.
- Enforce yielding to pedestrians in crosswalks.

Program & Policy Recommendations

Let's Go NC

Let's Go NC is a bicycle and pedestrian safety skills program for children in North Carolina. The bicycle component of the curriculum is based on the 1990's Basics of Bicycling Curriculum, developed for fourth and fifth graders. The pedestrian component is based on the National Highway Traffic Safety Administration pedestrian curriculum. Both components are modified for North Carolina and for use to instruct children in grades K-5. The program encourages children to be healthy and active by teaching the skills necessary for safely participating in bicycling and walking activities. The curriculum is available online and includes Safe Routes to School components, classroom curriculum materials, and videos and exercises.

The program should be developed through the Bertie County school system. The curriculum includes encouragement for teachers who are responsible for educating students on the program's curriculum. With the assistance and support of the North Carolina Active Transportation Alliance (NCATA) or local advocacy organizations, information should be available to schools and non-profits. These materials would be used to educate students on fun and safe ways to walk and bike to school.

Walking Programs

Walking programs such as a "Weekend Walkabout" are regularly occurring events that promote walking while also bringing attention to pedestrian infrastructure. "Weekend Walkabouts" could be scheduled and held in each region of the state in conjunction with the statewide Walk to School Day that takes place each fall. The events' walking routes should highlight safe and inviting places to walk in the public realm (rather than private or enclosed facilities such as walking tracks) and should be three miles or less in length. These events are ideal for families and seniors. Different walking programs may be organized based on themes for each event, such as an architectural tour, a "Steeple Chase" tour (visiting historic churches), a tour of parks, neighborhood strolls, etc. Follow the links below for more information:

- Safe Routes National Center – North Carolina: https://connect.ncdot.gov/projects/BikePed/Documents/NCDOT_SRTS_Description.pdf
- Walk/Bike to School Day: http://www.walkbiketoschool.org/
- Walking School Bus: http://www.walkingschoolbus.org/

Another method that the town may utilize to promote walkability is to establish a walking tour map that highlights key community and recreational opportunities. This map will also serve the town's economic development goals.

"Watch for Me NC" Pedestrian Campaign

Watch for Me NC is a comprehensive program, run by the North Carolina Department of Transportation (NCDOT) in partnership with local communities, aimed at reducing the number of pedestrians and bicyclists hit and injured in crashes with vehicles. The Watch for Me NC program involves two key elements:

- Safety and educational messages directed towards drivers, pedestrians, and bicyclists; and
- Enforcement efforts by area police to crack down on some of the violations of traffic safety laws.

Local programs are typically led by municipal, county, or regional government staff with the involvement of many others, including pedestrian and bicycle advocates, town planners, law enforcement agencies, engineers, public health professionals, elected officials, school administrators, and others.

The program, which started with a pilot program in Wake, Durham, and Orange counties in 2012, each year invites communities across North Carolina to become partner communities. As part of that effort, partner communities receive additional support and training from NCDOT.

The next application cycle is anticipated to open in January or February of 2018. See the link below for more information: http://www.watchformenc.org/. The Town may participate by visiting WatchForMeNC.org and downloading materials and information that may be used right away. The Town should also apply when the Call for Participants is issued, typically in February of each year (see website for contact information and notice of the annual program opening).

NCDOT School Crossing Guard Program

As traffic continues to increase on North Carolina's streets and highways, concern has grown over the safety of children as they walk to and from school. At the same time, health agencies, alarmed at the increase in obesity and inactivity among children, are encouraging parents and communities to get their children walking and biking to school.

In response, the Division of Bicycle and Pedestrian Transportation funded a study on pedestrian issues, including school zone safety, and decided to establish a consistent training program for law enforcement officers responsible for school crossing guards. According to the office of the North Carolina Attorney General, school crossing guards may be considered traffic control officers when proper training is provided as specified in GS 20-114.1. More information can be found at http://www.ncdot.gov/bikeped/about/training/school_crossing_guard/.

Active Routes to School Program/Safe Routes to School Program

North Carolina's Active Routes to School (ARTS) Program aligns Safe Routes to School (SRTS) with the North Carolina Community Transformation Grant Project. The program is designed to assess and evaluate the ability to implement non-motorized transportation improvements in K-8 schools. There are ten regions currently assisting the state. Windsor is located in Region 9. The Active Routes to School Coordinator for Region 9 is Leah Mayo Acheson. The ARTS program is taking more local participants on a first-come basis through June 2019. After that date, the program will enter a new funding cycle which is undetermined at the present time. Communities that are not formally participating in ARTS can always participate in Safe Routes to School through the self-help program recommendations and steps available at https://www.ncdot.gov/bikeped/safetyeducation/SafeRoutestoSchools/.

Safe Routes to School (SRTS) is a program that enables and encourages children to walk and bike to school. The program helps make walking and bicycling to school a safe and more appealing method of transportation for children. SRTS facilitates the planning, development, and implementation of projects and activities that will improve safety and reduce traffic, fuel consumption, and air pollution in the vicinity of schools. The North Carolina Safe Routes to School Program is supported by federal funds through SAFETEA-LU and MAP-21 legislation. Please note that all SRTS projects "shall be treated as projects on a Federal-aid system under Chapter 1 of Title 23, United States Code." Although no local match is required and all SRTS projects are 100% federally funded under the SAFETEA-LU, agencies are encouraged to leverage other funding sources that may be available to them, including grant awards, local, state, or other federal funding. SRTS funds can be used for proposed projects that are within 2 miles of a school, public or private, K-8, in a municipality or in the county jurisdiction. In response to the Strategic Transportation Investments law of June 2013, proposed SRTS projects will be considered as part of the Bicycle and Pedestrian project input with Strategic Prioritization Office for funding consideration. Most of the types of eligible SRTS projects include sidewalks or a shared-use path. However, intersection improvements (i.e., signalization, marking/upgrading crosswalks, etc.), on-street bicycle facilities (bike lanes, wide paved shoulders, etc.), or off-street shared-use paths are also eligible for SRTS funds. A more inclusive list can be found at the FHWA SRTS program website (www.saferoutesinfo.org).

Complete Streets Policy

Communities adopt Complete Streets policies for many reasons. Many local policies originate from a desire to improve safety for people walking and bicycling to their destinations and to encourage more walking and bicycling as a way to improve public health. Improving access to public transportation by making it safer, easier, and more attractive for all, including older residents and those with disabilities, is another driving factor in many communities. Safe Routes to School/Active Routes to School proponents also see the Complete Streets policy as essential in providing complete, safe routes for children heading to school. Some communities have rallied around a more equitable vision for transportation that provides better access to employment and educational opportunities in all neighborhoods, regardless of income or ethnicity.

The North Carolina Department of Transportation defines Complete Streets as "an approach to interdependent, multimodal transportation networks that safely accommodate access and travel for all users." More information can be found at http://www.completestreetsnc.org/.

An example Complete Streets Policy is provided below. This example, with adjustments as set forth by the Windsor Board of Commissioners, may be adopted as is.

> *The Town of Windsor shall ensure that the safety and convenience of all users of the transportation system are accommodated, including pedestrians, bicyclists, people with disabilities, the elderly, motorists, freight providers, emergency responders, and adjacent land users by creating a connected network of facilities accommodating each mode of travel that is consistent with and supportive of the local community, recognizing that all streets are different and that the needs of various users will need to be balanced in a flexible manner.*
>
> *In conjunction with projects relating to the design, planning, construction, reconstruction, resurfacing, rehabilitation, or maintenance of Town streets, departments, boards and commissions of the Town of Windsor shall give full consideration to the accommodation of the transportation needs of all users identified above.*
>
> *Facilities for all users will be considered on Town streets, except under one or more of the following conditions:*
>
> - *An affected roadway prohibits, by law, use by specified users, in which case a greater effort shall be made to accommodate those specified users elsewhere, including on roadways that cross or otherwise intersect with the affected roadway; or*
> - *The costs of providing accommodation are excessively disproportionate to the need or probable use; or*
> - *The existing and planned population, employment densities, and traffic volumes around a particular roadway as documented by the Windsor Planning Department are so low that future expected users of the roadway will not include pedestrians, freight vehicles, or bicyclists.*
>
> *Documentation shall be publicly available and exceptions for Town projects shall be granted by the Board of Commissioners and Mayor.*
>
> *The implementation of this Policy shall reflect the context and character of the surrounding built and natural environments, and enhance the appearance of such.*

To discern the success of this complete streets policy the following performance measures shall be inventoried:

- *Linear feet of new pedestrian accommodation;*
- *Number of new curb ramps and intersection enhancements installed along Town streets;*
- *Total miles of on-street bicycle lanes/routes defined by streets with clearly marked or signed bicycle accommodation;*
- *Number of new street trees planted along Town streets.*

The following provides a summary of all elements that should be incorporated into the Town's Complete Streets Policy. These elements reflect the needs and deficiencies outlined in Section 2.

- Include a vision for how and why the community wants to modify the existing street network.
- Specify that "all users" includes pedestrians, bicyclists, and passengers utilizing regional transit options of all ages and abilities, as well as trucks, buses, and automobiles.
- Apply to both new and retrofit projects, including design, planning, maintenance, and operations, for the entire right-of-way.
- Make any exceptions specific and set a clear procedure that requires high-level approval of exceptions.
- Encourage street connectivity and aim to create a comprehensive, integrated, connected network for all modes.
- Direct the use of the latest and best design criteria and guidelines while recognizing the need for flexibility in balancing user needs.
- Direct that Complete Streets solutions will complement the context of the community.
- Establish performance standards with measurable outcomes.
- Include specific next steps for implementation of the policy.

Development Standards

The Town should consider updating its development standards for subdivisions and site plans to require that new development and significant re-development connect via ADA-compliant routes to existing Town sidewalks and/or rights-of-way. New development should also construct sidewalks, or pay in-lieu fees for sidewalk construction, along street frontages. The requirements should be applied to an entire corridor, not applied depending on land use, because varying the requirements by type of land use will result in a variable/disconnected network along corridors. Also, access management policies (driveways) should also be reviewed for their impact on the pedestrian and bicycle network.

East Coast Greenway

The East Coast Greenway (ECG, https://www.greenway.org/) is a multi-use trail that extends from Maine to Florida, and it passes directly through Windsor (starting north of Windsor on Hoggard Mill Road, and following US 13 into Town on North King Street, then following Broad Street and North York Street to East Granville Street and out of Town along South Granville Street and US 13/17). Long-distance recreational cyclists traveling the ECG need places to stay, public restrooms, food and beverages, and services as they travel, so towns along the ECG are using it as an economic development opportunity. Windsor can capitalize on this theme in business development efforts by offering some public improvements designed to entice riders to stop or stay in the Town, spending money while they are there.

Methods for Developing Facilities

The following describes types of transportation facility construction and maintenance projects that can be used to create new facilities. Note that roadway re-construction projects offer excellent opportunities to incorporate facility improvements for bicyclists and pedestrians. It is much more cost-effective to provide a bicycle or pedestrian facility when these road projects are implemented than to initiate the improvement as a "retrofit."

In order to take advantage of upcoming opportunities to incorporate recommendations into routine transportation projects, the Town should continue to track the NCDOT repaving schedules, and other lists of projects. The following facility development methods primarily benefit cyclists.

Restriping

The simplest type of restriping project is the addition of bicycle lanes, edgelines, or shoulder stripes to streets without making any other changes to the roadway. Bicycle lanes, edgelines, and shoulder stripes can also be added by narrowing the existing travel lanes or removing one or more travel lanes. In some locations where the existing lanes are 12 to 13 feet wide, it may be possible to narrow them to 10 feet. This effort requires changing the configuration of the roadway during a resurfacing project.

Resurfacing

Resurfacing (repaving) projects provide a clean slate for revising pavement markings. When a road is resurfaced, the roadway should be restriped to create narrower lanes and provide space for bike lanes and shoulders. In addition, if the space on the sides of the roadway has a relatively level grade and few obstructions, the total pavement width can be widened to include paved shoulders. Opportunities to achieve this effort in Windsor are limited, but include the right-of-ways indicated for dedicated bike lanes and shared land markings as shown on Map 13.

Roadway Construction and Reconstruction

Bicyclists and pedestrians should be accommodated any time a new road is constructed or an existing road is reconstructed. In the long term, all new roadways should have on-road bicycle facilities and sidewalks.

Signage and Wayfinding Projects

Signage along specific routes or in an entire community can be updated to make it easier for people to find destinations throughout the Town's Central Business District. Bicycle route signs are one example of these wayfinding signs, and they can be installed along routes independent of other signage projects or as a part of a more comprehensive wayfinding improvement project.

Context Sensitive Design

Context Sensitive Design changes the thinking and design of transportation planning so that roadways accommodate communities rather than communities accommodating roadways. Many of the principles of Context Sensitive Design are reflected in this planning document, but it is still important that the community establish policy standards that reflect these principles. Policies should ensure that all roadway projects are designed to maximize the safety of the facility user and the safety of the surrounding community. The policies should also require that all transportation facility construction be completed in a manner that is consistent with the community's economic, social, and environmental objectives. In the end, the benefits of embracing this type of approach to transportation planning are a more efficient use of transportation construction dollars, better preservation of community resources, increased safety, and improved livability in the community.

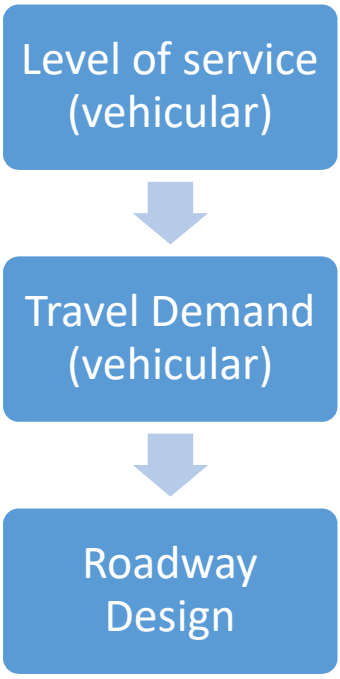


Figure 5-1: Conventional approach to roadway design is a linear process.

Continued adherence to the principles of Context Sensitive Design will require the full support of the locally elected officials as well as continued support through state-level transportation actions. These efforts should be coordinated with the Complete Streets Policy program discussed on page 5-4.

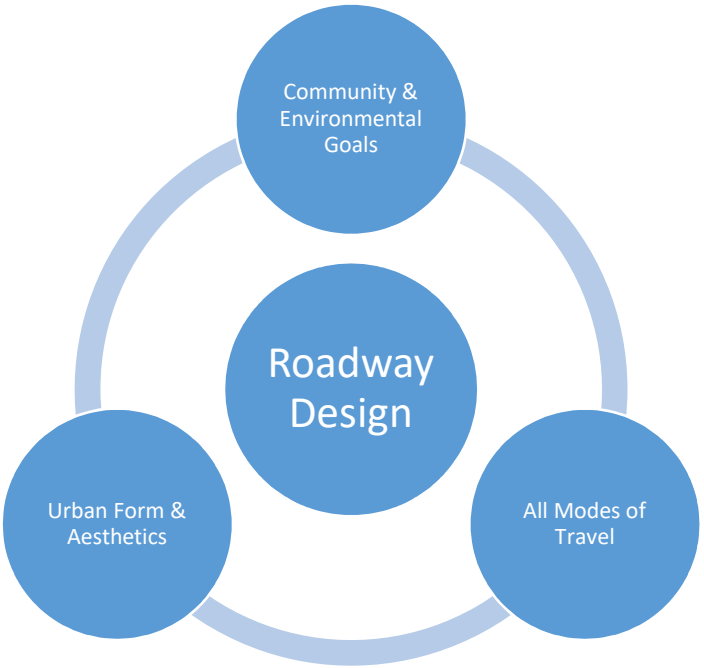


Figure 5-2: The context sensitive approach to roadway design includes more stakeholders and specifically addresses all community needs. The process results in a feedback loop.

Funding Sources

As part of the Fixing America's Surface Transportation (FAST) Act of 2015, the North Carolina General Assembly authorized the North Carolina Department of Transportation "to spend any federal, state, local, or private funds available to the Department and designated for the accomplishment" of fulfilling the duties laid out through the Act, and clearly stated that bicycle facilities" are a *bona fide* highway purpose, subject to the same rights and responsibilities, and eligible for the same considerations as other highway purposes and functions." (See G.S. 136-71.8 Findings and 136-71.12 Funds). MAP-21, the Moving Ahead for Progress in the 21st Century Act (P.L. 112- 141), was signed into law by President Obama on July 6, 2012. Funding surface transportation programs at over $105 billion for fiscal years 2013 and 2014, MAP-21 is the first long-term highway funding authorization enacted since 2005.

MAP-21 is a milestone for the U.S. economy and the Nation's surface transportation program. By transforming the policy and programmatic framework for investments to guide the system's growth and development, MAP-21 creates a streamlined and performance-based surface transportation program and builds on many of the highway, transit, bike, and pedestrian programs and policies established in 1991. In North Carolina, all bicycle and pedestrian projects are prioritized and scheduled into the State Transportation Improvement Program with the exception of projects funded locally. Bicycle and pedestrian projects may be funded with Federal funds; however, it should be noted that State monies cannot be utilized as a match related to bicycle and pedestrian improvement projects. Due to this fact, the Town should establish and maintain a line item in their General Fund operating budget to generate revenue needed to meet this match as this plan is implemented.

State Transportation Improvement Program

Bicycle and pedestrian projects across North Carolina can be included in NCDOT's State Transportation Improvement Program (STIP) outlining transportation priorities for the next ten years. However, based on current state legislation, NCDOT does not provide any state funds for independent bicycle and pedestrian projects. This fact means that the 20% match for federal funding must be provided by the local government seeking the project. The STIP indicates when each phase of a project is slated to begin and the cost of each project phase. Improvements for bicycling and walking may also be included in the STIP as part of the construction of a highway project, in which case they may be built partially using state funds according to cost share policies. The STIP projects are determined through the strategic prioritization process. Every two years, the Peanut Belt Rural Planning Organization (RPO) is given an opportunity to recommend bike and pedestrian projects to be included in the STIP. The submitted projects are prioritized and ranked through a methodology created by Division staff. The prioritized STIP projects are then included in the 5-year Work Program and the 10-year Program & Resource Plan.

Through NCDOT, there are a variety of funding programs comprised of Federal-Aid and/or State dollars. There are also other funding opportunities for projects and programs related to bicycle and pedestrian transportation which are not administered by NCDOT. Other state agencies and local governments may be more appropriate resources, depending upon the project. In addition, some communities look toward non-profit organizations, foundations, businesses, or other creative public/private partnerships to provide capital or resources as a way to move a project, program, or activity from a concept into reality. Much of the funding that passes through NCDOT is derived from the varying categories of Federal Aid Construction Funds, including National Highway System (NHS), Surface Transportation Program, or Congestion Mitigation and Air Quality funds. However, the

state does provide some State Construction Funds for the construction of sidewalks and bicycle accommodations that are part of roadway improvement projects. It should be noted that state funds may not be utilized as a match for bicycle and pedestrian projects. This will require that the town establish a dedicated fund balance to meet this match.

Strategic Transportation Initiatives – Funding Formula

The Strategic Mobility Formula component of the Strategic Transportation Investments bill (passed into law in 2013) outlines the general structure of NCDOT's project prioritization process. The formula includes t three funding categories – Statewide Mobility, Regional Impact, and Division Needs. Bike and pedestrian projects are only eligible within the Division Needs category. Metropolitan Planning Organizations (MPOs), Rural Planning Organizations (RPOs), and NCDOT Divisions may submit projects through the prioritization process. In Windsor, the Peanut Belt RPO would submit proposed projects to be funded through the STIP. Independent bike and pedestrian projects (shared-use paths, bike lanes, sidewalks, intersection improvements, etc.) are comparatively evaluated for possible inclusion in the STIP based on safety, access, demand/density, constructability, and benefit-cost criteria. The Town will have to offer the local funding match for independent (stand-alone) bike or pedestrian projects proposed for the STIP, since state funds are not available for these projects.

Bike/pedestrian projects must compete among all other transportation modes with projects across all modes ranked collectively. Projects that score well are selected for programming in the State Transportation Improvement Program. This process occurs every two years. Priority projects are included in the developmental STIP (years 6 to 10) and the 10-year Program & Resource Plan. Further information on state transportation funding legislation and the prioritization process can be found at the following website: https://connect.ncdot.gov/projects/planning/.

Other NCDOT Funding

Below is a list of other funding sources within NCDOT for a range of bicycle and pedestrian programs.

- Governor's Highway Safety Program (GHSP) http://www.ncdot.gov/programs/GHSP/default.html
- State Street-Aid (Powell Bill) Program http://www.ncdot.gov/programs
- 2017 Bicycle Helmet Initiative https://www.ncdot.gov/bikeped/safetyeducation/helmet_initiative/
- NCDOT Spot-Safety Funds (Division discretionary funds)

Pedestrian Capital Improvement Program (CIP)

A Capital Improvement Program (CIP) is a method for developing funding to implement capital projects. A municipality such as Windsor would use a CIP as a plan/program that assesses capital facility needs in a jurisdiction against its overall goals and objectives, using a multi-year planning horizon – usually five years. The capital plan contains projects budgeted in the current fiscal year as well as projects in subsequent years for which funding may not have been obtained or authorized. Since the CIP is not a legally binding document, it can and does change in the "out" years. The CIP is often spoken of as a rolling document since older projects drop off and new ones are added each year. A dedicated funding source can be identified to fund items contained in the CIP.

