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Clifton Corridor Bike Safety Assessment

By

April Biagioni
M.P.H., Emory University, 2012
B.A., University of Georgia, 2004

Thesis Committee Chair: Grant T. Baldwin, PhD, MPH

An abstract of
A Thesis submitted to the faculty of the
The Rollins School of Public Health of Emory University
in partial fulfillment of the requirements of the degree of
Master of Public Health in the Career MPH program
2012

Abstract

Clifton Corridor (CC) Bike Safety Assessment

By
April Rae Biagioni

This bike safety assessment was designed to determine specific locations and types of accidents and near misses to inform local transportation and health planning along the Clifton Corridor. The CC is one of the largest employment hubs in Atlanta which include; Emory University, Emory Healthcare, the Centers for Disease Control and Prevention (CDC), the Veterans Administration Medical Center & Regional Offices, and the DeKalb Medical Center. Using a convenience sample of Emory employees and students a survey was administered to over 22,790 people to collect information on attitudes toward bicycling, learn more about cyclists' and potential cyclists' commuting patterns, behaviors, and collect information about bicycle related accidents. There were 1,876 respondents (8%) that completed the survey from April 30, 2012 to May 24th, 2012. The results highlighted how the high volumes of bicycle and motor vehicles traveling through the CC, correlated to 254 incidences and 52 crashes or almost accidents in a twelve month period from April 2011- April 2012. Among the key recommendations for reducing the number and severity of bicyclist injuries and fatalities include creating dedicated bicycle lanes, off street bicycle networks, strategies increasing the visibility of cyclists on the roads, and implementing CC speed reduction. The collected data can provide safety indices to allow engineers, planners, and other practitioners to proactively prioritize roadway and intersection improvements with respect to bicycle safety.

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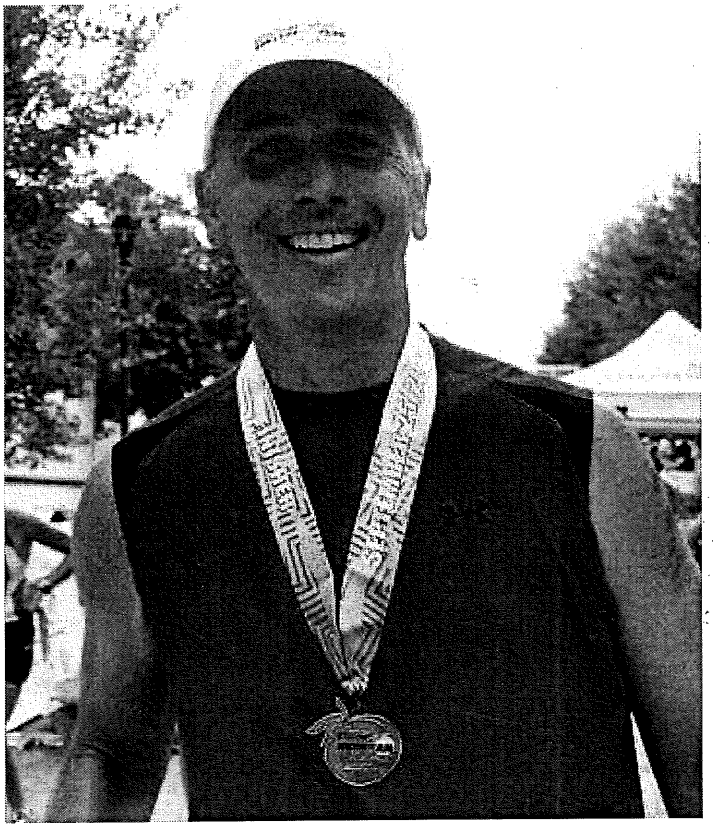
2012

ACKNOWLEDGEMENTS

This dissertation is dedicated to the memory of Paul Taylor. Paul Holton Taylor died April 30, 2012, in Atlanta, Georgia, following a bicycling accident on North Decatur Rd in Decatur GA. He was born on May 20, 1958, in Passaic, New Jersey.



I would like to give a special thanks to Dr. Grant Baldwin and Melissa Alperin for their expertise, patience, and guidance during the completion of my thesis.

I would also like to acknowledge my cohort for being such an intricate part of this learning endeavor. You gave me knowledge, support, and friendships that I'll cherish forever.

To my husband, Mark, and son Dononvan, I am forever grateful for your love and support throughout the duration of this academic degree.

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Background

The popularity of bicycling in America has grown dramatically in recent years due to many factors, including desire for exercise, enjoyment, economic advantages, and for environmentally conscience concerns. According to the U.S. Census, in 1990 the percentage of journeys to work by bicycle was .41 percent (or, 466,856 people). By 2006, the U.S. Census reported that participation grew to .50 percent (or, 508,873 people). During this time, Georgia has seen a 111% increase in the popularity of cycling, while the City of Atlanta recorded an 386% increase in the number of people biking to work, thus making Atlanta's increase the highest among the 51 cities surveyed (Alliance of Biking and Walking, 2012).

While biking is becoming increasingly popular, there are a number of safety concerns with biking here in Georgia. Currently, there are about 8,498 people in Georgia that commute by bicycle (Alliance of Biking and Walking, 2012). The total number of bicycle fatalities is low compared to the overall number of traffic accidents in the United States and in Georgia (NHTSA, 2011). Nevertheless, the United States, and Georgia in particular, have not been successful at reducing the number of deaths for this emphasis area. In 2009, 630 cyclists died on our country's roads and an additional 51,000 were injured in motor vehicle crashes (NHTSA, 2009b). This rate is down significantly from 2005 when 786 bicyclists were traffic fatality victims (NHTSA, 2009). While overall numbers of bicycle fatalities are declining, bicyclist fatalities and injuries continue to be a significant public health concern.

In Georgia there are approximately 775 bicycle crashes and 20 people die while riding their bicycle every year (GOHS, 2010) (Table 1). According to a recent report released by the

Alliance for Biking and Walking, Georgia is currently ranked 45th in the nation for bicycle and pedestrian safety (Alliance for Biking and Walking, 2012). Furthermore, Georgia ranks 8th among the states with the most bicycle fatalities, despite having among the lowest rates of bicycling in the country (GOHS, 2010) (Table 2). These statistics show that Georgia is relatively unsafe for bicycling.

Table 1. Traffic and Bicycle Fatalities in GA between 2004 and 2010

Type of fatalities	2004	2005	2006	2007	2008	2009	2010
Traffic fatalities	1,634	1,729	1,693	1,641	1,493	1,295	1,250
Bicyclists	20	23	19	15	20	21	N/A

From: Data from NHTSA, 2009a

Table 2. Top Ten Most Bicyclist Traffic Fatalities and Fatality Rates by State, 2010

Ranking (highest to lowest)	State	Total Traffic Fatalities	Resident Population (thousands)	Bicyclist Fatalities	Percent of Total	Bicyclist Fatalities per Million Population
1	Texas	2,998	25,257	42	1.4	1.66
2	California	2,715	37,349	99	3.6	2.65
3	Florida	2,445	18,843	83	3.4	4.4
4	Pennsylvania	1,324	12,710	21	1.6	1.65
5	North Carolina	1,319	9,562	23	1.7	2.41
6	**Georgia**	**1,244**	**9,713**	**18**	**1.4**	**1.85**
7	New York	1,200	19,392	36	3	1.86
8	Ohio	1,080	11,536	11	1	0.95
9	Tennessee	1,031	6,357	4	0.4	0.63
10	Michigan	942	9,878	29	3.1	2.94

From:Fatality Analysis Reporting System, NHTSA. Population Bureau of the Census 2010.

Bicycles offer a promising transportation alternative to private motor vehicles, especially in areas with congestion, poor air quality, and high fuel prices. However, many individuals choose not to utilize bicycle transportation for recreation or commuting because of safety concerns (US DOT, 2011). Thus, improving bicyclist safety may increase the rate of bicycle use. While incorporating biking into everyday life is not realistic for all areas of the state, it is possible at a dense employment center, such as a university setting where students, faculty, and staff live, work, and recreate in the area.

One such area is the Clifton Corridor (CC). This is a major employment hub in Atlanta. The CC includes Emory University, Emory Hospital, Children's Healthcare of Atlanta, Centers for Disease Control and Prevention (CDC), Yerkes National Primate Research Center, Ben Franklin Academy, Druid Hills High School, and the Veterans Affairs (VA) Hospital, totaling approximately 30,000 employees and 14,000 students in a three mile radius of Clifton Road. Like the rest of Georgia, the CC has also seen an increase in the number of bicyclists, and there is the potential for an even greater number of bicyclists in the future (Bike Emory, 2012). This area offers us a unique opportunity to understand bike safety and its impact on active commuting.

One of the biggest challenges that areas like the CC face when trying to increase their bike use is working with neighboring communities to create an environment that is safe, comfortable, and conducive to bicycling. Campus bicycle commuters typically spend the majority of their miles riding on city streets (Corbet, Gilpin, & Renfroe, 2011). According to the survey conducted by Bike Emory, the greatest disincentive for more people biking in the area is safety (Bike Emory, 2012). Yet, due to the large number of student and employees in the CC, traffic congestion has become a major issue. Additionally, the bicycling routes in some of the

main arteries to the CC are narrow. The traffic congestion combined with inadequate bike paths can increase the likelihood of injury if hit by a motor vehicle and might deter bike commuting.

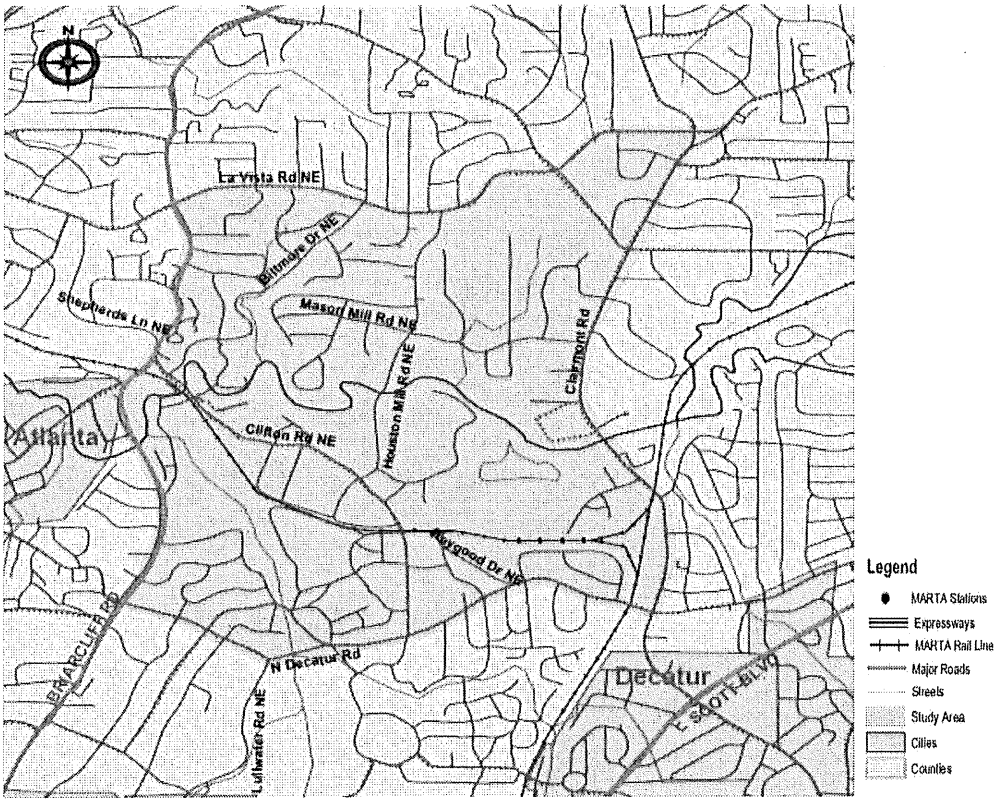
Purpose

The purpose of this study is to identify geographical areas of the CC that have more frequent bicycle-related crashes or may be more susceptible to bicycle-related crashes. To date, this type of analysis has not been done with previous Emory Bike surveys. By identifying areas that have more bicycle-related crashes, more specific measures can be taken to improve bike safety and promote biking within the CC. A secondary objective of this study will look at the priority areas mentioned in the Emory Bike Survey to see if there is a correlation between perceived areas of risk compared to actual bicycle -related crash locations.

Definition of Terms

The Clifton Corridor (CC) - Bike Emory defines the Clifton Corridor as a three mile radius from Cox Hall which consists of approximately 250 acres along Clifton Road. The CC extends through the Emory University campus and is the locale for most of the facilities of the schools of Medicine, Public Health, and Nursing (Figure 1).

Figure 1. Clifton Corridor Map



Facilities located along this corridor include:

- All Fired Up
- Bad Dog Taqueria
- Bank of America
- Barnes & Noble Emory Bookstore
- Children's Healthcare of Atlanta at Egleston
- Chipotle
- CVS Pharmacy
- Dave's Cosmic Subs
- Doc Chey's Noodle House
- Domino's Pizza
- Druid Hill High School
- Emory Chevron
- Emory Healthcare
- Emory Starbucks
- Emory University Hospital
- Emory Vaccine Center
- Emory Winship Cancer Institute
- Emory's Graduate Science Program
- Everybody's Pizza
- Evolve Boutique
- Falafel King Houqua Tea Room
- Majik Touch Cleaners
- New York Style Pizza
- Panera Bread
- Railroad Earth
- Rise -N- Dine
- Saba
- Shield's Market
- Starbucks

- SunTrust
- Supercuts
- The Ben Franklin Academy
- The Center for Rehabilitation Medicine
- The Emory Children's Center
- The Emory Clinic,
- The Emory Global Health Institute
- The Marcus Autism Center
- The Robert W. Woodruff Health Sciences Center
- The Rollins Research Center
- The U.S. Centers for Disease Control and Prevention
- The Whitehead Biomedical Research Building
- TME Computer Services
- Wesley Woods Center
- Woodruff Memorial Research Building
- Yerkes National Primate Research Center
- Yogli-Mogli Frozen Yogurt

Bike Safety- the methods or practices designed to reduce the risk of bicycle injuries and fatalities (RITA, 2012).

