East Haddam Downtown Roadway Redesign

East Haddam Village District

East Haddam, CT

A Major Qualifying Project Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the degree requirements for the degree of
Bachelor of Science

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Abstract

The East Haddam Village District (EHVD) along the Connecticut River is a historical village, home to the famous Goodspeed Opera House and other landmarks that attract many visitors. We collaborated with the East Haddam Redevelopment Agency and CTDOT to address heavy roadway congestion along the state highway through the EHVD. We assessed the current traffic data in the EHVD and previous EHVD redesign proposals to foster ideas for creating three novel roadway redesigns, that aim to create safe areas for pedestrians, improve the infrastructure to better accommodate events at the Opera House, and provide opportunities for future redevelopment. We incorporated CTDOT suggestions into our assessment of the three designs, helping us select and finalize one design to put forward as our proposal.

Authorship

This Major Qualifying Project (MQP) was completed by two Civil Engineering students and one Environmental Engineering student at Worcester Polytechnic Institute. The accompanying table details the main author(s) and contributing author(s) of each section, denoted by initials of the team members (JP for Jack Perriello, AS for Aaron Swann, NM for Nicholas Manz). Sections listed as “All” meant all team members contributed equally.

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Capstone Design

The Major Qualifying Project (MQP) at Worcester Polytechnic Institute (WPI) is a team-based, professional-level design or research experience that is the culmination of the undergraduate curriculum. In the Department of Civil, Environmental, and Architectural Engineering, the MQP fulfills the capstone design requirement of the Accreditation Board for Engineering and Technology (ABET), which accredits WPI's engineering B.S. programs. A key aspect of the ABET capstone design requirement is the application of physical design constraints on a real-world engineering project through the needs of the project as well as its relation to stakeholders. ABET suggests eight elements that must be considered by this project in order to fulfill the capstone design requirement. This project, which aimed to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, by creating a safe area for all modes of travel and supporting future development, addressed the eight constraining aspects through the following guidelines:

Economic: First, a preliminary construction cost analysis was conducted in order to gauge the economic feasibility of all roadway redesign options. Once a final design was chosen, cost analysis was completed for the town to build any recommended roadway or pedestrian access improvements. This project considered the costs of construction, environmental remediation, potential building relocation or demolition, and implementation as well as sources of funding to give the town the best estimation for the selected redesign.

Environmental: Suggested improvements to the East Haddam Village District, Connecticut State Routes 82 and 149, and local roadways were designed with the intention of not adversely affecting the environment. The team worked to improve pedestrian access throughout the village to reduce car usage. Additionally, the contaminated structures and soil located on the former Town Garage and Town Hall land in the village were major considerations in redesign, with plans for remediation.

Social: The intent of this project was to improve the usability of CT State Route 82 and connected roadways in and around the East Haddam Village District for regional commuters, tourists, residents, local workers, as well as others who utilize this roadway. Additionally, the project aimed to improve the safety of the downtown area for pedestrians visiting the historical attractions. Concerns of the residents of East Haddam and the surrounding area were factored into the final redesign, with the goal to ensure the design was a community-driven solution.

Political: The team collaborated with the Connecticut Department of Transportation, the East Haddam Redevelopment Agency, and the Town of East Haddam. Through these collaborations, the team modified the state highway design to improve traffic flow and pedestrian access while meeting state highway, local roadway, zoning, and any other relevant guidelines and regulations.

Ethical: The team did not threaten the reputation of WPI nor put the East Haddam Redevelopment Agency at risk. Before a final design was proposed, it was discussed with the Connecticut Department of Transportation as well as the East Haddam Redevelopment Agency to ensure it met necessary standards. All decision-making and project elements were completed in compliance with the ASCE Code of Ethics.

Health & Safety: The redesign of the roadway, pedestrian access, and parking in the East Haddam Village district serves to increase safety and create a safer environment for drivers, passengers, and pedestrians. The team ensured this through design by mitigating sharp curves in the roadway, expanding sidewalk size to meet state highway standards, adding more pedestrian traffic features including crosswalks, and adding traffic calming measures to reduce the risk of crashes in the village.

Constructability: The team assessed previous design proposals for the roadway through the East Haddam Village District and proposed new roadway and intersection designs. Both the previous proposed designs and the team-created ones were analyzed in regard to maintenance, construction time, necessary building demolition and relocation, environmental constraints, and stakeholder feedback. Based on these considerations, the team finalized and proposed one roadway redesign solution to the Connecticut Department of Transportation and the East Haddam Redevelopment Agency.

Sustainability: The roadway redesign aimed to improve traffic flow and pedestrian accessibility for current day needs as well as projected future needs based on expected growth in traffic at the historical attractions in the village and on the portion of Connecticut State Route 82 through the village. The goal was to create a roadway redesign that can serve the village for many years into the future.

Acknowledgements

We would first and foremost like to acknowledge and deeply thank our advisor, **Professor Suzanne LePage** for her guidance, insight, feedback, and support throughout this project. Her knowledge regarding traffic engineering greatly aided us in producing a professional proposal and applying knowledge we have gained from our academic courses at Worcester Polytechnic Institute.

We would also like to acknowledge and thank **Kevin LaRose** of Connecticut Department of Transportation for his insight and knowledge regarding state highway redesigns in Connecticut. We are also grateful for the opportunity to present to CTDOT through Mr. LaRose.

We extend a thanks to the **East Haddam Redevelopment Agency**, its former chair, **Melanie Kolek**, and its current chair, **Andrew Lord**, forgiving us this opportunity and providing insight into the area throughout the project. We are very grateful for the opportunity to present our findings to the board with our finalized proposal.

Finally, a special thanks to **Aidan Behilo**, a third-year Civil Engineering student at WPI who allowed this project to happen through his independent study of the East Haddam Village District in spring 2023. His personal insight regarding the area provided an extremely helpful foundation for our research.

The people listed above were essential to the success of our project. We are truly grateful for their insight and support for the past six months.

Professional Licensure Statement

In the United States, the National Council of Examiners for Engineering and Surveying (NCEES) has requirements for obtaining Professional Engineering (PE) licensure to ensure that engineers nationwide have the knowledge to safely practice engineering at a high standard and to take legal responsibility for one's work.

An individual wishing to begin the process of obtaining PE licensure must first receive a degree from an ABET-accredited college or university in an engineering-related field. From there, one must take and pass the Fundamentals of Engineering (FE) exam, created by the NCEES, in the desired discipline to receive their Engineer-in-Training (EIT) Certification. The exam is meant to prove that one has proficient knowledge of the given engineering discipline to perform work in said field.

While working with an EIT certification, a licensed PE must sign off on any work completed by the individual. One must work as an EIT for a minimum of four years if they graduated from a four year ABET-accredited engineering program. After this point, one can apply to take the Principles and Practice of Engineering Exam through the state in which they wish to gain a license in. In general, states require the EIT to write an application for this exam detailing the work they completed as an EIT. Once this is accepted, the exam can be taken. If the exam is passed, the candidate has obtained the PE license in specific state, certifying the candidate has proficient knowledge and experience in the given engineering field as well as a sufficient idea of ethical responsibility of an engineer. Note PE license is only valid in a single state, and a transfer of licensure through NCEES is required if one wishes to be certified in another state within the United States.

By obtaining a PE license, one can approve and certify engineering plans for a firm, leading to more opportunities and higher salaries. Having a PE license is necessary to move out of entry level positions in most fields. As a PE, one assumes responsibility to guarantee the safety of infrastructure created through their projects. The license certifies that one has the ability and technical knowledge to complete a project that meets client specifications and state requirements.

Executive Summary

East Haddam, Connecticut is a rural town located along the Connecticut River in the southeastern area of the state. The town is best known for the East Haddam Village District (EHVD), a historical village in the National Register of Historic Places home to the famous Goodspeed Opera House, the East Haddam Swing Bridge, and other landmarks that attract many visitors. The main concern regarding the EHVD for local residents is parking for the Goodspeed-owned attractions as well as traffic through the area. The swing bridge is a part of Connecticut State Route 82 and is the only river crossing within 15 miles or 25 minutes both north and south along the river, making it a critical route for commercial vehicles as well as residents of East Haddam and surrounding towns. The East Haddam Redevelopment Agency (EHRA), formerly the East Haddam Village Revitalization Committee, is the principal town agency tasked with creating a redevelopment plan for the downtown area to alleviate congestion, improve roadway and pedestrian safety, and promote economic growth. The goal of this project was to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, creating a safe area for all modes of travel and supporting future development.

We first assessed the initial conditions of the EHVD to gain an understanding of the current state of traffic. This included gathering data regarding traffic counts and collision rates, determining the roadway capacity and level of service of Route 82 within the EHVD, and creating a Civil3D model of the roadway through the village. The team also assessed four previously proposed redevelopment plans for the EHVD submitted to the EHRA: the Fellner, Fuss & O'Neill, Centerbridge, and Rob Smith Plans. These plans were then assessed with respect to accessibility, parking, pedestrian safety, potential redevelopment area, environmental concerns, roadway congestion and safety, and relocation work. Additional closer analysis was given to the three major roadway intersections along Route 82 within the EHVD.

The team incorporated ideas from each of the plans when creating three novel roadway designs in Civil3D, the Minimal Roadway Redesign, Modified Rob Smith, and Squared Intersections Plans. These plans focused only on the roadway redesign and were assessed based on the same criteria as the previous proposals, but with estimated grading as an added factor to the assessment. After assessing each design and speaking with CTDOT to assess the feasibility of each design, the team selected the Squared Intersections Design as the optimal design to

propose based on potential benefits regarding roadway congestion, traffic safety, and development space.

The Squared Intersections Design was then modified to meet local constraints and CTDOT highway standards. The team then completed a cost estimate of the final design based on previous, similar state highway redesign projects in Connecticut. Additionally, the team created a rough construction sequencing plan for this proposal and provided estimates for redevelopment spaces within the EHVD with the new roadway. A conceptual plan including green infrastructure was also created by the team. We also provided insight into the next steps to advance the proposal and make the roadway redesign a reality in the future.

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1.0 Introduction

East Haddam, Connecticut is a rural town along the Connecticut River in the southeastern area. The town is best known for the East Haddam Village District (EHVD), seen in Figure 1. The historical village of the town is adjacent to the banks of the river and the East Haddam Swing Bridge, the longest swing bridge in the world. The EHVD has been listed in the National Register of Historic Places since 1983 due to its historically significant buildings and landmarks as well as the prominent role of the district in local, state, and even national history (National Parks Service, 1983). The Goodspeed Opera House, located adjacent to the Connecticut River in the village, was built in 1876. Goodspeed still produces musicals here today, as well as performing multiple shows per year multiple times a week. It has become a major historical landmark in Connecticut and the world of musical theatre. The Gelston House, adjacent to the Goodspeed Opera House, is a famous restaurant and hotel built in 1736 that still operates under the owners of the opera house today (The Town of East Haddam, n.d.). The back of the Gelston House contains a beer garden, a popular spot for local nightlife, and a green area that hosts summer concerts. Goodspeed owns many other properties near the EHVD used for actor housing, storage, and office space (East Haddam Redevelopment Agency (EHRA), personal communication, September 14, 2023). These two historical buildings and the swing bridge attract visitors to the village throughout the year.

The EHVD has been the focus of the town in recent times, with talks of redevelopment occurring for the past twenty or so years. For East Haddam residents, the main concern regarding the area is parking for the Goodspeed-owned attractions and traffic through the area. The swing bridge is a part of Connecticut State Route 82 and is the only river crossing within 15 miles or 25 minutes both north and south along the river, making it a critical route for commercial vehicles as well as residents of East Haddam and surrounding towns. Within a tenth of a mile after the bridge within the EHVD, the route also meets Connecticut State Route 149. Between the bridge and this intersection are the Goodspeed attractions and town parking areas, as well as other local shops and restaurants. Route 82 also has narrow lanes and sharp curves through the EHVD. Thus, the traffic issues need to be addressed by a reworking of the roadway system through the EHVD prior to planning for the revitalization of downtown area. In addition to these concerns, construction on the 110-year-old bridge to add sidewalks and make repairs began in fall 2022 and is expected to continue until the summer of 2024. The construction includes complete bridge

shutdowns, timed openings of the bridge, and constant single lane closures which significantly worsen the traffic within the EHVD due to backup for vehicles waiting to cross (East Haddam Swing Bridge Project, 2023).

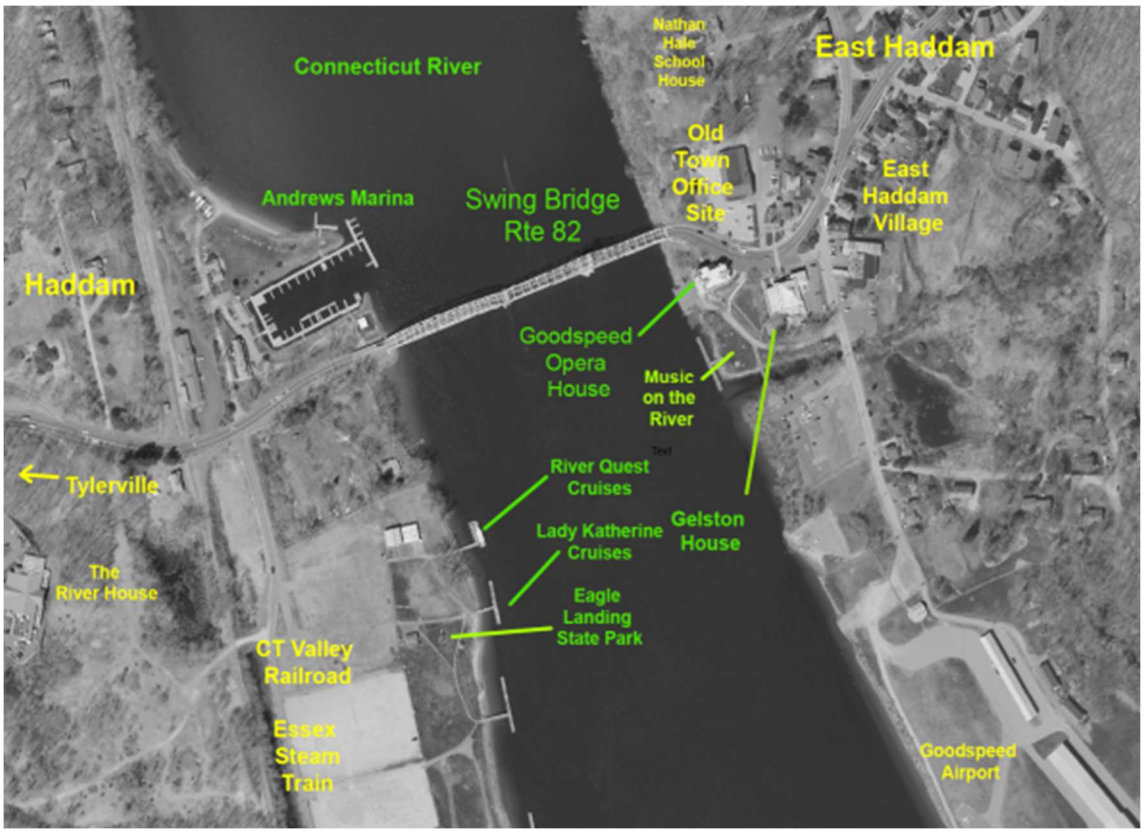


Figure 1. Overview of East Haddam Village District (Top Right) and the surrounding area (Town of Haddam, 2020).

The goal of this project was to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, creating a safe area for all modes of travel and supporting future development.

The objectives included:

1. Understand the existing conditions of the East Haddam Village District and the CT State Route 82 through the village.
2. Produce differing design options to create a safer and more supportive East Haddam Village District.
3. Evaluate each of the design options in various aspects.
4. Select and finalize the preferred design option.

2.0 Background

The East Haddam Village District has a long history of redevelopment plans which have yielded minimal success. This background details the past attempts at redesign, the existing properties in the East Haddam Village District, and current ideas and plans for redevelopment.

2.1 Early Redevelopment Studies and the EHVRC

Starting in 2000, the town-owned garage was vacated, leading to questions about environmental safety, mainly in connection with its underground storage tanks (USTs). In 2004, the EHVD had a traffic improvement study conducted by Fuss & O'Neill, which yielded a signalized intersection, but no other plans were enacted. In 2006, a study on site reuse was conducted, prompted by a relocation of town offices to an old middle school building. The recommendations that came out of the study were to not heavily develop the site but rather use the space to maintain the village character. Preliminary information was gathered, such as background data collection, resident visions, conceptual site plans, and a financial analysis, but no plans followed (Behilo, 2023).

In 2008, the East Haddam Plan of Conservation & Development was updated to include future development of the EHVD, office site, and expansion of the opera house as this to promote village economic growth (Behilo, 2023). Following this updated plan, the first iteration of the East Haddam Village Revitalization Committee (EHVRC) was formed in 2009. One of the first plans submitted to the EHVRC was a plan proposed by Rob Smith, which planned to straighten out the roadway between the East Haddam Swing Bridge and the Route 82 and Route 149 intersection, as seen in Figure 2. This would have cut across the old Town Hall and Garage property as well as at least one currently privately owned parcel (Smith, n.d.). No action was taken with this plan.

Figure 2. The proposed roadway redevelopment by Rob Smith (Smith, n.d.).

In 2010, the EHVRC and Fellner Associates collaborated on a design for redevelopment, but no plans came to fruition as no bids were received. For 3 years, the EHVRC was unsuccessful in developing plans and dissolved in 2013, though it was reformed in 2017. In 2018, the town offices once again moved, this time into a new municipal building (Behilo, 2023). The EHVRC soon held a community hearing to hear the thoughts of residents regarding the revitalization efforts and what direction they should take.

2.2 The Centerbridge Group and the EHRA

In 2019, the Centerbridge Group was co-founded by Jeff Riley, who was Quinnipiac University's chief architect for over 40 years. In 2019, a request for proposal was sent out, but the Centerbridge Group was the only group to submit a proposal, which proposed a mixed-use development. Throughout 2020 and 2021, the citizens became concerned about how scope of the project would interfere with the character of the EHVD and local, preexisting businesses, and that it did not rectify their primary concerns of traffic congestion or parking. These resident concerns caused the Centerbridge Group to pause their efforts in late 2021. Sometime in 2022, the ENVRC was once again dissolved, and the East Haddam Redevelopment Agency (EHRA) was formed. Presently, the EHRA has several subcommittees for environmental assessment, project management, TIF consulting, finance, and grant writing. This is in an effort to attract developers by committing resources to site improvements (Behilo, 2023).

On December 8th of 2022, the Centerbridge Group proposed a public and private partnership that outlined a redevelopment plan with new features and more details. Although the Centerbridge Group permanently pulled out due to Jeff Riley's retirement in early 2023, the EHRA still utilized the plan as a reference for downtown development. The plan begins by listing the existing challenges of the site, with one being environmental remediation due to previous contamination of the soil around the old Town Garage. It lists the total project upfront costs at $13,485,596 adjusted for inflation in 2025 (Centerbridge, 2022). Along with the environmental remediation, it includes tasks like property acquisitions, site clearing, demolitions, and creation of new town utilities. The plan then goes into detail about Route 82 improvements and lists the cost at $9,240,000 adjusted for inflation in 2025. This included tasks such as relocating the Connecticut State Bridge Easement for the swing bridge generator, burying 2000 linear feet of power lines, replacing sidewalks, and general quality of life improvements for pedestrians along Route 82. The plan then detailed the overall master plan for East Haddam, which is a mixed-use development to help drive the residential, condo, and hotel market that plans to target six separate demographics (Centerbridge, 2022). The developer planned to create an amenity rich environment, with a mix of commercial and residential uses, that maintains the town's character in its architecture, while promoting a walkable environment. The overview of the master plan is shown in Figure 3, with each of the building uses marked.

