ISSUES AND OPPORTUNITIES: TRANSPORTATION, WATER, GREEN INFRASTRUCTURE, AND ENERGY

DRAFT 1/15/2021

CONTENTS

1. INTRODUCTION

This section presents an overview about the issues and opportunities regarding Carrboro's existing infrastructure which includes transportation, water and wastewater, energy, and green infrastructure. Due to the linked nature of these topics, solutions (or problems) for one can create problems for the other. Combining transportation, water, energy, and green infrastructure provides Carrboro the opportunity to identify, evaluate, and provide solutions in a more comprehensive and efficient manner.

Carrboro residents and Town staff are dedicated to understanding how to better navigate and coordinate a transportation network that addresses barriers to access, update the Town energy supply to be renewable, and better plan for sustainable water supply and access, wastewater treatment, and stormwater management. Future plan recommendations will consider the topics' interconnectedness and present potential projects and initiatives cohesively.

This chapter identifies key assets and describes emerging needs. Carrboro's Capital Improvement Plan is a direct reflection of the Town's priorities and highlights its desire to maintain and enhance its existing infrastructure and protect its current investments while implementing adopted plans. Items listed include upgrades to technology and public works and safety projects, sidewalk and greenway projects, stormwater projects, and access to recreation and parks. The Town's infrastructure is seen as the basis for improving residents' overall quality of life. Additionally, the quality and location of infrastructure directly impacts social equity by determining accessibility to job centers and recreational areas, and housing affordability.

As the comprehensive plan develops, focus will be given to strategies that demonstrate practices that advance equitable and sustainable principles.

2. OVERVIEW AND DATA TRENDS

A. TRANSPORTATION

Carrboro, located in the Piedmont ecoregion and north-central North Carolina, has excellent access to regional transportation networks including Interstates 85 and 40 just to the north, the Raleigh-Durham International Airport, and is nearby other municipalities in the Triangle region. Its geographic proximity to large employment centers, notable institutions (including but not limited to) UNC Chapel Hill and Duke University, an outstanding primary and secondary public education system, open space/recreation, and various transportation modes has contributed to its desirability, and in turn, recent population growth. Town officials and residents have touted the small Town as a desirable community to live and work in and one that is served by a vibrant transit system. However, many residents have also shared the desire to expand active transportation options, while ensuring equity and sustainability remain as top priorities in future planning and decision-making efforts. The Town's FY2021 Capital Budget is an indication of the Town's commitment to expanding and improving transportation options as total investments for projects are upwards of $27 million for sidewalks, greenways, bus shelters, and road maintenance and upgrades.

1. MAJOR ROADS AND ARTERIALS

Classifications

All roadways in Carrboro are classified according to the Federal Highway Administration (FHA) classification system. The following designations are found within the Town:

- Major Arterial: Roadways with high traffic volumes and regional connections. Carrboro examples include NC-54 and Estes Drive Ext.
- Minor Arterial: Provide service for trips of moderate length and likely carry local bus routes. Carrboro examples include Main Street and Jones Ferry Road.
- Major Collector: Gather traffic from local roads and funnel them into the Arterial network. Carrboro examples include Old Fayetteville Road and Hillsborough Road.
- Local: Provides access to abutting land uses and is not intended for use in long distance travel.

Roads

While missing a formal grid transportation system may make travel a little more difficult, Carrboro residents acknowledge their local (and regional) transportation system as a major asset. State Highway NC-54 serves as a downtown bypass and provides a direct connection to unincorporated areas to the west and Chapel Hill to the east. Jones Ferry Road and Main Street travel northeast and southeast, respectively, through Carrboro providing direct connection to Chapel Hill's main thoroughfare, Franklin Street. Hillsborough Road/Greensboro Street/Smith Level Road provides the closest north-south directionality and travels from unincorporated Calvander to unincorporated Dogwood Acres.

Traffic Volume

Carrboro's highest average daily traffic counts (AADT) are located along NC-54 (from 18,500 at Old Fayetteville Road to 33,500 in the downtown), Greensboro Road (14,000-17,000), and Jones Ferry Road (12,000 between Old Fayetteville Road and NC-54) (see Figure 2).

Figure 1: Major Arterials and Local Streets

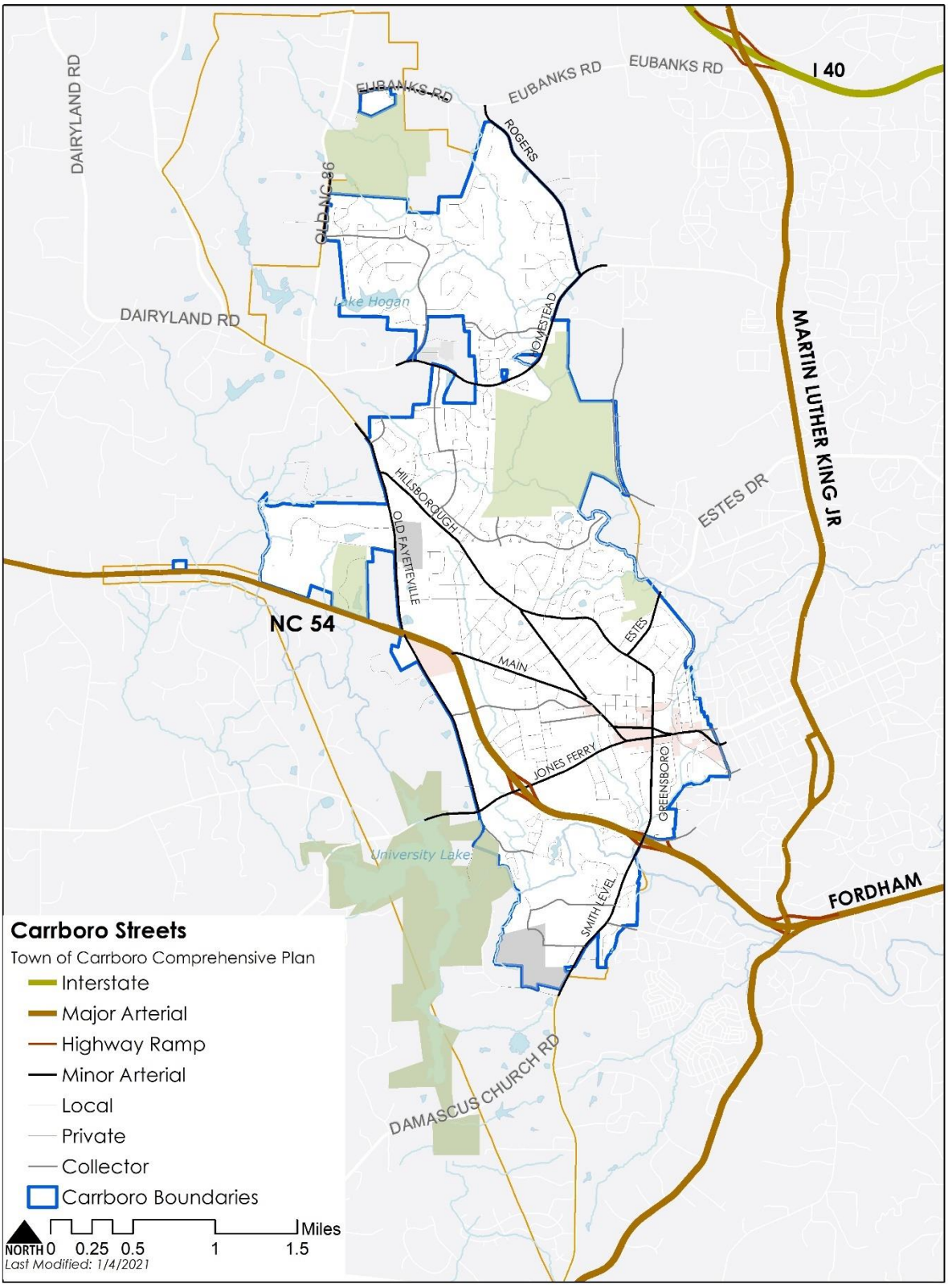
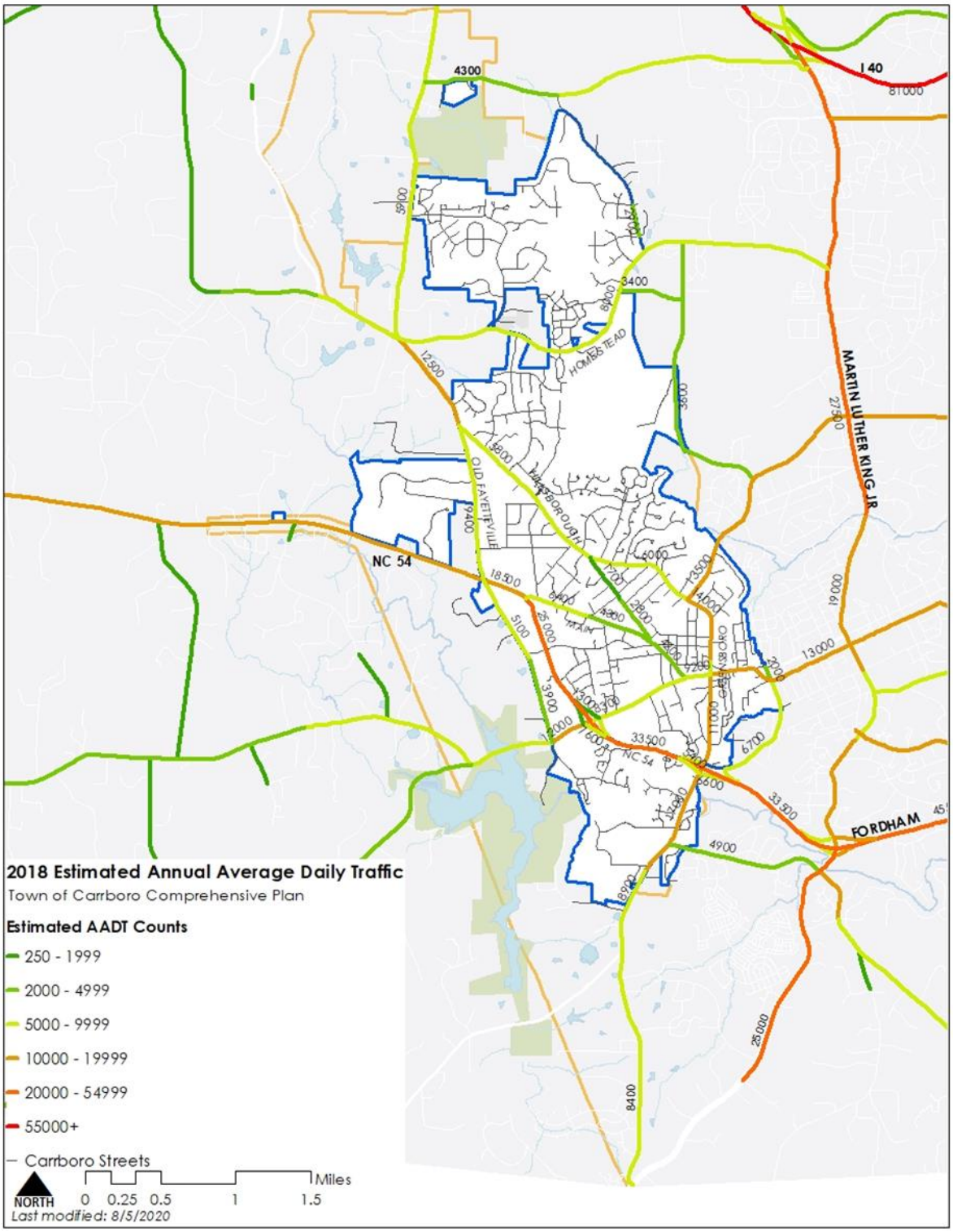


Figure 2: Traffic Volumes of Major Streets in Carrboro



Source: NCDOT, https://connect.ncdot.gov/resources/State-Mapping/Pages/Traffic-Survey-GIS-Data.aspx

Traffic Congestion: Mitigation and Future Development

According to the DCHC's 2040 Metropolitan Transportation Plan, traffic congestion is a consequence of the area's rapidly growing population and economy, with commuters traveling longer distances in single-occupant vehicles, and the expansion of UNC Chapel Hill and surrounding areas like Chatham County. While improvement options have been identified, local leadership is looking to expand transit options rather than further roadway expansion, as well as reduce the direct effect of air pollution. Prioritization of future projects will be those that incorporate climate-friendly transit measures over streets' levels of service.

Roadway improvements should be prioritized for high-demand areas where people are connecting to employment centers (Orange County's major employers include UNC Chapel Hill, UNC Health Care System, and Chapel Hill-Carrboro Schools), or areas identified as hotspots for increased crashes. Improvements should focus on improving safety for all users without restricting access. Town staff have highlighted the need to be mindful that traffic control devices do not negatively impact street connectivity, particularly after a new development is completed. The Connector Roads Policy, updated in 2005, states that old and new developments and businesses in the Town should connect to each other, both to disperse newly generated traffic and to give a sense of connectivity and unity as it grows.

Air Quality

Traffic congestion is a product of increased single-occupancy vehicle (SOV) use which results in: the impediment of transit vehicles, the use of materials for batteries that are not equitably sourced, dangerous situations for people who walk, bike and take transit, and the continued funding of infrastructure for automobiles (at the state and federal level) which induce new SOV drivers. In addition to these consequences, the increase of personal automobiles on the road are a major contributor to vehicle emissions and degradation of air quality. The Town of Carrboro is a member of the Triangle Clean Cities Coalition, a network that seeks to advance the use of alternative fuels and advanced vehicle technologies, with the goal of reducing the region's dependence on petroleum-based fuels and cultivating sustainable transportation strategies. The Town's commitment to driving smarter and "greener" is apparent in the many ongoing initiatives to promote active transportation and a healthy lifestyle for all residents. Various resources are offered to local drivers on the Town's website to discourage singular vehicle use when possible, and create opportunities to walk, bike or take public transit. In addition, the Durham-Chapel Hill-Carrboro Metropolitan Planning Organization (DCHC MPO) reached nonattainment status after demonstrating air quality conformity (showing that future hazard emissions from the transportation sector would be below a set threshold).