Motor Vehicle- An automotive vehicle not operated on rails; especially: one with rubber tires for use on highways; car, truck, bus, scooter (Webster Dictionary, 2012).

Bike Commuter- Someone who uses a bicycle for utilitarian travel (that is, not recreation) on a reasonably regular basis.

Incident- A bicycle occurrence, in which a bicyclist was hit, fell, almost fell or experienced motorist hostility.

Almost Accident- Incident where a motor vehicle came very close to making contact with a bicycle.

Summary

Due to a number of economic, environmental, and health concerns, biking instead of driving is becoming an attractive commuting alternative. In particular, urban, dense in traffic and high transportation cost make biking a more appealing alternative. One area in particular, CC, with its large workforce, sprawling campus community, parking limitations, and focus on

sustainability is eager to increase its biking population. The problem is that the existing traffic patterns, environment and landscape were constructed without attention to biking accessibility. Research has shown that bike related crashes and deaths are more common in areas that have these similar conditions, but CC conduciveness for bike safety has not yet been assessed. This study will measure and assess geographic areas of the CC in order to determine how best to design new routes and create an environment safe for the cycling community, which is an important component in people's decision to bike.

Chapter 2: Review of the Literature

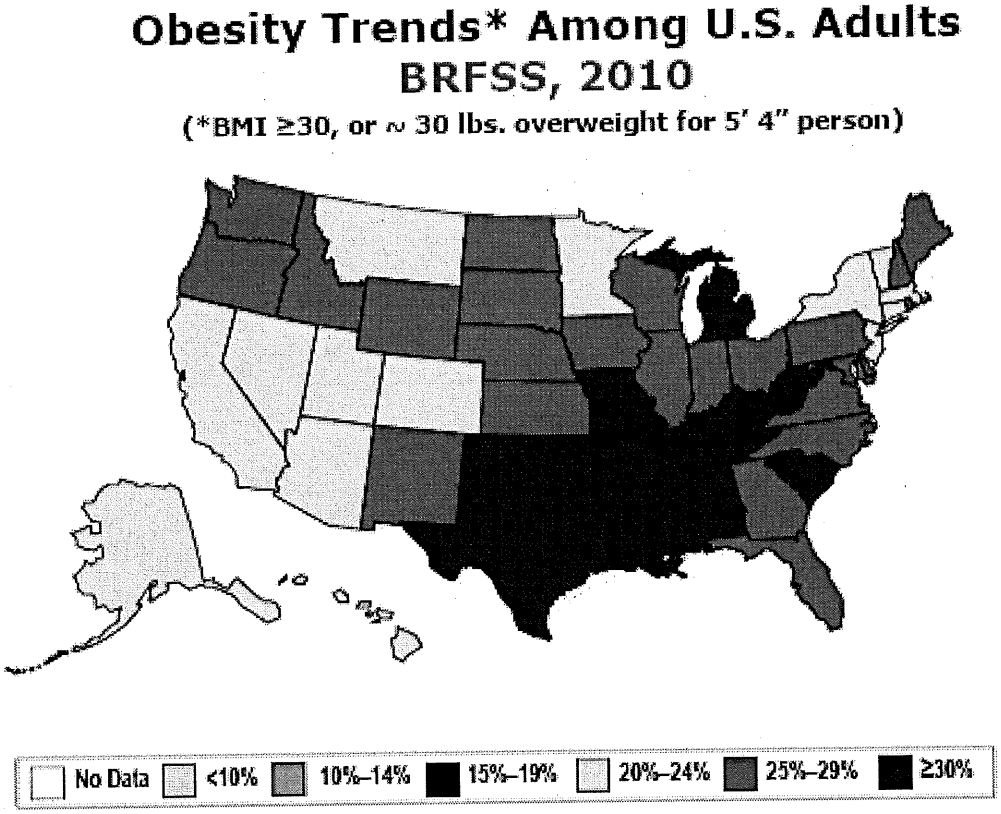
Introduction

Accompanying the growth in bicycling for commuting purposes is the increased need for safe and convenient bike facilities to accommodate bicyclists. The need is especially high at intersections where the potential for conflict with motor vehicles is higher (Korve & Niemeier, 2002). This chapter provides a summary and review of the literature relating to bicycle safety. The goal of the literature review was to identify existing information relating to the health benefits of bicycling, bicycle behaviors, bicycle usage, bicycle related accident rates, bicycle injury costs, and bicycle infrastructure intended to improve on-street bicyclist safety.

Public Health Burden

Adult obesity rates increased in 28 states in the past year, and declined only in the District of Columbia (D.C.), according to F as in Fat: How Obesity Threatens America's Future 2010, a report from the Trust for America's Health (TFAH) and the Robert Wood Johnson Foundation (RWJF). More than two-thirds of states (38) have adult obesity rates above 25 percent (Voelker R., 2012) (Figure 2.). In 1991, no state had an obesity rate above 20 percent (Voelker R., 2012). Additionally, the average American spends more than 100 hours per year commuting, with the vast majority of those hours being spent in a car (McKenzie & Rapino, 2011).

Figure 2. Obesity Trends Among U.S Adults



From: Center for Disease Control and Prevention, Behavioral Risk Factor Surveillance System 2010

In a recent study conducted on Atlanta residents commuting habits, Atlanta ranked fourth on Smart Growth America's top-10 list of the most sprawling U.S. metropolitan areas. The results showed for every extra 30 minutes of commuting time per day, participants had a 3% greater likelihood of obesity than peers who drove less (Frumkin, Frank, & Jackson, 2004). According to the CDC, the extra driving and physical inactivity associated with regional sprawl has been linked to obesity rates which have doubled since the 1980s (CDC, 2010). The medical costs of obesity are estimated at $2.1 billion annually in Georgia. These costs include direct expenses of diagnostic and treatment services and indirect costs of reduced productivity and lost

wages (GADPH, 2010). With roughly 64% percent of Atlanta residents currently overweight or obese, biking offers solutions to curb this growing and costly epidemic.

Fatalities for bicyclists and the type of injuries involved in a bicycle crash are typically more severe, mainly because bicyclists are largely unprotected from impact. Fatalities and injuries from bicycle-related crashes in 2005 cost society $5 billion in direct medical and social costs in (Naumann et al., 2005). The Fatality Analysis Reporting System (FARS) data indicate that in 2010, 618 bicyclists were killed and an additional 52,000 were injured in motor vehicle traffic crashes. Bicyclist deaths accounted for 2 percent of all motor vehicle traffic fatalities, and made up 2 percent of all the people injured in traffic crashes during the year, despite the fact that they make up roughly 1.0% of all trips according to NHTSA estimates, (NHTSA, 2009). In the 51 largest U.S. cities, bicycling account for 1.1% of trips yet 3.1% of traffic fatalities are bicyclists (NHTSA, 2009) (Table 3.). As shown in Table 3, the majority of bicyclist fatalities in 2010 occurred in urban areas (72%) and at non-intersections (67%). The difference in speed between cars and bicycles at a conflict point is very important: a reduction in collision speed from 30 mph (48 km/h) to 20 mph (32 km/h) means that the risk of fatal injury is reduced from 45% to 15 or 5% (a factor of 3 or 9) (Fortuijn, 2003). Thus, finding solutions to make bicycling safer and increasing rates of bicycling use are key components to improving the community's health. While it is difficult to determine all the contributing factors in many bicycle related accidents because of varying factors from accident reporting to bicycle safety measure taken, it is important to understand whether bicycle infrastructure and facility improvements have an impact on the rate of bicycle-related crashes and injury rates.

Table 3. Total US Fatalities and Bicyclist Fatalities in Traffic Crashes, 2001–2010

Year	Total Fatalities	Bicyclist Fatalities	Percent of Total Fatalities
2001	42,196	732	1.7
2002	43,005	665	1.5
2003	42,884	629	1.5
2004	42,836	727	1.7
2005	43,510	786	1.8
2006	42,708	772	1.8
2007	41,259	701	1.7
2008	37,423	718	1.9
2009	33,883	628	1.9
2010	32,885	618	1.9

From: NHTSA's National Center for Statistics and Analysis 2010

Public Health Benefits

To determine how bicycling influences public health, the Alliance for Biking and Walking compared public health data to bicycling. Data from the Behavioral Risk Factor Surveillance System (BRFSS) and the American Cancer Society (ACS) reflect a direct relationship between levels of bicycling and several public health indicators which provide data that suggests that the risk for such health problems such as obesity, diabetes, asthma, and hypertension will decrease with more bicycling (Alliance for Biking and Walking, 2012). States with lower bicycling levels on average have higher levels of obesity, diabetes, hypertension, and asthma. States with higher levels of bicycling also have a greater percentage of adults who meet the recommended 30-plus minutes of daily physical activity (Alliance for Biking and Walking, 2012). This suggests that increasing bicycling can help achieve public health goals of increasing physical activity and lowering rates of overweight and obesity. According to Brent Buice of Georgia Bikes, "the benefits to Georgia of increased biking are clear: better quality of life, sustainable economic activity, and improved public health, an important consideration for a state with almost a third of its adult population considered obese.

Physical Environment Correlates of Physical Activity

The research has proven that bicycling has the potential to improve fitness and reduce obesity rates amongst other environmental public health benefits. However, bicyclists incur a higher risk of injuries requiring hospitalization than motor vehicle occupants (Reynolds, Harris, et.al, 2009).

In 2009 an extensive literature review by Conner Reynolds was conducted on the impact of transportation infrastructure had on bicycle related injuries and crashes. From this review of 28 papers (8 that examined intersections and 15 that examined straightaways) it was suggested that infrastructure influences injury and crash risk. This intersection studies focused mainly on roundabouts. They found that multi-lane roundabouts can significantly increase risk to bicyclists unless a separated cycle track is included in the design. Studies of straightaways grouped facilities into few categories, such that facilities with potentially different risks may have been classified within a single category. Results to date suggest that sidewalks and multi-use trails pose the highest risk, major roads are more hazardous than minor roads, and the presence of bicycle facilities (e.g. on-road bike routes, on-road marked bike lanes, and off-road bike paths) was associated with the lowest risk (Reynolds Harris, et.al, 2009).

The state of California, in collaboration with the American Association of State Highway and Transportation Officials (AASHTO), has identified three types of bikeways that serve as model for bike commuting classification. Since the state of Georgia does not currently have a standard, this study will use the Caltrans model as a guide for this review (Figure 3).

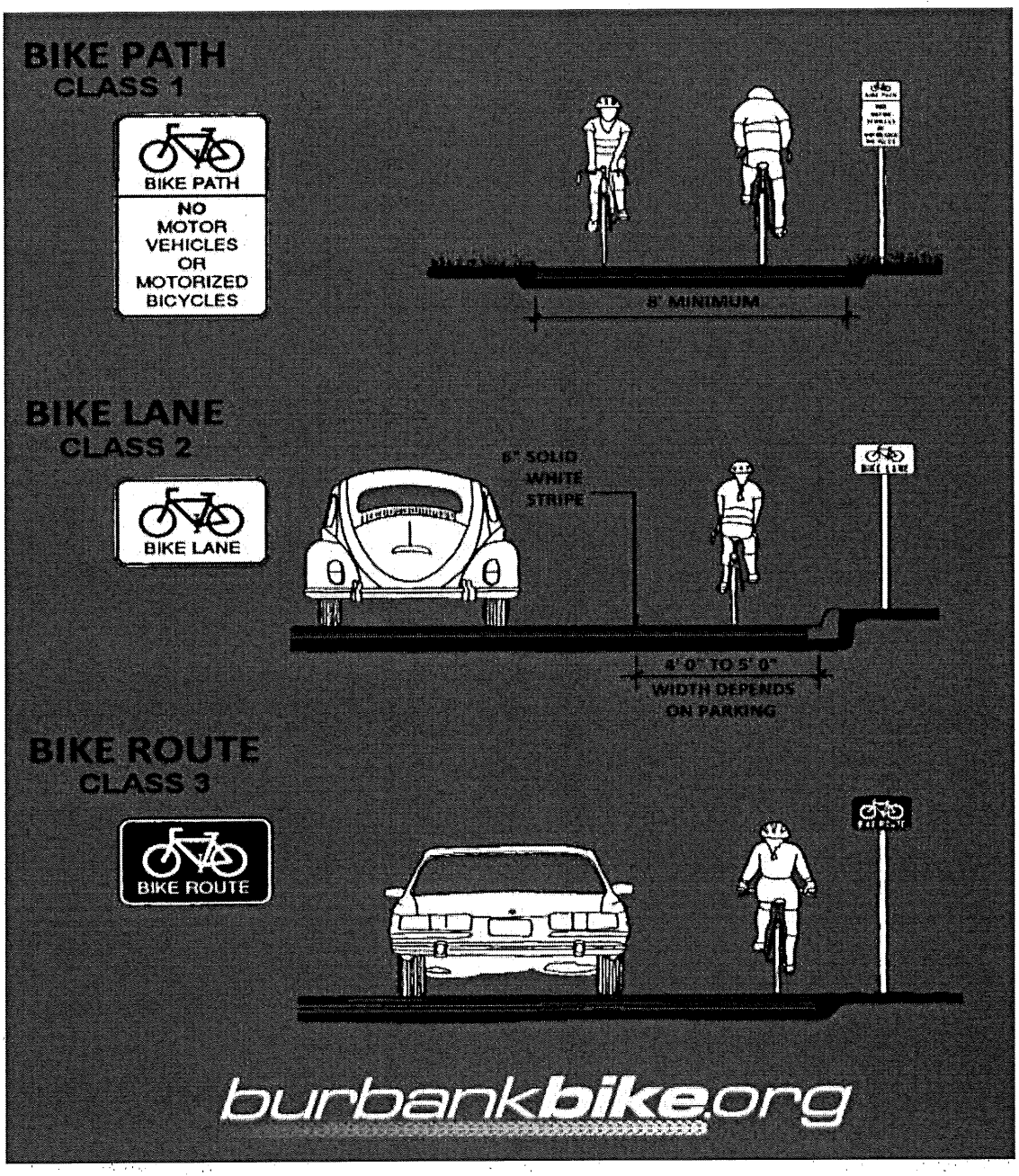
They are as follows:

Class I Bikeway Typically called a "bike path," a Class I bikeway provides bicycle travel on a paved right-of-way completely separated from any street or highway.

