Corridor Study of Route CT-156 in East Lyme, Connecticut

Project Report

A Major Qualifying Project Submitted to the Faculty of Worcester Polytechnic Institute in Partial Fulfillment of the requirements for the Bachelor of Science Degree

Creators
Michaela Dos Santos, Luna Daury, Lauren Hess

Advisor
Suzanne LePage

Co-Advisor
Robert Krueger

Sponsors
Katherine Hedberg-Klose
Connecticut Department of Transportation

Abstract

This MQP team collaborated with the Connecticut Department of Transportation to provide recommendations for improving Route CT-156 in East Lyme, Connecticut. Existing conditions of the corridor were documented, including curb ramp components, street layout, Complete Streets characteristics, and crash data. Improvements to the corridor included revising sidewalk accessibility to meet Americans with Disabilities Act regulations and incorporating bike paths in the street redesign. AutoCAD and Streetmix were used to finalize and present the recommendations.

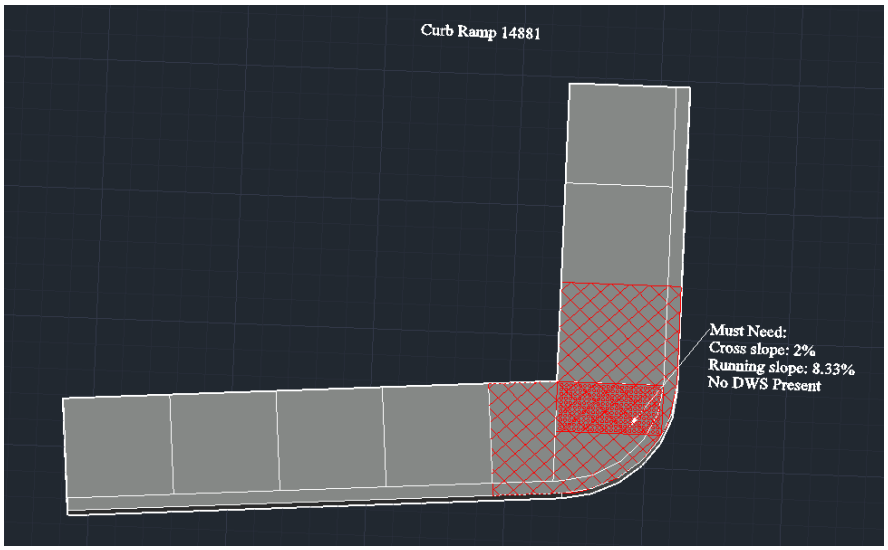
Executive Summary

East Lyme, a small coastal town, is heavily populated with tourists during the summer months. The project was centered on Route CT-156, beginning at the intersection of East Pattagansett Road through Main Street and concluding at Cini Memorial Park. The Connecticut Department of Transportation (CTDOT) identified the corridor as requiring improvements to prioritize the safety of the public. Many of the ramps and curbs in the corridor are considered non-compliant by the Americans with Disabilities Act (ADA) standards.

This Major Qualifying Project's goal was to collaborate with CTDOT to establish a Corridor Concept Plan for Route CT-156 that incorporates design criteria from Complete Streets, ensuring curbs and ramps become ADA compliant while addressing Electric Vehicle infrastructure. This plan developed a Complete Streets design that was safe and accessible for everyone. The team familiarized themselves with relevant concepts and evaluated existing conditions to develop improvements for the site.

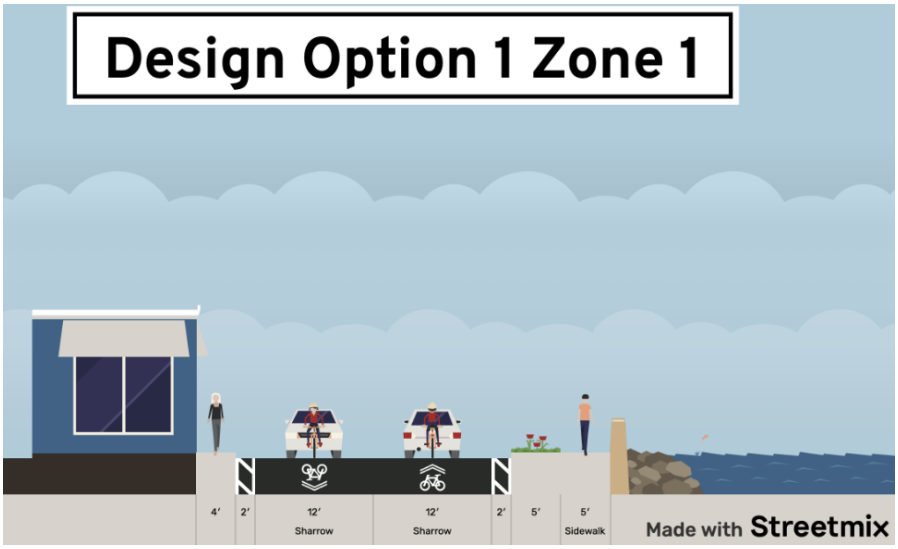
The designs and recommendations were created based on the guidelines given by the CTDOT. Data was collected through site visits and information provided by CTDOT. The UCONN Connecticut Crash Data Repository website provided the team with crash data from 2018-2024 on the corridor. Crash rates and diagrams were created for each of the zones. Parking inventories were counted for the four zones that were created.

Based on the data collected, improvements for each zone were identified and incorporated into a design. Solutions included curb ramp and street redesign. The team focused on non-ADA-compliant curb ramps in the four zones and offered solutions to rectify those issues. 3D Models located in Appendix D highlights problems for each curb ramp, accompanied by AutoCAD models and Google Earth images. Recommendations span the addition of detectable warning strips, securing landing areas, addressing slope requirements, and eliminating water ponding and obstructions. These measures aim to ensure compliance with ADA regulations. A sample design image follows:



Proposed curb ramp for Curb Ramp i at Intersection D

The team also developed street redesigns to incorporate bike lanes. The CTDOT has adopted Complete Streets standards for bicycle routes based on the width of the streets and speed limits. The design was created with the use of Streetmix and Google Earth. The team's recommendation along with a sample design image follows:



Recommended Zone 1 Cross Section

The team recommended both short and long-term solutions for the redesign of Route CT-156. To encourage cycling safety, short-term measures include integrating a sharrow (shared bike and car designated area) on driving lanes and decreasing the speed limit in Zone 4. Long-term plans include designated bike lanes along the corridor and utilizing an abandoned police station for public parking to eliminate street parking. To incorporate ADA compliance, the long-term solutions would be to add detectable warning strips, and address all curb ramp slopes that exceed the maximum requirements.

Acknowledgements

The achievement of this project would not have been possible without the resources and opportunities afforded by Worcester Polytechnic Institute (WPI) and Connecticut Department of Transportation. We would like to thank Katherine Hedberg-Klose from the CTDOT and Alex Klose from the Town of East Lyme whose resources and guidance assisted in the completion of this project. We would like to thank our WPI project advisors, Suzanne LePage and Robert Kreuger who offered continual support and feedback throughout the course of this project.

Authorship

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Appendix E	Luna/ Lauren
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Appendices	All
AutoCAD Curb Ramp Designs	Luna/Lauren
StreetMix Designs	Michaela

Capstone Design Statement

This project focused on redesigning a section of Route CT-156 in East Lyme, Connecticut, specifically between Black Point Road and the Niantic River Bridge. The purpose of this redesign was to meet the needs of the town and the community, which included the necessity of improving the roads to ensure the safety of everyone regardless of disabilities. The Accreditation Board for Engineering and Technology (ABET) requires that all students in an accredited engineering program complete a capstone design experience before acquiring an engineering degree. Through a capstone design experience, students demonstrate skills and knowledge acquired through their studies and coursework. The project aligns with Outcome C criteria, which states that graduates should have the ability to design a system that meets needs within realistic constraints such as economic, environmental, social and political, ethical, health and safety, and sustainability (*Criteria for Accrediting Engineering Programs, 2018 – 2019*, 2021).

The project considered the following six constraints:

1. *Economic:* Potential funding options were researched to implement the improvements that were recommended. The benefits of each funding organization were looked into before making any recommendations.
2. *Environmental:* The project took into account the environmental impact of all improvement concepts and aimed to mitigate those impacts. Efforts were made to improve the environmental conditions along the corridor by possibly adding vegetation and absorbent surfaces.
3. *Social and Political:* The team familiarized themselves with regulations and community objectives at the city and state levels. Any recommendations given comply with those regulations and take into consideration the needs of stakeholders. The team made sure to address the needs of the people of East Lyme, regardless of their socio-economic status, by promoting safe and efficient utilization of the road by all modes of transportation.
4. *Ethical:* The project adhered to the ASCE Code of Ethics for civil engineers to maintain the reputation of WPI and Connecticut's Department of Transportation.
5. *Health and Safety:* The project focused on improving dangerous intersections, sections of roads with high crash rates, and poor traffic designs. Countermeasures were considered based on their ability to reduce any injury to improve safety.
6. *Sustainability:* The project presented long-term improvement concepts that address present and future needs for the corridor. The final design and recommendations accounted for future traffic demands and population growth to ensure efficient use of Route CT-156 in the future.

Professional Licensure Statement

A professional engineer must, “hold paramount the safety, health, and welfare of the public,” in all cases when working on an engineering project (National Society of Professional Engineers, 2024). Before receiving such responsibility through licensure, an engineers must experience immense training in their respective areas.

A licensed engineer must first graduate from an accredited university by the state licensing board. Any student who has one semester left prior to graduation is eligible to be an Engineer-in-Training (EIT). In order to obtain an EIT license, one must first pass the Fundamentals of Engineering Exam (FE), which is administered by the National Council of Examiners for Engineering and Surveying (NCEES). It is required that after completing the FE exam, the Engineer-in-Training must be supervised by another licensed professional engineer for the next four years. In order to receive a professional engineering license, one must pass The Principles and Practice of Engineering Exam (PE) (National Society of Professional Engineers, 2024).

Once an engineer receives their PE license, they have the ability to review drawings and designs for approval. A PE has the authority to seal engineering project drawings. In order to maintain a PE license, the engineer must remain competent in their area of expertise as well as continuously advance their technical skills and education. Throughout the duration of the project, the team learned the essential technical, educational, and collaborative skills to effectively proceed with necessary steps of becoming Engineers-in-Training, and ultimately, Professional Engineers.

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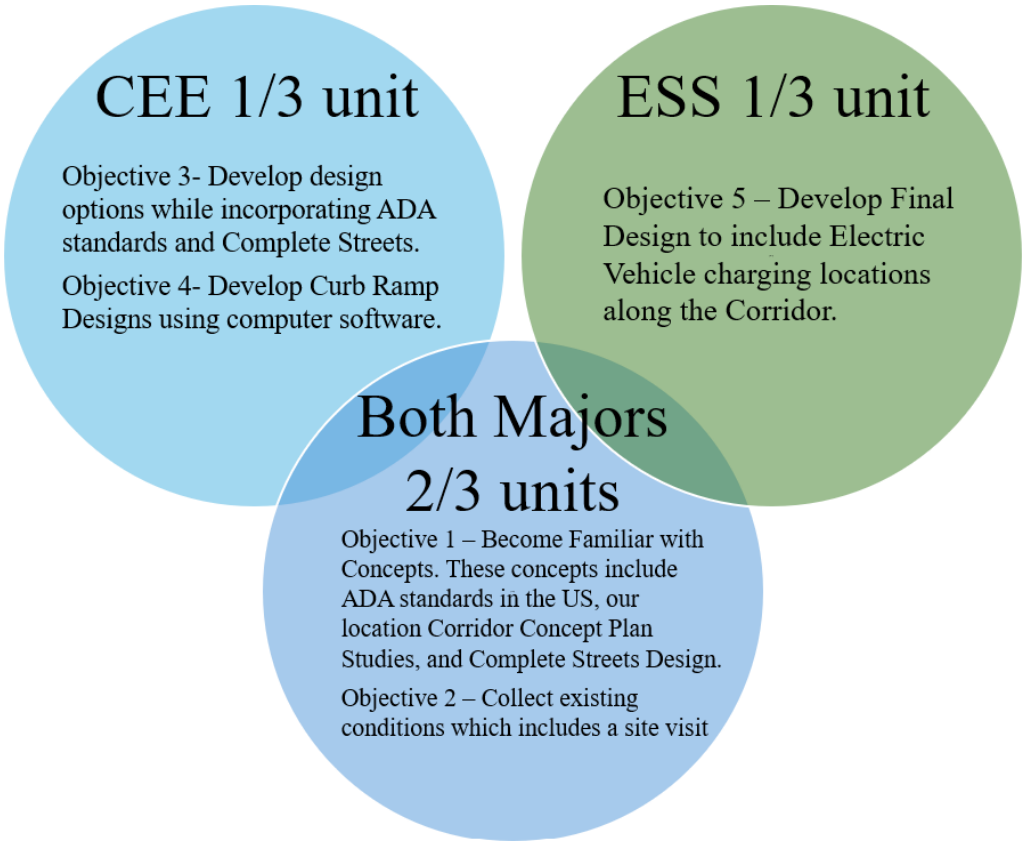
Civil Engineering & Environmental and Sustainability Studies Credit Distribution

Lauren Hess undertook this project as part of a double-major MQP, with credits allocated between the Civil Engineering (CEE) and Environmental and Sustainability Studies (ESS) programs. An additional ⅓ credit was earned during the D-term, commencing in March 2024. This Credit Distribution Venn Diagram provides a visual representation of how credits were distributed for this project. Objective 5 is the part of the project that Lauren independently completed.



1.0 Introduction

East Lyme is located along the shoreline of Connecticut as a typical New England town with a vibrant community and historical landscape. Figure 1 displays a simplistic map of the corridor location which includes many attractions that captivate residents and tourists.

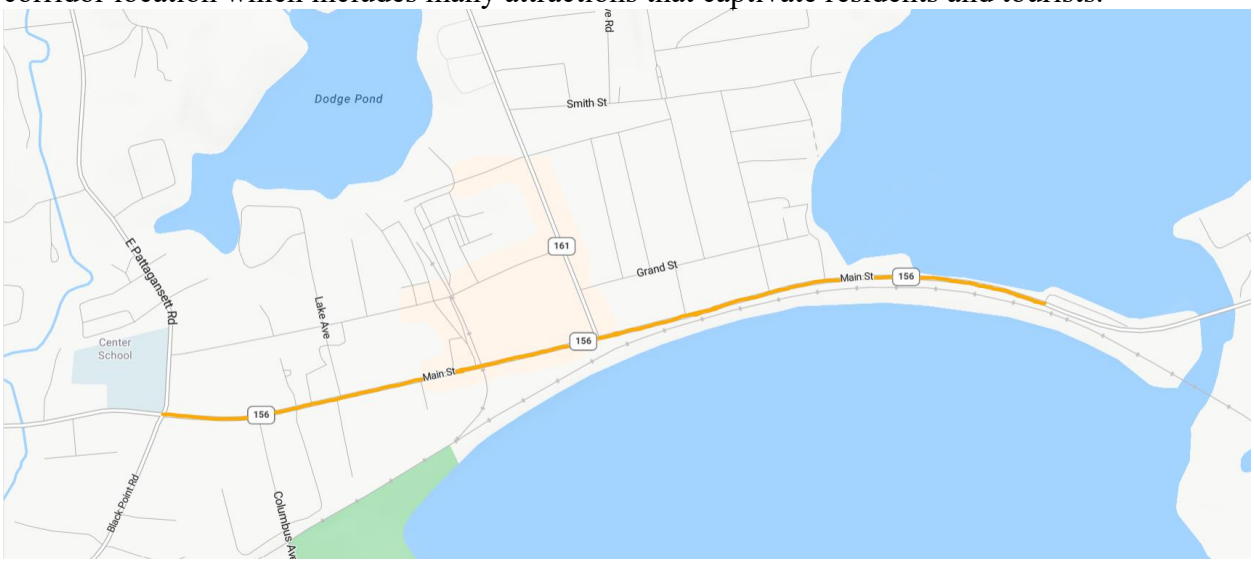


Figure 1: A Google Maps image of Route CT-156 and adjacent streets with an orange line representing the project site in East Lyme, CT.

This project took place in the heart of East Lyme, Route CT-156. The corridor has been identified by the Connecticut Department of Transportation (CTDOT) as needing improvements to ensure the safety of everyone using the road. Currently, the site provides little security for pedestrians as many ramps and curbs are considered non-compliant by the Americans with Disabilities Act (ADA) standards in the state's records.

Specifically, the project's location starts at the intersection of East Pattagansett Road through Main Street and concludes at Cini Memorial Park. East Lyme is seeking infrastructure improvement suggestions. This Major Qualifying Project's goal was to work with the CTDOT to create a Corridor Concept Plan in East Lyme that incorporates the design of Complete Streets, ensuring compliance with the ADA standards and addressing the future need for Electric Vehicle infrastructure. This plan included a Complete Streets design that was safe, accessible, and welcoming to all people regardless of disabilities. The team also recognized the demand for electric vehicle infrastructure as it becomes more popular.

In order to address our goal, the approach was divided into the following five main objectives:

1. Become Familiar with Concepts
2. Document Existing Conditions
3. Develop Cross Sectional Designs
4. Develop Curb Ramp Designs
5. Select Electric Vehicle Charging Station Locations

2.0 Background

This chapter will review the concepts surrounding the creation of the Americans with Disabilities Act (ADA) as well as an introduction to the Connecticut Department of Transportation transition plan. The background will also discuss how a Corridor Concept Plan (CCP) ties into the project location and how it can help address the wants and needs of residents and create a better way of transportation in East Lyme. Finally, to focus on the environmental aspect of the project, the background will also examine how Route CT-156 could be upgraded to accommodate the growing need for Electric Vehicles (EVs).

2.1 Location: Town of East Lyme

The location of the project is Route CT-156, located in East Lyme, CT. Route CT-156, also referred to as Main Street, travels Eastbound and Westbound through East Lyme. The area of focus for this project begins (from east to west), at the intersection of 10-2 E Pattagansett Rd through Main Street and will conclude at location Cini Memorial Park.

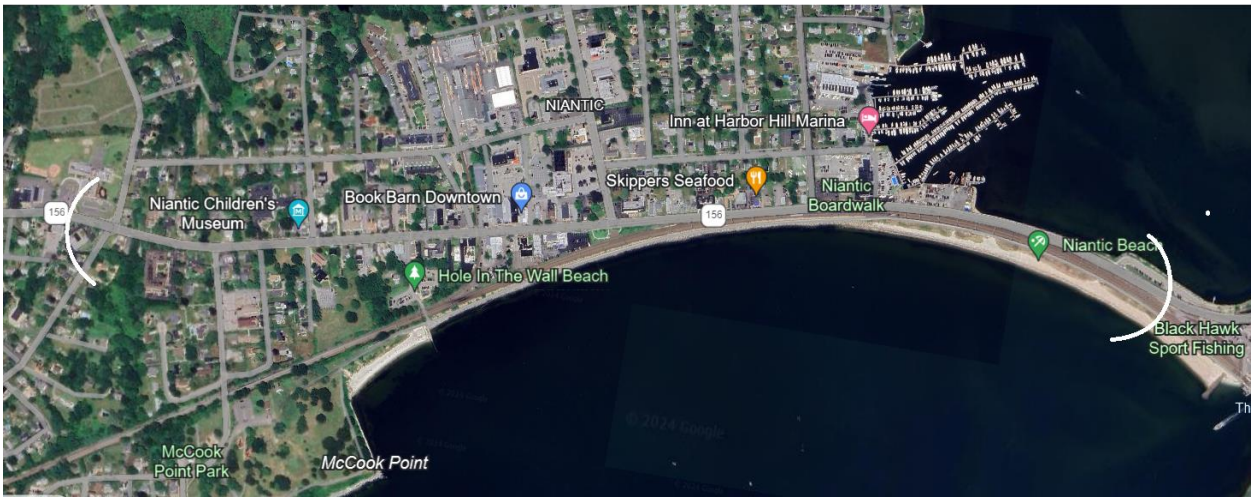


Figure 2: Google Earth image of the Route CT-156 in East Lyme, CT within the boundaries of this study.

East Lyme holds a population of over 18,000 residents, some of those residents located along Main Street (*U.S. Census Bureau quickfacts: East Lyme Town, Southeastern Connecticut,* n.d.). Based on information collected from Google Maps, the route is surrounded by both municipal buildings and residential houses. Additionally, there is the Niantic Bay Beach Boardwalk which stretches 0.5 of a mile adjacent to Route CT-156 on the southern side. During the summer months, this location becomes heavily populated with tourists, thereby increasing the number of pedestrians (Town of East Lyme, 2023). The intersection of CT-161 (Pennsylvania

Ave) and Route CT-156 (Main St) carries about 9,000 vehicles per day. The surrounding residential houses, municipal buildings, and boardwalk along Route CT-156 are shown in Figure 2. The municipal buildings that are located alongside this route include restaurants, shops, a bank, and a marina. Beyond the municipal buildings along Route CT-156 lie residential houses.

2.2 United States Americans with Disabilities Act Guidelines

The Americans with Disabilities Act initially began before 1990 when people throughout the United States gathered and formed groups to advocate for the inclusion of individuals with disabilities. These gatherings led to a movement to end discrimination against people with disabilities, which caught the attention of local governments and got passed down to Congress (Mayerson, 2021). With the help of many like-minded individuals, they have made these prejudices more noticeable to the public eye and the people of power as well. The disability rights movement helped push the official creation of the civil rights law.

The United States has general ADA requirements that all states must follow, however, some states may have more detailed requirements than others and some of those details might vary.

The general specifications for sidewalk and ramp construction include, but are not limited to (*Requirements for Accessible Sidewalk Design: EMC*, n.d.):

- 3’ minimum of clearance in the walkway
- A paved and smooth sidewalk
- No obstacles or debris in the way
- A maximum grade of 5%
- Include a buffer between the sidewalk and the street
- Detectable warning strips must be included on ramps

According to the U.S. Access Board’s *Guide to the ADA Accessibility Standards* in Figure 3, curb ramps must have a top landing length and width of 48” and a maximum slope of 2%. The running slope must be at a maximum slope of 8.33%, and a maximum cross slope of 2%. Side flare slopes need to have a maximum slope of 10%. To achieve ADA compliance, the curb ramp running slope must be flush against the street or have a maximum lip height of ¼” as it slopes downward depicted in Figure 3. These regulations apply to perpendicular curb ramps with non-walking surfaces.

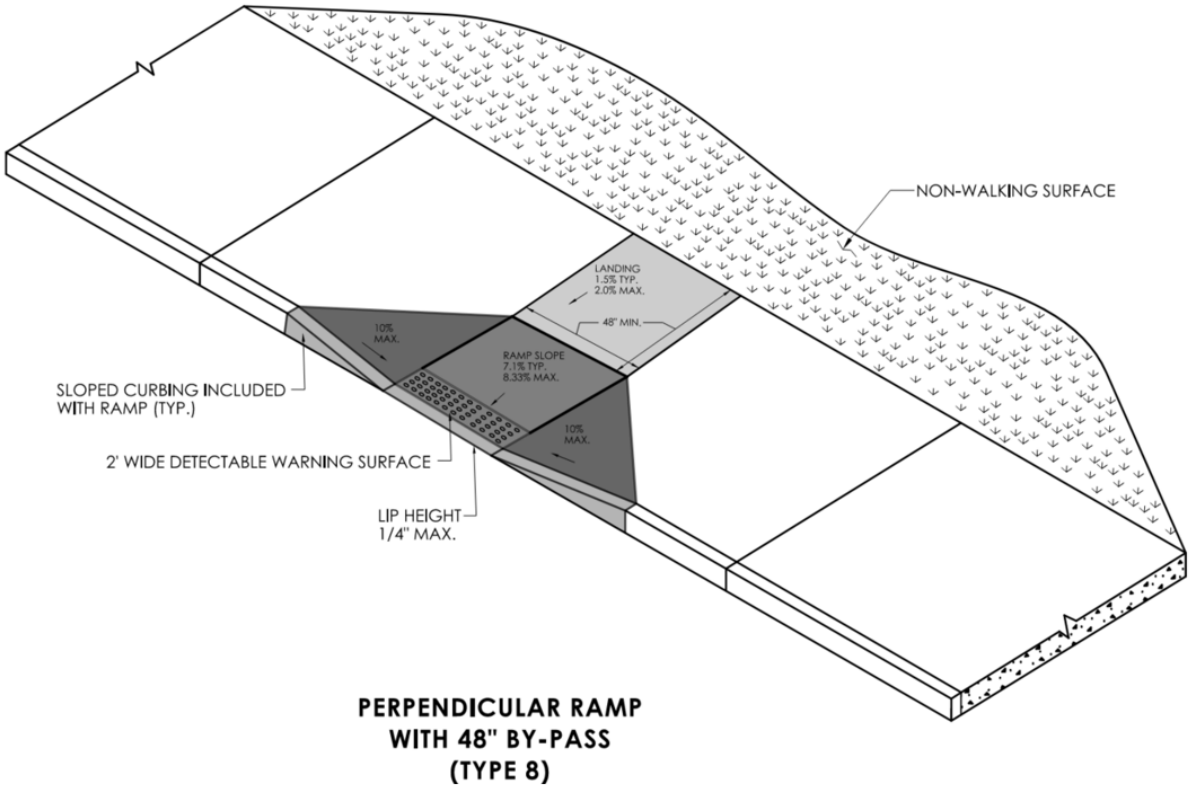


Figure 3: Perpendicular Ramp with 48” By-Pass (Type 8)
Curb Ramp diagrams provided by Katherine Hedberg presentation: *Introduction to CTDOT ADA Engineering Coordination Unit*

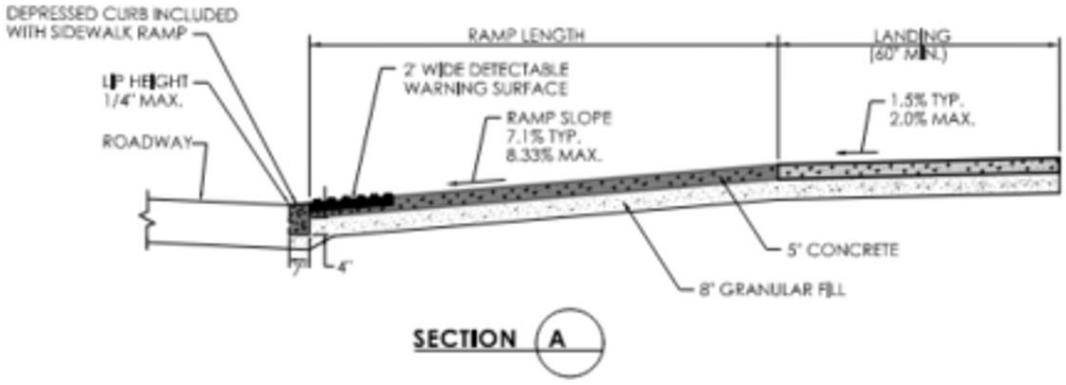


Figure 4: Cross section of the Perpendicular Ramp with 48” By-Pass
Curb Ramp diagrams provided by Katherine Hedberg presentation: *Introduction to CTDOT ADA Engineering Coordination Unit*

For parallel curb ramps without a non-walking surface, the maximum ramp slope must be 8.33%. The length of the landing needs to be at a minimum of 60” while the width is 48” (same

width as the sidewalk itself). The landing slope must be 2% at most and a lip height limit of ¼". All details are located in Figure 5.

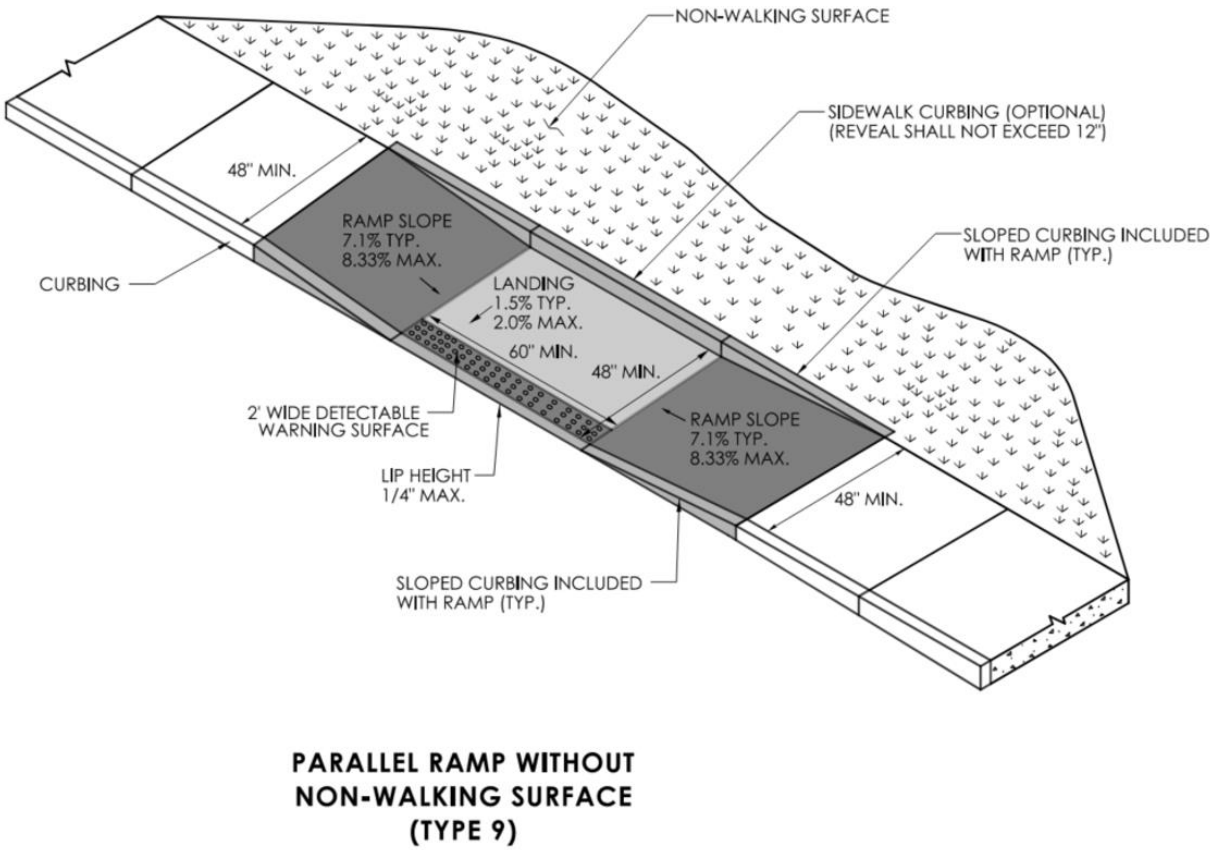


Figure 5: Parallel Ramp without Non-Walking Surface (Type 9)
Curb Ramp diagrams provided by Katherine Hedberg presentation: *Introduction to CTDOT ADA Engineering Coordination Unit*

For curb ramps with a grade break greater than 5', the guidelines remain the same as the previous perpendicular and parallel curb ramps; however, the top landing must have a minimum running and cross slope of 2% while the bottom landing area needs to have a minimum running and cross slope of 2% and a maximum of 5%. Where the grade break is located, the two ends must be measured at least 5' away from the back of the curb and the detectable warning mat is placed along the curb ramp which is illustrated in Figure 6.

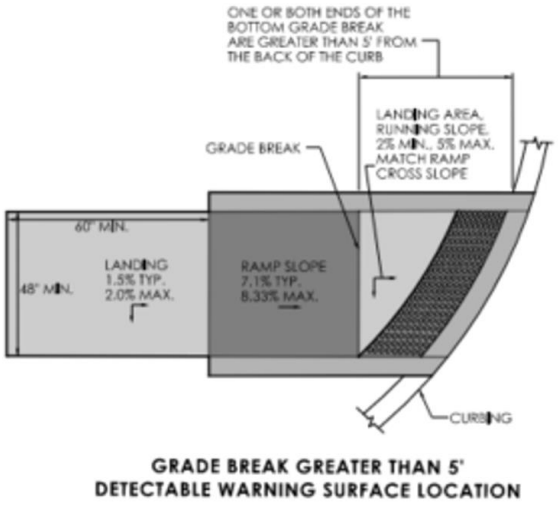


Figure 6: Grade Break Greater than 5' Detectable Warning Surface Location
Curb Ramp diagrams provided by Katherine Hedberg presentation: *Introduction to CTDOT ADA Engineering Coordination Unit*

The next curb ramp type that is present at some locations of the corridor is the ramp warping curb ramp. As one can observe in Figure 7, the ramp matches the roadway profile slope with the detectable warning mat located at the edge of the curb and must be flush against the roadway. Its cross slope must also be a maximum of 2%. Like the other curb ramp types, the landing running and cross slope must be 2% maximum with a length of 60" and width of 48".

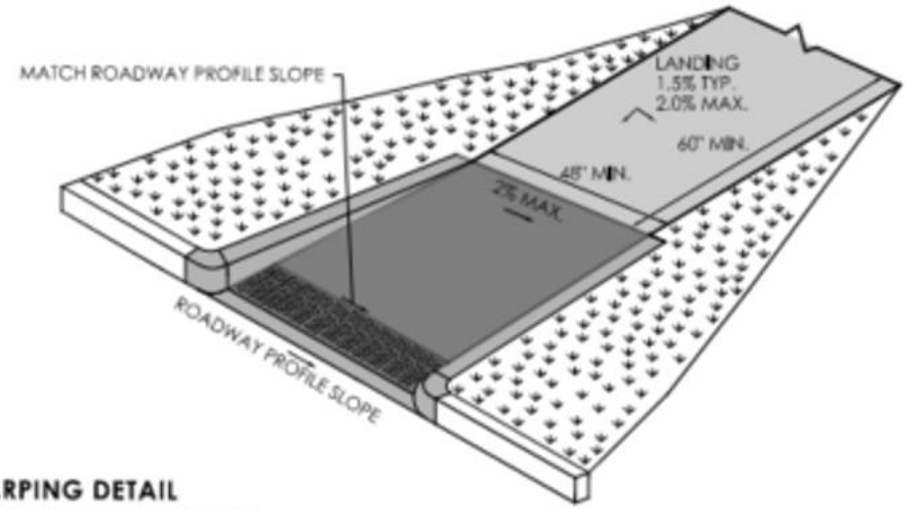


Figure 7: Ramp Warping Detail
Curb Ramp diagrams provided by Katherine Hedberg presentation: *Introduction to CTDOT ADA Engineering Coordination Unit*

The final curb ramp type that was included is the curb ramp with a grade break of 5'or less. All regulations for this type of curb ramp are the same including the measurements and slopes of landing areas, however, the detectable warning mat is placed along the front of the ramp slope before the second landing area. Figure 8 shows the design of this specific curb ramp type.

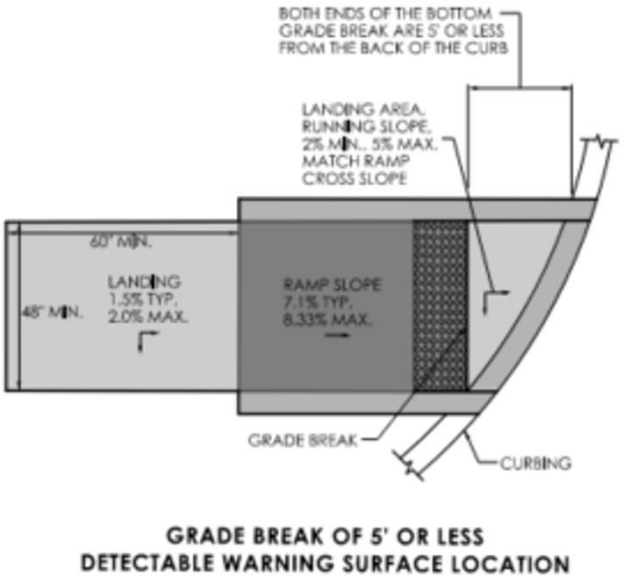


Figure 8: Grade Break of 5' or Less Detectable Warning Surface Location
Curb Ramp diagrams provided by Katherine Hedberg presentation: *Introduction to CTDOT ADA Engineering Coordination Unit*

This project will address two main Federal Statutes: Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA); specifically Title II and Public Right-of-Way Guidelines, PROWAG. These regulations provide information and guidelines for design and funding towards any development that provides any service, program, or activity as well as transportation to persons with disabilities to be as self-sufficient as possible.

Section 504 of the Rehabilitation Act of 1973

Section 504 is a federal law that protects persons with disabilities from discrimination in receiving services, activities, and programs that receive federal financial assistance. It also ensures states and local governments guarantee that persons with disabilities have equal opportunity to access any services, programs, and activities receiving federal financial assistance (*Connecticut Department of Transportation.Pdf*, n.d.).

The Americans with Disabilities Act of 1990 (ADA)

The Americans with Disabilities Act is a federal civil rights law that prohibits discrimination against people with disabilities. There are five separate titles, Title II applies to state and local governments and protects all peoples for all services, programs, and activities as well as transportation(*Connecticut Department of Transportation.Pdf*, n.d.).

The Public Right-of-Way Guidelines (PROWAG)

The Public Right-of-Way Guidelines are supplemental information for the ADA guidelines. PROWAG addresses every component of public rights-of-way and pedestrian access to sidewalks such as crosswalks, curb ramps, street furnishing, pedestrian signals, and parking (*Connecticut Department of Transportation.Pdf*, n.d.).

All of these applicable regulations have been incorporated into CTDOT programs, facilities, and public rights-of-way to protect people with disabilities and give them equal opportunity. CTDOT currently is working on completing the ADA requirements which include a roadway Self-Assessment and Transition Plan. The Self-Assessment includes a review of all the policies regarding ADA compliance in CTDOT. The CTDOT Self-Evaluation compliance includes evaluating building facilities, rights-of-way facilities, and communications to identify any accessibility obstacles or issues that need to be addressed urgently. In addition, CTDOT has developed a grievance procedure that provides a location online where the public can report an ADA issue whether public transit service or a public right-of-way issue. All of the data gets stored in the CTDOT Transition Plan.

2.3 Connecticut Department of Transportation Transition Plan

The Connecticut Department of Transportation developed the Transition Plan as an essential response to the Americans with Disabilities Act of 1990 and the ADA Amendments Act of 2008. The Transition Plan represents a profound commitment to promoting accessibility and ensuring strict compliance in Connecticut’s infrastructure. The Transition Plan includes a list of physical barriers that limit the accessibility of programs, activities, or services as well as methods and schedules to remove such barriers.

In the Transition Plan of 2019, several crucial elements were introduced to underpin the program's overarching mission.

A pivotal development within the program was the approval of ten precisely crafted curb ramp design guidelines. These guidelines serve as a blueprint for the construction of curb ramps that rigorously adhere to ADA standards. By providing clear and detailed standards, these guidelines ensure that construction teams will create curb ramps that facilitate a smooth and safe transition for individuals with disabilities, thus encouraging inclusivity within public spaces. An example of compliant and not-compliant sidewalks and curb ramps can be seen in Figure 9.

Figure 9: Provides photos to demonstrate what sidewalks and curb ramps could look like with the corresponding categorization.

Furthermore, curb ramps, a vital element of accessible infrastructure, were categorized into four distinct types, enabling a systematic evaluation of their compliance levels. The following categories are:

1. Existing concrete curb ramps with tactile warning strips are assumed to meet current ADA standards.
2. Existing curb ramps constructed from bituminous or concrete without tactile warning strips are assumed to be partially non-compliant.
3. Lack of curb ramp at pedestrian crossing.
4. Lack of curb ramp at traffic signal push button.

Table 1 provides statistics for how many curbs in the state of Connecticut that are within each of the mentioned categories, as of 2019. Meanwhile, pedestrian crossings and locations with traffic signal push buttons with no curb ramps are critical gaps in accessibility in Connecticut that demand attention and improvement.

Existing concrete curb ramp with tactile warning strip	Existing curb ramp (bituminous or concrete) without tactile warning strip	No curb ramp at pedestrian crossing	No curb ramp at traffic signal pushbutton
3,183	11,594	1,577	1,327

Table 1: A chart representing the current curbs and their categories in Connecticut.

Over the years, the program has made notable strides in expanding accessibility. Since its inception in 2014, over 2,000 new curb ramps have been successfully added through various CTDOT projects. This substantial achievement underscores the program's commitment to actively pursuing accessibility goals.

