Redesigning Lincoln Street: Improving Safety, Aesthetics, and Access to Public Transportation

A Major Qualifying Project Proposal
of the A/B Term 2019 site in Worcester, MA,
submitted to the faculty of

WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the

Degree of Bachelor of Science

by:

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Abstract

This project, on behalf of the Green Hill Neighborhood Association, aimed to redesign the Lincoln Street Corridor in Worcester, MA with the goal of improving safety, accessibility, and appearance. Existing conditions of the corridor were documented with layouts of the street, crash data, and transit usage. Potential designs were identified, cost estimated, and evaluated on effectiveness with input from the GHNA. Final recommendations included: best designs of the corridor, cost estimates, prioritization of countermeasures and improvements, and potential funding sources.

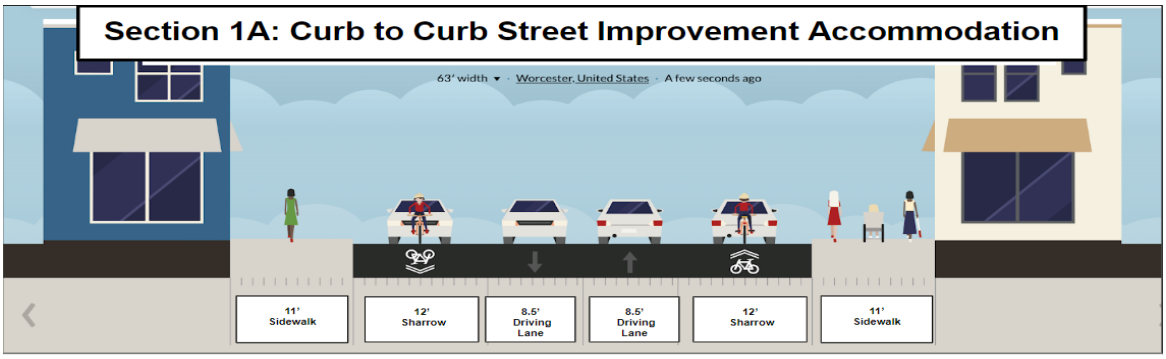
Executive Summary

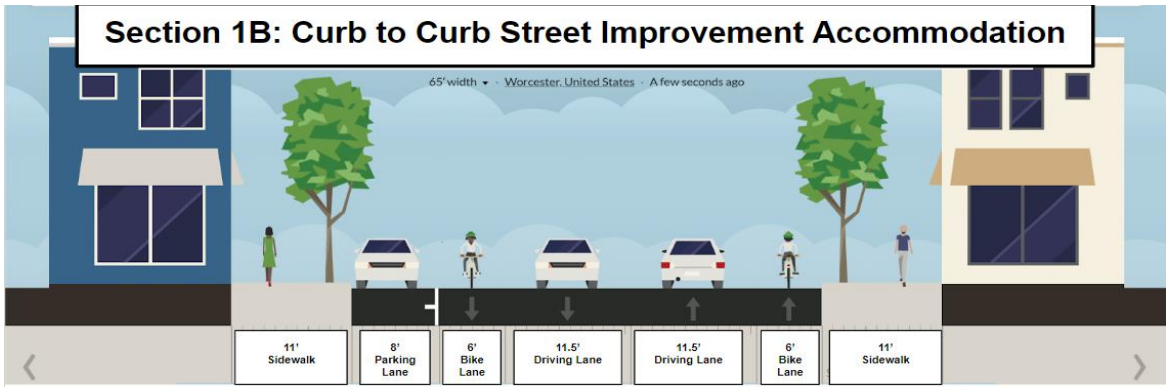
Lincoln Street is a heavily trafficked through-street located in Worcester, MA. The corridor is designed primarily for vehicular traffic, but contains businesses and residences that are destinations for people traveling through the corridor on foot or by bicycle. Since businesses and residences are in close proximity, it allows for people to walk, bike, or take public transit, rather than drive a personal vehicle. The Green Hill Neighborhood Association, in which Lincoln Street is located, has identified Lincoln Street as a corridor in need of many improvements. This project focuses on a section of Lincoln Street from the intersection of Catharine Street to Brittan Square that includes a signalized intersection, two travel lanes, on-street parking, and minimal pedestrian and bicycle accommodations.

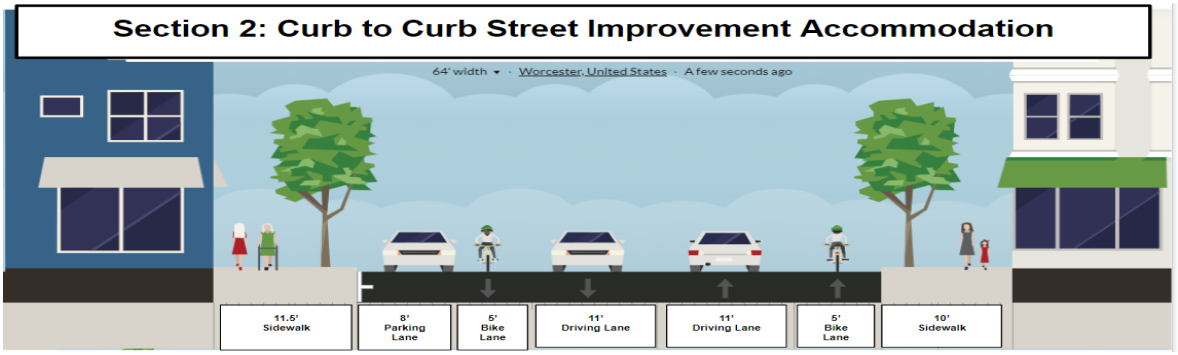
The goal of this Major Qualifying Project (MQP) was to prepare a design to reimagine Lincoln Street for The Green Hill Neighborhood. This team evaluated existing safety and efficiency data along with site conditions to determine potential countermeasures and improvements for the project section. Crash data was obtained from the Massachusetts Department of Transportation (MassDOT) to identify dangerous sections of the street. Based on the existing conditions and the obtained data, countermeasures and improvements for different sections of the corridor were identified and prioritized.

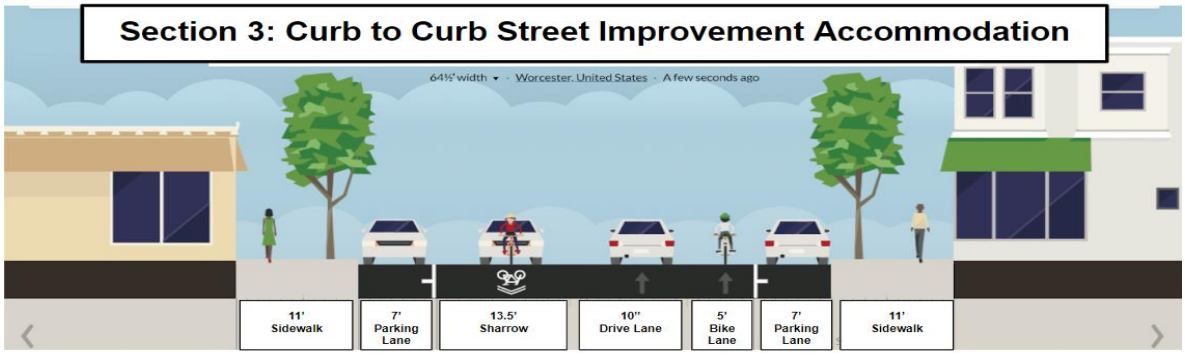
The solutions determined in this project followed the guidelines set forth by the Massachusetts Department of Transportation and the City of Worcester. Local, state, and federal funding can be requested in the future to complete the project. For this reason, a cost estimate and implementation plan were developed to aid in securing possible funding in the future. Deliverables for Curb to Curb street designs, which can be seen on the next page, were presented through the software Streetmix. This set of Curb to Curb designs were chosen from a group of

other designs which can be viewed in our Preliminary Designs. The cost estimate for the Curb to Curb designs were configured by using MassDOT's weighted bid prices project builder application with a 20% contingency added by our team.









Proposed Curb to Curb Street Improvements for Different Sections of Lincoln Street

Acknowledgements

Our team would like to thank all of the parties that made this project possible. The project would not have been possible without the support of resources and opportunities by Worcester Polytechnic Institute (WPI) and the Green Hill Neighborhood Association (GHNA). We would first like to thank our advisors on this project, Professor Suzanne LePage and Professor Michael Elmes, who offered continual support, guidance, and feedback throughout the course of our project. We would also like to thank some of the key individuals who served as our sponsors from the Green Hill Neighborhood Association. These individuals include Debra Bolz of the GHNA and Yahaira Graxirena a member of the GHNA and the Central Massachusetts Regional Planning Commission. Additionally, we would like to thank the members of the Lincoln Street community for providing insightful feedback throughout the course of the project.

Authorship

This MQP report was completed through the joint effort of each team member. Each team member was responsible for writing and editing the paper as a whole, as well as occasionally writing independently. Team member William Mitchell was primarily responsible for analyzing cost and creating the data tables. Michael Montano wrote about the existing conditions as well as created the preliminary designs through the Streetmix Software. Brendan Chipman was responsible for writing about project funding and analyzing crash data from the MassDOT and the CMRPC. Stephen Lauro wrote about the neighborhood characteristics and the non-safety issues along the Lincoln Street Corridor.

Capstone Design Statement

This project focused on the Lincoln Street corridor between the intersection of I-290 and the intersection of Brittan Square in Worcester, Massachusetts. This team redesigned this corridor of Lincoln Street, thereby satisfying the needs of the Green Hill Neighborhood Association, as well as the requirement of students completing a Major Qualify Project (MQP) with a capstone design element prior to graduation. These requirements are set forth by Worcester Polytechnic Institute (WPI) to fulfill the criteria for Accrediting Engineering Programs by the Accreditation Board for Engineering and Technology (ABET). The following factors and constraints were used to fulfill these requirements.

Economic:

While choosing designs for Lincoln Street, cost was one factor that our team analyzed in order to determine the most feasible designs. A grant was awarded to the Green Hill Neighborhood Association (GHNA) to fund a study to assist in identifying solutions for the corridor as well as being able to lay down the foundations for the Green Hill community's first transportation plan. During the study, the MQP team developed designs to improve Lincoln Street. A cost-estimate was then completed to help differentiate the economic factors that constrained or influenced each design.

An implementation process was created by the team for the Green Hill Neighborhood Association. The team identified funding options to assist in the implementation of designs and suggested improvements. These funding options will enable an efficient transition from the team's final recommendations to implementing the designs and suggestions for the corridor.

Environmental:

Our designs will have an impact on the environment through the addition of shrubs, flowers, and trees, as well as a better means of waste disposal in the forms of recycling and trash bins. Part of our project focused on designing the corridor of Lincoln Street to provide a more aesthetic look which will provide a more prominent cultural identity to the neighborhood. Since there are sections of the corridor that possess overgrown vegetation and limit the sight of walkers, drivers, and bikers, our design aims to reduce this overgrowth and increase visibility along with sidewalk accessibility throughout the corridor.

Ethical:

This project abides by the ASCE Code of Ethics for all Civil Engineers.

Social and Political:

The team became familiar with regulations and community objectives at the city and state level. We focused on following city and state regulations while also taking the wants, needs, and other recommendations of the Green Hill Neighborhood into consideration. Our involvement with the Green Hill Neighborhood Association influenced our designs based upon what they wanted to see fixed or added to the corridor. The final recommendations comply with such regulations and the needs of the stakeholders and Green Hill Neighborhood Association. The team addressed the needs of Lincoln Street users by promoting the safe and efficient utilization of Lincoln Street by all modes of transportation regardless of their socio-economic status.

Sustainability:

In order for our design to be successful, it must be one that offers a sustainable long-term solution. Long-term improvement concepts were presented by this team with the goal of addressing present and future needs for the corridor. The final design and recommendations

account for alternative modes of traffic to the street as well as future implementation plans and costs. The implementation of these designs and recommendations will ensure efficient use of this section of Lincoln Street for all modes of traffic for years to come.

Health and Safety:

This project addressed safety concerns by focusing on the improvement of sections of Lincoln Street with high crash rates and poor design. Countermeasures are ranked with safety being the main concern to improve within the corridor. Factors to focus on to make the street safer for travel included narrowing driving lanes, creating bike lanes, and proposing that more speed limit signs be installed along the corridor.

Professional Licensure Statement

A professional engineer must, “Hold paramount the safety, health, and welfare of the public,” in all cases where they may be affected by any engineering project (National Society of Professional Engineers, 2017). Before acquiring such responsibility through licensure, an engineer must undergo rigorous training in their respective fields. To become a licensed engineer, one must first graduate from a university that is accredited by the state licensing board in the state where an engineer is seeking licensure. When a studying engineer is within one semester of graduating, they may pursue an Engineer-in Training (EIT) certification. In order to receive this license, a studying engineer must pass the Fundamentals of Engineering Exam (FE), which is administered by the National Council of Examiners for Engineering and Surveying (NCEES) and tests basic engineering knowledge. The second and final exam required to receive a professional engineering license is the Principles and Practice of Engineering Exam (PE). Each state licensing board administers their own PE, therefore, each state differs slightly in terms of required knowledge and experience. However, each state requires that, after successfully completing the FE, an Engineer-in-Training must complete four years of professional experience in their respective field under a licensed engineer. (National Society of Professional Engineers, 2017).

When an engineer passes their PE Exam and becomes licensed, they are able to take on new responsibilities within the workplace, such as reviewing drawings and designs for approval. In order to maintain the professional engineering license, an engineer is responsible for engaging in opportunities for professional development through continued education courses or other opportunities for professional development in their respective field (National Society of

Professional Engineers, 2017). Through the completion of this project, our team was able to learn valuable skills relating to teamwork and professional practice as entry-level engineers.

Table of Contents

List of Tables

List of Figures

1.0 Introduction

Lincoln Street is a heavily trafficked road located in Worcester, MA. Comprised of two lanes of two-way traffic and a stop light, the corridor is designed with preference to vehicle traffic with sidewalks on both sides, bus stops, parking, and small shops. The street is also lined with apartments and many streets that lead into the corridor filled with apartments and houses. The high population density that surrounds the corridor results in it being utilized by a diverse group of users including vehicle drivers, bicyclists, public transit commuters, and walkers. The current conditions of the Lincoln Street Corridor suggest that the street is not reaching its full potential in safety and serving all of these populations that live in the Green Hill Neighborhood as well as those who pass through it on a daily basis. This is evident due to the high number of pedestrians, bicyclists, and vehicle crashes that have taken place in the last five years within the corridor along with the input from the Stakeholders of the Green Hill Neighborhood.

This project focused specifically on the section of Lincoln Street between the I-290 overpass and the intersection of Brittan Square, presented in Figure 1. In order to create a corridor with a more welcoming presence that would be less of a danger to its users, the team decided to focus on safety, accessibility, cost effectiveness, and appearance.

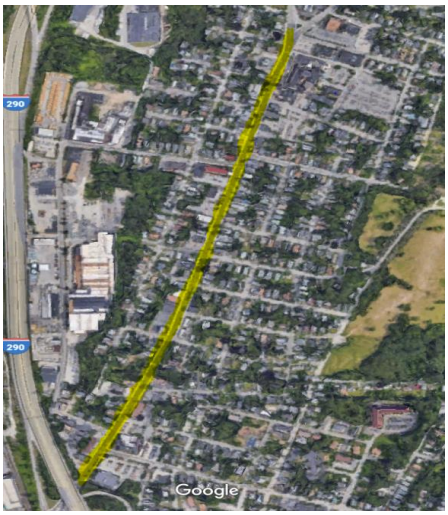


Figure 1: ***Lincoln Street Corridor***

Based upon our observations, the data suggests that there are numerous safety concerns for all of the users of the corridor. The lack of signage for pedestrian crosswalks creates a safety hazard for those who are trying to cross the street. The lack of signage accompanied with the poor lighting at night makes crossing the street for the people who travel through the corridor a very unsettling experience. A factor that ties into creating a dangerous crosswalk experience is the speed at which cars currently travel through the corridor. The corridor has wide street lanes which may give drivers a feeling that they have plenty of room in their driving lane, allowing them to travel well over the speed limit without feeling in danger. While they may not feel as though they are going too fast, the high speed promotes hazards for those who are parked along the corridor as well as those who are trying to cross.

With the help of our sponsors from the Green Hill Neighborhood Association, a local non-profit organization devoted to improving their community, we sought to improve upon the current safety and appearance issues of the corridor. In order to do so, the following list of objectives were identified including:

- Identify the Green Hill Neighborhood and the characteristics of the neighborhood involving the area that makes up the neighborhood, population, and demographics.
- Segment the corridor into three different sections to allow the MQP team to develop designs that could fit the needs of the different sections of the corridor.
- Analyze the existing conditions of the Lincoln Street Corridor by carrying out site visits, attending walk audits, gathering data, and receiving input from stakeholders via surveys and interviews.
- Create and analyze possible solutions to improve safety, traffic, and aesthetics of the corridor.
- Provide a cost-estimate for the possible solutions.
- Develop evaluation criteria to analyze options.
- Recommend a final design and provide an implementation process to the Green Hill Neighborhood Association.

2.0 Background

The purpose of this section is to provide an overview of the Lincoln Street corridor and the Green Hill Neighborhood that surrounds it. Worcester's Strategic Plan, The Green Hill Neighborhood Association, demographics of the Lincoln Street corridor, and street design concepts, which include crosswalk signage and design, lane and sidewalk widths, and other amenities will be discussed in the following sections of this chapter.

2.1 Worcester's Strategic Plan

Over the last few years the city of Worcester, Massachusetts has been working hard to rehabilitate certain sections of the city and to redefine its image by becoming a well-respected city known for its culture, food, and environment. Worcester is in the midst of its Strategic Plan, which includes a three to five-year period of "Inclusion, Integrity, and Innovation" (The City of Worcester, 2019). Within this plan, the city has focused on several objectives that they wish to implement within the city. A few of these objectives are "Vibrant, Thriving Cities" and "Strong Neighborhoods" that focus on not only building the City of Worcester's economic state, but also keeping the safety and well-being of its residents as the number one priority. Examples of areas in Worcester that have benefited from such rehabilitation include Shrewsbury Street and Main Street. Shrewsbury Street is now home to over 40 local eateries that have boosted the culture and economy within the city while Main Street resolved many traffic issues in addition to filling empty storefronts.

While the City of Worcester has been working to improve several neighborhoods and communities, there are still some neighborhoods with empty storefronts and unsafe infrastructure that would benefit from the city's attention and possible upgrade. Within the city of Worcester,

the Green Hill Neighborhood located within the Lincoln Street corridor is one of these communities that would benefit from such an upgrade.

2.2 The Green Hill Neighborhood Association

The Green Hill Neighborhood Association is a non-profit organization made up of community members, police officers, and shop owners who collaborate in hopes of improving their community. Founded in 2013 by Winifred "Winnie" Octave and Waldir Cruz, The Green Hill Neighborhood Association takes pride in its neighborhood, always trying to find ways in which they can better their community. A member of the Green Hill Neighborhood Association, Debra Bolz worked as a sponsor for this Major Qualifying Project (MQP), helping the project team focus on important issues of the Lincoln Street corridor. Every last Monday of the month, the association holds a meeting in which the residents of the community can gather and discuss topics that are on their mind (Green Hill Neighborhood Association, 2019). These meetings are a time when city officials, policemen, and residents are able to discuss issues or ideas for improvements within the neighborhood. Ideas that have been brought up by members of the association include improving pedestrian safety, managing parking issues, and improving the aesthetics of the corridor.

2.3 The Lincoln Street Corridor Demographic

Lincoln Street, located in the heart of Worcester Massachusetts, is home to a multitude of businesses and cultures. Also referred to as Route 70, it is comprised of mostly two lanes with a few turning lanes. Many different populations make up the 6,000 residents that call Lincoln Street home. Of the total population, 58% of residents would be classified as minorities in the

United States, while 22.8% live below the poverty level. Approximately 17% of the total population are limited English speaking households, displaying Lincoln Street's cultural diversity (Transportation of Massachusetts, 2019). The residents of these populations utilize cars, public transportation, bicycling, and walking in order to meet daily needs (Transportation of Massachusetts, 2019).

2.4 Street Design Concepts

The characteristics of a street help to create the identity of a given street corridor. They include the streets' safety features, dimensional layout, and provided amenities. With regard to the makeup of a corridor, there are several characteristics that contribute to the safety of both pedestrians and drivers. These characteristics can be broken into the subcategories of signage, crosswalks, lighting, lane dimensions, and sidewalk orientation. In the sections below we discuss the best practices involved in street design and how they impact the safety of all modes of transportation along a corridor.

2.4.1 Crosswalk Signage and Design

Safety features including signage, crosswalks, lighting, and lane dimensions are vital aspects used to make a street safer for all modes of transportation. Having plentiful and clear signage at crosswalks can greatly improve the safety of a street. Some of this signage can include speed limit signs that are clearly visible as well crosswalk signs (SRTS Guide, 2019). By providing speed limit signs leading up to a crosswalk and crosswalk signs that are clear for all users of a street to see, pedestrians can be directed to the preferred crossing areas of the street. Pedestrians will have more awareness of where the crosswalks are located within the street that they are traveling through. By making a street sign easily visible with the use of long-lasting

plastic or epoxy material with embedded reflective glass beads, users of a street are more likely to take note of the sign and abide by the rules of the displayed signage (SRTS Guide, 2019).

Along with the signage of crosswalks, the design of the crosswalk itself can help improve the safety for pedestrians and drivers. One strategy that is widely used across the United States is the use of daylighting a crosswalk. The purpose of "daylighting" is to clear the sight line between pedestrian crossings and vehicles that are oncoming (American Walks, 2019). Daylighting is usually done by creating no-parking zones at the curbs in front of crosswalks at that intersection. Daylighting a crosswalk helps to provide better visibility for both drivers and pedestrians by preventing parking from 20'-30' of the crosswalk (WalkBoston, 2019. This allows for the width of the crosswalk that a driver is able to see to increase significantly. The area of visibility for a crosswalk both before and after incorporating a daylighting effect can be seen below in Figure 2.

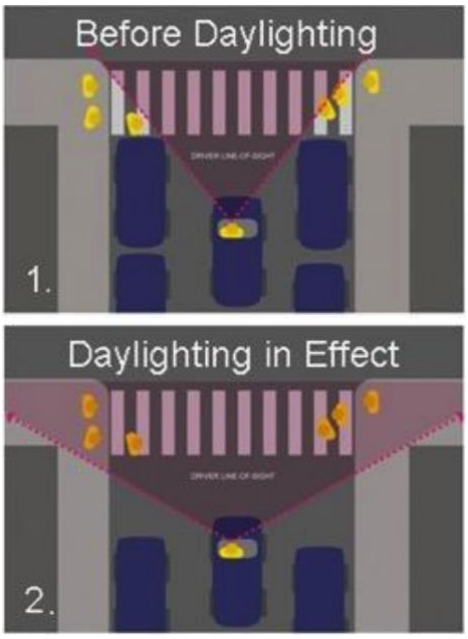


Figure 2: ***Daylighting Effect (WalkBoston, 2019)***

In addition to the daylighting effect, raising a crosswalk and painting it appropriately can also help to improve safety for pedestrians and drivers. By raising the crosswalk, a physical change in the roadway encourages drivers to be more aware of a crosswalk as well as slow down their speed, providing for a safer crossing experience for pedestrians (WalkBoston, 2019). The standard for painting a crosswalk onto the road is two parallel lines, as seen in Figure 3. By painting a ladder design on the crosswalk, as seen in Figure 4, the crosswalk is much more visible to the driver and is worth the extra cost of having to paint more.

Figure 3: ***Standard Striped Crosswalk***

Figure 4*: Striped Crosswalk*

With the increased visibility of the crosswalk for an approaching vehicle, drivers have been shown to improve their yielding behavior (NACTO, 2019).

2.4.2 Lane and Sidewalk Widths

The lane and sidewalk widths have a significant impact on improving the safety of a street. By reducing the widths of lanes, the speeds at which drivers travel will decrease. Based upon data provided by Walk Boston, narrowing down a travel lane from 11 feet to 10 feet reduces the speed of a driver by an average of 7 miles per hour (WalkBoston, 2019). Also, decreasing the lane widths provides more space within the road for bike lanes, bus lanes, and sidewalks. Due to the reallocated space, the condensing of a driving lane can also have an impact

on the safety of crosswalks. By decreasing the travel lane width, the crossing distance that a pedestrian has to travel is also decreased. This also provides larger waiting areas for pedestrians who are waiting to cross the street as well as a space to store snow so that the walking zone is completely clear for those traveling on foot (WalkBoston, 2019).

Another benefit of restructuring the widths of driving lanes is allowing for other travel lanes to be installed. Figure 5 shows a street design concept that includes a driving lane and bike lane going one direction. The other direction has a driving, bike, and parking lane. Not only will this reduce the speed of drivers, but it enables other forms of transportation to be utilized along a street (WalkBoston, 2019).

Figure 5: ***Example of Different Travel Lanes***

2.4.3 Other Amenities to Improve the Corridor

Various amenities such as lighting, vegetation, public seating, bike racks, and waste receptacles can play a significant role in creating an identity and developing a sense of space around a street. By strategically placing these amenities in different locations along the corridor, the street can improve in terms of both aesthetic appeal and safety (Yucel, 2012). Placing trash and recycling receptacles near benches, bus stop locations, and in front of business buildings are most efficient (Sidewalk Trash Cans, 2018). If these amenities are not placed in a strategic location, they can impede upon the safety of drivers by obstructing their view, along with putting pedestrians at risk by creating large crowds too close to the street. The quality of street furniture

and other amenities can vary significantly based upon the amount of money invested into each improvement. Therefore, it is of great importance to place the amenities in the location that best fits the street and creates the greatest value of usage.

In addition, adding better lighting will not only give cars better visibility of pedestrians, but according to a study conducted in New York City, increasing lighting can reduce crime at night by 39%. Furthermore, it was found that index crimes, which consist of higher-level crimes such as murder, robbery, and aggravated assault, were reduced by 7% (Outdoor Lighting, 2018).

3.0 Methods

The goal of the project was to Re-Imagine Lincoln Street by creating designs to improve safety, create more access to public transportation, and to provide a more aesthetically pleasing corridor. The following objectives were used to facilitate the overarching goals:

- Identify the Green Hill Neighborhood and the characteristics involving the area that makes up the neighborhood, population, and demographics.
- Segment the corridor into three different sections to allow the MQP team to develop designs that could fit the needs of the different sections of the corridor.
- Analyze the existing conditions of the Lincoln Street Corridor by carrying out site visits, attending walk audits, gathering data, and receiving input from stakeholders via surveys and interviews.
- Create and analyze possible solutions to improve safety, traffic, and aesthetics of the corridor.
- Provide a cost-estimate for the possible solutions.
- Develop evaluation criteria to analyze options.
- Recommend a final design and provide an implementation process to the Green Hill Neighborhood Association.

In order to reach all of the previously mentioned goals, a schedule was created to guide the project throughout B-Term. The schedule can be seen in the MQP proposal in Appendix A.

3.1 Analyze Existing Characteristics of the Green Hill Neighborhood

The first objective of our methodology was to identify the characteristics of the Green Hill Neighborhood. This allowed our team to have a better understanding of the entire area, helping comprehend the demographics of the people that live in and around the Lincoln Street corridor. Our first step was to determine the boundaries as defined by the Federal Financial Institutions Examination Council, or FFIEC, Geocoding system. By determining the sections that the Green Hill Neighborhood is a part of, we were then able to find census data involving the population size as well as the demographics living in the Green Hill Neighborhood area. This allowed our team to compare the data of the Green Hill Neighborhood to Worcester County in general, as well as to national averages of population levels and demographics. By comparing the data, we were able to further understand the need for an improved corridor to meet the needs of all those who live in this area.

3.2 Analyze Existing Conditions of the Lincoln Street Corridor

After analyzing the characteristics of the Green Hill Neighborhood, our team was able to analyze the existing conditions of the Lincoln Street corridor. This objective entailed our team investigating the corridor and its primary usages which include transit, vehicles, bicycling and walking. Then, our team compiled the existing safety issues within each of the three sections that make up the entire length of the corridor. Finally, our team compiled all other issues and concerns within the entire length of the corridor.

3.2.1 Define Street Sections

Since the Lincoln Street corridor was found to be nearly a mile long and have different characteristics at certain points, we decided the best way to approach designs for the corridor was to break it down into three distinct sections. After conducting multiple site visits, compiling data from the walk audit, and obtaining stakeholder input, we understood that the corridor had unique areas that were primarily business oriented, residentially-based, or a combination of both. We determined that it was not as beneficial to design the entirety of the Lincoln Street corridor based on the needs of solely the residential area, because each segment was different and had its own set of needs. Rather, it was more beneficial to have certain areas of the corridor designed specifically for their needs, and then combined into one final design for the entire corridor. For example, there are spots on the corridor that have bus stops, and others that do not. Those specific sections of the corridor were designed differently than a section of the corridor that does not have a transit stop.

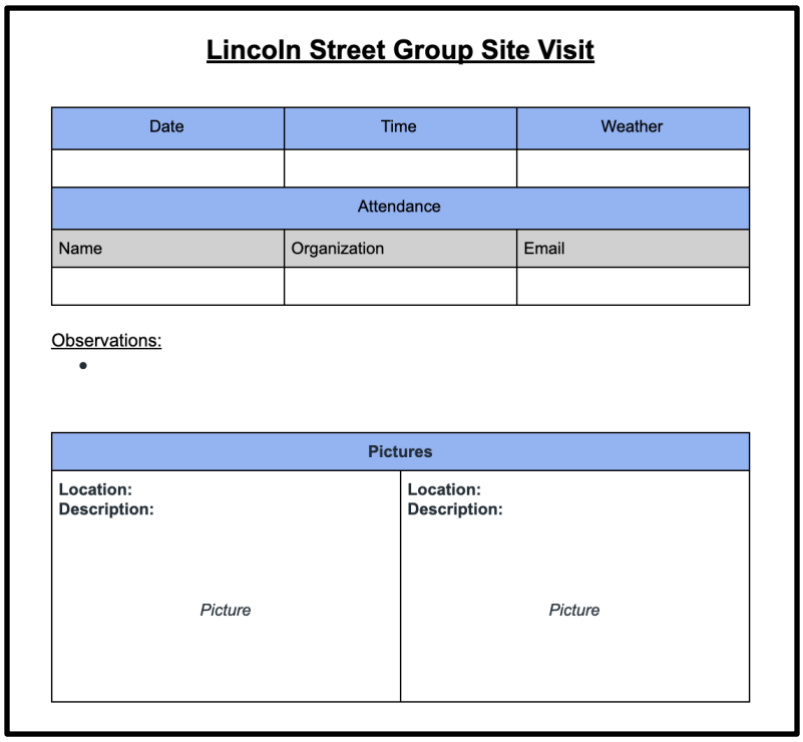
3.2.2 Compile Existing Safety Issues of Each Section

In order to compile the safety issues for each section of the corridor, our team completed site visits, gathered crash data from various sources, analyzed surveys, and analyzed the input of stakeholders within the community.

Site Visits

Our team completed existing safety issues of each section by making site visits along the Lincoln Street corridor. Our team completed several site visits which entailed taking measurements and observations of each section of the corridor. These site visits occurred from April of 2019 and finished in December of 2019. They occurred at different hours during the day which gave different perspectives to our observations that we took. Our team conducted these

site visits during morning hours (8:00 am - 12:00 pm), afternoon hours (12:00 pm - 5:00 pm), and evening hours (5:00 pm - 10:00 pm). The template that the team used to record our observations from our site visits can be seen below in Figure 6. The site visit with specific dates, times, and information can be found in Appendix C.



