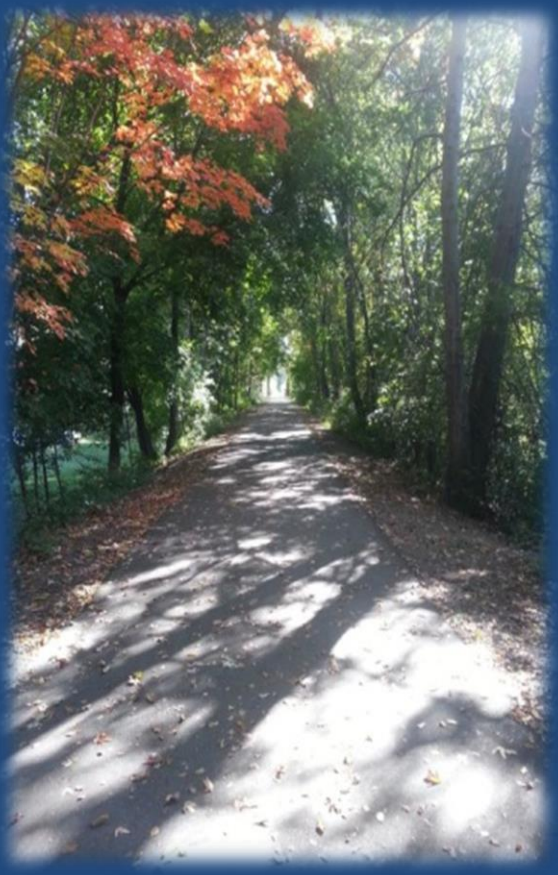


The Ultimate Commute

An Assessment of Bike Path Conditions in Keene N.H.

Brian Cote

Mike Harpool

Crystal Hoke

Brian Jones

Abby Martelle

Geography Department
Faculty Supervisor: Dr. Christopher Brehme

Keene
STATE COLLEGE

Table of Contents

Acknowledgments

The completion of this study would not have been possible without the contributions made by several individuals. Our research team would like to thank these individuals for their time, effort, and guidance during the long hours spent researching and writing to put this report together.

We would like to give a special thanks to our Keene State professor and faculty supervisor, Dr. Christopher Brehme. Without your support, guidance, and encouragement, this report would not have been possible. We would also like to thank several other individuals that helped us throughout this research project:

- Andy Bohannon, Director, Parks Recreation and Cemeteries
- Will Schoefmann, GIS Technician, City of Keene
- The South West Regional Planning Commission with a special thanks to Steve Waleryzsyak
- Dr. Christopher Cusack, Professor of Geography, Keene State College
- Dr. Al Rydant, Professor of Geography, Keene State College

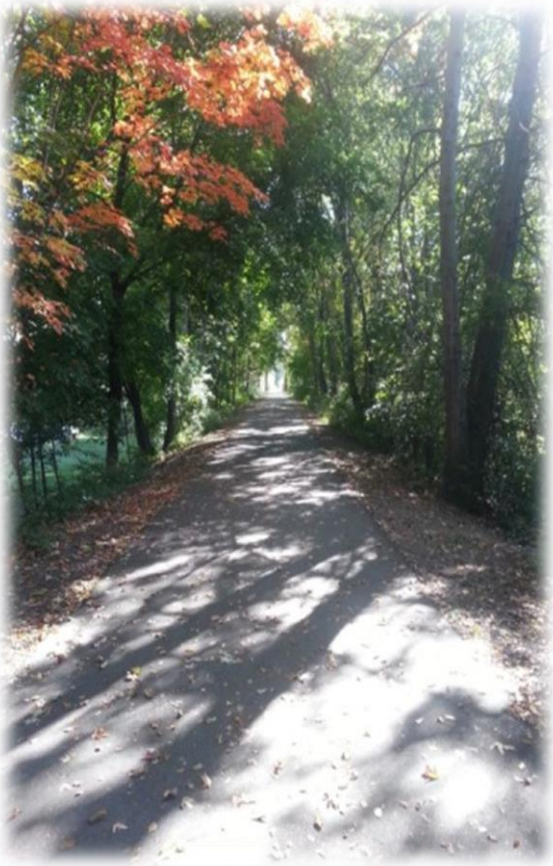
List of Figures

List of Tables

Abstract

Cycling has increased in popularity throughout the US, thanks in part to local investment in bike path infrastructure. Cycling is not only accessible, cheap and good for the environment but is also a healthy form of transportation. The safety and upkeep of bike paths can have an impact on their overall use. The goal of this project is to assess the conditions and current use of bike paths in the city of Keene, New Hampshire. Data were obtained using bike counters, GPS receivers, visual counting and through surveys administered to the public and Keene State College students.

Data from the two survey samples were analyzed in Excel and SPSS and results showed varying frequencies of use, opinions about path conditions, and levels of knowledge regarding the paths. Results also revealed that upperclassmen are more aware of, and use the paths more frequently, than underclassmen. Field data showed that the paths get maximum use between ten in the morning and six at night, when there is the most light. This was further confirmed by survey results which showed that path users are more concerned about their safety at night. Data also showed that paths get significantly more use from walking than from cycling.



Chapter 1

Introduction

Finding a way to change peoples' primary mode of transportation to the bicycle could potentially address many of the world's social and environmental challenges. The United States is burdened by increasing rates of diabetes and heart disease, and substantial air pollution. Potential methods to reduce the impact from these health and environmental issues should be a main concern of local and regional governments. Biking reduces multiple types of pollution and decreases the risk of car accidents by removing cars from the road, and decreases the incidence of fatal diseases caused by a lack of exercise. Networks of bicycle pathways are becoming popular in urban centers of the United States. Some of the busiest cities have embraced bicycling not just for recreation, but as a major component of transportation, resulting in the need for strong bicycling infrastructure.

Portland, Oregon is known as one of the most bike friendly cities in the United States. It has an infrastructure which includes 86 miles of bike paths, 30 miles of low-traffic bike boulevards and 176 miles of bike lanes, all of which are used by 8 percent of citizens who claim that biking is their primary form of transportation, and an additional 10 percent who say a bike is their secondary vehicle (Brown 2013).

Some cities like Washington D.C. have had bike paths within their city limits for many years, but have recently realized that updates must be made to keep pace with the ever changing urban environment. Developing a successful bike path infrastructure takes persistence, as it is important to provide individuals access to recreational, business, and residential areas. This is a struggle in many cities that have developed in a sprawl like fashion.

Bicycle sharing companies are one response to the increasing interest in alternative transportation. Hub Way in Metro-Boston and Bicing in Barcelona, Spain have flourished within

their cities. Hub Way currently has over one hundred different stations around the city and over 1,000 bikes to share. Bicing is an even larger company that has 420 stations and over 6,000 bicycles in rotation. These systems require an initial subscription which allows the user to pay before they ride a bike to commute around the city. In Barcelona, the bike stations have enough room for thirty to forty bikes and are located on major roadways close to subway stations. The system covers approximately 70 percent of the city and has a daily use of about 47,000 people and an annual ridership of almost fourteen and a half million people (City of Barcelona). These numbers portray a substantial acceptance of the program by city residents. These systems are becoming popular in other cities around Europe and the United States.. Employment, reduction of air and noise pollution, decrease in traffic congestion, and a decrease in traffic accidents are some of the many important benefits derived from bike sharing (City of Barcelona).

Figure 1: *Biking lane in Barcelona, Spain*

Transportation and Health Concerns

The United States' dependence on automobiles has grown since Henry Ford rolled the first Model T off the assembly line in 1908. This dependence was facilitated by the growth of urban sprawl, which has had a negative effect on transportation efficiency. Cheap fuel and land prices led to increased investments for highway construction that have contributed to an increase in a sprawl of urban development. The problem was exacerbated by oil companies that pushed local railroads out of business. The expansive nature of current urban infrastructure cannot support a complete change to alternative transportation due to this sprawled pattern. Some places around the United States like Keene, New Hampshire actively promote alternative transportation as a means to increase physical activity and improve community health.

Air pollution and community health problems go hand in hand. The negative side effects of our current transportation infrastructure include worsening air quality, declining human health, and roadways that cannot sustain current peak traffic levels. Carbon dioxide emissions may be just one contributing factor of air pollution but it is a major environmental risk to health. Lower levels of air pollution in a city can contribute to a healthier community.

The use of alternative transportation like walking or biking can also decrease health concerns like obesity. Obesity rates have doubled in adults and children since the 1970's. More than one third (34.9 percent) of adults were obese in 2011-2012. Conditions including heart disease, stroke, type 2 diabetes and certain types of cancer have been connected to obesity. Obesity in the U.S. has a medical cost of $147 billion in 2008 which is $1,429 per person higher than those of normal weight (Center for Disease Control and Prevention 2013).

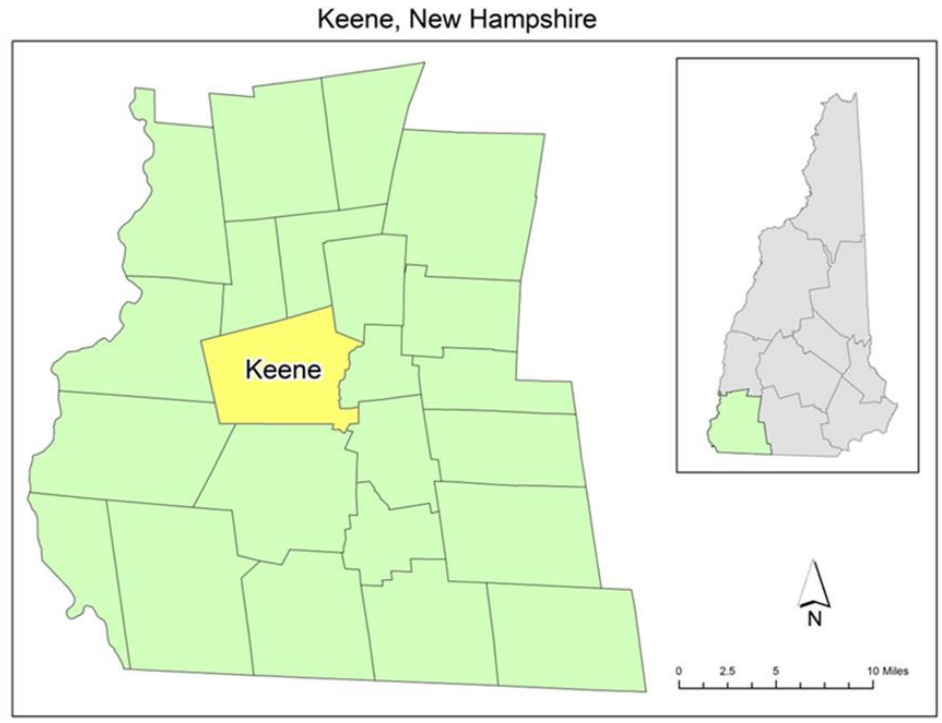
Welcome To Keene

Keene is a relatively small city with a population of 23,272 residents located in Southwestern New Hampshire (Figure 2). However, it is a regional center that serves a much larger daytime population of workers and shoppers. The city is only 6.4 square miles north to south and 8.4 square miles east to west. Keene is mostly flat, making it ideal for alternative modes of transportation such as biking, walking, and boarding (Figure 3).

Through the efforts of several organizations, Keene is taking the initiative to become a greener city. Keene is currently a member of the Monadnock Region Transportation Management Association (MRTMA), which is a coalition of organizational and individual members interested in a sustainable transportation future for the region. Pathways For Keene (PFK) is a non-profit group of volunteers who promote the development and use of bicycle and pedestrian pathways. Through PFK, the Institute for Community Environment Management published a report called the Roundhouse-T Project that eventually was incorporated into the City of Keene Bicycle/Pedestrian Pathways Master Plan. The Roundhouse-T Projects' objective is to create a "T-shaped" intersection to connect bike path routes that lead outward from the city to the east, west and south. These major routes are: south to Swanzey, Winchester, and Hinsdale, east towards Marlboro, Harrisville and Jaffrey, and west towards Westmoreland and Walpole.

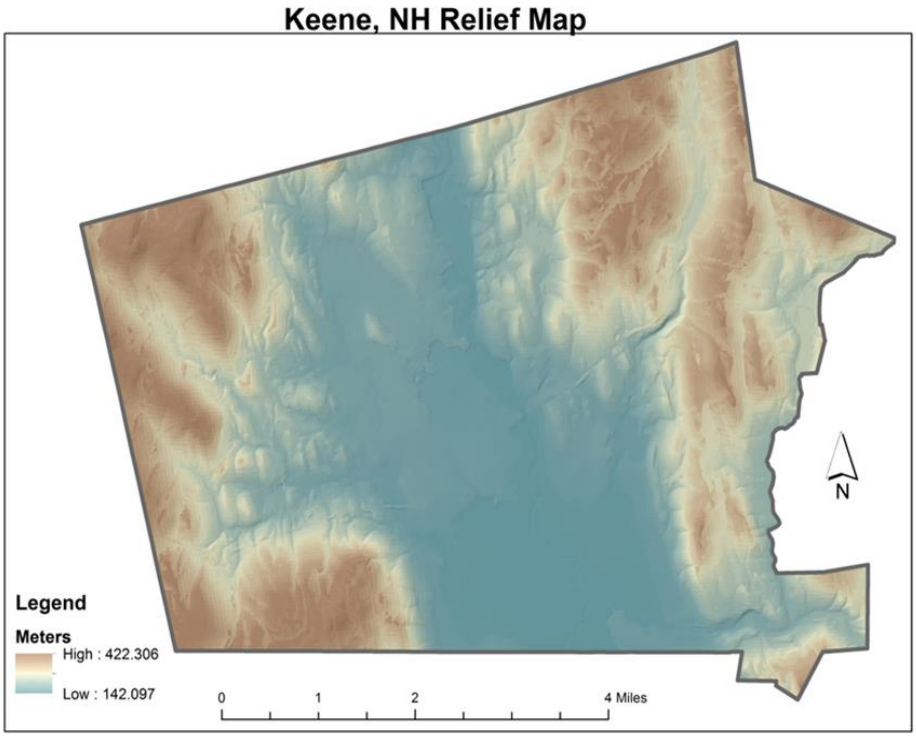
The Green Team is a group in Keene whose work will support the city's goals for achieving sustainability. They are developing a comprehensive plan for addressing the environmental challenges that city government will face in the coming years. Ultimately, the work that the Green Team does will support the goals of Keene's citizens to achieve a

sustainable community. Keene also has a Committee for Climate Protection (CCP) whose mission is to educate the community on the effects of global climate change and how the reduction of greenhouse gas emissions can be good for public health.



Source: NH GRANIT and Authors
Figure 2: *Map of Keene, NH*

These organizations are working to bring citizens together and to create a healthy active community. This effort is vital for achieving the goals within Vision 2020, which plans for an environmentally-conscious and physically active community. The City of Keene has a goal of encouraging more people to ride bicycles for personal, business, social and recreational trips.



Source: NH GRANIT and Authors
Figure 3: *Map of Keene, NH Relief*

Biking

Over twenty miles of bike paths run through the City of Keene and extend further into surrounding towns. These paths provide residents and citizens with a safe way of travelling via bike or foot. These trails lead to many different parks where more recreational activities await. In the Keene area there are approximately 2,000 acres of recreational land. This land falls under the care of Keene's Parks and Recreation Department. The bike trails and parks promote healthy living and offer citizens opportunities to experience regular physical activity.

Bike paths require constant maintenance due to wear and tear from users and from weather. Bicycle and pedestrian safety is essential to a successful bike friendly community. The city of Keene has several local citizen-based organizations dedicated to improving the

quality of bicycle and pedestrian activities within the community. These organizations include: Heart of New England Cycling Club, Pathways for Keene Inc., Team Frank, and Keene Crime Watch Bike Patrol. These groups engage in the education of the community about pathway development, fundraising, and sponsor special events such as mountain cycling, in-line skating and other activities. Positive interaction between cyclists, pedestrians, and drivers needs to be promoted and taught. Dispersing information to the public regarding laws and regulations by creating maps and brochures can be helpful. Giving the community this information can encourage residents to be safe and pursue active living.

Safety is a major issue when cyclists are traveling on shared roadways. A shared roadway is any street or highway which contains no special provisions for bicyclists. There are numerous roads in cities and towns where there is no dedicated space for cyclists, causing an increase in unsafe traveling. According to Bicycle/Pedestrian Path Master Plan 1999, most shared roadways are typically a twelve foot wide travel lane with no shoulders, allowing cars to pass only by crossing the center line or moving into another traffic lane. These lanes are safer on local streets in residential areas with lower traffic speeds, however, larger and busier streets present more risk to both cyclists and motorists. Changes can be made to increase the safety of these shared bike lanes. These changes include widening the roadways to provide additional operating room for the cyclist and paving shoulders on rural roadways. A wider, paved shoulder allows cyclists to feel safer and more confident while riding. Locations of signs are a major factor for both motorists and cyclists as well. “Share the Road” signs encourage motorists to look for cyclists on roadways.

Bike paths separated from roadways are safer but creating them is timely and costly. According to the Bicycle/Pedestrian Path Master Plan (1999) the creation of a bike path can cost anywhere from $300,000 - $400,000 per mile due to the cost of acquiring the "right-of-way", and the need for building bridges. Shared bike lanes are far less expensive to make, and range from $3,000-$30,000 per mile.