In terms of overarching goals, CTDOT has set an ambitious target: to comprehensively update accessibility across the entire state of Connecticut within 15 years, with a specified target

year of 2035 (*CTDOT Updating ADA/Section 504 Transition Plan*, 2023). This long-term vision reflects the program's consistent dedication to inclusivity and accessibility, thus emphasizing that this mission is not merely a short-term endeavor, but an ever-lasting commitment. Supporting these initiatives, CTDOT has allocated a significant annual budget of $6 million for curb ramp construction.

In addition to its involvement in curb ramp construction, CTDOT is assigned the responsibility of ensuring the ongoing accessibility of crosswalks and traffic crossings on state-owned highways. This expanded mandate adds to the program's approach to accessibility, recognizing that creating an accessible transportation network extends beyond individual curb ramps to encompass the broader range of pedestrian-related infrastructure.

The Transition Plan stands as a comprehensive and transformative initiative to align with federal disability laws and advance accessibility throughout Connecticut (*CTDOT Updating ADA/Section 504 Transition Plan*, 2023).

The Office of Equal Opportunity and Diversity is the department in CTDOT that meets quarterly with the Federal Highway Administration (FHWA) to ensure steady progression with the Transition Plan. CTDOT has also created a technical infeasibility form (TIF) which is filled out when a project can’t meet ADA accessibility. PROWAG has been recognized as a good practice for designers. When a design element doesn’t satisfy PROWAG guidelines, then it should be documented and approved with the technical infeasibility form (*ED-2019-7_PROWAG_Links.Pdf*, n.d.).

2.4 Corridor Concept Plan

A Corridor Concept Plan (CCP) is a report that outlines a strategy for the development and/or improvement of transportation corridors in a certain region. The report is typically created by transportation agencies, like the CTDOT, as a set of future guidelines to manage developmental growth along major transportation corridors.

A CCP focuses on a specific corridor which could be a highway, road, or even a transit route. A CCP aims to address many transportation challenges, including safety issues and substandard infrastructure. The plan provides an integral approach to corridor development, considering multiple transportation modes, such as cars, public transit, bikes, and pedestrians, to ensure an efficient transportation system (*SR 580 Corridor Planning and Concept Development Study*).

The CT DOT has various resources available to support the development of CCPs. These resources include:

1. Studies and Reports: The CT DOT conducts studies and prepares reports on transportation-related subjects. These documents analyze existing conditions, identify challenges, and propose recommendations for improvement in specific corridors.
2. Data Collection and Analysis: The CT DOT collects and analyzes data related to travel patterns, crash statistics, and other relevant information for corridors. This data helps to identify priorities for decision-making.
3. Public Involvement: The CT DOT seeks public input and engages community members, including local governments and businesses, throughout the CCP process. Public meetings, surveys, and other engagement methods help gather feedback to ensure that the plan aligns with the needs of the affected communities.
4. Environmental Considerations: The CT DOT incorporates environmental considerations into CCPs by addressing potential impacts on air and water quality and natural resources. The department follows environmental guidelines and regulations to ensure sustainable practices to minimize negative effects on the environment.

Developing a Corridor Concept Plan requires a broad approach that considers a range of factors, including transportation demand, infrastructure needs, community preferences, and environmental impacts. The CT DOT's resources and collaborative efforts ensure that CCPs are well-informed, sustainable, and responsive to the transportation needs of Connecticut's communities.

2.5 Corridor Concept Plan of CT-161

The Southeastern Connecticut Council of Governments (SCCOG), in collaboration with BETA Group, Inc., has conducted a Corridor Concept Study on CT-161 which is another route that intersects Main Street (The Southeastern Connecticut Council of Governments, n.d.). This study will help mitigate traffic congestion, emphasize pedestrian safety, accommodate more bicycle lanes, and overall improve user safety and experience. The study will also benefit the advancement of this project, especially when creating a Corridor Concept Plan on Route CT-156.

Since the corridor study is located within proximity to the project location, it is reasonable to assume residents are most likely to request similar needs. The wants and needs of residents who participated in the CT-161 study will likely match the wants and needs of residents located along Route CT-156. This information collected on CT-161 corridor study will help determine what are the resident’s greatest desires based on feedback from the corridor study. Ideas created from the corridor study will also be implemented into the project since existing conditions, terrain, and zoning regulations at CT-161 are analogous to the Route CT-156 site location. Since a corridor study that focuses on Route CT-156 has never been officialized, the team will establish our designs and plans based on the CT-161 corridor study. A typical corridor study lasts 16 months, so it would not be feasible for the team to conduct a new corridor study

within the time limit of a three-term Master Qualifying Project or 21 weeks (*The Southeastern Connecticut Council of Governments*, n.d.).

2.6 Complete Streets Policies

The Complete Streets policies are an implementation by the CT DOT that aims to create safe and sustainable transportation networks for all users, despite their mode of transportation. The program focuses on accommodating pedestrians, bicyclists, and motorists while also increasing safety. The goal of this policy is to develop streets that meet the diverse needs of the community, encouraging active transportation (bicycling, running, walking, etc.), improving air quality, and promoting public health (*Complete Streets* 2015). Figure 10 is an example of an ideal complete street design that many communities would like to incorporate.

Figure 10: This picture is a comparison of what the current streets look like before and after Complete Streets. The ‘After Complete Streets’ picture includes bike lanes and pedestrian crosswalks.

CT DOT provides resources including guidelines, manuals, and publications that provide a wide range of information on different aspects of Complete Streets implementation. Notable resources include the "Complete Streets Design Guidelines" which offer design guidelines for developing and retrofitting streets according to Complete Streets principles. The guidelines cover pedestrian and bicycle facilities, public transit accommodations, traffic calming measures, and accessibility standards.

The CT DOT has also developed plans to integrate additional bicycle and pedestrian routes that connect within different regions around the state. These plans emphasize the

integration of active transportation into the transportation network whilst highlighting the importance of the Complete Streets program (*Complete streets,* 2023).

In addition to these resources, the CT DOT often collaborates with municipalities and organizations through training sessions and assistance programs. This collaboration aims to promote the implementation of Complete Streets principles across Connecticut.

2.7 Connecticut Department of Transportation Bikeway Guidelines

The CT DOT has developed design standards to add bicycle paths around the state (*Netchapter4pdf.Pdf*, n.d.). There are many different types of bicycle designs such as shared roadway, wide curb lanes, bicycle lanes and separate multi-use paths. The location and kind of bicycle route is dependent on many factors like safety, accessibility and the environment. The route should be placed in locations that it would be maximally used. Bicycle routes are connected in a direct manner. There are specific lengths, standards, and speed limits necessary to provide a safe bicycle route for the public as shown in Table 2.

Bike Path Requirement						
	Shoulder Width	Bike Lane Width	Vehicle Lane Width	Sidewalk	Parking	Speed Limit
Shared Roadway	2 feet	0 feet	12 - 14 feet	4 - 5 feet	8 - 10 feet	35 mph
Bike Lanes	2 feet	4 - 6 feet	10 - 12 feet	4 - 5 feet	8 - 10 feet	20-25 mph

Table 2: Bike Route Requirements

Shared Roadway

Shared roadways are streets that both vehicles and bicycles can travel on. A shared roadway should be continuous and/ or designated as preferred routes of the public in a corridor. There should be an advantage to using a shared roadway such as deregulating traffic and integrating users. Shared roadways give a place for bicyclists while maintaining the composition of the pavement.

Bicycle Lanes

Bicycle lanes are separated paths for bicycle users. There is high demand for bicyclists in the areas that include separated bike paths. The bicycle lanes are designed to be used just by bicyclists.

2.8 Electric Vehicles

As transportation transitions toward a future more dependent on EVs and cleaner transportation options, the landscape of environments will be impacted. There are several insights from experts that bring attention to the transformative potential of EVs and the accompanying evolution of urban infrastructure.

The evolution of EV-friendly infrastructure extends to public charging stations. This transformative approach not only enhances sustainability but also creates more pleasant and eco-conscious urban environments (Kuchta, 2022). Charging infrastructure includes an Open Charge Point Interface which includes an electric vehicle supply equipment port and a connector.

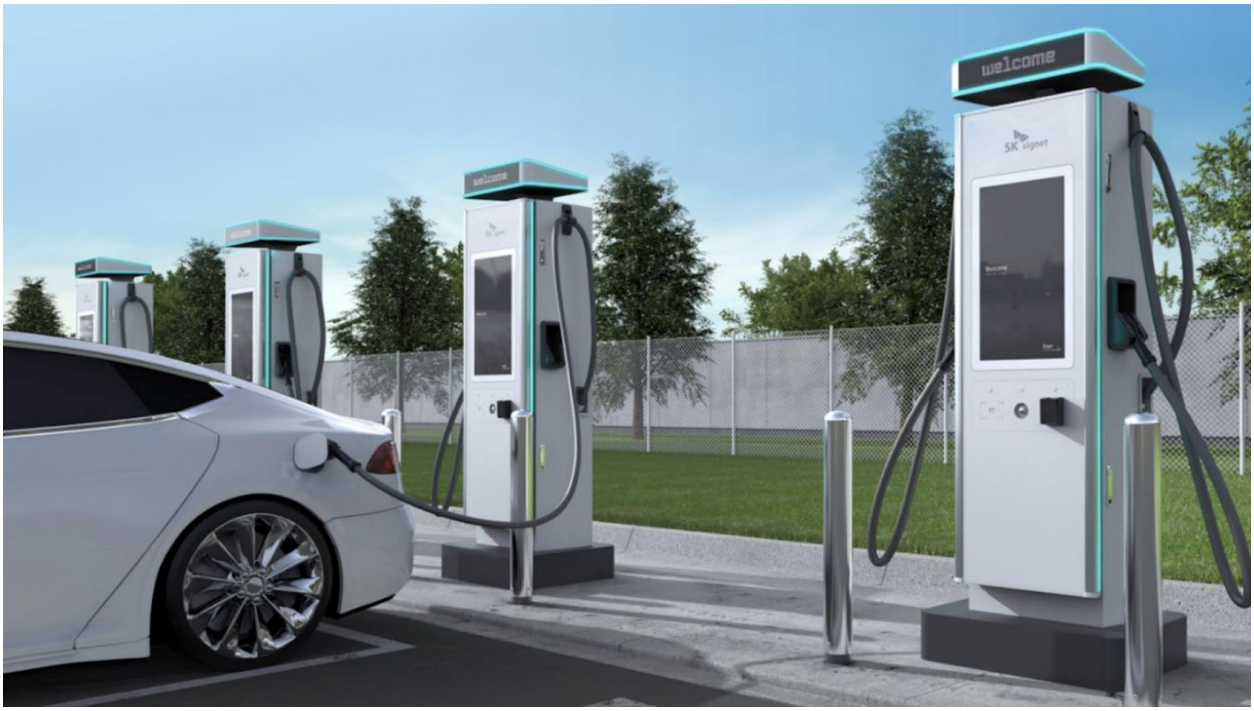


Figure 11: Standard Charging Station

As more and more electric vehicles are used by people, there is a growing demand for charging stations. The rise of electric vehicles is reshaping urban landscapes. The rise of EVs and charging stations foreshadows a new era of urban infrastructure that aligns with sustainability and the changing needs of evolving cities.

3.0 Methodology

As previously stated in the Introduction section, the goal for this project was to create a Corridor Concept Plan in East Lyme that incorporates the design of Complete Streets, while ensuring ADA compliance as well as addressing the future need for Electric Vehicle infrastructure. To address the goal, the team divided our approach into the following five main objectives:

1. Become Familiar with Concepts
2. Collect and Analyze Existing Conditions
3. Develop Cross Sectional Designs
4. Develop Curb Ramp Designs
5. Select Elertic Vehicle Charging Station Locations

3.1 Objective 1 - Become Familiar with Concepts

At the beginning of this MQP, CTDOT provided information on the goals of the project and ADA standards in the state of Connecticut. Each document was reviewed and used as a basis for the project.

The team has reviewed the ADA standards in the United States, and the standard CTDOT enforces throughout the state. The team familiarized themselves with *Title 2* and *PROWAG.* A site visit was conducted in East Lyme to understand the location and existing conditions. The team also researched Complete Streets designs to learn how to incorporate the design into Route CT-156. Additionally, the team researched corridor studies to be able to develop a corridor concept plan within the three allotted terms. The Corridor Plan made on CT-161 was selected based on clarity in terms of design objective, proximity, and applicability to Route CT-156.

Becoming familiar with Title 2 and PROWAG not only helped the team with the development of design options and knowing which aspects of the Corridor Concept Plan were emphasized in terms of ADA compliance, but also it gave us a better understanding of how ADA serves the public. Additionally, this section addressed the existing conditions of the four different zones. Based on the information collected from ADA resources, the design options for Route CT-156 were developed. From there, options were evaluated and determined which option was the most feasible to construct.

3.2 Objective 2 - Collect and Analyze Existing Conditions Data

This section discusses how the specific data was collected, documented, and analyzed to complete upcoming objectives. This data includes sidewalk and curb ramp accessibility, amount of parking available, and traffic and crash rates.

3.2.1 Site Layout and Zones

Throughout the corridor, the street width varied. Increased street width allows for sidewalks, on-street parking, and bike lanes. In the project's focused section of Route CT-156, there are two lanes of traffic, except for an added lane for turning at an intersection towards the middle of the corridor. There are sidewalks located on some parts of the corridor but not throughout.

To study certain parts of the corridor, the corridor was divided into zones based on factors including the width of the road, parking, and the amount of lanes on the road. These zones allowed the team to create designs that work for each zone but are also consistent throughout the corridor.

3.2.2 Sidewalk and Curb Ramp Accessibility

Accessibility is a critical aspect of this Major Qualifying Project. Information on curb ramp and sidewalk accessibility along Route CT-156 was collected. A digital level inclinometer was used to measure cross slopes, running slopes, and a tape measure to measure the dimensions of the curb ramps. Using the data collected and Americans with Disabilities Act (ADA) standards, it was determined if the curbs are compliant.

3.2.2.1 Site Visit

The ADA has created specific regulations that one must follow with the construction of curb ramps to establish continuity across the United States. With that in mind, the Connecticut DOT follows the regulations and guidelines set forth by PROWAG and U.S. ADA whether it be to construct and inspect new or existing curb ramps.

The team conducted a site visit along the Route CT-156 corridor. In October of 2023, our sponsor Katherine Hedberg met the team in East Lyme. Visual inspections and measurements of both Route CT-156 and Route CT-161 were completed to document the existing conditions of each curb ramp. For the site visit, the team focused mainly on curb ramp inspections. The inspection involved measuring the ramp's horizontal (cross) slope, vertical (running) slope, and side flares slope with a digital level. With a measuring tape, the team also measured the width and top landing of each curb ramp as well. In addition to measuring slope and lengths, the team also inspected the curb ramp as it transitions to the street. The team visually analyzed the curb ramps for the presence of detectable warning mats, vegetative obstruction, and any possible signs of water ponding. On-site, the team conducted inspections based on CTDOT ADA compliance as well as new guidelines set by PROWAG. The group collectively decided that it was best to prepare for the site visit by first visualizing and then familiarizing ourselves with the different types of curb ramps that are present at Route CT-156. Before the site visit, the team analyzed what different types of sample curb ramps would look like based on detailed AutoCAD drawings provided by our sponsor Katherine Hedberg.

Figure 12: Measuring Curb Ramps During Site Visit

3.2.3 Parking Inventory

To analyze the traffic flow and business of the corridor, a parking inventory needed to be conducted to understand where both the community and the tourists park when needed. To evaluate this aspect of the corridor, parking spots shown on Google Earth along the corridor were counted individually.

3.2.4 Existing Crash Conditions

The UCONN Connecticut Crash Data Repository website provided crash data that can be downloaded with many filters. The area and route filter were used to obtain crash data for Route CT-156, and then manually filtered to ensure the data was within the MQP's study area.

Data was limited to the most recent five-year span, 2018-2023. CDOT Crash and Traffic Volume portal included an Annual Average Daily Traffic (AADT) Reporting Total that provided the AADT of each segment on Route CT-156. Area and route filters were used to collect data that correlated to the count stations in the location of Route CT-156 within the MQP's study area. From the intersection of E Pattagansett Road and Black Point Rd to the intersection of Main Street and CT-161, the AADT is 6700. From the intersection of Main Street and Route CT-161 to Cini Memorial Park, the AADT is 6600. Figure 13 shows a map of the AADT and Hourly Volume Map from the portal in the location. The AADT was used to calculate the crash rates of each segment.

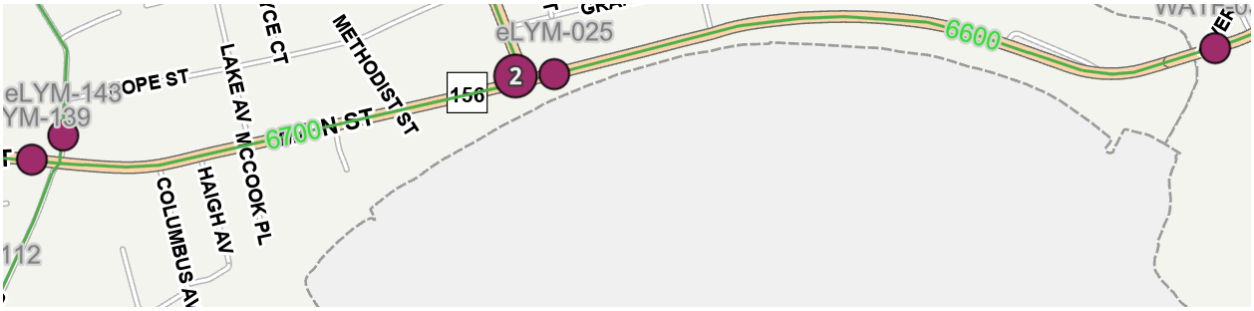


Figure 13: AADT and Hourly Volume Map on Route CT-156

The crash rates for each zone were calculated using the following equation:

Roadway Segment Crash Rate
= (# of crashes/ year * 1,000,000) ÷ (AADT * Length of segment * 365)

The data downloaded from the UCONN Crash Data Repository website was organized and sorted to create crash diagrams for each location. The crash diagrams include the date, time, crash severity, light and road conditions as well as the kind of crash. The data and crash rate calculations can be found in Appendix B and C.

3.3 Objective 3 - Develop Cross Sectional Designs

Complete streets incorporates the design approach to make streets safer for all users. This includes the addition of bike lanes as well as ADA compliance, sidewalks, crosswalks and other design elements to enhance road safety. The MQP decided to develop designs that included bike paths to ensure that cyclists are not utilizing the sidewalks. Each zone was analyzed individually based on the existing conditions. An investigation of the state roadway standards was completed to be able to understand the options that could be incorporated onto existing conditions. Factors such as speed limit, width of the road including sidewalks, and safety were used to develop designs in StreetMix, which is an online software that is used to design and visualize customized street layouts. Many options were created for each zone. There was one option from each zone that was preferred for a long term recommendation.

3.4 Objective 4 - Develop Curb Ramp Designs

During the site visit, all curb ramp dimensions were collected allowing the team to model the ramps in AutoCAD. This provides a 3D view of the curb ramp along with its surrounding area.

If the curb ramp was compliant, then the model was marked as so. CTDOT provided excel sheets that included exact reasons as to why that certain curb ramp was marked as non-compliant. Based on these excel tables, the models were adjusted to meet CTDOT's standards to make it compliant. Dimensions or characteristics that were changed were highlighted in red to make it easier for a viewer to see what was changed.

The table from Appendix C provides all the information needed to determine what curb ramps are non-compliant and the possible reasons why. This table includes curb ramp details such as the intersection letter of each intersection within the zone as well as the individual Asset ID number of each curb ramp. The individual Asset ID number is unique to each curb ramp. The column to the right of the Asset ID states the condition of each curb ramp from when it was last inspected. Following that column is where the curb ramp is either compliant or non-compliant. The table includes columns describing reasoning as to why the curb ramp might not be compliant. In the table, all curb ramps except for one are labeled as "No" under the "Structurally Infeasible" column meaning that most curb ramps are possible to reconstruct so that they return to ADA compliance. Cells highlighted in red indicate the reasons why the curb ramp is non-compliant. Finally, the last column determines if any part of the curb ramp, whether it be landing, running, or flare slopes, exceeds the minimum slope measurements for ADA compliance. If there are no possible reasons to indicate why a curb ramp is non-compliant, it is assumed that either the running, cross, or flare slopes and/or landing measurements exceed the maximum ADA requirements.

In each zone subsection under section 4.2 Existing Conditions, there are smaller-scaled tables that are inserted from the larger table in Appendix C that only pertain to the intersections and curb ramps from their respective zones for ease of viewing.

3.5 Objective 5 - Select Electric Vehicle Charging Station Locations

Electric Vehicles are only growing more popular, especially in areas that are tourism-heavy. As of 2023, East Lyme had around 285 EV drivers (*Connecticut Department of Transportation.Pdf*, 2023). This number doesn't include the electric vehicles traveling to East Lyme during the warmer months. This is a 138% increase from the year prior. The closest charging station for EVs are almost 5 miles away. The areas surrounding the corridor are densely populated with shops, restaurants, and public parking lots; these factors equate to a good opportunity to place charging stations in those parking lots.

To determine the most feasible location for the proposed EV charging station, the approach started by reviewing publicly available records on the environmental conditions that could potentially be impacted by construction of EV charging stations. With this information, potential constraints for the development of the EV charging station could be identified. A review of the desktop records included Federal Emergency Management Administration (FEMA) for mapped floodplains, Environmental Risk Information Services (ERIS) for environmentally regulated concerns or risks, Natural Resources Conservation Service (NRCS) for geological conditions, and United States Fish and Wildlife (USFWS) Information for Planning and Consultation (IPaC) for protected species that may be impacted by the construction of the EV charging stations. Comparing the findings of the desktop research with the observations of the existing site conditions, one can assess the site's most feasible location based on minimal environmental impact and minimal construction constraints.

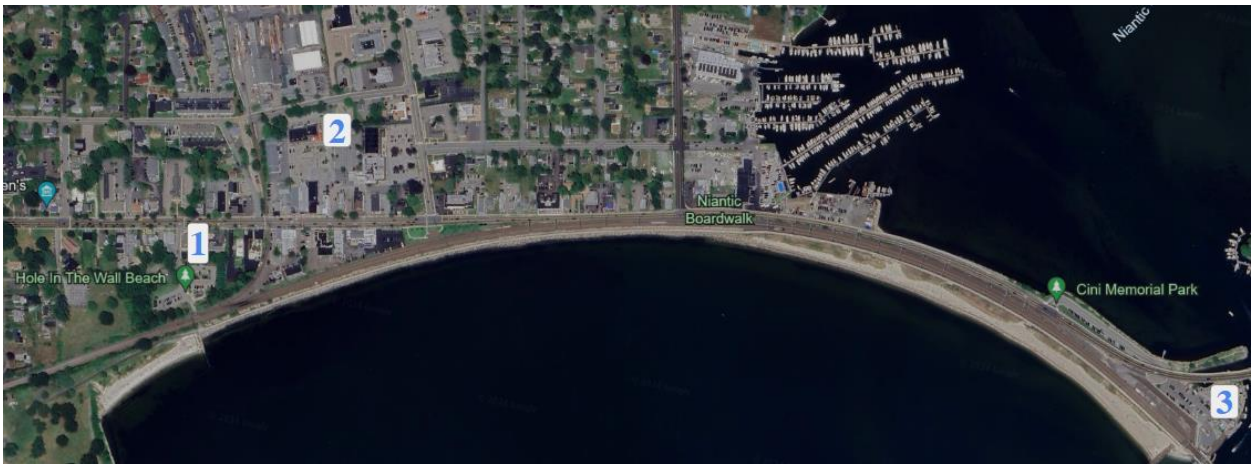


Figure 50: Locations numbered along the corridor that will be accessed.

Figure 50 shows the three potential locations for charging stations along the corridor. Location 1 is within the parking lot that contains the entrance to the boardwalk from the west side. Location 2 is within a larger parking lot that is surrounded by shops and restaurants. Location 3 is a parking lot that includes the entrance to the east side of the boardwalk and a dock for boats.

4.0 Existing Conditions

Gathering existing conditions data for all four zones of the Route CT-156 corridor was an essential step in the project because it allowed the team to gain a better understanding of how each aspect of the street, curb, and zone intermingled with each other when transitioning.

The team sought to achieve a baseline of understanding for each zone before any changes or improvements were recommended. With ADA compliance, it was important to note how many curb ramps were considered to be non-compliant, as it assisted the team with focusing on which curb ramps would need the most attention when developing design options for the corridor.

4.1 Zone 1: East Pattagansett Road to Haight Avenue

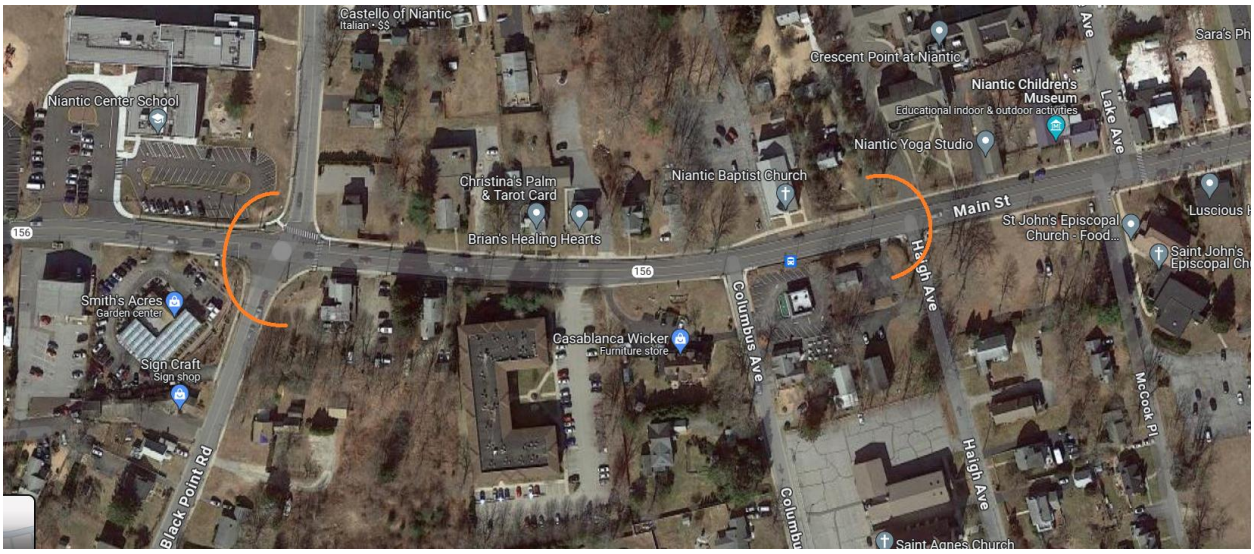


Figure 14: Zone 1 of the Corridor Study along Route CT-156

4.1.1 Site Layout

Zone 1 of Route CT-156 is a designated section of road measuring 860 feet long, or roughly 0.16 of a mile. As depicted in Figure 14, Zone 1 begins at the western end and intersects with East Pattagansett Road, where there is an elementary school on the northwest corner of the signalized junction. Continuing east, the road maintains a steady path until it reaches a stop-controlled intersection with Columbia Avenue. This road branches off from the southern side of Route CT-156, and drivers on Columbia Avenue must come to a complete stop at a designated stop sign. From there, the road gradually curves until it meets another stop-controlled intersection with Haigh Avenue, which also originates from the southern side of Route CT-156.

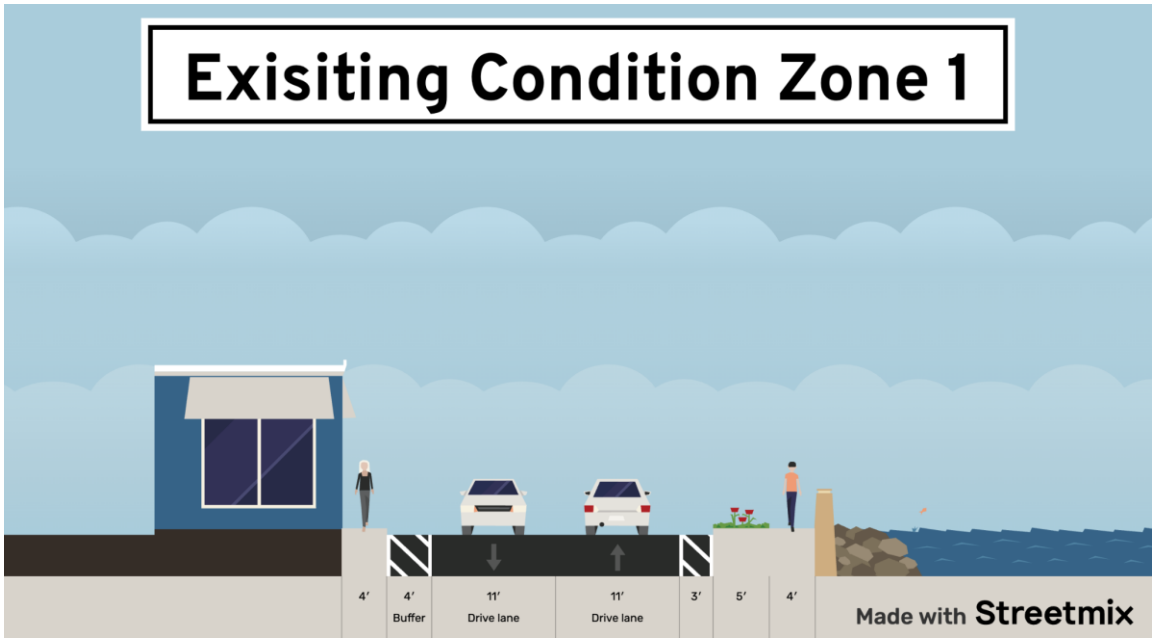


Figure 15: Existing Condition of Zone 1

Zone 1 has a road width of around 45 feet. This width expands gradually as the road bends. The majority of the abutting properties in Zone 1 are privately owned and primarily used for residential purposes.

4.1.2 Sidewalk and Curb Ramp Accessibility

This zone included a total of three intersections with eight curb ramps as tabulated in Table 3. Figure 16 provides a view of the zone with the intersection and curb ramps labeled. As seen in Table 3 and in upcoming tables, only one curb ramp was compliant while all others were labeled as non-compliant. The only curb ramp that was compliant from this whole corridor of Route CT-156 was Intersection B, Curb Ramp i. Two out of the eight curb ramps had no detectable warning mat present and no landing area. Intersection A Curb Ramp iii had no landing area and a turning space obstruction. Seven out of eight curb ramps were labeled as “Good” condition.

Zone 1											
					Possible Reasons (If not ADA compliant):						
Intersection	Curb Ramp #	Asset ID	Condition	ADA Compliant	Detectable Mat Present	Obstructions	Landing Area	Turning Space Obs	Water Ponding	Structurally Infeasible	Exceeds Min Slope
Intersection A: 156-East Pattagansett Rd	i	8120	Good	No	No		No	No	N/A	No	Yes
	ii	19160	N/A	No	Yes	No	Yes	No	N/A	No	Yes
	iii	37227S	Good	No	Yes	No	No	Yes	N/A	No	Yes
	iv	37227N	Good	No	No	No	No	N/A	N/A	No	Yes
Intersection B: 156-Columbus Ave	i	2057	Good	Yes	Yes	No	Yes	No	N/A	No	No
	ii	2058	Good	No	Yes	No	Yes	No	N/A	No	Yes
Intersection C: 156-Haigh Ave	i	2059	Good	No	Yes	No	Yes	No	N/A	No	Yes
	ii	2060	Good	No	Yes	No	Yes	No	N/A	No	Yes

Table 3: Zone 1 curb ramp information and possible reasons for ADA noncompliance.

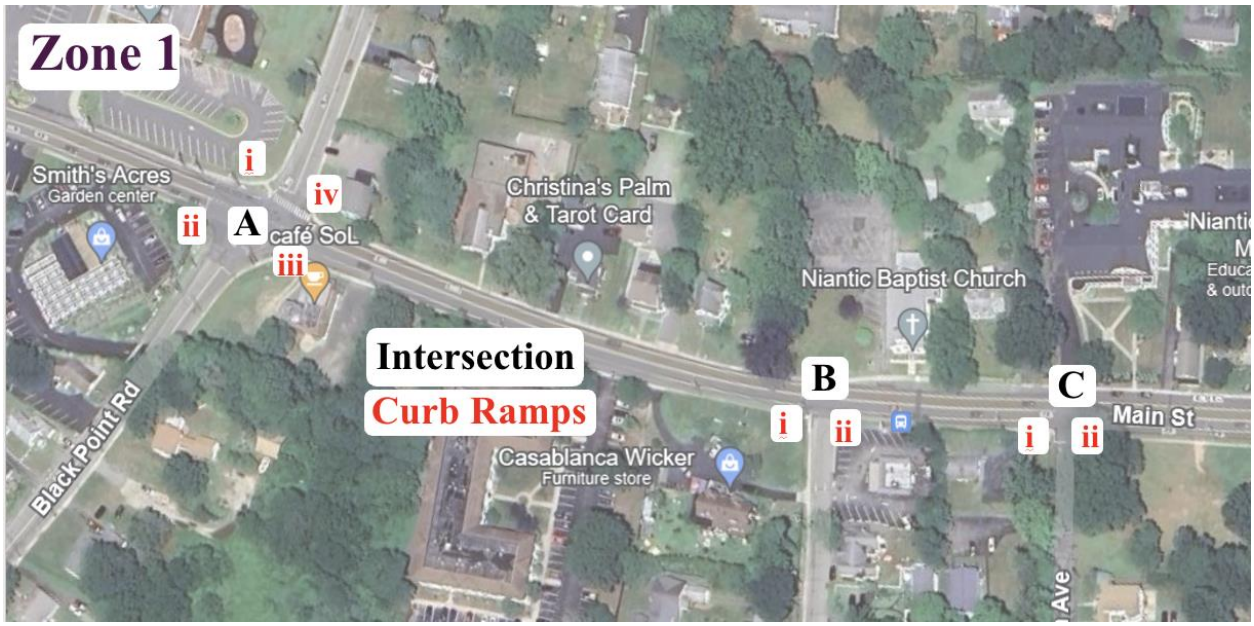


Figure 16: Google Earth view of Zone 1 with intersections and curb ramps labeled.

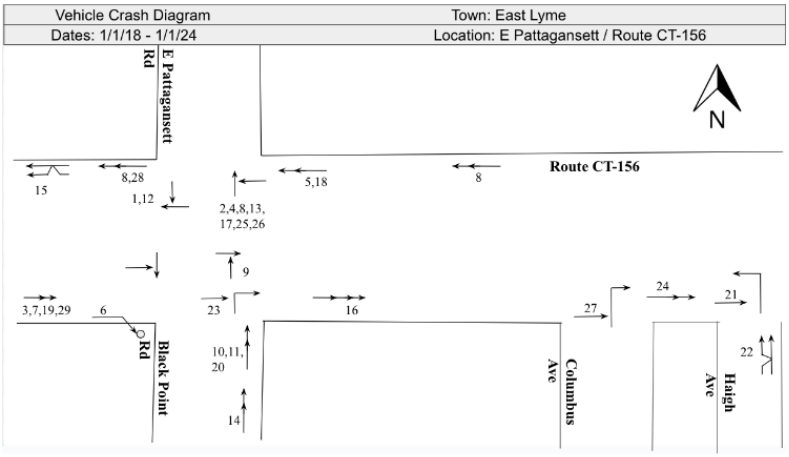
4.1.3 Parking Inventory

In Zone 1, there is a distinct lack of on-street parking due to the exclusive private ownership of all properties surrounding the area. As a result, there are no public parking choices available within the boundaries of Zone 1.

4.1.4 Existing Traffic and Crash Data

The crash diagram for the segment of Zone 1 is displayed in Figure 17. The diagram includes various information including; type of crash, time, day and severity. There were 29 total

crashes that occurred in Zone 1 of the corridor between 2018 to 2023. There was a car that hit a light pole off the road. This zone includes a school near the intersection of East Pattagansett Rd and Route CT-156.



Symbols	Light Conditions	Surface Conditions
Angle, Head On, Sideswipe Turning Move, Fixed Object, Rolled Over Rear End	1 Daylight 2 Dawn 3 Dusk 4 Dark-Lighted 5 Dark-Not Lighted 6 Dark-Unknown Lighting 97 Other 99 Unknown	1 Dry 2 Wet 3 Snow 4 Slush 5 Ice/Frost 6 Moving Water 7 Sand 8 Mud. Dirt, Gravel 9 Oil 10 Standing Water 97 Other 99 Unknown

Crash Severity	
Fatal (Kill)	K
Injury of any Type (Serious, Minor, Possible)	A
Property Damage Only	O

#	DATE	TIME	DAY	SEV	L	R	#	DATE	TIME	DAY	SEV	L	R
1	1/2/18	9:34	TUES	O	1	1	16	3/6/20	17:52	FRI	A	4	2
2	2/4/18	8:23	SUN	O	1	2	17	6/10/20	16:08	WED	A	1	1
3	3/2/18	13:11	FRI	O	1	2	18	9/4/20	19:40	FRI	O	4	1
4	4/10/18	7:04	TUES	A	1	2	19	9/26/20	10:50	SAT	O	1	1
5	5/3/18	16:21	THURS	O	1	1	20	10/24/20	15:09	SAT	O	1	1
6	10/15/18	11:26	MON	A	1	1	21	10/2/21	8:25	SAT	O	1	1
7	12/21/18	17:00	FRI	O	4	2	22	10/9/21	14:24	SAT	O	1	1
8	3/7/19	14:13	THURS	O	1	1	23	4/7/22	16:54	THURS	O	1	2
9	6/2/19	18:34	SUN	A	1	1	24	8/3/22	16:34	WED	O	1	1
10	7/29/19	18:21	MON	O	1	1	25	10/11/22	14:12	TUES	A	1	1
11	8/7/19	20:09	WED	O	4	1	26	1/7/23	21:16	SAT	O	4	1
12	8/11/19	15:46	SUN	A	1	1	27	3/7/23	16:44	TUES	O	1	1
13	11/1/19	19:09	FRI	O	4	1	28	6/19/23	15:49	MON	O	1	1
14	12/16/19	15:27	MON	A	1	1	29	6/28/23	12:56	WED	O	1	1
15	1/8/20	14:12	WED	O	1	1							

Figure 17: Zone 1 Crash Diagram

The team was able to also calculate the crash rates for the roadway segments. The AADT was used to calculate the crash rates of each segment. From the intersection of E Pattagansett Road and Black Point Rd to the intersection of Main Street and CT-161, the AADT is 6600.The roadway section crash rate for Zone 1 was 12.54 crashes per million VMT.

4.2 Zone 2: Haigh Avenue to Intersection

Figure 18: Zone 2 along Route CT-156 along the Corridor.

4.2.1 Site Layout

Zone 2 of Route CT-156 is a 2050 foot stretch of road, 0.4 mile, with an average width of 60 feet. In Figure 18, a visual representation of Zone 2 of the road can be observed. Heading towards the east, the first noteworthy feature on the south side of Route CT-156 is a stop-controlled intersection with McCook Place. A short distance from there is another stop-controlled intersection on the north side of the road with Lake Avenue. At this intersection, a crosswalk can be found on the right side linking to the south side of the street. Continuing down the road, two more stop-controlled intersections can be encountered. The first is at Baptist Lane, connecting to the south side of the street and featuring a crosswalk that connects both the north and south sides of the road. A few feet ahead, Methodist Street intersects Route CT-156 from the north side.