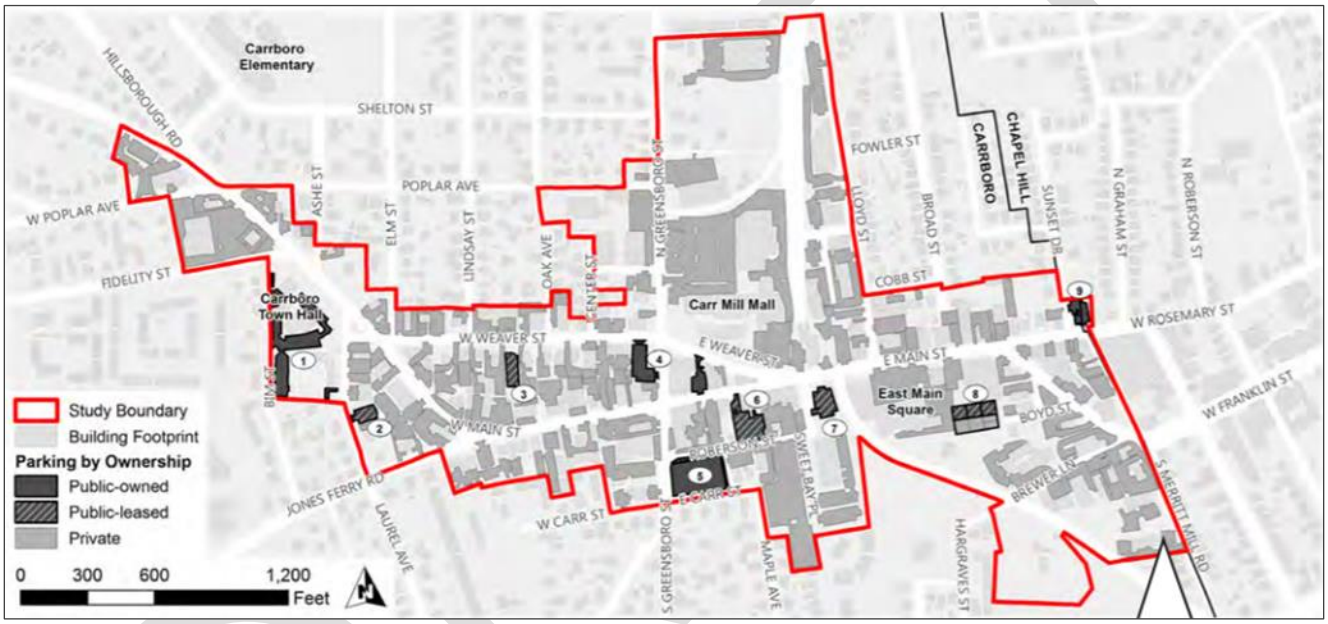
Parking

Interviews have revealed that parking, particularly in Carrboro's Downtown, is the "white elephant" in the room, remaining a highly controversial topic amongst residents. Carrboro's Downtown has 9 free parking lots along Main Street, as well as various private parking lots (see Figure 3). A 2017 Downtown Parking Study revealed that the presumptive standard in the Town's Land Use Ordinance (LUO) seemed to match parking needs – however the challenge remained that while some residents wanted more parking, others wanted less. The study also noted that parking demand did not outpace the downtown's supply, however, it did exceed recommended occupancy at specific sites (such as the redeveloped 300 East Main Street) that could become exacerbated by future development and demand. The study recommended that the Town improve wayfinding and regulatory signage (to increase visibility of the public parking lots), improve lighting and sidewalk conditions (to encourage

visitors to park once and walk to their destination), enforce time-limited parking options (to improve parking flexibility), investigate shared parking arrangements (agreements between property owners), and collect data on parked vehicles on an annual basis (continue to conduct counts at regular intervals to monitor parking needs). Although potential recommendations are in place, the Town will have to address nuances related to those suggestions as downtown stakeholders have raised concerns such as: parking spaces in front of storefronts being used for their customers only (resulting in high demand locations only allowing parking for their business) and additional driving by consumers to access different small businesses within the downtown (not "parking once" during a one-time trip), amongst others.

A data collection update, parking price study, and wayfinding plan implementation have all been initiated following the plan's adoption. Some actions have been delayed due to COVID-19.

Figure 3: Parking Lots by Ownership Type



2. PUBLIC TRANSIT

Local Bus Service

Chapel Hill Transit (CHT) service is a fare-free public transportation service (including paratransit, and front bike racks) that serves over 30,000 riders daily. CHT offers NextBus, a mobile app designed to track busses and provide estimated arrival times. Bus routes in Carrboro (see Figure 3) include the:

- J (*Carrboro/Downtown CH/Jones Ferry Road*)
- CW (*Carrboro/Weaver St*), F (*Colony Woods/Franklin Street/McDougle School*)
- CM (*Carrboro/Merritt Mill Rd/Family Medicine*)
- HS (*CH High/MLK Jr Blvd/Southern Human Services/Culbreth Road*)
- N (*Estes Park/UNC Hospitals/Family Medicine*)
- CPX (*Carrboro Plaza Express) [discontinued as of August 2020]*

- JFX (*Jones Ferry Road Express*)
- CW Saturday (*Carrboro/Weaver St*)
- and JN Saturday (*Estes Park/Rock Creek*)

CHT has connecting routes to the regional transit provider, GoTriangle (servicing Chapel Hill, Durham, Raleigh, and Triangle Park), which has retained a steady annual ridership since fiscal year 2017. Carrboro has budgeted $1.9M in FY2020-21 for the public transportation operating costs.

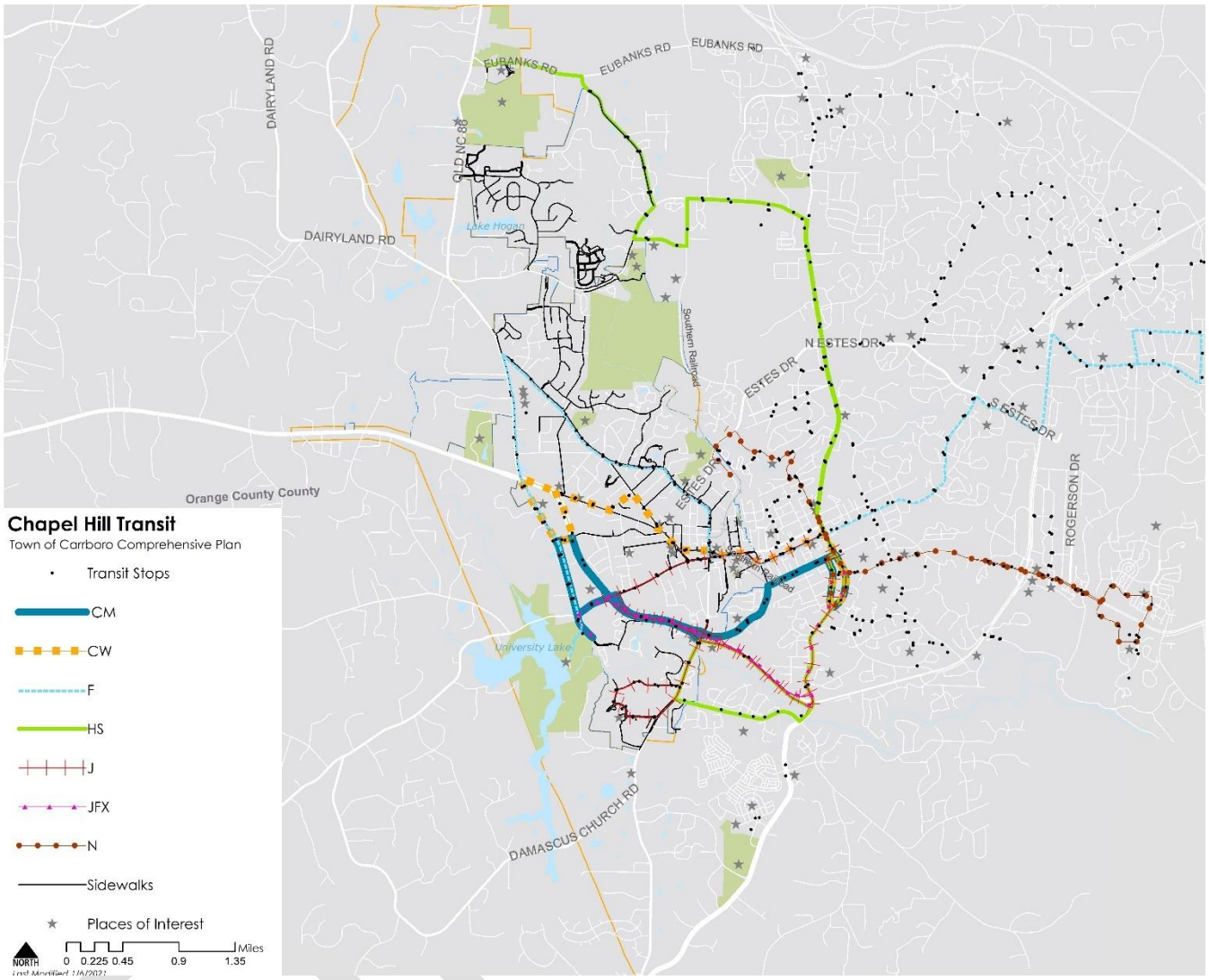
Chapel Hill Transit's ridership was at its highest since 2009 pre-pandemic, and with the increase in 65+ population statewide, Carrboro leadership should continue planning for the increasing need for public transit options that are safe, accessible, affordable, and connect residents to daily services. Our Transit Future, a website prepared as part of the regional transit plans for Orange, Durham and Wake Counties, and devoted to the expansion of bus service (with improved bus stops and BRT) in the Triangle, seeks to create a regional network that provides alternatives to driving, while increasing access to jobs, healthcare and education in the counties. Public transportation goals in the 2045 Metropolitan Transportation Plan of 2018 also recommends promoting multimodal and affordable choices, partially by enhancing transit services, amenities, and facilities (a 2050 update is underway). With the discontinuation of the Durham-Orange Light Rail Transit project, attention has shifted to encouraging denser development around and extending service of major bus routes (public transit is only efficient when the density of residents and destinations support the use).

- 13% of Commuters use Transit
- 91% of Households Live within ½ Mile of Transit
- 9% of Households do not own Vehicles
- Annual Vehicle Ownership Cost: $11,355
- Annual driving costs increase as you move north in Carrboro

Source: CNT's AllTransit & Total Driving Costs

Various Town staff and residents have shared that installing the bus system in Carrboro opened-up the community to more opportunities and access to work and amenities. Current efforts are in place to improve existing bus infrastructure (stops, lighting, crosswalks) and interest has been expressed in exploring opportunities for redevelopment along major corridors NC-54 and Jones Ferry Road as mixed-use developments consistent with existing transit service.

Figure 4: Chapel Hill Transit (CHT) Routes Servicing Carrboro, 2021



Note: Routes F and JFX were not running during the Covid-19 pandemic.

Figures 5 & 6: Existing Bus Stops along NC-54

Photo Caption: Traditionally, Carrboro used the wood shelter with the blue awning style roof for bus shelters. Moving forward, the Town is designing and replacing them with standard bronze plexiglass, like the ones used in Chapel Hill.

3. WALKING AND BIKING

Carrboro is oftentimes described as a highly walkable and increasingly bikeable town (with easy access to UNC Chapel Hill and greenways/trails), many have attributed these factors in their decision to locate within the community, but not all areas of Town are equally accessible (see Figure 8). The Town of Carrboro continues to invest in active transportation options (sidewalks, bike facilities) and would like to continue targeting dense nodes for increased walking and biking activity, while exploring creative manners to encourage residents living in lower density developments to "leave their cars behind". Potential improvements the Town is considering to enhance bicycle safety (such as was done at the intersection of Jones Ferry Road and NC-54), include: decreasing the number of travel lanes, the addition of turn bays, and adding buffered bike lanes.

One of the Town's highest priorities is to create a highly connected network focused on sidewalk connectivity and safe access to transit. Carrboro has been labeled as "car-dependent" by WalkScore (a function of land use and infrastructure), with a walkability score of 28 and bikeability score of 59. In comparison to surrounding major cities, Carrboro generally scores lower in walkability, but is significantly higher in biking (see Table 1).*

Table 1: WalkScore Comparisons

	Walkability Score	Bikeability Score
Carrboro, NC	28	59
Chapel Hill, NC	36	50
Durham, NC	29	41
Raleigh, NC	31	41
Cary, NC	27	40

Source: walkscore.com

*Note: The Walk Score program evaluates properties based on the distance from that location to certain types of destinations and the infrastructure to get to that destination using a particular travel mode. With that in mind, there can be a significant difference in Walkscores depending on where in these communities you live.

Figure 7 shows the lack of sidewalk connections throughout the Town, noticeably south and west of the downtown and in the Town's most northeastern corner. Meanwhile bikeways appear well-connected to one another, local parks, major corridors, existing sidewalks, the downtown, and other several points of interest.