Bike Paths of Keene

There are four main paths in the city of Keene bike path system: Cheshire Rail Trail, Ashuelot Rail Trail, Appel Way Trail, and the Jonathon Daniels Trail which is also called the Ashuelot River Trail (Appendix A and B). Along with these paths, Washington Street and Marlboro Street have bike lanes and sharrows in which cyclists ride alongside motor vehicles. A bike lane is a specific lane on the side of the road made for cyclists. A sharrow is indicated by markings on the street where cyclists may ride. A sharrow is not a designated lane, but the markings warn drivers that cyclists have the right to ride in that area. The sharrows, lanes, and path system helps to create safer travelling for cyclists and pedestrians, and to connect residents to major shopping centers and areas of interest.

The Cheshire Rail Trail is an abandoned railroad line that was used by trains in the late 1800's and early 1900's. It was then converted into a bike path and has become a main route for traveling across town either by bike or foot. The main part of the path starts in southeastern Keene, running through the center of town, and then over New Hampshire State Highways 9/10/12 on The North Bridge, which creates a safer passage over the highway. This section of the path is paved with asphalt. After crossing the North Bridge the path runs near Stonewall Farm and continues north into Surry, NH. West of the North Bridge, the path turns to

a hard pack material for a mile or so. This material is nearly as smooth as the asphalt. The Cheshire Rail Trail is an important route for non-motorists as it connects people to shopping areas like the Center at Keene, the Colony Mill Marketplace, Target, and the new Monadnock Food Co-op.

The Ashuelot Rail Trail is another retired railroad line that has been converted into a usable bike path. This path begins at the Center at Keene shopping center and runs south. The Ashuelot Rail Trail runs on the east side of the Keene State College campus, allowing college students to have a safe route into the center of Keene. The path continues south and eventually reaches NH Route 101. NH 101 is a very busy highway with little gaps in traffic, making for a dangerous place to cross for cyclists and pedestrians. The surface of the path north of the NH 101 intersection is paved asphalt. South of the 101 intersection the path is made of hard pack material. It continues south into Swanzey, NH. The Ashuelot River Trail allows access to landmarks such as the Riverside Plaza, the Joyce Athletic Fields, and the Keene State College Athletic Complex.

The Jonathon Daniels Trail begins at its intersection with the Cheshire Rail Trail and runs north, parallel with the Ashuelot River. The path is made of natural materials, but it is cleared of trees and brush for cyclists. It runs north until it meets with the Appel Way Trail. Although the Jonathon Daniels Trail does not have any major landmarks within a close proximity, it does connect people who live on Court Street to the center of town. Also, as an extension of the Ashuelot River Park people using the park often walk along the path.

The last path in the system is the Appel Way Trail. There are two access points: one at the Wheelock Park entrance and another at the intersection of Court Street. Starting at Court

Street the path runs west on a large pedestrian bridge over the Ashuelot River and then underneath an existing auto bridge of NH Highway 9. After a short segment, the path runs underneath the highway again and then comes to a hill where it joins NH Highway 9 on a bridge over NH State Highway 12. Here the path is separated from the highway by a concrete barrier topped with a chain link fence. It then continues west where it runs through Wheelock Park and ends at Park Avenue.

In addition to these five paths, there are also many natural and unbuilt paths in Keene located in Ashuelot River Park and Robin Hood Park. A significant example is the path that continues north beyond the Jonathon Daniels intersection with the Appel Way Trail. This small section of path may get most of its use by employees at Cheshire Medical Center. They likely use this natural path to get exercise and fresh air during breaks.

The Keene State College Trail is not recognized by the City but is used daily by students and local residents. It runs through the Keene State College campus and has two intersections with the Ashuelot Rail Trail. Most college students use it to access the Joyce Athletic fields or the Keene State Athletic Complex for sporting events. It is also heavily used for running by the cross country and track teams at Keene State College. The Keene State College Trail is important because there is a pedestrian bridge known locally as “Jurassic Park”, which allows students to safely cross under NH 101 to the athletic fields. This underpass offers a safer alternative to crossing the highway but it does present a personal safety issue, as the path here is dark and out of view.

Keene Master Plan

In the spring of 2006 the regional hospital for Keene and surrounding region, Cheshire Medical Center/Dartmouth-Hitchcock Keene challenged Cheshire County to become the healthiest community in the nation by the year 2020. From this challenge came the Vision 2020 project (Cheshire Medical Center 2010). The project focuses on five main areas that the community can work on to improve their health (Figure 4). This is a community change initiative designed to foster and sustain a positive culture of health throughout Cheshire County.

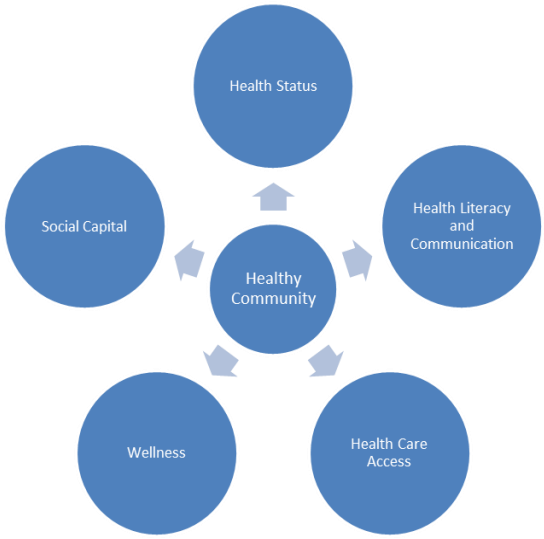


Figure 4: *Five main areas of the Vision 2020 project*

Keene's Comprehensive Master Plan (2010) discusses the components of a walkable community. Much of downtown Keene is walkable with a mix of land uses, provision of sidewalks, connections to trails, and close proximity of goods, services, housing, and employment. The main reason Keene is not considered a "walkable community" in Keene's Comprehensive Master Plan is because its current walkablity is limited to downtown. In order

for Keene to be considered a walkable community, pedestrians and cyclists need to be kept safe from traffic along major corridors, and paths must be updated to support the increased number of users. Keene's Comprehensive Master Plan discusses the concept of "complete streets." This is a national program that encourages local municipalities across the country to build road networks that are safer and more welcoming to all forms of transportation.

A healthy lifestyle has many positive outcomes that can help an individual live a longer and more fulfilling life. An effective means of encouraging healthy living is to start with younger generations. Creating separate bike paths is an important way to encourage cycling among children who are not skillful enough to ride in traffic. In Keene, the 5-2-1-0 After School Club motivates children to participate in physical activities outside. The club provides "age appropriate, meaningful and fun activities enabling children to learn and experience a connection between being physically active, eating well, and staying healthy" (Vision 2020). The objective of the 5-2-1-0 programs is for kids to: eat (5) servings of fruit/vegetables per day, cut screen time (TV) to (2) hours per day, participate in at least (1) hour of physical activity per day, and reduce sugar intake to (0). This program plays a major role in educating children. Obtaining this knowledge at a young age can prepare an individual for a healthy active future (Cheshire Medical Center 2010).

Demographics

Keene's population has increased by 3.7 percent over the past thirty years. According to the U.S. Census Bureau the population as of July 1st 2012 was 23,272 people. This is a slight decline in population (-0.6 percent) from the 2010 census which listed the population at 23,409. Within this population, there are 9,052 occupied households and 4,843 families.

The median age of New Hampshire residents is 41.1 years old, while the median age of Keene is 34. Keene's demographics are highly impacted by its college population

The largest age group in Keene is 18 to 24 years old at 24.1 percent (Figure 5). This is mainly because of the presence of three local colleges: Keene State College, Antioch University New England, and River Valley Community College. Keene State College has an enrollment of over 5,000 undergraduate students, or 22 percent of the population of Keene. Antioch with over 1,000 students and River Valley with a little over 1,300 students make up a smaller portion of the population and each has an older median age then Keene State.

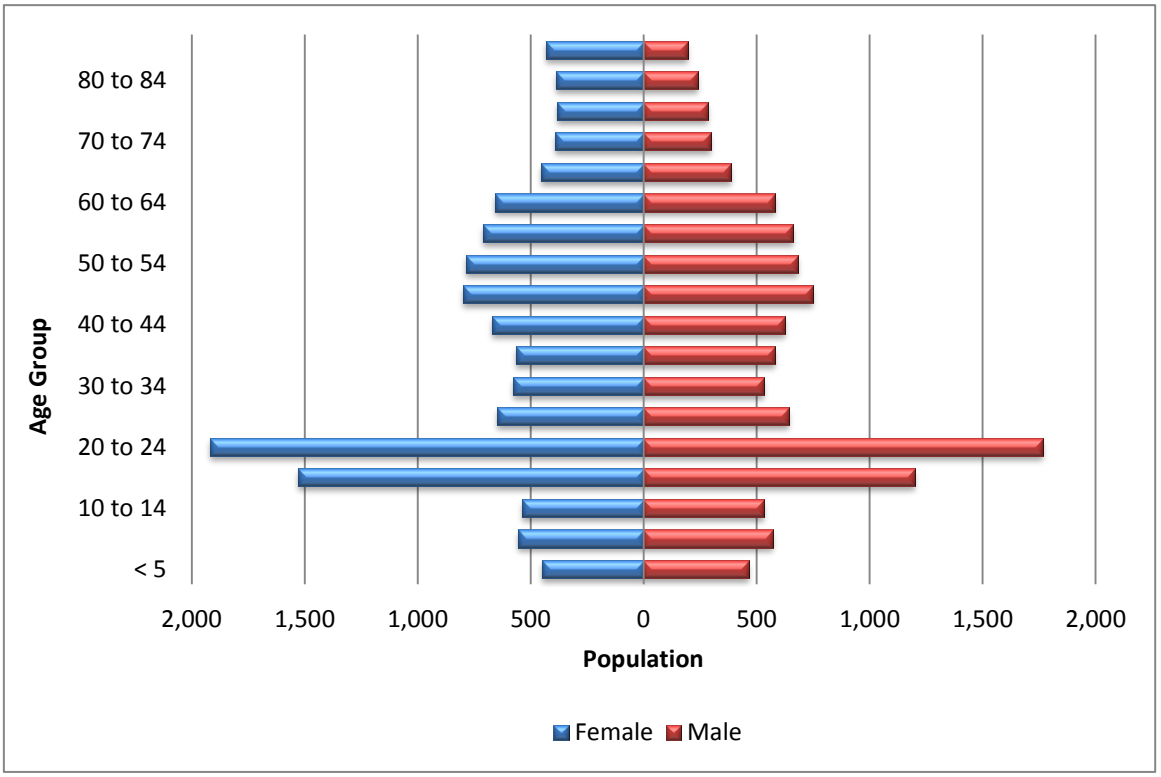
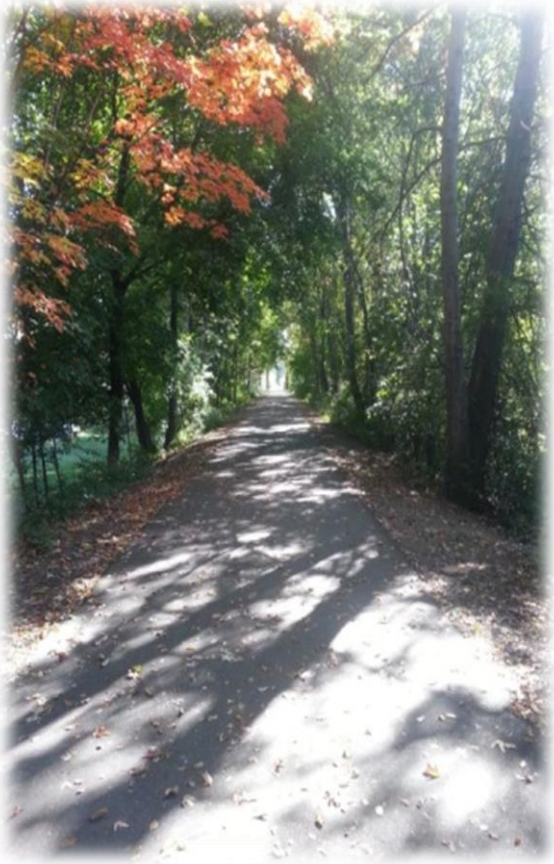


Figure 5: *Population Pyramid of Keene, NH*



Chapter 2

Literature Review

The diminished amount of physical activity among communities has created a movement to implement increased options for healthy living. People are influenced by the natural and built environment around them. Bike path systems that interconnect between local businesses and residential areas can be used to promote this mission.

Promoting Active Living

The apparent decrease in physical activity among Americans has encouraged communities to look for effective ways to support exercise. Although the bicycle has been extremely popular throughout Europe since the 20th century, the age of railroads and automobiles overshadowed it as a means of alternative transportation in the United States.

Mailbach (2003) discusses how community members can use social marketing as a means of promoting active living just like companies use social marketing to promote their products. He states that marketing will enhance individual's motivation to utilize parks, bike paths, and public facilities. Mailbach concluded that the use of social marketing can aid in identifying consumers who are less physically active and encourage them to pursue healthy alternatives. However, active living is often hindered by the way cities are constructed. The built environment within a community determines whether citizens have the capability of spending their free time doing healthy activities outdoors. This can be resolved through the work of urban planners and developers. Providing new greenspace and creating networks of bike paths between these spaces can increase active lifestyles for those who previously lack access. City planning efforts designed to increase the use of bikes opens opportunities for people to get their daily recommended physical activity. Adding bike lanes on roadways and

placing bike racks in convenient locations are also important parts of bike planning projects. Advertisement for these new features can help promote their use.

The construction of bike paths can be facilitated by using existing public land, or by using the "right of way" along utility line corridors or abandoned rail lines. In 1983 the U.S. Congress passed the National Trails System Act which allowed abandoned rail beds to be used for alternative transportation (Penna 1995). During World War I, there were 270,000 miles of actively used rail line and by 1995 this declined to 130,000 miles. In many places these unused rails are being transformed into trail systems (ibid. 1995). One of the advantages of using abandoned rail lines is that they are relatively flat, and are therefore accessible for children, elderly, and people with disabilities. The factors that went into building a safe rail line turn out to be very beneficial for recreation. Trains required broad turns and gentle slopes as well as a ten foot wide easement. The lines link cities and towns in convenient locations making them more desirable for recreation.

The benefits of reclaiming rail lines for the purpose of "rail trails" are not limited to their convenience. Rail trails also keep the historic aspects of the rail line alive. These trails are a reminder that the railroads were indispensable to the economic growth of the United States (Fogel 1964).

Bike Lanes and Urban Development

The process of designing a successful bike path without using an existing path like a rail trail is complicated and costly. Creating a separate road for pedestrians and cyclists is a transportation strategy that has slowly gained popularity over the past two decades. If cities were to convert to a bike friendly system, they could reduce street congestion, air pollution,

and noise pollution. To do so cities would replace travel lanes and roadside parking with bike lanes. Limiting travel lanes encourages drivers to use the provided bike lanes. Bike-sharing companies allow citizens who drive or take a train downtown to commute around the city without having to bring their own bicycle. These companies have parking stations at convenient locations, and allow users to get to their point of interest in a timely manner. This gives citizens a less costly form of transportation with a greater health benefit.

One particular bike path that has been developed and proven to be successful is the Midtown Greenway of Minneapolis, MN (Davidson 2008). The Greenway is 5.5 miles long and follows the former railroad through the southern part of the city. In these higher populated areas it is normal to see a large number of people choosing to bike to their destinations. Several thousand people use the Greenway each spring, summer, and fall while hundreds of hearty cyclists and runners use it each winter (Midtown Greenway Coalition, 2013). It is stressed that when assembling a project like this, attractions have to be accessible to recreational paths as well as neighborhoods, shops, restaurants, and other places of interest.

Trails may be funded through parks and recreation departments along with the transportation and public works departments (Forsyth and Kruse 2011). Grant programs administered by the Federal Transit Administration (FTA) may be used to fund the design, construction, and maintenance of pedestrian and bicycle projects that enhance or relate to public transportation facilities (Federal Register 2011). Some projects seek donations from the community, for example the Midtown Greenway Coalition has a website where citizens can donate money to help enhance and protect this path. Funding often makes these projects

possible and ultimately provides a more cost efficient way of keeping people safe when traveling by bike or foot.

Safety on Bike Paths

Safety is another important focus for urban planners when designing bike paths. They must take into consideration the safety of the cyclists and pedestrians, as well as motorists. Urban designers have long been keen on attending to the pedestrian environment. Forsyth and Kruse (2011) discuss how in the past, people considered cyclists another form of vehicle, while others see them as a "faster pedestrian". One's perception of whether bikes are "slow cars" or just pedestrians is an important distinction when it comes to safety and travel. Cyclists move further and faster than pedestrians, making cycling more feasible when traveling a mile or more. Alternatively, the bicycle can be recognized as a vehicle and not a "pedestrian" (ibid 2011)

Forsyth and Kruse (2011) describe three different classes of cyclists; the A class is advanced cyclists, the B class is 'basic' cyclists who are less confident, and the C class is child cyclists. The authors stress that it is important to acknowledge these separate classes of cyclist for efficient planning. Having multiple bike paths to accommodate each class of cyclist would be ideal, but with traffic and multiple intersections it is not plausible. The key to making a successful bike path is to combined the needs of all the classes and design something that is safe for everyone.