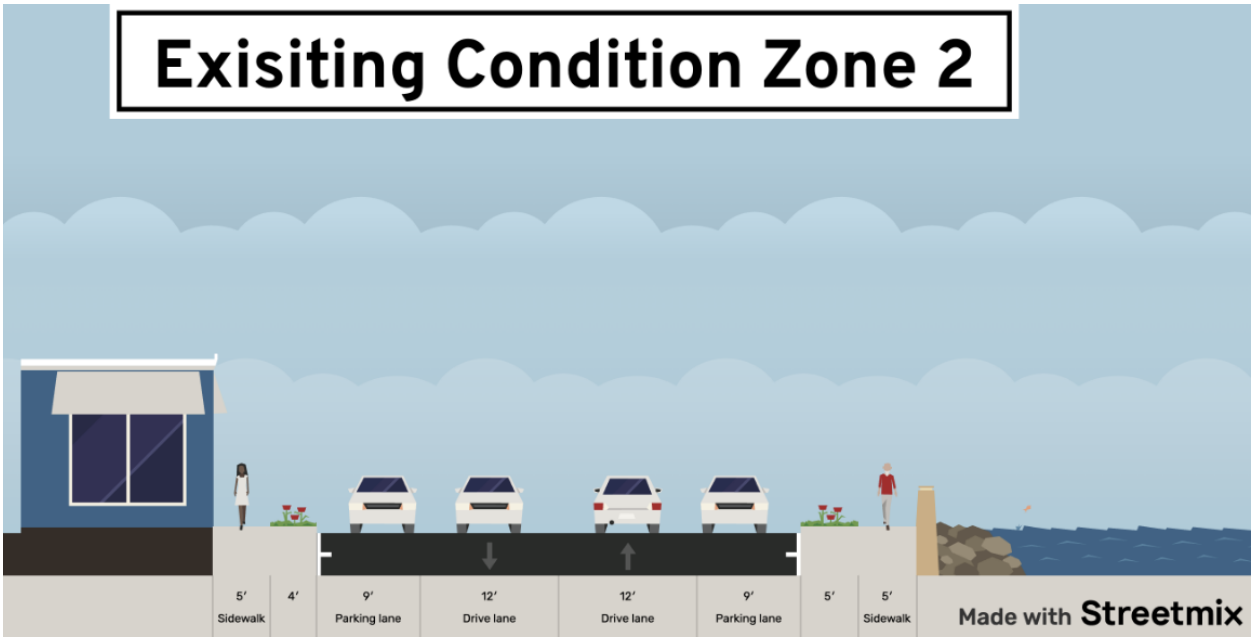


Figure 19: Existing Condition of Zone 2

In Zone 2, sidewalks line both sides of the street and on-street parking is available. The properties along Zone 2 are mostly private, with many of them being commercial.

4.2.2 Sidewalk and Curb Ramp Accessibility

As shown in Table 4 Zone 2 includes five intersections with 18 curb ramps in total. Figure 20 gives a view of the zone with the intersection and curb ramps labeled. None of the intersections were considered ADA-compliant per the most recent inspection; however, there is a correlation to the non-compliant ramps in this zone: 10 out of the 18 curb ramps located at every intersection have obstructions that block the path of the sidewalk. Obstructions of any sort, such as vegetation or objects, cause the curb ramp to become non-compliant with ADA regulations. Three out of the 18 curb ramps had water ponding, or water collecting at the downward slope of the ramp. Water ponding at the curb ramp entrances contributes to their ADA non-compliance. The remaining eight curb ramps that do not have obstructions or any other indicators of non-compliance did however exceed the maximum slope or lengths as noted on the “Exceeds Min Slopes” column.

Zone 2											
Intersection					Possible Reasons (If not ADA compliant):						
	Curb Ramp #	Asset ID	Condition	ADA Compliant	Detectable Mat Present	Obstructions	Landing Area	Turning Space Obs	Water Ponding	Structurally Infeasible	Exceeds Min Slope
Intersection D: 156-Lake Ave-McCook Pl	i	14881	Good	No	No	Yes	Yes	No	No	No	Yes
	ii	14883	New	No	Yes	Yes	Yes	No	No	No	Yes
	iii	14885	New	No	Yes	N/A	Yes	No	N/A	No	Yes
	iv	14886	Good	No	Yes	N/A	Yes	No	N/A	No	Yes
	v	37227S	New	No	Yes	No	Yes	No	N/A	No	Yes
	vi	37227N	New	No	Yes	No	Yes	No	N/A	No	Yes
Intersection E: 156-Baptist La	i	11074	New	No	Yes	Yes	Yes	No	No	No	Yes
	ii	11075	New	No	Yes	No	Yes	No	N/A	No	Yes
	iii	37227N	New	No	Yes	Yes	Yes	No	No	No	Yes
	iv	37227S	New	No	Yes	No	Yes	No	N/A	No	Yes
Intersection F: 156-Methodist St	i	8123	New	No	Yes	No	Yes	No	N/A	No	Yes
	ii	19161	N/A	No	Yes	Yes	Yes	No	N/A	No	Yes
	iii	37227S	New	No	Yes	Yes	Yes	No	N/A	No	Yes
	iv	37227N	New	No	Yes	Yes	Yes	No	N/A	No	Yes
Intersection G: 156-Crosswalk (ATM)	i	37227N	N/A	No	Yes	Yes	Yes	No	Yes	No	Yes
	ii	37227S	N/A	No	Yes	Yes	Yes	No	Yes	No	Yes
Intersection H: 156-Crosswalk (The Black Sheep)	i	37227N	N/A	No	Yes	No	Yes	No	N/A	No	Yes
	ii	37227S	N/A	No	Yes	Yes	Yes	No	Yes	No	Yes

Table 4: Zone 2 curb ramp information and possible reasons for ADA noncompliance.

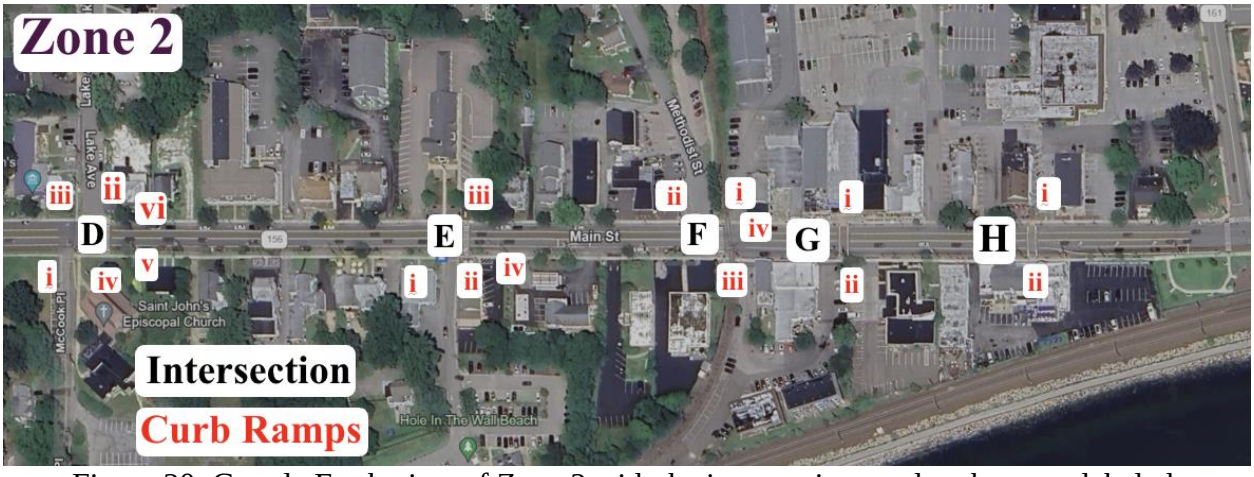


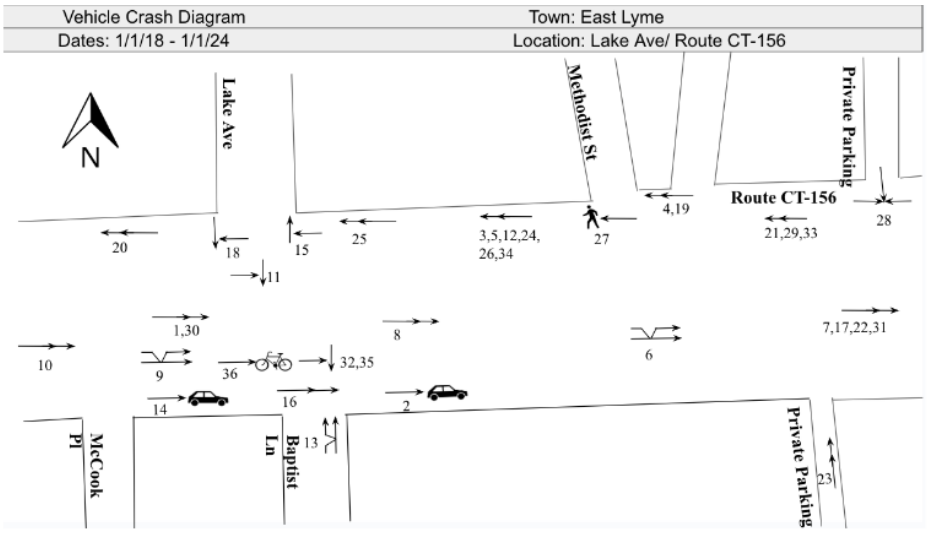
Figure 20: Google Earth view of Zone 2 with the intersections and curb ramps labeled.

4.2.3 Parking Inventory

With the on-street parking along both sides of the street, Zone 2 can hold an estimated 300 cars on the streets alone. In addition, there is a public parking lot located off Baptist Lane, which is south of the zone. This lot has 80 parking spots that are available to the public. In addition, there is a large lot that can hold up to 460 parking spots in the northeast part of this zone. This lot is surrounded by shops; however, the parking is available to the public.

4.2.4 Existing Traffic and Crash Data

The crash diagram for the segment of Zone 2 is displayed in Figure 21. There were 36 total crashes that occurred in Zone 2 of the corridor between 2018 to 2023. In the diagram, there are car images that are meant to refer to a parked car. In Zone 2, there is on-street parking on both sides of the street. Some cars collided into parked cars, resulting in these crashes classified as rear-end crashes. There was also a crash between a pedestrian and a bicyclist. Baptist Lane is a road that enters a parking lot for a beach called Hole in The Wall Beach. This area is populated with people trying to go to the beach and the boardwalk mainly during the warmer months.



Symbols	Light Conditions	Surface Conditions
Angle, Head On, Sideswipe, Turning Move, Fixed Object, Rolled Over, Rear End	1 Daylight 2 Dawn 3 Dusk 4 Dark-Lighted 5 Dark-Not Lighted 6 Dark-Unknown Lighting 97 Other 99 Unknown	1 Dry 2 Wet 3 Snow 4 Slush 5 Ice/Frost 6 Moving Water 7 Sand 8 Mud. Dirt, Gravel 9 Oil 10 Standing Water 97 Other 99 Unknown

Crash Severity	
Fatal (Kill)	K
Injury of any Type (Serious, Minor, Possible)	A
Property Damage Only	O

#	DATE	TIME	DAY	SEV	L	R	#	DATE	TIME	DAY	SEV	L	R
1	4/14/18	11:29	SAT	O	1	1	19	2/1/20	11:20	SAT	O	1	1
2	5/30/18	12:47	WED	O	1	1	20	1/15/20	12:04	WED	O	1	1
3	7/31/18	14:18	TUES	O	1	1	21	5/7/20	16:47	THURS	O	1	1
4	8/2/18	16:03	THURS	O	1	1	22	7/4/20	6:07	SAT	O	1	1
5	8/5/18	17:01	SUN	O	1	1	23	10/14/20	15:40	WED	O	1	1
6	8/18/18	18:11	SAT	O	1	2	24	11/13/20	17:04	FRI	O	4	2
7	10/11/18	18:08	THURS	O	4	2	25	7/29/21	9:53	THURS	O	1	1
8	10/19/18	16:52	FRI	O	1	1	26	1/30/22	20:33	SUN	O	4	2
9	10/20/18	15:49	SAT	O	1	1	27	2/10/22	16:50	THURS	A	1	1
10	12/13/18	18:30	THURS	A	4	1	28	4/6/22	19:50	WED	O	4	1
11	3/7/19	13:25	THURS	A	1	1	29	6/12/22	10:21	SUN	A	1	1
12	6/25/19	13:31	TUES	O	1	2	30	7/8/22	22:03	FRI	O	4	1
13	5/25/19	9:07	SAT	O	1	1	31	7/19/22	12:55	TUES	O	1	1
14	7/3/19	10:35	WED	O	1	1	32	7/31/22	15:30	SUN	A	1	1
15	8/29/19	13:49	THURS	O	1	1	33	11/6/22	11:38	SUN	O	1	1
16	9/15/19	16:35	SUN	O	1	1	34	1/6/23	17:36	FRI	A	4	2
17	12/20/19	16:15	FRI	O	1	1	35	5/13/23	9:35	SAT	O	1	1
18	12/23/19	17:30	MON	A	4	1	36	8/15/23	9:32	TUES	A	1	1

Figure 21: Zone 2 Crash Diagram

From the intersection of Main Street and CT-161 to Cini Memorial Park, the AADT is 6600. The AADT was used to calculate the crash rates of each segment. The roadway section crash rate for Zone 2 was 6.23 crashes per million VMT.

4.3 Zone 3: Route CT-156 - CT161 Intersection

Figure 22: Google Earth view of Zone 3 to Route CT-156 of the Corridor.

4.3.1 Site Layout

Zone 3 of Route CT-156 is a designated section of road surrounding the Route CT-156 and CT-161 Intersection. This section is around 450 feet long with the average width of 65 feet. A visual representation of Zone 3 can be observed in Figure 22. This particular zone is centered around a signalized intersection with CT-161, with a short stretch of road leading up to the intersection on both sides of the road. West of the intersection, there is a crosswalk equipped with a signal.

The existing condition of Zone 3 is shown from both sides. One way facing the east and other facing the west because the dimensions of the road change based on the location of the turning lanes.

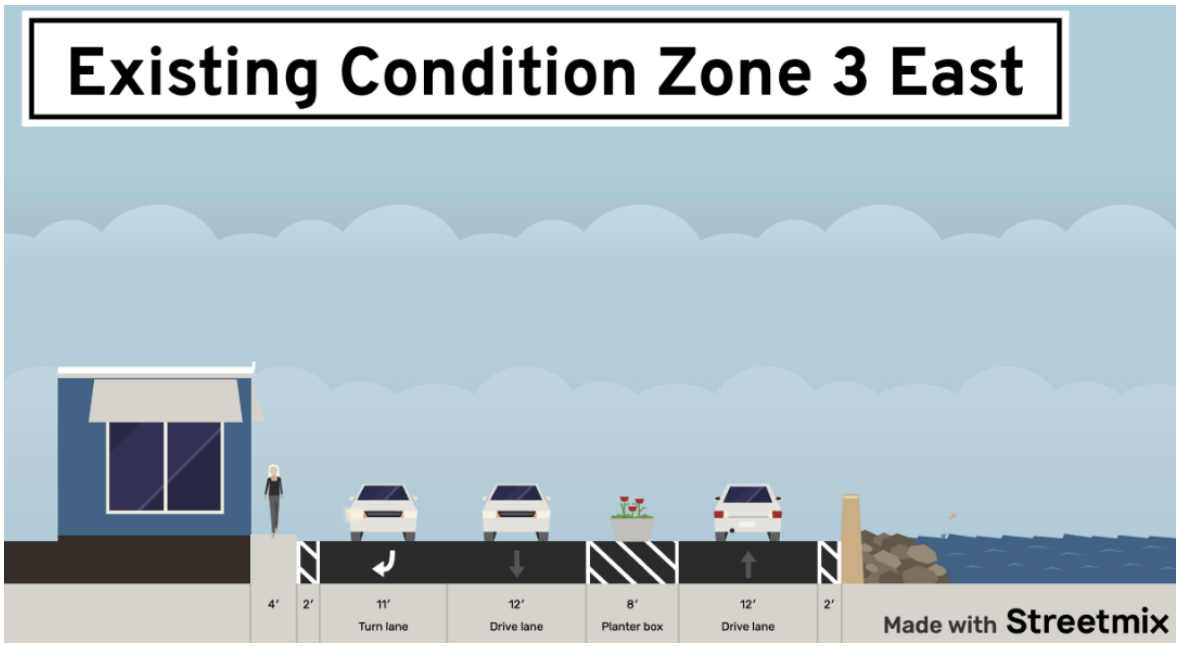


Figure 23: Existing Condition of Eastern Side of Zone 3

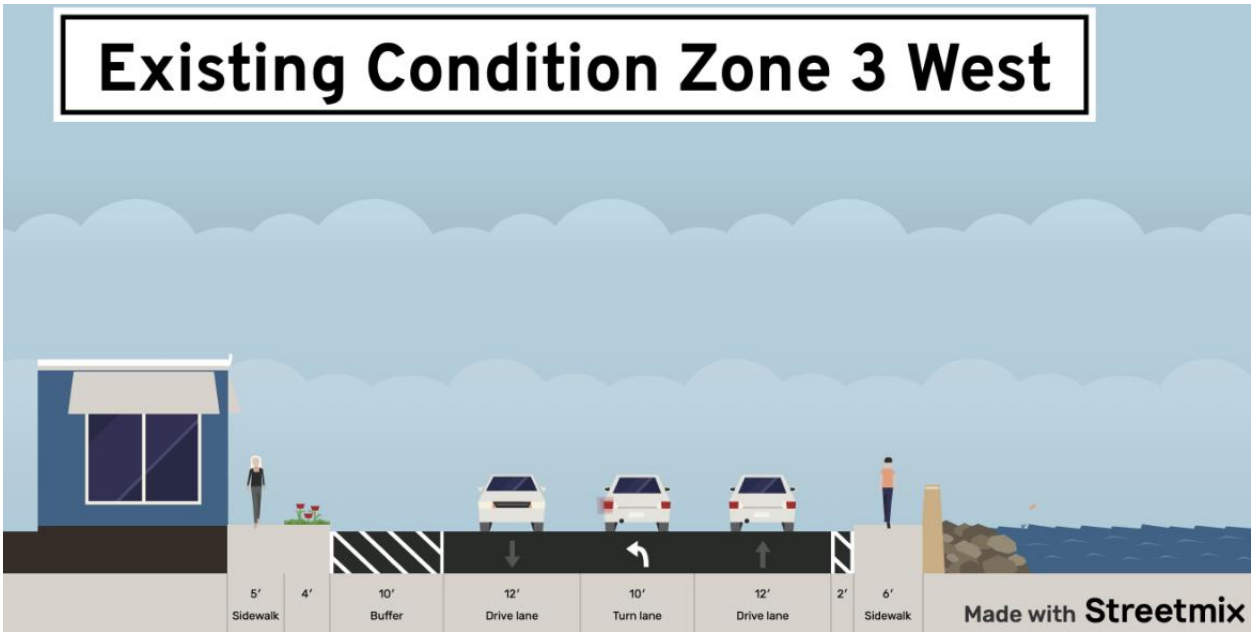


Figure 24: Existing Condition of Western Side of Zone 3

Within Zone 3, there is a transition in on-street parking availability as it gradually diminishes to make way for a turning lane onto CT-161. The sidewalk remains present on the north side of the road. However, on the south side, the sidewalk terminated shortly to the east of the intersection due to the proximity of the rail tracks.

4.3.2 Sidewalk and Curb Ramp Accessibility

In Table 5, Zone 3, there is only one intersection (Route CT-156 and Route CT-161) that has a total of three curb ramps. Figure 25 provides a view of the zone with the intersection and curb ramps labeled. All three curb ramps from Intersection I are labeled with their condition (two are labeled "New" and one "Good"), all of which are non-compliant. Similar to the previous Zone 2, the reasons why all ramps are non-compliant are because of obstructions either vegetative or objects. Intersection I Curb Ramp i, ii, and iii all contain obstructions. Only Curb Ramps i and ii have no landing area as well as turning space obstructions. Finally, Curb Ramp i was observed to have water ponding at the end of the curb ramp.

Zone 3											
					Possible Reasons (If not ADA compliant):						
Intersection	Curb Ramp #	Asset ID	Condition	ADA Compliant	Detectable Mat Present	Obstructions	Landing Area	Turning Space Obs	Water Ponding	Structurally Infeasible	Exceeds Min Slope
Intersection I: 156-161	i	37227S	New	No	Yes	Yes	No	Yes	Yes	N/A	Yes
	ii	37227W	New	No	Yes	Yes	No	Yes	No	N/A	No
	iii	37227N	Good	No	Yes	Yes	Yes	No	No	N/A	Yes

Table 5: Zone 3 curb ramp information and possible reasons for ADA noncompliance.

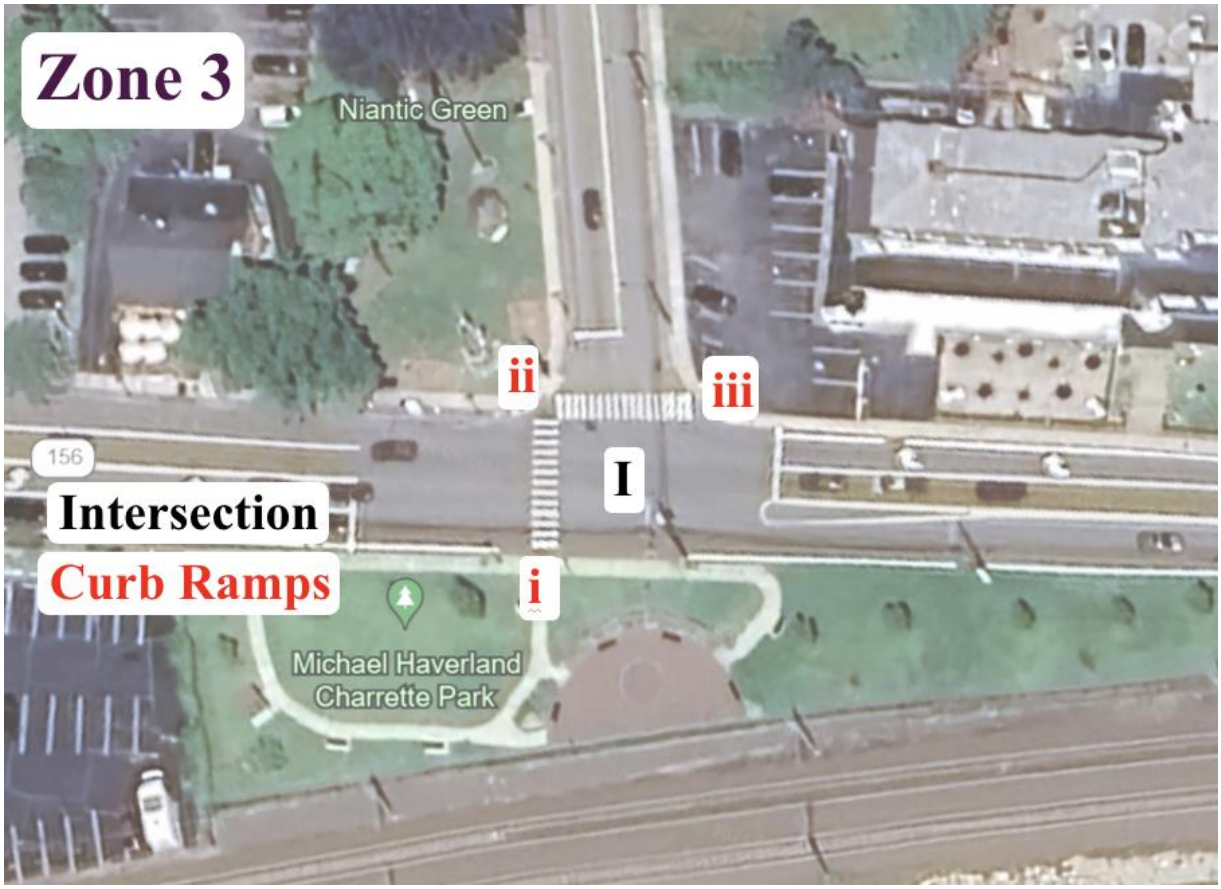


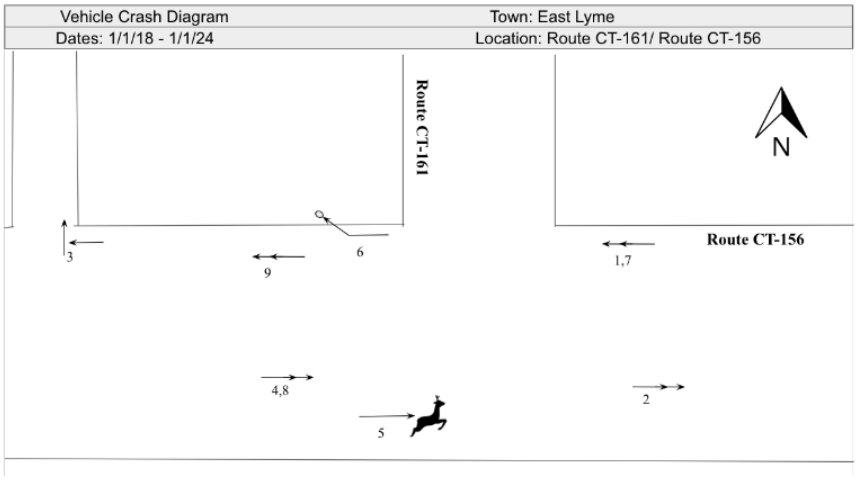
Figure 25: Google Earth view of Zone 3 with the intersection and curb ramps labeled.

4.3.3 Parking Inventory

All the properties included within Zone 3 are private therefore public parking is unavailable throughout the zone.

4.3.4 Existing Traffic and Crash Data

For the intersection of Main Street and Route CT-161 to Cini Memorial Park, the crash diagram was created using the information retrieved from UCONN crash data repository. The crash diagram for the segment of Zone 3 is displayed in Figure 26. There were 9 total crashes that occurred in Zone 3 of the corridor between 2018 to 2023. Of the 9 crashes, there was a crash into a deer near the intersection. There was a car that crashed into the light pole off the road.



Symbols	Light Conditions	Surface Conditions
Angle, Head On, Sideswipe Turning Move, Fixed Object, Rolled Over Rear End	1 Daylight 2 Dawn 3 Dusk 4 Dark-Lighted 5 Dark-Not Lighted 6 Dark-Unknown Lighting 97 Other 99 Unknown	1 Dry 2 Wet 3 Snow 4 Slush 5 Ice/Frost 6 Moving Water 7 Sand 8 Mud. Dirt, Gravel 9 Oil 10 Standing Water 97 Other 99 Unknown

Crash Severity	
Fatal (Kill)	K
Injury of any Type (Serious, Minor, Possible)	A
Property Damage Only	O

#	DATE	TIME	DAY	SEV	L	R
1	8/20/20	20:43	THURS	O	4	1
2	11/19/21	14:29	FRI	O	1	1
3	12/16/21	14:59	THURS	O	1	1
4	4/1/22	8:19	FRI	O	1	1
5	6/2/22	7:03	THURS	O	1	1
6	6/5/22	18:17	SUN	O	1	1
7	6/14/22	10:48	TUES	O	1	1
8	7/19/22	12:48	TUES	O	1	1
9	4/8/23	16:11	SAT	O	1	1

Figure 26: Zone 3 Crash Diagram

From the intersection of Main Street and Route CT-161 to Cini Memorial Park, the AADT is 6650. The AADT was used to calculate the crash rates of each segment. The roadway section crash rate for Zone 3 was 7.72 crashes per million VMT.

4.4 Zone 4: CT-161 Intersection to Cini Memorial Park

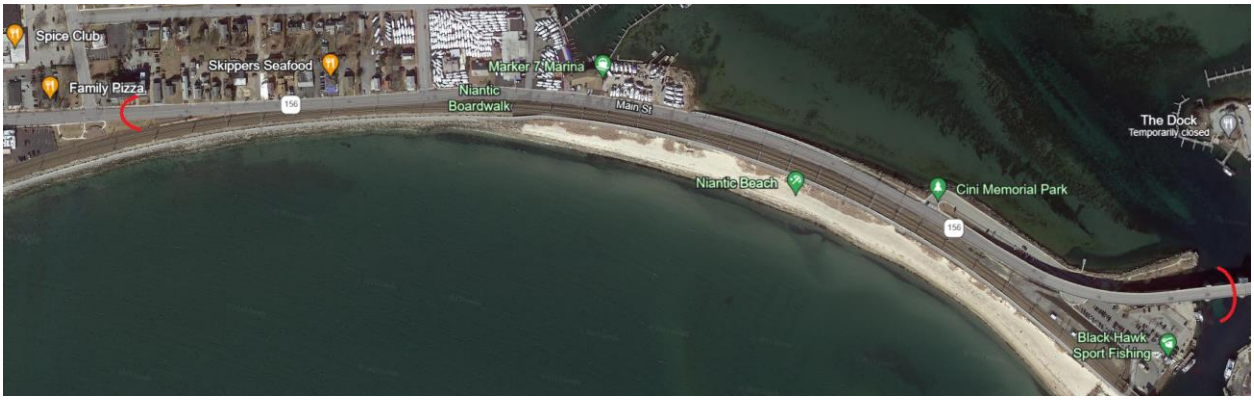


Figure 27: Google Earth view of Zone 4 on Route CT-156 along the Corridor.

4.4.1 Site Layout

This section of Route CT-156, categorized as Zone 4, is a 3,125-foot (0.6 mile) stretch of road. Zone 4 can be seen in Figure 27.

The existing condition of zone 4 was split into two parts showing the cross section of different locations. From the intersection to Smith Ave, there is just a sidewalk. However, a little east of Smith Ave, the sidewalk turns into a boardwalk.

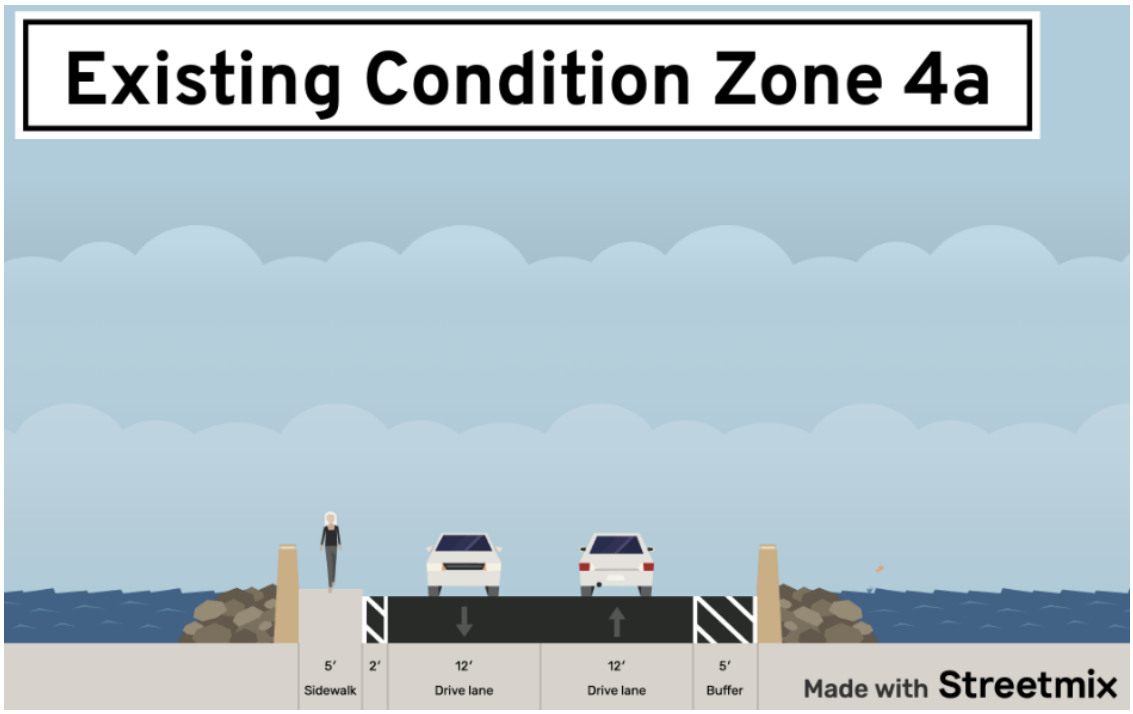


Figure 28: Existing Condition of Zone 4

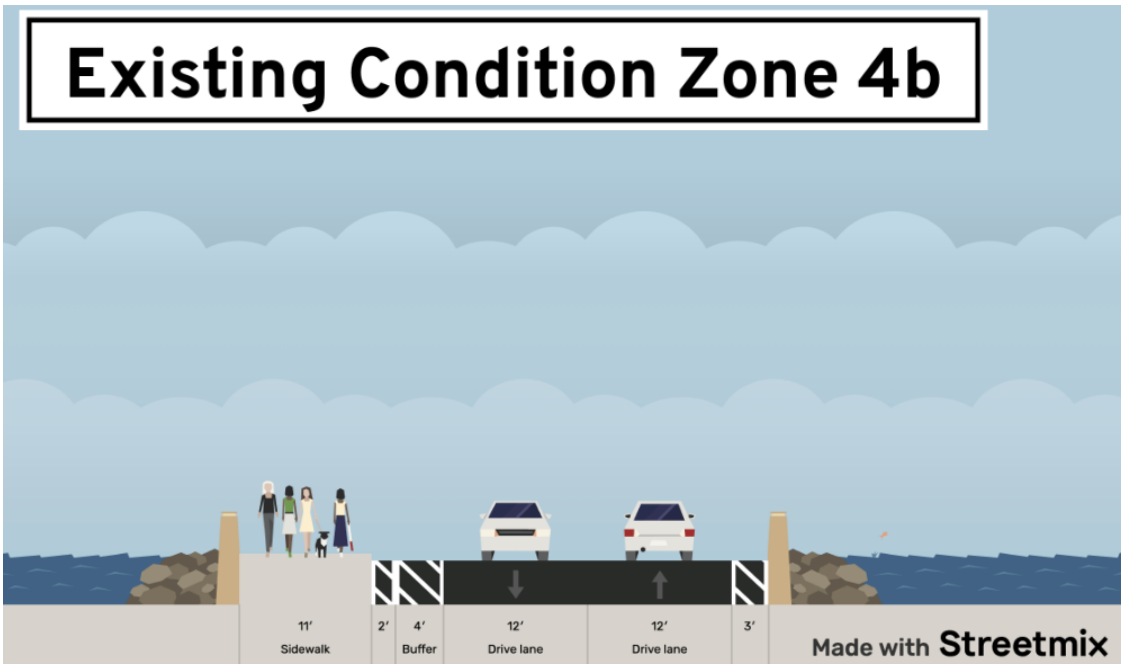


Figure 29: Existing Condition of Zone 4

This section of the road runs alongside the train tracks. The width of the road is 30 feet. There is a sidewalk on the north side of the road.

4.4.2 Sidewalk and Curb Ramp Accessibility

Table 6 is the last of the zones, Zone 4. There are two intersections associated with the zone and a total of four curb ramps. Figure 30 gives a view of the zone with the intersection and curb ramps labeled. No curb ramps are considered to be ADA-compliant. Only Intersection J Curb Ramp i and ii were labeled as “Good” condition. Three out of the four curb ramps have reasons listed in the table as to why they are non-compliant. Intersection J Curb Ramp i is the only curb ramp to have no detectable warning mat present while Intersection K Curb Ramp i is the only curb ramp that has an obstruction. The two curb ramps from Intersection J have no landing area as well, one with a turning space obstruction. Intersection K is the only recorded intersection to have water ponding.

Zone 4											
					Possible Reasons (If not ADA compliant):						
Intersection	Curb Ramp #	Asset ID	Condition	ADA Compliant	Detectable Mat Present	Obstructions	Landing Area	Turning Space Obs	Water Ponding	Structurally Infeasible	Exceeds Min Slope
Intersection J: 156-Smith Ave	i	2095	Good	No	No	No	No	Yes	N/A	N/A	Yes
	ii	2096	Good	No	Yes	N/A	No	No	N/A	N/A	Yes
Intersection K: 156-Cini Memorial	i	19172	N/A	No	Yes	Yes	Yes	No	Yes	No	Yes
	ii	19173	N/A	No	Yes	No	Yes	No	N/A	No	Yes

Table 6: Zone 4 curb ramp information and possible reasons for ADA noncompliance.

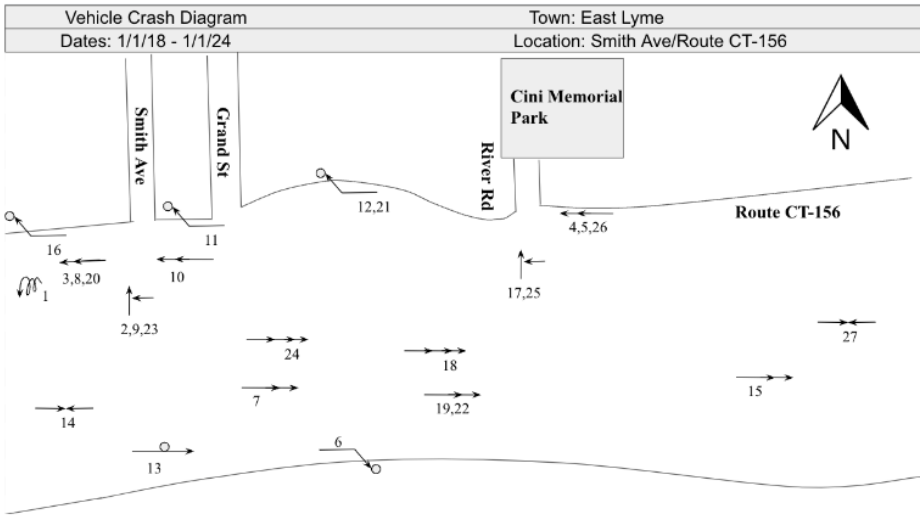
Figure 30: Google Earth view of Zone 4 with the intersections and the curb ramps labeled.

4.4.3 Parking Inventory

There isn't any on-street parking within this zone but there is a large lot towards the eastern end of the zone available to the public. This lot is mainly used by people wanting access to either the beach, the boardwalk, or the water itself. This lot has 150 parking spots.

4.4.4 Existing Traffic and Crash Data

The crash diagram for the segment of Zone 4 is displayed in Figure 31. There were 27 total crashes that occurred in Zone 4 of the corridor between 2018 and 2023. There were 3 cars that crashed into fixed objects off the road. One car crashed into the rails. One car rolled over. A lot of the crashes are assumed to be caused because of the traffic caused by entering and exiting the Cini Memorial Park parking lot.



Symbols	Light Conditions	Surface Conditions
Angle, Head On, Sideswipe, Turning Move, Fixed Object, Rolled Over, Rear End	1 Daylight 2 Dawn 3 Dusk 4 Dark-Lighted 5 Dark-Not Lighted 6 Dark-Unknown Lighting 97 Other 99 Unknown	1 Dry 2 Wet 3 Snow 4 Slush 5 Ice/Frost 6 Moving Water 7 Sand 8 Mud. Dirt, Gravel 9 Oil 10 Standing Water 97 Other 99 Unknown

Crash Severity	
Fatal (Kill)	K
Injury of any Type (Serious, Minor, Possible)	A
Property Damage Only	O

#	DATE	TIME	DAY	SEV	L	R	#	DATE	TIME	DAY	SEV	L	R
1	5/24/18	13:36	THURS	A	1	1	15	9/21/19	13:18	SAT	O	1	1
2	6/22/18	15:18	FRI	A	1	1	16	12/22/19	14:57	SUN	O	1	1
3	7/30/18	17:18	MON	A	1	1	17	2/15/20	15:14	FRI	A	1	1
4	8/14/18	11:06	TUES	O	1	1	18	8/25/20	19:02	TUES	O	1	2
5	1/11/19	16:49	FRI	O	1	1	19	9/25/21	13:50	SAT	O	1	1
6	3/8/19	19:07	FRI	O	4	1	20	1/4/22	13:53	TUES	O	1	1
7	5/2/19	17:53	THURS	O	1	1	21	1/22/22	1:57	SAT	O	6	1
8	6/1/19	13:41	SAT	O	1	1	22	2/16/22	7:05	WED	A	1	1
9	6/7/19	22:08	FRI	O	4	1	23	4/1/22	15:54	FRI	O	1	1
10	7/7/19	15:39	SUN	O	1	1	24	7/12/22	11:53	TUES	A	1	1
11	7/13/19	19:12	SAT	O	1	1	25	10/3/22	7:49	MON	O	2	1
12	7/13/19	19:37	SAT	A	1	1	26	4/21/23	18:28	FRI	O	1	1
13	7/14/19	9:13	SUN	O	1	1	27	9/14/23	11:04	THURS	K	1	1
14	8/23/19	8:55	FRI	O	1	1							

Figure 31: Zone 4 Crash Diagram

The team was able to also calculate the crash rates for the roadway segments using the AADT values discussed previously. From the intersection of Main Street and CT-161 to Cini Memorial Park, the AADT is 6700. The AADT was used to calculate the crash rates of each segment.The roadway section crash rate for Zone 4 was 3.07 crashes per million VMT.