Figure 6: Walkways and Bikeways

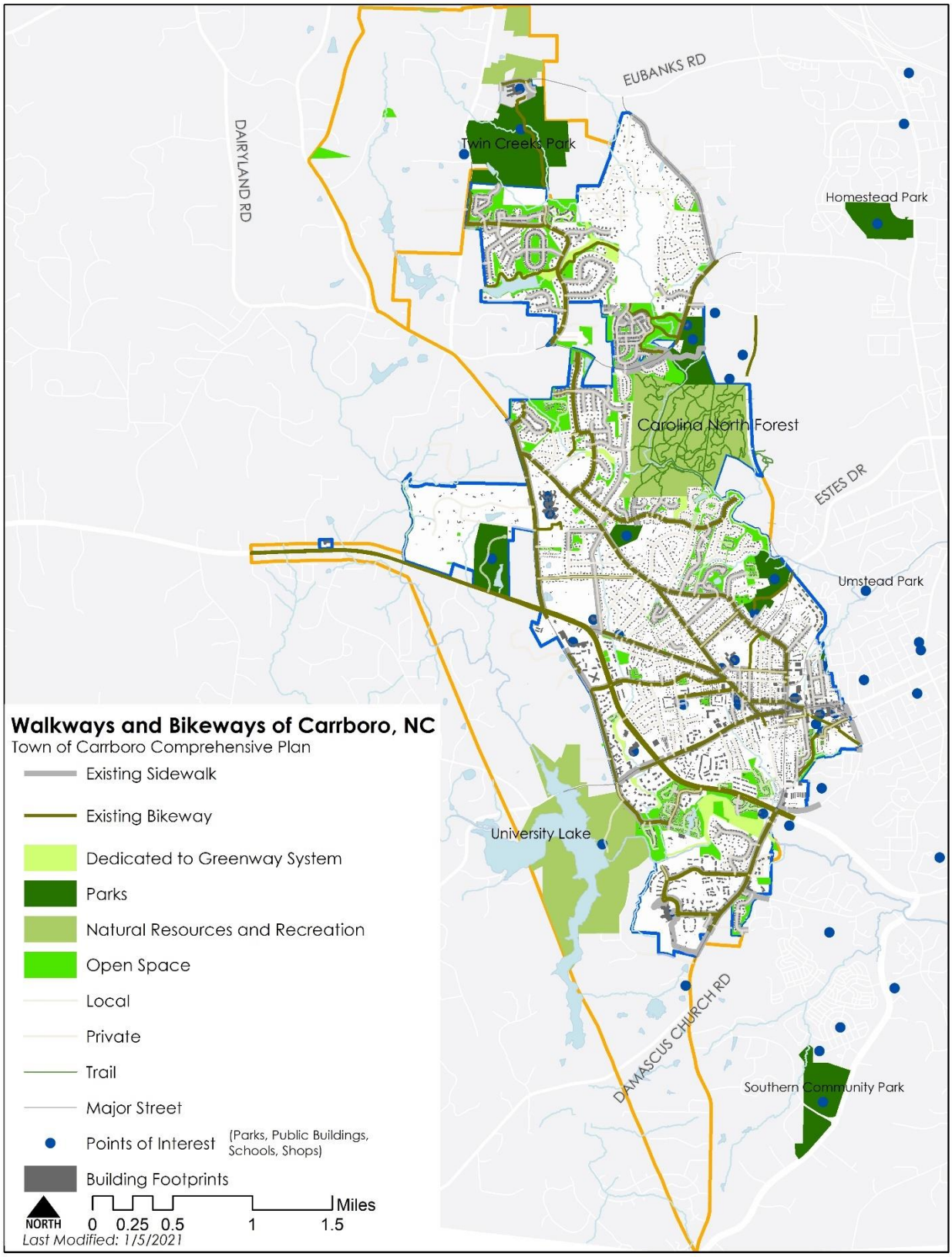
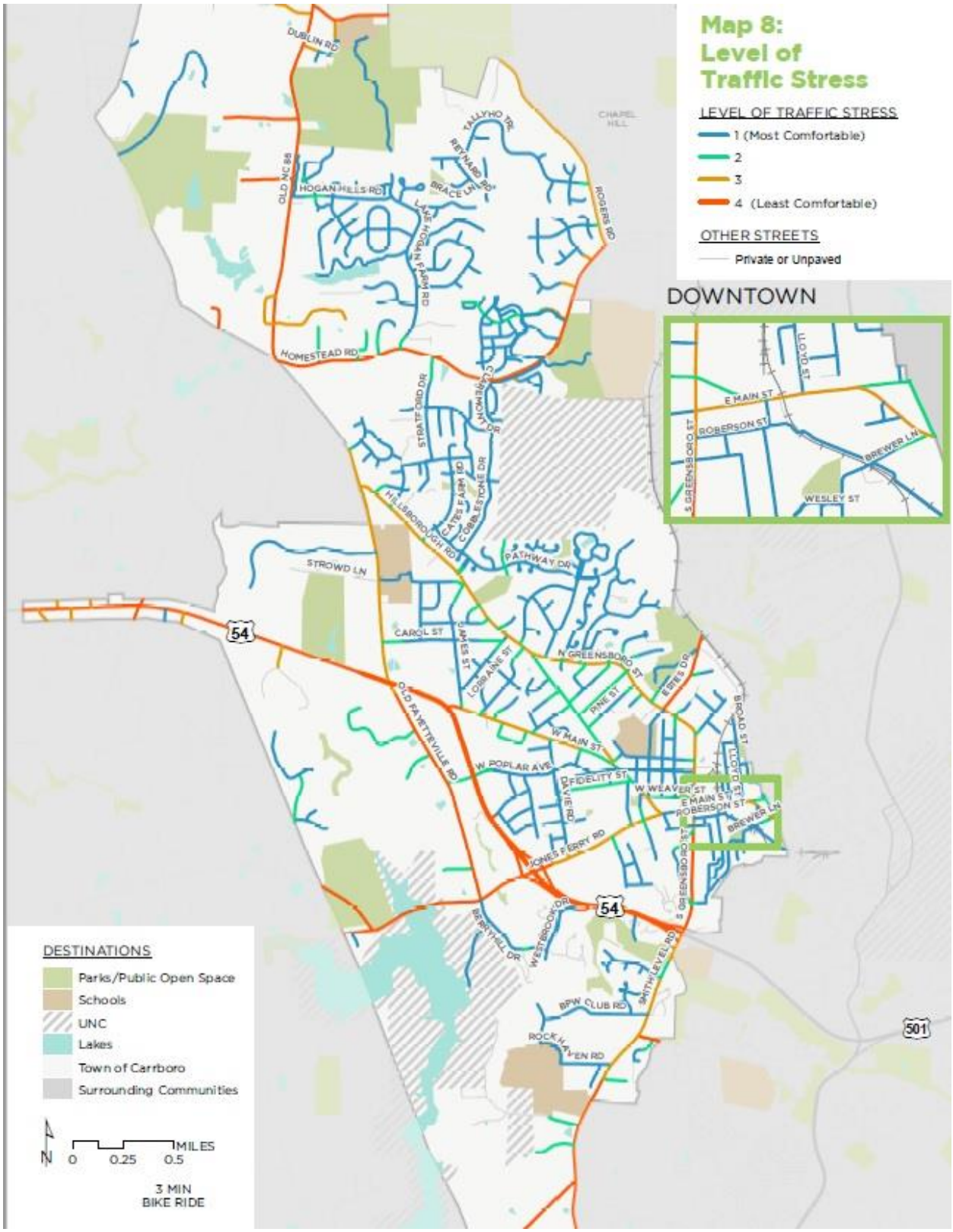


Figure 8: Carrboro Bikeways: Level of Traffic Stress



4. TRANSPORTATION AND STORMWATER

Historically, transportation infrastructure has been created from a "grey" infrastructure rather than "green" infrastructure paradigm. Until recently, roads, sidewalks, multiuse paths, and parking lots have been built with no stormwater treatment, and their impervious surfaces have significantly added to the amount of runoff and degraded the quality of runoff reaching surface waters. The "grey" paradigm uses both above and below ground conveyances to shed runoff effectively and expeditiously. The emerging "green" transportation paradigm integrates new infrastructure into the landscape through "green streets" and green infrastructure/ Low Impact Development measures such as bioretention, suspended pavement integrated stormwater/tree planters, and permeable pavement. In this paradigm, streetscapes are vibrant, nature-based, and people friendly environments that attract development, commerce, and outdoor and pedestrian oriented environments. These places and this paradigm can integrate into the equity and sustainability-oriented focus for Carrboro's future.

5. EQUITY AND SUSTAINABILITY

Traditionally the topics of equity and sustainability have been competing topics in community planning, however more recent national research has shown that lack of access to walkable communities, biking options, open space, healthy foods, and severe climate impacts disproportionately affects communities of color. Carrboro's commitment to ensuring that race/ethnicity and income levels are not predeterminants of lower quality transportation options have been echoed throughout multiple interviews and conversations. While Carrboro is regarded as a transit rich, walkable and bikeable community, racial/ethnic and income barriers are still challenges to be addressed.

Affordable Housing and Transit Costs

Much of Carrboro's more affordable housing stock, consists of apartment complexes, are located along the NC 54 corridor. The corridor is home to smaller shopping centers at Old Fayetteville Road and Jones Ferry Road, along with local institutions, parks, and frequent transit service. However, NC-54 has been described as both a physical barrier, and racial and income separator. The "NC 54 Pedestrian and Bicycle Corridor Safety Study of 2019" assessed that all the different factors associated to the corridor (high speed and volume roads, lack of sidewalks and paths, wooded areas) create a challenging environment for safe pedestrian crossings, connection to the downtown, and access to transit. Interviews with Town staff have pointed to prioritizing safe transportation access along NC-54 so nearby Carrboro residents have equitable access to safe and efficient travel and connections to jobs and services. Potential considerations for improving the corridor in the safety study included safer crosswalks, traffic signals at bus stops, and additional pedestrian lighting.

Traditional measures of housing affordability ignore transportation costs, typically a households second largest expenditure. CNT's Housing + Transportation Affordability Index for Carrboro is 49%, meaning that on average, households retain 51% of their income after paying household and transportation costs.

Street Maintenance

The Town of Carrboro provides free traffic calming services to the town's residential streets, but the process entails being knowledgeable of and filling-out a Traffic Calming Request Form. Interviewees have suggested that traffic calming is an equity question as it is a petition-based process for traffic calming measurements to be installed and is mostly done in subdivisions (which are generally not majority African American & Latino). Town staff have expressed the desire to assess and better understand where town improvements have been requested, and in-turn, implemented. Potential opportunities to address disparities in residential street maintenance may lie with providing supportive alternatives and additional resources to fill-out request forms (translated forms (most commonly spoken languages other than English), community resource advocates, and responding to traffic calming requests focused on locations identified by residents where vehicle speed and/or volume is higher than they would like.

B. WATER SUPPLY, WASTEWATER, AND STORMWATER

This section focuses on water infrastructure in Carrboro. An overview of data and information from the existing literature provided by Carrboro is summarized.

1. WATER DEMAND

Following two significant droughts in 2001-02 and 2007-08, access to water became the focus of much attention. Water is provided by the Orange Water and Sewer Authority (OWASA), a public, non-profit water, wastewater, and reclaimed water agency established in 1977 to serve the Carrboro-Chapel Hill community. The agency was formed by the partnership of the Town's of Carrboro and Chapel Hill's, and the University of North Carolina at Chapel Hill's, water and wastewater infrastructure and resources. A 9-member Board of Directors is made up of representatives appointed by the elected officials of the Town of Carrboro (two members), Town of Chapel Hill (five members), and Orange County (two members). The water supply relies on three water sources: Cane Creek Reservoir, University Lake, and Quarry Reservoir (there are future plans to expand the Quarry reservoir from 200 million to 2.2 billion in 2030: https://www.owasa.org/water/).[i] Following the first major drought, OWASA successfully led an initiative to decrease water use by 25% by 2013. This initiative included seasonal higher water rates, the addition of a permanent water recycling system, a reclaimed water system in partnership with UNC that utilizes reclaimed water for non-drinking purposes, and revising conservation standards and local ordinances on conservation.[ii] Decreasing water demand has effectively proven to strengthen the durability of the water system in the event of another drought. Exploring ways to decrease demand on a per capita basis is also relevant given that the population receiving service by OWASA is projected to increase by at least 10,000 each decade.[iii] However, it should be noted that decreasing water demand is also a vulnerability for OWASA because it would result in less revenue. Based on water demand projections from 2013, OWASA can provide 10.5 million gallons of water daily (MGD) and maintain a minimum 20% storage reserve of water in a drought like the scale of the one in 2001-02.[iv] Nonetheless, OWASA continues to follow a risk-based approach to managing drought-related decisions, and stresses the need to continue to advance water conservation and efficiency initiatives in communities.

OWASA is a member of the Jordan Lake Partnership, a collaboration between thirteen local governments focused on maintaining water supply (in particular, managing the use of Jordan Lake) to the Triangle region. In the event of a severe drought, OWASA is insured a Level II allocation of 5.0 MGD of Jordan Lake's water supply to provide its customers, including those in Carrboro. Level II allocations are meant to be used for future needs in the longer term (more than 5 years from now).[v] OWASA also has three emergency agreements, with the Towns of Cary/Morrisville, Durham, and Hillsborough.[vi] OWASA's water demand is primarily residential, which made up 50.9% of the demand in 2010.[vii] The dynamic of OWASA's service is expected to change depending on changes in real estate (such as housing types and the number of commercial buildings), and renovations to implement water efficiency measures.[viii]

Table 2: Town of Carrboro Water Use*

	2016	2017	2018	2019
Water Usage (thousands of gallons per year)	417,197	418,903	411,295	416,876
Population	20,867	21,099	21,314	21,190
Usage per Capita	19.99	19.85	19.29	19.67

Source: OWASA Sustainability Manager, 2020, U.S. Census Population Estimates

*Note: In 2001 Orange County, OWASA, and the Towns of Chapel Hill, Hillsborough, and Carrboro entered into a Water and Sewer Management, Planning, and Boundary Agreement, the WSMPBA.

Figure 9: OWASA Water Supply Sources, Watersheds, and Service Boundary Area

2. WASTEWATER INFRASTRUCTURE

Wastewater (WW) infrastructure is important in the Town of Carrboro's comprehensive planning not only as a key component of the local service delivery and infrastructure, but because of the importance of the wastewater corridors in the landscape and as they interact with the local land use and population. As with the local water supply system, OWASA owns and manages the public wastewater infrastructure. Sewer lines run through environmentally sensitive areas and maintenance of these easements is important to ecosystem health. As pipes age out, planning for their replacement is an important community issue. OWASA, indicated in its latest Annual Wastewater Report Card that 3.8 miles of wastewater pipes were renewed between 2019 and 2020 to avoid overflows and maintain the system's resilience. Another primary concern for wastewater infrastructure is pipe maintenance. OWASA reported that between 2019 and 2020, approximately 120 miles of wastewater pipes, or 36% of the wastewater system, was cleaned due to clogs from fats, oil, dental floss, and wipes. A 600-gallon sewer overflow in 2019 was credited to debris in the pipes, and another 945-gallon sewer overflow was credited to interfering tree roots. Informing the community on proper methods of disposing waste should be undertaken by Carrboro. Wastewater pipes are also collocated with current and potential future bike/pedestrian transportation infrastructure.

3. STORMWATER INFRASTRUCTURE

The Town holds an EPA National Pollutant Discharge and Elimination System stormwater permit that requires the Town to implement and enforce a program to reduce the discharge of pollutants to protect water quality and satisfy requirements of the Clean Water Act. This is being pursued through both source control and delivery reduction measures. The benefits include not only improved surface and drinking water quality and aquatic and riparian ecosystems, but also: land preservation and improved /preserved terrestrial habitats; erosion reduction; reduction of sanitary sewer overflows because of storm water infiltration; decreased flooding related problems, and other ecological and community improvements.

Carrboro's current conveyance system utilizes a combination of conveyance devices. These range from sheet flow from streets, sidewalks and shoulders into curb/gutter, concrete piping, grassed swales, and ditches. These conveyances outlet in some cases through energy dissipation, retention, detention and other stormwater management measures prior to entering receiving waters. More recent development has been subject to more extensive stormwater management requirements. In recent years, the Town has begun to retrofit its stormwater infrastructure to better manage runoff for both water quality and flood mitigation benefits and is programming additional green infrastructure improvements in the Capital Improvement Program. The Town specifically created a Stormwater Utility in 2017 (and increased in 2020) to provide dedicated revenue and staff to oversee the Town's stormwater related efforts. The Town also supported a study in 2019/20 that was driven by flood related concerns in the upper Toms Creek watershed and included a recommendation to pilot a green infrastructure-based residential assistance program.

The Town has not formally or systematically defined the term "green infrastructure." The Town is committed via policies, plans, and ordinance provisions to green infrastructure in the form of and provisions for open space, natural areas, and greenways. Flexible parking requirements are provided in the Land Use Ordinance and development review process to minimize creation of unnecessary parking. Water conservation provisions to some extent support rainwater harvesting implementation. The Town has investigated steps for removing green infrastructure restrictions such as in Homeowner Association covenants. The Town has also pursued watershed restoration efforts in the Bolin Creek watershed and efforts related to Jordan Lake rule requirements.

Figure 10 displays flood hazards (impervious surfaces – buildings, garages, driveways, streets, and the FEMA flood hazard layer), current gray stormwater infrastructure, and self-reports of flooding between 2012 – 2018 in Carrboro. Table 3 provides a summary of self-reported flooding events in Carrboro since 2012, pointing to the substantial majority being reported from Plantation Acres (located on the west side of the Carrboro).

