LYNX Blue Line Extension
Health Impact Assessment

Mecklenburg County Health Department

October 2014-July 2015

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The full HIA report and supporting documents can be found on the project website at:
http://charmeck.org/mecklenburg/county/HealthDepartment/CommunityHealthServices/Pages/Blue-Line-Extension-(HIA).aspx

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Executive Summary

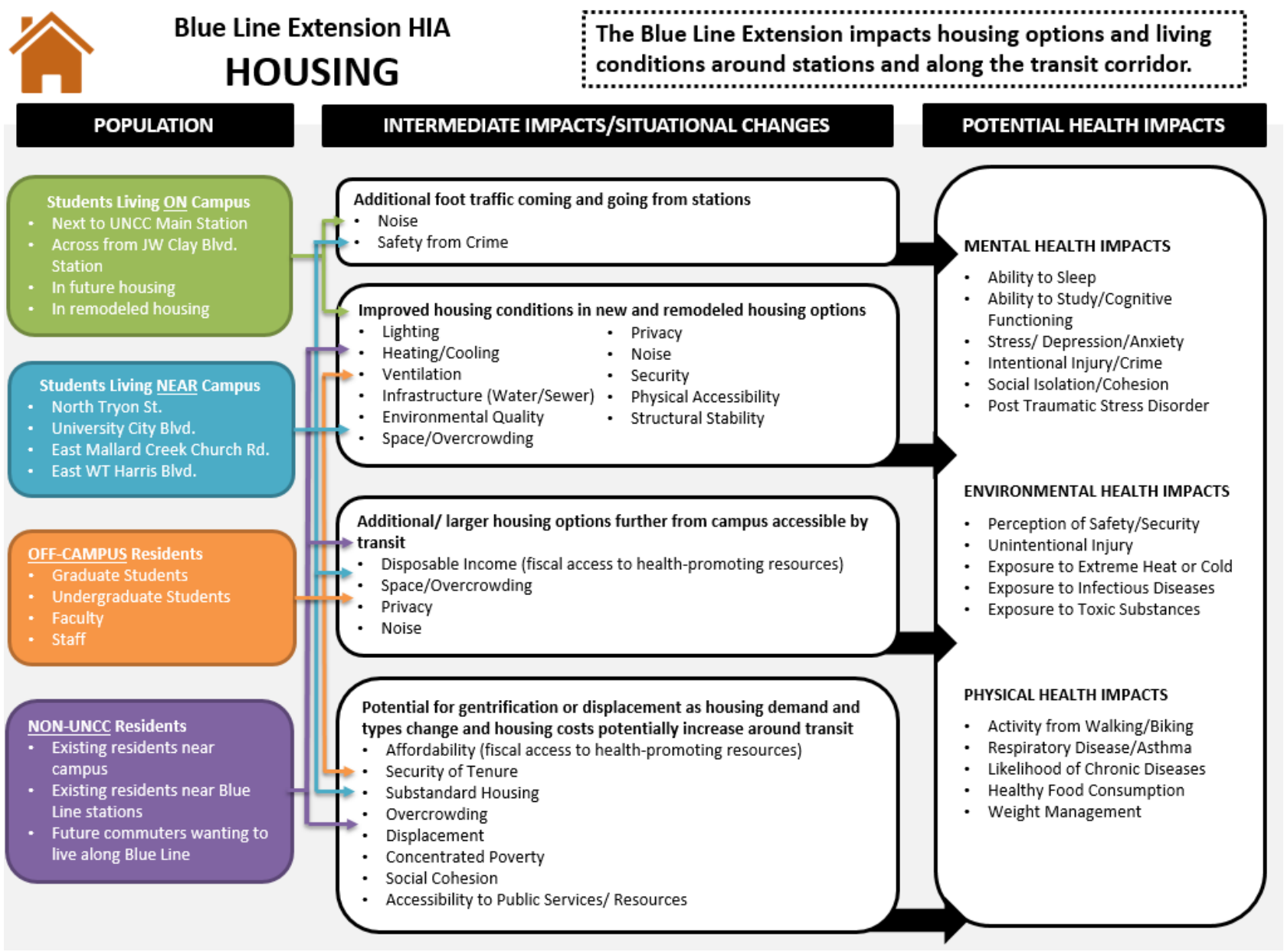
Nationally, investment in public transit has steadily increased as a means to encourage sustainable development patterns and decrease traffic congestion, especially in highly populated areas such as Charlotte, North Carolina. Opened Fall 2007, the LYNX Blue Line Light Rail has experienced immense popularity with ridership numbers more than doubling initial projections. Plans to expand the 9.6 mile line an additional 9.3 miles, connecting the 9th Street Station in Center City to the North Davidson (NoDA) and University areas to terminate on the University of North Carolina Charlotte (UNCC) Main Campus, were approved and construction on the extension started in 2013. The Blue Line Extension, featuring 10 new stations, is scheduled to open Fall 2017 and will provide UNCC students, faculty, and staff (and others) an additional means of transportation and access to health promoting opportunities.

The Blue Line Extension Health Impact Assessment was conducted from October 2014 to July 2015 by the Mecklenburg County Health Department in conjunction with representatives from UNCC and the Charlotte Area Transit System (CATS). This report summarizes the findings and recommendations of that assessment. The goal of the HIA is to inform decision-making surrounding the Blue Line Extension, focusing on the light rail's potential impacts on the four categories of housing, transportation, environment, and UNCC policies (See Figures E.S. 1-4).

What is HIA?

The National Research Council defines HIA as "a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects" (National Research Council, 2011).

Figure E.S. 1: Potential Health Impacts of Housing



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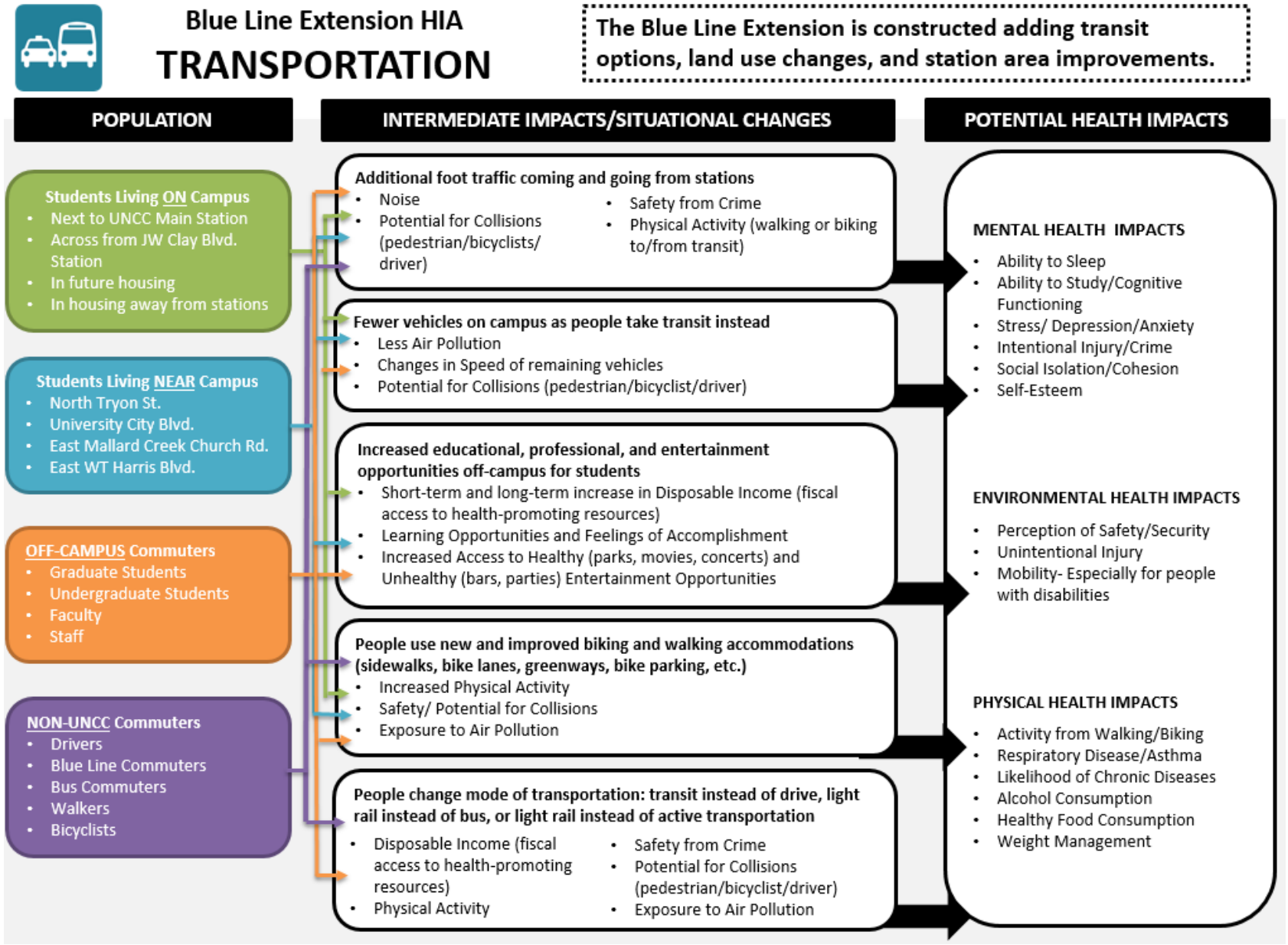

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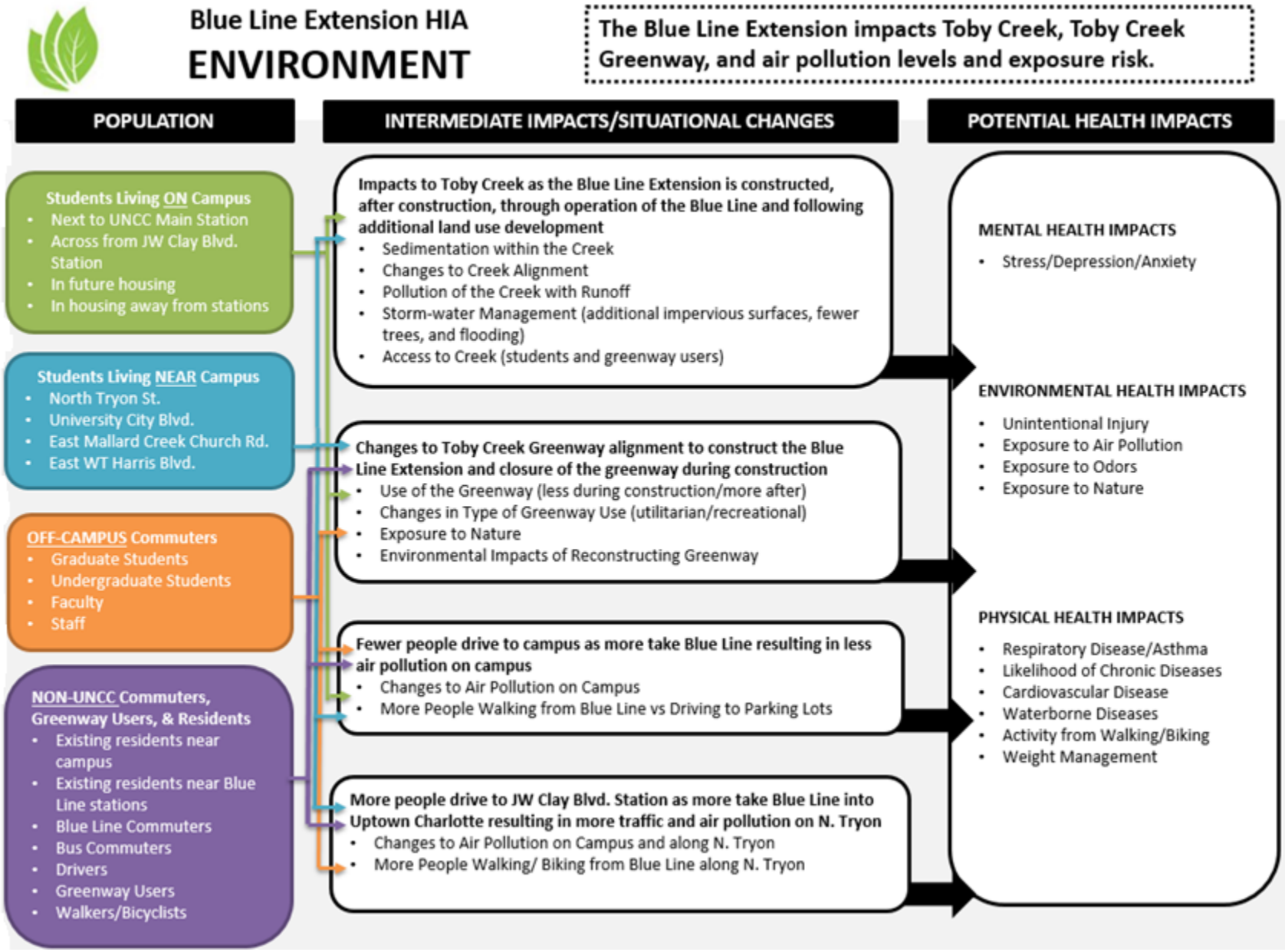

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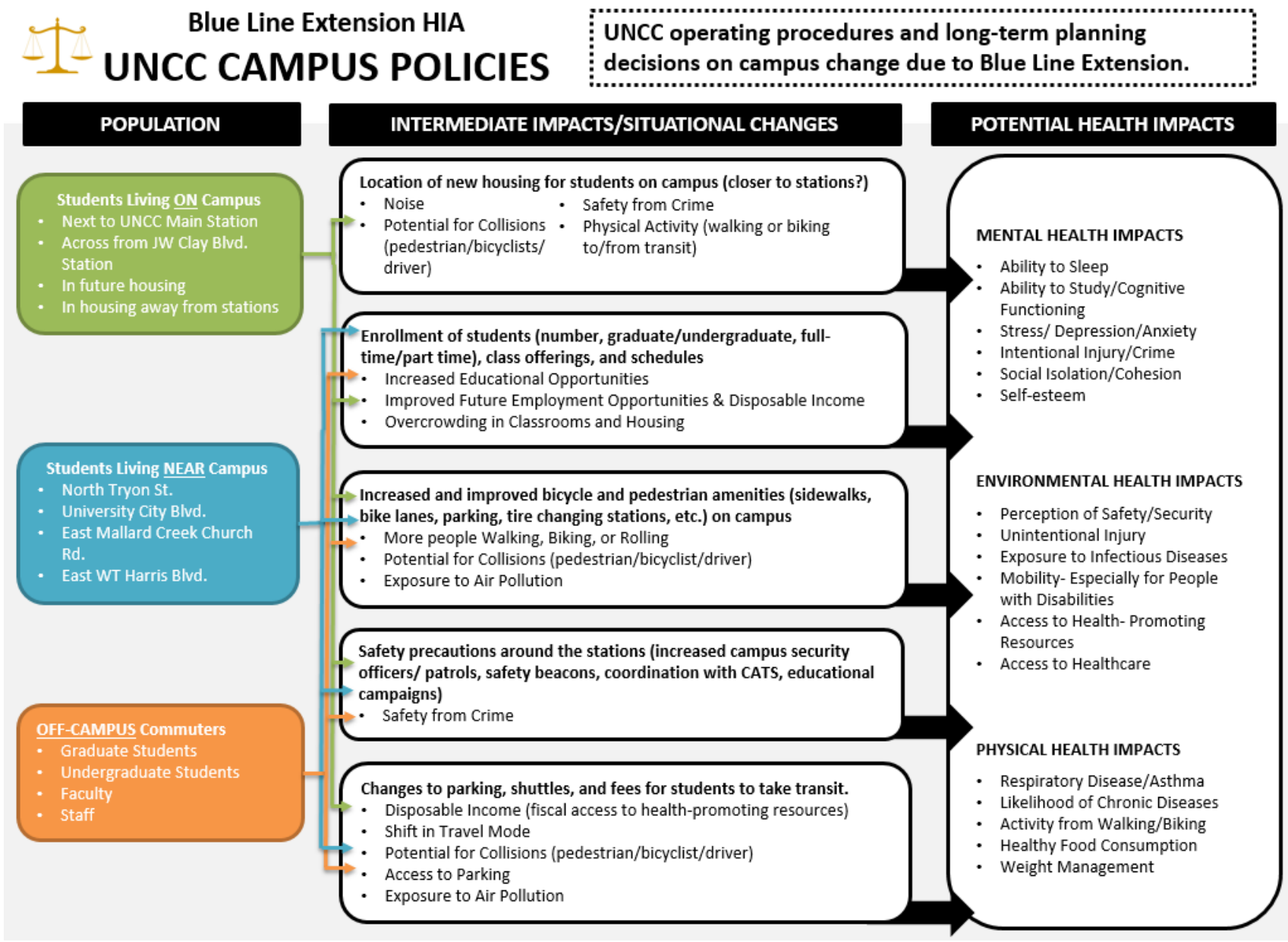


Major Findings

After examining national literature, local data, survey results, and conversations with stakeholders, a mixture of potential positive and negative health impacts emerged based on possible responses to housing, transportation, environmental, and UNCC policy options.

The condition of **housing** is expected to improve as new development takes place causing positive health impacts. Affordability and potential gentrification is a concern; however, the increased mixture of types of housing and price-points could either improve or be detrimental to health depending on whether or not policies are in place to protect affordability and increase housing options. With increased police monitoring around stations, station design, and noise controls being implemented, the neighborhood and community conditions around the stations and residential buildings should also improve with the addition of transit options causing positive health impacts.

Transportation options, speeds, safety, and vehicle miles traveled should improve with the introduction of transit, potentially reducing the amount of air pollution, severe collisions, road rage, and traffic congestion. Physical activity levels are expected to increase, respiratory disease rates should decrease, health equity should improve with increased access, and the severity of injury or fatality caused by vehicle collisions should decrease. Because the extension terminates on UNCC Main Campus, additional considerations of campus safety, noise and potential access to unhealthy activities (increased alcohol consumption) should also be addressed.

Environmental considerations include impacts on water quality and stormwater management which should improve as long as best management practices are implemented with the construction of the Blue Line and the use of transit decreases the need for additional paved parking lots on campus. Regional air pollution should decrease, causing positive health impacts but the exposure risk for those walking and biking near traffic may increase. During the construction of the Blue Line, exposure to nature and physical activity on Toby Creek Greenway decreases due to trail closure; however, long-term access to parks and nature should increase with positive health impacts.

Depending on how **UNCC's campus policies** respond to the Blue Line coming to campus, many positive health impacts could be gained. With greater access to the Uptown Campus and the potential to use land designated for parking for additional classroom and student services, enrollment and course offerings could increase with many long-term positive health benefits. If transit becomes a viable option (perhaps through a subsidized "Go Pass") and the number of students, faculty, and staff needing parking decreases, associated financial savings could result in positive or negative health impacts depending on the use of these savings.

Recommendations

Overarching Recommendations

1. Continue to consider health implications as Charlotte Area Transit System (CATS) and Charlotte officials plan, construct and promote transit use in the greater Charlotte area.
2. Increase channels of communication between the Charlotte Area Transit System (CATS), the University of North Carolina Charlotte (UNCC), Charlotte-Mecklenburg Planning (CMP), Mecklenburg County Health Department (MCHD), and members of the community including transit users, developers, and business owners.

3. Support additional studies that collect baseline health data, record usage of the Blue Line Extension (especially by students, faculty, and staff of UNCC), and monitor the health impacts of increased transit options.
4. Follow the recommendations set forth in the Environmental Impact Statement conducted on the Blue Line Extension.
5. Increase the knowledge, use, and support of the Student Health Survey including the addition of custom questions relevant to commuting patterns.

Housing Recommendations

1. Identify neighborhoods at risk for gentrification. Implement policies and incentives that would protect existing low and middle-income neighborhoods from gentrification and require the inclusion of affordable housing and a wide variety of housing types and price points along the Blue Line Extension.
2. Increase awareness of developer incentives to promote housing density, life-cycle housing, and mixed-use development patterns within a quarter mile of transit stations.
3. Promote additional collaboration between University of North Carolina Charlotte (UNCC) Facilities Planning and local developers to balance the needs of low, middle, and high income residents and provide a balance of on-campus and off-campus housing for UNCC students.
4. Install noise control mechanisms on the rail line at turns near housing, additional soundproofing around the UNCC Main Campus Station and JW Clay Blvd Station, and greater noise-reducing insulation in the residential halls surrounding the stations.
5. Consider impacts on students living around the stations when setting transit schedules, establishing policing stations, and offering late-night shuttles from the stations.

Transportation Recommendations

1. Conduct a recurring commuter (motor vehicle operators, pedestrians, and bicyclists) survey and counts to determine commuting patterns of University of North Carolina Charlotte (UNCC) students, faculty and staff to determine where they are commuting from, the length of commute, time of commute, mode of travel, and barriers to taking transit.
2. Establish a “Go Pass” that would allow University of North Carolina Charlotte students, faculty, and staff to use their campus identification card to take all forms of public transit offered by the Charlotte Area Transit System (CATS), either for free (subsidized by UNCC using either student fees or parking permits) or for a reduced rate. While negotiating the “Go Pass,” review the policies on parking decks, usage and rate structure for CATS and for UNCC to reduce overcrowding at the JW Clay Blvd Station and reserve spaces for transit users and businesses.
3. Carefully plan wayfinding mechanisms including signs, painted pavement, landmarks, and electronic applications to guide riders in and around campus and to notify them of the arrival time for the next train and other transit connections. Provide incoming and current students with resources on active transportation opportunities on and around campus that include information on routes, safety, facilities, rental programs, etc.
4. Implement context sensitive solutions to improve safety and increase pedestrian, cyclist, and ADA access to campus.

5. Design the trains, stations, adjoining streets, and surrounding land uses to promote walk-up or bike-up services. Monitor bike arrival and boarding on the Blue Line to gauge the need versus availability of station racks, on-board racks, and storage space.
6. Market the health benefits (physical activity, weight management, stress reduction) and fiscal savings of taking transit.

Environment Recommendations

1. Include additional trees and vegetation plantings along the transit corridor, on campus, and around stations to help with localized air pollution and stormwater management.
2. Market the air quality benefits of taking transit noting daily air quality ratings (high ozone or unhealthy air quality days) on the Charlotte Area Transit System (CATS) website and at stations.
3. Monitor asthma incident rates at UNCC Student Health Services and area hospitals especially in comparison to poor air quality days.
4. Follow best management practices when constructing the bridge over Toby Creek.
5. Decrease the number of surface parking lots on campus and paved surfaces to reduce runoff and implement additional stormwater management measures such as bioswales and rain gardens.
6. Install a user-counter on Toby Creek Greenway, perform intercept surveys, and monitor usage of the greenway.
7. Reopen Toby Creek Greenway and connect the greenway to the larger Cross Charlotte Greenway Network as soon as possible.
8. Market and provide wayfinding to greenway connections and parks along the Blue Line.

UNCC Campus Policies Recommendations

1. Form a short-term taskforce at University of North Carolina Charlotte (UNCC) to address the implications of the Blue Line on campus to include representation from housing, student health, transportation, police, enrollment, academic scheduling, and the student body. Increase student involvement and information about student needs within the decision-making process.
2. Incent students, faculty and staff to use transit (especially to travel between campuses and from housing or work opportunities) and dis-incent having a car on campus.
3. Improve walkability, bikeablility, and ADA accessibility on campus including potentially expanding the amount of time available between classes for crossing campus.
4. Build a pedestrian bridge over the northbound lanes of North Tryon St. from the JW Clay Blvd Station to connect the station to the University of North Carolina Charlotte (UNCC).
5. Work with the Charlotte Area Transit System (CATS) to establish a “Go Pass” or at least extend the 10-Ride Local pass to include rides on the Blue Line and connecting bus shuttles.
6. Diversify funding sources for parking structures and transportation programs so that University of North Carolina Charlotte (UNCC) is not dependent on parking permit sales and can offer more services (pedestrian and bicycling facilities, extended shuttles, etc.).
7. Include transit information in various educational programs such as orientation for incoming students, healthy behavior courses (way of increasing physical activity and as a designated driver option), and safety instructions (safety on transit, using transit, locking doors in residential halls and vehicles, etc.).

8. Convert under-used surface parking lots to academic buildings, increase the demand for classes and programs offered at the Uptown Campus, and schedule classes to optimize use of classroom space in order to increase enrollment and the number of degrees offered at University of North Carolina Charlotte(UNCC).

Conclusions

The HIA provides a lot of background information on the Blue Line Extension, University of North Carolina Charlotte campus planning, and development patterns in Charlotte and examines these plans and projects through a lens of health. It is the intention of this HIA to provide a broad overview of the potential health impacts that the introduction of light rail transit and associated land use development and transportation improvements will have on the UNCC population (students, faculty, and staff). Hopefully this HIA will serve as a model for future HIAs in Mecklenburg County and a spring board for additional conversations as subsequent decisions are made in preparation for and in response to the Blue Line Extension being built.

Introduction to HIA

In 2011, a collaboration of experts convened by the National Research Council defined HIA as "a systematic process that uses an array of data sources and analytic methods and considers input from stakeholders to determine the potential effects of a proposed policy, plan, program, or project on the health of a population and the distribution of those effects within the population. HIA provides recommendations on monitoring and managing those effects" (National Research Council, 2011). To expand upon this definition, conducting an HIA requires following a six step process–screening, scoping, assessment, recommendations, reporting, and monitoring and evaluation– described in greater detail in the diagram below and throughout this report. It is a democratic process combining input from stakeholders or the population being impacted by the policy, plan, program, or project that the HIA is examining, with available data sources and literature on the topic. The HIA process is flexible and can be applied to a wide variety of topics such as transportation projects and plans, economic policy, housing and redevelopment projects, agricultural and nutrition policies, energy and sustainable growth plans, etc. HIAs are done prior to a decision being made and provide decision makers with recommendations to manage any anticipated negative health consequences and promote positive health outcomes. HIA is also used as a tool to promote health equity by examining the distribution of potential health effects within a population and suggesting ways to bridge health inequities.

This HIA was conducted by the Mecklenburg County Health Department (MCHD) in collaboration with the University of North Carolina Charlotte (UNCC) and the Charlotte Area Transit System (CATS). Funding for this HIA was provided by the National Association of County and City Health Officials (NACCHO).

Figure 1: Heath Impact Assessment Process

Background Information on Charlotte and Mecklenburg County, NC

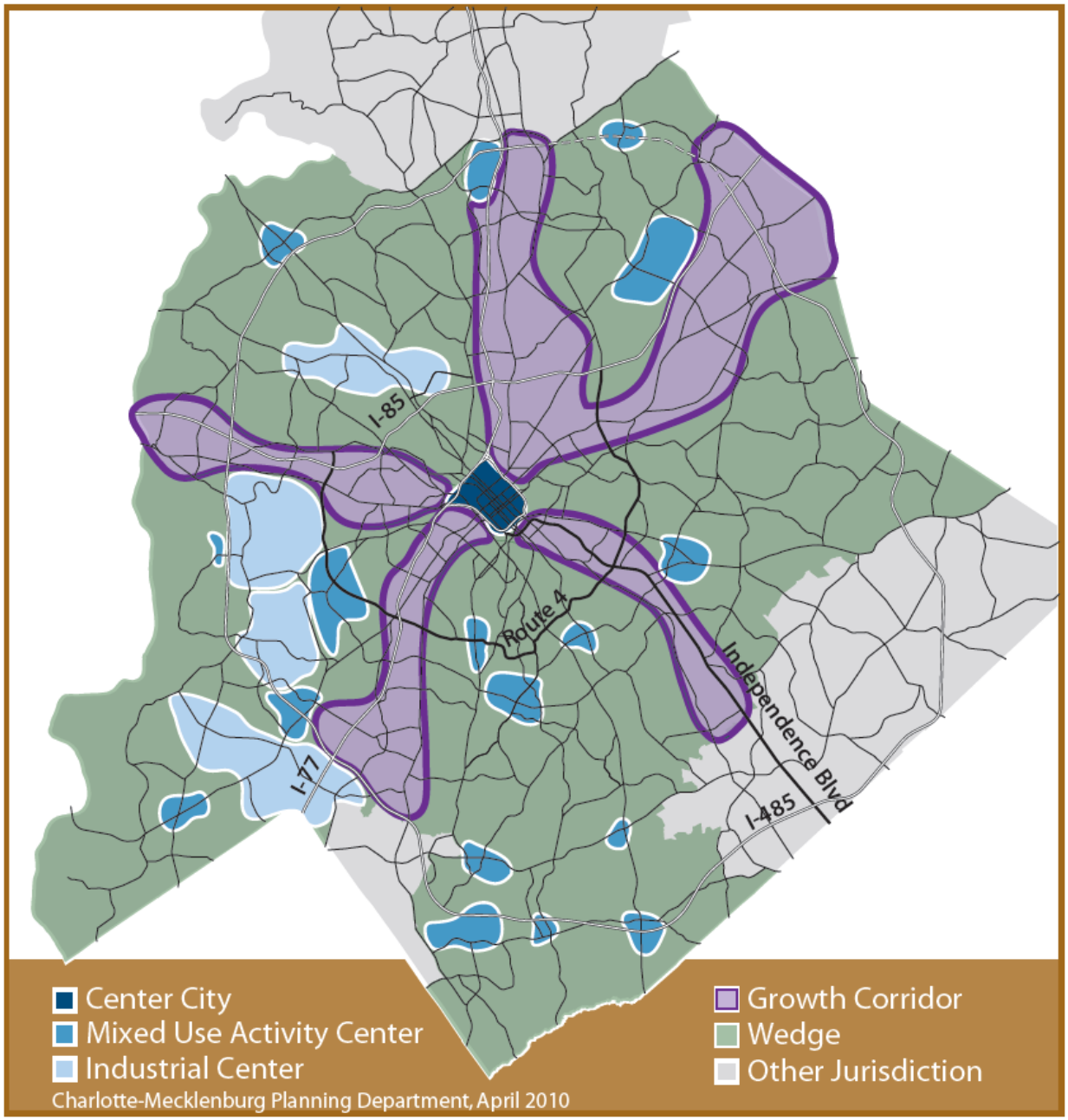
Charlotte has grown rapidly over the last few decades from a mid-sized city into the 19th largest city in the nation. Charlotte's population more than doubled from 1980 to 2010, increasing from 315,000 people to over 728,000. The city is expected to continue to grow and reach over a million people in the next 20 to 25 years. Through annexation, the city limits of Charlotte have also increased from 140 square miles in 1980 to 300 square miles by 2010. This rapid growth has placed increasing strain on the environment, that includes a loss of over 22% of its tree cover between 1984 and 2001. To guide future growth, expand opportunities for economic development, and protect the environment, character, and livability of Charlotte, the *Centers, Corridors and Wedges Growth Framework* was adopted by the Charlotte City Council in 2010 (City of Charlotte, 2010).

The framework identified five changing conditions since the last growth management plan for the city was presented in 1994. Of key importance to this HIA is the increased concentration of land use development on underutilized land or through infill re-development (within growth corridors and activity centers), demographic changes impacting land use decisions with Baby Boomers and Generation Xers preferring to live in urban environments, and the challenge of finding affordable housing within Charlotte. The framework also identified ten guiding principles including: residential opportunities to accommodate a diverse population in quality and livable neighborhoods; diligent consideration of environmental benefits and impacts; a healthy and flourishing tree canopy; and enhanced transportation networks for pedestrians, cyclists, motorists, and transit users (City of Charlotte, 2010).

The University of North Carolina Charlotte (UNCC) is located within the Northeast Growth Corridor, is near the University Research Park Mixed Use Activity Center and part of two Transit Station Areas (see Map 2). As such, the development surrounding the campus is guided by certain desired development characteristics (see Appendix 2), *General Development Policies*, and zoning and subdivision ordinances (City of Charlotte, 2010).

Map 1: Charlotte, North Carolina

Map 2: Charlotte's Activity Centers, Growth Corridors and Wedges



Background Information on the Blue Line Extension

Scheduled to open in 2017, the extension of the LYNX Blue Line Light Rail will expand the route by 9.3 miles to connect Center City with the main campus of the University of North Carolina Charlotte (UNCC). Once completed, the entire Blue Line will be 18.6 miles and connect the 26 stations from I-485 and South Blvd to the main campus of UNCC. The project will cost an estimated $1.16 billion to construct and is being funded through a combination of federal, state, and local dollars (CATS BLE, 2015).

By 2035, there is expected to be 24,500 weekday riders on the extension and 26,500 riders on the existing blue line for a total of 51,000 riders on the completed line. The extension will have parking facilities at four of the new stations, providing approximately 3,100 parking spaces. Travel time from City Center to UNCC is expected to be 25 minutes with an estimated 47 minutes of travel time from one end of the line to the other (I-485 at South Blvd to UNCC). The CATS bus system will be coordinated with the light rail schedule to connect surrounding neighborhoods to the 11 new stations (CATS BLE, 2015).

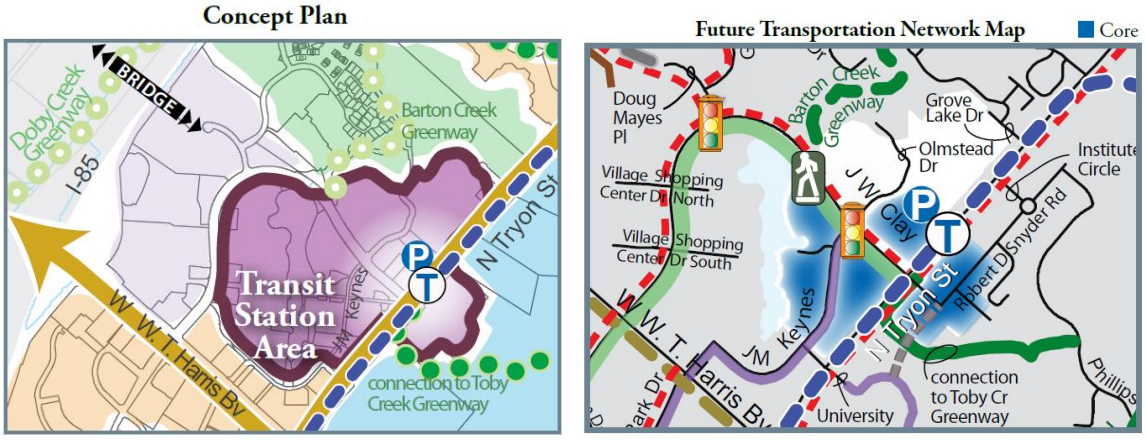
Current fares for riding the Blue Line are $2.20 per trip for the average rider and $1.10 for seniors, people with disabilities, and students. Additional pass options are also available for frequent LYNX users (CATS Fares, 2014). The extension is expected to operate a similar schedule to the existing line and offer weekday service from 5:26 a.m. to 1:26 a.m. with trains running every 10 minutes during peak travel times and every 15 minutes during non-peak hours. Weekend service will be every 20 minutes during the day and every 30 minutes during late night hours (CATS LBL, 2015).

Additional societal impacts of constructing the Blue Line extension include an expected 7,600 jobs generated by direct construction activities, over 10,000 new housing units, 3.8 million square feet of new office space, and 1.3 million square feet of new retail space. Changes in travel mode are also expected to reduce vehicle miles traveled in the Northeast Corridor by 119,000 miles or 0.2% of the daily vehicle miles traveled within the region. Additional bicycle and pedestrian improvements are also expected around each of the transit stations making access by active transportation safer and easier (CATS BLE, 2015).

JW Clay Blvd Station

The JW Clay Blvd Station will be located at the intersection of JW Clay Boulevard and North Tryon Street and is envisioned to become University City's town center and a destination for shopping, working, entertainment, and living. An existing water feature is expected to be enhanced, with buildings being oriented to take advantage of views of the lake and additional open space being provided around the lake. Accessibility to the station area will be enhanced and the station design will complement the style of UNCC as it expands on the adjacent side of North Tryon Street. Development will gradually scale down from higher density around the station to lower density office and retail space to single family residents on the periphery (City of Charlotte, 2015). A parking garage containing 690 parking spaces and 14 long-term bicycle spaces will be constructed in the northwest quadrant of the North Tryon Street/US-29 and JW Clay Boulevard intersection. Two bus bays and a pedestrian bridge over North Tryon Street/ US-29 are also expected (Blue Line EIS, 2011).