Other Funding Sources

The NC Department of Environment and Natural Resources also provides funds for bicycle and pedestrian projects. The NC Department of Health and Human Services may be a resource for educational and safety programs that increase physical activity and improve health. The following provides a list of additional sources:

- NC Recreational Trails Program
- NC Parks and Recreation Trust Fund Program
- National Scenic Byways Program
- Federal Transit Administration Grants
- Highway Safety Improvement Program
- National Park Service – Rivers, Trails, and Conservation Assistance Program
- Bureau of Land Management – Travel Management Implementation
- National Trails Training Partnership – Funding and Resources
- Walkinginfo.org – Funding Resources and Research

Various State and Federal Policies

- Complete Streets Policy http://www.completestreetsnc.org/
- NCDOT Bicycle Policy
- https://www.ncdot.gov/bikeped/download/bikeped_laws_Bicycle_Policy.pdf
- NCDOT Greenway Policy
  https://www.ncdot.gov/bikeped/download/bikeped_laws_Greenway_Admin_Action.pdf

Section 6: Implementation

Introduction

In order to fully implement the recommendations contained in this plan, it is suggested that the town's elected officials, staff, and citizenry take time, care, and effort. Many communities choose to appoint a specific board or commission that is charged with implementing the recommendations contained in a plan. If Windsor were to do so, ideally a bicycle and pedestrian advisory committee would be appointed. This group should consist of local officials, citizens, and staff. The committee should meet quarterly to track progress of the bicycle and pedestrian plan and identify opportunities that may arise as a result of standard road maintenance projects.

Additionally, Windsor officials should take strides to implement this plan over time. Recommended facilities should be constructed/installed over the course of many years. The town should track these improvements on a yearly basis and set target goals regarding the number of improvements to the pedestrian network that should be met during a set amount of time.

Strategies

Strategies for plan implementation are provided in the following table. For each strategy, a timeline, a responsible party, and plan section reference is included.

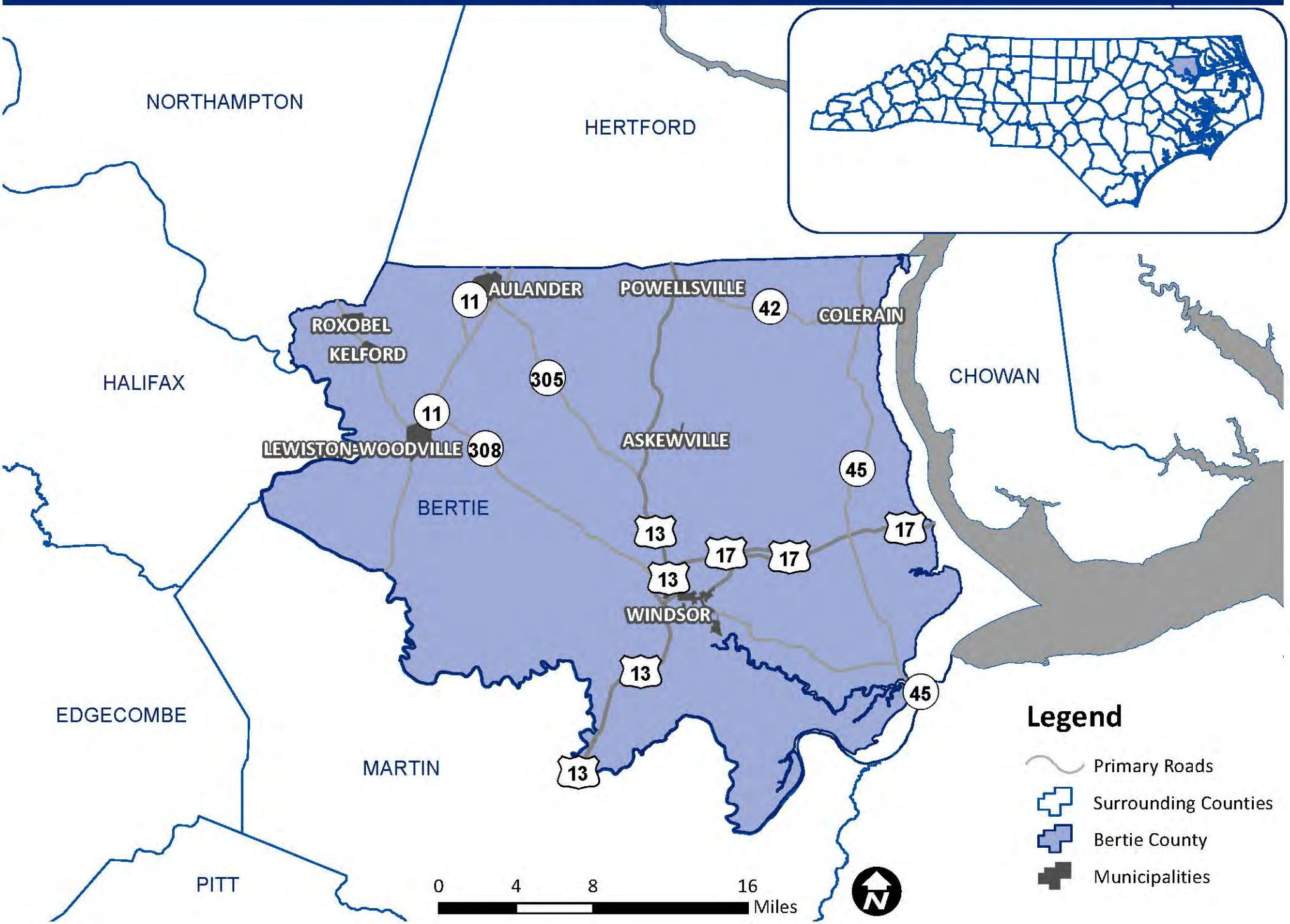
Implementation Strategy	Timeframe	Responsible Party	Section Reference
Establish a Bicycle and Pedestrian Advisory Committee (BPAC). The committee should meet quarterly to track progress of the plan and make recommendations regarding implementation and funding. An existing town committee can also function in this capacity.	Short-term	Board of Commissioners	Chapter 4
Create a five- to six-year Pedestrian Capital Improvement Program (CIP). The CIP should be based upon the prioritization of projects outlined by the Bicycle and Pedestrian Advisory Committee.	Short-term	BPAC	Chapter 4
Identify and establish a dedicated fund for pedestrian capital improvement projects. This dedicated fund should address the fact that all funded projects will require a 20% local fund match. This fund may accrue through annual capital budgeting.	Short-term	Board of Commissioners	N/A
Pursue funding opportunities to construct projects identified in the CIP. Coordinate with the NCDOT Division 1 engineer & planning engineer.	Medium-term	Town staff; Board of Commissioners; BPAC	Chapter 4 & 5
Adopt a Complete Streets Policy	Medium-term	Town staff; Board of Commissioners; BPAC	Chapter 5

Implementation Strategy	Timeframe	Responsible Party	Section Reference
Pursue grant funding through the Safe Routes to School Program. Identify schools, such as Windsor Elementary, which are in need of sidewalk connections.	Medium-term	Town staff; Board of Commissioners; Bertie County Schools; BPAC	Chapter 5
Work with local schools and NCDOT to identify education and enforcement programs suitable for the town.	Medium-term	Town staff; Board of Commissioners; Bertie County Schools: BPAC	Chapter 5
Create a walking tour map that traverses several pedestrian destinations, particularly within the downtown area.	Long-term	Town staff; BPAC	Chapter 3 & 4
Work with the Bertie County School system to develop "Let's Go NC" curriculum.	Long-term/ Ongoing	Town staff; Board of Commissioners; Bertie County Schools; Bertie County Board of Commissioners; BPAC	Chapter 5
Submit an application to participate in the "Watch for Me NC" program to address bicycle and pedestrian safety in the community.	Long-term/ Ongoing	Town staff; Board of Commissioners; BPAC	Chapter 5
Establish performance measures based upon the use of existing and constructed pedestrian facilities.	Long-term/ Ongoing	Town staff; Board of Commissioners; BPAC	Chapter 4
Continue to track NCDOT paving schedules in an effort to maximize the benefits of these efforts, where feasible.	Quarterly	Town staff, BPAC, NCDOT	Chapter 5
Implement the improvements outlined on page 4-5 regarding access and crossing improvements along Cooper Hill Road adjacent to Windsor Elementary School. Continue to monitor the conditions around school sites and make improvements where necessary	Short-term	Board of Commissioners	Chapter 5
Maintain close contact with NCDOT Division 1 staff regarding the division's 3-year resurfacing/restriping schedule. This effort will ensure that when the opportunities for resurfacing/restriping efforts occur, recommendations in this plan are taking into consideration.	Short-term	Town staff, Board of Commissioners, BPAC	Chapter 3
Work towards implementation of this plan including design and development of all projects identified as areas of concern, as well as all cycling and pedestrian improvements outlined in Chapter 4 of the plan.	Short-term	Town staff, Board of Commissioners, BPAC	Chapter 4
Consider a redesign of King Street downtown in accordance with the recommendation outlined on page 4-36.	Long-term	Town staff, Board of Commissioners, BPAC	Chapter 4

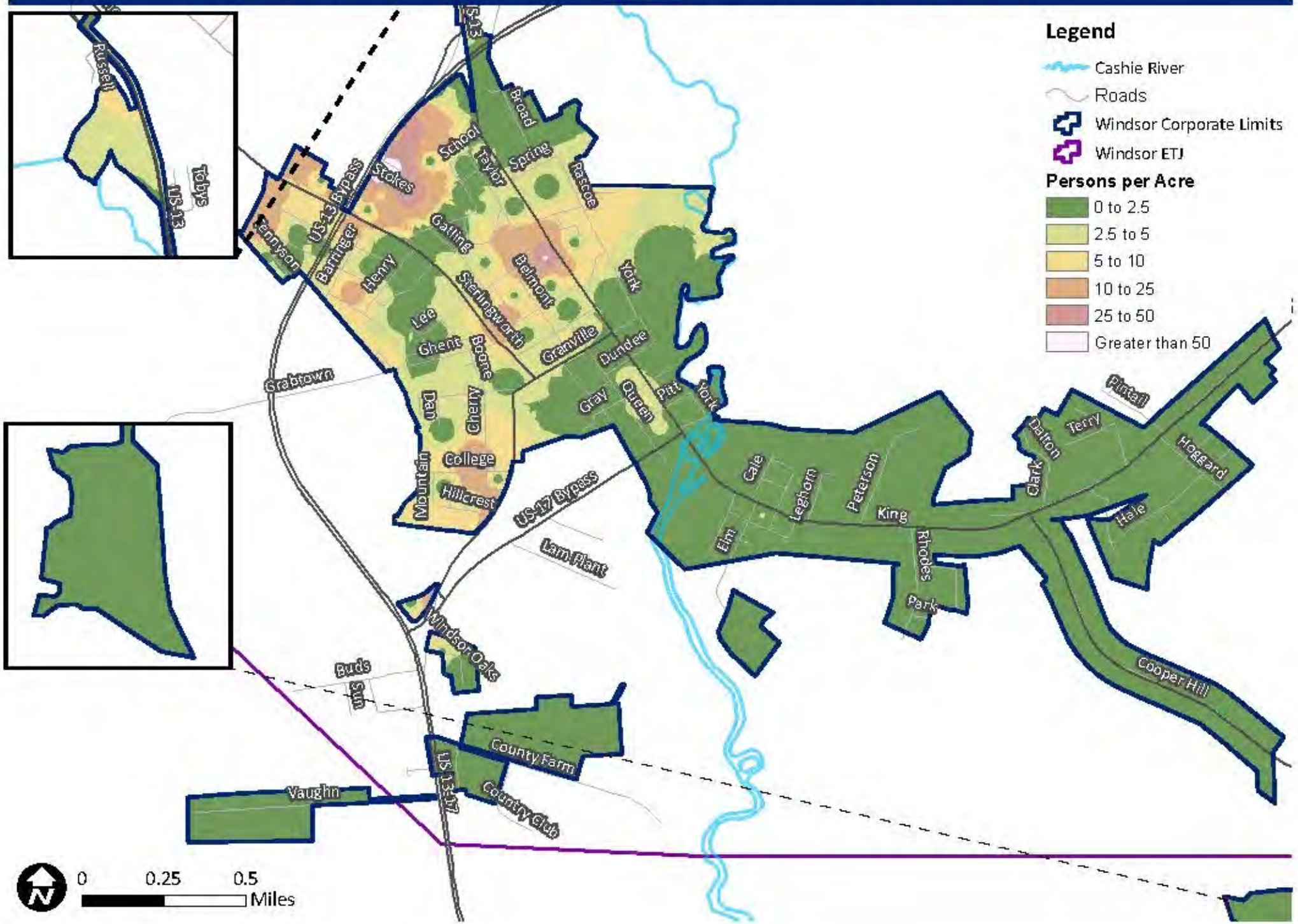
Implementation Strategy	Timeframe	Responsible Party	Section Reference
Consider amending Town development standards to accommodate increased multi-modal transportation options in accordance with the recommendations outlined on page 5-5.	Short-term	Staff, Board of Commissioners, BPAC	Chapter 5
Support and work towards implementation and development of the East Coast Greenway as discussed on page 5-6.	Medium-term	Board of Commissioners, BPAC	Chapter 5

Appendix A: Full-Size Maps

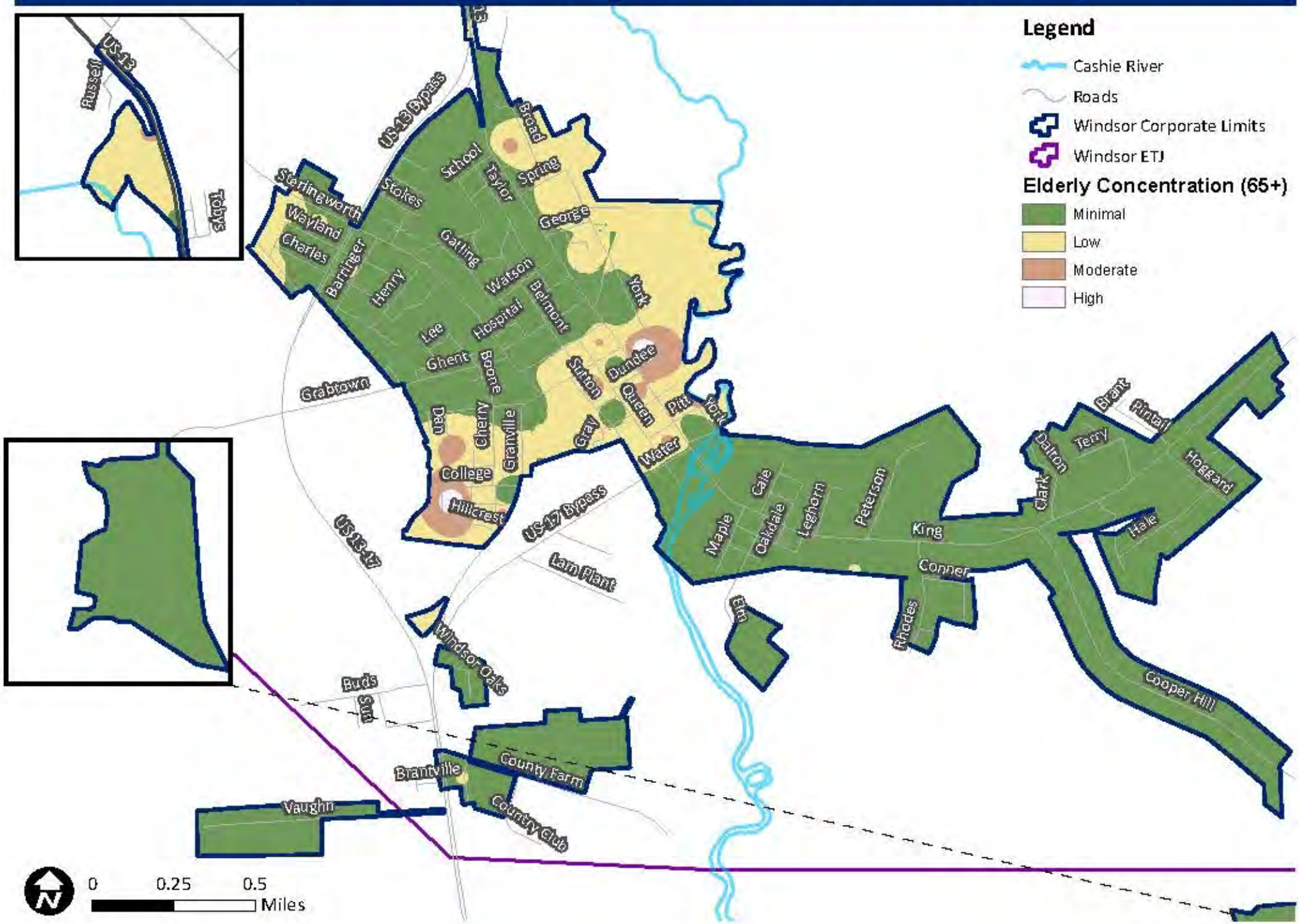
Map 1: Regional Location



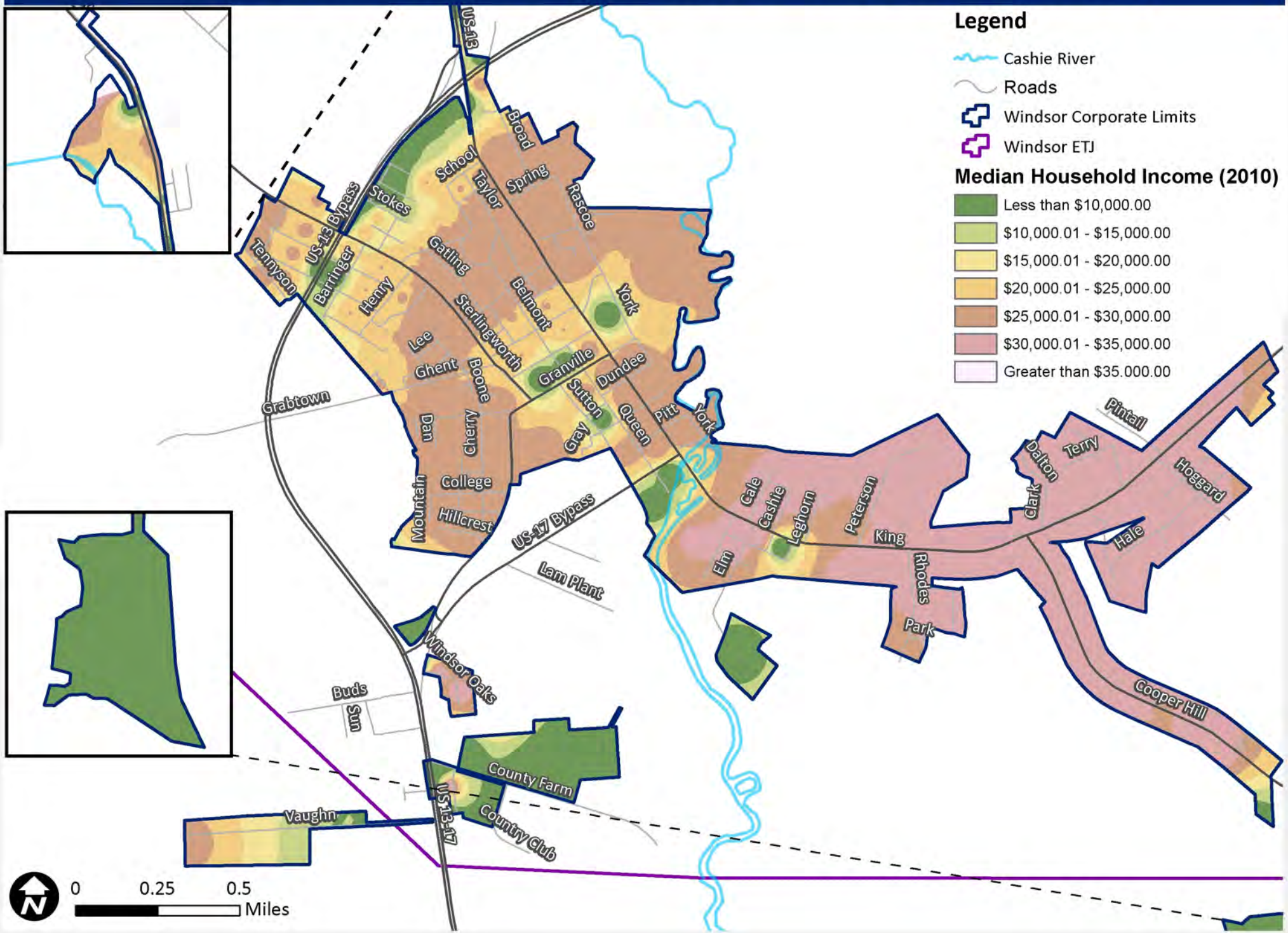
Map 2: 2010 Population Density



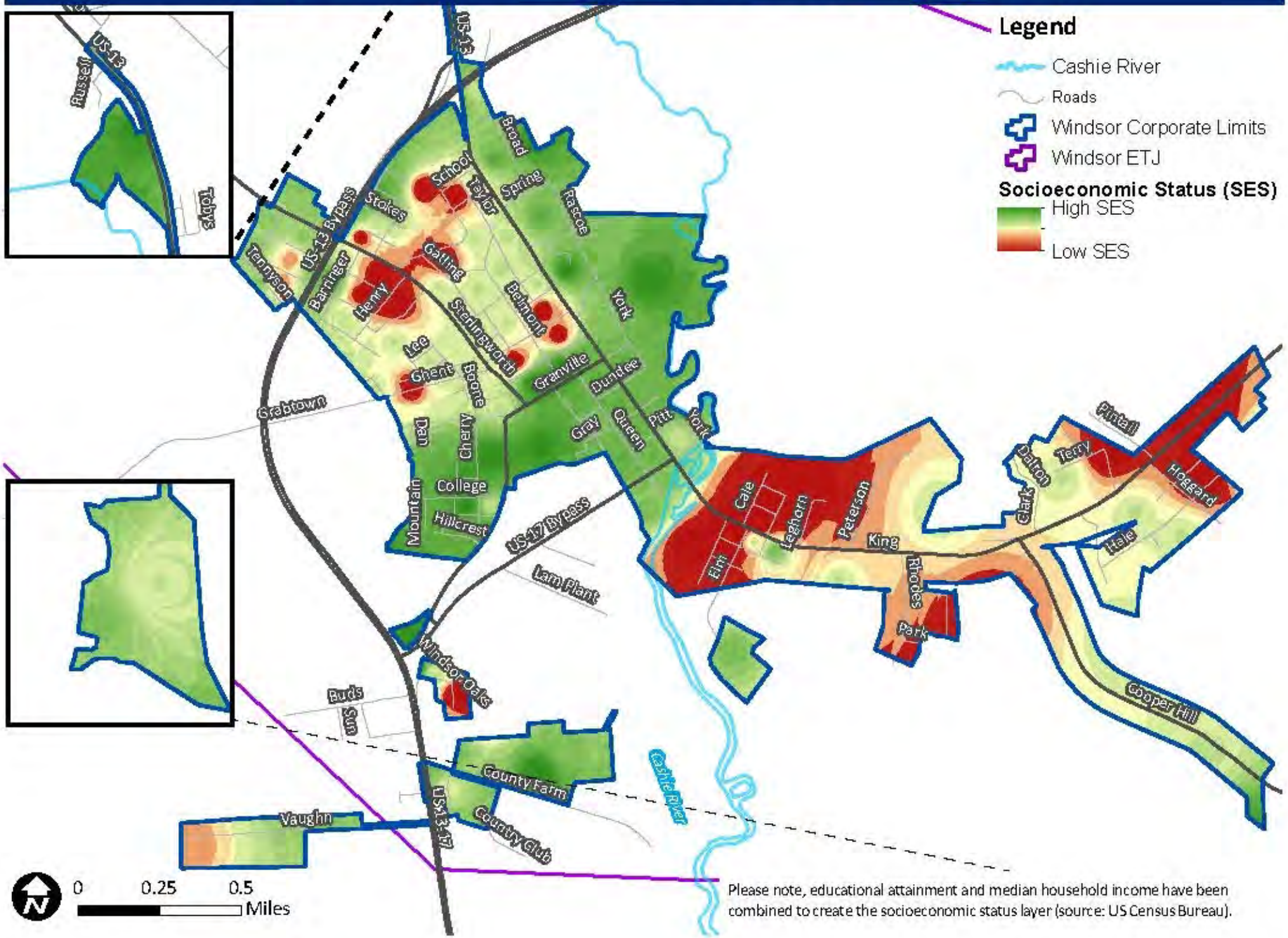
Map 3: Elderly Concentration (65+)