Figure 10: Flooding Hazards and Stormwater Management Measures

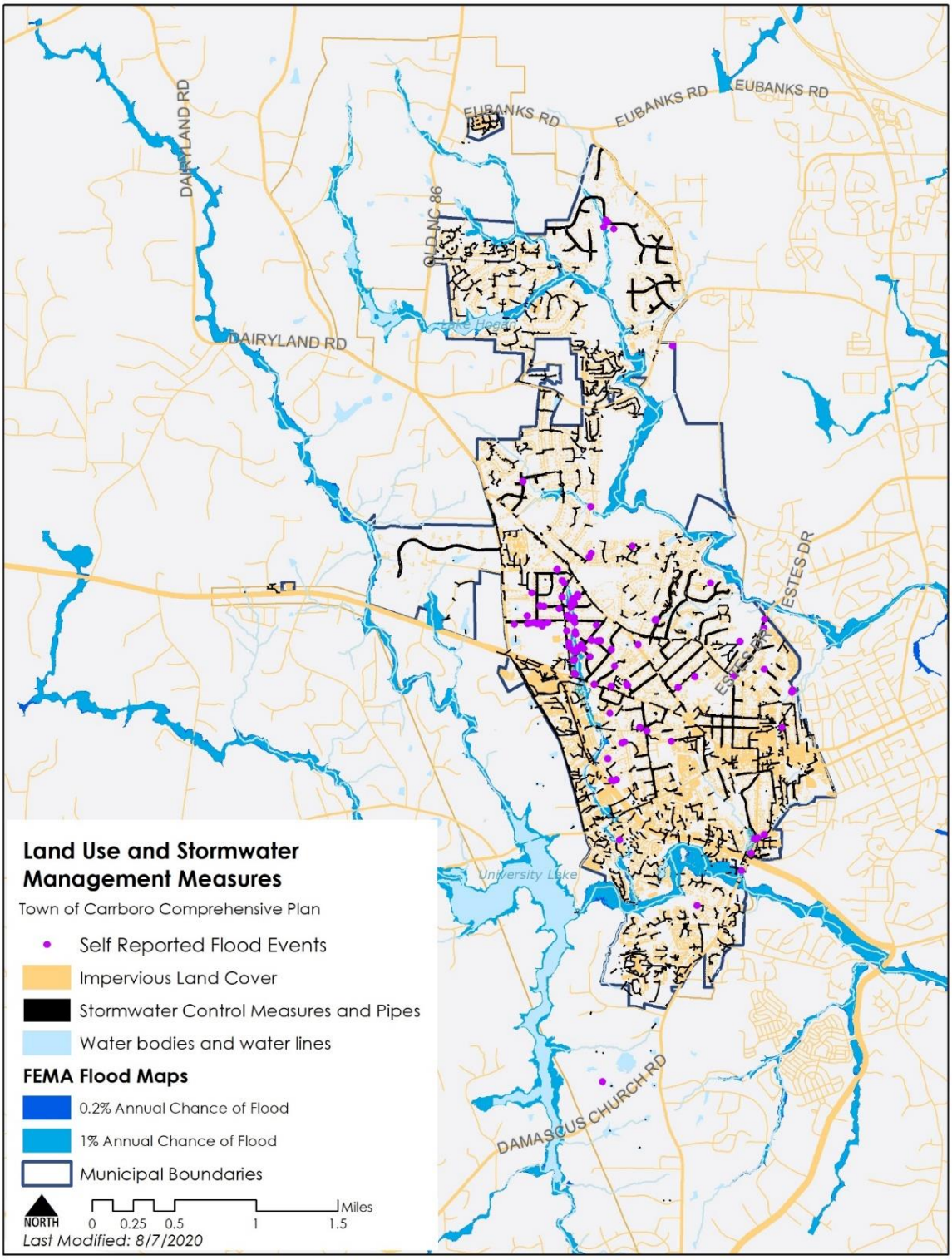


Table 3: Self-Reported Flood Events Since 2012

Neighborhood or Subdivision	Self-Reported Flood Events (since 2012)
Plantation Acres	64
Windwood	7
Fox Meadow	4
Hillsborough Road	3
Poplar-Davie	3
Quarterpath Trace	3
Adams Tract	2
Carolina Blue Village	2
Lloyd-Broad Street	2
S Greensboro St	2
Sudbury	2
Not Within Carrboro Municipal Boundaries	2
Ashbrook	1
Barrington Hills	1
Berryhill	1
Bolin Forest	1
Brighton Square	1
Central Business District	1
Cobblestone	1
Estes Park	1
Fire Station	1
Hunter Place	1
Keith & Kiowa Dixon	1
N Greensboro Street	1
Pine Hill	1
Pleasant Drive	1
Rocky Point Mhp	1
S Greenboro St	1
Near Carrboro Public Works	1
Waverly Forest	1

4. THE "ONE WATER" APPROACH

Regional Councils of Government and others are advocating for a new and transformative "One Water" approach to how we view, value, and manage water. The "One Water" approach views all water – from the water resources in our ecosystems to our drinking water, wastewater, and stormwater – as resources that must be managed holistically and sustainably in order to secure a bright, prosperous future for our children, our communities, and our country. A "One Water" approach can take many different forms, but has some unifying characteristics:

- A mindset that all water has value
- A focus on achieving multiple benefits - economic, environmental, and social
- Approaching decisions with a systems mindset
- Utilizing watershed-scale thinking and action
- Relying heavily on partnerships and inclusion

The "One Water" approach is specifically being recommended as a platform for all stakeholders in the Jordan Lake watershed to collaborate because of the watershed's wide- and far-reaching benefits.

C. GREEN INFRASTRUCTURE

At the scale of a city or county, green infrastructure refers to the patchwork of natural areas that provide biodiversity, habitat, flood protection, cleaner air and water, and natural areas for people to enjoy. At the scale of a neighborhood or site, green infrastructure typically refers to the systems that mimic nature by soaking up and storing water and minimizing urban impacts such as the "heat island" effect and air pollution. From a strictly hydrologic perspective, "green stormwater infrastructure" refers to features such as green streets, roofs, and parking lots; rain gardens, wetlands, and bioswales; rainwater harvesting and reuse; and impervious surface disconnection and permeable pavement. New plantings/landscaping and soil quality improvements can mitigate stormwater impacts and increase other ecological services and have other positive economic and social benefits. Any change that involves improving soil, better management of stormwater, and creating habitat and increasing biodiversity contributes to Carrboro's green infrastructure.

1. NATURAL AREAS

The North Carolina Natural Heritage Program (NHP) formally defines a natural area as land or water important for the conservation of the natural biodiversity of North Carolina, and identifies these areas based on biological surveys. The program has identified 2,500+ natural areas in North Carolina that contain rare species populations, habitats, and communities, including those in Orange County, and several in or very near Carrboro's jurisdiction. There are other minimally developed or altered areas that exhibit many of the traits of the NHP natural areas but have not obtained the necessary threshold to be formally recognized in the program.

The Carolina North Forest and the land around University Lake are the two largest intact natural areas contributing to Carrboro's natural green infrastructure. Various other sites, including parks, designated open space, land set aside in conservation, greenways, and undeveloped public and private lands contribute to green infrastructure. In April 2000, Orange County enacted a comprehensive program for the acquisition of priority critical natural and cultural resource lands entitled the "Lands Legacy Program." The Town partnered with the program and the North Carolina Clean Water Management Trust Fund to purchase the Adams Tract, a forested tract adjacent to Wilson Park near downtown Carrboro. The Triangle Land Conservancy protects conservation lands in the Research Triangle Area. The North Carolina Botanical Gardens and Piedmont Wildlife Center foster healthy connections among people, wildlife, and nature.

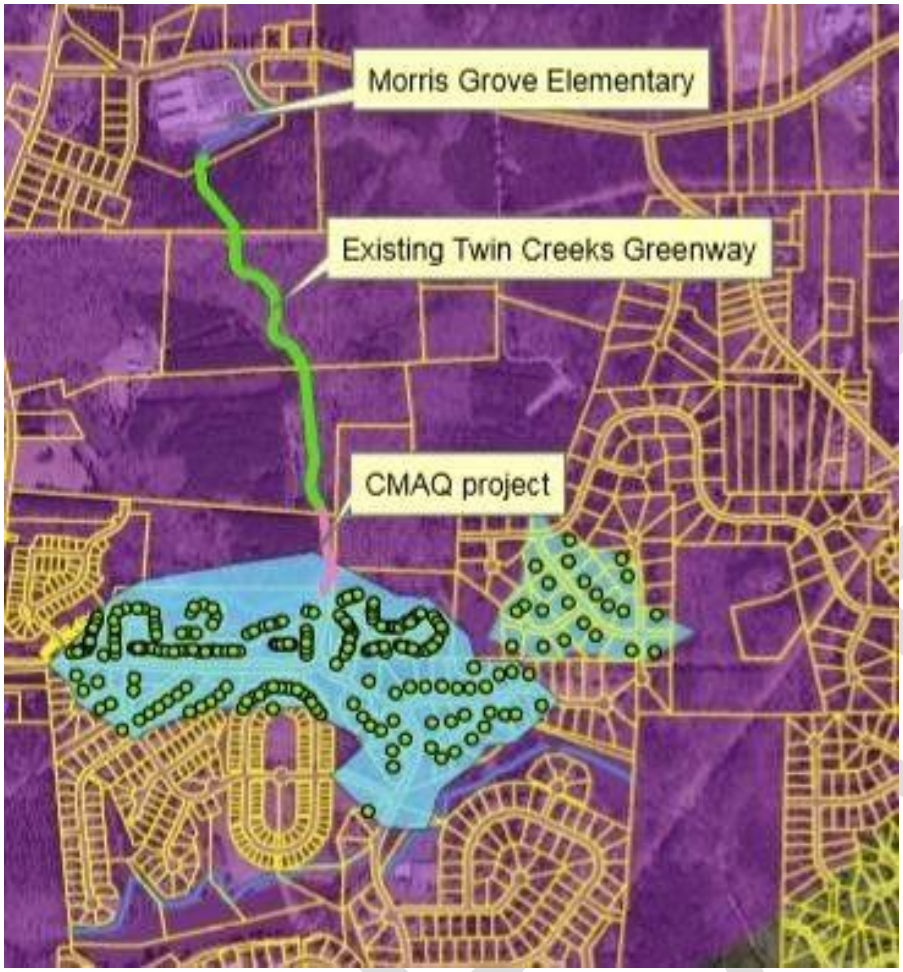
2. GREENWAYS

Greenways are corridors that provide access to undeveloped natural areas for people to enjoy without harming the ecosystem. Greenways can support ecosystems by filtering pollutants (such as road runoff) from entering creeks, can act as natural floodplains, and promote environmentally friendly modes of transportation that can improve both air quality and human health (ex: biking, walking, etc.).[1] Additionally, greenways provide a way to use sensitive or undevelopable lands in a way that provides public access, recreation, relief from urban development, and off-road connections.

The Town of Carrboro has been actively encouraging and supporting the development of greenways dedicated to public use along streams and easements (Carrboro Vision 2020). Several initiatives are underway to improve access to and traveling through existing trails and greenways. Current projects include Jones Creek Greenway, Homestead-CHHS Multi-use path, and Morgan Creek Greenway. The Jones Creek Greenway map (Figure 11) is described as 10 ft. wide shared use path for bicyclists and pedestrians and provides an example of how the greenway will connect residential areas to local and regional community assets.

Two greenways, Jones Creek and Morgan Creek, are currently being funded in the CIP budget (the CIP budget dedicates $1,987,500, with federal monies funding 80% of that value, to the development of greenways along Jones and Morgan Creek). Small scale green infrastructure will require financing and an effort by the Town to make sure everyone has equitable access to this type of infrastructure. Based on interviews with planning management, financing is a limitation for Carrboro. Funding climate and ecosystem programs must be balanced against other costs (?) of living, so that the community remains affordable to its residents. Since the Town of Carrboro would like to see better and more accessible parks and greenways for families and underserved communities, here is an opportunity to make strategic investments as a Town to mitigate impacts on marginalized residents.[2]

Figure 11: Jones Creek Greenway Map



3. URBAN FORESTRY, LANDSCAPING, AND PLANTING

There is significant merit and synergy in managing Carrboro's forest to reduce energy consumption and store carbon, while simultaneously forwarding many community goals. Trees influence thermal comfort and energy use by providing shade and reducing wind speeds (for example, large trees strategically placed on the sunny side of a house can reduce the air-conditioning demand by roughly 30 percent). One acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. The urban forest also provides significant ecological and societal services such as air, water, and soil quality improvement, wildlife habitat, enhanced biodiversity, mental, emotional, and physical health and well-being, and aesthetic and economic value.

Examples of past Town urban forestry efforts include participation in Tree City USA, purchase of the Adams Tract and development of a management plan for the property, and development of provisions for tree protection and open space in the Land Use Ordinance. Town staff have recently started using i-Tree for assessing and managing Carrboro's urban forest. The North Carolina Urban Forest Council and North Carolina Forest Service Urban Forestry Program offer resources to help

with urban forestry activities. An emerging urban forestry interest is in planning for forest resilience in consideration of the impacts of climate change.

The Bolin Forest and Quarterpath Trace neighborhoods recently collaborated to pursue a neighborhood-driven forest stewardship campaign. The effort included invasive plant management, a community workshop at the Century Center, and preparation of a report. The report "presents a holistic approach informed by a synthesis of ecological restoration and urban forestry management strategies." Relatively healthy and mature forest canopy, adjacent large tracts of open land, and extensive trail networks all contribute to the value and benefits that the neighborhood enjoys. However, conditions including overgrown areas of invasive species, impervious surfaces, and even common landscape management practices contribute to negative impacts such as impaired water quality, soil compaction, and limited species diversity. Strengths, weaknesses, threats, and opportunities were identified under these broad headings: Preserve and Restore; Plan and Coordinate; Inspire and Educate; Understand and Adapt.

Depending on how they are pursued, landscaping and gardening practices can either contribute to or present risks to Carrboro's green infrastructure. The Town's Public Works Department is responsible for landscaping for Town-managed lands, including parks, street right-of-ways, and facilities, whereas private landowners are responsible for a vast majority of the other landscapes in Carrboro. Ways that the community can help create vibrant, resilient, and healthy landscapes in Carrboro include (credit: NC Botanical Garden):

- The protection and restoration of natural areas, which recognizes the importance of habitat conservation to the survival of biological diversity and establishes the importance of nature's own gardens, as well as human gardens.
- The elimination of invasive species and replacement with non-invasive alternatives.
- Gardening in nature's context, which seeks to promote plants that support native biodiversity, including pollinators and seed dispersers.
- Sustainable gardening, which seeks to promote environmentally-friendly gardening practices and which involves such practices as sustainable water use, protected stream quality, xeriscaping (using drought-tolerant plants), ecoscaping (planting plants in the right places according to their ecological requirements), zeroscaping (working with the established plants in a landscaping plan), integrated pest management, renewable energy sources, non-toxic and sustainably produced materials, recycling and reuse.
- Education: supplying critical information on conservation of the flora of the southeastern United States and on the Garden's conservation programs.
- People-nature relations, which describes how important plant diversity and natural areas are to physical and psychological health.