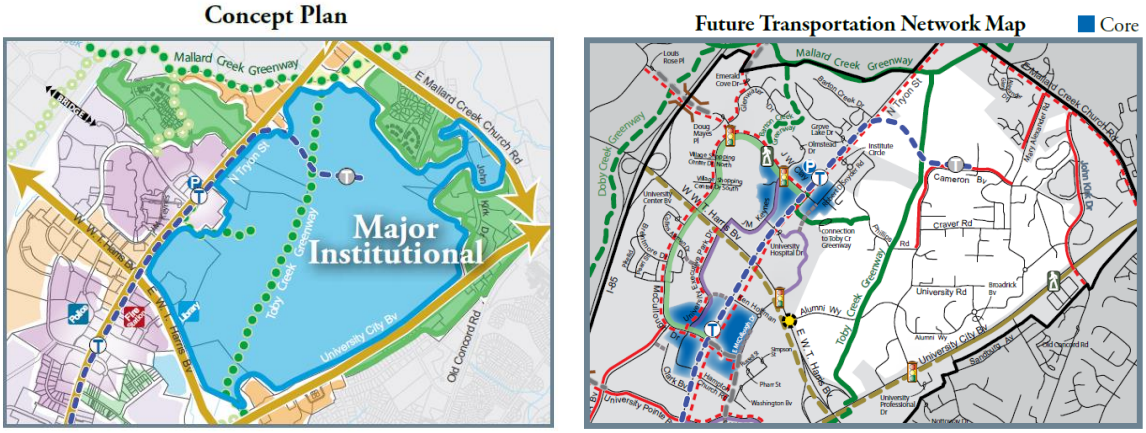
Maps 3 & 4: JW Clay Blvd Station Concept Plan and Future Transportation Network Map



UNCC Main Campus Station

The UNCC Main Campus Station will be located off of Cameron Boulevard next to parking lot 25 and across from Wallis Residential Hall (City of Charlotte, 2015). Because the station is located within the UNCC Main Campus, development around the station is determined by the *UNC Charlotte Campus Master Plan 2010* (2011). This plan is referenced frequently in this report and depicts what development will take place on the campus over the next ten to fifteen years. Plans for both stations include improved connections to the campus and it is expected that students, employees, and visitors to UNCC will support the additional retail, services, and entertainment opportunities being created around the JW Clay Blvd Station (City of Charlotte, 2015). In a short survey of people associated with UNCC, 61% of respondents indicated that they would use the light rail to get to Main Campus and 65% said they would use it to reach the Uptown Campus (See Appendix 4). Reasons indicated for taking light rail include convenience, cost savings, reduced stress, and environmental protection. The UNC Charlotte Station will be designed for walk-up access, with 32 short-term bicycle parking spaces and two bus bays for connections to campus shuttle service (Blue Line EIS, 2011)

Maps 5 & 6: UNCC Main Campus Station Concept Plan and Future Transportation Network Map



Background Information on the University of North Carolina Charlotte

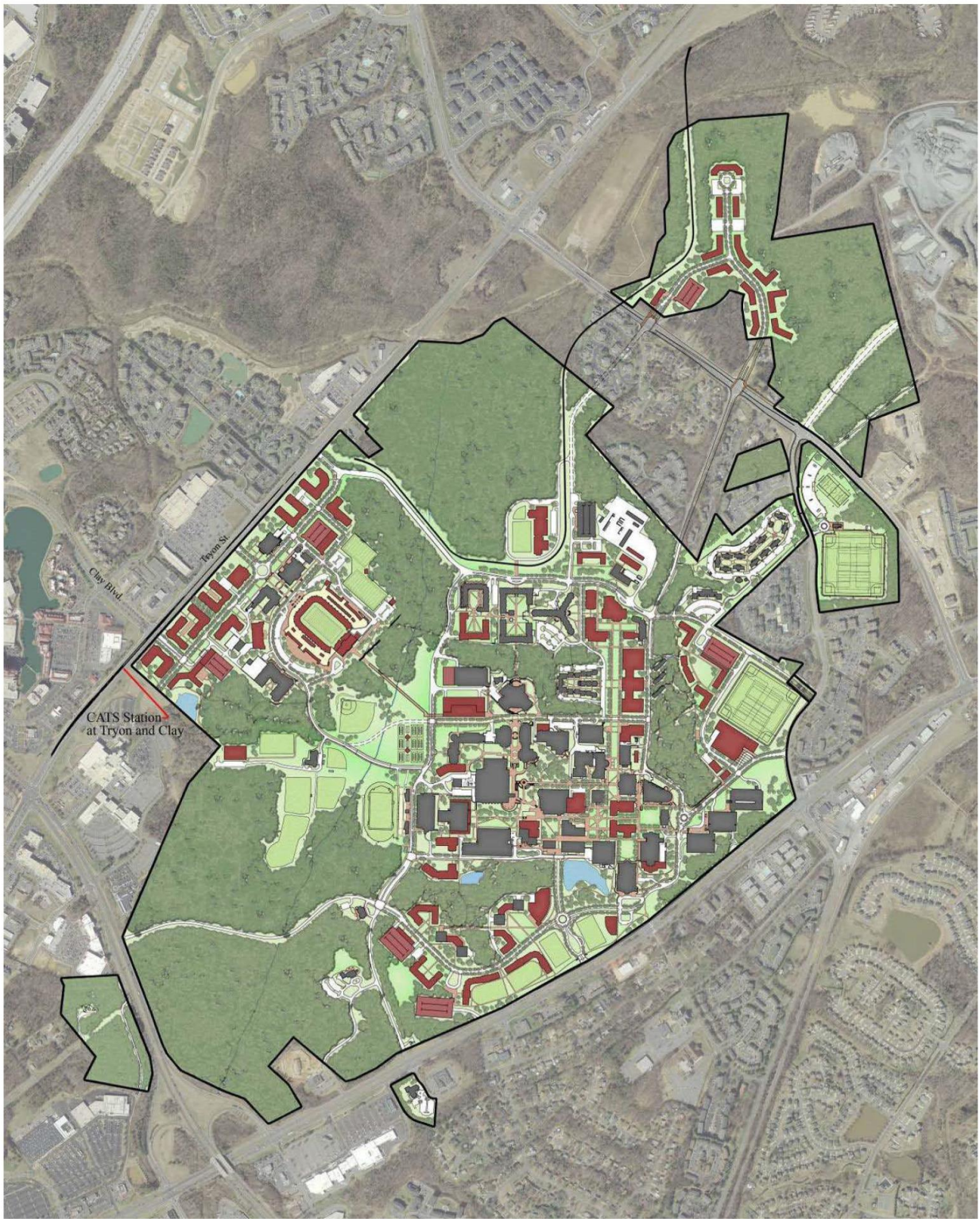
The University of North Carolina Charlotte (UNCC) is the largest university in the region with more than 27,200 students enrolled at the 1,000-acre campus located in the University City Area (a specialized tax district which operates as an organizing entity for development purposes). In 2011, the university opened a Center City Campus adjacent to the future LYNX Blue Line 9th Street Station offering graduate and continuing education courses. First established as the Charlotte Center in 1946, UNCC was moved to its current location in 1961 and joined the University of North Carolina's System in 1965. The university employs over 3,500 faculty and staff people (UNCC, 2010).

UNCC has seven professional colleges– Belk College of Business, the College of Arts and Architecture, the College of Computing and Informatics, the College of Education, the College of Health and Human Services, the College of Liberal Arts and Sciences, and the William States Lee College of Engineering– offering over 170 undergraduate and graduate programs in a wide range of disciplines (UNCC, 2010).

Plans for growth at the university include:

- Increased enrollment to 35,000 students by 2020
- An additional 4.25 million square feet in academic and student support buildings
- A student health and wellness center
- A football stadium (15,000 seats) and concession area
- Parking decks around the stadium and replacing surface lots around campus
- A Charlotte Mecklenburg school
- A child care center
- A new physical plant complex
- A music performance building
- New pedestrian bridges and arts walk
- New residence halls in East Village, South Village, and Mallard Creek Church Road Village (offering 4,000 additional beds)
- A recreational field complex and garden welcoming center
- A new student dining hall
- A visitor center

Map 7: UNC Charlotte Master Plan 2010 at Full Build-Out



Baseline Health Indicators for the University of North Carolina Charlotte

In the Spring of 2013, UNCC participated in the National College Health Assessment II (ACHA-NCHA II) conducted by the American College Health Association. This survey provides the largest known comprehensive data set on the health of college students, providing the college health and higher education fields with a vast amount of information on student health. The following health information for UNCC students was taken from the *University of North Carolina Charlotte Executive Summary for Spring 2013,* establishes baseline conditions for a variety of physical and mental health conditions, and characterizes positive and negative health behaviors that may be impacted by the expansion of the LYNX Blue Line. The Spring 2013 survey consisted of 1,171 respondents with an overall response proportion of 14.6% (ACHA-UNCC, 2013). Corresponding percentages from the national reference group are also included for easy comparison (ACHA-Reference, 2013).

A summary of the UNCC data from the ACHA-NCHA II survey conducted in Spring 2015 was made available in April of 2015 (ACHA-UNCC, 2015). However, the national reference group data is not available, so the figures below show 2013 percentages from both UNCC and the national reference group for the sake of comparison. After looking at data from the 2013 and 2015 UNCC summary reports, there were no dramatic differences, but there were some interesting trends to be mindful of:

- There were fewer participants in the 2015 survey (1,110 compared to 1,171 in 2013)
- In 2015, fewer students reported being in good, very good, or excellent health (86.5% compared to 92.5% in 2013)
- The number reporting allergies, asthma, bronchitis, diabetes, high blood pressure, migraine headaches, or sinus infections increased slightly
- Those reporting attention deficit and hyperactivity disorder, deafness/hearing loss, or partial sightedness/blindness decreased slightly
- Rates for chronic illness and mobility/dexterity disability increased slightly
- Those with a diagnosed psychiatric condition doubled from 3.7% in 2013 to 7.4% in 2015
- Students are feeling safer on campus and the community surrounding campus during the daytime and nighttime
- Alcohol use and the percentage of college students reporting driving after having any alcohol increased slightly; however, the number driving after 5 or more drinks decreased slightly
- Fruit and vegetable consumption increased slightly while exercising decreased slightly with fewer students meeting recommended levels
- BMI levels showed a slight increase in all three classes of obesity as well as underweight students and there were fewer students being considered a healthy weight or overweight
- In the area of mental health there were slight increases in feeling overwhelmed, exhausted, sad, depressed, anxious, or angry
- Although there were fewer attempted suicides, a greater percentage of students reported seriously considering suicide and intentionally injuring themselves
- Students reported getting more sleep

Table 1: UNCC ACHA-NCHA II Spring 2013: Student Demographics and Characteristics

Category	UNCC (%)	Nation (%)
Gender		
Female	63.5	63.8
Male	34.7	33.6
Transgender	0.2	0.2
Age		
18-20 years	47.2	44.9
21-24 years	31.7	33.6
25-29 years	12.0	11.9
30+ years	9.1	9.6
Ethnicity		
White	67.5	65.3
Black or African American	16.6	6.6
Hispanic or Latino/a	7.4	13.9
Asian or Pacific Islander	8.3	13.5
Other	8.8	9.2
Student Status		
Undergraduate	86.5	80.8
Graduate or Professional	12.9	17.7
Other	0.6	1.6
Full-time Student	98.3	88.2
Part-time Student	1.3	10.9
Other Student	0.3	0.9
Housing		
Campus Residence Hall	29.3	30.2
Fraternity or Sorority House	1.0	1.0
Other University Housing	2.3	5.1
Parent/Guardian Home	17.7	18.7
Other Off-Campus Housing	45.9	38.7
Other	3.9	6.2

Table 2: UNCC ACHA-NCHA II Spring 2013: Student General Health Questions

Condition	UNCC (%)	Nation (%)
General Health Condition		
Reported Very Good or Excellent Health	59.0	58.8
Health Problems in Last 12 Months		
Allergies	18.5	19.0
Asthma	7.3	8.4
Bronchitis	5.0	5.8
Diabetes	0.5	1.1
High Blood Pressure	3.2	3.3
Migraine Headache	7.5	7.6
Sinus Infection	17.0	15.6
Chronic Disease or Disability		
Attention Deficit and Hyperactivity Disorder	9.3	7.6
Chronic Illness	4.7	4.6
Deafness/Hearing Loss	2.3	2.0
Mobility/ Dexterity Disability	0.6	1.0
Partial Sightedness/ Blindness	2.7	2.4
Psychiatric Condition	3.7	5.7

Table 3: UNCC ACHA-NCHA II Spring 2013: Academic Impacts Questions

Academic Impact	UNCC (%)	Nation (%)
Alcohol Use	3.7	4.2
Allergies	2.0	2.6
Anxiety	18.6	19.7
Attention Deficit/ Hyperactivity Disorder	7.2	5.5
Chronic Health Problem or Serious Illness	3.0	3.6
Depression	11.9	12.6
Finances	8.2	7.3
Injury	1.6	2.3
Stress	27.5	28.5
Work	15.1	14.7

Table 4: UNCC ACHA-NCHA II Spring 2013: Injury Prevention Questions

Behavior	Did Not Participate in Activity (UNCC %, Nation %)		Never (UNCC %, Nation %)		Rarely or Sometimes (UNCC %, Nation %)		Mostly or Always (UNCC %, Nation %)	
Wear a seatbelt when you rode in a car	0.3	0.9	0.3	0.5	2.7	4.0	97.1	95.5
Wear a helmet when you rode a bicycle	63.5	48.4	42.6	42.9	24.1	22.7	33.3	34.4

Table 5: UNCC ACHA-NCHA II Spring 2013: Perception of Safety Question

Perception of Safety (feel very safe)	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
On Campus (Daytime)	85.2	86.2	74.7	83.0	78.2	83.9
On Campus (Nighttime)	25.0	51.5	6.5	26.2	13.0	34.9
In the Community Surrounding Campus (Daytime)	46.4	61.0	37.1	52.9	40.2	55.6
In the Community Surrounding Campus (Nighttime)	13.8	31.3	4.9	14.5	8.1	20.3

Table 6: UNCC ACHA-NCHA II Spring 2013: Alcohol Use Questions

Behavior	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Frequency of Alcohol Use						
Never Used	22.3	21.5	19.8	21.0	21.0	21.3
Used, but not in the last 30 days	12.9	13.0	19.1	14.4	16.9	13.9
Used 1-9 days	44.6	46.2	50.4	50.8	47.8	49.0
Used 10-29 days	18.3	17.2	10.3	13.2	13.3	14.6
Used all 30 days	2.0	2.1	0.4	0.7	1.0	1.2
Any use within the last 30 days	64.9	65.5	61.1	64.6	62.1	64.8
Number of Drinks						
4 or fewer	39.7	46.6	52.1	67.3	47.5	60.0
5	6.2	10.7	7.8	11.7	7.2	11.3
6	5.2	8.9	4.4	7.4	4.8	7.9
7 or more	20.9	33.8	7.5	13.5	12.2	20.7
Consumed 5 or more Drinks in One Sitting (last two weeks)						
N/A don't drink	23.0	21.8	22.4	21.6	22.6	21.7
None	42.3	37.0	53.8	50.1	49.7	45.5
1-2 times	20.5	25.5	18.7	20.7	19.5	22.3
3-5 times	10.9	12.2	4.0	6.4	6.4	8.4
6 or more times	3.2	3.5	1.1	1.2	1.8	2.0

- 3.2% of UNCC college students (3.0% nationwide) reported driving after having 5 or more drinks in the last 30 days
- 29.4% of UNCC college students (23.2% nationwide) reported driving after having any alcohol in the last 30 days
- 85.9% of UNCC college students (82.7% nationwide) reported using a designated driver most of the time or always when they "partied" or socialized during the last 12 months

Table 7: UNCC ACHA-NCHA II Spring 2013: Nutrition, Exercise, and Weight Questions

Behavior	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Daily Servings of Fruits and Vegetables						
0 servings per day	11.1	7.9	7.7	5.1	8.9	6.1
1-2 per day	64.1	60.7	66.6	57.6	66.0	58.7
3-4 per day	21.3	25.7	21.5	30.7	21.2	28.9
5 or more per day	3.5	5.7	4.2	6.6	3.9	6.3
Moderate-Intensity Cardio or Aerobic Exercise (30 minutes)						
0 days	23.4	22.8	23.0	23.6	23.2	23.4
1-4 days	58.5	54.7	60.4	57.8	59.7	56.6
5-7 days	18.2	22.6	16.6	18.6	17.1	20.0
Vigorous-Intensity Cardio or Aerobic Exercise (20 minutes)						
0 days	34.5	33.0	43.8	41.2	40.6	38.4
1-2 days	37.0	31.3	29.5	29.8	32.3	30.2
3-7 days	28.5	35.7	26.7	29.1	27.1	31.4
Physical Activity Guidelines Met						
Met Physical Activity Guidelines	47.6	52.8	42.8	46.7	44.3	48.8
BMI						
<18.5 Underweight	1.7	3.3	5.3	6.4	4.0	5.3
18.5-24.9 Healthy Weight	54.6	56.2	55.3	63.6	54.9	61.0
25.0-29.9 Overweight	33.5	28.3	24.3	18.5	27.6	21.9
30.0-34.9 Class I Obesity	6.2	8.3	8.6	6.9	7.8	7.4
35.0-39.9 Class II Obesity	2.0	2.7	4.8	2.7	3.8	2.7
≥ 40 Class III Obesity	2.0	1.2	1.8	1.9	1.8	1.7

Table 8: UNCC ACHA-NCHA II Spring 2013: Mental Health Questions

Emotion	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Felt things were hopeless						
No, never	45.3	42.2	30.1	31.4	35.4	35.1
No, not last 12 months	20.8	19.3	19.4	20.3	19.9	19.9
Yes, last 2 weeks	10.4	13.5	19.5	17.2	16.4	15.9
Yes, last 30 days	6.9	7.3	7.9	9.6	7.5	8.8
Yes, in last 12 months	16.6	17.7	23.1	21.6	20.8	20.2
Any time within the last 12 months	33.9	38.5	50.5	48.3	44.7	45.0
Felt overwhelmed by all you had to do						
No, never	19.2	18.1	6.1	6.9	10.7	10.9
No, not last 12 months	10.6	8.1	3.9	3.9	6.3	5.4
Yes, last 2 weeks	34.0	37.5	55.7	54.3	48.2	48.4
Yes, last 30 days	14.3	15.3	17.1	17.1	15.9	16.5
Yes, in last 12 months	21.9	20.9	17.2	17.8	18.9	18.9
Any time within the last 12 months	70.2	73.7	90.0	89.2	83.0	83.7
Felt exhausted (not from physical activity)						
No, never	24.0	21.4	10.1	10.1	15.0	14.1
No, not last 12 months	10.1	8.8	5.3	5.8	7.0	6.8
Yes, last 2 weeks	33.9	37.6	56.7	51.2	48.8	46.4
Yes, last 30 days	15.8	15.1	15.2	16.9	15.4	16.3
Yes, in last 12 months	16.1	17.2	12.7	16.0	13.8	16.4
Any time within the last 12 months	65.8	69.9	84.6	84.1	78.0	79.1
Felt very lonely						
No, never	36.9	31.7	19.8	21.2	25.8	24.9
No, not last 12 months	18.3	19.8	18.5	19.0	18.6	18.2
Yes, last 2 weeks	14.6	18.6	27.1	24.3	22.8	22.3
Yes, last 30 days	9.7	10.4	14.2	13.7	12.4	12.5
Yes, in last 12 months	20.5	19.5	20.4	21.9	20.4	21.0
Any time within the last 12 months	44.8	48.5	61.7	59.8	55.7	55.9

Emotion	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Felt very sad						
No, never	34.8	30.2	17.3	18.7	23.4	22.7
No, not last 12 months	22.1	19.8	16.7	16.5	18.7	17.6
Yes, last 2 weeks	11.9	17.7	28.7	26.2	22.8	23.3
Yes, last 30 days	9.7	10.7	15.6	14.5	13.5	13.2
Yes, in last 12 months	21.4	21.6	21.7	24.0	21.6	23.1
Any time within the last 12 months	43.0	50.0	66.0	64.8	57.9	59.6
Felt so depressed that it was difficult to function						
No, never	57.5	52.1	42.8	44.0	47.8	46.7
No, not last 12 months	22.0	20.9	25.2	22.6	24.1	22.0
Yes, last 2 weeks	5.7	8.7	10.4	10.7	8.9	10.1
Yes, last 30 days	4.2	5.1	6.2	6.6	5.4	6.1
Yes, in last 12 months	10.6	13.2	15.4	16.2	13.7	15.2
Any time within the last 12 months	20.5	27.0	32.0	33.4	28.1	31.3
Felt overwhelming anxiety						
No, never	49.5	43.7	29.2	29.0	36.3	34.1
No, not last 12 months	16.3	16.5	15.8	14.0	16.0	14.8
Yes, last 2 weeks	11.6	14.7	24.6	23.4	20.1	20.4
Yes, last 30 days	6.9	8.8	13.0	13.1	10.8	11.6
Yes, in last 12 months	15.6	16.2	17.3	20.5	16.8	19.0
Any time within the last 12 months	34.2	39.8	54.9	57.0	47.7	51.0
Felt overwhelming anger						
No, never	48.0	44.6	37.5	40.0	41.1	41.6
No, not last 12 months	20.5	21.3	20.8	21.6	20.7	21.5
Yes, last 2 weeks	8.2	10.6	15.2	12.1	12.8	11.7
Yes, last 30 days	7.4	7.3	8.5	8.8	8.1	8.3
Yes, in last 12 months	15.8	16.2	17.9	17.5	17.2	17.0
Any time within the last 12 months	31.4	34.1	41.7	38.4	38.1	37.0

Emotion	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Seriously considered suicide						
No, never	82.3	81.0	77.1	78.2	78.7	79.0
No, not last 12 months	13.2	12.0	15.6	14.4	14.9	13.6
Yes, last 2 weeks	1.5	1.7	1.6	1.5	1.6	1.6
Yes, last 30 days	0.7	1.1	0.7	1.1	0.7	1.1
Yes, in last 12 months	2.2	4.2	5.0	4.8	4.1	4.6
Any time within the last 12 months	4.5	7.0	7.3	7.5	6.4	7.4
Attempted suicide						
No, never	94.0	92.4	90.1	90.7	91.4	91.2
No, not last 12 months	5.0	6.1	8.4	8.0	7.3	7.4
Yes, last 2 weeks	0.5	0.5	0.7	0.3	0.6	0.4
Yes, last 30 days	0.2	0.2	0.0	0.2	0.1	0.2
Yes, in last 12 months	0.2	0.8	0.8	0.9	0.6	0.9
Any time within the last 12 months	1.0	1.4	1.5	1.3	1.3	1.5
Intentionally cut, burned, bruised, or otherwise injured yourself						
No, never	86.9	86.2	80.3	79.6	82.5	81.8
No, not last 12 months	10.4	9.3	15.0	13.8	13.4	12.3
Yes, last 2 weeks	1.5	1.4	0.9	1.6	1.2	1.6
Yes, last 30 days	0.5	0.8	0.5	1.1	0.5	1.0
Yes, in last 12 months	0.7	2.4	3.2	3.9	2.3	3.4
Any time within the last 12 months	2.7	4.5	4.7	6.6	4.1	5.9
Within the last 12 months, diagnosed or treated by professional for the following:						
Anxiety	7.1	7.8	14.2	15.5	11.7	12.9
Attention Deficit and Hyperactivity Disorder	6.2	5.7	5.5	4.7	5.7	5.1
Depression	7.1	7.3	10.9	12.8	9.7	11.0
Insomnia	2.7	3.4	3.8	4.6	3.5	4.3
Other Sleep Disorder	2.0	2.3	2.0	2.1	2.1	2.2
Panic Attacks	3.2	3.1	8.2	7.4	6.5	6.0
Substance Abuse or Addiction	1.5	1.5	0.7	0.9	1.0	1.2

Emotion	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Within the last 12 months, any of the following have been traumatic or very difficult to handle:						
Finances	28.5	30.3	44.3	37.0	38.9	34.8
Sleep Difficulties	19.8	23.9	33.0	28.4	28.4	26.9
Within the last 12 months, how would you rate the overall level of stress experienced:						
No stress	3.2	3.9	1.1	1.0	1.8	2.1
Less than average stress	16.5	13.3	5.0	5.5	9.0	8.2
Average stress	45.4	40.0	35.7	36.7	39.3	37.8
More than average stress	26.9	34.9	46.7	45.4	39.5	41.7
Tremendous stress	7.9	7.9	11.5	11.4	10.3	10.3

Table 9: UNCC ACHA-NCHA II Spring 2013: Sleep Questions

Behavior	Male (UNCC %, Nation %)		Female (UNCC %, Nation %)		Total (UNCC %, Nation %)	
Past 7 days, getting enough sleep to feel rested in the morning:						
0 days	8.2	8.9	10.1	10.6	9.5	10.1
1-2 days	26.7	27.2	37.4	31.6	33.6	30.0
3-5 days	50.7	49.7	43.8	47.2	46.2	48.0
6+ days	14.4	14.3	8.8	10.6	10.8	11.9
Past 7 days, how often felt tired, dragged out, or sleepy during the day:						
0 days	14.1	13.1	3.7	7.0	7.3	9.1
1-2 days	37.9	35.6	30.2	29.5	32.8	31.6
3-5 days	38.1	38.9	43.4	45.0	41.5	42.9
6+ days	9.9	12.3	22.8	18.6	18.4	16.5
Past 7 days, how much of a problem with sleepiness during daytime activities:						
No problem	15.3	14.6	7.7	8.9	10.4	10.9
A little problem	52.7	49.6	48.9	48.4	50.2	48.7
More than a little problem	21.5	22.1	22.6	24.6	22.3	23.7
A big problem	6.4	9.7	14.9	12.7	11.9	11.6
A very big problem	4.0	4.1	5.8	5.4	5.3	5.0

UNCC Student Health Center

The UNCC Student Health Center provides consultation, diagnosis, treatment, and follow-up care for acute illness or injury; as well as routine medical care, preventative care, annual physicals, and treatment for chronic illnesses. Of particular interest to this HIA are its services in the areas of allergies, psychiatry, nutrition consultation, the center for wellness promotion, the collegiate recovery community, and the area of partnerships and community. During the 2014-2015 academic year, there were 37,375 appointments at the Student Health Center including 2,565 appointments for upper respiratory infections and 506 appointments for allergies. As a result of these appointments there were 56,898 diagnoses entered including: 45 for hypertension, 66 for elevated blood pressure, 27 for diabetes, 101 for asthma, 84 for allergies, 101 for bronchitis, 8 for pneumonia, 112 for sinusitis, and 653 for upper respiratory infection.

Baseline Health Indicators for the Study Area & Mecklenburg County

The study area consists of the eight block groups and 5 census tracts within one mile of the geographic center of the University of North Carolina Charlotte Main Campus (see Map 8 and Appendix 1). Demographic, poverty, and income data for the study area was obtained from the *American Community Survey 5-Year Estimates for 2009-2013*; however, health data is not available for such a small geographic scale (US Census, 2013). Additional housing and transportation data for the study area is included within the corresponding sections of the assessment.

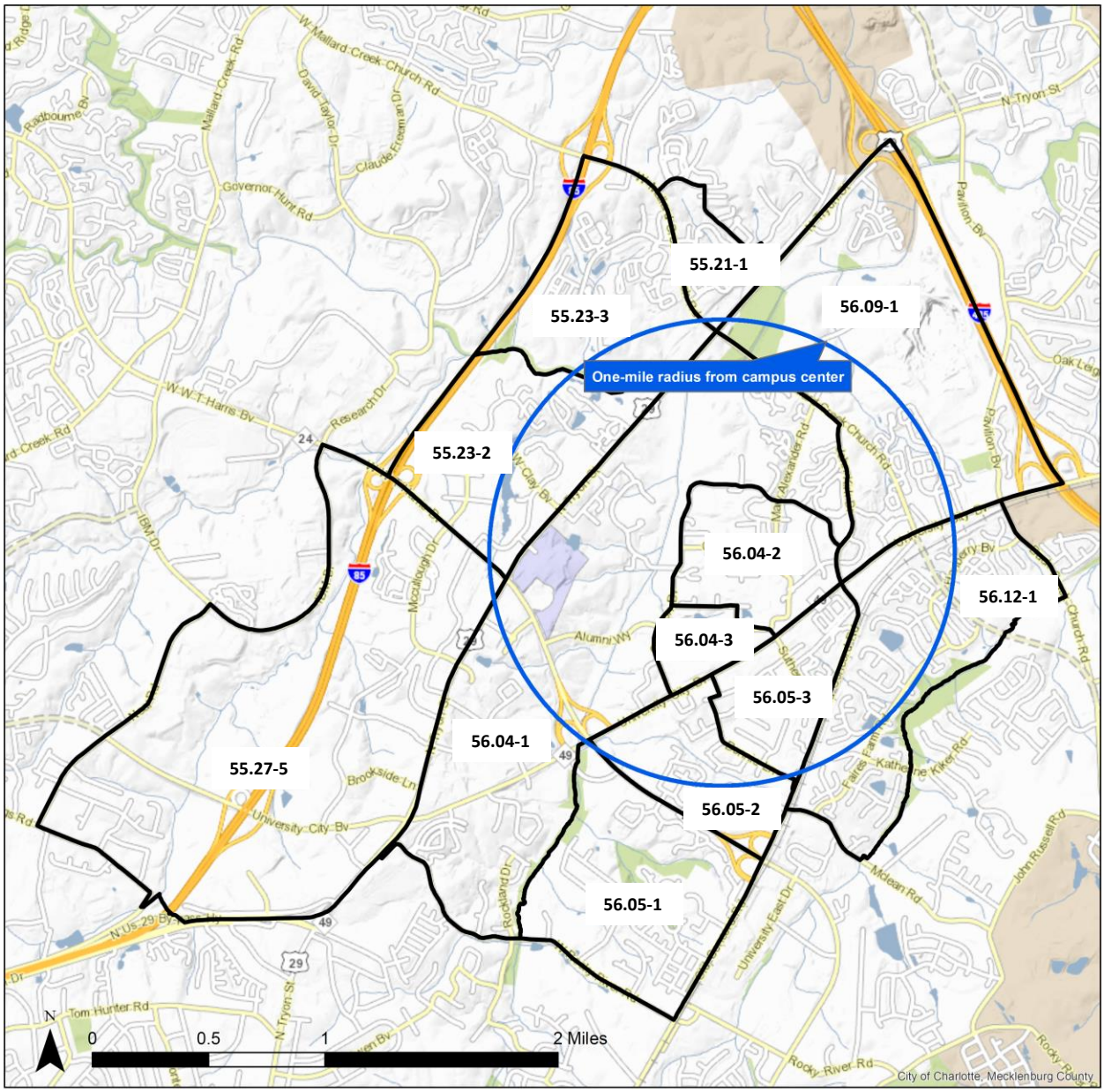
Demographic Findings:

- The study area contains 35,666 people (4% of the county's population)
- The study area contains 8,960 people between the ages of 18 and 24 (10% of the county's population between the ages of 18 and 24)
- 25% of the population living within the study area is between the ages of 18 and 24
- 46% of the Study Area is White (57% countywide), 31% is Black or African American (31% countywide), 12% is Asian (5% countywide), 6% is Two or More Races (3% countywide), 3% is Some Other Race (4% countywide), and 1% is American Indian or Alaska Native (0% countywide)

Poverty and Income Findings:

- The median household income (in 2013 inflation-adjusted dollars) for the study area is $34,932.50 (countywide median household income is $55,444). For householders under the age of 25 years old, the median household income is $24,182.50 ($26,930 countywide).
- Household income varies greatly within the study area with no clear range of the majority of households making a certain amount. This is similar but more dramatic than the county's distribution of income (See Figure 2).
- There is a greater percentage of nonfamily households within the study area having less than $10,000 in household income than Mecklenburg County as a whole (11% compared to 10%). The majority of nonfamily households within the study area make less than $40,000/year (63%). Mecklenburg County has two peaks; one at less than 10,000 and another between $50,000 and $99,999 (10% and 27% respectively). The median nonfamily household income for the study area is $37,120. The Mecklenburg County median nonfamily household income is $39,256.
- Median per capita income for the study area is $15,626 compared to $32,482 in Mecklenburg County. The range of per capita income for the block groups within the study area is $3,205 to $28,152.
- 3% of the county's population with income in the past 12 months being below poverty level is located within the study area. 36% of the population in the study area is living below the poverty level (compared to 15% countywide). Of those in the study area living below the poverty level, 75% are living in nonfamily households and 25% in family households.
- 71% of the population in the study area's 5 census tracts living below the poverty level were between the ages of 18 and 24 (compared to 17% countywide). 16% of the population in the study area's 5 census tracts living at or above the poverty level were between the ages of 18 and 24 (compared to 7% countywide).

Map 8: Study Area Map (Block Groups)



* *Labels indicate block group number.*

Figure 2: Household Income in the Study Area and Mecklenburg County

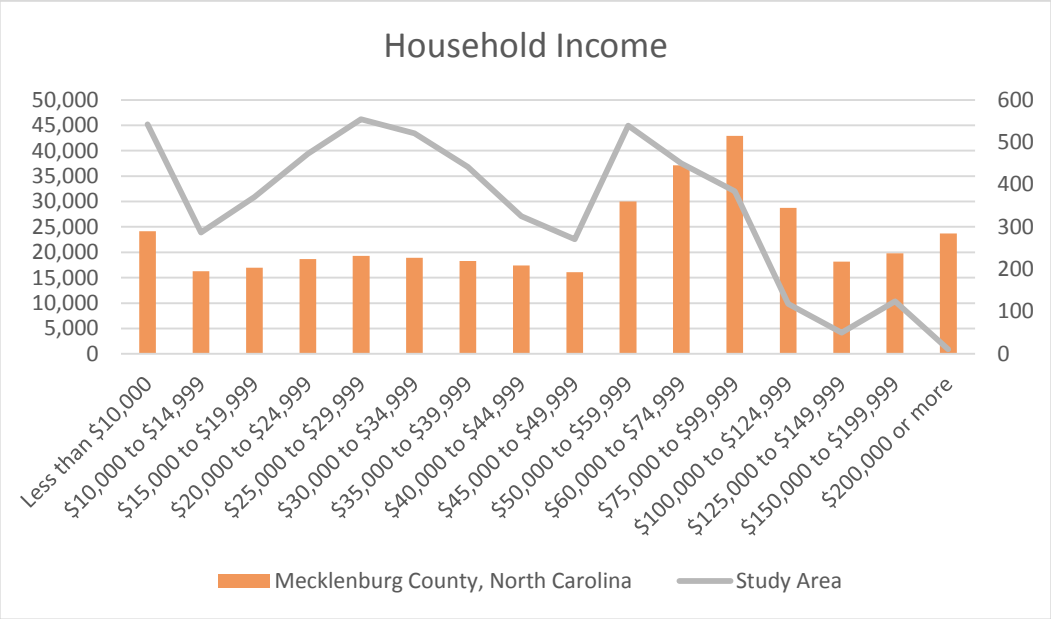


Figure 3: Household Income in the Study Area by Age

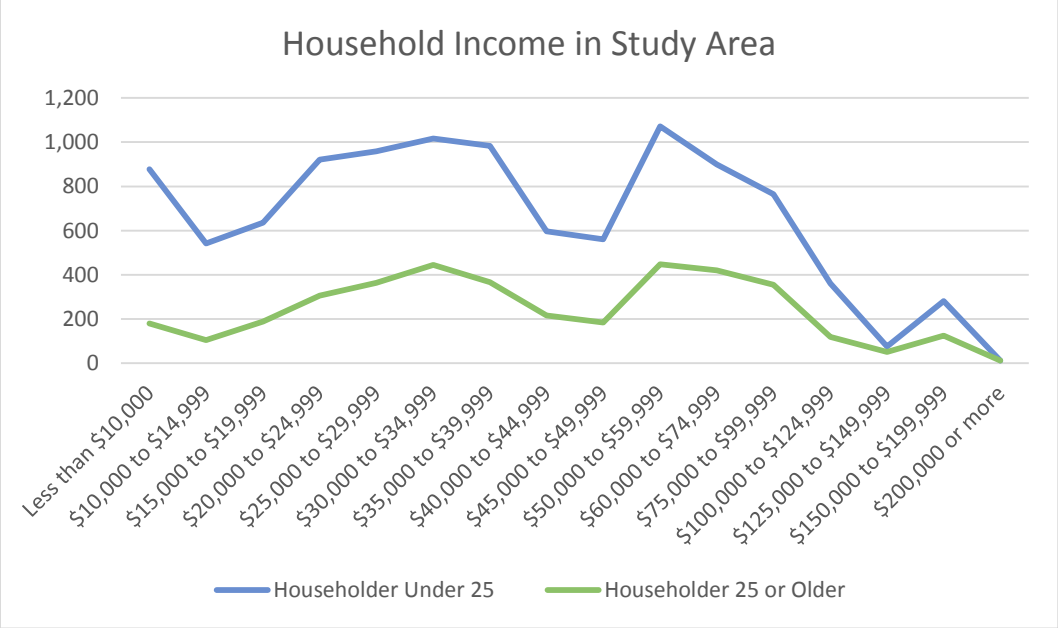
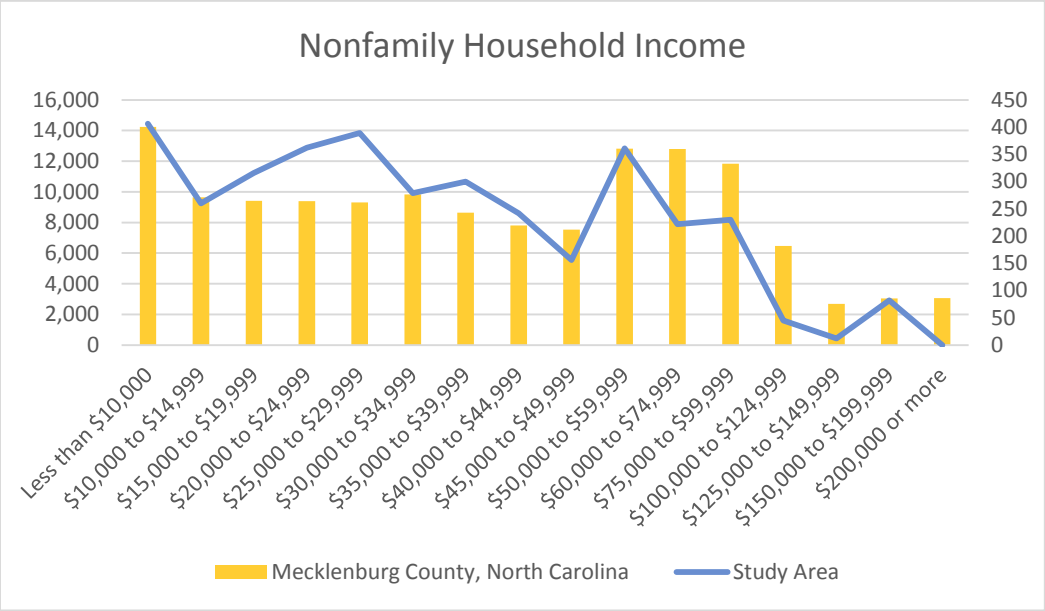


Figure 4: Nonfamily Household Income in the Study Area and Mecklenburg County



Mecklenburg County Demographics and Health Indicators

According to the *2014 Mecklenburg State of the County Health Report*, there are 990,977 people living in Mecklenburg County (as of 2013) with a median age of 34.5 years. In Mecklenburg, the percentage of people living in poverty is less than the state average (15% compared to the state average of 18%) and the median household income is higher ($54,278 compared to $45,906 in North Carolina). Unemployment rates are slightly lower at 9.3% and the percent uninsured is slightly higher at 17.7% (compared to state averages of 9.7% and 15.6% respectively). The county's racial or ethnicity distribution is 49% White, 31% African American, 13% Hispanic, 5% Asian, 2% Two or More Races, and 1% Other. Educational attainment is also diverse with 42% having a Bachelor's degree or higher, 7% having an Associate's degree, 21% having some college but no degree, 19% having either a high school diploma or equivalency degree, and 11% having no high school diploma (Mecklenburg County Health Department, 2014).

Vulnerable population groups have been defined by the Mecklenburg County Health Department as "groups that have not been well integrated into health care systems due to cultural, economic, geographic, or health characteristics. These populations may also be at higher risk during disasters."