In the United States, traffic fatalities account for a large portion of deaths. In 2011, 32,367 people were killed due to motor vehicle accidents, and of these, 5,307 were non-motorists (NHSTA 2011). Cyclists are safer when they are separate from the normal flow of

traffic. Infrastructure is very important when it comes to bike lanes. The chance of injury drops about 50 percent when riding on a similar road with a bike lane and no parked cars. The same is true on local streets with designated bike lanes. A bike lane that is separated from the flow of traffic by a physical barrier can decrease the risk of injury by 90 percent (Badger 2012).

There are positives and negatives to having bike paths separate from main roads. Schneider (2000) states that fewer motor vehicle accidents are likely to occur if bike lanes are separated from car traffic. Paths separated from main roads can be just as unsafe as paths along main roads, if planners do not take certain measures. Bike paths that are separated from main roads are far more prone to criminal activity. In response, Schneider (2000) suggests that it is important for planners to incorporate proper natural surveillance, including lighting and signage when planning bike paths.

Sufficient lighting on bike paths is very important because criminals are more likely to act in the dark. Proper signage is needed to prevent people from getting lost and to prevent accidents with motorists (ibid 2000). Natural surveillance also increases the cyclist's safety. Criminals are less likely to victimize people when others are nearby. The further away path users are from the view of passing Good Samaritans, the more easily they could be victimized. In response, there should not be thick brush or tall solid fences surrounding bike paths in areas with criminal history.

Bike lanes and walkable paths are a useful choice of transportation because they are good for the environment and a safe choice for exercise (Harney 2009). They provide commuters with an easy and healthy alternative to driving to work and can shorten the commute. They also help to cut down traffic congestion on main roads and increase the safety

of pedestrians. Bike lanes require particular characteristics in order to grant the users safety. Unlike off-road paths, bikers travel alongside cars, trucks, and other motorized vehicles leaving them at risk to fatal collisions. If the existing infrastructure cannot support these lanes then riders are forced to illegally use sidewalks or use dangerous travel lanes.

The presence of a college may be an important contributor to urban pollution, because a lot of young adults are dependent on their cars and most bring them along to school. Parking is always a problem and the additional cars can lead to more traffic problems. Harney (2009) states that "many college campuses are becoming more dangerous for pedestrians due to increased car congestion." Colleges are starting to encourage students to bike whenever possible. The University of New England has started to give new bikes to incoming freshmen who agree to not bring cars to school (Harney 2009). Keene State College has a program called Green Bikes, which allows students to borrow bikes with locks from the library, just as one would borrow a book. The bikes can be used by the student for two weeks at a time and can be renewed once before being returned.

In order to drive a car from point A to B, there needs to be parking available at each location. Having access to an automobile is convenient, but not if there is no parking available. In cities where everything is close together it is often easier to walk, bike or take public transportation. One way to limit car use is to regulate the amount of parking spaces provided. It could be argued that the fewer parking spaces available, the fewer cars will be driven. Many cities around the world such as Paris, Amsterdam, New York and San Francisco have started replacing parking spaces with bus lanes and bike lanes. In some instances city planners have

built small parks to replace parking spaces. This encourages the use of city and community bike lanes and other forms of public transportation (Salter 2011).

The Built Environment

It is difficult for citizens to be physically active each day if their community is difficult to traverse on foot or bike. It is essential that planners develop communities that offer citizens a way to stay healthy by incorporating sidewalks, bike paths, and recreational facilities such as gyms. In the United States some communities are more active and healthy than others. In order to determine the relationship between physical activity and local environment Adams (2013) categorized neighborhoods in eleven countries including the United States in terms of their support for physical exercise. Neighborhoods were grouped into five classes based on housing, distance to transit and shops, biking facilities, sidewalks, low cost recreation, and crime rate. The five classes Adams came up with were 1) overall activity supportive, 2) highly walkable and unsafe with few recreation facilities, 3) safe with active transport facilities, 4) transit and shops dense with few amenities, and 5) safe but activity unsupportive. The results reveal that in the United States, neighborhoods that are overall activity supportive have far greater rates of physical activity than others. The results also portray the importance of safety when considering modification of the built environment. The category of neighborhoods which are safe but do not support physical activity have a higher rate of physical activity than unsafe neighborhoods with few recreation facilities. The results support the World Health Organization's recommendation for a change towards more active-supporting communities (Adams et al. 2013).

The United Nations and World Health Organization have recommended several policies to improve community access to parks and recreation to encourage physical activity. Such policies would increase the number of sidewalks to create easily navigable streets and improve access to nearby shopping centers and recreational facilities. However, these policies will also need to incorporate safety. If people do not feel safe leaving their house they are less likely to take advantage of the built environment around them. It is also important to maintain and build public paths outside of the business district for the population who seek pleasure from physical activities such as hiking and mountain biking.

Path Maintenance and Assessment

Bike path maintenance is an important factor for urban planners to consider. Bike path conditions may influence where and how often cyclists and pedestrians use paths, especially for recreational purposes. Tilahun, Levinson, and Krizek (2007) found that people are more willing to pay higher prices to implement designated bike lanes on roads rather than create off road bike paths. However, unpaved off road bike paths used by mountain bikers and hikers are still important and need to be maintained (Tilahun and Krizek 2007).

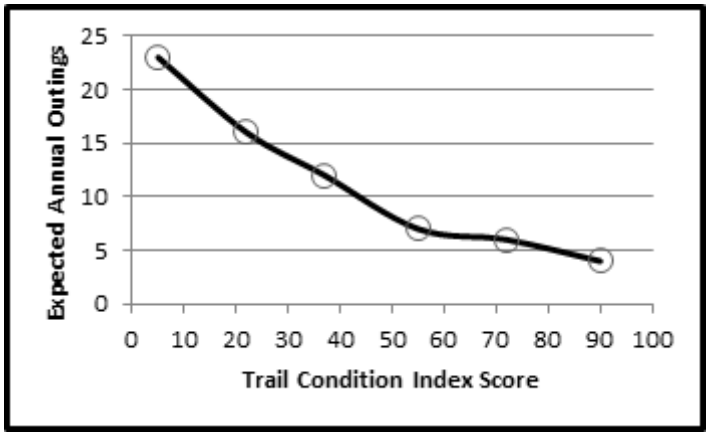


Figure 6: *Path conditions and use*

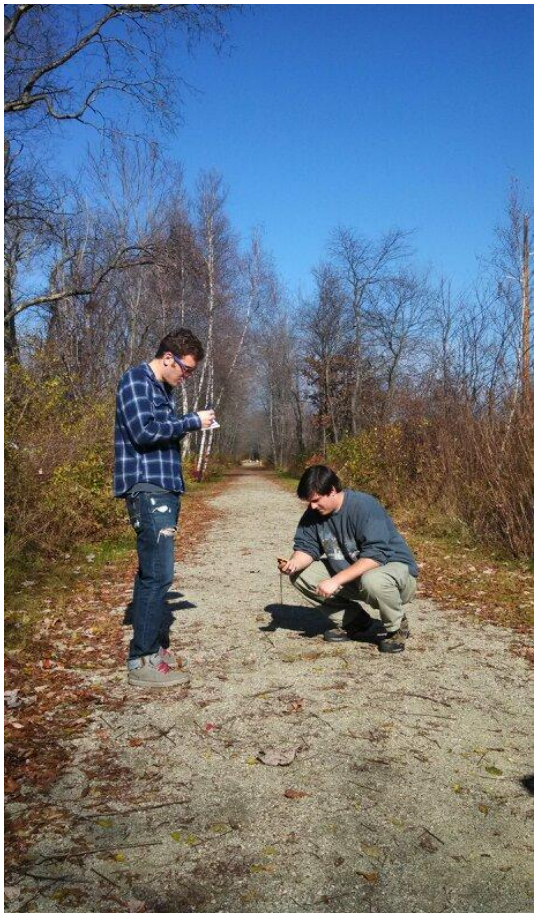
Path condition directly relates to how often people use off road bike paths (Naber 2008) (Figure 6). It was found that cyclists are likely to go on more outings per year if path conditions are better. If these unpaved paths are not maintained and kept up to the standards of the cyclists using them, then there is a higher chance that cyclists migrate to different paths. In order to maintain the condition of bike paths the International Mountain Bicycling Association (2001) suggests filling or packing in any significant holes on the paths, removing or fixing features that promote puddling on the paths, and removing any natural obstacles such as rocks or trees that block the path or that may impede safety.

One way to ensure that the paths are safe and well used is to conduct regular assessments. Marion and Leung (2001) describe three different types of assessments: trail inventory, trail maintenance, and trail condition. Trail inventory is assessing what the trail is currently being used for, the trail's length, the trail's width, and the difficulty of the trail. Using GPS receivers to map the location and condition of the trail can support accurate assessments. Trail maintenance assessments are descriptions of current work and changes needed on a trail, which include developing new signs and installing bridges or other structures that could improve the trail. Trail condition assessments describe what the trail is currently like.

Physical assessment is a useful means to understand the condition of a path; however, it is not an accurate way of assessing who uses the paths, how often the path is used, and the reasons it is used (Figure 7). This is better done in the form of survey. Naber (2008) conducted a survey on people who use mountain bike paths in North Carolina. He administered the surveys personally to users at trail heads after or before their outing. This method proved

effective at producing a large sample size. Only two users that were asked to complete the survey declined. Of the 413 people that completed the survey, 398 provided complete and usable surveys. In contrast, Alder and Geoft (2001) distributed their surveys on mountain bike trails through retail outlets. They left them at retailers in the hopes of people filling them out on their own. Of the 963 surveys admitted only 183 surveys were collected. Tilahun, Levinson, and Krizek (2007) randomly administered surveys on different types of biking routes (on-road and off-road) to 2,500 employees at the University of Minnesota through e-mail. A fifteen dollar participation reward was granted to anyone willing to take the survey. Of the 2,500 people that received the survey only 181 people responded and of those 167 were complete and usable.

These three methods of distributing surveys illustrate different results. Naber's survey was so successful because it was administered to people who cared about the research that he was doing. There was a bias in his research because the participants are already interested in biking. Alder and Geoft's survey was less effective because it was completely dependent on the willingness of random people to fill out their survey. Tilahun, Levinson, and Krizek's survey showed few results for the same reason although they provided a participation reward. User interest is an important factor to consider when administering a survey in a community, even though it may create some bias because the targeted citizens are more likely to support the research and will have different views then the general population.



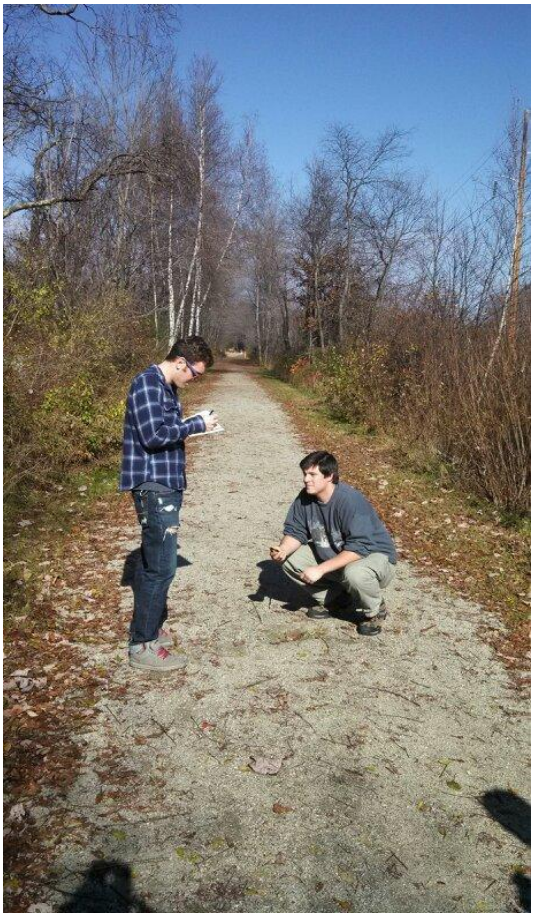
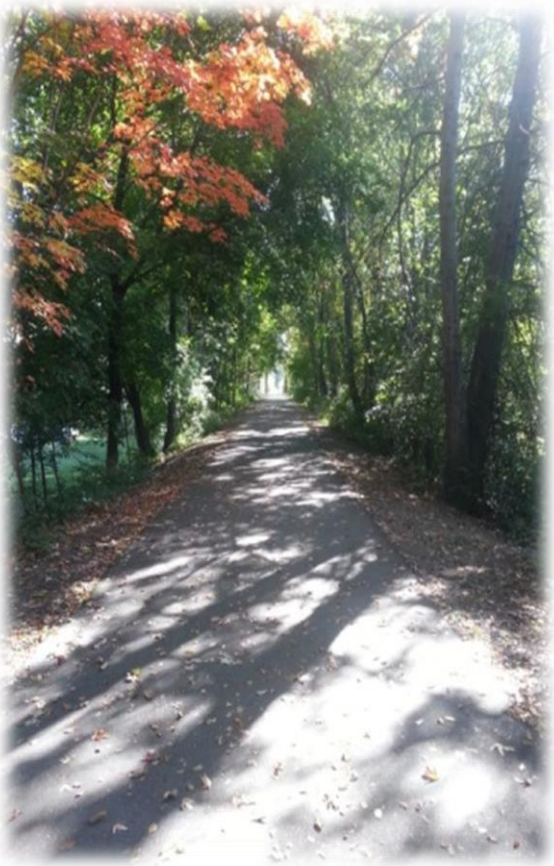


Figure 7: *Photograph of our team conducting a physical assessment on the Ashuelot Rail Trail*



Chapter 3

Methodology & Results

To develop the necessary research on our topic we used five data collection methods including: a student survey, a community survey, bike counters, visual counting, and physical path assessment. We used collected data to create charts, graphs, and maps and run statistical tests between variables. The results will allow us to answer questions regarding the existing bike paths in Keene and build a platform for future development.

Student Survey Methods

A survey was distributed to undergraduate students at Keene State College (Appendix C). The goal of the survey was to explore student's knowledge about the paths. The design of the student survey went through several iterations to improve the structure of the information. We conducted a pilot of the survey to gauge its effectiveness and credibility. The survey is a two-sided sheet of paper with an introduction that described our goals. The survey begins with general questions asking gender and grade level. Subsequent questions pertain specifically to the bike paths.

Each member of our team distributed surveys in introductory level classes. Classes were chosen to produce a sample of students from a variety of majors and grades. The surveys were also placed in Mason Library on campus where willing participants could answer them. This process was not completely random because library patrons may not be representative of the student body at Keene State College. The questions were designed to determine if students are taking advantage of the bike paths or even know they exist. If there is a lack of knowledge about the paths, one outcome might be to educate students about the path and encourage their use. We collected ninety seven surveys and none had to be discarded because of

erroneous completions. We used spreadsheets in Excel to asses our data and plot graphs. We used SPSS for statistical analysis.

Student Survey Results

An important part of analyzing students' knowledge of the paths was determining if grade level plays a role in who has and has not seen a map of the bike paths. We feel that all students should be equally knowledgeable of the bike paths and know where to find a map. However, it is clear that a larger number of upper classmen (juniors and seniors) than under classmen (freshmen and sophomores) have seen a map of Keene's bike paths (Figure 8).

To determine students' interests in the bike paths and parks in Keene, we asked the following question: "Do you think a map of the Bike paths and parks in Keene should be provided at freshman orientation?" Our results show that 84 percent of students said "Yes", a map should be provided at freshman orientation, 13 percent said "Do not care" and 2 percent said "No".

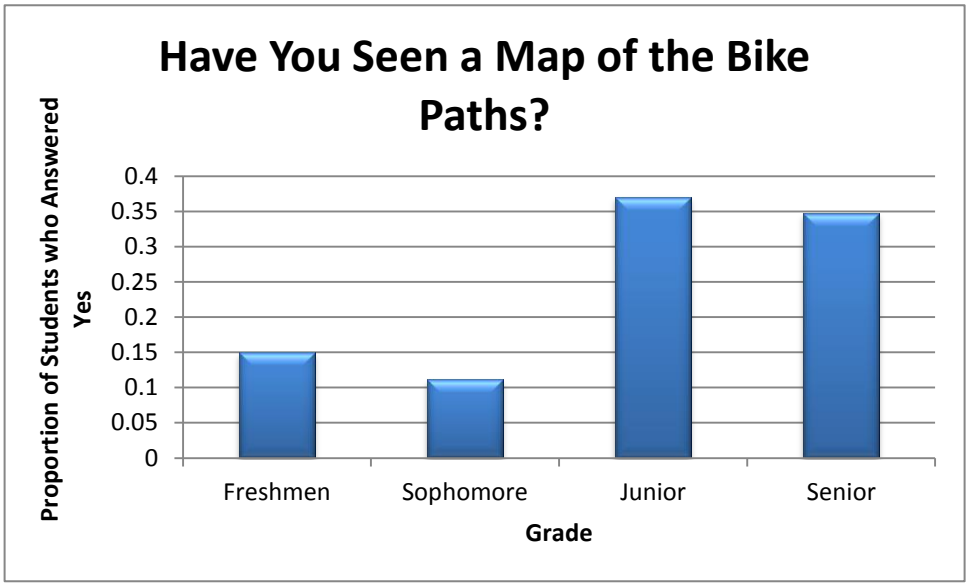


Figure 8: *Graph of proportions of students who have seen a map of the bike paths.*

One of the main points of our survey was to determine who is using the bike paths more frequently: freshman, sophomore, juniors or seniors. We assumed that juniors and seniors are more likely to live off campus and own are car, therefore, they may be less likely to use the bike paths. We also assumed that sophomores are more likely to be knowledgeable of the paths than the freshmen. Our assumptions lead us to believe that sophomores will use the trails most.