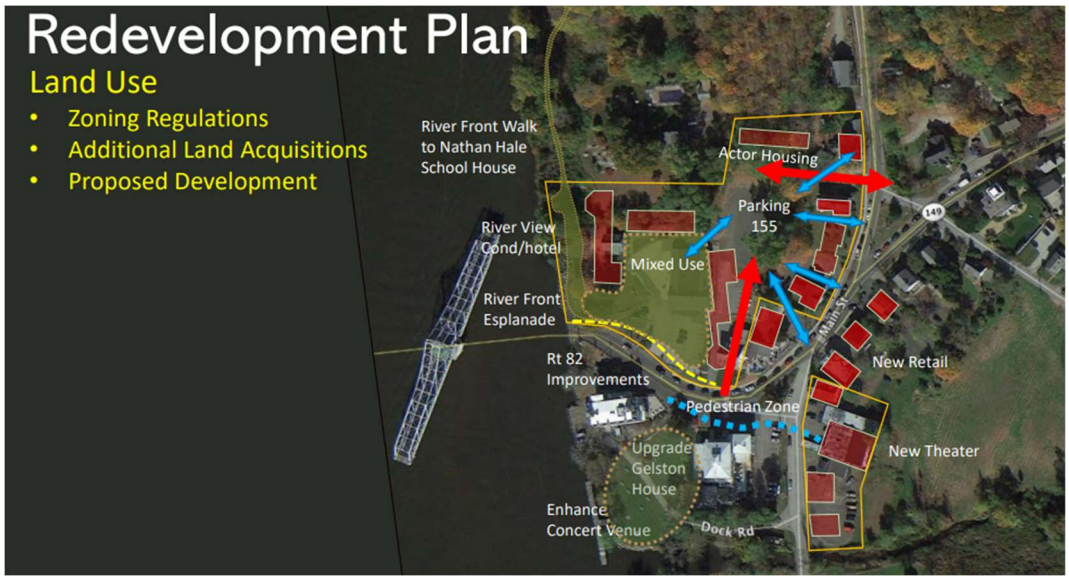


Figure 3. Centerbridge Group Redevelopment Plan (Centerbridge, 2022).

2.3 Traffic Issues through the EHVD

While the EHRA is still considering the plan from the Centerbridge Group, the town recognizes that it does not meet the roadway redesign criteria to create a safer downtown area with better traffic flow without diminishing the historical character of the EHVD. The EHRA is open to other roadway redesign plans, as this is the most important aspect of the redevelopment of the village according to residents (EHRA, personal communication, September 14, 2023).

The major concern for the town regarding the current state of the downtown area as well as any future redevelopment plans is the traffic issues. The roadway design is already dangerous, as tractor trailers and buses cannot easily navigate through the downtown area with two major sharp turns in the road, one of which does not meet Connecticut Department of Transportation (CTDOT) minimum highway design standards. Heavy through traffic is constant as Route 82 is the only road that crosses the Connecticut River for roughly 15 miles in either direction. Additionally, Route 82 meets Connecticut State Route 149 at the northern edge of the EHVD, which adds additional traffic to the area. Furthermore, the Goodspeed Opera House performs multiple shows per week, including nightly shows on the weekends and some weekdays, adding to the congestion.

Another issue causing congestion is the repair and modification project on the East Haddam Swing Bridge, which has further impacted traffic flows since the beginning of 2021. This construction has included multiple overnight and 63-hour complete road closures, which deviated traffic from the area and made entering the EHVD worse as there is only one road in from the east. The single-lane closures, which have been constant throughout the project, also significantly backup traffic. When complete, the roadway on the bridge will have a bike lane and pedestrian lane, connecting a large parking lot located on the Haddam side of the river to the EHVD, potentially aiding village development (EHRA, personal communication, September 14, 2023). CTDOT currently has no plans to modify the initial exit off the bridge into the EHVD to mitigate the traffic impacts and provide a safer entrance and exit to the bridge (K. LaRose, CTDOT, personal communication, September 26, 2023).

Pedestrian accessibility, including sidewalks and crosswalks, is a current issue as well. There currently are only two pedestrian crosswalks within the EHVD, one located between the town-owned property and the Gelston House, and one further east where Route 82 meets Route

149, as seen in Figure 4. Thus, many people who arrive for shows try to cross the street closer to the Opera House and the swing bridge, which has proven to be extremely dangerous as vehicles exiting the bridge have limited visibility. Additionally, cars and buses will attempt to drop people off in front of the opera house prior to shows, but there is currently no dedicated area off the roadway to do so. This danger is increased due to poor roadway lighting, especially when the musicals end late at night. The sidewalks are also very narrow and require updating (EHRA, personal communication, September 14, 2023).

Figure 4a (left) and Figure 4b (right). Narrow sidewalk on southbound lane of Route 82 in the EHVD (Swann, September 14, 2023).

2.4 Constraints in the EHVD

Another factor that needs to be considered when redeveloping the roadway is environmental concerns. The Town of East Haddam owns two properties across the street from the Goodspeed Opera House within the EHVD which currently contain the old Town Hall and Garage buildings. The structures are not structurally sound and will be demolished, yielding more space for redevelopment (EHRA, personal communication, September 14, 2023). However, there is heavily contaminated soil containing mostly arsenic, lead and polychlorinated biphenyls (PCBs) from former USTs and storage of other potentially hazardous materials on site. The existing structures also contain asbestos and lead-based paint. Any plans to potentially utilize the area for parking or roadways would require floor slab removal, soil removal and/or capping, building demolition, and subsequent environmental monitoring (Eagle Environmental, Inc., 2023). In April 2023, Vanesse Hangen Brustlin (VHB) began work to acquire a grant from the Connecticut Department of Economic & Community Development for environmental assessment and remediation work on behalf of the town (Behilo, 2023). The project received a

$200k grant for future arsenic testing at the site. Once the testing is complete and the scope of remedial work is established, VHB and East Haddam will apply for another grant for remediation (EHRA, personal communication, September 14, 2023).

Many of the structures within the potential redevelopment area present another challenge for roadway modification as labelled in Figure 5. First, the generator for the swing bridge is located between the old Town Garage and the bridge. This state-owned property would need to be moved if the roadway were to be straightened immediately after exiting the bridge. On the town-owned parcel that contains the old Town Garage, there exists a white house on the northwestern corner of the property that is a part of the historical district, meaning that it cannot be demolished and would need to be relocated if redevelopment plans utilize the area. Other properties adjacent to this town-owned site include 9 and 11 Main Street, properties containing buildings that are currently vacant, 17 Main Street, a building owned by Goodspeed that houses actors, and 19 Main Street, a vacant former ice cream shop. Additionally, the one property on Broom Road, which abuts the town property to the north, is a privately owned site (EHRA, personal communication, September 14, 2023). One or more of these properties may need to be purchased or utilized for the modified roadway.

Figure 5. An overview of the parcels in the East Haddam Historic District (EHRA, n.d.).

2.5 Vision for the EHVD

While there are currently no plans in place for EHVD redevelopment, the EHRA and the residents of East Haddam have a vision of what they hope the village will become. The EHRA wants a high-density, mixed-use area with structures 3-4 stories high that includes sufficient crosswalks, sidewalks, drop-off areas and river access all while creating a roadway that minimizes traffic impacts and allows for a safe drive through the EHVD (EHRA, personal communication, September 14, 2023). The team recognizes that through the creation of a roadway redesign that aids traffic flow, improves pedestrian accessibility and safety, and creates a drop-off area and sufficient parking is key before any commercial redevelopment plan is considered.

3.0 Methodology

The goal of this project was to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, creating a safe area for all modes of travel and supporting future development.

The objectives include:

1. Understand and evaluate the existing conditions of the East Haddam Village District and the CT State Route 82 through the village.
2. Produce roadway design options for a safer and more supportive East Haddam Village District.
3. Evaluate each of the design options in various aspects.
4. Select and finalize the preferred design option.

A schedule detailing these objectives is seen in Figure 6.

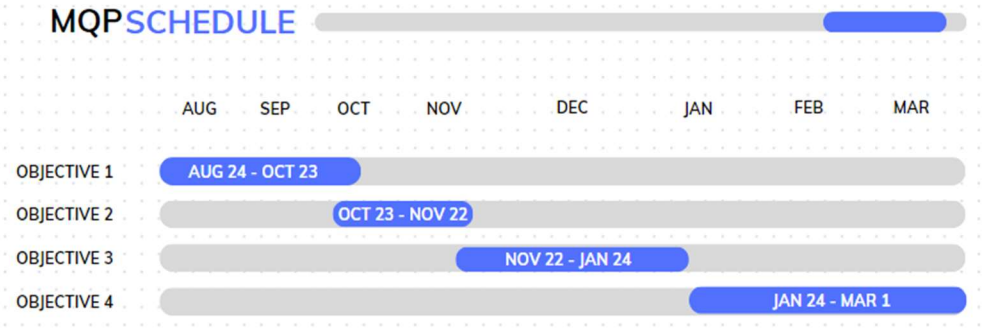


Figure 6. An overview of objective completion timeline.

3.1 Objective 1: Understanding Existing Conditions of the EHVD

In order to determine the effectiveness of any roadway redesign, research into the existing conditions of the roadway and the surrounding area was necessary. Regarding traffic information, the road that runs directly through the EHVD is a state road, Connecticut State Route 82. Thus, the Connecticut Department of Transportation (CTDOT) has extensive traffic data over the years for various points in and around the EHVD. This data is available through the CTDOT Traffic Monitoring Station Index online, which provides traffic counts at various locations along state roads. The data provides information from various traffic studies at a certain point completed in the 21st century including hourly vehicle counts, vehicle type, and recorded speeds of vehicles in both directions as well as separated by direction at the point along the

roadway. Existing data including the annual average daily traffic, average speed separated by direction, and the peak traffic hour per day was utilized by the team to understand the traffic flow in the area.

The team also assessed conditions surrounding the roadway in the EHVD. This included further correspondence with the EHRA and review of previous EHRA meeting minutes to determine the feasibility of a redesign project as well as the status of the former Town Hall and other buildings that may need to be moved or demolished with a roadway redesign. Additionally, there exist previous renditions of EHVD redesign plans that have been submitted through the EHRA or the former EHVRC, including the Fuss & O'Neill, Rob Smith, Fellner Associates, and Centerbridge Group Plans. The team reviewed these plans using knowledge of the area and comments from the EHRA and East Haddam residents on the designs to assess feasibility, as well as if any components could be incorporated into new designs.

Regulations and standards from the town and state were followed to ensure the redesign of the roadway and pedestrian areas comply with state codes and follow any special regulations East Haddam has in the Village District. Specifically, the team researched and utilized the most recent edition of the CTDOT Highway Design Manual and Standard Drawings for creating designs that met grade, curve, width, and any additional requirements. The information on the CTDOT Division of Highway Design Website provided the team with roadway classification information. Additional correspondence with CTDOT also occurred to understand the necessary process one would need to complete to propose a major state roadway redesign.

3.1.1 Roadway Capacity, Level of Service, and Crash Rate Equations

The Federal Highway Administration (FHWA) and National Cooperative Highway Research Program (NCHRP 825) method for capacity calculation was used to determine the roadway capacity of Route 82 through the EHVD (Office of Highway Policy Information, 2020). The calculation method is seen in Equation 1.

$$Capacity = \frac{\left(2{,}200 + 10 \times (\min(70, FFS) - 50)\right)}{1 + \%HV/100} \times Lanes \qquad \textbf{(1)}$$

In equation 1, %HV is the percentage of heavy vehicles in decimal form and min(70, FFS) refers to whichever number is lower, either greater than 70 mph or the free flow speed (FFS).

Another measurement for determining how effectively or poorly a road operates, Level of Service (LOS), was used. To determine LOS, the Highway Capacity Method was used (*Traffic and Highway Engineering*, 2018). The calculation determines LOS by percent free flow speed (PFFS), derived using equation 2.

$$PFFS = \frac{ATS_d}{FFS} \quad \textbf{(2)}$$

This equation states average travel speed in the analysis direction (ATS_d) divided by free flow speed (FFS) equals PFFS. The calculation for ATS_d is seen in equation 3.

$$ATS_d = FFS - 0.00776(V_{d,ATS} + V_{0,ATS}) - f_{ns,ATS} \quad \textbf{(3)}$$

Here, $V_{d,\,ATS}$ is the demand volume for the analysis direction, $V_{0,\,ATS}$ is the demand volume for the opposing direction, and $f_{ns,\,ATS}$ is an adjustment factor for passing zones. The equation to find $V_{d,\,ATS}$ and $V_{0,\,ATS}$ is seen in equation 4.

$$V_{i,ATS} = \frac{V_i}{(PHF)(f_{g,ATS})(f_{HV,ATS})} \quad \textbf{(4)}$$

$V_{i,\,ATS}$ is the demand volume without direction, PHF is the peak hour factor, $f_{g,\,ATS}$ is a variable that accounts for terrain factors, and $f_{HV,\,ATS}$ is an adjustment factor considering heavy vehicles. FFS is determined by equation 5.

$$FFS = SFM + 0.00776\left(\frac{V}{f_{HV,ATS}}\right) \quad \textbf{(5)}$$

S_{FM} is the mean speed of a sample. Finding $f_{HV,\,ATS}$ required its own equation, equation 6.

$$f_{HV,ATS} = \frac{1}{1 + PT(ET - 1) + PR(ER - 1)} \quad \textbf{(6)}$$

In equation 6, E_T is a variable that considers trucks or buses on a given terrain, E_R is a variable that considers RVs on a given terrain, P_T is the proportion of trucks or buses in a traffic stream, and P_R is the proportion of RVs in a traffic stream. Finding these variables and equations allowed the PFFS to be found, which then determined LOS.

The final indicator of how a road operates that was considered was crash rate, and the Federal Highway Administration (FHWA) method was used to accomplish that (Federal Highway Administration, 2011). The equation for crash rate is seen in equation 7.

$$R_{seg} = \frac{\frac{crashes}{years} x\ 100{,}000\ VMT}{AADT\ x\ 365\ x\ segment\ length} \quad \textbf{(7)}$$

R_{seg} is the crash rate in the road segment in a given number of years over 100,000 vehicles miles traveled (VMT). Crashes/years is the total number of crashes over the observation period in years. AADT is the annual average daily traffic.

3.2 Objective 2: Roadway Redesign Options

Based on the traffic studies, existing information regarding the EHVD downtown area, the EHRA visions, and the East Haddam resident's interests for the village, the team created multiple downtown roadway redesigns to mitigate the traffic issues. The new designs aimed to produce a more pedestrian-friendly area by adding speed reduction and greater safety measures. Design considerations were also made to include an adequate drop-off and pick-up area in front of the Goodspeed Opera House and the Gelston House. The parking spaces in front of the two historical buildings were reconfigured for ease of access and aesthetics. Finally, traffic calming measures were also implemented to reduce speeds through the EHVD, to create a safer downtown and for visitors to see all the village has to offer.

Each plan aims to improve the walkability of the downtown area and access to the Goodspeed Opera House. Each roadway plan redesigned the intersections along Route 82 to improve efficiency and safety. The sidewalks in each plan were widened and improved for ADA accessibility. More crosswalks were added in the downtown area to improve ease of access and safety for pedestrians along Route 82. The general plan of the roadway design process was as follows:

1. The team gathered existing survey data.
    a. This consisted of gathering existing survey data through state databases, in the form of LIDAR data imported into AutoCAD, to provide a baseline for the roadway design.
2. The team researched existing roadway standards.
    a. This consisted of the team gathering completed project information for projects on Route 82 and researching any existing CT roadway standards.
3. The team design new roadway layouts in AutoCAD Civil3D.

a. Each new roadway layout was designed in Civil3D, graded appropriately, and overlayed over the existing survey data to determine the amount of cut or fill necessary to complete the roadway project.
b. New or improved sidewalks were designed in Civil3D.
c. New crosswalks or parking were marked out in a new roadway design, as well as any curb cuts.
d. Moved utilities were roughly designed along the new roadway corridor.
e. Necessary traffic calming measures and intersection control devices were determined

3.3 Objective 3: Roadway Design Evaluation

Once the team created the designs for the improved EHVD roadways, the designs were evaluated based on existing traffic data and projections as well as financial feasibility. After creating the roadway designs, the team evaluated each of the intersections in the comparison matrix in Appendix F. Each roadway design was evaluated based on the following criteria: Pedestrian Access, ADA accessibility, Roadway Congestion, Roadway Safety, Parking, Grading, Redevelopment Space, Environmental Concerns, Relocation of Buildings, and on each intersection created in each redesign plan.

3.4 Objective 4: Roadway Design Finalization

Once each roadway design and traffic flow analysis were complete, the team presented the project designs to the major stakeholders to select one design for the final proposal. The stakeholders included CTDOT and EHRA. The team met with CTDOT first to determine the feasibility of each design, and if any design would not be acceptable based on the requirements for state roads. All input on modifications to the existing designs was considered. Based on the comments and feedback from CTDOT, one design was chosen as the final proposal, with necessary modifications made after the meeting to reflect any CTDOT constraints. The constraints the team looked at were curve and intersection radius.

Along with curve radius, intersection radius must be considered in the final design to meet the CTDOT standards. The intersection connecting Route 82 and the drop-off lane must be large enough to accommodate large vehicles such as buses, according to the CTDOT HDM (CTDOT, 2023).

The team finalized this design by adding more detail to the final proposal. Additional considerations included environmental constraints and historical landmarks and their impact on redevelopment area.

The team created a final conceptual plan that added more details such as parking spaces, improved vehicle and pedestrian safety measures, and aesthetic improvements. The team ensured all CTDOT highway and pedestrian access standards were met in their design as part of the finalization. Construction sequencing was also proposed as a part of the final design option. The team completed a cost estimate for the project based on similar projects involving a roadway redesign with intersection realignments using Connecticut's Route 66 Corridor Study. Items like excavation, signals, and roadway materials were considered in the cost estimate. After this, the team presented the finalized design to the EHRA.

4.0 Results

The team first understood the EHVD through assessing initial conditions and looking at prior redesign proposals before creating novel redesigns. From there, a final novel design was chosen to propose to the EHRA.

4.1 Initial Conditions Assessment

The initial assessment of the roadway through the East Haddam Village District (EHVD) included an analysis of the intersections, parking, traffic, and collision history on the roadways through the village. Additionally, four past redevelopment options, including proposals by Fellner Associates Architects, Fuss & O'Neill Inc., Centerbridge Group, LLC, and Mr. Rob Smith, were assessed to determine which had potential to be used in the roadway designs created by the team.