Class II Bikeway. Often referred to as a "bike lane," a Class II bikeway provides a striped and stenciled lane for one-way travel on a street or highway.

Class III Bikeway Generally referred to as a "bike route," provides for shared use with pedestrian or motor vehicle traffic and is identified only by signing

Figure 3. Caltrans Bikeway Classification



From: AASHTO 2006.

In general, Class I bike paths are desirable for recreational uses, particularly by families and children. Class I bike paths are preferred for corridors where there are few intersections or crossings, to reduce the potential for conflicts with motor vehicles. Class II bike lanes provide an additional buffer between traffic and sidewalks, aiding pedestrians. When properly designed, bike lanes help improve the visibility of bicyclists. In general, Class II bike lanes are highly desirable for bicycle commute routes. On streets with low traffic volumes and speeds (under 5,000 vehicles per day, 30 mph), bike lanes may not be needed at all. This is based on the potential for serious conflicts being so low that the cost of installing bike lanes is not warranted. On low-traffic neighborhood streets, Class III bike routes can serve as important connectors to schools and recreational areas such as parks. Class III bike routes may also be desirable on certain commute routes where installing bike lanes is not possible, provided that appropriate signage is installed to alert motorists to the presence of bicycles on the roadway.

Social Dynamics and Community Health

Bicycle improvements are often discussed in terms of the "Four E's" of bicycle planning and design: Engineering, Education, Enforcement and Encouragement. Combined, the "Four E's" will ensure the effectiveness of projects and programs while ensuring that the needs of all bicyclists are met.

The detailed project recommendations to improve bicyclist safety are shown in (Table 4).

TABLE 4. Bicycle Planning

Approach	Recommendation	Rationale
Engineering	Self-Explaining Roads 1. Dedicated bike lanes 2. Bike paths 3. Lane width reduction	The built environment is a large factor in whether people will commute by bicycle. Well-designed and maintained facilities increase the likelihood that people bike and will improve safety for those that already do.
Engineering	Speed Reduction	Slowing down traffic is key to improve bicyclist safety. Slowing down traffic reduces the chance of bicyclist injury as drivers have the ability to stop over a shorter distance. The severity of the crash is also decreased at slower speeds.
Encouragement	More Bike to Work Events	Encouragement from leaders is necessary for a successful bicycle-commuting program. It's pertinent that the CC have the commitment of the top management of the major employers in the area and that commuting is promoted on a regular basis.
Encouragement	More Incentives	By backing up their endorsement with financial or other incentives, employers can demonstrate that their commitment is sincere, and that they regard bicycling as a legitimate and professionally acceptable mode of transportation.
Enforcement	Basic Traffic Law Enforcement	Local law enforcement agencies can help ensure good driving and bicycling behavior.
Education	Rules of the Road Pocket Guides	Education includes teaching bicyclists of all ages how to ride safely in any area and also educating motorists how to share the road safely with bicyclists.Additionally, bicycle education is also used to promote bicycling

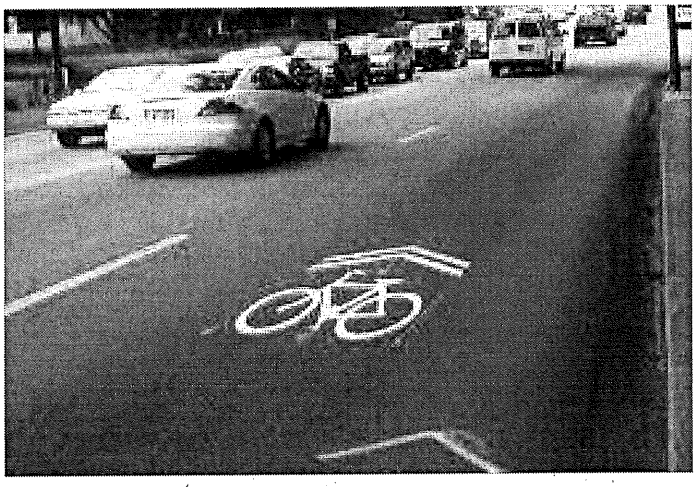
One of the greatest divergences of opinion lies between those who feel paved bike paths, separated from roadways, should be constructed wherever physically possible, versus those who feel more comfortable riding on streets on lanes or routes. This preference is usually based on personal feeling regarding comfort, safety, and experience level. The literature available on bicycle commuting preferences for various types of bicycle facilities usually relies on surveys to gather preferable route choices. In a survey conducted at the University of Minnesota respondents were willing to travel up to twenty minutes more to switch from an unmarked on-road facility with side parking to an off-road bicycle trail, with smaller changes associated with less dramatic improvements (Tilahun et al, 2007). Additionally research from the Frequency of Bicycle Commuting, found from an internet based stated preference survey that bicyclist were willing to commute 10% longer travel times on residential streets or routes with bicycle lanes rather than on minor or major arteries with no dedicated bicycle lanes (Stinson & Bhat 2003).

Emory University developed a partnership called Bike Emory in 2007 with international bike company Fuji Bikes and local bike shop Bicycle South. This partnership provides many benefits to cyclists, including a bike rental program that provides bicycles for daily use at three locations on the main Emory campus and one location on Oxford campus. Emory's commitment to creating a bicycle culture and support for Bike Emory is still strong four years later. Emory's invested $250,000 (including partner contributions) to launch the Bike Emory program. This funding was used to hire a director, create a bicycle sharing system, build a website, launch a mobile repair center, provide discounted bicycles and execute a comprehensive marketing and bicycle safety campaign.

CC Road Design and Crash Risk

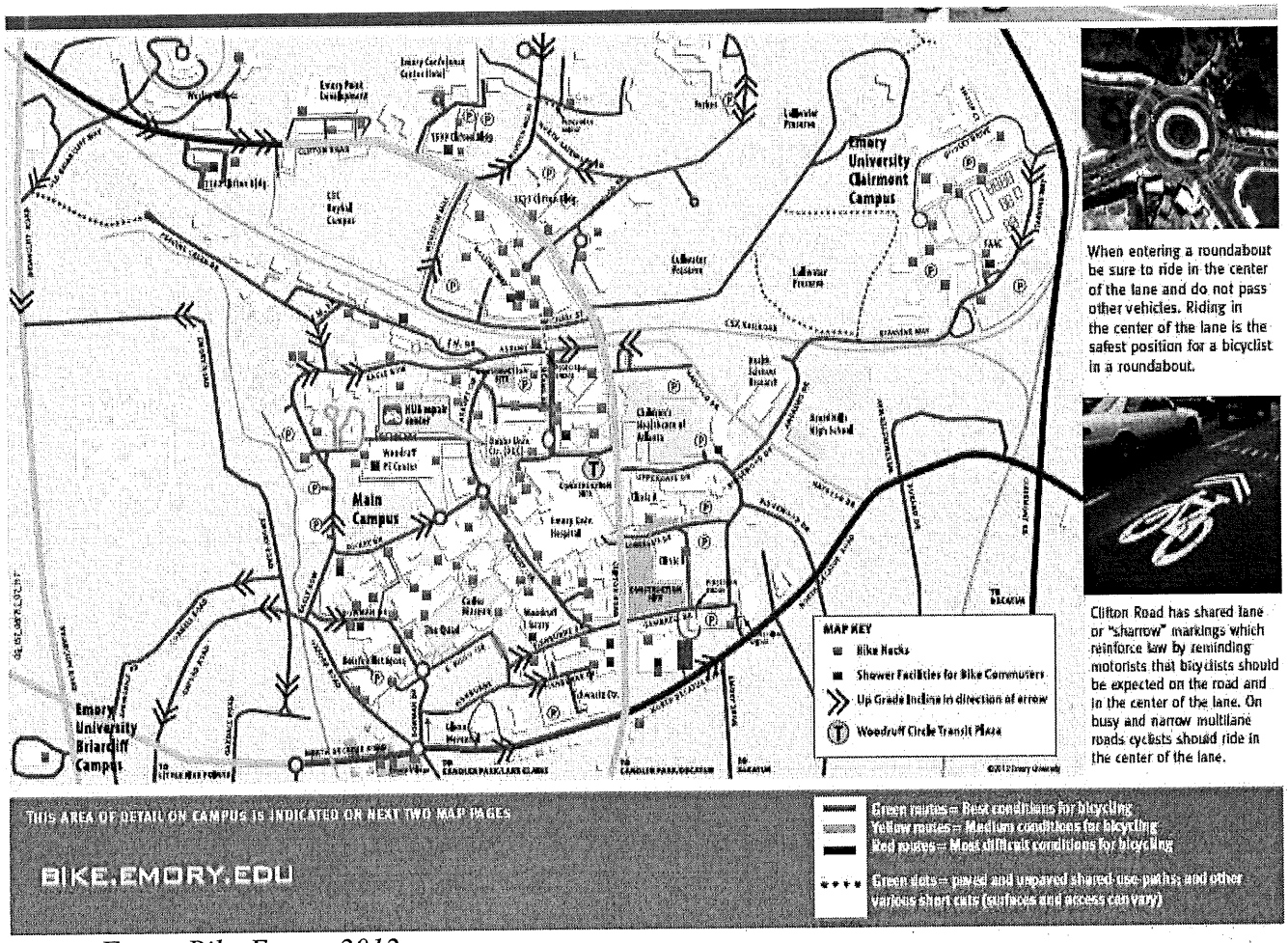
Currently the bike pathways on the CC consist of Class III bike routes. However, through the advocacy of Bike Emory the CC introduced shared bike lane or sharrows with the option of occupying the entire lane on Clifton Road in the fall of 2011 (Figure 4). Additionally, with the improvements and roundabout in the Emory Village Dekalb County also added a bike box at the intersection of North Decatur and Clifton Road. The CC's existing bicycle network is shown in (Figure 5).

Figure 4. Clifton Road Sharrow



From: Bike Emory 2012

Figure 5. Clifton Corridor Bicycle Network



From: Bike Emory 2012

The availability and quality of bicycling facilities are important factors to encourage bicycle commuting. Studies conducted in 2003 and 1997 by have shown that there is a positive correlation between the number of facilities that are provided and the percentage of people that use bicycling for commuting purposes (Dill & Carr, 2003), (Nelson & Allen,1997). While both studies state that causality cannot be proved from the data, Nelson and Allen (1997) state that in addition to having bicycle facilities, facilities must connect appropriate origins and destinations to encourage cycling as an alternative commuting mode. Bicycle parking space is also an important component in planning bicycle facilities and encouraging widespread use because bicycles are one of the top stolen items in all cities and college campus's nationwide (Corbet, et.

al, 2011). Several studies suggest that fear of cycle theft may discourage bicycle use (Rietveld, & Koetse, 2003). With today's bicycles often costing between $350 to over $2,000, many people won't even use a bicycle unless they have secure parking available. In addition to parking accommodations, clothing locker facilities offer a great incentive to make bicycle commuting a viable option for many bicyclists and contribute to the viability of bicycling as a commute option to those who are hesitant. The Clifton Corridor network consists of both on and off-street facilities to help address these issues (Table 5).

Table 5. Clifton Corridor off Street Bicycle Facilities

Building	Type of Facility
Mathematics and Science Center	Showers open access, no lockers
Psychology Building	Shower, open access, no lockers
Woodruff Library	Shower, open access, lockers are only for students who commute more than one hour away
Goizueta Business School (x2)	Gender-specific showers, with daily use lockers.
Law School Building	Lockers are reserved online for students (they provide locks); no shower.
Williams Medical Education Building	Lockers for medical students only (are assigned).
Woodruff PEC	Shower and locker access for members only; locker reservations can be made through PEC office.
FM Building F	Shower only for campus services staff.
Whitehead	Showers are only for department staff use, no other access
Grace Rollins Building	Showers and lockers for School of Public Health students, staff, faculty.
1599 Clifton	Open access showers, lockers can be reserved.
1762 Clifton	Building is locked, no lockers
Student Activities and Academics Center	Shower and locker access for members only; locker reservations can be made through SAAC office.

From: Bike Emory 2012.

Summary

During the course of the literature review, articles were reviewed that analyzed bike safety interventions and infrastructure although only a few reviewed specific geographic information to assess accident or accident-prone areas. Since bicyclists incur a higher risk of injuries requiring hospitalization than motor vehicle occupants, finding solutions to make bicycling safer and increasing rates of bicycling use are key components to improving the community's health (Reynolds, Harris, et.al, 2009). The built environment from street lighting, paved surfaces, and bike lanes are important factors to consider when trying reducing crashes and injuries among bicyclists. This analysis of CC will be a practical tool to determine specific points were bike safety could be improved. By identifying these specific problem areas, meaningful progress can be accomplished for bike safety infrastructure, education, and awareness programs. By focusing on these areas, major deterrents for bike commuting will be addressed and ideally bike ridership in the CC will increase.