Table 10: Mecklenburg County Vulnerable Population Groups

Vulnerable Group Characteristic	Estimated Persons	% of Population
Disabled	91,831	9.3%
Limited English Proficiency	85,224	8.6%
Homeless	2,014	0.2%
Children less than 5 years	70,376	7.1%
Persons 65 years and older	96,252	9.7%
Persons 85 years and older	11,065	1.1%

Similar to the National College Health Assessment, Mecklenburg County and the North Carolina State Health Department collect countywide health data using the Behavioral Risk Factor Surveillance System and the Youth Risk Behavior Survey. As part of the *2013 Mecklenburg Community Health Assessment*, four priority areas were identified: 1) Chronic Disease Prevention, 2) Mental Health, 3) Access to Care, and 4) Violence Prevention.

Table 11: Mecklenburg County Chronic Disease Prevention

Selected Health Indicator (Source of Data)	Mecklenburg	North Carolina	Trend in Mecklenburg	Racial and Ethnic Health Disparity Ratios (Black to White)
Adults reporting overweight/obesity (2013 BRFSS)	61%	66%	Increased	1.3 to 1
Adults consuming 5 or more fruits/vegetables per day (2013 BRFSS)	11%	12%	Decreased	1 to 1
Adults reporting no physical activity (2013 BRFSS)	21%	27%	Stable	1.3 to 1

Table 12: Mecklenburg County Mental Health

Selected Health Indicator (Source of Data)	Mecklenburg	North Carolina	Trend in Mecklenburg	Racial and Ethnic Health Disparity Ratios (Black to White)
Adults reporting mental health not good for at least 8 of the past 30 days (2013 BRFSS)	10%	9%	Increased	1.3 to 1
High school students reporting attempted suicide (2011 YRBS)	15%	16%	Stable	1.2 to 1
Age-adjusted suicide death rate, deaths per 100,000 population (2008-2012 NC SCHS)	9.4	12.2	Increased	1 to 3

Table 13: Mecklenburg County Access to Care

Selected Health Indicator (Source of Data)	Mecklenburg	North Carolina	Trend in Mecklenburg	Racial and Ethnic Health Disparity Ratios (Black to White)
Adults without a primary care provider (2013 BRFSS)	31%	27%	Increased	2.1 to 1
Adults unable to see a doctor due to cost (2013 BRFSS)	21%	19%	Stable	2.1 to 1
Uninsured population (2013 US Census)	18%	16%	Stable	1.4 to 1

Table 14: Mecklenburg County Violence

Selected Health Indicator (Source of Data)	Mecklenburg	North Carolina	Trend in Mecklenburg	Racial and Ethnic Health Disparity Ratios (Black to White)
Age-adjusted homicide rate, deaths per 100,000 population (2008-2012 NC DHHS)	6.7	6.0	Decreased	7 to 1
Number of filed criminal incident reports with a domestic violence relationship (2013)	9,321	-	Decreased	-
Child abuse cases: % of substantiated cases due to child abuse (2012 DSS)	14%	-	Stable	-
High school students ever electronically bullied or cyberbullied (2013 YRBS)	10%	-	Decreased	1 to 1.8

Table 15: Leading Causes of Death

Leading Causes of Death	Mecklenburg	North Carolina	Males	Females	Whites	Minorities
Cancer	1	1	1	1	1	1
Heart Disease	2	2	2	2	2	2
Alzheimer's Disease	3	6	6	3	3	7
Stroke	4	4	5	4	6	3
COPD	5	3	4	5	4	
Unintentional Injury	6	5	3	7	5	6
Kidney Disease	7	9	-	6	-	4
Diabetes	8	7	7	-	-	5
Septicemia	9	10	8	-	-	-
Influenza & Pneumonia	10	8	-	8	7	-
Suicide	-	-	-	-	8	-

Screening

Screening establishes the need for and value of conducting an HIA and is essential for high-quality HIA practice.

Outputs:

- Describes the proposed policy, program, plan, or project, including timeline for decision and political and policy context.
- Presents preliminary opinion on the importance of a proposal for health and the opportunities for the HIA to inform the decision, and states why the proposal was selected for screening.
- Outlines expected resource requirements to conduct HIA.
- Provides recommendation on whether HIA is warranted.

The idea of conducting an HIA on the Blue Line Extension Light Rail came about as a result of a brainstorming activity performed by the Mecklenburg County Health Department (MCHD), Centralina Council of Governments (CCOG), the University of North Carolina Charlotte (UNCC), and the Charlotte Regional Transportation Planning Organization (CRTPO) on potential HIAs for a funding application to the Centers for Disease Control and Prevention (CDC) in 2014. Although the plan to extend the Blue Line to UNCC Main Campus was already decided upon, it was determined that the construction of stations and the extension of the line to UNCC would have immense impacts and spur other land use, transportation, and campus policy decisions that were not even being discussed yet. The HIA would be timed to coincide with the initial phase of construction of the extension and could therefore still be useful in informing the station area plans and land use decisions including housing options, proposed changes to the surrounding transportation network (sidewalks, bike lanes, bus schedules), environmental impacts (air pollution, water quality, trails and greenways), and campus policies in response to station construction (parking, enrollment, class scheduling).

After the proposal to the CDC failed to receive funding, MCHD revised the proposal and submitted it to a funding opportunity from the National Association of County and City Health Officials (NACCHO). Following the award of funding from NACCHO, the health department determined that an intermediate HIA could be accomplished with the $15,000 and hired Katherine Hebert to provide training in HIA and assistance in conducting the HIA.

Scoping

Scoping identifies the populations that might be affected; determines which health effects will be evaluated in the HIA; identifies research questions and develops plans to address them; identifies the data, methods to be used, and alternatives to be assessed; and establishes the HIA team and plan for stakeholder participation throughout the HIA process.

Outputs:

- Summarizes the pathways and health effects to be addressed and provides rationale for those included and excluded.
- Identifies affected populations and vulnerable groups.
- Describes research questions, data sources, the analytic plan, data gaps, and how gaps will be addressed.
- Identifies alternatives to the proposed action to be assessed.
- Summarizes stakeholder engagement, issues raised by stakeholders, and responses to those issues.

Scoping Workshop

A scoping workshop was held on January 28, 2015 with 32 attendees from the University of North Carolina Chartlotte (UNCC), Charlotte Area Transit System (CATS), Mecklenburg County Health Department (MCHD), Urban Institute, Charlotte Neighborhoods and Business Services (CN&BS), Charlotte Regional Transportation Planning Organization (CRTPO), University City Partners, Mecklenburg County Park and Recreation (MCP&R), Charlotte Mecklenburg Planning (CMP), Charlotte Department of Transportation (CDOT), Charlotte-Mecklenburg Land Use and Environmental Services Agency (LUESA), Centralina Council of Governments (CCOG), the Public Library, and City Public and Community Relations (P&CR). The workshop consisted of: an introduction to the relationship between public health and the built environment, a report on the Blue Line Extension Light Rail project, a presentation and handouts on the HIA process, a tour of the UNCC Main Campus, and a small group activity which scoped out the possible health implications in the categories of transportation, housing, environment, and campus policies (See Appendix 3). Participants were asked to consider how the new station would impact the living conditions and behaviors of various population groups in these categories and how those changes would impact their health. These groups also considered possible sources of data available to research these topics, potential recommendations, and ways to evaluate the impacts. The findings of the workshop were used to create pathway diagrams for each of the four categories.

Pathway Diagrams

The following pathway diagrams were developed during the scoping stage of the HIA and revised throughout the HIA process to capture stakeholder concerns and incorporate available data sources. Due to the inter-related nature of housing, transportation, environmental impacts, and campus policies a large percentage of the health impacts can be found in multiple pathway diagrams.

Figure 5: Housing Pathway Diagram

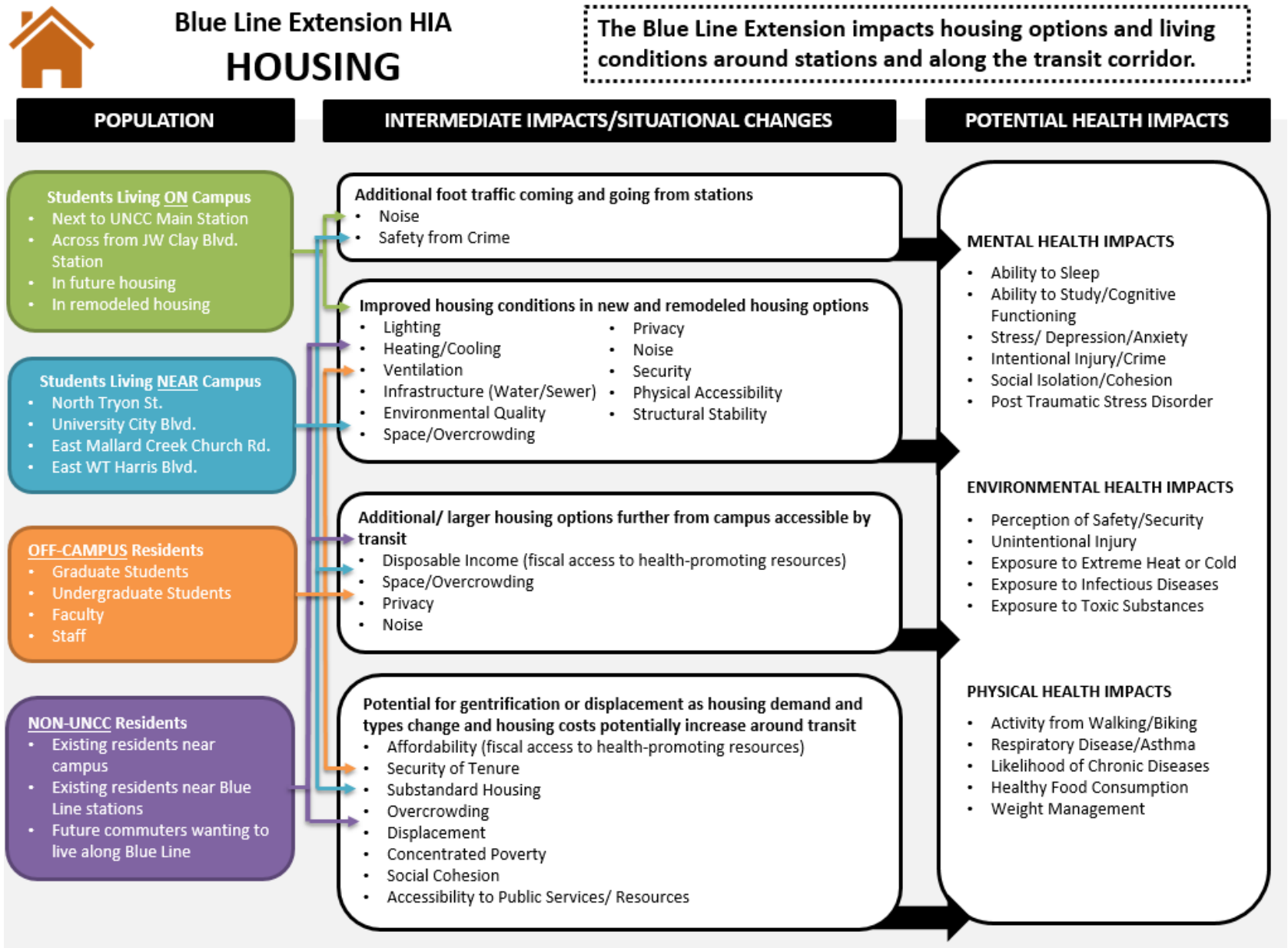


Figure 6: Transportation Pathway Diagram

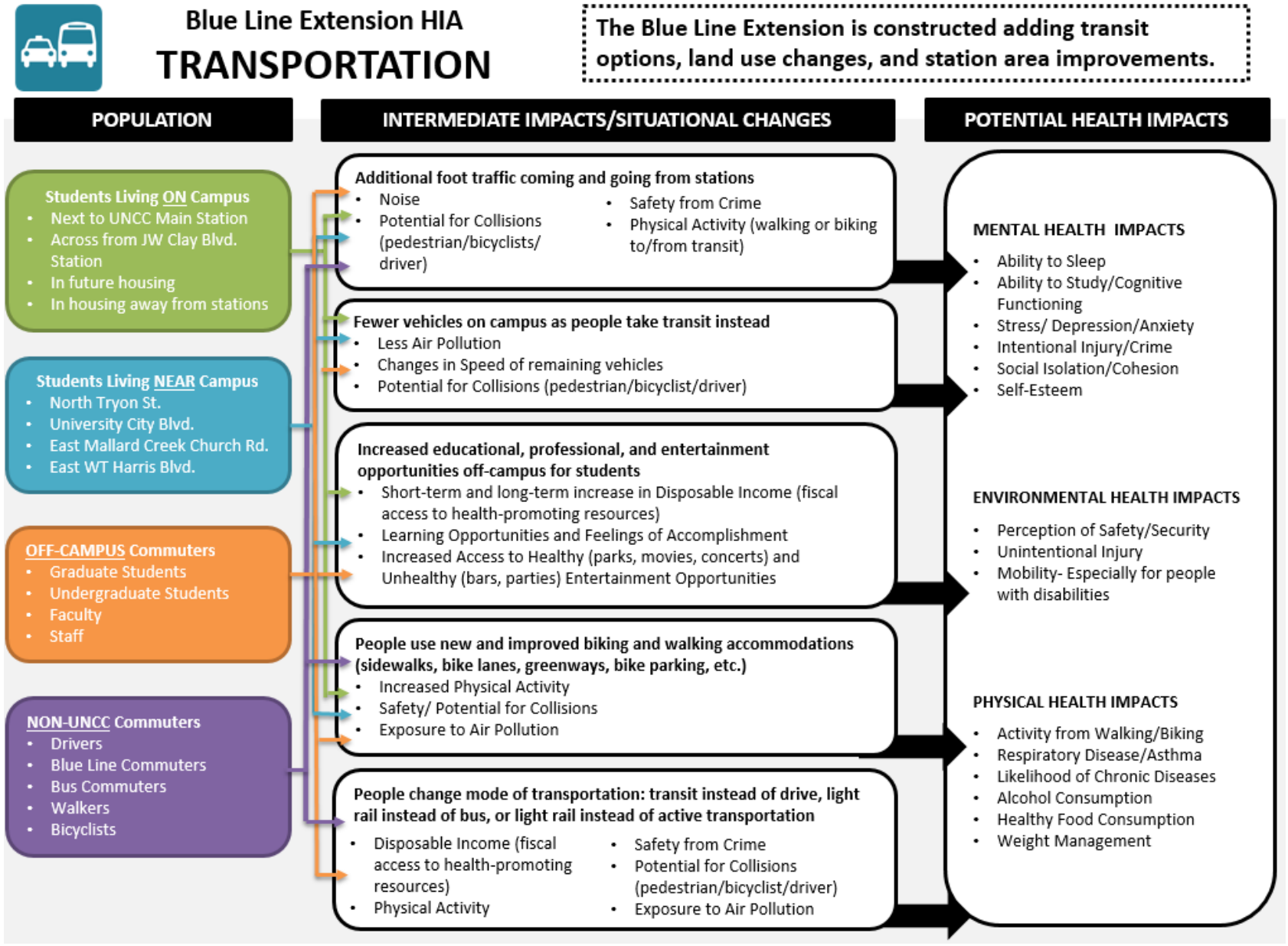


Figure 7: Environmental Impacts Pathway Diagram

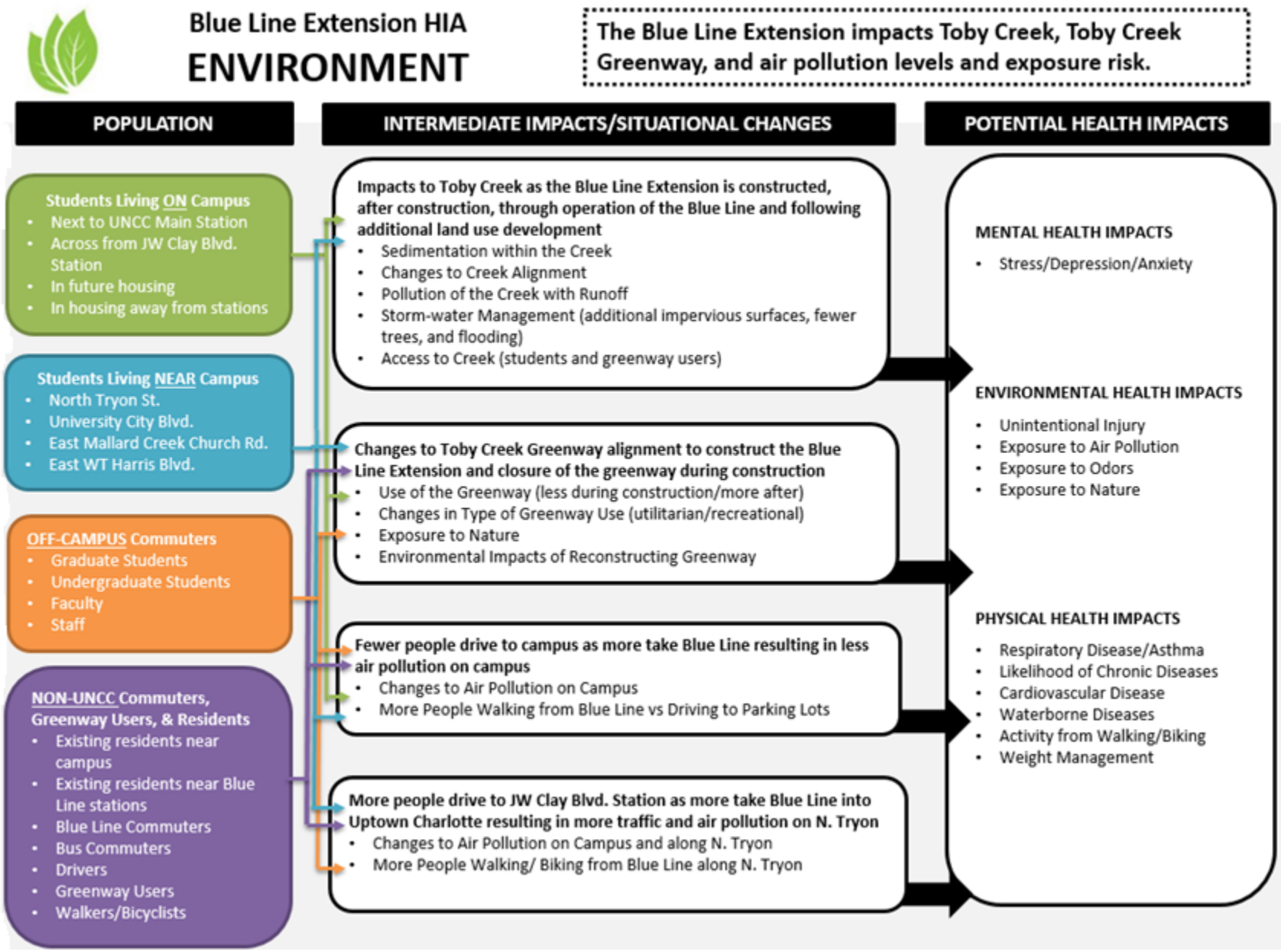
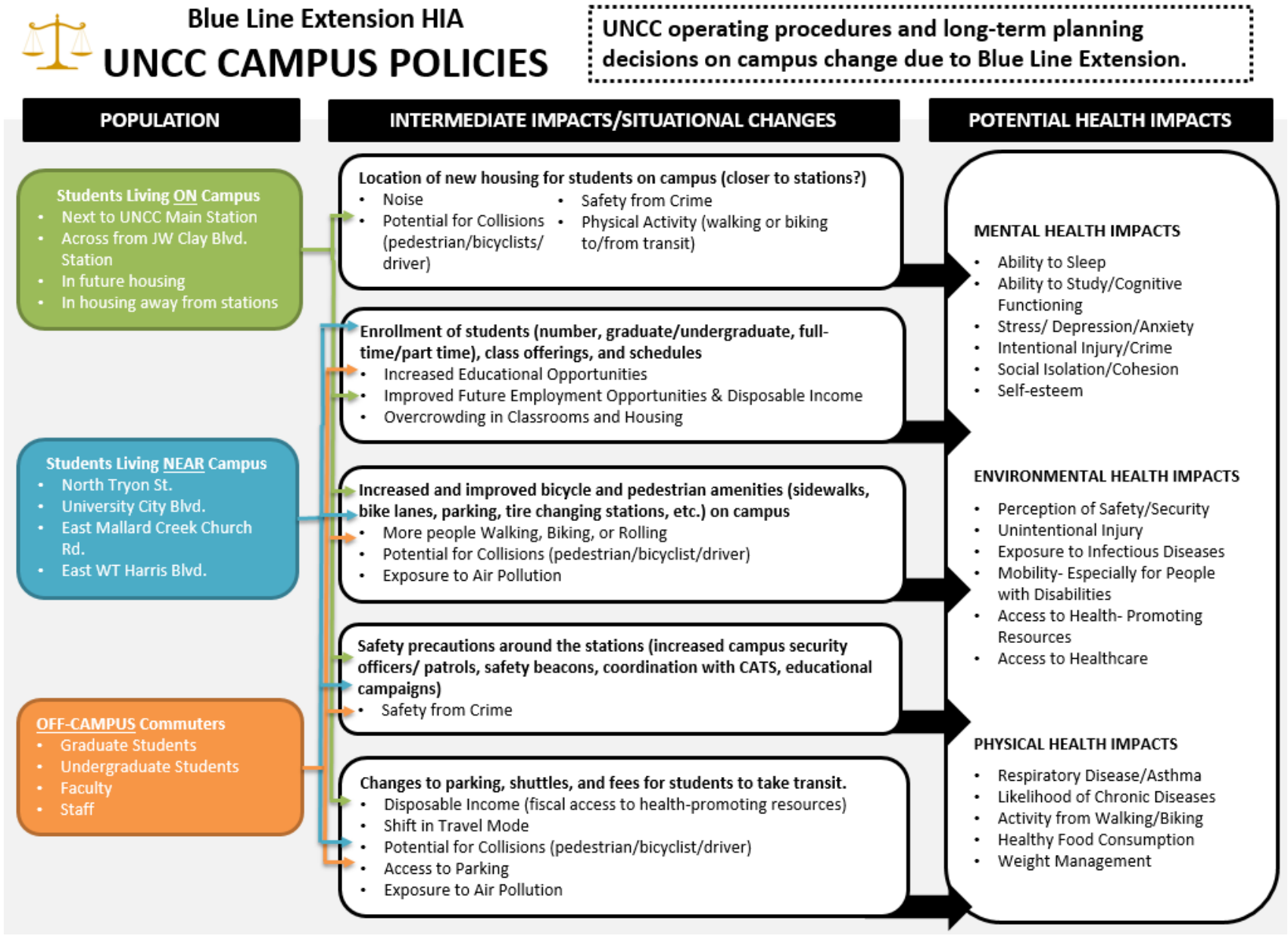


Figure 8: UNCC Campus Policies Pathway Diagram



Assessment

Assessment describes the baseline health status of the affected populations, characterizes the expected effects of the proposal on health (and its determinants) of the proposal, and compares each alternative under consideration relative to the baseline and each other.

Outputs:

- Describes the baseline health status of affected populations.
- Analyzes and characterizes beneficial and adverse health effects of the proposal and each alternative.
- Describes data sources and analytic methods used.
- Documents stakeholder engagement and integrates input into the analysis.
- Identifies clearly the limitations and uncertainties of the analysis.

The assessment stage of this HIA consisted of: a literature review on the topics of housing, transportation, environmental impacts, higher education, and employment opportunities; an analysis of secondary data sources on UNCC, the University City Area, and Mecklenburg County; interviews with key stakeholders; a brief survey conducted at a UNCC event; and a cost benefit analysis (See Appendix 6). The findings of the assessment are aligned with the pathway diagrams developed during the scoping phase and are presented in the categories of housing, transportation, environment, and UNCC campus policies. In the following sections of the report, the relationship between public health and the category is explained first followed by: findings from the literature review, local information from secondary data sources, and findings from the interviews and survey (See Appendix 4) being included where applicable.

Due to limitations in funding and time, a more scientifically rigorous survey and structured interviewing process was deemed impossible; however, the scoping meeting allowed the HIA team to receive feedback from a large number of stakeholder representatives at one time and the findings of the survey coincided with countywide data sets especially in the areas of commuting times and travel modes. Because of the long-term nature of the Blue Line Light Rail construction (expected completion in 2017) and multiple decision points taking place once the final two stations are in place, this HIA report is seen as a living document with additional assessment and input from stakeholders expected in the future.

Table 16: Blue Line Light Rail Extension Questionnaire Respondents

Respondent Type	Percentage
UNCC Faculty Member	*13*
UNCC Staff Member	*22*
UNCC Graduate Student	*22*
UNCC Undergraduate Student	*4*
Resident of University City Area	*7*
Resident of Greater Charlotte Area	*22*
Other	*11*

Housing

The average person spends over half their day within their home. Housing represents both a physical protection from weather and hostile environments as well as a psychological place of meaning, aspirations, identity, safe and secure havens, and setting for family life (Rybczynski, 1987; Marcus, 1997). Therefore, it is important that housing be safe, healthy, well-maintained, affordable, and located within a neighborhood that provides additional amenities (friendly neighbors, access to parks and greenways, sidewalks and bike paths, good schools, stores and job opportunities, etc.) to live a physically, socially, and mentally healthy life.

Conditions of Home

- Healthy houses are dwellings that are sited, designed, built, and maintained to promote the health of their occupants by creating healthy indoor environments and by linking occupants to healthy neighborhoods (U.S. DHHS, 2009).
- Hazards in homes included lead, allergens, mold, environmental tobacco smoke, carbon monoxide, asbestos, radon, volatile organic compounds, excessive heat and cold, crowding, and conditions associated with falls, among others. These are linked to many adverse health outcomes, including asthma, allergies, lung cancer, injuries, poor mental health, and neurodevelopment disorders (Dannenberg, Frumkin, & Jackson, 2011).
- A home is substandard if it has conditions that cause hazards, such as excessive moisture, defects in the building envelope, inadequate ventilation, lack of sanitation, and lead and asbestos contamination (Dannenberg, Frumkin, & Jackson, 2011).
- Effective interventions that address substandard conditions improve health outcomes. Key examples include improving ventilation, moisture-proofing building envelopes, diverting radon gas, controlling pests through integrated pest management, and installing smoke and carbon monoxide alarms (Dannenberg, Frumkin, & Jackson, 2011).
- Strategies to promote healthy housing include implementation of healthy and green housing guidelines for new and existing construction, enhancement and enforcement of housing codes, greater access to multicomponent home visit programs, and policies that promote smoke-free homes (Dannenberg, Frumkin, & Jackson, 2011).
- Housing design and location can have disproportionate effects for people with disabilities (stairs, narrow doorways), seniors (ability to age in place), those living in different geographic locations (natural disasters, radon gas levels), and those at increased risk due to structural defects/maintenance issues (increased risk of illness, injury, and disability) (U.S. DHHS, 2009).
- Crowded places are associated with distress (Evans, Wells, & Moch, 2003). More crowded rooms predict greater physiological stress as well as greater negative health effects (Evans, Lepore, & Allen, 2000).
- Children and low income individuals living in high-rise, multifamily housing have been linked to subclinical symptoms of anxiety and depression (Evans, Wells, & Moch, 2003).

- Crowding is linked to aggressive behavior. The number of people per room or high social density, subjects people to unwanted interactions and the inability to coordinate activities (Dannenberg, Frumkin, & Jackson, 2011).

- Health conditions related to air quality in homes-

    - Eye, nose, throat irritation, chronic conditions (respiratory and heart disease), cancer, poisoning (unconsciousness, neurological failure, disability, death)
    - Smoking, wood smoke, natural gas combustion, radon, scents, poor ventilation, temperatures, humidity, carbon monoxide, allergens (U.S. DHHS, 2009).

- Health conditions related to water quality in homes-

    - Gastrointestinal illness, reproductive problems, neurological disorders
    - Contaminants, sewage treatment, well maintenance (U.S. DHHS, 2009).

- Health conditions related to chemicals in homes-

    - Neuropsychologic deficits, poisonings
    - Pharmaceuticals, non-pharmaceuticals (household cleaners, etc.), pesticides (U.S. DHHS, 2009).

- Health conditions related to structure and design in homes-

    - Injuries (falls, fire, choking, drowning, firearms, poisoning)
    - Lead paint/lead levels in blood
    - Mental health (crowding, noise, lighting, dampness, mold)
    - No heat, hot water, electricity, significant upkeep issues, structural problems, ventilation
    - Accessibility (U.S. DHHS, 2009).

Affordability and Gentrification

- Affordable housing may improve health outcomes by freeing up family resources for nutritious food and health care expenditures (Cohen, 2011).

- By providing families with greater residential stability, affordable housing can reduce stress and related adverse health outcomes (Cohen, 2011).

- Stable, affordable homeownership may positively impact mental health by increasing the control that homeowners have over their physical environment and minimizing the disruptions associated with frequent, unwanted moves. However, the stress and disruption associated with mortgage defaults and foreclosures suggest that unsustainable forms of homeownership may have strong negative impacts on health (Cohen, 2011).

- Well-constructed and managed affordable housing developments can reduce health problems associated with poor quality housing by limiting exposure to allergens, neurotoxins, and other dangers (Cohen, 2011).

- Stable affordable housing may improve health outcomes for individuals with chronic illnesses and others by providing a stable and efficient platform for the ongoing delivery of health care and reducing the incidence of certain forms of risky behavior (Cohen, 2011).
- By providing families with access to neighborhoods of opportunity, certain affordable housing strategies can reduce stress, increase access to amenities, and generate important health benefits (Cohen, 2011).
- By alleviating crowding, affordable housing can reduce exposure to stressors and infectious disease, leading to improvements in physical and mental health (Cohen, 2011).
- By allowing victims of domestic violence to escape abusive homes, affordable housing can lead to improvements in mental health and physical safety (Cohen, 2011).
- Use of green building strategies reduces environmental pollutants, lowers monthly energy costs, and improves home comfort and indoor environmental quality (Cohen, 2011).
- Affordable and accessible housing linked to supportive services enables older adults and others with mobility limitations to remain in their homes (Cohen, 2011).
- Gentrification has been defined as a physical or social manifestation of neighborhood change, the process of increasing land values in traditionally poor areas through redevelopment and renovation, and the transition from a low-income population to a higher-income population. During gentrification, existing residents are displaced due to decreasing affordable housing options (Ross, 2007).
- Left unchecked, the process of neighborhood change can:
    - Force residents to spend too much on housing (no more than 30% of income should go towards housing- spending more than 30% decreases accessibility to other health promoting activities and resources)
    - Make residents live in substandard or overcrowded housing (increased risk of injury, lead poisoning, respiratory illness)
    - Cause residents to move away- relocating to further distances from employment often resulting in an increase in transportation costs, time in a vehicle, and stress which is disproportionate for families earning less than $40,000 (Ross, 2007).
- Gentrification leads to a concentration in poverty, creating neighborhoods that lack amenities, stressful environments, and an increased reliance on having an automobile (Ross, 2007).
- Gentrification causes a loss of social cohesion and connections to the family, neighborhood, identity group, locality, and society. This results in a lack of support, reduced participation in the democratic process, and public engagement; increasing feelings of stress and isolation, and reducing employment opportunities (Ross, 2007).

Neighborhood or Community Conditions Surrounding Home (Noise, Crime, Access)

- Noise is sound that is unwanted by the listener because it interferes with important activities, is unpleasant or bothersome, or is thought to be harmful. A greater level of noise results in a greater degree of psychological distress (Evans, 2001).
- Excessive noise in homes may result in sleep disturbances, hypertension, performance reduction, increased annoyance responses, and adverse social behavior. Lack of noise-proofing features such as insulation and double-pane windows is also associated with increased noise exposure (Dannenberg, Frumkin, & Jackson, 2011).
- Noise, crowding, and high temperatures are linked to aggression and violence. Noise reliably suppresses altruistic behavior and can accentuate aggression among adults already primed by violent stimuli or provocations (Evans, 2006).
- Psychological distress has been caused by children witnessing acts of violence. Signs of post-traumatic stress disorder (PTSD)- eating, sleeping, attention, relating to others, anxiety, fear- has been observed in children, and problems sleeping, nightmares, and high levels of anxiety has been reported by adults in high crime areas (Dannenberg, Frumkin, & Jackson, 2011).
- Absence of crime is positively related to physical activity in youths (Evenson et al., 2007).
- Low-income individuals and racial or ethnic minorities are more likely to live in highly walkable neighborhoods, but less likely to use these features due to the environment being aesthetically unpleasant, high in crime, heavy in traffic, and low in social cohesion (Cutt et al., 2009).
- The concept of crime prevention through environmental design (CPTED) incorporates three basic environmental design approaches: natural surveillance, access control, and territoriality (Crowe, 2000). Natural surveillance assumes that crimes are less likely to occur when potential criminals find themselves open to being observed. Examples include bright outside lighting and frequent pedestrian activity. Access control consists of environmental features that limit access to and escape routes from crime targets (i.e. secured entrances). Territoriality refers to features that establish a sense of ownership or belonging, distinguishing people who belong from trespassers or intruders (Dannenberg, Frumkin, & Jackson, 2011).
- Access to food stores and food service places, particularly supermarkets, differs by socioeconomic status with over three times as many supermarkets being found in wealthier neighborhoods compared to the lowest-wealth areas. The lack of access to supermarkets reduces the availability of most healthy food items at lower prices (Moreland et al., 2002).
- Housing and employment areas next to transit increase opportunities for those who rely on public transportation to gain and maintain employment and access to adequate healthcare/ health insurance (Joint Center for Political and Economic Studies and PolicyLink, 2004; Chappelle, 2001).
- People are willing to walk half a mile to access a park and parks can provide opportunities for physical and social activity and stress relief (Talen, 1998).

Housing in Study Area and Mecklenburg County

Using the *American Community Survey 5 Year Estimates for 2009-2013*, the following housing characteristics were collected for the 8 block groups and 5 census tracts of the study area (one mile from the geographical center of UNCC Main Campus). Countywide numbers were also collected and provided here for comparisons. (See Appendix 1 for more information on the study area and tables reviewed).

- 4,138 people or 23% of people within the study area live within group quarters. This makes up 27% of Mecklenburg's population that lives in group quarters.
- The remaining 13,608 people within the study area live in households with 58% of these living in nonfamily households and another 2% living in family households with nonrelatives. 28% of the population living within households have a housemate or roommate.
- Within the study area, there are 6,003 housing units (1% of the county's housing units). 25% of these units are owner occupied, 66% are renter occupied, and 9% are vacant. 3% of the county's renter occupied units are located within the study area.
- Of the 5,901 renter occupied units within the study area's 5 census tracts, 55% of householders were 15 to 34 years old. Of the nonfamily, renter occupied units 76% of householders were 15 to 34 years old.
- The median gross rent for the study area is $954.83 ($889 countywide).
- Within the study area's 5 census tracts, the majority (84%) of households spend between $700 and $1,999 on monthly housing costs– 37% between $1,000 and $1,499, 16% between $800 and $899, 13% between $700 and $799, 10% between $1,500 and $1,999, and 9% between $900 and $999.
- Countywide, the majority (55%) of households spend over $1,000 in monthly housing costs– 28% between $1,000 and $1,499, 14% between $1,500 and $1,999, and 13% $2,000 or more.

According to the Environmental Impact Statement, no residential units will be acquired to construct the Blue Line Extension. Gentrification is also unlikely as the neighborhoods are well established within the study area. However, the mixture of future development to balance the needs of UNCC students, young professionals, and seniors wanting to live along the Blue Line will need to be carefully considered to promote the health of new and existing residents. A recommendation to develop affordable housing strategies as part of station area plans is included within the Environmental Impact Statement (EIS, 2011).

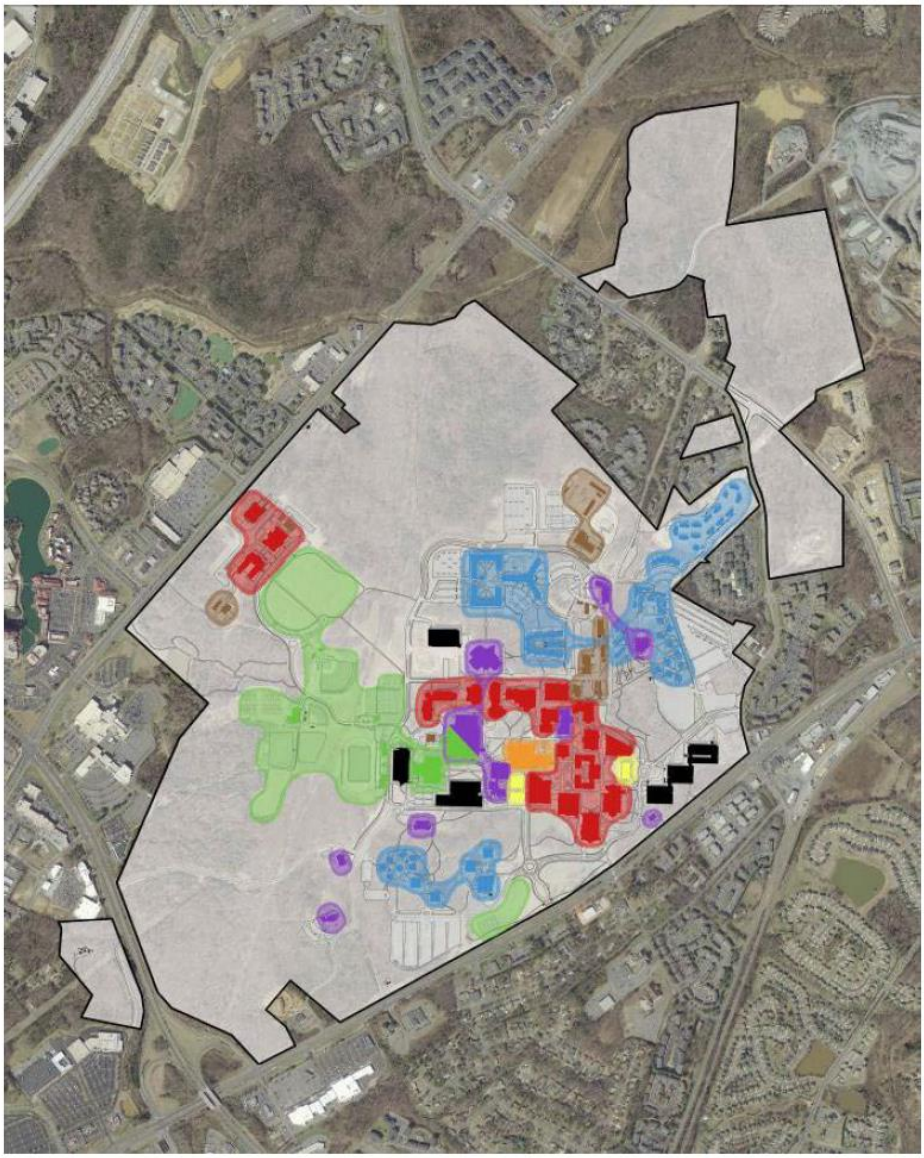
UNC Charlotte Housing

Based on the data included within the *UNCC 2010 Master Plan*, 22% of students (4,500) live on campus within the 18 residence halls and apartment complexes. The majority of these students are first year students (69% of the population living on campus) with dramatic decreases for second year (24%), Juniors (16%), and Seniors (10%). Only 1% of students living on-campus are graduate students. As student enrollment continues to grow to over 35,000, the Office of Housing and Residence Life plans to continue to offer the same proportion of students on-campus housing opportunities, which will involve increasing the number of beds from 4,796 to 7,700 (UNCC, 2011).