Lincoln Street Group Site Visit

Date	Time	Weather
Attendance		
Name	Organization	Email

Observations:

-

Pictures	
Location: **Description:** *Picture*	**Location:** **Description:** *Picture*

Figure 6*:* Site Visit Template

During each site visit we were able to take several measurements. The measurements included widths of sidewalks, driving lanes, and parking lanes. In addition, we were able to measure the distances between crosswalks throughout the entirety of each specific section. Our team focused on pedestrian behavior, public transportation, and vehicle behavior while on these site visits. Our team also observed other aspects of the corridor that affect the safety, such as signage and crosswalk hazards along the corridor. Based on the data provided from the CMRPC and the setup of signage for bus stops throughout the corridor, the team also determined if the transit stops needed to be relocated, increased in number, or decreased in number. Figure 7

shows two of our team members measuring the width of the parking lanes along Section 2 of the corridor.

Figure 7*: Measuring Parking Lane Widths During Site Visit*

Walk Audits

The team participated in a Bikeability and Walkability Audit that took place on November 2, 2019. The audit was completed in order to gather observations and data on the existing conditions of the Lincoln Street Corridor in regard to pedestrian safety and accessibility. Professionals from the WalkBike Worcester and Boston Organization led the WalkBike audit that consisted of walking down the entire corridor starting from the intersection of Catherine Street and Lincoln Street and ending at Brittan Square (Burncoat Street Intersection). While on the walk, individuals noted any observations or suggestions for improving the safety of the Lincoln Street corridor based on the WalkBike audit criteria. After the audit was complete, the professionals from WalkBike Boston and Worcester gathered the notes taken by the individuals

who completed the walk and created a report based on the observations which can be referenced in Appendix B.

Figure 8*: Participating in Walk Audit*

Crash Data

Crash maps relating to the corridor were obtained from the Central Massachusetts Regional Planning Commission (CMRPC) from the years of 2014 through 2016. In addition, our team was able to access the Massachusetts Department of Transportation (MassDOT) website in order to analyze crash incidents that occurred along the corridor from 2014 through 2016. The crash maps can be seen in Chapter 4 of this report, specifically in Section 4.2.1 through 4.2.3. The MassDOT crash information can be seen in these sections of the report as well. For further information on crash data, refer to Appendix D.

3.2.3 Compile Other Issues for the Entire Corridor

While conducting the various site visits, walk audits, and other means of gathering data we recorded the other issues along Lincoln Street that were not primarily safety related. These issues were mainly aesthetic in nature or related to the lack of public seating and signage. We

decided that addressing these issues, although non-essential to the safety of those using the corridor, would help us to reach our goal of reimagining the corridor and creating a better public image for the main street of the Green Hill Neighborhood. Both stakeholder input and surveys were analyzed in order to gather data on the other issues along the corridor.

Stakeholder Input

While collecting data was crucial for the project, obtaining the various perspectives of the Lincoln Street stakeholders was just as important. The recommendations, observations, and thoughts of the individuals who go through the corridor on an everyday basis helped provide deeper insight into the corridor's current state. Using this insight as well as meeting with Worcester Transportation planners on specific design criteria for streets, allowed us to identify and address the areas of concern within the corridor. It was crucial to ensure that any designs created adhered to the criteria of the city's Complete Streets policy. This would not only support that the design was feasible, but also in acquiring funding from the Complete Streets program in the future.

Surveys

The Division of Public Health (DPH) created a survey that the residents, business owners, and employees of the Lincoln Street corridor completed. This survey asked questions regarding any issues or improvements the residents have seen or think are necessary to be dealt with on the corridor. Our team obtained the survey results by contacting Penelope Karambinakis, the employee at the DPH responsible for facilitating this survey. The results of the survey can be referenced in Appendix E.

3.3 Develop Preliminary Designs

Based on the data of the existing conditions, the perspective of various stakeholders, and researched case studies, the team analyzed potential solutions based on several factors. These factors included improvement to safety, public transportation needs of the community, cost, and aesthetics of the corridor. With these factors analyzed, the team created packages of designs that were focused on these respective factors. Our team created designs in order to clearly visualize the changes that we felt needed to be addressed to improve the corridor. These designs were done through Streetmix (Streetmix.net), which is a software that depicts the cross-sectional view of a certain designed street which includes features like types of lanes, dimensions of lanes, crosswalks widths, etc.

The possible solutions that our team determined were discussed with two Senior Transportation Planners for the City of Worcester, Brian Pigeon, and the Assistant Chief Development Officer for the Planning and Regulatory Services Division of Worcester, Stephen Rolle. Based upon the feedback from Brian and Stephen, we determined to further develop our solutions and create more than one preliminary design for each section of Lincoln Street. These possible solutions will allow the Green Hill Neighborhood Association to not limit themselves to one solution, rather they will have a variety of solutions that they could implement in the future. The team then identified its preferred solutions and justified our reasoning based upon the existing issues within the corridor.

3.4 Determine Solutions to Improve Street Amenities

After identifying the other issues not involving the cross section of the corridor, the team conducted research on how to further reimagine the corridor and improve upon the amenities of the street. This involved looking into past projects that involved reimagining a street and

identifying ways to improve upon the overall corridor to make it a safer and more attractive location for people to travel through. We then took these improvements and scored them by obtaining feedback from our stakeholders. The scoring system that we used is presented in section 3.6 "Developed an Evaluation Method for Designs and Improvements to the Corridor.

3.5 Conduct Cost Estimates for Preliminary Designs and Improvements of Street Amenities

In order for the team to make selections for what countermeasures and improvements were to be included in our final design, we needed to determine the cost of each one. By conducting research from case studies involving street improvements as well as using the MassDOT Construction Project Estimator, we were able to provide an estimate for each corridor improvement. This allowed our group to weigh options and solutions that we determined by comparing how economically feasible each solution was, further narrowing down the scope of our implementation. A cost analysis also allowed our team to use our scoring rubric, which is explained in section 3.6, to rank how effective each improvement is compared to each other.

Once the cost estimate for implementing our countermeasures and improvements was determined, we researched potential sources of funding for the GHNA to carry out our recommendations. Providing possible sources of funding for the GHNA will help guide them with further implementation. These sources of funding could potentially come from the city of Worcester, state and federal sources, as well as fundraised by the Lincoln Street community. This step in our recommendation will set the GHNA up with a realistic plan for implementation.

3.6 Develop an Evaluation Method for Designs and Improvements to the Corridor

After communicating with the project sponsors, it was important to clearly define how we would score each of our countermeasures and improvement ideas as well as what categories that we would focus on. By creating a rubric, we were able to provide a quantitative measure that allowed us to compare the cost of each countermeasure and improvement to the quality of the improvement. The three categories that we focused on were as follows:

A. Affordability
B. Appearance
C. Safety

Based upon the needs expressed by our stakeholders, we then determined the weight of importance for the aforementioned categories. By assigning a weight, we were able to distinguish which category was of greater importance to our stakeholders and set the multiplier to the scoring system we discuss in the following paragraph.

Within each of these categories, we used a quantitative scoring scale of 1-5 for each countermeasure and improvement. A score of "1" showed that the countermeasure has a strong negative impact in a category, a "2" meant a slightly negative, a "3" meant no impact on the category, a "4" meant a slightly positive impact, and a "5" meant a strong positive impact. The scoring of each countermeasure compared to each of these categories was determined by our team based upon our research of the existing conditions of Lincoln Street, along with our research of case studies. This made it clear to us which of the countermeasures and improvements we came up with were the strongest, and which one we needed to leave behind in our efforts of creating a final design. The criteria for how we used each of these categories is as follows:

A. **Affordability** - Based upon our cost estimates of implementing each improvement to Lincoln Street, we assigned a score of 1-5. A score of "1" meant that the improvement was not very cost effective due to its high cost. A score of "5" meant that the improvement was very cost effective due to its low cost. Once we were able to determine all of the cost estimates for each improvement, we then set the price ranges for our scoring, allowing us to see how economically feasible each option was compared to the price ranges.

B. **Aesthetic** - When it comes to the appearance of each countermeasure and improvement, a score of "1" showed that the improvement lacked aesthetically pleasing qualities, whereas a score of "5" displayed high aesthetically pleasing qualities.

C. **Safety** - In order to score safety, we analyzed how well each countermeasure improved upon the safety of the corridor for pedestrians, bicyclists and motorists. A score of "1" displayed that the countermeasure did not improve upon the safety, whereas a score of "5" showed that the countermeasure had a significant impact on improving the safety of the corridor.

3.7 Recommended Final Design to Green Hill Neighborhood

The final design for the project included different cross sections of the Lincoln Street Corridor. The focus was on areas of the corridor that are in greatest need of improvements. This design was our team's final recommendation - one that we believe is the most feasible for the Green Hill Neighborhood Association to implement in the future.

The design of the sections differed based on residential or shop fronts, as well as the differences in width of the sidewalk in different sections of the street. Each final design was

presented through a software called Streetmix (Streetmix, n.d). Within this software, the user is able to render a visual of the cross section of a specific roadway. In this project's case, we focused on key spots that our team deemed most important to specific stakeholders. Streetmix enables the user to design specific widths of sidewalks, driving lanes, bike lanes, etc. The software allowed Green Hill Neighborhood Association to have a visual representation of what the cross section of the street would look like if the designs were to be implemented.

3.8 Prioritize Solutions to Improve the Corridor

After evaluating the scoring rubric for the other improvements of the corridor, our team prioritized the highest rated improvements to further recommend to the Green Hill Neighborhood Association. These other improvements, along with our teams final cross-section design recommendations are included together to provide the GHNA with a final prioritized recommendation that our team felt was most crucial to the scope of the project. While our team feels the prioritized recommendations are most critical for the GHNA to improve first, our team did not rule out the other improvements that were not a part of the prioritized solutions and improvements.

3.9 Provide Implementation and Funding Options for Green Hill Neighborhood

After conducting our scoring and cost estimates for all of our improvements, it was clear that finding sources of funding was going to be an essential part of the reimagining of Lincoln Street. In order to set up the Green Hill Neighborhood with a way to carry out our suggested improvements, we researched various potential funding sources that could be utilized. This included further researching into programs that the GHNA was already aware of, as well as identifying new potential sources.

The team further provided an implementation process for the Green Hill Neighborhood Association. The implementation plan included our research of funding sources, our final design, as well as a rough timeline for how long we expect the final design to be implemented. By providing a plan for the GHNA of how our design will be implemented, we were able to ensure that the work we performed throughout this MQP will be implemented.

4.0 Results

This section discusses the results that were gathered and analyzed by our team throughout the duration of the project. The chapter includes the following sections.

- Green Hill Neighborhoods' Demographic Characteristics
- Existing Conditions of the Lincoln Street Corridor
- Preliminary Designs and Cost-Estimates
- Final Design and Implementation Plan

4.1 Neighborhood Characteristics

Understanding the demographics of the Green Hill Neighborhood was vital for the team when making designs for the corridor. In order to access and analyze the data, the team researched a variety of demographic categories that represent the Green Hill Neighborhood, including data from the Federal Financial Institutions Examination Council (FFIEC.org) and the Metropolitan Area Planning Council (mapc.org). Within the FFIEC data, the Green Hill Neighborhood is split into two tract numbers which make up the entirety of the neighborhood that will be affected by the project. The data from each tract number is referenced within the following sections.

4.1.1 Population Density

Table 1 "Population Density" presents the 2015 census data.

Population Density	
2015 Green Hill Neighborhood Population	6866 people
2010 Worcester County Population	798,552 people
2015 Green Hill Neighborhood Housing Units	3001
2010 Worcester County Housing Units	336,485
2015 Green Hill Neighborhood Vacant Housing Units	543
2015 Green Hill Neighborhood Multi-Family Housing Units	2333
2015 Green Hill Neighborhood Registered Vehicles	2298
2015 Green Hill Neighborhood Vehicles per Household	0.77

Table 1: ***Population Density of the Green Hill Neighborhood***

Analyzing the data within the population characteristic provided our team with the total population of 6,866 residents who live within the Green Hill Neighborhood. Of the total population, the percent of minority ranges from 48.31 to 58.85 percent based on proximity to the I-290 interchange or Brittan Square. The total number of households within the neighborhood at the time the census data was collected was 3,001 and the total number of families was 1,458. It is evident that the Green Hill Neighborhood population depends upon the use of the corridor for transit due to the number of multi-family housing units being larger than the number of registered cars in the neighborhood. The fact that there are only 0.77 vehicles per household shows that many people in the neighborhood are reliant on public transportation, along with walking and biking to travel through the corridor.

4.1.2 Income of Green Hill

Table 2, "Income for Green Hill Neighborhood" displays data estimated based upon the 2015 census data and from the Federal Financial Institutions Examination Council (FFIEC).

Income for Green Hill Neighborhood	
2019 Green Hill Neighborhood Estimated Median Family Income	$57,208
2019 FFIEC National Estimated Median Family Income	$95,300
2019 National Poverty Line (4 Person Household)	$25,750
Percent Below National Poverty Line	30.29%

Table 2: ***Income of Green Hill Neighborhood***

The data from the FFIEC GeoMaps website allowed us to further understand the economic situation of the residents of the Green Hill Neighborhood. From the data we were able to understand that 8.93% to 30.29%, depending on the distance from I-290, of the population of the Green Hill Neighborhood falls below the national poverty line. In addition, as seen in Table 2, the median family income of residents in the Green Hill Neighborhood falls nearly $40,000 dollars below the national median family income. This shows that residents of the neighborhood are generally at a lower economic standing than the rest of the country. This lower level of income combined with families having an average of less than one car per household implies that many of the residents rely upon alternate methods of transit, not just driving a car they own.

4.2 Existing Conditions

Our team decided to break down the corridor into three distinct sections based on their usage. The entire length of the corridor that we reimagined started at the intersection of Catherine Street and Lincoln Street and ended at Brittan Square. While analyzing the street, our

team decided that from Catherine Street to Orne Street, the primary usage was structured towards having more businesses along the corridor. Orne Street to Harlow Street entailed both businesses and residential buildings along the corridor which is why our team decided to refer to this as our second section. The third section started at Harlow Street and ended at Brittan Square. This section was primarily used for both businesses and the University of Massachusetts Memorial Hahnemann Family Health Center.

By separating the corridor into several sections, our team was able to create designs which fit each section's specific needs. For example, our designs for our first section needed to differ from those of our third section because there was a higher need of parking lanes in our third section. If we kept the entire length of the corridor as a whole and created one design, we would not have been able to create a design that maximizes the needs to improve safety and further enable access to public transit.

4.2.1 Existing Conditions Section 1

Street Views

Below are figures that represent what both parts of Section 1 look like from a cross-sectional standpoint. Figure 9 represents section 1A which consists of 4 total driving lanes, 2 northbound and 2 southbound. Section 1A only lasts about 100 feet in distance and then changes a driving lane to a parking lane on the north and southbound sides of the street. Figure 10 represents the cross-sectional view of section 1B.

Figure 9: ***Existing Street View, Section 1A***

Figure 10: ***Existing Street View, Section 1B***

Streetmix View

Through several site visits that our team was able to complete throughout the duration of this project, the measurements of both parts of Section 1 were recorded and can be referenced in the site visits in Appendix C. Both Figures 11 and 12 represent the measurements of driving lane widths, parking lane widths, and sidewalk widths for the existing street conditions of Section 1. These views were done in Streetmix because our team believes that this is the best way to display the improvements to the existing designs.

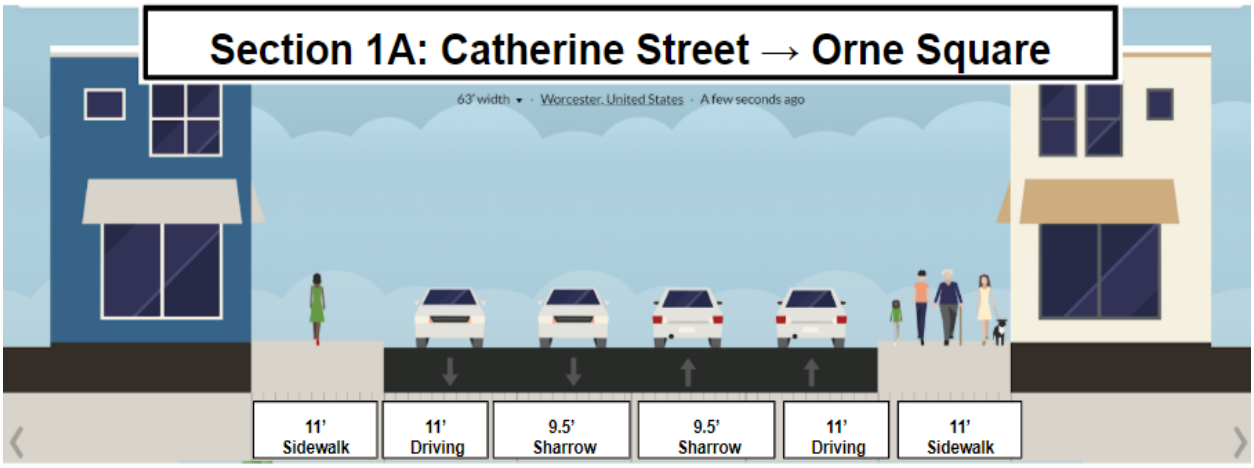


Figure 11*: Streetmix View of Existing Conditions, Section 1A*

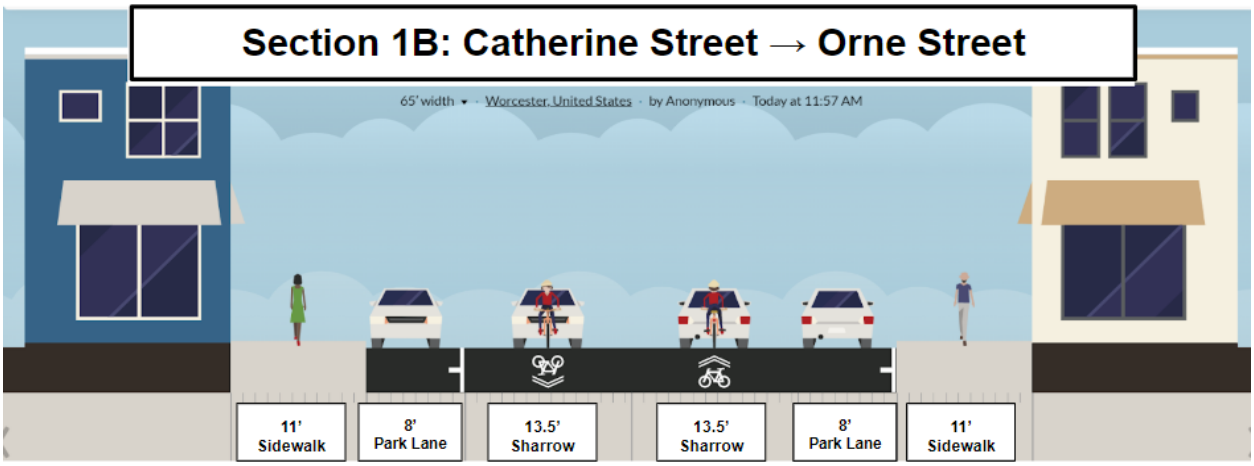


Figure 12*: Streetmix View of Existing Conditions, Section 1B*

In the following sections, our team will go into detail on the types of crashes that occur on the corridor and other existing safety issues for Section 1.

Central Massachusetts Regional Planning Commission Crash Results Section 1

Our team analyzed the crashes and their locations within the corridor by using the crash map provided by the Central Massachusetts Regional Planning Commission (CMRPC). Figure 13 below represents the severity of crashes that occurred from 2014 through 2016 within Section 1 of the corridor. This crash map presented five categories which included Non-Injury, Injury, Fatal, HSIP (Highway Safety Improvement Plan) Cluster Crashes and the Top 200 Crash

Clusters. An HSIP eligible cluster is one in which the total number of "equivalent property damage only crashes" is within the top 5% in the region. There were HSIP Crash Clusters and a Top 200 Crash Cluster within the years of 2014 through 2016. The Top 200 Crash Clusters are ranked using the Equivalent Property Damage Only (EPDO) crash rates. This cluster is located at the Intersection of Catherine and Lincoln Street. The HSIP Clusters are represented by the blue circles, while the Top 200 Clusters are represented with the cross-hatches. This area was considered a Top 200 Crash Cluster due to the amount of crashes that resulted in either injuries or fatalities. The crashes that result in injury or fatality are weighted significantly higher than those that are only property damage crashes, which in turn is why this area on the map is a Top 200 Crash location.

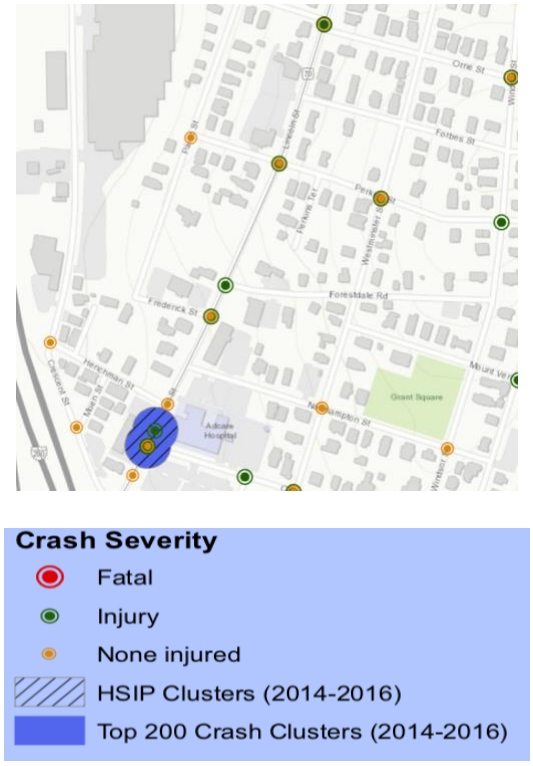


Figure 13*: Crash Map of Section 1A-1B from CMRPC*

After analyzing the crash maps from the CMRPC, our team was able to gather crash data from the Massachusetts Department of Transportation from the years 2014 to 2016. This allowed our team to compare the data from the MassDOT to the CMRPC crash maps.

Massachusetts Department of Transportation Crash Results Section 1

Crash report data from the Massachusetts Department of Transportation (MassDOT) from the years 2014 to 2016 were accessed and categorized into distinct categories for each of the 3 Sections within the Lincoln Street Corridor. Total Number of Crashes, Time of Day, Extent of Injury, and Vehicle Configuration. The data for Section 1 of Lincoln Street can be seen in Table 3.

There were a total of 45 crashes. When looking at the Crash Map, it is evident that there are not a total of 45 different crash locations. However, there are multiple locations that have had more than one crash occur there. For example, at the Intersection of Lincoln and Catherine, there are 21 crashes that occurred from the years of 2014 to 2016 based on the MassDOT data, but only two locations of crashes on the map.

Of the total number of crashes, there were 15 that occurred during the dark hours of the day. About 33 percent, or 5 of the 15 crashes that occurred during dark hours, were located at the intersection of Catherine and Lincoln Street. It is evident that the street lighting had a large impact on the numerous crashes that have occurred at this intersection.

Section 1 Crash Data							
Number of Crashes	**Time of Day**		**Extent of Injury**			**Vehicle Configuration**	
	Daylight	Dark/Dusk	Non-Injury	Injury	Fatal	Veh. vs. Veh.	Veh. vs. Pedestrian/Cyclist
45	30	15	27	16	2	42	3

Table 3: ***Section 1 Crash Data (MassDOT, 2014-2016)***

Forty percent of the crashes that occurred within Section 1 of the corridor resulted in either an injury or a fatality.. To reference more data and specific times of crashes, refer to Appendix D.

Crosswalk Safety

The current crosswalk situation along the first section of the corridor can be harmful to pedestrians that access the corridor. There is only one cross walk along the length of this section, which is roughly 1,584 ft or 0.3 miles. Since the only crosswalk is at the intersection of Catharine Street, pedestrians need to walk another 0.3 miles northbound in order to access another crosswalk. This becomes an even more dangerous issue because there are three total bus stop locations on the northbound and southbound sides of Section 1. Our team witnessed several pedestrians jaywalk after they depart their bus due to the fact that there is poor access to crosswalks along the corridor. The existing locations of the crosswalks can be seen in Figure 14 along with existing bus stop locations in Figure 15.

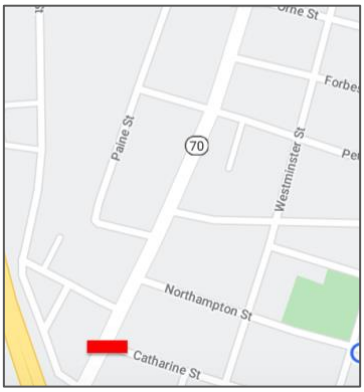


Figure 14: ***Existing Crosswalk Location in Section 1***

Figure 15: ***Existing Bus Stop Locations in Section 1***

4.2.2 Existing Conditions Section 2

Street View

Figure 16 depicts the cross-sectional view for the entire length of the second section within our corridor. This section starts at the intersection of Orne and Lincoln Street and ends at the intersection of Harlow and Lincoln St, which gives a total length of 0.25 miles.

Figure 16*: Existing Street View, Section 2*

Streetmix View

Figure 17 provides a visual of the cross-sectional view of Section 2 in the Streetmix software. This software allowed our team to provide the measurements for the specific parts of the street. In the figure the measurements for driving lane width, parking lane widths and sidewalk widths are depicted. In addition, our team was able to represent that both driving lanes have sharrows which are supposed to let drivers know that they must share the lane with bicyclists.

Figure 17*: Streetmix View of Existing Conditions, Section 2*

The following sections discuss the types of crashes that occurred within Section 2 of the corridor along with the existing safety issues.

Central Massachusetts Regional Planning Commission Crash Results Section 2

The crash map provided by the CMRPC was used to analyze crashes and their locations within Section 2 of the Lincoln Street corridor. Figure 18 represents the severity of crashes that occurred from 2014 through 2016 within Section 2 of the corridor. This crash map presented five categories which included Non-Injury, Injury, Fatal, HSIP (Highway Safety Improvement Plan) Crash Clusters, and the Top 200 Crash Clusters. There was not a HSIP Crash Cluster or a Top 200 Crash Cluster within the years of 2014 to 2016 for Section 2. The crash report data that was

accessed from the CMRPC allowed our team to analyze the severity and locations of crashes that occurred between vehicles in Section 2 of the corridor. However, multiple crashes occurred in the same spots making it difficult to gain a complete understanding. The number of crashes for each respective category can be seen below in Table 4. The exact locations, times, lighting, etc. can be seen in Appendix D referencing the MassDOT data.

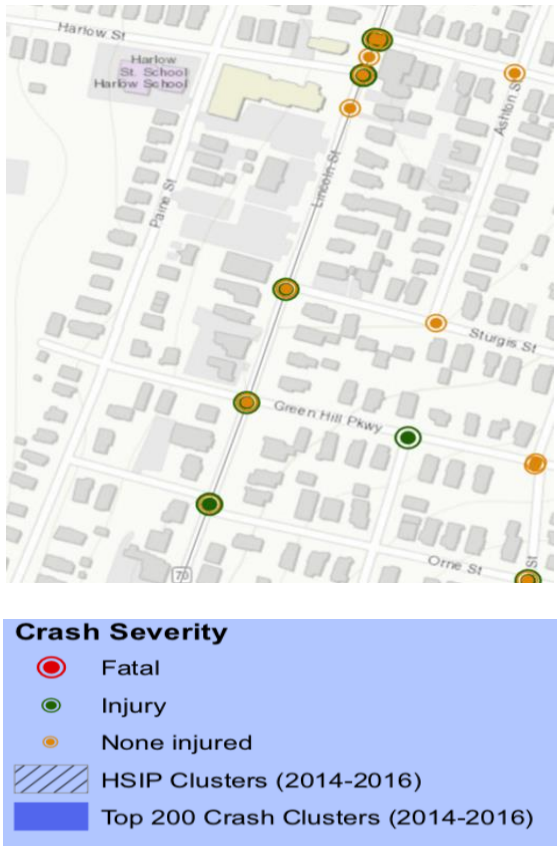


Figure 18 : ***Crash Map of Section 2 from CMRPC***

After analyzing this crash map from the CMRPC, our team was able to gather crash data from the Massachusetts Department of Transportation from the years 2014 to 2016. This allowed our team to compare the data from the MassDOT to the CMRPC crash map.

Massachusetts Department of Transportation Crash Results Section 2

Crash report data from the Massachusetts Department of Transportation (MassDOT) from the years of 2014 to 2016 was accessed and categorized into distinct categories for each of

the 3 Sections within the Lincoln Street Corridor. Total Number of Crashes, Time of Day, Extent of Injury, and Vehicle Configuration for Section 2 can be seen in Table 4.

There was a total of 34 crashes that occurred within Section 2 of the corridor based on the MassDOT data. When looking at the crash map for Section 2, it is evident that there is not a total of 34 different crash locations due to there being locations where multiple crashes have occurred, as stated above. Of the total number of crashes, there were 11 that occurred during dark hours of the day. Again, indicating that the lighting may have a large effect on safety within the corridor.

Section 2 Crash Data							
Number of Crashes	Time of Day		Extent of Injury			Vehicle Configuration	
	Daylight	Dark	Non-Injury	Injury	Fatal	Veh. vs. Veh.	Veh. vs. Pedestrian/Cyclist
34	23	11	24	10	0	34	0

Table 4: ***Section 2 Crash Data (MassDOT, 2014-2016)***

Section 2 of the corridor had the least amount of crashes from 2014 to 2016 compared to Sections 1 and 3 of the corridor. There was a total of 34 crashes with 10 resulting in injuries. There were 0 crashes involving pedestrians or cyclists. Appendix D can be referenced to analyze further information, such as the exact time of day that each crash occurred.

Crosswalk Safety

Section 2 of the corridor, which starts from Orne Street and ends at Harlow Street only has two existing crosswalks. This includes one located parallel to Orne Street and another parallel to Harlow Street. The existing crosswalk locations can be seen in Figure 19 below. This means there are only crosswalks at the beginning of section 2 and at the end. In the upcoming sections of this chapter, our team discusses the existing bus stop locations throughout each section of the corridor. Section 2 has a total of two bus stop locations going northbound and two

stops going southbound. However, there is no crosswalk at the intersection of Sturgis Street. and Lincoln and Green Hill Parkway and Lincoln Street. One of the bus stops going southbound and another going northbound are located between Green Hill Parkway and Sturgis Street, as can be seen in Figure 20 below. This means pedestrians would need to walk further from the bus stop in order to access a crosswalk. Our team has realized, through talking with stakeholders and witnessing firsthand during our site visits, that there are many pedestrians who jaywalk. This creates a danger to both vehicle drivers and the pedestrians themselves.