4.1.1 Traffic Data

In 2021, the East Haddam Swing Bridge and EHVD experienced an annualized average daily traffic (AADT) of 10,000 cars on a two-lane road, resulting in heavy traffic flow daily (CTDOT, 2023). The Connecticut Department of Transportation has performed multiple traffic studies along Route 82, which cuts through EHVD as well as Route 149, which meets Route 82 just north of downtown. The results from the latest four-day study from March 29th to April 1st, 2021, is as follows, with Figure 7a showing traffic data from AADT, speed limit, road class, and vehicle counts and Figure 7b showing the data from Tuesday, March 30th displayed across various speed ranges.

eHAD-039 - Combined - e/w

Route 82 - 3.97 mi SW of Route 149

Collected during COVID-19 epoch

Staff Issue: REJ Class

Town.....East Haddam
Station.....39
Location..... 41.452371,-72.461348
Posted Speed Limit.....25 MPH
2015-Minor Arterial 4.....2015-Rural
Start Report.....29-Mar-2021 01:00PM
End Report.....01-Apr-2021 01:00PM
Annualized ADT.....10000
24-Hour Count.... 9029 * G2(1.08) = 9751.3
Day 1.....+ 9608 * G2(1.08) = 20128.0
Day 2.....+ 9168 * G2(1.08) = 30029.4
UnRounded AADT.....30029.4 / 3 = 10009.8
OK 2021 Mon 29-Mar -this report-...10000
OK 2018 Wed 09-May 11500
OK 2015 Mon 15-Jun 9000
OK 2009 Mon 04-May 9900
OK 2006 Mon 27-Mar 10200
Dataset Details.....1

	29-Mar Mon	30-Mar Tue	31-Mar Wed	01-Apr Thu
12:00am		38	34	41
01:00am		9	12	4
02:00am		10	7	5
03:00am		11	7	15
04:00am		51	52	48
05:00am		237	246	219
06:00am		521	521	523
07:00am		746	710	684
08:00am		624	596	632
09:00am		287	521	528
10:00am		458	498	530
11:00am		546	511	528
12:00pm	x	544	553	596
01:00pm	581	593	563	x
02:00pm	742	708	707	
03:00pm	800	911	776	
04:00pm	929	1035	925	
05:00pm	736	828	772	
06:00pm	465	568	440	
07:00pm	293	350	242	
08:00pm	172	244	196	
09:00pm	117	140	133	
10:00pm	54	74	90	
11:00pm	58	75	56	
Totals	4947	9608	9168	4353

Hour	MPH 0-15	MPH 16-20	MPH 21-25	MPH 26-30	MPH 31-35	MPH 36-40	MPH 41-45	MPH 46-50	MPH 51-55	MPH 56-60	MPH 61-65	MPH 66-70	MPH 71-75	MPH 76+	Total Vol.	Daily Vol.
Tuesday 30-Mar																
12:00am	.	2	5	10	14	7	.	.	.	.	.	.	.	.	38	0%
01:00am	.	3	1	2	1	.	2	.	.	.	.	.	.	.	9	0%
02:00am	.	1	2	2	4	1	.	.	.	.	.	.	.	.	10	0%
03:00am	.	1	2	6	1	.	1	.	.	.	.	.	.	.	11	0%
04:00am	1	5	20	18	5	2	.	.	.	.	.	.	.	.	51	1%
05:00am	.	15	129	68	18	6	1	.	.	.	.	.	.	.	237	2%
06:00am	2	38	234	176	41	24	6	.	.	.	.	.	.	.	521	5%
07:00am	2	56	361	210	68	36	12	1	.	.	.	.	.	.	746	8%
08:00am	7	68	250	185	69	36	9	.	.	.	.	.	.	.	624	6%
09:00am	39	57	86	69	28	7	1	.	.	.	.	.	.	.	287	3%
10:00am	18	76	157	124	53	21	6	3	.	.	.	.	.	.	458	5%
11:00am	1	52	215	138	105	30	3	.	2	.	.	.	.	.	546	6%
12:00pm	3	55	175	162	98	47	3	1	.	.	.	.	.	.	544	6%
01:00pm	5	63	227	159	96	34	8	1	.	.	.	.	.	.	593	6%
02:00pm	37	116	249	186	83	35	2	.	.	.	.	.	.	.	708	7%
03:00pm	4	67	269	271	223	67	8	1	1	.	.	.	.	.	911	9%
04:00pm	4	48	266	269	307	124	16	1	.	.	.	.	.	.	1035	11%
05:00pm	2	53	194	206	231	115	26	1	.	.	.	.	.	.	828	9%
06:00pm	1	39	151	134	163	68	11	1	.	.	.	.	.	.	568	6%
07:00pm	2	26	88	88	99	38	6	3	.	.	.	.	.	.	350	4%
08:00pm	1	17	63	49	72	31	10	1	.	.	.	.	.	.	244	3%
09:00pm	.	9	27	33	37	28	5	1	.	.	.	.	.	.	140	1%
10:00pm	1	7	12	23	19	9	2	.	1	.	.	.	.	.	74	1%
11:00pm	.	2	12	22	18	14	6	1	.	.	.	.	.	.	75	1%
Totals	130	876	3195	2610	1853	780	144	16	4	0	0	0	0	0	9608	
Percent	1.35	9.12	33.25	27.16	19.29	8.12	1.50	0.17	0.04	0.00	0.00	0.00	0.00	0.00		

Figures 7a and 7b. Traffic Study Data from 2021 in the EHVD, including AADT, vehicle counts, speed limit and road class (7a) and traffic counts divided by speed (7b) (Connecticut Department of Transportation, 2023).

4.1.2 Roadway Capacity

The Federal Highway Administration (FHWA) and National Cooperative Highway Research Program (NCHRP 825) method for capacity calculation was used to determine the roadway capacity of Route 82 through the EHVD. The required variables are the free flow speed (FFS), where 70 MPH is the maximum allowable variable, and percent heavy vehicles. For Route 82, based on similar roadways in similar areas, an estimated 30 MPH was used for free

flow speed, and an estimated 10% was used for percent heavy vehicles (%HV). This % HV would be acceptable because the range of one-way capacity usage will not drop below 1980 v/hr and will not exceed 1999 v/hr (for a %HV range of 0.01-0.99). The capacity of Route 82 through the EHVD is 3996 vehicles per hour (see Figure B2 for calculation). This capacity greatly exceeds the current usage, as on March 30th, 2021, the peak traffic hour was 4 PM with a count of 1035 vehicles. Based on these results, the capacity of Route 82 is sufficient to handle the traffic in the EHVD.

4.1.3 Level of Service (LOS)

When looking at Level of Service (LOS), mixed results were found. Based on the NCHRP 825 criteria seen in Table 1, which factored in urban or rural areas, rolling or level terrain, peak hour traffic, and AADT, Route 82 sits squarely in LOS A. Given the area and that the Connecticut Department of Transportation Highway Design Manual (CTDOT HDM) considers Connecticut to have rolling terrain, Route 82 is in an urban area with rolling terrain.

Table 1. Roadway level of service criterion with the EHVD corresponding to an urban rolling area highlighted in blue (Kentucky Transportation Cabinet, 2022).

Area Type	Terrain	Peak Hour Peak Direction (veh/h/ln)			AADT (2-way veh/day/ln)		
		LOS A-C	LOS D	LOS E (capacity)	LOS A-C	LOS D	LOS E (capacity)
Urban	Level	1,550	1,890	2,150	14,400	17,500	19,900
Urban	Rolling	1,480	1,810	2,050	13,700	16,700	19,000
Rural	Level	1,460	1,770	2,010	12,100	14,800	16,800
Rural	Rolling	1,310	1,600	1,820	11,000	13,400	15,200

Similarly, according to the criteria used by the City/County Association of Governments of San Mateo County (C/CGA), Route 82 operates at LOS A, but with differing criteria. The C/CGA method from Table 2 below uses functional classification (arterials) and average speed to determine LOS. Using this methodology, Route 82 in downtown East Haddam is considered a minor arterial or class III roadway due to average free flow speed and average travel speed.

Table 2. Level of service criteria for arterials, which is the designated roadway type for Route 82 through the EHVD (CCGA, 2005).

Level of Service Criteria for Arterials

Arterial Class	I	II	III
Range of Free-Flow Speeds (mph)	45 to 35	35 to 30	35 to 25
Typical Free-Flow Speed (mph)	40 mph	33 mph	27 mph

Level of Service	Average Travel Speed (mph)		
A	≥ 35	≥ 30	≥ 25
B	≥ 28	≥ 24	≥ 19
C	≥ 22	≥ 18	≥ 13
D	≥ 17	≥ 14	≥ 9
E	≥ 13	≥ 10	≥ 7
F	< 13	< 10	< 7

When using the Highway Capacity Manual calculations to determine LOS, the results from the equations used to determine LOS show that Route 82 operates at LOS D as seen in Table 3 and Table 4 (see Figure B1 for calculations associated with Table 4).

Table 3. LOS for two-lane highways (*Traffic & Highway Engineering*, 2018).

	Class I Highways		*Class II Highways*	*Class III Highways*
LOS	*ATS (mi/h)*	*PTSF (%)*	*PTSF (%)*	*PFFS (%)*
A	>55	≤35	≤40	>91.7
B	>50–55	>35–50	>40–55	>83.3–91.7
C	>45–50	>50–65	>55–70	>75.0–83.3
D	>40–45	>65–80	>70–85	>66.7–75.0
E	≤40	>80	>85	≤66.7

SOURCE: From *Highway Capacity Manual 2010*. Copyright, National Academy of Sciences, Washington, D.C. Reproduced with permission of the Transportation Research Board.

Table 4. PFFS for the EHVD in both directions and separated by direction.

Percent Free Flow Speed (PFFS)	Estimated	Eastbound	Westbound
PHF	30 MPH	33 MPH	35 MPH
0.85	63.1%	66.4%	68.3%
0.90	65.1%	68.3%	70.1%
0.95	67.0%	70.0%	71.7%

4.1.4 Collisions

The roadways in and around the EHVD have issues regarding sharp turns, lines of sight, and difficult turns at intersections. This has resulted in a crash rate of 0.88 crashes for the road segment per 100,000 vehicles miles traveled (VMT) since 2015, which is a low rate given the concerns many local citizens have. For example, the average crash rate for minor arterials in urban areas in Massachusetts is 2.98, which is a reasonable comparison given that Massachusetts and Connecticut are neighboring states with similar geographies (see Figure B2 for calculation). Most of these collisions involved only damage to vehicles, and no accidents in the EHVD have been fatal since 2015 as of January 2024.

Figure 8 shows a collision diagram detailing all motor vehicle accidents that have occurred in this time, with a full list of collisions in Table C1 in Appendix C. Note that the area with the highest rate of accidents was the sharp turn at the entrance and exit to the East Haddam Swing Bridge. This area experienced 16 accidents within the scope of the EHVD, as well as six additional collisions on the East Haddam side of the swing bridge near the village entrance. There were also numerous accidents at the intersection between Routes 82 and 149, with 11 in total since 2015.

Based on the resulting data, congestion and crashes seem to be due to poor design factors such as bottlenecking, poor sight lines, terrain, narrow bridge, and impedance by events rather than due to exceeded capacity. In other words, the roadway needs a redesign to improve flow and safety, not capacity.

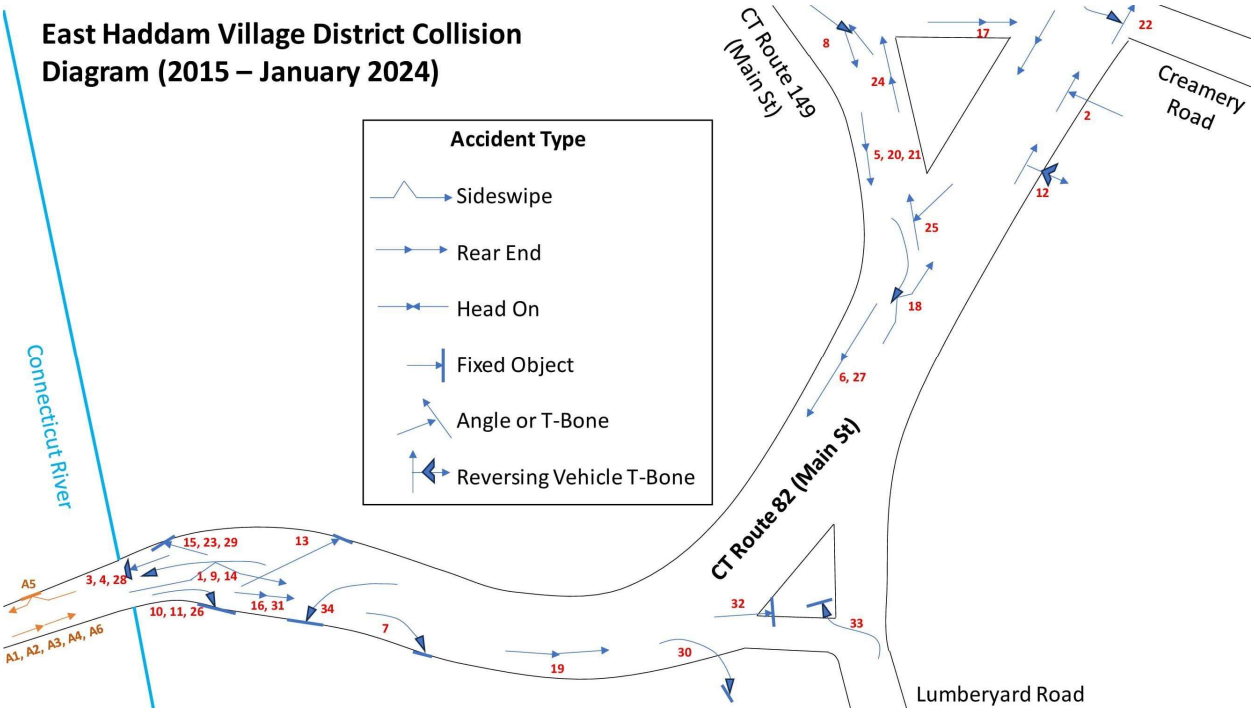


Figure 8. Collision diagram of the EHVD with accidents from January 2015 to January 2024. The numbers correspond to the collision table in Appendix C.

4.1.5 Parking

Parking in the EHVD is mostly for visitors to the Goodspeed buildings along with some spots reserved for the Goodspeed employees and actors. Figure 9 and Table 5 below show the available parking lots and number of spaces, with blue denoting visitor parking and red denoting employee parking. The two main visitor parking areas include the large Goodspeed-owned parking lot off Lumberyard Road (Lot F) and the area on town-owned property across Route 82 from the Gelston House (Lots A and B). In total, it is estimated that there are currently 262 visitor parking spaces across Lots A, B, C, F, and G, as well as 53 parking spaces for employees across Lots D, E, H, I, and J.

Lot Letter	Number of Spaces
A	20
B	58
C	11
D	5
E	24
F	164
G	9
H	3
I	14
J	7

Figure 9 and Table 5. Parking Lots in EHVD and the corresponding number of spaces per lot. Note blue denotes visitor parking and red denotes employee parking.

4.1.6 Civil3D Rendering of Existing Roadway

In order to create a baseline for comparison, the team first created a Civil3D rendering of the existing roadway and parking conditions in the EHVD based on aerial footage in Figure 10. Based on crash history, CTDOT standards, and communication with the EHVD, the key characteristics that were slotted for redesign were the sharp S-curve on Route 82 east of the East Haddam Swing Bridge. The other two locations are the intersections of Route 82 with Lumberyard Road and Route 149.

Figures 10a and 10b. The Civil3D renderings of the existing roadways and parking conditions of the EHVD with aerial image overlay (10a) and without (10b).

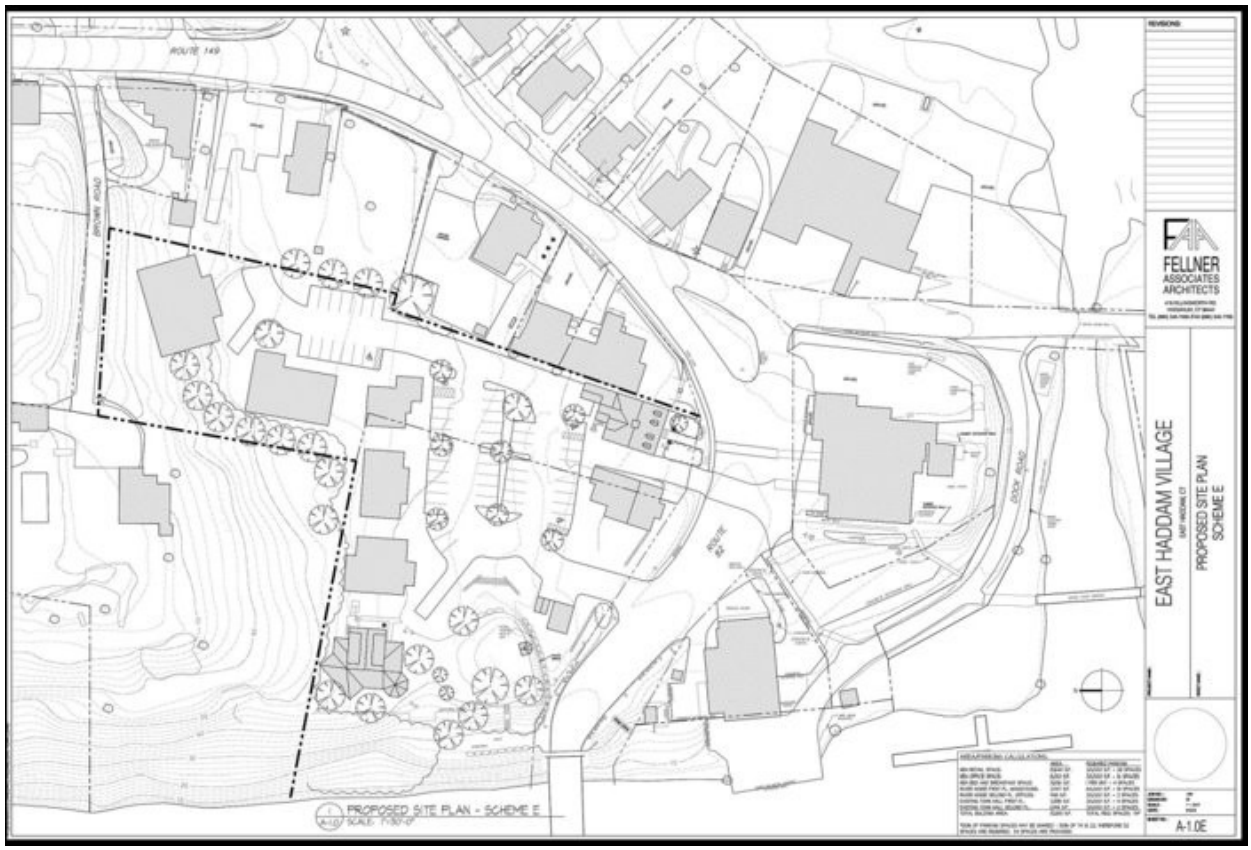
4.2 Previous Roadway Redesign Options

Along with the existing conditions assessment of the EHVD, the team reviewed four redesign plans proposed throughout the years to the former East Haddam Redevelopment Committee and the current East Haddam Redevelopment Agency (EHRA). The Fellner Associates Architects, Fuss & O'Neill Inc., Centerbridge Group, LLC, and Mr. Rob Smith plans

varied in scope and focus, with some focusing on the roadway redesign while others focused more on the economic redevelopment of the downtown area. Our team focused on the roadway redevelopment aspects of each plan as it falls within our project's scope.

4.2.1 The Fellner Plans

The first plan the team reviewed was the Fellner Architects Associates Plans (Fellner Plans) proposed commercial and residential redevelopment plans for the village. These plans, displayed in Figure 11, did not propose any roadway adjustments and only modified some access points to parking. In the two designs proposed by Fellner, there were no changes to any of the existing roads. Both plans proposed additional parking for new developments in the town-owned lots. The design in Figure 11a shows the proposed development assuming acquisition of the parcel on Route 149, which would have extended the parking. The design in Figure 11b shows the design if the developer did not acquire the Route 149 parcel.



Figures 11a and 11b. Fellner Redesign Options of the EHVD. Both designs mainly focus on parking and commercial redevelopment with slight variations in lot access between the two.

4.2.2 The Fuss & O'Neill Plan

The next plan the team looked at was the plan created by Fuss & O'Neill, Inc., or the Fuss & O'Neill Plan, which focused both on roadway redevelopment in some areas of the EHVD along with commercial redevelopment for Goodspeed. This plan also had two variations depending on the type of development the town wanted, both a mixed used plan and a plan to add a new opera house and expand Goodspeed operations. Note that the plans displayed in Figures 12a and 12b only varied in the amount of parking while the roadway redevelopment plans stayed the same. The key aspect of this plan's roadway redevelopment was creating a squared off intersection at the intersection of Route 82 and Lumberyard Road instead of the existing Y intersection with a traffic island to improve safety. The plan also updated the existing parking lot on the town-owned property and added new parking between Lumberyard Road and Creamery Road. Additionally, the plan created a drop-off lane in front of the Gelston house, replacing the current system of cars stopping in traffic to drop visitors off.


ROUTE 149
ROUTE 82
CREAMERY ROAD
LUMBERYARD ROAD
CONNECTICUT RIVER

Figures 12a and 12b. The Fuss & O'Neill, Inc. plans for redevelopment of the EHVD, with one plan (12a) proposing a mixed use development with additional parking and one plan (12b) proposing a new opera house.

4.2.3 The Centerbridge Plan

The third plan, created by Centerbridge Group, LLC was another plan that focused on commercial redevelopment of the village and proposed minimal design alterations to the existing Route 82. As displayed in Figure 13, the plan calls for new retail buildings, the relocation of historical buildings, the introduction of green space, and new parking on the town-owned property with slight modifications to the roadway. This includes a designated pedestrian zone in front of the Gelston House and softens the curve coming off the East Haddam Swing Bridge but does not change any other roadway geometry. Renderings of the plan in Civil 3D are shown in Figures 14a and 14b.

Figure 13. The Centerbridge Group, LLC redevelopment plan for the EHVD.