Chapter 3 Methodology

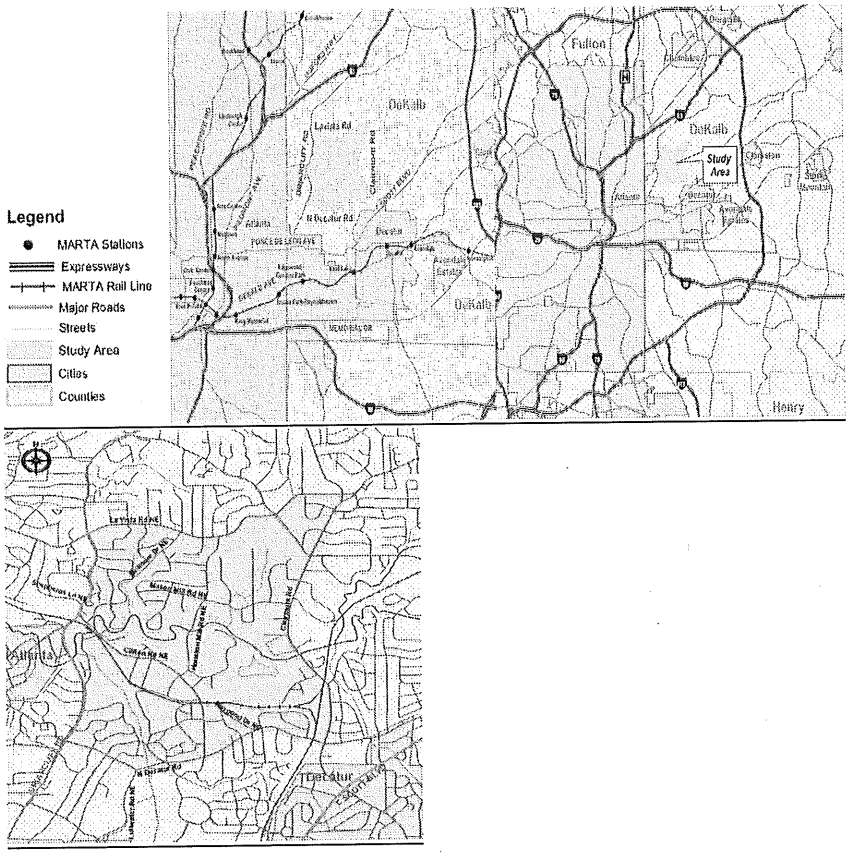
Introduction

Commuting by bicycle in longer, busier corridors has unique safety concerns (Tilahun et al., 2009). While many travel surveys try to capture bicycle ridership, they do not often include questions about people's routes or facility preferences (Dill & Carr, 2003). This study attempts to capture both of those variables in its analysis. For the purpose of this study, the definition of bicycle commuting is the use of a bicycle to travel from home to a place of work or study. It is important to note that 20-25 % of trips by bike nationally are commute trips (Pucher, Renne 2003). According to Litman, a travel survey should attempt to gather the following information: demographics, origin and destination, time of day, and trip purpose (Litman et al., 2000). This study looks at most of those recommended variables with the exemption of time of day. This thesis focuses on a bicycle safety assessment of the CC located in Atlanta Georgia. Understanding user characteristics, behavior, personal preferences of bicyclists, attitudes and beliefs of both bicyclist and non-bicycle commuters, as well as location of accidents will help inform planning, policy, advocacy, and bicycle infrastructure design within the CC.

CC Background

The CC includes some of the largest activity centers in metro Atlanta. These conditions have created high levels of traffic congestion on a severely limited network of roadways as shown below in (Figure 6).

Figure 6. CC Network and Roadways



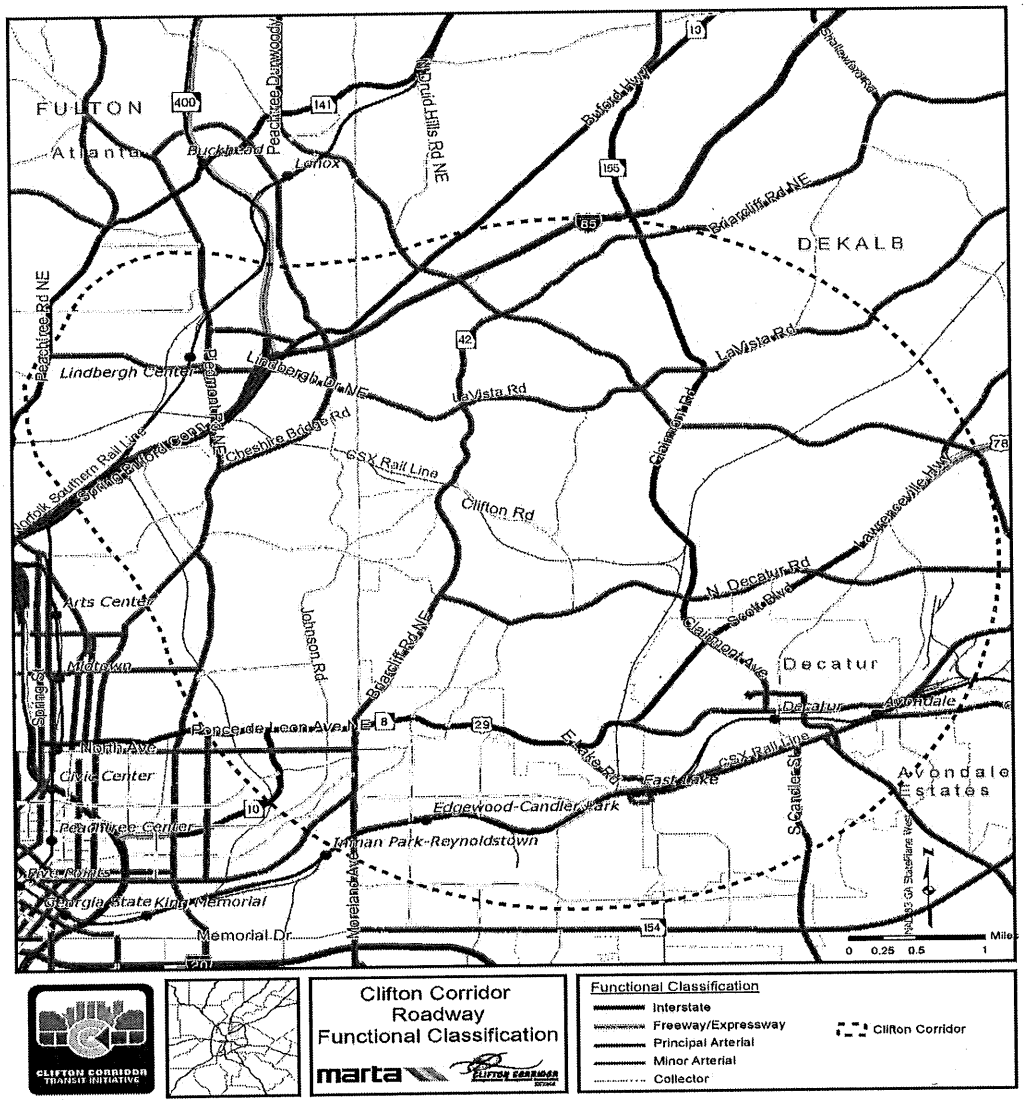
From: DeKalb County, City of Atlanta and City of Decatur Land Use Plans

The Clifton Corridor consists of the neighborhood Druid Hills/ Emory, which was developed in the early 20th century. The planned community was initially conceived by Joel Hurt, and developed with the effort of Atlanta's leading families, including Coca-Cola founder Asa Candler. It contains some of Atlanta's historic mansions and bungalows from the late 19th and early 20th century. Druid Hills includes the main campus of Emory University, which relocated to Atlanta in 1914. Druid Hills was designed by Frederick Law Olmsted and was one of his last projects (White & Krammer,1979).Olmsted's visions of an ideal suburb, consisted of "good roads and walks, sewer, water and gas pipes, and sufficiently cheap, rapid, comfortable transportation to the center of the city (King, 2005)." Residential streets were landscaped on both sides like parkways, and front yards of the spacious lots were landscaped in a natural manner that

flowed down into the street-side landscaping, to create the feeling of a continuous park (King, 2005). Of tremendous importance were the covenant restrictions included in his plans, to protect Druid Hills from future commercial development and to uphold the high standards proposed for this suburban area (King, 2005).

The CC is bounded by arterials such as the US 29 facility (Ponce De Leon Avenue/Lawrenceville Highway facility), which runs east west through the southern portion of the Clifton Corridor. Clairmont Avenue runs north south in the central eastern portion. Minor arterials include Briarcliff Road, LaVista Road, North Decatur Road, North Druid Hills Road, DeKalb Avenue, and Cheshire Bridge Road, as shown in (Figure 7). The general lane configurations for the major roadways are limited to mostly undivided two-lane facilities with a few four-lane facilities. Traffic signals are prevalent along these roadways. Minor and principal arterials are signalized at more than 130 locations in the corridor.

Figure 7. CC Roadway Characteristics



From: DeKalb County, City of Atlanta and City of Decatur Land Use Plan

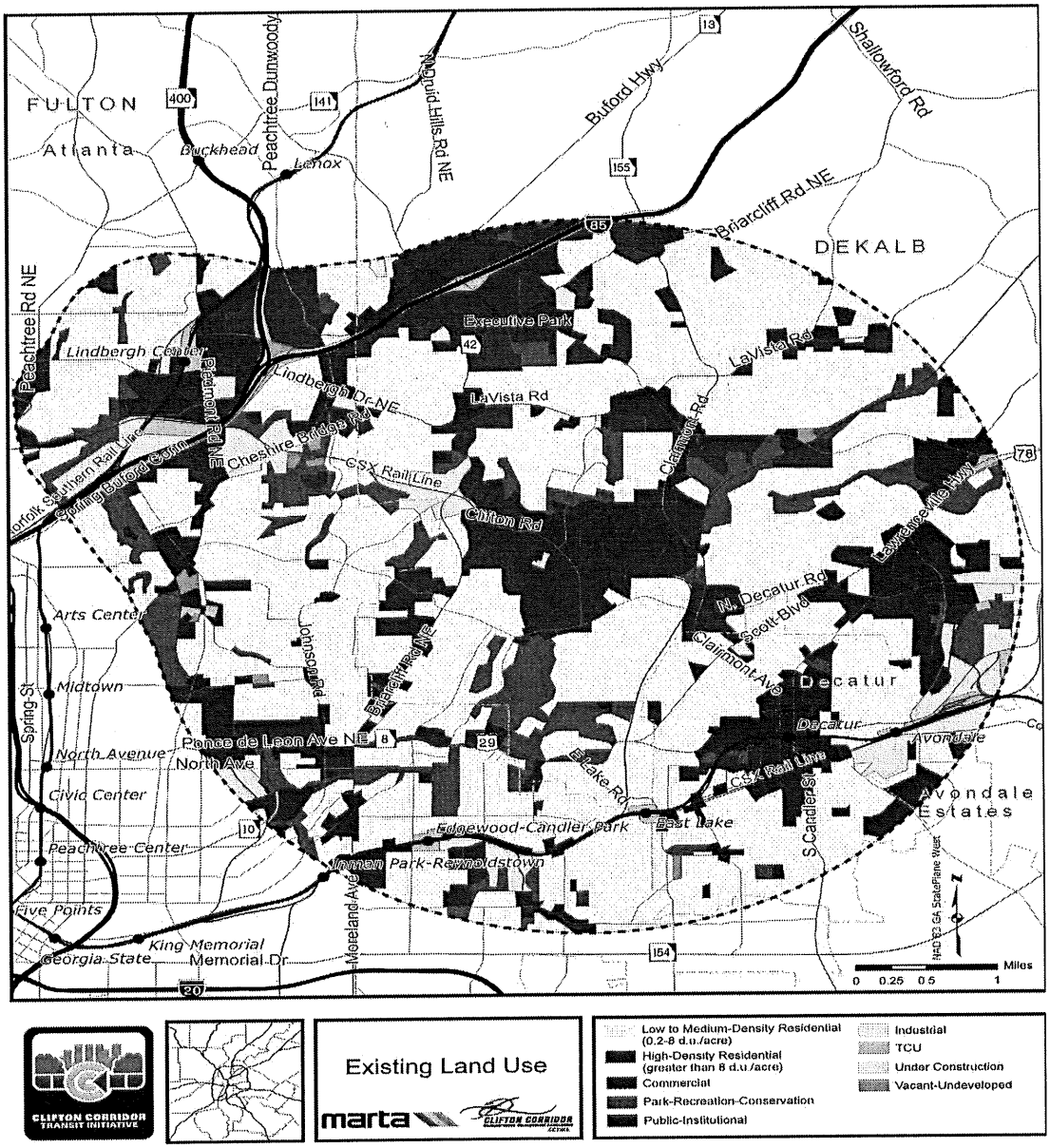
Emory Village is the historical commercial center for Druid Hills and Emory University. As one of the oldest suburban town centers in Atlanta, the toll over the years, of widening the roads, growth of the expansion of the Village became increasingly difficult and dangerous to access by the community and the business declined as a result. In 2000, Leon Eplan, former Planning Commissioner for the City of Atlanta offered to develop a plan with the Urban Land Institute and formed the Alliance to Improve Emory Village. The goal was to revitalize the

ailing commercial shops and increase pedestrian safety along the entrance of Emory University. In 2011 the final phase of the project was completed which now offers a roundabout, bike lanes, and increased side walk and pedestrian road crossing access.

Social and Political Environment

As seen in the (Figure 8), the CC supports both residential and commercial development. This means that Clifton Corridor residents commute out of, or around, the area, and employees commute in from around the region. The CC area is comprised of predominately single-family homes on one-quarter to two-acre lots (Ames, & McClelland, (2002). This represents a residential density of one-half to four dwelling units per acre (Ames, & McClelland, (2002). These are largely historic neighborhoods found in close proximity to the CC. They feature a gridded street system and small-scale commercial structures interspersed within residential areas. This land use category includes some of Atlanta's most desirable and affluent historic neighborhoods including Inman Park, Candler Park, Virginia-Highlands, Lenox Park and Morningside, these neighborhoods were originally served by trolley car lines (Kind, 2005). As a result they are walkable and pedestrian friendly. The ARC Lifelong Communities program developed a site plan for the neighborhood that incorporates mixed-use development to serve this population and support increased residential uses in the area (Morken, 2012). Existing single-family neighborhoods are expected to remain primarily single-family into the future (Morken, 2012) (Figure 8).