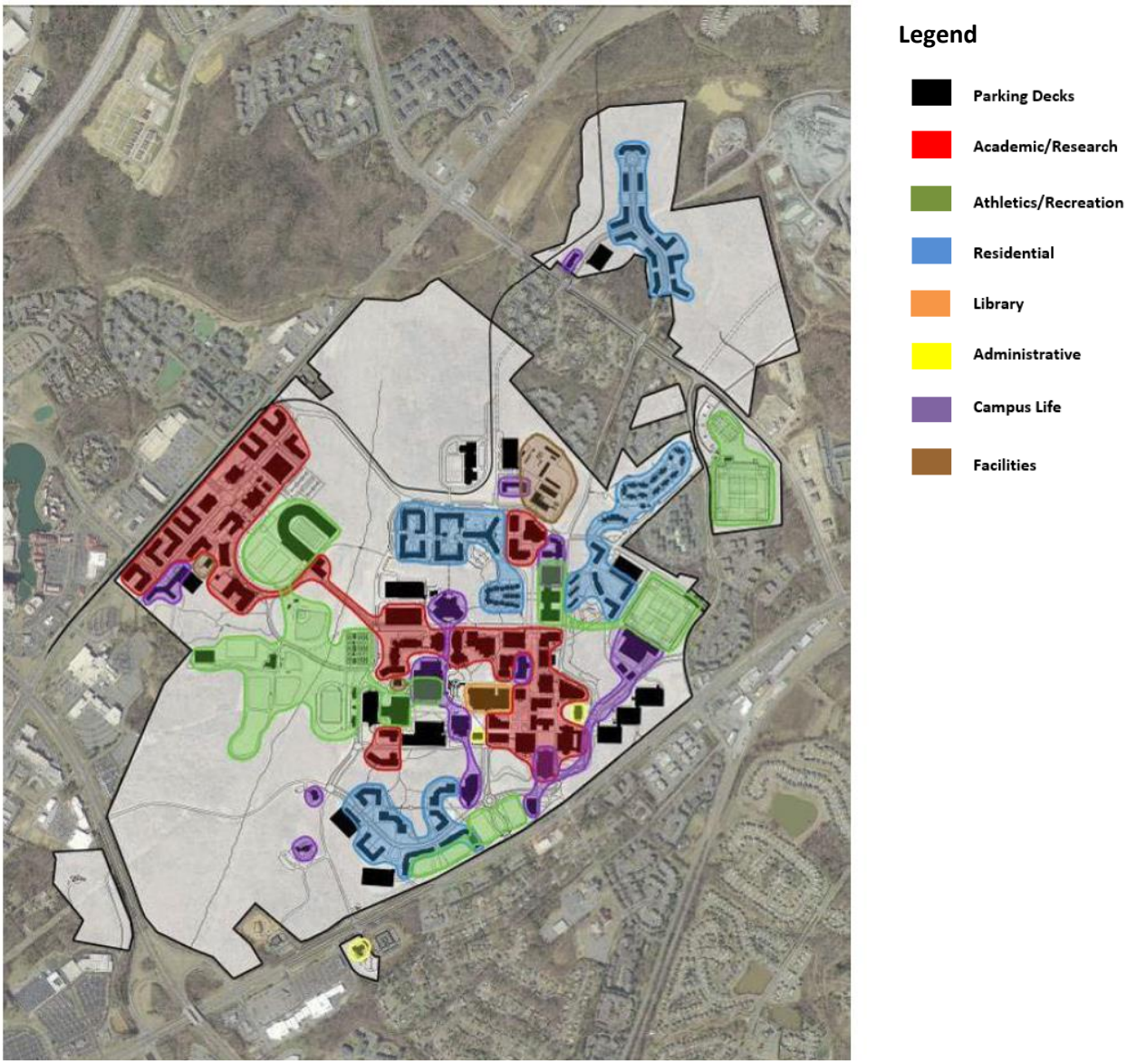
The cost, location, and distribution of types of housing units is also important as UNCC increases the number of beds offered. Currently, 34% of the beds are in apartments, 25% are in suites, 5% are

traditional-dormitory-layout single rooms, 29% are traditional-dormitory-layout double rooms, and 7% are part of Greek housing (UNCC, 2011). The cost of living on campus during the 2014-2015 Academic Year was estimated at $9,820 for room and board compared to $8,470 for living off-campus (College Portrait, 2014). The location of future and existing residential halls is shown in blue in the following two maps.

Map 9: Current UNC Charlotte Buildings and Land Use

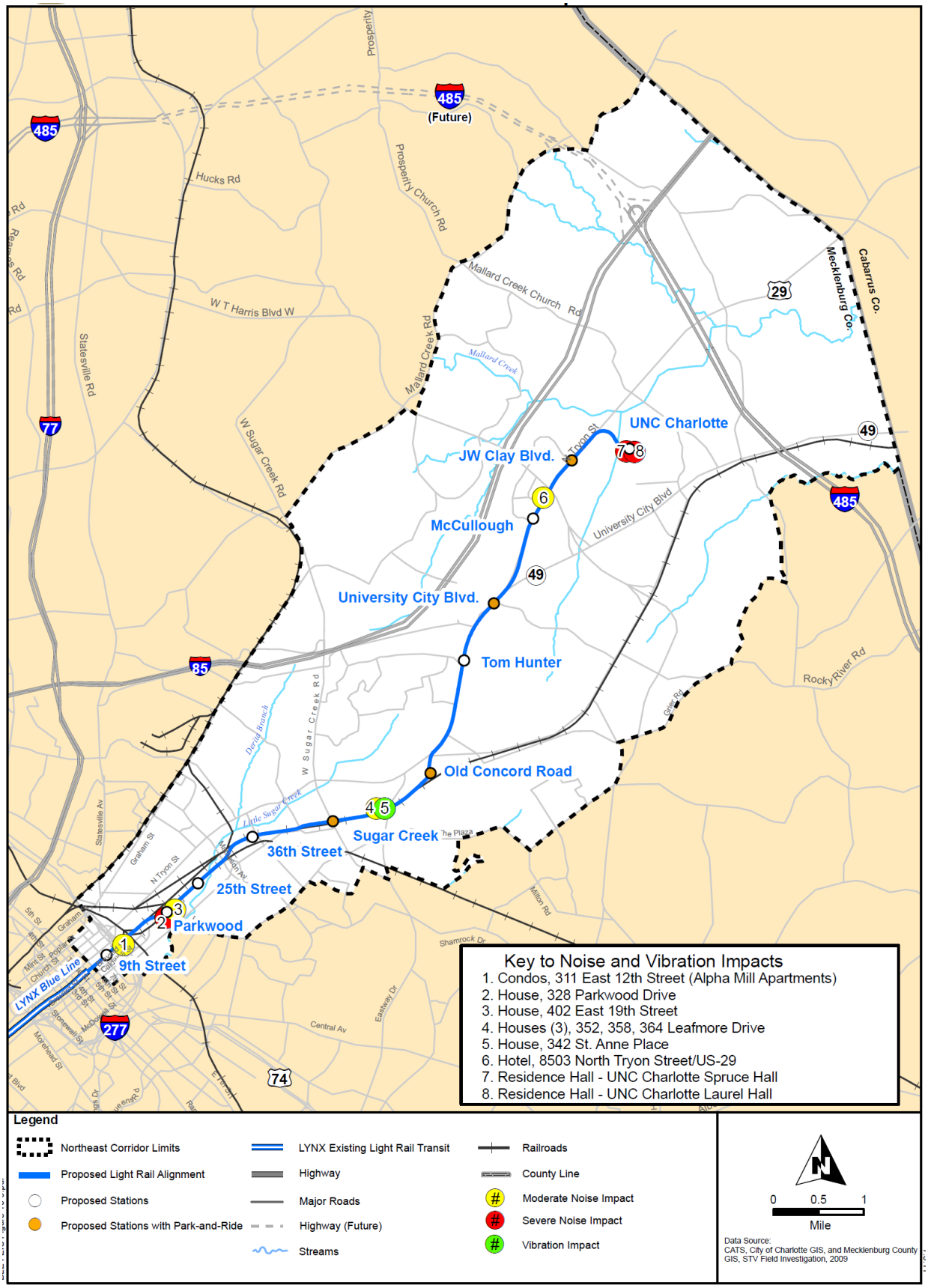


Map 10: Proposed Land Use



In the Environmental Impact Assessment conducted for the Blue Line Light Rail Extension, noise concerns were considered severe for Laurel and Spruce Hall (recently renamed Wallis and Miltimore Halls) which are located directly across from the station on UNCC campus. Project-generated noise in the severe impact range can be expected to cause a significant percentage of people to be highly annoyed by the new noise and represents the most compelling need for mitigation. Noise mitigation will normally be specified for severe impact areas unless there are truly extenuating circumstances that prevent it. To mitigate these concerns an automated top of rail friction modifier system along the curve and specially engineered hardware were recommended (CATS, 2011).

Map 11: Noise and Vibration Impacts in the Northeast Corridor



Baseline Crime Statistics for the University of North Carolina Charlotte

UNC Charlotte has its own police department with officers certified by the State of North Carolina. The campus is patrolled 24 hours a day, seven days a week. Officers patrol the campus in cars, on bicycles and on foot. There are over 200 emergency blue light phones located on campus (EIS, 2011). According to the Jeanne Clery Disclosure of Campus Security Policy and Campus Crime Statistics Act (20 USC 1092 (f)), every year colleges and universities are required to report crime and fire statistics and campus security policies to students and employees. The following table is from the *2014 Annual Security and Fire Safety Report for the University of North Carolina at Charlotte*.

Table 17: Crime Statistics for the University of North Carolina Charlotte (2011-2013)

Type of Offense	Year	On-Campus	Residential Facility	Non-Campus Building or Property	Public Property
Criminal Homicide					
Murder and Non-Negligent Manslaughter	2011	0	0	0	0
	2012	0	0	0	0
	2013	0	0	0	0
Negligent Manslaughter	2011	0	0	0	0
	2012	0	0	0	0
	2013	0	0	0	0
Sex Offense					
Forcible Sex Offense	2011	2	2	0	0
	2012	5	4	0	0
	2013	3	3	0	0
Non-Force Sex Offense	2011	0	0	0	0
	2012	0	0	0	0
	2013	0	0	0	0
Other Part 1 Offenses					
Robbery	2011	6	1	0	0
	2012	4	0	0	0
	2013	1	0	1	1
Aggravated Assault	2011	1	1	0	0
	2012	2	2	0	0
	2013	4	1	0	0

Type of Offense	Year	On-Campus	Residential Facility	Non-Campus Building or Property	Public Property
Other Part 1 Offenses					
Burglary	2011	65	32	0	0
	2012	43	34	0	0
	2013	22	10	0	0
Motor Vehicle Theft	2011	9	0	0	0
	2012	2	0	1	0
	2013	8	0	0	0
Arson	2011	0	0	0	0
	2012	1	0	0	0
	2013	1	1	0	0
Arrest: Type of Offense					
Weapons Violation	2011	6	2	0	0
	2012	9	2	0	0
	2013	5	2	0	0
Drug Violations	2011	23	3	0	1
	2012	79	35	0	1
	2013	63	46	0	0
Alcohol Violations	2011	11	3	0	0
	2012	98	66	0	0
	2013	268	191	1	0
Judicial Referrals: Type of Offense					
Weapons Violation	2011	6	4	0	0
	2012	4	4	0	0
	2013	4	3	0	0
Drug Violations	2011	126	103	0	0
	2012	126	90	0	0
	2013	36	36	0	0
Alcohol Violations	2011	521	488	0	2
	2012	273	250	0	3
	2013	265	238	0	1

Type of Offense	Year	On-Campus	Residential Facility	Non-Campus Building or Property	Public Property
Domestic Violence Offences					
Domestic Violence Offenses	2011	-	-	-	-
	2012	-	-	-	-
	2013	0	0	0	0
Dating Violence	2011	-	-	-	-
	2012	-	-	-	-
	2013	4	2	0	0
Stalking	2011	-	-	-	-
	2012	-	-	-	-
	2013	6	3	0	0

Baseline Crime Statistics for Mecklenburg County and the University City Area

The Charlotte-Mecklenburg Police Department (CMPD) provides law enforcement within the City of Charlotte and some areas of Mecklenburg County. The Mecklenburg County Sheriff's Office provides additional law enforcement in Mecklenburg County (EIS, 2011). According to the CMPD website, there was a 0.4% increase in Index Offenses between 2013 and 2014. Although property crime increased by 0.6%, violent crime decreased by 0.6%. Table 18 shows the crime statistics for the entirety of Mecklenburg County and Table 19 shows crime rates specifically for the University City Area.

Table 18: Crime Statistics for Charlotte Mecklenburg

Index Offenses	This Year to Date (December 2014)	Last Year to Date (December 2013)	% Change
Homicide (Murder and Non-Negligent Manslaughter)	42	53	-20.8%
Rape	258	263	-1.9%
Robbery Total	1586	1811	-12.4%
Aggravated Assault Total	3217	3006	7.0%
Burglary Total	6069	6448	-5.9%
Residential	4473	5109	-12.4%
Commercial	1596	1339	19.2%
Larceny- Theft Total	22769	21992	3.5%
Vehicle Theft Total	1706	1878	-9.2%
Arson Total	166	217	-23.5%
Totals	35,813	35,668	0.4%

Table 19: University City Division Index Offense Statistics January 2013-December 2014

Index Offenses	This Year to Date (December 2014)	Last Year to Date (December 2013)	% Change
Homicide (Murder and Non-Negligent Manslaughter)	3	1	200.0%
Rape	23	26	-11.5%
Robbery Total	106	135	-21.5%
Armed	73	100	-27.0%
Strong-Arm	33	35	-5.7%
Aggravated Assault Total	174	131	32.8%
Firearm	113	60	88.3%
Knife or Cutting Instrument	19	34	-44.1%
Other Dangerous Weapon	37	32	15.6%
Hands, Fists, Feet, Etc.	5	5	0.0%
Burglary Total	714	673	6.1%
Residential	478	495	-3.4%
Commercial	236	178	32.6%
Larceny- Theft Total	2479	2521	-1.7%
From Auto	901	920	-2.1%
Bicycle	26	36	-27.8%
Shoplifting	564	546	3.3%
Others	988	1019	-3.0%
Vehicle Theft Total	159	154	3.2%
Arson Total	12	20	-40.0%
Totals	3670	3661	0.2%

Transportation

Typically, transportation is viewed through a public health lens in the areas of: vehicle speed, collisions and injury or fatality prevention; vehicle miles traveled (VMT), air quality and disease; and active transportation opportunities and physical activity levels. Access to transportation opportunities such as public transit can also be examined in terms of health equity, fiscal savings, and increased access to health-promoting options such as a full grocery store, a park, and educational or employment opportunities. In terms of mental health, traffic congestion has been associated with stress and incidents of road rage. Good wayfinding can also decrease stress for drivers, bicyclists, and pedestrians. Given the location of the transit stop near residential halls on a college campus, the topics of safety, noise, and increased access to unhealthy options such as alcohol venues should also be considered.

Vehicle Speed, Collisions, and Injury/Fatality Prevention

- Traffic safety is considered in terms of volume, speeds, injury severity and number (Frumkin, Frank, & Jackson, 2004).
- Traffic volume is a main determinant of traffic conflicts, crashes, and fatalities (Litman & Fitzroy, 2005; Ewing & Dumbaugh, 2009)
- Sprawling communities generate more traffic volume and vehicle miles traveled (VMT) than do compact communities and therefore generate more exposure to risk (Ewing, Schieber, & Zegeer, 2003).
- Motor vehicle travel accounts for more than 90% of transportation-related fatalities and is the leading cause of death for those aged 5 to 34 years oldin the U.S. (CDC National Center for Injury Prevention and Control, 2011).
- Safety in urban areas is greater when streets have less forgiving designs- fewer lanes, narrower lanes, street trees near the curb, traffic-calming measures such as traffic circles and speed humps, and a constant flow of pedestrians and bicyclists- which force drivers to slow down (Ewing & Dumbaugh, 2009).
- Traffic safety is an issue in every neighborhood, yet low-income neighborhoods and people of color are particularly impacted. African Americans drive less than Whites, but die at higher rates in car crashes. Walking is also more dangerous for people of color. For example, CDC data from the mid-1990s revealed that the pedestrian death rate for Latino males in the Atlanta metropolitan area was 6 times greater than for Whites. Also, while African Americans make up 12% of all the U.S. population, they account for 20% of pedestrian deaths (PolicyLink & Prevention Institute, n.d.).
- In the U.S., 1% of transportation funding is spent on pedestrian and bicycle facilities (Alliance for Walking and Biking, 2010).
- Pedestrian deaths per distance traveled in the U.S. are three times higher than in Germany and five times higher than the Netherlands (countries that are building safe systems including road designs that separate motor vehicles from pedestrians and bicyclists and reduce vehicle speeds) (Pucher & Dijkstra, 2003).

- Strategies for safer roadways include: separating pedestrians from motor vehicles and installing traffic signals, in-pavement flashing lights, four-way stops, pedestrian overpasses, fences that inhibit street access, and sidewalks (Retting, Ferguson, & McCartt, 2003).
- Crosswalks without signals can actually increase risk for elderly pedestrians (Koepsell et al., 2002) and crosswalks without signals on streets with more than two lanes increase risk for all pedestrians (Zegeer et al., 2005).
- Roadway illumination and relocating bus stops to the far side of intersections decrease injury risk (Retting, Ferguson, & McCartt, 2003).
- Small roundabouts in neighborhoods, four-way stops and speed humps decrease vehicle speeds and reduce child pedestrian injuries in a neighborhood setting (Tester et al., 2004).
- Ewing & Dumbaugh, 2009 suggests: routing traffic away from residential settings, paving off-road trails for pedestrians and bicyclists, and implementing area wide traffic calming (Dannenberg, Frumkin, & Jackson, 2011).

Vehicle Miles Traveled, Air Quality, and Disease

- Public transportation takes cars off the road. According to the Maryland Department of Transportation's estimates, up to 200 cars could be taken off the road for each full commuter rail car. In St. Louis, a full Metrolink light rail train removes 125 cars from the roads, and the entire system removes 12,500 cars from daily rush-hour traffic (American Public Transportation Association, 2011).
- Particle pollution is a mixture of microscopic solids and liquid droplets suspended in air. This pollution, also known as particulate matter, is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens (such as fragments of pollen or mold spores) (U.S. EPA, 2003).
- Small particles less than 10 micrometers are worse for health because they can move deep into the lungs and into the bloodstream (U.S. EPA, 2003).
- Symptoms of air pollution exposure include: irritation of nose, eyes, throat, bronchitis, asthma attacks, respiratory infections, coughing, wheezing, shortness of breath, fatigue, chest pain, heart attacks, and arrhythmia (depends on length of exposure and predisposition- health, age, etc.) (U.S. EPA, 2003).
- Ozone is an odorless, colorless gas composed of three atoms of oxygen. Ozone occurs both in the Earth's upper atmosphere (good ozone) and at ground level (bad ozone). Bad ozone is formed when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight (U.S. EPA, 1999).
- 1 out of 3 people are at higher risk for ozone-related health effects (children, those who are active outdoors, those that have a respiratory disease, or are unusually susceptible to ozone) (U.S. EPA, 1999).

- Symptoms of ozone exposure include: irritation of nose and lungs, coughing, reduced lung function, asthma attacks, lung inflammation, and damage to the lining of the lungs (U.S. EPA, 1999).
- For ozone levels above 0.12 ppm, no vigorous outdoor activity for even a short period of time is recommended. For ozone levels between 0.08-0.12 ppm, even moderate exertion for a long period of time should be avoided (U.S. EPA, 1999).
- Emissions from traffic congestion and vehicle miles traveled can cause respiratory and cardiovascular diseases and increase the risk of cancer (Frumkin, Frank, & Jackson, 2004).
- A systematic review of the evidence between tailpipe emissions and health was completed in 2010 by the Health Effects Institute. "The evidence was 'sufficient' to infer a causal relationship between exposure to traffic-related air pollution and exacerbation of asthma and 'suggestive but not sufficient' to infer a causal relationship with onset of childhood asthma, non-asthma respiratory symptoms, impaired lung function and total and cardiovascular mortality" (Dannenberg, Frumkin, & Jackson, 2011).
- In recent decades air quality has improved due to regulations, reduced emissions from vehicles, and decline in smokestack industries. However, current levels in most cities are still not safe (Pope et al., 2002; Katsoyanni et al., 2009)
- Microenvironments where people spend time in physical activity are particularly critical because activity increases the volume of air inhaled and the amount of pollution that enters the respiratory tract (Dannenberg, Frumkin, & Jackson, 2011).
- Susceptible populations include elderly, people with heart and lung disease, children, fetuses, and people with diabetes. Those with lower socio economic status tend to have higher exposure due to location of their home (Dannenberg, Frumkin, & Jackson, 2011).
- Air Pollution and related health impacts are particularly prominent in low-income communities and communities of color (PolicyLink & Prevention Institute, n.d.).
- The American Lung Association found that 61.3% of African American children, 67.7% of Asian American children, 69.2% of Latino children, and 50.8% of White children live in areas that have high levels of ozone (PolicyLink & Prevention Institute, n.d.).
- Air pollution is one of the most underappreciated triggers of asthma according to the CDC. Nearly 7% of adults and 9% of children have experienced asthma. The rate is considerably higher in low-income and minority communities. For example, in predominantly African American and Latino Harlem and Washington Heights, nearly 25% of children suffer from asthma (PolicyLink & Prevention Institute, n.d.).

Active Transportation Opportunities and Physical Activity Levels

- Public transit use is classified as active travel because almost every transit trip requires walking to or from the transit stop (Besser & Dannenberg, 2005).
- Rates of walking and biking increase and driving alone decreases in transit-oriented neighborhoods within a larger region that supports transit use (Cervero & Gorham, 1995).

- Principles of transit-oriented development include: walkable design with the pedestrian as the highest priority, a high density, high quality, mixed use development (residential, office, public, and commercial uses) within a ten minute walk of a transit station, and reduced and managed parking inside the ten minute walking area (Cervero et al., 2004).
- Transit availability is associated with increased opportunities for physical activity and decreased likelihood of obesity (MacDonald, Stokes, Cohen, Kofner, & Ridgeway, 2010).
- Less vigorous activity (such as walking to transit) is more likely to be sustained because it becomes part of daily life (MacDonald, Stokes, Cohen, Kofner, & Ridgeway, 2010).
- Transit users are more likely to reach physical activity recommendations, which is especially important for minorities and low income individuals (MacDonald, Stokes, Cohen, Kofner, & Ridgeway, 2010).
- In a study of Blue Line Light Rail users, light rail use resulted in a 1.18kg/m^2 decrease in Body Mass Index, or approximately 6.45 pounds for a 5'5" person. Transit users were 81% less likely to become obese over time, had increased physical activity levels and were more likely to meet weekly recommended levels (MacDonald, Stokes, Cohen, Kofner, & Ridgeway, 2010).
- Half of the 3% of adults in the 2001 National Household Travel Survey who walked to and from transit spent 19 minutes walking with 1/3 exceeding 30 minutes (Besser & Dannenberg, 2005).
- New York City train commuters took 9500 steps/day, which is 2000 or 30% more steps than car commuters (Wener & Evans, 2007).
- Obesity increases with time spent in cars and decreases with mixed land use and walking (Frank et al., 2004).
- BMI decreases with increased density of bus stops, subway stops, and population around New York City (Rundle et al., 2007).
- Use of public transit is associated with an extra 8.3 minutes of walking/day, which is not enough to stop obesity, but enough to curb its growth (Edwards, 2007).
- Active transportation results in a decrease in the number of overweight young adults (Gordon-Larsen et al., 2006).
- Connectivity, measured by the number of intersections, increases the number of routes and the directness of routes available, leading to a shorter distance traveled and an increased likelihood of walking or biking (Frank, Engelke, & Schmid, 2003).
- Specialized networks for non-motorists, such as off-street facilities, specialized bike facilities, multi-use facilities, and pedestrian/bicyclist facilities, can increase travel by active transportation means (Frank, Engelke, & Schmid, 2003).
- Greater connectivity and better facilities lead to higher pedestrian traffic volumes (Moudon et al., 1997).
- Bicycle pathway miles, the percent of college students, and the number of rain days are significantly related to commuting by bicycle (Nelson & Allen, 1997).

- Network connectivity of residences to employment destinations is also important in determining likelihood of bicycling (Nelson & Allen, 1997).
- Improvements in bicycle facilities resulted in a 6% to 8% increase in bicycle usage and a corresponding decrease in auto use (Hartman, 1993).
- Improved infrastructure and an educational campaign resulted in an increase of bicycle use by 13% with a rise in mode share from 23% to 26% of all trips (Hulsmann, 1993).
- Walkability of neighborhoods leads to lower levels of depressive symptoms in men (Berke et al., 2007).

Public Transit, Health Equity, Fiscal Savings, and Access to Healthy Activities

- Variables that determine transit use include population density, land-use mix, intersection density, and distance to the nearest transit stop (Ewing & Cervero, 2010).
- Transportation funding should prioritize transit, walking and biking, and communities with greatest need: low income, of color, disabled, and older (PolicyLink & Prevention Institute, n.d.).
- Nearly 1/3 of the U.S. population is transportation disadvantaged: they cannot easily access basic needs such as foods, medical care, jobs and education (PolicyLink & Prevention Institute, n.d.).
- People of color have limited access to cars: 19% of African Americans, 13.7% of Latinos, and 4.6% of Whites lack access to automobiles. (PolicyLink & Prevention Institute, n.d.).
- Poverty compounds the problem: 33% of poor African Americans, 25% of poor Latinos, and 12.1% of poor Whites lack automobile access. Cars owned by low-income people tend to be older, less reliable, and less fuel-efficient making commuting to work and getting to appointments unpredictable and expensive (PolicyLink & Prevention Institute, n.d.).
- Elderly and disabled populations drive less and therefore must rely more on other transportation options to get around. More than 1 in 5 Americans age 65 and older do not drive. More than 50% of elderly non-drivers (3.6 million Americans) stay home on any given day, in part, due to lack of transportation options. More than half of this group (1.9 million) is disabled. Older non-drivers take 15% fewer trips to the doctor; 59% fewer trips to shops and restaurants; and 65% fewer trips for family, social, and religious activities than their counterparts who drive (PolicyLink & Prevention Institute, n.d.).
- Transportation costs create a barrier for many. U.S. households earning $20,000 to $35,000 and living far from employment centers spend approximately 37% of their income on transportation, while the average U.S. household spends about 18% of its income on transportation. The more a household spends on transportation, the less it has left over for food, medical expenses, childcare, housing and other essential costs (PolicyLink & Prevention Institute, n.d.).
- Physical activity levels are associated with obesity and diabetes and other chronic diseases, which impact low-income communities and communities of color disproportionally. A 2004 study found that for every additional hour spent commuting by car there was a 6% increase in the likelihood of obesity. In contrast, walking and biking are associated with lower rates of

obesity. For every additional kilometer walked there was an approximate 5% reduction in obesity. African Americans and Latinos are less likely than whites to get enough daily exercise. They also have higher rates of obesity than their white counterparts (PolicyLink & Prevention Institute, n.d.).

- For every dollar earned, the average household spends 18 cents on transportation, 98% of which is for buying, maintaining and operating cars, the largest source of household debt after mortgages (American Public Transportation Association, 2011).
- For the poorest households, transportation costs can exceed 35% of income (American Public Transportation Association, 2011).
- Household transportation costs rise in areas with sprawl and few public transportation services (American Public Transportation Association, 2011).
- Americans who live in transit-intensive areas save $22 billion each year by using public transportation. This savings could buy a four-year public college education for half a million students (American Public Transportation Association, 2011).
- Savings add up for everyone: every $10 million invested in public transportation saves more than $15 million, for both highway and transit users. This includes individual savings of about $1,500 and 200 gallons of gas per year. Plus, transit availability can reduce the need for additional cars, a yearly expense of between $4,800 and $9,700 (American Public Transportation Association, 2011).

Traffic Congestion, Road Rage, and Wayfinding

- Road rage is an act of aggression on the part of one driver directed toward another driver, passenger, or pedestrian. This can include verbal comments, obscene gestures, and actions involving the vehicle or altercations outside of the vehicle (Dannenberg, Frumkin, & Jackson, 2011).
- Suggested causes of road rage include anonymity provided by being in a car, the stress of modern life, and the increasing length of the typical auto commutes (Dannenberg, Frumkin, & Jackson, 2011).
- Most suggestions for preventing road rage relate to changes in social policy and education (Asbridge, Smart, & Mann, 2006).
- Possible built environment solutions include actions that: allow people to walk or ride to work, reduce auto times, and provide reliable, safe public transportation (Dannenberg, Frumkin, & Jackson, 2011).
- Wayfinding can prevent disorientation and confusion (Dannenberg, Frumkin, & Jackson, 2011).
- Quality of experience improves by knowing where you are or at least feeling that you will find your way (Dannenberg, Frumkin, & Jackson, 2011).
- Kevin Lynch (1960) states that distinct qualities make a city “legible” by providing emotional security and an invitation to explore. Ways to make a city legible include elements such as

landmarks or districts, clear edges and pathways, and appropriate signage (Dannenberg, Frumkin, & Jackson, 2011).

Safety, Noise, and Access to Unhealthy Activities

- Compared to road systems, transit systems are significantly safer. Trips with similar destinations result in 200,000 fewer deaths, injuries and accidents when made by public transit than by car, adding between $2 billion and $5 billion per year in safety benefits. The National Safety Council estimates that riding the bus is over 170 times safer than automobile travel (American Public Transportation Association, 2011).
- New visual, voice, and data communication systems linking vehicles, stations and riders with state-of-the-art operations centers, make transit more secure than roadways (American Public Transportation Association, 2011).
- Time and time again, the availability of public transportation in times of emergency- both natural and manmade- has proven to be critical in maintaining basic access, mobility and safety for individuals who come in harm's way. The value of public transportation services in providing essential redundancy and resiliency in our transportation network cannot be overstated (American Public Transportation Association, 2011).
- In a study done on the relationship between increased scheduling of Metro in D.C., Driving Under the Influence (DUI) rates, increased alcohol consumption, and crime rates:
    - D.C. Metro extended hours Friday and Saturday night from midnight to 3:00 AM;
    - Each additional hour of late night public transportation reduced fatal accidents involving intoxicated drivers by 70%;
    - Experienced a 7% increase in ridership in the evening (1,064 riders per hour);
    - Had a decrease in DUI and alcohol related fatal traffic accidents by as much as 40%;
    - Each late hour increased alcohol consumption, especially in areas where vendors are located near Metro. The number of heavy drinkers increased by 16%;
    - There was a reduction in DUI arrests of up to 44%, but also an increase in alcohol related crimes up to 8% (urinating in public, obscene gestures, drinking in public, possession of open alcohol containers, or defacing a building, and crimes at higher risk due to own high alcohol assumption- assault, unarmed robbery, rape, indecent exposure, indecent sexual proposal); and,
    - Accidents in outer suburbs increased (Jackson & Owens, 2009).
- Alcohol related crashes in the U.S. cost about $51 billion each year (Jackson & Owens, 2009).
- Alcohol consumption rates are very responsive to price changes, including the cost of getting home safely (Jackson & Owens, 2009).

- Noise is sound that is unwanted by the listener because it interferes with important activities, is unpleasant or bothersome, or is thought to be harmful. A greater level of noise results in a greater degree of psychological distress (Evans, 2001).

- Excessive noise in homes may result in sleep disturbances, hypertension, performance reduction, increased annoyance responses, and adverse social behavior. Lack of noise-proofing features such as insulation and double-pane windows is also associated with increased noise exposure (Dannenberg, Frumkin, & Jackson, 2011).

Transportation in Study Area and Mecklenburg County

Using the *American Community Survey 5 Year Estimates for 2009-2013*, the following commuter travel information was collected for the 8 block groups and 5 census tracts of the study area (one mile from the geographical center of UNCC Main Campus). Countywide numbers were also collected and provided here for comparisons (See Appendix 1).

- 12,555 people commute to work within the census tracts that form the study area.
- 4,193 of these commuters are between the ages of 16 and 24 years old (33%).
- 76% of commuters within the study area drive alone to work (77% countywide), 9% Carpooled (10% countywide), 3% took public transportation (3% countywide), 7% walked (2% countywide), and 1% took a taxi, motorcycle, or bicycle (1% countywide).
- Of those who take public transportation within the study area, 32% are between the ages of 16 and 24 years old.
- Of those who walk within the study area, 60% are between the ages of 16 and 24 years old.
- Of those who took a taxicab, motorcycle, bicycle or other means, 78% are between the ages of 16 and 24 years old.
- Collectively, Mecklenburg's 460,885 commuters spend 178,315 hours a day traveling to work (23 minutes on average).
- Collectively, the study area's 12,555 commuters spend 4,650 hours traveling to work (37 minutes on average).
- 2% of the study area does not have a vehicle available to them, 30% of those without a vehicle drove alone (23% countywide), 9% carpool with others (22% countywide), 55% take public transportation (40% countywide), 7% walk (9% countywide), and none of them used a bicycle, motorcycle or taxi cab (4% countywide).

City of Charlotte Automobile Collision Data

According to the traffic collision data collected by the Charlotte Department of Transportation, there were 20,957 collisions in 2013 resulting in 50 deaths. Of these 50 deaths, 9 were pedestrians and 2 were pedalcyclists (21% and 5% respectively).The leading causes of collision were inattention, failure to reduce speed, and failure to yield right of way (responsible for 54% of collisions). There are also 6 intersections within a 2-mile radius of UNCC Main Campus that have been placed on the 2014 High Accident Locations list. From 2011 to 2013 there were 381 collisions within these six locations with the intersection of East W.T. Harris Boulevard & North Tryon Street & West W.T. Harris Boulevard having 110 collisions. Total daily traffic through these intersections is 225,720 vehicles (Charlotte Department of Transportation, 2014). Recommendations provided within the *Blue Line Extension Environmental*

Impact Statement include providing safe and convenient access to the transit stations and bus stops for pedestrians and bicyclists (EIS, 2011).

Figure 9: Fatal Collision by Crash Type

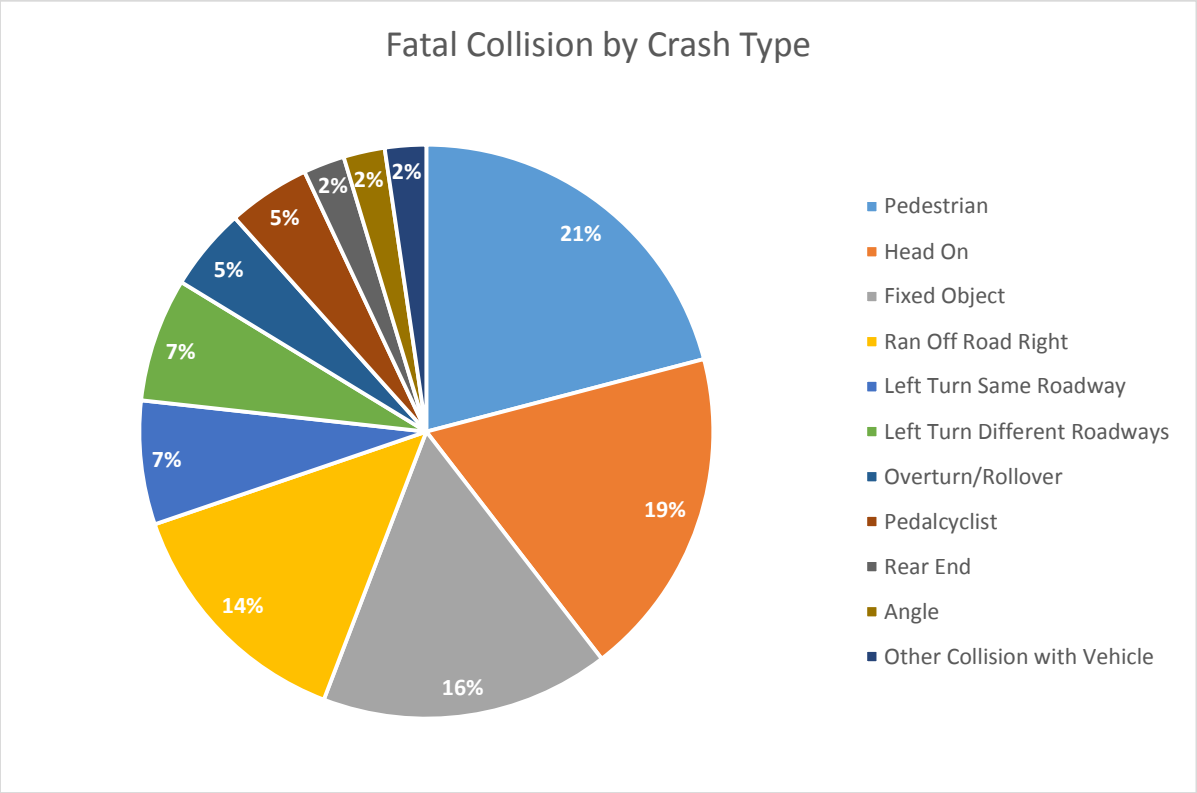


Table 20: Pedestrian and Bicycle Collisions by Population

Year	Population	Pedestrian Collisions	Pedestrian Collisions Per 10,000 Persons	Bicycle Collisions	Bike Collisions Per 10,000 Persons
2004	614,330	223	3.63	105	1.71
2005	632,760	198	3.13	79	1.25
2006	640,270	230	3.59	92	1.44
2007	664,342	311	4.68	91	1.37
2008	674,752	345	5.11	114	1.69
2009	692,097	297	4.29	83	1.20
2010	731,424	305	4.17	95	1.30
2011	731,424	252	3.45	90	1.23
2012	775,202	299	3.86	112	1.44
2013	796,921	317	3.98	101	1.27

Table 21: 2014 High Accident Locations around Campus

Location	2011	2012	2013	3 Years Total	2013 Average Traffic Volume	Crash Rate	2013 Rank	2014 Rank
Doug Mayes Place & JW Clay Boulevard	5	6	9	20	11,800	1.55	26	21
North Tryon Street & University Pointe Boulevard	15	20	21	56	3,520	1.45	12	31
Newell-Hickory Grove Road & Old Concord Road	7	3	7	17	10,800	1.44	95	32
East W.T. Harris Boulevard & North Tryon Street & West W.T. Harris Boulevard	23	35	52	110	73,800	1.36	43	38
East Mallard Creek Church Road & North Tryon Street & West Mallard Creek Church Road	26	26	31	83	57,100	1.33	32	42
J.W. Clay Boulevard & McCullough Drive & West W.T. Harris Boulevard	21	34	40	95	68,700	1.26	74	52

Transportation at UNCC

UNC Charlotte is currently an auto-centric campus. It is easily accessible from Interstate 85, Interstate 485, State Route 29 (Tryon Street), and US Highway 49 (University City Boulevard). This ease of access has facilitated its historic growth as well as its current parking, traffic, and general circulation problems. In the Blue Line Extension Questionnaire, 86% of respondents indicated they drove alone and another 5% carpooled to UNCC Main Campus (the remaining 9% took the bus, walked, biked, or took another form of transportation). The average travel time to campus for respondents is 21 to 30 minutes. The LYNX Blue Line extension, with its two northern most stops located across from campus on North Tryon Street and on campus, is expected to significantly reduce travel times from UNCC Main Campus to Uptown Charlotte and provide an alternative commuting option to campus (UNCC, 2011). Questionnaire participants indicated that they plan to use the Blue Line Extension to get to UNCC Main Campus (61%) and Uptown Campus (65%).