5.0 Cross Sectional Design

This section provides the process and results of developing cross sectional designs for each zone. Each design was made through StreetMix. Each zone was designed with two options. Design option 1 incorporates a sharrow or a shared bike lane. Design option 2 includes a separated bike path. The dimensions in the design reference Table 2 in the Background section regarding the bike route standards. There was a focus on designing for continuity and safety. Both design options are continuous throughout the zones as a corridor except zone 4 because of complications discussed in a later section.

5.1 Zone 1: East Pattagansett Road to Haight Avenue

Zone 1 has a generous width of around 45 feet. There are sidewalks and shoulders on both sides. One side includes a planter. There are two vehicle lanes. Design Option 1 includes sharrows on both sides of the road. Adding sharrows to zone 1 would not require a change to the pavement or road; it would just require restriping. The shoulder loses a foot. The dimensions fit within the standards of a sharrow.

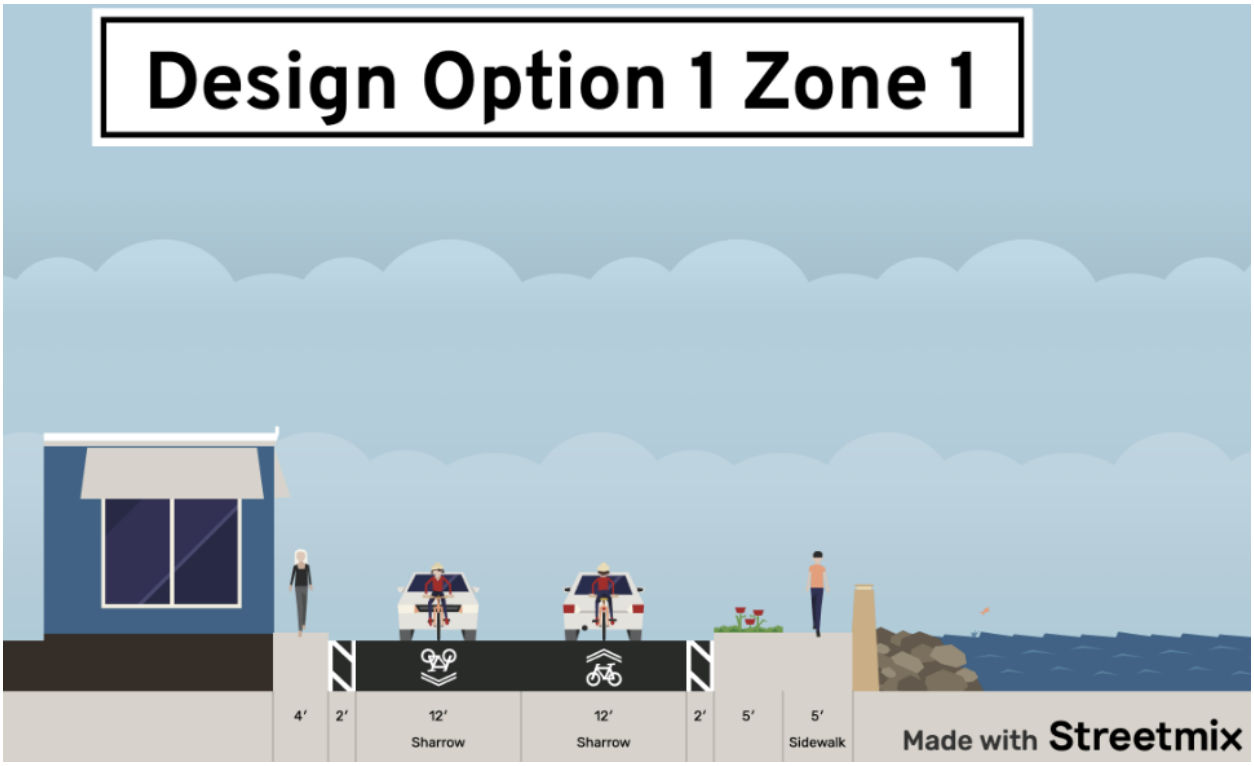


Figure 32: Design Option 1 of Zone 1 incorporating a Sharrow

Design Option 2 includes a separated bicycle path on both sides of the road. Adding bike paths to zone 1 would require a change in pavement width. There would need to be reconstruction in the zone. The planter would be two feet instead of five feet and the vehicle

lanes would be ten feet instead of eleven feet. The dimensions fit within the standards of a bike path.

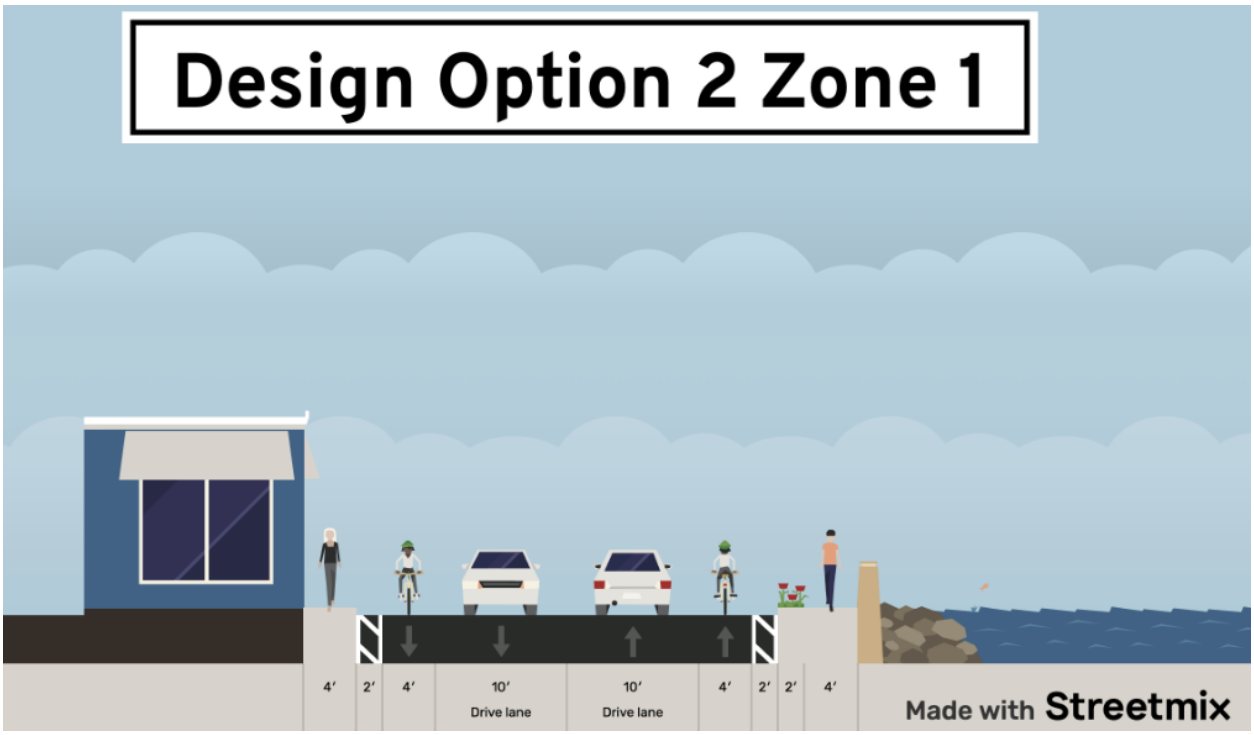


Figure 33: Design Option 2 of Zone 1 incorporating a Separated Bike Path

5.2 Zone 2: Haigh Avenue to Intersection

Zone 2 has a width of around 60 feet. There are sidewalks, buffer zones, planters and on street parking on both sides. There are two vehicle lanes. Design Option 1 includes sharrows on both sides of the road. Adding sharrows to zone 2 would not require a change to the pavement or road; it would just require restriping. The dimensions fit within the standards of a sharrow.

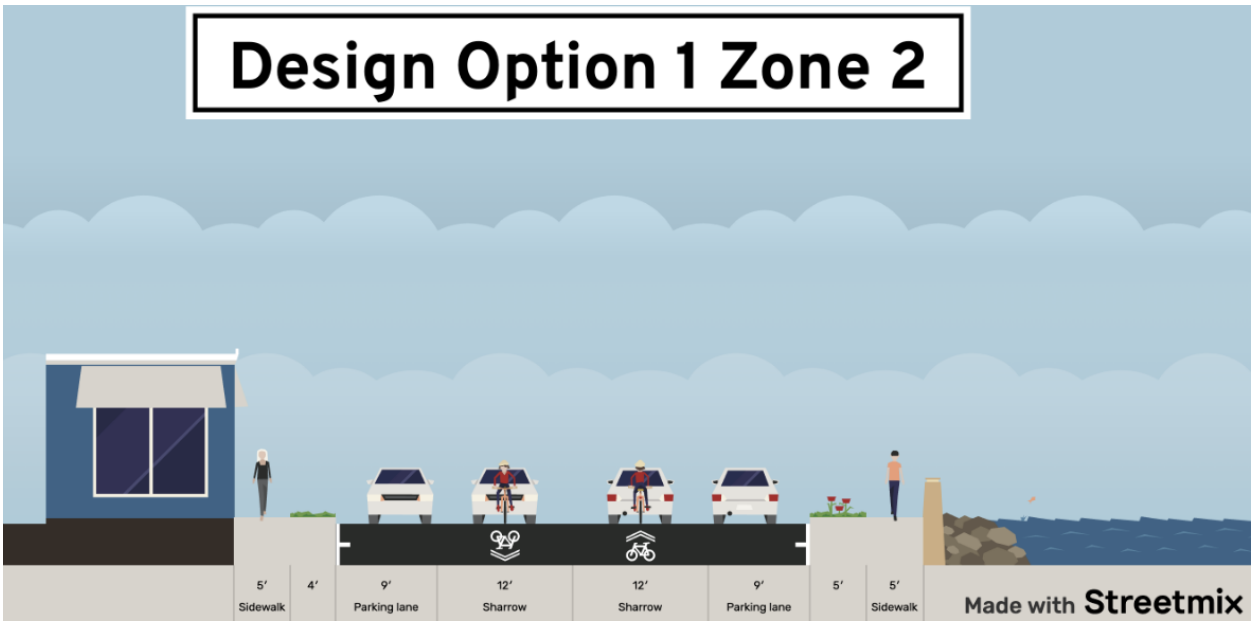


Figure 34: Design Option 1 of Zone 2 incorporating a Sharrow

Design Option 2 includes a separated bicycle path on both sides of the road. Adding bike paths to zone 2 would require a change in pavement width. There would need to be reconstruction in the zone. The planter would be two feet instead of four feet and the vehicle lanes would be eleven feet instead of twelve feet. The dimensions fit within the standards of a bike path.

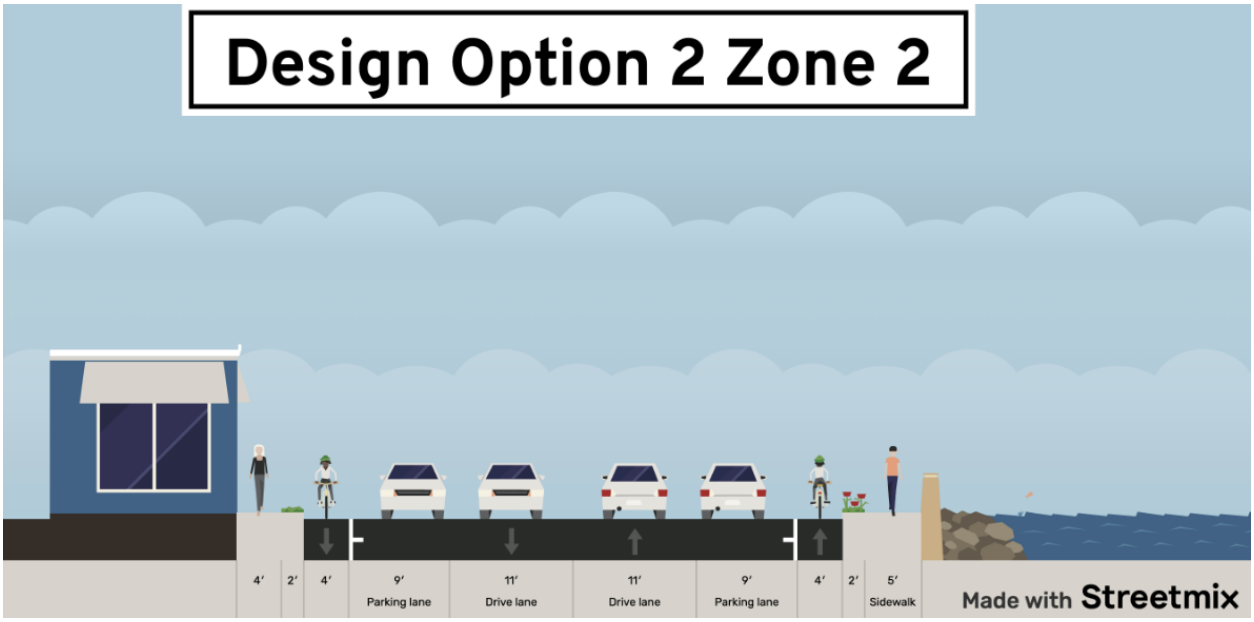


Figure 35: Design Option 2 of Zone 2 incorporating a Separated Bike Path

5.3 Zone 3: Route CT-156 - CT161 Intersection

Zone 3 has a width of around 65 feet. This zone was broken into two because it is an intersection and there are turning lanes that change what could be designed. For zone 3 from the east, there is a sidewalk, planter, and a turning lane. There are also shoulders on both sides. There are two vehicle lanes. Design Option 1 includes sharrows on both sides of the road. Adding sharrows to zone 1 would not require a change to the pavement or road; it would just require restriping. The planter in the middle loses two feet. The dimensions fit within the standards of a sharrow.

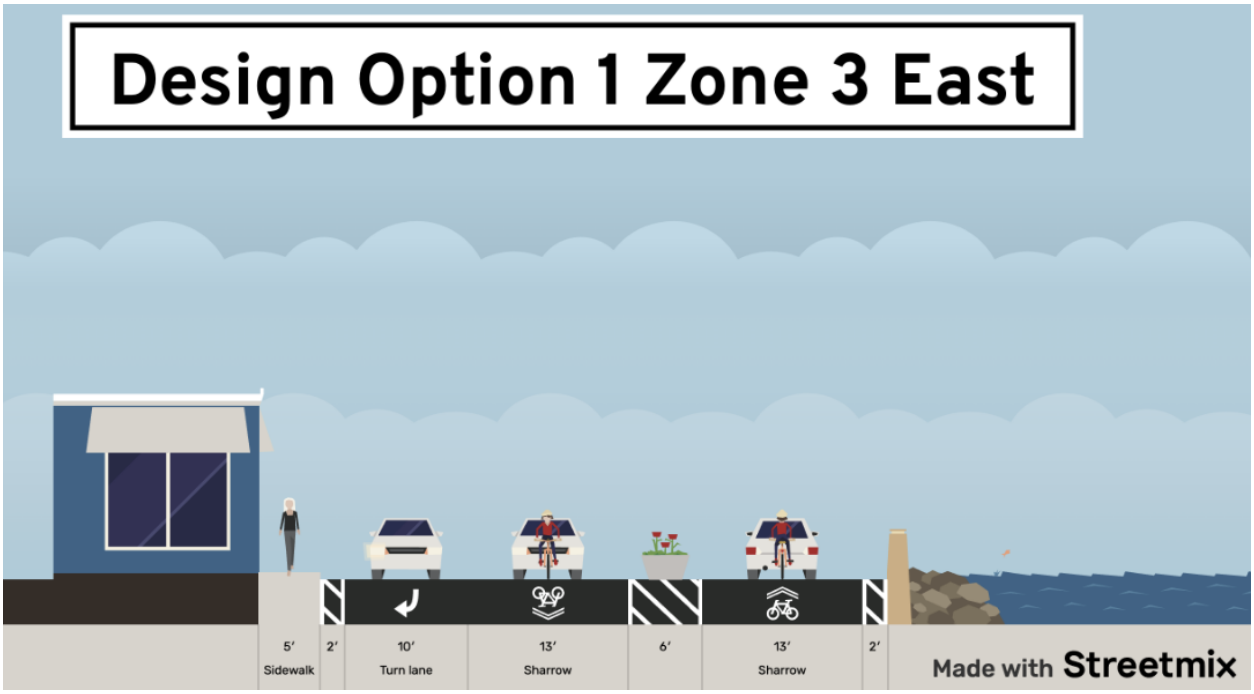


Figure 36: Design Option 1 of Zone 3 East incorporating a Sharrow

Design Option 2 includes a separated bicycle path on both sides of the road. Adding bike paths to zone 3 east would require a change in pavement width. The planter would be eliminated and the turning lane would be ten feet instead of eleven feet.

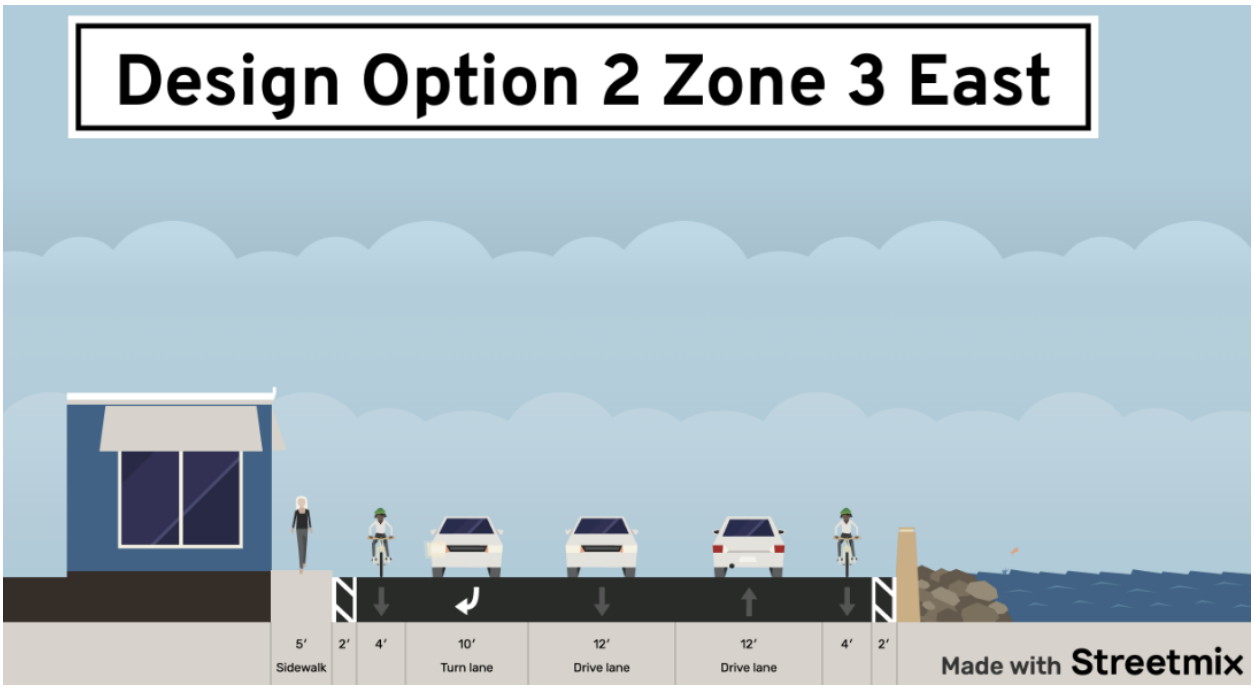


Figure 37: Design Option 2 of Zone 3 East incorporating a Separated Bike Path

Zone 3 from the western side has a generous width of around 65 feet. There are sidewalks and buffer zones on both sides. One side includes a planter. There are two vehicle lanes and one turning lane. Design Option 1 includes sharrows on both sides of the road. Adding sharrows to zone 1 would not require a change to the pavement or road; it would just require restriping. The shoulder loses a foot. The dimensions fit within the standards of a sharrow.

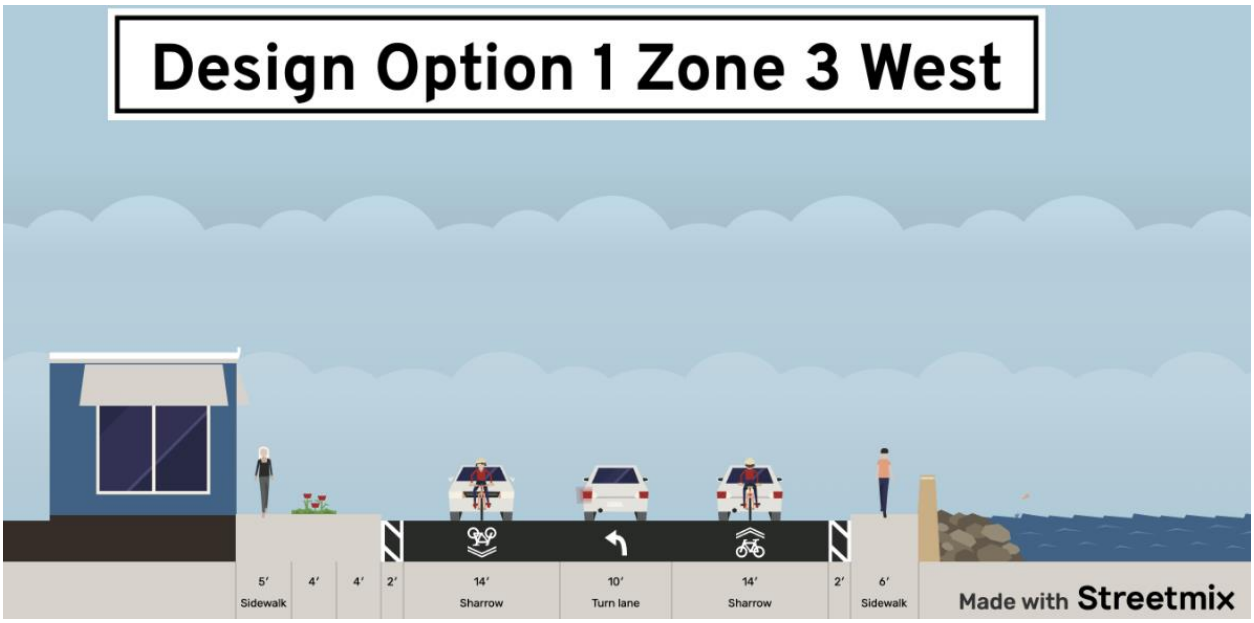


Figure 38: Design Option 1 of Zone 3 West incorporating a Sharrow

Design Option 2 includes a separated bicycle path on both sides of the road. Adding bike paths to zone 3 west would require a change in pavement width. The shoulder would be reduced to the standard two feet instead of ten feet and the vehicle lanes would be eleven feet instead of twelve feet. The dimensions fit within the standards of a bike path.

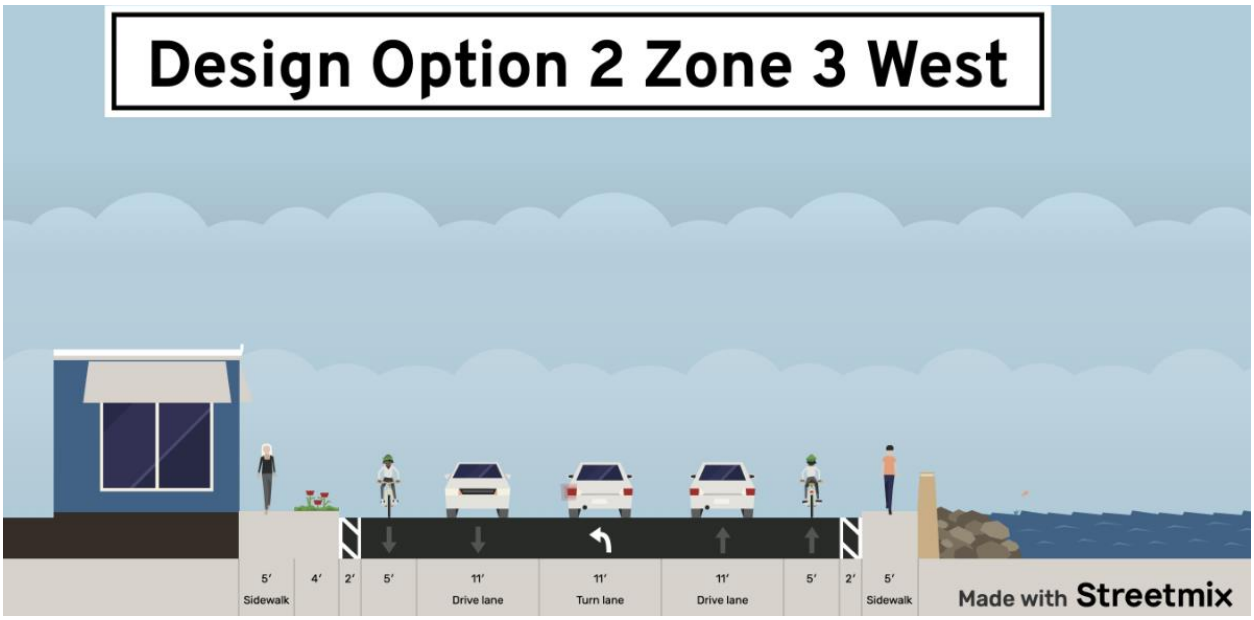


Figure 39: Design Option 2 of Zone 3 West incorporating a Separated Bike Path

5.4 Zone 4: CT-161 Intersection to Cini Memorial Park

Zone 4 has very little width as it runs along the train tracks. It is around 30 feet. This zone had to be broken into two parts because of the shift from sidewalk to boardwalk. The boardwalk cannot be disturbed as it is built separately from the road and has fencing. Therefore, there is zone 4a and 4b. For this zone, the width is a big constraint. There is only one option for both locations. The existing condition for zone 4a includes a sidewalk, two shoulders, and two driving lanes. The only possible circumstance is to change the driving lanes to sharrows. The dimensions do not have to change but the speed limit would have to be lowered to ensure safety. Adding sharrows to zone 4a would not require a change to the pavement or road; it would just require restriping. The dimensions fit within the standards of a sharrow.

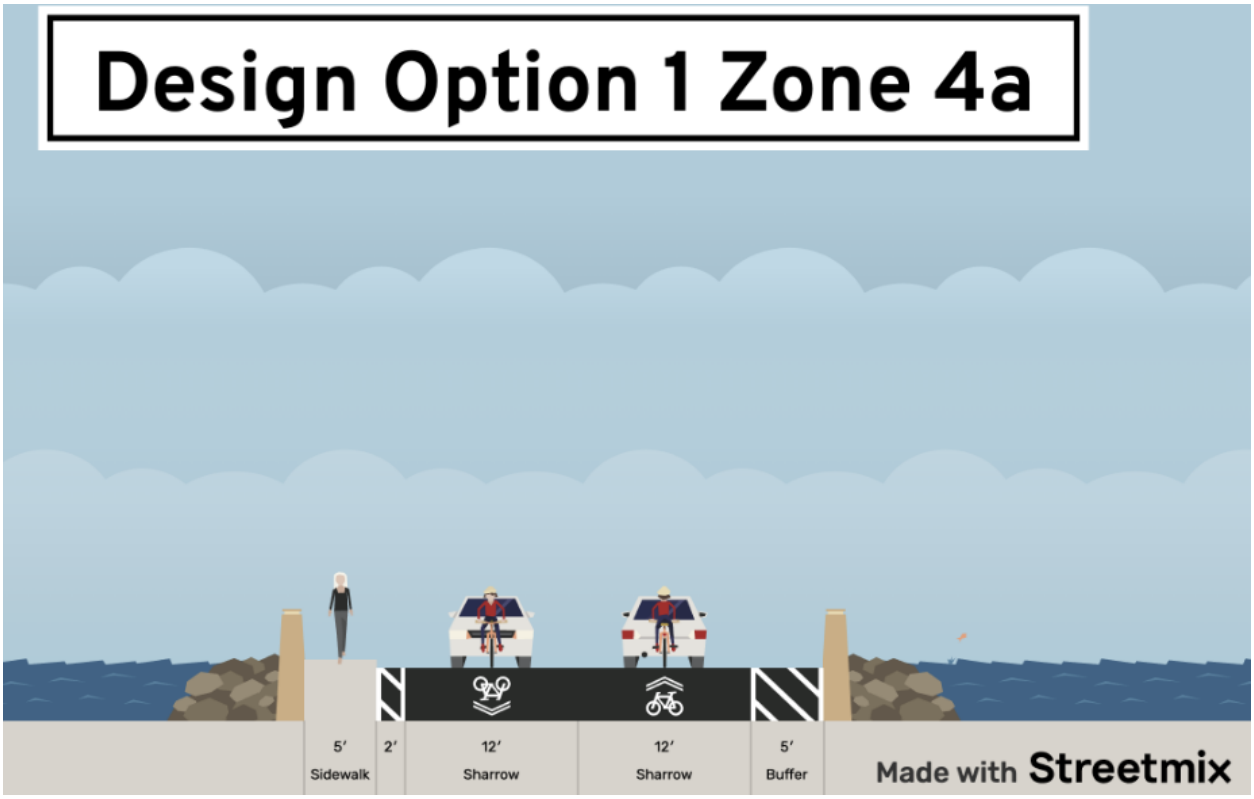


Figure 40: Design Option 1 of Zone 4a incorporating a Sharrow

The existing condition for zone 4b includes a boardwalk, two shoulders, and two driving lanes. The only possible circumstance is to change the driving lanes to sharrows. The dimensions do not have to change but the speed limit will have to be lowered to ensure safety. Adding sharrows to zone 4b would not require a change to the pavement or road; it would just require restriping. The dimensions fit within the standards of a sharrow. Design option 1 with the sharrows will be consistent throughout zone 4b.

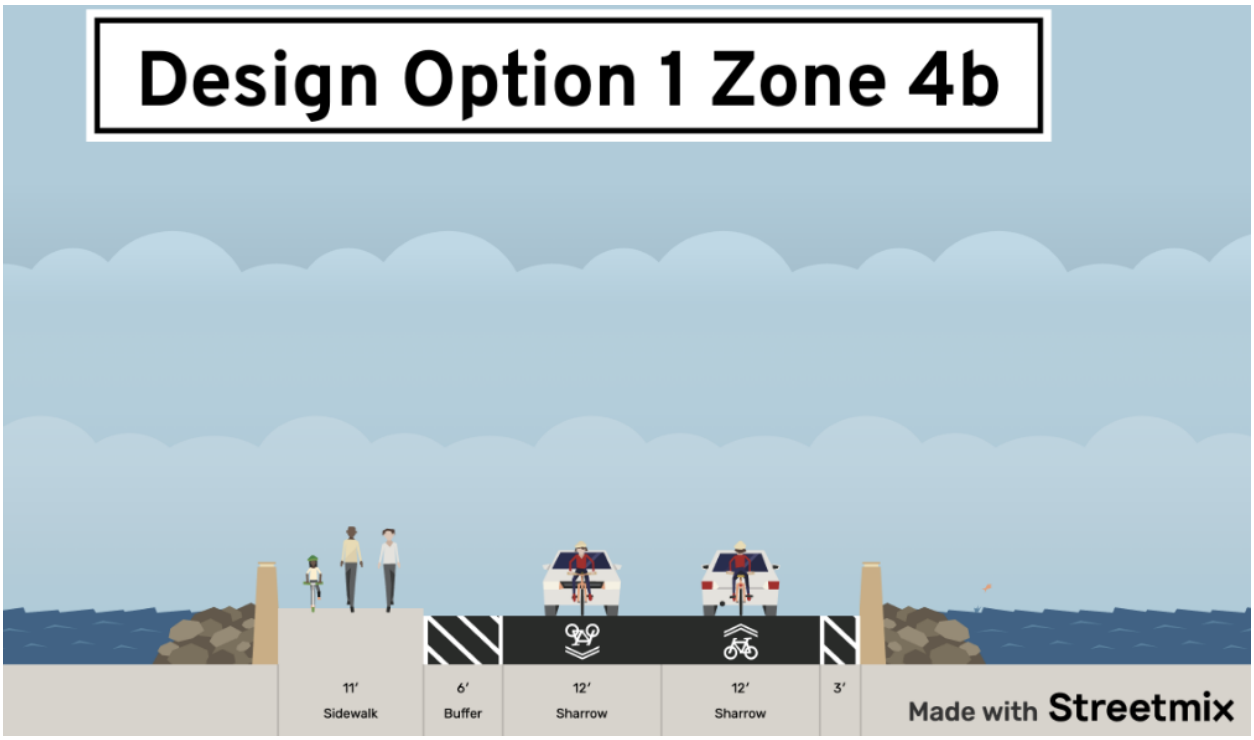


Figure 41: Design Option 1 of Zone 4b incorporating a Sharrow

6.0 Curb Ramp Design

Through research on ADA compliance regulations, the team identified which curb ramps were non-compliant. There were a total of 32 out of 33 curb ramps that were labeled as non-compliant. The team was provided with potential reasons as to why these curbs were not ADA-compliant in an excel provided by Katherine. The table found in Appendix C helped the team better understand how to go about resolving issues with curb ramp compliance. This section addresses the issues that are present with all 32 non-compliant curb ramps and provides recommendations on how to reconstruct them so they meet ADA requirements.

To address issues with running, cross, and flare slopes exceeding their maximum slope percentage, the team decreased their slope in AutoCAD to make all slopes compliant. The slopes which needed to be fixed in AutoCAD were running slopes that exceeded 8.33%, cross slopes that exceeded 2.0%, and flare slopes that exceeded 10%. All slopes that exceeded their maximum limit were hatched in red in AutoCAD. In terms of a detectable warning mat present, the team added a mat in AutoCAD in its appropriate place. If there was no mat present in the curb ramp's existing conditions on site, then it was also hatched red. In terms of water ponding present, the solution was to raise the structure of the curb ramp itself and adjust the slopes accordingly so the water can flow into the nearest catch basin. Raising the curb ramps structure to eliminate water ponding also addresses the issue with leaf obstructions at the opening.

The ADA has created specific regulations that one must follow with the construction of curb ramps to establish continuity across the United States. With that in mind, the Connecticut DOT follows the regulations and guidelines set forth by PROWAG and U.S. ADA whether it be to construct and inspect new or existing curb ramps.

Updated ADA compliant curb ramp designs were completed with AutoCAD software. For the purposes of simplicity with this report, the curb ramps that required the most adjustments in AutoCAD in order to become ADA compliant were featured and discussed in the upcoming sections of Chapter 6. The full list of the curb ramps with recommendations can be found in the Appendix. The same concepts and recommendations mentioned in the following subsections apply to the other curb ramps in the Appendix that are not featured in these subsections.

6.1 Zone 1: East Pattagansett Road to Haigh Avenue

This zone contained a total of 8 curb ramps with only one compliant ramp in the zone. The first curb ramp, Curb Ramp i in Intersection A, is located in a four-way intersection. The curb ramp is coming from the corner of the elementary school. The existing curb ramp can be seen in Figure 42. The curb ramp lacks a detectable warning strip and a proper landing area. However, adding those changes will make the curb ramp compliant. Adding an additional crosswalk to the south side of the street, instead of only the east side, would allow safer options for pedestrians crossing the road. Figure 43 shows the proposed redesign of the curb ramp. The detectable warning strip and landing area have been added along with a more curved edge for pedestrians going either to the east or south.

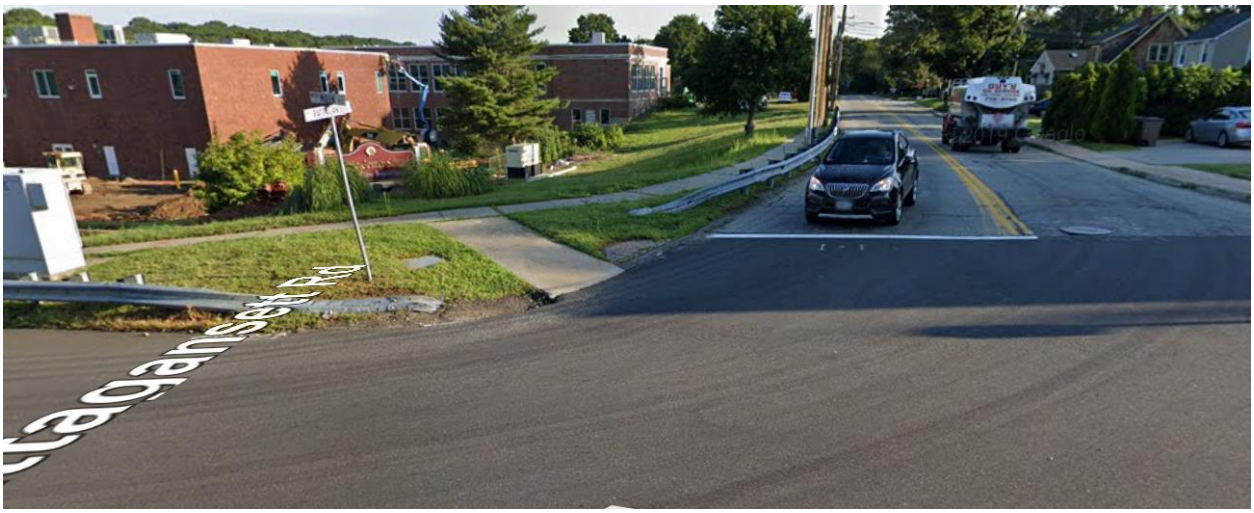


Figure 42: Google Earth view of Existing Condition of Curb Ramp i at Intersection A.

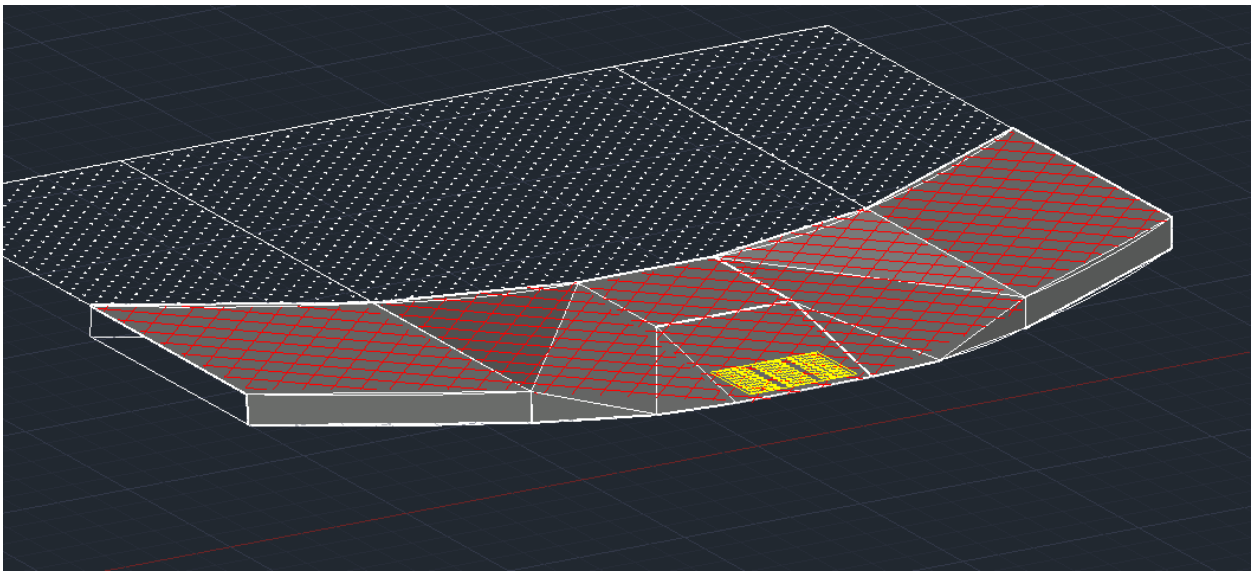


Figure 43: Proposed AutoCAD model of Curb Ramp i at Intersection A.

6.2 Zone 2: Haigh Avenue to Intersection

The curb ramp i, in Figure 44 and 45 is located on Intersection D Zone 2 was featured because there were many problem areas associated with this particular curb ramp. There is no Detectable Warning Mat at this curb ramp intersection. The crack also exceeds ¼ inch vertical gap at the landing area. The landing turning space cross slope and running slope both exceed the maximum requirements. Recommendations for this curb ramp will be to adjust the running and cross slopes so they are within the maximum 8.33% and 2% slopes per ADA requirements. Adding a detectable warning mat and leveling the curb ramp so the crack does not exceed ¼ inches at the landing area will transform this curb ramp to ADA standards.