In October 2014, Carrboro became the third municipality in the country to join Bee City USA. Bees and other pollinators around the globe have experienced dramatic declines due to a combination of habitat loss, use of pesticides, spread of pests and diseases, intensification and industrialization of apiculture, and reduced genetic diversity. Becoming a Bee City USA affiliate publicly announced Carrboro's intention to promote healthy, sustainable habitats for bees and other pollinators. For municipal operations, Carrboro has been pursuing a Least Toxic Integrated

Pest Management Policy since the 1990s that recognizes the importance of avoiding and minimizing impacts of municipal operations on pollinators and other species.

The benefits of (native and honey) bee-friendliness are:

- Healthy ecosystems: Insect pollinators are required for pollination and reproduction of about 85% of flowering plants globally that: 1) are vital for clean air and water; 2) provide food, fiber and shelter for people and wildlife; and 3) support the insects that pollinate crops and form the basis of food webs.
- Increased habitat for natural enemies of crop pests and therefore reduced need for pesticides.
- Increased demand for pollinator-friendly plant materials from local nurseries and growers.
- Income earned by beekeepers and others through the sale of bee products, beekeeping equipment and supplies, and hive rentals for pollination; and heightened prestige and premium asking prices for place-based honey.

4. SOILS

Soil quality is an extremely important component of green infrastructure, "the operative activity for gardeners should not be "feeding plants," but rather encouraging a healthy soil ecosystem in which plants will naturally thrive" (Jared R. McKinley). Moreover, soils are a foundation of our community's infrastructure.

1) Soils act like sponges, soaking up rainwater and limiting runoff. Soils also impact ground-water recharge and flood-control potentials in urban areas.
2) Soils act like faucets, storing and releasing water and air for plants and animals to use.
3) Soils act like supermarkets, providing valuable nutrients and air and water to plants and animals. Soils also store carbon and prevent its loss into the atmosphere.
4) Soils act like strainers or filters, filtering and purifying water and air that flow through them.
5) Soils buffer, degrade, immobilize, detoxify, and trap pollutants, such as oil, pesticides, herbicides, and heavy metals, and keep them from entering ground-water supplies. Soils also store nutrients for future use by plants and animals above ground and by microbes within the soils.

There are more than 22,000 different soils identified and mapped in the United States and close to 1,000 different kinds of soils in North Carolina. While in the Piedmont there is only a subset of what is found more widely, there is still a significant amount of diversity in the native soils. There has also been a good deal of impact to the soils from historical practices and development. Much of the topsoil has been lost, and much of what can be done can work against improving the quality of Carrboro's soils. Having this understanding allows engineers and others to design projects that will not require high maintenance costs, will last a long time, will not harm individuals, society, or ecosystems, and will not fail and/or require expensive repair and/or removal costs.

D. ENERGY

This section presents an overview of the issues and opportunities regarding Carrboro's energy usage. It will identify Carrboro's energy sources and energy usage, and the intersection of buildings and energy use.

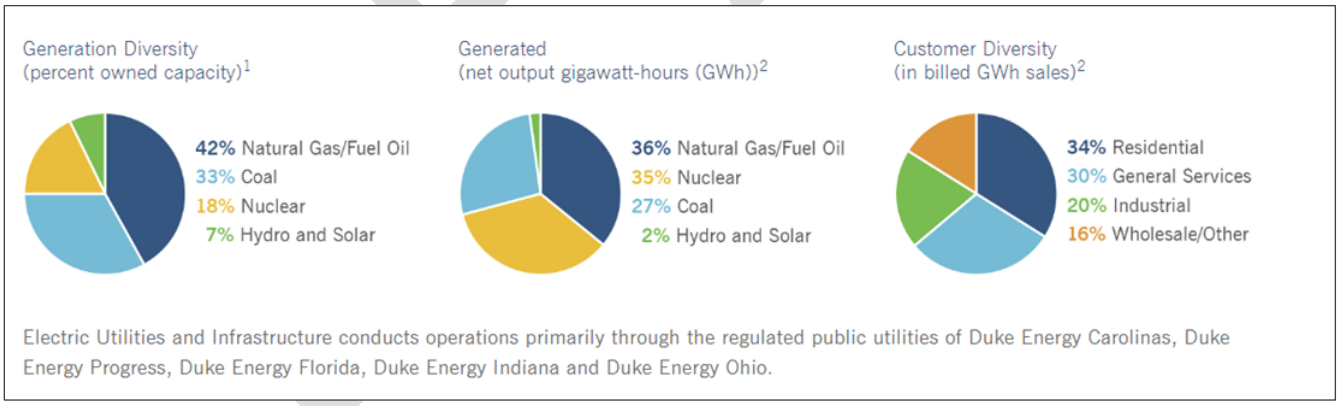
Carrboro residents and Town staff understand the importance of energy usage to helping maintain Carrboro's affordability in addition to addressing its sustainability goals. A majority of Carrboro's energy usage comes from residential buildings, thus plans and interviewees referred to the intersection of housing and energy efficiency to address energy use. Additionally, Carrboro hopes to expand its renewable energy profile but faces limitations since it does not operate its own municipal utility.

Carrboro is approaching climate action with a two-pronged approach. The municipality pursues climate actions as a model for private residents and businesses, while developing community-based approaches to expand progress towards goals.

1. ENERGY SOURCES AND USES

Carrboro residents receive natural gas from Public Service North Carolina (part of Dominion Energy). In 2016, Carrboro account holder's natural gas usage was 11.26 MWH (megawatt hour).[1] Carrboro's electricity comes from Duke Energy Carolinas and Piedmont Electric Membership Cooperative which resells Duke's electricity. Carrboro account holders used 7.2 MWH of electricity in 2016.[2] The chart below shares Duke Energy's generation diversity capacity, generated diversity, and customer diversity.

Figure 12: Electric Utilities and Infrastructure

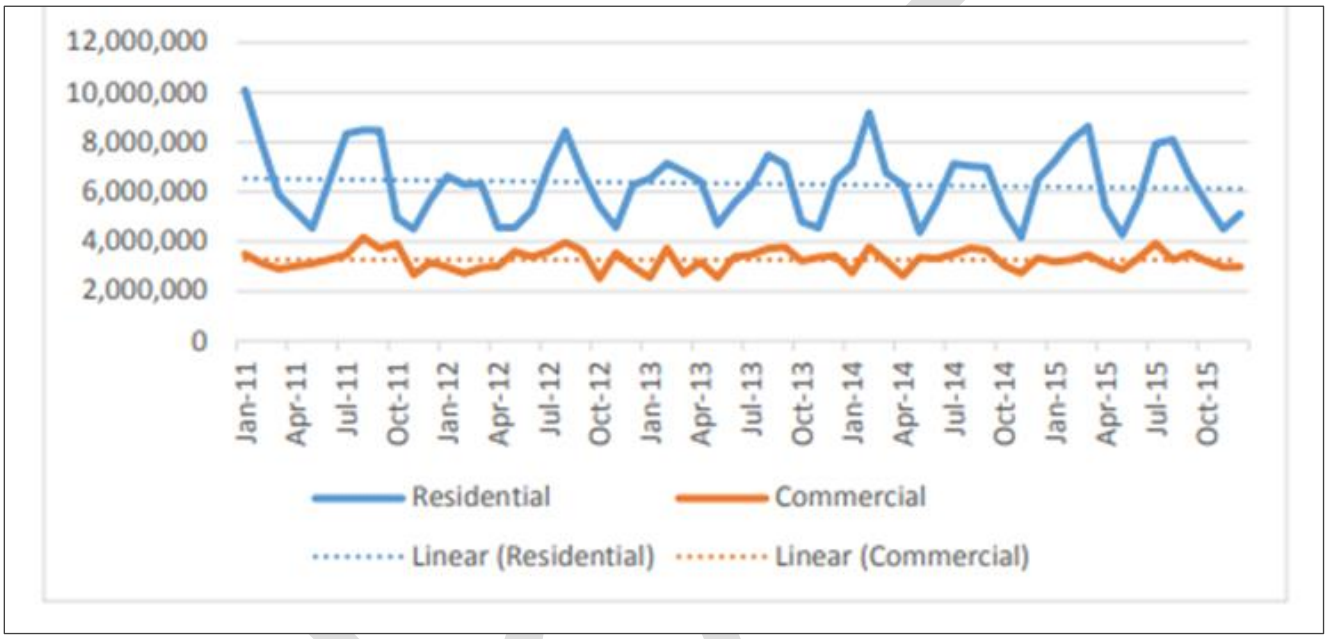


Source: Duke Energy, "Duke Energy At A Glance," Duke Energy 2019 Sustainability Report, 2020, https://sustainabilityreport.duke-energy.com/introduction/duke-energy-at-a-glance/.

[1] U.S. Department of Energy, "State and Local Energy Data," Energy Efficiency & Renewable Enery, 2016, https://www.eere.energy.gov/sled/#/results/elecandgas?city=Carrboro&abv=NC&section=electricity&currentState=North%20Carolina&lat=35.9101438&lng=-79.0752895.
[2] U.S. Department of Energy, "State and Local Energy Data."

The middle chart shows that 54.3% of Duke Energy's generated energy (per GWh) comes from fossil fuel sources (Natural Gas/Fuel Oil and Coal), 35% from nuclear, and 2% from hydro and solar sources. Carrboro's Community Climate Action Plan displayed the below graph (Figure 13) which depicts residential and commercial Duke Electricity usage in kwh. Residential use is about twice the amount of commercial use. Additionally, residential use changes with the seasons – lower energy use in October and April and higher energy use in January and July.

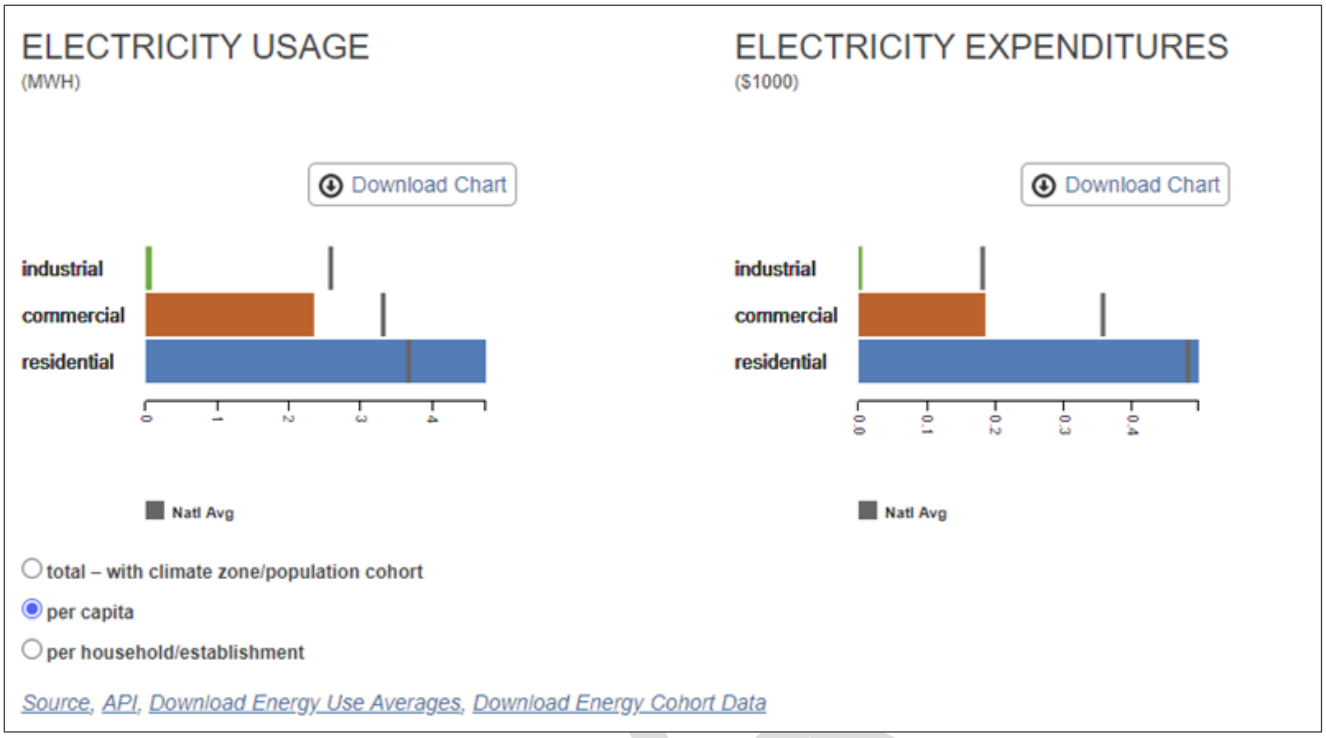
Figure 13: Duke Electricity Usage for Carrboro



Source: Carrboro Energy and Climate Action Task Force, "Community Climate Action Plan: Reducing Greenhouse Gas Emissions, Saving Energy, Generating Renewable Energy, and Enhancing Ecosystems."

Department of Energy (DOE) data from 2016 also states that residential energy use in Carrboro is higher than commercial use for both electricity and natural gas, and that residential electricity use is higher than when compared to the nation.

Figure 14: Electricity Statistics for Carrboro, 2016 (est.)



Source: U.S. Department of Energy, "State and Local Energy Data."

Table 4: Electricity Use for Carrboro, 2016

	Electricity Usage (MWH)		Electricity Expenditure ($1000)	
	Carrboro	National Average	Carrboro	National Average
Industrial	0.09	2.56	0.01	0.18
Commercial	2.35	3.29	0.19	0.35
Residential	4.76	3.64	0.50	0.48

Figure 15: Natural Gas Statistics for Carrboro, 2016 (est.)