Figure 8. Existing Land Use CC

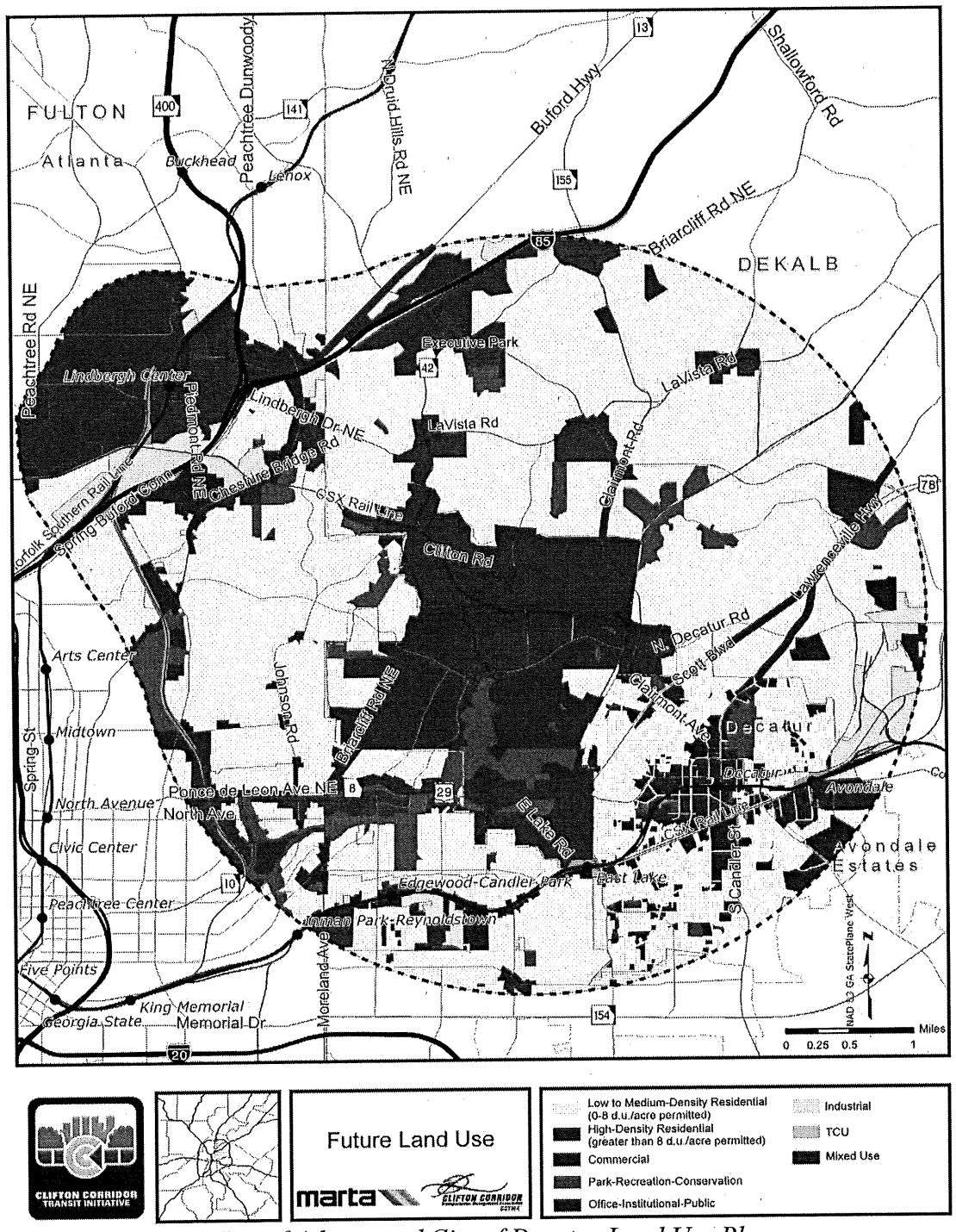


From: DeKalb County, City of Atlanta and City of Decatur Land Use Plans

Currently, the CC is unlike other metro activity centers in that its areas of high employment concentration are not centralized with adequate highway accessibility (Reid et. al, 2003)

Instead, many major employment destinations are buffered from highway access by residential areas. The CC population is expected to grow at a lower rate than the region as a whole, with approximately 20% population growth from 2005 to 2030 (Marta, 2010). However, corridor employment is expected to grow by 43% during that same period, so the corridor will remain a popular destination (Marta, 2010). The area around Emory is expected to experience the highest population growth (83%) from 2005 to 2030 (Marta, 2010). It is expected to grow from 1,950 residents to 3,570, largely due to increased housing for those who work in the healthcare cluster (Marta, 2010). Population in the CC is increasing in density as well, in 2005 density for the entire corridor was 6.0 persons per acre and by 2030, it is projected to be 7.1 persons (Marta, 2010). The total population of CC in 2010 was 14, 568 experiencing a 14.3% increase in the 10-year period between 2000 and 2010 (Georgia Institute of Technology, 2002) (Figure 9) illustrates the projected growth in population in the Clifton Corridor and Atlanta region.

Figure 9: CC Future Land Use Map



From: DeKalb County, City of Atlanta and City of Decatur Land Use Plans

Data Collection

This thesis uses a 22 question internet based survey from the survey company Vovici, which was administered to 22,790 faculty, staff, and students at Emory University on Monday, April 30th. The results analysis includes answers from all respondents who took the survey in the 25-day period from Monday, April 30, 2012 to Thursday, May 24, 2012. There were 1,876 respondents (8%) out of 22,790 invites that completed the survey during this time. In addition, a review of the relevant literature to understand how user characteristics and experiences can be used as an indicator to access whether or not there are areas within the CC that are more prone to bicycle related accidents. This information can be analyzed and used by organizations located in the CC to assess whether bicycle facilities, bicycle policies, and bicycle planning can make the CC safer. This project was deemed exempt by Emory's Institutional Review Board (see Apendix A).

Sample Selection for Survey Purposes

A convenience sample was utilized through a survey sent out by Emory University's Provost Office. The input will was self-reported by Emory University faculty, staff, and students who are willing to respond to the survey. The respondents were both bicycle commuters and non-bicycle commuters.

Timeline

The survey was distributed to the Emory University wide listserve on Monday, April 30 2012 and was open for 25 days. After collecting the responses, an analysis was made to reflect and answer the research questions.

Research Questions:

Research Question 1 (RQ1) – What is the frequency and circumstances surrounding bicycle accidents and almost-accidents around the CC?

RQ1a: How many accidents or near-misses occurred during the past year?

Research Question 2 (RQ2): Are there certain areas within the CC that are more prone to bicycle related crashes?

Research Question 3 (RQ3): What improvements to the CC could be made to make bicycling safer?

RQ3a: What are the opinions of bicyclists on the CC regarding improvements to overall bicycling infrastructure in the CC?

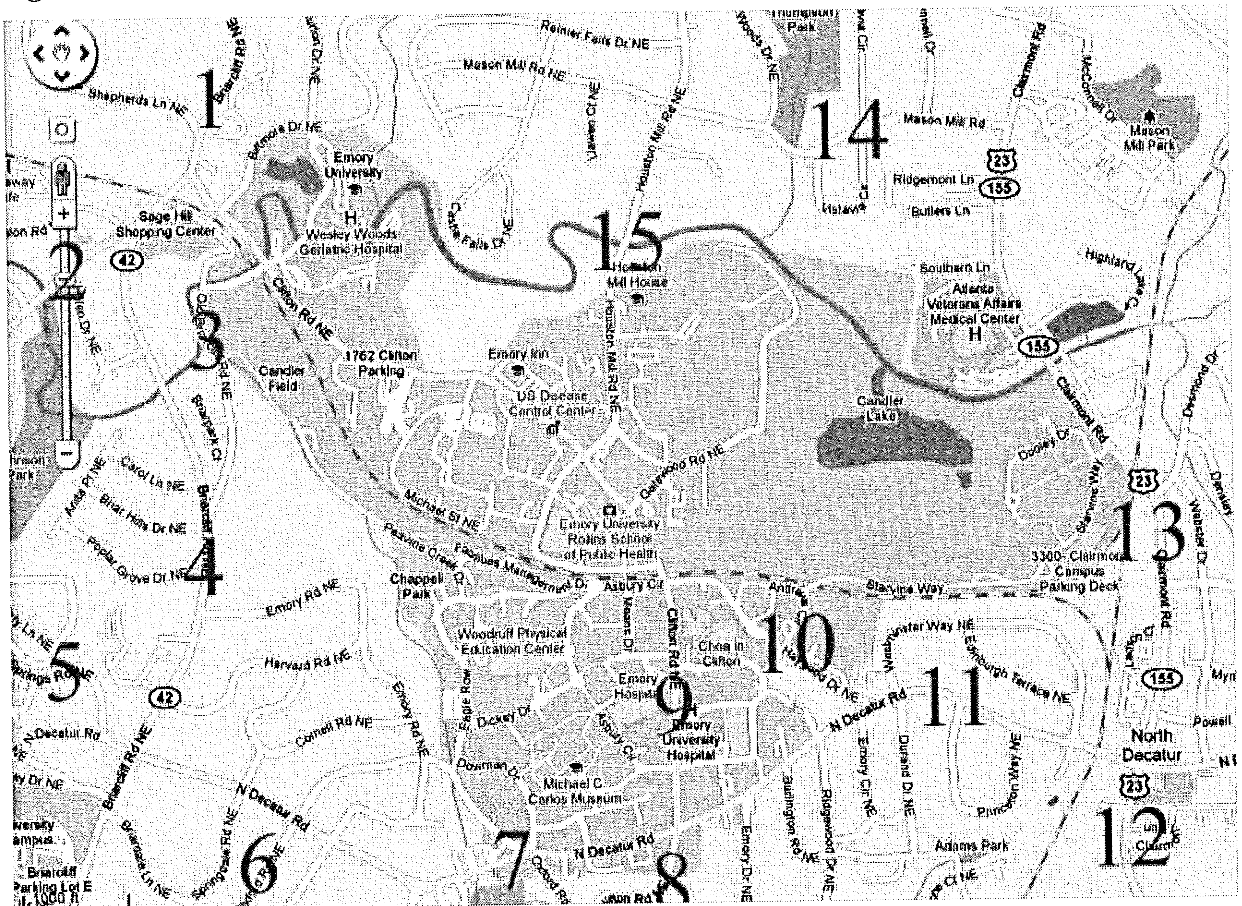
RQ3b: What are the opinions of bicyclists on the CC regarding improvements to overall bicycling facilities in the CC?

RQ3c: What reasons do respondents give for using or not using bicycles in the CC based on infrastructure, distance, etc.?

RQ3d: What are some safe or unsafe behaviors of bicyclist in the CC?

The study focused on 15 major roads, which feed in to Clifton Road the major artery of the CC (Figure 9).

Figure. 9 Clifton Corridor Main Road Arteries



1. Briarcliff Rd. (North of Clifton Rd.)

2. Johnson Rd. to Briarcliff Rd. to Clifton Rd.

3. Old Briarcliff Rd. (Briarcliff Rd. to Clifton Rd.)

4. Briarcliff Rd. (Clifton Rd. to N. Decatur Rd.)

5. East Rock Springs Rd. (West of Briarcliff Rd.)

6. Oakdale/Oxford/Springdale Rd. to N. Decatur Rd.

7. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.)

8. Clifton Rd. (South of N. Decatur Rd.)

9. Clifton Rd (N. Decatur Rd. to Briarcliff Rd.)

10. Haygood Dr. (N. Decatur Rd. to Clifton Rd.)

11. N. Decatur Rd. (Clifton Rd. to Clairmont Rd.)

12. Clairmont Rd. (South of N. Decatur Rd.)
13. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)
14. Mason Mill Rd. (Clairmont Rd. to Houston Mill Rd.)
15. Houston Mill Rd. (Lavista Rd. to Clifton Rd.)

Data Analysis

The analysis plan was tailored to the nature of each question. For each of the research questions that correlate with a survey question, summary statistics like RQ3, (eg frequency, percentages) is presented. For purely qualitative (open-ended) questions, like RQ, this study coded all answers individually and identifies common underlying themes. To enhance objective assessment of responses, an evaluation method was utilized to abstract the responses of each respondent. For questions like RQ3d, a description of these domains is presented using both quantitative (percentage of domains) and qualitative terms (summary statements). Quantitative analyses was be performed by Vovici and is presented in rank order.

Recruitment

Subjects were recruited by an email invitation to participate in the Bike Emory Survey. Survey participants were offered an incentive to be entered in a random drawing by offering one $50 gift card randomly drawn from the pool of participants. For participants be eligible, they simply completed the survey or sent a postcard to Emory University, Bike Emory 1599-001-1AM1599 Clifton Road, Atlanta, GA 30322 by May 9, 2012.

Instrument

The questionnaire has three purposes: 1) document the burden of adverse bicycling events in the CC, 2) to evaluate and improve the quality of bicycle behavior and belief data 3) determine areas within the CC that might be more prone to bicycle related accidents. To reach

these objectives, a survey has been designed to include quantitative as well as qualitative questions. A copy of the survey is provided in Appendix A. The six components of the survey are:

1. Questions asking about collisions, falls, or almost accidents and the nature of their crash (es.)
2. Questions related to the quality of infrastructure improvement and perceived attitudes, measured using a Likert Scale
3. Question sought bicyclists' perceptions of safety of various bicycle facilities.
4. Characteristics and riding experience and facility use
5. Questions evaluating knowledge where performance can be quantified and compared with future surveys
6. Open-ended questions to get input on important areas for future focus and improvements.

Summary

This project focused on the Druid Hills area of Northwest Atlanta, and focused on a bike safety assessment of the CC. As one of the largest employment hubs in Atlanta, corridor employment is expected to grow by 43%. The area around Emory is expected to also experience the highest population growth from 1,950 residents to 3,570, largely due to increased housing for those who work in the healthcare cluster (Marta, 2010). This rapid increase in population in a small geographic area will continue to add to the already congested traffic conditions and thus add another obstacle for bicycling in the CC. Data to inform the proposed research was collected through a web-based survey using a mixed method approach to gather both qualitative and quantitative data. The qualitative data is an accumulation of people's concerns and detailed information of where and why some accidents occurred. I'll apply those findings for the specific areas of the CC in the Implications/Conclusions section.