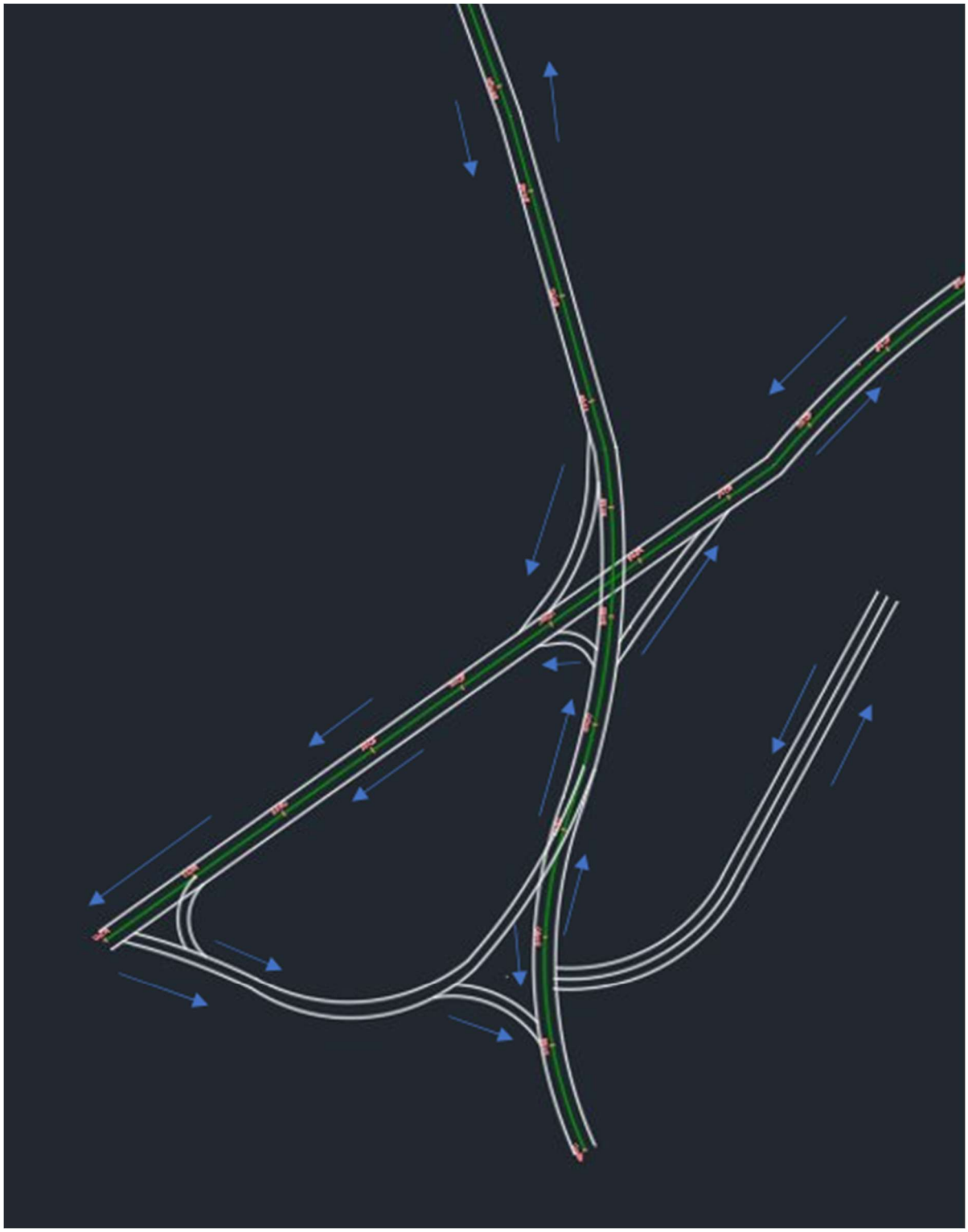
Figures 14a and 14b. The Civil3D renderings of the Centerbridge Group, LLC plans for the roadways in the EHVD with aerial image overlay (14a) and without (14b).

4.2.4 The Rob Smith Plan

Finally, the plan proposed by Mr. Rob Smith was a drastic roadway redesign proposal that straightened CT Route 82 through the EHVD onto currently town-owned property and some private property. The existing roadway that goes past the Goodspeed properties would become one-way in efforts to reduce congestion and danger for visitors. Thus, the plan changed the flow of traffic into a traffic loop. Many of the existing roads are changed to one-way roads to support the circular flow of traffic. It also adds a two-way road behind the Goodspeed properties

connecting to Lumberyard Road. As shown in Figure 15, the space north and south of the new Route 82 can be used for parking or potential redevelopment based on what the town wants for the village. The Civil3D renderings of the Rob Smith plan are exhibited in Figures 16a and 16b.

Figure 15. The Rob Smith Plan for a roadway redevelopment in the EHVD.



Figures 16a and 16b. The Civil3D renderings of the plans created by Mr. Rob Smith for the roadways in the EHVD with aerial image overlay (16a) and without (16b).

4.2.5 Assessment of Previous Roadway Redesign Options

The team then created an information matrix which summarized the key information for each of the four existing redevelopment plans with a focus on the roadway redevelopment. The matrix included information on pedestrian access, ADA accessibility, roadway congestion, roadway safety, parking, necessary grading, redevelopment space created, relocation of buildings, and environmental concerns with respect to the contamination on the town-owned property. The matrix also specifically assessed the proposed changes at three specific points along the roadway that have caused much concern through collision data and town comments: the intersection of Route 82 and Route 149; the intersection of Route 82 and Lumberyard Road; and the entrance and exit of the EHVD at the East Haddam Swing Bridge. The full matrix can be found in Appendix D, and key takeaways are shown in Table 6.

Table 6. Summary and key points of existing redesign options assessment.

Fellner Plan	Fuss & O'Neill Plan	Centerbridge Plan	Rob Smith Plan
• No roadway improvements • New parking entrance to town-owned lot may worsen traffic on Rt. 149 • Relocation of 17 & 19 Main St. buildings • Contaminated soil removal needed	• Drop-off lane in front of Gelston House adds pedestrian safety, reduces roadway congestion • New parking entrance to town-owned lot may worsen traffic on Rt. 149 • T-intersection created at Lumberyard Rd. & Rt. 82 intersection • Widens Rt. 82 near bridge to straighten alignment and minimize curve	• Slight easement of bridge curve • New parking entrance to town-owned lot may worsen traffic on Rt. 149 • Relocation of bridge generator, river house • Green space over contaminated soil (capping)	• One way traffic circle would ease congestion, offer more safety near Goodspeed properties • Rt. 149 & Rt. 82 intersection modified for 2-way intersection • Rt. 149 eastbound, Rt. 82 westbound no stopping • Bridge curve eased westbound • Relocation of bridge generator

Based on the information matrix assessment, the team decided which redevelopment proposals would be used as sources for new roadway redesigns. The Fellner Plan, which did nothing to improve the roadway and was mainly a commercial and residential redevelopment proposal, was not used in consideration for the new roadway designs. The team took ideas from the remaining three proposals for roadway design options. First, the Fuss & O'Neill plan provided two main pieces for new roadway designs. The team believed that the proposed disconnected drop-off lane in front of the Gelston House in this plan would be integral for

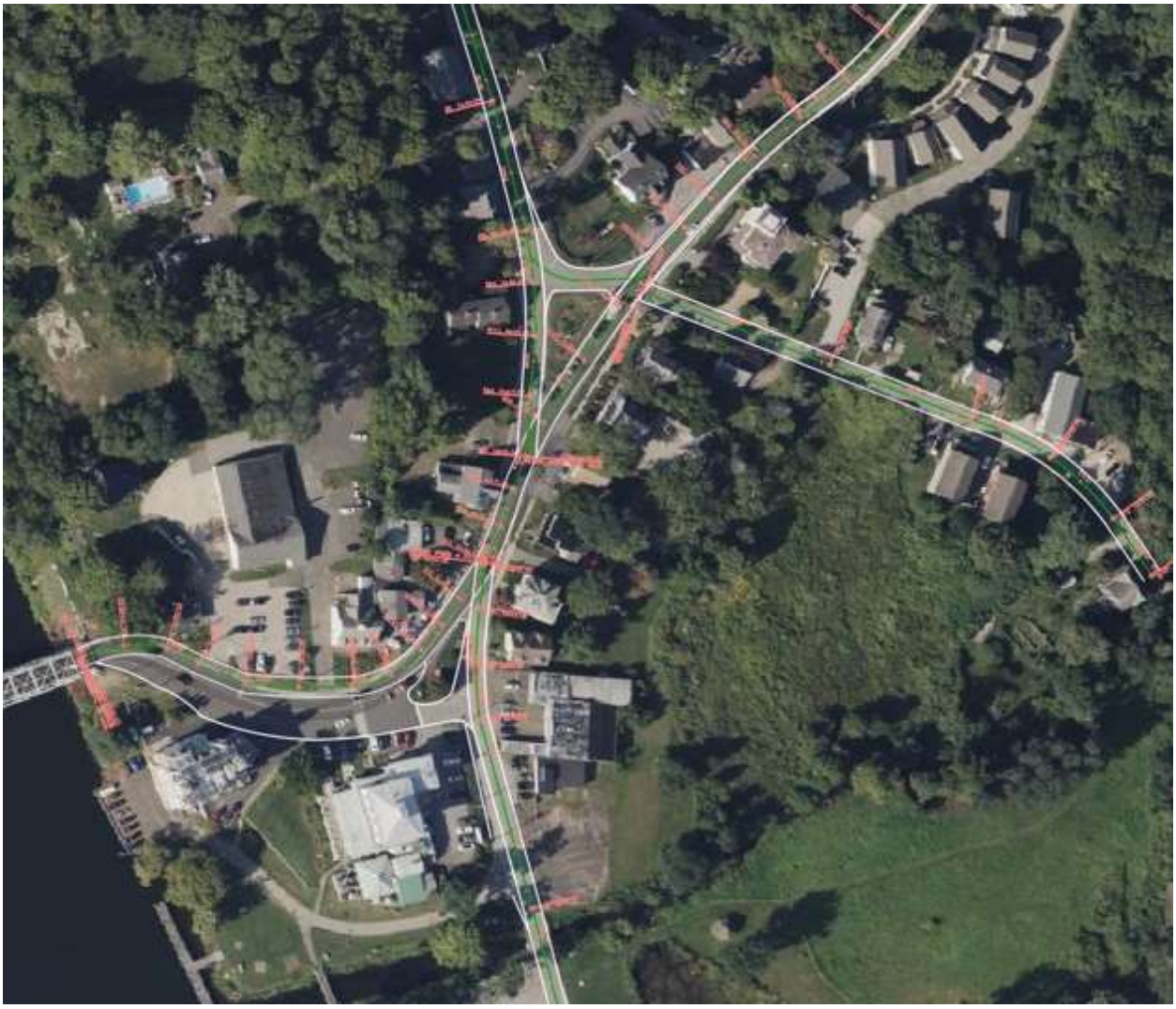
accessibility to the Goodspeed properties. Communications with EHVD indicated dropping off in traffic had been a major issue, so the team decided to include this drop-off lane in all new designs. Fuss & O'Neill also proposed squaring off the intersection of Lumberyard Road and Route 149, which the team concluded to be a design option to potentially improve pedestrian safety, minimize collisions, and lessen congestion. Next, the Centerbridge Plan proposed only necessary roadway reconstruction to ease curves, which the team recognized may be the most feasible plan for CTDOT and the town. Thus, this was used as inspiration for one of our new designs. Finally, the team recognized that the idea of a roadway straight through the EHVD as proposed by Mr. Rob Smith was likely the most complete solution to improving the congestion of Route 82 in the area. The team, to some degree, utilized the one-way road idea, creating a traffic loop through the village along with a new Route 149 and Route 82 intersection.

4.3 New Redesign Options

The team used knowledge from the EHRA and local residents, past redesign proposals, and background knowledge on roadway redesign to create three novel redesigns for the EHVD. Two of the redesigns were based on the previous roadway designs proposed to East Haddam, and one design was created based on what the team saw as the best fit solution. Each design has three aerial views, where two are conceptual designs that show the proposed roadway layout, and one view is a functional design that shows the grading required to successfully create the new roadway.

4.3.1 Minimal Roadway Redesign

The team's first redesign is based off the minimal roadway redesign of the Centerbridge Plan, but it uses more of the town-owned land to soften the S-curve coming from the East Haddam Swing Bridge. This allows for more drop off space in front of the Goodspeed Opera House and makes the curve safer for drivers and pedestrians. Figure 17 shows the Civil3D rendering of the minimal impact redesign option, while Figure 18 shows the grading required for this design.

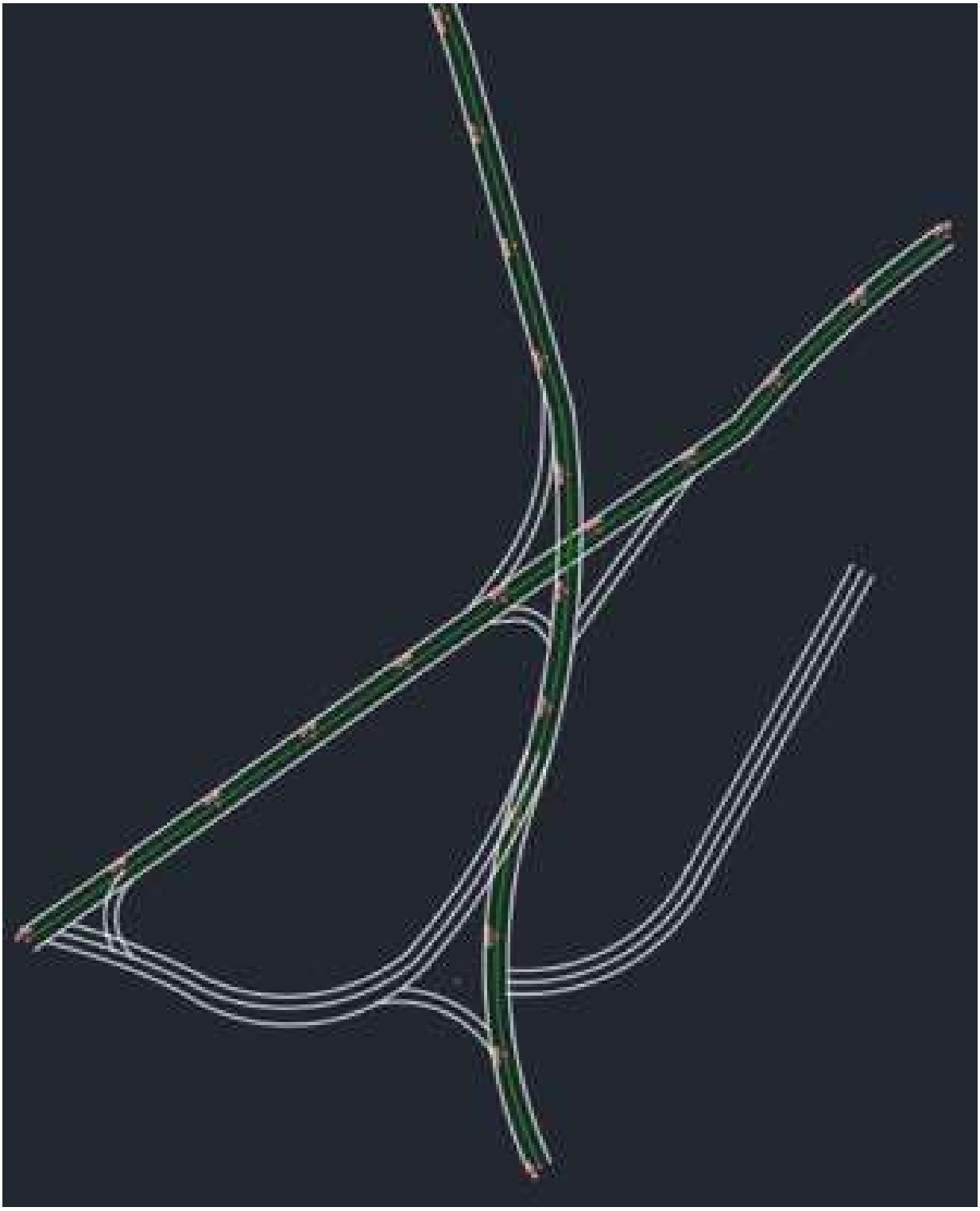


Figures 17a and 17b. Civil3D renderings of the minimal impact roadway design for the EHVD with aerial imagery (17a) and without (17b). This design eases the curve off of the East Haddam Swing Bridge and creates a designated drop-off lane for pedestrians.

Figure 18. A Civil3D rendering of the minimal impact roadway design for the EHVD with the new highway corridor, along with the new grading area required for the redesign. The red areas show cut needed, and the green areas show fill needed.

4.3.2 Modified Rob Smith Plan

The second redesign option, seen in Figure 19, is based mainly on the Rob Smith plan that recommended the addition of a roadway directly through the EHVD. The only notable change between the Rob Smith plan and this option is that the southern part of the downtown loop that passes in front of the Goodspeed Opera house would be widened to two lanes to accommodate drivers dropping off passengers in front of the opera house. Adding a second lane will result in less congestion near the drop-off area entrance near the bridge. An auxiliary road has also been created to connect Lumberyard Road to Creamery Road where many Goodspeed workers reside. This is the largest redesign plan and would excavate about 120,000 cubic feet of soil as seen in Figure 20.



Figures 19a and 19b. Civil3D renderings of the modified Rob Smith thruway design for the EHVD with aerial imagery (19a) and without (19b). This design creates a one-way traffic flow in the EHVD and widens the roadway in front of the Goodspeed properties to two lanes with a drop off area.