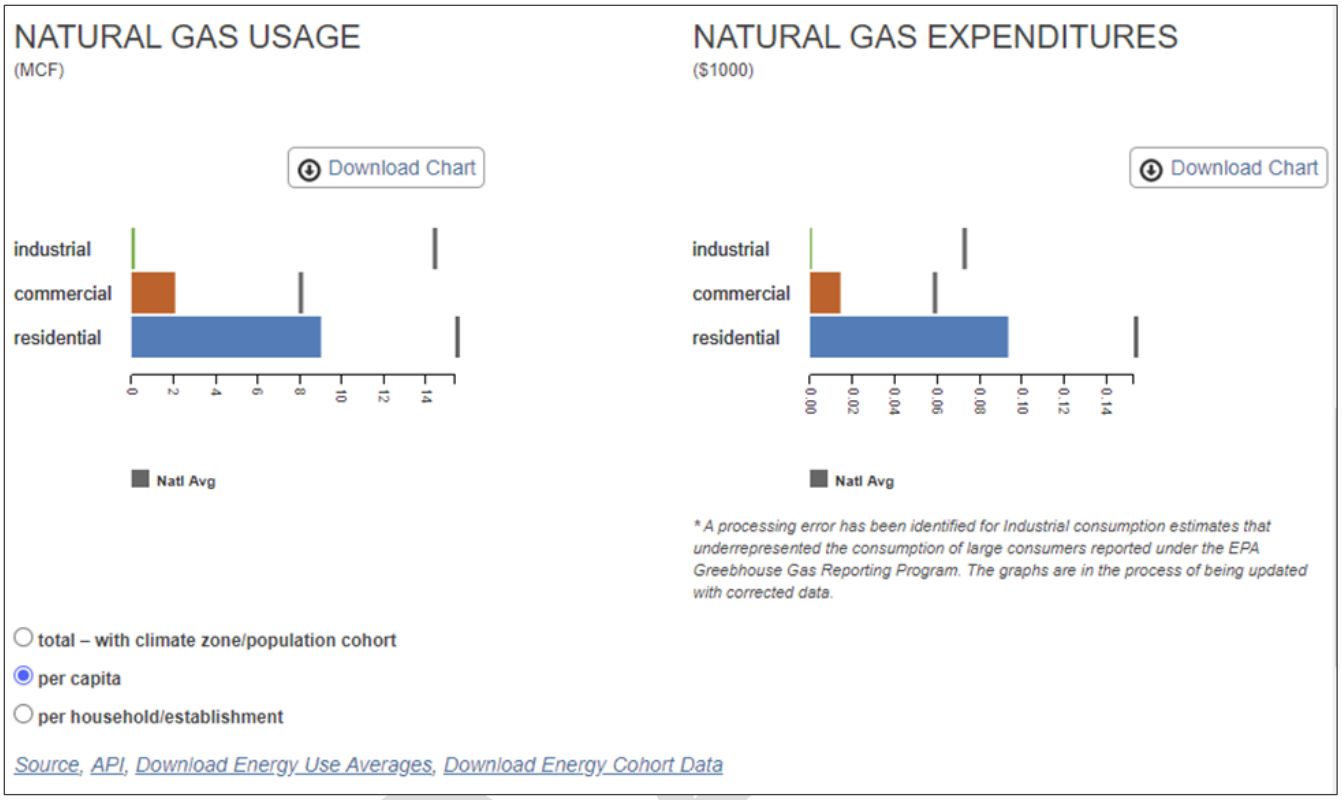


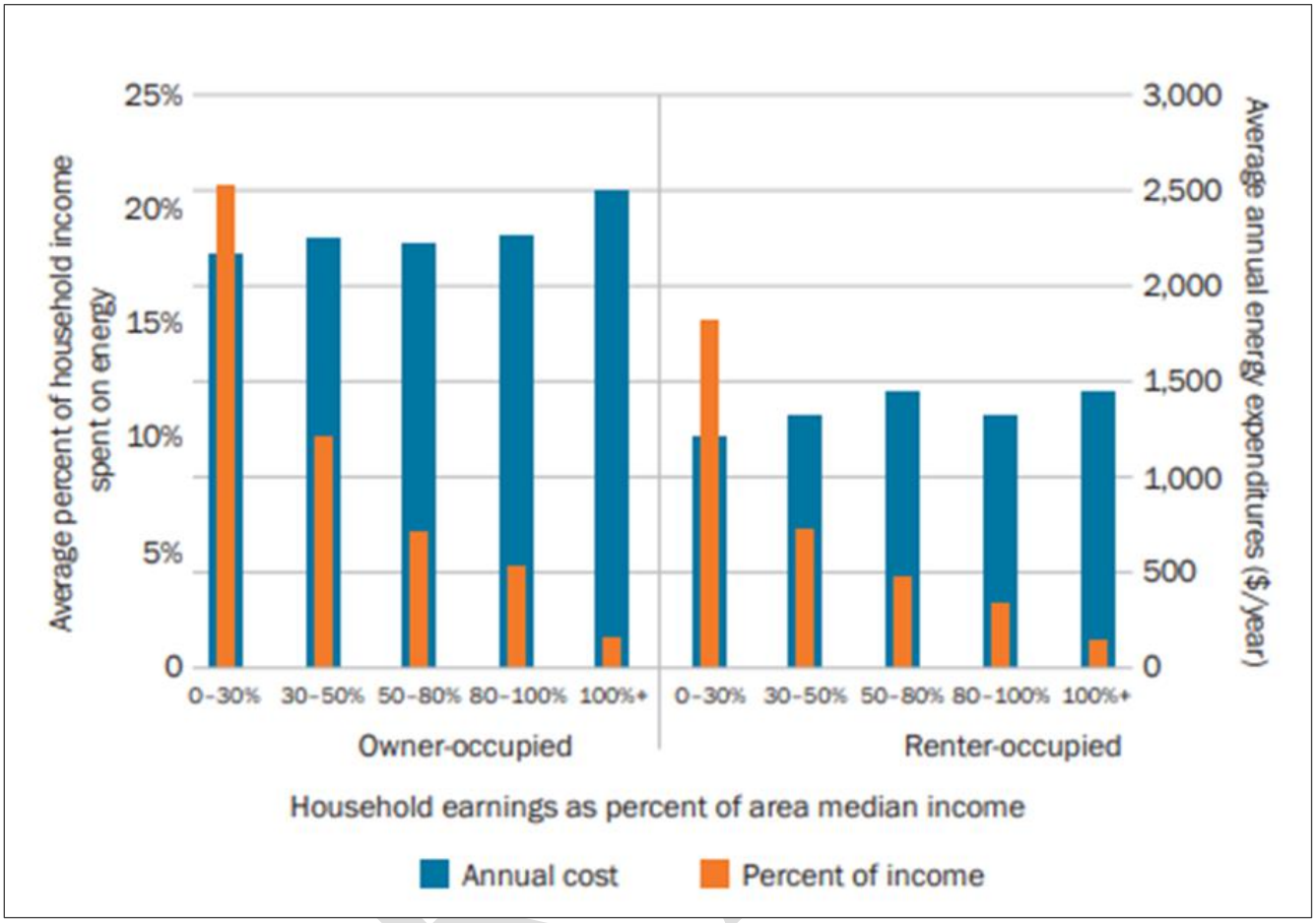
Table 5: Natural Gas Statistics for Carrboro, 2016

	Natural Gas Usage (MWH)		Natural Gas Expenditure ($1000)	
	Carrboro	National Average	Carrboro	National Average
Industrial	0.16	14.35	0	0.07
Commercial	2.08	7.96	0.01	0.06
Residential	9.02	15.42	0.09	0.15

2. ENERGY EXPENDITURE AND AFFORDABILITY

Both the Energy and Climate Protection Plan (ECPP) and the Community Climate Action Plan (CCAP) acknowledge that the residential sector contributes most to Carrboro's energy use and thus both plans highlight the importance of energy efficiency measures in buildings. Figure 12 from the U.S. Department of Energy shows that the lowest-income households of Carrboro are particularly burdened by energy costs, spending about 20% of household income on energy.

Figure 16: Average Energy Expenditures and Energy Burden for Residential Sector in Carrboro, 2015



Source: Office of Energy Efficiency & Renewable Energy, "Carrboro, North Carolina: Achieving Building Efficiencies for Low-Income Households" (U.S. Department of Energy, September 2017),

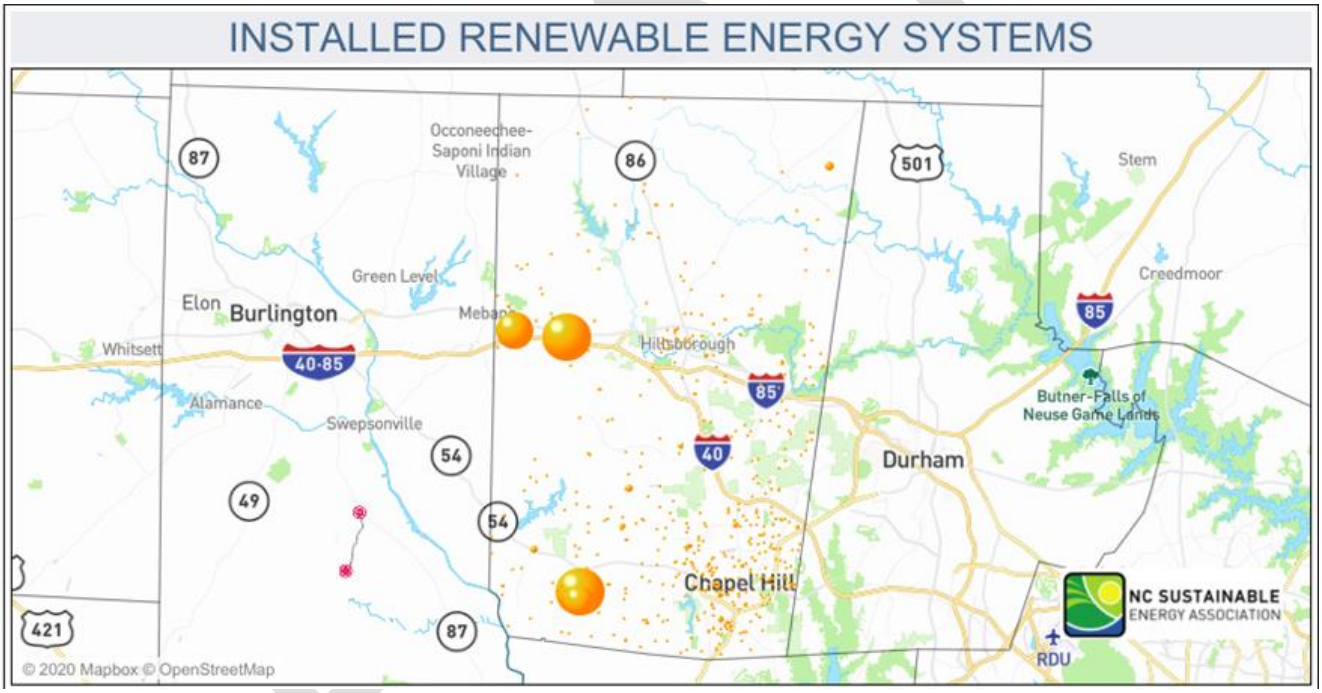
Using federal stimulus funds, Carrboro previously ran the Worthwhile Investments Save Energy (WISE) Energy Efficiency program to help owners of small, commercial and residential buildings finance energy efficiency measures. Grant funds have ended but the Town is now considering potential program ideas with funds from the commercial loans that are being paid back. The ECPP recommended building assessments, ratings and retrofitting for energy efficiency, beginning with Town Hall and the Century Center (underway). Additionally, the plan suggested conducting life-cycle cost analysis and collecting data of energy savings after retrofitting. It is mentioned that the Town does not have the authority to regulate energy efficiency in private buildings.

3. RENEWABLE ENERGY INITIATIVES

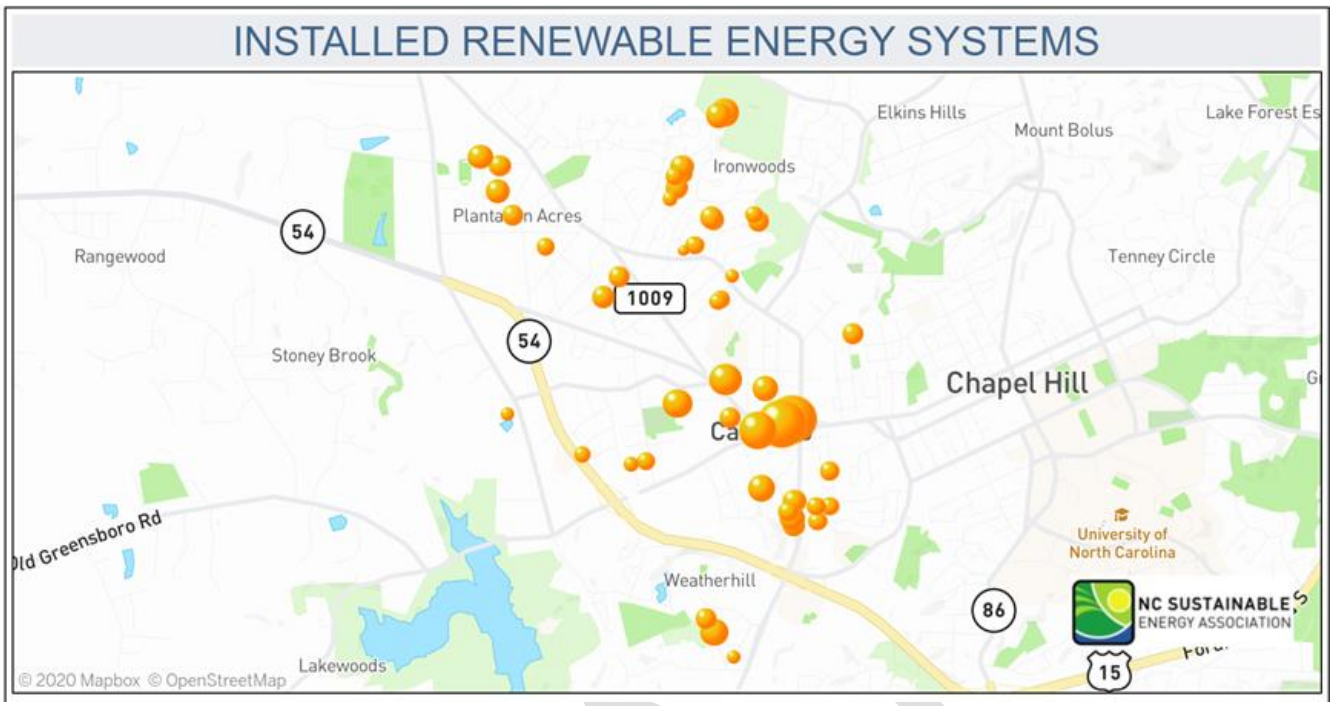
Carrboro has had a long interest in renewable energy efforts and in 2012, the Town partnered with Carrboro Community Solar and the Appalachian Institute for Renewable Energy for a small-scale (5kW) solar electric system at Town Commons. As a separate undertaking, a "Solarize" initiative was run by NextClimate in 2014 and 2015 to encourage community members to install solar electric systems by addressing challenges such as access to information and qualified installers and reduction in "soft costs", or the costs besides the hardware and labor costs for installation. The Town has also amended the LUO to further encourage/incentivize the use of solar. The maps below show installed renewable energy systems (519) in Orange County and in Carrboro.[3]

Carrboro has 45 installed renewable energy systems with a total capacity of 0.3 MW (megawatt), which is 1.57% of Orange County's total capacity.

Figures 17 & 18: Installed Renewable Energy Systems



[3] NC Sustainable Energy Association, "Maps," NC Sustainable Energy Association, July 2020, https://energync.org/maps/.