We created a graph which portrays the frequency with which students in each grade use the bike paths (Figure 9). Frequency was measured using a Likert Scale ranging from never to daily. This figure shows that sophomores utilize the bike paths more frequently than any other grade at Keene State College.

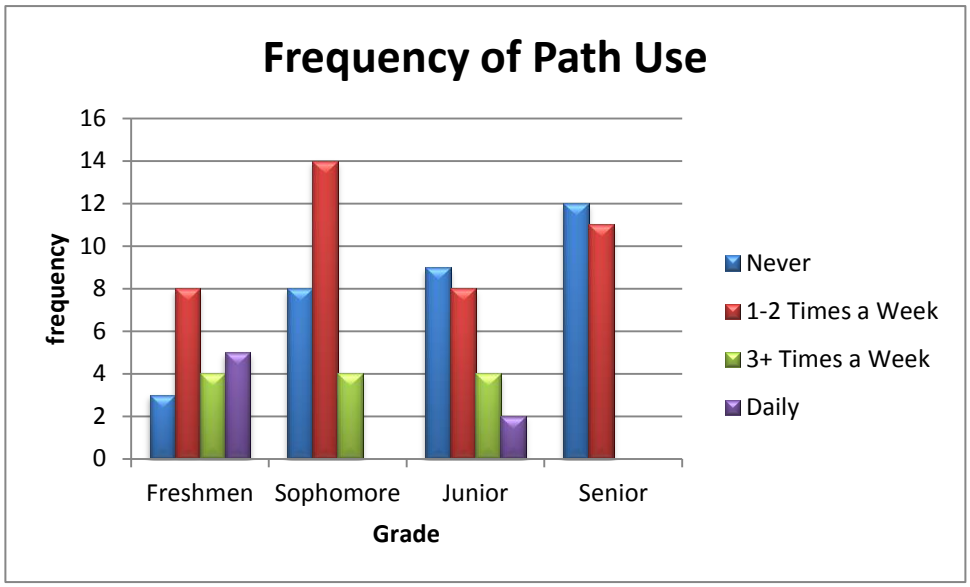


Figure 9: *Students grade compared to frequency use of paths*.

To determine if there is a significant difference in the frequency of bike path use between grade levels we ran a one-way ANOVA. A one-way analysis is an analysis of variance

which compares the means of two or more samples. Our test had four samples: freshmen, sophomores, juniors, and seniors.

Null hypothesis: Student's grade level does not relate to how often they will use the bike paths.

Our results show that students' grade level does affect how often they use the path (Table 1). We ran this test at the 95 percent confidence level giving us a threshold value of 0.05. We rejected our null hypothesis because the p-value was 0.004. This is less than 0.05, showing that there is a statistically significant difference in the frequency of use between grade levels. To find which grade level is significantly different we ran a post-hoc test. Our results revealed that sophomores use the trails a statistically significant amount more than the other grade levels.

Table 1: *ANOVA ran between students' grade and use of the bike paths*.

ANOVA

Grade	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	14.616	3	4.872	4.748	.004
Within Groups	95.425	93	1.026		
Total	110.041	96			

Lastly, we wanted to see if there was a difference between familiarity regarding specific landmarks in Keene. We ran an independent sample t-test comparing underclassmen's and upperclassmen's knowledge of certain landmarks that are within close proximity to some of Keene's bike paths: Ashuelot River Park, Wheelock Park, Colony Mill, KSC Athletic Complex, and Hannaford Plaza. We first compared means between all four grade levels but we did not come up with statistically significant results So, we decided to group them into two classes.

Null hypothesis: Upperclassman and underclassman have the same knowledge of certain locations in Keene.

We were able to reject our null hypothesis because the p-value was 0.000 which is less than 0.05 (Table 2). When we compare the mean number of locations known between underclassmen and upperclassmen of 2.125 and 3.286, respectively, it is clear that the upperclassmen have a greater knowledge of these areas in Keene.

Table 2: *Independent Sample t-test comparing knowledge of landmarks and student grad level.*

Class	N	Mean	Std. Deviation	Std. Error Mean
Underclassman	48	2.1250	1.31481	.18978
Upperclassman	49	3.2857	1.39940	.19991

Community Survey Methods

A community survey was developed to retrieve useful feedback from Keene residents about the use, conditions, and safety of the bike paths (Appendix C). Harmful trail conditions such as potholes and poor signage is an important safety concern and one we wanted to gather information about. Since it is very important for people to feel safe from crime while using the bike paths, personal safety is another issue we explored. The community survey was left at Stonewall Farm in Keene and was filled out by eight willing participants. It was also distributed in an online form. A link to the online form was posted on the City of Keene Recreation Department's Facebook Page. Thirty participants followed the link, but only 24 fully completed the survey. Both surveys asked the same questions. There were a total of thirty-two usable surveys; we had to discard six due to erroneous data.

We downloaded the online survey results into an Excel file. The downloaded results were in a qualitative format so we converted them to a quantitative format. We then added the survey results from Stonewall Farm. We used SPSS to run a test on how safe men feel compared to how safe women feel while on the paths. Graphs and other methods of descriptive analyses were also used to analyze the use and satisfaction of the paths.

Community Survey Results

We feel that it is important for the paths to provide a feeling of safety to everyone regardless of their age and gender. However, women are more vulnerable to violent attacks than males. While doing visual counting we observed that females seem more aware of their surroundings when alone and are constantly browsing their horizon. To test our assumption that women do not feel as safe on the trails we asked participants how often they feel safe on the trail, using a Likert scale their options ranged from “never feel safe” represented by zero to “always feel safe” represented by four. We used the results of this question to run an independent samples t-test.

Null hypothesis: There is no difference between how safe men feel on Keene’s bike paths compared to females.

Assuming equal variances our results gave us a probability value of 0.001 with a confidence level of 0.05 allowing us to reject the null hypothesis. This means that there is a statistically significant difference between how safe males feel compared to females on the paths. We compared the means of the results and found that it is women who feel less safe. With a mean of 2.57, females are closer to the value of zero which again represents never feeling safe.

Violent attacks on individuals are more likely to occur in dark secluded areas. We believe that the lighting of the paths has a strong impact on whether or not users will feel safe. Therefore we incorporated a question asking if respondents feel the lighting is sufficient. Our results show that 72 percent of users do not feel the lighting is sufficient enough. This is a clear indication that there needs to be an improvement in lighting on the paths, so that users can feel safe.

The community survey was also used to determine which trails are being utilized the most. Keene's trails consist of the Cheshire Rail Trail, Ashuelot Rail Trail, Ashuelot River Trail, Appel Way Trail, and the Keene State College Trail (Figure 10). Survey participants were asked to check off all of the trails that they use. Among our respondents the Cheshire Rail Trail is the most popular and the College Trail is the least popular. These results contrast with our results from the student survey which showed the College Trail is most popular among the student population. The targeted participants in the community survey were not college students and may have little need for the College Trail or may not be aware of it unless they are riding south of NH Route 101.

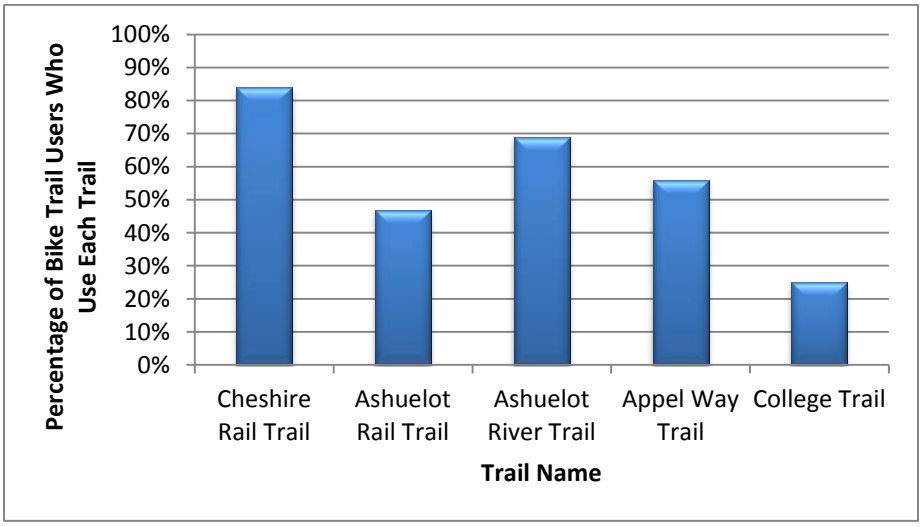


Figure 10: *Popularity of Trails among the Community.*

We also asked participants about their overall satisfaction with the paths (Figure 11). The majority of users are currently satisfied with the bike paths and 37.5 percent are "very satisfied" or "extremely satisfied". To our surprise we found that no users find the paths unsatisfactory. However, 21.87 percent are only "somewhat satisfied."

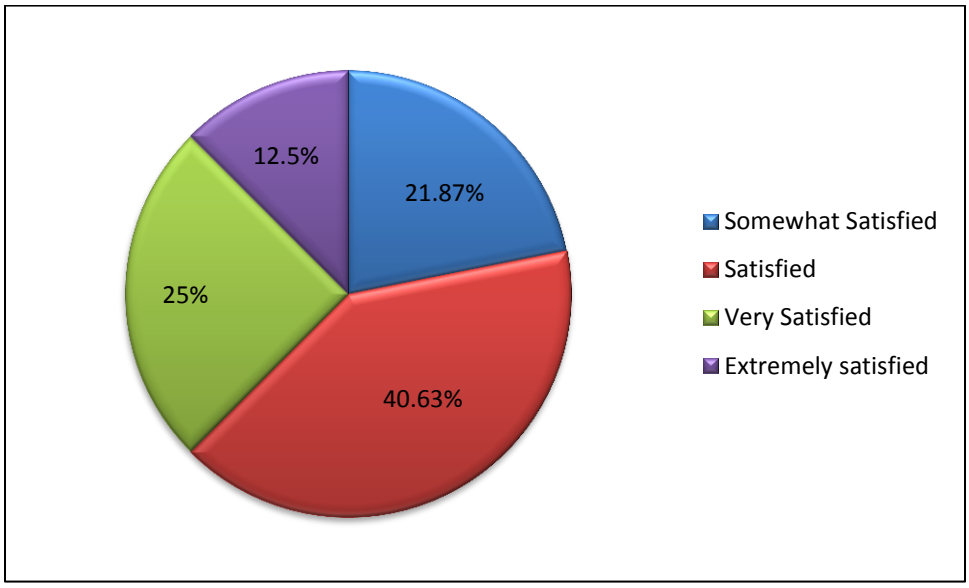


Figure 11: Overall satisfaction

The remaining survey questions supplied us with qualitative data regarding why people use the trails and how they feel about the safety of riding in the bike lanes that accompany the shoulders of several of Keene's streets. We also asked how far they live from an entrance to a bike path, their opinions about surface conditions of the bike paths, and recommendations to improve the bike paths.

Bike Counter Data Methods

Bike paths are becoming more popular around the country as a means to reduce traffic, reduce air pollution from motor vehicles, and promote active living. Millions of dollars are spent by local governments to create new paths, restore old paths, and maintain existing paths.

The City of Keene spent 2.3 million dollars constructing a bridge spanning NH State Highway 9 that allows bicyclists and pedestrians to safely cross this busy thoroughfare and continue along the Cheshire Rail Trail. The Keene Recreation Department has ideas for constructing new path connections and creating new bridges, but only if these new additions will be used. Accurately assessing current use by placing bike counters on the paths is a useful way to determine if new additions will be worth the time and money.

The Southwest Region Planning Commission (SWRPC) placed bike counters at several key locations on the paths for different weeks during September 2013 (Table 3). From these counters we received data on the total number of bikes and the dates the counters were deployed. We used these data to find the average number of bikes per day for given sections of the bike paths. We assumed that the bike counters were counting the majority of bikers between 10:00 A.M and 6:00 P.M. From our visual counts (described in the next section) we determined that the majority of bikers were using the paths between these times. When we did visual counting before or after these hours the number of users was much less significant. Once it gets dark there are few lights on the paths which makes riding at night difficult. Using these hours, we calculated the average number of bikes per hour.

These statistics can be useful, but with multiple counters deployed on the same path, the same bike may be counted twice. To minimize the potential error for "double counting" we divided the trails into sections and assigned data from one counter to each section. We then created a map using proportional symbology (Figure 12). The thicker the line representing a section of the path, the higher the bike counts along that section.

Bike Counter Data Results

The number of bikes that passed over each counter is presented below (Table 3). It is clear that the Cheshire Rail Trail gets the most use (Figure 12). This is likely due to the paths convenient location, as it runs across Main Street and through the center of town. More specifically, the section of the Cheshire Rail Trail that starts at the intersection with the Ashuelot Rail Trail and ends on the west side of Main Street receives more use than any other section on any path. Since there was no counter placed on the Jonathan Daniels Trail we assumed that the use of the southern half of the trail was indicated by bike counter number six and that the northern half of the trail was similar to bike counter number two. The southeast end of the Cheshire Rail Trail has no data because it is mainly unused, as bike and pedestrian traffic is directed onto Eastern Avenue which runs parallel with the path.

An interesting result that emerged from these data was the pattern of use along the Ashuelot Rail Trail. The northernmost counter on this path counted 267 bikes. The next section showed a count of only 31 bikes while the southernmost section revealed a count of 150 bikes. This data is significant because it allows us to infer that bikers are not using the middle section and instead are taking an alternate route to continue on the trail, whether travelling north or south. Although the College Trail did not have a counter, it is very likely that bikers are using this trail as an alternate route.

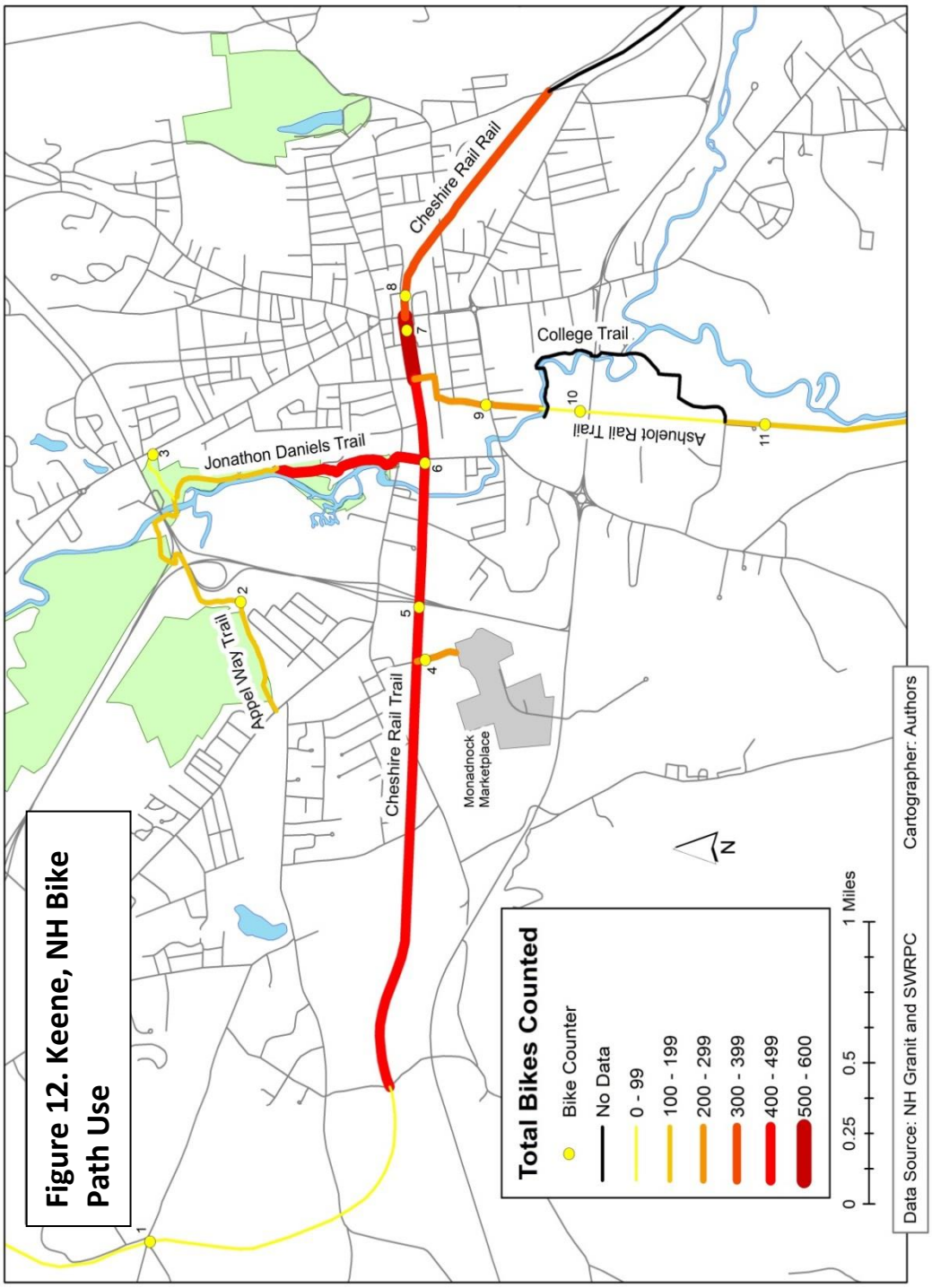


Figure 12. Keene, NH Bike Path Use
Cheshire Rail Rail
College Trail
Ashuelot Rail Trail
Jonathon Daniels Trail
Appel Way Trail
Cheshire Rail Trail
Monadnock Marketplace
1
2
3
4
5
6
7
8
9
10
11
N
Total Bikes Counted
Bike Counter
No Data
0 - 99
100 - 199
200 - 299
300 - 399
400 - 499
500 - 600
0
0.25
0.5
1 Miles
Data Source: NH Granit and SWRPC
Cartographer: Authors

Table 3: *SWRPC bike counter data.*

Map Location	Counter	Number of Bikes	Start Date	End Date
1	Cheshire Rail Trail South of Hurricane Road	25	9/16/2013	9/23/2013
2	Appel Way Trail at Wheelock Park Entrance	155	9/9/2013	9/16/2013
3	Trail Head of Appel Way Trail West of Court Street	89	9/16/2013	9/23/2013
4	Monadnock Marketplace Entrance_Exit	214	9/9/2013	9/16/2013
5	Cheshire Branch Railbed West of North Bridge	442	9/9/2013	9/16/2013
6	Downtown Bike Path West of Island Street	446	9/9/2013	9/16/2013
7	Downtown Bike Path West of Main Street	559	9/16/2013	9/23/2013
8	Industrial Heritage Trail East of Main Street	390	9/16/2013	9/23/2013
9	Ashuelot Trail at Foundry Street (North of Winchester Street)	267	9/9/2013	9/16/2013
10	Ashuelot Trail just north of 101	31	9/16/2013	9/23/2013
11	Ashuelot Trail South of Krif Road	150	9/23/2013	9/30/2013

Bike counter number four was placed at the intersection of the Cheshire Rail Trail and the emergency access road that leads from Pitcher Street to Monadnock Marketplace. The Monadnock Marketplace includes stores like Target, Dick's Sporting Goods, and Home Depot. We can assume that the majority of use of this route is for shopping purposes because this service road does not lead directly to any other paths or residential areas. For the week that the counter was deployed, 214 bikes were counted. This shows that many people are using their bikes for shopping purposes. Instead of taking vehicles, these shoppers are using alternative transportation whether for the exercise or to help reduce air pollution from their car. Another likely source for the use of this section is for commuting purposes. The

Monadnock Marketplace is loaded with retail stores which employ lots of entry level jobs. Since so many people work there at likely low wages, they may be using the service road to commute by bike.