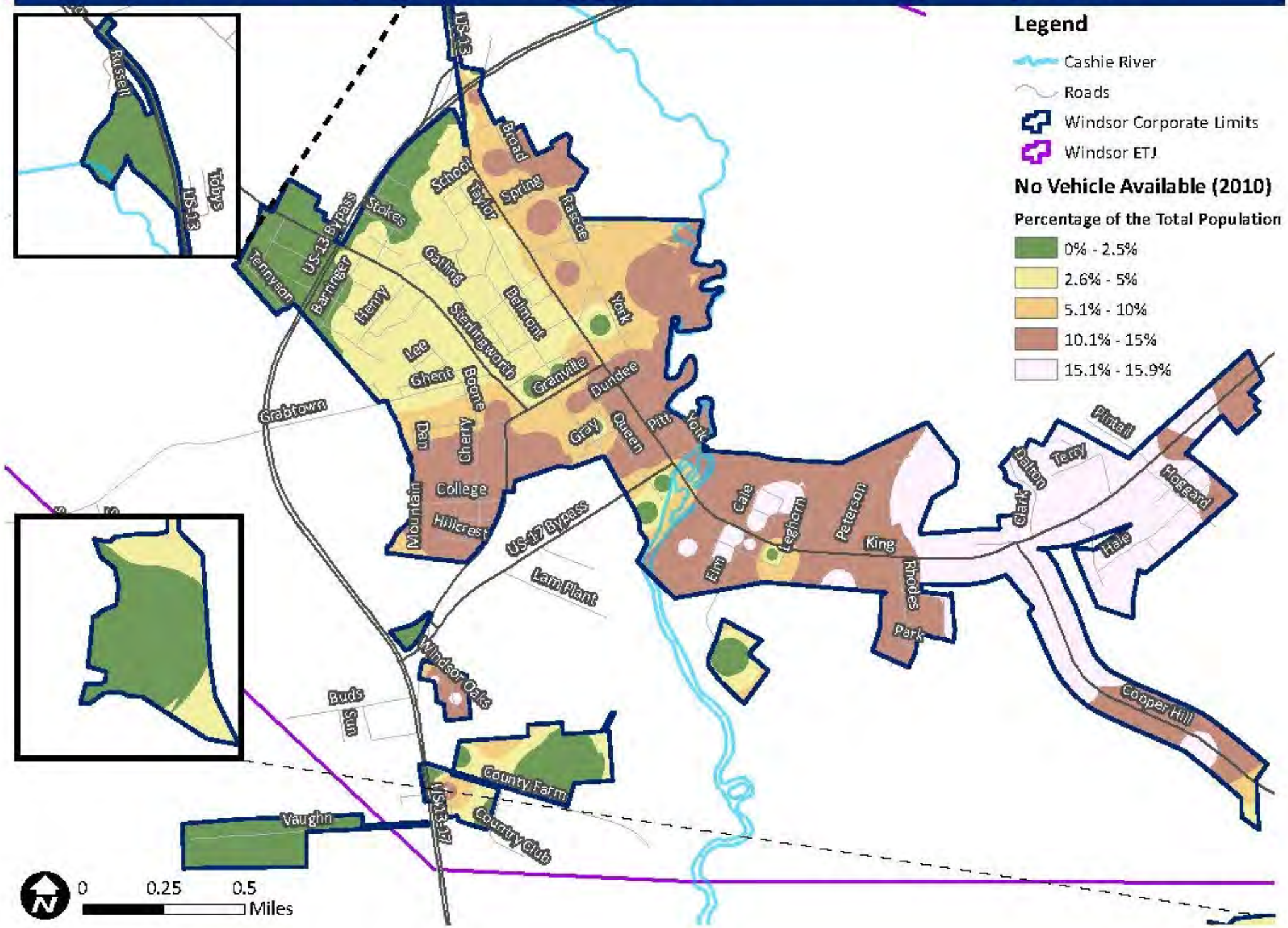
Map 4: Median Household Income (2010)



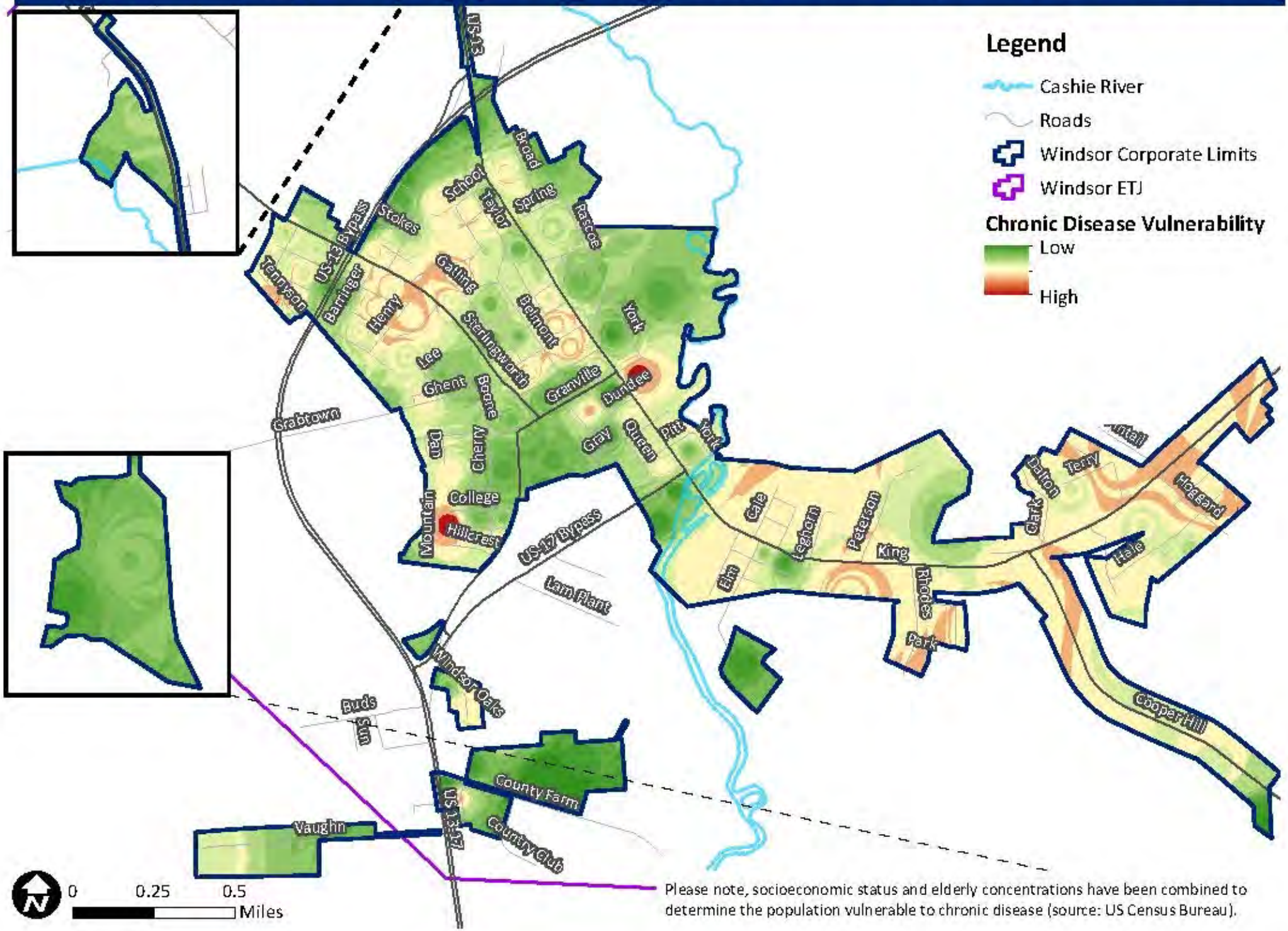
Map 5: Socioeconomic Status (SES)



Map 6: Population with No Vehicle Available

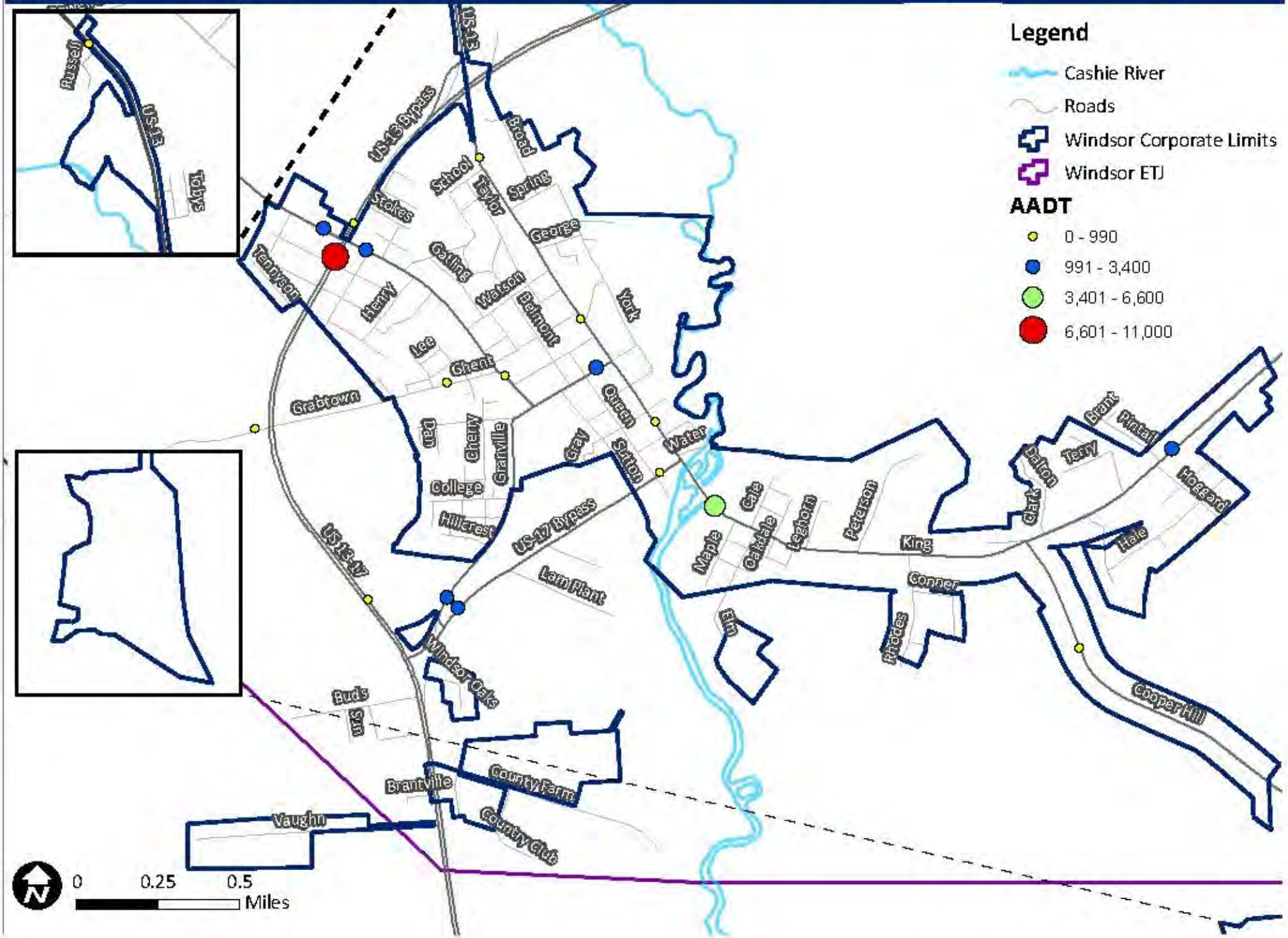


Map 7: Population Vulnerable to Chronic Disease



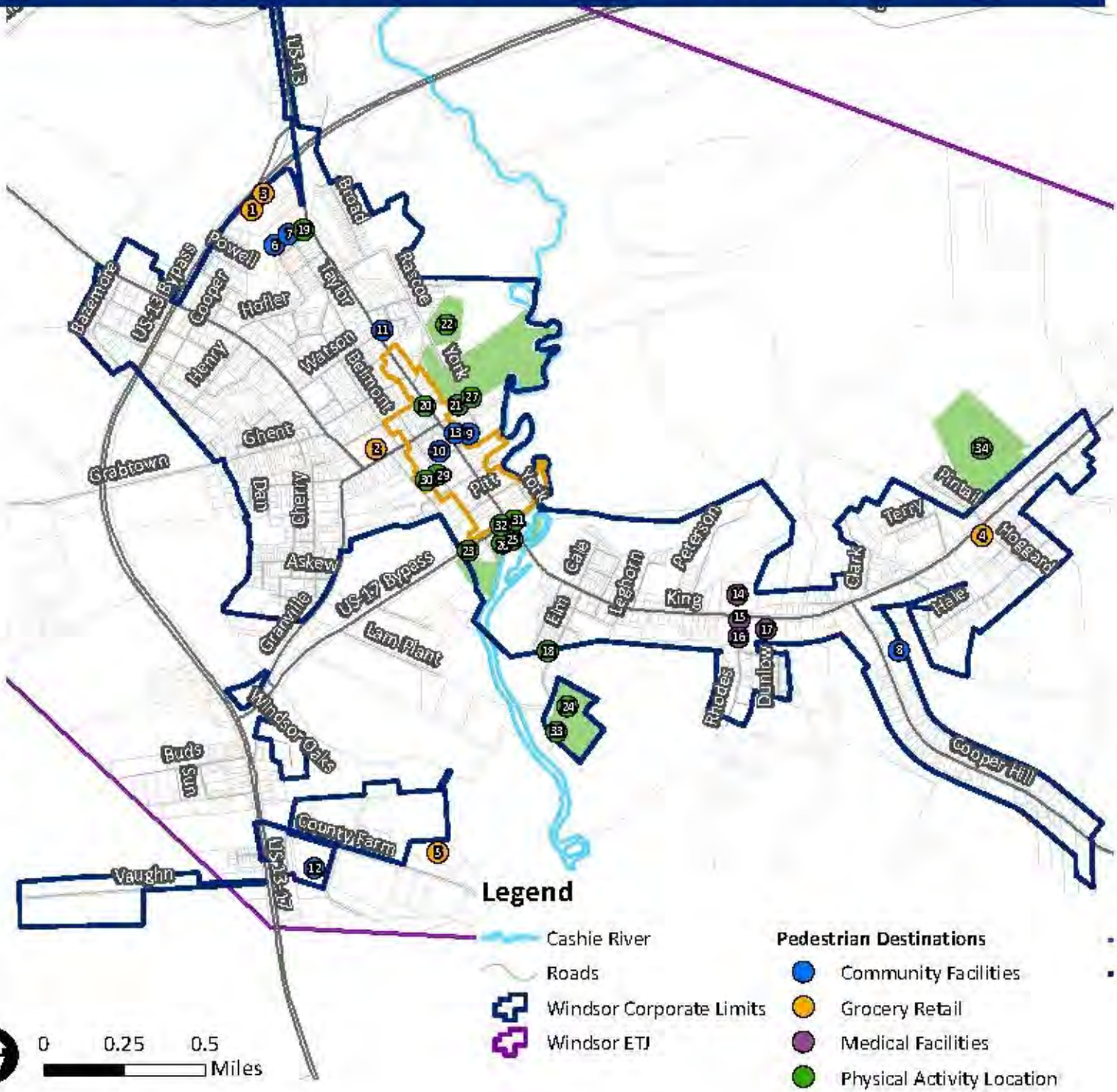
Please note, socioeconomic status and elderly concentrations have been combined to determine the population vulnerable to chronic disease (source: US Census Bureau).