Figure 19*: Existing Crosswalk Locations in Section 2*

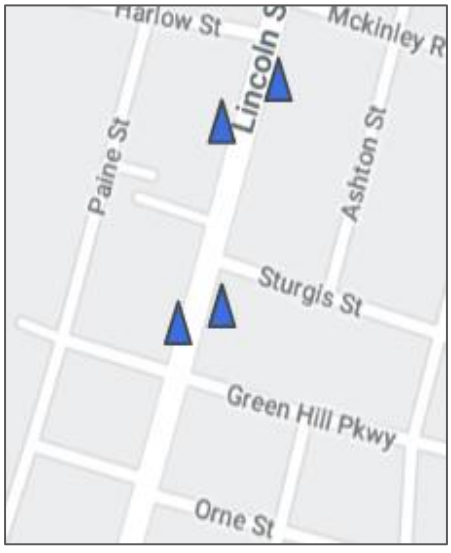


Figure 20: *Existing Bus Stop Locations in Section 2*

4.2.3 Existing Conditions Section 3

Street View

Figure 21 depicts a cross-sectional view of Section 3 within the corridor. This section starts at the intersection of Harlow Street and Lincoln Street and ends at Brittan Square giving a total length of around 0.4 miles.

Figure 21: ***Existing Street View, Section 3***

Streetmix View

Figure 22 provides a visual of what the cross section of section 3 looks like in Streetmix. Set up the same as sections 1 and 2, the Streetmix for Section 3 contains the measurements for driving lane widths, parking lane widths, and sidewalk widths. In addition, our team was able to represent that both driving lanes have sharrows which let drivers know that they are to share the lane with bicyclists.

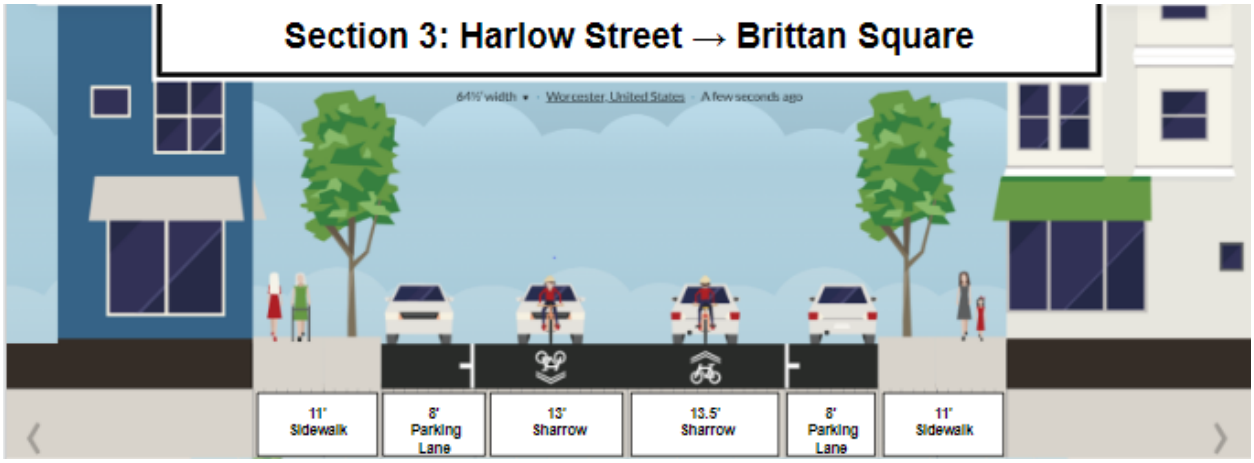


Figure 22*: Streetmix View of Existing Conditions, Section 3*

The following sections discuss the types of crashes that occurred within Section 3 of the corridor along with other safety issues.

Central Massachusetts Regional Planning Commission Crash Results Section 3

Our team used the data we received from the CMRPC to determine the locations of the crashes in Section 3 of the corridor. Figure 23 below represents the locations along with severity of crashes that occurred from 2014 through 2016. This crash map presented five categories: Non-Injury, Injury, Fatal, HSIP (Highway Safety Improvement Plan) Cluster Crashes and the Top 200 Crash Clusters. Section 3 had locations within the corridor that involved fatalities, injuries, and non-injury crashes. Section 3 of the corridor had no HSIP Clusters (2014-2016) or Top 200 Crash Clusters for the region.

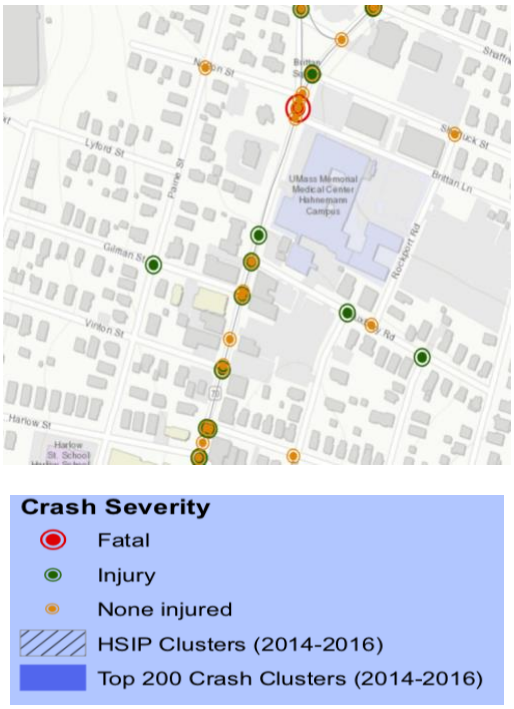


Figure 23*: Crash Map of Section 3 from CMRPC*

Massachusetts Department of Transportation Crash Results Section 3

Crash report data from the Massachusetts Department of Transportation from the years of 2014 to 2016 was accessed and categorized into distinct categories for each of the 3 Sections within the Lincoln Street Corridor. Total Number of Crashes, Time of Day, Extent of Injury, and Vehicle Configuration for Section 3 can be seen in Table 5.

There were a total of 53 crashes that occurred within Section 3 of the corridor based on the data from MassDOT. When looking at the Crash Map, it is not entirely clear that there are 53 crashes that occurred in this section. This is because there are multiple locations that experienced more than one crash, but only look like one data point on the map. For example, based upon the MassDOT data, 4 crashes occurred at the intersection of Lincoln Street and Gilman Street from 2014 to 2016, but are only seen as 2 on the crash map.

Of the 53 crashes that occurred from 2014 to 2016, 13 out of 53, or 24% of the crashes happened during the dark hours of the day. The lack of sufficient lighting in this section was seen

during our site visits (reference Appendix C), and could have been a contributing factor to the crashes occurring at night.

Section 3 of the corridor had 13 injuries and 1 fatality. Forty-nine of the crashes were between vehicles only and 4 crashes involved pedestrians/cyclists. Appendix D provides further details of the crashes that our group obtained through MassDOT. Further details include crash date, crash time, number of vehicles involved, etc.

Section 3 Crash Data							
Number of Crashes	**Time of Day**		**Extent of Injury**			**Vehicle Configuration**	
	Daylight	Dark	Non-Injury	Injury	Fatal	Veh. vs. Veh.	Veh. vs. Pedestrian/Cyclist
53	40	13	39	13	1	49	4

Table 5: ***Section 3 Crash Data (MassDOT, 2014-2016)***

Crosswalk Safety

Section 3 of the corridor has four existing crosswalks. The locations of these crosswalks in reference to Lincoln Street can be found in Figure 24. However, these crosswalks are not all located directly next to the bus stops in Section 3, as can be seen in Figure 25. This means pedestrians would need to walk a little further from the bus stop in order to access a crosswalk.

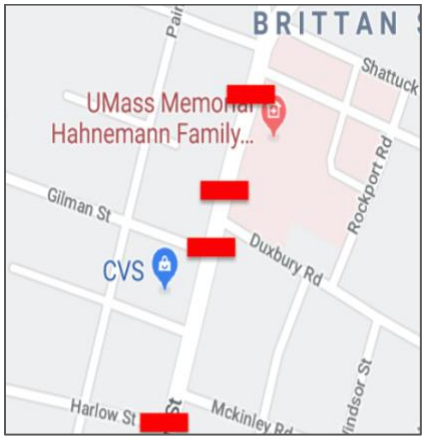


Figure 24: ***Existing Crosswalk Locations in Section 3***

Figure 25: ***Existing Bus Stop Locations in Section 3***

4.2.4 Pedestrian Safety Issues Along Corridor

Lighting/Visibility

The safety of pedestrians is of extreme importance for the Green Hill Neighborhood and everyone who uses the corridor on a regular basis. There are other issues that provide an unsafe environment for the people who access the street. For example, the lighting during the evening hours is poor and limits drivers' and pedestrians' visibility throughout the entire corridor. Our team noticed this during several sight visits. Figures 26 and 27 below show the insufficient lighting that is present in Section 3 and Section 1 of the corridor.

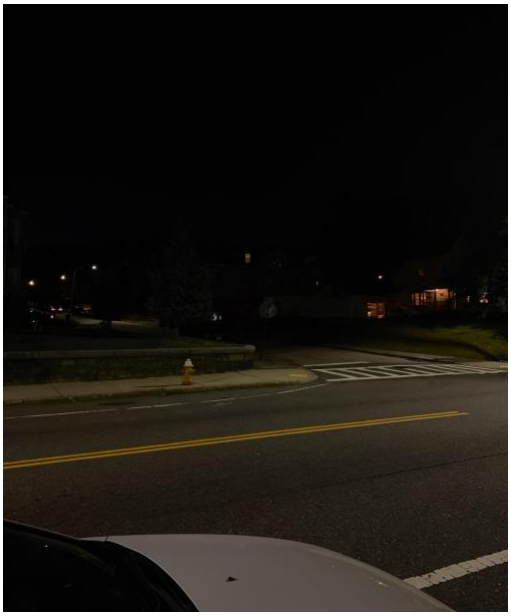


Figure 26*: Street Lighting in Section 3*

Figure 27*: Street Lighting in Section 1*

Access to Sidewalks

Not only is the lighting in the corridor an issue for pedestrians, but so is the overgrown vegetation that limits sidewalk access. This can be dangerous for community members who walk throughout the corridor. There are spots along the corridor which provide little to no space to walk along the sidewalk. A survey was conducted by the Department of Public Health (DPH) for the community stakeholders of the Green Hill Neighborhood. One of the questions asked was, "How well are the sidewalks in your neighborhood maintained?" There were a total of 36 responses and 33.33% answered "Not so well" and an additional 5.56% answered "Not at all well". Almost 40% of the stakeholders that participated in this survey are not pleased with the lack of maintenance along the corridor. Additional questions and results of the survey can be seen in Appendix E. Figures 28 and 29 show what parts of the sidewalk look like and how it limits the space for pedestrians in Section 1 and 2.

Figure 28*: Overgrown Vegetation Section 1*

Figure 29*: Overgrown Vegetation, Section 2*

Walk Audit

While performing our site visits and attending the WalkBoston walk audit, it was clear that vehicles along the corridor were traveling above the speed limit. During the walk audit, one member of the WalkBoston team used a radar gun to record the speeds of oncoming vehicles. Additional findings and key recommendations of the Walk Audit included the following:

- Install marked, visible, accessible crosswalks at high pedestrian utilization locations along Lincoln Street
- Improve level of comfort for people walking in the Green Hill Neighborhood by adding features that make Lincoln Street feel like a place for all modes of travel
- Implement traffic calming strategies to slow vehicle speeds on Lincoln Street
- Improve the connection between the bus system and the pedestrian network to increase the safety of local transit users

The audit results can be referenced in Appendix B along with the site visits in Appendix C.

4.2.5 Other Safety Issues Involving the Corridor

Recurring issues throughout the corridor include the lack of signage for crosswalks, the lack of signage for bus stops, and the safety hazard presented from trees planted within the sidewalks. The lack of signage for the crosswalks causes a safety hazard for those trying to get from one side of the street to the other. Not only are there few crosswalks to begin with, but the ones that are there are old and worn making it difficult for drivers to be aware of them. These crosswalks would benefit from proper signage and new paint.

The problems with the bus stop signs are that they are small, losing stickers, and can be tough to read even when up close to them. This not only makes it difficult for people trying to use the transit system, but for the bus drivers themselves. A new driver that is new to a bus route that travels through Lincoln Street might find it difficult to locate these small and worn-down bus stops. An example of what one of these signs looks like can be seen in Figure 30 below.

Figure 30*: Bus Stop Signage*

There is also a safety hazard that is present from the trees planted in sections of the sidewalk. As can be seen in the image below, these trees have the ability to provide an aesthetic

appeal to the corridor, but because the beds are lower than the sidewalk, a tripping hazard is created. The trees take up sidewalk room and create a hazard which is why we believe these tree beds either need to be addressed for safety or removed. Figure 31 represents the lack of mulch in a tree bed along the corridor.

Figure 31: ***Sidewalk Trees***

4.3 Preliminary Designs

After compiling the existing conditions and issues of the corridor, we developed three different sets of preliminary designs for each of the three sections of the corridor. The first set of preliminary designs accommodate a bus lane for better transit accessibility. The second design was curb-to-curb in the sense that it did not change the physical dimensions of the corridor, but instead changed the lane widths to add bike lanes. The last preliminary design focused on cutting back the sidewalk to accommodate both bike lanes and parking lanes.

4.3.1 Bus Lane Accommodations

The first set of preliminary designs include the addition of a bus lane going northbound and southbound for Sections 1B, 2, and 3. Section 1A did not have enough physical space to include a bus lane in both directions due to this section having 2 driving lanes going northbound

and 2 going southbound. The four designs that include the addition of bus lanes for each section can be seen in Figures 32 through 35.

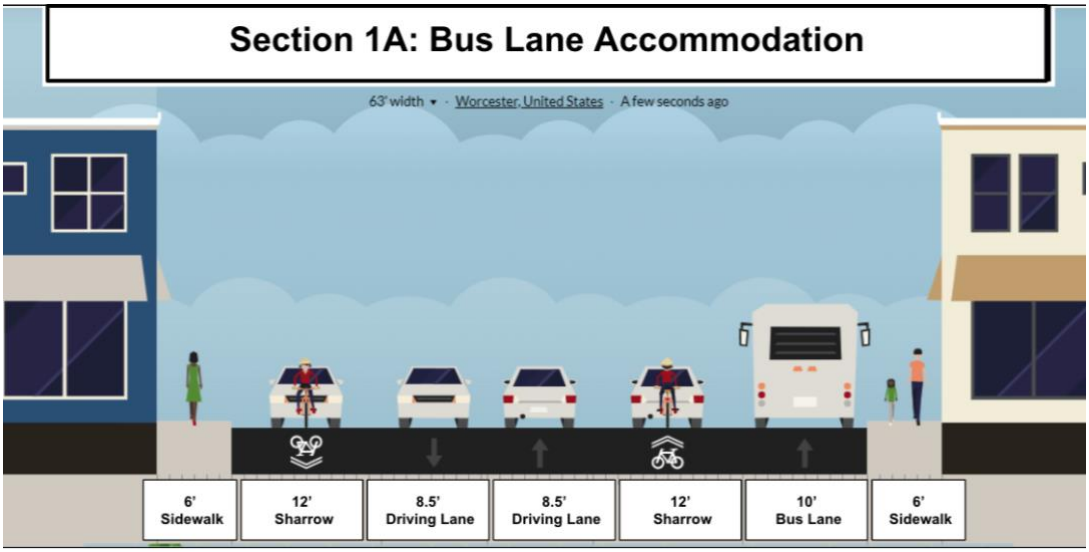


Figure 32: ***Bus Lane Accommodation, Section 1A***

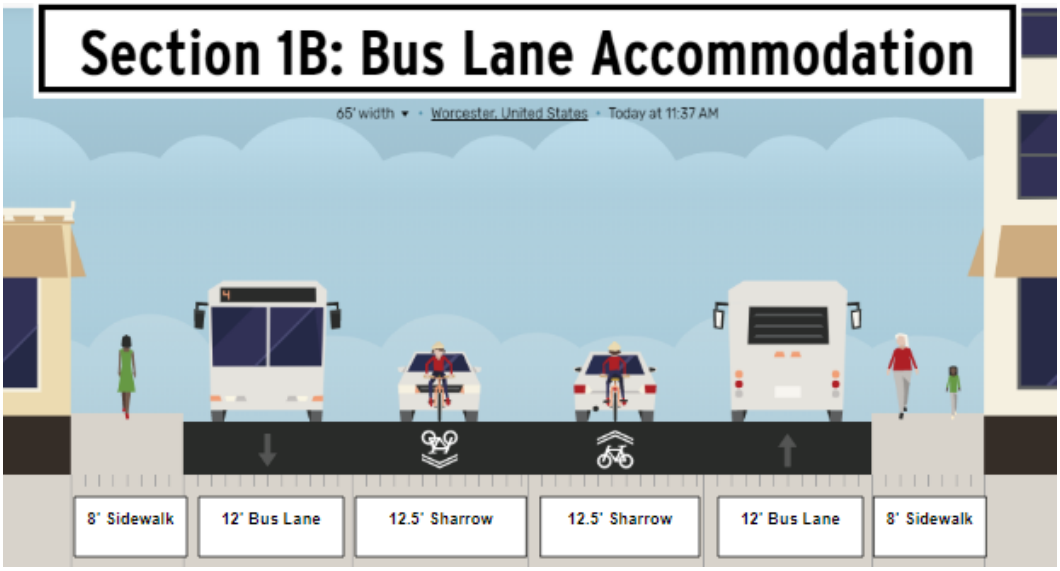


Figure 33: ***Bus Lane Accommodation, Section 1B***

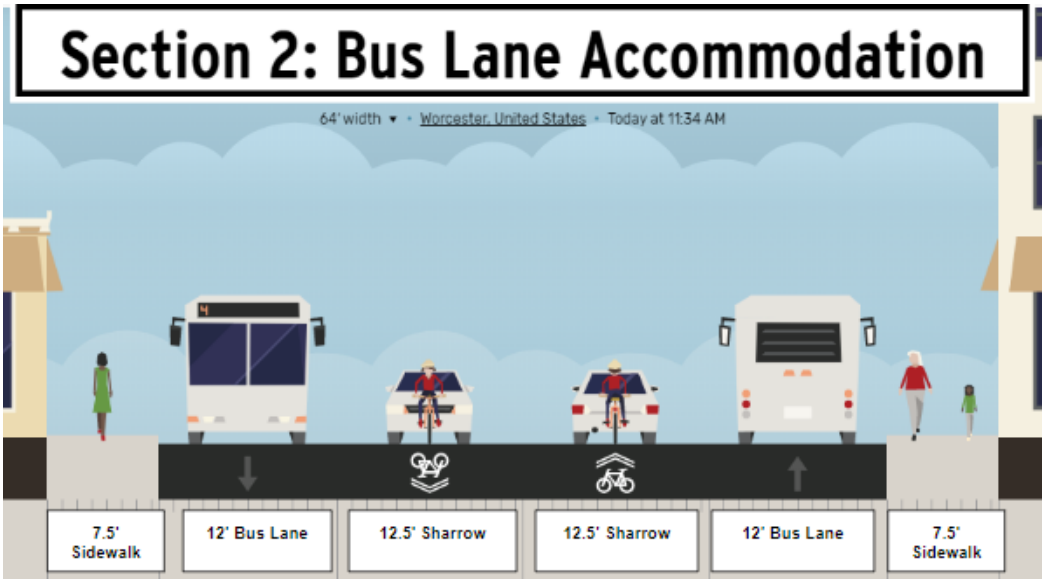


Figure 34*: Bus Lane Accommodation, Section 2*

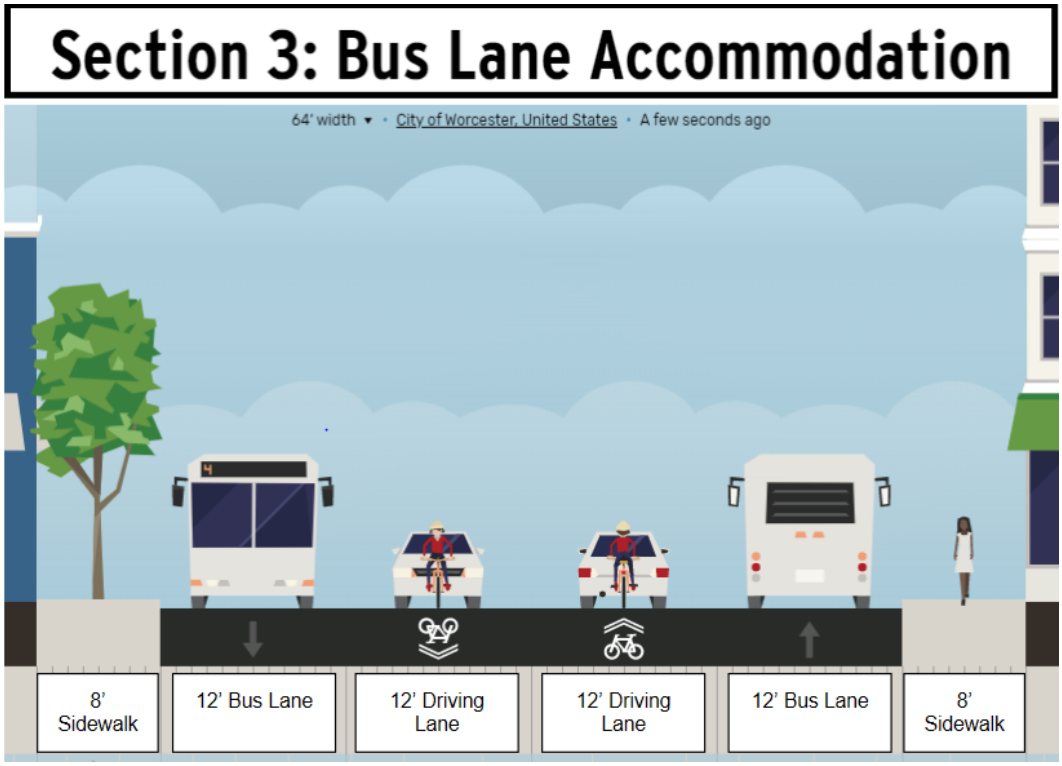


Figure 35*: Bus Lane Accommodation, Section 3*

In order to have enough room for a bus lane to be implemented along with other street lanes, the sidewalks would need to be cut back. After briefly researching the expenses of cutting

back a sidewalk, our group decided that these designs would not meet the cost effectiveness criteria. Our team was informed by Worcester transportation planners that there are no current streets in Worcester that use or are in need of a bus lane. For these reasons, we decided to eliminate the bus lane accommodation designs from the set of potential corridor designs.

4.3.2 Complete Cross-Section Improvement Options

The second set of preliminary designs involved changing the dimensions of the corridor by cutting back the sidewalk to accommodate bike lanes and parking lanes in each of the three sections. The complete cross-section improvement designs are shown in Figures 36 through 39.

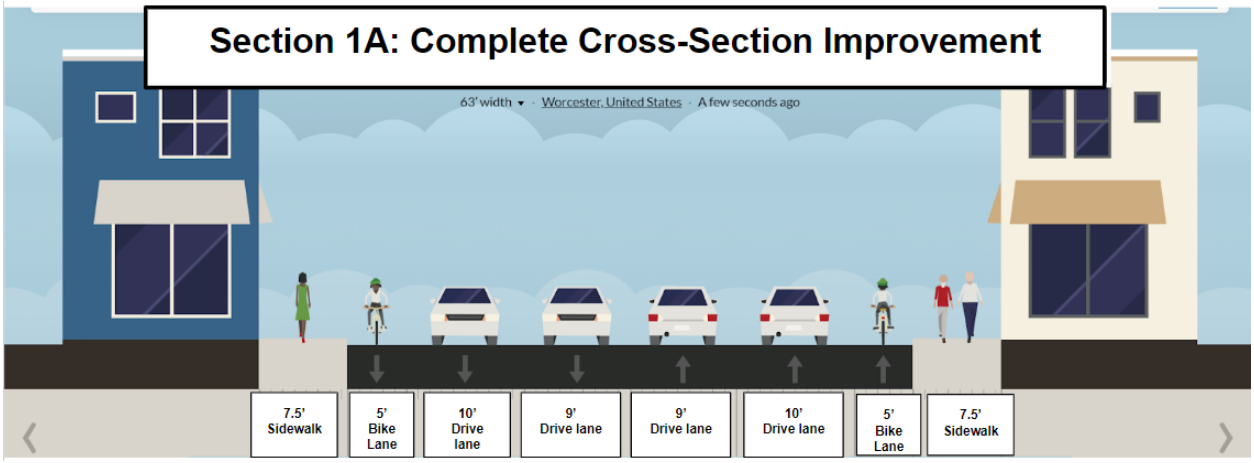


Figure 36*: Complete Cross-Section Improvement, Section 1A*

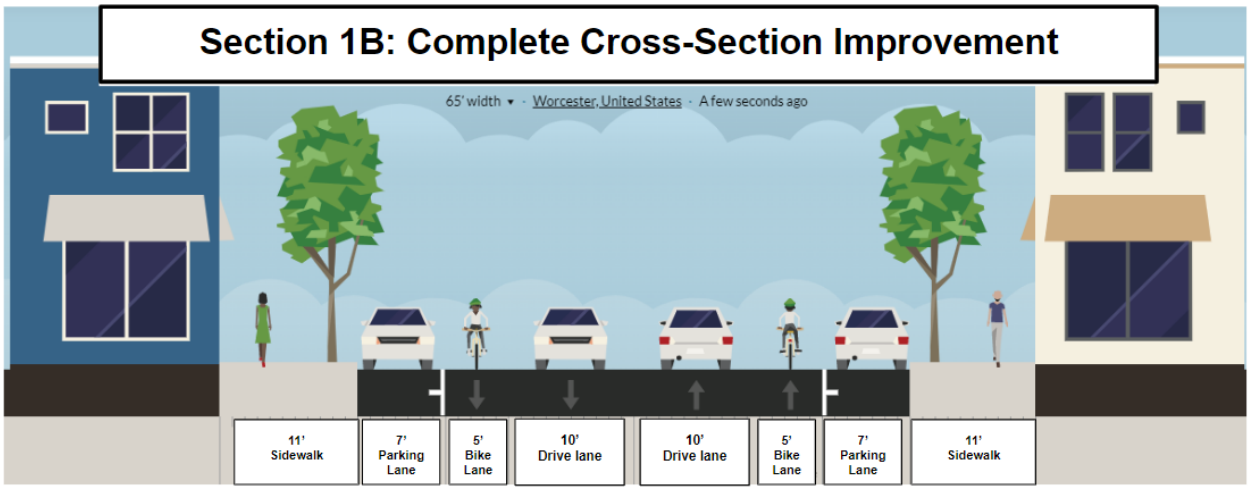


Figure 37: *Complete Cross-Section Improvement, Section 1B*

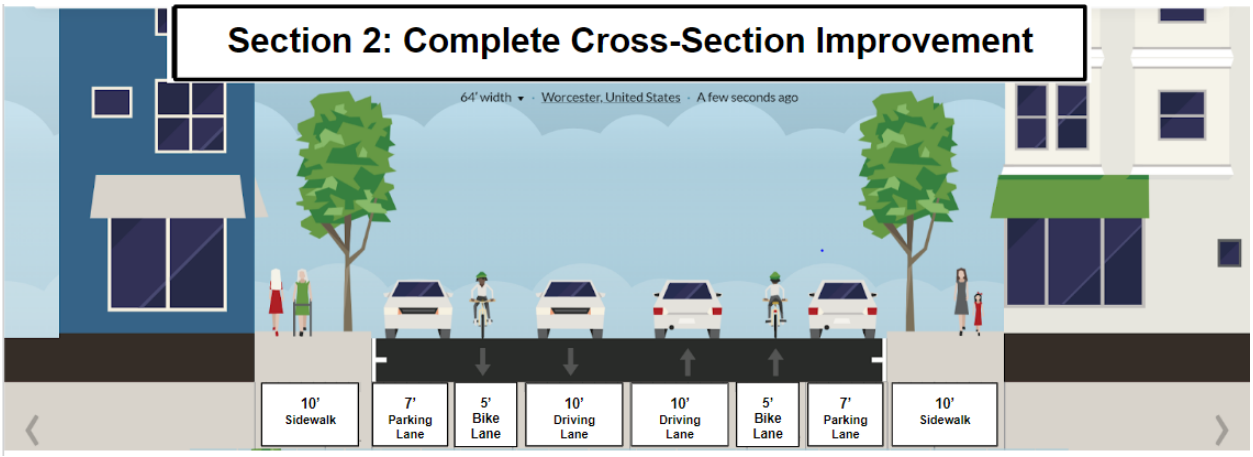


Figure 38*: Complete Cross-Section Improvement, Section 2*

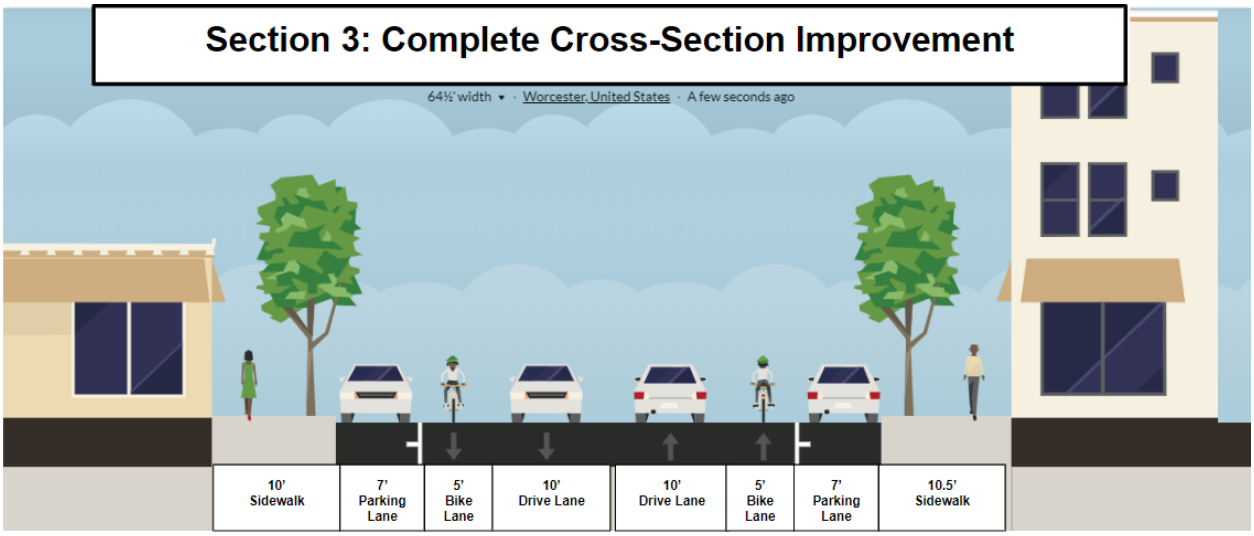


Figure 39*: Complete Cross-Section Improvement, Section 3*

Similar to the set of designs that included a bus lane accommodation, our group found that while cutting the sidewalk would improve the corridor's various forms of transit, it would also be cost prohibitive.

4.3.3 Curb-to-Curb Street Improvements

The third set of preliminary designs include the restructuring of the lane widths to accommodate bike lanes while not changing the sidewalk dimensions. The four designs that keep the sidewalk dimensions intact are shown in Figures 40 through 43.