In 2017, the CCAP expanded upon the ECPP. The CCAP underscored the impact of split incentives between owners and renters, meaning that owners do not benefit from energy efficiency measures because renters pay the utilities. The lack of owner buy-in limits both progress towards energy efficiency and opportunity to address the energy cost burden to low-income households. Additionally, the CCAP called for further solarization through community solar initiatives.

In summer of 2019, the Town's Environmental Advisory Board (EAB), composed primarily of volunteers, was tasked by the Town Council to review Carrboro's progress towards its CCAP and ECPP plans and provide ideas for project implementation. The EAB passed a motion to change the ECPP and CCAP greenhouse gas (GHG) goals to 80% of 2010 levels by 2030. They also expressed interest in a net-zero energy footprint, going beyond goals and recommendations of the ECPP. The Town has continued its WISE program, but staff members have found that retrofitting all Carrboro buildings to the same extent as retrofits performed with the WISE program alone is not enough to achieve a 50% building emissions decrease. In other efforts to switch energy sources, the EAB tasked Town staff to consider the potential for geothermal energy, which was found prohibitive in some cases, and to look into purchasing RECs or increasing contributions to NC Green Power.

Energy use in the transportation sector is mentioned in the 2045 Metro Transportation Plans. However, the Town did not develop a 2045 Fast Act Target for energy consumption per capita from transportation sources.

E. CAPITAL BUDGET AND CAPITAL IMPROVEMENT PLAN

The Town adopts an annual capital budget as well as prepares a five-year Capital Plan. The Capital Plan is guided by six goals:

i. Maintaining the existing infrastructure in order to protect the Town's investments

ii. Expanding the Town's tax base in a way that will benefit both current and future citizens

iii. Complying with state and federal mandates

iv. Incorporating energy and climate protection strategies

v. Providing Town services in the most efficient, safe and quality manner

vi. Managing and encouraging orderly implementation of Town adopted needs assessments, strategic and program master plans (e.g. Vision 2020, Downtown Visioning Plan, Downtown Traffic Circulation Study, Recreation and Parks Master Plan, etc.)

2021 CAPITAL BUDGET AND 2021-2025 CAPITAL IMPROVEMENTS PLAN

The 2021 Capital Budget reflects these goals as shown in Table 5, in particular, the emphasis on greenways, sidewalks, parks and 203 South Greensboro Street.

The Town Council has appropriated $26.9 million for nineteen (19) capital projects that are currently underway.

Table 6: 2021 Capital Budget

Technology Projects / Public Works Projects	
South Greensboro St. Conduit	$ 95,000
Vehicle Replacements	$ 1,089,814
Rogers Road Conduit	$ 155,000
Town Hall Renovations (Replace Roof)	$ 100,000
Street Resurfacing	$ 550,000
Public Safety Projects	
Bus Shelter Replacement	$ 288,000
Self-Contained Breathing Apparatus	$ 314,924
Unpaved Road Upgrades	$ 230,000
Sidewalk Repairs	$ 115,000
Sidewalks & Greenways Projects	
LED Streetlights	$ 40,000
Jones Creek Greenway	$ 850,250
Morgan Creek Greenway	$ 1,567,500

Storm Water Projects	
Rogers Road Sidewalk	$ 1,471,658
Broad St. Culvert Replacement	$ 20,000
South Greensboro Street Sidewalk	$ 1,750,119
Public Works Stream Restoration	$ 80,000
Planning Projects Other Projects	
Comprehensive Plan	$ 200,000
Other Projects	
203 South Greensboro Street [4]	$ 15,699,895
Recreation and Parks	
MLK Jr. Park Construction Design	$ 2,761,196
Grand Total	$ 26,948,106

Projected capital expenses over the FY 2021-FY 2025 are approximately $59 million, broken down as follows.

Table 7: Capital Plan Summary

	Total Project Costs	% of Total
General Government	$ 15,699,895	26.7%
Vehicles/Equipment	$ 4,153,214	7.0%
Information Technology	$ 428,000	0.7%
Public Safety	$ 314,924	0.5%
Planning and Zoning	$ 10,286,494	17.5%
Public Works	$ 23,624,658	40.1%
Recreation and Parks	$ 2,761,196	4.7%
Storm Water	$1,670,000	2.8%
TOTAL	**$58,938,381**	**100%**

Source: Town of Carrboro, North Carolina Capital Improvement Plan: FY 2021-FY2025

[4] Please see Recreation, Parks and Cultural Resources chapter for description of 203 South Greensboro project.

Table 8: Annual Capital Budget Needs

	Previous Appropriations	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	FY21-FY25 Total	Project Total
General Government	$16,789,709	$921,000	$476,500	$639,400	$501,500	$525,000	$3,063,400	$19,853,109
Information Technology	$250,000	$178,000	-	-	-	-	$178,000	$428,000
Public Safety	$314,924	-	-	-	-	-	-	$314,924
Planning & Zoning	$3,937,619	$1,288,512	$834,363	$1,125,000	$1,137,000	$1,964,000	$6,348,875	$10,286,494
Public Works	$2,794,658	$1,200,000	$1,850,000	$3,130,000	$8,050,000	$6,600,000	$20,830,000	$23,624,658
Recreation & Parks	$2,761,196							$2,761,196
Storm Water	$100,000	$425,000	$100,000	$390,000	$215,000	$440,000	$1,570,000	$1,670,000
TOTAL	$26,948,106	$4,012,512	$3,260,863	$5,284,400	$9,903,500	$9,529,000	$31,990,275	$58,938,381

Source: Town of Carrboro, North Carolina Capital Improvement Plan: FY 2021-FY2025

Stormwater projects that are planned for 2021-2025 include:

Broad St. Culvert Replacement	$170,000
Public Works Stream Restoration	$355,000
Green Infrastructure Projects (TBD)	$190,000
Grey Infrastructure Projects (TBD)	$535,000
Anderson Park Storm Water Retrofits	$370,000
Morgan Creek Stream Restoration	$ 50,000
TOTAL	**$1,670,000**

Transportation projects that are planned for 2021-2025 include:

Table 9: Transportation Projects FY 2021-2025

Project	Federal/State Amount	Local Match Amount	Total Cost
Barnes Street Sidewalk	$233,600	$58,400	$292,000
Este Drive Bike-Ped Improvements	$851,200	$366,425	$1,217,625
Jones Creek Greenway	$680,200	$170,050	$850,250
Jones Ferry Road Sidewalk	$448,800	$112,200	$561,000
NC 54 Side Path	$1,175,200	$293,800	$1,469,000
Morgan Creek Greenway	$1,354,000	$338,500	$1,692,500
S. Greensboro Street Sidewalk	$1,154,626	$595,493	$1,750,119
TOTAL	**$5,897,626**	**$1,934,868**	**$7,832,494**
% of Total	**75.3%**	**24.7%**	**100%**

KEY ISSUES AND OPPORTUNITIES

These discussions corresponded with documents and policies, indicating a consensus among stakeholders. The findings are listed below.

A. TRANSPORTATION

1. Equity-Focused Transportation Initiatives and Outreach

The Carrboro community is committed to addressing disparate impacts of transportation decisions and investments in their racial minority and lower income populations. Equitable approaches and solutions should be considered in all aspects of transportation planning to ensure no Carrboro resident is undermined quality access to transportation and connections to jobs, recreation, and services. Conducting targeted outreach to the town's specific populations will help government staff prioritize and implement policies and projects in a thoughtful and more efficient manner. Carrboro can develop a more comprehensive approach by identifying and addressing the potential disparate impacts of projects and decisions across all modes of transportation (walking, biking, transit, and driving).

2. Connected Biking and Walking System

Carrboro staff, Town Council, residents, and other stakeholders have strongly pointed to the desire for a community where streets are safe, accessible, and comfortable for all users. A truly functional multi-modal system includes prioritizing walking and biking as a viable means of transportation and physical activity. The Town of Carrboro is recognized as a highly walkable and bikeable community, with current investments and capital projects to show. Improving walking and biking in the town will require continued investment in sidewalk connectivity and repairs, extending bike path/trail connections, and exploring diverse techniques to educate and encourage racial minority, lower income, and residents living in less dense areas of town to "leave their cars behind".

3. Public Transit System that Encourages Non-Auto Travel

Interviews with local stakeholders have highlighted the desire to encourage non-car use in the community, reduce vehicle miles travelled through land use decisions (denser mixed-use nodes), and pursue development that lends itself to transit use. The region's public transit system has proved to be a catalyst for the community, providing quick and affordable connections to key areas (large employment centers, education, healthcare, etc.) within and outside of the town. Improvements to the public transit system should prioritize safe access to (crosswalks) and at stops (shelters, benches, lighting), timely and efficient service (BRT, traffic congestion), and an increased effort to reach and provide adequate service for racial minority, lower income, and older adult populations.

B. WATER

1. Education & Awareness

As OWASA continues its efforts to efficiently reduce water use and prepare for a future drought, educating and engaging Carrboro's citizens on these issues is critical. Interviews with planning staff indicated that one of the key goals is to make Carrboro's citizens more comfortable with engaging with the local government. In the latest update on its strategic plan, OWASA notes its progress on its community engagement initiative. In summary, the three goals of this initiative are to understand the community's expectations and perspectives, inform the community on efficient water use and protecting water quality, and keeping the community updated on OWASA's work and provide room for input.[ix] Interviews with town stakeholders also cited the importance of community engagement events (such as volunteer initiatives to clean-up streams), and the town's acknowledgement of droughts and water conservation (as many have stakeholders have asked the local government to prioritize).

2. Maintaining a Sustainable Water Supply

Interviews with various stakeholders indicated a growing concern in Carrboro of affordability and the pricing out of lower income residents. Previous efforts and current recommendations by OWASA to continue to reduce water use, adds to the issue of affordability. The two main initiatives taken by OWASA to lower water use were 1.) increasing water rates and 2.) replacing or retrofitting water and wastewater facilities.[xii] However, customers complained of rates being too high. As of 2019, OWASA shifted the rate for multi-family master-metered customers from seasonal to year-round. Rate structures are important for equity related initiatives, which are of interest to Carrboro. Carrboro can collaborate with OWASA and voice concerns on affordability for their residents to make sure future conversations on alternative rate structures are water efficient but also more equitable. Carrboro's citizens are interested in progressive goals according to multiple stakeholder interviews, but the town does not have enough financial capacity and increasing taxes and fees risks making the town unaffordable for residents. OWASA is actively considering more equitable approaches to their operations, and there is an opportunity to create a system to ensure that the ability to achieve water efficient retrofits are equitable and accessible for all residents regardless of the type of residency (rented, owned, affordable housing, etc.) or income. A recent example is the Care to Share program led by the Inter-Faith Council for Social Service (IFC) in partnership with OWASA. This program encourages those able to add $12.50 to their water bill to help fund the payment of water bills for those in Carrboro and Chapel Hill, after the economic impact of COVID-19 led to a 73% increase in the number of OWASA customer with overdue water bills.[xv]

3. Exploring Alternatives for Water Supply

Preparing for a drought is critical for Carrboro and the broader OWASA region. There are multiple recommendations and plans for making sure the region has access to water in the event of a drought. Aside from the Jordan Lake Level II allocation, University Lake and the Quarry Reservoir are part of proposed plans to expand the water supply. OWASA's latest long-range plan for water supply indicates that expanding the Quarry Reservoir is the most viable option financially and politically, particularly because it is locally controlled by OWASA and will provide an additional 2.1-2.9 MGD for less than $2 million (2009 dollars) in costs.[xvi] More significant to Carrboro's residents is the possibility of expanding University Lake, which is another key water supply source. However, the project to expand University Lake for an additional 4.7 MGD would cost a significant change to the infrastructure and land use in the area near University Lake, including residential and University of North Carolina at Chapel Hill (UNC) property.[xvii] As noted by OWASA, this would be met with great scrutiny since Carrboro's residents frequently visit University Lake as a common recreational site. University Lake is no longer being considered, but it is an example of how important it is for Carrboro to actively voice the interests of its citizens to OWASA.

4. Resident Education & Assistance for Green Stormwater Infrastructure (GSI) Implementation

Much of the Town of Carrboro's water infrastructure (stormwater and waste) is older and in need of upgrades/replacements and maintenance, however it can be costly and invasive to both the Town and its residents. Stormwater pipes need to be dug-up and replaced to meet newer regulations and guidelines. Wastewater pipes are near environmentally sensitive areas, require upgrades and maintenance, and can interfere with future bike/pedestrian infrastructure projects. As larger GSI initiatives may be more costly and longer-term, Carrboro has an opportunity to expand community education on installing smaller-scale GSI on private property. Carrboro residents have expressed an interest in installing rain gardens on their properties (with technical or financial assistance from the Town).

C. GREEN INFRASTRUCTURE

1. Connected Greenways and Parkways, while Protecting the Natural Environment

Environmental sustainability is a priority for Carrboro and the development of greenways and parkways that connect to a comprehensive sidewalk and biking network will amplify opportunities for recreational activity (leading to healthier lifestyles), while protecting the natural environment and improving air quality. In addition, transportation infrastructure should use a "green infrastructure" paradigm using stormwater management elements to encourage building environmentally and pedestrian-friendly places. Special attention should be placed on ensuring all residents have ample access to greenspace and safe access to recreational amenities, particularly those belonging to marginalized populations (racial/ethnic, income, age, disability).

D. ENERGY

1. Equitable Initiatives & Affordability

Carrboro needs to continue working towards its energy goals if the town hopes to reach 80% of 2010 GHG levels by 2030. A recurring theme in interviews was the concern of the energy burden for low-income households. Several interviewees highlighted the desire to include racial justice in the comprehensive plan and mentioned the lack of affordable housing. Low-income households spend 24% of income on energy costs. The lack of affordable housing units coupled with high energy bills contributes to the displacement of low-income, households of color. Moreover, the split incentives between owner and renters for energy efficiency have made it difficult for renters to benefit from energy efficiency measures. Prioritizing financing for energy efficiency measures, easing access to energy and weatherization resources for low-income households, and initiating a Rental Property Task Force to address the split incentives in rental units present key opportunities for Carrboro to respond to social justice while working towards its energy goals.

2. Energy Efficiency

Energy audits were mentioned in the ECPP and CCAP for several purposes including both calculating accurate energy usage data before and after interventions and informing potential buyers to incentivize purchase of energy efficient homes. Carrboro has yet to implement energy audits town-wide, though staff have mentioned doing so for Town Hall and Century Center.

Relatedly, energy efficiency measures and renewable energy sourcing needs to increase for all buildings. Carrboro can prioritize net zero stretch codes in new municipal and private construction to ensure that further development aligns to Carrboro's energy goals. Some of these opportunities will require advocacy at the state to obtain statutory authority from the State. Additionally, Carrboro can seek to enforce sustainability measures within HOAs to work towards energy goals. The town has limited authority over HOA rules until Carrboro puts forth an ordinance to prevent restriction of energy efficient practices in HOAs.