Chapter 4 Results

Introduction

This study recognized and utilized important public stakeholders (Emory University faculty, staff, and students) to identify data for bicycle usage, as well as specific bicycle safety concerns with in the CC. A web-based survey was developed to solicit input and perspectives from the Emory University community regarding bicycle accident, usage patterns, and concerns related to bicycle safety. A link to the survey was emailed to the Emory University distribution list. A short statement introduced the purpose of the survey and invited the Emory University community to participate. Summaries of the responses that address the research question to the study are provided below.

Findings

Survey Question: Do you use a bicycle for any part of your commute to work or class (Table 6)*?*

Table 6. The Number of People that use a Bicycle to Commute to Work or Class

Response	Count	Percent
Yes	400	27.0%
No	1080	73.0%

Survey Question: Do you use a bicycle for your primary or secondary mode of transportation for commuting to work or class (Table 7)*?*

Table 7. The Number of People that use a Bicycle for Primary or Secondary Transportation

Response	Count	Percent
Primary mode (mode of transportation you use most often)	227	56.6%
Secondary mode	174	43.4%

Research Question 1 (RQ1) – What is the frequency and circumstances surrounding bicycle accidents and almost-accidents around the CC?

RQ1a: How many accidents or near-misses occurred during the past year (Table 8).

Survey Question: Have you experienced any of the following during your commute to work or class in the last 12 months?

Table 8. Accidents or Near-misses Occurring in the Past Year

	Yes	No
Have you fallen off your bicycle?	28.2% (134)	71.8% (341)
Have you been hit by a motor vehicle?	8.6% (41)	91.4% (434)
Have you been hit by an opening car door?	1.5% (7)	98.5% (468)
Have you been deliberately pushed off your bicycle?	1.3% (6)	98.7% (469)
Have you been almost hit by a motorist?	61.9% (294)	38.1% (181)
Has a motorist exhibited hostile behavior towards you?	55.4% (263)	44.6% (212)
Total	**745**	**2105**

Interpretation RQ1. What is the frequency and circumstances surrounding bicycle accidents and almost-accidents around the CC?

According to the survey question above, there were 745 bicycle related incidences that occurred between May 2011- May 2012 during survey participants bicycle commute in to the CC. Out of those 745 incidences, there was 41 reports of bicyclists being struck or hit and 294 reports of bicyclists being almost hit by a motor vehicle. Additionally, there were seven occurrences where a bicyclist was hit by a car door and six occurrences of bicyclists being deliberately pushed off their bicycles.

Research Question 2 (RQ2): Are there certain areas within the CC that are more prone to bicycle related crashes?

Survey Question: If you answered yes, to the above questions where did the incident occur? (Optional)

Table 9. Location and Number of Accidents Occurring in the CC

Location in CC	Number of Incidents	Number of Crashes, Falls, Almost hits
1. Briarcliff Rd. (North of Clifton Rd.)	7	0
2. Johnson Rd. to Briarcliff Rd. to Clifton Rd.	4	0
3. Old Briarcliff Rd. (Briarcliff Rd. to Clifton Rd.)	1	0
4. Briarcliff Rd. (Clifton Rd. to N. Decatur Rd.)	3	0
5. East Rock Springs Rd. (West of Briarcliff Rd.)	6	1
6. Oakdale/Oxford/Springdale Rd. to N. Decatur Rd.	13	3
7. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.)	25	4
8. Clifton Rd. (South of N. Decatur Rd.)	9	2
9. Clifton Rd (N. Decatur Rd. to Briarcliff Rd.)	61	14
10. Haygood Dr. (N. Decatur Rd. to Clifton Rd.)	13	5
11. N. Decatur Rd. (Clifton Rd. to Clairmont Rd.)	35	6
12. Clairmont Rd. (South of N. Decatur Rd.)	11	0
13. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)	29	5
14. Mason Mill Rd. (Clairmont Rd. to Houston Mill Rd.)	0	0
15. Houston Mill Rd. (Lavista Rd. to Clifton Rd.)	12	3
16. Places inside Emory Campus	25	9
Total	**254**	**52**

Interpretation RQ2. Are there certain areas within the CC that are more prone to bicycle related crashes?

Out of the 745 responses of bicyclist experiencing an incident on their commute to CC 254 of those incidences occurred inside the CC. The four arteries with the most incidents reported on the survey in order from highest to lowest were 9. Clifton Rd (N. Decatur Rd. to

Briarcliff Rd.), 11.N. Decatur Rd. (Clifton Rd. to Clairmont Rd.), 13. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.), 7. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.). While 229 of those incidences were reported to have occurred on one of the 15 major arteries in CC, 25 incidences occurred in smaller areas of Emory's campus and resulted in 9 crashes/falls/ or almost hits.

Research Question 3 (RQ3): What improvements to the CC could be made to make bicycling safer (Table 10).

Survey Question: Roadway prioritization for facilities. Please share which road segments you think should receive priority for cycling improvements. Examples of improvements could be signage, striping, dedicated lanes or other ideas.(Please rank 3 of the following options in the order of priority)

Table 10. Roadway Prioritization for Facilities in the CC

Rank Item	Rank	Votes
9. Clifton Rd (N. Decatur Rd. to Briarcliff Rd.)	1	1757
11. N. Decatur Rd. (Clifton Rd. to Clairmont Rd.)	2	1540
7. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.)	3	1053
13. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)	4	920
1. Briarcliff Rd. (North of Clifton Rd.)	5	876
15. Houston Mill Rd. (Lavista Rd. to Clifton Rd.)	6	793
4. Briarcliff Rd. (Clifton Rd. to N. Decatur Rd.)	7	710
8. Clifton Rd. (South of N. Decatur Rd.)	8	514
12. Clairmont Rd. (South of N. Decatur Rd.)	9	482
10. Haygood Dr. (N. Decatur Rd. to Clifton Rd.)	10	440
6. Oakdale/Oxford/Springdale/Lullwater Rds. (South of North Decatur Rd.)	11	298
14. Mason Mill Rd. (Clairmont Rd. to Houston Mill Rd.)	12	246
2. Johnson Rd. (Briarcliff Rd. to East Rock Springs Rd.)	13	196
5. East Rock Springs Rd. (West of Briarcliff Rd.)	14	191
3. Old Briarcliff Rd. (Briarcliff Rd. to Clifton Rd.)	15	178

RQ3a: What are the opinions of bicyclists on the CC regarding improvements to the facilities?

Survey Question: How satisfied are you with bicycle parking where you work or take classes (Table 11).

Table 11. Satisfaction with Bicycle Parking

Response	Count	Percent
Very satisfied	194	40.8%
Somewhat satisfied	183	38.5%
Somewhat dissatisfied	57	12.0%
Very dissatisfied	25	5.3%
N/A	16	3.4%
Total	**475**	

RQ3b: What are the opinions of bicyclists on the CC regarding improvements to overall bicycling infrastructure in the CC?

Survey Question: Shared lane ("sharrow") markings and "bicycles may take full lane" signs were recently placed on Clifton Rd. How have they impacted your experience with riding a bike at Emory (Table 12).

Table 12. Do Sharrows on Clifton Road Impact Biking Experiences

	Agree	Disagree	N/A
I feel safer riding on Clifton	42.4% (195)	35.3% (166)	22.3% (105)
It has made no difference	40.2% (188)	34.8% (163)	25.0% (117)
Motorists know to expect bicyclists now	39.0% (181)	40.3% (187)	20.7% (96)
Motorists are less hostile	28.8% (133)	45.7% (211)	25.5% (118)
Total	**699**	**727**	**436**

RQ3c: What reasons do bicyclists give for using or not using the CC based on infrastructure, distance, etc.?

Survey Question: What discourages you from including bicycling in your commute to work/class (Table 13).

Table 13. What are the Discouragements to Include Bicycling in the CC

Response	Count	Percent
Do not feel safe riding on the roads from my home to work	791	42.2%
Live too far away	391	20.8%
Lack of shower facilities at work	262	14.0%
Need personal car for business related meetings/travel	244	13.0%
Run personal errands during the day or on way to/from work	233	12.4%
Other (please specify)	207	11.0%
Drop off/pick up children at Daycare/School	151	8.0%
Lack of secure bicycle parking at work site	81	4.3%
Lack of Covered Bike parking	62	3.3%

Survey Question: Why did you stop bicycling to Emory (Table 14).

Table 14. Reasons for no longer Biking in the CC

Reason	Number of Responses
Safety	56
Too much traffic	19
No shower/too sweaty	18
No bike lane	14
Live too far/moved	13
Hills	10
Prefer to walk	9
Time	8
Weather	7
Need to take children to childcare	7
No longer have a bicycle	2

Survey Question: Why do you prefer to bicycle for transportation to school or work (Table 15).

Table 15. Reasons why People Bicycle in the CC

Response	Count	Percent
It's great exercise and keeps me in shape.	398	21.2%
I enjoy being outdoors.	361	19.2%
It saves me money.	338	18.0%
It's the easiest/quickest way for me to travel.	299	15.9%
It's very green, and I am doing my bit for the planet.	298	15.9%
Bicycling reduces my stress.	264	14.1%
I don't have good public transit options.	129	6.9%
It's the best part of my day.	113	6.0%
I don't have a car.	103	5.5%
I can do something fun with family and friends.	101	5.4%
I want to be a leader in my family and community.	57	3.0%
I can stop and chat when I see people I know.	48	2.6%
I use my bike to get to my local bus stop/transit station.	38	2.0%
Other (please specify)	11	0.6%

RQ3d: What are some safe or unsafe behaviors of bicyclist in the CC?

Survey Question: Please indicate how frequently you do the following when you use your bicycle (Table 16).

Table 16. Safe or Unsafe Behaviors of Bicyclist in the CC

	Always (100% of the time)	Very Often (75% - 99% of the time)	Often (50% - 74% of the time)	Sometimes(25% - 54% of the time)	Seldom if Ever (0-24% of the time)
Wear a helmet	72.0% (342)	8.0% (38)	4.0% (19)	3.4% (16)	12.6% (60)
Bicycle on the street	37.5% (178)	35.2% (167)	13.3% (63)	8.8% (42)	5.3% (25)
Bicycle on the sidewalk	4.0% (19)	12.2% (58)	13.3% (63)	16.0% (76)	54.5% (259)

Survey Question: When you ride on the street, what lane position do you take (Table 17).

Table 17. Lane Positions Bicyclist take in the CC

Response	Count	Percent
It depends on the traffic conditions.	197	41.6%
I ride a few feet out from the curb.	132	27.9%
I ride as close as possible to the curb.	110	23.3%
I will only ride in the street if there is a bike lane.	23	4.9%
Other (please specify)	7	1.5%
I never ride on the street, only on off-road paths or trails.	4	0.8%

Interpretation RQ3. What improvements to the CC could be made to make bicycling safer?

From the survey results cited as areas with the most incidences, it was interesting to see that those same four arteries with the most incidents reported were also cited as road segments that needed to receive priority for cycling improvements. Examples of improvements were signage, striping, dedicated lanes or other ideas to improve bicyclist safety. Bicycle Parking, storage and shower/changing rooms are important ways to provide convenience and security for cyclists at destinations. According to the survey, respondents seem satisfied with the bicycle parking provided by Emory. However, respondents were less optimistic about the improvements to overall bicycling infrastructure in the CC in regards to the new bike sharrows installed along Clifton Road The response between whether or not bicyclist were satisfied or unsatisfied with the signage of the sharrows if the signage made them feel safer, or if they saw a change in motor vehicle awareness were almost equal. Another factor regarding safety was motorist hostility. A large majority of qualitative and quantitative data reported motorist hostility towards bicyclist riding in the CC. Motorist hostility was included in bike related incidences.

A main reason why people are discouraged from commuting by bicycle in to the CC is a concern of safety. According to the survey 44.2% of people polled said that they do not feel safe

bicycling to work or class and the number one response to why people have stopped bicycling was also due to them not feeling safe. The 27% of people who commute by bicycle within the CC cited exercise, being outdoors, and saving money as reasons why they use a bicycle for transportation. Of that 27%, 80% wear a helmet between 75-100% of the time. The majority, over 60% also responded that they ride on the street rather than the sidewalk. These responses show that the majority of the people who do commute practice basic safety precautions when commuting in to the CC.

Summary

Of the 1,876 respondents who participated in the Bike Emory Survey, 400 people declared that they rode a bicycle for a portion of their commute in to the CC. Of those 400 commuters, 227 people or 56.6% used their bicycle as their primary mode of transportation. From both bike and non-bike commuters, there is a perceived lack of safety in riding on city and campus streets especially the main arteries within the CC; Clifton Road., North Decatur Road, and Clairmont Road. This is reflected in the 745 incidences that were self-reported as occurring on commutes in to the CC and in the open ended responses as to why commuters don't bike more often, and the desire for dedicated bike lanes or separate paths to protect bicyclists. Bike and no-bike commuters agreed that dedicated bike lanes rather than sharrows on campus or city streets, and trails and pathways separated from the road are the critical amenities to encourage them to ride, or ride more often, to campus. Bicycle commuters reported that they bike to campus for exercise, to be outdoors, and save money.

Chapter 5 – Implications/Conclusions

Introduction

This thesis can guide policy makers, urban planners, and transportation engineers in making decisions to increase public safety. Those decisions may affect bicycle ridership, therefore increasing human and environmental health within the CC. The results found that there are several arteries with in the CC that are more prone to bicycle accidents or almost accidents. These locations are critical in increasing bicyclist safety, while reducing collision and injury rates. The CC should determine these as areas of importance, and priority when considering bikeway improvements.