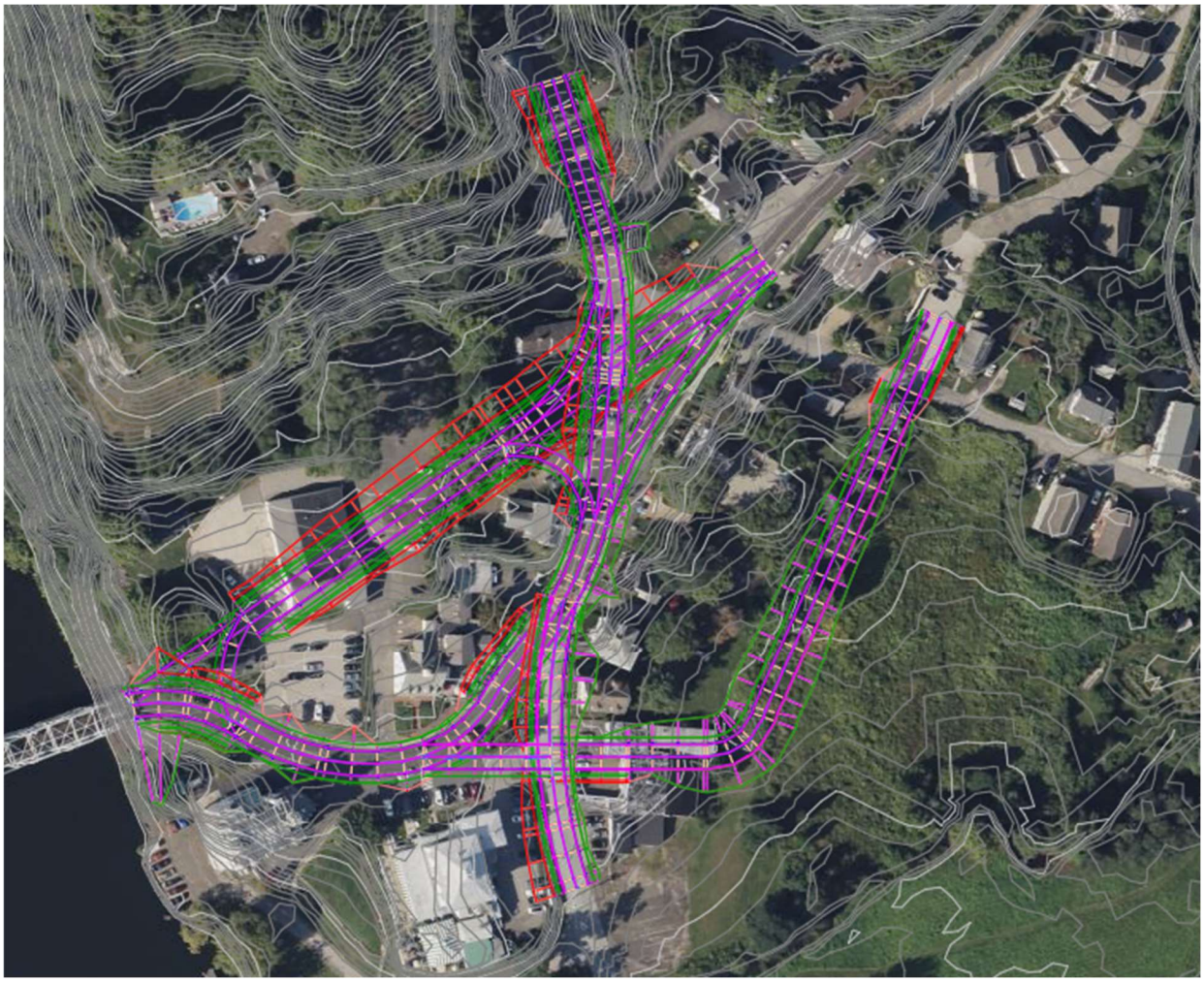
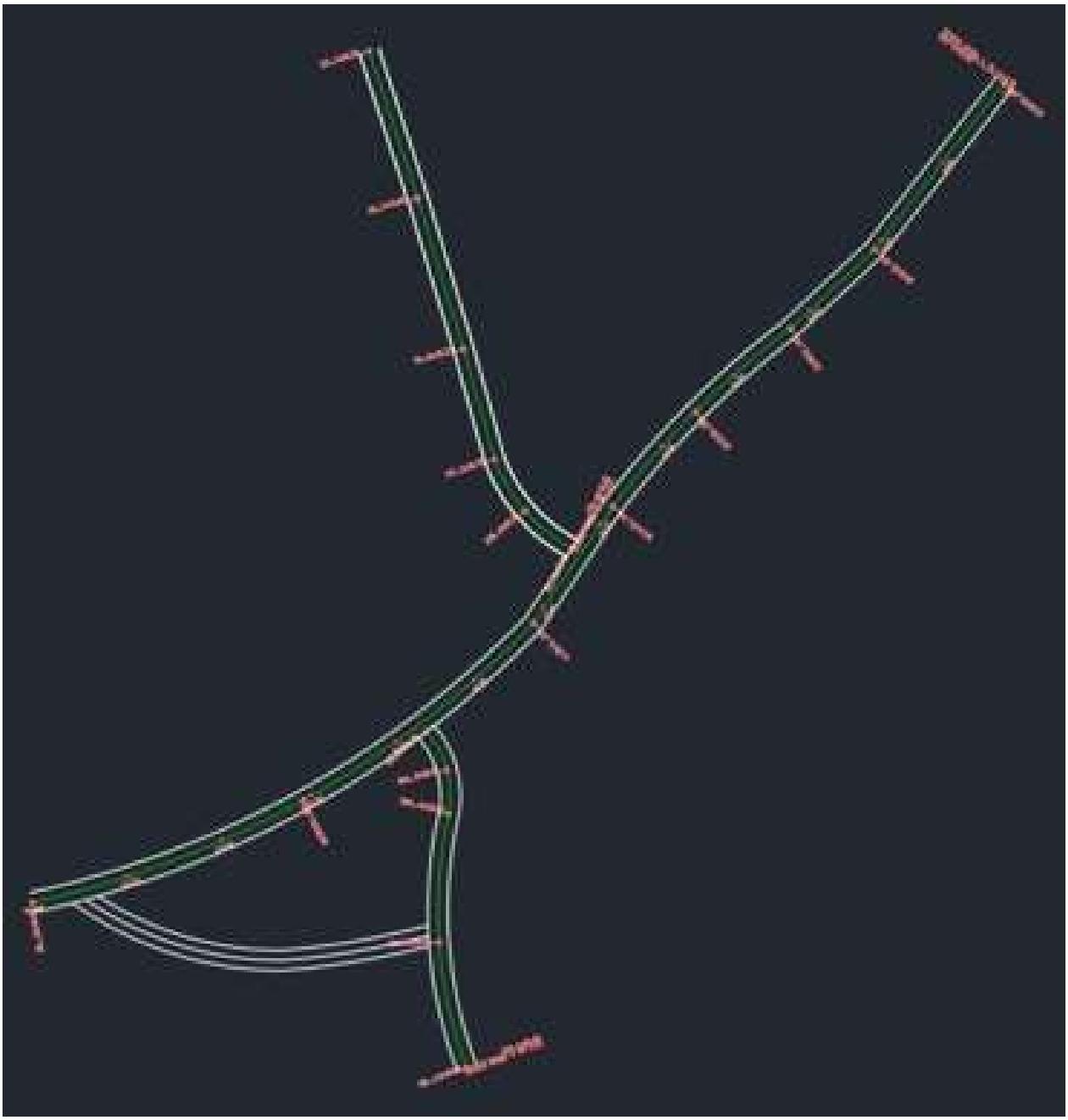


Figure 20. A Civil3D rendering of the modified Rob Smith design for the EHVD with the new highway corridor, along with the new grading areas required for the redesign. The red areas show cut needed, and the green areas show fill needed.

4.3.3 Squared Intersections Plan

The team created a third redesign option for the roadway through the EHVD that took inspiration from the roadway realignment of the Rob Smith plan and the reconfiguration of the Lumberyard Road and Route 82 intersection from the Fuss & O'Neill plan. The plan, as seen in Figure 21, would create a squared off intersection between Route 82 and Route 149, which would likely require signalization to regulate traffic and reduce collisions. The Lumberyard Road and Route 82 intersection would also be squared off but likely only require stop signs on Lumberyard Road. This plan also retains the drop off lane in front of the Gelston House which would only be accessible via Lumberyard Road to reduce conflict points on Route 82. The grading required for this plan is seen in Figure 22.



Figures 21a and 21b. Civil3D renderings of the squared intersections roadway design for the EHVD with aerial imagery (21a) and without (21b). This design creates a straightened Route 82 through the EHVD and squares the Route 82 intersections with Lumberyard Road as well as Route 149.

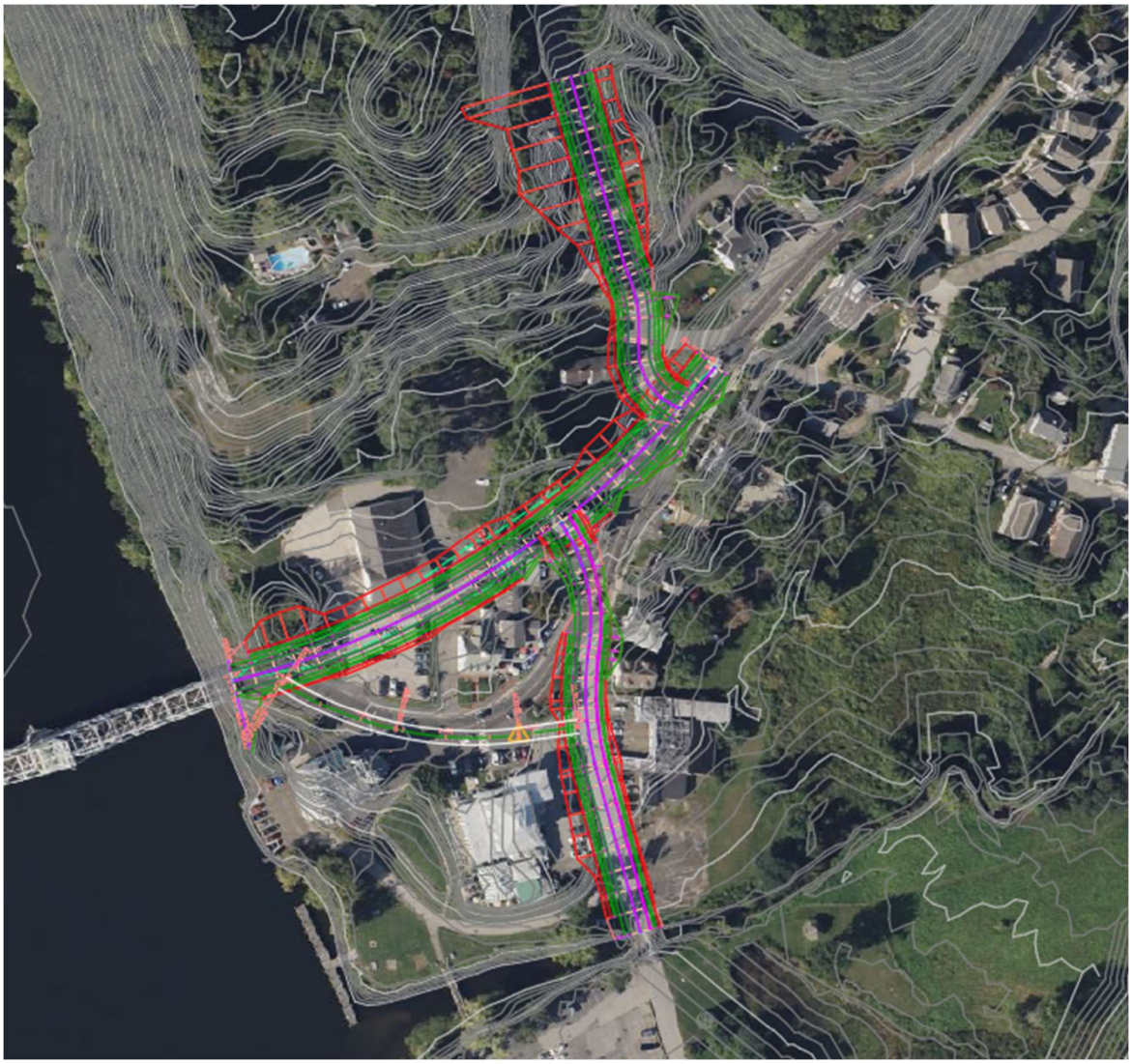


Figure 22. Civil3D rendering of the squared intersections redesign option for the EHVD with the new highway corridor, along with the new grading areas required for the redesign, with the red areas showing cut needed, and the green areas showing fill needed.

4.3.4 Construction Staging Considerations

Construction staging is a crucial part of the development process, as large amounts of equipment and materials are shipped to the project site in advance to keep the flow of construction uninterrupted. To allow this, materials and equipment need a storage or staging area, where they can stay when they are not in use, but easily be moved to the construction site when needed. The construction staging for the three separate designs are shown below.

For construction staging with the minimal impact redesign plan, the existing town owned parking lot can be utilized, and only around 70 cubic feet of soil would need to be excavated to

soften the curve. The excavated soil could then be stored in the construction staging until it is removed. During construction, one lane on Route 82 would need to be closed to accommodate the excavation but would provide minimum disruption to traffic flow.

The modified Rob Smith Plan would require complex sequencing, starting with realigning the Route 82 and Route 149 intersection. The construction could be staged in either the town parking lot, or the parking lot south of Gelston House. Once the intersection is realigned, construction would have to create the new Route 82 road through the existing town property. No disruption would occur to the road other than construction movements from the staging yard to the site. Once the new road is completed, a new traffic flow pattern will need to be installed, and the Lumberyard Road intersection would need to be realigned, which would have a large impact on the traffic flow. This plan is the most complex plan out of the three in terms of redevelopment required.

Finally, the squared intersections plan would require construction staging in the town owned lots, and potentially the parking lot south of the Goodspeed buildings, as seen in Figure 22. For sequencing, first the new road would have to be built through the town-owned parcels, which would not cause much disruption. Once that is completed, the Lumberyard Road intersection and the Route 82 and Route 149 interchange would need to be realigned, which would cause a significant amount of disruption to the traffic and would require the installation of temporary signals at each intersection to allow for lane closures, and the eventual installation of permanent traffic signals at the Route 82 and Route 149 interchange. Staging would first take place in the northern highlighted parcel in Figure 23, and then move to the southern parcel as construction takes place.

Figure 23. General Construction Staging Areas.

4.3.5 Assessment of Preliminary Design Options

The three redesign options created by the team were presented to CTDOT in January 2024 to assess feasibility. Based on the feedback from CTDOT, all three designs were determined to be feasible and in accordance with the Highway Design and Safety Standards of Connecticut, including sufficient lines of sight, acceptable horizontal and vertical curves, and no roadways exceeding maximum slope requirements.

The three preliminary redesigns were assessed using a similar information matrix to the one used for the previous roadway redesign options (see Section 4.2.5). This matrix included an assessment of accessibility, parking, pedestrian safety, potential redevelopment area, environmental concerns, roadway congestion and safety, necessary grading, and relocation work. The same three areas of the roadway were specifically analyzed, the entrance and exit to the

EHVD off the East Haddam Swing Bridge along with the intersections between Route 82 and Lumberyard Road as well as Route 82 and Route 149. The full matrix can be found in Appendix F, and key takeaways are shown in Table 7.

Table 7. Summary and Key Points of Preliminary Design Options Assessment.

Minimal Redesign Plan	Modified Rob Smith Plan	Squared Intersections Plan
• Drop-off lane lowers congestion • Eases sharp curve near bridge • No relocation of buildings needed • Areas with high collision rates not addressed	• Drop-off lane lowers congestion • One-way traffic improves pedestrian safety • Rt. 149 & Rt. 82 intersection modified for 2-way intersection • Rt. 149 eastbound, Rt. 82 westbound no stopping • Provides largest redevelopment area (center of one-way traffic) • Rt. 82 westbound curve near bridge straightened, will need traffic calming measures • Rt. 82 eastbound faces existing curve • Removal of 17 Main Street, bridge generator buildings	• Drop-off lane lowers congestion • Removal of Y-intersections • Potential traffic light at Rt. 149 & Rt. 82 intersection improves roadway safety, but may add congestion • Two-way straightened road will need traffic calming measures • Removal of 11 & 15 Main Street, bridge generator buildings

The team then finalized the assessment of each design and determined that the Squared Intersections Design was the most optimal design for recommendation to the town. This design best modified traffic flow so that the area in front of the Goodspeed Properties was the safest for pedestrian traffic. It also eliminated the roadway areas where crash rates were high, including the removal of the sharp curve near the swing bridge and modifying the Route 82 and Route 149 intersection to become a much safer, signalized two-way intersection. Although this design will require three buildings to be removed or relocated, the roadway redesign will maximize roadway safety near the Goodspeed properties and offer new redevelopment spaces in the village.

5.0 Final Design Modifications

With the final design selected, the team reviewed and modified the design to meet CTDOT roadway standards. The curvature of the intersection of the drop of lane and Route 82 was changed to meet CTDOT Highway Standards, and a finalized Civil3D drawing is shown below with grading information. The team also created a more detailed construction sequencing and rough cost estimate for the town to use as groundwork for this redesign option.

5.1 Additional Considerations

The team has compiled additional information that may impact this design's construction in the future. Based on correspondence with local resident and WPI student, Aidan Behilo, the team identified a historical landmark at the intersection of Route 149 and Route 82 that may be impacted by the redesign. The original location of the Nathan Hale Schoolhouse, along with a bust of Nathan Hale, is in the middle of the intersection as seen in Figure 24. While the squared intersections redesign only impacts a portion of this existing grass area (see Figure 21a), grading work to construct the intersection may impact the landmark. Depending on how the town views the significance of the original location, modifications may have to be made to the redesign at its eastern end if the entire grass area needs to be preserved.

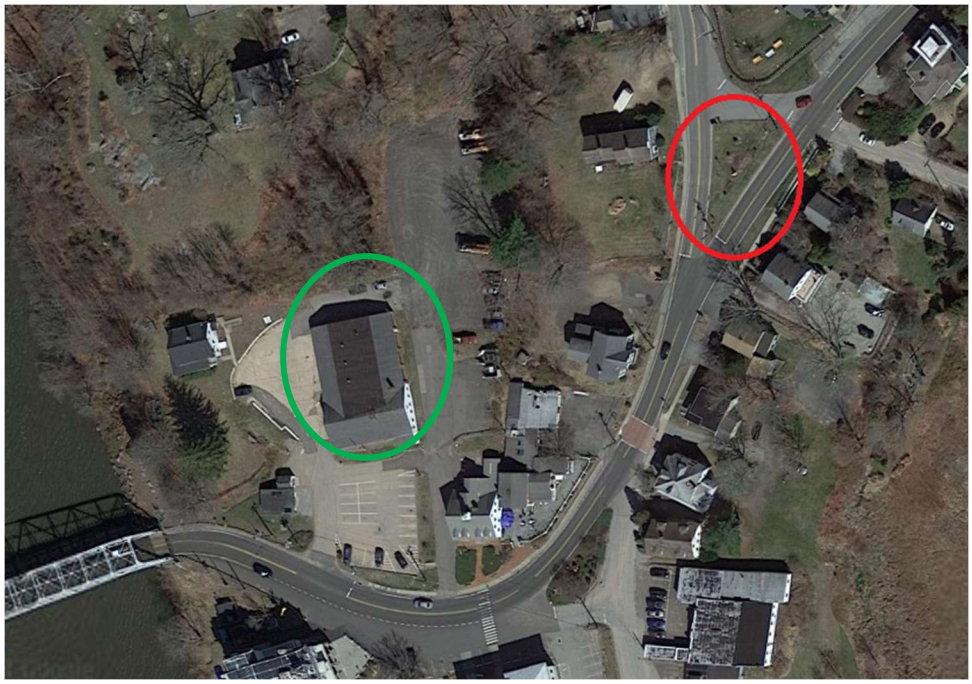
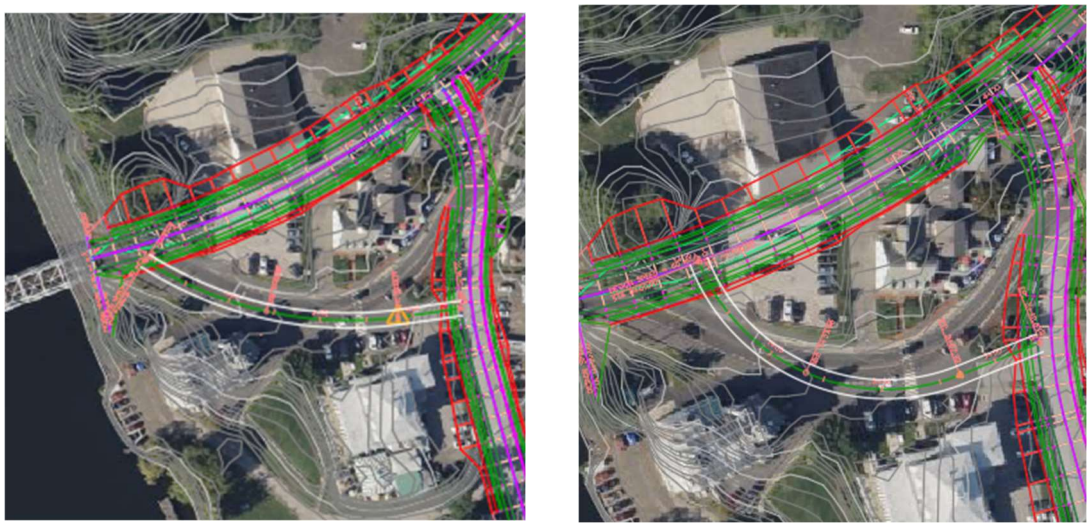


Figure 24. The location of the Nathan Hale Bust and original location of the historical Nathan Hale School House (red circle) and the contaminated building and soil on the town property (green circle).

An additional consideration is the environmental contamination located on the town-owned property at the site of the former town garage, as seen in Figure 24. The building itself is believed to be contaminated with asbestos while the surrounding soil may be contaminated with arsenic based on preliminary sampling. The town currently has plans to demolish the garage prior to any redevelopment. With the squared intersections design, the roadway would travel over the remaining contaminated soil. The team recommends additional testing on the soil be completed to determine if arsenic is the only contaminant of concern and to determine a more exact area of contamination. Once complete, assuming arsenic is the only contaminant, the team recommends the contaminated area be capped and used exclusively for the roadway and parking to save costs and time on the redevelopment.

5.2 Roadway Modifications Based on CTDOT Standards

Everything about the final design was compliant with CTDOT standards except the intersection radius. The radius at the intersection connecting Route 82 and the drop-off lane was also too small in the initial version of the final design, so it was squared off more to be compliant with the 60’ minimum radius to accommodate large, left-turning vehicles such as buses as seen in Table B1 (CTDOT, 2023). The change in design can be seen between Figure 25a (before) and 25b (after). The updated and finalized squared intersections plan requires about 15,000 cubic feet of soil to be removed as seen in Figure 26.