Shuttles on Campus

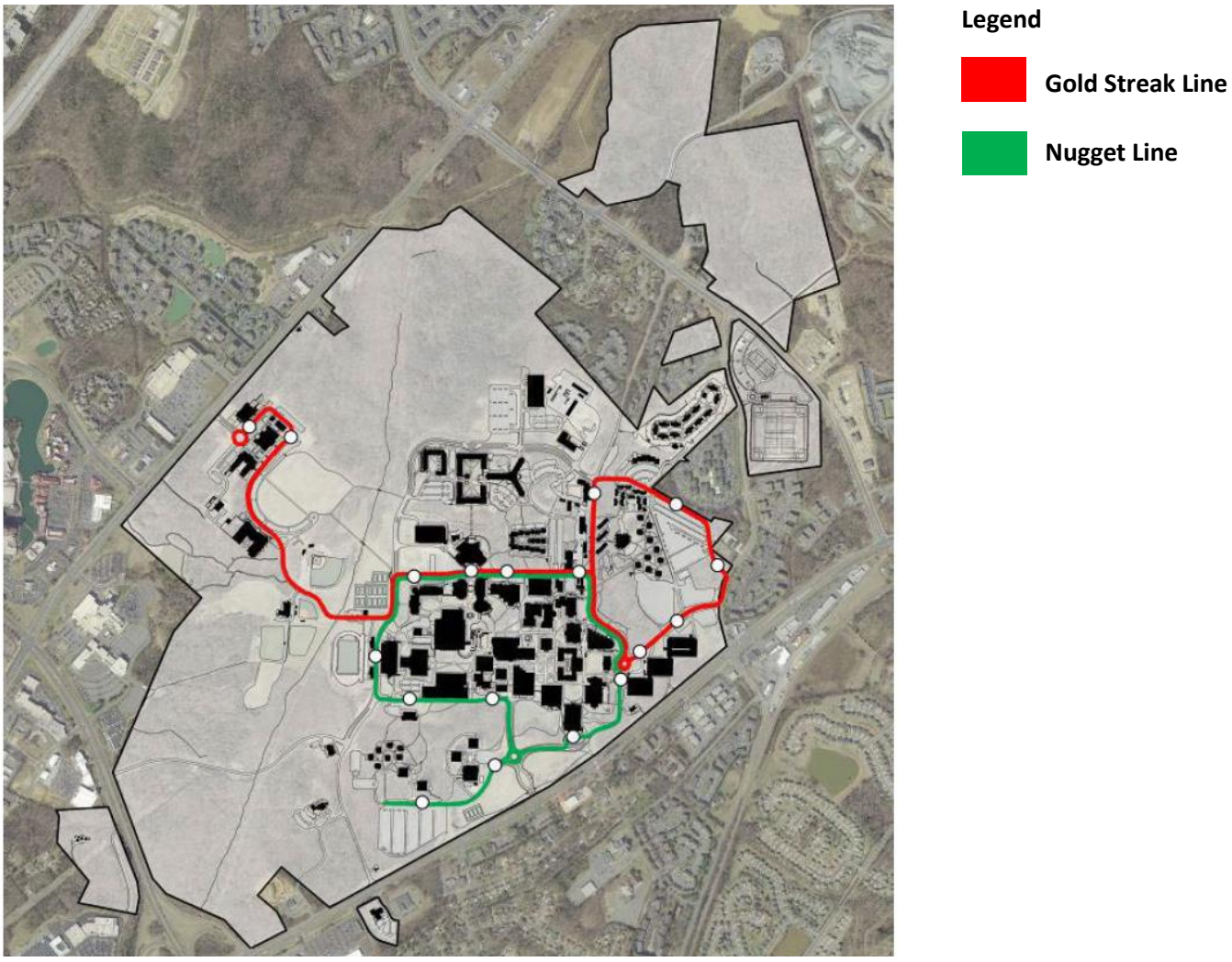
Since 2006, UNCC has offered two free shuttle buses on campus operated by CATS and subsidized by the University with funding from the state. The Yellow Line travels the South Campus Loop, provides

weekday shuttle services to 12 stops from South Village to campus core, and consists of one bus with a runtime of about every 15 minutes. The bus operates Monday-Thursday, 7:00 AM to 10:00 PM and Friday 7:00 AM to 6:00 PM. The Green Line travels the Perimeter Loop, provides weekday shuttle services to 18 stops from South Village and North Campus to the campus core, and consists of one bus with a runtime of about every 20 minutes. The Green Line operates the same hours as the Yellow Line (UNCC, 2015).

There are also 7 apartment buildings that provide shuttle services to and from the Main UNCC campus for their residents. UNCC determines where these shuttles can unload and pick up students, but does not regulate these private services in any other way.

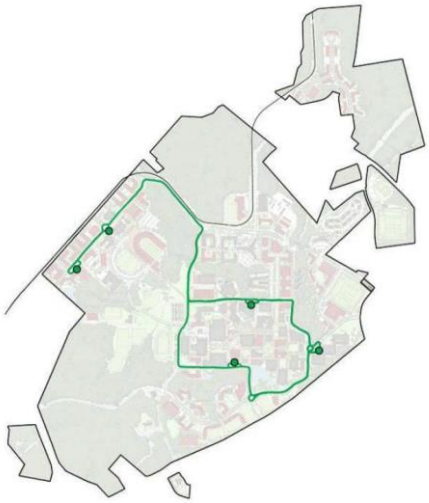
For after hours and for students with mobility limitations, UNCC started the Safe-Ride Program which runs from 6:00 PM to 2:30 AM. Started after requests from the student body in 2008, these are ADA-accessible vehicles that run a fixed route and are funded by student fees.

Map 12: Existing Shuttle Routes



Map 13: Proposed Core Shuttle Route

Map 14: Proposed CRI Shuttle Route



Pedestrian and Bicycle Circulation

All academic buildings in Campus Core are within a five-minute walk of the center of campus (Atkins Library) and residence halls are generally within a ten-minute walk. The Charlotte Research Institute (CRI) campus and Greek Village are slightly further with a fifteen-minute walk to Atkins Library. Although the size of campus is conducive to walking and bicycling, the changes in topography can make the walks seem longer and create challenges in building accessible walkways and gradual inclines for bicycling facilities (UNCC, 2011).

The highest concentration of pedestrian activity occurs between the parking lots and core academic buildings and between residence halls and Campus Core. The section of Mary Alexander Road that separates the East Decks from the academic buildings and University Road near the Cone Decks are highly trafficked by pedestrians. The Belk Tower Quad and the plaza near the Prospector are also well traveled by students during the day (UNCC, 2011).

Pedestrian travel on campus is often interrupted by roads and parking lots and an incomplete system of adequate sidewalks makes walking near vehicular traffic unpleasant. Off-campus, high traffic volumes; sidewalks that end unexpectedly, are missing on both sides of the road, or are not buffered from traffic; and poorly marked crossings make walking unpleasant and dangerous in some areas. There are plans to improve several of the key intersections around campus and pedestrian circulation within campus (UNCC, 2011).

According to the *UNCC 2010 Campus Master Plan*, only one percent of the University community (faculty, staff, and students) bicycles to campus. The university provides designated bicycle lanes and bicycle storage outside academic and residential buildings including: racks and 86 lockers located at the North Lot, South Lot, Lot #7 and CRI Lot that can be rented for $15/ semester or $40/ year for those who don't have a parking permit and free for those who do. However, the campus topography and road conditions surrounding campus limit biking to campus. Additional greenways and roadway

improvements in and around campus would provide a more pleasant, safer alternative to biking on the current road network and could increase the number of people biking to and on campus.

Safety on Transit, in Park-and-Ride Lots, and Approaching the Stations

CATS provides law enforcement on transit vehicles, at transit stations and at park-and-ride lots through the Transit Police using Charlotte-Mecklenburg Police Department officers and by contracting for private law enforcement. These police officers provide roving patrols at CATS facilities and on CATS vehicles. Surveillance of the transit stations is conducted through monitoring of Closed Circuit Televisions (CCTV) placed on each station platform and in park-and-ride facilities. Transit Police and Fare Inspectors provide roving fare inspection services on all CATS light rail vehicles and at CATS light rail stations. Blue light emergency phones are located on station platforms and throughout the park-and-ride facilities. Passenger assistance phones for non-emergency use are located on each of the ticket vending machines that are also located on the station platforms. Crime prevention through environmental design (CPTED) is used in the design of all of CATS facilities to increase natural surveillance. CATS is taking proactive measures to provide safe and secure transit operations by creating a center of activity at the transit stations that would provide the opportunity for increased pedestrian traffic and more natural surveillance of the transit facilities and the surrounding community, resulting in a positive impact on safety and security within the communities surrounding the stations. (EIS, 2011).

Vehicle, bicycle, and pedestrian safety provisions will also be made at new stations and along the transit corridor to minimize conflicts between automobiles, bicyclists, and pedestrians. Crossings will be clearly marked with signage and limited to dedicated locations. Rail crossing gates, which include an active warning system that will alert the control center of any interference with the gates, would be used to stop vehicles at the railroad tracks. Bicycle and pedestrian crossings will be provided at all street and rail crossings (EIS, 2011).

Environment

An environmental impact assessment was done as part of the planning of the Blue Line Extension, so this report will not include all of the findings of that analysis. However, it will consider the potential human health impacts that expected changes to the environment may cause. Topics of concern that were brought up during meetings with UNCC planning staff and the scoping workshop include impacts to Toby Creek and the surrounding floodplains, changes to the alignment of the Toby Creek Greenway, closure of the greenway during Blue Line construction, and expected changes to air pollution levels as a greater number of people use transit.

Water Quality and Stormwater Management

- Surfaces paved to accommodate more traffic result in increased urban runoff, which is responsible for:
    - 55% of environmentally impaired ocean shorelines;
    - 46% of impaired estuary miles; and,
    - 21% of impaired lake miles (American Public Transportation Association, 2011).
- As the amount of pavement per unit area increases, more precipitation runoff flows to urban streams and other catchments. Increased flooding is a problem indicative of explosive growth and not keeping up with the infrastructure or flood plain demarcation (Dannenberg, Frumkin, & Jackson, 2011).
- Flooding increases risk of human exposure to waterborne pathogens and chemical contaminants (CDC, 2008).
- The goal is to minimize storm water runoff and improve water quality. Strategies to accomplish this include rain barrels, roof gardens, and swales (Dannenberg, Frumkin, & Jackson, 2011).

Air Pollution

- Particle pollution is a mixture of microscopic solids and liquid droplets suspended in air. This pollution, also known as particulate matter, is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, soil or dust particles, and allergens (such as fragments of pollen or mold spores) (U.S. Environmental Protection Agency, 2003).
- Small particles less than 10 micrometers are worse for health because they travel deep into the lungs and into the bloodstream (U.S. EPA, 2003).
- Symptoms of exposure to air pollution include: irritation of nose, eyes, throat, bronchitis, asthma attacks, respiratory infections, coughing, wheezing, shortness of breath, fatigue, chest pain, heart attacks, and arrhythmia (depends on length of exposure and predisposition- health, age, etc.) (U.S. EPA, 2003).
- Those particularly at risk for exposure to air pollution include: children, seniors, and people with heart or lung disease (U.S. EPA, 2003).

- Avoid going outside and heavy exertion on bad particulate matter days. Avoid heavy traffic areas for physical activities and filter indoor air (U.S. EPA, 2003).
- Ozone is an odorless, colorless gas composed of three atoms of oxygen. Ozone occurs both in the Earth's upper atmosphere (good ozone) and at ground level (bad ozone). Bad ozone is formed when pollutants emitted by cars, power plants, industrial boilers, refineries, chemical plants, and other sources react chemically in the presence of sunlight (U.S. EPA, 1999).
- 1 out of 3 people are at higher risk for ozone-related health effects (children, those who are active outdoors, those with a respiratory disease, and those who are unusually susceptible to ozone) (U.S. EPA, 1999).
- Symptoms of ozone exposure include: irritation, coughing, reduce lung function, asthma attacks, lung inflammation, and damage to the lining of the lungs (U.S. EPA, 1999).
- During periods of time when ozone levels are above 0.12 ppm, it is recommended that no one participates in vigorous outdoor activity even for a short period of time. When ozone levels are between 0.08-0.12 ppm, even moderate exertion for a long period of time should be avoided (U.S. EPA, 1999).
- The Air Quality Index is a scale of 0-300 that indicates the amount of air pollution that is forecasted or measured and how that affects health. The higher the AQI value, the greater the amount of pollution that is present in the outdoor air and the greater the health concern. The two pollutants that are commonly represented in the scale are ozone and particulate matter (U.S. EPA, 1999).

AQI Color Code	AQI Value	Air Quality
Green	0-50	Good
Yellow	51-100	Moderate
Orange	101-150	Unhealthy for Sensitive Groups
Red	151-200	Unhealthy
Purple	201-300	Very Unhealthy

Greenways and Exposure to Nature

- Living in close proximity to parks, trails, and private recreation facilities is related to recreational physical activity (Bauman & Bull, 2007; Kaczynski & Henderson, 2007). For every quarter-mile increase in distance from people's homes, the likelihood of using a trail decreased by 42% (Troped et al., 2001).
- Use of trails is significantly associated with meeting physical activity recommendations (Deshpande et al., 2005).
- The presence of more greenspace in a person's living environment is associated with enhanced feelings of safety, except in very dense urban areas (Maas et al., 2009).

- Places without nearby nature- that is, places that provide few opportunities to recover from mental fatigue- are more likely to be associated with higher levels of incivilities, aggression, and violence (Kuo & Sullivan, 2001).

- Seasonal affective disorder (SAD) takes place when low levels of daylight lead to seasonal depression (Beauchemin & Hays, 1996). Signs of SAD include sadness, depression, anxiety, irritability, loss of interest in usual activities, withdrawal from social activities and inability to concentrate (Cleveland Clinic, 2010).

- The health benefits of exposure to nature include attention restoration, stress reduction, child development, social support/interactions, physical healing, disease prevention (joint pain, depression, anxiety, headaches, heart disease, diabetes, asthma), cooling, etc. (Dannenberg, Frumkin, & Jackson, 2011).

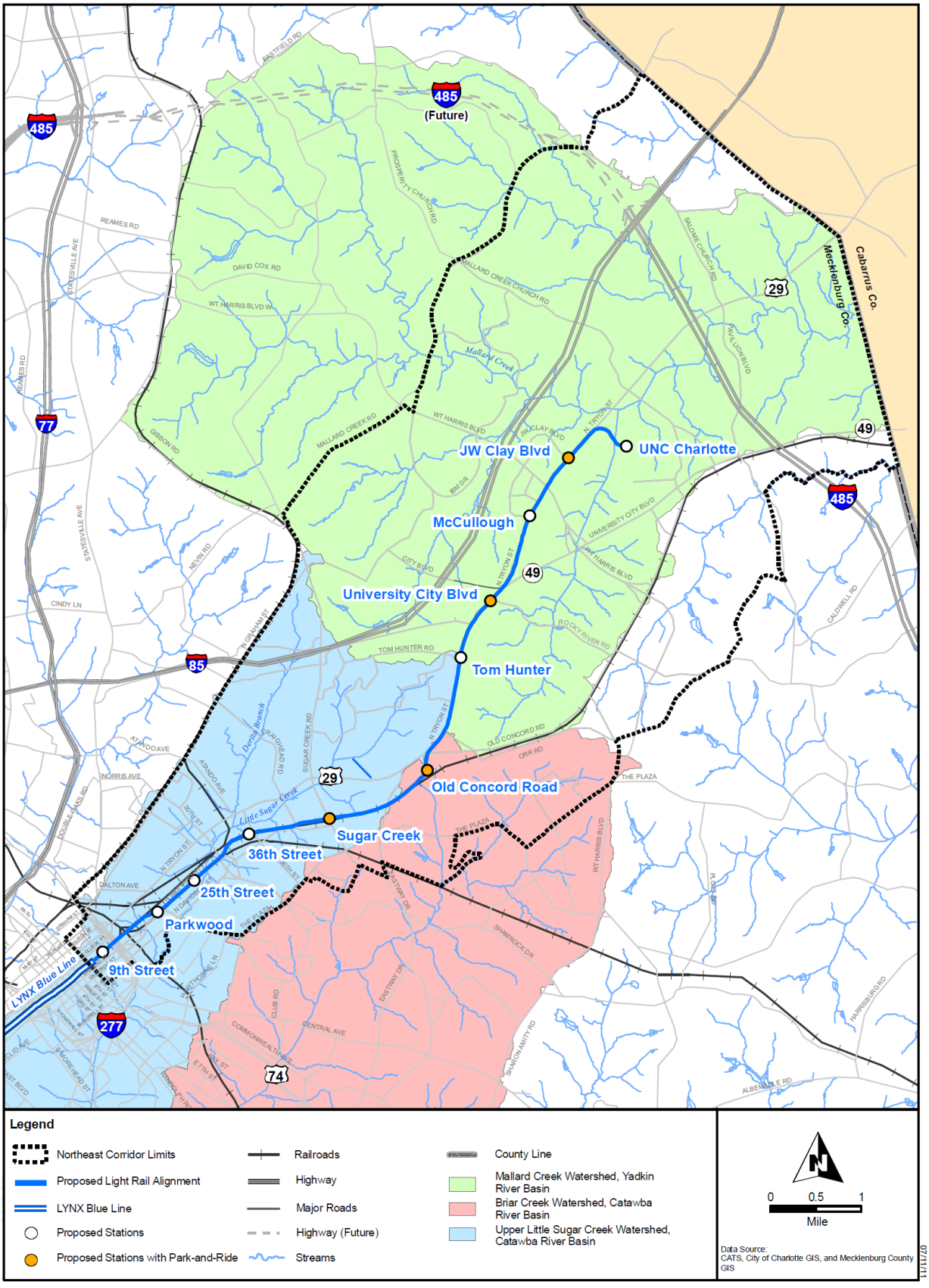
Water, Flood Plains, Stormwater Management

UNC Charlotte is located within the Mallard Creek Watershed with two sub-watersheds, Toby Creek and the stream flowing through the Susie Hardwood Garden, running northward through campus and emptying into Mallard Creek at the northern edge of campus (UNCC, 2011). Toby Creek is considered an impaired stream for biotic life and fish tissue (US EPA, 2014). According to the Environmental Impact Assessment conducted on the Blue Line Extension Project: 3,304 linear feet of streams and 0.462 acres of wetlands will be impacted, with 0.02 acres of the right of way being within the FEMA floodway, 0.24 acres within the Community Encroachment Area, and 2.18 acres within the Community Floodplains. There are no anticipated impacts to the groundwater.

Roughly 100 acres of the campus's 900 acres contain floodplains, wetlands, or streams. The volume of stormwater run-off from parking lots and other impervious surfaces is of particular concern as it erodes streambeds and contributes to the pollution and flooding of Toby Creek. Toby Creek is 20-25 feet wide, with a bank height of 8 -10 feet, and bottom of sand, silt, cobble, and rock. High flow has been observed with depths greater than 24" and fish have been observed (BLE EIS, 2011). Phillips Road, which connects the Main Campus Core to the CRI campus, has been flooding regularly since Fall 2008, essentially cutting off access to the two campuses. (UNCC, 2011). The Blue Line Extension will require a bridge crossing of Toby Creek impacting 734 square feet of FEMA Floodway, 10,263 square feet of Community Encroachment Area, and 36, 501 square feet of Community Floodplain (BLE EIS, 2011).

Recommended mitigations to minimize impacts to the streams and water quality include limiting the use of riprap at pipe inlets and outfalls, relocating channels using natural channel design techniques, and preserving stream banks at proposed bridge crossings. Coordination with the City of Charlotte's Stormwater Services to minimize impacts to water resources and water quality during the station area planning process is also recommended within the Environmental Impact Statement (EIS, 2011).

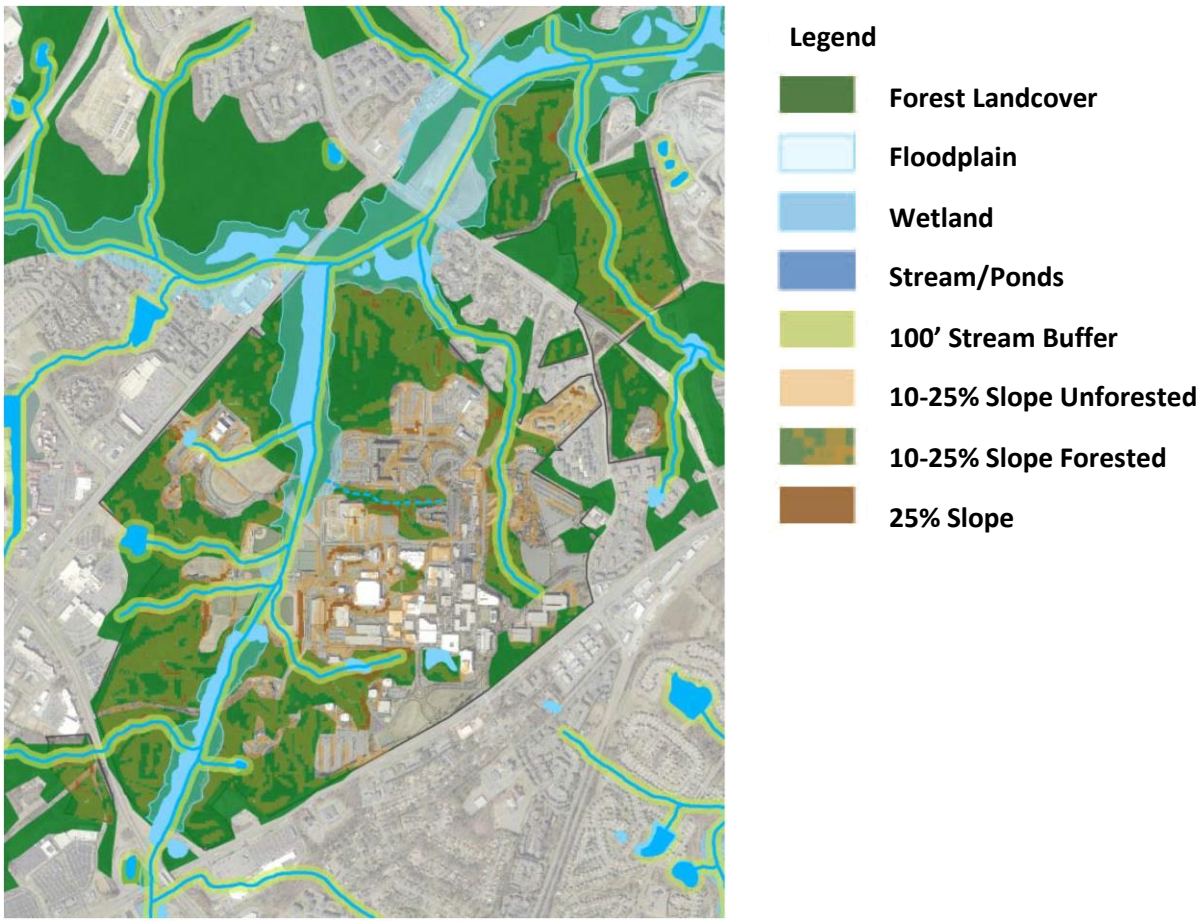
Map 15: Watersheds around Blue Line Extension



Topography

Campus is also greatly shaped by its topography with a 160-foot difference between the southeast edge (high) and the west side (low) of campus. The lowest elevation is along Toby Creek and steep slopes (greater than 25%) occur in a number of areas on campus making campus development difficult. One of the university's greatest challenges will be connecting the Campus Core to the CRI campus located on the western edge of campus near Tryon Street for pedestrians and bicyclists (UNCC, 2011).

Map 16: UNC Charlotte Floodplains, Streambeds, Wetlands, and Forest Cover



Forest Cover

In total, it is estimated that the Blue Line Extension will require the removal of 10.48 acres of mixed pine/ hardwood forests for a park and ride facility and for the UNC Charlotte alignment. Impacts will be mitigated with replacement trees and landscaping to replace the vegetation loss (BLE EIS, 2011).

Mecklenburg County Air Quality

Mecklenburg County's overall ambient air quality continues to improve. In 2012, the average annual air quality index (AQI) value for Mecklenburg County was 45, which equates to good air quality. From 2002 to 2012, the average annual AQI has progressed from 64 to 45 - a 27.9% improvement over the period. In 2012 there were 279 good days (76.5%), 77 moderate days (21%), and 9 unhealthy days (unhealthy for sensitive populations and unhealthy for all) (2.5%). The two primary contributors to the County's AQI value are particulate matter (PM 2.5) and ozone (O3) and the most significant sources of air pollution are mobile sources. Although PM 2.5 contributes to decreased air quality, the County meets national standards. Mecklenburg County achieved compliance with the 1997 ozone standard, but O3 levels violate the 2008 national standard of 0.075 ppm. (Mecklenburg County Land Use and Environmental Services Agency, 2014).

According to the 2014 Mecklenburg County State of the Environment Report, Mecklenburg County is improving in overall air quality, ozone, particulate matter, and NOx, SO2, CO, and lead levels. While overall air quality and NOx, SO2, CO, and lead levels are good, particulate matter levels are fair and ozone is poor (Mecklenburg County Land Use and Environmental Services Agency, 2014).

Figure 10: Air Quality Environmental Indicators

Ground-level ozone is the primary constituent of smog, and is the air pollutant of greatest concern in Mecklenburg County. Mecklenburg County was designated as a non-attainment area for the ozone National Ambient Air Quality Standards (NAAQS) (0.12 parts per million) in March 1978 and remained in non-attainment through the 1980's. Based on monitoring data collected from 1990 - 1992, Mecklenburg County was designated as attaining the 1979 NAAQS on July 5, 1995 (Mecklenburg County Land Use and Environmental Services Agency, 2014).

In July 1997, EPA revised the ozone standard to an 8-hour standard with a level of 0.08 ppm. The compliance value measured in the Mecklenburg County network from 2001-2003 was 0.098 ppm. Therefore on June 15, 2004, Mecklenburg County was designated non-attainment for the 8 hour NAAQS. Mecklenburg County demonstrated compliance with the 1997 ozone standard at the end of the 2010 ozone season with a compliance value of 0.082 ppm. In 2011, Mecklenburg County's compliance value remained below the 1997 ozone standard at 0.079 ppm. A Redesignation Demonstration and Maintenance Plan for the region was submitted to the U.S. Environmental Protection Agency (EPA) on November 2, 2011. The EPA announced on December 2, 2013 that it is taking final action to approve the state of North Carolina's request to redesignate the Charlotte area to attainment of the 1997 8-hour ozone standard. This action is based on air quality monitoring data for the three-year period of 2008, 2009, and 2010 that meets the standard. The area continues to attain this standard (Mecklenburg County Land Use and Environmental Services Agency, 2014).

On March 12, 2008, EPA again significantly strengthened the NAAQS for ground-level ozone. EPA revised the 8-hour "primary" ozone standard, designed to protect public health, to a level of 0.075 ppm. The 2010-2012 compliance value for Mecklenburg County was 0.083 ppm, which exceeds the level of the 2008 NAAQS (Mecklenburg County Land Use and Environmental Services Agency, 2014).

Figure 11: Annual Average Air Quality Index- Mecklenburg County, NC (2002-2012)

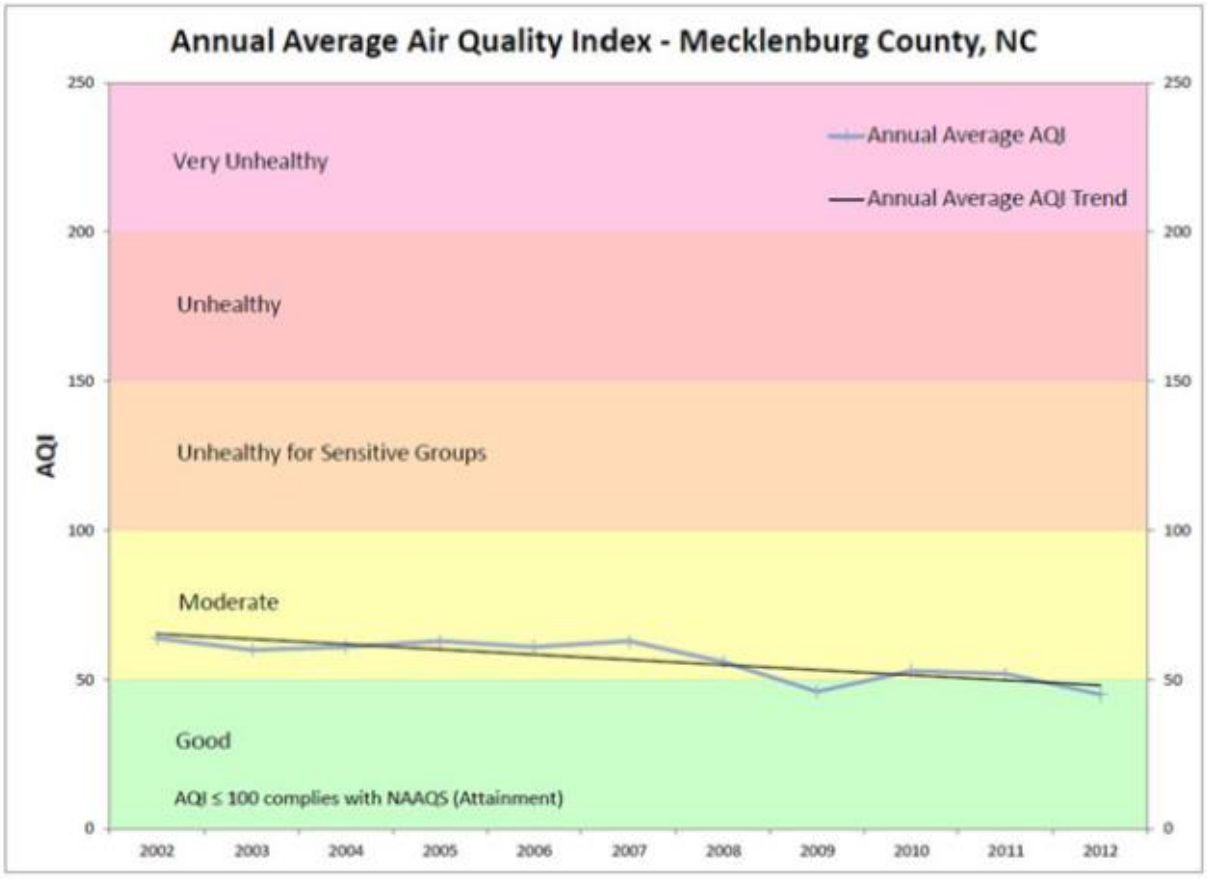


Figure 12: Ozone Air Quality Index Mecklenburg County, NC (2002-2012)

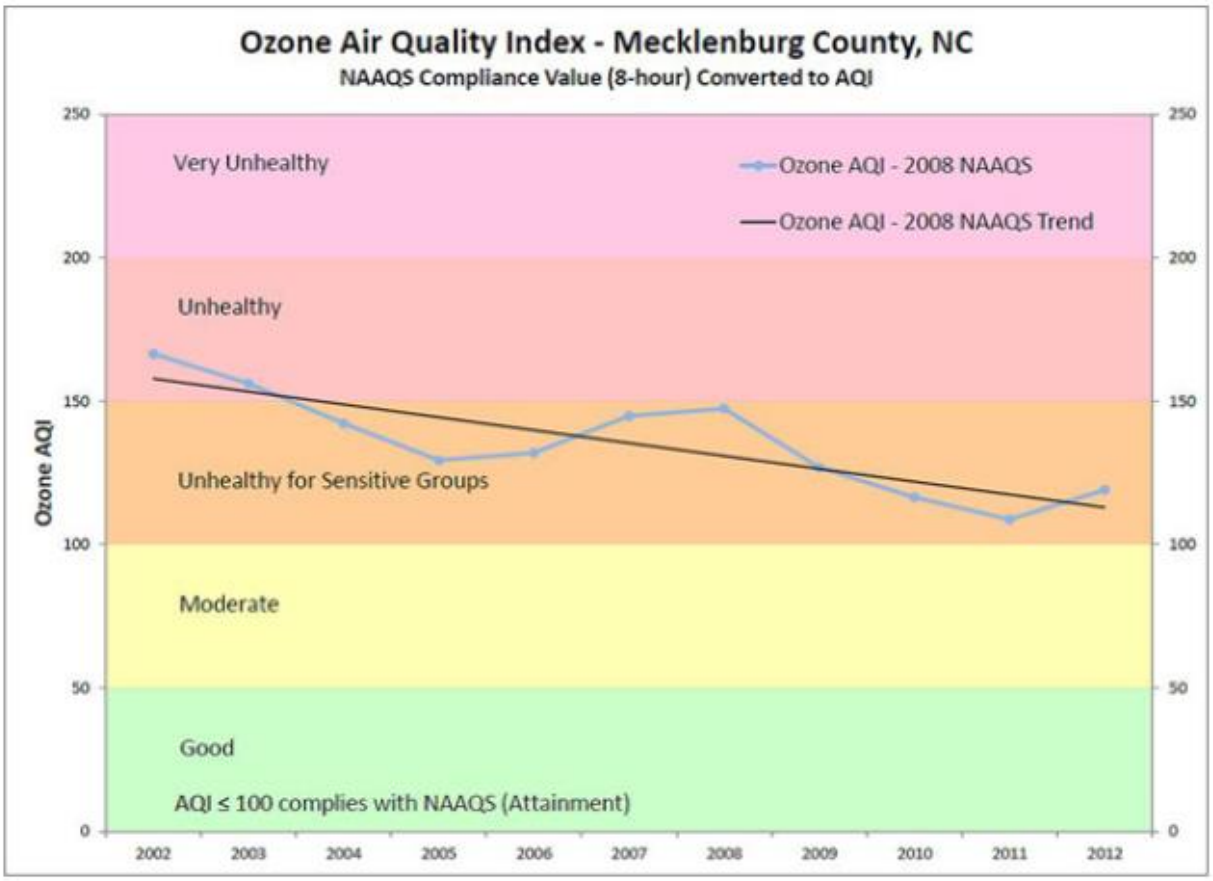
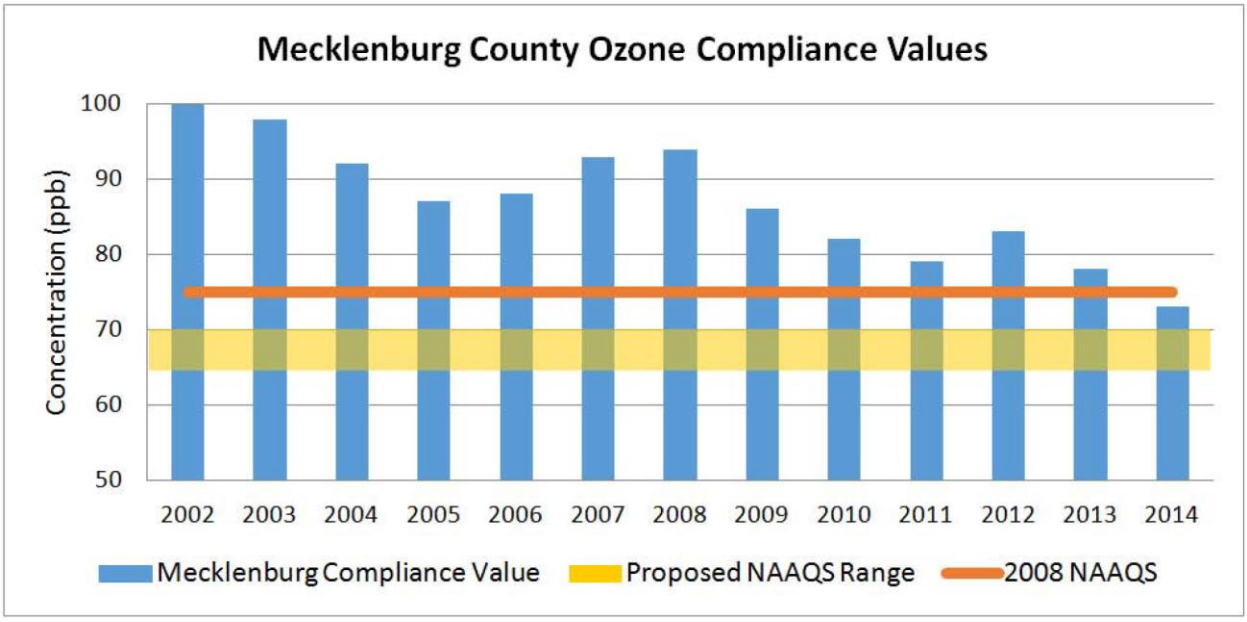
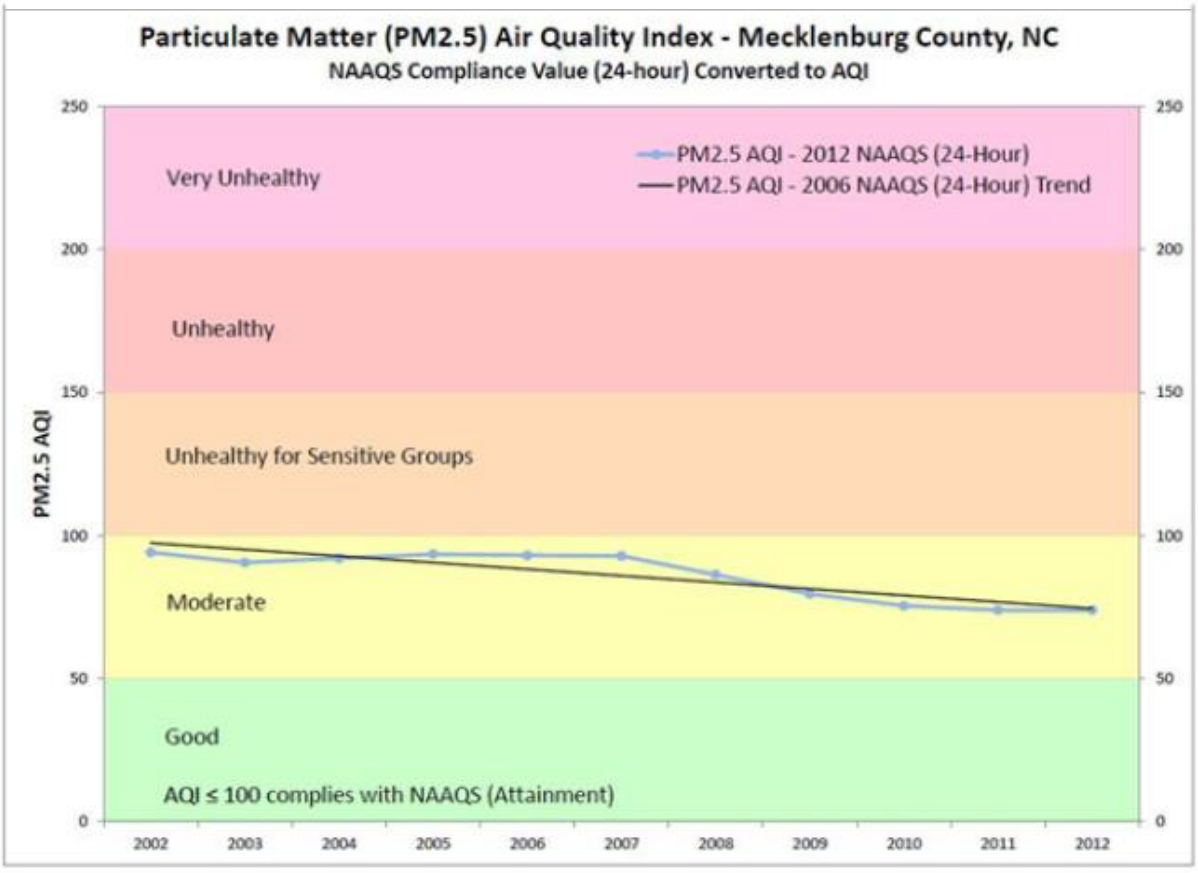


Figure 13: Mecklenburg County Ozone Compliance Values (2002-2014)



Particulate Matter (PM), also known as particle pollution, is a complex mixture of extremely small particles and liquid droplets. The size of particles is directly linked to their potential for causing health problems. The current 24-hour $PM_{2.5}$ standard is 35 micrograms per cubic meter (µg/m³) and the annual $PM_{2.5}$ standard is 12.0 µg/m³. The existing national 24-hour PM_{10} standard is 150 µg/m³. Mecklenburg County is currently in compliance with the NAAQS for PM_{10} and $PM_{2.5}$ (Mecklenburg County Land Use and Environmental Services Agency, 2014).