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Figure 44: Google Earth view of Curb Ramp i at Intersection D in Zone 2

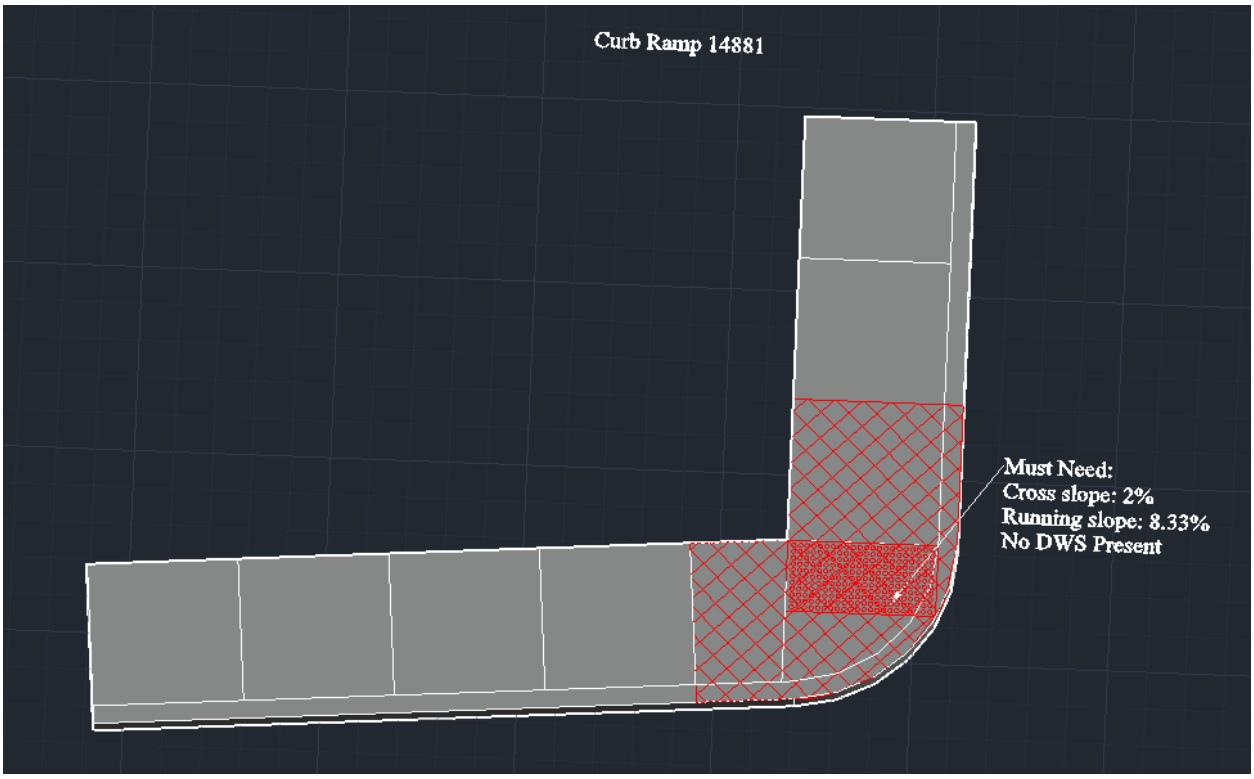

Figure 45: Proposed AutoCAD model of Curb Ramp i at Intersection D.

6.3 Zone 3: Route CT-156 - CT161 Intersection

For this curb ramp located in Zone 3, the problem areas that were prominent in this zone included issues with both running, cross, and flare slopes. Additionally, there is water ponding

located near the opening of the curb ramp. There is no landing area for the curb ramp and there are obstructions present. One can observe there are leaves that are collected at the opening, which is a result of the water ponding, and also contributes to the obstructions. The crosswalk pole located on the top left of the picture also is considered an obstruction to the accessibility of the curb ramp. The recommendation would be to construct a landing area for this curb ramp, and eliminate the water ponding by raising the structure so runoff can flow into a catch basin. By doing so, obstructions will no longer cause the curb ramp to be non-compliant. Adjust the flare and running slopes accordingly so they comply with ADA regulations.

Figure 46: Google Earth view of Curb Ramp i at Intersection I.

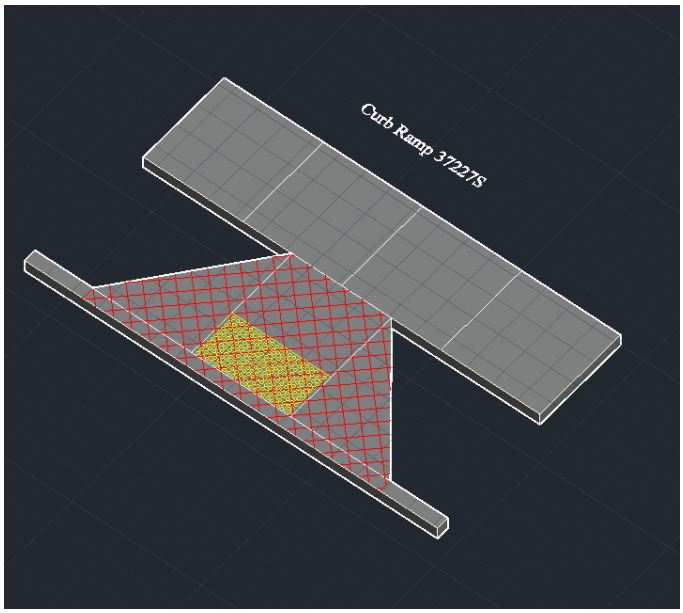

Figure 47: Proposed AutoCAD model of Curb Ramp i at Intersection I.

6.4 Zone 4: CT-161 Intersection to Cini Memorial Park

This curb ramp had only three problem areas, however, they are from different categories which is why this curb ramp was chosen. The right flare slope exceeded the maximum requirement of 8.33% and there is water ponding at the opening of the curb. Similar to the previous curb ramp addressed in Zone 3, the recommendation would be to raise the structure of the curb ramp so there is no possibility for water to pool at the base. Reconstruct the right flare slope so it is 8.33% slope maximum.

Figure 48: Proposed Google Earth view of Curb Ramp i at Intersection K in Zone 4.

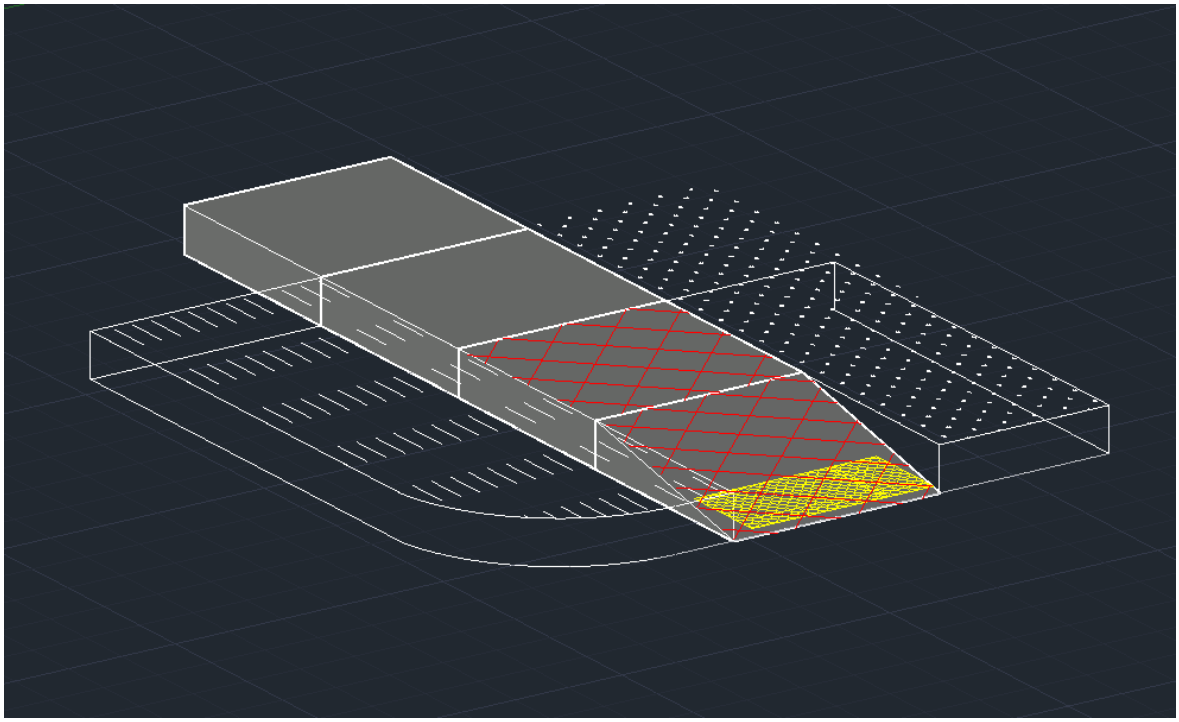

Figure 49: Proposed AutoCAD Model of Curb Ramp i at Intersection K in Zone 4.

7.0 Electric Vehicle Charging Station Locations

This area of Connecticut has three main endangered species. These species are the Northern Long-eared Bat, the Roseate Tern, and the Monarch Butterfly; however, these locations have already been through the process of construction in the past. Since this part of East Lyme is so densely populated with both people and infrastructure, to expand with EV charging stations would mean to expand on already completed construction projects. Any permits that were needed have been approved previously. This is crucial to carefully assess the potential impact of possible construction on the local wildlife. If there were any endangered species within the area, construction would not be able to start without special permits.

7.1 Location 1

Figure 51: Location 1 with potential EV charging stations outlined in red. Route CT-156 is to the northwest of this parking lot.

Location 1, can be seen in Figure 51, is within Hole in the Wall. This is a publicly owned car park with residential properties surrounding it. The parking lot leads to a walk-able tunnel that funnels to the boardwalk. This is only one out of the two entrances to the boardwalk.

This parking lot can hold about 80 cars, so up to five parking spots can be converted to EV charging stations without the worry of taking gas-operated cars' parking spots. With the parking lot leading to the boardwalk, this gives EV drivers an activity to occupy their time while their vehicle is charging.

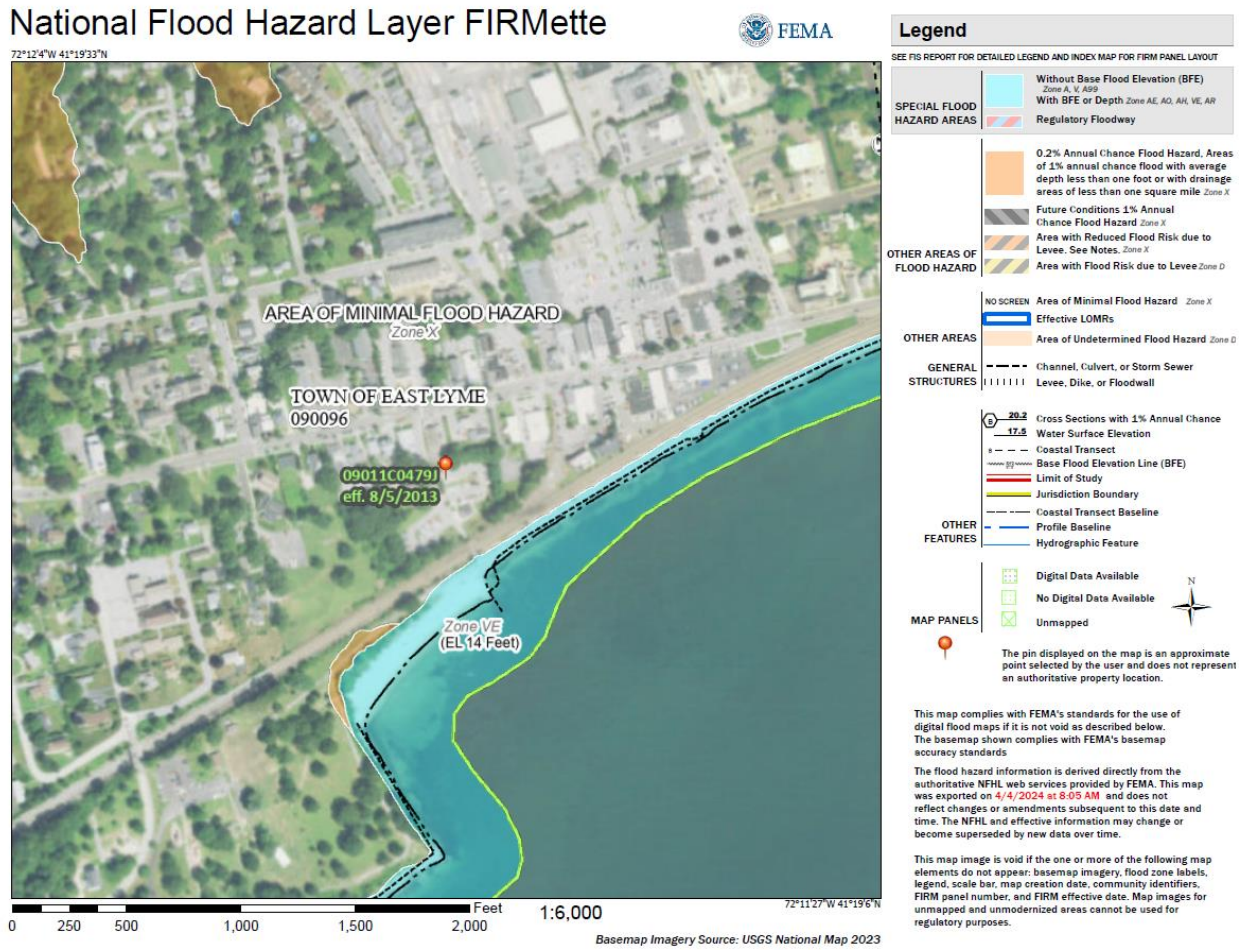

Figure 52: Satellite map of Location 1 with legend.

Location 1 is an ideal spot for installing charging stations for electric vehicles as this parking lot is not within any mapped floodplain. In Figure 52, the location is marked with a red dot. There is a floodplain close, which is the blue shaded region to the south of the location; however, the floodplain is over 100 feet away, leaving enough distance from the parking lot to not have to take it into consideration when in construction. Potential flooding in these areas could damage the charging stations, posing a safety hazard to both the vehicles and individuals using them. By selecting a location outside of a floodplain, the charging stations can be better protected and maintained, ensuring reliable access for electric vehicle users.

7.2 Location 2

Figure 53: Location 2 with the potential EV charging stations outlined in red. Route CT-156 is to the southeast of the parking lot.

Location 2, can be seen in Figure 53, is within a large parking lot surrounded by shops and restaurants. This is a privately-owned parking out by some of the different property owners around it.

This parking lot can hold about 260 cars, so up to 20 parking spots can be converted to EV charging stations without the worry of taking gas-operated cars' parking spots. With many commercial properties close by, this gives EV drivers an activity to occupy their time while their vehicle is charging.

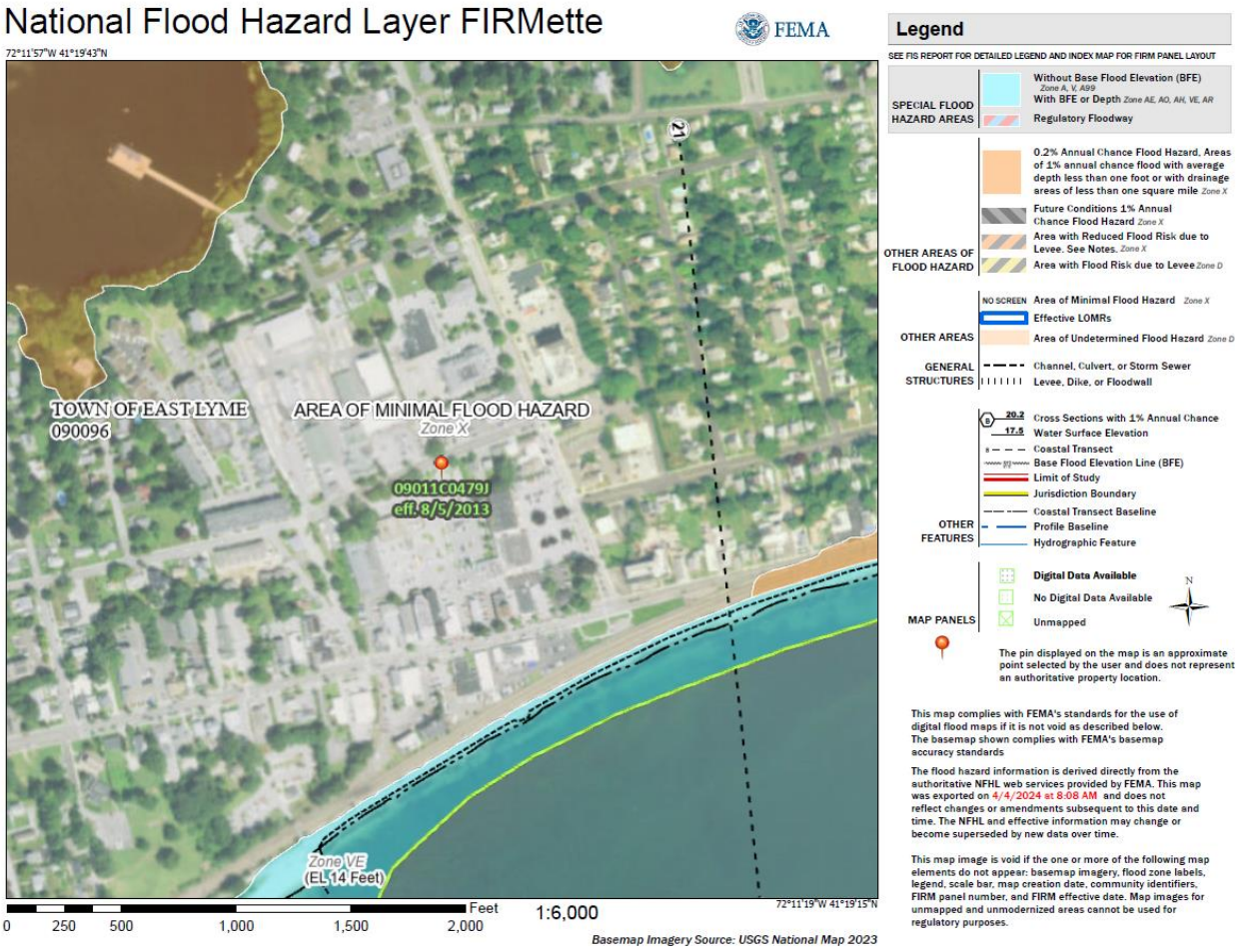

Figure 54- Satellite map of Location 2 with legend.

Figure 54 gives a visual of Location 2 that is another adequate location for installing charging stations. Similarly to Location 1, there is a floodplain to the south of the parking lot, but this distance is close to 700 feet. This distance is enough to not have to take the floodplain into consideration for construction.

7.3 Location 3

Figure 55: Location 3 with the potential EV charging stations outlined in red. Route CT-156 is to the north of the parking lot.

Location 3, can be seen in Figure 55, is within Cini Memorial Park. This is a publicly owned car park. This parking lot leads to the second entrance of the boardwalk.

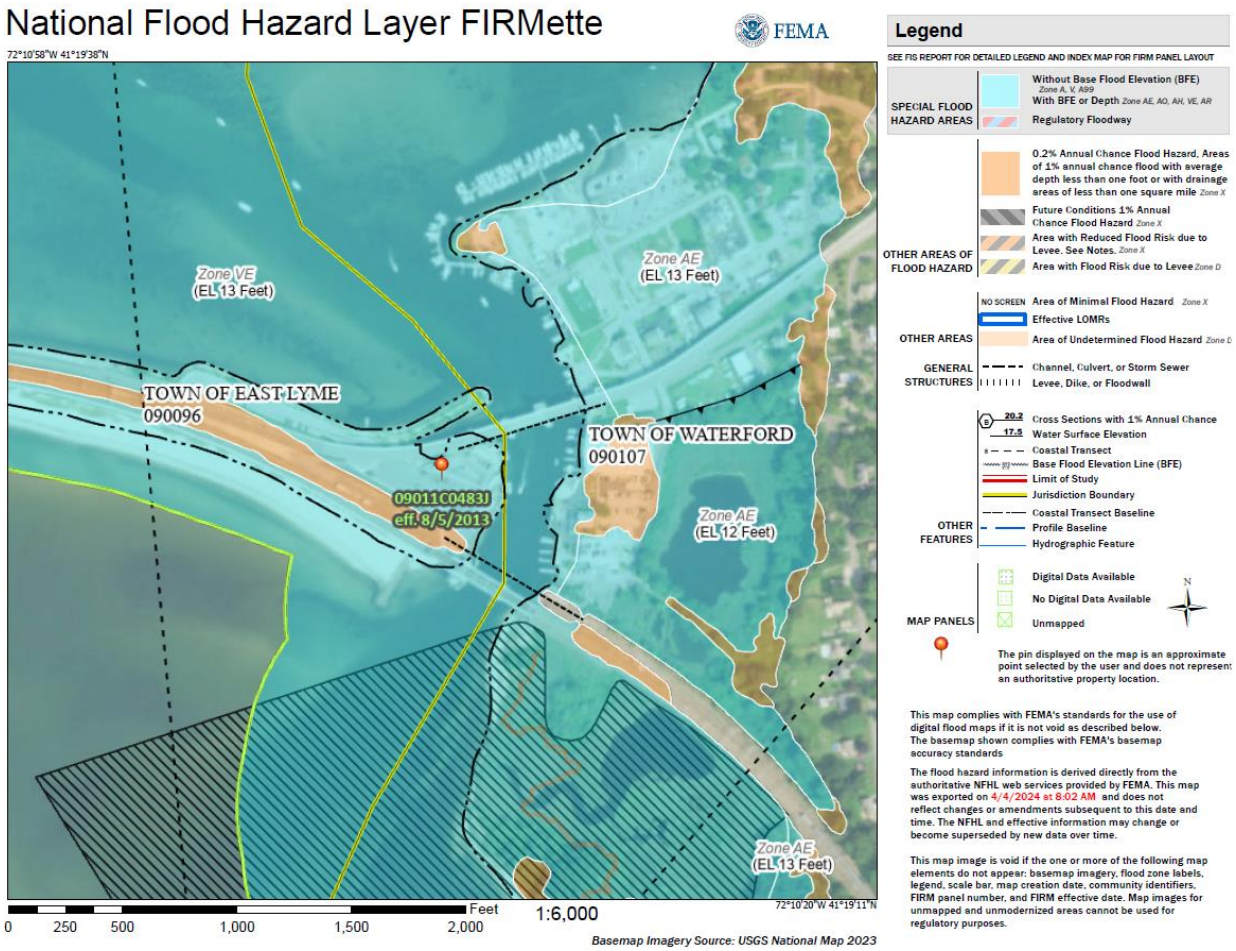

Figure 56- Satellite map of Location 3 with legend.

The results of this floodplain data, can be seen in Figure 56, indicate that the parking lot under review cannot accommodate charging stations for electric vehicles due to its location within a mapped 100-year floodplain. Charging stations in this location would pose a significant risk to both the charging stations and the vehicles utilizing them, as they would be at a high chance of damage or destruction in the event of a flood.

8.0 Recommendations

Short-Term Improvements

For short term recommendations on improving Route CT-156, the team would recommend including bicycle accommodations. Throughout the four zones of this corridor, incorporate sharrows into the driving lanes. It would be best to paint the designated sharrow path for cyclists to identify where they can share the street. In addition, painting the sharrow symbols will signify to drivers that there is a sharrow present in the road. To further improve the safety of pedestrians and cyclists, it is recommended to reduce the speed limit in Zone 4 to accommodate the sharrow.

To address curb ramp accessibility, remove all obstructions located on, or surrounding, curb ramps. Blocking the direct path to these curb ramps makes the curb ramp itself non-compliant per ADA standards

Long-Term Improvements

To address long term recommendations along Route CT-156, it would be beneficial to add a designated bicycle lane along both sides of the corridor until Zone 4 which becomes a sharrow at the intersection between Route CT-156 and CT-161. This would include reconstruction and would be costly, however, the corridor would benefit from the bike lane. The aesthetics of the area as well as the demand from the public call for a designated bike path. In terms of parking accommodations for drivers, it is recommended to include additional parking lots within this corridor. During this project site visit, an abandoned police station was identified. This parcel could be used for public parking and which could potentially replace on-street parking along the corridor, thus allocating more space to bike paths or wider sidewalks.

For long term curb ramp improvements, it would be ideal to raise the structure of the curb ramp to eliminate water ponding. If the city required a repavement of the corridor, the recommendation would be to align the height of the curb ramp opening to the street so it is flush with the road. As previously mentioned and depicted in Figure 4, the lip height must not exceed ¼ inches, so by regrading the repaved road, no curb ramp opening will exceed the maximum lip height. Repaving the road would also help to exclude any water ponding.

For long term sustainable improvements, it would be recommended to add EV charging stations at two location along the corridor, adding up to about 25 total charging stations. The locations, both being within existing car parks, are surrounded by commercial properties and the boardwalk. This leaves more than enough activities to occupy the EV drivers' time while their vehicle charges.

It is also recommended to add pedestrian signals along the corridor. The purpose of these indicators signal to drivers when a pedestrian is crossing at a designated crosswalk. This addition would be most useful to implement near the Niantic Center School located at the intersection of Route CT-156 and East Pattagansett Road. This long-term recommendation would be the preferred option; however, it would be a more costly implementation. This leads to a recommendation for future MQP projects which would be to recommend conducting a cost analysis for both short term and long-term improvements to this corridor. Future studies for MQP projects would include conducting the cost analysis, and then analyzing which recommendations would be most cost effective, and most positively impactful to cyclists, pedestrians, and drivers.

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Appendix A

Corridor Study of Route CT-156 in East Lyme, Connecticut

Project Proposal

Creators
Michaela Dos Santos, Luna Daury, Lauren Hess

Advisor
Suzanne LePage

Co-Advisor
Robert Kreuger

Sponsors
Katherine Hedberg
Connecticut Department of Transportation

Table of Contents

Capstone Design

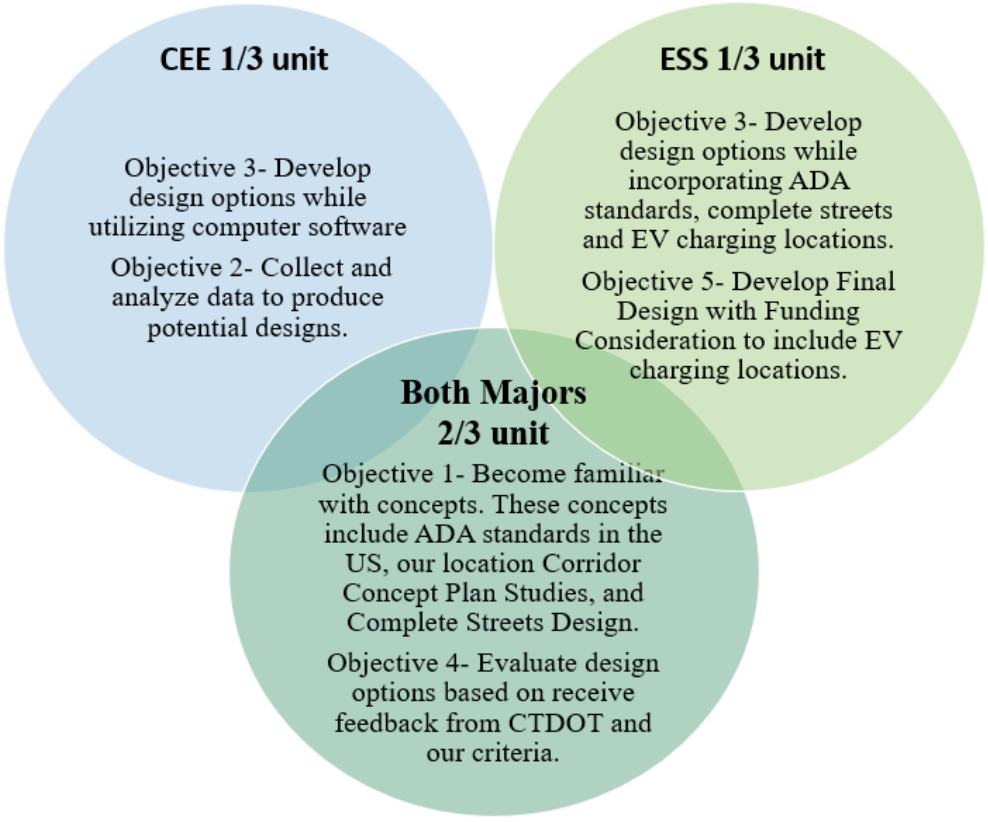
This project will focus on redesigning a section of Route CT-156 in East Lyme, Connecticut, specifically between Black Point Road and the Niantic River Bridge. The purpose of this redesign is to meet the needs of the town and the community which includes the necessity of improving the roads to ensure the safety of everyone regardless of disabilities. The Accreditation Board for Engineering and Technology (ABET) requires that all students in an accredited engineering program complete a capstone design experience before acquiring an engineering degree. Through a capstone design experience, students demonstrate skills and knowledge acquired through their studies and coursework. The project aligns with Outcome C criteria, which states that graduates should have the ability to design a system that meets needs within realistic constraints such as economic, environmental, social and political, ethical, health and safety, and sustainability (*Criteria for Accrediting Engineering Programs*, 2021).

The project will consider the following six constraints:

1. *Economic:* Potential funding options will be researched to implement the improvements that will be recommended. The benefits and costs of each funding organization will be looked into before making any recommendations.
2. *Environmental:* The project will take into account the environmental impact of all improvement concepts and aim to mitigate those impacts. Efforts will be made to improve the environmental conditions along the corridor by possibly adding vegetation and absorbent surfaces.
3. *Social and Political:* The team will familiarize themselves with regulations and community objectives at the city and state levels. Any recommendations given will comply with those regulations and will take into consideration the needs of stakeholders. The team will make sure to address the needs of the people of East Lyme, regardless of their socio-economic status, by promoting safe and efficient utilization of the road by all modes of transportation.
4. *Ethical:* The project will adhere to the ASCE Code of Ethics for civil engineers to maintain the reputation of WPI and Connecticut's Department of Transportation.
5. *Health and Safety:* The project will focus on improving dangerous intersections, sections of roads with high crash rates, and poor traffic designs. Countermeasures will be considered based on their ability to reduce any injury to improve safety.
6. *Sustainability:* The project will present long-term improvement concepts that address present and future needs for the corridor. The final design and recommendations will account for future traffic demands and population growth to ensure efficient use of Route CT-156 in the future.

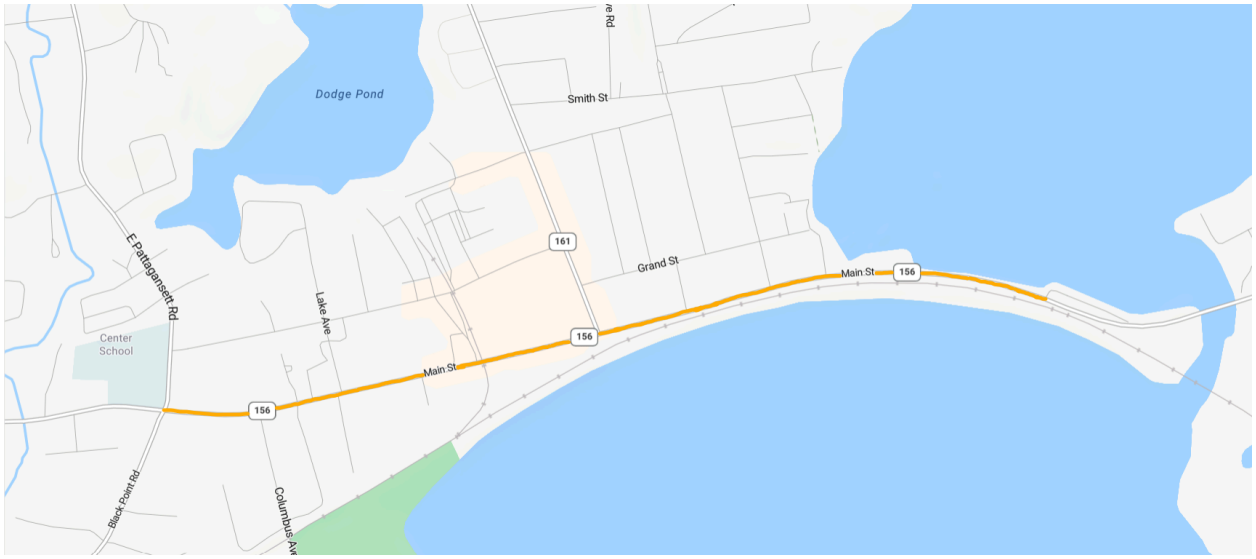
Civil Engineering & Environmental and Sustainability Studies Credit Distribution

Lauren Hess will undertake this project as part of a double-major MQP, with credits allocated between the Civil Engineering (CEE) and Environmental and Sustainability Studies (ESS) programs. An additional ⅓ credit will be earned during the D-term, commencing in March 2024. This Credit Distribution Venn Diagram provides a visual representation of how credits will be distributed for this project. The objectives placed on the right side of the diagram are the ones that Lauren will independently accomplish.



1.0 Introduction

East Lyme is located along the shoreline of Connecticut as a typical New England town with a vibrant community and historical landscape. Figure 1, displays a simplistic map of our corridor location which includes many attractions that captivate local residents and tourists.



(Figure 1: A Google Maps image of Route CT-156 and adjacent streets with an orange line representing our project site in East Lyme, CT.)

This project will take place in the heart of East Lyme, Route CT-156. Route CT-156 has been identified by the Connecticut Department of Transportation (CTDOT) as needing improvements to ensure the safety of everyone using the road. Currently, the site provides little security for pedestrians as many ramps and curbs are considered non-compliant by the Americans with Disabilities Act (ADA) standards in the state's records (*Connecticut Department of Transportation.Pdf*, n.d.-a).

Specifically, the project will start at the intersection of E Pattagansett Road through Main Street and conclude at Cini Memorial Park. The demand for sustainable inclusivity and urban planning development for future needs are apparent in East Lyme. This Major Qualifying Project's goal is to work with the CTDOT to create a Corridor Concept Plan in East Lyme that incorporates the design of Complete Streets, ensuring compliance with the ADA standards and addressing the future need for Electric Vehicle infrastructure. This plan will include a Complete Streets design that will be safe, accessible, and welcoming to all people regardless of disabilities. We also recognize the demand for electric vehicle infrastructure in a world that is constantly changing.

In order to address our goal, we divided our approach into the following five main objectives:

1. Become Familiar with Concepts
2. Collect and Analyze Data
3. Develop Design Options
4. Evaluate Design Options
5. Select Final Design with Funding Considerations

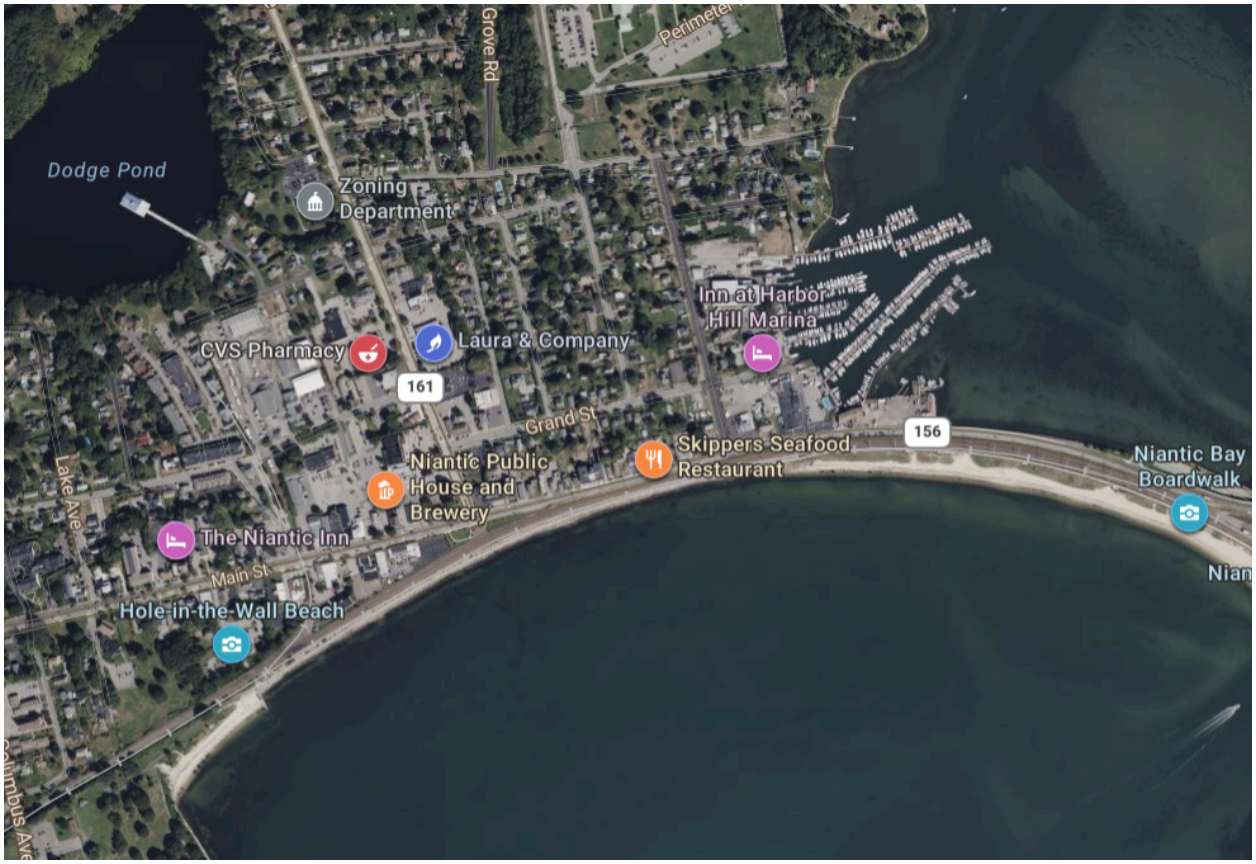
2.0 Background

This chapter will review the concepts surrounding the creation of the Americans with Disabilities Act (ADA) as well as an introduction to the Connecticut Department of Transition transition plan. The background will also discuss how a Corridor Concept Plan (CCP) ties into our project location and how it can help us address the wants and needs of residents and create a better way of transportation in East Lyme. Finally, to focus on the environmental aspect of the project, the background will also examine how Route CT-156 could be upgraded to accommodate the growing need for Electric Vehicles (EVs).

2.1 Location: Town of East Lyme

The location of our project is Route CT-156, located in East Lyme, CT. Route CT-156, also referred to as Main Street, travels Eastbound and Westbound through East Lyme. The area of focus for this project will begin (from east to west), at the intersection of 10-2 E Pattagansett Rd through Main Street and will conclude at location Cini Memorial Park.

East Lyme holds a population of over 18,000 residents, some of those residents located along Main Street (*U.S. Census Bureau quickfacts: East Lyme Town, Southeastern Connecticut,* n.d.). Based on information collected from Google Maps, the route is surrounded by both municipal buildings and residential houses. Additionally, there is the Niantic Bay Beach Boardwalk which stretches 0.5 of a mile adjacent to Route CT-156 on the southern side. During the summer months, this location becomes heavily populated with tourists, thereby increasing the number of pedestrians (Town of East Lyme, 2023). The intersection of CT-161 (Pennsylvania Ave) and Route CT-156 (Main St) carries about 9,000 vehicles per day. The surrounding residential houses, municipal buildings, and boardwalk along Route CT-156 are shown in Figure 2 above.



(Figure 2: Displays a Google Maps image of Route CT-156 including public areas and adjacent streets in East Lyme, CT.)

The municipal buildings that are located alongside this route include restaurants, shops, a bank, and a marina. Beyond the municipal buildings along Route CT-156 lie residential houses. Several intersections along Route CT-156 are currently not considered ADA-compliant based on the Connecticut Department of Transportation reports.

2.2 United States Americans with Disabilities Act Guidelines

The Americans with Disabilities Act initially began before 1990 when people throughout the United States gathered and formed groups to advocate for the inclusion of individuals with disabilities. These gatherings led to a movement to end discrimination against people with disabilities, which caught the attention of local governments and got passed down to Congress (Mayerson, 2021). With the help of many like-minded individuals, they have made these prejudices more noticeable to the public eye and the people of power as well. The disability rights movement helped push the official creation of the civil rights law.