Though the commercial sector contributes less to Carrboro's energy usage, it provides an opportunity for Carrboro to reduce energy. Commercial buildings can partner together in the business district to implement energy efficiency measures and host renewable energy sites. Additionally, by developing an alliance among sectors, the town can identify additional steps to move forward to reduce energy use. The town should continue to provide financing opportunities to support these endeavors.

3. Renewable Energy & Electrification

Renewable energy and electrification of transportation are additional opportunities Carrboro can consider. Carrboro's CCAP mentioned hosting community solar sites but electric utilities restrict community ownership. The town can advocate the NC General Assembly to pass a law about a 3rd party being able to sell electricity to power consumers to overcome this barrier. Carrboro currently has had several resources online to help residents consider solar energy and partnered with various groups in the past, but could develop updated partnerships for residents, especially

low-income residents. Finally, Carrboro can plan to incorporate transportation energy costs in its energy audit.

4. SUMMARY GOALS AND STRATEGIES FROM EXISTING PLANS

TRANSPORTATION

A. RESIDENTIAL MANAGEMENT TRAFFIC PLAN FOR SPEED AND TRAFFIC CONTROL, 1996

The plan promotes safety and livability in the residential neighborhoods of Carrboro by providing a process for identifying and addressing problems related to speeding and safety. The process includes: reporting the problem neighborhood consensus, data collection, town staff review (stages 1 & 2 of traffic calming), staff recommendation, board approval, evaluation.

B. COMPREHENSIVE BICYCLE TRANSPORTATION PLAN UPDATE, 2009

The plan envisions a connected system of on- and off-road facilities to accommodate varying level of bicyclists. Comprehensive plan approach includes programs and policies that complement facility recommendations. Plan is structured under the framework of receiving Platinum level designation from the LABBFC program.

Plan Goals

i. To have bicycling as a viable transportation alternative
ii. Continuing process for updating and implementing bike-related policies
iii. Comprehensive bicycle program
iv. Safe and accessible bike network

C. CARRBORO VISION 2020, 2020

Transportation Chapter Goals

i. Continue implementing connector roads policy
ii. Cooperate with regional entities in comprehensive transportation plan
iii. Support passenger rail connection between Horrace William Property, Downtown Carrboro and UNC campus
iv. Locate new high-density development along future public transit routes
v. Continue facilitating access to youth opportunities and educational activities
vi. Participate in community bus system with Chapel Hill and UNC
vii. Support transportation services that meet the needs of disabled citizens
viii. Implement bike and ped network plan
ix. Establish bike and ped connections with other jurisdictions
x. Widen existing roads for bikes and ped, not automobile
xi. Developers to install new sidewalks and bike paths in new developments
xii. Comprehensive plan should recommend alternative funding mechanisms to finance infrastructure improvements

D. BOLIN CREEK GREENWAY CONCEPTUAL MASTER PLAN, 2009

Purpose: Alternative transportation, recreation, environmental protection and restoration.

Plan Goals

i. Create the necessary governance and administrative capability to oversee plan implementation (Carrboro Greenway Commission, Trails Coordinator)
ii. Coordinate with stakeholders: neighboring jurisdictions and utilities
iii. Begin land acquisition process
iv. Project construction and administration
v. Trail programming
vi. Create signage system
vii. Operations and maintenance

E. MORGAN CREEK GREENWAY CONCEPTUAL MASTER PLAN, 2010

Feasibility study determining the possible alignment options of a paved trail in the Morgan Creek corridor.

F. 2045 METROPOLITAN TRANSPORTATION PLAN, 2018

Plan Goals

i. Protect environment and minimize climate change
ii. Reduce GHG and energy consumption
iii. Connect people
iv. Connect to jobs and education
v. Transportation needs are met for all (minorities, aging, youth, disabled…)
vi. Promote multimodal and affordable travel choices
vii. Manage congestion and system reliability
viii. Promote TDM
ix. Enhance ITS
x. Improve infrastructure condition
xi. Ensure equity and participation
xii. Ensure transportation investments don't create disproportional burden on communities
xiii. Enhance public participation
xiv. Promote safety and health
xv. Stimulate economic vitality

G. 2050 METROPOLITAN TRANSPORTATION PLAN (UNDERWAY)

Plan Goals

i. Protect human & natural environment and minimize climate change
ii. Ensure equity and participation
iii. Connect people and places

iv. Ensure that all people have access to multimodal and affordable transportation choices
v. Promote safety, health, and well-being
vi. Improve infrastructure condition and resilience
vii. Manage Congestion & system reliability
viii. Stimulate inclusive economic vitality

H. GO TRIANGLE SHORT – RANGE TRANSIT PLAN, 2018

Carrboro-related Plan Goals

i. Route 405 runs through Downtown and connects to Durham and Chapel Hill (UNC, Duke, Duke/VA Hospital, employment centers)

    a. Recommend additional stop at Patterson Place in southwest Durham

I. SOUTH GREENSBORO STREET SIDEWALK PROJECT, 2020

Plan Goals

i. Pedestrian safety improvements at intersections
ii. Stormwater improvements as needed
iii. Adding bicycle lanes as part of or prior to resurfacing, currently anticipated in 2022

J. EAST MAIN STREET OPERATIONAL ANALYSIS AND RESTRIPING PLAN, 2020

Plan Goals

i. East Main Street up for resurfacing in 2021 – town to consider modifying pavement markings.
ii. With declining traffic volumes, town looking to reallocate space to bike lanes.
iii. Restriping plan to include: bike lanes, bike boxes, intersection bike markings, center turn lanes, additional crosswalks, maintain parking.

K. CHAPEL HILL AND CARRBORO 2035 LONG RANGE TRANSIT PLAN, 2009

Plan Goals

i. Investment in stronger public transit with BRT, improved connectivity, connections to regional transit services, park and ride facilities and transit supportive land use development (pedestrian friendly, high density, mix use) is justified in six corridors (NC 86, US 15/501, E NC54, Hillsborough Rd, W NC54, S US 15/501).
ii. Implement LRT connecting NC54 E and US15/501 E
iii. Extensive Chapel Hill Transit bus network to support regional commuter rail service

L. NC 54 PEDESTRIAN AND BICYCLE CORRIDOR SAFTEY STUDY, 2019

Plan Goals

i. Include more visible pedestrian markings and signals
ii. Align bus stops to pedestrian access ways/side walks
iii. Bicycle connectivity across signalized intersections

M. NC 54 WEST CORRIDOR STUDY

Plan Goals

i. Sidewalk and shared use path
ii. Four lane with swales
iii. Increase safety for cars on NC 54

N. CHAPEL HILL TRANSIT SHORT RANGE PLAN, 2020

The purpose of this report is to summarize the background conditions of Chapel Hill Transit (CHT) and provide a comprehensive evaluation of existing services and system performance. Recommended project goals include:

i. Improve transit mode shift
ii. Increase ridership
iii. Create high frequency transit corridors
iv. Emphasize equity
v. Improve weekend service
vi. Enhance the convenience of living without a private vehicle

O. CARRBORO BIKE PLAN UPDATE (TO BE ADOPTED OCTOBER 2020)

i. Keep momentum on bicycle projects that are already in development.
ii. Use equity to prioritize projects for future implementation.
iii. Strategically and proactively fund and build strategic priority projects.
iv. Use the long-term network of recommendations to build other projects incrementally over time.
v. Leverage partnerships to implement new policy and programs.

P. ORANGE COUNTY TRANSIT PLAN (CURRENTLY IN DEVELOPMENT)

To be added once available

WATER

A. LITTLE CREEK WATERSHED 2003 ASSESSMENT

Preservation of Natural Areas

i. Implement feasible and cost-effective stormwater retrofit projects to mitigate the hydrologic effects of existing development. Priority should be given to areas with the most density. Long-term retrofits should be considered during infrastructure improvements. Additionally, implement effective stormwater management for all new development to prevent further channel erosion and habitat degradation, for example infiltration practices and low impact development practices.
ii. Develop a strategy to address toxic inputs such as source reduction and stormwater treatment methods. Additional methods may include stormwater and dry weather sampling strategies to target pollutant removal and installation of best management practices for stormwater volume control and velocities. Furthermore, organic loading must be addressed by identifying and eliminating illicit discharges, education of residents about fertilizer use and installation of features to remove excess nutrients.
iii. Implement stream channel restoration activity in conjunction with stormwater retrofit best management practices to improve aquatic habitat. Additionally, the Town of Carrboro should consider rapid establishment of stabilizing vegetation in new construction.
iv. Cooperate with OWASA and Town of Chapel Hill to improve riparian vegetation condition along sanitary sewer rights of ways and greenways. All partners should commit to limiting disturbance of riparian areas to the minimum extent necessary to maintain infrastructure.

B. MORGAN CREEK LOCAL WATERSHED 2004 PLAN

Preservation of Natural Areas

i. Identify best management practices for retrofitting and current designs to address the negative impacts of stormwater runoff in conjunction with natural channel design and bioengineering methods to restore aquatic habitats. Some practices may include stormwater wetlands, detention ponds, and rain gardens.

C. BOLIN CREEK WATERSHED RESTORATION PLAN 2012 TOWN OF CARRBORO

Preservation of Natural Areas

i. Implement selected strategies for watershed management and restoration (Appendix 5), including: Engineered stormwater control structures; Pollution prevention measures; Ecosystem function rehabilitation and restoration measures;

Cleanup, remediation, and mitigation measures; Erosion control and soil protection or rehabilitation practices; and Infrastructure mitigation techniques.

ii. Implement policy measures, including stormwater fee credit policies, incentive programs, and reverse auctions (Appendix 5).

D. OWASA – LONG RANGE WATER SUPPLY PLAN, 2013

This report summarizes the existing water supply capacity, demand projects, and options for meeting increased water demand for the OWASA region.

E. TRIANGLE REGIONAL WATER SUPPLY, 2014

This plan is focused on assessing and projecting future and current water demands for the counties associated with the TRWSP. It offers both a needs assessment, and possible alternatives for maintain water supply.

F. CARRBORO: ILLICIT DISCHARGE DETECTION AND ELIMINITATION PROGRAM, 2020

This report focuses on the basics of illicit discharges and Carrboro's Illicit Discharge program. This includes an explanation of illicit discharges (such as) This report outlines the overall framework, goals, progress tracking, and guidelines for program implementation.

G. COLLABORATE REPORT WATER CONSERVATION STRATEGIES, 2008

This report provides recommendations on a variety of potential water conservation partnership strategies as well as long term supply/demand projections, goals, and guiding principles.

GREEN INFRASTRUCTURE

A. COMMUNITY CLIMATE ACTION PLAN 2017 TOWN OF CARRBORO

Climate Resilience

i. Pursue watershed restoration actions to protect local streams from changing precipitation patterns due to climate change.

Preservation of Natural Areas

i. Create a stormwater utility.
ii. Study the extent to which the deer population and climate change affect natural ecosystems.
iii. Study and implement a comprehensive organics collection and composting program.
iv. Support tree preservation, protection, and conservation efforts, including the formation of a community-led tree coalition for the community forest.
v. Pursue regulatory and non-regulatory approaches to discourage non-native and invasive plants and encourage native plan use.

B. NPDES PHASE II: STORMWATER MANAGEMENT IN CARRBORO: COMPREHENSIVE STORMWATER MANAGEMENT PLAN 2018 TOWN OF CARRBORO

Preservation of Natural Areas

i. Implement a variety of specific stormwater best management practices (BMPs) addressing regulatory requirements, public education and involvement, detecting and eliminating illicit discharges, controlling runoff, and preventing pollution from municipal operations.
ii. Establish a program to identify and prioritize opportunities for retrofit projects that will improve water quality.
iii. Continue to identify and pursue watershed restoration activities in Bolin Creek including ecosystem monitor, partner collaboration, targeted outreach to encourage citizens to adopt BMPs, and completion of a new significant restoration project.
iv. Continue to fund retrofits and other watershed restoration measures through the stormwater utility and enterprise fund.

C. RAINREADY CARRBORO PILOT STUDY 2019 TOWN OF CARRBORO

Climate Resilience

i. Implement a targeted and multifaceted communications plan to address the varying concerns of residents experiencing different types of flooding. Identify local resident "champions" who can partner with the Town to support the development of the program and serve as a liaison to residents. Cultivate resident-led groups that can participate in program outreach and consensus building efforts.
ii. Offer a technical assistance and cost-share grant program to residents seeking to install green infrastructure as a solution for localized flooding. Partner with local organizations who can launch and deliver aspects of the program. Consider coordinating program delivery across Town departments, to support program administration tasks. Identify funding and financing mechanisms to support the long-term operation of the program.

Social Equity

i. Identify program design options that provide financial support to enable lower income residents to participate in a technical assistance and cost-share grant program to install green infrastructure.
ii. Conduct targeted outreach to owners of rental housing and consider program design options to encourage participation in the technical assistance and cost-share green infrastructure program.

ENERGY

A. ENERGY AND CLIMATE PROTECTION PLAN, 2014 WITH EAB 2019 UDPATES

Carrboro's Environmental Advisory Board has strengthened Carrboro's commitment to energy savings and GHG emissions reduction. Energy reduction opportunities are dependent on how Carrboro decides to address buildings' energy usage, especially for residential buildings.

i. 80% reduction 2010 levels of per capita greenhouse emissions by 2030.
ii. Conduct building energy assessments and ratings for all municipal buildings and inventory energy efficiency measures throughout the town.
iii. Increase energy efficiency within municipal buildings from technologies used to weatherization efforts.
iv. Replace the municipal fleet an energy efficient and electric vehicle.
v. Convert all public outdoor lighting to LED fixtures.
vi. Support energy efficiency financing to small businesses through the Energy Efficiency Revolving Loan Fund.
vii. Develop a renewable energy portfolio that takes advantage of federal and state tax credits and supports increased solarization.

B. COMMUNITY ACTION CLIMATE PLAN, 2017 WITH EAB 2019 UDPATES

Plan Goals:

1. 80% reduction 2010 levels of community greenhouse emissions attributed to Carrboro buildings by 2030.
2. Integrate climate action and social equity initiatives. An example: Address limitations to financing energy efficiency for low-income households and renters by creating and administratively supporting a Rental Environmental Task Force including owners and renters.
3. Facilitate low cost financing for energy efficiency and renewable energy projects.
4. Conduct an energy audit of town buildings and develop a Community Energy Dashboard to identify progression or regression from the town's energy goal over time.

[1] The Trails and Greenways Clearinghouse. (n.d.). *Benefits of Trails and Greenways*. Retrieved from https://www.railstotrails.org/resourcehandler.ashx?id=2988#:~:text=Trails%20and%20greenways%20help%20improve,by%20agricultural%20and%20road%20runoff.

[2] Jim Wise, "Durham Tax Rate 2nd Highest among Top NC Cities," The News & Observer, February 15, 2015, https://www.newsobserver.com/news/local/community/durham-news/article10330817.html.