Figure 14: Particulate Matter (PM2.5) Air Quality Index Mecklenburg County, NC (2002-2012)



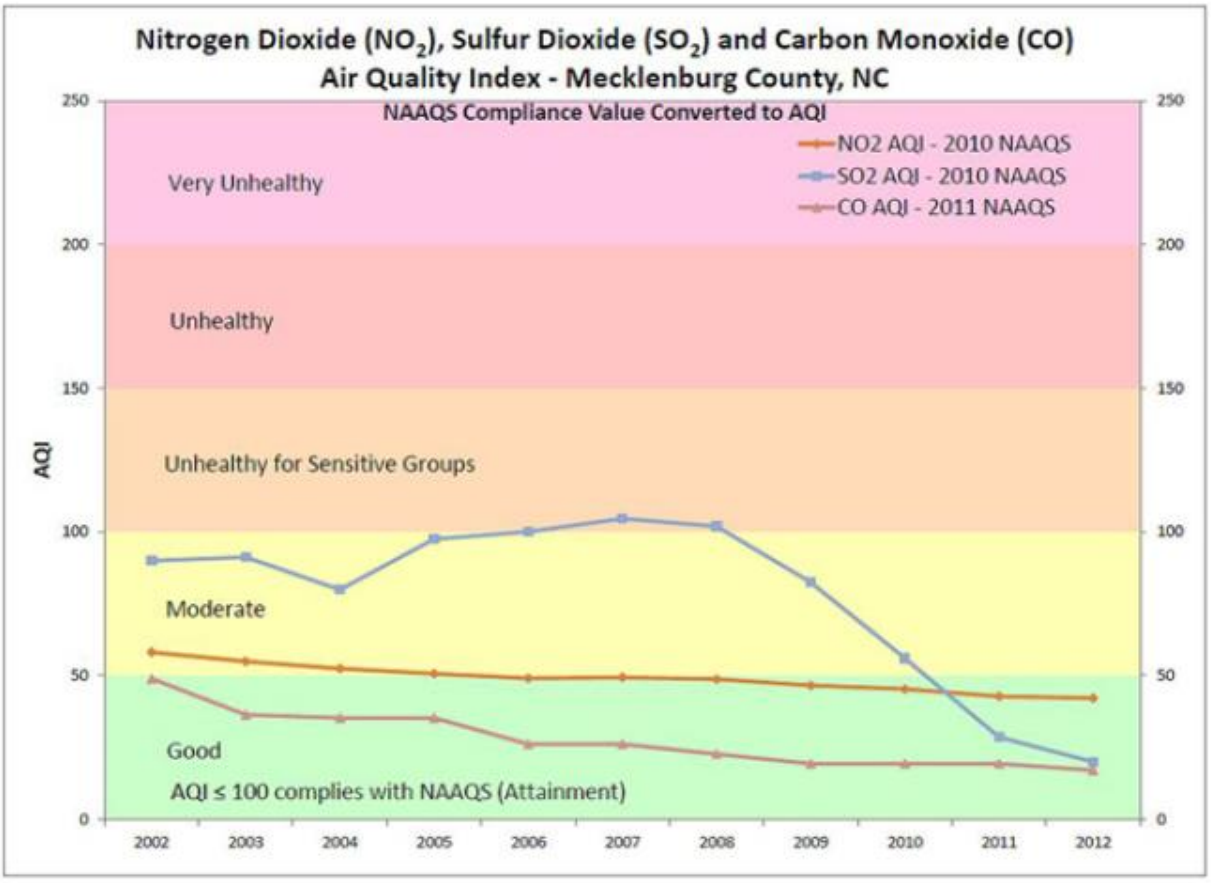
Nitrogen dioxide (NO_2) is one of a group of highly reactive gases known as nitrogen oxides (NOx). While the Environmental Protection Agency's National Ambient Air Quality Standards (NAAQS) covers the entire NOx group, NO_2 is the component of greatest interest and the indicator for the larger group of nitrogen oxides. NO_2 forms quickly from emissions from cars, trucks and buses, fossil fuel-fired power plants and off-road equipment. NO_2 is a key precursor to ozone formation. The NAAQS for NO_2 is a primary 1-hour standard of 100 parts per billion (ppb) and an annual standard of 53 ppb. Mecklenburg County meets the current NO_2 standards (Mecklenburg County Land Use and Environmental Services Agency, 2014).

Sulfur dioxide (SO_2) is one of a group of highly reactive gases known as "oxides of sulfur." It is produced from the burning of fossil fuels (coal and oil) and the smelting of mineral ores (aluminum, copper, zinc, lead and iron) that contain sulfur. The NAAQS for SO_2 is a 1-hour standard of 75 ppb and a 3-hour standard of 0.5 ppm. Mecklenburg County meets the current SO_2 standards (Mecklenburg County Land

Use and Environmental Services Agency, 2014).

Carbon Monoxide (CO) is a colorless, odorless gas that is formed when carbon in fuel is not burned completely. CO is a component of motor vehicle exhaust. Higher levels of CO generally occur in areas with heavy traffic congestion. In Mecklenburg County, the majority of all CO emissions come from motor vehicle exhaust. The NAAQS for CO consist of a primary 8-hour standard at 9 ppm and a 1-hour primary standard at 35 ppm. Mecklenburg County meets the current CO standards (Mecklenburg County Land Use and Environmental Services Agency, 2014).

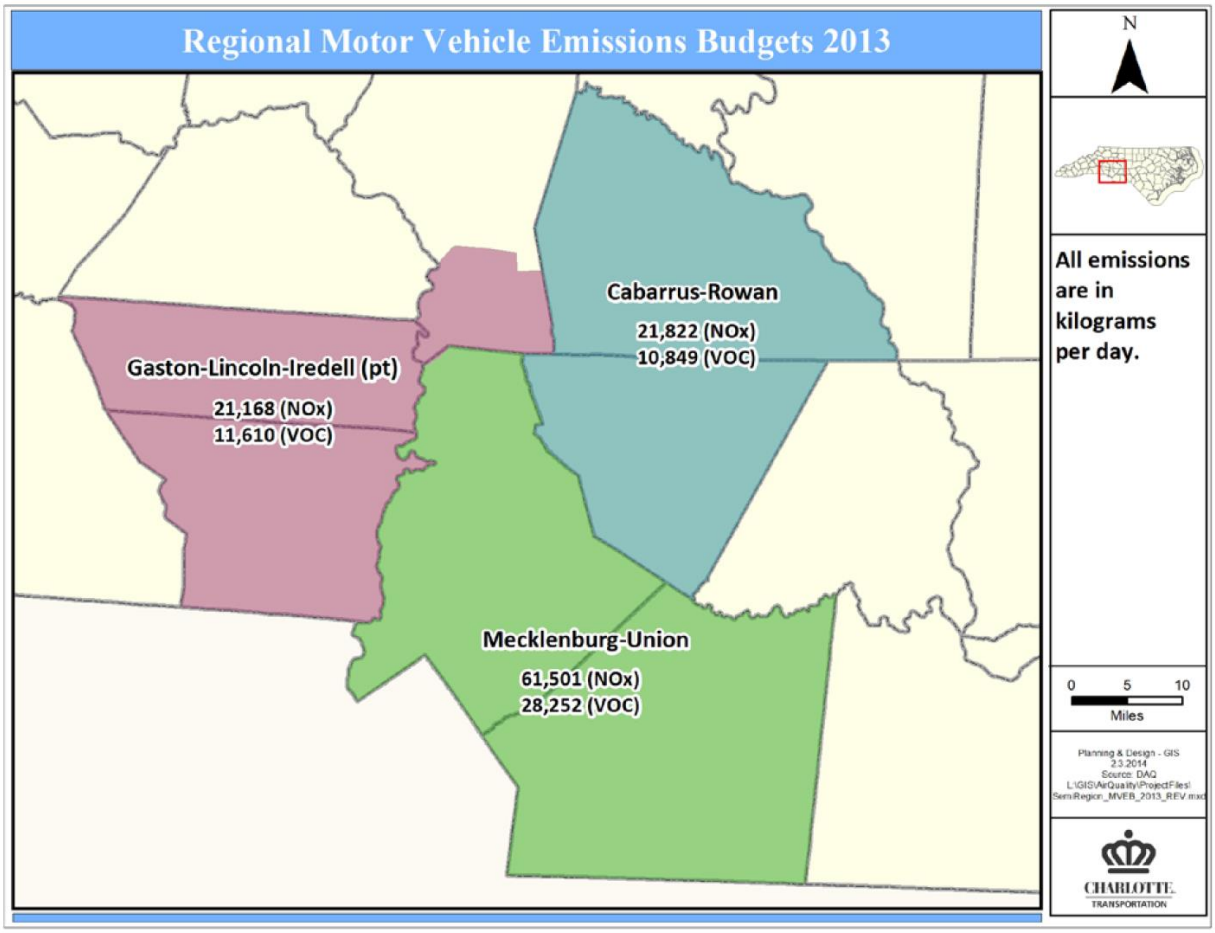
Figure 15: Nitrogen Dioxide (NO2), Sulfur Dioxide (SO2) and Carbon Monoxide (CO) Air Quality Index-Mecklenburg County, NC (2002-2012)



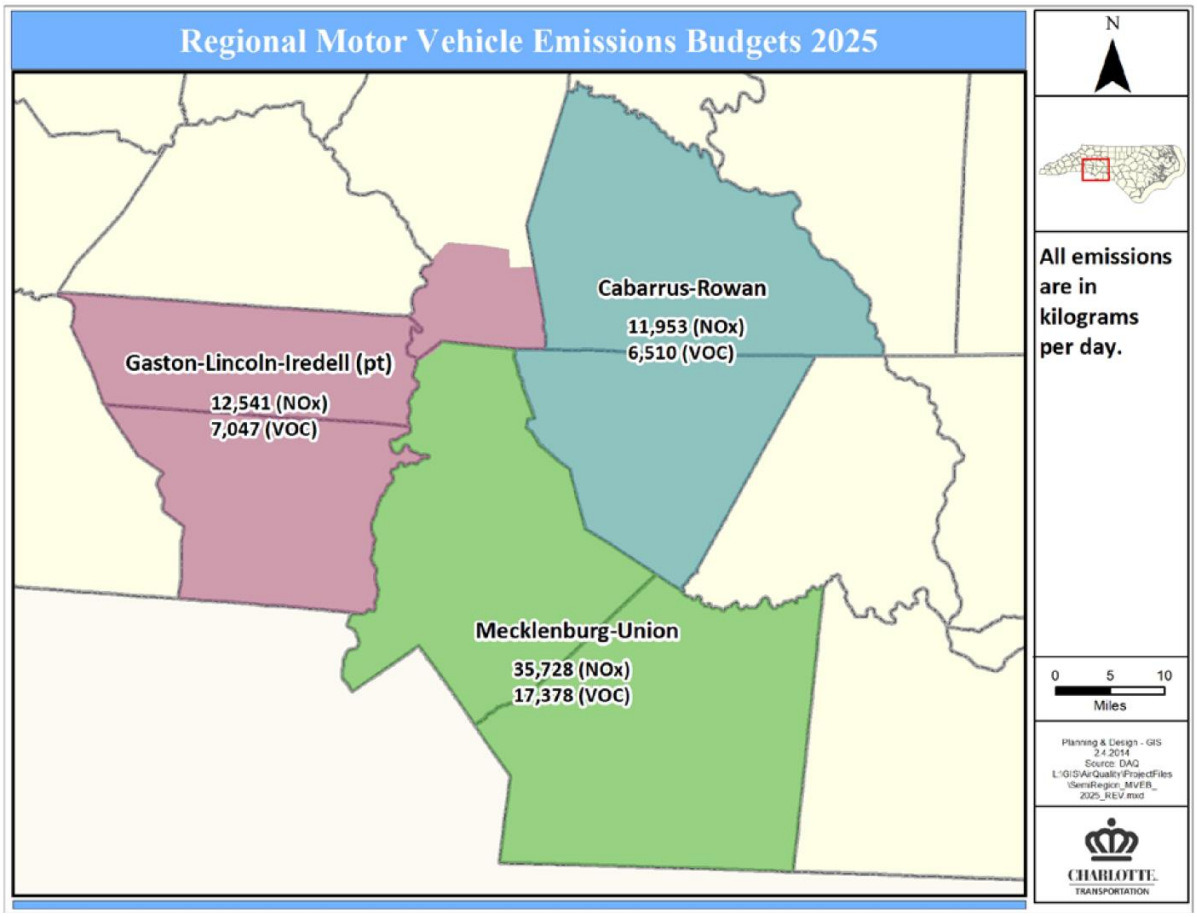
Lead is a metal found naturally in the environment as well as in manufactured products. The highest levels of lead concentrations are usually found near lead smelters. Other stationary sources that produce lead emissions are waste incinerators, utilities and lead-acid battery manufacturers. With almost no known lead sources, Mecklenburg County has not routinely conducted lead monitoring. On December 14, 2010, EPA revised the ambient monitoring requirements for lead which resulted in MCAQ implementing a lead monitoring network in 2011 to determine compliance with the revised NAAQS. The NAAQS for lead (Pb) is a rolling 3 month average of 0.15 µg/m3. The compliance value for the rolling three month average of Pb is 0.003 µg/m3. Mecklenburg County meets the current lead standard. (Mecklenburg County Land Use and Environmental Services Agency, 2014).

Because Mecklenburg County is part of the Mecklenburg-Union County non-attainment area for air quality, the North Carolina Department of Environment and Natural Resources developed the following regional motor vehicle emissions budgets that the Charlotte Regional Transportation Planning Organization must conform to for future transportation initiatives. Certain transportation control measures, including transit improvements and bicycle and pedestrian facilities, are exempt from these regulations and can be included in state implementation plans to meet NAAQS (Cabarrus-Rowan Metropolitan Planning Organization, Charlotte Department of Transportation, and the North Carolina Department of Environment and Natural Resources, 2014).

Map 17: Regional Motor Vehicle Emissions Budgets 2013



Map 18: Regional Motor Vehicle Emissions Budgets 2025



Blue Line Impact on Air Quality

The Blue Line Extension is expected to decrease vehicle miles traveled by 75 million miles/year (BLE EIS, 2011). The regional reduction in vehicle miles traveled would subsequently reduce annual CO, NOx and volatile organic compounds (VOC) emissions which will positively contribute to regional air quality.

Table 22: Comparison of Regional Emissions for the No-Build and Build Blue Line Extension, 2035

Factor	No-Build Alternative	Build Blue Line Extension	Change from No-Build
Annual Regional VMT (millions of miles/year)	33,971	33,896	-75
Annual CO Emissions (tons)	157,878	157,530	-348
Annual NOx Emissions (tons)	5,550	5,537	-13
Annual VOC	8,680	8,661	-19

Table 23: Existing Maximum Carbon Monoxide Concentrations at Intersections, 2009

Intersection	Maximum CO Concentration (ppm)		Location of Maximu CO Concentration
	1-Hour Average NAAQS-35ppm	8-Hour Average NAAQS-9ppm	
North Tryon Street/ US-29 and Sugar Creek Road	3.9	3.2	Receptor 14- At Sidewalk-west of Sugar Creek Road and approximately 130 feet north of North Tryon St./ US-29
North Tryon Street/ US-29 and 1-85 Connector	2.0	1.7	Receptor 2- Parking lot north of North Tryon St./ US-29
North Tryon Street/ US-29 and University City Blvd./ NC-49	1.9	1.6	Receptor 2- parking lot south of North US 29 Bypass Highway
North Tryon Street/ US-29 and W.T. Harris Blvd.	3.9	3.2	Receptor 8- Sidewalk north of North Tryon St./ US-29, about 100 feet east of W.T. Harris Blvd.

Table 24: Maximum Carbon Monoxide Concentrations at Intersections by Alternatives, 2030

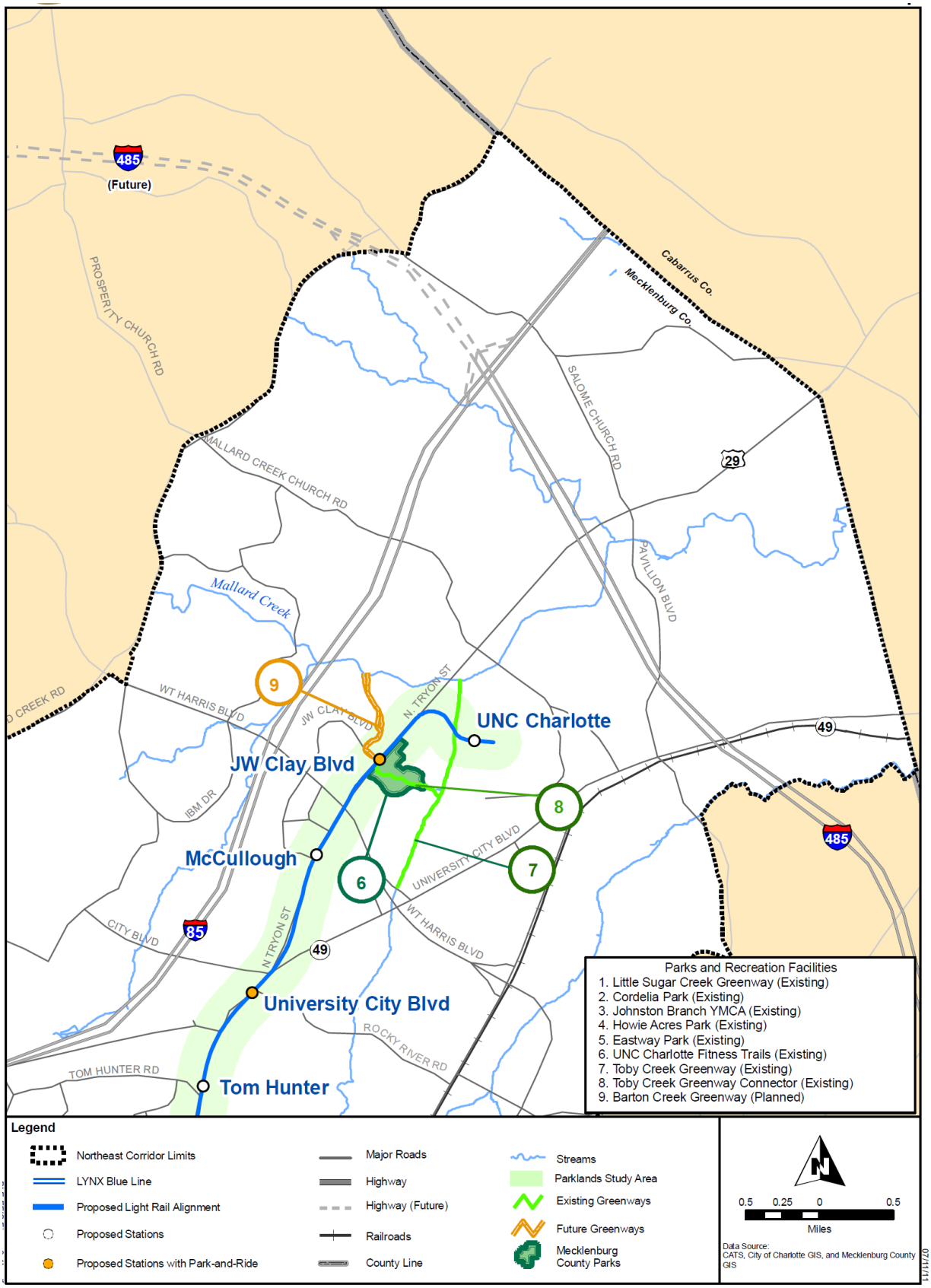
Intersection	1-Hour Average NAAQS-35 ppm		8-Hour Average NAAQS-9 ppm		Location of Maximum Concentration
	No-Build	Preferred Alternative	No-Build	Preferred Alternative	
North Tryon Street/ US-29 and Sugar Creek Road	2.5	2.6	2.1	2.2	At Sidewalk west of Sugar Creek Road and about 215 feet north of North Tryon St./ US-29
North Tryon Street/ US-29 and 1-85 Connector	1.6	1.7	1.3	1.4	Parking lot south of North Tryon St./ US-29
North Tryon Street/ US-29 and University City Blvd./ NC-49	1.7	1.7	1.4	1.4	Parking lot at northwest corner of North Tryon St./ US-29 and Statson Drive
North Tryon Street/ US-29 and W.T. Harris Blvd.	2.5	2.5	2.1	2.1	West of W.T. Harris Blvd. about 70 feet south of North Tryon St./ US-29

Toby Creek Greenway and Exposure to Nature

Toby Creek Greenway is a linear park that follows Toby Creek from University City Boulevard/ NC-49 through the UNCC Campus. Completed in 2011, the greenway is two miles of multi-use trail which connects to the Mallard Creek Greenway. Long-term plans involve connecting Toby Creek Greenway to the future Barton Creek Greenway on the west side of North Tryon Street/US-29 with the Toby Creek Greenway Connector. Toby Creek Greenway will also connect at its southern end across NC-49 to the Toby Creek II Project, providing another active transportation acces point to Main Campus. The Toby Creek Greenways and the eastern segment of the Mallard Creek Greenway will eventually be part of the 30.3-mile Cross Charlotte Trail, stretching from the Cabarrus County line south to the South Carolina line.

With the introduction of the Blue Line, there are expected long-term visual impacts to the Toby Creek Greenway that will be mitigated through the use of vegetative screens (Blue Line EIS, 2011). Generally, the Blue Line Extension is expected to increase access to parks and greenways; however, during construction, access to Toby Creek Greenway will be limited while the bridge crossing Toby Creek is built. Proposed forms of mitigation included providing an alternative route, attempts to coordinate closure during a period of least activity (such as the winter holiday when students and faculty are absent), and coordination between CATS and Mecklenburg County Parks and Recreation regarding communication about greenway closures.

Map 19: Parks and Recreation Facilities along the Blue Line Extension



UNCC Campus Policies

Although a lot of UNCC campus policies have overlapping literature and findings with the categories of housing and transportation (location of housing in regards to transit stations, improved bicycle and pedestrian amenities, safety around the stations, and changes to campus shuttles), other policies such as increasing enrollment of students due to improved connections to the Uptown Campus and ability to open up more classroom space for additional courses, changes to parking policies and parking lot provision, and fees for students to take the light rail and connecting forms of transit, have not been covered previously within the HIA.

Enrollment of Students, Higher Education, and Future Employment Opportunities

- Education is linked with health:
    - Health knowledge and behaviors;
    - Employment and income; and,
    - Social and psychological factors (RWJF: Commission to Build a Healthier America, 2009).
- Health knowledge and behaviors:
    - Those with greater level of education make better informed choices;
    - Participate in healthy eating, physical activity, and refraining from smoking or alcohol;
    - Respond faster to health advice, evidence, and campaigns;
    - Are able to live in less stressful neighborhoods with access to healthy foods and recreational facilities (greater health promoting environments equals more healthy behaviors); and,
    - Have higher health literacy- those with below basic health literacy increases from 3% of college graduates to 15% of high school graduates to 49% of adults without high school degree- those with higher literacy self-report better health (RWJF: Commission to Build a Healthier America, 2009).
- Better employment and higher income:
    - Those with a greater level of education are more likely to be employed- 15.5% unemployment for those without high school degree, 9.8% for high school graduates, 8.0% for some college, versus 4.7% for college graduates;
    - More likely to work in healthier working conditions leading to a differentiation in exposure risk, injury, fatality, psychosocial stress (perceived balance between workers efforts and rewards, perceived justice, and discrimination in the workplace, and social support among co-workers);
    - Obtain better employment based benefits such as sick days, personal leave, workplace wellness programs, child and elder care resources, retirement, health insurance; and,

    - Earn higher wages- each year of schooling represents 11% increase in income (2007 median yearly income was $32,862 for high school grad, $40,769 for some college, $56,118 for bachelor's degree), economic security, stress, ability to obtain wealth and resources (RWJF: Commission to Build a Healthier America, 2009).

- Social and psychological factors:
    - Those with higher education experience a greater sense of control- higher levels of self-rated health, lower levels of physical impairment, decreased risk of chronic conditions, health related behaviors;
    - Have greater social standing-greater educational attainment equals greater social standing which equals better health status and greater access to resources; and,
    - Increased social support including both emotional and practical support, more friends, greater family stability, more time and resources to support themselves and others, and better physical and mental health outcomes including stress reduction. Networks provide access to health promoting resources and healthy behavior norms (RWJF: Commission to Build a Healthier America, 2009).
- Education leads to better jobs and higher income, reduced risk of illness, increased vitality, longevity, and better school success for future generations (RWJF, 2013).
- College graduates live at least five years longer than individuals who have not finished high school (RWJF, 2013).
- The better educated are less likely to die from acute or chronic diseases, less likely to be overweight or obese, and report more positive health behaviors (including smoking) (RWJF, 2013).
- Asthma and aggression are associated with lower school performance which disproportionally impact lower-income, urban, minority youth (RWJF, 2013).
- Infant mortality rate among children born to women who never graduated from high school is nearly double college educated women (8.1% and 4.2%) (RWJF, 2013).
- 13.3% of children of parents with no degree get a college degree (compared to nearly half of children of parents with a degree) (RWJF, 2013).
- Improving health through education policies and programs:
    - Education is key to promoting social mobility and breaking cycle of intergenerational disadvantages and related health disparities;
    - If the U.S. equalized the gaps between non-college graduates and college graduates, the nation would experience $1 trillion in potential gains annually in better health and life expectancy; and,
    - Closing the gap in educational attainment is key to decreasing health disparities (RWJF: Commission to Build a Healthier America, 2009).

- The better educated are less likely to self-report a past diagnosis of an acute or chronic disease, less likely to die from the most common acute and chronic diseases, and are less likely to report anxiety or depression (National Poverty Center, 2007).
- More education reduces risk of :
    - Heart disease by 2.2 percentage points (base 31%); and,
    - Diabetes by 1.3 percentage points (base 7%) (National Poverty Center, 2007).
- 4 additional years of higher education:
    - Lowers probability of fair or poor health by 6 percentage points (mean of 12%);
    - Reduces lost days of work to sickness by 2.3 days each year (5.2 average); and,
    - Increases reports of more positive health behaviors- less likely to smoke (11 percentage points with mean 23%), drink a lot (7 fewer days of 5+ drinks base of 11), less likely to be overweight or obese (5 percentage points average 23%), or use illegal drugs (0.6 percentage points average 5%) (National Poverty Center, 2007).
- American adults spend more than half their waking hours at work (RWJF, 2013).
- Good paying, stable jobs are associated with the ability to live in healthier neighborhoods, provide quality education and child care for their children, and buy nutritious foods (RWJF, 2013).
- Good jobs equal good benefits with 54% of workforce receiving health insurance from employment (RWJF, 2013).
- Higher earnings result in a longer lifespan- since 1977 life expectancy of male workers retiring at age 64 has risen 5.8 years in the top half of the income distribution, but only 1.3 years in the bottom half (RWJF, 2013).
- There are 12.3 million unemployed Americans as of Oct 2012 (5 million for 27 weeks or more). The unemployed are 54% more likely to have fair or poor health, and 83% more likely to develop a stress related condition, such as stroke, heart attack, heart disease or arthritis (RWJF, 2013).
- The unemployed are far more likely to be diagnosed with depression and report feelings of sadness and worry (RWJF, 2013).
- There are 10.5 million Americans who are underemployed and are less likely to have health insurance coverage and less likely to access preventive care services such as screenings for blood pressure and cholesterol (RWJF, 2013).

Provision for Parking

- In a study done at UC Berkeley on parking pricing and staff and faculty travel patterns:
    - Parking pricing was seen as a potentially effective transportation demand management tool;

- Prices of parking neither reflected the true cost of parking nor the actual demand of parking; and,
- Parking price had uncertain impacts on different social groups.
- Other studies had shown that increasing parking pricing decreased parking demand (San Francisco, Portland, Toronto, Dublin, Sydney) and removing parking subsidies decreases solo driving trips (15-38% in Los Angeles and 60% in Portland).
- At the time of the study 49% of faculty and staff drove alone with 70% of those driving preferring to park in a campus parking garage or lot.
- Factors influencing parking preference included: opportunities to walk from off-site parking locations, whether they were a part-time or full-time employee, expense, anxiety about finding a space, and the safety of the parking location.
- Factors influencing travel mode choice included: transit pass availability and cost, transit reliability, and availability of campus transit subsidies.
- Socioeconomic factors associated with the purchase of a monthly parking pass included university affiliation (staff more than faculty were likely to choose monthly passes), income (higher income preferred monthly and daily options more than hourly), and age (older employees more likely to choose unlimited monthly parking options than hourly options).
- The more time spent on campus also impacted whether employees chose a monthly parking pass or daily parking options.
- The study's conclusions included:
    - Changes in pricing have to be coupled with other incentives to be effective;
    - Free off-campus parking locations serve as alternatives to on-campus parking and influence the impact of parking pricing;
    - The frequency of commute trip and duration of the stay on campus affects parking location type; and,
    - The differences in value placed on walking time provided insights to optimal parking locations (Ng, 2014).

- Universities usually have fewer parking spaces (supply) than the number of commuters who wish to park on campus (demand). Therefore, universities can be expected to behave similarly to central business districts (Bond & Steiner, 2006).
- In larger cities (which averaged $1.00/hour in on-street parking costs, allowed up to 2 hours parking, charged $11/day in commuter lots, and had fines ranging from $25 to $200 for parking violations- minor to handicapped parking violations), higher parking costs were associated with a 2.3-fold increase in public transit miles, after adjusting for economic features of each city. (Auchincloss, Weinberger, Aytur, Namba, & Ricchezza, 2014).

- Free work-site parking is associated with lower probability that workers would use transit and higher probability that workers would drive alone (Badland, Garrett, & Schofield, 2010; Hess, 2001).
- In Portland, Oregon there are no minimum parking requirements for multifamily residential, commercial, and institutional structures located less than 500 feet from a transit stop with twenty-minute peak hour service. Bicycle parking may also substitute for up to 25 % of public parking and the amount of parking supplied is regulated by parking caps (Dannenberg, Frumkin, & Jackson, 2011).
- In San Francisco, parking in residential units were unbundled from the cost of housing, making housing more affordable. Additionally, parking spaces were reserved for car-sharing organizations to meet the needs of those who could not afford or decided against full-time car ownership (Dannenberg, Frumkin, & Jackson, 2011).
- The cost of parking passes on campuses ranged from $14 to $300 a semester with a mean of $83.43 (Gutkowski & Daggett, 2003). Even at schools with higher parking pricing, the universities are not recovering 100% of the cost to provide parking: salaries of parking personnel, accounting, construction costs, and loss of available land (Bond & Steiner, 2006).
- At the University of Florida, 19,371 spaces are divided among students, faculty, and staff (5,094 for students who live on campus, 7,719 for faculty and staff, and 6,558 for students off campus). Parking decals are sold at a ratio of 1.43 to 1 for parking spaces available (even worse in prime areas with a ratio of 2.7 to 1). Due to limitations in parking, parking prices, and increased access to transit and lower transit costs, the numbers of students arriving on campus by bus more than doubled the number of students who arrived by car (Bond & Steiner, 2006).

Fees and Transit Use

- In a study of the UCLA BruinGO Unlimited Access program:
    - The Unlimited Access program is an agreement between UCLA and the Blue Bus Service where the university pays for each transit ride ($0.45) when students, faculty or staff swipe their campus cards. Payment for the transit rides is taken from revenue earned from parking fees and permit sales.
    - Started with an eight month pilot program with a total fare payment of $64,000 for 62,700 eligible riders (36,900 students and 26,800 staff and faculty) or a rate of $1.27 per person per month.
    - There are 3 goals of BruinGo
        - Increase bus ridership to campus;
        - Reduce vehicle trips to campus; and,
        - Reduce parking demand on campus.
    - Faculty and Staff Commuting:

        - Between 1995 and 2000, the bus share for faculty and staff commuting declined in every year but one, and fell from 9.2% in 1995 to 7.6% in 2000.
        - Bus share jumped from 7.6% to 13.1% in 2001 after implementing the BruinGo program- 73% increase in one year or estimated 1,163 new bus riders.
        - Changed from 1 bus commuter for every 5 solo drivers to 1 bus rider for every 2 solo drivers.
        - For every 100 commuters, 11 began to ride the bus after BruinGo initiated- 4 switched from solo driving, 4 from carpools, 2 from vanpools, and 1 from biking or walking.
    - Student Commuting:
        - Bus share rose from 17% to 24% and driving alone fell from 17% to 12%.
        - For every 100 students- 7 began to ride the bus and 2 began to walk, 5 switched from solo driving, 2 switched from bicycles and 1 switched from carpools.
    - Estimated a 10% reduction in fair would increase bus ridership by 2.8%.
    - Long-term ridership increases due to: service improvements, greater familiarity with the transit system, and changes in residential choices.
    - Parking Demand:
        - Before BruinGO began, 3,400 faculty and staff and 3,000 students drove to campus alone from within the Blue Bus service area. Changed to 3,100 faculty and 2,000 students with BruinGO- 1,300 fewer drivers/parking spots needed.
        - Reduced demand- 1,332 students left the parking wait list.
    - Non-commute Trips:
        - Staff to get to off-campus worksites; and,
        - Students to cultural activities, internships, volunteer work, beach, etc.
    - Cost Benefit Analysis:
        - Cost- $810,000 total cost- taken from parking fees and parking permit sales (17% students, 25% faculty and staff, 4% university departments, and 54% campus visitors).
        - Benefits-
            - Reduced fare payments- savings to riders- total $524,000 ($409,000 for existing riders and $115,000 for new riders) seen as an increase in financial aid packet for students and does not include savings from not needing a parking permit or in some cases a car.

            - Reduced parking demand- savings to campus for not having to build a new 1,500 car parking structure- $31,500 per space- estimated $32.1 million in parking demand savings or $2.7 million per year in parking savings.

        - Total quantified net benefits of $2.4 million a year or a benefit/cost ratio of 4 to 1. Estimated student benefit/cost ratio was estimated at 6.3 to 1.