The United States has general ADA requirements that all states must follow, however, some states may have more detailed requirements than others and some of those details might vary.

The general specifications for sidewalk and ramp construction include, but are not limited to (*Requirements for Accessible Sidewalk Design: EMC*, n.d.):

- 3’ minimum of clearance in the walkway
- A paved and smooth sidewalk
- No obstacles or debris in the way
- A maximum grade of 5%
- Include a buffer between the sidewalk and the street
- Detectable warning strips must be included on ramps

This project will deal with two main Federal Statutes: Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) specifically Title II and Public Right-of-Way Guidelines (PROWAG). These regulations provide information and guidelines for design and funding towards any development that provides any service, program, or activity as well as transportation to persons with disabilities to be as self-sufficient as possible.

Section 504 of the Rehabilitation Act of 1973

Section 504 is a federal law that protects persons with disabilities from discrimination in receiving services, activities, and programs that receive federal financial assistance. It also ensures states and local governments guarantee that persons with disabilities have equal opportunity to access any services, programs, and activities receiving federal financial assistance (*Connecticut Department of Transportation.Pdf*, n.d.).

The Americans with Disabilities Act of 1990 (ADA)

The Americans with Disabilities Act is a federal civil rights law that prohibits discrimination against people with disabilities. There are five separate titles, Title II applies to the state and local government and protects all peoples for all services, programs, and activities as well as transportation(*Connecticut Department of Transportation.Pdf*, n.d.).

The Public Right-of-Way Guidelines (PROWAG)

The Public Right-of-Way Guidelines are supplemental information for the ADA guidelines. PROWAG addresses every component of public rights-of-way and pedestrian access to sidewalks such as crosswalks, curb ramps, street furnishing, pedestrian signals, and parking (*Connecticut Department of Transportation.Pdf*, n.d.).

All of these applicable regulations have been incorporated into CTDOT programs, facilities, and public rights-of-way to protect people with disabilities and give them equal opportunity. CTDOT currently is working on completing the ADA requirements which include a roadway Self-Assessment and Transition Plan. The Self-Assessment includes a review of all the policies regarding ADA compliance in CTDOT. The CTDOT Self-Evaluation compliance includes evaluating building facilities, rights-of-way facilities, and communications to identify any accessibility obstacles or issues that need to be addressed urgently. In addition, CTDOT has developed a grievance procedure that provides a location online where the public can report an ADA issue whether public transit service or a public right-of-way issue. All of the data gets stored in the CTDOT Transition Plan.

2.3 Connecticut Department of Transportation Transition Plan

The Connecticut Department of Transportation developed the Transition Plan as an essential response to the Americans with Disabilities Act of 1990 and the ADA Amendments Act of 2008. The Transition Plan represents a profound commitment to promoting accessibility and ensuring strict compliance in Connecticut's infrastructure. The Transition Plan includes a list of physical barriers that limit the accessibility of programs, activities, or services as well as methods and schedules to remove such barriers

In the Transition Plan of 2019, several crucial elements were introduced to underpin the program's overarching mission.

A pivotal development within the program was the approval of ten precisely crafted curb ramp design guidelines. These guidelines serve as a blueprint for the construction of curb ramps that rigorously adhere to ADA standards. By providing clear and detailed standards, these guidelines ensure that construction teams will create curb ramps that facilitate a smooth and safe transition for individuals with disabilities, thus encouraging inclusivity within public spaces. An example of compliant and not-compliant sidewalks and curb ramps can be seen in Figure 3.

(Figure 3- Provides photos to demonstrate what sidewalks and curb ramps could look like with the corresponding categorization.)

Furthermore, curb ramps, a vital element of accessible infrastructure, were categorized into four distinct types, enabling a systematic evaluation of their compliance levels. The following categories are:

1. Existing concrete curb ramps with tactile warning strips are assumed to meet current ADA standards.
2. Existing curb ramps constructed from bituminous or concrete without tactile warning strips are assumed to be partially non-compliant.
3. No curb ramp at pedestrian crossing.
4. No curb ramp at traffic signal push button.

Table 1 gives exact numbers for how many curbs are within each of the mentioned categories. Meanwhile, pedestrian crossings and locations with traffic signal push buttons with no curb ramps are critical gaps in accessibility in Connecticut that demand attention and improvement.

Existing concrete curb ramp with tactile warning strip	Existing curb ramp (bituminous or concrete) without tactile warning strip	No curb ramp at pedestrian crossing	No curb ramp at traffic signal pushbutton
3,183	11,594	1,577	1,327

(Table 1- A chart representing the current curbs and their categories in Connecticut.)

Over the years, the program has made notable strides in expanding accessibility. Since its inception in 2014, over 2,000 new curb ramps have been successfully added through various CTDOT projects. This substantial achievement underscores the program's commitment to actively pursuing accessibility goals.

In terms of overarching goals, CTDOT has set an ambitious target: to comprehensively update accessibility across the entire state of Connecticut within 15 years, with a specified target year of 2035 (*CTDOT Updating ADA/Section 504 Transition Plan*, 2023). This long-term vision reflects the program's consistent dedication to inclusivity and accessibility, thus emphasizing that this mission is not merely a short-term endeavor, but an ever-lasting commitment. Supporting these initiatives, CTDOT has allocated a significant annual budget of $6 million for curb ramp construction.

In addition to its involvement in curb ramp construction, CTDOT is assigned the responsibility of ensuring the ongoing accessibility of crosswalks and traffic crossings on state-owned highways. This expanded mandate adds to the program's approach to accessibility, recognizing that creating an accessible transportation network extends beyond individual curb ramps to encompass the broader range of pedestrian-related infrastructure.

The Transition Plan stands as a comprehensive and transformative initiative to align with federal disability laws and advance accessibility throughout Connecticut (*CTDOT Updating ADA/Section 504 Transition Plan*, 2023).

The Office of Equal Opportunity and Diversity is the department in CTDOT that meets quarterly with the Federal Highway Administration (FHWA) to ensure steady progression with the Transition Plan. CTDOT has also created a technical infeasibility form (TIF) which is filled out when a project can't meet ADA accessibility. PROWAG has been recognized as a good practice for designers. When a design element doesn't satisfy PROWAG guidelines, then it should be documented and approved with the technical infeasibility form (*ED-2019-7_PROWAG_Links.Pdf*, n.d.).

2.4 Corridor Concept Plan

A Corridor Concept Plan (CCP) is a report that outlines a strategy for the development and or improvement of transportation corridors in a certain region. The report is typically created by transportation agencies, like the CTDOT, as a set of future guidelines to manage developmental growth along major transportation corridors.

A CCP focuses on a specific corridor which could be a highway, road, or even a transit route. A CCP aims to address many transportation challenges, including safety issues and substandard infrastructure. The plan provides an integral approach to corridor development, considering multiple transportation modes, such as cars, public transit, bikes, and pedestrians, to ensure an efficient transportation system (*SR 580 Corridor Planning and Concept Development Study*).

The CT DOT has various resources available to support the development of CCPs. These resources include:

1. Studies and Reports: The CT DOT conducts studies and prepares reports on transportation-related subjects. These documents analyze existing conditions, identify challenges, and propose recommendations for improvement in specific corridors.
2. Data Collection and Analysis: The CT DOT collects and analyzes data related to travel patterns, crash statistics, and other relevant information for corridors. This data helps to identify priorities for decision-making.
3. Public Involvement: The CT DOT seeks public input and engages community members, including local governments and businesses, throughout the CCP process. Public meetings, surveys, and other engagement methods help gather feedback to ensure that the plan aligns with the needs of the affected communities.
4. Environmental Considerations: The CT DOT incorporates environmental considerations into CCPs by addressing potential impacts on air and water quality and natural resources.

The department follows environmental guidelines and regulations to ensure sustainable practices to minimize negative effects on the environment.

Developing a Corridor Concept Plan requires a broad approach that considers a range of factors, including transportation demand, infrastructure needs, community preferences, and environmental impacts. The CT DOT's resources and collaborative efforts ensure that CCPs are well-informed, sustainable, and responsive to the transportation needs of Connecticut's communities.

2.5 Corridor Concept Plan of Route CT-161

The Southeastern Connecticut Council of Governments (SCCOG), in collaboration with BETA Group, Inc., has conducted a Corridor Concept Study on Route CT-161 which is another route that intersects Main Street (The Southeastern Connecticut Council of Governments, n.d.). This study will help mitigate traffic congestion, emphasize pedestrian safety, accommodate more bicycle lanes, and overall improve user safety and experience. This Corridor Study will benefit the advancement of this project, especially when creating a Corridor Concept Plan on Route CT-156.

Since the corridor study is located within proximity to the project location, it is reasonable to assume residents are most likely to request similar needs. The wants and needs of residents who participated in the CT-161 study will likely match the wants and needs of residents located along Route CT-156. This information collected on Route CT-161 corridor study will help us determine what are the resident's greatest desires based on feedback from the corridor study. Ideas created from the corridor study will also be implemented into our project since existing conditions, terrain, and zoning regulations at CT-161 are analogous to our Route CT-156 site location. Since a corridor study that focuses on Route CT-156 has never been officialized, we will establish our designs and plans based on the CT-161 corridor study. A typical corridor study lasts 16 months, so it would not be feasible if we were to conduct a new corridor study ourselves within the time limit of a three-term Master Qualifying Project or 21 weeks (*The Southeastern Connecticut Council of Governments*, n.d.).

2.6 Complete Streets Policies

The Complete Streets policies are an implementation by the CT DOT that aims to create safe and sustainable transportation networks for all users, despite their mode of transportation. The program focuses on accommodating pedestrians, bicyclists, and motorists while also increasing safety. The goal of this policy is to develop streets that meet the diverse needs of the community, encouraging active transportation (bicycling, running, walking, etc.), improving air quality, and promoting public health (*Complete Streets* 2015). Figure 4 is an example of an ideal complete street design that many communities would like to incorporate.

(Figure 4- This picture is a comparison of what the current streets look like before and after Complete Streets. The ‘After Complete Streets’ picture includes bike lanes and pedestrian crosswalks.)

CT DOT provides resources including guidelines, manuals, and publications that provide a wide range of information on different aspects of Complete Streets implementation. Notable resources include the "Complete Streets Design Guidelines" which offer design guidelines for developing and retrofitting streets according to Complete Streets principles. The guidelines cover pedestrian and bicycle facilities, public transit accommodations, traffic calming measures, and accessibility standards.

The CT DOT has also developed plans to integrate additional bicycle and pedestrian routes that connect within different regions around the state. These plans emphasize the integration of active transportation into the transportation network whilst highlighting the importance of the Complete Streets program (*Complete streets,* 2023).

In addition to these resources, the CT DOT often collaborates with municipalities and organizations through training sessions and assistance programs. This collaboration aims to promote the implementation of Complete Streets principles across Connecticut.

2.7 Electric Vehicles

As transportation transitions toward a future more dependent on EVs and cleaner transportation options, the landscape of environments will be impacted. There are several insights from experts that bring attention to the transformative potential of EVs and the accompanying evolution of urban infrastructure.

The evolution of EV-friendly infrastructure extends to public charging stations. This transformative approach not only enhances sustainability but also creates more pleasant and

eco-conscious urban environments. Charging infrastructure includes an Open Charge Point Interface which includes: location, electric vehicle supply equipment port, and connector. As more and more electric vehicles are used by people, there is a growing demand for charging stations because charging at home won't be enough. The rise of electric vehicles is reshaping our urban landscapes. The rise of EVs and charging stations foreshadows a new era of urban infrastructure that aligns with sustainability and the changing needs of evolving cities.

3.0 Methodology

As previously stated in the Introduction section, our goal for this project is to create a Corridor Concept Plan in East Lyme that incorporates the design of Complete Streets, while ensuring ADA compliance as well as addressing the future need of Electric Vehicle infrastructure. In order to address our goal, we are dividing our approach into the following five main objectives:

1. Become Familiar with Concepts
2. Collect and Analyze Data
3. Develop Design Options
4. Evaluate Design Options
5. Develop Final Design with Funding Considerations

3.1 Objective 1 - Become Familiar with Concepts

The team will research to gain an understanding and familiarity with the information necessary for the project. The team will study CTDOT and the Office of Equal Opportunity and Diversity which is the department we will be working with during the continuation of this project. As a team, we will research the ADA standards, in the United States and the standard CTDOT enforces throughout the state. The team will familiarize themselves with *Title 2* and *PROWAG.* The team will study the location, Route CT-156, and conduct site visits. The team will research Complete Streets designs to understand how to incorporate the design into Route CT-156. By familiarizing ourselves with the location, we can understand the limitations that might be encountered for a Complete Streets design and be able to work around it. The team will also research corridor studies to be able to develop a corridor concept plan within the three allotted terms.

3.2 Objective 2 - Collect and Analyze Data

This objective discusses what specific data we need to gather to have all the information we need to complete upcoming objectives. This data includes sidewalk and curb ramp accessibility, amount of parking available, and traffic and crash rates. We will consult with our sponsor Katherine Hedburg (Transportation Engineer 3 - ADA Coordinating Engineer - Project Administration) from CT DOT to obtain any specific information we need to collect that will be useful for us to accomplish our overall goal.

3.2.1 Sidewalk and Curb Ramp Accessibility

Accessibility is a critical aspect of this Major Qualifying Project. The accessibility of the sidewalks and ramps on Route CT-156 is important information that will be collected. Sidewalk and curb ramp design impacted by changes in level and detectable warnings will need to be collected. We will be using a digital level inclinometer to measure cross slopes, running slopes, and a tape measure to measure the dimensions of the curb ramps. Using the data collected and Americans with Disabilities Act (ADA) standards, we will determine if the curbs are compliant.

3.2.2 Parking

There is a lot of information that needs to be collected to provide the town with possible EV charging station locations. We need to determine what parking spaces are public and which are private. We will need to collect parking data such as the location of public parking and the number of cars that use the space during peak hours. However, during the winter off-season, we will need to use data from previous summers to identify parking patterns. We will discuss this with our sponsor Katherine Hedburg to provide us with this data.

3.2.3 Traffic and Crash Rates

We will be looking at the crash data on the UCONN Crash Data and Connecticut Crash Data Repository (CTCDR) provided by CTDOT to see the traffic patterns on Route CT-156. We will limit our data collection to the intersection of 10-2 E Pattagansett Rd through Main Street and will conclude at location Cini Memorial Park. We will analyze the data collected from the past ten years to identify certain areas within the corridor that need development. We will collect the following aspects: date of collision, route, collision type, injury severity, wet/dry road conditions, and speed of the vehicle. We will use the data to calculate crash rates by dividing the total number of crashes within the corridor over a specified time period. Using these calculations, we will produce collision diagrams with consideration to traffic trends.

3.2.4 Mapping

We will be mapping the data such as streets, sidewalks, non-compliant curb ramps, and parking using ArcGIS. These maps will be catered to reflect the goal of this MQP.

3.2.5 Analyze Data

We will analyze the data we collect from the site as well as from our sponsor Katherine Hedburg. The data will include the evaluation of sidewalk and curb ramp accessibility, the amount of parking available for EVs, and traffic and crash rates. This information will be used to help determine designs and solutions to the problems on Route CT-156.

3.3 Objective 3 - Develop Design Options

After the data has been collected and analyzed, we will develop designs to address the areas of noncompliance according to ADA standards and incorporate Complete Streets principles.

We will utilize computer software such as AutoCAD and Streetmix to create initial designs of what the Corridor Concept Plan will look like based on the data analyzed. An AutoCAD basemap provided by CTDOT will be given to us to help facilitate our initial designs. The designs would include the addition of sidewalks, bike lanes, crosswalks, and traffic calming measures. We will also use the information that will be collected from the Corridor Study on Route CT-161 in our designs regarding the feedback from residents.

Furthermore, one specific improvement that this project will address when preparing designs and creating corridor concept plans, will be to improve the condition of sidewalks, specifically making sidewalks and ramps more accessible to meet ADA standards. The goal is to develop plans and designs that address Route CT-156 as a whole with ADA compliance being the main focus of our conceptual designs.

An additional portion of this project design will concentrate on the installation of electric vehicle charging stations. As previously mentioned, Route CT-156 passes through commercial areas, which is where public buildings are located. These public buildings provide various parking lots which are the ideal location to add EV stations as there are more spaces to use for EV charging. We will research which parking lots are the most effective locations to construct these stations while also considering aspects such as power supply and accessibility.

3.4 Objective 4 - Evaluate Design Options

The final design for Route CT-156 will be decided based on the needs of the town and CT DOT. The initial designs will be presented to CT DOT and other staff members associated with the project to gain feedback. As a team, we will re-evaluate and redesign our options based on the feedback received from CT DOT and members of the town as well as compliance with ADA standards.

The team has created a criteria to evaluate design options:

1. Safety: Implementing traffic calming measures to ensure safety for pedestrians and cyclists.
2. Accessibility: Incorporating ADA standards and being accessible to all people regardless of disability.
3. Public: Involving public input into the design.
4. Diversity: Including diversity in the streets with bike paths, crosswalks for pedestrians, and parking spaces for EVs.
5. Funding: The design will be able to be funded by the town.

The feedback will be used to make adjustments to the designs to guarantee success.

3.5 Objective 5 - Develop Final Design with Funding Considerations

In the pursuit of our mission to create a more inclusive infrastructure in compliance with ADA standards, selecting the final design is the next step. This objective is not only about design, but also about ensuring that the necessary funding is considered in order to bring the finalized design to life.

A significant aspect of our final design will revolve around improving the accessibility of sidewalks and ramps, with the ultimate goal of achieving full ADA compliance. Recognizing this challenge, our project prioritizes ADA compliance as a central focus of our conceptual designs. It is important to note that government agencies, such as the DOT, often offer grants and funding opportunities for projects aimed at enhancing accessibility and compliance with ADA standards.

The design will incorporate modernizing infrastructure by involving electric vehicle charging stations. Route CT-156 includes many areas, and the installation of these charging stations aligns with sustainable and forward-thinking urban planning. Government funding may also be available to support projects that promote clean energy and infrastructure development, including electric vehicle charging stations.

The final design will be displayed using computer software such as AutoCAD and Streetmix to present the Major Qualifying Project's vision.

3.6 Project Timeline

Milestone	Task	Sub-Task	A-Term							
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
A-Term (Aug-Oct 2023)	*Objective 1- Become Familiar with Concepts*	ADA standards								
		CTDOT								
		Route CT-156								
		Complete Streets								
		Corridor Study on Route CT-161								
		Corridor Study on Route CT-161								
	Writing Proposal	Introduction								
		Background								
		Methods								
	Presentation Methods									
	Site Visit									
Milestone	***Task***	**Sub-Task**	B-Term							
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
B-Term (Oct-Dec 2023)	*Objective 2- Data Collection*	Location of Interestion								
		Running Slope								
		Cross Slope								
		Location of Possible EV Stations								
		Collect Traffic Data								
		Collect Crash Data								
	Site Mapping	Streets								
		Sidewalks								
		Parking								
	Objective 2 - Analyze Data									
	Objective 3- Develop Design Options	Research Solutions								
		Develop Design using AutoCAD, ArcGIS								
	Final Report Writing									
Milestone	***Task***	**Sub-Task**	C-Term							
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
C-Term (Jan-Mar 2024)	*Objective 3- Develop Design Options*									
	Present to CT DOT									
	Objective 4- Evaluate Design Options									
	Final Report Writing	Introduction								
		Background								
		Methods								
		Results								
		Recommendations								
Milestone	***Task***	**Sub-Task**	B-Term							
			Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8
D-Term (Mar-May 2024)	*Objective 5- Develop Final Design with Funding Considerations*	Identify potential EV charging stations								
		Identify a few funding options								
	Final Report Writing	Results								
		Recommendations								

(Figure 5: The figure above is the timeline of tasks for the project to the start of May.)

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Appendix B

Roadway Segment Crash Rate
Rseg = (#Crashes/ year x 1,000,000) / (AADT x 365 days x length of roadway segment)

Zone 1
# Crashes = 29 crashes
Year = 6 years
AADT = 6600
Length of Roadway segment = 0.16 miles
= (29/6 * 1,000,000)/ (6600 * 365 *0.16) = 12.54 crashes per million VMT

Zone 2
# Crashes = 36 crashes
Year = 6 years
AADT = 6600
Length of Roadway segment = 0.4 miles
= (36/6*1,000,000)/ (6600*365*0.40) = 6.23 crashes per million VMT

Zone 3
# Crashes = 9 crashes
Year = 6 years
AADT = 6650
Length of Roadway segment = 0.08 miles
= (9/6*1,000,000)/ (6650*365* 0.08) = 7.72 crashes per million VMT

Zone 4
# Crashes = 27 crashes
Year = 6 years
AADT = 6700
Length of Roadway segment = 0.60 miles
=(27/6*1,000,000)/(6700*365*0.60) = 3.07 crashes per million VMT

	Zone 1	Zone 2	Zone 3	Zone 4
Crashes	29	36	9	27
Year	6	6	6	6
	1,000,000	1,000,000	1,000,000	1,000,000
AADT	6600	6600	6650	6700
Length	0.16	0.4	0.08	0.6
Days	365	365	365	365
Total	12.53978138	6.226650062	7.724791431	3.066857493

Appendix C

CrashId	Date Of Crash	Time of Crash	Crash Severity	Crash Severity Text Format	Most Severe Injury Text Format	Weather Condition	Weather Condition Text Format	Light Condition	Light Condition Text Format	Road Surface Condition	Road Surface Condition Text Format	Manner of Crash / Collision Impact	Manner of Crash / Collision Impact Text Format	Crash Specific Location	Crash Specific Location Text Format	Average Daily Traffic
377266	1/2/18	9:34:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	3	Angle	2	Intersection	7700
387233	2/4/18	8:23:00	O	Property Damage Only	No Apparent Injury (O)	2	Cloudy	1	Daylight	2	Wet	3	Angle	2	Intersection	7700
407900	3/2/18	13:11:00	O	Property Damage Only	No Apparent Injury (O)	4	Rain	1	Daylight	2	Wet	1	Front to rear	1	Non-Junction	7700
408189	4/10/18	7:04:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	4	Rain	1	Daylight	2	Wet	3	Angle	2	Intersection	7700
415846	5/3/18	16:21:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	1	Front to rear	3	Intersection-Related	7700
470502	10/15/18	11:26:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Clear	1	Daylight	1	Dry	88	Not Applicable	1	Non-Junction	7700
501548	12/21/18	17:00:00	O	Property Damage Only	No Apparent Injury (O)	4	Rain	4	Dark-Lighted	2	Wet	1	Front to rear	1	Non-Junction	7700
530239	3/7/19	14:13:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	3	Angle	2	Intersection	7800
571668	7/29/19	18:21:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	1	Front to rear	1	Non-Junction	10000
573083	8/7/19	20:09:00	O	Property Damage Only	No Apparent Injury (O)	2	Cloudy	4	Dark-Lighted	1	Dry	1	Front to rear	2	Intersection	7800
575023	8/11/19	15:46:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	1	Clear	1	Daylight	1	Dry	3	Angle	2	Intersection	7800
607599	6/2/19	18:34:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Clear	1	Daylight	1	Dry	3	Angle	2	Intersection	7800
610058	11/1/19	19:09:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	4	Dark-Lighted	1	Dry	3	Angle	2	Intersection	7800
626380	12/16/19	15:27:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	1	Clear	1	Daylight	1	Dry	1	Front to rear	1	Non-Junction	7800
638281	1/8/20	14:12:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	4	Sideswipe, sam	8	Driveway Access	7400
669114	3/6/20	17:52:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	4	Rain	4	Dark-Lighted	2	Wet	1	Front to rear	97	Other	9700
714393	6/10/20	16:08:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Clear	1	Daylight	1	Dry	97	Other	2	Intersection	7400
717765	9/4/20	19:40:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	4	Dark-Lighted	1	Dry	1	Front to rear	1	Non-Junction	9700
735069	10/24/20	15:09:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	1	Front to rear	2	Intersection	7400
859467	10/2/21	8:25:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	3	Angle	2	Intersection	
869419	10/9/21	14:24:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	4	Sideswipe, sam	2	Intersection	
927321	4/7/22	16:54:00	O	Property Damage Only	No Apparent Injury (O)	4	Rain	1	Daylight	2	Wet	1	Front to rear	2	Intersection	7500
961310	8/3/22	16:34:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	1	Front to rear	11	Through Roadway	9800
981287	10/11/22	14:12:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	1	Clear	1	Daylight	1	Dry	1	Front to rear	1	Non-Junction	7500
1011992	1/7/23	21:16:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	4	Dark-Lighted	1	Dry	3	Angle	2	Intersection	
1029824	3/7/23	16:44:00	O	Property Damage Only	No Apparent Injury (O)	2	Cloudy	1	Daylight	1	Dry	3	Angle	2	Intersection	
1063638	6/19/23	15:49:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	1	Front to rear	97	Other	
1063759	6/28/23	12:56:00	O	Property Damage Only	No Apparent Injury (O)	1	Clear	1	Daylight	1	Dry	1	Front to rear	3	Intersection-Related	
410235	4/14/18	11:29:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	2	Intersection	9800
433265	5/30/18	12:47:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9800
444378	8/5/18	17:01:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9800
446361	7/31/18	14:18:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	2	Intersection	9800
447715	8/2/18	16:03:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	2	Intersection	9800
457768	8/18/18	18:11:00	O	Property Damage Only	No Apparent Injury (O)	4	Sideswipe, same direction	4	Rain	1	Daylight	2	Wet	1	Non-Junction	9800
467556	10/11/18	18:08:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	2	Cloudy	4	Dark-Lighted	2	Wet	9	Driveway Access-Related	9800
475146	10/20/18	15:49:00	O	Property Damage Only	No Apparent Injury (O)	4	Sideswipe, same direction	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9800
491692	10/19/18	16:52:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9800
496438	12/13/18	18:30:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	1	Front to rear	1	Clear	4	Dark-Lighted	1	Dry	1	Non-Junction	9800
527108	3/7/19	13:25:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	3	Angle	1	Clear	1	Daylight	1	Dry	11	Through Roadway	10000
572274	6/25/19	13:31:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	4	Rain	1	Daylight	2	Wet	11	Through Roadway	10000
572560	5/25/19	9:07:00	O	Property Damage Only	No Apparent Injury (O)	4	Sideswipe, same direction	1	Clear	1	Daylight	1	Dry	2	Intersection	10000
576802	7/3/19	10:35:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	10000
590104	9/15/19	16:35:00	O	Property Damage Only	No Apparent Injury (O)	99	Unknown	1	Clear	1	Daylight	1	Dry	97	Other	10000
603966	8/29/19	13:49:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	1	Daylight	1	Dry	1	Non-Junction	
627397	12/20/19	16:16:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	97	Other	10000
630665	12/23/19	17:30:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	3	Angle	1	Clear	4	Dark-Lighted	1	Dry	2	Intersection	10000
649681	2/1/20	11:20:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9700
669102	1/15/20	12:04:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9700
678813	5/7/20	16:47:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9700
694677	7/4/20	6:07:00	O	Property Damage Only	No Apparent Injury (O)	4	Sideswipe, same direction	2	Cloudy	1	Daylight	1	Dry	8	Driveway Access	9700
731154	10/14/20	15:40:00	O	Property Damage Only	No Apparent Injury (O)	99	Unknown	1	Clear	1	Daylight	1	Dry	97	Other	9700
732812	8/25/20	19:02:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	2	Wet	1	Non-Junction	9000
758624	11/13/20	17:04:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	4	Rain	4	Dark-Lighted	2	Wet	1	Non-Junction	9700

840562	7/29/21	9:53:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	2	Intersection	9800
881520	12/16/21	14:59:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	1	Daylight	1	Dry	8	Driveway Access	
903817	1/30/22	20:33:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	4	Dark-Lighted	2	Wet	11	Through Roadway	9800
917613	2/10/22	16:50:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Serious Injury (A)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	2	Intersection	9800
927320	4/6/22	19:50:00	O	Property Damage Only	No Apparent Injury (O)	2	Front to front	1	Clear	4	Dark-Lighted	1	Dry	97	Other	9800
940783	6/5/22	18:17:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	1	Daylight	1	Dry	10	Shared-Use Path or Trail	9800
947259	6/12/22	10:21:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Front to rear	1	Clear	1	Daylight	1	Dry	17	Other Location Not Listed Above Within an Interchange Area (median, shoulder and roadside)	9800
950405	7/8/22	22:03:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	4	Dark-Lighted	1	Dry	97	Other	9800
958033	7/31/22	15:30:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	3	Angle	1	Clear	1	Daylight	1	Dry	9	Driveway Access-Related	9800
958076	7/19/22	12:48:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9800
963035	7/19/22	12:55:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9800
976540	4/1/22	8:19:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9800
990888	11/6/22	11:38:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9800
1018836	1/6/23	17:36:00	A	Injury of any type (Serious, Minor, Possible)	Possible Injury (C)	1	Front to rear	1	Clear	4	Dark-Lighted	2	Wet	2	Intersection	
1038376	4/8/23	16:11:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	
1048916	5/13/23	9:35:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	1	Daylight	1	Dry	2	Intersection	
1079095	8/15/23	9:32:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Serious Injury (A)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	2	Intersection	
717761	8/20/20	29:28.0	O	Property Damage Only	No Apparent Injury (O)	2	Front to rear	1	Clear	4	Dark-Lighted	1	Dry	1	Non-Junction	9000
883198	11/19/21	34:21.0	O	Property Damage Only	No Apparent Injury (O)	2	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	
881520	12/16/21	22:38.0	O	Property Damage Only	No Apparent Injury (O)	2	Angle	1	Clear	1	Daylight	1	Dry	8	Driveway Access	
976540	4/1/22	47:30.0	O	Property Damage Only	No Apparent Injury (O)	2	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	9800
948301	6/2/22	00:49.0	O	Property Damage Only	No Apparent Injury (O)	1	Not Applicable	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9800
940783	6/5/22	18:27.0	O	Property Damage Only	No Apparent Injury (O)	2	Angle	1	Clear	1	Daylight	1	Dry	10	Shared-Use Path or Trail	9800
944685	6/14/22	38:31.0	O	Property Damage Only	No Apparent Injury (O)	2	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9100
958076	7/19/22	49:49.0	O	Property Damage Only	No Apparent Injury (O)	2	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9800
1038376	4/8/23	08:33.0	O	Property Damage Only	No Apparent Injury (O)	2	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	
430593	5/24/18	13:36:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Serious Injury (A)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	8	Driveway Access	8200
442341	6/22/18	15:18:00	B	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	3	Angle	1	Clear	1	Daylight	1	Dry	97	Other	8200
442812	7/30/18	17:18:00	B	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8200
453021	8/14/18	11:06:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8200
503890	1/11/19	16:49:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
523459	3/8/19	19:07:00	O	Property Damage Only	No Apparent Injury (O)	88	Not Applicable	1	Clear	4	Dark-Lighted	1	Dry	1	Non-Junction	8300
547439	5/2/19	17:53:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
572561	7/7/19	15:39:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
763559	7/13/19	19:12:00	O	Property Damage Only	No Apparent Injury (O)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
566488	6/1/19	13:41:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
566820	7/14/19	9:13:00	O	Property Damage Only	No Apparent Injury (O)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	13	On a Bridge	8300
612528	8/23/19	8:55:00	O	Property Damage Only	No Apparent Injury (O)	2	Front to front	4	Rain	1	Daylight	2	Wet	11	Through Roadway	8300
582304	9/21/19	13:18:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	13	On a Bridge	8300
584812	7/13/19	19:37:00	A	Injury of any type (Serious, Minor, Possible)	Suspected Serious Injury (A)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
588728	12/22/19	14:57:00	O	Property Damage Only	No Apparent Injury (O)	88	Not Applicable	1	Clear	1	Daylight	1	Dry	1	Non-Junction	8300
638280	6/7/19	22:08:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	4	Dark-Lighted	1	Dry	1	Non-Junction	8300
660557	2/14/20	15:14:00	B	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	3	Angle	1	Clear	1	Daylight	1	Dry	8	Driveway Access	9000
732812	8/20/20	20:43:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	4	Dark-Lighted	1	Dry	1	Non-Junction	9000
854010	9/26/20	10:50:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	97	Other	7400
898082	9/25/21	13:50:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	9	Driveway Access-Related	
898274	11/19/21	14:29:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	
909182	1/4/22	13:53:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	9	Driveway Access-Related	9100
924048	1/22/22	1:57:00	O	Property Damage Only	No Apparent Injury (O)	88	Not Applicable	1	Clear	6	Dark-Unknown	1	Dry	1	Non-Junction	9100
956773	2/16/22	7:05:00	B	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Front to rear	1	Clear	1	Daylight	1	Dry	3	Intersection-Related	9100
978699	4/1/22	15:54:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9100

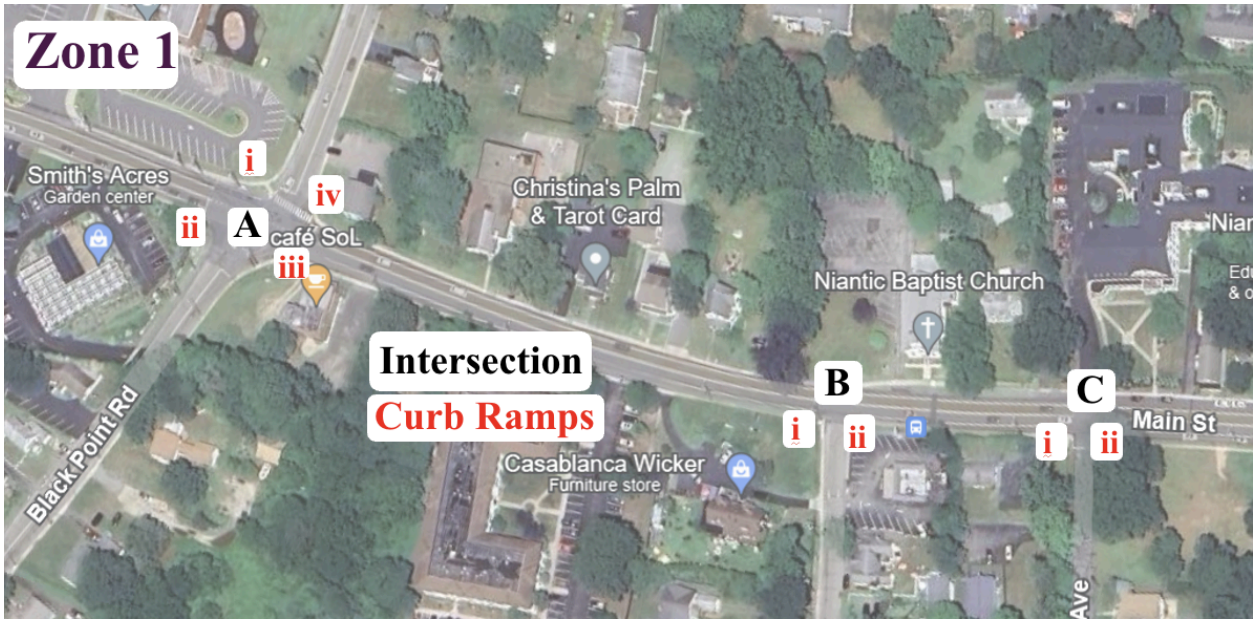
1043135	6/14/22	10:48:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	9100
1090452	7/12/22	11:53:00	B	Injury of any type (Serious, Minor, Possible)	Suspected Minor Injury (B)	1	Front to rear	1	Clear	1	Daylight	1	Dry	3	Intersection-Related	9100
978699	10/3/22	7:49:00	O	Property Damage Only	No Apparent Injury (O)	3	Angle	1	Clear	2	Dawn	1	Dry	3	Intersection-Related	9100
1043135	4/21/23	18:28:00	O	Property Damage Only	No Apparent Injury (O)	1	Front to rear	1	Clear	1	Daylight	1	Dry	11	Through Roadway	
1090451	9/14/23	11:04:00	K	Fatal (Kill)	Fatal Injury (K)	2	Front to front	1	Clear	1	Daylight	1	Dry	13	On a Bridge	

Appendix D

Asset ID	Ramp ID	Curb Ramp Opening Width	Curb Ramp Running Slope	Curb Ramp Cross Slope	Curb Ramp Flare Slope (R)	Curb Ramp Flare Slope (L)	Landing Turning Space Cross Slope	Landing Cross Slope	Detectable Warning Mat Present	Detectable Warning Panel Damage	Water Ponding	Crack Exceeds 1/2 inch Horizontal Gap	Crack Exceeds 1/4 Inch Vertical Gap	Obstructions	Detectable Warning Mat Not Covering Full Width of Ramp	Curb Ramp Flare Prepared Surface (R)	Curb Ramp Flare Prepared Surface (L)	Landing Area	Turning Space Obstruction	Turning Space Obstruction Sloped Ground	Structurally Infeasible	ADA Compliant	Presence of Notable Natural Feature	Compliance Score	OBJECT ID
37227S	156 - 18.43 - A	48	10.5	7.3					No							No	No	No	No		No	Not ADA	No	16	81099
8120	156 - 18.43 - B	48	5.8	0.8			3.1	1	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	34	81074
37337S	156 - 18.43 - C	48	0.4	2.1					Yes	No				No	No	No	No	No	Yes	No	No	Not ADA	No	36	81075
19160	156 - 18.43 - D	48	11.2	5.4					No					No		No	No	No			No	Not ADA	No	16	81073
2057	156 - 18.55 - A	48	0.7	0.2			1.2	1.1	Yes	No				No	No	No	No	Yes	No		No	ADA	No	30	81071
2058	156 - 18.55 - B	48	0.5	1.6			1.1	2.3	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	34	81070
2059	156 - 18.6 - A	48	7.8	0.6			1.3	0.2	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	29	81068
2060	156 - 18.6 - B	48	0.5	1.5			2.1	1.9	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	35	81069
14881	156 - 18.66 - A	48	15.4	0.6			3.6	1.3	No		No	No	Yes	Yes		No	No	Yes	No		No	Not ADA	No	31	81067
37227S	156 - 18.66 - B	36	8.1	2.2	8.8	11.9	3.1	0.5	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No		No	Not ADA	No	32	81065
14883	156 - 18.66 - C	36	8.3	0.8	3.8	7.3	5.3	0.5	Yes	No					No	Yes	Yes	Yes	No		No	Not ADA	No	37	81063
37227N	156 - 18.66 - D	36	7	1.3			2	2.6	Yes	No					No	No	No	Yes	No		No	Not ADA	No	28	81064
14885	156 - 18.66 - E	36	7.3	2.6			1.5	2.6	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	29	81062
14886	156 - 18.66 - F	36	4.6	2			0.5	3.1	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	31	81066
11074	156 - 18.77 - A	60	2.8	3.1			2	2.7	Yes	No	No	No	Yes	Yes	Yes	No	No	Yes	No		No	Not ADA	No	37	83051
11075	156 - 18.77 - B	36	4.3	2			1	2.2	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	31	83050
37227N	156 - 18.77 - C	36	7.4	0.8		9	7.8	0.7	Yes	No	No	Yes	No	Yes	No	No	Yes	Yes	No		No	Not ADA	No	40	83048
37227S	156 - 18.77 - D	36	7.3	0.7			3	2.8	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	28	83049
19161	X	36	3.5	1.1			3.4	3.3	Yes	No				No	No	No	No	Yes	No		No	Not ADA	No	31	83057
37227S	156 - 18.85 - A	36	2.6	3.4	4.2		2.1	4.2	Yes	No	No	No	Yes	Yes	No	Yes	No	Yes	No		No	Not ADA	No	37	83047
8123	156 - 18.85 - B	36	5.3	1.5			5	1.5	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No		No	Not ADA	No	37	83045
37227N	156 - 18.85 - C	36	2.3	0.7			2.1	0.3	Yes	No	No	No	Yes	Yes	No	No	No	Yes	No		No	Not ADA	No	38	83046
37227S	X	36	0.8	1.2		12.2	3.2	0.8	Yes	No	Yes	No	No	Yes	No	No	Yes	Yes	No		No	Not ADA	No	39	82633
37227N	X	36	11	0	11	13.3	9	0	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	No		No	Not ADA	No	35	83044
37227N	X	36	9.4	1.2	11.9		1.9	0.7	Yes	No				No	No	Yes	No	Yes	No		No	Not ADA	No	29	83042
37227S	X	36	10.5	1.2	12.4	12.728	2.8	0.8	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes	No		No	Not ADA	No	34	83043
37227S	156 - 19.01 - A	36	8.8	0.6	11	11.7	11.8	0.2	Yes	No	Yes	No	No	Yes	No	Yes	Yes	No	Yes	Yes					
37227N	156 - 19.01 - B	60	1.1	0.3	4.9	3.6	1.1	0.3	Yes	No	No	No	No	Yes	No	Yes	Yes	No	Yes	No					
37227W	156 - 19.01 - C	48	7	0.6	5.8	7.702	6.3	0.2	Yes	No	No	No	Yes	Yes	No	Yes	Yes	Yes	No						
2095	156 - 19.24 - A	72	10.2	1.2					No					No		No	No	No	Yes	Yes	Yes	Not ADA	No	22	83038
2096	156 - 19.24 - B	60	1.1	3.1			0.8	1.6	Yes	No					No	No	No	No	No		No	Not ADA	No	31	83037
19172	X	48	8	1	10.3	9.3	0.1	0.6	Yes	No	Yes	No	No	Yes	No	Yes	Yes	Yes	No		No	Not ADA	No	44	83036
19173	X	48	4.7	5.6	3.3	11.9	1.3	7.2	Yes	No				No	No	Yes	Yes	Yes	No		No	Not ADA	No	37	83035