The data received by bike counter three, on Appel Way Trail indicated a lack of path use. This may be due to the path's inconvenient location. The eastern end of the path begins at Court Street, where there is not a parking area for vehicles so people are less likely to begin a trip in this location. Not many people begin or end a ride at this location. This section of path also has a very steep incline, as it approaches Court Street, making it hard for many bicyclists to travel east. When bicyclists get to the intersection of the Appel Way Trail and the Jonathon Daniels Trail they can decide to go left or right. If they choose to turn right after a short while they reach the bottom of this steep hill. This may cause casual riders without a destination to turn around because they do not want to make the climb. The little use of this section also tells us that residents who live along Court Street may not be taking advantage of this bike path. Either they do not use their bike very often, are deterred by the steep incline, or use an alternative route.

Visual Counting Data Methods

While the bike paths in Keene are a convenient way for bicyclists to get around the city, these paths are also used by walkers, joggers, and runners. The paved paths are also used by long boarders. These modes of transportation account for a large amount of the paths' use, but are not recorded by the counters placed by the SWRPC. Since these other modes of transportation are important we chose locations on the paths to visually count all path users. We counted users on each of the five paths for one hour increments. We recorded the time,

date, number of bikes, and the number of people on foot. Not all paths were observed for an equal number of hours so we transformed the data to number of people and bikes per hour for map display (Figure 13).

Visual Counting Data Results

Just as the bike counter data showed, the Cheshire Rail Trail saw more use than the other trails. Our visual counts also tell us how much more walkers, joggers, and runners use the paths than cyclists (Table 4). On many of the paths twice as many pedestrians were counted than bikes. This difference in the number of pedestrians and bikes was evident on all the paths. It was most prevalent on the College Trail, partly because many of the Keene State College cross country and track team members use this path as part of their running route. Our student surveys also support this because a large percent of students said they use the paths only for walking, jogging, or running. These results indicate that even though they are called bike paths, non-cyclists dominate the paths.

Table 4: *Visual counting data*

Bike Path	Hours Counted	Total People	People/Hour	Total Bikes	Bikes/Hour
Ashuelot Rail Trail	16	195	12.19	91	5.69
Cheshire Rail Trail	16	281	17.56	147	9.19
Appel Way Trail	21	211	10.05	90	4.29
Jonathon Daniels Trail	18	194	10.78	109	6.06
College Trail	21	422	20.10	138	6.57

The data collected from our visual counts and the SWRPC bike counters show a very similar number of bikes per hour on the paths. After discovering during our visual counts the majority of users were coming between ten in the morning and six at night we applied this same

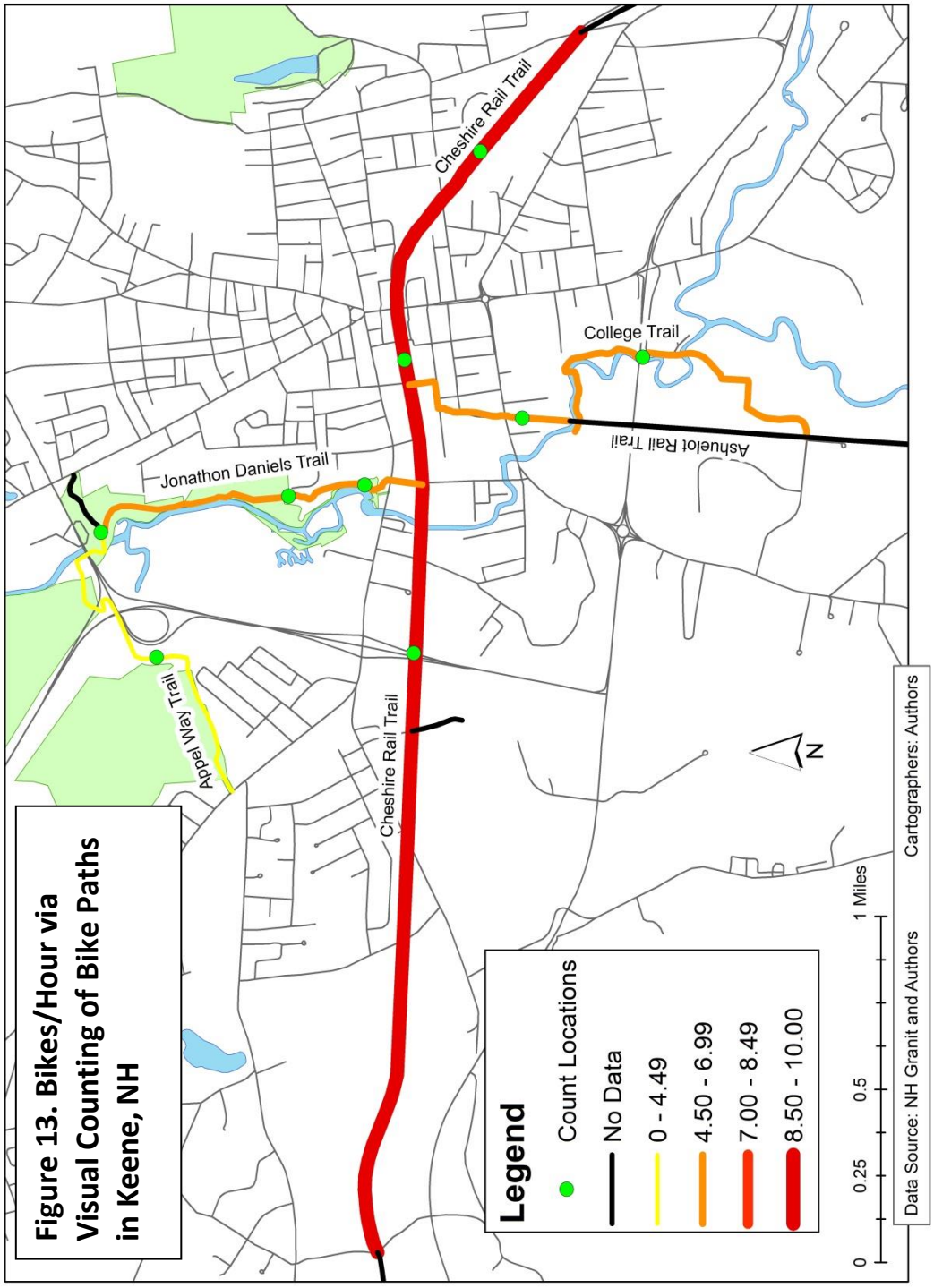


Figure 13. Bikes/Hour via Visual Counting of Bike Paths in Keene, NH
Legend
Count Locations
No Data
0 - 4.49
4.50 - 6.99
7.00 - 8.49
8.50 - 10.00
Cheshire Rail Trail
Cheshire Rail Trail
Jonathon Daniels Trail
Appel Way Trail
College Trail
Ashuelot Rail Trail
N
0
0.25
0.5
1 Miles
Data Source: NH Granit and Authors
Cartographers: Authors

The data collected from our visual counts and the SWRPC bike counters show a very similar number of bikes per hour on the paths. After discovering during our visual counts the majority of users were coming between ten in the morning and six at night we applied this same knowledge to the bike counter data (Table 5). This allowed us to compare our two data sets to each other (Figure 14). Looking at the graph, our numbers from the visual counting of the Ashuelot Rail Trail is similar to bike counter 9. This bike counter was very close to where we did our visual count which allows us to compare the two.

Table 5: *Bike counters' bikes per hour*

Bike Path	Counter	Bikes/Hour	Location on Map
Cheshire Rail Trail	Cheshire Rail Trail South of Hurricane Road	0.45	1
Appel Way Trail	Appel Way Trail at Wheelock Park Entrance	2.77	2
Appel Way Trail	Trail Head of Appel Way Trail West of Court Street	1.59	3
Cheshire Rail Trail	Monadnock Marketplace Entrance_Exit	3.82	4
Cheshire Rail Trail	Cheshire Branch Railbed West of North Bridge	7.89	5
Cheshire Rail Trail	Downtown Bike Path West of Island Street	7.96	6
Cheshire Rail Trail	Downtown Bike Path West of Main Street	9.98	7
Cheshire Rail Trail	Industrial Heritage Trail East of Main Street	6.96	8
Ashuelot Rail Trail	Ashuelot Trail at Foundry Street (North of Winchester Street)	4.77	9
Ashuelot Rail Trail	Ashuelot Trail just north of 101	0.55	10
Ashuelot Rail Trail	Ashuelot Trail South of Krif Road	2.68	11

When we counted the Cheshire Rail trail we moved along the main part of the path and counted users. In approximately the same locations of our visual counts are bike counters 5, 6, 7, and 8. When comparing them on the graph, all five are hovering around eight to ten bikes per hour which shows that our visual counting of the path may be representative of the actual

use of the path. The Appel Way Trail visual count is slightly higher than the result from bike counter 2 which shows that we may not have representative data for this path.

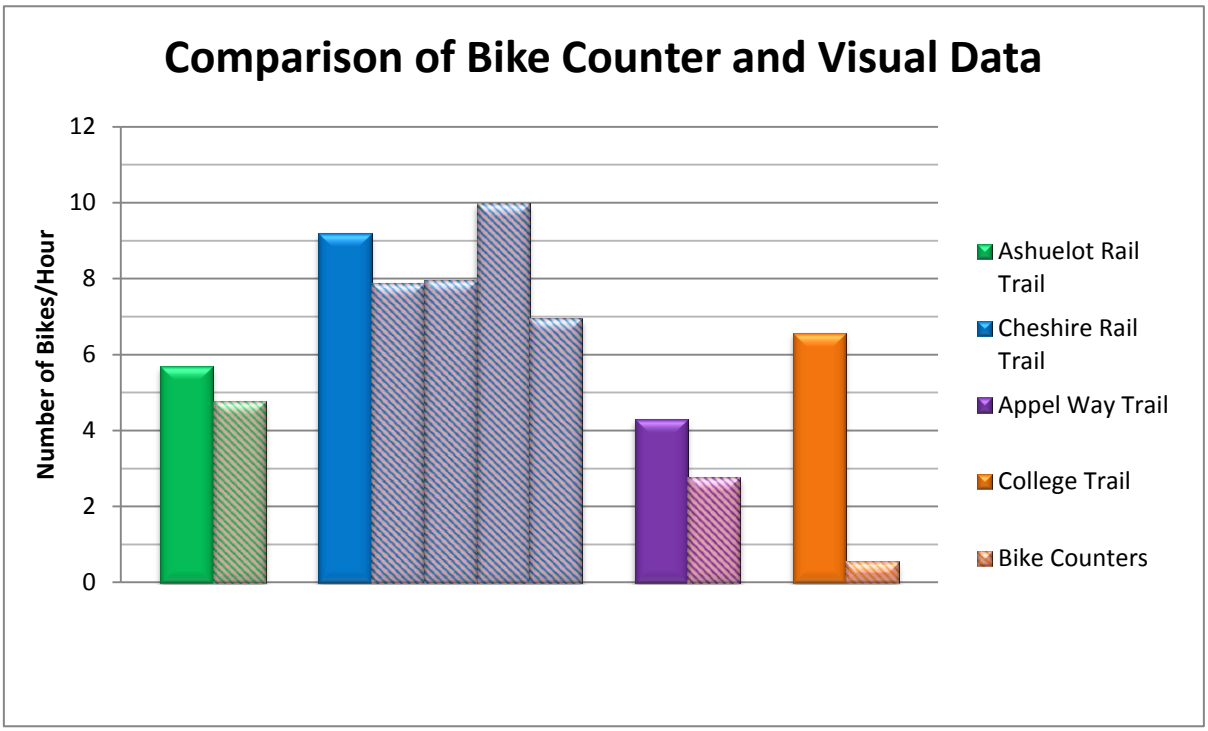


Figure 14: *Comparison of bike counter and visual data*

We then did a fourth comparison between the College Trail visual count and bike counter 10. We did this because we felt that people are using the College Trail as an alternate route around the NH Route 101 Crossing. Looking at the graph it is very clear that the College Trail gets much more use than the section of the Ashuelot Rail Trail that is just north of the intersection with Route 101. Although much of this use may just be college students commuting by bike from southern parts of Keene, there may also be bikers who are taking the College Trail to safely cross Route 101.

Since our visual counts of bikes per hour were very close to the actual bikes per hour for the majority of the counter, we can conclude that the number of people counted per hour is also representative.

Physical Assessment Data Methods

A primary emphasis of this project was to make an accurate physical assessment of the path conditions. Safety can play a critical role in determining if individuals use the bike paths. Assessing the conditions of bike paths is also important because people do not want to use paths that are not pleasant and appealing to the eye. To conduct this assessment the City of Keene provided a safety checklist (Appendix D). Using a GPS receiver, each potential hazard and path flaw was marked with a waypoint. A potential hazard or path flaw includes potholes, cracks, missing fence, rotting material, insufficient signage, and trail erosion. We converted these GPS waypoints into a shapefile to use for GIS analysis.

Physical Assessment Data Results

We created a map of all the potential hazards found during our assessment of the bike paths (Figure 15). The Cheshire Rail Trail is in the best condition of all the paths, which may be another reason why it is the most used (Figure 16). While the Cheshire Rail Trail is the longest path we assessed, it had the least amount of issues. This means the path was likely constructed well because it has maintained its good shape through all the use it has received.