Map 8: Annual Average Daily Traffic (AADT): 2014

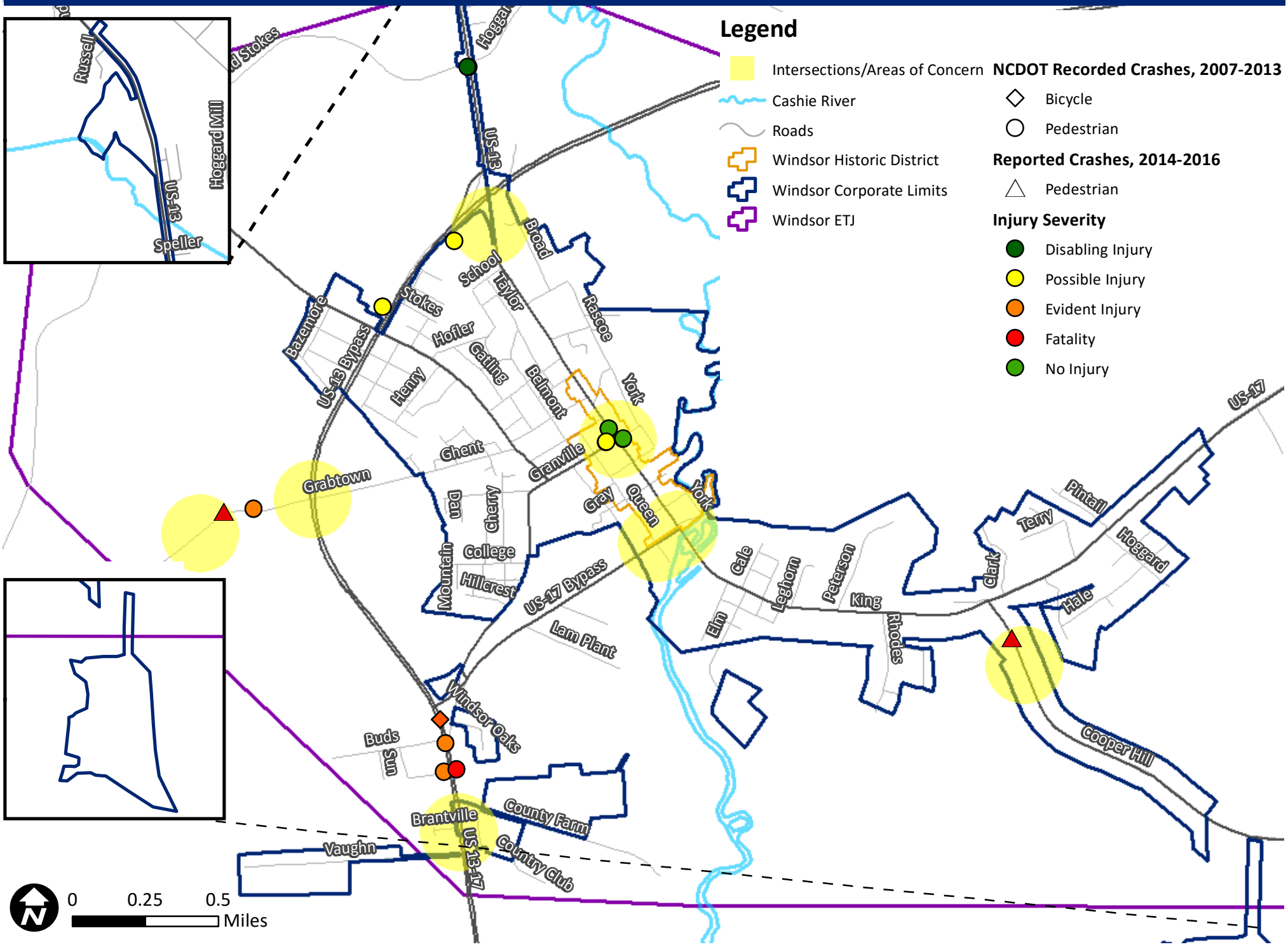


Map 9: Windsor Pedestrian Destinations

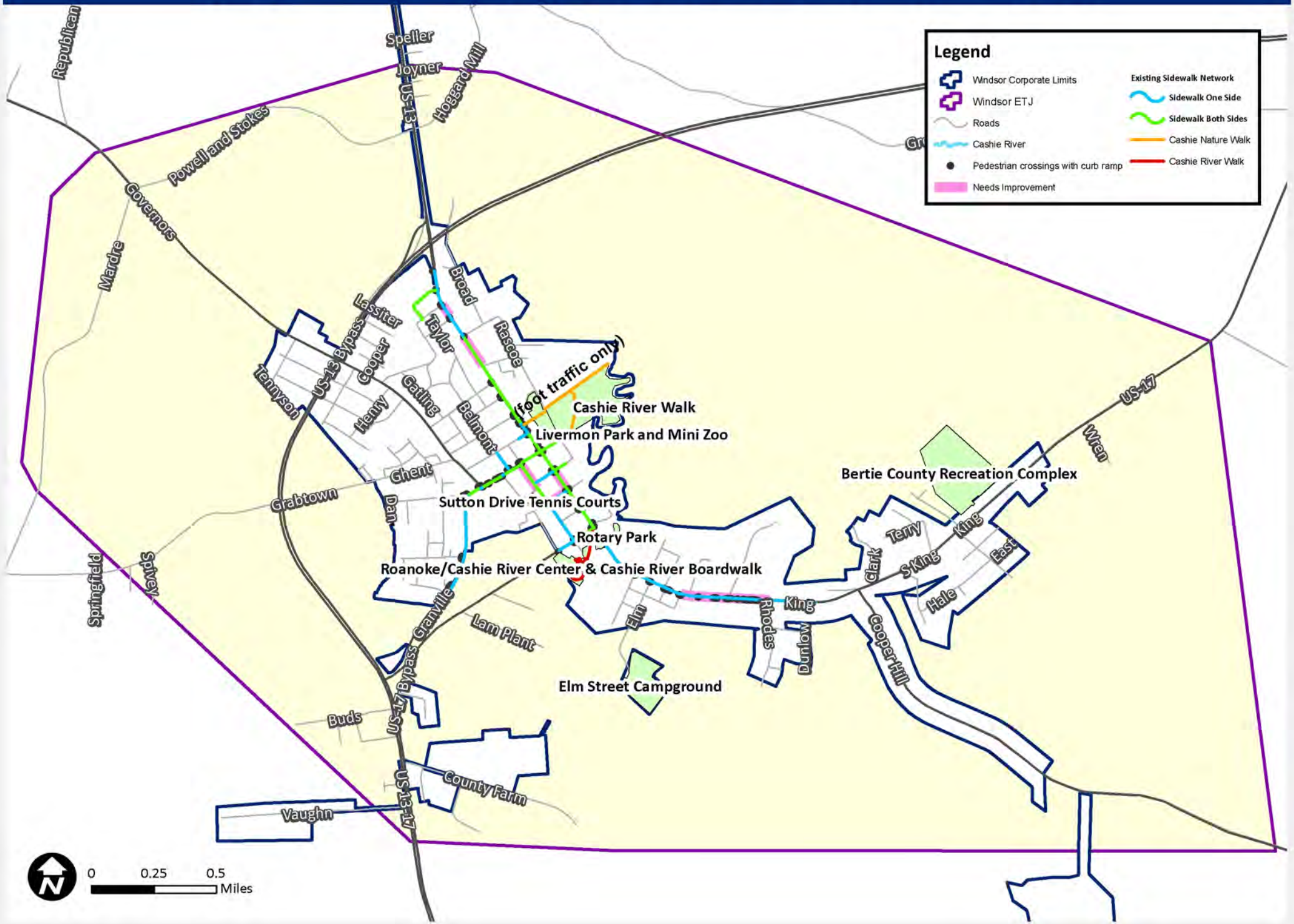
1 Food Lion
2 Dollar General
3 Duck Thru Food Store
4 Butcher Block
5 Cucumber Market
6 Bertie County Aging Council
7 Bertie County Parks & Rec Dept.
8 Windsor Elementary School
9 Lawrence Memorial Public Library
10 Bertie County Magistrate
11 Windsor Fire Department
12 Heritage College Leadership Academy
13 Windsor Police Department & Town Hall
14 Brain Center Health & Rehab
15 Bertie County Health Dept.
16 Bertie County Rural Health
17 Vidant Bertie Hospital
18 Windsor Disc Golf
19 YMCA
20 Windsor Municipal Park
21 Livermon Park & Mini-Zoo
22 Davis Ball Park
23 Roanoke Cashie River Center
24 Cashie River Campground and Treehouses
25 Cashie River Boat Access
26 Cashie Riverwalk
27 Cashie Wetland Walk & Canoe Trail
28 Hoggard Mill Road ADA Boat Access
29 Windsor Community Building
30 Sutton Drive Tennis Courts
31 Rotary Park
32 Williford Park
33 NCWRC Cashie River Boating Access
34 Bertie County Recreation Complex



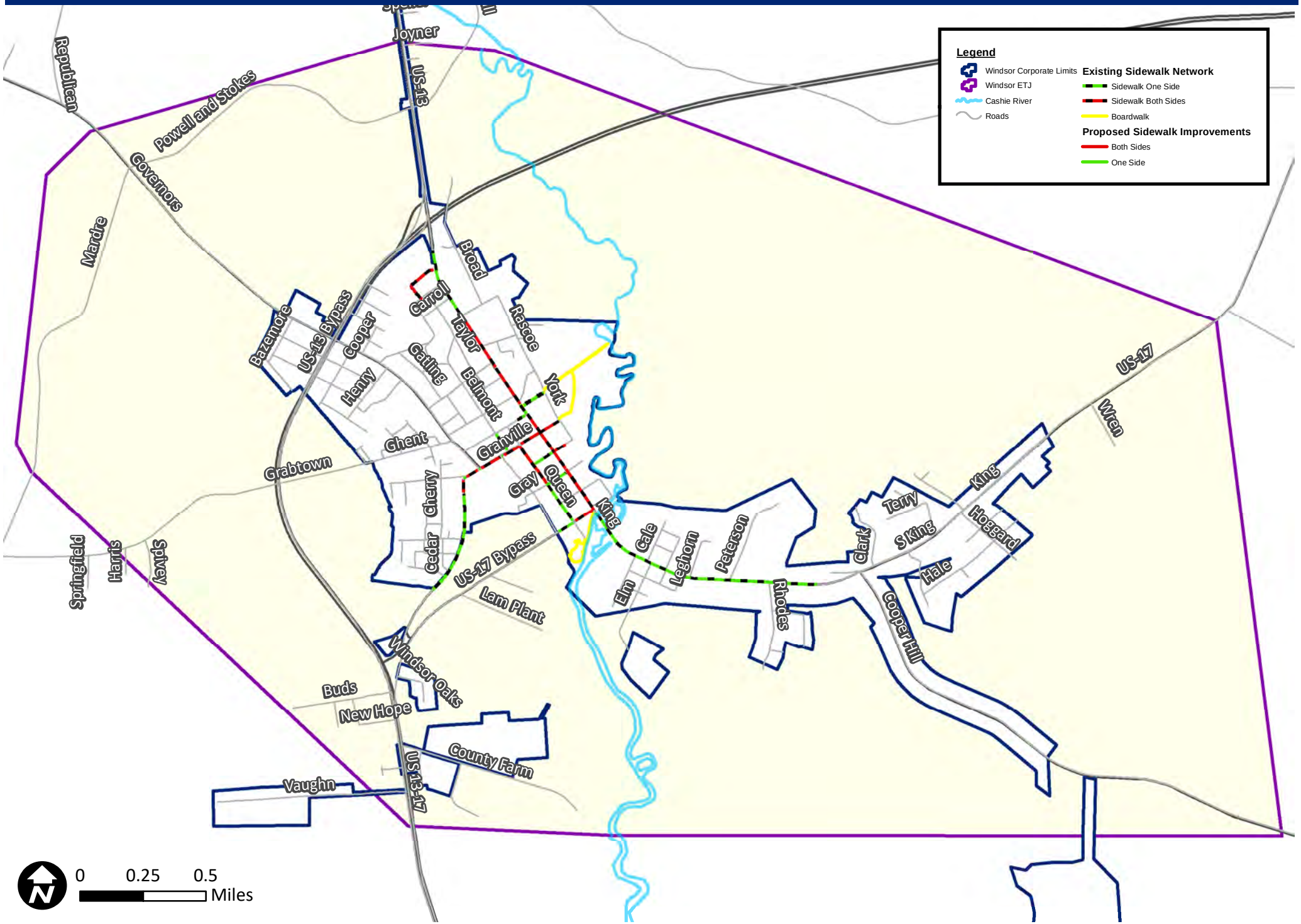
Map 10: Intersections/Areas of Concern



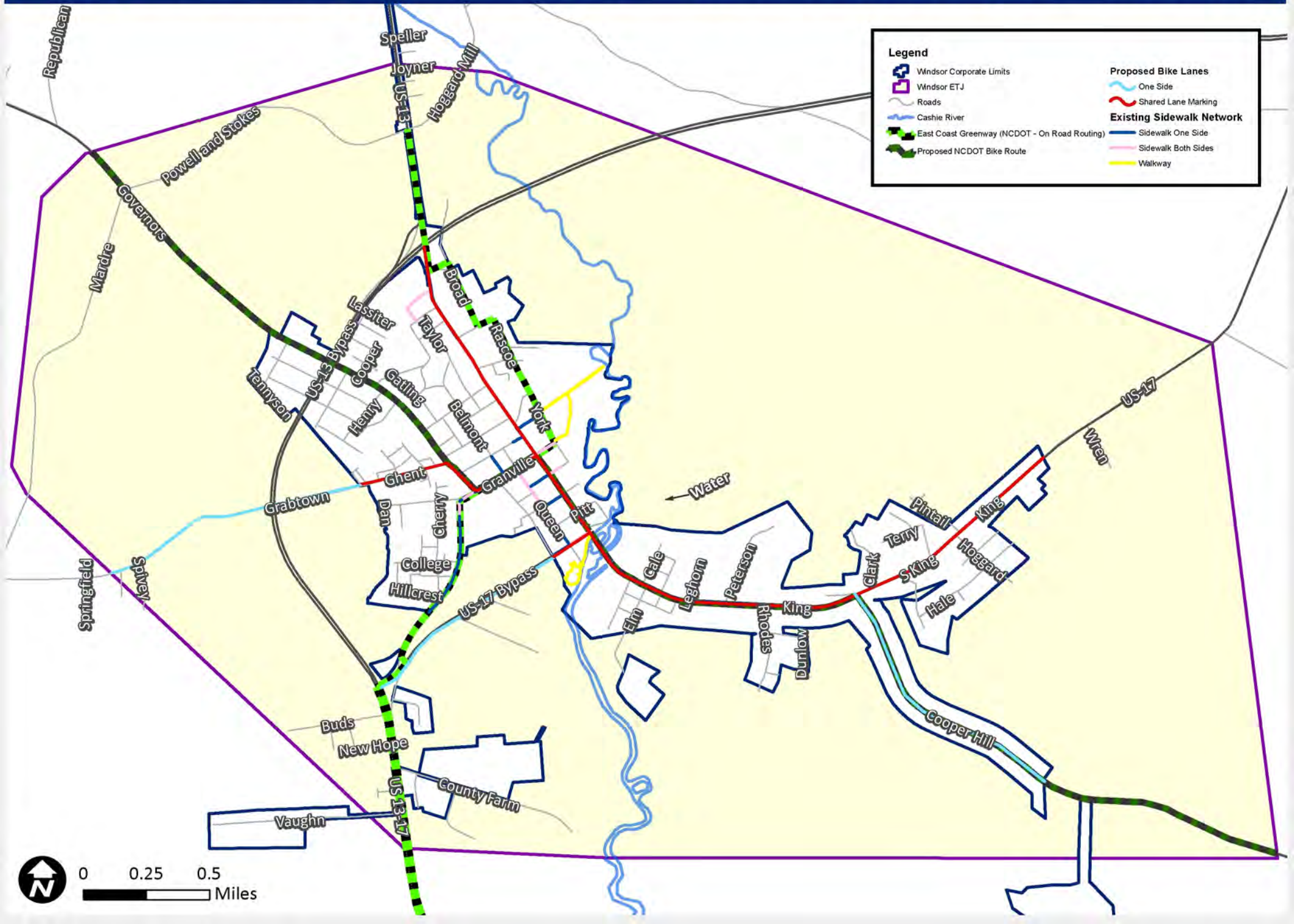
Map 11: Existing Pedestrian Network



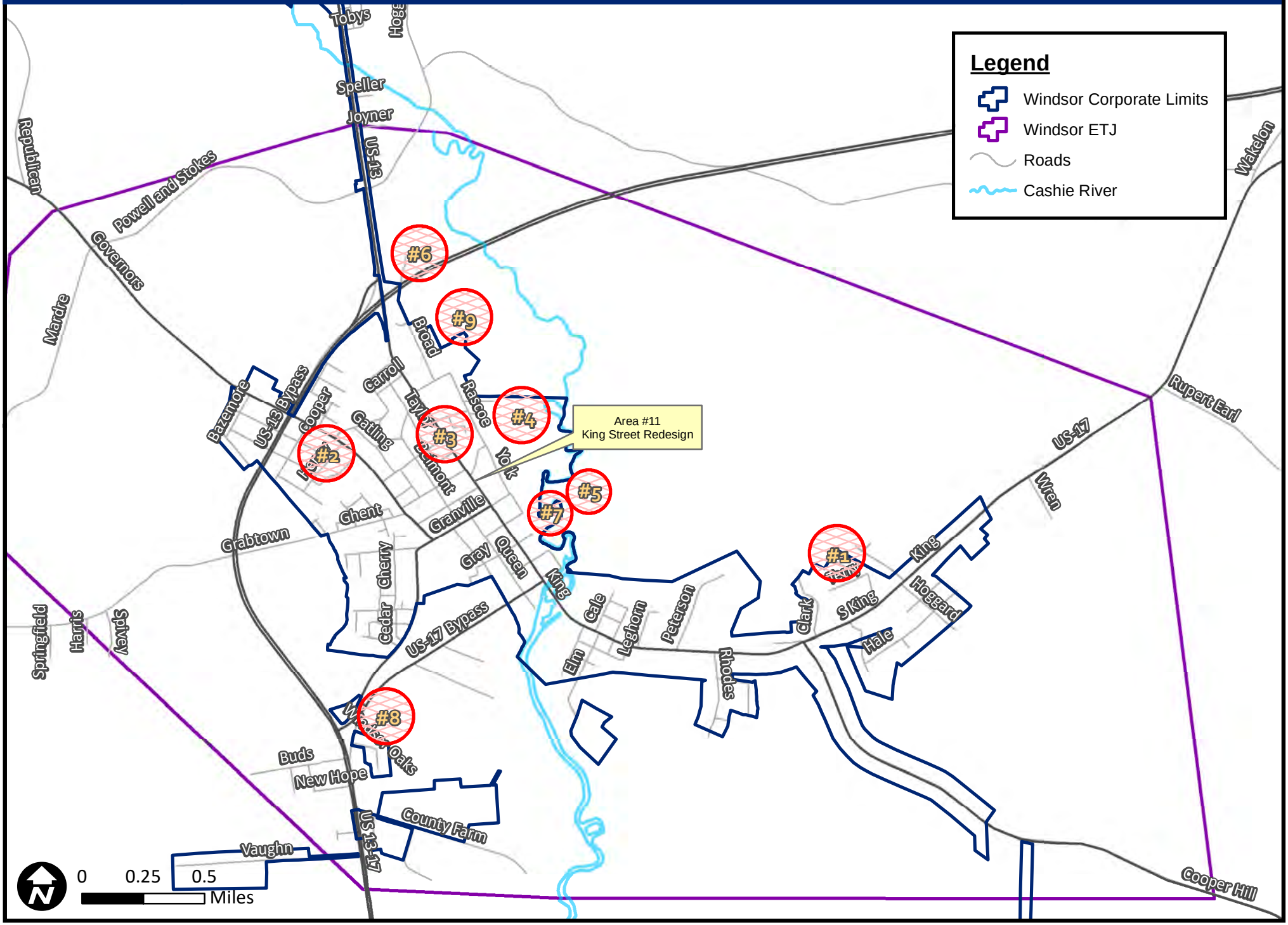
Map 12: Proposed Pedestrain Networks



Map 13: Proposed Bicycle and Greenway Networks



Map 14: Areas of Concern



Appendix B: Design Guidelines

Introduction

The following guidelines are provided to serve as a basis for facility design in Windsor. Alterations may be necessary for specific projects. Consultation with a professional engineer or licensed landscape architect should take place when designing and installing any of the listed facilities. Coordination with the NC Department of Transportation may be required in instances where innovative practices are utilized.

The following resources were used in the creation of these guidelines:

- NC Complete Streets: http://www.completestreetsnc.org/wp-content/themes/CompleteStreets_Custom/pdfs/NCDOT-Complete-Streets-Planning-Design-Guidelines.pdf
- AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities
- Model Design Manual for Living Streets www.Modelstreetdesignmanual.com
- Pedestrian and Bicycle Information Center, 2010 www.walkinginfo.org/engineering/ www.bicyclinginfo.org/engineering/
- Bicycle Parking Design Guidelines www.bicyclinginfo.org/engineering/parking.cfm
- Manual on Uniform Traffic Control Devices (MUTCD) U. S. Department of Transportation, Washington, DC, 2009 http://mutcd.fhwa.dot.gov
- Context Sensitive Solutions in Designing Major Urban Thoroughfares for Walkable Communities: An ITE Proposed Recommended Practice.

Pedestrian Facilities

ESSENTIAL PRINCIPLES OF PEDESTRIAN CROSSINGS

The following principles should be incorporated into every pedestrian crossing improvement:

- The safety of all street users, particularly more vulnerable groups, such as children, the elderly, and those with disabilities, and more vulnerable modes, such as walking and bicycling, must be considered when designing streets.
- Pedestrian crossings must meet accessibility standards and guidelines.
- Real and perceived safety must be considered when designing crosswalks—crossing must be "comfortable." A "safe" crossing that no one uses serves no purpose.
- Crossing treatments that have the highest crash reduction factors (CRFs) should be used when designing crossings. A crash reduction factor (CRF) is the percentage crash reduction that might be expected after implementing a given countermeasure at a specific site.

- Safety should not be compromised to accommodate traffic flow.
- Good crossings begin with appropriate speed. In general, urban arterials should be designed to a maximum of 30 mph or 35 mph (note: 30 mph is the optimal speed for moving motor vehicle traffic efficiently).
- Every crossing is different and should be selected and designed to fit its unique environment.
- Ideally, uncontrolled crossing distances should be no more than 21 feet, which allows for one 11-foot lane and one 10-foot lane. Ideally, streets wider than 40 feet should be divided (effectively creating two streets) by installing a median or two crossing islands.

Sidewalks

A Standard sidewalk is usually five feet minimum in width, concrete, and placed along roadways with curb and gutter. In general, the width of sidewalks should accommodate two persons walking past one another, a width generally recognized to be five feet, at a minimum. Other circumstances that may require additional sidewalk width are: (1) to accommodate the overhang of parked vehicles from off-street or angled on-street parking areas; (2) additional buffer from traffic when a planting strip cannot be installed; and (3) high pedestrian use areas such as downtown.

Additional design considerations for on-street sidewalk facilities include the following:

- Maximum cross-slope of 1:50 (2%) is considered to be level. Limit running slope to 5% (1:20), or no greater than 8.33% (1:12) where topography requires it.
- Ramps with level upper and lower landings are necessary for ADA requirements. Eliminating both high and low contact points with tree branches, mast-arm signs, overhanging edges of amenities or furniture, and
- Providing clear space between walls on one side of the walkway and amenities, parking overhang, or plantings on the curb side of the walkway.

In general, standard sidewalks should be concrete, which is more durable than asphalt. A more flexible material, such as rubberized paving, can be considered in situations in which there is the potential for tree roots to crack and lift the concrete. Using these types of materials can reduce the risk of a tripping hazard, and also lower maintenance costs. More permeable materials, such as porous pavers, can also be considered for all pedestrian-ways, and in particular for greenways near streams, in order to reduce run-off from storm events. Caution should be used to consider total, lifecycle costs for alternative materials. For example, porous pavements are more expensive initially to install, but will also usually lose their porosity if the air spaces in the pavement are not regularly cleaned

Crosswalk Markings

According to the MUTCD, the minimum crosswalk marking shall consist of solid white lines. They shall not be less than 6 feet in width, though a wider width (10 ft.) is recommended in areas w/ higher pedestrian traffic.

Placement

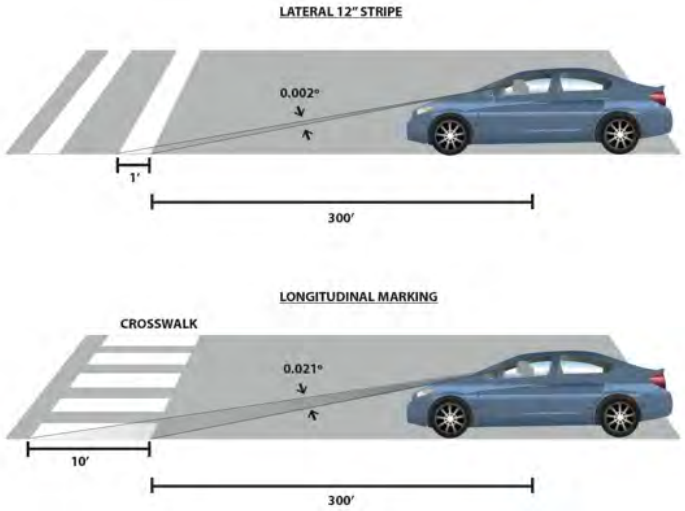
The best locations to install marked crosswalks are

- All signalized intersections
- Trail crossings
- High land use generators
- School walking routes
- When there is a preferred crossing location due to sight distance
- Where needed to enable comfortable crossings of multi-lane streets between controlled crossings spaced at convenient distances

High-Visibility Crosswalks

Because of the low approach angle at which pavement markings are viewed by drivers, the use of longitudinal stripes in addition to or in place of transverse markings can significantly increase the visibility of a crosswalk to oncoming traffic. While research has not shown a direct link between increased crosswalk visibility and increased pedestrian safety, high-visibility crosswalks have been shown to increase motorist yielding and channelization of pedestrians, leading the Federal Highway Administration to conclude that high-visibility pedestrian crosswalks have a positive effect on pedestrian and driver behavior. Colored and stamped crosswalks should only be used at controlled locations.

Staggered longitudinal markings reduce maintenance since they avoid vehicle wheel paths.