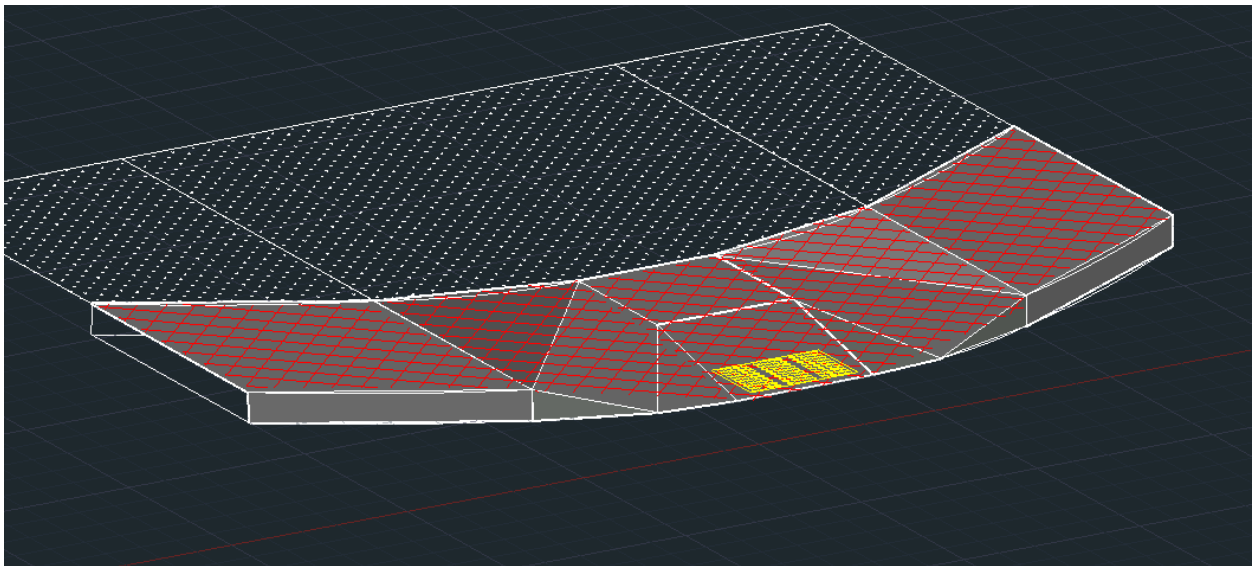
Appendix E
AutoCAD Curb Ramp Designs

Zone 1



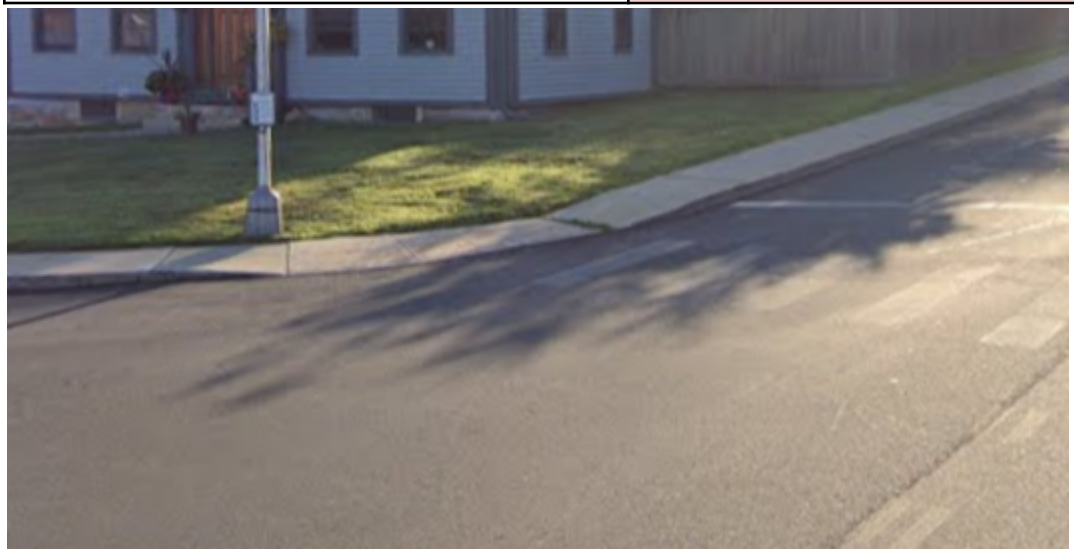
Intersection A - Curb Ramp i

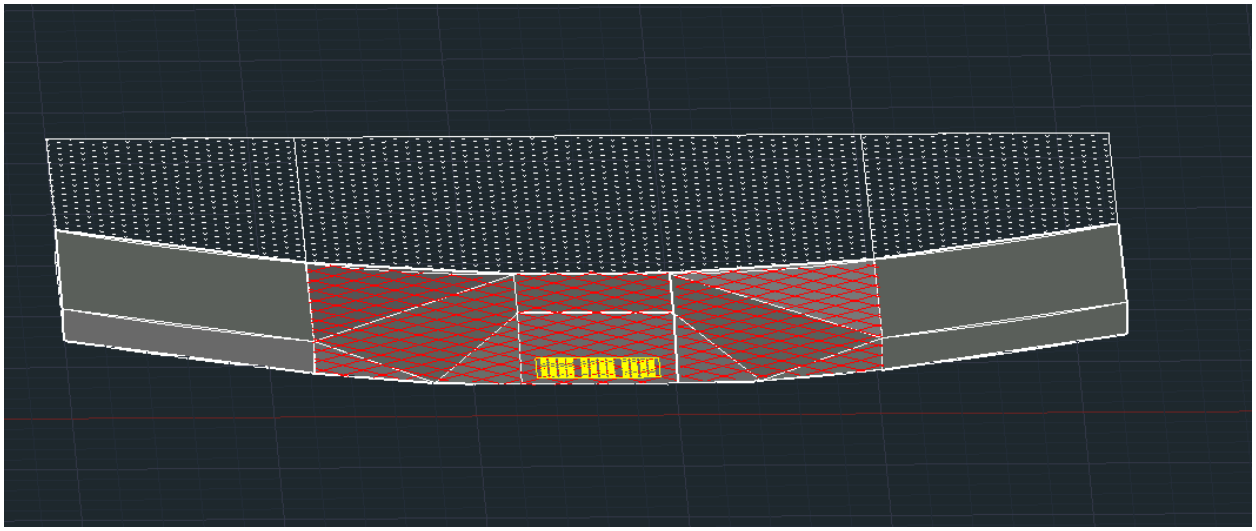
Asset ID	8120
Existing Condition	Good
Running Slope	Compliant
Cross Slope	7.3%
Detectable Mat Present	No
Landing Area	No



Intersection A - Curb Ramp iv

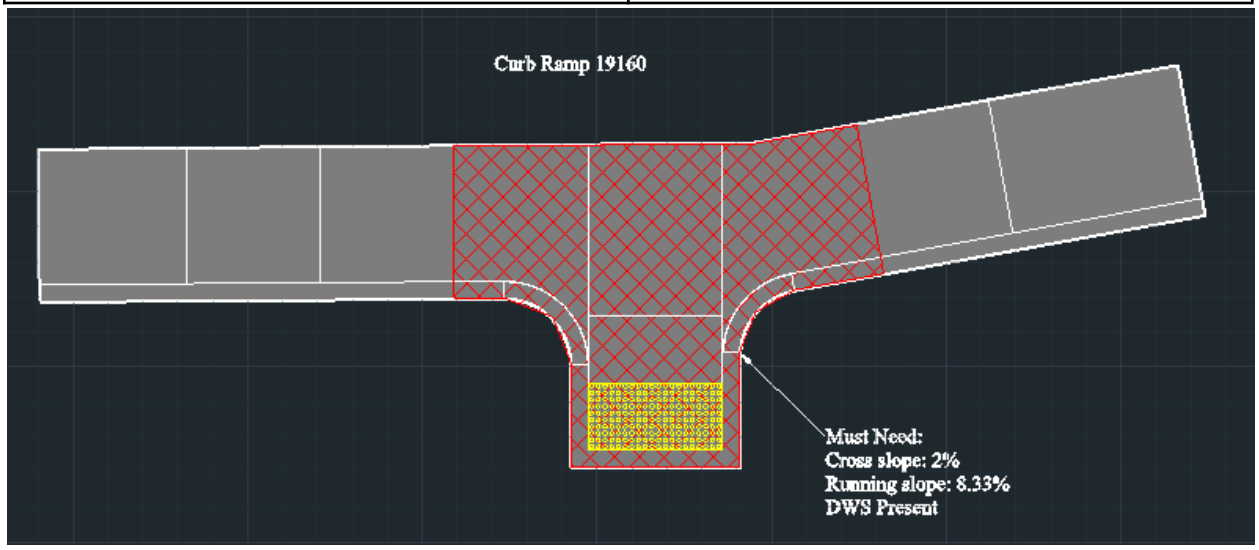
Asset ID	37227N
Condition	Good
Running Slope	11.2%
Cross Slope	5.4%
Detectable Mat Present	No
Landing Area	No





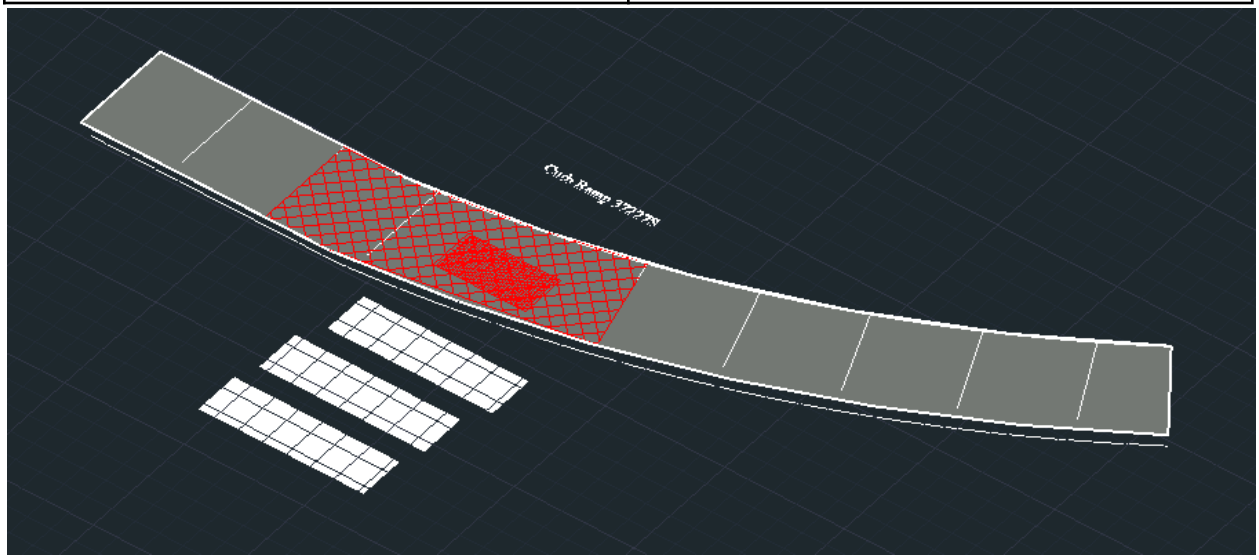
Intersection A - Curb Ramp ii

Asset ID:	19160
Curb Ramp ID:	156 - 18.55 - D
Detectable Mat Present:	Compliant
Running Slope:	7.7%
Cross Slope:	8.6%
Flare Slope:	N/A



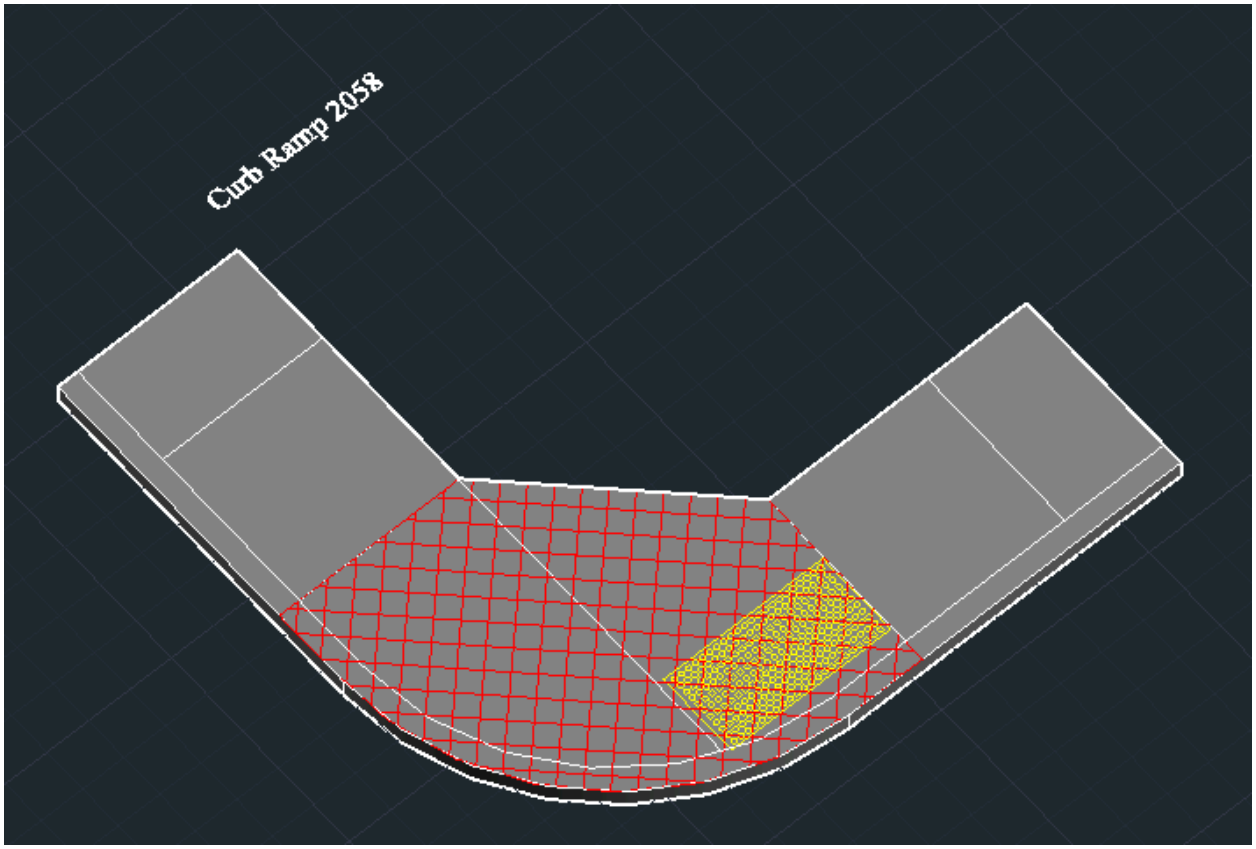
Intersection A - Curb Ramp iii

Asset ID:	37227S
Curb Ramp ID:	156 - 18.43 - A
Detectable Mat Present:	Non-Compliant
Running Slope:	10.5%
Cross Slope:	7.3%
Flare Slope:	N/A



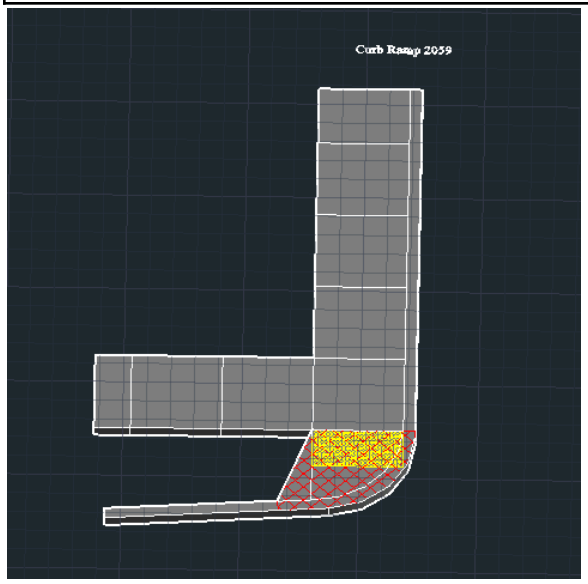
Intersection B - Curb Ramp ii

Asset ID:	2058
Curb Ramp ID:	156 - 18.55 - B
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	1.6%
Flare Slope:	N/A



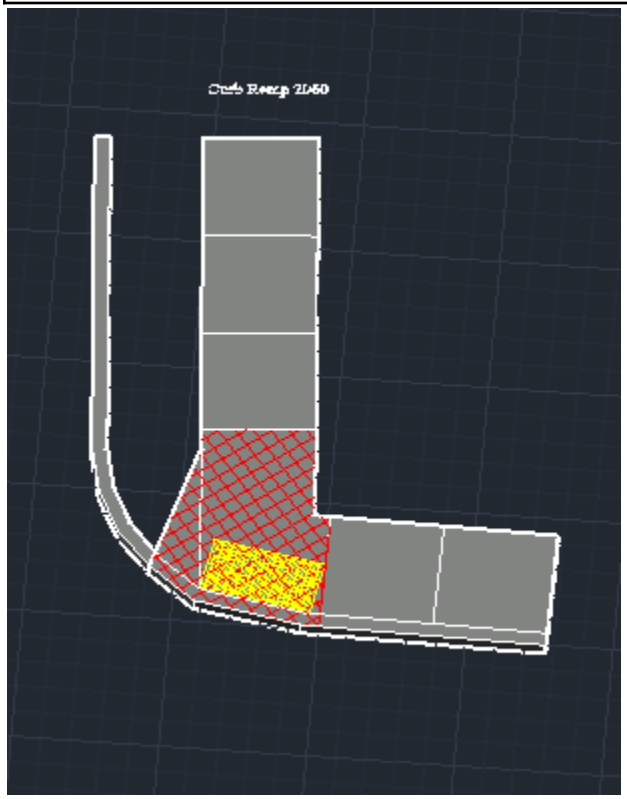
Intersection C - Curb Ramp i

Asset ID:	2059
Curb Ramp ID:	156 - 18.6 - A
Detectable Mat Present:	Compliant
Running Slope:	10.5%
Cross Slope:	Compliant
Flare Slope:	N/A
Detectable Mat Present:	Compliant
Additional: Road Slope Parallel to Ramp	10.9%

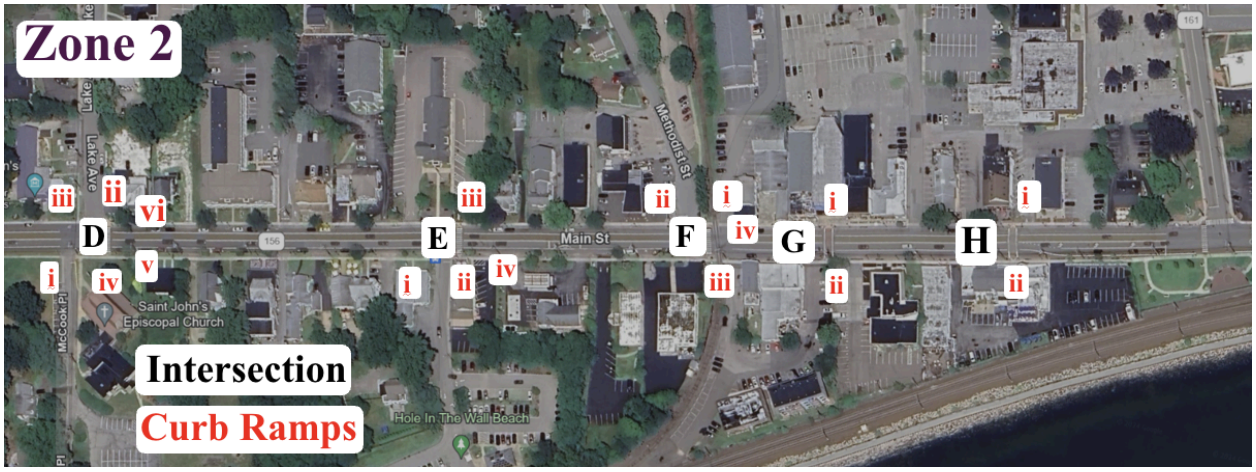


Intersection C - Curb Ramp ii

Asset ID:	2060
Curb Ramp ID:	156 - 18.6 - B
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	2.1%
Flare Slope:	N/A

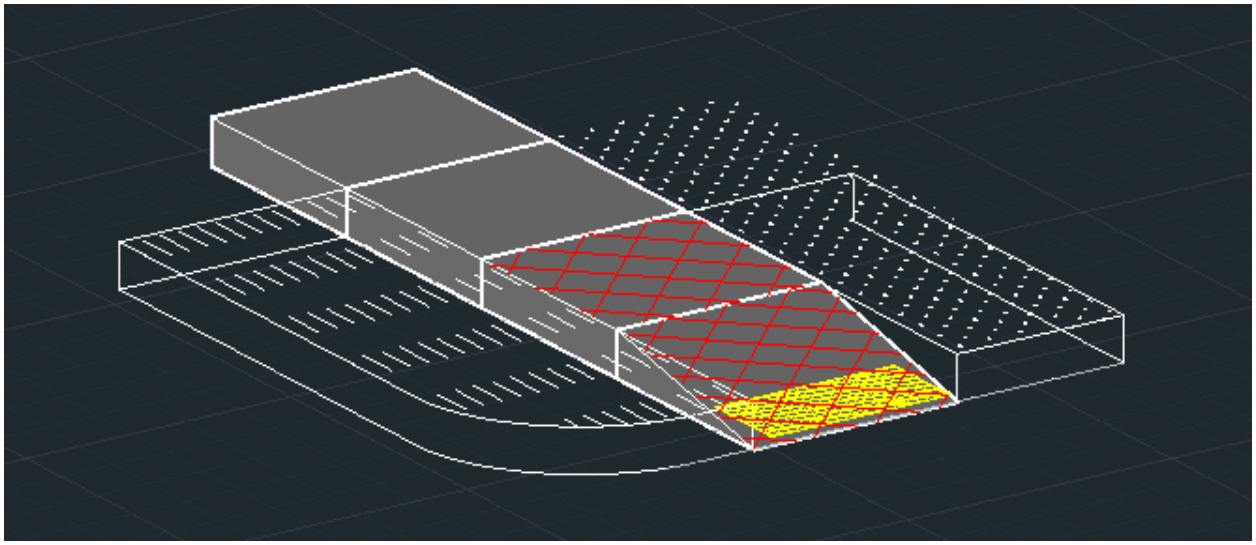


Zone 2


Zone 2
Lake Ave
Methodist St
Main St
Saint John's Episcopal Church
McCook Pl
Hole In The Wall Beach
D
E
F
G
H
iii
ii
vi
v
iv
i
iii
ii
iv
i
ii
iii
i
iv
i
ii
i
ii
Intersection
Curb Ramps

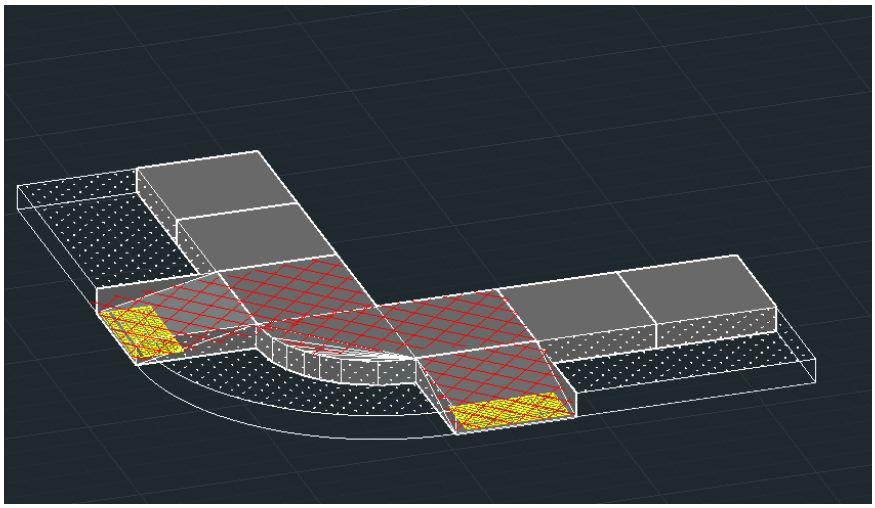
Intersection D - Curb Ramp iii

Asset ID	14885
Condition	Good
Detectable Mat Present	No
Obstructions	Yes
Landing Cross Slope	2.6%
Landing Turning Space Cross Slope	2.6%



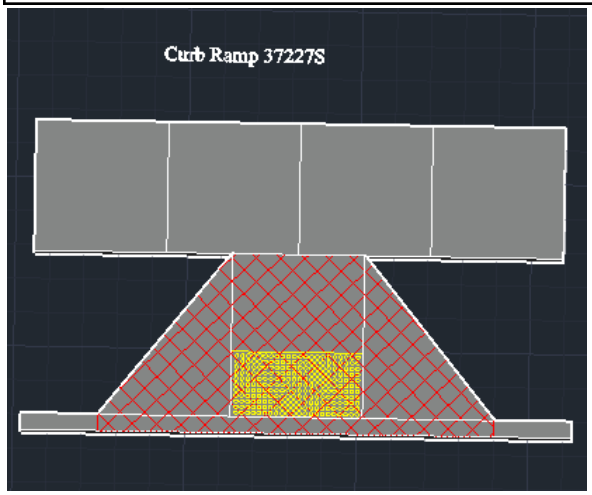
Intersection D - Curb Ramp ii and vi

Asset ID	14883
Condition	New
Detectable Mat Present	Yes
Obstructions	Yes
Landing Turning Space Cross Slope	5.3%
Landing Cross Slope	2.6%



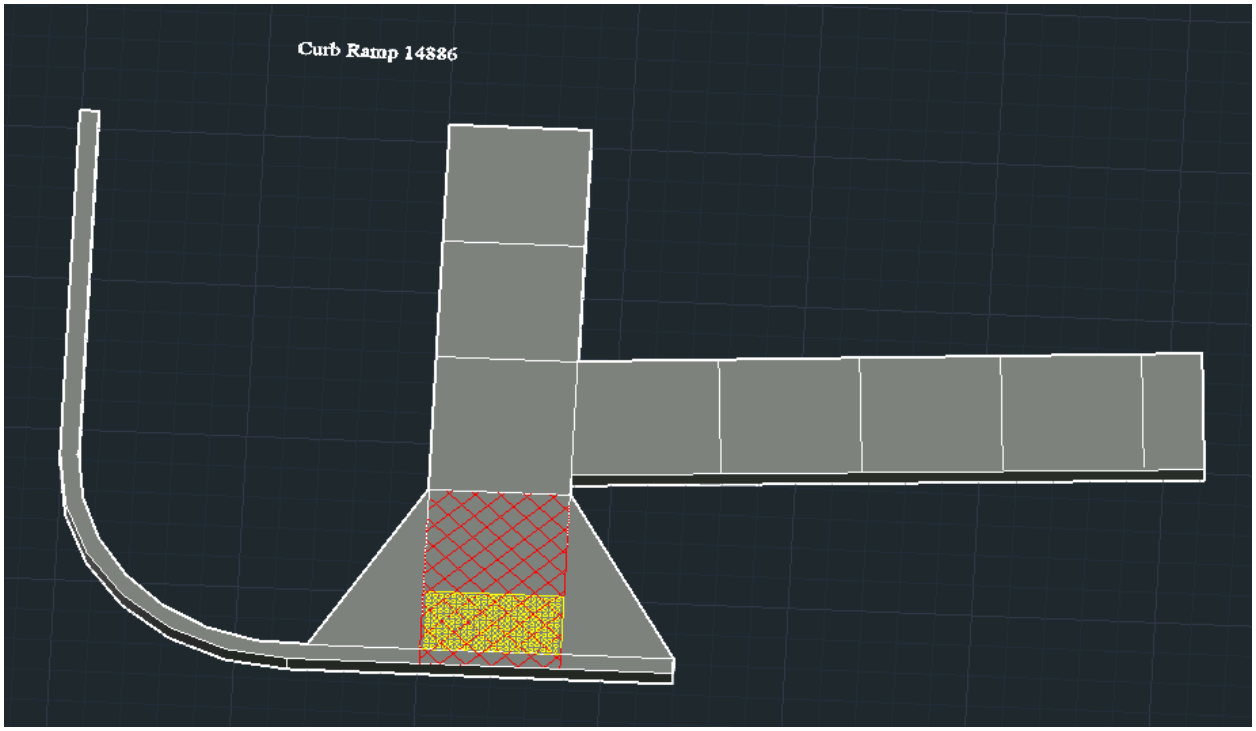
Intersection D - Curb Ramp v

Asset ID:	37227S
Curb Ramp ID:	156 - 18.66 - B
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	2.2%
Landing Turning Space Cross Slope:	3.1%
Flare Slope (L):	11.9%



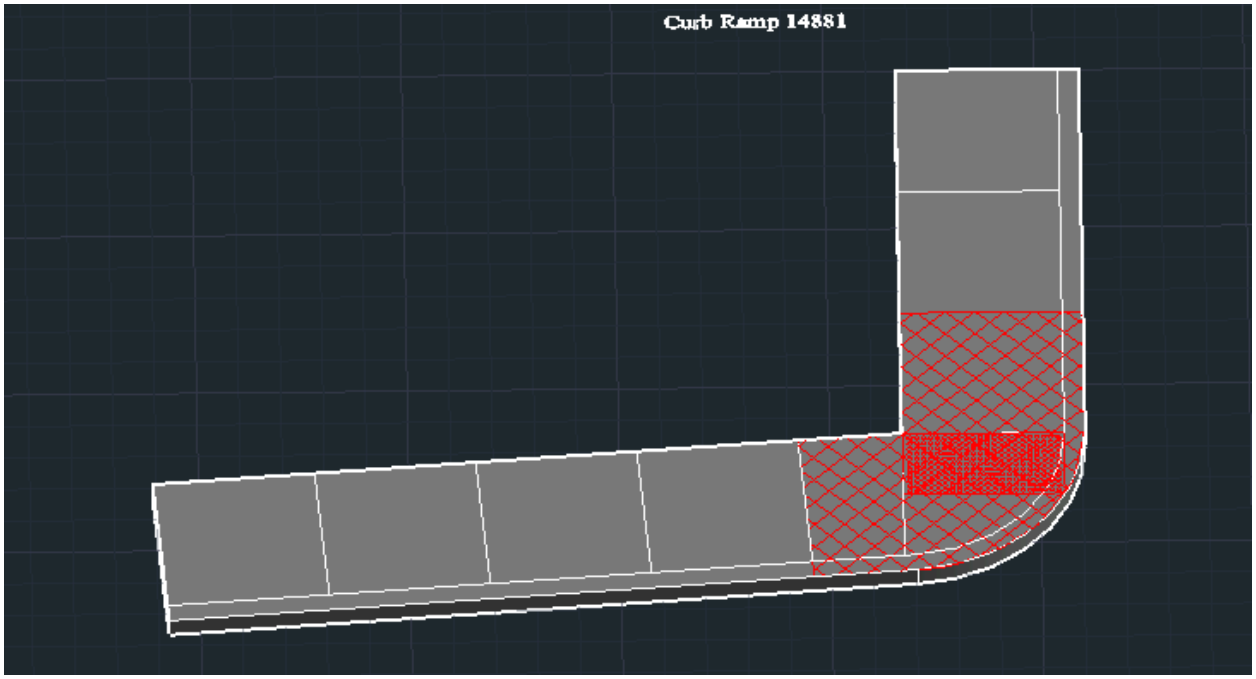
Intersection D - Curb Ramp iv

Asset ID	14886
Curb Ramp ID:	156 - 18.66 - F
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	Compliant
Landing Cross Slope:	3.1%



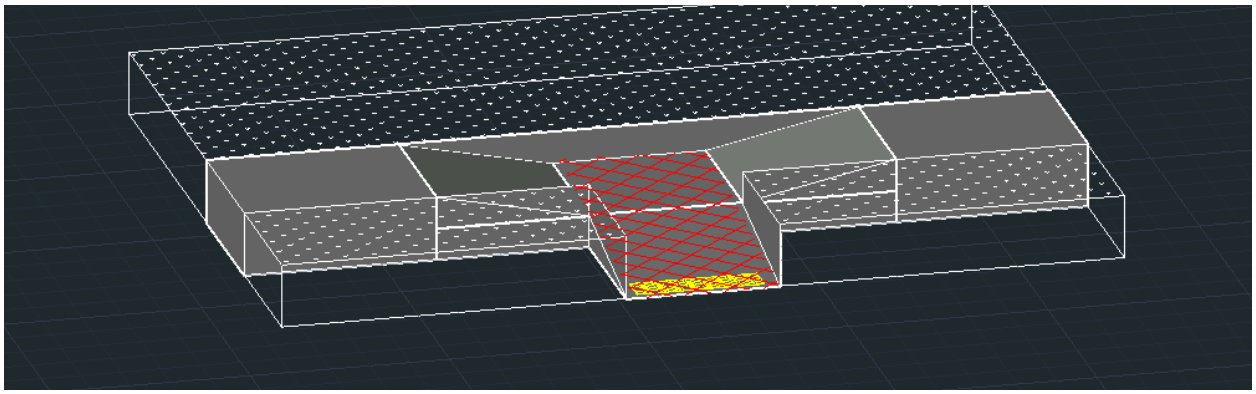
Intersection D - Curb Ramp i

Asset ID:	14881
Curb Ramp ID:	156 - 18.66 - A
Detectable Mat Present:	Non-Compliant
Running Slope:	15.4%
Cross Slope:	Compliant
Flare Slope:	N/A



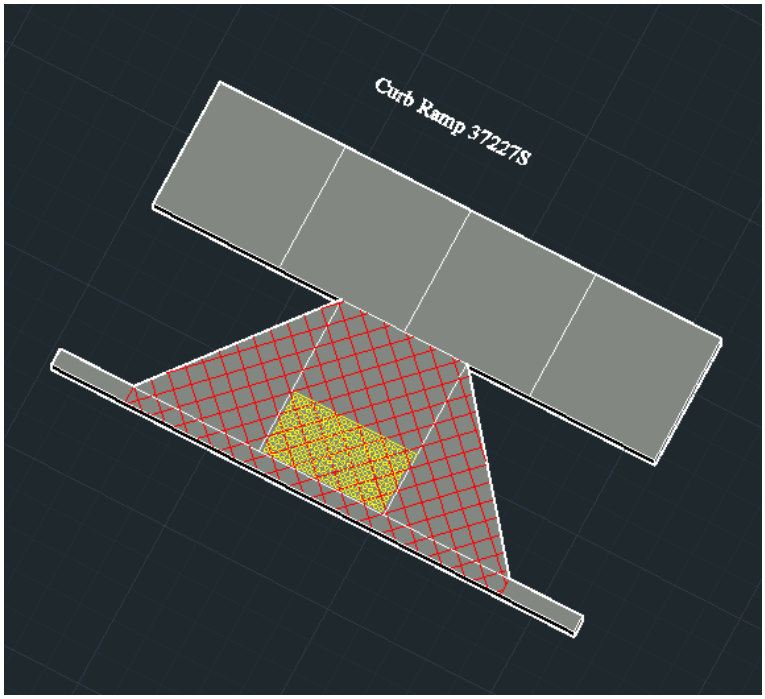
Intersection E - Curb Ramp iii

Asset ID:	37227N
Condition:	New
Detectable Mat Present	Yes
Obstructions:	Yes
Curb Ramp Flare Slope:	Non-compliant



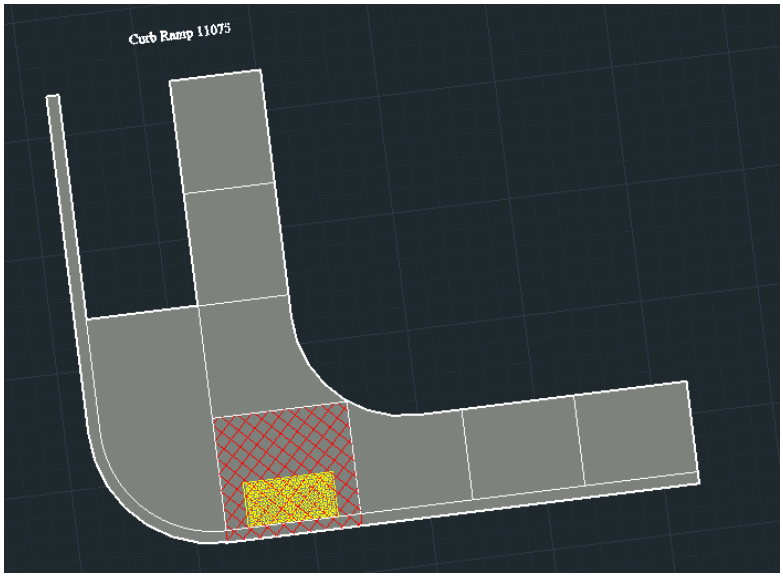
Intersection E - Curb Ramp iv

Asset ID:	37227S
Curb Ramp ID:	156 - 18.77 - D
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Landing Turning Space Cross Slope:	3.0%
Landing Cross Slope	2.8%



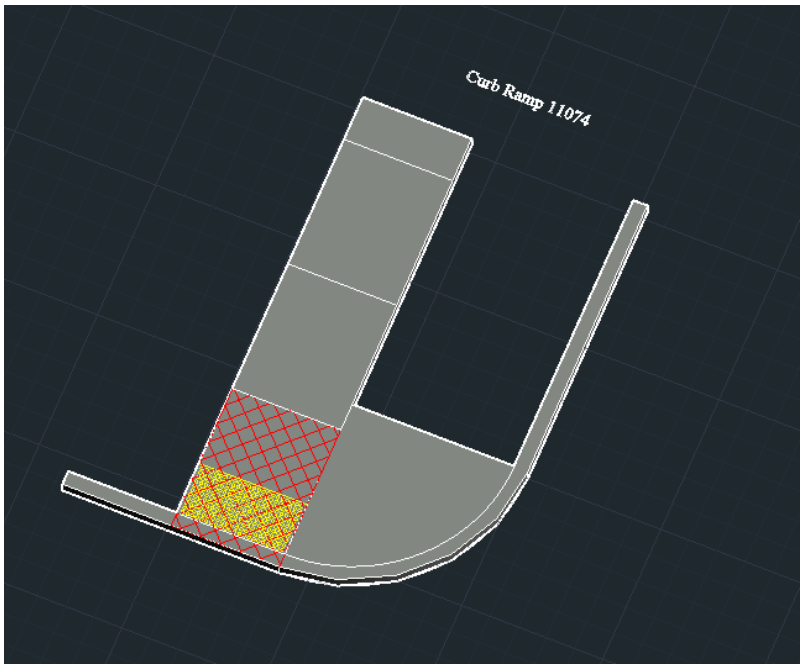
Intersection E - Curb Ramp ii

Asset ID:	11075
Curb Ramp ID:	156 - 18.77 - B
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	Compliant
Landing Cross Slope	2.2%