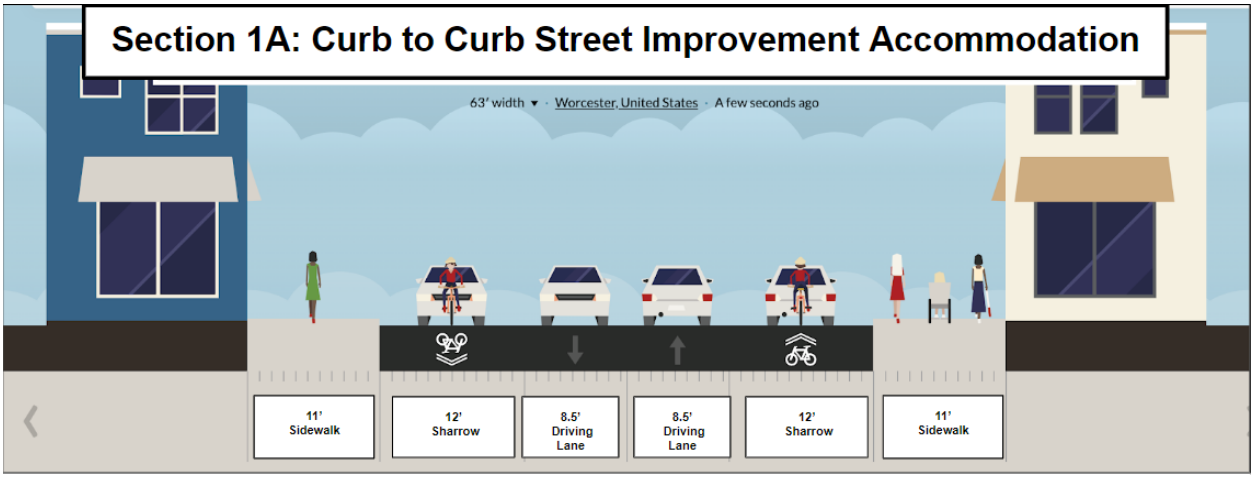


Figure 40*: Curb to Curb Street Improvement Accommodation, Section 1A*

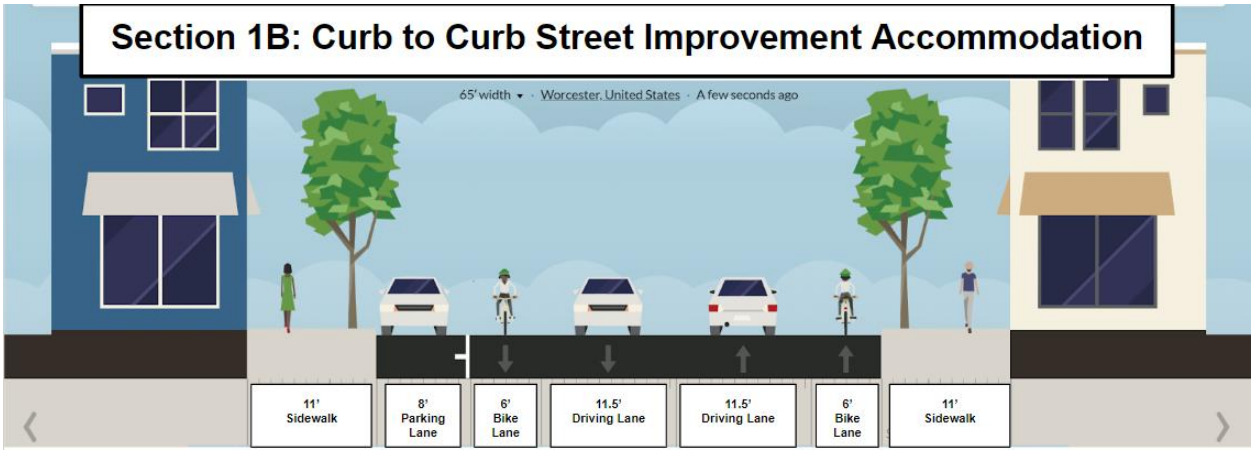


Figure 41*: Curb to Curb Street Improvement Accommodation, Section 1B*

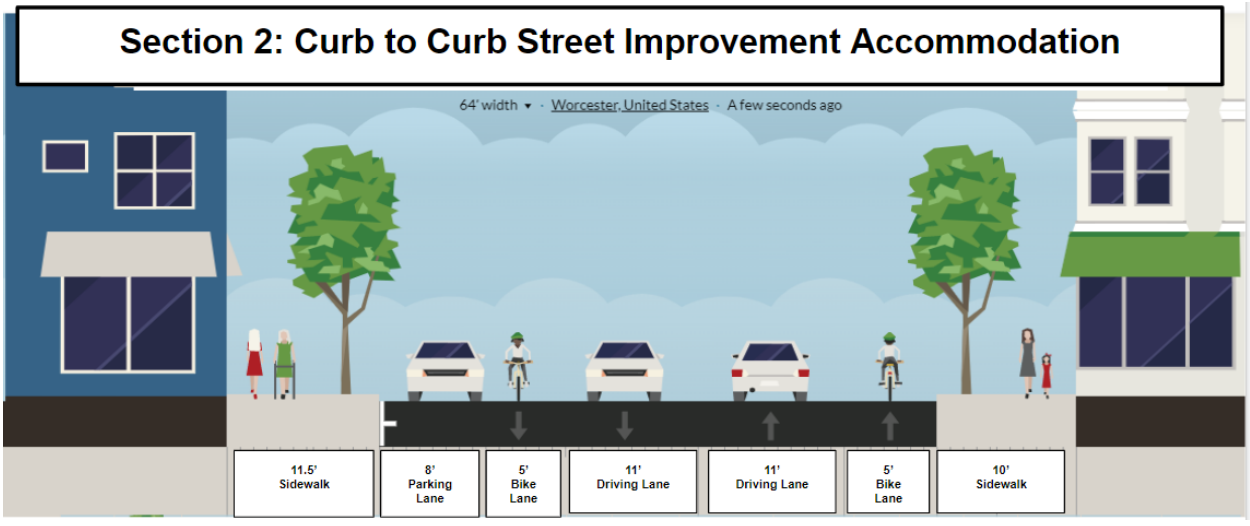


Figure 42*: Curb to Curb Street Improvement Accommodation, Section 2*

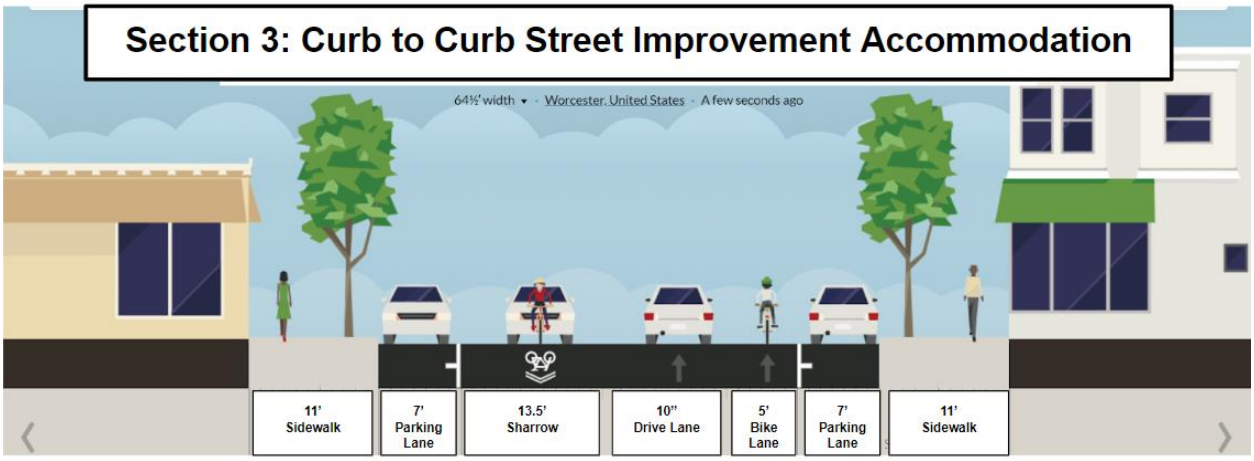


Figure 43*: Curb to Curb Street Improvement Accommodation, Section 3*

After deciding to eliminate the designs that included a bus lane accommodation, our group thought it was best to keep the given dimensions of the corridor and change the lane widths within the boundaries of the curbs. This allowed for our designs to include bike lanes while not drastically increasing the overall cost.

4.4 Improvements to other Issues on the corridor

Each section of the corridor can benefit from an increase in crosswalks as well as flashing crosswalk signs and new bus stop signs. We designed for extra crosswalks to be added near existing bus stop locations. This will help people cross the street near the bus stop they want to get picked up at without having to worry about jaywalking or getting hit by a traveling vehicle. The addition of crosswalks can be seen in Figure 44. The red crosswalks in the images are existing crosswalk locations on Lincoln Street and the gray crosswalks are locations in which our team deemed it necessary to add crosswalks.

Figure 44: ***Locations to Add Crosswalks***

Each street section would also benefit from added benches, trash and recycling receptacles, streetlights, and better signage in regard to crosswalks, bus stops, and store signage. The team recommends that a bench, trash can, and recycling can be placed near every bus stop location. This will be beneficial to those waiting at bus stops, giving them a chance to sit down to wait for the bus when it could be more straining on them to stand and wait. The trash cans and recycling cans will help create a cleaner street if used properly.

The addition of lights, better signage for crosswalks and bus stops, and better signage for store fronts work together to make the corridor safer and create a better aesthetic to bring out the culture of the street. There are many design opportunities to make the street safer and more vibrant and these examples are what the team believes should be prioritized the most in order to do so.

4.5 Cost Estimate

In order to provide cost estimates, our team utilized the Massachusetts Department of Transportation - Highway Division Construction Project Estimator (MASSDOT, 2019). The estimator provided an abundance of information and cost estimates involved in designing a road. By determining the costs of each design as well as each improvement (i.e, crosswalks, street-lights, and crosswalk signs) we were able to determine which designs and improvements were the most feasible from an economic viewpoint. The estimates that were involved in redesigning of the corridor are presented for the following categories: curb and gutter remodeling, restriping the road, implementing bike lanes, and other amenities that could improve the corridor.

4.5.1 Curb and Gutter Remodeling

In order to implement the "Complete Cross-Section" designs shown in section 4.3.2, we determined the cost of cutting out some of the corridor as well as remodeling the curb once it was cut back. Based upon the MASSDOT Construction Project Estimator, we determined the costs for each of the three sections, seen in Table 6 .

Curb and Gutter Remodeling							
Section #	Description	Unit of Measure	Unit Price	Total Quantity	Price	Contingency (20%)	Total Cost
Section 1	Curb and Gutter Remodeled	FT	$100/ft	3248 ft	$324,800	$59,280	$384,080
Section 2	Curb and Gutter Remodeled	FT	$100/ft	2200 ft	$220,000	$44,000	$264,000
Section 3	Curb and Gutter Remodeled	FT	$100/ft	2072 ft	$207,200	$41,440	$248,640
Totals				7,520 ft	$752,000	144,720	$896,720

Table 6: ***Curb and Gutter Cost Estimates***

After running the Construction Project Estimator to give a basis for the number of feet that would need to be cut back and remodeled along the corridor, it was evident that this process would be extremely costly.

4.5.2 Restriping the Corridor Based Upon Preliminary Designs

The next cost estimate that our team determined was the cost to restripe the road for each of our preliminary designs. This allowed our team to evaluate each design by seeing side by side cost estimates for the curb to curb designs as well as the complete cross section designs for sections 1, 2, and 3. In order to create this cost estimate, we determined the total linear length of each striping. The cost estimates of restriping the road can be seen in Table 7.

Cost Estimates for Restriping Road							
Section #	Accomodation Type Improvement	Length of Section (Feet)	Unit Price	# of Lines Needed	Cost	Contingency (20%)	Total Cost (Cost + Contingency)
Section 1A	Curb to curb	150 ft	$0.47/ft	3	$212	$42	$254
	Complete Cross Section	150 ft	$0.47/ft	4	$282	$56	$338
Section 1B	Curb to curb	1474 ft	$0.47/ft	2	$1,386	$277	$1,663
	Complete Cross Section	1474 ft	$0.47/ft	4	$2,771	$554	$3,325
Section 2	Curb to curb	1099 ft	$0.47/ft	2	$1,033	$207	$1,240
	Complete Cross Section	1099 ft	$0.47/ft	2	$1,033	$207	$1,240
Section 3	Curb to curb	1037 ft	$0.47/ft	3	$1,462	$292	$1,754
	Complete Cross Section	1037 ft	$0.47/ft	2	$975	$195	$1,170
Totals							$10,984

Table 7: ***Restriping Road Cost Estimates***

It is important to note that cutting back the sidewalk and adding more room within the corridor in the complete cross-section designs do not necessarily mean that it would cost more to restripe the road. Many of the existing street lines are in excellent condition and would not need to be repainted. If the GHNA decides that they want to repaint all of the street lines, then the costs for restriping the road will increase in some of the sections.

4.5.3 Bike Lanes

The team felt it was important to provide cost estimates for the bike lanes themselves because of the significant impact they have on making the corridor safer and more accessible to bicyclists. The bike lane cost estimates are separate from the line painting cost estimates because there is much more detail that goes into implementing bike lanes. Bike lanes need proper signage along the corridor, both on the pavement as well as street signage. Based upon the MassDOT cost estimator, we were able to determine that the average unit price per mile for implementing a bike lane costs around $30,000. We were able to use this price along with the length of each section and the number of lanes involved in each accommodation type to determine a cost for each design. The estimated costs for implementing bike lanes into the various sections and accommodation types can be seen in Table 8.

Cost Estimates for Implementing Bike Lanes							
Section #	Accommodation Type Improvement	Length of Section (meter)	Avg. Unit Price per Mile	# of Bike Lanes	Price	Contingency (20%)	Total Cost
Section 1A	Curb to Curb		$30,000	N/A	N/A	N/A	N/A
	Complete Cross Section	45 m	$30,000	2	$2,000	$400	$2,400
Section 1B	Curb to Curb		$30,000	2	$20,500	$4,100	$24,600
	Complete Cross Section	450 m	$30,000	2	$20,500	$4,100	$24,600
Section 2	Curb to Curb		$30,000	2	$16,000	$3,200	$19,200
	Complete Cross Section	335 m	$30,000	2	$16,000	$3,200	$19,200
Section 3	Curb to Curb		$30,000	1	$7,500	$1,500	$9,000
	Complete Cross Section	316 m	$30,000	2	$15,000	$3,000	$18,000
Total			$30,000				$117,000

Table 8: ***Implementing Bike Lanes Cost Estimates***

4.5.4 Safety Improvements and Other Amenities

The next cost estimates that were determined were the improvements that could help make Lincoln Street a safer and more aesthetically pleasing corridor. Table 9 shows the various

items that we focused on as well as the number of each item that we felt would be appropriate to implement into the corridor. The prices associated with each item were determined by researching the unit costs of each and finding items that could make a positive impact based off of pricing and ratings. We felt as though it was best to include a 20% contingency cost based upon our feedback from the Worcester Transportation planners due to examples of past projects that they have worked on.

Cost Estimates For Safety Improvements				
Item	# Needed	Unit Cost	Contingency (20%)	Total Cost
Crosswalk Signs	30	$1,327	$265	$47,772
Vertical Crosswalk Signs	15	$125	$25	$2,250
Street Lights	37	$259	$52	$11,543
Park Bench	12	$528	$105	$7,603
Trash Cans	12	$319	$63	$4,593
Recycle Cans	12	$450	$90	$6,480
Removal of Overgrown Vegetation	40 hrs	$25	N/A	$1,000
Street Trees/ Shrubbery	35	~$100	$120	$4,200

Table 9: ***Safety Improvements and Other Amenities Cost Estimates***

Crosswalk Signs: The team feels that it is necessary to improve the crosswalk signs located at the crosswalks along the corridor. We determined that the number of crosswalk signs needed is 30, with the addition of the crosswalks in the designs we came up with. Figure 45 shows the style of crosswalk signs that we recommend adding to the corridor. The signs would help to improve the safety for pedestrians crossing the street because of their ability to capture the driver's attention by flashing LED lights.

Figure 45: ***Manual on Uniform Traffic Control Devices (MUTCD) Crosswalk Sign***

Vertical Crosswalk Signs: Vertical crosswalk signs can also improve safety for pedestrians and drivers within a street. These signs are relatively low-cost and can be implemented at any time. These in-street signs will reduce drivers' speeds due to the sign being in the middle of the street which provides a better visual for drivers to see. Our team believes that implementing a single in-street sign at each crosswalk location would be most beneficial. Figure 46 is an example of what an In-Street Crosswalk Sign looks like.

Figure 46*: In-Street Crosswalk Sign*

Street Lights: Improving upon the street lighting can play a crucial impact in making the corridor safer for all parties when traveling at night. We recommend replacing all of the street

lights along the corridor with brighter lights due to the present lighting situation. Improving the lighting by implementing LED street lights, seen in Figure 47 below, will increase visibility at night for all users of the corridor. The height of the lights would not cause a hazard for drivers.

Figure 47*: Possible Overhead Street Lighting*

Park Bench: Park Benches play a vital role in strengthening the aesthetic nature of a neighborhood. They allow pedestrians the chance to sit and enjoy the environment or to just stop to rest. The team recommends that park benches be installed at every bus stop location. This will allow pedestrians to sit and wait for public transportation. Figure 48 is a possible type of bench that could be used along the corridor.

Figure 48*: Outdoor Park Bench*

Trash Cans: Trash cans along a street help to improve the cleanliness and aesthetic feel of a street. Having trash receptacles allows residents and pedestrians to properly dispose of waste

rather than littering in the street or along the sidewalks. Our team encountered several pieces of garbage during our site visits. We recommend that each bus stop location be equipped with a trash receptacle. Figure 49 is a type of trash receptacle that could be used for the outdoors and would limit pedestrians to stack a large amount of trash due to the small opening on top.

Figure 49: ***Outdoor Trash Receptacles***

Recycle Cans: Similar to trash cans, the addition of recycling cans along the corridor could help to keep the corridor cleaner as well as more environmentally friendly. By adding a recycling can next to each trash can, similar to the one seen in Figure 50 below, the street would be able to improve upon the overall cleanliness.

Figure 50: ***Outdoor Recycling Receptacles***

Street Trees/Shrubbery: While Lincoln Street already has trees along its sidewalks, there are actions that could improve their aesthetic appeal and safety. Many of the street tree beds have very little mulch and act as potential tripping hazards. Stakeholders that participated in the Walk

Audit noticed and pointed this out. Improving the existing trees would improve the aesthetic appeal along the corridor and help improve the safety for pedestrians. Figure 51 is an example of the aesthetic appeal that street trees bring to a city and a street.

Figure 51: ***Example of Street Trees***

Removal of Vegetation/Shrubbery: There are several locations along the corridor that limit pedestrians from walking down the sidewalks due to overgrown vegetation. Overgrown vegetation not only is dangerous for pedestrians, but also for drivers. If it is during the evening hours and there is a pedestrian who has to step into the street in order to get past overgrown vegetation on the sidewalk, then that puts the driver and walker at risk. Our team recommends that there should be a cleanup along the sidewalks for the removal of overgrown vegetation.

4.6 Design Criteria and Selection

In order for our team to recommend a final design, we scored the curb to curb street improvement designs as well as the complete cross-section improvements for each section. We scored the designs based on affordability, safety, and transit accessibility. In order to differentiate between the importance of these three categories we assigned each a weight based upon the input from our sponsors of the Green Hill Neighborhood Association. After conversing with our sponsors, we found it best to weigh safety the highest, followed by affordability, and lastly

transit accessibility. Each of the design types were scored between 1 and 5, with 5 being the most preferred. The weights were then applied to the scores in order to pick the designs that corresponded best with the values of our sponsors and stakeholders. The scoring for the street designs can be seen in Table 10, "Scoring Rubric for Street Designs".

Scoring Rubric for Street Designs					
Scoring (1 Least Preferred to 5 Most Preferred)					
Section	Design	Affordability * (Weight=1.5)	Safety * (Weight=2)	Transit Accessibility * (Weight=1)	Total
1A	Curb to Curb Street Improvement	7.5	6	2	15.5
	Complete Cross-Section Improvements	4.5	6	4	14.5
1B	Curb to Curb Street Improvement	7.5	8	4	19.5
	Complete Cross-Section Improvements	1.5	10	5	16.5
2	Curb to Curb Street Improvement	7.5	8	4	19.5
	Complete Cross-Section Improvements	1.5	10	5	16.5
3	Curb to Curb Street Improvement	7.5	6	3	16.5
	Complete Cross-Section Improvements	1.5	10	5	16.5

Table 10: ***Scoring Rubric for Street Designs***

Based on the results of Table 10, it became clear to our team that the designs that best fit the values of our sponsors were our "Curb to Curb Street Improvement" designs for each section. The biggest differentiating factor was the cost differences between the designs. Although affordability came second in terms of the weights of importance of the three scoring categories, the difference in price was too large to ignore.

Along with the scoring of the street designs, we had to score the improvements to other safety issues and amenities as well. We used the same system as scoring the designs to score the safety and amenity improvements. The one change that was made was deciding to base the scoring off the categories of affordability, safety, and aesthetic. After corresponding with our sponsors, we determined it was best to weigh safety as the highest, affordability second, and

aesthetic third. Again, we scored each countermeasure and improvement on a scale of 1 to 5, with 1 being the least preferred and 5 being the most preferred. The scoring for each countermeasure with the weights applied can be seen in Table 11.

Scoring Rubric for Safety Improvements				
Scoring (1 Least Prefered to 5 Most Preferred)				
Countermeasure/Improvement	Affordability* (Weight=2)	Aesthetic* (Weight=1)	Safety* (Weight=3)	Total
LED Flashing Crosswalk Sign	4	5	15	24
Vertical Crosswalk Sign	10	5	9	24
Street Lights	6	4	15	25
Park Benches	6	5	9	20
Trash Cans	6	5	3	14
Recycling Cans	6	5	3	14
CrossWalks	8	4	15	27
Curb Extensions	2	3	15	20
Removing Overgrown Vegetation	8	5	9	22
Street Trees/ Shrubbery	10	5	6	21

Table 11: ***Scoring Rubric for Safety Improvements***

Our team determined that it was best to recommend any score that came out to be higher than 20, per request from our sponsors. The countermeasures that score higher than 20 are highlighted in green in Table 11. It is also important to note that ideally, all of the countermeasures and improvements listed above would be implemented along the Lincoln Street Corridor. However, in order to provide a realistic recommendation when it comes to affordability, we thought it was best to prioritize the countermeasures and improvements. It is our hope that as time goes on, all of the improvements can be implemented into the corridor.

5.0 Final Design and Implementation Plan

Once the final deliverables were presented to the Green Hill Neighborhood Association, an implementation plan was created to provide the GHNA with a prioritization plan of what needs to be improved and a funding plan to provide the GHNA with "Next Steps" options.

5.1 Prioritization of Improvements

The prioritization of street needs and other street amenities were based off of the scoring rubrics for the designs and the countermeasures and improvements. By using these rubrics, the team was able to decide which designs and countermeasures are the most realistic to prioritize for implementation. These designs and countermeasures were prioritized based on safety, affordability, and aesthetics. In these rubrics, previously discussed in Section 4.6, there are weights added to each factor of safety, affordability, and aesthetics which helped us determine which improvements should be prioritized first.

The chosen designs and countermeasures/improvements that the team believes the GHNA should focus on first are highlighted in green in the rubrics in Section 4.6. The green highlighted recommendations in these rubrics were put into a final table to provide a total cost for the prioritized final design recommendations which can be found below in Table 12.

Total Cost Estimates for Prioritized Final Design Recommendations		
Item	Quantity	Total Cost
Section 1A Curb to Curb Design	1	$305
Section 1B Curb to Curb Design	1	$26,263
Section 2 Curb to Curb Design	1	$20,440
Section 3 Curb to Curb Design	1	$10,754
LED Flashing Crosswalk Sign	30	$47,772
Vertical Crosswalk Sign	15	$2,250
Street Lights	37	$11,544
Crosswalks	8	$7,392
Removal of Overgrown Vegetation	40 hrs	$1,000
Street Trees/ Shrubbery	35	$3,500
Total		$129,133

Table 12*: Total Cost Estimates for Prioritized Final Design Recommendations*

5.2 Funding Options for Green Hill Neighborhood

After discussing with our sponsor from the CMRPC, Yahaira Graxirena, we were guided into researching more into the following funding options. These options are the most feasible and realistic for the Green Hill Neighborhood Association to pursue.

Transportation Improvement Program

Each Metropolitan Planning Organization (MPO) is required to develop a Transportation Improvement Program (TIP). The Transportation Improvement Program (TIP) of the Central Massachusetts Metropolitan Planning Organization (CMMPO) is a federally-required planning document that lists all highway, bridge, transit, and intermodal projects in the Central Massachusetts planning region that are programmed to receive federal-aid funding (FTA, 2015). The next steps for the GHNA include contacting the City of Worcester, while using our report as a recommendation, for consideration for the TIP development process. The transportation staff of

the CMRPC update the TIP project listing on an annual basis. Amendments and adjustments occur periodically. The GHNA can contact Richard Rydant who is a member of the CMRPC and deals with TIP updates. His phone number is (508) 459-3312 and his email is rrydant@cmrpc.org.

Submitting this report as a consideration in the TIP development process will increase the chances that our recommendations for Lincoln Street will be considered by the City of Worcester for improvements and funding. This may also increase the chances of the City of Worcester putting Lincoln Street on the list for Complete Streets.

Complete Streets

Complete Streets are streets designed and operated to enable safe use and support mobility for all users (U.S. DOT, 2020). The Complete Streets Organization aims to integrate people and place into the planning, design, construction, operation, and maintenance of transportation networks.

The MassDOT Complete Streets Funding Program should be pursued by the GHNA in order to gain assistance in redesigning the corridor to make it safer for walkers, bicyclists, and vehicle drivers. Lincoln Street is eligible to apply for assistance from Complete Streets because it meets their eligibility checklist of needing assistance. In order to get into contact with Complete Streets, the GHNA must first contact the City of Worcester transportation division. The GHNA needs to communicate the needs of Lincoln Street to the City in an effort to get on the prioritized list for Complete Streets. The GHNA can only use our report as a recommendation to the City of Worcester.

Chapter 90 Program

Another possibility for the GHNA would be to urge the City of Worcester to utilize some of their Chapter 90 funds to improve Lincoln Street. However, the GHNA cannot directly apply for funding through the Chapter 90 Program. This is because Chapter 90 provides money to cities and towns. The cities and towns use the money at their discretion for roadway improvements.

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Appendix A: Project Proposal

Redesigning Lincoln Street: Improving Safety, Aesthetics, and Access to Public Transportation

A Major Qualifying Project Proposal
of the A/B Term 2019 site in Worcester, MA,
submitted to the faculty of
WORCESTER POLYTECHNIC INSTITUTE

in partial fulfillment of the requirements for the
Degree of Bachelor of Science
by:

Brendan Chipman

Stephen Lauro

Michael Montano

Billy Mitchell

Submitted on:
(DATE)

Professor Suzanne LePage
Professor Michael Elmes

Capstone Design

This project focused on the Lincoln Street corridor between the intersection of I-290 and the intersection of Brittan Square in Worcester, Massachusetts. This team redesigned this corridor of Lincoln Street, thereby satisfying the needs of the Green Hill Neighborhood Association, as well as the requirement of students completing a Major Qualify Project (MQP) with a capstone design element prior to graduation. These requirements are set forth by Worcester Polytechnic Institute (WPI) to fulfill the criteria for Accrediting Engineering Programs by the Accreditation Board for Engineering and Technology (ABET).

Economic:

When choosing designs for Lincoln Street, cost will be analyzed in order to determine the most feasible designs. A grant has been awarded to the Green Hill Neighborhood Association to identify solutions for the corridor as well as being able to lay down the foundations for the first community transportation plan in Worcester. After the completion of the study, designs will be made by the MQP team. Our team will analyze the cost of certain materials that will ultimately be used in our designs. Furthermore, a cost-estimate will be completed in order to provide the Green Hill Neighborhood with an assessment of estimated pricing for the design.

Environmental:

Our designs will have an impact on the environmental aspects of Lincoln Street. Part of our project will focus on designing the corridor of Lincoln Street to provide a more aesthetic look and feel which will provide a more prominent cultural feel to the neighborhood. This will include designs which will limit overgrown vegetation on sidewalks. There are sections of the corridor which possess overgrown vegetation thus limiting the sight of walkers, drivers, and

bikers. In addition, our design will focus on providing the corridor with easier access to recycling.

Ethical:

This project abides by the ASCE Code of Ethics for all Civil Engineers so as not to damage the reputation of WPI or the Green Hill Neighborhood Association.

Social and Political:

This team became familiar with regulations and community objectives at the city and state level. The final recommendations of this team are in compliance with such regulations and take the needs of stakeholders into consideration. This team addressed the needs of Lincoln Street users by promoting the safe and efficient utilization of Lincoln Street by all modes of transportation and users no matter their socio-economic status.

Sustainability:

In order for our design to be successful, it must be one that offers a sustainable solution. Long-term improvement concepts were presented by this team with the goal of addressing present and future needs for the corridor. The final design and recommendations account for future traffic demands and population growth to ensure efficient use of this section of Lincoln Street over time.

Health and Safety:

This project addresses safety concerns by focusing on the improvement of sections of Lincoln Street with high crash rates and poor design. Countermeasures are ranked based on their ability to reduce the number of crashes at a given location so as to improve the safety of the corridor. This project will focus on creating a safer environment for the stakeholders of the

Lincoln Street corridor. This may include narrowing driving lanes, creating bike lanes, and proposing that more speed limit signs are installed along the corridor.

1.0 Introduction

Lincoln Street, located in the heart of Worcester Massachusetts, is home to a multitude of businesses and cultures. Also referred to as Route 70, it is comprised of mostly two lanes with a few turning lanes. Many different populations make up the 6,000 residents that call Lincoln Street home. Of the total population, 58% of residents are part of the United States minority based on ethnicity while 22.8% live below the poverty level. Approximately 17% of the total population are limited english speaking households, displaying Lincoln Street's cultural diversity (Transportation of Massachusetts, 2019). The residents of these populations utilize public transportation, bicycling, and walking in order to meet everyday needs (Transportation of Massachusetts, 2019).

Although Lincoln Street has been a staple of the Worcester Community for decades, in 2019 it is considered unsafe and deficient in several aspects (Personal Communication, Y. Graxirena and September 7th). This is evident, not only due to the fact that over the last few years there have been several accidents that have resulted in fatalities, but also because residents and employees fear for their lives while navigating through the street (Personal Communication, Lincoln Street Residents, 2019). Lincoln Street's driving lanes are very wide which usually results in drivers traveling even faster. In addition, there are several spots along the street where vegetation is overgrown, which limits the visibility of automobile drivers, bicyclists, and pedestrians who are walking. The lack of street lighting for after dark is another factor that plays into the deficiencies of Lincoln Street.