Longitudinal crosswalk markings are more visible than lateral crosswalk markings (Credit: Michele Weisbart)

Typical crosswalk markings: Continental, Ladder, Staggered Continental
(Credit: Michele Weisbart)

Continental striping (far left)

Pedestrian Signals at Intersections

- A displayed automatic Walk signal with a countdown is recommended at all intersections when pedestrians have the right-of-way to cross, whether or not the button was activated.
- Timed signals should display the entire countdown phase until it reaches zero, when all pedestrian and vehicle traffic should get a red light in that direction. Pedestrian signals should display a walk symbol at all times when the pedestrian has the right of way, and include the countdown as soon as the signal is scheduled to change.
- A safe and adequate time must be allowed for any pedestrian to cross who may already be in the intersection. A 3.8 foot per second walking speed is recommended for timing pedestrian clearance intervals at locations with normal pedestrian demographics (i.e., downtown areas, shopping areas, most neighborhoods, schools areas) or locations where the age or physical disability status of the pedestrian population is unknown. When the proportion of pedestrians over the age of 65 exceeds 20 to 50% of the total pedestrians at a location, walking speeds of 3.3 to 3.6 feet per second are recommended for pedestrian clearance timings. A 2.9 foot per second walking speed is recommended for intersections where nearly all of the pedestrians are over age 65.
- Clear, consistent activation buttons 42" high are necessary where these buttons are preferred.
- Countdown signals can be installed 7 – 10 feet high.
- Visible signs should be placed in the medians for automobiles to be reminded that North Carolina State Law requires vehicles to stop for pedestrians in both marked and unmarked crosswalks.

Pedestrian Countdown Signal
(Credit: Holland Consulting Planners)

Crosswalks and Accessibility

Decorative crosswalk treatments, as shown here in Ayden, NC made of distinctive materials can become uneven over time.

Longitudinal crosswalk markings provide the best visibility for pedestrians with limited vision.

Decorative crosswalk pavement materials should be chosen with care to ensure that smooth surface conditions and high contrast with surrounding pavement are provided. Textured materials within the crosswalk are not recommended. Without reflective materials, these treatments are not visible to drivers at night.

Decorative pavement materials often deteriorate over time and become a maintenance problem while creating uneven pavement.

The use of color or material to delineate the crosswalks as a replacement of retro-reflective pavement marking should not be used, except in slow speed districts where intersecting streets are designed for speeds of 20 mph or less.

Raised/Landscaped Medians

Raised islands and medians are the most important, safest, and most adaptable engineering tool for improving street crossings. *Note* on terminology: a median is a continuous raised area separating opposite flows of traffic. A crossing island is shorter and located just where a pedestrian crossing is needed. Raised medians and crossing islands are commonly used between intersections when blocks are long (500 feet or more in downtowns) and in the following situations:

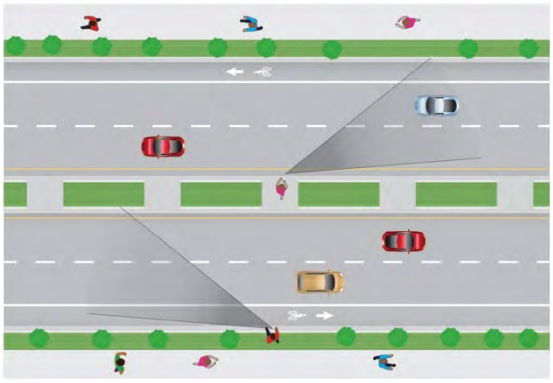
- Speeds are higher than desired
- Streets are wide
- Traffic volumes are high
- Sight distances are poor

Staggered median crossing
(Credit: Marcel Schmaedick)

Raised/landscaped medians parallel to a street should be a minimum of 20 feet in width and a minimum of 6 feet wide. Raised islands have nearly universal applications and should be placed where there is a need for people to cross the street. They are also used to slow traffic.

Reasons for Effectiveness

Their use changes a complex task, crossing a wide street with traffic coming from two opposing directions all at once, into two simpler and smaller tasks. With their use, conflicts occur in only one direction at a time, and exposure time can be reduced from more than 20 seconds to just a few seconds.



Medians and crossing islands allow pedestrians to complete the crossing in two stages.
(Credit: Michele Weisbart)

On streets with traffic speeds higher than 30 mph, it may be unsafe to cross without a median island. At 30 mph, motorists travel 44 feet each second, placing them 880 feet out when a pedestrian starts crossing an 80-foot wide multi-lane road.

In this situation, this pedestrian may still be in the last travel lane when the car arrives there; that car was not within view at the time he or she started crossing. With an island on multi-lane roadways, people would cross two or three lanes at a time instead of four or six. Having to wait for a gap in only one direction of travel at a time significantly reduces the wait time to cross. Medians and crossing islands have been shown to reduce crashes by 40 percent (Federal Highway Administration, Designing for Pedestrian Safety course).

As a general rule, crossing islands are preferable to signal-controlled crossings due to their lower installation and maintenance cost, reduced waiting times, and their safety benefits.

Curb Extensions

Curb extensions extend the sidewalk or curb line out into the parking lane, which reduces the effective street width. Curb extensions significantly improve pedestrian crossings by reducing the pedestrian crossing distance, visually and physically narrowing the roadway, improving the ability of pedestrians and motorists to see each other, and reducing the time that pedestrians are in the street. Reducing street widths improves signal timing since pedestrians need less time to cross.

Curb extensions
(Credit: Michele Weisbart)

Motorists typically travel more slowly at intersections or mid-block locations with curb extensions, as the restricted street width sends a visual cue to slow down. Turning speeds are lower at intersections with curb extensions (curb radii should be as tight as is practicable). Curb extensions also prevent motorists from parking too close to the intersection.

Curb extensions also provide additional space for two curb ramps and for level sidewalks where existing space is limited, increase the pedestrian waiting space, and provide additional space for pedestrian push button poles, street furnishings, plantings, bike parking and other amenities. A benefit for drivers is that extensions allow for better placement of signs (e.g., stop signs and signals).

Curb extensions are generally only appropriate where there is an on-street parking lane. Where street width permits, a gently tapered curb extension can reduce crossing distance at an intersection along streets without on-street parking, without creating a hazard. Curb extensions must not extend into travel lanes or bicycle lanes.

Example of curb extensions
(Credit: Marcel Schmaedick)

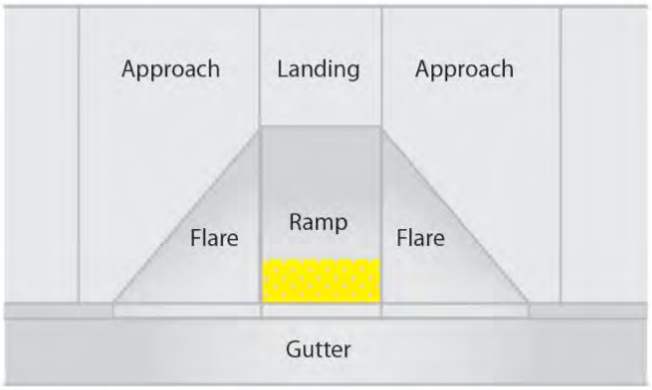
Curb extensions can impact other aspects of roadway design and operation as follows:

- May impact street drainage and require catch basin relocation
- May impact underground utilities
- May require loss of curbside parking, though careful planning often mitigates this potential loss, for example by relocating curbside fire hydrants, where no parking is allowed, to a curb extension
- May complicate delivery access and garbage removal
- May affect the turning movements of larger vehicles such as school buses and large fire trucks

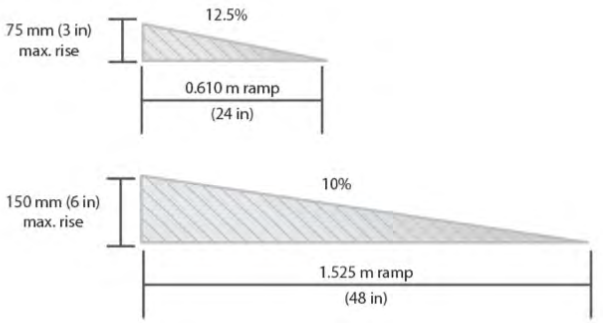
Curb Ramps

Proper curb ramp design is essential to enable pedestrians using assistive mobility devices (e.g., scooters, walkers, and crutches) to transition between the street and the sidewalk. These design guidelines provide a basic overview of curb ramp design. The ADA requires installation of curb ramps in new sidewalks and whenever an alteration is made to an existing sidewalk or street. Curb ramps are typically installed at intersections, mid-block crossings (including trail connections), accessible on-street parking, and passenger loading zones and bus stops.

The following define the curb ramp components along with minimum dimensions:



- **Landing** – the level area at the top of a curb ramp facing the ramp path. Landings allow wheelchairs to enter and exit a curb ramp, as well as travel along the sidewalk without tipping or tilting. This landing must be the width of the ramp and measure at least 4 feet by 4 feet. There should also be a level (not exceeding a 2 percent grade) 4 foot by 4 foot bottom landing of clear space outside of vehicle travel lanes.
- **Approach** – the portion of the sidewalk on either side of the landing. Approaches provide space for wheelchairs to prepare to enter landings.
- **Flare** – the transition between the curb and sidewalk. Flares provide a sloped transition (10 percent maximum slope) between the sidewalk and curb ramp to help prevent pedestrians from tripping over an abrupt change in level. Flares can be replaced with curb where the furniture zone is landscaped.



Curb ramp components, and alternate ramp slopes (Credit: Michele Weisbart).

- **Ramp** – the sloped transition between the sidewalk and street where the grade is constant and cross slope at a minimum. Curb ramps are the main pathway between the sidewalk and street.
- **Gutter** – the trough that runs between the curb or curb ramp and the street. The slope parallel to the curb should not exceed 2 percent at the curb ramp.
- **Detectable Warning** – surface with distinct raised areas to alert pedestrians with visual impairments of the sidewalk-to-street transition.

There are several different types of curb ramps. Selection should be based on local conditions. The most common types are diagonal, perpendicular, parallel, and blended transition.

Diagonal Curb Ramps

Diagonal curb ramps are single curb ramps at the apex of the corner. These have been commonly installed by many jurisdictions to address the requirements of the ADA, but have since been identified as a non-preferred design type as they introduce dangers to wheelchair users. Diagonal curb ramps send wheelchair users and people with strollers or carts toward the middle of the intersection and make the trip across longer.

Perpendicular Curb Ramps

Perpendicular curb ramps are placed at a 90-degree angle to the curb. They must include a level landing at the top to allow wheelchair users to turn 90 degrees to access the ramp, or to bypass the ramp if they are proceeding straight. Perpendicular ramps work best where there is a wide sidewalk, curb extension, or planter strip. Perpendicular curb ramps provide a direct, short trip across the intersection.

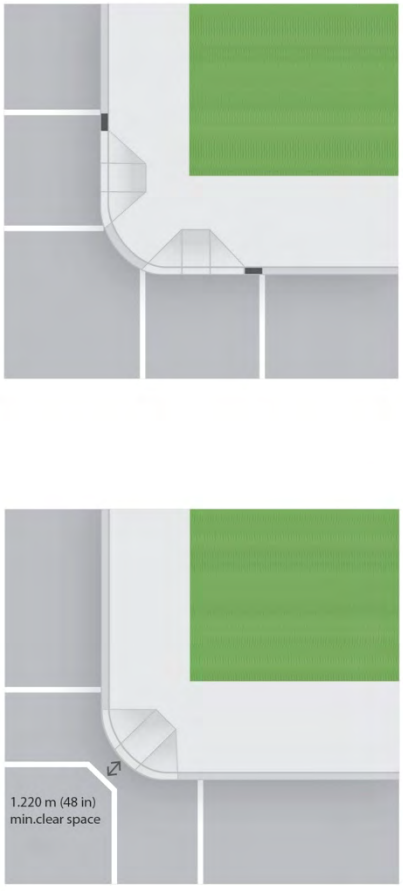
Parallel Curb Ramps

Parallel curb ramps are oriented parallel to the street; the sidewalk itself ramps down. They are used on narrow sidewalks where there isn't enough room to install perpendicular ramps. Parallel curb ramps require pedestrians who are continuing along the sidewalk to ramp down and up. Where space exists in a planting strip, parallel curb ramps can be designed in combination with perpendicular ramps to reduce the ramping for through pedestrians. Careful attention must be paid to the construction of the bottom landing to limit accumulation of water and/or debris.

Curb Ramp Placement

One ramp should be provided for each crosswalk, which usually translates to 2 per corner. This maximizes access by placing ramps in line with the sidewalk and crosswalk, and by reducing the distance required to cross the street, compared with a single ramp on the apex.

A single ramp at the apex requires users to take a longer, more circuitous travel path to the other side and causes users to travel towards the center of the intersection where they may be in danger of getting hit by turning cars; being in the intersection longer exposes the user to greater risk of being hit by vehicles. A single ramp at the apex should be avoided in new construction and may be used only for alterations where a design exception is granted because of existing utilities and other significant barriers. In all cases, reducing the curb radius makes ramp placement easier.



One ramp per crosswalk vs. single ramp at the apex (Credit: Michele Weisbart)

Signs

Signs can provide important information to improve road safety by letting people know what to expect, so they can react and behave appropriately. Sign use and placement should be done judiciously, as overuse breeds noncompliance and disrespect. Too many signs create visual clutter.

Regulatory signs, such as STOP, YIELD, or turn restrictions, require driver actions and can be enforced. Warning signs provide information, especially to motorists and pedestrians unfamiliar with an area.

Advance pedestrian warning signs should be used where motorists may not expect pedestrian crossings, especially if there are many motorists who are unfamiliar with the area. The fluorescent yellow/green color is designated specifically for pedestrian, bicycle, and school warning signs (Section 2A.10 of the 2009 MUTCD) and should be used for all new and replacement installations. This bright color attracts the attention of drivers because it is unique.

Sign R1-5 should be used in conjunction with advance yield lines, as described below. Sign R1-6 may be used on median islands, where they will be more visible to motorists than signs placed on the side of the street, especially where there is on-street parking.

Signs W11-1, W11-2, W11-15, may be used where pedestrian and bicycle users are expected. W11-15 can be used in conjunction with trail crossings. All signs should be periodically checked to make sure that they are in good condition, free from graffiti, reflective at night, and continue to serve a purpose.

All sign installations need to comply with the provisions of the MUTCD.

Wayfinding

Provide signs at decision points to help wayfinding decisions. Place signs, when necessary, at decision points. Decision points are where the navigator must make a wayfinding decision (for example, whether to continue along the current route or to change direction.) A sign embeds additional information into the space to direct the navigator's next navigational choice. This information should be relevant to both the choices offered to the navigator at that point, and the larger goal of the navigational task. Simply put, a sign should tell the navigator what's in the direction it points, and the destinations so indicated should help the navigator reach his eventual goal.

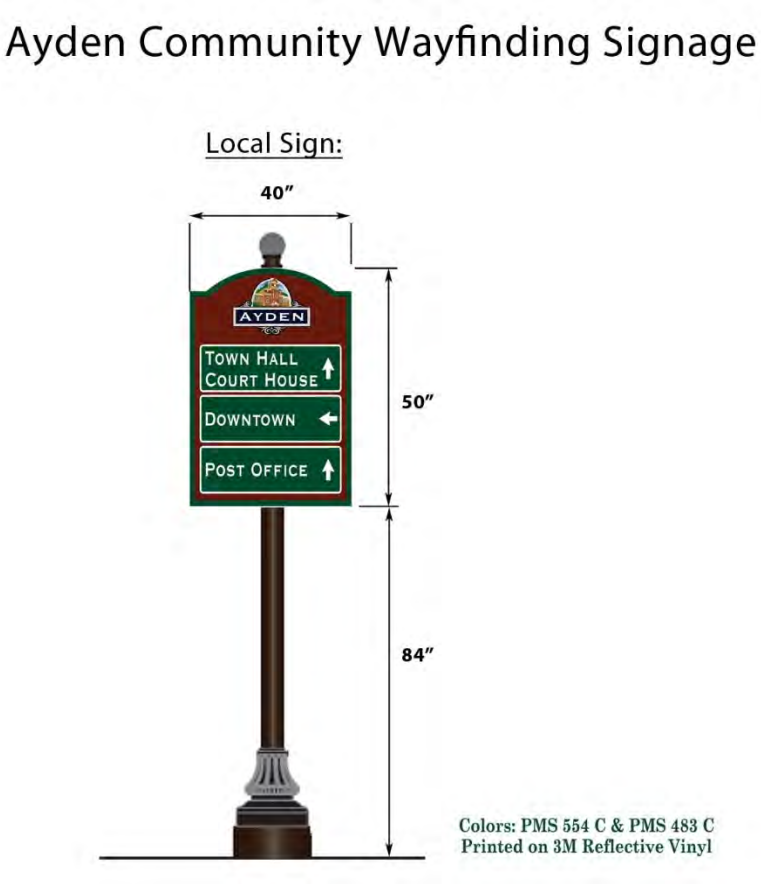
At decision points along the route, the navigator combines observation of local features with previous knowledge of the space to make the proper navigational move.

When the navigator does not have previous knowledge of the space, or a map to refer to, only the local features at the decision point can inform his navigational choice. A sign placed at a decision point in this framework, needs to inform the navigator of the correct route.

By design, signs must be in a location to acquire the navigator's attention, yet space for signage is a scarce resource. The benefits of signage must be weighed against the other potential uses for the space it occupies.

Other Considerations:

- An encroachment agreement may be required on NCDOT roads
- The signage must meet standards set forth in the MUTCD
- Font type, color, and size are all important components in the creation of wayfinding signs.



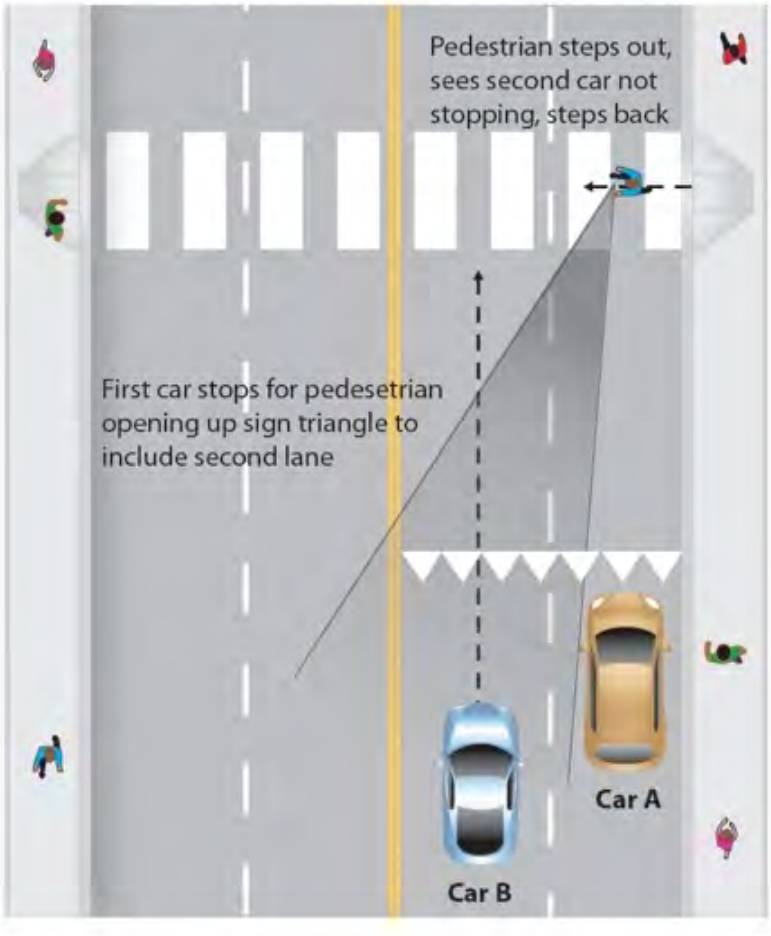
Example Wayfinding Sign in Ayden, NC. (Credit: HCP)

Advanced Yield/Stop Lines

Stop lines are solid white lines 12 to 24 inches wide, extending across all approach lanes to indicate where vehicles must stop in compliance with a stop sign or signal. Advance stop lines reduce vehicle encroachment into the crosswalk and improve drivers' view of pedestrians. At signalized intersections, a stop line is typically set back between 4 and 6 feet.

When used at controlled intersections, stop lines should be placed approximately 3.0 m [10 ft], and no less than 1.2 m [4 ft], in advance of and parallel to the nearest crosswalk line."

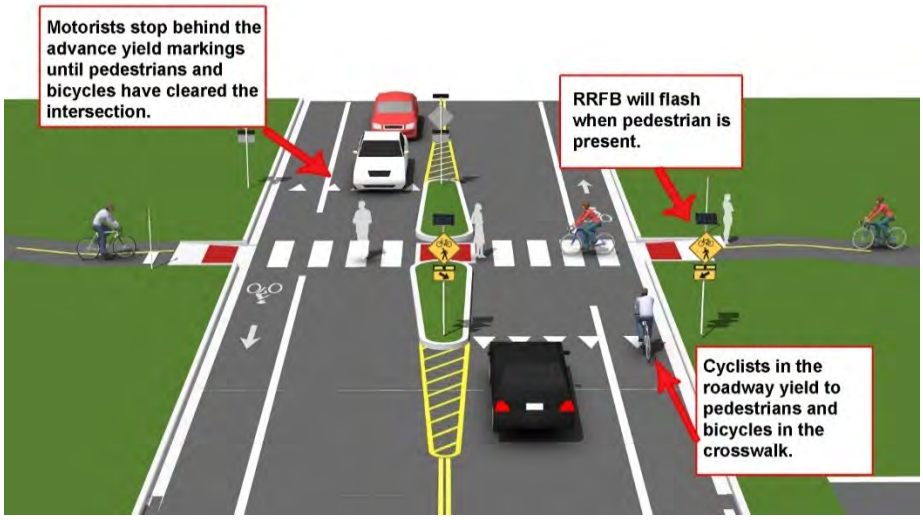
At uncontrolled crossings of multi-lane roads, advance yield lines can be an effective tool for preventing multiple threat vehicle and pedestrian collisions. Section 3B.16 of the MUTCD specifies placing advanced yield markings 20 to 50 feet in advance of crosswalks, depending upon location-specific variables such as vehicle speeds, traffic control, street width, on-street parking, potential for visual confusion, nearby land uses with vulnerable populations, and demand for queuing space. Thirty feet is the preferred setback for effectiveness at many locations. This setback allows a pedestrian to see if a car in the second (or third) lane is stopping after a driver in the first lane has stopped.