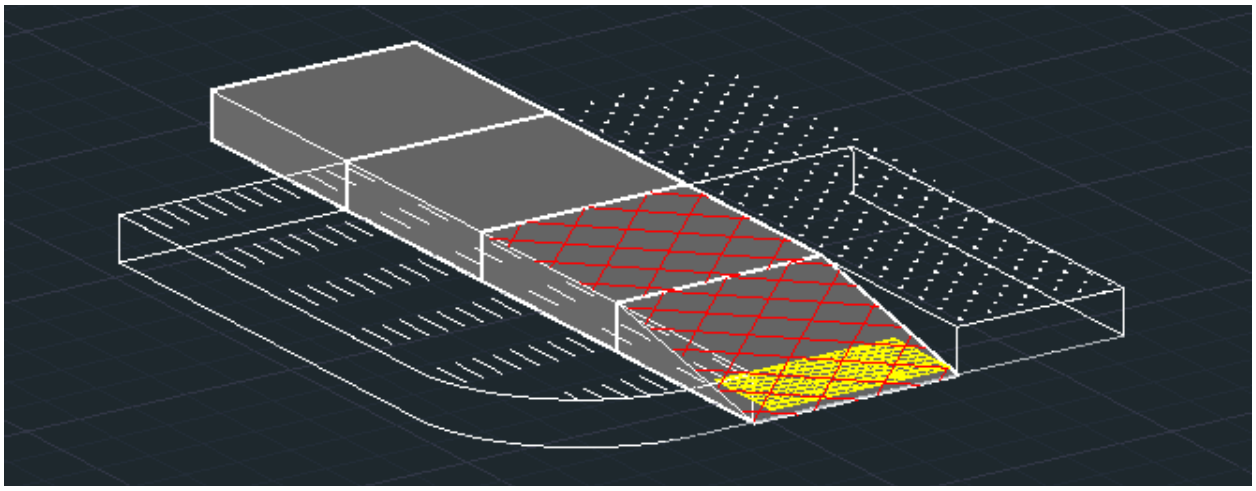
Intersection E - Curb Ramp i

Asset ID:	11074
Curb Ramp ID:	156 - 18.77 - A
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	3.1%
Landing Cross Slope	2.7%



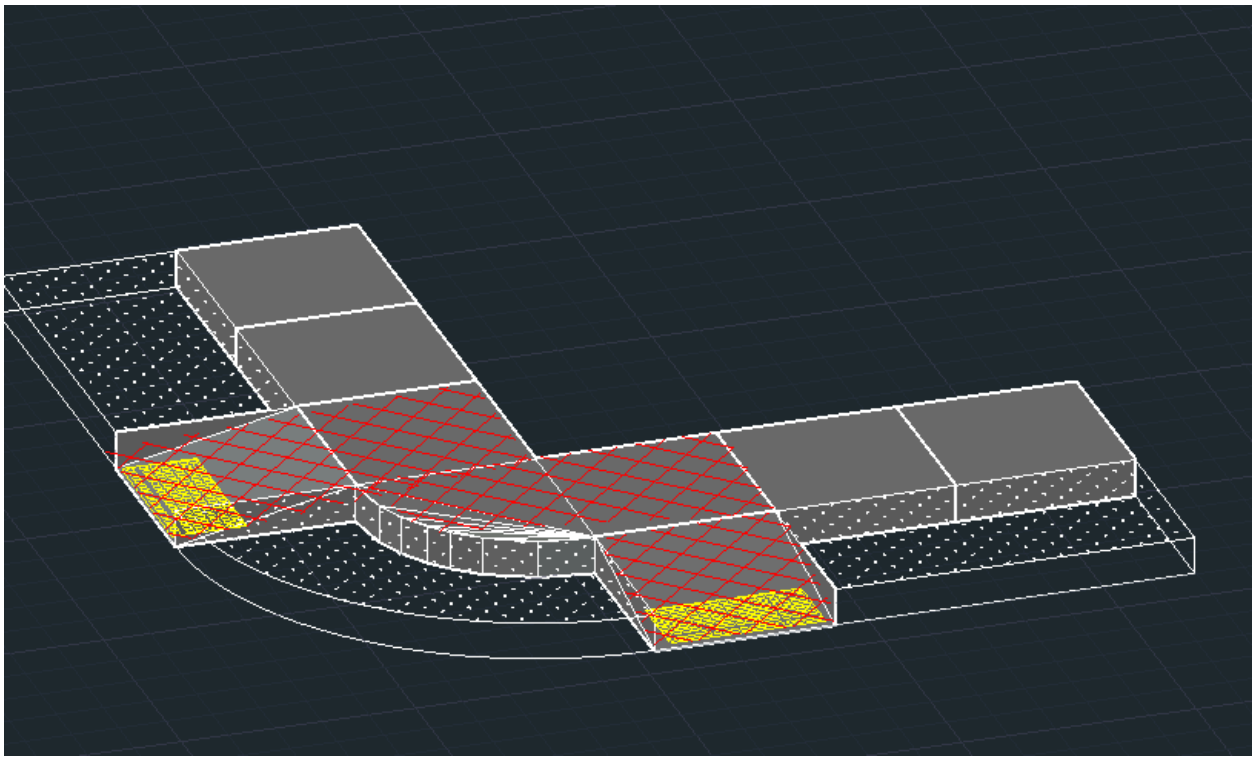
Intersection F - Curb Ramp ii

Asset ID:	19161
Condition:	New
Detectable Mat Present	Yes
Curb Ramp Cross Slope:	3.4%
Landing Turning Space Cross Slope:	2.1%
Landing Cross Slope:	4.2%



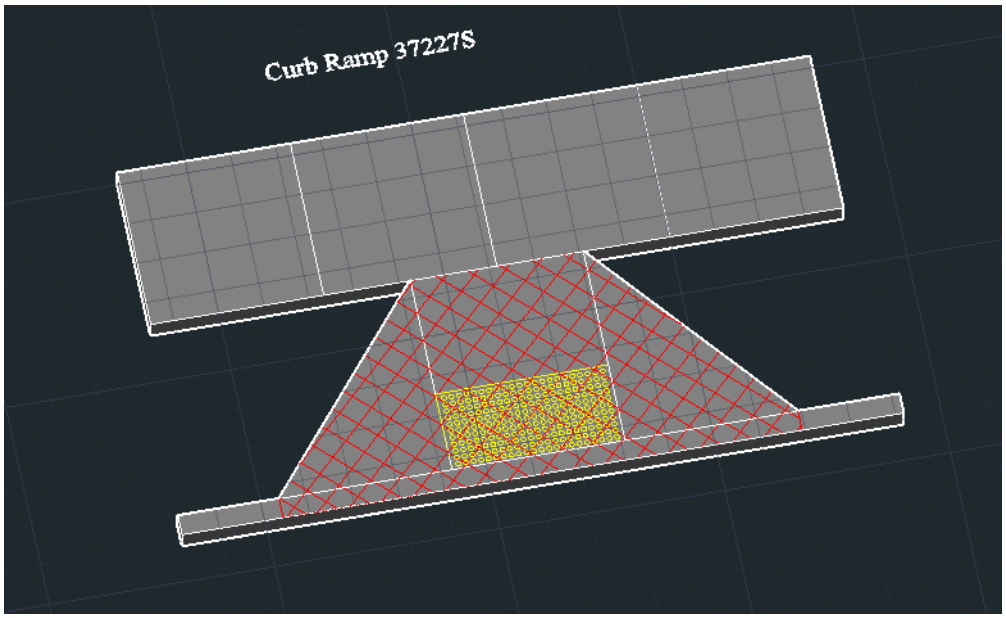
Intersection F - Curb Ramp i and iv

Asset ID:	8123 & 37227N
Condition:	New
Detectable Mat Present:	Yes
Landing Turning Space Cross Slope:	3.4%
Landing Slope:	3.3%



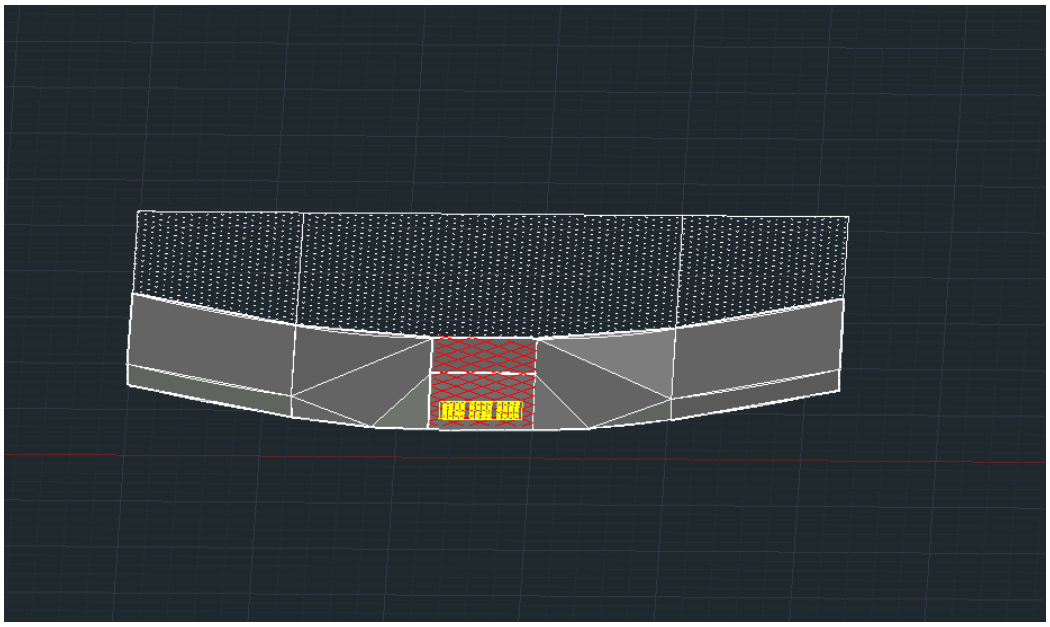
Intersection F - Curb Ramp iii

Asset ID:	37227S
Curb Ramp ID:	156 - 18.85 - A
Detectable Mat Present:	Compliant
Running Slope:	Compliant
Cross Slope:	3.4%
Landing Cross Slope	4.2%



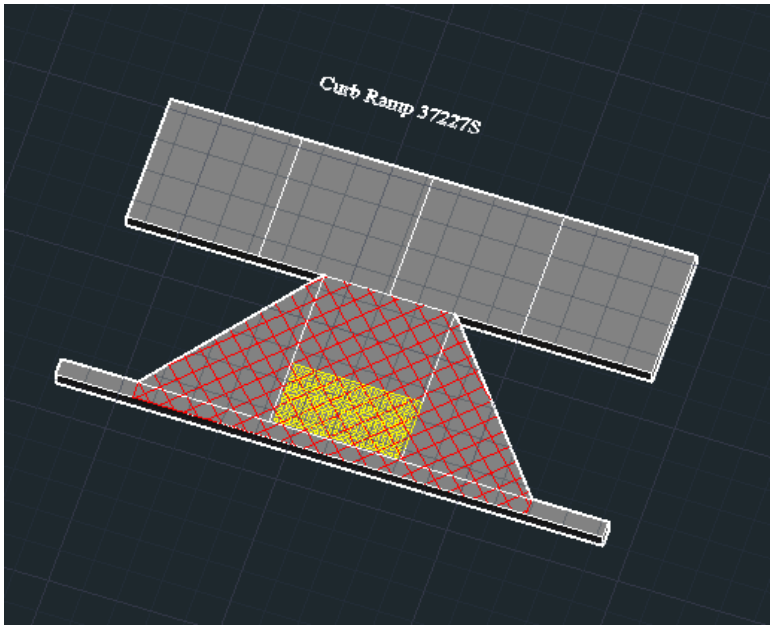
Intersection G - Curb Ramp i

Asset ID:	37227N
Condition:	N/A
Curb Ramp Running Slope:	11%
Curb Ramp Flare Slope (Right):	11%
Curb Ramp Flare Slope (Left):	13.3%
Water Ponding:	Yes



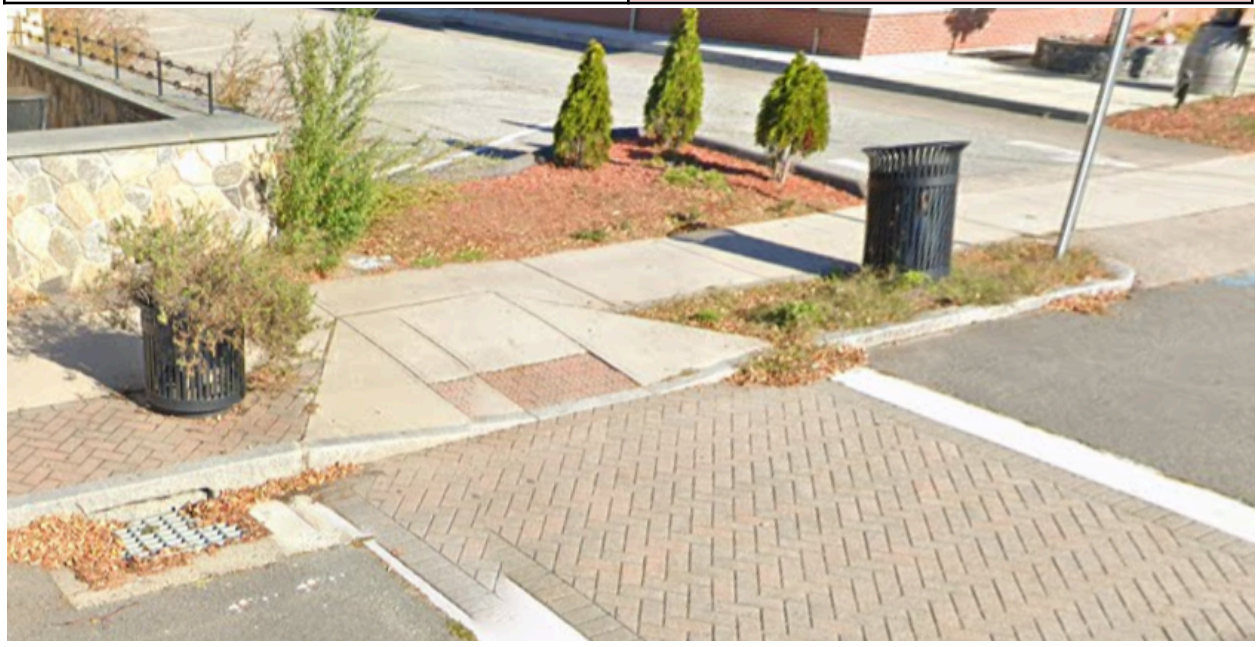
Intersection G - Curb Ramp i

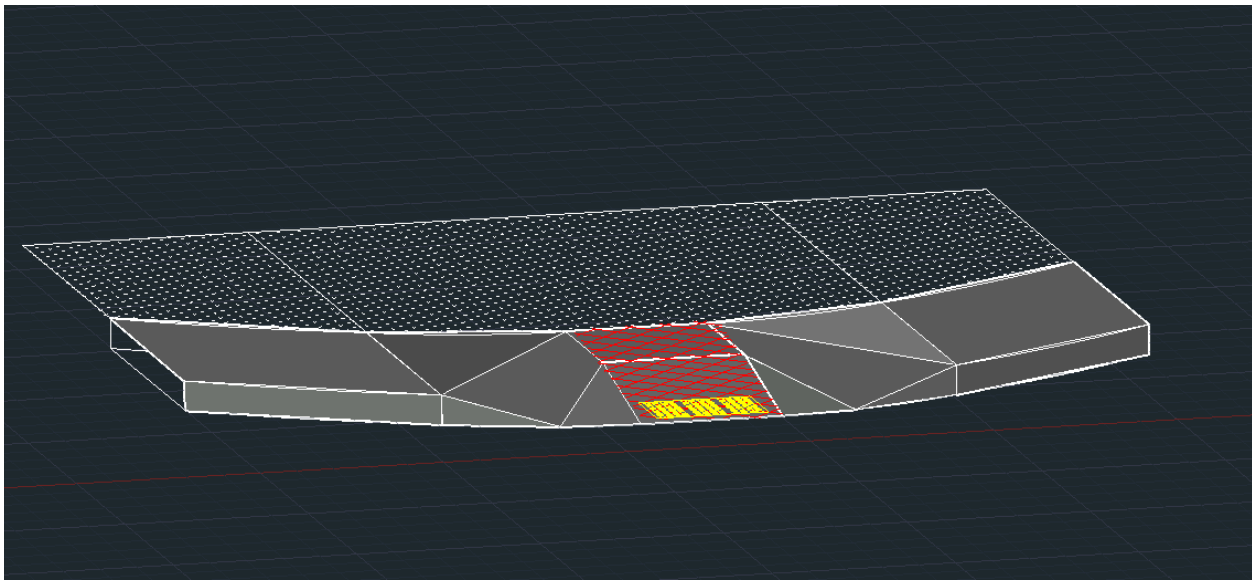
Asset ID:	37227S
Condition:	N/A
Detectable Mat Present:	Yes
Curb Ramp Flare Slope (Left):	12.2%
Water Ponding:	Yes%
Landing Turning Space Cross Slope:	3.2%



Intersection H - Curb Ramp i

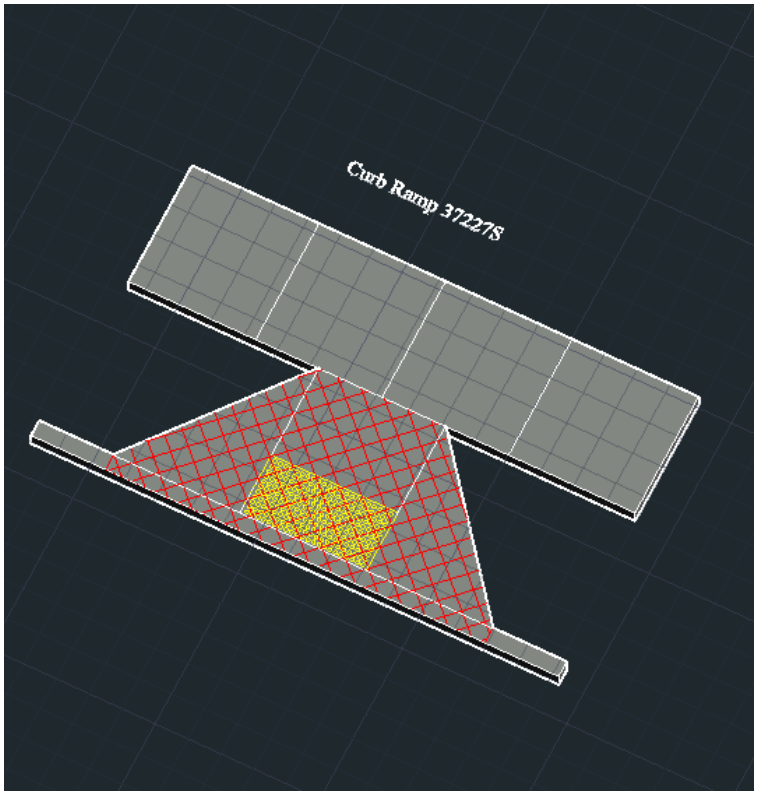
Asset ID:	37227N
Condition:	N/A
Detectable Mat Present:	Yes
Obstructures:	No
Curb Ramp Running Slope:	9.4%
Curb Ramp Flare Slope (Right):	11.9%



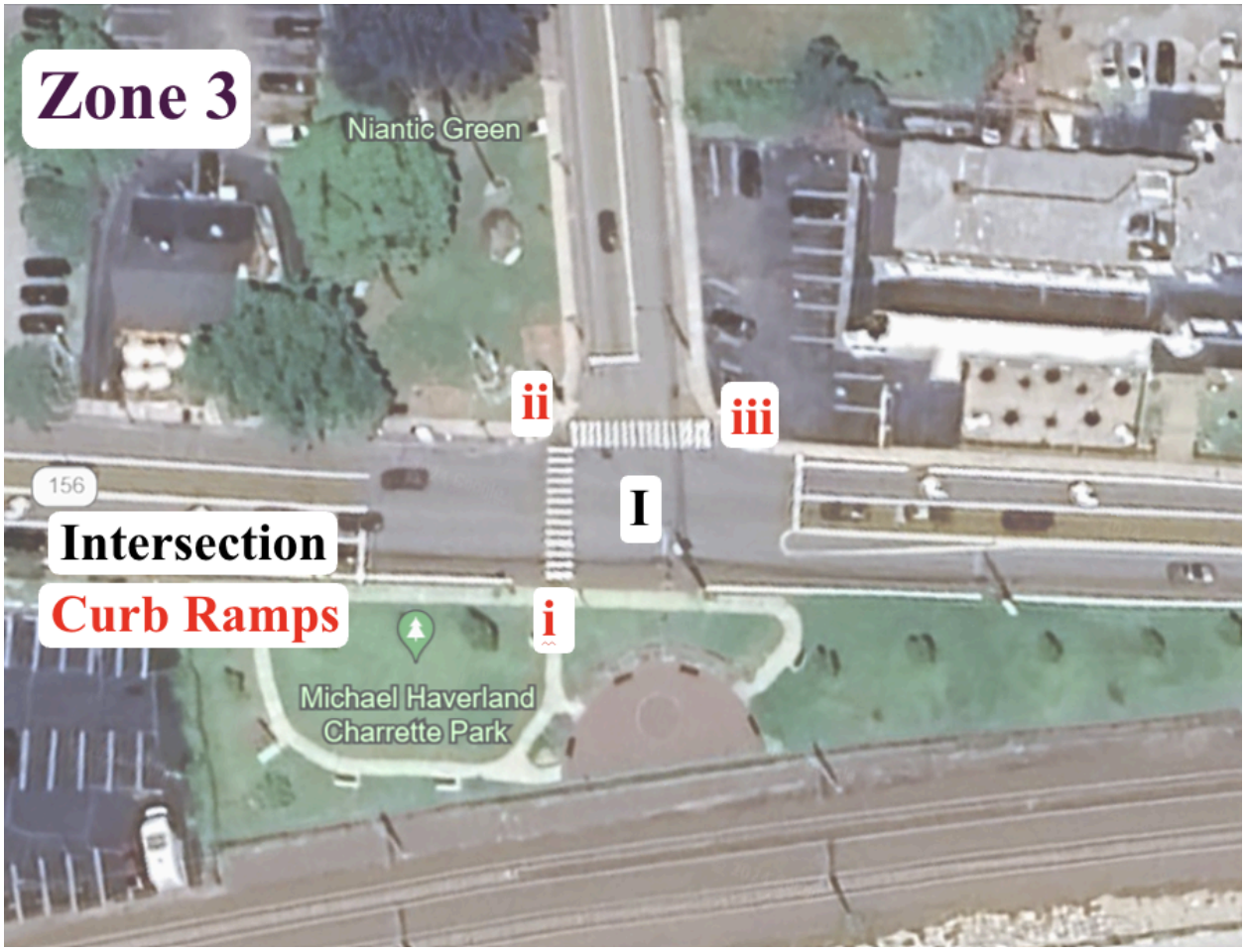


Intersection H - Curb Ramp ii

Asset ID:	37227S
Condition:	N/A
Curb Ramp Running Slope:	10.5%
Curb Ramp Flare Slope (R):	12.4%
Curb Ramp Flare Slope (L):	12.728%
Landing Turning Space Cross Slope:	2.8%
Water Ponding:	Yes

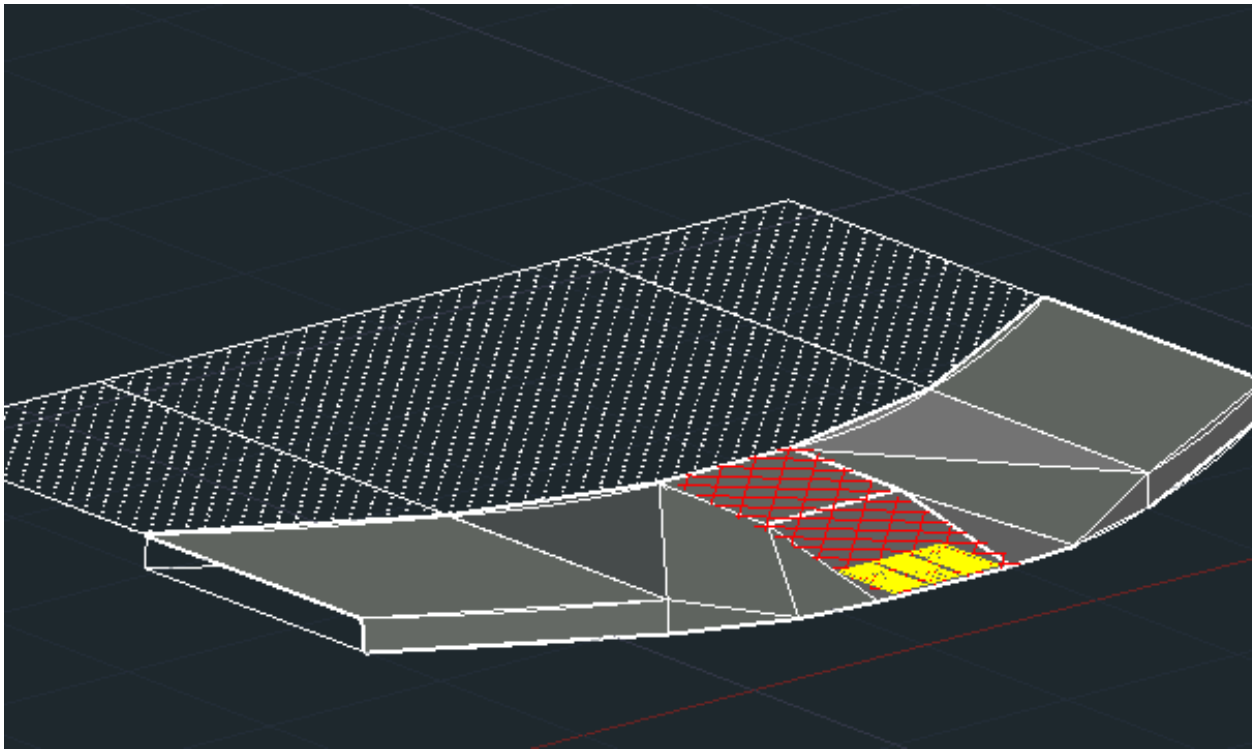


Zone 3


Zone 3
Niantic Green
ii
iii
156
I
Intersection
Curb Ramps
i
Michael Haverland
Charrette Park

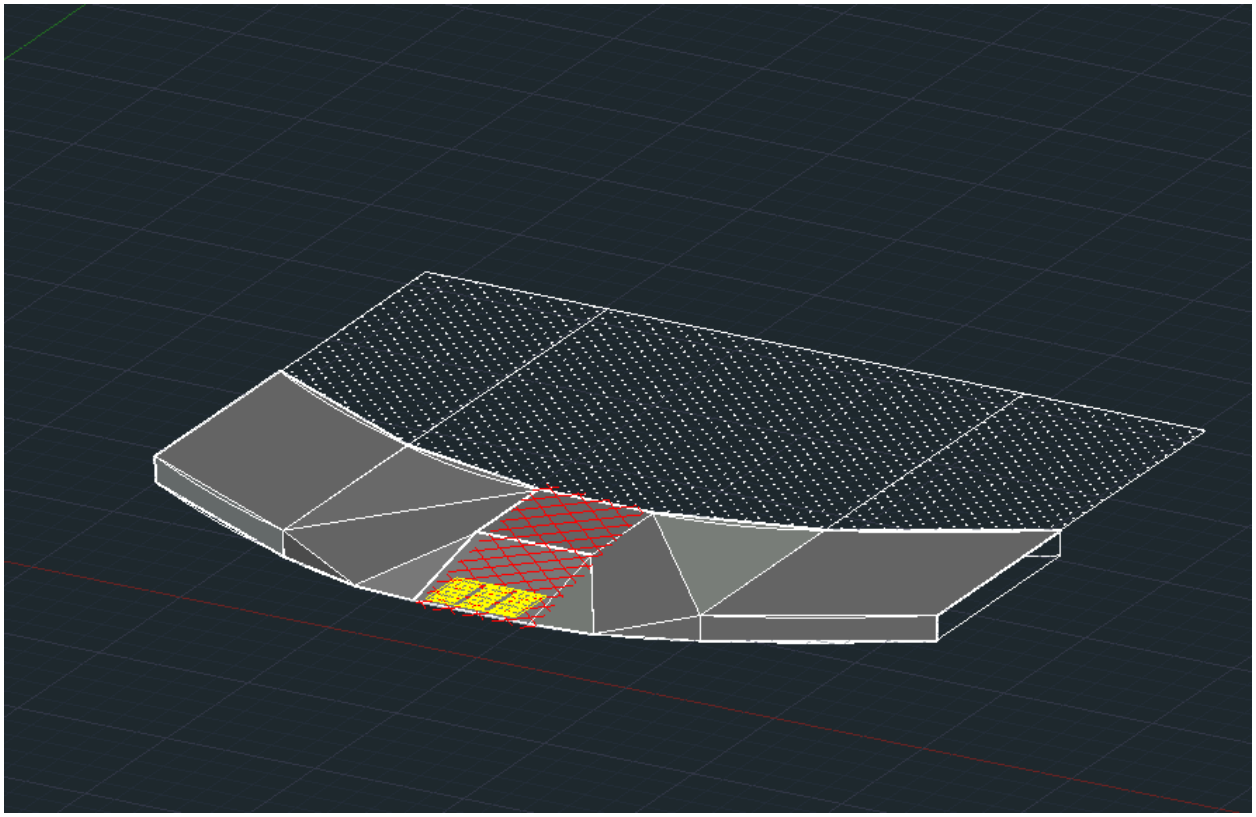
Intersection I - Curb Ramp ii

Asset ID:	37227W
Condition	New
Detectable Mat Present:	Yes
Obstructions:	Yes



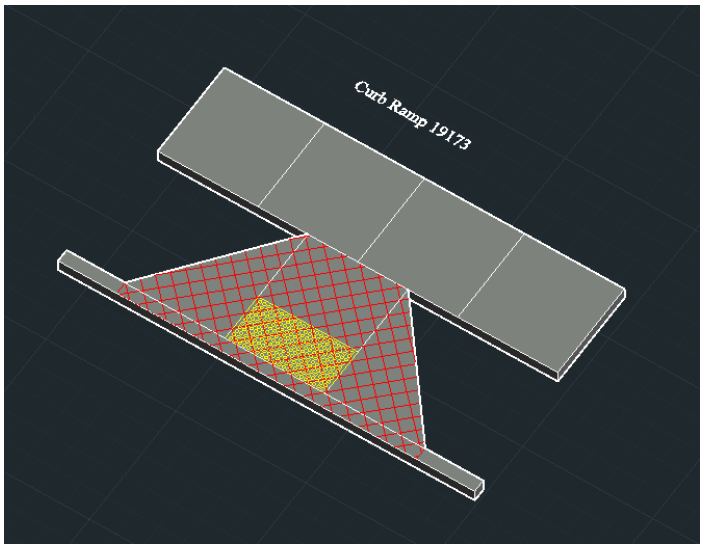
Intersection I - Curb Ramp iii

Asset ID:	37227N
Condition	Good
Obstructures	Yes
Landing Turning Space Cross Slope:	6.3%
Detectable Mat Present:	Yes



Intersection I - Curb Ramp i

Asset ID:	37227S
Curb Ramp ID:	156 - 19.01 - A
Condition:	New
Detectable Mat Present:	Compliant
Curb Ramp Running Slope:	8.8%
Curb Ramp Flare Slope (R):	11%
Curb Ramp Flare Slope (L):	11.7%
Landing Turning Space Cross Slope:	11.8%
Water Ponding:	Yes

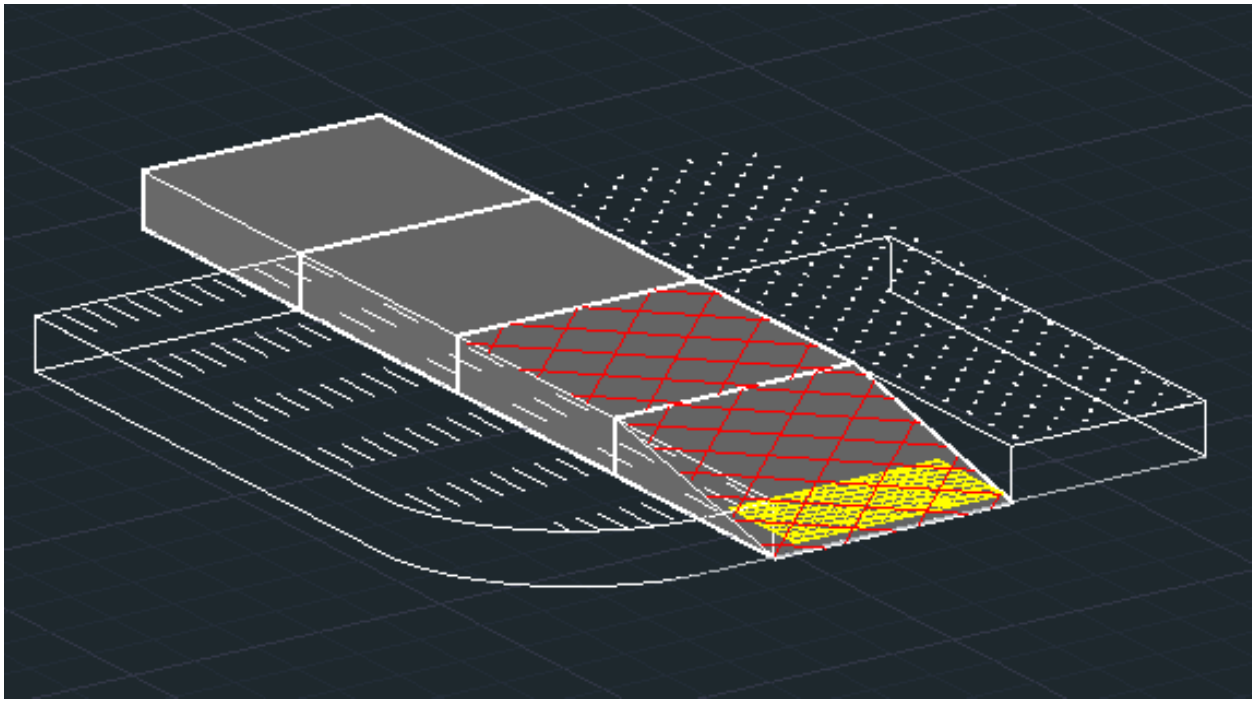


Zone 4


Zone 4
Grand St
Smith Ave
i
ii
J
Niantic
Boardwalk
Main St
Intersection
Curb Ramps
i
ii
K

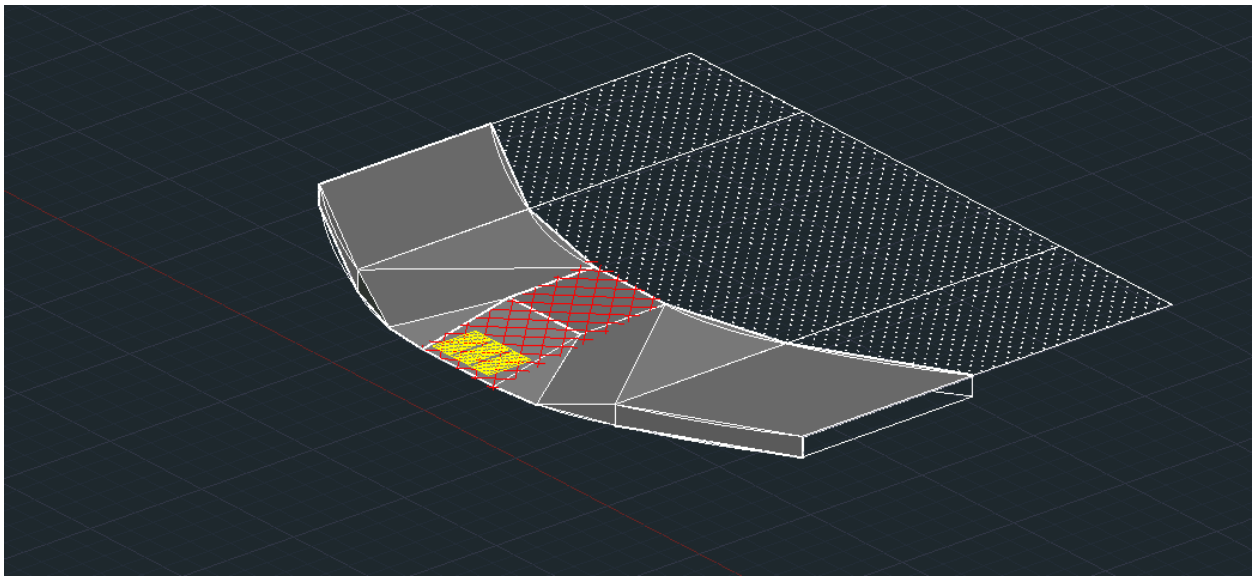
Intersection J - Curb Ramp i

Asset ID:	2095
Condition	Good
Detectable Mat Present	No
Curb Ramp Running Slope:	10.2%



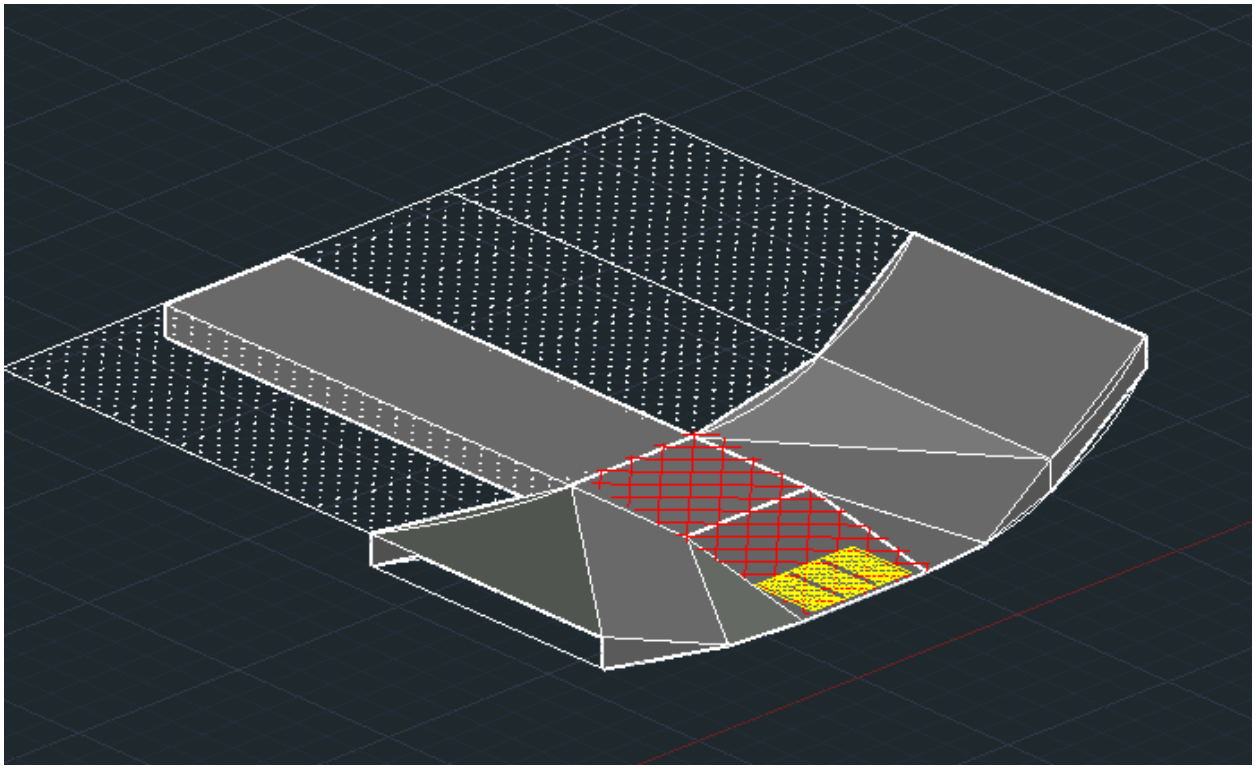
Intersection J - Curb Ramp ii

Asset ID:	2096
Condition	Good
Detectable Mat Present	Yes
Curb Ramp Cross Slope:	3.1%



Intersection K - Curb Ramp i

Asset ID:	19172
Condition	N/A
Detectable Mat Present	Yes
Curb Ramp Flare Slope (Right):	10.3%
Water Ponding	Yes



Intersection K - Curb Ramp ii

Asset ID:	19173
Condition	N/A
Detectable Mat Present	Yes
Curb Ramp Cross Slope:	5.6%
Curb Ramp Flare Slope (Left):	11.9%
Landing Cross Slope:	7.2%