Figures 25a & 25b. The Squared Intersections Plan before (a, left) and after (b, right), conforming to meet the minimum curve radius.

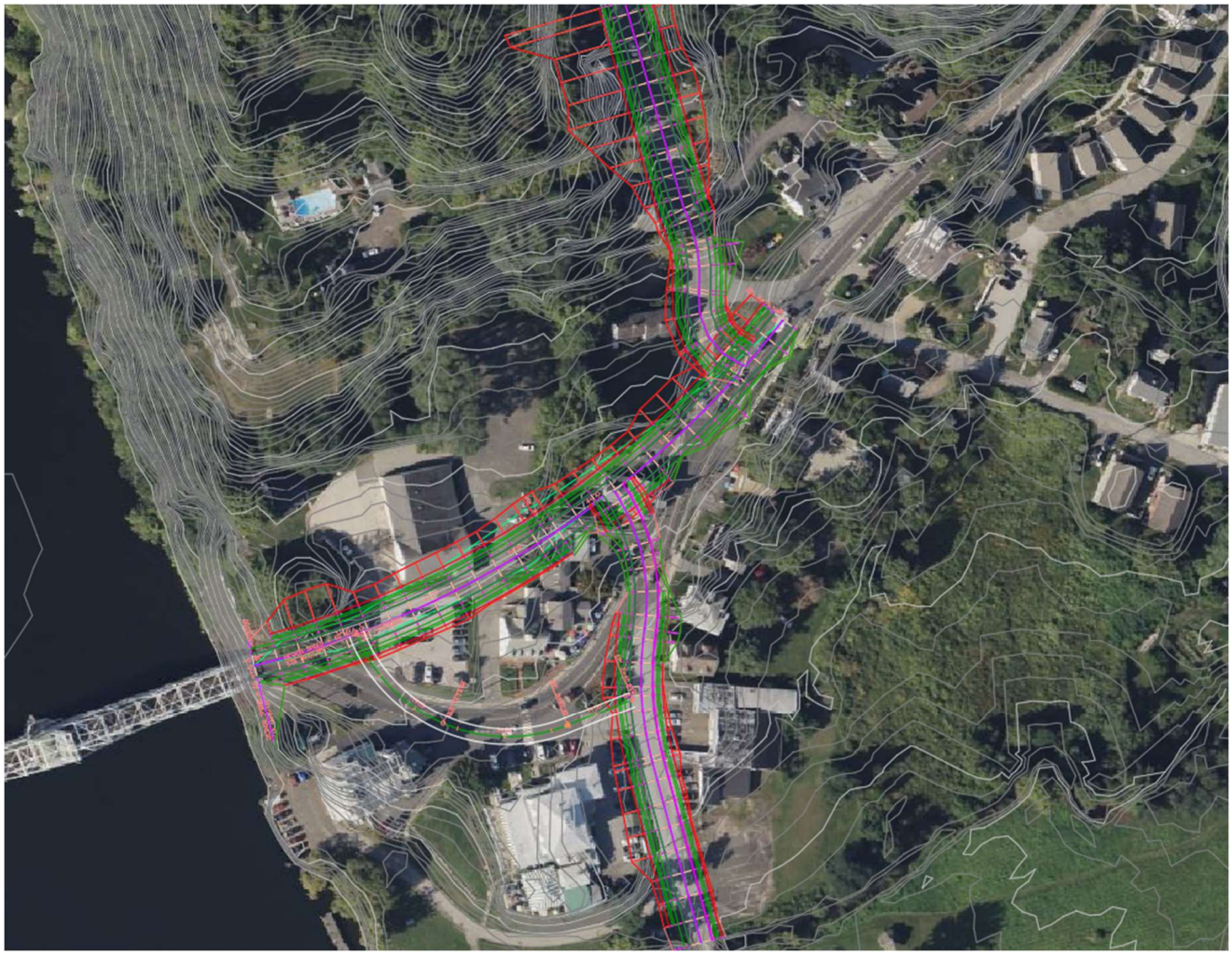


Figure 26. The final Civil3D rendering of the squared intersections redesign option for the EHVD with the new highway corridor, along with the new grading areas required for the redesign, with the red areas showing cut needed, and the green areas showing fill needed.

5.3 Redevelopment Considerations

The remaining area surrounding the new roadway can be utilized for a variety of redevelopment options based on the town's plans and desires for the village district. The team has divided the town-owned land not being used in the roadway redevelopment into five sections as seen in Figure 27.

Figure 27. Areas for redevelopment in the EHVD under the squared intersections plan.

Each area has different options to add development to the village.

- Area 1, or the location of the existing town garage and surrounding soil, would need to be capped due to arsenic contamination in the soil. This area would best be used as a parking lot or green space, as any buildings planned for this area would require contaminated soil removal.
- Area 2 is an existing parking lot that could stay as a parking lot or be redeveloped into commercial or residential buildings.
- Area 3 is the traffic island and roadway in the existing three-way intersection of Route 82 and Route 149. Any roadway work done on the southern and western areas of the island may require the historical marker to be moved slightly further from the EHVD, which would be possible with the new redevelopment space.
- Area 4 is the largest and most central redevelopment area that could have the most options for redevelopment. This area does contain some privately-owned properties, but the town may choose to purchase those if they wish to make this area a green space or residential development. It may also be used for commercial development, potentially boosting the economy of the downtown area with shops. Area 4 may be used for parking if the town believes proximity of parking to the Goodspeed properties is most important.

- Area 5 is new area in front of the Goodspeed Opera House. It could be used for a widened drop-off lane, handicap parking, or additional green space.
- Finally, Area 6 contains a historic house that may limit redevelopment. It would also likely be the new home of the bridge generator that would need to be relocated for the roadway. Any additional space in this area could be an extension of the parking lot or green space from Area 1.

5.4 Construction Sequencing

For the chosen design, construction should be carried out in three general phases to minimize traffic disruption. The first phase, as seen in Figure 28, would be to construct the new Route 82 corridor through the existing town parcels to reduce the curved radius coming off the bridge to create a safer flow of traffic. Once the new roadway is completed, the existing intersections with the new corridor would need to be repainted to allow for traffic flow with the new roadway geometry. During phase 1, traffic can use the existing Route 82 Corridor while construction is completed on the new corridor.

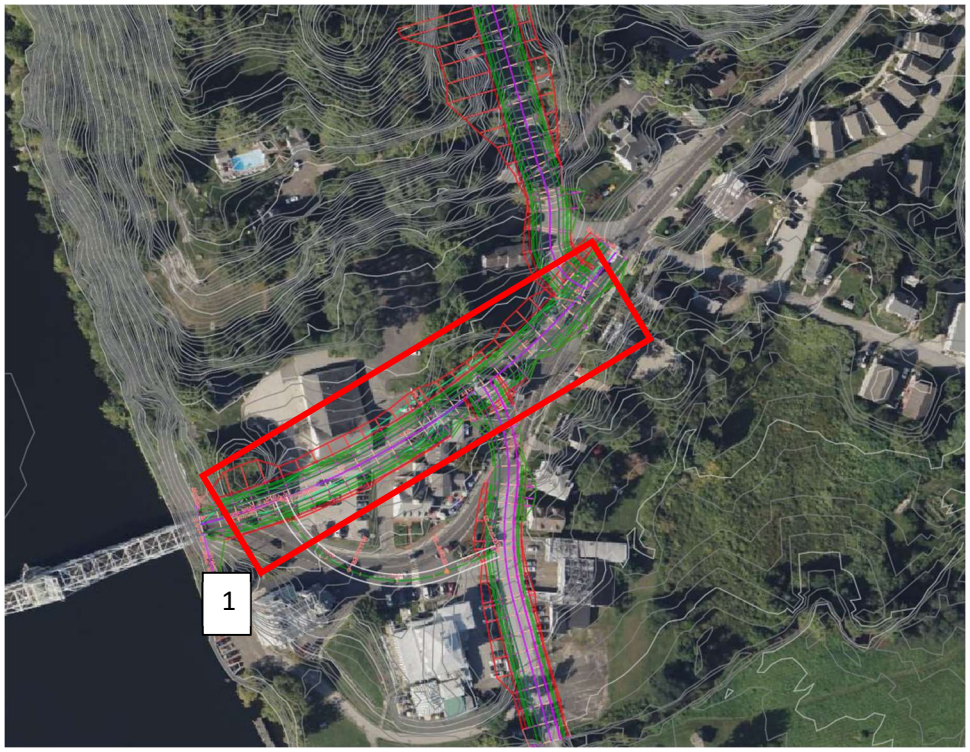


Figure 28. The first phase of construction of the proposed design is highlighted in red.

The second phase of construction, seen in Figure 29, is to realign the lumberyard road intersection with the newly constructed Route 82. This section of Lumberyard Road can be

closed, as Lumberyard Road could be accessed through the old Route 82 Corridor during construction. Once Lumberyard Road and the corresponding intersection are realigned, stop signs can be installed on Lumberyard Road to control traffic coming onto Lumberyard Road. Between phase 2 and phase 3, normal traffic can resume while construction staging takes place for stage 3.

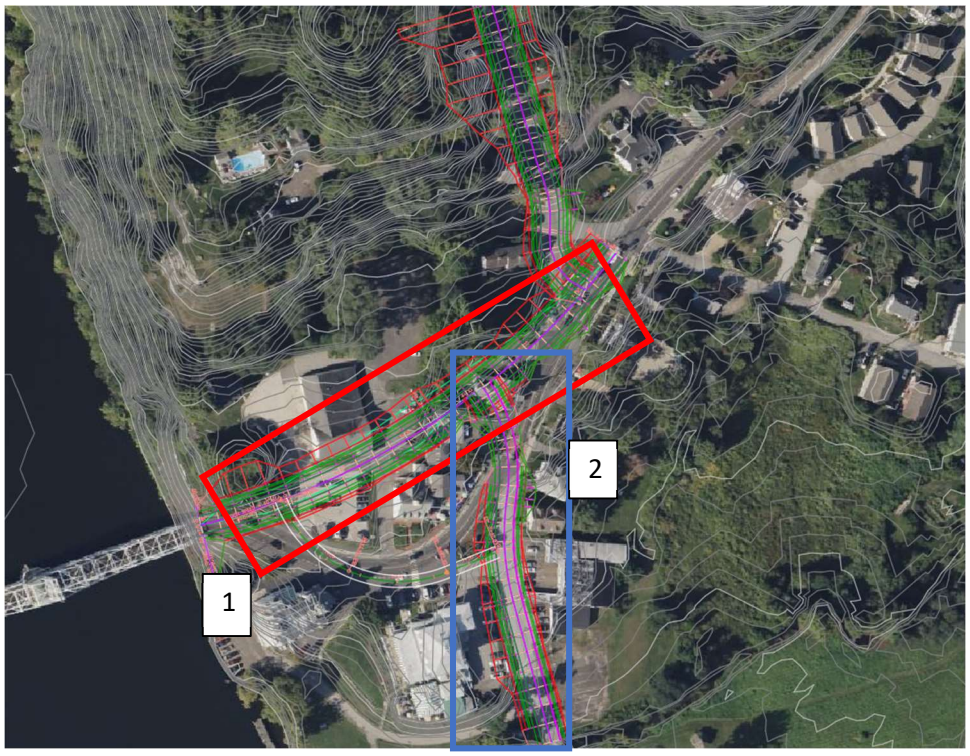


Figure 29. The second phase of construction of the proposed design is highlighted in blue.

The third construction phase of the proposed design, seen in Figure 30, would be the most disruptive to normal traffic. This construction would have to close one lane at a time, then realign one lane, so one lane could stay open for through traffic, as to not close Route 149 completely. This would require the installation of temporary signals to allow traffic to flow through the one lane section of the road. Once the roadway is realigned, new traffic signals would need to be installed to control traffic flow between Route 149 and Route 82. Once this is completed, traffic can flow as usual. The existing Route 82 corridor can be constructed solely into a drop off lane, and the rest of the land can be redeveloped.

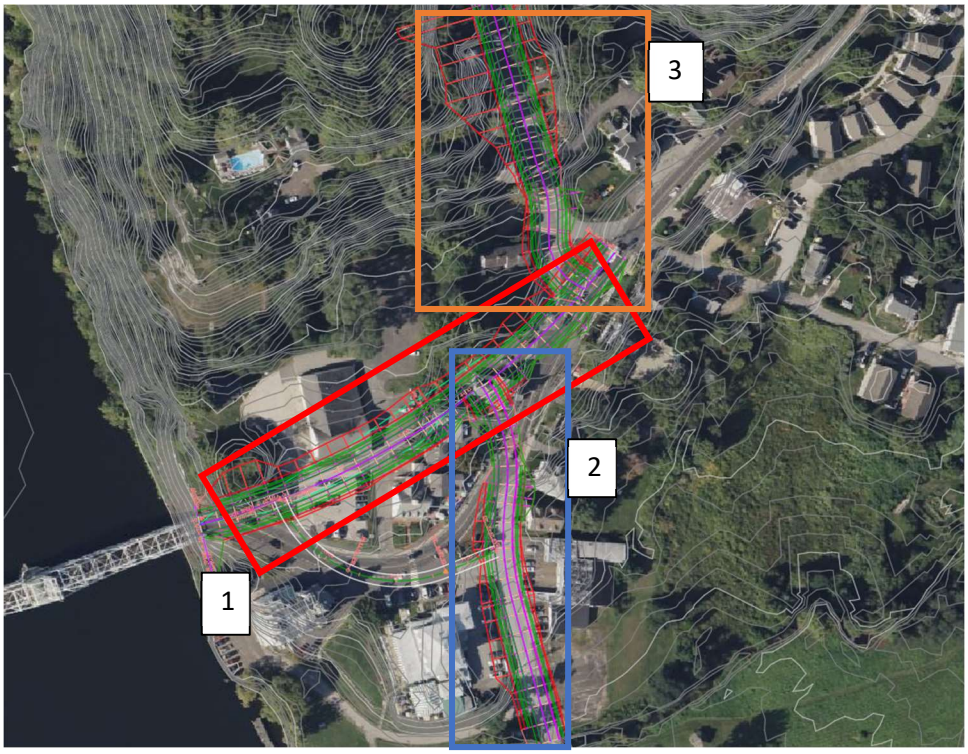


Figure 30. The third phase of construction of the proposed design highlighted in orange.

5.5 Cost Estimate

The cost estimate for the Squared Intersections Plan is based off the Route 66 at Route 151 intersection improvements. The example is provided by the Lower Connecticut River Valley Council of Governments, which is an intersection where the roadway is being widened and new signals are being installed. For our chosen design, it is estimated at 5.59 million dollars as seen in Table 8. The estimate was based on a project of similar scale, which was an intersection redesign from the Route 66 Corridor Study. This cost estimate is from the Lower Connecticut River Valley Council of Governments (RiverCOG) and is estimated to be 4.2 million for a smaller intersection seen in Table 9 (RiverCOG, 2023).

Table 8. A Cost Estimate for the Squared Intersections Roadway Redesign.

Type	Total
Excavation	$20,388
Rock Excavation	$5,400
Traffic Signal	$450,000
Pedestrian Push Button and Sign	$5,440
Utility Pole Relocation	$150,000
Concrete Curbing	$150,000
Concrete Sidewalk	$150,000
Subbase	$15,000
Concrete	$400,000
Subgrade	$3,000
Asphalt	$1,400,000
Pipes and Sewer	$20,000
Clearing and Grubbing	$60,000
Mobilization	$424,384
Minor Items	$707,307
Incidentals	$813,403
Contingencies	$813,403
Total	$5,587,725

The reference cost estimate completed by Tighe & Bond at a similar, nearby site can be seen in Table 9.

Table 9. A sample Cost Estimate from the Route 66 Corridor Study from RiverCOG.

Tighe&Bond
Engineers | Environmental Specialists

Prep'd Date 3/23/2020 By A. Weber
Ch'kd Date 4/10/2020 By M. Stoutz
Town of Portland & East Hampton, CT
Project No. 21-5001-001
Sheet No. 1 of 1

Opinion of Probable Cost for the Construction of
Route 66 Transportation Planning Study Improvements
Concept A-3 - Main Street at Marlborough Street

Item	Unit	Quantity	Price	Amount
Earth Excavation	CY	300	$35.00	$10,500
Rock Excavation	CY	30	$135.00	$4,050
Formation of Subgrade	SY	500	$5.00	$2,500
Subbase	CY	200	$50.00	$10,000
Sedimentation Control System	LF	300	$6.00	$1,800
HMA S1.0	TN	150	$150.00	$22,500
HMA S0.50	TN	2,200	$155.00	$341,000
Milling of Bituminous Concrete 0-4"	SY	18,000	$16.00	$288,000
12" R.C. Pipe	LF	50	$75.00	$3,750
Concrete Curbing	LF	3,500	$35.00	$122,500
Concrete Sidewalk	SF	6,100	$20.00	$122,000
Concrete Sidewalk Ramp	EA	12	$1,350.00	$16,200
Furnishing And Placing Topsoil	SY	1,000	$8.00	$8,000
Turf Establishment	SY	1,000	$2.00	$2,000
Utility Pole Relocation	EA	2	$10,000.00	$20,000
Landscaping	LS	1	$10,000.00	$10,000
Type "C" Catch Basin	EA	1	$3,750.00	$3,750
Manhole	EA	1	$3,750.00	$3,750
8' Aluminum Pedestal	EA	8	$600.00	$4,800
1 Way Pedestrian Signal Pedestal Mounted	EA	8	$600.00	$4,800
2" Rigid Metal Conduit In Trench/ Roadway	LF	200	$13.00	$2,600
Pedestrian Push Button and Sign	EA	4	$340.00	$1,360
New Traffic Signal	LS	1	$450,000.00	$450,000
Major Signal Modification	LS	1	$100,000.00	$100,000
Sub-Total				$1,606,000
Lump Sum Items				
Clearing and Grubbing (3%)				$48,200
M&P of Traffic (5%)				$80,300
Mobilization (7%)				$112,400
Construction Staking (2%)				$32,100
Minor Items (25%)				$402,000
Incidentals (25%)				$470,000
Contingencies (25%)				$470,000
Total				$3,221,000

5.6 Conceptual Plan

The team created a conceptual plan of the final design as seen in Figure 31, complete with utility poles, pedestrian safety measures, and stormwater infrastructure for the downtown. The new roadway would cut through an area that has steep gradients, thus creating a need for runoff control measures.

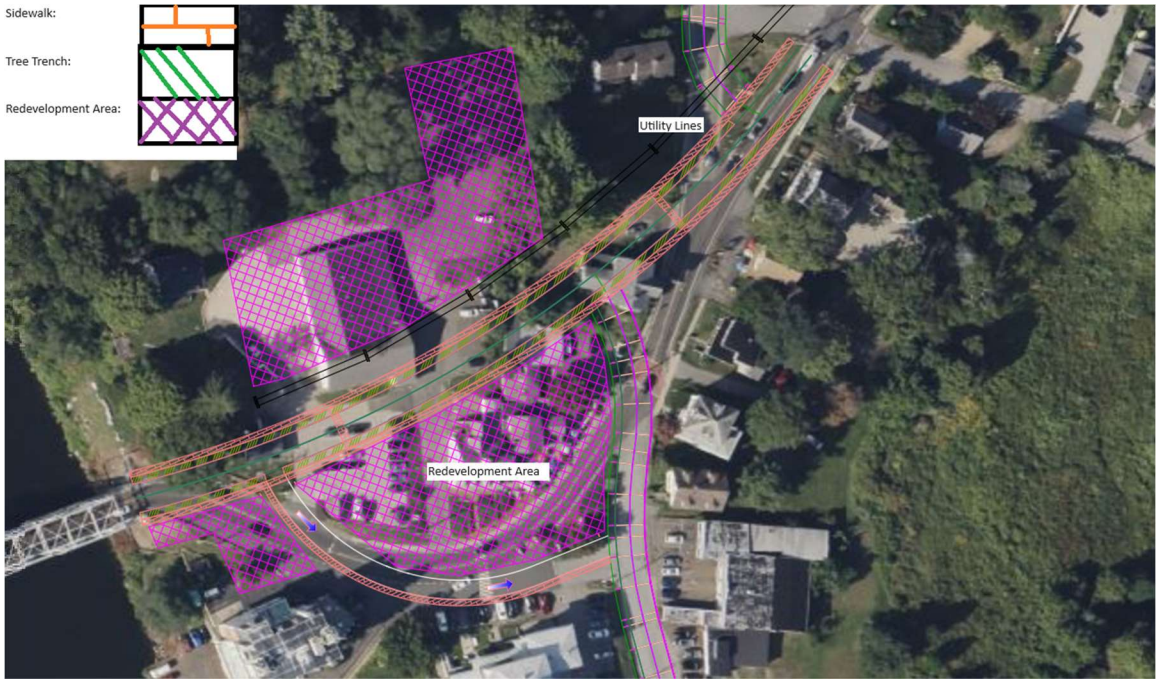


Figure 31. The Conceptual Road Design of the EHVD showing tree trench locations, sidewalks, and development areas.