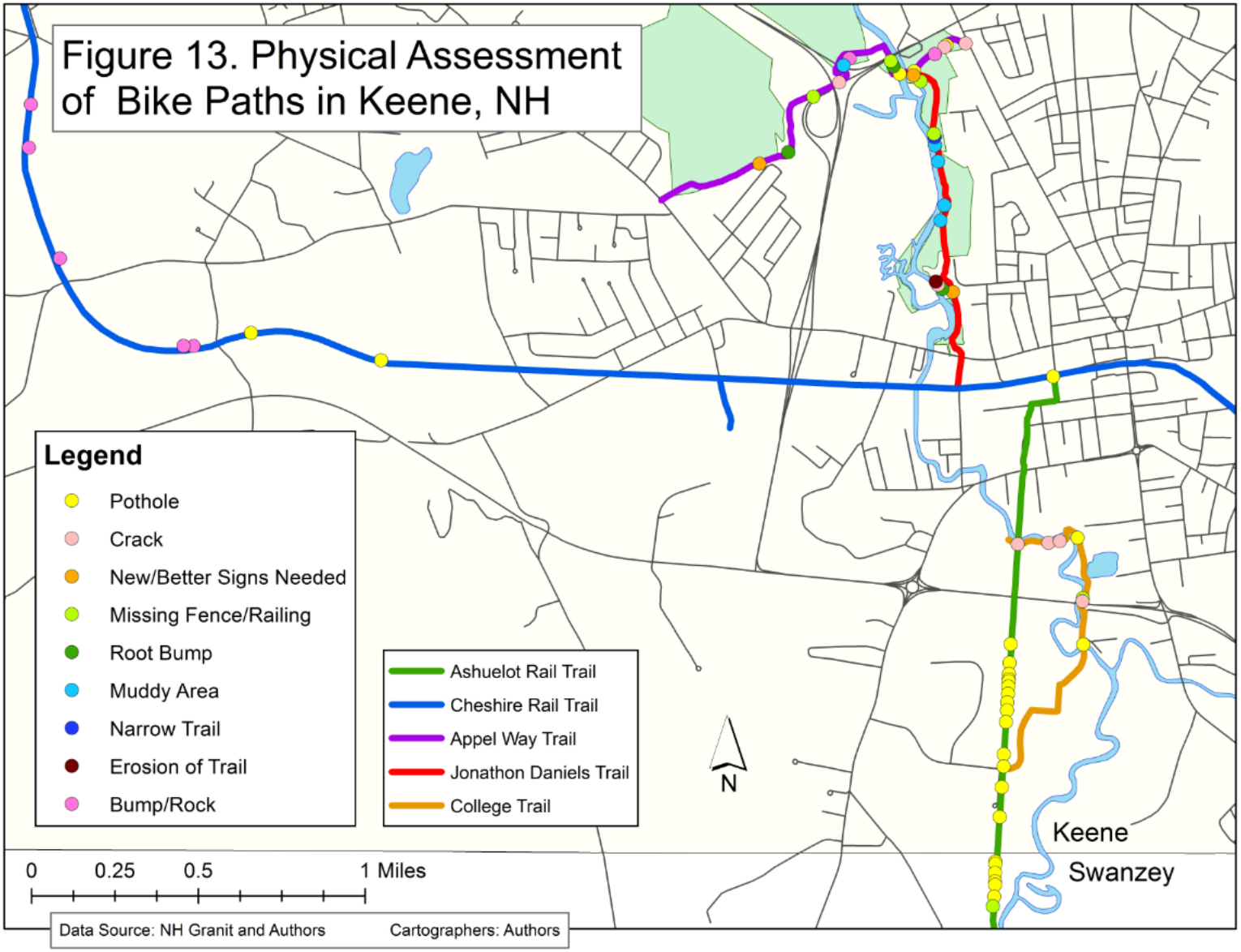


Figure 13. Physical Assessment of Bike Paths in Keene, NH
Legend
Pothole
Crack
New/Better Signs Needed
Missing Fence/Railing
Root Bump
Muddy Area
Narrow Trail
Erosion of Trail
Bump/Rock
Ashuelot Rail Trail
Cheshire Rail Trail
Appel Way Trail
Jonathon Daniels Trail
College Trail
N
Keene
Swanzey
0 0.25 0.5 1 Miles
Data Source: NH Granit and Authors
Cartographers: Authors

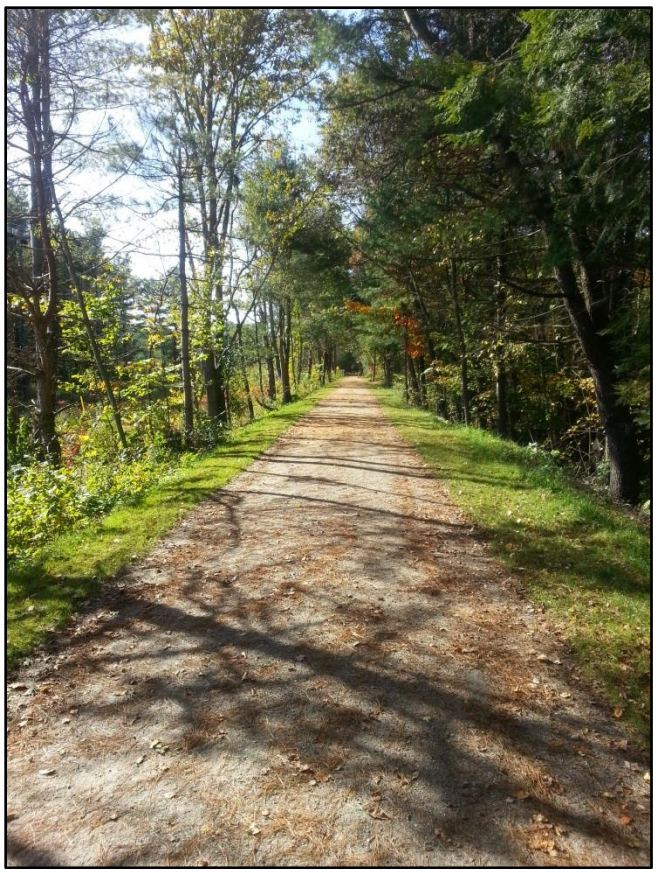


Figure 16: *The Cheshire Rail Trail*

The Appel Way Trail and the Jonathon Daniels Trail were in the worst condition (Figure 17 and 18). The Appel Way Trail is paved with asphalt for its entire length, but in some sections the pavement has deteriorated. Starting at the easternmost section of the path, there is a steep downward slope which is covered with cracks, bumps, and potholes. This path also has many overhanging trees and vegetation very close to the path's edge. As a result, this section of the path is covered in leaves and needles, creating a slippery surface for bikers, especially for those going up or down the steep slope. The path condition improves as one moves west along the path towards Wheelock Park. There are missing fences along the path and some of the bike signs painted on the pavement need to be repainted. Overall the western half of the path is in better condition than the eastern portion.

Figure 17: *The Appel Way Trail*

Figure 18: *Jonathan Daniels Trail*

The Jonathan Daniels Trail is also in poor condition compared to the other trails. This path is cleared of trees, but the natural materials that comprise the path surface seriously affect its condition. After precipitation of any kind, the trail becomes very muddy and hard for bikes to travel through. The trail also has many roots growing across it making it uncomfortable for cyclists. Two of the wooden bridges which cross over small streams are in poor condition. One bridge has no railings at all while the other bridge's railings are not sturdy. This path runs parallel with the Ashuelot River, providing a beautiful scenic view. It is not a paved or hard-packed surface, which may be a result of the city trying to preserve its natural feel.

The Ashuelot Rail Trail is in great condition north of its intersection with NH Highway 101. South of the highway, the path has numerous potholes throughout the trail. The path is a

former railroad so these holes may be due to poor construction of the path. There are a number of holes that seem to be created by animals. Where this path leaves Keene and enters Swanzey, there is a bridge in very bad shape. On the edges of the bridge there are rotting boards that are flimsy and unsafe. The middle of the bridge is bumpy and if going too fast a cyclist could easily lose control and fall. This bridge is in very poor condition and may discourage users. It should be evaluated to avoid possible accidents. (See Appendix B).

Chapter 4

Discussion and Conclusion

Our data show that the section of the Ashuelot Rail Trail that intersects NH 101 (Figure 19) is not being used as much as other sections of the trail. This may be due to the dangerous crossing of the highway since there is a constant flow of cars from the traffic circle to the west. This traffic circle allows for little gaps in traffic because there are no traffic lights at which cars much stop. This suggests that in order for users to cross safely without having to take a detour down the College Trail the construction of a bridge under or over the highway is necessary. Although this would cost a significant amount of money it would be beneficial for this bike path. Knowing that there is a safe way to cross the highway would encourage bikers to use this path more frequently. There may be some users who use the Ashuelot Rail Trail and come to this intersection but turn around because they do not want to take the risk of crossing.

Figure 19: *Route 101 crossing*

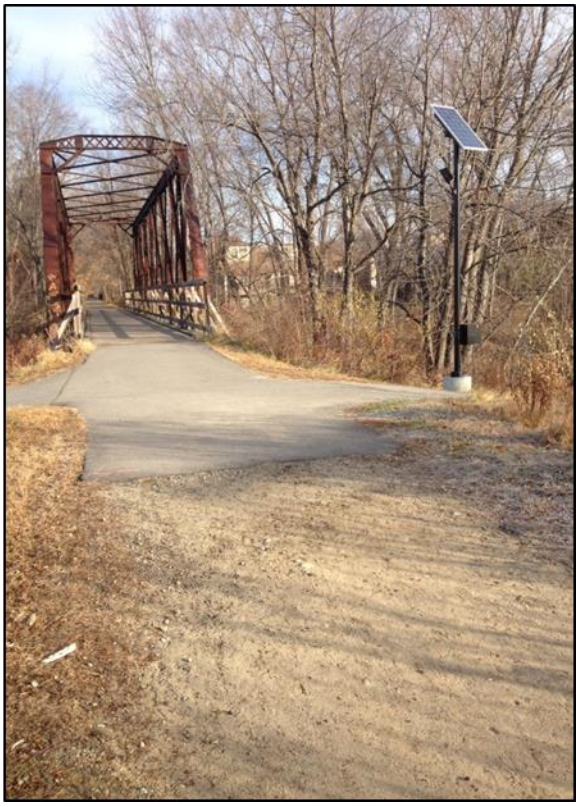


Figure 20: *Ashuelot Rail Trail/College Trail split*

An alternate solution to this danger of crossing Route 101 would be to set up new signs informing users to take the College Trail. Our data show that many people may already be doing this, while the users that do not know about the College Trail may turn around rather than continuing down the path. Erecting signs would be helpful to path users who are not as familiar with the bike path system in Keene. These new signs would go at the two intersections of the Ashuelot Rail Trail and the College Trail (Figure 21). If new signs were put into place then markings along the College Trail would be necessary to direct users through campus so they reach the Ashuelot Rail Trail on the opposite side of the highway.

Although the College Trail is not fully recognized as a bike path since it is maintained by Keene State College, data from our visual counts show the path gets similar, if not more, use than other paths in the system. Incorporating this path into the system is important because it provides route to safely cross NH Route 101. The path runs partly through the Keene State College Campus making it very important for students and others travelling through campus.

Utility Cycling

Pitcher Street in Keene, which connects the Cheshire Rail Trail with the Monadnock Marketplace, is an important route for people who do their shopping via biking or walking. There may be more people in Keene who want to do their shopping by bike, but do not know how to transport the items they buy. There is equipment available to allow for what is called "errand cycling" or "utility cycling". This equipment includes messenger bags, panniers, frame bags, seat bags, and regular backpacks (Moses 2010). Introducing this equipment to the community by educating them on places they could buy these accessories may inspire people to use their bikes to do their shopping if they live close enough.

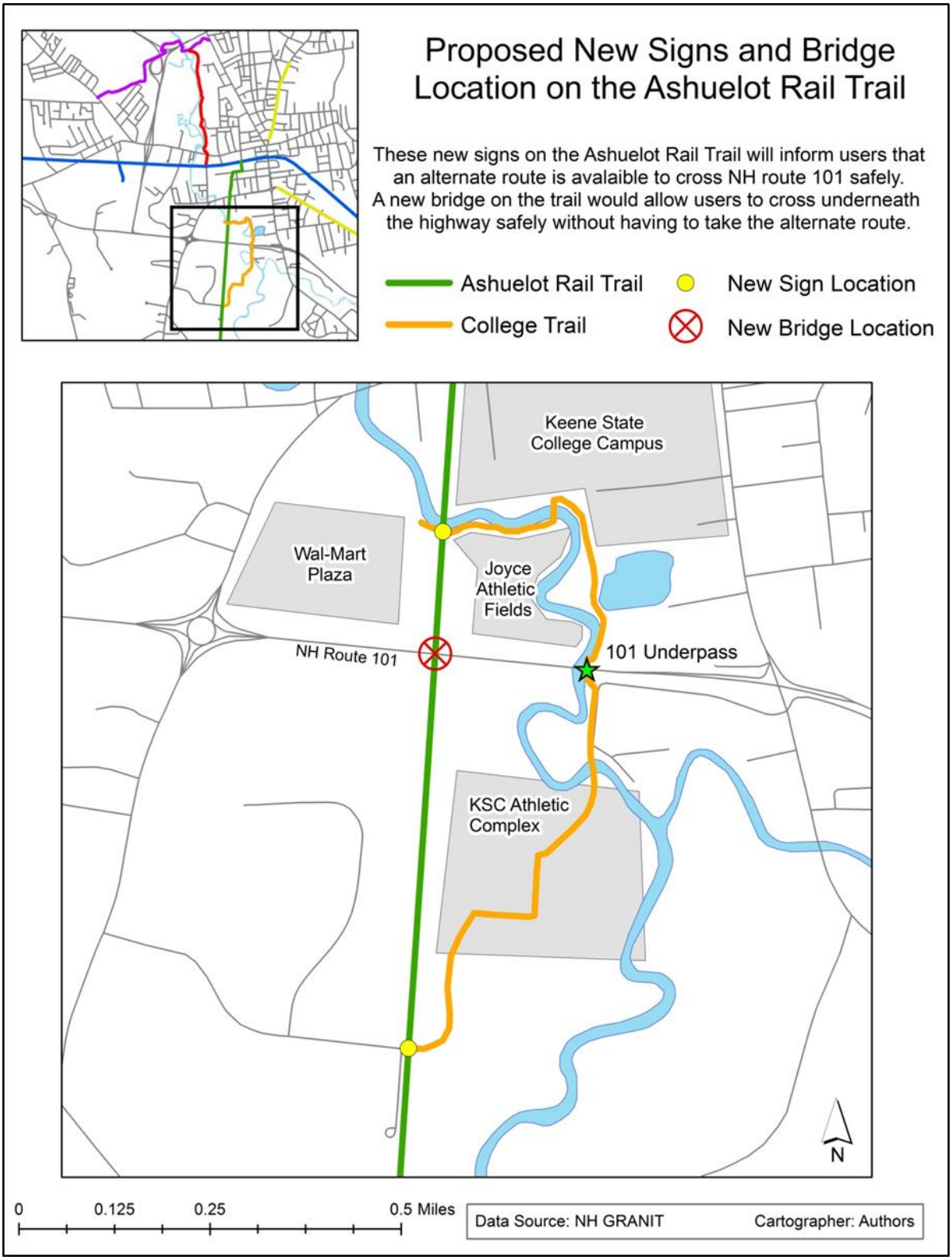


Figure 21: *Map of proposed new signs and bridge location*

Leaving flyers at grocery stores and shopping centers informing people that errand cycling is a plausible way of shopping could help spread the idea.

Path Maintenance

Many of the bike paths have experienced wear and tear and could use repair. Some trails need much more attention than others. Leaving the paths in their current conditions will only cause more problems in the future. Holes will get bigger and muddy areas will likely get worse, so repairing them as soon as possible is a priority. While some areas, like the eastern end of the Appel Way Trail will need more extensive work, others like the Ashuelot Rail Trail only need quick fixes, such as filling in potholes. Although it will take some time to do, repairing the path will help create a smoother ride for cyclists who will no longer need to dodge surface hazards.

The bridge at the end the southern end of the Ashuelot Rail Trail should be completely reconstructed due to its terrible condition. This bridge is not safe and the longer it remains, the more hazardous it becomes. The bridge is slowly rotting and floorboards are beginning to fall through, which creates an unsafe environment for both cyclists and people on foot (Figure 22).

Other serious trail issues that need to be resolved are the missing fences prevalent along many of the paths. There is a missing fence on the Appel Way Trail parallel to the Ashuelot River underneath the Route 9 bridge (Figure 23). If a cyclist loses control of their bike descending from the slight hill, they could end up crashing into the rocky outcrop and end up in the river instead of being caught by the fence. Overall, the paths need at least minor maintenance so they will be safe for users. Having quality paths is essential to having a bike path system that flourishes and keeps the users coming back.

Figure 22: *Bridge on the Ashuelot Rail Trail*

Figure 23: *Missing fence on the Appel Way Trail*

Student Conclusions

Our results showed that 84 percent of students surveyed thought that a map of the bike paths should be provided at freshman orientation while only 16 percent said no or they do not care. This shows that students are interested in the bike paths and would like this map so they can start using the paths during their freshman year. This would allow them to become familiar with landmarks in Keene. Underclassmen only knew an average of 2.125 out of 5 locations on the survey. This shows that underclassmen are not as familiar with the city as they could be. We have created a proposed brochure to send out to students during orientation week in August of each year (Figure 24). We will present this brochure to the orientation leaders of Keene State College for approval along with the Keene Recreational Department for additional changes and ideas.

Figure 24: *Proposed brochure of bike information in Keene*

Welcome to Keene, New Hampshire

The City of Keene provides citizens with over 22 miles of diverse pathways offering an opportunity to escape everyday life and experience the scenery of rural New England. Given this possibility of an alternative mode of transportation, you are also connected to businesses, residential areas, along with parks and Athletic Fields. Keene's Park and Recreational Department maintain approximately 2,000 acres of recreational land for the public to enjoy.

IF THERE IS AN ACCIDENT!
If a motorist is involved please contact the Keene Police Department at (603) 357-9813

UNSAFE PATH CONDITIONS?
Please Contact the Keene Parks and Recreational Department at (603) 357-9829

Cycling Associations

Monadnock Cycling Club
http://www.monadnockcycling.org/

New England Mountain Bike Association
http://www.nemba.org/

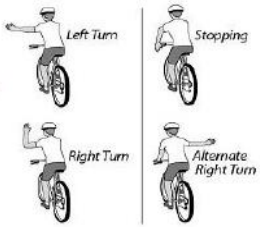
Pathways For Keene
http://www.tlaorg.org/pathways/pathmap.html

Tips for Safe Bicycling

STAY ALERT! Remember drivers or pedestrians may not see you

*

Always use hand signals when stopping or turning



Be aware of surrounding traffic

*

When riding with others, ride single file

*

Ride with the flow of traffic and obey traffic signs and lights

*

Traffic signs, signals and pavement markings apply to bicyclists as well.