Implications for Practice

Implications of this research suggest infrastructure improvements; reduction in speed, traffic education for bicyclist and drivers, and driver and bicycle law enforcement can provide positive impacts on overall bicyclist safety. Cyclists and non-cyclists were in agreement that bicycling in the CC was unsafe due to motor vehicle traffic and roadway conditions. The findings show that safety is the most significant barrier to bicycling. This section describes the ranking methodology for the recommended bicycle facilities and includes a list of prioritized projects. The four arteries within the study segments that had more to accidents were located on (Table 18).

Table 18. Top Four Arteries in the CC that Bicycle Incidents Occur

Artery	Number of incidents	Number of crashes, hits, almost hits
1. Clifton Rd (N. Decatur Rd. to Briarcliff Rd.)	61	14
2. N. Decatur Rd. (Clifton Rd. to Clairmont Rd.)	35	6
3. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)	29	5
4. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.)	25	4
Total	**150**	**29**

Additional areas of interest include:

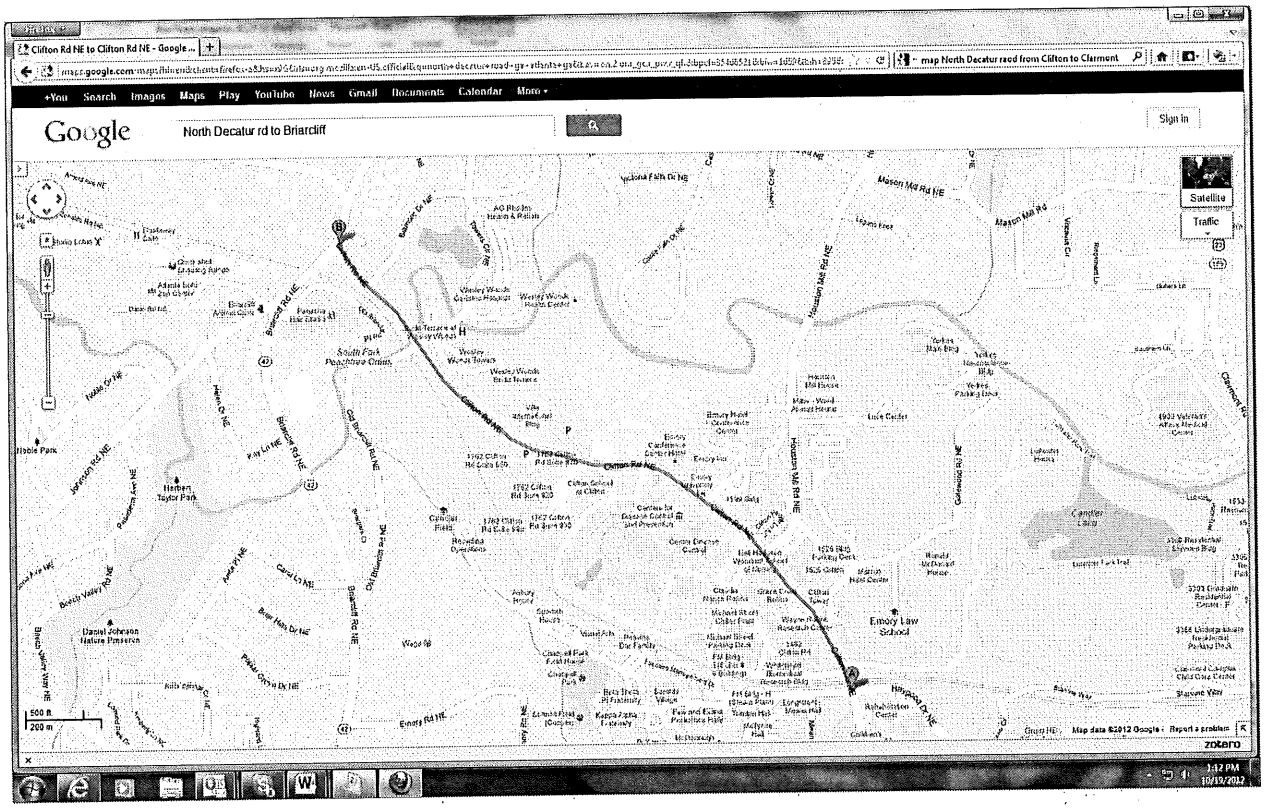
- Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)
- Briarcliff Rd. (North of Clifton Rd.)
- Houston Mill Rd. (Lavista Rd. to Clifton Rd.)

The these arteries are where bicycle commuters identified as unsafe and therefore should be priority areas within the CC where interventions need to happen.

Recommended Projects, Programs and Policies

Below are specific issues and recommendation that germane. Based on the review of the literature of safety improvements and incorporating bicyclist feedback of recommendations. The recommendations are listed in order of where the most bicycle accidents and almost accidents occurred and the preferences of where bicyclist would like to see roadway improvements.

Figure 10. Clifton Rd (N. Decatur Rd. to Briarcliff Rd.)



This artery is approximately 1.6 miles long and is the center of CC. According to the Georgia Department of Transportation, DOT, daily traffic counts there are on average 19,530 vehicles that use this road (GA DOT, 2012).

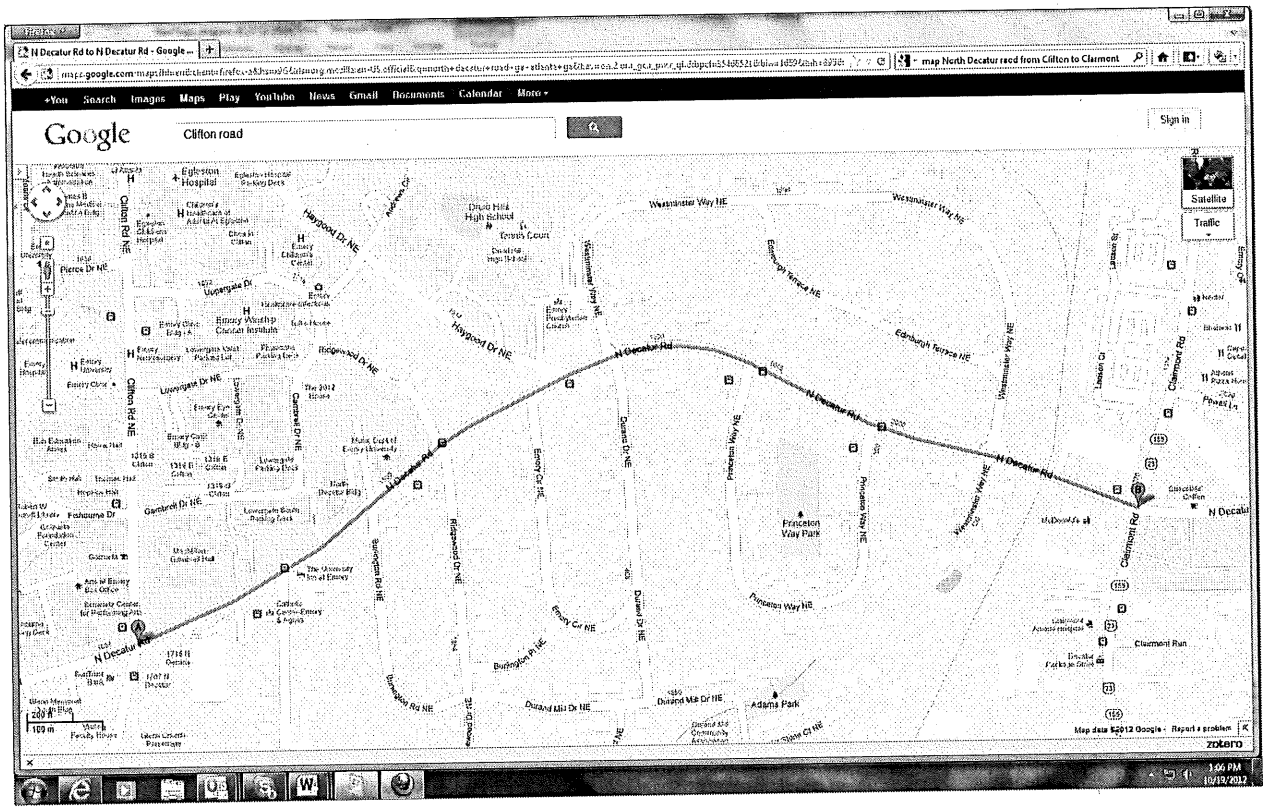
Issue:

- High number of accidents (61)
- High traffic volumes
- Multiple intersections and driveways Create numerous conflict points for vehicles, bicycles, and pedestrians
- Multiple left turning vehicles, many conflict points
- Feels unsafe to bicyclists

Recommendation:

- Introduce "cycletracks" at redlights to give bicyclists priority and promote safety
- Well marked and signed intersections
- Reduce street travel lane to make room for a separate bike lane

Figure 11. N. Decatur Rd. (Clifton Rd. to Clairmont Rd.)



This 0.9 miles stretch of CC is extremely treacherous because the four lane road is narrow and the pavement is uneven. According to the Georgia Department of Transportation, DOT, daily traffic counts there are on average 16,220 vehicles that use this road (GA DOT, 2012).

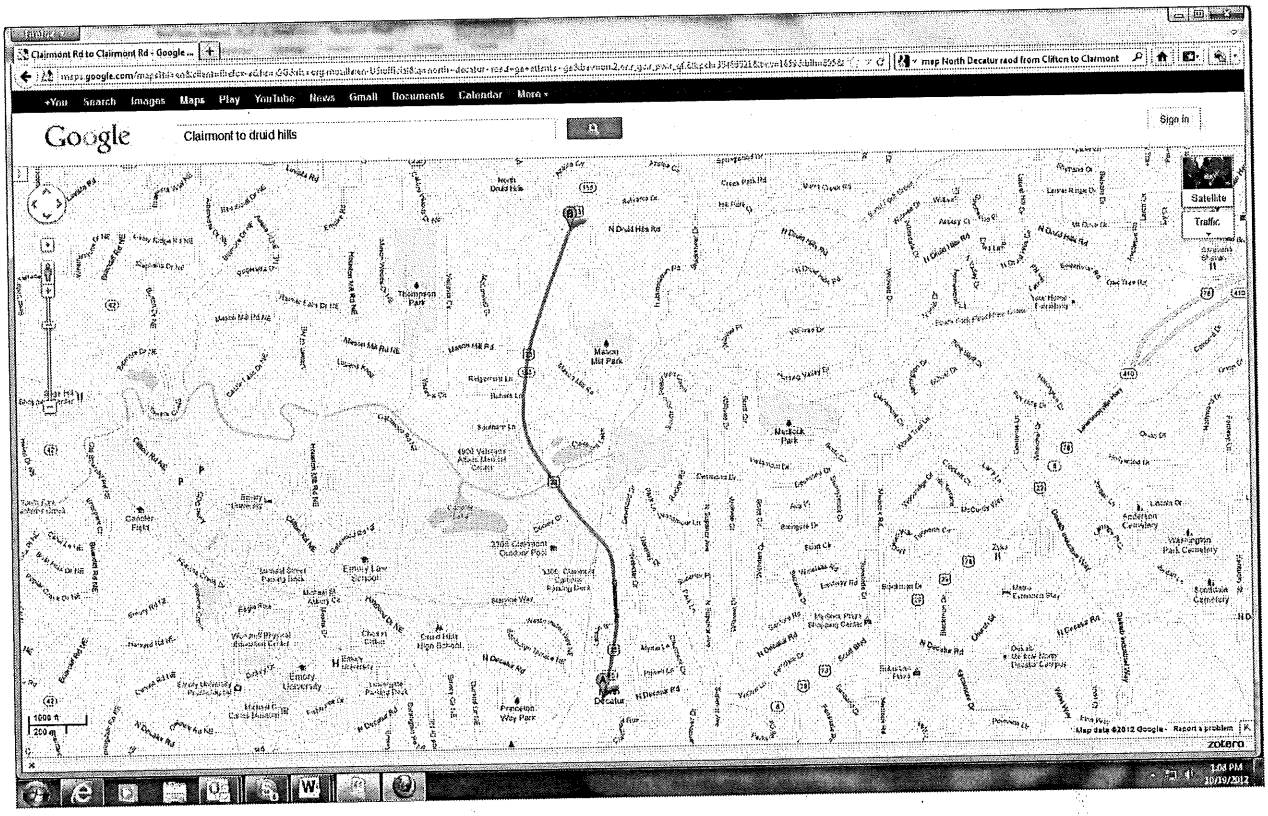
Issue:

- Extremely high traffic volumes, especially during peak hours
- No dedicated bicycle facilities or Amenities
- Narrow lanes feels unsafe to bicyclists
- Multiple driveways

Recommendation:

- Reduce street travel lane to make room for a separate bike lane
- Investigate possible expansion of existing narrow road
- Investigate potential complete street including on street bicycle facilities
- Introduce "cycletracks" at relights to give bicyclists priority and promote safety
- Bicyclist road signage

Figure12. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)



This 1.7 mile artery of the CC experiences the highest traffic volume with an average of 32, 488 vehicles traveling on it every day (GA DOT, 2012).