Advanced Yield/Stop Lines (Credit: Michele Weisbert).

Rectangular Rapid Flash Beacon (RRFB)

- RRFBs are user-actuated amber LEDs that supplement warning signs at unsignalized intersections or mid-block crosswalks. They can be activated by pedestrians manually by a push button or passively by a pedestrian detection system.
- RRFBs use an irregular flash pattern that is similar to emergency flashers on police vehicles.
- RRFBs may be installed on either two-lane or multi-lane roadways.



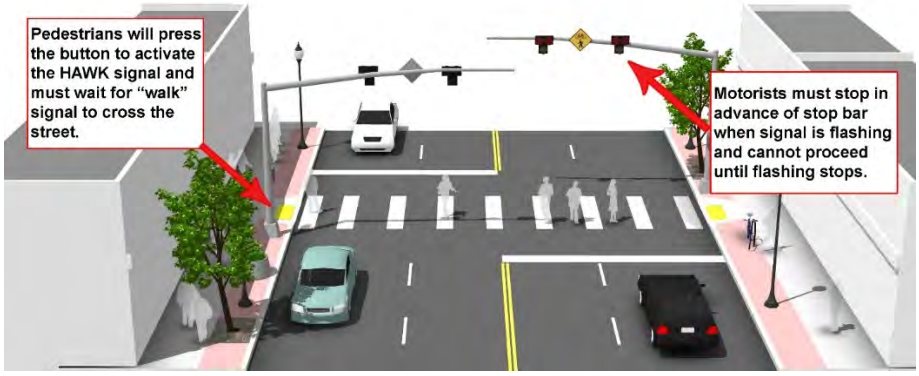
RRFB - Image Source: City of Bloomington, Indiana

Potential Benefits

- RRFBs are a lower cost alternative to traffic signals and hybrid signals that are shown to increase driver yielding behavior at crosswalks significantly when supplementing standard pedestrian crossing warning signs and markings.
- An official FHWA-sponsored experimental implementation and evaluation conducted in St. Petersburg, Florida found that RRFBs at pedestrian crosswalks are dramatically more effective at increasing driver yielding rates to pedestrians than traditional overhead beacons.
- The novelty and unique nature of the stutter flash may elicit a greater response from drivers than traditional methods.
- The addition of RRFB may also increase the safety effectiveness of other treatments, such as the use of advance yield markings with YIELD (or STOP) HERE FOR PEDESTRIANS signs. These signs and markings are used to reduce the incidence of multiple-threat crashes at crosswalks on multi-lane roads (i.e., crashes where a vehicle in one lane stops to allow a pedestrian to cross the street while a vehicle in an adjacent lane, traveling in the same direction, strikes the pedestrian), but alone they only have a small effect on overall driver yielding rates.

High Intensity Activated Crosswalk (HAWK) Signal

The HAWK signal is a mid-block crosswalk that is used on roads where the pedestrian would require help crossing with a signal. This system uses traditional traffic and pedestrian signal heads but in a different configuration. It includes a sign instructing motorists to "stop on red" and a "pedestrians" overhead sign. There is also a sign informing pedestrians on how to cross the street safely. When not activated, the signal is blanked out. The HAWK signal is activated by a pedestrian push button. The overhead signal begins flashing yellow and then solid yellow, advising drivers to prepare to stop. The signal then displays a solid red and shows the pedestrian a "Walk" indication. Finally, an alternating flashing red signal indicates that motorists may proceed when safe, after coming to a full stop. The pedestrian is shown a flashing "Don't Walk" with a countdown indicating the time left to cross.



HAWK Signal - Image Source: City of Bloomington, Indiana

Mid-Block Crossings

- Install only on roads with a speed limit of less than 45 MPH.
- Do not install within 300 feet from another signalized crossing point.
- Base installation of a mid-block crossing on an engineering study or pedestrian route.
- These crossings are recommended near schools, pedestrian routes, retail areas, recreation, and residential areas.
- Require advance warning signs and good visibility for both the driver and the pedestrian.
- Placing a stop bar with signage a few car lengths before the crosswalk will ensure better visibility for the vehicles and the pedestrian.
- Providing a safe crossing point is necessary since pedestrians will not walk far for a signalized intersection.
- Provide an audible tone at signalized crosswalks.
- Include a pedestrian refuge island on wide streets where:
    - There are fast vehicle speeds or large vehicle or pedestrian traffic volumes.
    - There is more than one travel lane in any direction.

- Children, people with disabilities, or elderly people would cross.
- There are complex vehicle movements.
- There is insufficient time to cross the entire road because of traffic demands.

Trail Overpass

Bridges are used for above-grade crossings and should be designed with specific structural engineering and safety considerations. If crossing an interstate highway, specific and stringent standards will apply.

- Safety should be the primary consideration in bridge/overpass design.
- Specific design and construction specifications will vary for each bridge and can be determined only after all site-specific criteria are known.
- Always consult a structural engineer before completing bridge design plans, before making alterations or additions to an existing bridge, and prior to installing a new bridge.
- A 'signature' bridge should be considered in areas of high visibility, such as over major roadways. While often more expensive, a more artistic overpass will draw more attention to the trail system in general, and could serve as a regional landmark.
- For shared-use facilities, a minimum width of 14-feet is recommended.
- Trail overpasses are prohibitively expensive and should only be placed in areas of substantial need.

Bicycle Facilities

ESSENTIAL PRINCIPLES OF BIKEWAY DESIGN

The following principles should be followed when designing facilities for bicyclists:

- Bicyclists should have safe, convenient, and comfortable access to all destinations.
- Every street is a bicycle street, regardless of bikeway designation.
- Street design should accommodate all types, levels, and ages of bicyclists.
- Bicyclists should be separated from pedestrians.
- Bikeway facilities should take into account vehicle speeds and volumes, with
  - Shared use on low volume, low-speed roads.
  - Separation on higher volume, higher-speed roads.
- Bikeway treatments should provide clear guidance to enhance safety for all users.
- Since most bicycle trips are short, a complete network of designated bikeways has a grid of roughly ½ mile.

Bicycle Lanes

Bike lanes are a portion of the traveled way designated for preferential use by bicyclists; they are most suitable on avenues and boulevards. Bike lanes may also be provided on rural roads where there is high bicycle use. Bike lanes are generally not recommended on local streets with relatively low traffic volumes and speeds, where a shared roadway is the appropriate facility. There are no "hard and fast" mandates for providing bike lanes, but as a general rule, most jurisdictions consider bike lanes on roads with traffic volumes in excess of 3,000-5,000 ADT or traffic speeds of 30 mph or greater.

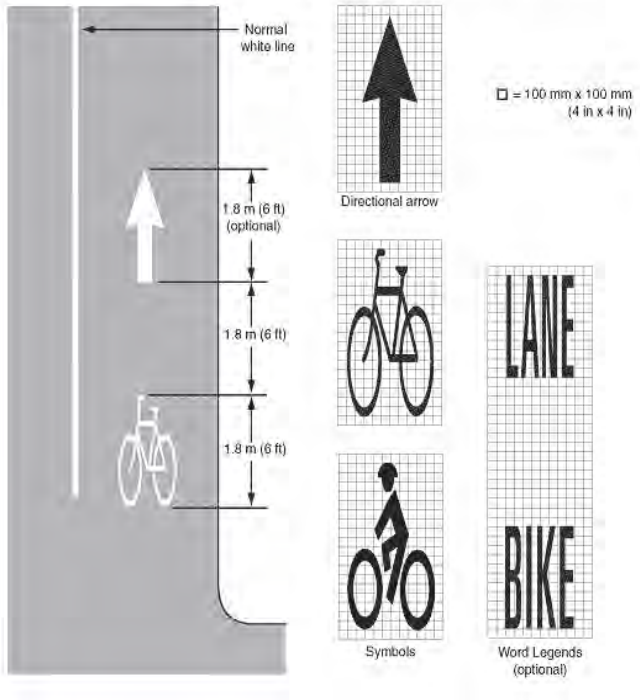
Bike lanes have the following advantages:

- They enable cyclists to ride at a constant speed, especially when traffic in the adjacent travel lanes speeds up or slows down (stop-and-go).
- They enable bicyclists to position themselves where they will be visible to motorists.
- They encourage cyclists to ride on the traveled way rather than the sidewalk.

Bike lanes are created with a solid stripe and stencils. Motorists are prohibited from using bike lanes for driving and parking, but may use them for emergency avoidance maneuvers or breakdowns. Bike lanes are one-way facilities that carry bicycle traffic in the same direction as adjacent motor-vehicle traffic. Bike lanes should always be provided on both sides of a two-way street. One exception is on hills where topographical constraints limit the width to a bike lane on one side only; the bike lane should be provided in the uphill direction as cyclists ride slower uphill, and they can ride in a shared lane in the downhill direction.

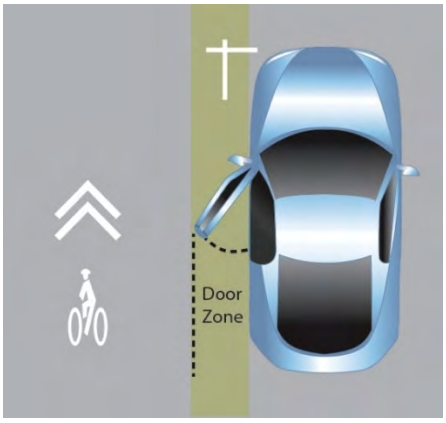
The minimum bike lane width is 5 feet from the face of a curb, or 4 feet on open shoulders. If on-street parking is permitted, the bike lane should be placed between parking and the travel lane with a preferred width of 6 feet so cyclists can ride outside the door zone. Streets with high volumes of traffic and/or higher speeds need wider bike lanes (6 feet to 8 feet) than those with less traffic or slow speeds. On curbed sections, a 4-foot (minimum 3 feet) wide smooth surface should be provided between the gutter pan and stripe. This minimum width enables cyclists to ride far enough from the curb to avoid debris and drainage grates and far enough from other vehicles to avoid conflicts. By riding away from the curb, cyclists are more visible to motorists than when hugging the curb. Where on-street parking is permitted, delineating the bike lane with two stripes, one on the street side and one on the parking side, is preferable to a single stripe.

Figure 9C-6. Example of Optional Word and Symbol Pavement Markings for Bicycle Lanes



Shared Lanes (Sharrow)

Shared-lane marking stencils ("SLMs," also commonly called "sharrows") may be used as an additional treatment for shared roadways. The stencils can serve a number of purposes: they remind bicyclists to ride farther from parked cars to prevent "dooring" collisions; they make motorists aware of bicycles potentially in the travel lane; and they show bicyclists the correct direction of travel. Sharrows installed next to parallel parking should be a minimum distance of 11 feet from the curb. Installing farther than 11 feet from the curb may be desired in areas with wider parking lanes or in situations where the sharrow is best situated in the center of the shared travel lane to promote cyclists taking the lane. Placing the sharrow between vehicle tire tracks increases the life of the markings and decreases long-term maintenance costs.



Sharrow
(Credit: Michele Weisbart)

Example of a sharrow
(Credit: Ryan Snyder)

Bicycle Parking

Secure bicycle parking at likely destinations is an integral part of a bikeway network. Bicycle thefts are common and lack of secure parking is often cited as a reason people hesitate to ride a bicycle. The same consideration should be given to bicyclists as to motorists, who expect convenient and secure parking at all destinations. Bicycle parking should be located in well-lit, secure locations close to the main entrance of a building, no farther from the entrance than the closest automobile parking space. Bike parking should not interfere with pedestrian movement. Bike racks along sidewalks should support the bicycle well, and make it easy to lock a U-shaped lock to the frame of the bike and the rack. The sample to the right shows an "Inverted–U" rack.

Inverted-U Bike Rack (Credit: Sky Yim)

Maintenance

Maintenance is a critical part of safe and comfortable bicycle access. Two areas that are of particular importance to bicyclists are pavement quality and drainage grates. Rough surfaces, potholes, and imperfections, such as joints, can cause a rider to lose control and fall. Care must be taken to ensure that drainage grates are bicycle-safe; otherwise a bicycle wheel may fall into the slots of the grate, causing the cyclist to fall. The grate and inlet box must be flush with the adjacent surface. Inlets should be raised after a

pavement overlay to the new surface. If this is not possible or practical, the new pavement should taper into drainage inlets so the inlet edge is not abrupt.

The most effective way to avoid drainage-grate problems is to eliminate them entirely with the use of inlets in the curb face. This may require more grates to handle bypass flow, but is the most bicycle-friendly design.

Greenways/Multi-Use Path

Width and Clearance

Ten feet is the recommended minimum width for a two-way, shared use path on a separate right- of-way. Other critical measurements include:

- 8 feet (2.4m) may be used where bicycle traffic is expected to be low at all times, pedestrian use is only occasional, sightlines are good, passing opportunities are provided, and maintenance vehicles will not destroy the edge of the trail.
- 12 feet is recommended where substantial use by bicycles, joggers, skaters, and pedestrians is expected, and where grades are steep (see later).
- 2 feet of graded area should be maintained adjacent to both sides of the path.
- 3 feet of clear distance should be maintained between the edge of the trail and trees, poles, walls, fences, guardrails or other lateral obstructions.
- 8 feet of vertical clearance to obstructions should be maintained; rising to 10 feet in tunnels and where maintenance and emergency vehicles must operate.

Design Speed, Horizontal and Vertical Alignment

The design of a shared use path should take into account the likely speed of users, the ability of bicyclists to turn corners without falling over, skidding, or hitting their pedal on the ground as they lean over. The AASHTO Guide for the Design of Bicycle Facilities has a number of tables, and equations to help designers meet the tolerances of a bicyclist based on the following key numbers:

- 20 miles per hour (30 km/h) is the minimum design speed to use in designing a trail
- 30 miles per hour (50 km/h) should be used where downgrades exceed 4 percent
- 15 miles per hour (25 km/h) should be used on unpaved paths where bicyclists tend to ride more slowly (and cannot stop as fast without skidding or sliding on a loose surface)

The result is a series of recommended desirable minimum curve radii for corners that should be safe for bicyclists.

Grade

Another critical factor in trail design is the grade or slope of the path. Generally, grades greater than 5 percent (one feet of climbing for every 20 feet traveled forward) are undesirable as they are hard for bicyclists to climb and may cause riders to travel downhill at a speed where they cannot control their bicycle. However,

recognizing that trails cannot always remain quite flat, the AASHTO Guide offers the following suggested lengths for certain grades:

- 5-6 percent is acceptable for up to 800 feet (240m)
- 7 percent is acceptable for up to 400 feet (120 m)
- 8 percent is acceptable for up to 300 feet (90m)
- 9 percent is acceptable for up to 200 feet (60m)
- 10 percent is acceptable for up to 100 feet (90m)
- 11 percent plus is acceptable for up to 50 feet (15m)

However, slopes with 9 percent grade are not acceptable for inexperienced bicyclists and are not compliant with Americans with Disabilities Act (ADA) guidelines. Consider the ADA grade guidelines as a guide to better meet the needs of pedestrians or bicyclists with disabilities and inexperienced bicyclists.

And, suggestions are offered for ways to mitigate the impact of steeper slopes, such as:

- adding 4-6 feet of additional width to the trail to allow sufficient space for a cyclist to dismount and walk their bicycle without blocking the trail, or to allow cyclists to pass each other,
- alerting cyclists to the approaching grade with appropriate signs and markings posting a recommended descent speed
- exceeding the usual minimum stopping sight distances to allow for the higher speeds
- exceeding the usual minimum thresholds for providing recovery areas, railings etc
- using a series of short switchbacks to contain the speed of descending riders

Sight Distances

The ability of a cyclist to stop or slow down to avoid a collision or crash is affected by many things. The rider must have time to identify a potential problem and react accordingly, which means that they must be able to see approaching intersections or corners in plenty of time even when they are traveling at the design speed of the trail. The bicycle itself must be able to be stopped or brought under control in time, which is affected by the braking ability of the bike, the surface material (a loose surface requires greater stopping distance), and the weather (wet conditions require greater stopping distances than dry). Once again, the AASHTO Guide and state/local manuals have tables and charts to enable the designer to calculate the appropriate sight distances in a range of situations.

Drainage

In response to a message about trail maintenance posted recently to an e-mail listserv, one trail manager identified the three most important issues: drainage, drainage and drainage. Poor drainage can ruin a good trail. The AASHTO Guide recommends a minimum cross slope of 1 percent and the need to make trails

accessible to people using wheelchairs demands a maximum cross slope of 2 percent. Other considerations to ensure adequate drainage include:

- slope the trail in one direction rather than having a crown in the middle of the trail
- ensure a smooth surface to prevent ponding and ice formation
- place a ditch on the upside of a trail constructed on the side of a hill (where needed)
- place drainage grates, utility covers etc out of the travel path of bicyclists, unless they can be made fully bicycle-friendly.
- preserve natural ground cover adjacent to the trail to inhibit erosion

Surface

Another important consideration in trail design is the type of surface that will be provided. A hard surface, such as cement or asphalt, will generally see cyclists operating at a faster speed than a soft surface, but may not be as popular with joggers and is more expensive to install. A soft surface trail (i.e. crushed granite) will discourage or prevent in-line skating but may be less expensive to install (although it will require more maintenance than concrete). Factors such as weather conditions and soil types can affect the choice of asphalt, concrete, or crushed rock. Choices in surface will affect requirements for periodic monitoring of the path surface and appropriate levels of maintenance.

Structures

One of the great advantages and unique features of trails along former railroad corridors is that they often have grade separated intersections with the highway system, and have bridges to carry them over rivers or stream valleys. However, not all corridors have this asset and structures of all kinds are needed to carry trail users under or over obstacles such as highways, rivers, freeways etc. The critical dimensions to use in designing underpasses, overpasses, bridges and tunnels, include:

a. the minimum width of the trail (usually 10 feet) should be maintained through the structure

b. the clear distance of two feet on either side of the trail surface should also be maintained through the structure — otherwise, riders will tend to ride in the center of the trail to stay away from the wall or railing of the structure

c. an overhead clearance of 10 feet (8 feet with good horizontal and vertical clearance, good sightlines etc) should be maintained through an underpass or tunnel

d. railings, fences, or barriers on both sides of a path on a structure should be at least 42 inches (1.1m) high, and where they are higher than this a rub rail should be provided at the approximate handlebar height of 42 inches.

e. clearances should allow for maintenance and emergency vehicles, as should the strength of the bridge (live loading)

Under-crossings are generally less expensive than overpasses and require less change in grade as a clearance height of only 10 feet is required. However, they may present security problems due to reduced visibility and drainage problems, both of which can be expensive to fix.

Over-crossings are more open and present fewer security problems but they require much longer approaches to achieve the minimum 17 feet of clearance from a roadway, and they are often more expensive. Overpasses also may result in complaints from nearby residences due to a loss of privacy or due to aesthetic concerns.

Another issue is when retrofitting a shared use path onto an existing highway bridge, should a separate path on one side, both sides, or an on-street facility be recommended?

The Florida DOT's Bicycle Facilities Planning and Design Handbook discusses the various options and recommends that:

- the shared use path should be carried across the bridge on one side where:
    - the bridge facility connects to a shared use path at both ends
    - sufficient width exists on one side of the bridge, or can be obtained by widening or restriping lanes
- provisions are made to physically separate bicycle and pedestrian traffic from motor vehicle traffic on-street facilities such as bike lanes may be advisable where:
    - the shared use path transitions into bicycle lanes at one end of the bridge
    - sufficient width exists or can be obtained by widening or restriping.

The AASHTO Guide also warns that this latter option must only be used if the transition from bike lanes to shared use path can be achieved without increasing the potential for wrong way riding or inappropriate crossing movements.

Lighting

Shared use paths in urban and suburban areas often serve travel needs both day and night, for example, commuter routes and trails accessing college campuses. Fixed source lighting improves visibility along trails and at intersections, and is critical for lighting tunnels and underpasses. The AASHTO guide recommends using average maintained illumination levels of between 5 and 22 lux.

Preventing Motor Vehicle Use of Paths

In some locations, shared use paths may be mistaken for motor vehicle roads or may suffer from illegal or unauthorized motorized use. At intersections with roadways, therefore, the path should be clearly signed, marked and/or designed to discourage or prevent unauthorized motorized access. A variety of alternatives exist to achieve this:

a. Bollards. Probably the most common device is the bollard, often lockable, collapsible or removable to allow for authorized access to the trail. Great care should be used in locating the bollard to ensure that they are visible, allow trail users through, and are not placed so as to channel both directions of trail

users towards the same point in the trail. If bollards are to be used, they should be retro-reflective, brightly colored, and have pavement markings around them. On a ten foot trail, one bollard should be used in the center of the trail. If more than one bollard is necessary, there should be five feet between them.

b. Splitting the trail in two. Many manuals suggest the option of splitting a ten foot trail into two five foot approaches to an intersection, with a planted triangle between them. This may increase maintenance costs.

c. Medians. The Florida DOT manual notes that "curbing with tight radii leading up to the roadway can often prevent motorists from attempting to enter the path. Medians should be set back from the intersection 25 feet (8m) to allow bicyclists to exit the roadway fully before navigating the reduced pathway width."

Signing and marking

While fewer signs may be needed on paths compared to on-street facilities, adequate signing and marking are essential on shared use paths, just as they are on streets and highways. Trail users need to know about potential conflicts, regulatory information, destinations, cross streets etc. The Manual on Uniform Traffic Control Devices (MUTCD) provides some minimum traffic control measures that should be applied and a range of options.

Striping: a yellow center line stripe is recommended where trails are busy, where sight distances are restricted, and on some unlit trails where night time riding is expected. The line should be dashed when adequate passing sight distance exists, and solid when no passing is recommended.

A solid white line may be used to separate pedestrians from bicycle/blading traffic, and solid white edge stripes may also be useful where nighttime riding is expected.