Figure 1*: Project Map, Green Hill Neighborhood and Lincoln Street (MassDOT)*

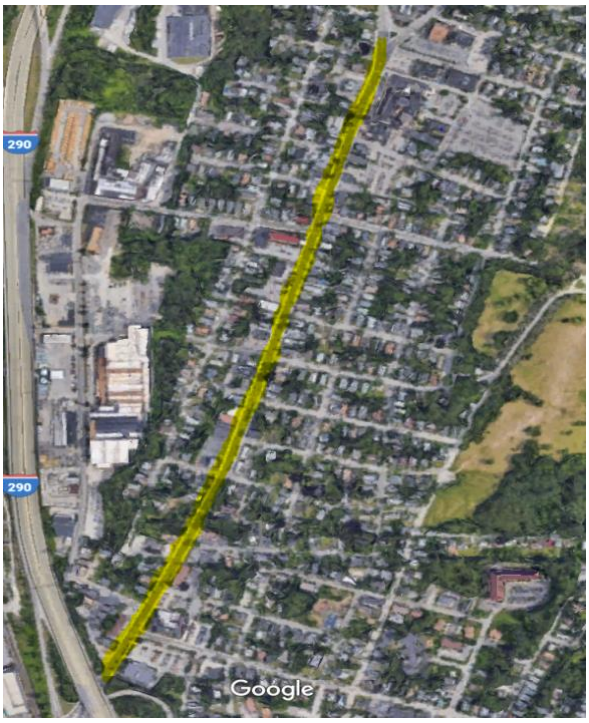

Figure 2: ***Project Map, Lincoln Street Corridor (Google Earth)***

The goal of our project is to reimagine Lincoln Street by creating designs that will improve safety, create more effective modes of public transportation, and provide a more aesthetically pleasing corridor. This corridor has been identified by the Green Hill Neighborhood Association (GHNA) as an area in need of improvements (D. Bolz and Y. Graxirena, personal communication, September 13, 2019). Pedestrians, bicyclists, and the transit-dependent population face multiple challenges ranging from a lack of bus shelters, benches, and signage stops to faded crosswalks and sharrows. When streets are not equipped with proper signage, pedestrians and bicyclists are at a safety disadvantage. Along with addressing the issues with safety and traffic congestion, providing an aesthetically pleasing corridor will enable the culture of the community to thrive.

In order to achieve our goal, our team plans on completing several objectives. Our objectives include:

- Analyze existing conditions of the Lincoln Street Corridor
- Create and analyze possible solutions to improve safety, traffic, and aesthetics of the corridor.
- Provide a cost-estimate for the possible solutions.
- Recommend a final design to the Green Hill Neighborhood Association

In the following chapters, our team will discuss the background research of the issues involving safety and traffic of the Lincoln Street corridor that we are working to re-design. The methodology provides a detailed outline of the steps taken in order to provide designs that will improve Lincoln Street's safety and enable effective modes of public transportation while also providing an aesthetic corridor which resembles the culture of the community. Finally, several

designs will be compiled and evaluated so the Green Hill Neighborhood Association can improve the Lincoln Street Corridor.

2.0 Background

The purpose of this section is to provide an overview of the organization that we are partnering with, the history of Lincoln Street, as well as the possible funding sources that could be utilized. This section discusses the Complete Streets program, corridor development plan, safety issues along a roadway, and the funding application for the Transportation Justice/Climate Initiative. In addition, this chapter goes into detail of the various problems that are currently occurring on Lincoln Street in terms of safety, lack of aesthetics, access to public transportation, and how these problems could potentially be resolved based on other case studies.

2.1 Worcester's Strategic Plan

Over the last few years the city of Worcester, Massachusetts has been working hard to rehabilitate certain sections of the city and by trying to redefine its image by become a well-respected city known for its culture, food, and environment. Worcester is in the midst of its Strategic Plan, which includes a three to five-year period of "Inclusion, Integrity, and Innovation" (The City of Worcester, 2019). Within this plan, the city has focused on several objectives that they wish to implement within the city. A few of these objectives are "Vibrant, Thriving Cities" and "Strong Neighborhoods" that focus on not only building the City of Worcester's economic state, but by keeping the safety and well-being of its residents as the number one priority. An example of an area that has benefited from such rehabilitation includes Shrewsbury Street and Main Street in Worcester. Shrewsbury Street is now home to over 40 local eateries that have boosted the culture and economy within the city while Main Street has solved many traffic issues in addition to filling empty storefronts.

While the city of Worcester has been working to improve several neighborhoods and communities, there are still a multitude of neighborhoods within Worcester containing empty

storefronts and unsafe infrastructure that would benefit from addressing these issues and looking to upgrade them. Within the city of Worcester the Green Hill Neighborhood located within the Lincoln Street corridor is one of the communities that would benefit from such an upgrade.

2.2 The Green Hill Neighborhood Association

The Green Hill Neighborhood Association is a non-profit organization made up of community members, police officers, and shop owners who collaborate amongst themselves in hopes to improve their community. Founded in 2013 by Winifred "Winnie" Octave and Waldir Cruz, The Green Hill Neighborhood Association takes pride in its neighborhood, always trying to find ways in which they can better their community. Also, a member of the Green Hill Neighborhood Association, Debra Bolz will be working as a sponsor for this project, helping the project team focus on important issues of the Lincoln Street corridor. Every last Monday of the month, the association holds a meeting in which the residents of the community can gather and discuss topics that are on their mind (Green Hill Neighborhood Association, 2019). These meetings are a time when city officials, policemen, and residents are able to discuss issues or ideas for improvements within the neighborhood. Ideas that have been brought up by members of the association include improving pedestrian safety, parking issues, and improving the aesthetics of the corridor.

2.3 Lincoln Street Corridor Demographic

The area surrounding Lincoln Street is a melting pot of many cultures and people from various ethnic backgrounds. Within the 1.345 square mile area surrounding the street, the following statistics are available based upon the data listed on City-Data.com. The total population within the Lincoln Street area is 5,776, giving the area a slightly less population

density than the average in the entire city of Worcester, MA. The following pie chart shows the distribution of the various races that live in this section of Worcester.

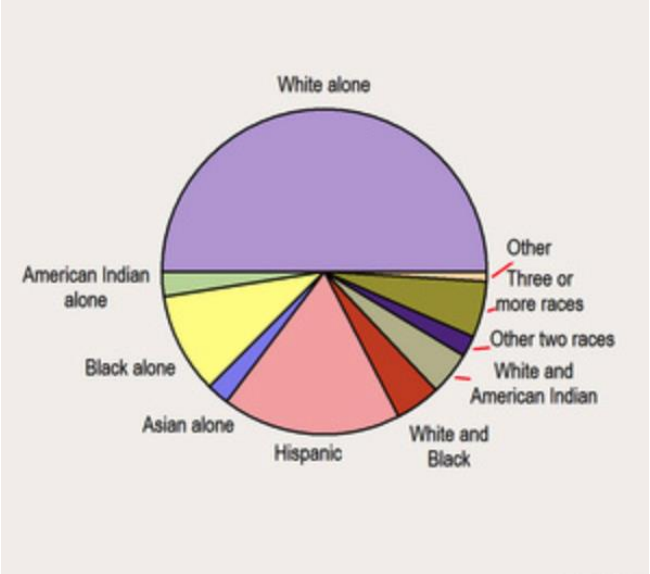

Figure 3: ***Race Distribution - Lincoln Street (City-data.com 2019)***

The area around Lincoln Street is displayed, with slightly larger than 50% of the population being a mix of races other than white.

Along with the cultural distribution, it is important for the average income of this area to be highlighted. This area has a history of being low-income compared to the Massachusetts median income. The average median income of the Lincoln Street area is $54,974, whereas the Massachusetts median income is $77,385 (Department of Numbers, 2017).

2.4 Pedestrian and Bicyclist Issues Involving Lincoln Street

Lincoln Street has had a history of issues involving the safety of pedestrians crossing the street as well as bicyclists commuting on the street and through intersections. Our sponsor from the Green Hill Neighborhood Association, Debra Bolz, has stressed the issue of the corridor not being a safe place for pedestrians to travel. The street does not have designated bike lanes, however there is signage within the vehicle travel lane, represented by sharrows. The picture

below displays signage for sharrows that is similar to the signage that exists currently on Lincoln Street. After taking a trip as a team to the corridor on Friday, September 13th, we noticed how poorly lit the street is at night. The poorly lit corridor creates a safety hazard for anyone who is trying to cross the street or ride a bike at night.

Figure 4: ***Sharing the Road with Sharrow (Seattle DOT, 2019)***

2.5 Congestion Issues Involving Lincoln Street

The area on Lincoln street from the I-290 Interchange north to its intersection with Burncoat Street faces many traffic congestion issues. On February 2, 2018, a map representing the daily traffic volumes for the Lincoln Street corridor was created. The traffic ranged from 7,500 to 14,999 (CMRPC, 2018) on the day the corridor was analyzed. The main streets, roadways, and interstates in Worcester are categorized into 5 ranks (colors) that depict the daily traffic volumes. Lincoln Street is the 3rd ranked (yellow) for volume of daily traffic.

There are two types of congestion and traffic that the Department of Transportation describes. The first type of congestion is recurring congestion. Recurring congestion is described

as the type of traffic that happens on a daily basis and is due to the lack of capacity on the road, or in other terms, the number of vehicles traveling at a given time cannot physically fit. The second type of congestion is non-recurring which the Department of Transportation describes as being "temporary" backups caused by bad weather, an emergency vehicle passing, or a vehicle accident (Department of Transportation, 2019). Recurring congestion is primarily due to the infrastructure of the road. The roads and streets cannot physically fit the influx of vehicles at certain times of the day on Lincoln Street. These times are specifically during rush hour in the morning and during the evenings. Traffic is the worst during evening hours from 3:30 pm to 5:30 pm. In the mornings, traffic is not nearly as prominent as the later afternoon (personal communication, D. Bolz, September 27,2019).

2.6 Complete Streets

Complete Streets is a funding program provided by the Massachusetts Department of Transportation whose mission is to help provide safe and accessible options for all methods of travel. This includes walking, biking, and driving. The program's focus is to help provide both construction funding and technical assistance for municipalities that qualify by passing a Complete Streets policy and then providing a prioritization plan. In order to be considered for the Complete Streets Program, applicants must complete a three-tier process. Municipalities must attend a program workshop, pass a Complete Streets Policy score of 80 or more and develop a Complete Streets Prioritization Plan to be eligible for construction funds. A local example of the Complete Streets program funding a project was in 2017 Newton, MA (Newman 2017). The town of Newton received $400,000 in state funding from the program and used it towards funding the installation of a new traffic light, curb extensions, new sidewalks, wheelchair ramps,

accessible pedestrian signals, bicycle detection, signage, and pavement markings (Newman, 2017).

Complete Streets improvements are designed to be context sensitive, which means they aim to incorporate improvements that fit the community they are being implemented within. They are also designed to help encourage alternative methods of transit such as walking, biking, or public transportation. Improvements can often include widening existing corridors to accommodate bike lanes, turning lanes, new crosswalks, added bus stops, added lighting, pedestrian accommodations like median refuge islands, improved connections to transit, and altered signal timing to decrease congestion and increase pedestrian safety (Complete Streets Funding Program Guide, 2019).

2.7 Corridor Development Plan

While a complete street is a street available for usage by all modes of transportation, a corridor development plan is a broader plan that could be used to make a corridor into a complete street, but this is not always the case. Corridor planning is the coordination of transportation and land use activity within a linear area, usually along a major transportation link, such as a state highway. Corridors can be defined narrowly, to include only one road and its adjoining land use, or more broadly to include a network of parallel routes and transit lines (Delaware Valley Regional Planning Commission., 2007). Corridor plans provide state departments of transportation, local governments, landowners, developers, and residents along the corridor with an overall guidance and coordination on what future infrastructure improvements are needed for the corridor. Corridor plans often include descriptions of capital improvements, implementation phasing, access and circulation issues, and protected lands

(Delaware Valley Regional Planning Commission., 2007). Some examples of typical studies that may warrant a corridor development plan include; congestion, inappropriate speeds on the corridor, lack of alternative transportation modes, lack of sidewalk and bike infrastructure, and an overall unattractive street environment.

In Massachusetts, the Massachusetts Department of Transportation manages transportation projects and planning studies like corridor development plans. The MassDOT works to develop master plans on major roadways and corridors to help guide improvements and safety (Massachusetts Department of Transportation, 2019b). One example of how the Massachusetts Department of Transportation is using a corridor development plan locally is in and the Town of Shrewsbury. MassDOT is working to develop a master plan for the Route 20 corridor in Shrewsbury in hopes of guiding future designs and improvements to address congestion and safety (Massachusetts Department of Transportation, 2019b). On MassDOT's website it is clear that transportation studies are done more often than corridor development plan studies with fewer corridor studies represented. While transportation studies and corridor plans are sometimes used interchangeably, corridor plans are used less because the implementation of corridor development plans take a tremendous amount of time, with the route 20 master plan in Shrewsbury expecting to be a 20-year implementation plan. The corridors are chosen based on things such as; high value-to-price ratio through developing projects that return investment and are priced realistically, immediate safety issue concerns, and a strong need for better design (Delaware Valley Regional Planning Commission, 2007). It is hard for the state to be able to help each corridor in need, due to the high volume of streets that need improvement throughout the state. Therefore, it is of vital importance to meet the state's requirements for a realistic and feasible corridor design.

2.8 Studying Traffic and Safety Issues

In addition to meeting the operational traffic needs of a given corridor, it is important to keep in mind the safety needs as well when designing traffic improvements. According to the Highway Safety Manual published by the American Association of State Highway and Transportation Officials (AASHTO) in 2010, the quantitative method for managing road safety is broken down into a six-step cycle. The first step is to conduct a network screening where the main focus is to identify locations along the given corridor that would benefit most from safety improvements. In network screening, the safety performance of each individual location is compared to similar locations to determine if the safety performance of the subject location is acceptable.

The next step is to diagnose contributing factors to crashes at the various locations identified by the network screening. Once the crash factors have been determined, potential countermeasures are listed based on their effectiveness to mitigate the locations traffic problems. Subsequently, an economic appraisal of each potential countermeasure must be conducted as well to determine if the countermeasure is economically feasible. In these steps, multiple countermeasures will often be provided because some may be better suited than others in terms of safety improvement factor or economic feasibility.

The prioritization of countermeasures is the next step where the goal is to choose countermeasures that maximize safety benefits and crash reductions while being mindful of budgetary restrictions. Once countermeasures have been chosen and implemented, the final step is to conduct a safety effectiveness evaluation. This entails monitoring and assessing implemented solutions on their safety and crash reduction effectiveness. This step helps practitioners make informed decisions about each countermeasure's effectiveness. The road

safety management process does not end, however, it is instead a continuous cycle of attempting to improve the safety of a given corridor or location (Office of Safety, 2019).

2.9 Congestion Reduction and Safety Improvements

Methods for solving traffic congestion vary depending on the existing conditions of the intersection or corridor. These conditions can include pedestrian, vehicle, and bicycle traffic, as well as the width of the corridor, the number of lanes, and rush-hour. Based on the combination of these conditions, solutions can be formed and implemented to help ease traffic flow in a safe and logical manner.

In addition to easing congestion, both driver and pedestrian safety are of the utmost importance when improving the design of an intersection or corridor (Massachusetts Department of Transportation). A balance between traffic congestion and safety are required to make the street both easy flowing and safe for all.

One method to help improve the corridor safety is to install traffic calming techniques such as neckdowns, raised crosswalks, or flashing radar speed signs. All of these methods cause the driver to reduce their speed without altering the actual speed limit of the roadway. In conjunction with the installation of a neckdown, which would narrow the street and leave room for aesthetics, a protected bike lane could also be installed between the sidewalk and the street. This way the neckdown acts as a barrier from vehicles for both pedestrians walking along the sidewalk and riding bikers. A con to this improvement, however, is that it limits the amount of parking that could be placed along the sidewalk (How Traffic Calming Works, 2019).

In terms of the increasing safety at the corridors' intersections, one type of improvement is programming traffic lights to alter their patterns based on the time of day and traffic and

pedestrian volume. In addition, the lights should also be programmed with a timed grace period to allow pedestrians to have a headstart crossing before traffic resumes. To protect drivers at intersections, a protected left turn sign could be installed to limit confusion as when to turn or yield on green.

2.10 Funding Application

The Green Hill Neighborhood Association (GHNA) was awarded the 2019 Transportation Justice/Transportation and Climate Initiative in 2018. GHNA requested $7,500 in order to identify solutions for the Lincoln Street corridor and lay down the foundations for the first community transportation plan in Worcester. The GHNA, through this grant, plans on having several partners which include neighbors, health institutions, faith groups, schools and other organizations within the community. Two of the organizations will include Walk/Bike Worcester and Boston. These organizations help communities promote pedestrian safety by means of walking and biking. The GHNA has envisioned the funds to maximize the community engagement efforts and hire technical assistance to perform a traffic study, and connect with organizations to do walk and bike infrastructure assessments.

This project directly affiliates with the plans that the Green Hill Neighborhood Association has in store for their community. We will be partnering with the GHNA in order to provide designs which will improve safety, enable easy access to public transportation, and improve the aesthetic feel and look to the corridor of Lincoln Street.

3.0 Methodology

The goal of our project is to Re-Imagine Lincoln Street by creating designs that will improve safety, create more effective modes of public transportation, and provide a more aesthetically pleasing corridor. The following methods will be used to facilitate our overarching goals:

- Analyze existing conditions of the Lincoln Street Corridor
- Create and analyze possible solutions to improve safety, traffic, and aesthetics of the corridor.
- Provide a cost-estimate for the possible solutions.
- Recommend a final design to the Green Hill Neighborhood Association

In order to reach all of the previously mentioned goals, we have created a schedule to guide our project throughout B-Term. The schedule can be seen in the figure below.

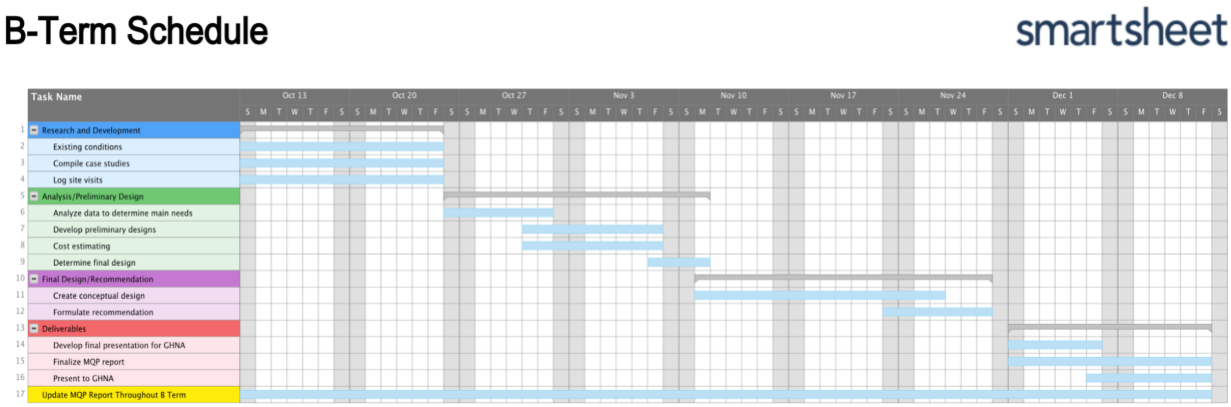

Figure 5: ***B-Term Schedule (smartsheet.com)***

3.1 Analyze Existing Conditions of the Lincoln Street Corridor

The first object is to gather data and information in regards to the existing conditions of the Lincoln Street corridor. This objective will entail multiple different approaches. These approaches will be discussed in the following sections.

3.1.1 Compiling Site Visits

The first sets of data will be comprised of observations recorded during site visits. These observations will include focusing on congestion areas, pedestrian behavior, and public transportation routes. These visits will occur on weekdays during morning hours (8:00 am - 11:00 am), afternoon hours (3:00 pm - 5:00 pm) and evening hours (later than 6 pm). The factors that affect safety and public transportation will differ throughout the day. This will allow our team to obtain a variety of data. While on the visits, different measurements of the corridor will also be recorded. This will include the widths of driving lanes, parking lanes, and sidewalks.

3.1.2 Walk Audit

The team will participate in a Bikeability and Walkability Audit set to take place in October of 2019. This audit will be done in order to gather observations and data on the existing conditions of the Lincoln Street Corridor in regard to pedestrian safety and accessibility. Professionals from the WalkBike Worcester Organization, will lead our team, as well as stakeholders of the Lincoln Street corridor, through the process of a WalkBike audit. This process includes walking down the entire corridor starting from the intersection of Catherine Street and Lincoln Street and ending at Brittan Square (Burncoat Street Intersection). While on the walk, individuals will note any observations or suggestions for improving the safety of the Lincoln Street corridor based on the WalkBike audit criteria.

3.1.3 Intersection Crash Data

Crash data relating to the corridor will be obtained from the Central Massachusetts Regional Planning Commission (CMRPC) and the MassDOT website. This data will allow our

team to complete crash diagrams for several intersections of the corridor of Lincoln Street. These diagrams will enable our team to determine the patterns of accidents and identify possible solutions to mitigate crashes. The data that we will be analyzing includes crash data and clusters from 2014 to 2016.

3.1.4 Public Transit Data

Public transit data will be obtained from our project sponsor, the GHNA, and a transportation planner from the CMRPC. Our sponsor will provide data on Ridership Information by Route and Stop for the average weekday in the month of January 2019. The Running Times data by trip and the On-Time Performance per route will also be given for routes 14, 23, and 26, all of which are bus routes for Worcester Regional Transportation Authority (WRTA). All of the aforementioned routes have corresponding transit stops and service stops along the corridor.

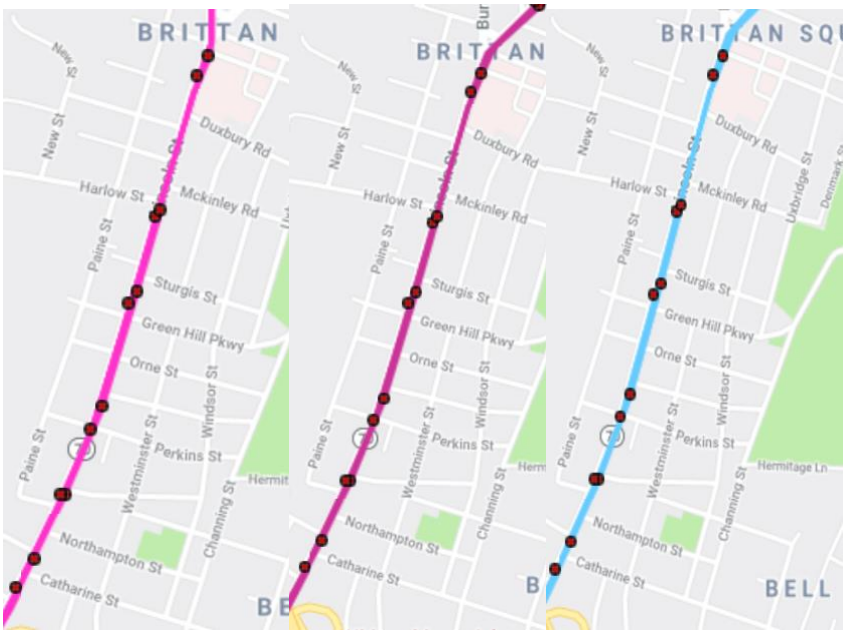

Figure 6: ***Bus Routes 14, 23, and 26 Respectively Through Lincoln Street Corridor (Worcester Regional Transit Authority, 2019)***

3.1.5 Stakeholder Input and Design Criteria

While collecting data is crucial for the project, obtaining the various perspectives of the Lincoln Street stakeholders is just as important. The recommendations, observations, and thoughts of the individuals who go through the corridor on an everyday basis will provide deeper insight into the corridor's current state. The Division of Public Health (DPH) has created a survey that the residents, business owners, and employees of the Lincoln Street corridor will complete. Once this survey is distributed and completed by the Lincoln Street stakeholders, our team will obtain the survey results by contacting Penelope Karambinakis, the employee at the DPH responsible for facilitating this survey.

Our team will also be contacting the City of Worcester's Transportation Planner, Brian Pigeon, to clearly define the design criteria needed to meet the city's Complete Streets Policy. By defining the required criteria, our team will be able to identify and address the areas of concern of the corridor. It is crucial to ensure that any designs created adhere to the criteria of the city's Complete Streets policy. This would not only support that the design is feasible, but could help in acquiring funding from the Complete Streets program.

3.1.6 Characterization of Corridor Segments

The Lincoln Street corridor has distinct areas such as areas with businesses and areas that are residential. It would not be beneficial to design the entirety of the Lincoln Street corridor based on the needs of the residential area. Rather, it would be more beneficial if certain areas of the corridor were designed specifically for their needs, and then combined into one final design

for the entire corridor. For example, there are spots on the corridor that have bus stops, while others do not. Those specific sections of the corridor should be designed differently than that of a section of the corridor that does not have a transit stop. The different sections will be determined based on our previous data collection and site visits.

3.2 Create and Analyze Possible Solutions to Improve Safety, Traffic, and Aesthetics Within the Corridor

Based on the data of the existing conditions, the perspective of various stakeholders, and researched case studies, we will analyze potential solutions based on several factors. These factors include improvement to safety, public transportation needs of the community, cost, and aesthetics of the corridor. With all of these factors analyzed our team will create packages of designs that are focused on these respective factors. The possible solutions that our team determines will be discussed with the Senior Transportation Planner for the City of Worcester.. Based upon the feedback from the Senior Transportation Planner, we will determine whether or not to further develop our solutions. These possible solutions will allow Green Hill Neighborhood Association to not limit themselves to one solution, rather they will have a variety of solutions that they could implement in the future. With that being said, our team will provide which of these solutions we believe should be preferred and support it with numerous reasons why.

3.3 Provide a Cost-Estimate for the Possible Solutions

In order for the team to make selections for what countermeasures and improvements will be included in our final design, we will need to determine how much each one will cost. By conducting research from case studies involving street improvements, we will be able to provide

an estimate for each corridor improvement. This will allow us to weigh options and solutions that we determine by comparing how economically feasible each solution is, further narrowing down the scope of our implementation. A cost analysis will also allow our team to use our scoring rubric, which is explained in section 3.3.1, to rank how effective each improvement will be compared to each other.

Once the costs estimates for implementing our countermeasures and improvements are determined, we will research potential sources of funding for the GHNA to carry out our recommendations. Providing possible sources of funding for the GHNA will help guide them with further implementation steps once our design is recommended. These sources of funding could potentially come from the city of Worcester, as well as fundraised by the community of Lincoln Street. This step in our recommendation will set the GHNA up with a realistic plan for implementation.

3.3.1 Scoring Rubric

After communicating with our project sponsors, it will be important to clearly define how we will score each of our countermeasures and improvement ideas as well the categories that we will focus on. By creating a rubric, we will be able to provide a quantitative measure that we will allow us to compare the cost of each countermeasure and improvement to the quality of the improvement. The four categories that we will focus on are as follows:

A. Affordability
B. Appearance
C. Safety

Within each of these categories, we will use a quantitative scoring scale of 1-5 for each countermeasure and improvement. A score of "1" shows that the countermeasure has a strong negative impact in a category, a "2" means slightly negative, a "3" means no impact on the category, a "4" means slightly positive impact, and a "5" means a strong positive impact. The scoring of each countermeasure compared to each of these categories will be determined by our team based on our research of the existing conditions of Lincoln Street, along with our research of case studies. This will make it clear to us which of the countermeasures and improvements we come up with are the strongest, and which one we need to leave behind in our efforts of creating a final design. The criteria for how we plan to use each of these categories is as follows:

A. **Affordability** - Based upon our cost estimates of implementing each improvement to Lincoln Street, we will assign a score of 1-5. A score of "1" will mean that the improvement is not very cost effective due to its high cost. A score of "5" will mean that the improvement is very cost effective due to its low cost. Once we are able to determine all of the cost estimates for each improvement, we will be able to set price ranges for our scoring, allowing us to see how economically feasible each option is compared to the price ranges.
B. **Appearance** - When it comes to appearance, a score of "1" will show that the improvement lacks aesthetically pleasing qualities, whereas a score of "5" will show high aesthetically pleasing qualities.
C. **Safety** - In order to score safety, we will analyze how well each countermeasure improves upon the safety of the corridor for pedestrians, bicyclists and motorists. A score of "1" will display that the countermeasure does not improve upon the safety, whereas a

score of “5” will show that the countermeasure has a significant impact on improving the safety of the corridor.

3.4 Select the Final Design

The final design for the project will include a design that represents different cross sections of the Lincoln Street Corridor. The focus will be on areas of the corridor that are in need of improvements. This design will be our team’s final recommendation in which we see as most feasible for the Green Hill Neighborhood Association to implement in the future. The final design will consist of different cross sections that were characterized in the previous objectives. For example, the residential sections of the corridor and the business front sections of the corridor will have different design elements that provide the most beneficial solutions respectively. The design of the sections will differ based on residential or shop fronts, as well as the differences in width of the sidewalk in different sections of the street. Each final design will be presented through a software called Streetmix (Streetmix, n.d). Within this software, the user is able to provide a visual of the cross section of a specific roadway. In our project’s case, it will be of the certain spots that our team deems most important to specific stakeholders. Streetmix enables the user to design specific lengths or sidewalks, driving lanes, bike lanes, etc. The software will allow Green Hill Neighborhood Association to have a visual representation of what the cross section of the street would look like if the designs were to be implemented.

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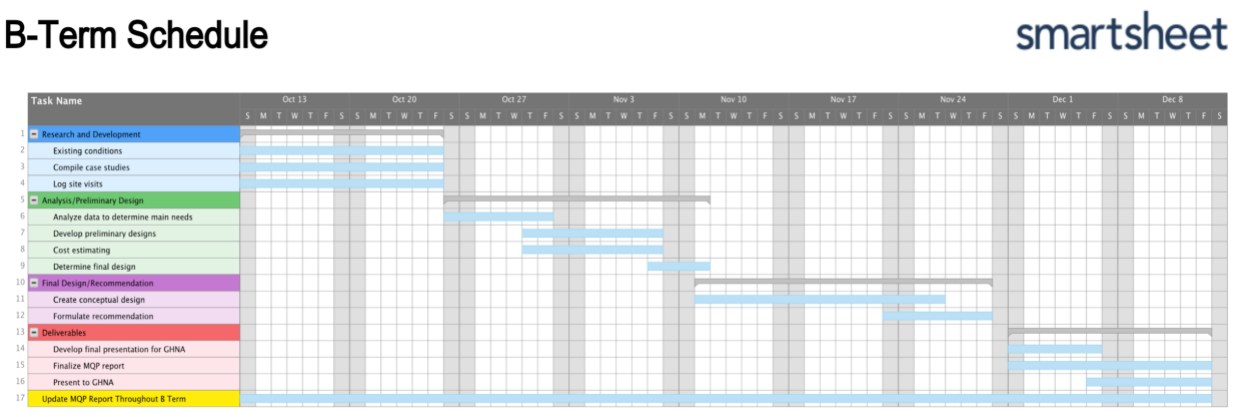


Appendix B: Walk Audit

walkBoston™

Mass in Motion
Better health. It's your move.

Green Hill Neighborhood Walk Audit
Worcester, MA

November 2, 2019

With funding from the Massachusetts Department of Public Health Mass in Motion Program

MAKING MASSACHUSETTS MORE WALKABLE

Old City Hall | 45 School Street | Boston MA 02108 | T: 617.367.9255 | F: 617.367.9285 | info@walkboston.org | www.walkboston.org

Background

On November 2, 2019, WalkBoston conducted a walk audit in the Green Hill Neighborhood of Worcester, MA. This walk audit was completed through the Massachusetts Department of Public Health's Mass in Motion Program, which grants funding and provides technical assistance to help communities improve access to healthy food and lead more active lifestyles. WalkBoston has been providing technical assistance to Mass in Motion projects throughout the state.

The goal of the walk audit was to provide recommendations to make the Lincoln Street corridor of the Green Hill neighborhood a safe, comfortable place to walk. The Green Hill Neighborhood walk audit was conducted along Lincoln Street from Harlow Street to Catharine Street.