*

Wear bright colored clothing so others can see you

*

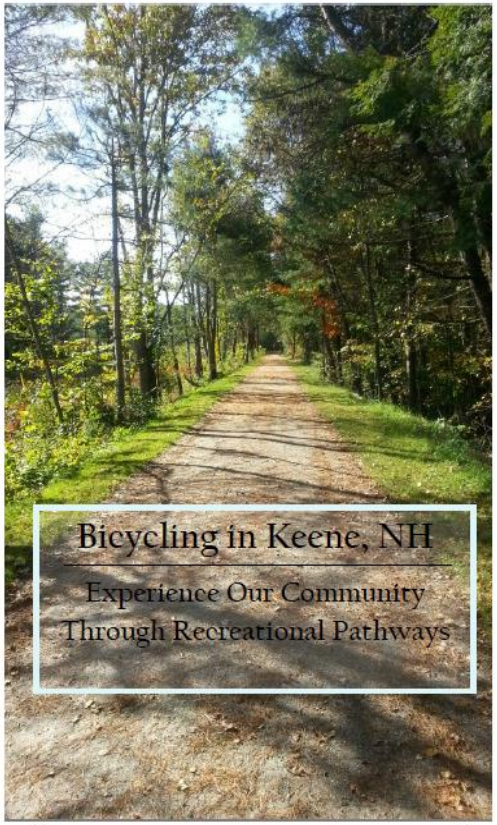
When riding at night use lights and reflectors to make yourself more visible

*

Bicyclists should always wear a helmet, especially cyclists under the age of 16

*

Be safe, Be considerate, Be aware



Bicycling in Keene, NH

Experience Our Community Through Recreational Pathways

Prepared by:

Keene State College
Geography Department

Senior Seminar Bike Path Assessment Group 2014

B. Cote, M. Harpool, C. Hoke, B. Jones, A. Martelle

Keene STATE COLLEGE

Personal Safety

Safety on the bike paths is important. Since women do not feel as safe on the bike paths as men it is important to make them feel safe. 72 percent of people surveyed did not feel that the bike paths were sufficiently lighted. Incorporating lights in some of the more heavily trafficked sections of the paths could make people feel safer and increase the use of the paths. Replacing missing fences is also important to personal safety. Having the fences in particular areas makes it more difficult for criminals to hide and take cover. Providing citizens with information on safe use of the bike paths would also be beneficial. Informing people about proper preparation for a bike ride, such as carrying whistles, flashlights, and pepper spray will improve awareness of potential dangers and provide a way to avert them.

Overall, the paths are an important part of the city of Keene and their value will only grow in the future. Promoting the use of the paths for exercise, commuting, and shopping should be a high priority for Keene as part of their Vision 2020 goals. Creating a safe environment by maintaining the paths and setting up lights in certain areas will help. While the paths are of high quality and are vital to the city, work still needs to be done so Keene can become better known for its healthy and innovative way of life.

Conclusion

With Keene's population of young adults and a relatively flat terrain, this is a perfect combination for alternative modes of transportation. Benefits may include the reduction of air and noise pollution along with reduced traffic congestion and motor vehicle accidents. There are also health benefits which include decreased chances of diabetes, heart disease and other life altering diseases. In order to have a successful biking system, infrastructure is important.

Two ways of adapting a city's infrastructure are to replace motor vehicle lanes and on road parking with bike lanes and to convert abandoned rail lines into rail trails.

This project used five methods for data collection. These methods included: distribution of student and community surveys, bike counter data received from the SWRPC, conducting our own visual counts, and physically assessing each individual path using GPS receivers. From our student results, we created a brochure that will benefit incoming freshman on the knowledge of Keene's bike paths. This brochure consists of: tips for safe cycling, a small overview of the city of Keene, contact information for any possible issues, along with different cycling associations.

Our visual counting proved to be a viable method of data collection because it compared well with the data received from the bike counters. The bike counter data proved to be vital in determining the amount of use for each path however, it might have been more beneficial to do this during the peak riding season in the summer. We found that building the North Bridge proved to be useful in the respect that it received a large amount of use. This supports the city's case to build a bridge over Route 101 on the Ashuelot Rail Trail. While the bike paths are in good condition, there is always room for improvement in order to provide a safe environment for users.

References

Arvidson, A. 2008. Pedal Pushers. *Planning* 74(3):6-12.

Badger, E. 2012. *Dedicated Bike Lanes Can Cup Cycling Injuries in Half.* http://www.theatlanticcities.com/commute/2012/10/dedicated-bike-lanes-can-cut-cycling-injuries-half/3654/ (last accessed 20 October 2013).

Centers for Disease Control and Prevention. 2013. Prevalence of Obesity Among Adults: United States 2011-2012. http://www.cdc.gov/nchs/data/databriefs/db131.htm (last accessed 2 November 2013).

Center for Sustainability. 2013. Alternative Transportation. http://www.centerforsustainability.org/resources.php?root=10&category=246 (last accessed 2 November 2013).

City of Keene New Hampshire. 2013. Cities for Climate Protection Committee. http://www.ci.keene.nh.us/government/boards-commissions/cities-climate-protect (last accessed 6 November 2013).

City of Keene New Hampshire. 2013. Keene Green Team. http://www.ci.keene.nh.us/sustainability/keene-green-team (last accessed 6 November 2013).

Duane, D. 2013. *Is it O.K. to Kill Cyclists?* http://www.nytimes.com/2013/11/10/opinion/sunday/is-it-ok-to-kill-cyclists.html?pagewanted=1&_r=0&adxnnlx=1384538990-Pkn2/66qgOno0082GSq4pA (last accessed 15 November 2013).

Fogel, W. 1964. *Railroads and American Economic Growth*. Baltimore: The John Hopkins Press.

Forsyth, A. K, Kevin. 2001. Urban Design: Is there a distinctive view from the bicycle? *Journal of Urban Design* 16 (4): 531-549.

Harney, J. 2009. Green Days on Campus. *The New England Journal of Higher Education* 23 (3):7.

International Mountain Bicycling Association. 2001. *Building Better Trails: Designing, Constructing, and Maintaining Outstanding Trails*. Boulder, CO: International Mountain Bicycling Association.

Maibach, W. Edward. 2003. Recreating Communities to Support Active Living: A New Role for Social Marketing. *The Science of Health Promotion.* 18(1): 114-119.

Marion, J., and Leung, Y. 2001. Trail resource impacts and an examination of alternative assessment techniques. *Journal of Park and Recreation Administration* 19(1).

Monadnock Region Transportation Management Association. 2013. MRTMA. http://www.monadnocktma.org/about (last accessed 6 November 2013).

Monadnock Region Transportation Management Association. 2013. Roundhouse-T Project. http://www.tlaorg.org/pathways/roundhouset.html (last accessed 6 November 2013).

Moses, S. 2010. *Carrying Your Stuff: Bicycle Bags and Racks.* http://www.utilitycycling.org/2010/04/ carrying-your-stuff-bicycle- bags-and-racks/ (last accessed 20 November 2013).

Naber, David M. 2008. *Integrating Trail Condition Assessment with Recreation Demand Modeling of Mountain Bikers in the Research Triangle, North Carolina.* Ann Arbor, MI: ProQuest LLC.

National Highway Traffic Safety Administration. 2011. http://www-fars.nhtsa.dot.gov/People/PeopleAllVictims.aspx (last accessed 13 September2013).

Penna, C. 1995. *Great Rail-Trail of the Northeast*. Florence: New England Cartographics.

Rails to Trails Conservancy. 2013. History of the Rail-Trail Movement. http://www.railstotrails.org/ourWork/trailBasics/railTrailHistory.html (last accessed 2 November 2013).

Rosenthal, E. 2011. *On, Biking, Why Can't the US Learn Lessons from Europe?* http://e360.yale.edu/feature/on_biking_why_cant_the_us_learn_lessons_from_europe/2425/ (last accessed 2 November 2013).

Salter, D. 2011. As The World Warms. *Sierra Club* 96 (6): 24-25.

Schneider, T. 2000. Bike Path Phobia: Selling Skeptic Greenway Bike Path Safety. *Parks and Recreation* 35 (8): 62-70.

Shinbein, P., and A, Jeffery. (). Land use and Rail Transit. *Transportation Quartely* 49 (3): 83-92.

Tilahun, N. Y., Levinson D. M., and Krizek, K. J. Trails, lanes, or traffic: Valuing bicycle facilities with an adaptive stated preference survey. Transportation *Research Part A: Policy and Practice* 41.

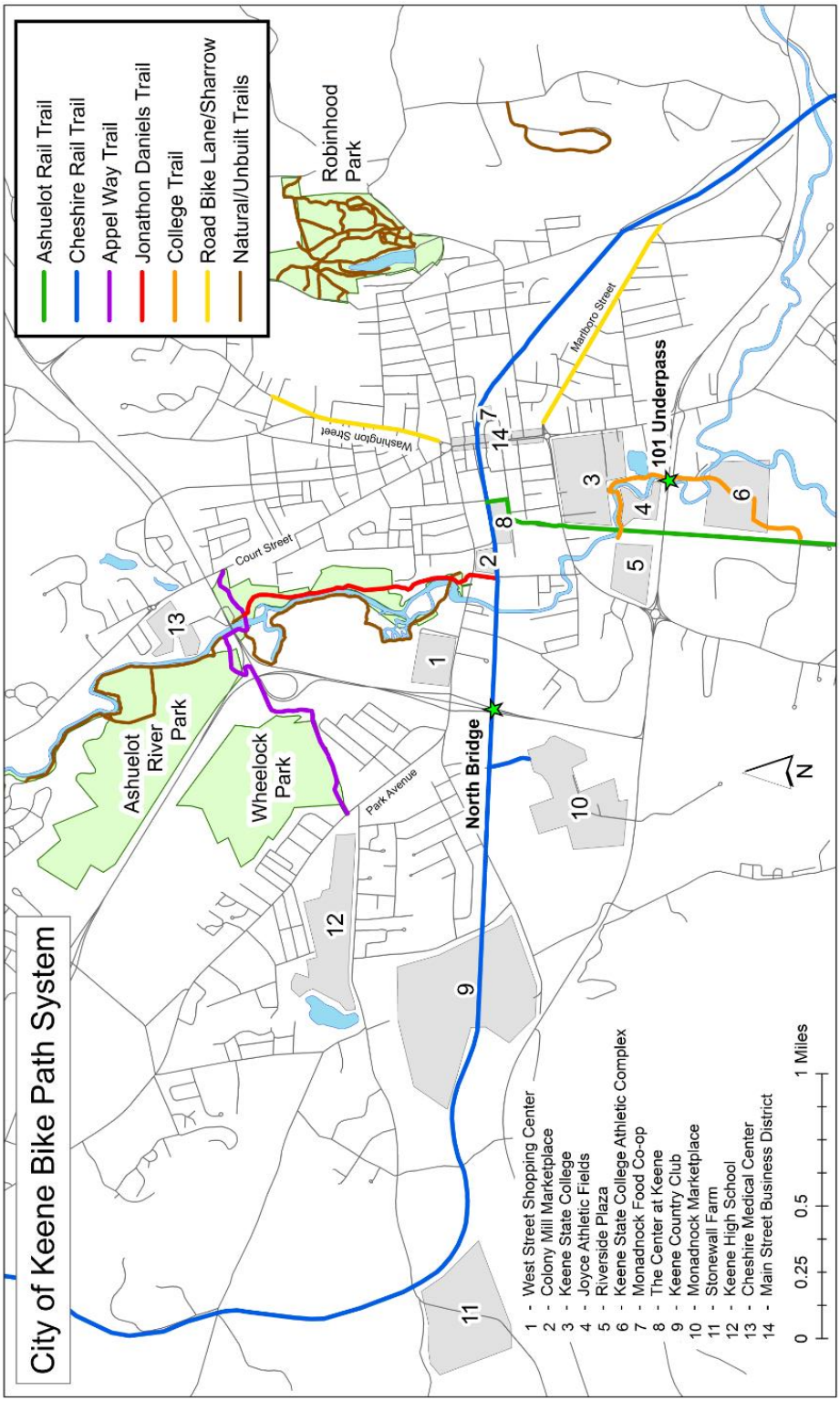
Thom Little Associates, Ltd. 2013. Pathways for Keene. http://www.tlaorg.org/pathways/pfknow.html (last accessed 6 November 2013).

Union of Concerned Scientists. 2013. Cars, Trucks, and Air Pollution. http://www.ucsusa.org/clean_vehicles/why-clean-cars/air-pollution-and-health/cars-trucks-air-pollution.html (last accessed 2 November 2013).

US Census Bureau. 2013. American Fact Finder. http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml (last accessed 19 November 2013).

Appendix A: Map

Map of the bike paths in Keene, NH

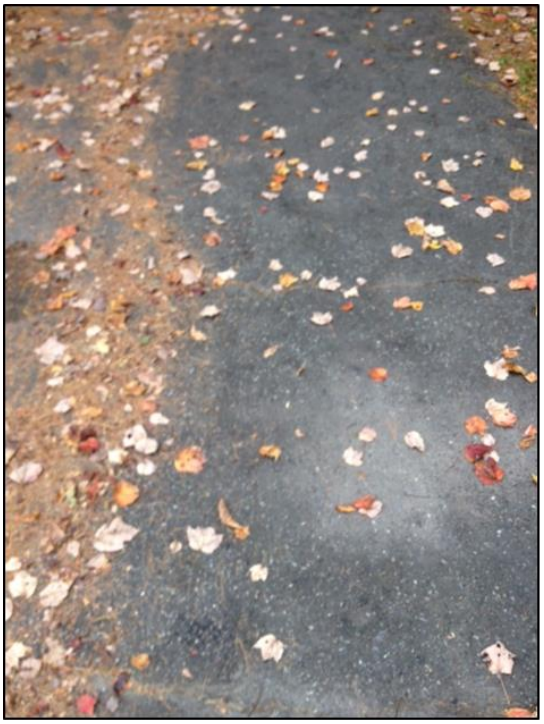


Appendix B: Pictures of the Bike Paths

Appel Way Trail

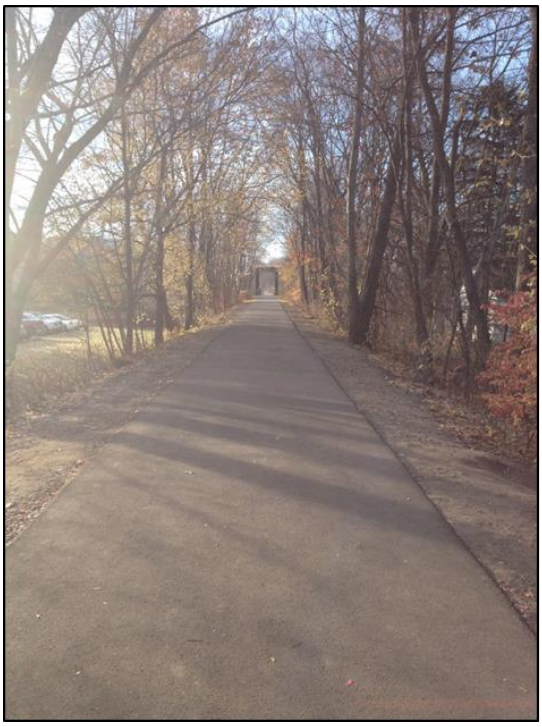
This path is paved with asphalt for its entire length, but in some places it is in very poor shape. The following pictures will depict the quality of the path.