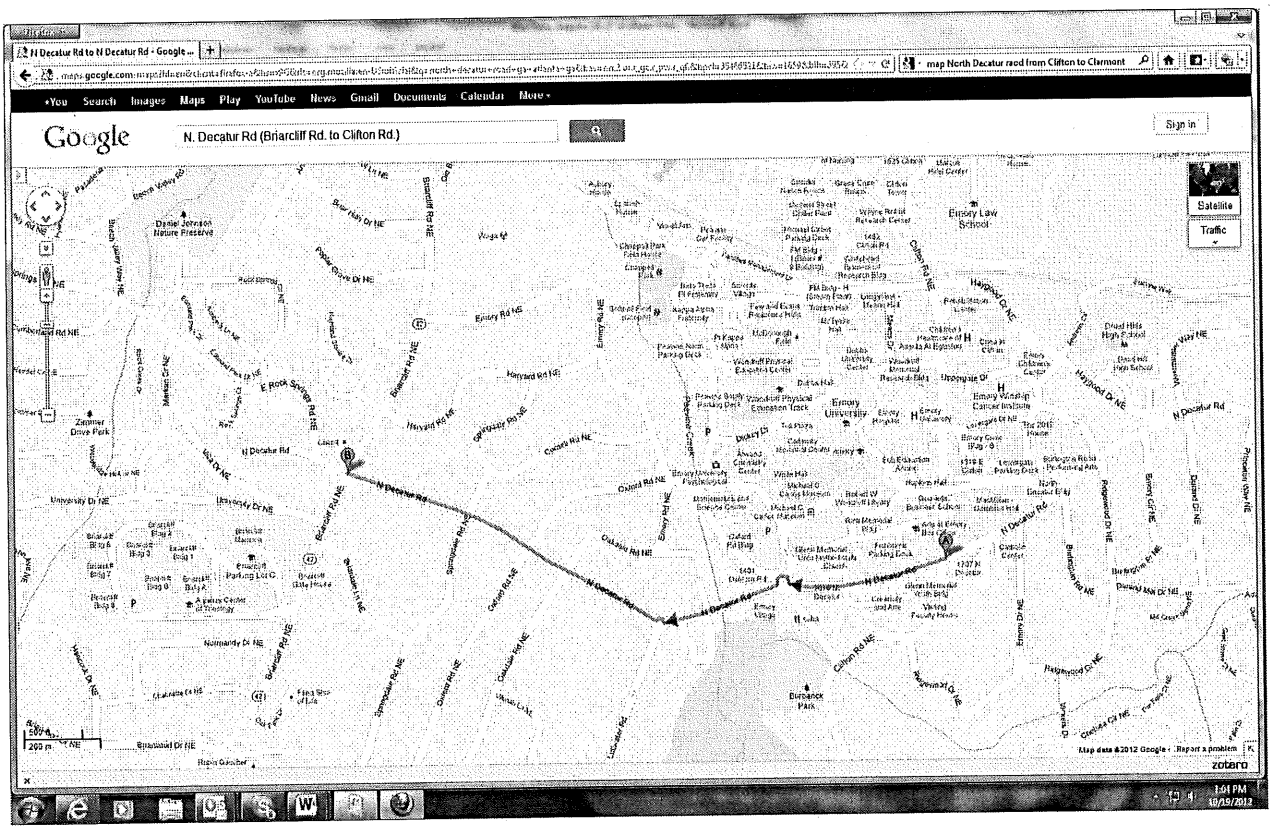
Issue:

- Extremely high traffic volumes, especially during peak hours
- No dedicated bicycle facilities or Amenities
- Multiple driveways
- Large hill which can accelerate driver speeds

Recommendation:

- Reduce street travel lane to make room for a separate bike lane
- Investigate potential complete street including on street bicycle facilities
- Introduce "cycletracks" at redlights to give bicyclists priority and promote safety
- Speed reduction
- Bicyclist road signage

Figure 13. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.)



This 1.1mile stretch of the CC has about 7,900 vehicles daily and it also has two roundabouts which are not common in Atlanta (GA DOT, 2012).

Issue:

- No dedicated bike lanes from Emory Village to Briarcliff Rd
- Extremely high traffic volumes, especially during peak hours
- Many people do not understand roundabout rules in the Emory Village
- Patrons of stores do not look for bicyclist before backing out of parking spots

Recommendation:

- Reduce street travel lane to make room for a separate bike lane
- Partner with stores in the Emory Village to promote bicycle awareness
- Introduce "cycletracks" at red lights to give bicyclists priority and promote safety
- Bicyclist road signage

Implications for Public Health

Implications for public health include reduction in bicycle accident injuries because roadway improvements were made to make commuting by bicycle safer, an increase in overall CC population health as more people might commute by bicycle thus increasing exercise, and less traffic related pollution because more people will use alternative means of commuting. Bicycle traffic accidents pose a considerably bigger societal problem than most people assume. While such accidents are 1% of all reported traffic accidents, their detrimental effects are disproportionately larger.

As the CC continues to grow due to the large employment opportunities and the newly constructed Emory Point, which includes 80,000 square feet of retail space and more than 400 apartments, will produce an increase in the number of people on the roads and will lead to an obvious increase in traffic collisions with bicyclists. Additionally, because higher speeds are associated with more severe injuries and higher rates of fatalities, there is particular concern about crashes between motorized vehicles and unprotected road users like bicyclists.

Limitations

There are weaknesses associated with the selected sample:

(a) Volunteer/Referral/Selection bias - Because this sub-population (only bike and non-bike commuters employed or studying at Emory), and not all possible commuters work at Emory, the results of the survey may not be generalizable to the entire population of bike commuters and non-bicycle commuters in the CC. Also, those who respond may hold different views or possess different skills, attitudes, behavior, and backgrounds compared to those who do not respond.

(b) Reporting and recall bias – due to methodological and resource constraints, responses could not be verified for accuracy and respondents may not recall their biking experiences with a high degree of accuracy.

(c) The biggest obstacle to analyzing bicycle data is the lack of "exposure" data. Unlike with motor vehicles, we do not have bicycle counts or bicycle-miles-traveled data. Therefore, while we know there is a moderate increase in bicycle related accidents, we do not know the bicycle's direction of travel (riding with or against traffic), the bicycle maneuver (was the bicyclist traveling straight or turning left or right?), or the accompanying bike facility. Additionally, none of these reports indicated whether the bicyclist was using headlights or rear reflectors/lights. This lack of data makes it difficult to understand the root causes of certain crashes.

Delimitations

The survey was designed to be administered online. A web-based survey was chosen because of the time and cost efficiency of programming, ease of posting the survey on the University of Emory's Bike Emory website, and readily available access to data as compared to a postcard survey that requires printing, distribution, mailing, and tabulation. Given that college students, faculty, and staff were the target of the survey, higher response rates were anticipated with an online survey compared to a postcard that would need to be returned through the mail

The strengths of this approach are:

(a) Cohort selection - The well-defined and easily accessible cohort of respondents provides the opportunity to follow-up with a second survey to evaluate the improvements made over time.

(b) Sample Size – large same size of over 1,800 respondents

Conclusion

Although, bicycling in the CC can be a fun and accessible way for people to add physical activity to their daily lives while replacing cars to commute, streets can be dangerous for bicyclists who have to make a place for themselves on the road with motor vehicles. During this study, the bicycling community was saddened to learn of the tragic death of cyclist, father, and esteemed community member Paul Taylor, who was riding in the study area of CC on North Decatur Road. While biking is on the rise across Atlanta, too many streets in the CC lack safe accommodations or even reasonable speeds, and are unsafe to those on bicycles. Regardless of Emory University being recognized as a bicycle friendly university by the League of American Bicyclist in 2010, a study of American cities clearly indicate that more bike paths and lanes would most encourage people to cycle" (Pucher J, Buehler , 2005).

The perception that cycling on the road is dangerous is an important barrier to the promotion of this active form of transportation and ultimately a barrier to a healthier CC population. What people fear the most is the chance of getting hit by a motor vehicle, and in with 745 reported bike safety related incidents in the CC, the fear is currently warranted. This study has shown that the perception of safety on the streets is a factor, which can encourage or discourage bicycling. When people perceive a safety issue, they are less likely to bicycle themselves. Among the key recommendations for reducing the number and severity of bicyclist injuries and fatalities include creating dedicated bicycle lanes, off street bicycle networks, increasing the visibility of cyclists on the roads, and implementing CC speed reduction strategies,. The well-being of bicyclist who share the road is critical to the overall safety cultural of the CC.

As bicycling popularity increases in the CC, the corresponding need for more bike safety

awareness, promotion, and projects will also need to increase. This thesis project can be incorporated for local advocacy to influence transportation planning at CDC, Emory, and DeKalb County. Furthermore the findings from this project could be tailored for a press release to highlight the safety issues related to bicycling in a busy corridor. An additional use for this project that would be beneficial to public awareness would be to send a summary of the findings to all survey respondents.

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Appendix A.

Emory Bicycling Survey, Spring 2012

Monday, April 30th, 2012

Dear Emory Community,

Thank you for participating in the 2012 Emory Bicycling Survey. You may access the survey by clicking on the following link:
http://vovici.com/l.dll/JGsB672C7F970lZzD9U776648J.htm

The goal of the Emory Bicycle Survey is to collect information on attitudes toward cycling and to learn more about cyclists' and potential cyclists' commuting patterns. NOTE: You do not have to be a cyclist to participate in the survey.

Your continued feedback is greatly appreciated and will directly influence bicycle planning and advocacy in the Emory community. The survey takes approximately 10 minutes to complete. To thank you for your time, we are offering one $50 gift card that will be randomly drawn from the pool of participants. To be eligible, simply complete the survey or send a postcard to the below address by May 9, 2012.

Thank you again for your time and comments!

For questions or to send a postcard:
Attn: Jamie Smith,
Emory University, Bike Emory
1599-001-1AM
1599 Clifton Road,
Atlanta, GA 30322

Do you live on campus or off campus?

Response
On campus
Off campus

Do you commute to Emory's Main (Druid Hills) Campus at least ONCE A WEEK?

Response
Yes
No

Where does your commute to Emory begin (primary residence)?

Do you use a bicycle for any part of your commute to work or class?

Response
Yes
No

Please tell us where you commute to work or class. At this time we are only surveying commuters and residents at the Druid Hills Campus, but we want to know your location in case we need to address the commuting needs of employees or students at your location in the future.

What is your primary Emory status?

Response
Undergraduate
Graduate/Professional Student
Faculty
Staff
Other (please specify)

Do you ever use a bicycle for transportation?

Response
Yes
No

How long have you been bicycling to Emory?

Response
Less than a week
More than a week, but less than a month
1-5 months
6-12 months
1-5 years
6 years or more
Other (please specify)

Do you use a bicycle for your primary or secondary mode of transportation for commuting to work or class?

Response
Primary mode (mode of transportation you use most often)
Secondary mode

How many days per week do you use a bicycle to commute to Emory for class or work?

Response
0
1
2
3
4
5
6

7

How many miles do you travel (one way) to work using your bicycle?

Value
0.00 thru 9.99
10.00 thru 19.99
20.00 thru 29.99
30.00 thru 39.99
40.00 thru 49.99
50.00 thru 59.99
60.00 thru 69.99
70.00 thru 79.99
80.00 thru 89.99
90.00 thru 99.99
100.00 thru 109.99

Please indicate how frequently you do the following when you use your bicycle.

	Always (100% of the time)	Very Often (75% - 99% of the time)	Often (50% - 74% of the time)	Sometimes(25% - 54% of the time)	Seldom if Ever (0-24% of the time)
Wear a helmet					
Bicycle on the street					
Bicycle on the sidewalk					

When you ride on the street, what lane position do you take?

Response
I ride as close as possible to the curb.
I ride a few feet out from the curb.
It depends on the traffic conditions.

I will only ride in the street if there is a bike lane.
I never ride on the street, only on off-road paths or trails.
Other (please specify)

Shared lane ("sharrow") markings and "bicycles may take full lane" signs were recently placed on Clifton Rd. How have they impacted your experience with riding a bike at Emory?

	Strongly Agree	Agree	Disagree	Strongly Disagree	N/A
I feel safer riding on Clifton					
It has made no difference					
Motorists know to expect bicyclists now					
Motorists are less hostile					

How satisfied are you with bicycle parking where you work or take classes?

Response
Very satisfied
Somewhat satisfied
Somewhat dissatisfied
Very dissatisfied
N/A

Where do you primarily work or take classes?

Have you experienced any of the following during your commute to work or class in the last 12 months?

Have you fallen off your bicycle?
Have you been hit by a motor vehicle?
Have you been hit by an opening car door?

Have you been deliberately pushed off your bicycle?
Have you been almost hit by a motorist?
Has a motorist exhibited hostile behavior towards you?

If you answered YES to any of the above questions, please list where your incident(s) occurred

Do you use a bicycle for any trips or purposes other than going to work or class?

Response
Yes
No

For what purpose(s) do you use a bicycle other than going to work or class? (Select all that apply)

Response
Exercise
Social Activities
Running errands
Other (please specify)

Why do you prefer to use a bicycle for transportation? (Select all that apply)

What discourages you from including bicycling in your commute to work/class? (Select all that apply)

What would encourage you to include a bicycling component in your commute to work/class more often?

Do you own a bicycle?

What do you use your bicycle for? (Select all that apply)

Have you ever tried bicycling to Emory?

Why did you stop bicycling to Emory?

What discourages you from using a bicycle for transportation?

Roadway prioritization for facilities. Please share which road segments you think should receive priority for cycling improvements. Examples of improvements could be signage, striping, dedicated lanes or other ideas.(Please rank 3 of the following options in the order of priority)

1. Briarcliff Rd. (North of Clifton Rd.)
2. Johnson Rd. to Briarcliff Rd. to Clifton Rd.
3. Old Briarcliff Rd. (Briarcliff Rd. to Clifton Rd.)
4. Briarcliff Rd. (Clifton Rd. to N. Decatur Rd.)
5. East Rock Springs Rd. (West of Briarcliff Rd.)
6. Oakdale/Oxford/Springdale Rd. to N. Decatur Rd.
7. N. Decatur Rd (Briarcliff Rd. to Clifton Rd.)
8. Clifton Rd. (South of N. Decatur Rd.)
9. Clifton Rd (N. Decatur Rd. to Briarcliff Rd.)
10. Haygood Dr. (N. Decatur Rd. to Clifton Rd.)
11. N. Decatur Rd. (Clifton Rd. to Clairmont Rd.)
12. Clairmont Rd. (South of N. Decatur Rd.)
13. Clairmont Rd. (N. Decatur Rd. to N. Druid Hills Rd.)
14. Mason Mill Rd. (Clairmont Rd. to Houston Mill Rd.)
15. Houston Mill Rd. (Lavista Rd. to Clifton Rd.)

Demographic Information (Optional)

1. What is your sex?
2. What is your age?
3. What is your race/ethnicity?
4. What is the highest level of education you completed?
5. What is your primary Emory status?