Warning signs: a range of warning signs can be used to inform users that recommended design criteria cannot be met, for example curve radii or grades or where unexpected conditions may exist.

Informational signs: trail users need to know where they are, where they are going, what cross streets they are crossing, how far destinations are away, and what services are available close to the trail. The MUTCD has information on the appropriate signs to use in these instances. Although not in the MUTCD, many trails post signs encouraging uniform trail user etiquette (e.g. "give audible signal when passing" or which type of trail user has the right-of-way).

Intersection markings and signs: pavement marking and signs at intersections should channel users to cross at clearly defined locations and indicate that crossing traffic is to be expected. Similar devices to those used on roadways (STOP and YIELD signs, stop bars, etc) should be used on trails as appropriate.

The AASHTO Guide notes that in addition to traditional warning signs in advance of intersections, motorists can be alerted to the presence of a trail crossing through flashing warning lights, zebra-style or colored pavement crosswalks, raised crosswalks, signals, and neck-downs/curb-bulbs. However, some devices such as flashing warning lights are expensive to install and maintain and should be kept to a minimum.

Sidepaths

A sidepath is essentially a multi-use path that is oriented alongside a road but is separate from the road. The AASHTO Guide to the Development of Bicycle Facilities and North Carolina Bicycle Facilities Planning and Design Guidelines strongly caution those contemplating a sidepath (or wide sidewalk) facility to investigate various elements of the roadway corridor environment and right-of-way before making a decision. AASHTO provides nine cautions/criteria (pp. 34-35) for designing sidepaths.

In addition to AASHTO's cautions, research from the US and abroad confirm that bicycle/motor vehicle crash rates are higher for bicyclists riding on a sidepath than on a roadway. Consequently, designers are advised to be very careful when choosing to design sidepaths. There are some high-volume, high-speed roadways where sidepaths are the only bicycle facility that can be provided without very costly changes to the roadway corridor. In these cases, it may be preferable to provide a sidepath. This decision must consider the magnitude of intersecting driveway and roadway conflicts. In addition, sidepaths should be provided on both sides of the roadway if possible to encourage bicyclists to ride in the same direction as adjacent traffic. Finally, the long-term strategy on these roadways should be to widen the road or narrow the lanes to provide additional space for bicyclists in on-road bike lanes or shoulders.

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Streetscape

Urban Forestry

The urban forest includes all trees, shrubs, and other understory plantings on both public and private lands. Street trees and landscaping are essential parts of the urban forest, as they contribute positively to the urban environment—to climate control, stormwater collection, and the comfort and safety of people who live or travel along the street. A street lined with trees and other plantings looks and feels narrower and more enclosed, which encourages drivers to slow down and to pay more attention to their surroundings. Trees provide a physical and a psychological barrier between pedestrians and motorized traffic, increasing safety as well as making walking more enjoyable.

A healthy urban forest is also a powerful stormwater management tool. Leaves and branches catch and slow rain as it falls, helping it to soak into the ground. The plants themselves take up and store large quantities of water that would otherwise contribute to surface runoff. Part of this moisture is then returned to the air through evaporation to further cool the town.

As an important element along sidewalks, street trees must be provided with conditions that allow them to thrive, including adequate uncompacted soil, water, and air. This section provides guidance for appropriate conditions and selecting, planting, and caring for street trees, as well as for other landscaping along streets.

Street Trees

Goals and Benefits of Street Trees

The goal of adding street trees is to increase the canopy cover of the street, the percentage of its surface either covered by or shaded by vegetation, not simply to increase the overall number of trees. The selection, placement, and management of all elements in the street should enhance the longevity of a town's street trees and healthy, mature plantings should be retained and protected whenever possible.

Principles for Street Trees

The following principles influence the selection of street trees and landscaping design:

- **Seek out and reclaim space for trees**. Streets have a surprising number of residual or left-over spaces between areas required for travel lanes and parking, once they are examined from this perspective. Traffic circles, medians, channelization islands, and curb extensions can provide space for trees and landscaping.
- **Create optimum conditions for growth.** Space for roots and above ground growth is the main constraint to the urban forest achieving its highest potential. Typically a 6 to 8-foot wide, continuous sidewalk furniture zone must be provided, with uncompacted soil to a minimum of a 3-foot depth. If space for trees is constrained, provisions should be made to connect these smaller areas below the surface to form larger effective areas for the movement of air, root systems, and water through the soil.
- **Select the right tree for the space**. In choosing a street tree, consider what canopy, form, and height will maximize benefits over the course of its life. Provide necessary clearances below overhead high-intensity electrical transmission lines and prevent limbs from overhanging potentially sensitive

structures such as flat roofs. In commercial areas where the visibility of façade-mounted signs is a concern, choose species whose mature canopy allows for visibility, with the lowest branches at a height of 12 to 14 feet or more above the ground. Select trees with non-aggressive root systems to avoid damaging paving and sidewalks.

- **Start with good nursery stock and train it well.** When installing plant material, choose plants that have complete single leaders and are in good "form," and check that boxed trees are not root bound. Proper watering and pruning every three to four years will allow trees to mature and thrive for many years of service.

- **Do not subject plants to concentrated levels of pollutants.** Trees and other plants should be integrated within stormwater management practices whenever possible, but filtering of pollutants from "first flush" rain falls and street runoff will extend the life of trees and prevent toxic buildup of street pollutants in tree wells.

Guidelines

Climate and Soil

Selecting trees that are adapted to a site's climate and local rain cycles can create a more sustainable urban forest. The urban environment is harsh for many plants. Often plants native to an area are best adapted to that area's climate. Select plants that can tolerate the environmental elements, such as radiant heat from the sidewalk or street surface or 50 to 60 mph winds from passing traffic.

Urban soils have become highly compacted through construction activities and the passage of vehicle and even foot traffic. Compaction reduces the soil's capacity to hold and absorb water. Plants need healthy soil, air, and water to thrive.

Using planters in the urban forest can increase the biomass and canopy cover, but these plants and trees are still compromised and confined. At its bottom and sides, a barrier will exist as the prepared area meets the surrounding compacted soils. Covering the soil surface with some form of mulch can help as the shade, cooling, and retained moisture that mulch provides help support the biological activities close to the soil's surface. These activities open the pore structure of the soil over time, help keep it open, and cushion the impact of foot traffic. This process works better if the mulch material is organic, as opposed to stones. If planters have limited resources for soil preparation, they should have an extensive covering of mulch.

The generalized soil types map for a town can be used as a starting point when planning projects, but then the basic soil classifications should be identified on-site, especially when confronted by planting sites at the extreme ends of the spectrum: very fast-draining, nutrient-poor sands, and dense, often nutrient-rich, but oxygen-starved poorly drained clays.

Planting Sites

Traditionally, trees have been squeezed into whatever limited space is easily found, but this does not work well for either the tree or the street. The following guidelines provide recommended planting areas:

- Establish and maintain 6 to 8-foot wide sidewalk furniture zones, where possible. Many large trees need up to 12 feet in width, and are not suitable for placement in narrower furniture zones. In

residential areas, sidewalk furniture zones within the root zone should be unpaved and planted/surfaced with low groundcover, mulch, or stabilized decomposed granite where these can be maintained. Where maintenance of such extensive sidewalk furniture zones is not feasible, provide 12-foot long tree wells with true permeable pavers (standard interlocking pavers are not permeable).

- If the above conditions are not feasible, provide for the tree's root system an adequate volume of uncompacted soil or structural or gap-graded soil (angular rock with soil-filled gaps) to a depth of 3 feet under the entire sidewalk (in the furniture, frontage, and pedestrian sidewalk zones).

- Spacing between trees will vary with species and site conditions. The spacing should be 10 percent less than the mature canopy spread. Closer spacing of large canopy trees is encouraged to create a lacing of canopy, as trees in groups or groves can create a more favorable microclimate for tree growth than is experienced by isolated trees exposed to heat and desiccation from all sides. On residential streets where lots are 40 or 50 feet wide, plant one tree minimum per lot between driveways. Where constraints prevent an even spacing of trees, it is preferable to place a tree slightly off the desired rhythm than to leave a gap in the pattern.

- Planting sites should be graded, but not overly compact, so that the soil surface slopes downward toward the center, forming a shallow swale to collect water. The crown of the tree should remain 2 inches above finished grade and not be in the center of a swale, but off to the side. The finished soil elevation after planting is held below that of the surrounding paving so 2 to 3 inches of mulch can be added. The mulch layer must be replenished as needed to maintain a nearly continuous level surface adjacent to paving.

- Generally tree grates and guards are best used along streets with heavy pedestrian traffic. Along streets without heavy foot traffic and in less urban environments, use mulch in lieu of tree grates.

Species Selection

- Select trees with non-aggressive root systems to avoid damaging paving and sidewalks.

- In general, street trees should be species that will achieve a height and spread of 50 feet on residential streets and 40 feet on commercial streets within 10 years of planting to provide reasonable benefits. Typically, trees on commercial streets will not achieve the same scale as they will on residential streets where greater effective root zone volumes may be achieved. On commercial streets with existing multi-story buildings and narrow sidewalks, select trees with a narrower canopy than can be accommodated on the limited sidewalk width.

- Cities and towns should establish a list of recommended tree species for use in the public street rights-of-way. On commercial streets with ground-floor retail, deciduous trees with a strong central leader, such as Ginkos and London Planes, are desirable as they grow rapidly above the ground floor business signs. A town's list of recommended tree species should specify minimum planting site widths for each and which trees may be planted below utility lines. Where there are overhead power lines that are less than 50 feet above grade, braided insulated electrical wire should be used so that trees do not have to be pruned to avoid the electrical lines. If braided insulated electrical wire cannot be provided,

appropriate trees that will not grow tall enough to reach the power lines should be specified and planted.

- Consistent use of a single species helps reinforce the character of a street or district, but a diversity of species may help the urban canopy resist disease or insect infestations. New plantings added to streets with existing trees should be selected with the aim of meeting the same watering requirements and creating visual harmony with existing trees and plantings. Native species should be considered for inclusion whenever possible, but consideration should be first given to a species' adaptability to urban conditions.
- Consider evergreen species where it is desirable to maintain foliage through the winter months.
- Consider deciduous species where their ability to allow sunlight to penetrate into otherwise shaded areas (such as south facing windows of adjoining buildings) during the winter months will be a plus.

Tree Spacing and Other Considerations

- Most jurisdictions have spacing requirements between trees and street lights (typically about 30 feet high), which typically vary from 10 to 20 feet. The smaller setback provides greater flexibility in tree spacing and allows for a more complete tree canopy.
- Pedestrian lights, which are about 12 feet tall, generally do not conflict with the tree canopy, so spacing is less rigid. Some jurisdictions still require wide clearance for their convenience in maintaining the lights, but this wide spacing greatly reduces tree canopy and is therefore discouraged. Spacing of 10 feet away from trees is generally adequate.
- An 8-foot minimum clearance must be maintained between accessible parking spaces and trees.
- Adequate clear space should be provided between trees and awnings, canopies, balconies, and signs so they will not come into conflict through normal growth or require excessive pruning to remediate such conflicts.
- Trees may be planted in medians that are 4 feet or wider, but must have an adequate clear height between the surface of the median and the lowest branches so that pedestrians can be seen. Where trees hang over the street, the clear height should be 14 feet.

Understory Landscaping

Understory landscaping refers to landscape elements beneath the tree canopy in areas within the public right-of-way not required for vehicular or pedestrian movement, including

- Medians
- Curb extensions
- Furniture and frontage zones

Benefits of Understory Landscaping

- Complements and supports street trees, in particular by providing uncompacted, permeable areas that accommodate roots and provide air, water, and nutrients
- Reduces impervious area and surface runoff
- Treats stormwater, improving water quality
- Provides infiltration and groundwater recharge
- Provides habitat
- Reduces the perceived width of the street by breaking up wide expanses of paving, particularly when the understory is in medians and sidewalk furniture zones
- Contributes to traffic calming
- Provides a buffer between the walkway zone and the street, contributing to pedestrian comfort
- Improves the curb appeal of properties along the street, potentially increasing their value
- Enhances the visual quality of the community

Principles

- Trees take precedence: the understory landscape should support them. It should not compete with them.
- Only pave where necessary: keep as much of the right-of-way unpaved and planted as possible to maximize benefits
- Design understory areas to infiltrate water
- The entire understory area does not have to be covered with plants—composted mulch is a good groundcover (top of mulch should be below adjoining hardscape so that runoff will flow into planting areas)
- Make the understory sustainable: use drought-tolerant plants
- Replenish the soil with compost
- Design the understory to contribute to the sense of place

Guidelines

Soil

Provide good quality, uncompacted, permeable soil. Soil analyses should address the concentration of elements that may affect plant growth, such as pH, salinity, infiltration rate, etc. Remove and replace or amend soil as needed. Good preparation saves money in the long run because it reduces the need to replace plants, lowers water consumption, and reduces fertilizer applications.

Design

Generally, understory landscaped areas should be as wide as possible where there are trees: when feasible, at least 6 to 9 feet wide for parkways and 8 to 12 feet wide for medians. However, many existing parkways and medians are less wide. Narrower parkways can support understory plants and some tree species. A path or multiple paths should be added as needed across a parkway as a means of access from the curb to the sidewalk. For example, where there are striped curbside parking spaces, a path across the parkway should be provided at every one or two parking spaces.

Install plant species that:

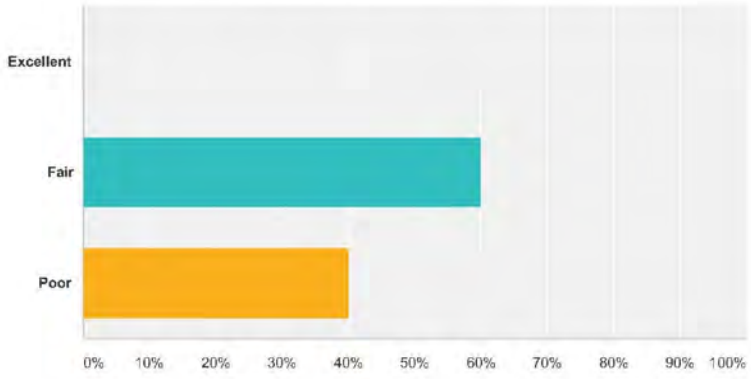
- Do not require mowing more frequently than once every few months
- Are drought tolerant and can survive with minimal irrigation upon establishment
- Do not exceed a height of 2 feet within 5 feet of a driveway/curb cut and within 20 feet of a crosswalk, and, excluding trees, 3 feet elsewhere
- Do not have thorns or sharp edges adjacent to any walkway or curb
- Are located at least 4 feet from any tree trunk

Appendix C: Windsor Comprehensive Bicycle and Pedestrian Plan Survey

Windsor Comprehensive Bicycle & Pedestrian Plan

Q1 How do you rate bicycling conditions in and around Windsor?

Answered: 15 Skipped: 1

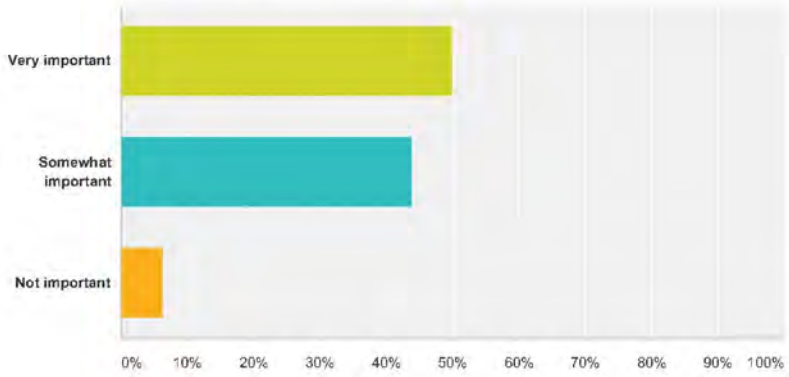


Answer Choices	Responses	
Excellent	0.00%	0
Fair	60.00%	9
Poor	40.00%	6
Total		15

Windsor Comprehensive Bicycle & Pedestrian Plan

Q2 How important to you is improving bicycling conditions in and around the Windsor area?

Answered: 16 Skipped: 0

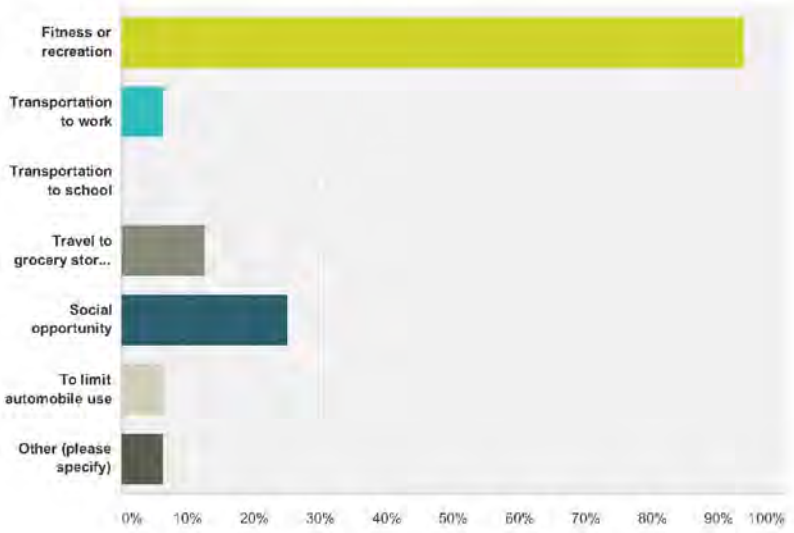


Answer Choices	Responses	
Very important	50.00%	8
Somewhat important	43.75%	7
Not important	6.25%	1
Total		16

Windsor Comprehensive Bicycle & Pedestrian Plan

Q3 For what purposes do you bike most now? (Choose all that apply)

Answered: 16 Skipped: 0



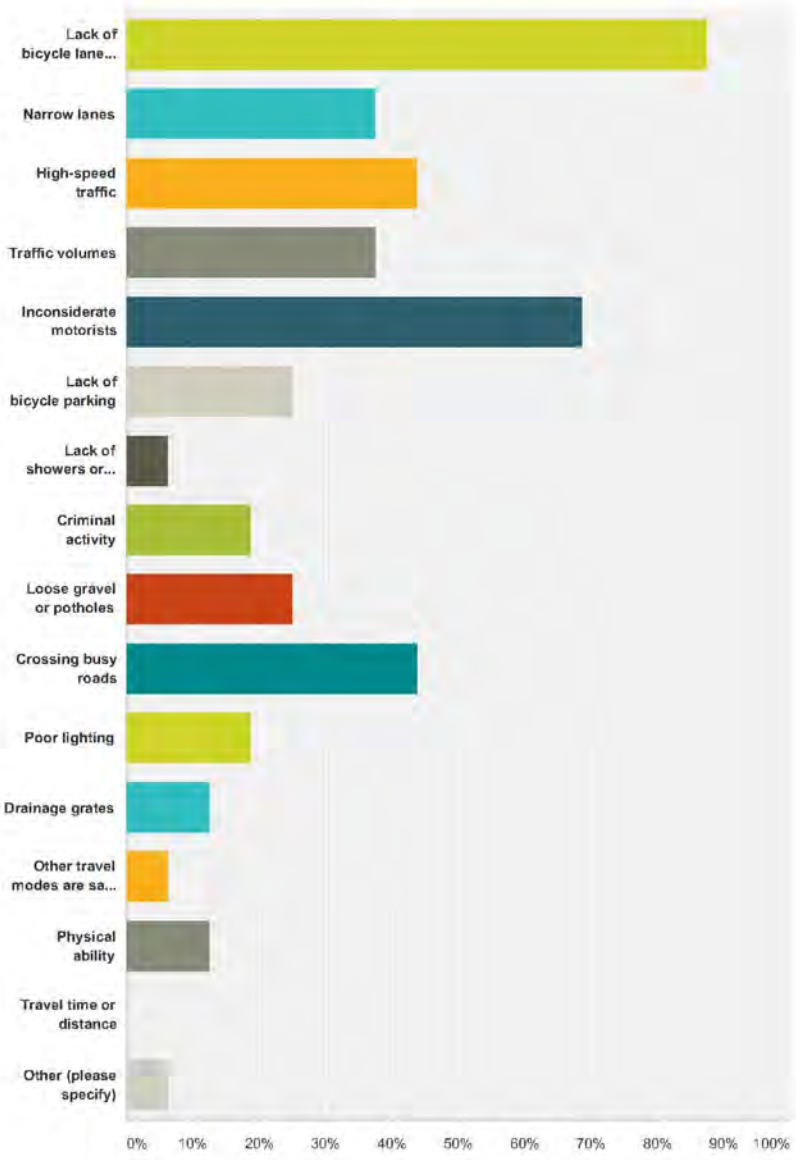
Answer Choices	Responses	
Fitness or recreation	93.75%	15
Transportation to work	6.25%	1
Transportation to school	0.00%	0
Travel to grocery store, shops, etc.	12.50%	2
Social opportunity	25.00%	4
To limit automobile use	6.25%	1
Other (please specify)	6.25%	1
Total Respondents: 16		

#	Other (please specify)	Date
1	none	8/22/2016 4:25 PM

Windsor Comprehensive Bicycle & Pedestrian Plan

Q4 What factors discourage biking? (Choose all that apply)

Answered: 18 Skipped: 0



Answer Choices	Responses

Windsor Comprehensive Bicycle & Pedestrian Plan

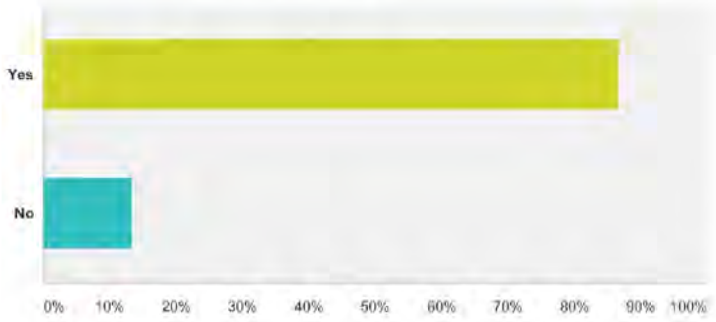
Lack of bicycle lanes, shoulders, or paths	87.50%	14
Narrow lanes	37.50%	6
High-speed traffic	43.75%	7
Traffic volumes	37.50%	6
Inconsiderate motorists	68.75%	11
Lack of bicycle parking	25.00%	4
Lack of showers or lockers at workplace	6.25%	1
Criminal activity	18.75%	3
Loose gravel or potholes	25.00%	4
Crossing busy roads	43.75%	7
Poor lighting	18.75%	3
Drainage grates	12.50%	2
Other travel modes are safer or more comfortable	6.25%	1
Physical ability	12.50%	2
Travel time or distance	0.00%	0
Other (please specify)	6.25%	1
Total Respondents: 16		

#	Other (please specify)	Date
1	log trucks	8/25/2016 3:46 PM

Windsor Comprehensive Bicycle & Pedestrian Plan

Q5 Would you bike more often if more bicycle lanes, trails, and safe roadway crossings were provided for bicyclists?