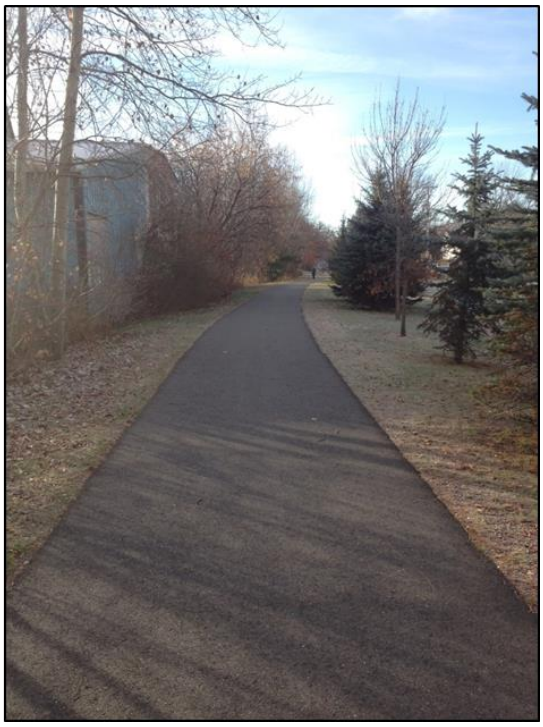

APPEL
WAY
TRAIL
www.ci.keene.nh.us/pathways
Call 603-357-9829
Report Trail Issues

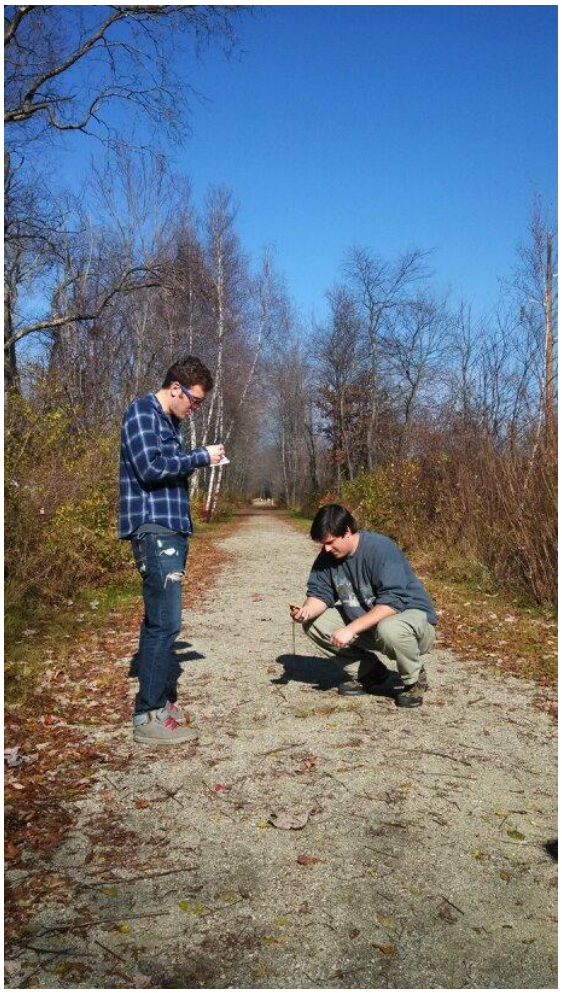


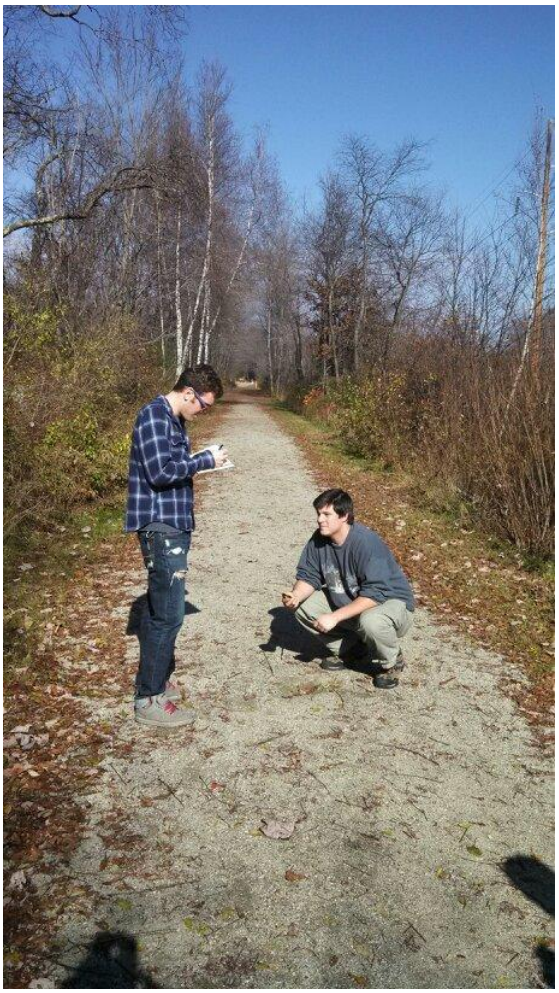
Ashuelot Rail Trail

This path is in good condition in the area North of 101 however poor condition on the Southern portion. The following pictures will depict the quality of the path.



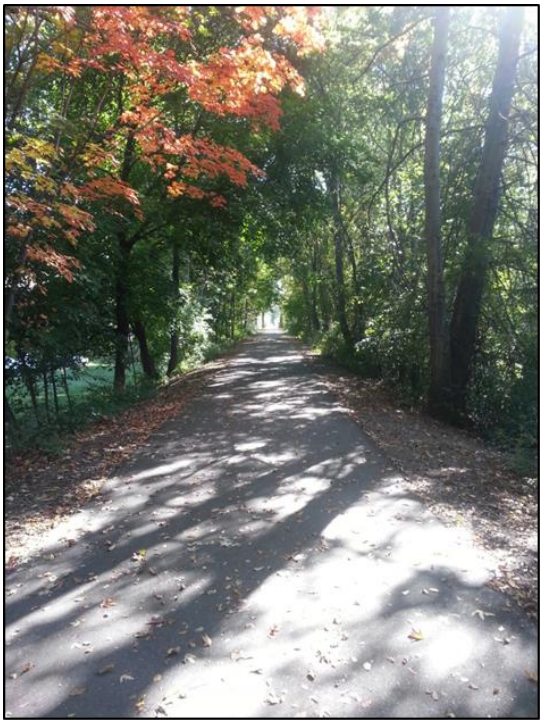


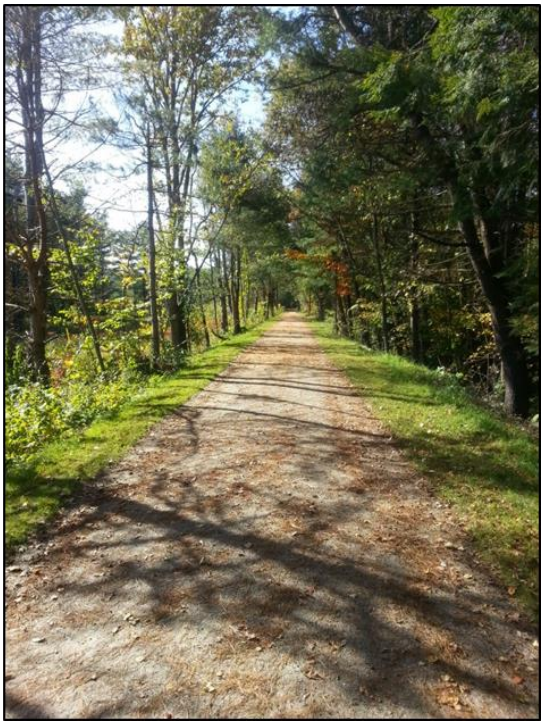


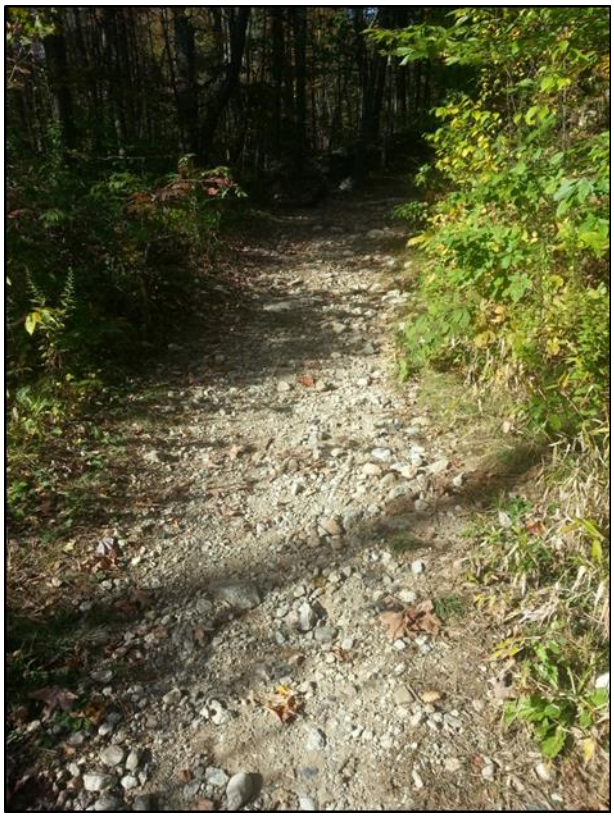


Cheshire Rail Trail

This path is in the best condition. The only part of the path that is in poor condition is by stonewall farm, but that of the path it used for mountain bikers. The following pictures will depict the quality of the path.

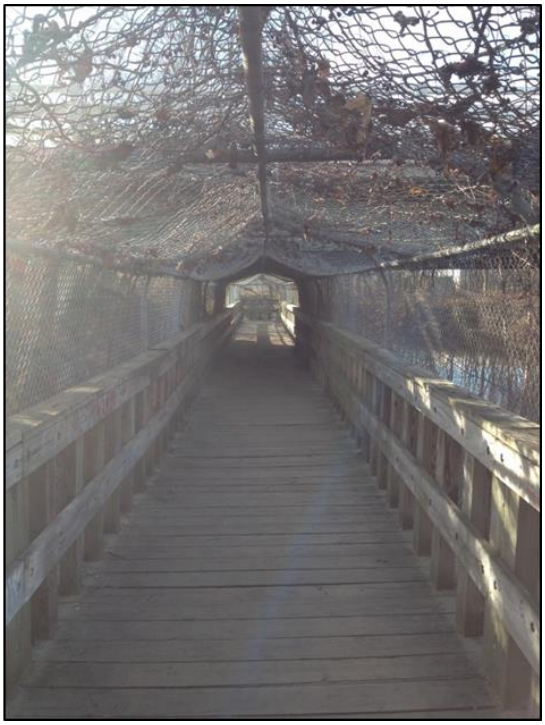






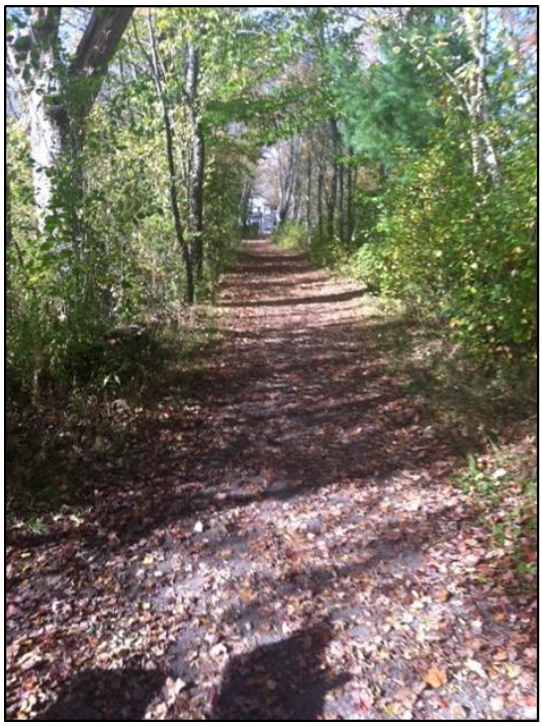
College Trail

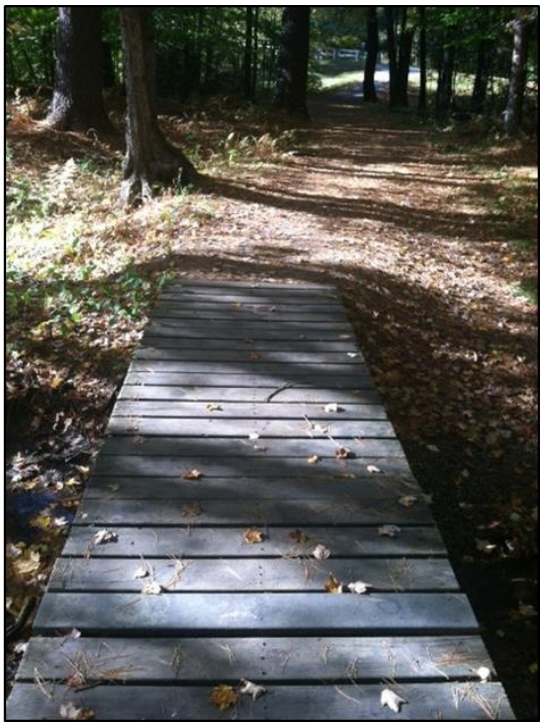
The college path itself is in good condition, it is just the bridge that is in bad condition. The bridge goes underneath Route 101. The following pictures will depict the path.



Jonathon Daniels Trail

This path is in the worst condition of all the paths. Most of it is not a hard surface so it gets muddy very easily and hard to bike or walk through. Also, the part of the path that does have hard surface is cracked and covered in pot holes. The following pictures will depict the path.





Appendix C: Surveys

Keene's Bike Path Assessment: Student Population Survey

This survey was constructed to gather data on the use of the Keene Bike Paths.

1. What year are you?

☐ Freshman ☐ Sophomore ☐ Junior ☐ Senior

2. Do you have a bike on campus?

☐ Yes ☐ No

3. How do you get to campus? Please check all that apply:

☐ Live on campus ☐ Bike ☐ Walk ☐ Public Transit ☐ Car

4. Have you seen a map of the Bike Paths in Keene?

☐ Yes ☐ No

5. Do you know where you can find a map?

☐ Yes ☐ No

6. Have you used any of the Bike Paths in Keene; if so how?

☐ No ☐ Walking ☐ Biking ☐ Running/Jogging

7. How often do you use the Bike Paths?

☐ Daily ☐ 3+ times a week ☐ 1-2 times a week ☐ Few times a week ☐ Never

9. Are you familiar with the location of any of these places in Keene?

☐ Ashuelot River Park ☐ Wheelock Park ☐ Colony Mill ☐ KSC Athletic Complex ☐ Hannaford Plaza

10. Are you familiar with the green bike program at KSC in which you can rent bikes from the Mason Library?

☐ Yes ☐ No

11. If yes, have you ever rented a bike from the Mason Library?

☐ Yes ☐ No

12. Do you think a map of the Bike Paths and parks in Keene should be provided at freshman orientation?

☐	☐	☐
Yes	No	Do not care

13. Why do you use the Bike Paths? Please list:

Keene's Bike Path Assessment: General Population Survey

This survey was constructed to gather data on the views of the Keene Bike Paths in order to assess their quality, safety, and overall usage.

☐ Male ☐ Female

Age group

☐ Under 18 ☐ 18-25 ☐ 25-40 ☐ 40-60 ☐ 60+

1. Do you use Keene's Bike Paths? (includes trails and road lanes)

☐ Yes ☐ No

If NO, please skip to question 15

If YES, please answer all questions except 15-16

2. What paths do you use the most? Please check all that apply

☐ Cheshire Rail Trail ☐ Ashuelot Rail Trail ☐ Ashuelot River Trail ☐ Appel Way Trail ☐ Road Lanes ☐ College Trail

3. What activity do you do the most on the paths?

☐ Walk ☐ Bike ☐ Run/jog ☐ Other

4. For what reason do you use the paths? Please check all that apply

☐ Commute for work ☐ Errand Biking ☐ Exercise ☐ Recreation

5. Do you feel safe while using the paths?

☐ Never ☐ Rarely ☐ Sometimes ☐ Most of the time ☐ Always

6. Do you feel safe riding your bike on main roads in Keene?

☐ Never ☐ Rarely ☐ Sometimes ☐ Most of the time ☐ Always

7. Do you feel safe crossing the roads in Keene?

☐ Never ☐ Rarely ☐ Sometimes ☐ Most of the time ☐ Always

---

8. How would you rate the general surface conditions of the paths you use?

☐	☐	☐	☐	☐
Poor	Fair	Good	Very Good	Excellent

9. Do you know where you could find a map of the Bike Paths?

☐	☐
Yes	No

10. How clear are the Bike Path signs that designate the different paths?

☐	☐	☐	☐	☐
Poor	Fair	Good	Very Good	Excellent

11. Please rate your overall satisfaction with the Bike Paths:

☐	☐	☐	☐	☐
Not at all satisfied	Somewhat satisfied	Satisfied	Very satisfied	Extremely satisfied

12. Are the paths that you typically use well lit at night?

☐	☐	☐
Yes	No	Unknown

13. How far do you live from the entrance to a Bike Path?

☐	☐	☐	☐
Within ½ mile	Within 1 mile	Greater than 1 mile	Unknown

14. Any suggested improvements? Please list:

If you answered <u>NO</u> to question 1 please continue here

15. How far do you live from the entrance to a Bike Path?

☐	☐	☐	☐
Within ½ mile	Within 1 mile	Greater than 1 mile	Unknown

16. Why do you not use the Bike Paths? Please check all that apply:

☐	☐	☐	☐
Did not know they exist	Do not know where they are	Do not bike or walk often	Do not feel they are safe

Appendix D: Path System Safety Checklist

City of Keene
Path System Safety Checklist

____ **Vegetation clearing and management:** overhanging limbs and weedy growth obstruct views, "widow-makers" in trees, poisonous vegetation near trail, debris on trail surface.

____ **Streams:** stream banks near trail eroding, drainage pipes clogged with debris cause stream overwash - leave standing water and mud on trail, water quality of stream is substandard.

____ **Roadway Crossings:** sight lines for motorists and path users obstructed, caution signs not located on trail and roadway, pavement markings for crossing inadequate.

____ **Trail Tread Surfaces:** hard surfaced pavement cracked and uneven, soft surface tread rutted, weedy vegetation encroaching into tread, standing water and mud in tread.

____ **Trail Bridges:** hand rails loose, bridge decking warped, loose or missing, bridge footings, exposed from erosion, rotting structural timbers, approach rails missing.

____ **Roadway Overpasses/Underpasses:** tread surface wet or full of litter and debris, lighting systems inoperable, light bulbs burned out, fencing inadequate to protect users.

____ **Safety Railings:** not located in areas of need, post and footings loose, handrails missing, rotting timbers, corroded steel, not long enough, not high enough for all users.

____ **Boardwalks:** rotting timber, handrails missing, bench seating vandalized, post and footings loose or sinking, decking warped, loose or missing.

____ **Signage Systems:** regulatory and warning signs missing or improperly located, information signs vandalized or missing, sign posts corroded or rotting, signs vandalized.

____ **Public Parking:** pavement surface littered with broken glass and debris, parking spaces not defined, handicap spaces not provided, trailer parking not provided, entry drive has poor site lines, vegetation obscures trail head.