MassDOT's crash data indicate 14 pedestrian-involved crashes in the Lincoln Street study area since 2016. In September 2019, there was a pedestrian fatality on Lincoln Street near the Catharine Street intersection. A map of the pedestrian-involved crashes along the walk audit route for the last three years is shown to the right.

Pedestrian crash map source: MassDOT IMPACT portal

The Green Hill Neighborhood association was awarded a Transportation Justice grant from Transportation for Massachusetts (T4MA) to "reimagine" Lincoln Street from Brittan Square to the Nativity School. As a part of this grant project, Green Hill residents hope to improve the safety and comfort of the walking environment in their neighborhood. The neighborhood association has been working with students from Worcester Polytechnic Institute (WPI) to develop a re-design of Lincoln Street corridor that makes this street a better place for all road users with enhancements that support people walking, biking, and using transit.

Key Recommendations

1. Install clearly marked, visible, accessible crosswalks at high pedestrian utilization locations along Lincoln Street
2. Enhance pedestrian visibility at existing Lincoln Street crosswalks
3. Improve the level of comfort for people walking in the Green Hill neighborhood by adding features that make Lincoln Street feel like a place for all modes of travel, not just cars
4. Implement traffic calming strategies to slow vehicle speeds on Lincoln Street
5. Improve the connection between the bus system and the pedestrian network to increase the safety of local transit users
6. Improve the connectivity and visibility of the neighborhood's Green Hill Park

Walk Audit Participants

Name	Organization
Deb Bolz	Green Hill Neighborhood Association
Winifred Octave	Green Hill Neighborhood Association
Edith Morgan Froehlig	Green Hill Neighborhood Association
Yahaira Graxirena	Central Massachusetts Regional Planning Commission
Karin Valentine Goins	WalkBike Worcester
Amy West	WalkBike Worcester
Denis Kennedy	WalkBike Worcester
Penelope Karaminakis	Worcester Division of Public Health
Kelsey Hopkins	Worcester Division of Public Health
Gabrielle Peloquin	Worcester Division of Public Health
Alyssa Llewelyn	Worcester Division of Public Health
Emilia Noyes	Worcester Division of Public Health
Amy Borg	Worcester Division of Public Health
Michael Montano	WPI
Brendan Kearney	WalkBoston
LeighAnne Taylor	WalkBoston

Walk Audit Route

Participants met at St. Bernard's Church of Our Lady of Providence Parish in the Green Hill neighborhood. The walk audit started at the intersection of Lincoln Street and Harlow Street. The group traveled south on Lincoln Street to the Catharine Street intersection along the west-side sidewalk and then traveled back north on Lincoln Street on the east-side sidewalk to return to the church. Along the route, audit participants made observations and suggested recommendations to enhance the walkability of their neighborhood.

Neighborhood Characteristics

The Green Hill neighborhood is a diverse, vibrant community of Worcester that has a 480-acre public park and local restaurants and retail establishments within walking distance of many of the neighborhood's residential streets. UMass Memorial Hospital is also located in this neighborhood. The Green Hill neighborhood abuts Interstate 290 to the west and the Green Hill Park to the east. The main roadway through the Green Hill neighborhood is Lincoln Street, which is MassDOT-owned State Route MA-70.

Many residents of Green Hill neighborhood walk along Lincoln Street to access the neighborhood businesses, health care facilities, Worcester Regional Transit Authority (WRTA) buses, and public-school buses. Many Green Hill residents do not own person vehicles and rely on walking and bus transit for commuting to work and accessing goods and services. A limited number of crosswalks, broken pedestrian signal heads, absent pedestrian infrastructure at bus stops, and a lack of separation from moving vehicle traffic create a low level of comfort when walking in this neighborhood.

Street Characteristics

Congestion and Speed

For most of the corridor, Lincoln Street is a two-lane minor arterial with one travel lane in each direction. Near the Catharine Street intersection and I-290, the street widens to two travel lanes in each direction. Lincoln Street has heavy traffic congestion during peak commuting times. Drivers often choose to cut through the residential streets in the Green Hill neighborhood to avoid this congestion. Residents expressed concern that vehicles travel at high speeds along this corridor during off-peak hours. On the day of the walk audit, participants used radar speed detection devices and recorded vehicle speeds in the range of 40-50 MPH, despite a 30 MPH speed limit on Lincoln Street. There are no speed limit signs posted anywhere within the study area. Wide lane widths, coupled with additional pavement to accommodate a bike sharrow and under-utilized on-street parking spaces, contribute to high vehicle travel speeds. On the morning of the walk audit, most on-street parking spaces were empty, leaving 20 feet of pavement for the travel lane.

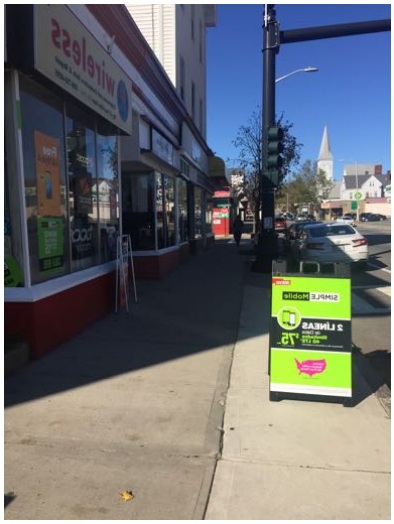
Walk audit participants recorded high vehicle speeds with radar detection devices

Lincoln Street has wide lane widths that contribute to high vehicle speeds

Sidewalks

Lincoln street has wide, well-maintained sidewalks on the west side of the corridor and many young street trees that will help separate people walking from moving vehicles once they reach full growth. The east side sidewalk is uneven in places and lacks a verge to separate people walking from moving vehicles. Lincoln Street has on-street parking along the length of the study area, with some time-limited parking spaces near the local businesses. Despite the presence of trees and on-street parking to separate people walking from vehicles, the sheer volume and speed of traffic make the walking environment feel uncomfortable.

Both the east and west sides of the Lincoln Street sidewalk have a number of street trees with tree pits in varying states of maintenance. Some tree pits have little mulch remaining and the depth of the exposed pits has created tripping hazards. A few of the tree pits also have overgrown weeds and vegetation. There are other sidewalk obstructions along the Lincoln Street corridor that include: overgrown vegetation at some residential properties, sandwich board marketing signs in front of businesses, fallen leaves, and litter.



Sandwich board signs are placed in front of business along Lincoln Street

Street trees separate people walking from moving vehicles. Additional mulch could minimize tripping hazard

The east side sidewalk of Lincoln Street is uneven in sections and is obstructed by overgrown vegetation and fallen leaves

Crosswalks

There are three crosswalks across Lincoln Street between Harlow Street and Catharine Street, which is a distance of 0.5 miles. Two of the three crosswalks are at signalized intersections (Harlow Street and Catharine Street) and one crosswalk is at the unsignalized intersection of Orne Street. The distance between the Harlow Street and Orne Street crosswalks is 0.2 miles (1056 feet) and the distance from the Orne Street to Catharine Street intersection is 0.3 miles (1584 feet). These distances exceed the National Association of City Transportation Officials (NACTO) recommended distance of 200 feet in highly utilized walking areas. The Orne Street crosswalk lacks advanced crosswalk signage and in-street signage, reducing the visibility of this crosswalk. Residents shared that there is poor visibility of pedestrians at these crosswalks in the evening due to dim street lighting. There are on-street parking spaces that abut

the Orne Street crosswalk, which also decreases visibility of people crossing Lincoln Street in this location.

Walk audit participants observed misalignment of tactile warning panels within curb ramps at many locations along Lincoln Street. The tactile warning panels were not aligned with the crosswalks, and instead led into vehicle travel lanes, posing a risk to persons with low-vision who utilize these panels for directional guidance when accessing crosswalks

The north-south crosswalks that allow pedestrians to cross over residential streets when moving in the north-south direction on Lincoln street have accessibility issues due to the hilly terrain of the Green Hill neighborhood. The steep slope to the east and west of Lincoln Street leads to severely slanted crosswalks in places, making it difficult to navigate for people walking with wheeled devices (wheelchairs, walkers, strollers, etc.)

Misaligned tactile warning panel at Harlow Street intersection


On-street parking is allowed to the edge of crosswalks on Lincoln Street, which limits the visibility of pedestrians


Crosswalks are steeply slopped on the hilly Lincoln Street terrain

Snow and Ice

Green Hill residents shared that snow and ice removal is a problem for people walking on Lincoln Street in the winter. Property owners are responsible for maintaining the sidewalk outside their residence or business. On the walk audit, participants observed puddled water at wheelchair ramps leading to crosswalks that likely freezes over in the winter, making much of the corridor inaccessible in both rain and snow. Residents shared that plowed snow mounds are not removed on this corridor and the stored snow causes issues with pedestrian visibility and creates a barrier to sidewalk and transit accessibility. The salting and plowing of roads also create issues with painted crosswalk and lane markings fading in the winter months.

Park Access

Green Hill Park, a 480-acre, city-owned public green space, can be accessed from the Green Hill neighborhood via Green Hill Parkway. There is minimal signage that indicates the presence of this park

and there is no wayfinding signage that would encourage people to access the park on foot. The residents would like to see this park highlighted as a prominent feature of their neighborhood with wayfinding signage and other placemaking features. There is also a desire to include a midblock crossing at the intersection of Green Hill Parkway and Lincoln Street that would allow people to cross the street at this location to access the park.

WRTA and School Bus Service

There are three WRTA buses (Rt 14,23 and 26) that service Lincoln Street. In the study area, there is only one bus shelter at the stop near the UMass Memorial Hospital campus. The other stops in the corridor are signified by a metal post sign alone, with no places to sit and no shelter from weather. None of the Green Hill bus stops have crosswalks, and most transit users must navigate unsafe crossing of multiple vehicle travel lanes if they wish to cross Lincoln Street at a bus stop. Cars do not always stop for transit users who are attempting to cross the traffic lanes, creating a dangerous scenario for those walking to and from the bus on Lincoln Street.

Most Lincoln Street bus stops lack crosswalks, benches, and shelters

There is also school bus service on Lincoln Street with pickup locations that do not have marked crosswalks. There is concern amongst residents for the visibility of students at bus stops and for cars that ignore the school bus STOP signs. The school bus depot is located on Crescent Street, which to the west of Lincoln Street, leading to a high volume of school bus movement in the mornings and afternoons.

A Green Hill resident describes safety concerns for her grandchildren, who must cross Lincoln Street where this no crosswalk to get to the school bus stop

Lincoln Street Corridor-Wide Recommendations

1. Slow speeds:
    - Consider narrowing the width of the travel lanes - this could be accomplished by installing bike lanes, adding a dedicated bus lane, or moving the existing sharrow to a mid-lane position and repainting the fog line to tighten the travel lane.
    - Post 30 MPH speed limit signs along Lincoln Street and consider using speed feedback signs to slow vehicle speeds.

2. Increase comfort:
    - Enhance features of the verge to further separate pedestrians from vehicle traffic, especially in low parking utilization areas where street trees have not been planted. This could be done through planting more street trees or adding a protected bike lane.
    - Work with the City Public Works Department to address the uneven east-side sidewalk.
    - Add elements that make it feel like Lincoln Street is a place for walking for people of all ages. Age-Friendly features could include: benches for resting, pedestrian-scale lighting, and wayfinding signage.
    - Evaluate city ordinances to reduce sidewalk obstructions (sandwich boards at businesses, fallen leaves, and vegetation overgrowth).
    - Consider adding trash receptacles to manage littering along Lincoln Street

Reducing litter is a top concern for Green Hill residents

Vegetation overgrowth obstructs portions of the Lincoln Street sidewalk

A lighting pole and parking bollards obstruct the sidewalk at Honey Farms

3. Improve the safety and visibility of crossings:
    - Evaluate the placement of additional enhanced mid-block crosswalks along Lincoln Street in high utilization areas, such as Green Hill Parkway, at bus stops, and at businesses.
    - Increase the visibility of existing crosswalks with pedestrian scale lighting, raised crosswalks, in-crosswalk pedestrian signage, advanced pedestrian crossing signage, curb bump-outs to shorten the crossing distance, and rectangular rapid flashing beacons (RRFBs).
    - Consider parking regulations to enhance pedestrian visibility, such as a no parking zone within 20 feet of a marked crosswalk.
    - Ensure that tactile warning panels of curb ramps are ADA-compliant and appropriately aligned with marked crosswalks.

4. Snow and Ice Removal:
    - Work with property owners on Lincoln Street to ensure that sidewalks are passible, crosswalks are accessible, and pedestrians are visible. Consider contacting MassDOT

District 3 Office to evaluate Lincoln Street/MA-70 as a pilot for the MassDOT sidewalk removal program pilot this winter.

5. Bus access:
    - Enhance the pedestrian accommodations at bus stops along Lincoln Street. For the comfort of transit users of all ages, benches and weather protection could be considered at the bus stops of this corridor. Evaluate the addition of unsignalized, marked crosswalks at the marked bus stops on Lincoln Street. These crosswalks should include features that enhance visibility and safety (pedestrian scale lighting, raised crosswalks, in-crosswalk pedestrian signage, advanced pedestrian crossing signage, curb bump-outs, and rectangular rapid flashing beacons (RRFBs)).

Key Intersections of Lincoln Street Study Area

Harlow Street and Lincoln Street

The Harlow Street and Lincoln Street intersection is located at the north end of the study area. This intersection has a recently upgraded signal with a pedestrian pushbutton and countdown WALK signs. These signals, however, are not Accessible Pedestrian Signals (APS) with tactical and audible crossing instructions. The crossing time at the Harlow Street intersection allows just 10 seconds to cross two vehicle travel lanes (42 feet of pavement). This pedestrian travel speed exceeds the recommended 3.5 feet/second travel time. This intersection has an exclusive pedestrian phase. No right turn is allowed at this intersection, which protects pedestrians from turning vehicles when crossing in the east-west direction at this intersection.

On-street parking within the Harlow Street intersection blocks visibility of pedestrians

The crosswalk at this intersection has high visibility continental stripped crosswalk markings; however, visibility of this crosswalk is limited because parking is allowed up to the crosswalk marking. Parking is also allowed within the intersection itself, with one on-street parking spot located between the north and south crosswalks of this intersection. The only lighting at this crosswalk, as with the rest of the corridor, is tall highway-scale street-lighting. The curb ramps had a lot of built up dirt, which led participants to infer that puddling occurs after rain or snow to block the ramp.

Intersection Recommendations

1. Upgrade the pedestrian signals to current APS standards.
2. Increase the WALK signal time to give people more time to cross at this intersection.
3. Adopt a parking ordinance that prohibits parking within 20 feet of a crosswalk and add features that prevent parking in this area such as flex posts or cement bollards.

4. Add additional pedestrian scale lighting, curb bump-outs, and a raised crosswalk at this intersection to improve the visibility of people walking.

Green Hill Parkway

The intersection of Lincoln Street and Green Hill Parkway is one of the main access points to Green Hill Park. There is no crosswalk at this intersection across Lincoln Street, and there is little signage to indicate the presence of the park.

Intersection Recommendations

1. Add an unsignalized, marked crosswalk at the intersection of Green Hill Parkway and Lincoln Street across Lincoln. This crosswalk should include features that enhance visibility and safety (pedestrian scale lighting, raised crosswalks, in-crosswalk pedestrian signage, advanced pedestrian crossing signage, curb bump-outs, and rectangular rapid flashing beacons (RRFBs)).

2. Consider placemaking features that signalize the entrance to the park such as pavement art, landscaping, and wayfinding signage.

Residents would like a midblock crossing at Green Hill Parkway

Residents want more visible signage to signify the entrance to Green Hill Park

Orne Street

The intersection of Orne Street and Lincoln Street has a marked crosswalk for people to cross Lincoln Street in the east-west direction at this location. Orne Street is in close proximity to one of the retail corridors of Lincoln Street. On-street parking is allowed to the edge of the crosswalk, which decreases the visibility of people crossing Lincoln Street at this location. There is no pedestrian crossing signage at this crosswalk.

The Orne Street crosswalk lacks elements that make it visible to drivers

Intersection Recommendations

1. This crosswalk needs features to enhance visibility and safety (pedestrian scale lighting, raised crosswalks, in-crosswalk pedestrian signage, advanced pedestrian crossing signage, curb bump-outs, and/or rectangular rapid flashing beacons (RRFBs)).

Catharine Street

The intersection of Catharine Street and Lincoln Street is at the south end of the walk audit study area. UMass Memorial lies to the east of this intersection and Honey Farms, a convenience mart lies to the west. This intersection is also in close proximity to two WRTA bus stops. This intersection is one of the most heavily trafficked pedestrian crossing areas in the corridor and was the site of the September 2019 pedestrian fatality.

The Catharine Street intersection is a high-volume pedestrian crossing

This intersection has marked crosswalks at all approaches and four pedestrian pushbuttons. This is an exclusive phase signalized intersection that permits right turns on red from Catharine Street to Lincoln Street. The crossing signals at this intersection are not accessible pedestrian signals (APS). On the day of the audit, participants attempted to use the two west-side pedestrian pushbuttons, and neither were operable. One walk audit participant crossed the intersection to attempt use of the east-side pushbutton, which did work. By the time this individual had unsafely crossed the intersection to use a functional pushbutton, the group had waited 4 minutes and 40 seconds before we were given a WALK signal. Audit participants shared that visibility in this intersection is very poor at night due to a lack of pedestrian scale lighting, which was a contributing factor on the night of the September 2019 pedestrian fatality.

Walk audit participants waited 4 minutes and 40 seconds for a WALK signal at Catharine Street

This intersection has steep curb ramps (may not be ADA compliant) and WalkBoston staff observed an individual in a wheelchair trying to navigate the ramp when planning the walk audit. Due to the slope of the curb ramp, the individual had to turn their wheelchair around in the crosswalk and reverse direction to get the leverage they needed to get up the ramp slope.

Intersection Recommendations

1. Upgrade the pedestrian signals to APS standards and allow 3.5 feet/second WALK times.
2. Evaluate signal timing and phasing of the traffic signal on Catharine Street to determine feasibility of prohibiting right turns on red.
3. Add pedestrian scale lighting to improve visibility of people walking at this intersection.
4. Evaluate the condition of the curb ramps to ensure ADA compliance.
5. Add additional features to enhance visibility and safety such as curb bump-outs.

Appendix C: Site Visits

Lincoln Street Group Site Visit

Date	Time	Weather
April 2019	5:00 pm	Overcast
Attendance		
Name	Organization	Email
Debra Bolz	GHNA	debrabolz@charter.net
Yahiara Graxirena	CMRPC	ygraxirena@cmrpc.org
Brendan Chipman	WPI Student	bdchipman@wpi.edu
Stephen Lauro	WPI Student	sflauro@wpi.edu
Billy Mitchell	WPI Student	wmmitchell@wpi.edu
Mike Montano	WPI Student	mpmontano@wpi.edu

Observations:

- Better lighting for darker hours
- Traffic coding
- Safer parking along the roadway
- A "Complete Street" type of neighborhood pride
- Aesthetics: flower pots, benches, nice trash cans
- Better crosswalks and crosswalk signage
- Cleaner gateway to get to downtown
- Intersection of 290 to Burncoat intersection

Lincoln Street Group Site Visit

Date	Time	Weather
9/13/19	7:00 pm	Clear Skies
Attendance		
Name	Organization	Email
Brendan Chipman	WPI Student	bdchipman@wpi.edu
Stephen Lauro	WPI Student	sflauro@wpi.edu
Billy Mitchell	WPI Student	wmmitchell@wpi.edu
Mike Montano	WPI Student	mpmontano@wpi.edu

Observations:

- Problems at Burncoat intersection and I-290 intersection
- accommodate a bike lane- a lot of cyclists on corridor
- side of street parking is mostly necessary throughout the corridor
- 3 bus routes going through Lincoln Street
    - signs are failing
    - heavy usage on transits
    - lack of bus benches
- a lot of people crossing in front of UMass medical down by Burncoat intersection at Brittan Square
    - workers and Burncoat elementary and middle school students
- Lincoln Street is a state street- Route 70
- Want our project to be a demonstration project with the city if a good example
- lighting not good on the street, a lot of jaywalking
- Transportation for Massachusetts, state grant
    - Applied for grant in Transportation Justice
    - only community group selected for grant
- September 30 meeting at St. Bernard Church
- Communicate with city councilor, local police officer at meetings
    - State rep?- has been very helpful in the community
- 290 traffic lights outdated
    - critical intersection for bicyclists

Lincoln Street Group Site Visit

Date	Time	Weather
9/27/19	3:30 pm	Sunny
Attendance		
Name	Organization	Email
Brendan Chipman	WPI Student	bdchipman@wpi.edu
Stephen Lauro	WPI Student	sflauro@wpi.edu
Billy Mitchell	WPI Student	wmmitchell@wpi.edu
Mike Montano	WPI Student	mpmontano@wpi.edu

Observations:

Morning: Brendan and Mike

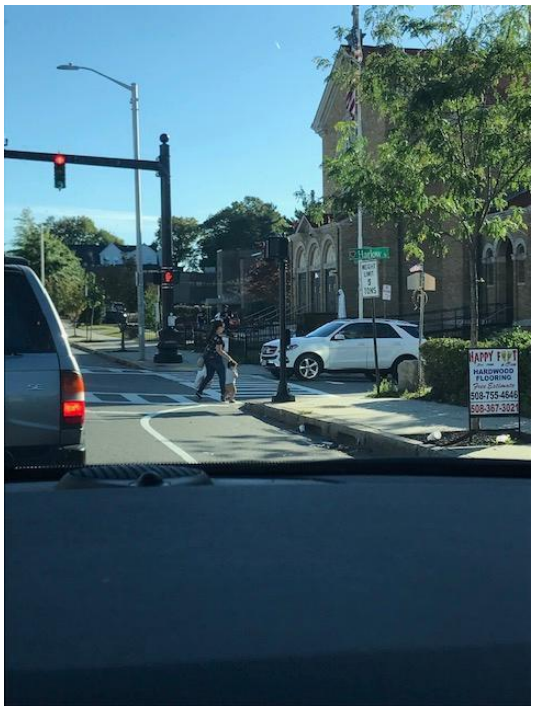
- Went and took measurements of the sidewalks and street from right in front of St. Bernard's Church (Section 2)
    - Sidewalk- 10'2"
    - Parking Lane- 7'6"
    - Driving Lane- 13'6"

Afternoon: Billy and Brendan

- Went and took pictures of traffic and congestion during busy time of the day, from 4-4:45
    - Gilman Street and Lincoln Street in need of flashing crosswalk sign at the crosswalk
    - Harlow and Lincoln Street- sat and waited over 5 minutes at the light, congested school bus stop going on as well
    - Catharine and Lincoln Street- flashing lights needed for crosswalk, also where man was killed on Sept. 3rd.

Pictures	
Location: Lincoln Street Corridor **Description:** Heavy Traffic Congestion 	**Location:** Lincoln Street Corridor **Description:** Poor quality bus stop 
Location: Lincoln Street Corridor **Description:** Heavy congestion caused by school bus 	**Location:** Lincoln Street Corridor **Description:** Heavy traffic congestion 

Location: Lincoln Street Corridor
Description: People crossing street



Lincoln Street Group Site Visit

Date	Time	Weather
10/25/19	11:10am	Sunny
Attendance		
Name	Organization	Email
Brendan Chipman	WPI Student	bdchipman@wpi.edu
Stephen Lauro	WPI Student	sflauro@wpi.edu
Billy Mitchell	WPI Student	wmmitchell@wpi.edu
Mike Montano	WPI Student	mpmontano@wpi.edu

Observations:

- Sections of the Corridor:
  - Section 1: Catharine - Orne (mostly business)
  - Section 2: Orne - Harlow (residential northbound, residential business southbound)
  - Section 3: Harlow - Britton Square (including UMASS Medical)
- Measurements @ Forbes Street Intersection
  - Sidewalk - 11.1 ft (Southbound side)
  - Parking Lane - 7.5 ft (Southbound side)
  - Driving Lane South bound - 13.5 ft
  - Driving Lane Northbound - 13 ft
  - Parking Lane - 7.8 ft (Northbound side)
  - Sidewalk - 10 ft (Northbound side)
- Measurements @ Perkins Sidewalk
  - Sidewalk section - 4.9 ft
  - Runoff section - 3.9 ft
- Bus Stops
  - Joseph J Cariglia Attorney 188 Lincoln Street sign only (South)
  - Across street from Joseph J Cariglia Attorney 188 Lincoln Street sign only (North)
  - Forbes Street to Perkins Street sign only (North)

    - Forestdale Rd sign only (North)
    - Frederick Street (South)
    - North Hampton Street full hub (North)
- In a span of 25 mins that the group was there, 3 fire trucks passed through the corridor
- Teddy's Cleaners and Tailor
    - There is a large parking lot that has very little use. Potential to provide parking for use of businesses' in section 1 of the corridor and reduce the need for street parking
- Sidewalks a little smaller, decrease the size of tree bed
- Need to look to see where lighting should be added and where crosswalk signals should be added

Picture sign onlys	
Location: Forbes Street Intersection **Description:** Team taking measurements of street layout 	**Location:** Forestdale Street corner **Description:** Bus stop sign 

Location: Perkins Sidewalk
Description: Steep runoff section of sidewalk

Location: Parking lot of Teddy's Cleaners
Description: Large parking lot

Location: Sidewalk of Section 1 of corridor
Description: Current tree aesthetic

Lincoln Street Group Site Visit

Date	Time	Weather
10/28/19	6:20pm	Light Rain/Overcast
Attendance		
Name	Organization	Email
Brendan Chipman	WPI Student	bdchipman@wpi.edu
Stephen Lauro	WPI Student	sflauro@wpi.edu
Billy Mitchell	WPI Student	wmmitchell@wpi.edu
Mike Montano	WPI Student	mpmontano@wpi.edu

Observations:

- Sections of the Corridor:
  - **Section 1:** Catherine - Orne (mostly business)
  - **Section 2:** Orne - Harlow (residential northbound, residential business southbound)
  - **Section 3:** Harlow - Britton Square (including UMASS Medical)
- Measurements @ Duxbury Road
  - Sidewalk - 11 ft (South bound side)
  - Parking Lane - 8 ft (South bound side)
  - Driving Lane South bound - 13 ft
  - Driving Lane North bound - 13.5 ft
  - Parking Lane - 8 ft (North bound side)
  - Sidewalk - 11 ft (North bound side)
  - Tree square- 5.5ft
- Observations
  - Decent lighting, could install lamp posts at crosswalks and at street corners to improve visibility and aesthetics
  - Parking lanes should be used and the wide driving lanes could be narrowed
  - Crosswalk past Duxbury and across from the white church; with no lights
  - No speed signs
  - Sidewalk in front of HFHC UMass is wide; 15.2ft (Northbound)
  - Crosswalk at second entrance going Northbound for UMass Memorial

Lincoln Street Group Site Visit

Date	Time	Weather
11/01/19	3:00 pm	Sunny
Attendance		
Name	Organization	Email
Brendan Chipman	WPI Student	bdchipman@wpi.edu
Stephen Lauro	WPI Student	sflauro@wpi.edu
Billy Mitchell	WPI Student	wmmitchell@wpi.edu
Mike Montano	WPI Student	mpmontano@wpi.edu

Observations:

- Catharine Street double lane by Honey Farms measurements
    - 11 ft sidewalk southbound
    - 9.5 ft inside right lane southbound
    - 11 ft outside lane southbound
    - 11 ft sidewalk northbound
    - 9.5 ft left lane northbound
    - 11 ft right lane northbound
    - .9 ft buffer zone northbound
- Corridor measurements by North Hampton Street
    - 11ft northbound sidewalk
    - 8 ft northbound parking lane
    - 13.5 ft northbound driving lane
    - 11ft southbound sidewalk
    - 8 ft southbound parking lane
    - 13.5 ft southbound driving lane

Crosswalk Distances crossing Lincoln Street		
Location #1	Location #2	Distance
Catharine Street	Orne Street	494 meters
Orne Street	Harlow Street	335 meters
Harlow Street	Gilman Street	149 meters
Gilman Street	Genesis Club	53 meters
Genesis Club	Umass Memorial Entrance	114 meters

Map of Crosswalk Locations

- Current crosswalk locations of Lincoln Street are displayed with red rectangles below
    - Currently 6 crosswalks in the section of the corridor that our project focuses on

Pictures	
Location: Lincoln Street Corridor **Description:** Measuring wheel being used to measure distances between crosswalks 	**Location:** Sidewalk of corridor **Description:** Overgrown bushes 
Location: Sidewalk in front of Teddy's Cleaners **Description:** Lack of cars parked on this side of street 	**Location:** Sidewalk **Description:** Aesthetically pleasing trees 