The team utilized green infrastructure to address runoff, including a covered tree trench running along the roadway between the road and the sidewalk, adding new trees to the area while also maximizing the infiltration area along the roadway. This was identified as the best infiltration tool, as it adds another layer of safety for pedestrians on the sidewalk. Other green roadway modifications such as porous concrete are not ideal for high-volume traffic areas. The team also recommends installing break-outs under the new roadway, which replace compact native soil with more porous structural soil under the roadway to further increase infiltration and provide trees with more space to extend their roots in tighter urban areas, such as the EHVD (The Conway School, 2014). These two measures combined would be easy and inexpensive to add to the roadway during construction and improve infiltration in an area that will have a large increase in paved surfaces.

6.0 Next Steps

With this finalized design, the EHRA and the town of East Haddam can start the process of requesting this major reconstruction project to commence. The first steps include project initiation, where resources such as funds and personnel are distributed to work on developing the project. East Haddam has begun this process with the East Haddam Redevelopment Agency, and the Redevelopment Agency could begin the next step, the studies phase. This phase was started by the MQP project but would need more information before Connecticut DOT would begin the preliminary design of the project. The town would need to complete a corridor evaluation, environmental tests, demand projections, and complete conceptual and functional designs for the project. Before Connecticut DOT takes the project, the East Haddam Redevelopment Agency would need to determine every variable involved with the project to make the project development process as smooth as possible, and to identify the key problem that is the source of the project. Next, East Haddam would have to secure funds from the Federal Highway Administration to fund the project. Once this is completed, the project can be passed on to CTDOT where they would begin a preliminary design, which consists of creating multiple alternatives to solve the problem that East Haddam outlined, and involves a series of new designs, along with a no-build alternative. Once the preliminary design is completed by CTDOT, the project would move into the final design, where one of the alternatives is picked and refined. Lastly, the project would move into the contract development phase where the project is bid out to contractors and engineering firms who will bring the project to completion.

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Appendix A: Proposal

WPI

East Haddam Roadway Redesign

East Haddam Village District

East Haddam, CT

Major Qualifying Project Proposal

October 12th, 2023

Jack Perriello

Aaron Swann

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Sponsor

East Haddam Redevelopment Agency

Capstone Design

The Major Qualifying Project (MQP) at Worcester Polytechnic Institute (WPI) is a team-based, professional-level design or research experience that is the culmination of the undergraduate curriculum. In the Department of Civil, Environmental, and Architectural Engineering, the MQP fulfills the capstone design requirement of the Accreditation Board for Engineering and Technology (ABET), which accredits WPI's engineering B.S. programs. A key aspect of the ABET capstone design requirement is the application of physical design constraints on a real-world engineering project through the needs of the project as well as its relation to stakeholders. ABET suggests eight elements that must be considered by this project in order to fulfill the capstone design requirement. This project, which aims to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, creating a safe area for all modes of travel and supporting future development, addresses the eight constraining aspects through the following guidelines:

Economic: First, a preliminary construction cost analysis will be conducted in order to gauge the economic feasibility of all roadway redesign options. Cost effectiveness will assist in the decision-making process for which redesigns make the most efficient improvements for the evaluated cost. Once a design is chosen, cost analysis will be completed for the town to build any recommended roadway or pedestrian access improvements. This project will consider the costs of construction, environmental remediation, potential building relocation or demolition, and implementation as well as sources of funding to give the town the best estimation for the selected redesign.

Environmental: Suggested improvements to the East Haddam Village District, Connecticut State Routes 82 and 149, and local roadways will be designed with the intention of not adversely affecting the environment. The team will also work to improve pedestrian access throughout the village to reduce car usage. Additionally, the contaminated structures and soil located on the former Town Garage and Town Hall land in the village will be major considerations in redesign, potentially with plans for remediation.

Social: The intent of this project is to improve the usability of CT State Route 82 and connected roadways in and around the East Haddam Village District for regional commuters, tourists, residents, local workers, as well as others who utilize this roadway. Additionally, the project

aims to improve the safety of the downtown area for pedestrians visiting the historical attractions. Concerns of the residents of East Haddam and the surrounding area will be factored into the final redesign, with the goal to ensure the design is a community-driven solution.

Political: The team will collaborate with the Connecticut Department of Transportation, the East Haddam Redevelopment Agency, the Town of East Haddam, as well as potentially other stakeholders such as the Lower Connecticut River Valley Council of Governments. Through these collaborations, the team plans to modify the state highway design to improve traffic flow and pedestrian access while meeting state highway, local roadway, zoning, and any other relevant guidelines and regulations.

Ethical: The team will not threaten the reputation of WPI nor put the East Haddam Redevelopment Agency at risk. Before a final design is proposed, it will be discussed with the Connecticut Department of Transportation as well as the East Haddam Redevelopment Agency to ensure it meets necessary standards. All decision-making and project elements will be made in compliance with the ASCE Code of Ethics.

Health & Safety: The redesign of the roadway, pedestrian access, and parking in the East Haddam Village district will serve to increase safety and create a safer environment for drivers, passengers, and pedestrians. The team will ensure this through design by mitigating sharp curves in the roadway, expanding sidewalk size to meet state highway standards, adding more pedestrian traffic features including crosswalks, and adding traffic calming measures to reduce the risk of accidents in the village.

Constructability: The team will assess previous design proposals for the roadway through the East Haddam Village District and will propose new roadway and intersection designs. Both the previous proposed designs and the team-created ones will be analyzed in regard to cost, maintenance, construction time, necessary building demolition and relocation, environmental constraints, and stakeholder feedback. Based on these considerations, the team will finalize and propose one roadway redesign solution to the East Haddam Redevelopment Agency.

Sustainability: The roadway redesign aims to improve traffic flow and pedestrian accessibility for current day needs as well as projected future needs based on expected growth in traffic at the historical attractions in the village as well as on the portion of Connecticut State Route 82 through the village. The goal is to create a roadway redesign that will serve the village for many years into the future.

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1.0 Introduction

East Haddam, Connecticut is a rural town located along the Connecticut River in the southeastern area of the state. The town is best known for the East Haddam Village District (EHVD), seen in Figure 1. The historical village of the town is adjacent to the banks of the river and the East Haddam Swing Bridge, the longest swing bridge in the world. The EHVD has been listed in the National Register of Historic Places since 1983 due to its historically significant buildings and landmarks as well as the prominent role of the district in local, state, and even national history (National Parks Service, 1983). The Goodspeed Opera House, located adjacent to the Connecticut River in the village, was built in 1876. Goodspeed still produces musicals here today, as well as performing multiple shows per year multiple times a week. It has become a major historical landmark in Connecticut and the world of musical theatre. The Gelston House, adjacent to the Goodspeed Opera House, is a famous restaurant and hotel built in 1736 that still operates under the owners of the opera house today (The Town of East Haddam, n.d.). The back of the Gelston House contains a beer garden, a popular spot for local nightlife, and a green area that hosts summer concerts. Goodspeed owns many other properties near the EHVD used for actor housing, storage, and office space (East Haddam Redevelopment Agency (EHRA), personal communication, September 14, 2023). These two historical buildings and the swing bridge attract visitors to the village today.

The EHVD is the focus of the town today, with talks of redevelopment occurring for the past twenty or so years. For the residents of East Haddam, the main concern regarding the area is parking for the Goodspeed-owned attractions as well as traffic through the area. The swing bridge is a part of Connecticut State Route 82 and is the only river crossing within 15 miles or 25 minutes both north and south along the river, making it a critical route for commercial vehicles as well as residents of East Haddam and surrounding towns. Within a tenth of a mile after the bridge within the EHVD, the route also meets Connecticut State Route 149. Between the bridge and this intersection are the Goodspeed attractions and town parking areas, as well as other local shops and restaurants. Route 82 also has narrow lanes and sharp curves through the EHVD. Thus, the traffic issues need to be addressed by a reworking of the roadway system through the EHVD prior to planning for the revitalization of downtown area. In addition to these concerns, construction on the 110-year-old bridge to add sidewalks and make repairs began in fall 2022 and is expected to continue until the summer of 2024. The construction includes complete bridge

shutdowns, timed openings of the bridge, and constant single lane closures which significantly worsen the traffic within the EHVD due to backup for vehicles waiting to cross (East Haddam Swing Bridge Project, 2023).

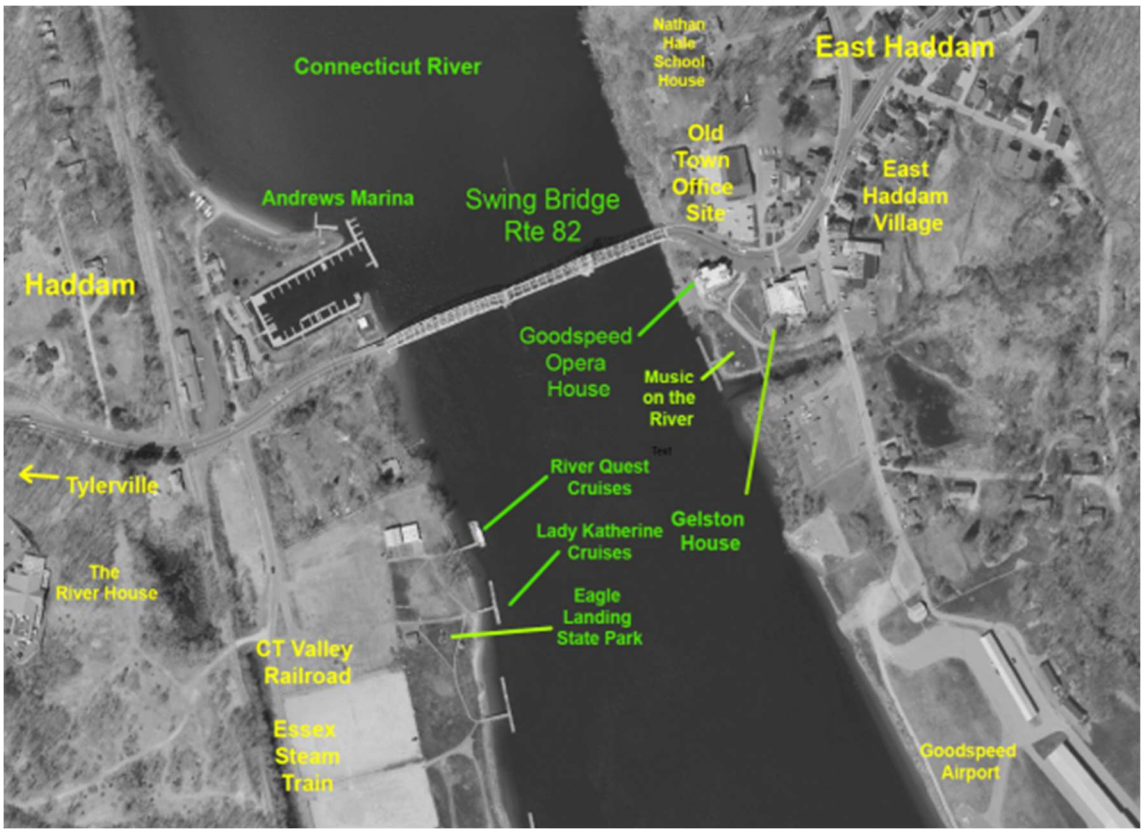

Figure 1. Overview of East Haddam Village District (Top Right) and the surrounding area (Town of Haddam, 2020).

The goal of this project is to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, creating a safe area for all modes of travel and supporting future development.

The objectives include:

5. Understand the existing conditions of the East Haddam Village District and the CT State Route 82 through the village.
6. Produce differing design options to create a safer and more supportive East Haddam Village District.
7. Test each of the design options in various aspects.
8. Select and finalize the preferred design option.

2.0 Background

The East Haddam Village District has a long history of unsuccessful redevelopment plans, which have yielded minimal to no success. This background details the past attempts at redesign, the existing properties in the East Haddam Village District, and current ideas and plans for redevelopment.

2.1 Early Redevelopment Studies and the EHVRC

Starting in 2000, the town-owned garage was vacated, leading to questions about environmental safety, mainly in connection with the USTs. In 2004, the EHVD had a traffic improvement study conducted by Fuss & O'Neill, which yielded a signalized intersection, but no other plans were enacted. In 2006, a study on site reuse was conducted, prompted by a relocation of town offices to an old middle school building. The recommendations that came out of the study were to not "load the site with the greatest amount of development" and "utilize the site to maintain the character of the village" (Behilo, 2023). Preliminary information was gathered, such as background data collection, resident visions, conceptual site plans, and a financial analysis, but no plans followed (Behilo, 2023).

In 2008, the East Haddam Plan of Conservation & Development was updated to include future development of the EHVD, office site, and expansion of the opera house as this "could create the critical mass that would sustain significant economic growth" (Behilo, 2023). Following this updated plan, the first iteration of the East Haddam Village Revitalization Committee (EHVRC) was formed in 2009. One of the first plans submitted to the EHVRC was a plan proposed by Rob Smith, which planned to straighten out the roadway between the East Haddam Swing Bridge and the Route 82 and Route 149 intersection, as seen in Figure 2. This would have cut across the old Town Hall and Garage property as well as at least one currently privately owned parcel (Smith, n.d.). No action was taken with this plan.

Figure 2. The proposed roadway redevelopment by Rob Smith (Smith, n.d.).

In 2010, the EHVRC and Fellner Associates collaborated on a design plan for redevelopment, but no plans came to fruition as no bids were received. For 3 years, the EHVRC was unsuccessful in developing plans, and was dissolved in 2013, though it was reformed in 2017. In 2018, the town offices once again moved, this time into a new municipal building (Behilo, 2023). The EHVRC soon held a community hearing to hear the thoughts of residents regarding the revitalization efforts and what direction they should take.

2.2 The Centerbridge Group and the EHRA

In 2019, the Centerbridge Group was co-founded by Jeff Riley, who was Quinnipiac University's chief architect for over 40 years. In 2019, a request for proposal was sent out, but the Centerbridge Group was the only group to submit a proposal, which proposed a mixed-use development. Throughout 2020 and 2021, the citizens became concerned about how scope of the project would interfere with the character of the EHVD and local, preexisting businesses, and that it did not rectify their primary concerns of traffic congestion or parking. These resident concerns caused the Centerbridge Group to pause their efforts in late 2021. Sometime in 2022, the ENVRC was once again dissolved, and the East Haddam Redevelopment Agency (EHRA) was formed. Presently, the EHRA has several subcommittees for environmental assessment, project management, TIF consulting, finance, and grant writing. This is in an effort to attract developers by committing resources to site improvements (Behilo, 2023).

On December 8th of 2022, the Centerbridge Group proposed a public and private partnership that outlined a redevelopment plan with new features and more details. Although the Centerbridge Group permanently pulled out due to Jeff Riley's retirement in early 2023, the EHRA still utilized the plan as a reference for downtown development. The plan begins by listing the existing challenges of the site, with one being environmental remediation due to previous contamination of the soil around the old Town Garage. It lists the total project upfront costs at $13,485,596 adjusted for inflation in 2025 (Centerbridge, 2022). Along with the environmental remediation, it includes tasks like property acquisitions, site clearing, demolitions, and creation of new town utilities. The plan then goes into detail about Route 82 improvements and lists the cost at $9,240,000 adjusted for inflation in 2025. This included tasks such as relocating the Connecticut State Bridge Easement for the swing bridge generator, burying 2000 linear feet of power lines, replacing sidewalks, and general quality of life improvements for pedestrians along Route 82. The plan then detailed the overall master plan for East Haddam, which is a mixed-use development to help drive the residential, condo, and hotel market that plans to target six separate demographics (Centerbridge, 2022). The developer planned to create an amenity rich environment, with a mix of commercial and residential uses, that maintains the town's character in its architecture, while promoting a walkable environment. The overview of the master plan is shown in Figure 3, with each of the building uses marked.

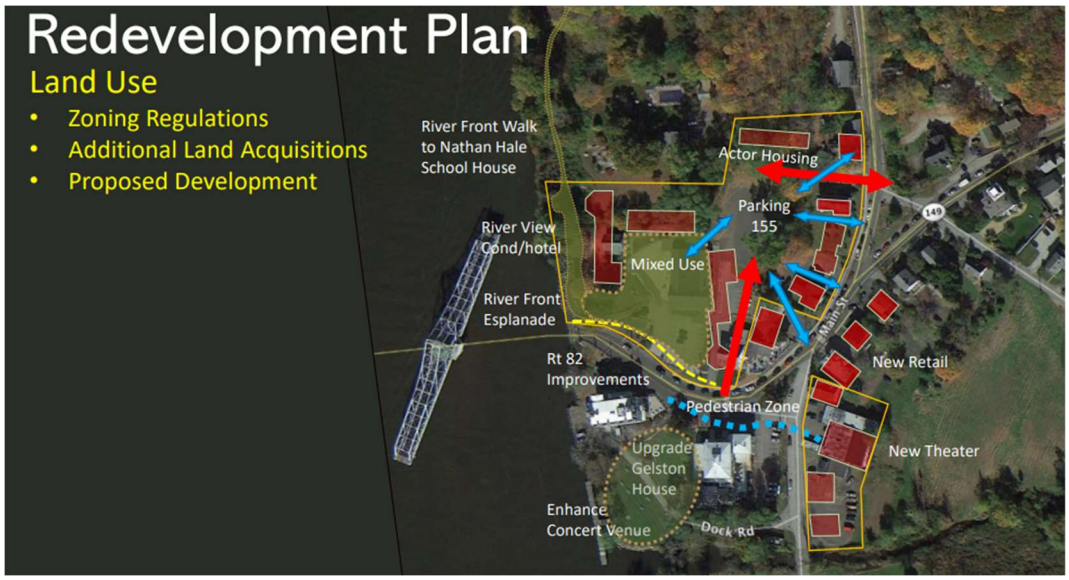

Figure 3. Centerbridge Group Redevelopment Plan (Centerbridge, 2022).

2.3 Traffic Issues through the EHVD

While the EHRA is still considering the plan from the Centerbridge Group, the town recognizes that it does not meet the roadway redesign measures to create a safer downtown area with better traffic flow without diminishing the historical character of the EHVD. The EHRA is open to other roadway redesign plans, as this is the most important aspect of the redevelopment of the village according to many residents (East Haddam Redevelopment Agency (EHRA), personal communication, September 14, 2023).

The major concern for the town regarding the current state of the downtown area as well as any future redevelopment plans is the traffic issues. The roadway design is already dangerous, as tractor trailers cannot easily navigate through the downtown area with the two major sharp turns in the road. Heavy traffic is constant as the roadway, Connecticut State Route 82, is the only roadway crossing of the Connecticut River in about 15 miles in either direction. Additionally, Route 82 meets Connecticut State Route 149 at the northern edge of the EHVD, which adds additional traffic to the area. The Goodspeed Opera House performs multiple shows per week, including nightly shows on the weekends and some weekdays, which make the area even more congested. The East Haddam Swing Bridge has undergone a repair and modification project which has further impacted traffic flows since the beginning of 2021. This construction includes multiple overnight and 63-hour complete road closures, which deviate traffic from the area and make entering the EHVD worse as there will only be one road in. The single lane closures, which will be a constant throughout the duration of the project, also significantly backup traffic. When complete, the roadway on the bridge will have a bike lane and pedestrian lane, connecting a large parking lot located on the Haddam side of the river to the EHVD, potentially aiding village development (EHRA, personal communication, September 14, 2023). The Connecticut Department of Transportation (CTDOT) currently has no plans to modify the initial exit off the bridge into the EHVD to mitigate the traffic impacts and provide a safer entrance and exit to the bridge (K. Larose, CTDOT, personal communication, September 26, 2023).