Answered: 15 Skipped: 1

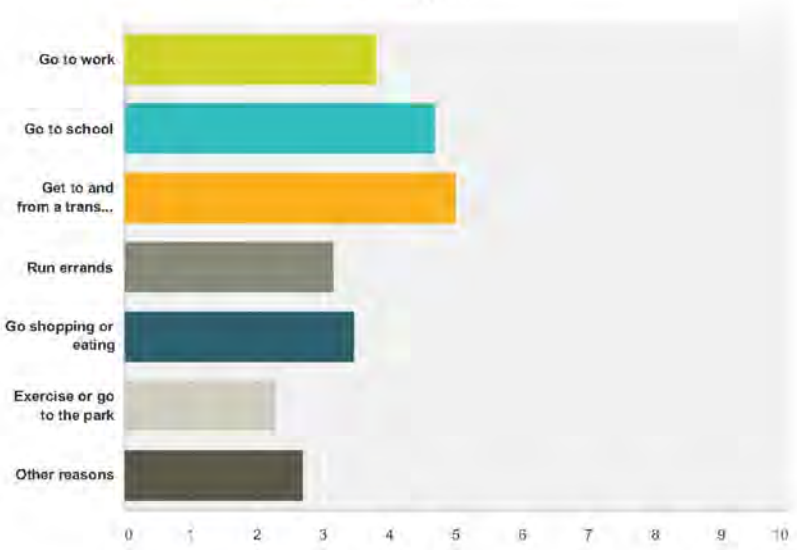


Answer Choices	Responses	
Yes	86.67%	13
No	13.33%	2
Total		15

Windsor Comprehensive Bicycle & Pedestrian Plan

Q6 On average, how frequently to you WALK outside for the following reasons?

Answered: 15 Skipped: 0

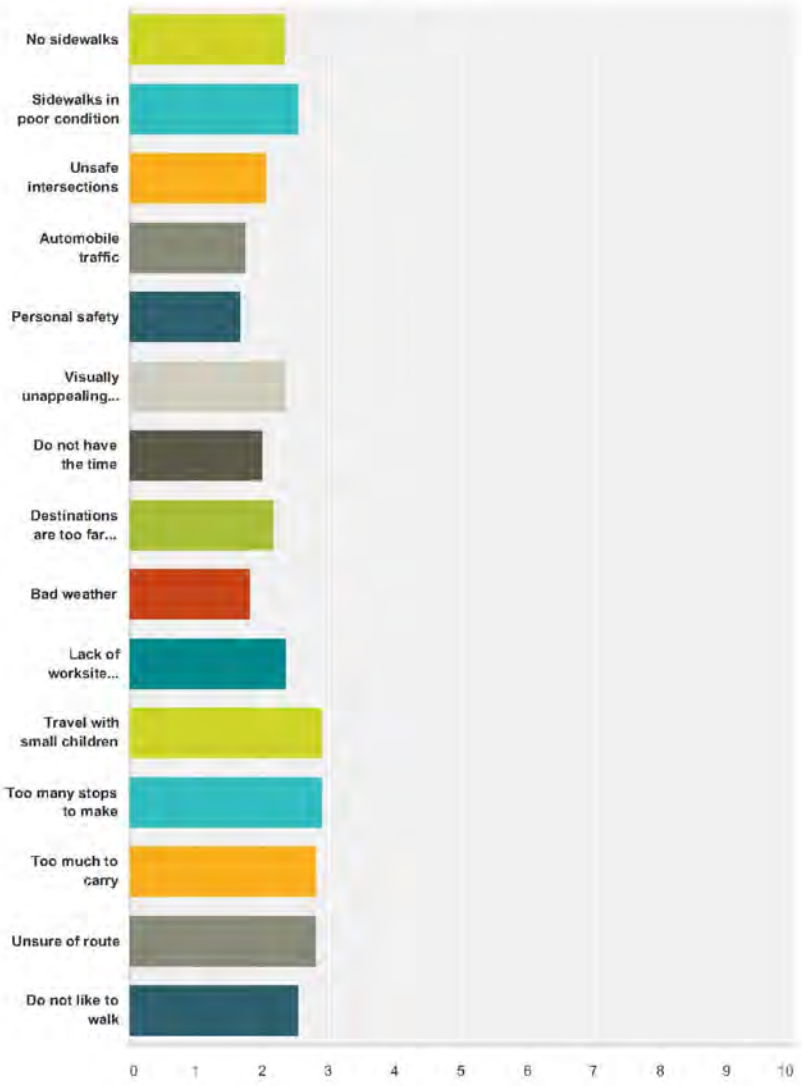


	Daily	At least once/week	At least once/month	At least once/year	Never	Total	Weighted Average
Go to work	21.43% 3	7.14% 1	7.14% 1	0.00% 0	64.29% 9	14	3.79
Go to school	8.33% 1	0.00% 0	0.00% 0	0.00% 0	91.67% 11	12	4.67
Get to and from a transit stop	0.00% 0	0.00% 0	0.00% 0	0.00% 0	100.00% 11	11	5.00
Run errands	23.08% 3	15.38% 2	23.08% 3	0.00% 0	38.46% 5	13	3.15
Go shopping or eating	7.69% 1	23.08% 3	23.08% 3	7.69% 1	38.46% 5	13	3.46
Exercise or go to the park	20.00% 3	46.67% 7	26.67% 4	0.00% 0	6.67% 1	15	2.27
Other reasons	20.00% 2	30.00% 3	30.00% 3	0.00% 0	20.00% 2	10	2.70

Windsor Comprehensive Bicycle & Pedestrian Plan

Q7 How would you rate the following as reasons that you do not WALK more frequently?

Answered: 15 Skipped: 1



	Major reason	Minor reason	Not a reason	Total	Weighted Average
No sidewalks	25.00% 3	16.67% 2	58.33% 7	12	2.33

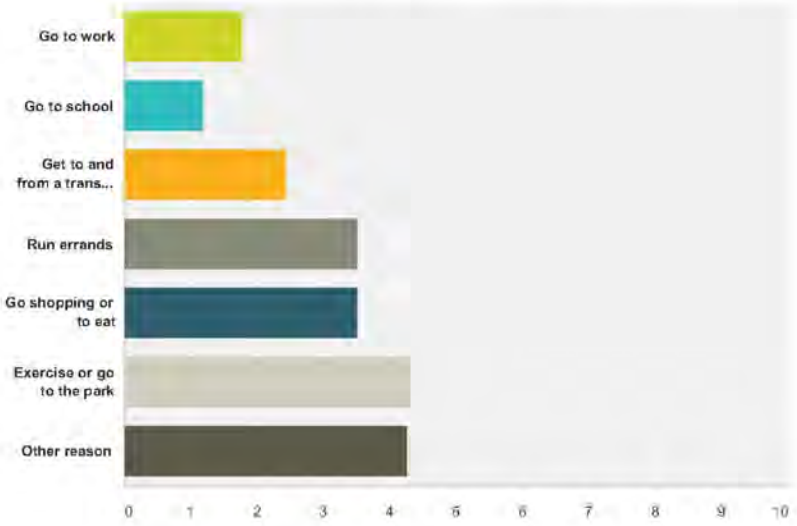
Windsor Comprehensive Bicycle & Pedestrian Plan

Sidewalks in poor condition	**0.00%** 0	**45.45%** 5	**54.55%** 6	11	2.55
Unsafe intersections	**28.57%** 4	**35.71%** 5	**35.71%** 5	14	2.07
Automobile traffic	**33.33%** 4	**58.33%** 7	**8.33%** 1	12	1.75
Personal safety	**50.00%** 6	**33.33%** 4	**16.67%** 2	12	1.67
Visually unappealing surroundings	**18.18%** 2	**27.27%** 3	**54.55%** 6	11	2.36
Do not have the time	**27.27%** 3	**45.45%** 5	**27.27%** 3	11	2.00
Destinations are too far away	**9.09%** 1	**63.64%** 7	**27.27%** 3	11	2.18
Bad weather	**27.27%** 3	**63.64%** 7	**9.09%** 1	11	1.82
Lack of worksite amenities	**9.09%** 1	**45.45%** 5	**45.45%** 5	11	2.36
Travel with small children	**0.00%** 0	**9.09%** 1	**90.91%** 10	11	2.91
Too many stops to make	**0.00%** 0	**9.09%** 1	**90.91%** 10	11	2.91
Too much to carry	**9.09%** 1	**0.00%** 0	**90.91%** 10	11	2.82
Unsure of route	**9.09%** 1	**0.00%** 0	**90.91%** 10	11	2.82
Do not like to walk	**9.09%** 1	**27.27%** 3	**63.64%** 7	11	2.55

Windsor Comprehensive Bicycle & Pedestrian Plan

Q8 If it were safe and convenient, how likely would you be willing to walk or bike for the following reasons? (1 - Not willing, 5 - Very willing)

Answered: 10 Skipped: 0

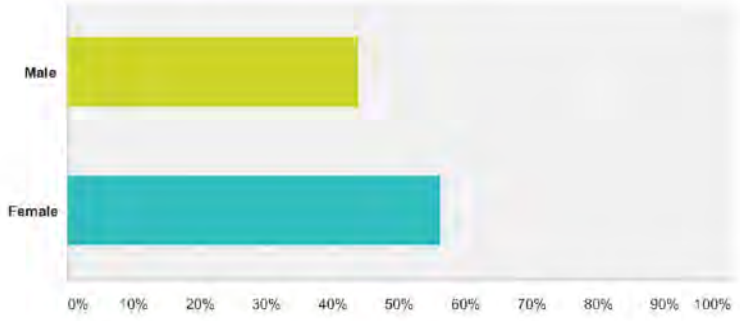


	1	2	3	4	5	Total	Weighted Average
Go to work	69.23% 9	0.00% 0	23.08% 3	0.00% 0	7.69% 1	13	1.77
Go to school	90.00% 9	0.00% 0	10.00% 1	0.00% 0	0.00% 0	10	1.20
Get to and from a transit stop	54.55% 6	0.00% 0	18.18% 2	0.00% 0	27.27% 3	11	2.45
Run errands	0.00% 0	21.43% 3	35.71% 5	14.29% 2	28.57% 4	14	3.50
Go shopping or to eat	7.14% 1	7.14% 1	35.71% 5	28.57% 4	21.43% 3	14	3.50
Exercise or go to the park	6.67% 1	0.00% 0	6.67% 1	26.67% 4	60.00% 9	15	4.33
Other reason	0.00% 0	12.50% 1	12.50% 1	12.50% 1	62.50% 5	8	4.25

Windsor Comprehensive Bicycle & Pedestrian Plan

Q9 What is your gender?

Answered: 16 Skipped: 0

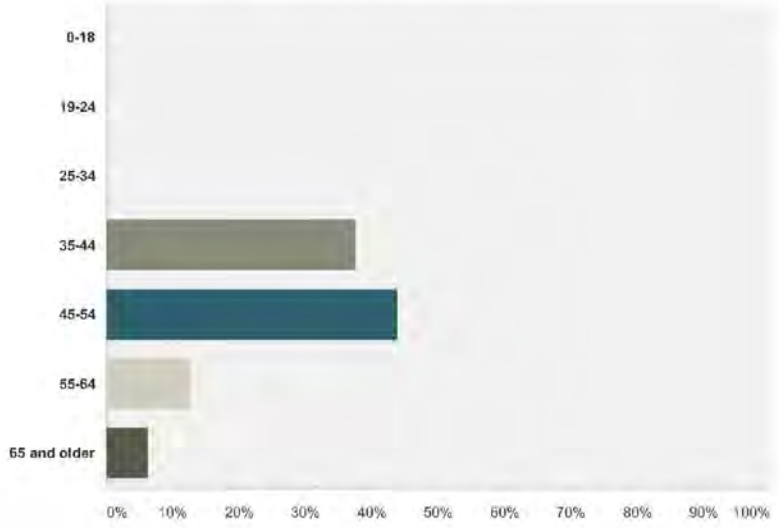


Answer Choices	Responses	
Male	43.75%	7
Female	56.25%	9
Total		16

Windsor Comprehensive Bicycle & Pedestrian Plan

Q10 What is your age?

Answered: 16 Skipped: 0

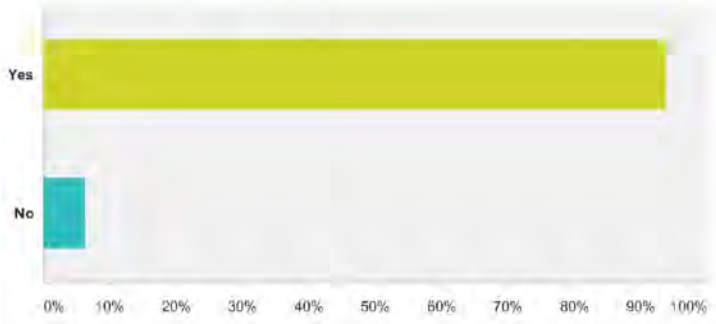


Answer Choices	Responses	
0-18	0.00%	0
19-24	0.00%	0
25-34	0.00%	0
35-44	37.50%	6
45-54	43.75%	7
55-64	12.50%	2
65 and older	6.25%	1
Total		16

Windsor Comprehensive Bicycle & Pedestrian Plan

Q11 Do you own a car or use an alternate mode of transportation other than bicycling or walking?

Answered: 16 Skipped: 0



Answer Choices	Responses	
Yes	93.75%	15
No	6.25%	1
Total		16

Windsor Comprehensive Bicycle & Pedestrian Plan

Q12 Which locations in Windsor do you think would benefit from signs with directional information?

Answered: 5 Skipped: 11

#	Responses	Date
1	entering Windsor from all directions	9/21/2016 10:30 AM
2	King Street beyound the hospital and Sterlingworth street around the old hospital	9/19/2016 6:25 PM
3	King Street & Granville Street	8/22/2016 4:25 PM
4	not sure	8/19/2016 1:08 PM
5	Champ NC Wild Life Cashier River Dist. Golf Course. Sign need to be larger.	8/16/2016 2:47 PM

Street Name	Maintenance	Proposed Improvement	From	To	Length (linear feet)	Cost
Maple	Windsor	Install sidewalk, one side	King	End of Street	1,166	$61,798
Center	Windsor	Install sidewalk, one side	Maple	End of Street	562	$29,786
Elm	Windsor	Install sidewalk, one side	King	Center	662	$35,086
Queen	Windsor	Install sidewalk, one side	Maple	Forest	1,061	$56,233
Oakdale	Windsor	Install sidewalk, one side	King	Queen	327	$17,331
Forest	Windsor	Install sidewalk, one side	King	Queen	334	$17,702
Rhodes	Windsor	Install sidewalk, one side	King	End of Street	1,859	$98,527
Park	Windsor	Install sidewalk, one side	Rhodes	End of Street	282	$14,946
Conner	Windsor	Install sidewalk, one side	Rhodes	Conner	674	$35,722
Dunlow	Windsor	Install sidewalk, one side	Conner	End of Street	666	$35,298
Gray	Windsor	Install sidewalk, one side	Sutton	End of Street	593	$31,429
nichols	Windsor	Install sidewalk, one side	Queen	Sutton	396	$20,988
Queen	Windsor	Install sidewalk, one side	Granville	Camden	473	$25,069
Camden	Windsor	Install sidewalk, one side	Sterlingworth	Existing sidewalk	1,298	$68,794
St Elmo	Windsor	Install sidewalk, one side	King	Ghent	1,600	$84,800
Byrd	Windsor	Install sidewalk, one side	King	Taylor	399	$21,147
Watson	Windsor	Install sidewalk, one side	King	Sterlingworth	1,629	$86,337
Gatling	Windsor	Install sidewalk, one side	Watson	Winwood	688	$36,464
Winwood	Windsor	Install sidewalk, one side	Gatling	School	1,691	$89,623
School	Windsor	Install sidewalk, one side	Winwood	King	676	$35,828
taylor	Windsor	Install sidewalk, one side	Carroll	School	350	$18,550
Carroll	Windsor	Install sidewalk, one side	Taylor	Winwood	350	$18,550
Hofler	Windsor	Install sidewalk, one side	Winwood	Sterlingworth	1,117	$59,201
Northboro	Windsor	Install sidewalk, both sides	Broad	End of Street	556	$29,468
Broad	Windsor	Install sidewalk, both sides	Northboro	Spring	2,728	$144,584
Srping	Windsor	Install sidewalk, both sides	Broad	Rascoe	742	$39,326
Rascoe	Windsor	Install sidewalk, both sides	Srping	York	1,840	$97,520
York	Windsor	Install sidewalk, both sides	George	Existing walkway	2,546	$134,938
Sterlingworth	Windsor	Install sidewalk, both sides	Granville	Ghent	1,630	$86,390
Sterlingworth	Windsor	Install sidewalk, both sides	Ghent	Confederate	3,354	$177,762
Sterlingworth	Windsor	Install sidewalk, both sides	Confederate	US-13 bypass	3,246	$172,038
Sutton	Windsor	Install sidewalk, both sides	Corporate Limit	Granville	2,622	$138,966
Gray	Windsor	Install sidewalk, both sides	Sutton	Existing sidewalk	636	$33,708
Pitt	Windsor	Install sidewalk, both sides	Queen	York	1,912	$101,336
York	Windsor	Install sidewalk, both sides	Pitt	Water	860	$45,580
Water	Windsor	Install sidewalk, both sides	King	York	990	$52,470
Gray	Windsor	Install sidewalk, both sides	King	End of Street	770	$40,810
Dundee	Windsor	Install sidewalk, both sides	Existing Sidewalk	York	390	$20,670
York	Windsor	Install sidewalk, both sides	Dundee	Granville	964	$51,092
Belmont	Windsor	Install sidewalk, both sides	Camden	St Elmo	936	$49,608
Belmont	Windsor	Install sidewalk, both sides	St Elmo	Byrd	932	$49,396
Byrd	Windsor	Install sidewalk, both sides	Belmont	Taylor	686	$36,358
Taylor	Windsor	Install sidewalk, both sides	Byrd	Watson	708	$37,524
Taylor	Windsor	Install sidewalk, both sides	Watson	Belmont	1,774	$94,022
Taylor	Windsor	Install sidewalk, both sides	Belmont	Carroll	1,470	$77,910
Carroll	Windsor	Install sidewalk, both sides	Taylor	King	674	$35,722
					51,819	$2,746,407

Proposed Dedicated Bike Lanes

Street name	Maintenance	Proposed Improvement	From	To	Length	Cost
King	NC DOT	Install bike lane, one side	Corporate Limit	Hoggard	2,437	$52,492.98
King	NC DOT	Install bike lane, one side	Hoggard	Cooper Hill	2,461	$53,009.94
King	NC DOT	Install bike lane, one side	Cooper Hill	Rhodes	1,962	$42,261.48
King	NC DOT	Install bike lane, one side	Rhodes	Forest	1,850	$39,849.00
King	NC DOT	Install bike lane, one side	Forest	Maple	1,067	$22,983.18
King	NC DOT	Install bike lane, one side	Maple	Water	1,322	$28,475.88
King	NC DOT	Install bike lane, one side	Water	Granville	1,964	$42,304.56
King	NC DOT	Install bike lane, one side	Granville	Watson	1,785	$38,448.90
King	NC DOT	Install bike lane, one side	Watson	School	1,948	$41,959.92
King	NC DOT	Install bike lane, one side	School	US-13 bypass	1,308	$28,174.32
Water	Windsor	Install bike lane, one side	King	Sutton	912	$19,644.48
Granville	Windsor	Install bike lane, one side	King	Sterlingworth	1,486	$32,008.44
Sterlingworth	Windsor	Install bike lane, one side	Granville	Ghent	819	$17,641.26
Grabtown	NC DOT	Install bike lane, one side	City Limits	US-13 Bypass	1,856	$39,978.24
Grabtwon	NC DOT	Install bike lane, one side	US-13 Bypass	Harris	3,670	$79,051.80
Cooper Hill	NC DOT	Install bike lane, one side	King	City Limits	5,808	$125,104.32
Ghent	Windsor	Install bike lane, one side	Sterlingworth	Oak Grove	1,891	$40,732.14
					34,546	$744,120.84
					6.5 Miles	
	Proposed Shared Lane Markings					
Grabtown	Windsor	Install share lane, both sides	Corporate Limit	US-13/17	n/a	$360.00
Grabtown	Windsor	Install share lane, both sides	US-13/17	ETJ	n/a	$360.00
US-17 Bypass	NC DOT	Install share lane, both sides	Corporate Limit	US-13/17	n/a	$360.00
US-13/17	NC DOT	Install share lane, both sides	Brantville	Granville (US-17)	n/a	$360.00
US-13/17	NC DOT	Install share lane, both sides	Granville	Grabtown	n/a	$360.00
US-13/17	NC DOT	Install share lane, both sides	Grabtown	Corporate Limit	n/a	$360.00
US-13/17	NC DOT	Install share lane, both sides	Corporate Limit	US-13	n/a	$360.00
US-13	NC DOT	Install share lane, both sides	US-13 bypass	ETJ	n/a	$360.00
US-13	NC DOT	Install share lane, both sides	ETJ	Lea Lumber	n/a	$360.00
Cooper Hill	Windsor	Install share lane, both sides	King	Corporate Limit	n/a	$360.00
						$3,600.00