Appendix D: Crash Data

RMV Crash Number	City Town Name	Crash Date	Crash Time	Crash Severity	Maximum Injury Severity Reported	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance From Nearest Roadway Intersection	Non Motorist Type
3831731	WORCESTER	15-Feb-2014	4:45 PM	Property damage	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Parked	V1: Not Reported / V2: Not Reported	Snow	Dusk	Snow/Snow		LINCOLN STREET / FORESTDALE ROAD	
4343706	WORCESTER	24-Dec-2016	11:15 AM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Angle	V1: Entering traffic lane / V2: Travelling straight ahead	V1: S / V2: S	Wet	Daylight	Cloudy/Rain		116 LINCOLN STREET	
3798133	WORCESTER	26-Feb-2014	11:34 AM	Property damage	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: N / V2: S	Dry	Daylight	Clear	LINCOLN STREET / CATHARINE STREET /		
3996454	WORCESTER	24-Sep-2014	1:12 PM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: S / V2: N	Dry	Daylight	Clear/Cloudy	LINCOLN STREET / CATHARINE STREET		
4334439	WORCESTER	09-Dec-2016	1:20 AM	Unknown	Not reported	2	0	0	Rear-end	V1: Turning left / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		LINCOLN STREET / PERKINS STREET	
4030938	WORCESTER	17-Oct-2014	4:30 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	1	1	0	Angle	V1: Turning left	V1: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / FREDERICK STREET		P2: Cyclist
4333587	WORCESTER	08-Dec-2016	9:04 AM	Property damage	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic	V1: N / V2: E	Dry	Daylight	Cloudy		112 LINCOLN STREET	
4339826	WORCESTER	10-Nov-2016	12:15 PM	Property damage	No injury	2	0	0	Sideswipe, same direction	V1: Turning left / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear/Clear	LINCOLN STREET / CATHARINE STREET		
4044115	WORCESTER	11-Nov-2014	5:36 AM	Non-fatal injury	Non-fatal injury - Non-incapacitating	3	1	0	Rear-end	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic / V3: Travelling straight ahead	V1: N / V2: N / V3: N	Dry	Dark - lighted roadway	Clear	LINCOLN STREET / NORTHAMPTON STREET		
4327386	WORCESTER	26-Sep-2016	7:45 PM	Property damage	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: S / V2: S	Dry	Dark - lighted roadway	Clear	LINCOLN STREET / CATHARINE STREET		
4040295	WORCESTER	05-Dec-2014	6:00 PM	Property damage	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: S / V2: N	Wet	Dark - lighted roadway	Rain/Cloudy	LINCOLN STREET / CATHARINE STREET		
4040704	WORCESTER	24-Dec-2014	4:00 PM	Property damage	No injury	2	0	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked	V1: Not Reported / V2: Not Reported	Wet	Dark - lighted roadway	Rain		169 LINCOLN STREET	
4327464	WORCESTER	18-Sep-2016	8:39 PM	Property damage	No injury	2	0	0	Angle	V1: Parked / V2: Backing	V1: Not Reported / V2: E	Dry	Dark - lighted roadway	Clear		169 LINCOLN STREET	
4319093	WORCESTER	01-Sep-2016	7:25 AM	Property damage	No injury	1	0	0	Single vehicle crash	V1: Turning left	V1: S	Dry	Daylight	Cloudy	PERKINS STREET / LINCOLN STREET		
4295260	WORCESTER	19-Aug-2016	5:50 AM	Not Reported	Not reported	3	0	0	Angle	V1: Parked / V2: Parked / V3: Parked	V1: Not Reported / V2: Not Reported / V3: Not Reported	Dry	Dark - lighted roadway	Clear/Clear		143 LINCOLN STREET	
4068201	WORCESTER	07-Jan-2015	10:00 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	3	0	Angle	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Dark - lighted roadway	Clear	LINCOLN STREET / PERKINS STREET		
4303469	WORCESTER	18-Aug-2016	11:30 AM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: S / V2: N	Dry	Daylight	Clear	CATHARINE STREET / LINCOLN STREET /		
4306667	WORCESTER	17-Aug-2016	11:41 AM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	2	0	Rear-end	V1: Travelling straight ahead / V2: Turning left	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear/Cloudy	CATHARINE STREET / LINCOLN STREET		
4049312	WORCESTER	24-Jan-2015	5:42 PM	Property damage	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Parked	V1: Not Reported / V2: Not Reported	Snow	Dark - lighted roadway	Snow/Sleet, hail (freezing rain or drizzle)		LINCOLN STREET / FREDERICK STREET	
4052231	WORCESTER	26-Jan-2015	3:30 PM	Property damage	No injury	4	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead / V3: Travelling straight ahead / V4: Travelling straight ahead	V1: S / V2: S / V3: S / V4: S	Wet	Daylight	Cloudy/Snow		131 LINCOLN STREET	
4262006	WORCESTER	22-Jan-2016	7:47 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	1	1	0	Single vehicle crash	V1: Turning left	V1: S	Dry	Daylight	Clear	LINCOLN STREET / CATHARINE STREET		P2: Cyclist
4276766	WORCESTER	13-Jan-2016	1:50 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: N / V2: S	Dry	Daylight	Clear/Rain		LINCOLN STREET / CATHARINE STREET	
4275947	WORCESTER	05-Jan-2016	3:12 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Angle	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1: N / V2: W	Wet	Other	Cloudy/Rain	LINCOLN STREET / CATHARINE STREET		
4245927	WORCESTER	28-May-2016	3:37 PM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Single vehicle crash	V1: Turning right / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Cloudy	LINCOLN STREET / CATHARINE STREET		
4222222	WORCESTER	23-Apr-2016	12:16 AM	Not Reported	Not reported	2	0	0	Single vehicle crash	V1: Parked / V2: Travelling straight ahead	V1: S / V2: S	Dry	Dark - lighted roadway	Clear		128 LINCOLN STREET	
4031772	WORCESTER	01-Mar-2015	9:20 AM	Not Reported	Not reported	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: Not Reported / V2: Not Reported	Dry	Daylight	Cloudy	LINCOLN STREET / CATHARINE STREET		
4238359	WORCESTER	18-Apr-2016	3:34 PM	Non-fatal injury	Non-fatal injury - Possible	3	3	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic / V3: Slowing or stopped in traffic	V1: W / V2: W / V3: W	Dry	Daylight	Clear		CATHARINE STREET / LINCOLN STREET	
4062642	WORCESTER	04-Mar-2015	4:30 PM	Property damage	No injury	2	0	0	Rear-end	V1: Backing / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Wet	Daylight	Clear		110 LINCOLN STREET	
3977618	WORCESTER	07-Jul-2014	1:00 PM	Not Reported	Not reported	2	0	0	Angle	V1: Making U-turn / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Cloudy	FORBES STREET / LINCOLN STREET		
4231110	WORCESTER	11-Apr-2016	9:50 AM	Property damage	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: N / V2: Not Reported	Wet	Daylight	Cloudy		LINCOLN STREET / FREDERICK STREET	
4193406	WORCESTER	05-Mar-2016	5:45 PM	Property damage	No injury	2	0	0	Angle	V1: Making U-turn / V2: Travelling straight ahead	V1: S / V2: S	Dry	Dusk	Clear		166 LINCOLN STREET	
4128358	WORCESTER	15-Aug-2015	8:09 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Head-on	V1: Turning left / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Dark - lighted roadway	Clear	LINCOLN STREET / CATHARINE STREET		
4068241	WORCESTER	25-Apr-2015	6:00 PM	Property damage	No injury	2	0	0	Head-on	V1: Turning left / V2: Slowing or stopped in traffic	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / CATHARINE STREET		
4068331	WORCESTER	28-Apr-2015	3:18 PM	Property damage	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear		150 LINCOLN STREET	
4177706	WORCESTER	19-Jan-2016	7:15 PM	Property damage	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1: Not Reported / V2: Not Reported	Dry	Dark - lighted roadway	Clear	CATHARINE STREET / LINCOLN STREET		
4076475	WORCESTER	14-May-2015	6:00 AM	Non-fatal injury	Non-fatal injury - Possible	1	1	0	Single vehicle crash	V1: Travelling straight ahead	V1: S	Dry	Daylight	Clear/Clear	LINCOLN STREET / CATHARINE STREET		
4167788	WORCESTER	20-Nov-2015	11:10 AM	Property damage	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: N / V2: S	Dry	Daylight	Clear	CATHARINE STREET / LINCOLN STREET		
4164832	WORCESTER	16-Nov-2015	1:26 PM	Property damage	No injury	2	0	0	Rear-end	V1: Turning left / V2: Slowing or stopped in traffic	V1: N / V2: W	Dry	Daylight	Clear	LINCOLN STREET / CATHARINE STREET		
4146015	WORCESTER	08-Sep-2015	9:30 AM	Non-fatal injury	Non-fatal injury - Possible	3	2	0	Head-on	V1: Travelling straight ahead / V2: Travelling straight ahead / V3: Not reported	V1: N / V2: S / V3: Not Reported	Dry	Daylight	Clear/Clear		168 LINCOLN STREET	
4084035	WORCESTER	12-Jan-2015	6:55 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Angle	V1: Overtaking/passing / V2: Turning left	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / FORESTDALE ROAD		
4075828	WORCESTER	16-Jul-2015	4:40 PM	Property damage	No injury	2	0	0	Head-on	V1: Turning left / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / CATHARINE STREET		
4199647	WORCESTER	26-Sep-2015	6:57 PM	Fatal injury	Fatal injury (K)	3	0	2	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked / V3: Parked	V1: W / V2: Not Reported / V3: Not Reported	Dry	Dusk	Clear		126 LINCOLN STREET	P2: Pedestrian / P5: Pedestrian
4144871	WORCESTER	26-Sep-2015	1:00 PM	Property damage	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear		128 LINCOLN STREET	
4140299	WORCESTER	15-Sep-2015	6:30 PM	Property damage	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Parked	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		268 LINCOLN STREET	
4091757	WORCESTER	26-Jun-2015	6:57 PM	Not Reported	Not Applicable	1	0	0	Angle	V1: Turning left	V1: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / CATHARINE STREET		

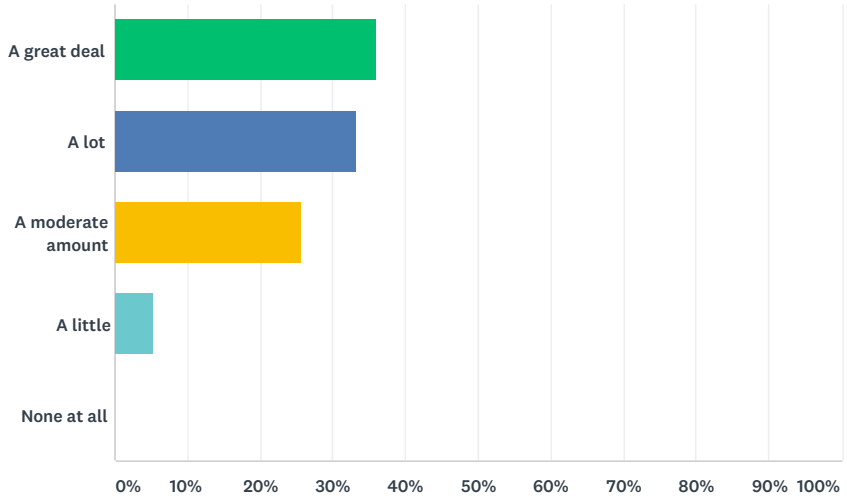
RMV Crash Number	City Town Name	Crash Date	Crash Time	Crash Severity	Maximum Injury Severity Reported	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance From Nearest Roadway Intersection
3786407	WORCESTER	28-Jan-2014	5:33 PM	Property damage only (none injured)	No injury	3	0	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked / V3: Parked	V1: N / V2: Not Reported / V3: Not Reported	Dry	Dark - lighted roadway	Cloudy		LINCOLN STREET / ORNE STREET
3996449	WORCESTER	24-Sep-2014	4:05 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: E / V2: E	Dry	Daylight	Clear		193 LINCOLN STREET
3818656	WORCESTER	05-Apr-2014	7:36 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: E / V2: N	Dry	Dark - lighted roadway	Clear/Cloudy	GREENHILL PARKWAY / LINCOLN STREET	
4021845	WORCESTER	04-Oct-2014	3:40 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Not reported	V1: Not Reported / V2: Not Reported	Wet	Daylight	Rain		176 LINCOLN STREET
3996396	WORCESTER	26-Sep-2014	8:21 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Making U-turn / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear		175 LINCOLN STREET
4333622	WORCESTER	07-Dec-2016	11:58 AM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	3	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: N / V2: S	Dry	Daylight	Cloudy	LINCOLN STREET / ORNE STREET / LINCOLN STREET	176 LINCOLN STREET / ORNE STREET / LINCOLN STRE
4341072	WORCESTER	02-Dec-2016	12:30 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1: N / V2: N	Dry	Daylight	Clear/Clear		216 LINCOLN STREET
4332192	WORCESTER	22-Nov-2016	4:00 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: N / V2: S	Dry	Daylight	Clear/Clear	LINCOLN STREET / GREEN HILL PARKWAY	
3908928	WORCESTER	16-May-2014	4:20 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Parked	V1: N / V2: E	Wet	Daylight	Cloudy/Rain	LINCOLN STREET / STURGIS STREET	
4035749	WORCESTER	13-Dec-2014	6:48 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Not reported	V1: Not Reported / V2: Not Reported	Dry	Dark - lighted roadway	Clear		193 LINCOLN STREET
4036457	WORCESTER	07-Jan-2015	10:25 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1: E / V2: E	Dry	Daylight	Clear/Clear		229 LINCOLN STREET
4047083	WORCESTER	16-Jan-2015	5:15 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Turning right / V2: Entering traffic lane	V1: S / V2: Not Reported	Dry	Dusk	Clear	LINCOLN STREET / STURGIS STREET	
4282693	WORCESTER	12-Jul-2016	10:38 AM	Non-fatal injury	Non-fatal injury - Possible	3	1	0	Sideswipe, opposite direction	V1: Leaving traffic lane / V2: Travelling straight ahead / V3: Travelling straight ahead	V1: S / V2: N / V3: N	Dry	Daylight	Clear/Clear		
4048527	WORCESTER	26-Jan-2015	5:50 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Wet	Dark - lighted roadway	Snow		210 LINCOLN STREET
4295188	WORCESTER	05-Jul-2016	5:00 PM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		200 LINCOLN STREET
4056071	WORCESTER	12-Feb-2015	12:10 AM	Non-fatal injury	Non-fatal injury - Possible	2	2	0	Angle	V1: Turning right / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Snow	Dark - lighted roadway	Clear/Clear	LINCOLN STREET / STURGIS STREET	188 LINCOLN STREET
3908928	WORCESTER	16-May-2014	4:20 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Parked	V1: N / V2: E	Wet	Daylight	Cloudy/Rain	LINCOLN STREET / STURGIS STREET	
3967458	WORCESTER	12-Jun-2014	2:43 AM	Property damage only (none injured)	No injury	2	0	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked	V1: S / V2: Not Reported	Dry	Dark - lighted roadway	Clear/Clear		
4262137	WORCESTER	05-Jan-2016	11:00 PM	Not Reported	Not reported	2	0	0	Unknown	V1: Parked / V2: Not reported	V1: Not Reported / V2: Not Reported	Wet	Dark - lighted roadway	Clear/Rain		LINCOLN STREET / GREENHILL PARKWAY
4241264	WORCESTER	21-May-2016	1:35 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	2	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: N / V2: S	Dry	Daylight	Cloudy		STURGIS STREET / LINCOLN STREET
4033884	WORCESTER	16-Mar-2015	4:15 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Entering traffic lane / V2: Parked	V1: S / V2: Not Reported	Unknown	Unknown	Unknown		LINCOLN STREET / GREEN HILL PARKWAY
3977571	WORCESTER	02-Jul-2014	11:47 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1: N / V2: Not Reported	Dry	Dark - lighted roadway	Clear		200 LINCOLN STREET
3979456	WORCESTER	12-Jul-2014	7:25 PM	Non-fatal injury	Non-fatal injury - Incapacitating	1	1	0	Single vehicle crash	V1: Travelling straight ahead	V1: Not Reported	Dry	Daylight	Clear/Clear		233 LINCOLN STREET
4072163	WORCESTER	12-Apr-2015	11:44 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: N / V2: N	Dry	Dark - lighted roadway	Clear	LINCOLN STREET / HARLOW STREET / LINCOLN STREE	213 LINCOLN STREET
4187010	WORCESTER	22-Feb-2016	9:36 AM	Property damage only (none injured)	No injury	1	0	0	Angle	V1: Turning left	V1: S	Dry	Daylight	Clear		229 LINCOLN STREET / HARLOW STREET / LINCOLN ST
4187011	WORCESTER	22-Feb-2016	9:20 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear		LINCOLN STREET / STURGIS STREET
4176351	WORCESTER	20-Jan-2016	8:59 AM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: S / V2: S	Dry	Daylight	Clear		187 LINCOLN STREET
4152304	WORCESTER	07-Dec-2015	12:55 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear		188 LINCOLN STREET
4165386	WORCESTER	07-Aug-2015	5:27 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		200 LINCOLN STREET
4153743	WORCESTER	02-Oct-2015	3:50 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: E / V2: N	Wet	Daylight	Rain/Rain	LINCOLN STREET / GREEN HILL PARKWAY	185 LINCOLN STREET
4102488	WORCESTER	31-Aug-2015	7:29 PM	Not Reported	Not reported	1	0	0	Single vehicle crash	V1: Travelling straight ahead	V1: Not Reported	Dry	Daylight	Clear		
4139942	WORCESTER	16-Sep-2015	1:38 AM	Property damage only (none injured)	No injury	2	0	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked	V1: N / V2: N	Dry	Dark - lighted roadway	Clear		/ LINCOLN STREET / ORNE STREET
4303482	WORCESTER	02-Aug-2016	11:31 AM	Non-fatal injury	Non-fatal injury - Incapacitating	1	1	0	Single vehicle crash	V1: Travelling straight ahead	V1: W	Dry	Daylight	Cloudy	LINCOLN STREET / ORNE STREET	188 LINCOLN STREET
4085578	WORCESTER	28-Jun-2015	7:01 PM	Property damage only (none injured)	No injury	2	0	0	Head-on	V1: Entering traffic lane / V2: Travelling straight ahead	V1: E / V2: S	Wet	Daylight	Rain/Cloudy	/ LINCOLN STREET	209 LINCOLN STREET

RMV Crash Number	City Town Name	Crash Date	Crash Time	Crash Severity	Maximum Injury Severity Reported	Number of Vehicles	Total Nonfatal Injuries	Total Fatal Injuries	Manner of Collision	Vehicle Action Prior to Crash	Vehicle Travel Directions	Road Surface Condition	Ambient Light	Weather Condition	At Roadway Intersection	Distance From Nearest Roadway Intersection	Non Motorist Type
3786941	WORCESTER	15-Jan-2014	5:15 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: S / V2: S	Dry	Dark - lighted roadway	Clear		250 LINCOLN STREET	
3786442	WORCESTER	23-Jan-2014	12:45 PM	Not Reported	Not reported	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / HARLOW STREET		
3979529	WORCESTER	29-Jul-2014	12:30 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: N / V2: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / DUXBURY ROAD		
3979537	WORCESTER	31-Jul-2014	3:02 PM	Non-fatal injury	Non-fatal injury - Incapacitating	2	2	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: W / V2: N	Dry	Daylight	Clear	LINCOLN STREET / DUXBURY ROAD		
4144382	WORCESTER	21-Dec-2016	5:49 PM	Property damage only (none injured)	No injury	2	0	0	Head-on	V1: Travelling straight ahead / V2: Not reported	V1: Not Reported / V2: Not Reported	Dry	Dusk	Clear	/ / LINCOLN STREET	299 / / LINCOLN STREET	
3799487	WORCESTER	04-Mar-2014	6:48 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Dark - lighted roadway	Clear		281 LINCOLN STREET	
3993421	WORCESTER	31-Aug-2014	8:03 PM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: N / V2: N	Wet	Dark - lighted roadway	Rain/Severe crosswinds		259 LINCOLN STREET	
4343169	WORCESTER	15-Dec-2016	11:01 AM	Not Reported	Not reported	3	0	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked / V3: Parked	V1: Not Reported / V2: Not Reported / V3: Not Reported	Dry	Daylight	Clear/Clear		279 LINCOLN STREET	
4000552	WORCESTER	09-Sep-2014	3:25 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		243 LINCOLN STREET	
3801874	WORCESTER	21-Mar-2014	12:15 PM	Non-fatal injury	Non-fatal injury - Possible	2	2	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Cloudy/Rain		281 LINCOLN STREET	
4024596	WORCESTER	23-Sep-2014	8:00 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Not reported / V2: Not reported	V1: S / V2: N	Dry	Daylight	Clear/Clear		281 LINCOLN STREET	
3806745	WORCESTER	08-Apr-2014	1:14 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Slowing or stopped in traffic / V2: Turning left	V1: S / V2: S	Dry	Daylight	Cloudy	LINCOLN STREET / SHATTUCK STREET	297 LINCOLN STREET / SHATTUCK STREET	
4018471	WORCESTER	03-Nov-2014	1:08 PM	Fatal injury	Fatal injury (K)	1	0	1	Single vehicle crash	V1: Travelling straight ahead	V1: S	Dry	Daylight	Clear/Clear		292 LINCOLN STREET	P2: Pedestrian
4332787	WORCESTER	09-Nov-2016	6:00 PM	Property damage only (none injured)	No injury	1	0	0	Single vehicle crash	V1: Travelling straight ahead	V1: S	Wet	Dark - lighted roadway	Rain		279 LINCOLN STREET	
4338419	WORCESTER	07-Nov-2016	11:26 AM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	1	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: N / V2: S	Dry	Daylight	Clear		260 LINCOLN STREET	
3909749	WORCESTER	23-May-2014	6:30 AM	Property damage only (none injured)	No injury	2	0	0	Sideswipe, same direction	V1: Turning left / V2: Overtaking/passing	V1: E / V2: E	Wet	Daylight	Rain		DUXBURY ROAD / LINCOLN STREET Rte 70 S	
4334912	WORCESTER	01-Nov-2016	10:39 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		274 LINCOLN STREET	
4329631	WORCESTER	20-Oct-2016	5:23 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic	V1: N / V2: N	Dry	Dusk	Cloudy/Cloudy		281 LINCOLN STREET	
4032761	WORCESTER	17-Nov-2014	4:30 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Turning right / V2: Travelling straight ahead	V1: W / V2: N	Wet	Dusk	Rain/Cloudy		250 LINCOLN STREET	
4327490	WORCESTER	01-Oct-2016	7:10 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: N / V2: S	Wet	Dark - lighted roadway	Cloudy/Rain	LINCOLN STREET / HARLOW STREET		
4041911	WORCESTER	04-Dec-2014	9:04 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Not reported	V1: S / V2: S	Dry	Daylight	Clear		292 LINCOLN STREET	
4320625	WORCESTER	21-Sep-2016	8:56 AM	Property damage only (none injured)	No injury	3	0	0	Angle	V1: Travelling straight ahead / V2: Slowing or stopped in traffic / V3: Turning left	V1: N / V2: W / V3: S	Dry	Daylight	Clear		LINCOLN STREET / DUXBURY ROAD	
4038656	WORCESTER	17-Dec-2014	3:30 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: N / V2: N	Wet	Daylight	Cloudy		267 LINCOLN STREET	
4039280	WORCESTER	27-Dec-2014	6:50 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	1	1	0	Single vehicle crash	V1: Travelling straight ahead	V1: Not Reported	Not reported	Dark - lighted roadway	Clear		LINCOLN STREET / BRITTAN LANE	P2: Pedestrian
4054240	WORCESTER	12-Jan-2015	5:15 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	2	3	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: S / V2: S	Wet	Dark - lighted roadway	Clear		256 LINCOLN STREET	
4303845	WORCESTER	17-Aug-2016	11:52 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic	V1: S / V2: N	Dry	Daylight	Clear/Cloudy		269 LINCOLN STREET	
4320083	WORCESTER	23-Sep-2016	7:37 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Making U-turn	V1: N / V2: S	Dry	Daylight	Clear		LINCOLN STREET / MCKINLEY ROAD	
4281955	WORCESTER	30-Jul-2016	6:55 PM	Non-fatal injury	Non-fatal injury - Possible	1	1	0	Single vehicle crash	V1: Travelling straight ahead	V1: N	Dry	Daylight	Cloudy		299 LINCOLN STREET	P3: Pedestrian
4050721	WORCESTER	04-Feb-2015	7:42 PM	Property damage only (none injured)	No injury	2	0	0	Single vehicle crash	V1: Travelling straight ahead / V2: Not reported	V1: Not Reported / V2: Not Reported	Snow	Dark - lighted roadway	Clear		261 LINCOLN STREET	
4266570	WORCESTER	17-Jun-2016	7:20 PM	Non-fatal injury	Non-fatal injury - Possible	4	2	0	Sideswipe, same direction	V1: Travelling straight ahead / V2: Parked / V3: Parked / V4: Parked	V1: N / V2: N / V3: N / V4: N	Dry	Daylight	Clear/Cloudy		269 LINCOLN STREET	
4284167	WORCESTER	15-Jun-2016	2:09 PM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		292 LINCOLN STREET	
3988669	WORCESTER	05-Jun-2014	9:43 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Not reported	V1: S / V2: Not Reported	Wet	Daylight	Cloudy/Rain		295 LINCOLN STREET Rte 3 S	
4056430	WORCESTER	17-Feb-2015	11:04 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Turning left / V2: Turning left	V1: W / V2: N	Snow	Daylight	Cloudy/Snow	LINCOLN STREET / SHATTUCK STREET		
4055415	WORCESTER	23-Feb-2015	9:35 AM	Non-fatal injury	Non-fatal injury - Possible	3	1	0	Rear-end	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic / V3: Travelling straight ahead	V1: Not Reported / V2: Not Reported / V3: N	Dry	Daylight	Cloudy	LINCOLN STREET / HARLOW STREET		
4084051	WORCESTER	20-Jun-2015	1:01 AM	Property damage only (none injured)	No injury	1	0	0	Angle	V1: Travelling straight ahead	V1: N	Dry	Dark - lighted roadway	Clear/Clear		249 LINCOLN STREET	
4226208	WORCESTER	07-Apr-2016	3:00 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Entering traffic lane / V2: Travelling straight ahead	V1: E / V2: S	Wet	Daylight	Rain		236 LINCOLN STREET	
3977577	WORCESTER	02-Jul-2014	2:50 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead	V1: N / V2: N	Dry	Daylight	Clear	LINCOLN STREET / GILMAN STREET		
4049231	WORCESTER	13-Apr-2015	4:28 PM	Property damage only (none injured)	No injury	3	0	0	Rear-end	V1: Travelling straight ahead / V2: Slowing or stopped in traffic / V3: Slowing or stopped in traffic	V1: Not Reported / V2: Not Reported / V3: Not Reported	Dry	Daylight	Clear		267 LINCOLN STREET	
4127306	WORCESTER	24-Aug-2015	11:13 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Turning left / V2: Travelling straight ahead	V1: W / V2: N	Dry	Daylight	Clear/Clear	LINCOLN STREET / DUXBURY ROAD		
4053094	WORCESTER	19-Mar-2015	12:52 PM	Non-fatal injury	Non-fatal injury - Possible	2	1	0	Rear-end	V1: Slowing or stopped in traffic / V2: Slowing or stopped in traffic	V1: S / V2: S	Dry	Daylight	Clear	LINCOLN STREET / GILMAN STREET		
4183545	WORCESTER	24-Feb-2016	7:20 AM	Not Reported	Not reported	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Wet	Daylight	Rain		266 LINCOLN STREET	
4183545	WORCESTER	24-Feb-2016	7:20 AM	Not Reported	Not reported	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Wet	Daylight	Rain		266 LINCOLN STREET	
4228847	WORCESTER	05-Apr-2016	11:00 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning right	V1: S / V2: S	Wet	Daylight	Clear/Clear		292 LINCOLN STREET	
4193397	WORCESTER	08-Mar-2016	9:45 AM	Property damage only (none injured)	No injury	3	0	0	Rear-end	V1: Travelling straight ahead / V2: Travelling straight ahead / V3: Parked	V1: Not Reported / V2: Not Reported / V3: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / GILMAN STREET		
4066788	WORCESTER	18-Apr-2015	12:00 AM	Not Reported	Not reported	1	0	0	Single vehicle crash	V1: Unknown	V1: S	Unknown	Dark - roadway not lighted	Unknown		268 LINCOLN STREET	
4177781	WORCESTER	26-Jan-2016	8:41 AM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Turning left / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Wet	Daylight	Cloudy		292 LINCOLN STREET	
4054289	WORCESTER	29-May-2015	3:30 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Entering traffic lane	V1: N / V2: N	Dry	Daylight	Clear		267 LINCOLN STREET	
4098210	WORCESTER	23-Jul-2015	4:20 PM	Non-fatal injury	Non-fatal injury - Non-incapacitating	1	1	0	Single vehicle crash	V1: Travelling straight ahead	V1: Not Reported	Dry	Daylight	Clear		267 LINCOLN STREET	P2: Pedestrian
4077019	WORCESTER	30-May-2015	5:45 PM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Turning left	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear	LINCOLN STREET / SHATTUCK STREET		
4164445	WORCESTER	08-Nov-2015	3:19 PM	Non-fatal injury	Non-fatal injury - Incapacitating	2	1	0	Angle	V1: Backing / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		281 LINCOLN STREET	
4153733	WORCESTER	02-Oct-2015	4:49 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Slowing or stopped in traffic / V2: Travelling straight ahead	V1: Not Reported / V2: Not Reported	Wet	Daylight	Cloudy/Rain		273 LINCOLN STREET	
4140299	WORCESTER	15-Sep-2015	6:30 PM	Property damage only (none injured)	No injury	2	0	0	Rear-end	V1: Travelling straight ahead / V2: Parked	V1: Not Reported / V2: Not Reported	Dry	Daylight	Clear		268 LINCOLN STREET	
4144340	WORCESTER	12-Sep-2015	11:30 AM	Property damage only (none injured)	No injury	2	0	0	Angle	V1: Travelling straight ahead / V2: Entering traffic lane	V1: N / V2: W	Dry	Daylight	Clear		LINCOLN STREET / GILMAN STREET	

Appendix E: Survey Results

Q1 Overall, how much do you like living in your neighborhood?

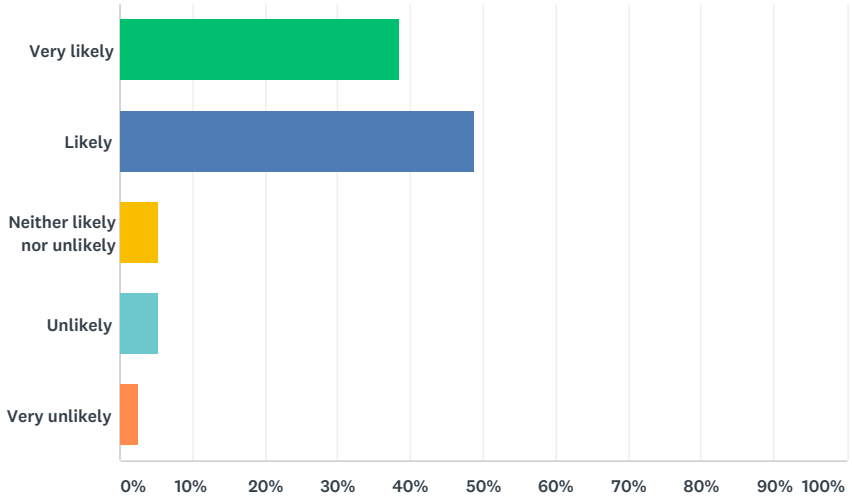
Answered: 39 Skipped: 0



ANSWER CHOICES	RESPONSES	
A great deal	35.90%	14
A lot	33.33%	13
A moderate amount	25.64%	10
A little	5.13%	2
None at all	0.00%	0
TOTAL		39

Q2 How likely are you to recommend this community to others?

Answered: 39 Skipped: 0



ANSWER CHOICES	RESPONSES	
Very likely	38.46%	15
Likely	48.72%	19
Neither likely nor unlikely	5.13%	2
Unlikely	5.13%	2
Very unlikely	2.56%	1
TOTAL		39

Q3 What do you like the most about your neighborhood?