        - Unquantified Benefits-

            - Quicker boarding times for card swipe versus coins and saved vehicle operating hours ($26,000/year); and,

            - Fewer vehicle trips and air pollution (1.5 million trips and 87 tons of CO, 9 tons of NO, 14 tons of reactive organic gases, and 7 tons of particulates) (Brown, Hess, & Shoup, 2003).

- In a study of the Transit Partnership and Transportation Demand Management System of University of Florida:

    - Universities and colleges have unique transportation needs:

        - They desire a walkable and green campus;

        - But parking often breaks up the campus landscape and occupies space that could be devoted to classrooms or laboratories; and,

        - Campuses tend to have a steady flow of commuters versus a city's transportation spikes.

    - Rising costs for constructing and administering transportation infrastructure is detracting from the university's primary mission of academics (Balsas, 2002). Therefore many universities are working to create a modal shift away from the automobile.

    - The University of Florida is implementing four Transportation Demand Management (TDM) strategies to create a substantial modal shift: parking restrictions, parking pricing, unlimited-access transit, and transit service improvements.

    - Individual TDM strategies have a modest impact on the transportation system, but when multiple strategies are applied in a coordinated manner the impact on mode choice can be substantial. Further, when multiple strategies are applied, the negative impacts on individual users are mitigated (Litman, 1999).

    - Transit Service Improvements:

        - Increased frequency

            - Twice as important as fare cost according to Cervero, 1990.

            - For every 10% in frequency, ridership goes up by 5% according to Evans, 2004.

        - Direct routes from home to work (Mierzejewski, 1990)
            - New routes effective in capturing new riders within a quarter mile radius according to Johnson, 2003.
            - Direct and express routes are also a powerful attractor for commuters (Mierzejewski, 1990).
    - Unlimited-Access Transit:
        - In practice since the late 1970s on campuses.
        - Free transit should theoretically increase ridership by a third (Curtin, 1986) but in practice ridership gains have been closer to 50% due to concurrent implementation of other TDM policies (Hodge et al., 1994).
        - Meets both needs to increase transit ridership and reduce parking demand (Brown et al., 2003).
    - University of Florida specifically:
        - Total enrolment of 47,373 students in 2003-2004 academic year with 28% being graduate or professional students and 72% undergraduates.
        - Over 4,000 faculty and 8,000 other staff members.
        - 58,000 people regularly commute to campus.
        - Bus transit is provided by the City of Gainesville by the Regional Transit System which has experienced growth in transit ridership since 1995 with a peak increase in ridership with the unlimited access program established in 1998.
        - Over the study period of 1995-1996 to the 2002-2003 academic year, ridership increased 284% to 8,106,964 boardings per year- mainly in the form of increased ridership from off-campus and the introduction of special routes serving student needs.
        - Funding for the unlimited access program includes maintenance of baseline services from the City of Gainesville, $1.5 million from parking fines and permit sales, and $5.26 million from a student fee based on credit hours ($4.10/credit hour in 2004-2005) for service enhancements (increased frequency, extra routes, later hours, etc.).
        - The Later Gator program, which offered routes Wednesday through Saturday from 8:30 pm to 3:00 am, accomplished three goals- increase transit use, reduced frequency of driving under the influence, and alleviated parking shortages in primary districts for late evening activity (Bond & Steiner, 2006).

Enrollment of Students at UNCC

As of Fall 2014, there are over 27,200 students enrolled at UNCC with aspirations to increase enrollment to 35,000 by 2030. Of the 22,216 undergraduate students, 85% are full-time (18,983) and the remaining 15% are considered part-time students (3,233). In addition to the undergraduate population there are 5,022 graduate students enrolled at UNCC with 45% of graduate students being full-time students (2,284) and 55% part-time (2,738).

Of the 15,610 new freshman applicants, 64% were admitted and 33% of the admitted students enrolled at UNCC in Fall 2014. Of the 5,345 transfer applicants, 82% were admitted and 63% of the admitted students enrolled at UNCC in Fall 2014. Annual tuition for in-state students for the 2014-2015 Academic Year was $3,522 for a full-time undergraduate student. Out-of-state tuition costs increase significantly to $16,693. The student to faculty ratio is 19 to 1 and 76% of undergraduate classes have fewer than 50 students. There are 1,076 full-time instructional faculty members and 83% of faculty have the highest academic degree offered in their field of study.

There were 5,898 degrees awarded in the 2013-2014 academic year with 4,362 being Bachelor's degrees, 1,413 Master's degrees, and 123 Doctoral degrees. Main areas of study for bachelor's degrees include general psychology (7%), finance and financial management services (6%), communication and media studies (6%), and criminal justice and corrections (6%). There are 79 bachelor programs, 64 master program, and 21 doctoral programs at UNCC (College Portrait, 2014).

Parking Fees and Availability

As of 2011, UNCC maintained 11,766 parking spaces on campus divided between six parking structures and multiple surface parking lots. Parking structures tend to be located close to the academic buildings in the Core Campus and available to visitors, commuters, faculty, and staff. Surface lots are located adjacent to residence halls and provide parking for resident students. Additional surface lots for commuter students can be found along John Kirk Drive, High-Rise Road, Cameron Boulevard, and University Road (UNCC, 2011).

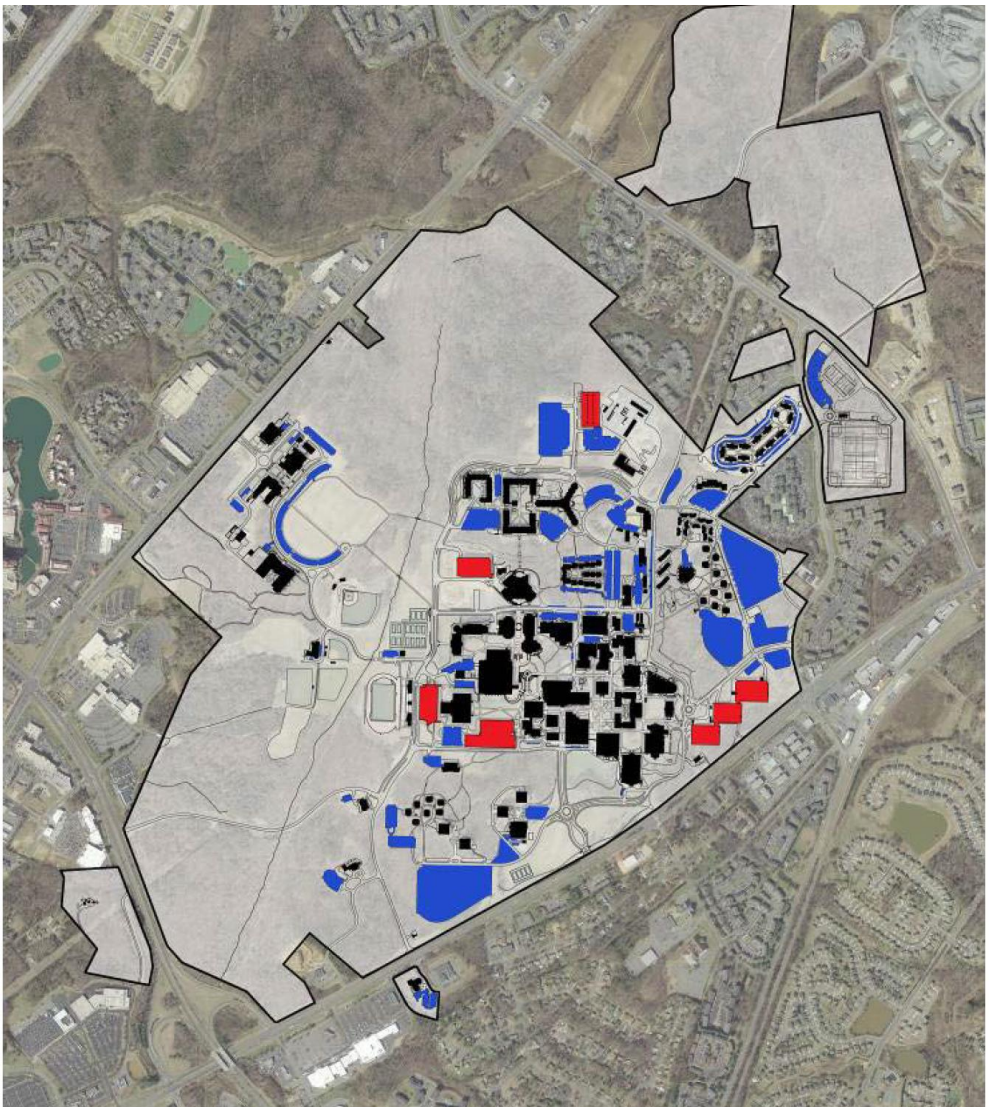
Most faculty, staff, and students purchase parking permits- approximately 17,000 permits are sold each year. According to a survey conducted in 2008, 91% of faculty and staff, 72% of commuter students, and 67% of resident students purchased a parking permit (UNCC, 2011). According to the Blue Line Extension Questionnaire, 86% of those who drive alone or carpool to campus, park on campus (See Appendix 4). Parking permits range from $210 for a remote lot parking permit to $450 for a full year permit for faculty, staff, and students starting at the beginning of the fall semester. A full permit allows students to park in a yellow or orange lot 24 hours a day, seven days a week. Faculty with a full permit can also park in any of these lots and most residential lots. For an additional $150, faculty can also have Premium Lot Access which includes Cone Decks 1 and 2, the Union Deck upper levels, CRI Lot 3, East Deck 1, and Lot 15. Students who commute to campus only two days a week for (Monday and Wednesday or Tuesday and Thursday) can also purchase a 2 day permit for $165 (UNCC, 2015).

The sale of parking permits provides 100% of the revenue for the UNCC Parking Services Offices. Currently there is a surplus of available parking with 3,500-4,000 extra spaces available during peak hours, partly due to the construction of four new decks over the last ten years. There are no plans to build additional parking decks in the near future; however, once the Southside of campus is built

additional parking may be needed for the convenience of students residing in those planned housing facilities.

In 2006, UNCC altered its academic schedule to be a four-day week, so the majority of parking structures are empty Friday-Sunday. According to the Blue Line Extension Questionnaire, Wednesday is the most traveled to campus day (81% of respondents) with Monday and Tuesday also being heavily travelled (75% each), and Thursday and Friday being less busy (53% and 59% respectively). This shows the ability of the campus to increase available parking through changes in policy versus building additional lots and structures. The extension of the LYNX Blue Line is also expected to impact the need for parking on campus, particularly in lots near the station (UNCC, 2011).

Map 20: Existing Parking



Partnership with Transit Providers, Fees, and Transit Use

Discounted CATS bus passes are available for sale at Parking Services at UNCC. The Campus is served by bus routes #29 to Southpark and #11 U N. Tryon to Uptown (UNCC, 2015). There are plans to discontinue the #11 bus route once the Blue Line Extension is in operation. There have also been conversations about opening up the 10 Ride Local Passes to Blue Line rides and offering those with a valid UNCC identification card the opportunity to have free rides on all CATS facilities (bus, light rail, street car, etc.). The hope is to have this "Go Pass" system in place once the Blue Line is fully operational.

Table 25: Charlotte Area Transit System Fare Rates for UNCC Students, Faculty and Staff

Pass Type	Description	Discounted Price	Regular Price
10 Ride Local	(Not valid on Lynx Blue Line)	$18.70	$18.70
Local Weekly	(Valid on Lynx Blue Line Sunday and Saturday)	$19.80	$22.00
Local Monthly	(Valid 1st through last of month, includes Lynx Blue Line)	$79.20	$88.00

Table 26: Summary of Findings

Category	National Literature	Local Data	Expected Health Impacts
Housing			
Conditions of Home • Potential Positive Health Impacts	• Substandard conditions in a home can increase exposure to multiple hazards having a wide variety of negative physical and mental health effects. • These impacts are disproportionate impacting people with disabilities, seniors, youth, and low income populations the most. • Effective interventions that address substandard conditions improve health outcomes.	• The majority of UNCC students (88%) live off-campus. • There is an increasing supply of student housing being built on and off campus over the next 5 years. • The neighborhoods surrounding the UNCC Main Campus are well established with well- maintained homes. • The conditions of housing are monitored and controlled by UNCC Housing and Charlotte-Mecklenburg Code Enforcement.	• Housing conditions are expected to improve as new housing for students is built on and off campus and older residential halls are demolished or remodeled. • As housing conditions improve, positive mental and physical health impacts should occur: ○ Increase Sleep ○ Increase Cognitive Functioning ○ Decrease Unintentional Injury ○ Decrease Exposure to Extreme Heat or Cold ○ Decrease Exposure to Infectious Diseases ○ Decrease Exposure to Toxic Substances ○ Decrease Respiratory Disease/Asthma
Affordability and Gentrification • No Health Impact in Immediate • Potential Negative Health Impact in Future	• The availability of affordable housing has multiple positive mental and physical health impacts. • The displacement caused by gentrification has multiple negative mental and physical health impacts. • Low-income populations and seniors are at the greatest risk.	• No residential units will be acquired to extend the Blue Line. • Given the commercial and campus nature of the northernmost stops, gentrification is unlikely in the short-term around these two stations. • The mixture of future housing opportunities for students, young professionals, and others wanting to live along the Blue Line could change the housing market in the University Area. • The cost of living on campus is approximately $1,350 more expensive than living off campus.	• In the short-term, gentrification is unlikely around the two northernmost stations and there is a limited health impact expected. • As future housing and mixed-use developments are built along the Blue Line and near stations, the mixture of housing options are expected to change and affordability may decrease. This could lead to students living further from campus, spending more on housing near campus, or living in overcrowded or substandard conditions (see expected health impacts of housing

		• The median gross rent for the Study area is $954.83.	conditions listed above).
Neighborhood or Community Conditions Surrounding Home • Potential Negative Health Impact	• Excessive noise has negative physical and mental health impacts and can lead to increased aggression and violence. • Psychological distress and the likelihood of being physically active are impacted by crime levels. • Low income and racial minorities are at greatest risk for crime. • Crime prevention through environmental design (CPTED) can be used to reduce crime levels. • Access to transit can increase access to healthy food, housing, employment, and parks- especially for those who do not have a vehicle or live in low-income neighborhoods.	• Noise from the train is a concern for Wallis and Miltimore Halls, which are located directly across from the Main Campus Station. • Although burglary and violent crimes have decreased or stayed the same from 2011 to 2013, there is concern that the Blue Line will increase criminal activity on campus particularly in nearby parking lots and residential halls. • Students from UNCC are expected to use the train to access increased entertainment and commercial opportunities along the Blue Line.	• If noise controlling mechanisms are not put in place or if noise is permitted late into the evening then: ○ Ability to Sleep and Cognitive Functioning will be decreased ○ Stress/Depression/ Anxiety will increase • If additional safety education, monitoring of parking lots and residential halls, and design considerations are not taken into account then: ○ Intentional Injury could occur leading to Stress/Depression/ Anxiety and Post Traumatic Stress Disorder ○ Decreased Perception of Safety/ Security
Transportation			
Vehicle Speed, Collisions, and Injury/Fatality Prevention • Potential Positive and Negative Health Impacts	• The more vehicle miles traveled and higher vehicle speeds, the greater risk of collisions and greater severity of injury or fatality. • Pedestrians and bicyclists are at particular risk with youths and seniors being at even higher risk of sustaining severe injuries or dying from a collision. • Interventions that separate motor vehicles and pedestrians/bicyclists and slow down traffic can decrease the risk.	• In 2013, 9 pedestrians and 2 bicyclists were killed during collisions in Charlotte. An additional 39 fatalities occurred during vehicular collisions. • There are 6 High Accident Locations within 2 miles of UNCC. From 2011 to 2013 there were 381 collisions in these 6 intersections.	• Pedestrian and bicyclist facilities are expected to be improved around stations and along N. Tryon due to the Blue Line. This should: ○ Decrease risk of Unintentional Injury ○ Increase Mobility ○ Increase Perception of Safety/ Security ○ Decrease Stress/ Anxiety • There is also expected to be a greater number of people walking and biking around stations which: ○ Increases the risk of Unintentional Injury for those walking/biking.

			• An increase in the pedestrian activity taking place around the station areas will increase visibility of walkers and bikers and lower traffic speeds: ○ Decreasing the rate and severity of collisions and Unintentional Injury for drivers, pedestrians, and cyclists.
Vehicle Miles Traveled, Air Quality, and Disease • Potential Positive and Negative Health Impacts	• Public transportation takes cars off the road, decreasing the number of vehicle miles travelled, and the level of regional air pollution. • Air pollution (including ozone and particulate matter) have negative physical health consequences- in particular to the respiratory system. • Youth, seniors, and those that are unusually susceptible to ozone or have existing health conditions, are at greater risk.	• Mecklenburg County's air quality continues to improve; however ozone and particulate matter (generated by mobile sources) is still a challenge. • The construction of the Blue Line Extension is expected to decrease regional vehicle miles traveled by 75 million/year, decreasing emissions by over 380 tons. • 7.3% of UNCC students have Asthma, 18.5% have Allergies, and 22% had Bronchitis or a Sinus Infection in 2013.	• Once the Blue Line Extension is built, more people should take transit, decreasing vehicle miles traveled and regional air pollution. This should have a positive impact on health including: ○ Decreased Respiratory Disease and Asthma • However, with more people walking or biking near traffic in order to access the station and greater vehicular traffic around the stations (park and ride lots) there could also be an increased risk of exposure to localized air pollution.
Active Transportation Opportunities and Physical Activity Levels • Potential Positive and Negative Health Impacts	• Public transit is considered active transportation because most trips begin or end with walking or biking. • Neighborhoods can be designed to promote transit use (Transit Oriented Design). • Transit users are more likely to reach recommended physical activity levels and less likely to be overweight or obese. • The physical activity and health benefits associated with transit use and active transportation is	• In a study done on the Blue Line, transit users loss approximately 6.5 pounds annually by using transit and were 81% less likely to be obese. • Additional bicycle and pedestrian facilities have been planned for around transit stops and along the N. Tryon corridor encouraging people to walk or bike to the Blue Line. • There is already a large amount of pedestrian activity on UNCC's Main Campus but planned	• As people use transit and the improved network of pedestrian and bicycle facilities, expected health impacts include: ○ Increased Physical Activity ○ Decreased Obesity and associated Chronic Diseases ○ Increased Exposure to Traffic, Air Pollution, and Respiratory Disease

	particularly important for low-income individuals and minorities.	improvements could increase connectivity and safety on campus and connectivity to the surrounding community.	
Public Transit, Health Equity, Fiscal Savings, and Access to Healthy Activities • Potential Positive Health Impacts	• Nearly 1/3 of the U.S. population is transportation disadvantage-particularly low-income individuals, minorities, and seniors. • The more a household spends on transportation the less it has for healthy food, medical expenses, childcare, housing, and other essential costs. • Transportation costs rise in sprawling communities with few transit services. • Transportation costs disproportionately impact minorities and low-income individuals.	• 76% of commuters within the 2 mile study area around UNCC Main Campus drive alone to work. • 11% of commuters within the study area take transit, walk, or bike to work. • 2% of the study area does not have an automobile available to them.	• As the number of transit opportunities increase with the Blue Line Extension opening, transit users should save on transportation costs leading to the following positive impacts: ○ Decreased Stress/ Depression/Anxiety ○ Increased Mobility ○ Decreased likelihood of Chronic Disease • Frequent transit users will have chances to interact with other users and increased transit opportunities allow those who are unable to drive to explore their community: ○ Increasing Social Cohesion ○ Decreasing Social Isolation
Traffic Congestion, Road Rage, and Wayfinding • Potential Positive Health Impacts	• Causes of road rage include the anonymity provided by being in a car, the stress of modern life, and increasing length of typical auto commutes. • Methods for reducing road rage include built environment solutions that: allow people to walk or ride to work, reduce auto times, and provide reliable, safe public transportation. • Wayfinding can prevent disorientation and confusion, improving the quality of experience for all users.	• The average commute time for the study area is 37 minutes (compared to 23 minutes county-wide). • 3% of the study area takes public transportation to get to work.	• By providing an alternative to driving, the Blue Line Extension should decrease traffic congestion and instances of road rage leading to positive health impacts including: ○ Decreased Intentional Injury ○ Decreased Stress/ Depression/Anxiety ○ Increased Social Cohesion ○ Increased Perception of Safety/Security • If improved wayfinding is incorporated within station area plans then potential health impacts include:

			○ Decreased Stress/ Depression/Anxiety ○ Increased Self-Esteem
Safety, Noise, and Access to Unhealthy Activities • Potential Positive and Negative Health Impacts	• Travel by public transit is safer than by personal automobile and transit systems can be a great asset during times of natural or man-made disasters. • The provision of transit systems can decrease incidences of driving under the influence and alcohol related traffic fatalities. • Alcohol consumption and alcohol related crimes also increases with each hour of late night transit service provided. • Excessive noise may result in negative health impacts.	• 3% of the study area takes public transportation to work-32% of which are between the ages of 16 and 24. • 3.2% of UNCC students reported driving after having 5 or more drinks. • 29.4% of UNCC students reported driving after consuming any alcohol. • 85.9% of UNCC students reported using a designated driver most of the time or always when they partied or socialized. • In 2013, there were 268 arrests on campus for alcohol violations and 265 judicial referrals for alcohol violations.	• If more people take public transit instead of driving alone then there could be positive health impacts including: ○ Fewer collisions and Unintentional Injuries • If students took transit to areas of socialization (parties, bars, etc.) then: ○ There should be fewer instances of DUI but higher instances of alcohol related crimes. ○ There could also be an increase in alcohol consumption. • Excessive noise caused by intoxicated transit users coming back at late hours may effect: ○ Ability to Sleep ○ Ability to Study/ Cognitive Functioning ○ Perception of Safety/ Security
Environment			
Water Quality and Stormwater Management • Potential Negative and Positive Health Impacts	• Urban runoff is responsible for 46% of impaired estuary miles nationwide. • Flooding increases risk of human exposure to waterborne pathogens and chemical contaminants. • Strategies for minimizing storm water runoff and improving water quality include rain barrels, roof gardens, and swales.	• UNCC Main Campus is part of the Mallard Creek Watershed with Toby Creek running through campus. • Runoff is of particular concern as it erodes streambeds and contributes to flooding of Toby Creek. • The Blue Line Extension requires a bridge crossing Toby Creek, impacting 734 square feet of FEMA floodway, 10,263 square feet of Community Encroachment Area, and 36,501 square feet of	• If best management practices are not implemented with the construction of the bridge crossing Toby Creek then there could be: ○ An Increase Risk of Exposure to Waterborne Diseases and Odors ○ Increase Unintentional Injuries if flooding takes place • If fewer parking lots are built because more people are taking transit to Campus then the amount of runoff and likelihood of flooding

		Community Floodplain.	would decrease, decreasing the likelihood of the negative health impacts listed previously.
Air Pollution • Possible Positive and Negative Health Impacts	• Particulate air pollution is produced by vehicle emissions and is most dangerous for health as the small particles can travel deep into the lungs and into the bloodstream. • Ozone is another form of air pollution composed of three atoms of oxygen. • The symptoms of exposure to air pollution include: irritation of nose, eyes, and throat, coughing, reduce lung function, asthma attacks, lung inflammation, fatigue, chest pain, heart attacks, and arrhythmia. • Seniors, children, and people with heart and lung disease are at particular risk for exposure to air pollution.	• The overall air quality for Mecklenburg County is good and improving; however ozone and particulate matter is still a challenge for the area. • The construction of the Blue Line Extension is expected to decrease regional vehicle miles traveled by 75 million/year, decreasing emissions by over 380 tons. • 7.3% of UNCC students have Asthma, 18.5% have Allergies, and 22% had Bronchitis or a Sinus Infection in 2013.	• Once the Blue Line Extension is built, more people should take transit, decreasing vehicle miles traveled and regional air pollution. This should have a positive impact on health including: o Decreased Respiratory Disease and Asthma • However, with more people walking or biking near traffic in order to access the station and greater vehicular traffic around the stations (park and ride lots) there could also be an increased risk of exposure to localized air pollution.
Greenways and Exposure to Nature • Potential Positive and Temporary Negative Health Impacts	• Living in proximity to parks, trails, and private recreation facilities is related to increased recreational physical activity. • Additional greenspace is associated with enhanced feelings of safety and the lack of places with nature can contribute to mental fatigue, higher levels of incivilities, aggression, and violence. • Health benefits associated with nature include: attention restoration, stress reduction, child development, social support/ interactions, physical healing, disease prevention, and cooling.	• Toby Creek Greenway is 2 miles of multi-use trails from University City Boulevard through UNCC campus. • Long term plans include connecting Toby Creek Greenway to the future Barton Creek Greenway and Cross Charlotte Greenway Network.	• The Blue Line Extension will increase access to parks and trails resulting in: o Increase Physical Activity o Decrease Likelihood of Chronic Diseases o Increase Exposure to Nature o Decrease Stress/ Depression/Anxiety • Construction of the Blue Line Extension will require the removal of trees near the Main Campus Station and the temporary closure of the Toby Creek Greenway causing a: o Decrease in Physical Activity o Decrease in Exposure to Nature

			○ Increase Stress/ Depression/Anxiety
UNCC Policies			
Enrollment of Students, Higher Education, and Future Employment Opportunities • Potential Positive Health Impacts	• Higher education is linked with increased health knowledge and behaviors, better employment and income, and healthier social and psychological factors. • On average, college graduates live 5 years longer than those without a high school diploma and infant mortality rates are greatly reduced when the mother has a college education. • Access to health care is closely tied to employment opportunities and the likelihood of receiving treatment and preventative screenings.	• As of Fall 2014 there are 27,200 students enrolled at UNCC. Plans are to increase enrollment to 35,000 by 2030. • There were 5,898 degrees awarded in the 2013-2014 academic year (4,362 Bachelor's degrees, 1,413 Master's degrees, and 123 Doctoral degrees). • Major areas of study include psychology, finance and financial management services, communication and media studies, and criminal justice and corrections. • There are 79 bachelor programs, 64 master programs, and 21 doctoral programs at UNCC.	• With the Blue Line Extension it is believed that additional courses could be offered at the Uptown Campus as well as increasing access to the Main Campus for classes. Land once reserved for parking decks or lots could be used for additional classroom space. Increased enrollment could lead to: ○ Decreased Stress/ Depression/Anxiety ○ Increased Social Cohesion ○ Improved Self-Esteem ○ Increased Access to Health-Promoting Resources and Healthcare ○ Decreased Likelihood of Chronic Disease
Provisions for Parking • Potential Positive Impacts	• Parking pricing is an effective transportation demand management tool- higher the prices the lower the demand. • Factors influencing travel choice include: parking availability and cost, transit pass availability and	• As of 2011, UNCC maintained 11,766 parking spaces on campus found in 6 parking structures and multiple lots. • Approximately 17,000 permits are sold each year ranging in price from $210 for a remote lot parking	• If students, faculty, and staff are able to use transit instead of purchasing a parking permit then they will have more disposable income and: ○ Decreased Stress/ Depression/Anxiety

	cost, transit reliability, and availability of transit subsidies. • Socioeconomic factors associated with the purchase of a monthly parking pass included university affiliation, income, and age.	permit to $450 for a full year permit. • There is a surplus of parking available (due to not everyone using their permit at the same time) and limited plans to build new parking structures over the next 10 years.	○ Increased Access to Health-Promoting Resources and Healthcare ○ Decreased Likelihood of Chronic Disease ○ Increased Physical Activity • There is also concern that students, faculty and staff will park in free lots at the JW Clay Blvd Station and walk to campus, reducing the number of spots available for transit users. ○ Increased Physical Activity
Fees and Transit Use • Potential Positive Health Impacts	• Subsidized transit fees (where the university or college pays for rides for students, faculty, and staff) resulted in higher use of transit, less demand for parking, and decreased traffic on campus. • Increased transit opportunities also led to increased non-commuting trips including travel to cultural activities, internships, volunteer work, and natural amenities. • Cost savings included savings to the riders in the form of free trips and parking permit savings, savings to transit providers with increased ridership and faster boarding times, and savings to the college or university in terms of reduced demand for parking structures.	• UNCC currently sells discounted transit passes for CATs busses and Blue Line (10 Ride Local Pass not valid on Blue Line). • Discussions with CATS to offer a "Go Pass" or extend the 10 Ride Local Pass to the Blue Line are underway and hopefully will be in place by the opening of the Blue Line Extension.	• If students, faculty, and staff are able to use transit for free instead of purchasing a parking permit then they will have more disposable income and: ○ Decreased Stress/ Depression/Anxiety ○ Increased Access to Health-Promoting Resources and Healthcare ○ Decreased Likelihood of Chronic Disease ○ Increased Physical Activity

Recommendations

Recommendations identify alternatives to the proposal or specific actions that could be taken to avoid, minimize, or mitigate adverse effects or to take advantage of opportunities for a proposal to improve health.

Outputs:

- Identifies alternatives to the proposal or actions that could be taken to avoid, minimize, or mitigate adverse effects and to optimize beneficial ones.
- Proposes a health-management plan to identify stakeholders who could implement recommendations, indicators for monitoring, and systems for verification.

Overarching Recommendations

1. Continue to consider health implications as Charlotte Area Transit System (CATS) and Charlotte officials plan, construct and promote transit use in the greater Charlotte area.
2. Increase channels of communication between the Charlotte Area Transit System (CATS), the University of North Carolina Charlotte (UNCC), Charlotte-Mecklenburg Planning (CMP), Mecklenburg County Health Department (MCHD), and members of the community including transit users, developers, and business owners.
3. Support additional studies that collect baseline health data, record usage of the Blue Line Extension (especially by students, faculty, and staff of UNCC), and monitor the health impacts of increased transit options.
4. Follow the recommendations set forth in the Environmental Impact Statement conducted on the Blue Line Extension.
5. Increase the knowledge, use, and support of the Student Health Survey including the addition of custom questions relevant to commuting patterns.

Housing Recommendations

1. Identify neighborhoods at risk for gentrification. Implement policies and incentives that would protect existing low and middle-income neighborhoods from gentrification and require the inclusion of affordable housing and a wide variety of housing types and price points along the Blue Line Extension.
2. Increase awareness of developer incentives to promote housing density, life-cycle housing, and mixed-use development patterns within a quarter mile of transit stations.
3. Promote additional collaboration between University of North Carolina Charlotte (UNCC) Facilities Planning and local developers to balance the needs of low, middle, and high income residents and provide a balance of on-campus and off-campus housing for UNCC students.
4. Install noise control mechanisms on the rail line at turns near housing, additional soundproofing around the UNCC Main Campus Station and JW Clay Blvd Station, and greater noise-reducing insulation in the residential halls surrounding the stations.

5. Consider impacts on students living around the stations when setting transit schedules, establishing policing stations, and offering late-night shuttles from the stations.

Transportation Recommendations

1. Conduct a recurring commuter (motor vehicle operators, pedestrians, and bicyclists) survey and counts to determine commuting patterns of University of North Carolina Charlotte (UNCC) students, faculty and staff to determine where they are commuting from, the length of commute, time of commute, mode of travel, and barriers to taking transit.
2. Establish a "Go Pass" that would allow University of North Carolina Charlotte students, faculty, and staff to use their campus identification card to take all forms of public transit offered by the Charlotte Area Transit System (CATS), either for free (subsidized by UNCC using either student fees or parking permits) or for a reduced rate. While negotiating the "Go Pass," review the policies on parking decks, usage and rate structure for CATS and for UNCC to reduce overcrowding at the JW Clay Blvd Station and reserve spaces for transit users and businesses.
3. Carefully plan wayfinding mechanisms including signs, painted pavement, landmarks, and electronic applications to guide riders in and around campus and to notify them of the arrival time for the next train and other transit connections. Provide incoming and current students with resources on active transportation opportunities on and around campus that include information on routes, safety, facilities, rental programs, etc.
4. Implement context sensitive solutions to improve safety and increase pedestrian, cyclist, and ADA access to campus.
5. Design the trains, stations, adjoining streets, and surrounding land uses to promote walk-up or bike-up services. Monitor bike arrival and boarding on the Blue Line to gauge the need versus availability of station racks, on-board racks, and storage space.
6. Market the health benefits (physical activity, weight management, stress reduction) and fiscal savings of taking transit.

Environment Recommendations

1. Include additional trees and vegetation plantings along the transit corridor, on campus, and around stations to help with localized air pollution and stormwater management.
2. Market the air quality benefits of taking transit noting daily air quality ratings (high ozone or unhealthy air quality days) on the Charlotte Area Transit System (CATS) website and at stations.
3. Monitor asthma incident rates at UNCC Student Health Services and area hospitals especially in comparison to poor air quality days.
4. Follow best management practices when constructing the bridge over Toby Creek.
5. Decrease the number of surface parking lots on campus and paved surfaces to reduce runoff and implement additional stormwater management measures such as bioswales and rain gardens.
6. Install a user-counter on Toby Creek Greenway, perform intercept surveys, and monitor usage of the greenway.
7. Reopen Toby Creek Greenway and connect the greenway to the larger Cross Charlotte Greenway Network as soon as possible.
8. Market and provide wayfinding to greenway connections and parks along the Blue Line.

UNCC Campus Policies Recommendations

1. Form a short-term taskforce at University of North Carolina Charlotte (UNCC) to address the implications of the Blue Line on campus to include representation from housing, student health, transportation, police, enrollment, academic scheduling, and the student body. Increase student involvement and information about student needs within the decision-making process.
2. Incent students, faculty and staff to use transit (especially to travel between campuses and from housing or work opportunities) and dis-incent having a car on campus.
3. Improve walkability, bikeablility, and ADA accessibility on campus including potentially expanding the amount of time available between classes for crossing campus.
4. Build a pedestrian bridge over the northbound lanes of North Tryon St. from the JW Clay Blvd Station to connect the station to the University of North Carolina Charlotte (UNCC).
5. Work with the Charlotte Area Transit System (CATS) to establish a "Go Pass" or at least extend the 10-Ride Local pass to include rides on the Blue Line and connecting bus shuttles.
6. Diversify funding sources for parking structures and transportation programs so that University of North Carolina Charlotte (UNCC) is not dependent on parking permit sales and can offer more services (pedestrian and bicycling facilities, extended shuttles, etc.).
7. Include transit information in various educational programs such as orientation for incoming students, healthy behavior courses (way of increasing physical activity and as a designated driver option), and safety instructions (safety on transit, using transit, locking doors in residential halls and vehicles, etc.).
8. Convert under-used surface parking lots to academic buildings, increase the demand for classes and programs offered at the Uptown Campus, and schedule classes to optimize use of classroom space in order to increase enrollment and the number of degrees offered at University of North Carolina Charlotte(UNCC).

Reporting

Reporting is the communication of findings and recommendations to decision-makers, the public, and other stakeholders.

Outputs:

- Provides clear documentation of the proposal analyzed, the population affected, stakeholder engagement, data sources and analytic methods used, findings, and recommendations.
- Communicates findings and recommendations to decision-makers, the public, and other stakeholders in a form that can be integrated with other decision-making factors (technical, social, political, and economic).

This document represents the complete HIA report. Additional reporting efforts included the development of a project webpage on the Mecklenburg County Health Department website to update participants on the progress of the HIA and publicly distribute this report, related presentations, the executive summary, and corresponding documents (http://charmeck.org/mecklenburg/county/HealthDepartment/CommunityHealthServices/Pages/Blue-Line-Extension-(HIA).aspx). Additional plans are underway to present the process, main findings, and recommendations to county, city, and UNCC decision-makers and stakeholders following the completion of this document (an initial meeting was held July 23, 2015 and additional meetings will take place sometime in the summer of 2015). As further decisions are made in regards to the Blue Line Extension and in response to station construction on and around UNCC Main Campus, it is the intention of this report to serve as a guide for future health-related conversations with decision-makers on specific aspects of light rail.

Evaluation and Monitoring

Monitoring and evaluation can be characterized by several activities. Monitoring can consist of tracking the adoption and implementation of HIA recommendations or tracking changes in health indicators (health outcomes or health determinants) as a new policy, program, plan, or project is implemented. Evaluation can be process evaluation (evaluation of whether the HIA was conducted according to its plan of action and applicable standards), impact evaluation (evaluation of whether the HIA influenced the decision-making process), or outcome evaluation (evaluation of whether implementation of the proposal changes health outcomes or health determinants).

Outputs:

- Tracks changes in health indicators or implementation of HIA recommendations.
- Evaluates (a) whether the HIA was conducted according to its plan and applicable standards (process evaluation), (b) whether the HIA influenced the decision-making process (impact evaluation), and (c) when practicable, whether implementation of the proposal change health indicators (outcome evaluation).

The evaluation of the HIA is still underway, but a description of possible evaluation methodology and a monitoring plan for the outcomes of the HIA is outlined below.

Evaluation Plan for Mecklenburg County Blue Line HIA

A. ***Process Evaluation***- assesses the design and execution of the HIA in light of its intended purpose and plan of action and applicable practice standards

Types:

1. Self-assessment and/or third party assessment: suitable methods used, degree of certainty of predictions, approach to stakeholder engagement, evidence rigorous, adequate, and appropriate, appropriate conclusions drawn, HIA quality product, and recommendations practical and appropriate.
2. Case study: evaluate the HIA process holistically.
3. Recording observations: methods of stakeholder engagement, interactions with decision-makers, and approaches to addressing analytic challenges.
4. Interviewing participants and stakeholders: process followed, communication, involvement sufficient, felt stakeholder perspectives considered, suggested changes for future HIAs, greater understanding of HiAP, greater understanding of HIA process, and greater awareness of health considerations.

B. ***Impact Evaluation***- attempts to judge whether the HIA influenced the decision-making process

Types:

1. Interview with decision-makers: recommendations viewed as practical and appropriate, communication adequate and in acceptable format, and how HIA influenced decision-making process.
2. List of recommendations that were adopted/accepted.
3. List of recommendations that were implemented.
4. List: new contacts made, new partnerships formed, participants in workshop, new sources of data identified, new methods of analysis used, and health considerations otherwise not taken into account.
5. Compare to initial objectives of the HIA: model HIA for county, trainings, peer learning opportunity, and entry point for HiAP work.
6. Additional questions include did the HIA:
    a. Alert decision makers to the general need to consider health in future decisions?
    b. Identify data gaps and questions for future research?
    c. Serve as a foundation for monitoring of health impacts?
    d. Develop a new forecasting method?
    e. Provide the public with accurate and complete information?
    f. Improve relationships and collaboration between stakeholders?