Answered: 34 Skipped: 5

#	RESPONSES	DATE
1	safety, cleanliness, hospitals nearby	11/4/2019 8:12 PM
2	green hill park	11/4/2019 8:05 PM
3	diversity, parks, close to all	11/4/2019 8:03 PM
4	the gym	11/4/2019 8:01 PM
5	friendly neighbors	11/4/2019 8:00 PM
6	it's safe for the kids and the park	11/4/2019 7:58 PM
7	shopping area	11/4/2019 7:56 PM
8	green rolling hills and land	11/4/2019 7:54 PM
9	*I could not read*	11/4/2019 7:52 PM
10	my apartment and build is nice, lots of buses, every store I need is close	11/4/2019 7:49 PM
11	my street is quiet	11/4/2019 7:45 PM
12	close to stores	11/4/2019 7:43 PM
13	it is well secure	11/4/2019 7:41 PM
14	A safer part of Worcester	10/28/2019 1:32 PM
15	I have lived here since 1967 and feel I have the best of all possible worlds. Great old house, great neighbors, great park,	10/28/2019 1:09 PM
16	close to stores	10/16/2019 11:21 AM
17	my street is quiet	10/16/2019 11:18 AM
18	it is well secured	10/16/2019 11:11 AM
19	convenience	10/4/2019 1:13 PM
20	friendly, just moved here	10/4/2019 1:11 PM
21	clean, lots of buses	10/4/2019 1:09 PM
22	convenience	10/4/2019 1:06 PM
23	good people	10/4/2019 1:03 PM
24	easy access, to businesses, church, and stores. the park is a plus	10/4/2019 1:00 PM
25	the garden	10/4/2019 12:57 PM
26	grant park, green hill park	10/4/2019 12:55 PM
27	access to businesses	10/4/2019 12:53 PM
28	quiet	10/4/2019 12:51 PM
29	quite, little crime	10/4/2019 12:46 PM
30	Old victorian neighborhood with history.	10/4/2019 12:40 PM
31	Availability of open space	9/30/2019 7:24 PM
32	We have a great neighborhood meeting that help us when we have problems in our community	9/30/2019 6:56 PM
33	Easy access to retail and highway.	8/1/2019 4:57 AM
34	Community and Legislators connections	7/30/2019 8:04 AM

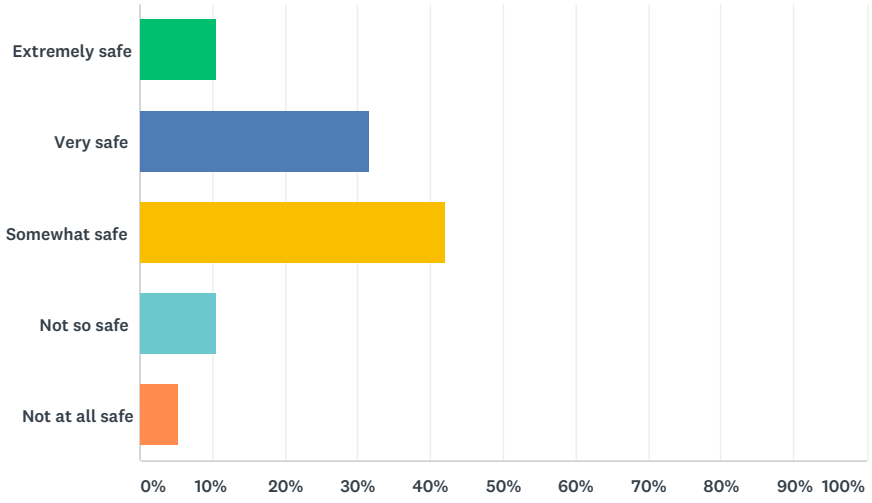
Q4 What do you like the least about your neighborhood?

Answered: 30 Skipped: 9

#	RESPONSES	DATE
1	traffic	11/4/2019 8:12 PM
2	the crime	11/4/2019 8:05 PM
3	traffic and crime	11/4/2019 8:03 PM
4	the gang violence	11/4/2019 8:01 PM
5	drug/alcohol addiction	11/4/2019 7:56 PM
6	not enough adult supervision over little children	11/4/2019 7:52 PM
7	school bus traffic, cops drive by fast	11/4/2019 7:49 PM
8	I only have to walk a couple miles down the street and not feel safe. Someone always asking for money or they are drunk	11/4/2019 7:45 PM
9	the people hanging outside the stores and bars	11/4/2019 7:43 PM
10	it could be cleaner	11/4/2019 7:41 PM
11	to much fast through traffic on Lincoln street	10/28/2019 1:09 PM
12	people hanging outside the stores and bars	10/16/2019 11:21 AM
13	I only have to walk a couple mins down the street to not feel safe, someone is always asking for money or they are drunk.	10/16/2019 11:18 AM
14	could be cleaner	10/16/2019 11:11 AM
15	shooting windows out, vandalizing, kids running around late at night	10/4/2019 1:13 PM
16	bus schedules	10/4/2019 1:11 PM
17	a lot of drug use, walking	10/4/2019 1:09 PM
18	traffic	10/4/2019 1:06 PM
19	n/a	10/4/2019 1:03 PM
20	not having a community school, transportation	10/4/2019 1:00 PM
21	poor security level	10/4/2019 12:57 PM
22	trash	10/4/2019 12:55 PM
23	not safe	10/4/2019 12:53 PM
24	fast drivers	10/4/2019 12:51 PM
25	speeding, trash	10/4/2019 12:46 PM
26	Need more access to the park. walkways at the top of McKinley road to the park. more lighting.	10/4/2019 12:40 PM
27	Traffic	9/30/2019 7:24 PM
28	The fact that I've been robbed three times	9/30/2019 6:56 PM
29	Not friendly.	8/1/2019 4:57 AM
30	I feel like it's the forgotten neighborhood and no community school	7/30/2019 8:04 AM

Q5 How safe do you feel in your neighborhood?

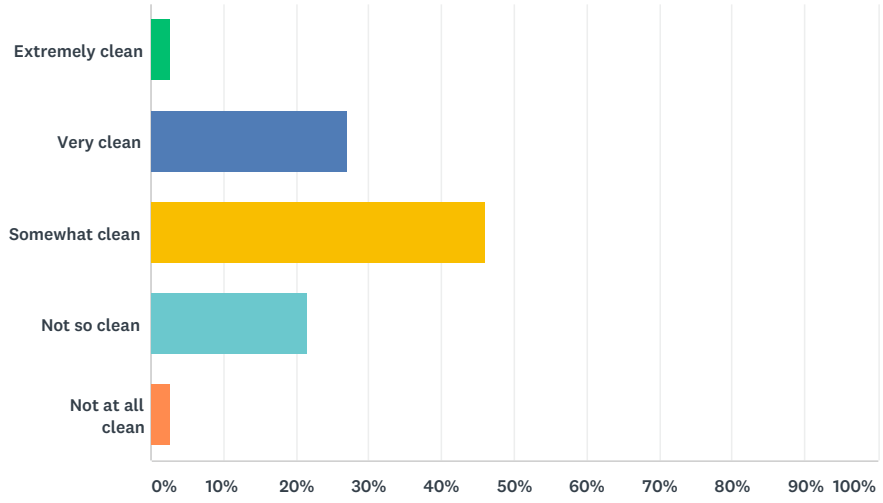
Answered: 38 Skipped: 1



ANSWER CHOICES	RESPONSES	
Extremely safe	10.53%	4
Very safe	31.58%	12
Somewhat safe	42.11%	16
Not so safe	10.53%	4
Not at all safe	5.26%	2
TOTAL		38

Q6 How clean is your neighborhood?

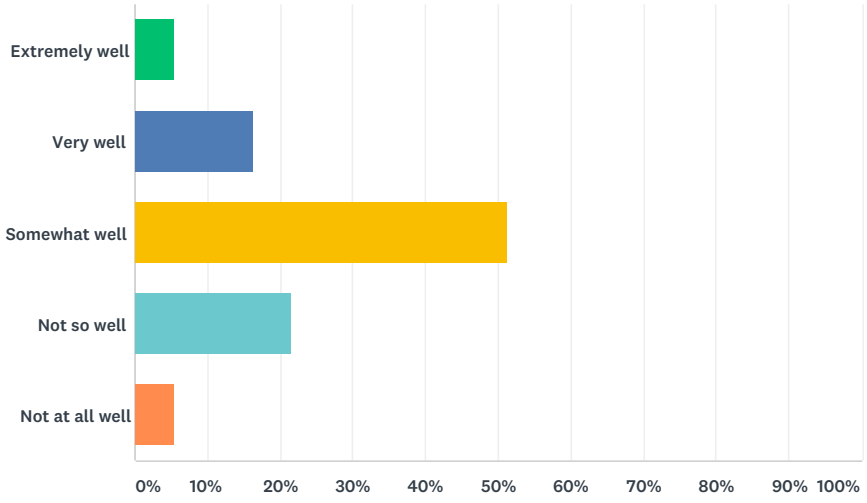
Answered: 37 Skipped: 2



ANSWER CHOICES	RESPONSES	
Extremely clean	2.70%	1
Very clean	27.03%	10
Somewhat clean	45.95%	17
Not so clean	21.62%	8
Not at all clean	2.70%	1
TOTAL		37

Q7 How well are the streets in your neighborhood maintained?

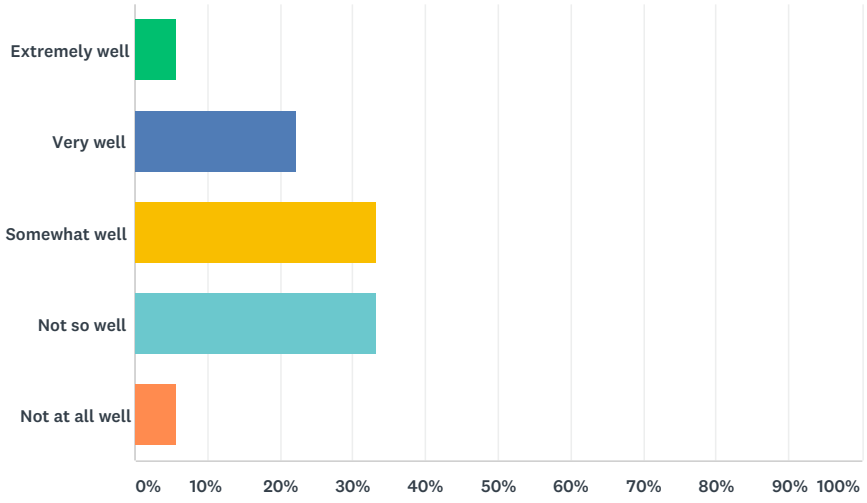
Answered: 37 Skipped: 2



ANSWER CHOICES	RESPONSES	
Extremely well	5.41%	2
Very well	16.22%	6
Somewhat well	51.35%	19
Not so well	21.62%	8
Not at all well	5.41%	2
TOTAL		37

Q8 How well are the sidewalks in your neighborhood maintained?

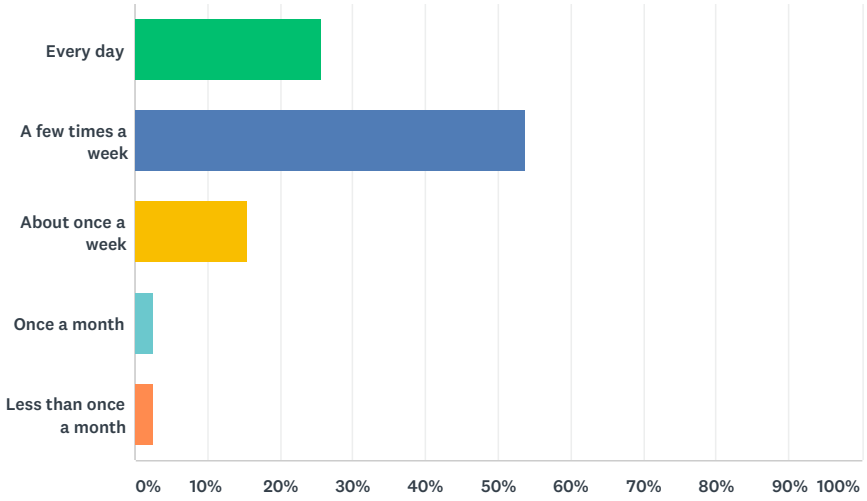
Answered: 36 Skipped: 3



ANSWER CHOICES	RESPONSES	
Extremely well	5.56%	2
Very well	22.22%	8
Somewhat well	33.33%	12
Not so well	33.33%	12
Not at all well	5.56%	2
TOTAL		36

Q9 How frequently do you visit any of the businesses and services located in Lincoln Street?

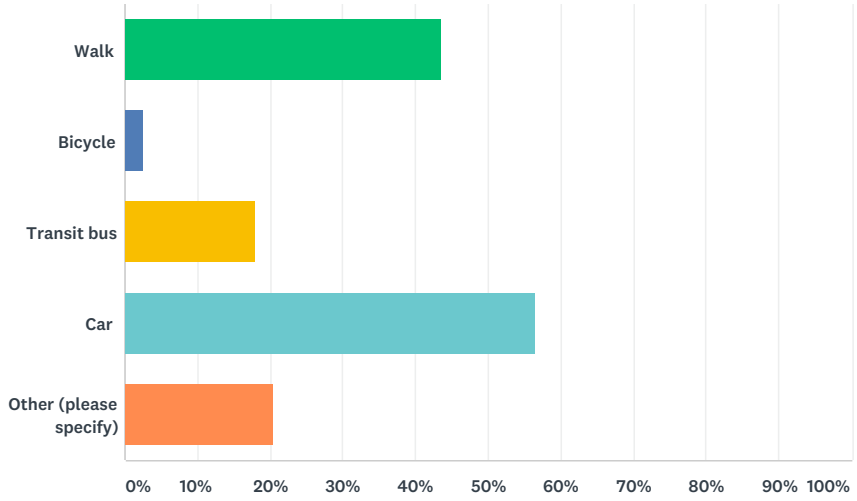
Answered: 39 Skipped: 0



ANSWER CHOICES	RESPONSES	
Every day	25.64%	10
A few times a week	53.85%	21
About once a week	15.38%	6
Once a month	2.56%	1
Less than once a month	2.56%	1
TOTAL		39

Q10 Which mode of transportation do you use to access the businesses and services in Lincoln Street?

Answered: 39 Skipped: 0

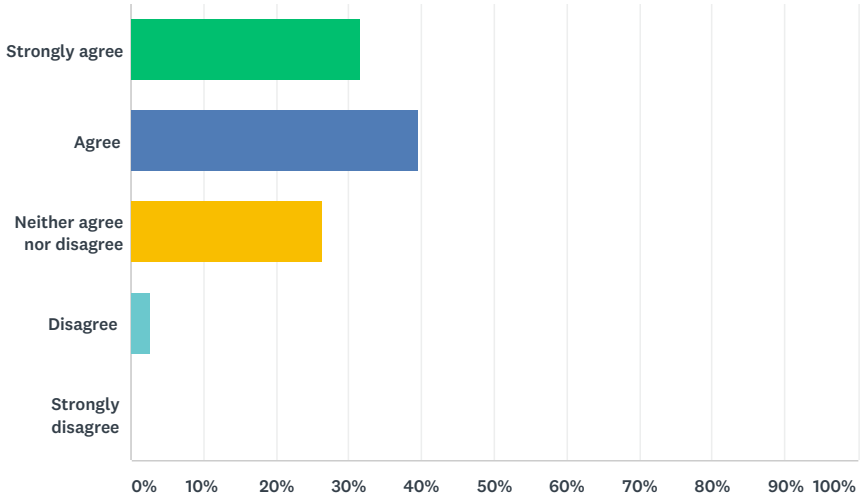


ANSWER CHOICES	RESPONSES	
Walk	43.59%	17
Bicycle	2.56%	1
Transit bus	17.95%	7
Car	56.41%	22
Other (please specify)	20.51%	8
Total Respondents: 39		

#	OTHER (PLEASE SPECIFY)	DATE
1	train	11/4/2019 8:05 PM
2	cab	11/4/2019 7:45 PM
3	wheel chair	11/4/2019 7:41 PM
4	walk, transit bus	10/28/2019 1:32 PM
5	walk and bicycle	10/16/2019 11:21 AM
6	walk, transit, cab	10/16/2019 11:18 AM
7	wheel chair	10/16/2019 11:11 AM
8	WRTA and Uber	7/30/2019 8:04 AM

Q11 Does the businesses and services in Lincoln Street cover all you regular needs?

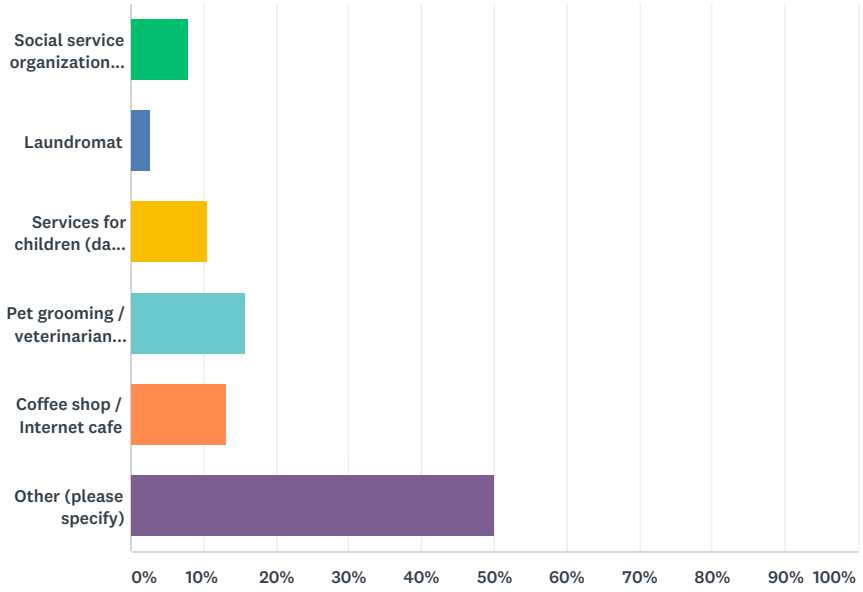
Answered: 38 Skipped: 1



ANSWER CHOICES	RESPONSES	
Strongly agree	31.58%	12
Agree	39.47%	15
Neither agree nor disagree	26.32%	10
Disagree	2.63%	1
Strongly disagree	0.00%	0
TOTAL		38

Q12 Which type of business or service will you like to see in Lincoln Street?

Answered: 38 Skipped: 1



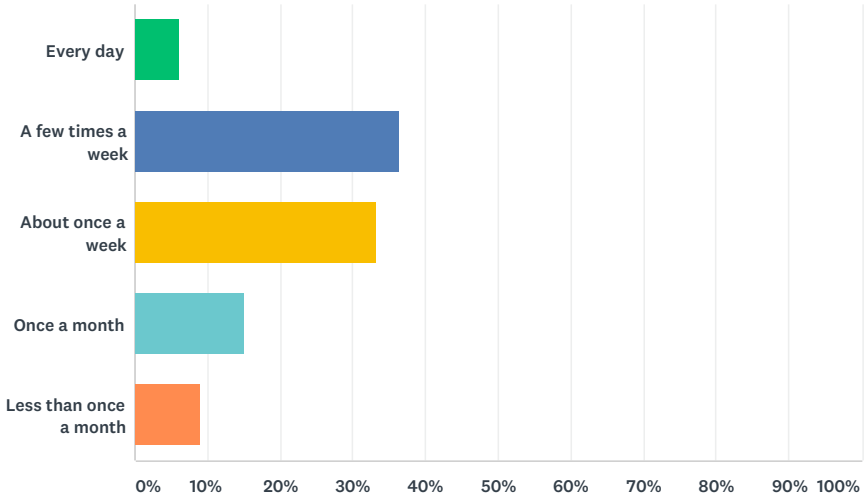
ANSWER CHOICES	RESPONSES	
Social service organizations (WIC, SNAP, etc)	7.89%	3
Laundromat	2.63%	1
Services for children (day care, after school programs)	10.53%	4
Pet grooming / veterinarian clinic	15.79%	6
Coffee shop / Internet cafe	13.16%	5
Other (please specify)	50.00%	19
TOTAL		38

#	OTHER (PLEASE SPECIFY)	DATE
1	ALL	11/4/2019 8:12 PM
2	restaraunt	11/4/2019 8:10 PM
3	better grocery store	11/4/2019 8:03 PM
4	shopping, groceries	11/4/2019 8:00 PM
5	bars, restaurants	11/4/2019 7:49 PM
6	restaurant	11/4/2019 7:45 PM
7	stop & shop	11/4/2019 7:41 PM
8	all of the above	10/28/2019 1:32 PM
9	need more services for children, coffee shop	10/28/2019 1:09 PM
10	restaurant	10/16/2019 11:18 AM
11	stop & shop	10/16/2019 11:11 AM
12	no room for more	10/4/2019 1:13 PM
13	happy with what is already offered	10/4/2019 1:11 PM
14	shopping, food	10/4/2019 1:09 PM
15	social services, more entertainment for children	10/4/2019 1:03 PM
16	social service organizations, services for children	10/4/2019 1:00 PM

17	all of the above	10/4/2019 12:49 PM
18	Bakery	9/30/2019 6:56 PM
19	A school	7/30/2019 8:04 AM

Q13 How frequently do you visit any of the parks or recreational areas?

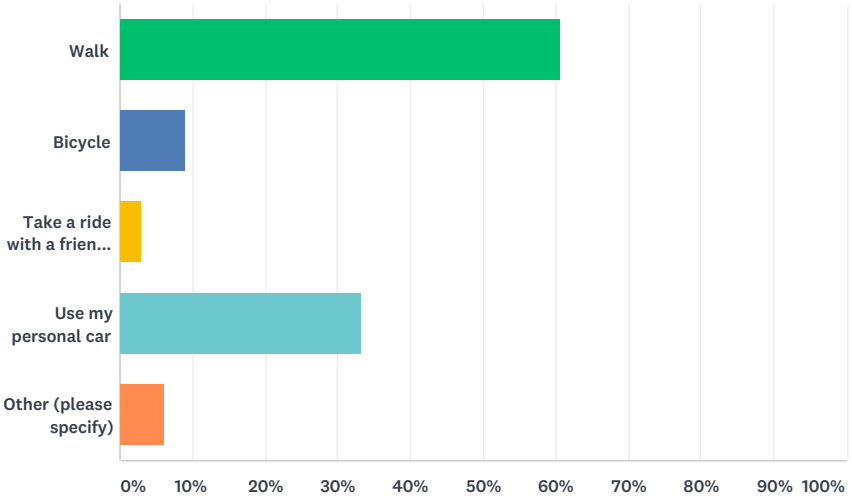
Answered: 33 Skipped: 6



ANSWER CHOICES	RESPONSES	
Every day	6.06%	2
A few times a week	36.36%	12
About once a week	33.33%	11
Once a month	15.15%	5
Less than once a month	9.09%	3
TOTAL		33

Q14 Which mode of transportation do you use to access the parks and recreational areas?

Answered: 33 Skipped: 6

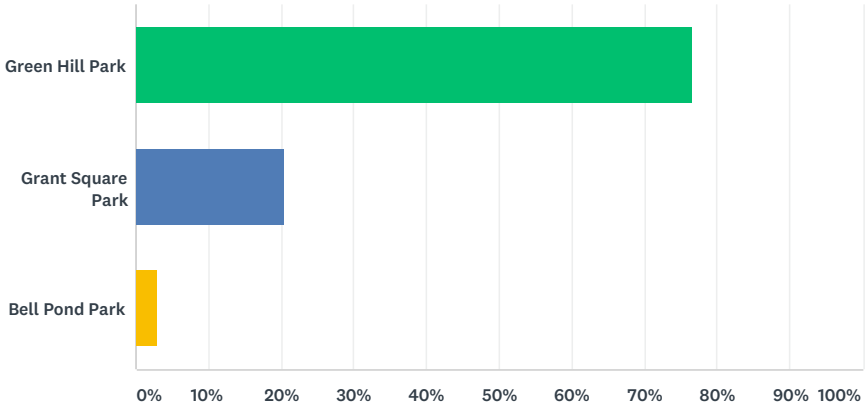


ANSWER CHOICES	RESPONSES	
Walk	60.61%	20
Bicycle	9.09%	3
Take a ride with a friend / neighbor	3.03%	1
Use my personal car	33.33%	11
Other (please specify)	6.06%	2
Total Respondents: 33		

#	OTHER (PLEASE SPECIFY)	DATE
1	wheel chair	11/4/2019 7:41 PM
2	uber	10/4/2019 1:11 PM

Q15 Which park do you frequent the most?

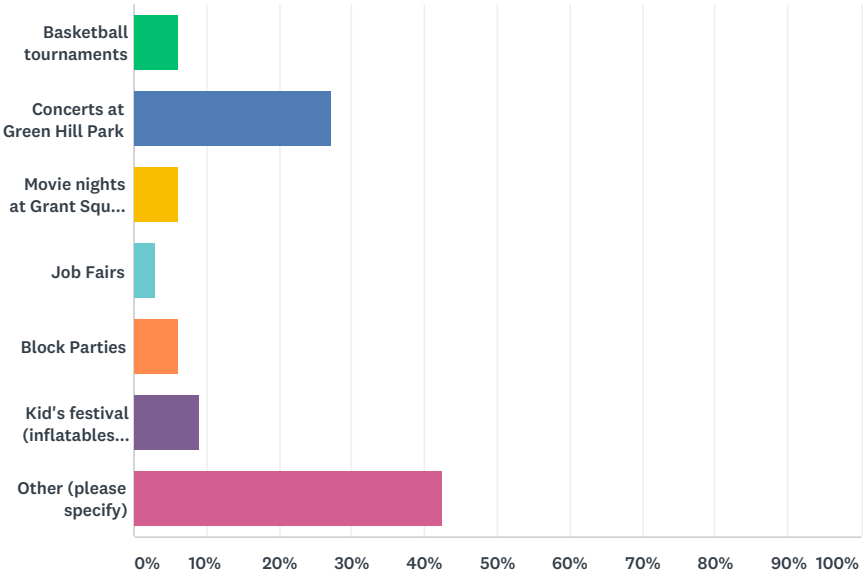
Answered: 34 Skipped: 5



ANSWER CHOICES	RESPONSES	
Green Hill Park	76.47%	26
Grant Square Park	20.59%	7
Bell Pond Park	2.94%	1
TOTAL		34

Q16 Which type of activity or event you would likely attend?

Answered: 33 Skipped: 6

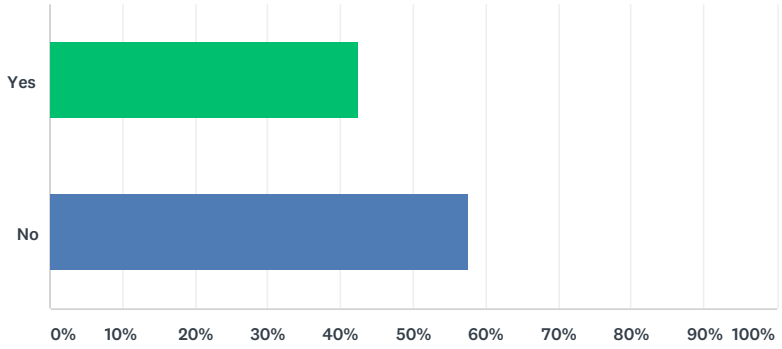


ANSWER CHOICES	RESPONSES	
Basketball tournaments	6.06%	2
Concerts at Green Hill Park	27.27%	9
Movie nights at Grant Square Park	6.06%	2
Job Fairs	3.03%	1
Block Parties	6.06%	2
Kid's festival (inflatables, music, games, etc.)	9.09%	3
Other (please specify)	42.42%	14
TOTAL		33

#	OTHER (PLEASE SPECIFY)	DATE
1	all of them	11/4/2019 8:05 PM
2	ALL	11/4/2019 8:00 PM
3	ALL	11/4/2019 7:58 PM
4	ALL	11/4/2019 7:56 PM
5	food trucks, beer fest	11/4/2019 7:49 PM
6	concerts, block parties, kids festivals	10/28/2019 1:09 PM
7	all of the above	10/4/2019 1:11 PM
8	basketbal tournaments, kids festival	10/4/2019 1:09 PM
9	basketball tournaments, concerts, movie night, kids festival	10/4/2019 1:03 PM
10	all of the above	10/4/2019 1:00 PM
11	concerts, movie night, block parties, kid festivals	10/4/2019 12:53 PM
12	concerts, movie night, block parties, kid festivals	10/4/2019 12:49 PM
13	none	10/4/2019 12:46 PM
14	all of the above	10/4/2019 12:40 PM

Q17 Have you heard about the GHNA?

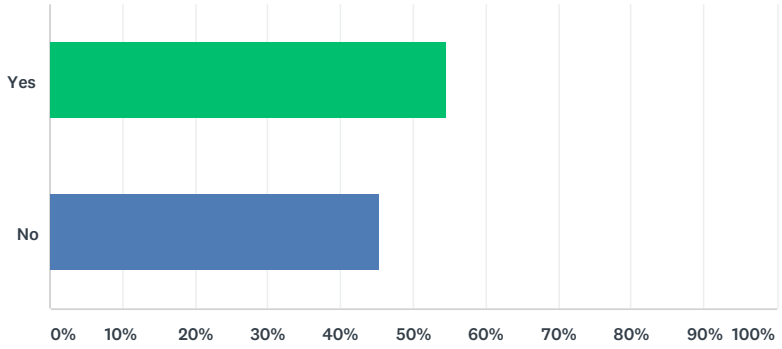
Answered: 33 Skipped: 6



ANSWER CHOICES	RESPONSES	
Yes	42.42%	14
No	57.58%	19
TOTAL		33

Q18 If yes, have you attended the monthly community meetings?

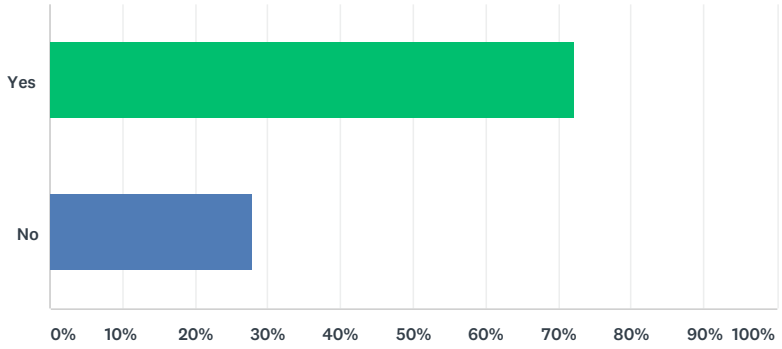
Answered: 22 Skipped: 17



ANSWER CHOICES	RESPONSES	
Yes	54.55%	12
No	45.45%	10
TOTAL		22

Q19 Would you like to keep in touch with the GHNA?

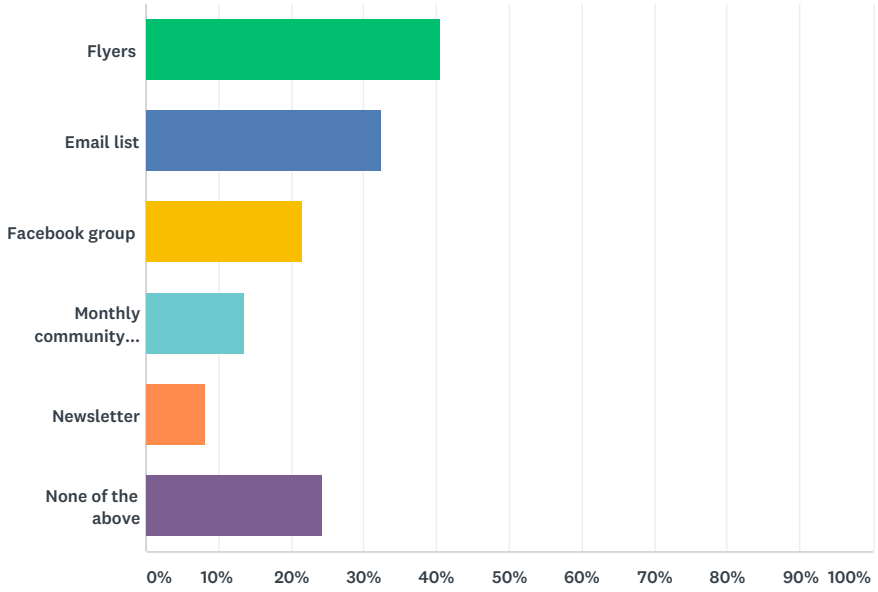
Answered: 36 Skipped: 3



ANSWER CHOICES	RESPONSES	
Yes	72.22%	26
No	27.78%	10
TOTAL		36

Q20 Which type of communication tool you prefer to be engaged with the GHNA? (Please select all that apply.)

Answered: 37 Skipped: 2



ANSWER CHOICES	RESPONSES	
Flyers	40.54%	15
Email list	32.43%	12
Facebook group	21.62%	8
Monthly community meeting	13.51%	5
Newsletter	8.11%	3
None of the above	24.32%	9
Total Respondents: 37		