C. ***Outcome Evaluation***- assesses whether the implementation of a decision has actual effects on health or health determinants (were your predictions accurate?)

1. Monitoring plan for outcomes: baseline data that is already being collected by an agency on a regular basis, additional data that should be collected and by whom/how often, and groups or contacts that should be met with following the implementation of HIA decisions and construction of the train to collect ridership information and see if there have been changes for students, staff, and faculty (CATS, UNCC, etc.).
2. Health Impacts Identified from pathway diagrams:
    a. Physical activity levels and associated benefits (student health survey)
    b. Unintentional Injury (student health center reports)
    c. Intentional Injury (Crime rates)
    d. Sleep (student health survey)
    e. Stress/Depression/ Anxiety (student health survey, student health center reports)
    f. Perception of Safety (student health survey)
    g. Exposure to Extreme Heat or Cold (student health center report, ER/hospital cases)
    h. Respiratory Disease/ Asthma (student health center report, ER/hospital cases)
    i. Exposure to Infectious Diseases (student health survey, student health center report, ER/hospital cases)
    j. Exposure to Toxic Substances (student health center reports, ER/hospital cases, building code reports)
    k. Social Isolation (student health survey)
    l. Likelihood of Chronic Diseases
    m. Post-Traumatic Stress Disorder (student health center report, ER/hospital cases)

n. Alcohol Consumption (student health survey, DUI/ Public Intoxication crime rates)
o. Self-Esteem
p. Waterborne Diseases (student health center report, ER/hospital cases)
q. Exposure to Nature (use of trails/greenways)
r. Exposure to Odors (campus reports)
s. Cardiovascular Disease
t. Access to Health-Promoting Resources
u. Access to Healthcare
v. Mobility (walkability, bikeability, focus group with people with disabilities on campus)

Conclusions

The extension of the Lynx Blue Line Light Rail to UNCC Main Campus will undoubtedly have an impact on the health and well-being of students, faculty, staff, transit users, commuters, and residents living along the rail corridor. Whether the impacts will be positive or negative and equally distributed among the impacted populations will depend greatly on how UNCC, the City of Charlotte, Charlotte Area Transit System, and other stakeholders respond to the introduction of additional transit opportunities to the region. This report presented the findings of the HIA, recommendations for actions to improve the potential health outcomes, and methods of monitoring these outcomes. The HIA provides an overview of the health implications of the Blue Line Extension and should be used as a starting point for many future conversations where health is taken into consideration as the light rail is constructed, development occurs around the stations and on campus, and as students, faculty, and staff start using the Blue Line to travel to and from campus.

References

Alliance for Walking and Biking. (2010). *Bicycling and Walking in the United States: 2010 Benchmarking Report*. Washington, DC: Alliance for Walking and Biking. Available at http://peoplepoweredmovement.org/site/index.php/site/memberservices/bicycling_and_walking_benchmarking_project/

American College Health Association. (2013). Spring 2013 Reference Group Executive Survey. *National College Health Assessment*.

American College Health Association. (2013). University of North Carolina Charlotte Executive Summary. *National College Health Assessment*.

American College Health Association. (2015). University of North Carolina Charlotte Executive Summary. *National College Health Assessment*.

American Public Transportation Association. (2011). *The Benefits of Public Transportation: An Overview.* Available at http://www.publictransportation.org/reports/asp/pub_benefits.asp

Asbridge, M., Smart, R.G., & Mann, R.E. (2006). Can we prevent road rage? *Trauma, Violence, & Abuse,* 7 (2), 109-21.

Auchincloss, A.H., Weinberger, R., Aytur, S., Namba, A. & Ricchezza, A. (2015). "Public parking fees and fines: A survey of U.S. cities." *Public Works Management & Policy*, 20 (1), 49-59.

Badland, H.M., Garrett, N., & Schofield, G.M. (2010). "How does car parking availability and public transport accessibility influence work-related travel behaviors?" *Sustainability,* (2), 576-90.

Beauchemin, K.M., & Hays, P. (1996). "Sunny hospital rooms expedite recovery from severe and refractory depressions." *Journal of Affective Disorder,* 40 (1-2), 49-51.

Berke, E.B., Gottlieb, L.M., Moudon, A.V., & Larson, E.B. (2007). "Protective association between neighborhood walkability and depression in older men." *Journal of the American Geriatrics Society,* 55 (4), 526-33.

Besser, L., & Dannenberg, A.L. (2005). "Walking to public transit: Steps to help meet physical activity recommendations." *American Journal of Preventive Medicine,* 29 (4), 273-80.

Bond, A., & Steiner, R. (2006). "Sustainable campus transportation through transit partnership and transportation demand management: A case study from the University of Florida." *Berkeley Planning Journal*, 19 (1), 125-142.

Brown, J., Hess, D.B, & Shoup, D. (2003). "Fare-Free public transit at universities: An evaluation." *Journal of Planning Education and Research*, (23), 69-82.

Cabarrus-Rowan Metropolitan Planning Organization and the Charlotte Department of Transportation. (2014). *Conformity Analysis and Determination Report for the Metrolina Area 2040 Metropolitan Transportation Plans and for the FY 2012-2018 Transportation Improvement Programs.*

Centers for Disease Control and Prevention: National Center for Environmental Health. (n.d.). *A Healthy Home for Everyone: The Guide for Families and Individuals.*

Cervero, R., & Gorham, R. (1995). “Commuting in transit versus automobile neighborhoods.” *APA Journal*, Spring (1995), 210-225.

Chapple, K. (2001). “Time to work: job search strategies and commute time for women on welfare in San Francisco.” *Journal of Urban Affairs,* 23(2), 155-173.

Charlotte Area Transit System. (2011). *LYNX Blue Line Extension Final EIS Presentation*. Available at http://www.slideshare.net/xcflash/lynx-blue-line-ext-final-eis

Charlotte Department of Transportation. (2014). *Traffic Collision Data for 2013*.

City of Charlotte. (2010). *Centers, Corridors, and Wedges Growth Framework*. Available at http://charmeck.org/city/charlotte/planning/AreaPlanning/CentersCorridorsWedges/Pages/Home.aspx

City of Charlotte. (2015). *University City Area Plan: Blue Line Extension Transit, Station Area Plans Update*. Available at http://charmeck.org/city/charlotte/planning/AreaPlanning/Plans/ucap/Pages/Home.aspx

Cleveland Clinic. (2010). *What Is Seasonal Depression?* http://my.clevelandclinic.org/disorders/seasonal_affective_disorder_sad/hic_what_is_seasonal_depression.aspx

Cohen, R. (2011). “The impacts of affordable housing on health: A research summary.” Center for Housing Policy, *Insights from Housing Policy Research,* May (2011). Available at www.nhc.org/media/files/Insights_HousingAndHealthBrief.pdf

College Portrait. (2014). *University of North Carolina at Charlotte College Portrait.* Available at http://www.collegeportraits.org/NC/UNCC

Cutts, B.B., Darby, K.J., Boone, C.G., & Brewis, A. (2009). “City structure, obesity, and environmental justice: An integrated analysis of physical and social barriers to walkable streets and park access.” *Social Science & Medicine,* (69), 1314-22.

Dannenberg, A.L., Frumkin, H., & Jackson, R.J. (2011). *Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability*. Washington: Island Press

Deshpande, A. D., Baker, E.A., Lovegreen, S.L., & Brownson, R.C. (2005). “Environmental correlates of physical activity among individuals with diabetes in the rural Midwest.” *Diabetes Care,* 28, 1012-18.

Edwards, R.D. (2007). Public transit, obesity, and medical costs: Assessing the magnitudes. *Science Direct*, 46(2008), 14-21.

Evans, G.W. (2001). Environmental stress and health. In A. Baum, T. Revenson, & J.W. Singer (Eds.), *Handbook of Health Psychology*, (571-610). Mahwah, NJ: Erlbaum.

Evans, G.W. (2006). “Child development and the physical environment.” *Annual Review of Psychology,* 57, 423-51.

Evans, G.W., Wells, N.M., & Moch, A. (2003). "Housing and mental health: A review of the evidence and a methodological and conceptual critique." *Journal of Social Issues,* 59, 475-500.

Evans, G.W., Lepore, S.J., & Allen, K.M. (2000). "Cross-Cultural differences in tolerance for crowding: Fact or fiction?" *Journal of Personality and Social Psychology,* 79, 204-10.

Evenson, K.R., Scott, M.N., Cohen, D.A., & Voorhees C.C. (2007). "Girls' perception of neighborhood factors on physical activity, sedentary behavior, and BMI." *Obesity,* 15, 430-45.

Ewing, R., & Dumbaugh, E. (2009). "The built environment and traffic safety: A review of empirical evidence." *Journal of Planning Literature,* 23 (4), 347-67.

Ewing, R., & Cervero, R. (2010). "Travel and the built environment." *Transportation Research Record*, no. 1780, 87-14.

Ewing, R., Schieber, R.A., & Zegeer, C.V. (2003). "Urban sprawl as a risk factor in motor vehicle occupant and pedestrian fatalities." *American Journal of Public Health,* 93 (9), 1541-45. Available at http://ajph.aphapublications.org/cgi/reprint/93/9/1541.pdf

Frank, L.D., Engelke, P.O., & Schmid, T.L. (2003). *Health and Community Design: The Impact of the Built Environment on Physical Activity*. Washington, DC: Island Press.

Frumkin, H., Frank, L.D., & Jackson, R. J. (2004). *Urban Sprawl and Public Health: Designing, Planning, and Building for Healthy Communities.* Washington, DC: Island Press.

Gordon-Larsen, P., Nelson, M.C., Page, P., & Popkin, B.M. (2006). Inequality in the built environment underlies key health disparities in physical activity and obesity. *Pediatrics,* 117, 417-24.

Hartman, J. (1993). The delft bicycle network. In R. Tolley (Ed.), *The Greening of Urban Transport: Planning for Walking and Cycling in Western Cities*. London: Belhaven Press.

Hess, D.B. (2001). Effect of free parking on commuter mode choice: Evidence from travel diary data. *Transportation Research Record: Journal of the Transportation Research Board*. Available at http://trb.metapress.com/content/b5541r0w736424x4/

Hülsmann, W. (1993). The 'bicycle-friendly' towns project in the Federal Republic of Germany. In R. Tolley (ed.), *The Greening of Urban Transport: Planning for Walking and Cycling in Western Cities*. London: Belhaven Press.

Jackson, C.K. & Owens, E.G. (2009). One for the road: Public transportation, alcohol consumption, and intoxicated driving. *Journal of Economic Literature*, I (18), R49.

Joint Center for Political and Economic Studies & PolicyLink. (2004). "A place for healthier living: Improving access to physical activity and healthy foods." Available at http://www.policylink.org/sites/default/files/PLACEFORHEALTHIERLIVING_FINAL.PDF

Katsouyanni, K., Samet, J.M, Anderson, H.R., Atkinson, R., Le Tertre, A., Medina, S., Samoli, E., Touloumi, G., Burnett, R.T., Krewski, D., Ramsay, T., Dominici, F., Peng, R.D., Schwartz, J., & Zanobetti, A. (2009). Air pollution and health: A European and North American Approach (APHENA). *Research Reports Health Effects Institute,* 142, 5-90.

Koepsell, T., McCloskey, L., Wolf, M., Moudon, A.V., Buchner, D., Kraus, J., & Patterson, M. (2002). Crosswalk markings and the risk of pedestrian-motor vehicle collisions in older pedestrians. *Journal of American Medical Association,* 17, 2136- 2143.

Kuo, F.E., & Sullivan, W.C. (2001). Aggression and violence in the inner city: Impacts of environment and mental fatigue. *Environment and Behavior,* 33 (4), 543-71.

Litman, T., & Fitzroy, S. (2005). *Safe Travels: Evaluating Mobility Management Traffic Safety Impacts*. Victoria, BC: Victoria Transport Policy Institute.

Maas, J., Spreeuwenberg, P., Van Winsum-Westra, M., Verheij, R.A., De Vries, S., & Groenewegen, P.P. (2009). Is green space in the living environment associated with people's feelings of social safety? *Environment and Planning*, 41 (7), 1763-77.

MacDonald, J.M., Stokes, R.J., Cohen, D.A., Kofner, A., & Ridgeway, G.K. (2010). The effect of light rail transit on Body Mass Index and physical activity. *American Journal of Preventive Medicine,* 39(2), 105-112.

Mecklenburg County Health Department. (2014). *State of the County Health Report: Overview of Selected Health Indicators for Mecklenburg County.*

Mecklenburg County Land Use and Environmental Services Agency. (2014). *2014 Mecklenburg County State of the Environment Report*. Available at http://charmeck.org/mecklenburg/county/LUESA/SOER/Pages/default.aspx

Morland K., Wing, S., & Diex-Roux, A. (2002). The contextual effect of the local food environment on residents' diet: the atherosclerosis risk in communities study. *Am J Public Health,* 92, 1761–1767.

Moudon, A.V., Hess, P.M., Snyder, M.C., & Stanilov, K. (1997). Effects of site design on pedestrian travel in mixed-use, medium- density environments. *Transportation Research Record,* 1578, 48-55.

National Poverty Center. (2007). *Policy Brief: Education and Health*. Policy Brief #9, March (2007).

National Research Council. (2011). *Improving Health in the United States: The Role of Health Impact Assessment*. Washington, DC: The National Academic Press.

Nelson, A. & Allen, D. (1997). If you build them, commuters will use them; Cross-Sectional analysis of commuters and bicycle facilities. *Transportation Research Record,* 1578, 79-83.

Ng, W.S. (2014). Assessing the Impact of Parking Pricing on Travel Demand and Behavior. *Sustainable Transportation Seminar*. October 10, 2014. Available at http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0CB4QFjAA&url=http%3A%2F%2Fweb.stanford.edu%2Fgroup%2Fpeec%2Fcgi-bin%2Fdocs%2Fevents%2F2014%2F10-10-14%2520Ng.pdf&ei=kBFdVeqSL4GWgwSXqYDoDw&usg=AFQjCNGjoDQ4OfuP6dIY5WaXdRFBlUXpwQ

PolicyLink & Prevention Institute. (n.d.) *Overview: Health, equity & transportation*. Available at *www.altfutures.org/.../**Equity**_in_**Transportation**_Policy_**Summary**.pdf*

Pope, C.A., Burnett, R.T., Thun, M.J., Calle, E.E., Krewski, D., Ito, K., & Thurston, G.D. (2002). Lung Cancer, Cardiopulmonary mortality, and long-term exposure to fine particulate air pollution. *JAMA,* 287, 1132-41.

Pucher, J., & Dijkstra, L. (2003). Promoting safe walking and cycling to improve public health: Lessons from the Netherlands and Germany. *American Journal of Public Health,* 93 (9), 1509-16.

Retting, R.A., Ferguson, S.A., & McCartt, A.T. (2003). A review of evidence-based traffic engineering measures designed to reduce pedestrian- motor vehicle crashes. *America Journal of Public Health,* 93 (9), 1456-63.

Robert Wood Johnson Foundation: Commission to Build a Healthier America. (2009). *Issue Brief 6: Education and Health.* September (2009). Available at www.commissionhealth.org

Robert Wood Johnson Foundation. (2013). How does employment-or unemployment- affect health? *Health Policy Snapshot: Public Health and Prevention*, Issue Brief, March (2013). Available at www.rwjf.org/healthpolicy

Robert Wood Johnson Foundation. (2013). Why does education matter so much to health? *Health Policy Snapshot: Public Health and Prevention*, Issue Brief, March (2013). Available at www.rwjf.org/healthpolicy

Ross, C.L. (2007). *Atlanta BeltLine Health Impact Assessment*. Center for Quality Growth and Regional Development, Georgia Institute of Technology.

Rundle A., Roux, A.V.D., Freeman, L.M., Miller, D., Neckerman, K., & Weiss, CC. (2007). The urban built environment and obesity in New York City: A multilevel analysis. *Am J Health Promotion,* 21(4), 326–334.

Talen, E. (1998). Visualizing fairness: Equity maps for planners. *Journal of the American Planning Association,* 64(1), 22-38.

Tester, J.M., Rutherford, G.W., Wald, Z., & Rutherford, M.W. (2004). A matched case-control study evaluating the effectiveness of speed humps in reducing child pedestrian injuries. *Am J Public Health,* 94(4), Apr. (2004).

Troped, P.J., Saunders, R.P., Pate, R.R., Reininger, B., Ureda, J.R., & Thompson, S.J. (2001). Associations between self-reported and objective physical environmental factors and use of a community rail-trail. *Preventive Medicine,* 32, 191-200.

University of North Carolina at Charlotte. (2011). *Campus Master Plan 2010*. Available at http://masterplan.uncc.edu/

University of North Carolina at Charlotte. (2015). *UNCC Campus Shuttles.* Available at http://pats.uncc.edu/transportation/campus-shuttle

University of North Carolina at Charlotte. (2015). *UNCC Parking Permit Information*. Available at http://pats.uncc.edu/parking/parking-permit-information

University of North Carolina at Charlotte. (2015). *UNCC Transportation Options*. Available at http://pats.uncc.edu/transportation

U.S. Census Bureau. (2013). 5-year estimate for 2009-2013. *American Community Survey*.

U.S. Department of Health and Humans Services. (2008). *Physical Activity Guidelines for Americans*. http://www.health.gov/PAGuidelines/pdf/paguide/pdf

U.S. Environmental Protection Agency. (1999). Smog-Who does it hurt? What you need to know about ozone and your health. Available at http://www.epa.gov/oar/oaqps

U.S. Environmental Protection Agency. (2003). Particle pollution and your health. Office of Air and Radiation, Available at www.epa.gov/air.

U.S. Environmental Protection Agency. (2014). 2012 Waterbody report for Toby Creek. Available at http://iaspub.epa.gov/tmdl/attains_waterbody.control?p_au_id=NC13-17-5-4&p_cycle=2012&p_state=NC&p_report_type=

Wener R.E., & Evans, G.W. (2007). A morning stroll: levels of physical activity in car and mass transit commuting. *Environment and Behavior*, 39, 62–74.

Zegeer, C.V., Stewart, J.R., Huang, H., Lagerwey, P.A., Feagan, J., & Campbell, B. J. (2005). *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines*. (FHWA-HRT-04-100). Washington, D.C.: Federal Highway Administration. Available at http://www.fhwa.dot.gov/publications/research/safety/04100/04100.pdf

Appendix 1: Study Area Description for American Community Survey, 5 Year Estimates (2009-2013)

The study area originally consisted of the block groups (12) and census tracts (7) within a one mile radius of the geographic center of the UNCC campus including:

- Block Group 1 in Census Tract 55.21
- Block Group 2 and 3 in Census Tract 55.23
- Block Group 5 in Census Tract 55.27
- Block Group 1, 2, and 3 in Census Tract 56.04
- Block Group 1, 2, and 3 in Census Tract 56.05
- Block Group 1 in Census Tract 56.09
- Block Group 1 in Census Tract 56.12

The following four block groups were removed from the study area due to their limited amount of the block group within the 1 mile radius of the center of campus:

- Block Group 1 in Census Tract 55.21
- Block Group 3 in Census Tract 55.23
- Block Group 5 in Census Tract 55.27
- Block Group 1 in Census Tract 56.05

Therefore, data was collected for the block groups (8) and census tracts (5) in the following study area:

- Block Group 2 in Census Tract 55.23
- Block Group 1, 2, and 3 in Census Tract 56.04
- Block Group 2 and 3 in Census Tract 56.05
- Block Group 1 in Census Tract 56.09
- Block Group 1 in Census Tract 56.12

Housing, transportation, income, and demographic data was collected from the American Community Survey, 5-Year Estimates, 2009-2013 using the smallest geographic scale available from the following tables:

Table	Description	Geography
B01001	Sex by Age	Block Group
B02001	Race	Block Group
B08101	Means of Transportation to Work by Age	Census Tract
B08013	Aggregate Travel to Time to Work (in Minutes) of Workers by Sex	Census Tract
B08141	Means of Transportation to Work by Vehicles Available	Census Tract
B09019	Household Type (Including Living Alone) by Relationship	Block Group
B17001	Poverty Status in the Past 12 Months by Sex by Age	Census Tract
B17021	Poverty Status of Individuals in the Past 12 Months by Living Arrangement	Block Group
B19001	Household Income	Block Group
B19037	Age of Householder by Household Income	Block Group
B19049	Median Household Income by Age of Householder	Block Group
B19201	Nonfamily Household Income	Block Group
B19202	Median Nonfamily Household Income	Block Group
B19301	Per Capita Income	Block Group
B25001	Housing Units	Block Group
B25002	Occupancy Status	Block Group
B25003	Tenure	Block Group
B25004	Vacancy Status	Block Group
B25007	Tenure by Age of Householder	Block Group
B25011	Tenure by Household Type (Including Living Alone) and Age of Householder	Census Tract
B25064	Median Gross Rent (Dollars)	Block Group
B25104	Monthly Housing Costs	Census Tract

Appendix 2: Mixed-Use Center and Transit Station Area Descriptions and Uses

	Mixed Use Center	Transit Station Area
Description of Type or Subarea	Mixed Use Activity Centers should: • Be focal points of community activity, providing opportunities for "live, work and play" for surrounding neighborhoods, as well as the greater Charlotte area; • Include a mix of uses, with retail, housing, office and civic components; • Include a cohesive, identifiable pedestrian-oriented core, with the remainder of the Activity Center linked to the core by a pedestrian and street network; and • Typically be surrounded by lower density residential neighborhoods.	Transit Station Areas are located within approximately ½ mile walking distance of an existing or planned rapid transit station. However, they generally exclude any established low density neighborhoods within that walking distance. These neighborhoods typically are targeted for preservation and are located within an Established Neighborhood Subarea. Many Transit Station Areas will have the same general characteristics as the Mixed Use type of Activity Center and will become focal points of community activity. The Transit Station Areas should: • Be pedestrian-oriented districts designed to include a mixture of complementary moderate to high intensity residential, office, retail/entertainment and civic uses located within easy walking distance of a rapid transit station; • Be designed as gathering places for the surrounding community; and • Have a dense, interconnected street network with extensive pedestrian facilities.
Land Use	Appropriate uses in Mixed Use Activity Centers typically will include: • Retail designed to serve the surrounding community and, in some cases, regional-serving retail as well; • Moderate to high density housing; • Regional and/or neighborhood serving office, which could sometimes include national and/or regional corporate headquarters; and	Appropriate uses in Transit Station Areas include a mix of complementary, transit supportive uses per the *Transit Station Area Principles* of the *General Development Policies*. These uses typically include: • Residential; • Office; • Neighborhood-serving retail and entertainment; and • Civic uses.

	• Civic uses such as urban parks, religious institutions and libraries. The area planning process will be used to determine which Mixed Use Activity Centers should have a strong retail emphasis, with limited office, and which should be more office oriented and include regional serving or corporate offices. Development intensity should typically be low or moderate, with high intensity development sometimes appropriate. The highest intensity development should be located within the core of the Activity Center. Areas outside the pedestrian core should be developed at lesser intensities, especially for sites abutting single family neighborhoods. Mixed use and multi-use represent the desired character of developments in these Activity Centers.	Transit Station Areas are appropriate for moderate to high density/intensity development. The minimum density of residential uses and the minimum intensity of non-residential uses should be consistent with the *Transit Station Area Principles* of the *General Development Policies* or an adopted station area plan. The highest densities/intensities are appropriate closest to the transit station, with lower densities adjacent to existing low density residential areas. Except for Center City, Transit Station Areas should have the highest densities/intensities of development. In Transit Station Areas, uses should be well-integrated, either vertically and/or horizontally.
Transportation	Mixed Use Activity Centers should be served by a range of existing and planned transportation modes, including: • Interstate or major thoroughfare access; • Dense and interconnected street network; • Well-developed pedestrian system, especially within the Activity Center core; • Direct pedestrian and vehicular connections from the core to the edge of the Activity Center and surrounding neighborhoods; • Local bus service and, where there is adequate demand, express bus service to the core of the Activity Center; circulator service throughout the Activity Center; community transit facilities; and	Transit Station Areas should be served by a range of transportation modes, including: • Rapid transit line and station; • Local bus service; • Dense and interconnected street network; • Extensive pedestrian network designed to support circulation throughout the station area and connect to the surrounding area; and • Bicycle facilities, especially to support those traveling to the transit station. Most people will access most Transit Station Areas by transit or automobile. Overall, the transportation focus should be on enhancing the existing system to promote walking, bicycling and transit

	• Bicycle facilities, within the Activity Center and with connections to surrounding neighborhoods. Mixed Use Activity Centers should be designed to allow easy access by vehicles, and to promote pedestrian accessibility and transit usage. There should be a strong emphasis on pedestrian circulation within the core of the Activity Center, with a balance of vehicular, transit and walking outside the core and between the Activity Center and surrounding neighborhoods. The transportation focus should be on enhancing the existing system to promote walking, bicycle and transit access- and on constructing new, interconnected streets to serve a range of transportation modes.	access and circulation, as well as on the creation of new streets needed to create the network necessary to accomplish this.
Infrastructure and Public Facilities	Mixed Use Activity Centers should include a range of public facilities designed to serve residents, employees and visitors. Facilities may include: • Urban parks; • Community recreation centers; • Greenways, especially along creeks running to and through the Activity Center, and overland connectors; • Schools (colleges, universities and K-12 schools); • Preschools and child care facilities; • Major libraries; • Post offices; and • Police sub-stations and fire stations. Mixed Use Activity Centers should be high priority areas for water and sewer extensions and upgrades, with an emphasis on providing capacity for anticipated urban development.	Transit Station Areas are appropriate for a range of public facilities designed to serve transit users, station area and surrounding residents, employees and visitors. Desired facilities include: • Urban parks/plazas; • Community/recreation centers; • Greenways and overland trail connections; • Libraries, schools, preschool and child care facilities; • Government service centers which include multiple public facilities; post offices; and • Medical facilities. Transit Station Areas should be priority areas for water and sewer extensions and upgrades, where needed, with an emphasis on providing capacity for moderate to high intensity transit oriented development.

	Infrastructure and public facilities should be designed to complement a moderate intensity urban environment.	
Environment and Site Design	Mixed Use Activity Centers should be urban and highly pedestrian-oriented, especially at their core. Most development should be low-to mid-rise buildings, with the greatest intensity at the core of these Activity Centers and lesser intensity and height at the edges, particularly when next to residential neighborhoods. These Activity Centers should be designed to provide a high level of vehicular access that supports transit, while encouraging a “park once” environment. Once in a Mixed Use Activity Center, it should be comfortable and easy for people to circulate on foot. Parking should be shared with a number of uses and, ideally, should not be located in surface lots to minimize the amount of impervious area devoted to parking lots. Streetscapes, public parks and open spaces should be designed to help create a comfortable and safe pedestrian environment and should enhance overall livability.	Transit Station Areas should be highly pedestrian-oriented, with buildings located at or near the back of sidewalks. Sidewalks should be wide enough to accommodate significant pedestrian activity. Most development should be in low- to mid-rise buildings with the greatest intensity nearest the station, and lesser intensity and height at the edges of the station area, closest to established neighborhoods. In some cases, high-rise buildings may be appropriate. Parking should be shared with a number of uses and, ideally, should be located in parking structures. Streetscapes, public parks and open spaces should be well designed to create a comfortable and inviting pedestrian environment.

Appendix 3: Blue Line HIA Workshop Agendas and Project Website

LYNX Blue Line Extension HIA Workshop Agenda

UNC Charlotte, Rm. 111 Cone Center

January 28, 2015, 1:00-5:00 PM

Sign In

Welcome by UNC Charlotte and Mecklenburg County Health Department

Overview of the Blue Line Expansion

Overview of the Built Environment and Public Health, HIA, and Mecklenburg County Health Indicators

Bathroom Break/ Light Refreshments

Site Visit to UNCC Main Campus Station

Small Group Activity and Report Back

Wrap Up/ Next Steps

Presentations from the workshop can be found at:
http://charmeck.org/mecklenburg/county/HealthDepartment/CommunityHealthServices/Pages/Blue-Line-Extension-(HIA).aspx

LYNX Blue Line Extension HIA Follow Up Meeting Agenda

Mecklenburg County Health Department, SE Multipurpose Room

July 23, 2015, 8:30-11:30 AM

I. Welcome by Mecklenburg County Health Department
II. Updates on the Progress of the Blue Line Extension
III. Updates from UNCC
IV. Findings from the HIA
V. Break
VI. Recommendations from the HIA
VII. Small Group Activity and Report Back
VIII. Wrap Up & Next Steps

Presentations from the workshop can be found at:
http://charmeck.org/mecklenburg/county/HealthDepartment/CommunityHealthServices/Pages/Blue-Line-Extension-(HIA).aspx

Appendix 4: Blue Line Light Rail Health Impact Assessment UNCC Questionnaire

Blue Line Light Rail Health Impact Assessment
UNCC Questionnaire

Thank you for taking the time to fill out this short questionnaire. We will use the responses to inform the Blue Line Light Rail Health Impact Assessment examining the potential health impacts of the light rail extension on the UNCC Campus and surrounding neighborhoods.

1. I am a _____ .
    a. UNCC Faculty Member
    b. UNCC Staff Member
    c. UNCC Graduate Student
    d. UNCC Undergraduate Student
    e. Resident of the University City Area
    f. Resident of the Greater Charlotte Area
    g. Other _____

2. I live on campus in _____ residence hall or I live off campus in _____ neighborhood, town/city, or apartment complex.

3. This semester, I am typically on UNCC Main Campus: (Circle all that apply)
    a. Monday
    b. Tuesday
    c. Wednesday
    d. Thursday
    e. Friday
    f. Saturday-Sunday

4. I have classes or regularly attend events/ work at the Uptown Campus. Yes No

5. I _____to UNCC Main Campus.
    a. Drive alone (Do you park on campus Y / N)
    b. Carpool (Do you park on campus Y / N)
    c. Take the Bus
    d. Walk
    e. Bike
    f. Other _____

6. It typically takes me _____ to get to classes/my office/worksite on campus from my residence.
    g. 1-5 minutes
    h. 6-10 minutes
    i. 11-15 minutes
    j. 16-20 minutes
    k. 21-25 minutes
    l. 26-30 minutes
    m. 31-35 minutes
    n. 36-40 minutes
    o. 41+ minutes

7. Once the Blue Line Light Rail Extension is open, I plan to use it to get to UNCC Main Campus. True False

8. Once the Blue Line Light Rail Extension is open, I plan to use it to get to UNCC Uptown Campus. True False

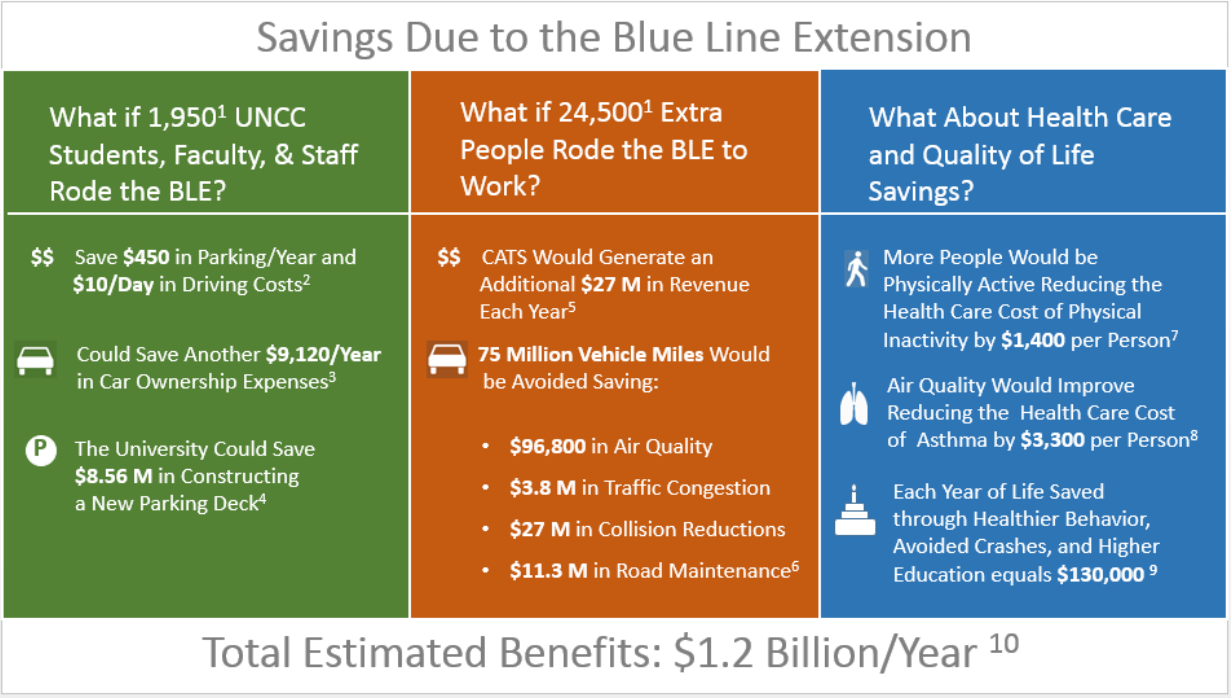
9. Why or why not?

THANK YOU!

Appendix 5: Table of Common Acronyms

Acronym	Organization/ Word
ACHA-NCHA	American College Health Association- National College Health Assessment
ACS	American Community Survey
AQI	Air Quality Index
BLE	Blue Line Extension
BMI	Body Mass Index
BRFSS	Behavioral Risk Factor Surveillance System
CATS	Charlotte Area Transit System
CCOG	Centralina Council of Governments
CDOT	Charlotte Department of Transportation
CMP	Charlotte Mecklenburg Planning
CMPD	Charlotte Mecklenburg Police Department
CRTPO	Charlotte Regional Transportation Planning Organization
DHHS	Department of Health and Human Services
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
HIA	Health Impact Assessment
HiAP	Health in All Policies
LUESA	Land Use and Environmental Services Agency
MCHD	Mecklenburg County Health Department
MCP&R	Mecklenburg County Parks and Recreation
NACCHO	National Association of County and City Health Officials
N&BS	Neighborhood and Business Services
NRC	National Research Council
P&CR	Public and Community Relations
RWJF	Robert Wood Johnson Foundation
TDM	Transportation Demand Management
TOD	Transit Oriented Design
UNCC	University of North Carolina Charlotte
VMT	Vehicle Miles Traveled
YRBS	Youth Risk Behavior Survey

Appendix 6: Cost Benefit Analysis



1. Estimated ridership for the entire extension (24,500 additional rides daily) and from the UNCC Main Campus Station (1,950 rides daily) were provided in presentations by the Charlotte Area Transit System (CATS) during the initial stakeholder workshop held on January 28, 2015 and available at http://charmeck.org/mecklenburg/county/HealthDepartment/CommunityHealthServices/Pages/Blue-Line-Extension-(HIA).aspx.
2. The annual cost of a full time parking permit at UNCC is $450 (http://pats.uncc.edu/parking/parking-permit-information). The 2015 standard mileage reimbursement rate is 57.5¢/mile (http://www.irs.gov/uac/Newsroom/New-Standard-Mileage-Rates-Now-Available;-Business-Rate-to-Rise-in-2015). It is estimated that taking the train could save someone 18 miles per day round-trip (twice the length of the extension) averaging about $10/day in transportation costs including gas, oil, maintenance, and vehicle wear and tear.
3. The annual ownership costs associated with owning a sedan in 2013 was $9,120/year including repairs, gasoline, tires, insurance, and depreciation (http://newsroom.aaa.com/2013/04/cost-of-owning-and-operating-vehicle-in-u-s-increases-nearly-two-percent-according-to-aaas-2013-your-driving-costs-study/).
4. The estimated cost of constructing a five-story, 145,000 square foot parking garage is $8.56 Million (http://www.fixr.com/costs/build-parking-garage).
5. An estimated $27 Million in additional revenue based on rates of $1.10 for student and senior fares and $2.20 for a regular fare ($27M ≈ ($1.10 for fare X 2 ways X 1,950 student riders X 36 weeks X 4 days a week) + ($2.20 fare X 2 ways X 24,500 riders X 49 weeks X 5 days a week)) (http://charmeck.org/city/charlotte/cats/fares/faresandpasses/pages/lynxfares.aspx).
6. Estimated Air Quality Improvement Benefits are $96,838/ year based on reducing miles traveled by 75 million miles/year (Blue Line EIS, 2011), preventing 348 tons of CO ($36.03/ton), 13 tons of NOx ($4,000/ton), and 19 tons of VOC ($1,700/ton). Traffic Congestion savings were estimated at the rate of $0.05/mile ($3.8 Million), Collision Reduction at the rate of $0.36/mile ($27

Million), and Road Maintenance $0.15/mile ($11.3 Million) (http://www.healthimpactnc.com/projects/pedestrian-and-active-transportation-plan/).

7. Medical costs attributed to obesity is $1,400 higher per person than medical costs associated with a person who is maintaining a healthy weight (http://www.heart.org/HEARTORG/GettingHealthy/PhysicalActivity/FitnessBasics/The-Price-of-Inactivity_UCM_307974_Article.jsp).
8. Asthma cost the US about $3,300/person from 2002 to 2007 in medical expenses, missed school and work days, and early deaths (http://www.aaaai.org/about-the-aaaai/newsroom/asthma-statistics.aspx).
9. The value of a year of life was determined to be $129,000 in 2008 and was rounded up to $130,000 for ease of calculation. (http://content.time.com/time/health/article/0,8599,1808049,00.html).
10. The Total Estimated Benefits of $1.2 Billion ($1,157,089,500 exactly) was calculated by adding:
    a. $877,500 (1,950 parking permits at $450/permit)
    b. $2,652,000 (1,950 students driving 18 miles per day for 136 days at a rate of $0.575/mile)
    c. $91,200 (10 students choose not to own a vehicle at $9,120/vehicle)
    d. $8.56 Million in Parking Deck
    e. $27 Million in CATS Revenue
    f. $96,800 in Air Quality Savings
    g. $27 Million in Collision Reduction
    h. $11.3 Million in Road Maintenance
    i. $34.3 Million in Physical Inactivity Savings ($1,400/person for 24,500 people taking transit)
    j. $7,146,000 in Asthma Savings ($3,300/person for 2,165 people)
    k. $1.014 Billion in Years of Life due to Higher Education ($130,000/person for additional 7,800 students)
    l. $20,266,000 Due to 2 Fatal Crashes being Prevented ($10,133,000/fatal crash for 2 crashes being prevented)