Pedestrian accessibility, including sidewalks and crosswalks, is a current issue as well. There currently are only two pedestrian crosswalks within the EHVD, one located between the town-owned property and the Gelston House, and one up the road closer to where Route 82

meets Route 149, as seen in Figure 4. Thus, many people who arrive for shows try to cross the street closer to the opera house and the swing bridge, which has proven to be extremely dangerous as vehicles exiting the bridge have limited visibility. Additionally, cars and buses will attempt to drop people off in front of the opera house prior to shows, but there is currently no real area off the roadway to do so. This danger is increased due to poor roadway lighting, especially when the musicals end late at night. The sidewalks are also very narrow and require updating (EHRA, personal communication, September 14, 2023).

Figure 4a (left) and Figure 4b (right). Narrow sidewalk on southbound lane of Route 82 in the EHVD (Swann, September 14, 2023).

2.4 Constraints in the EHVD

Another factor that needs to be considered when redeveloping the roadway is environmental concerns. The Town of East Haddam owns two properties across the street from the Goodspeed Opera House within the EHVD which currently contain the old Town Garage and old Town Hall buildings. The structures are not structurally sound and will be demolished, yielding more space for redevelopment (EHRA, personal communication, September 14, 2023). However, there exists heavily contaminated soils containing lead, arsenic, and polychlorinated biphenyls (PCBs) from former underground storage tanks (USTs) and storage of other potentially hazardous materials on site. The existing structures also contain asbestos and lead-based paint. Any plans to potentially utilize the area for parking or roadways would require soil and floor slab removal, building demolition, and subsequent environmental monitoring (Eagle Environmental, Inc., 2023). In April 2023, Vanesse Hangen Brustlin (VHB) began work to acquire a grant from the Connecticut Department of Economic & Community Development for environmental assessment and remediation work on behalf of the town (Behilo, 2023). The project received a $200k grant for arsenic testing at the site, which is projected to begin in late

2023. Once the testing is complete and the scope of remedial work is established, VHB and East Haddam will apply for another grant for remediation (EHRA, personal communication, September 14, 2023).

Many of the structures within the potential redevelopment area present another challenge for roadway modification as labelled in Figure 5. First, the generator for the swing bridge is located between the old Town Garage and the bridge. This state-owned property would need to be moved if the roadway were to be straightened immediately after exiting the bridge. On the town-owned parcel that contains the old Town Garage, there exists a white house on the northwestern corner of the property that is a part of the historical district, meaning that it cannot be demolished and would need to be relocated if redevelopment plans utilize the area. Other properties adjacent to this town-owned site include 9 and 11 Main Street, properties containing buildings that are currently vacant, 17 Main Street, a building owned by Goodspeed that houses actors, and 19 Main Street, a vacant former ice cream shop. Additionally, the one property on Broom Road, which abuts the town property to the north, is a privately owned site (EHRA, personal communication, September 14, 2023). One or more of these properties may need to be purchased or utilized for the modified roadway.

Figure 5. An overview of the parcels in the East Haddam Historic District (EHRA, n.d.).

2.5 Vision for the EHVD

While there are currently no plans in place for EHVD redevelopment, the EHRA and the residents of East Haddam have a vision of what they hope the downtown will become. The EHRA wants a high-density, mixed-use area with structures 3-4 stories high that includes sufficient crosswalks, sidewalks, drop-off areas and river access all while creating a roadway that minimizes traffic impacts and allows for a safe drive through the EHVD (EHRA, personal communication, September 14, 2023). The team recognizes that through the creation of a roadway redesign that aids traffic flow, improves pedestrian accessibility and safety, and creates a drop-off area and sufficient parking is key before any commercial redevelopment plan is considered.

3.0 Methodology

The goal of this project is to design a traffic redevelopment plan for the historical downtown village of East Haddam, Connecticut, creating a safe area for all modes of travel and supporting future development.

The objectives include:

5. Understand the existing conditions of the East Haddam Village District and the CT State Route 82 through the village.
6. Produce roadway design options for a safer and more supportive East Haddam Village District.
7. Evaluate each of the design options in various aspects.
8. Select and finalize the preferred design option.

A schedule detailing these objectives is seen in Figure 6 below.

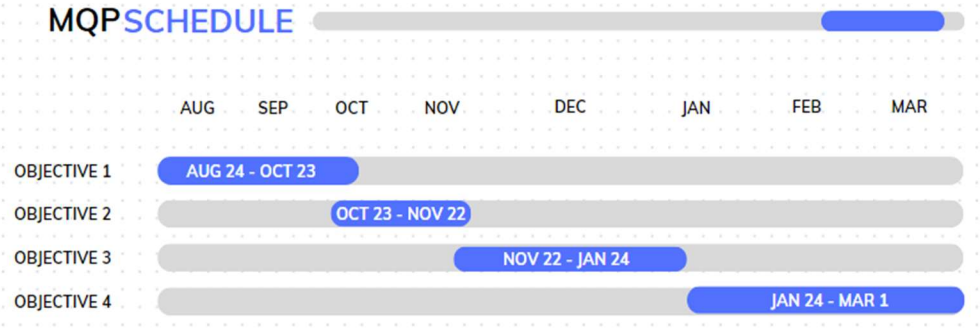

Figure 6. An overview of objective completion timeline.

3.1 Objective 1: Understanding Existing Conditions of the EHVD

In order to determine the effectiveness of any roadway redesign, research into the existing conditions of the roadway and the surrounding area is necessary. Regarding traffic information, the road that runs directly through the EHVD is a state road, Connecticut State Route 82. Thus, the Connecticut Department of Transportation (CTDOT) has extensive traffic data over the years for various points in and around the EHVD. This data is available through the CTDOT Traffic Monitoring Station Index online, which provides traffic counts at various locations along state roads. The data provides information from various traffic studies at a certain point completed in the 21st century including hourly vehicle counts, vehicle type, and recorded speeds of vehicles in both directions as well as separated by direction at the point along the roadway. Existing data including the annual average daily traffic, average speed separated by direction, and the peak traffic hour per day will be utilized by the team to understand the traffic flow in the area.

The team will also assess conditions surrounding the roadway in the EHVD. This will include further correspondence with the EHRA and review of previous EHRA meeting minutes

to determine the feasibility of a redesign project as well as the up-to-date status of the former Town Hall and other buildings that may need to be moved or demolished with a roadway redesign. The team will also continue research on the reports regarding the former Town Hall and Town Garage, located at 1 & 7 Main Street, which have environmental concerns that will need to be remediated prior to any redevelopment that includes the parcels. The research will include any documentation from the EHRA on the use of the existing structures as well as environmental reports detailing the environmental site assessments, groundwater sampling, soil sampling, as well as the hazardous materials surveys to determine the scope of contamination and how that may impact a redesign project utilizing portions of the parcels. Additionally, there exist previous renditions of EHVD redesign plans that have been submitted through the EHRA or the former EHVRC, including the Fuss & O'Neill, Rob Smith, Fellner Associates, and Centerbridge Group Plans. The team will review these plans using knowledge of the area and comments from the EHRA and East Haddam residents on the designs to assess feasibility, as well as if any components can be incorporated into new designs.

Regulations and standards from both the town and the state will be followed to ensure the redesign of the roadway and pedestrian areas are in compliance with state code and follow any special regulations East Haddam has in the Village District. Specifically, the team will research and utilize the most recent edition of the CTDOT State Highway Manual and Standard Drawings for creating a design that meets grade, curve, width, and any additional requirements. The information on the CTDOT Division of Highway Design Website will provide the team with roadway classification information. Additional correspondence with CTDOT may occur to understand the necessary process one would need to complete to propose a major state roadway redesign.

3.2 Objective 2: Roadway Redesign Options

Based on the traffic studies, existing information regarding the EHVD downtown area, the EHRA visions, and the East Haddam resident's interests for the village, the team will create multiple downtown roadway redesigns to mitigate the traffic issues. The new designs will create a more pedestrian-friendly area by adding speed reduction and greater safety measures. Design considerations will also be made to include an adequate drop-off and pick-up area in front of the Goodspeed Opera House and the Gelston House. The parking spaces in front of the two

historical buildings will be reconfigured for ease of access and aesthetics. Finally, traffic calming measures will also be implemented to reduce speeds through the EHVD, in an effort to create a safer downtown and for visitors to see all that the Village District has to offer.

At minimum, the multiple designs will be an unchanged roadway with improved pedestrian access, a straightened roadway plan, and a plan that removes the curve and replaces it with a large roundabout. Each plan looks to improve the walkability of the downtown area and access to the Goodspeed Opera House. Each roadway plan will also redesign the intersections along Route 82 to improve efficiency and safety. Sight distance calculations will be performed for each intersection to determine safety. The sidewalks in each plan will be widened and improved for ADA accessibility, as well as adding more crosswalks in the downtown area to improve ease of access and safety for pedestrians along Route 82. The general plan of the roadway design process is as follows:

4. The team will gather existing survey data.
    a. This will consist of gathering existing survey data through state databases, in the form of CAD files, to provide a baseline for the roadway design.
    b. Also gathered will be any data on existing utility corridors and locations.
5. The team will gather existing roadway standards.
    a. This will consist of the team gathering completed project information for projects on Route 82 and researching any existing CT roadway standards.
6. The team will design new roadway layouts in Civil3D.
    a. The new roadway layout will be designed in Civil3D, graded appropriately, and overlayed over the existing survey data to determine the amount of cut or fill necessary to complete the roadway project.
    b. New or improved sidewalks will be designed in Civil3D.
    c. New crosswalks or parking will be marked out in a new roadway design, as well as any curb cuts.
    d. Moved utilities will be roughly designed along the roadway corridor.
    e. Necessary traffic calming measures and intersection control devices will be determined using CAD software such as AutoTurn in Civil3D.

3.3 Objective 3: Roadway Design Evaluation

Once the team creates the designs for the improved EHVD roadways, they will be evaluated based on existing traffic data and projections as well as financial feasibility. After creating the roadway designs, the team will evaluate each of the intersections with the appropriate design vehicles using CAD software. Then, traffic analysis software will utilize the most recent existing traffic data for the area, combined with our traffic studies, to create a projection for each roadway design and how much they improve traffic flow. Along with the traffic data evaluations, each of the new roadway designs will be given a cost estimate, based off the amount of roadway material needed, the amount of cut or fill needed, any proposed signage, or intersection control devices. The team will use available information from similar projects to estimate the cost of each design, some of which can be found on the CTDOT website under low bid information. Lastly, the team will calculate sight distances for each intersection in the study area, whether redesigned or not, to determine the safety of each of the existing and redesigned intersections.

3.4 Objective 4: Roadway Design Finalization

Once each roadway design, traffic flow analysis, and financial evaluations are complete, the team will present the project designs to the major stakeholders to select one design for the final proposal. The stakeholders include, but may not be limited to, CTDOT, EHRA, and East Haddam residents. The team will meet with CTDOT first to determine the feasibility of each design, and if any design would not be acceptable based on the requirements for state roads. Any input on modifications to the existing designs will be considered. After this, the team will present to and receive feedback from the EHRA and the East Haddam residents with the designs that CTDOT determined were feasible.

Based on the comments and feedback from all three parties, one design will be chosen as the final proposal, with necessary modifications made after the meetings to reflect any constraints according to CTDOT and the wishes of the town stakeholders. The team will finalize this design by adding more detail to the final proposal. The final proposal will include further developed traffic and redevelopment evaluations. The team will add more details such as parking spaces, roadway sighting and fixtures, improved vehicle and pedestrian safety measures, and aesthetic improvements. The team will also include an updated cost estimate that will reflect the

cost of material needed for grading, necessary environmental remediation, and relocation or demolition of buildings as needed. The team will also complete cost and time estimates for the project based on comments from the stakeholders, similar projects involving a roadway redesign through a congested area, nearby roadway projects, or a potential conceptual traffic impact assessment. The team will present the final design as part of the final proposal at the end of the project.

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Appendix B: Traffic Engineering Calculations & References

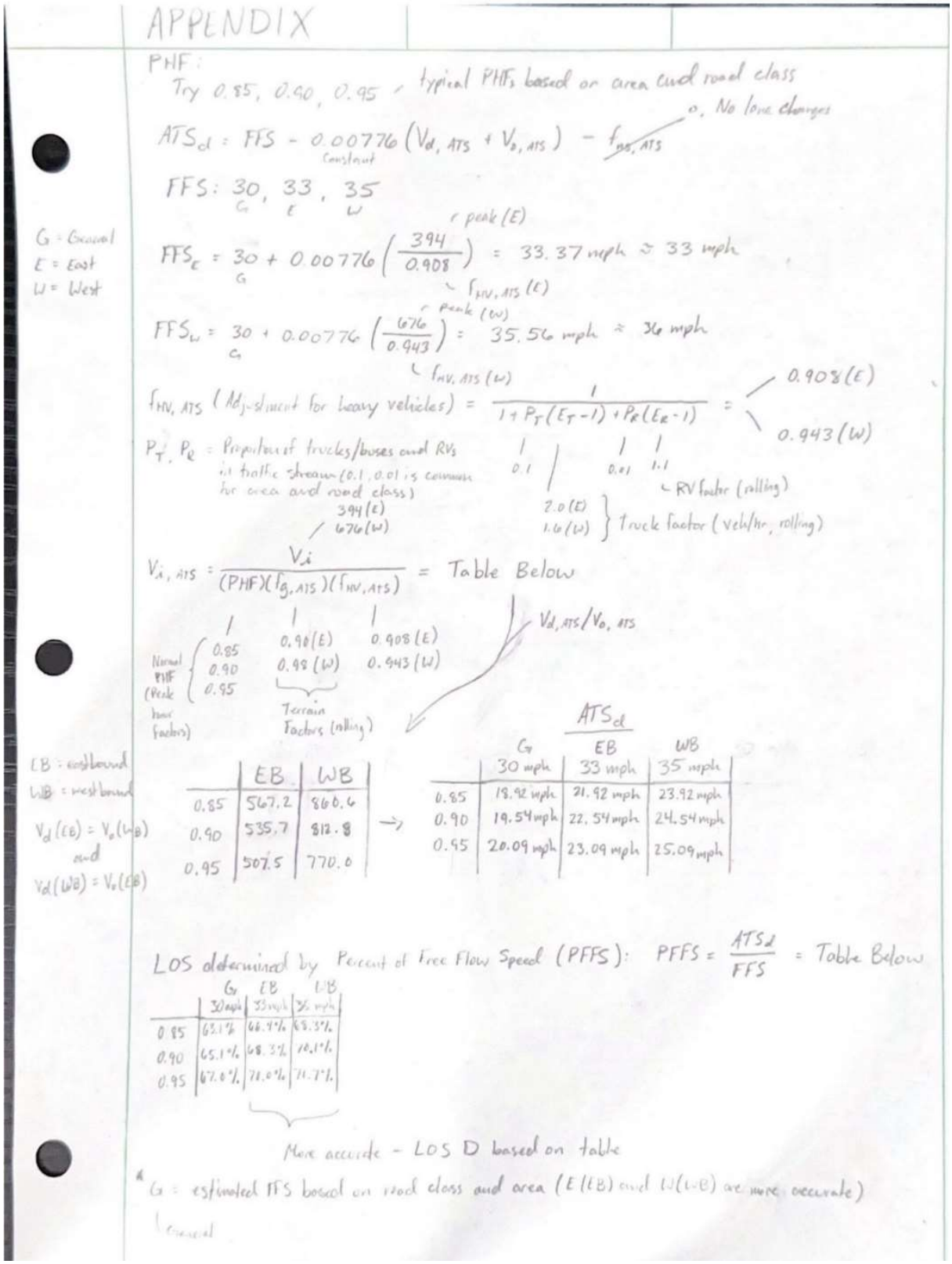

Figure B1. LOS Calculations.

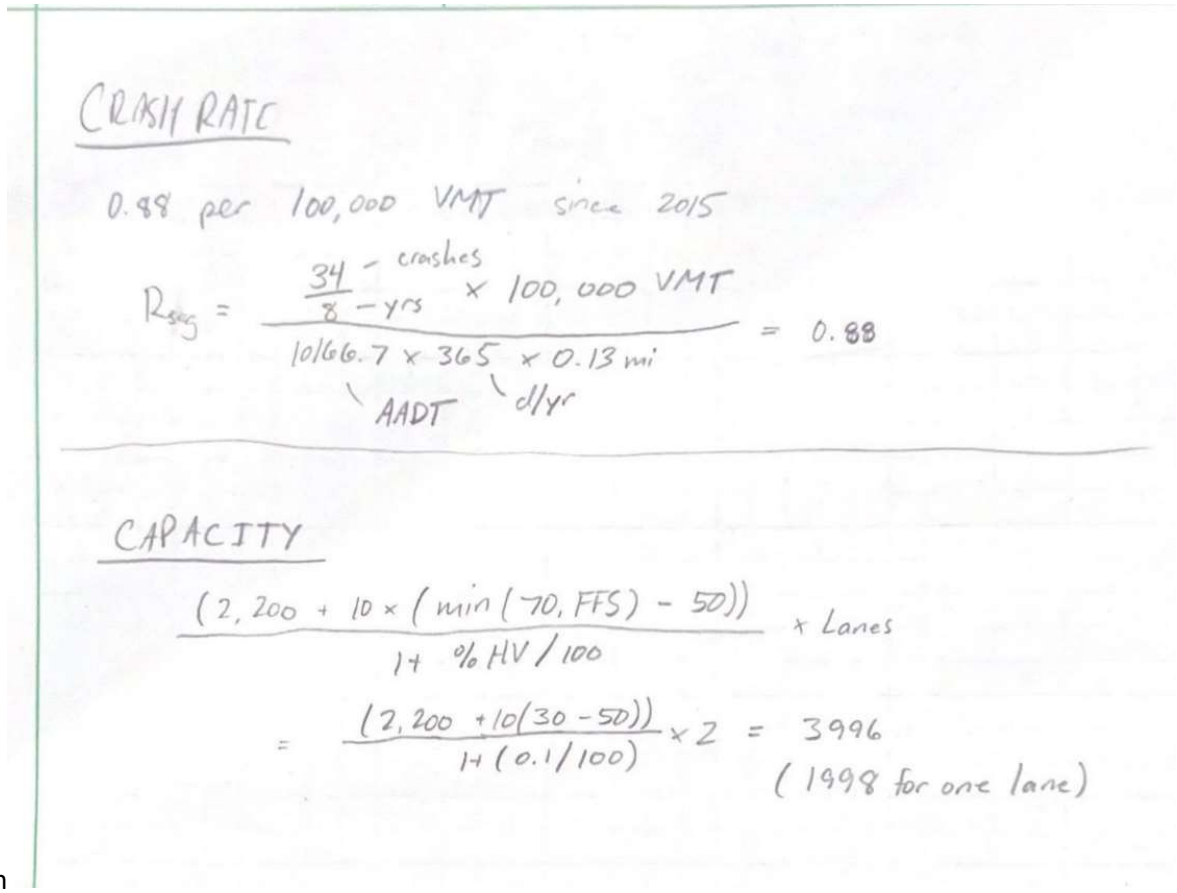

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Figure B2. Crash Rate and Capacity Calculations.

For Turn Made From	For Turn Made Onto	Minimum Suggested Design Vehicle	Turning Radii (ft)
Freeway Ramp	All	WB-62 WB-67[4]	60
Arterial	Arterial Collector Local	WB-62	60
Collector	Arterial Collector Local	SU	60
Local	Arterial Collector Local	SU	45

Table B1. Intersection Radius Table.

Appendix C: Collision Diagram Table

Table C1. Collision Diagram Accident Information. Note PI means "Personal Injury" and PD means "Property Damage" regarding the extent of the accident.

Crash Number	Date	Time	Day	Severity
1	1/4/2015	5:18 PM	Sunday	PD
2	2/19/2015	4:57 PM	Thursday	PD
3	6/19/2015	2:40 PM	Friday	PI
4	10/10/2015	9:40 AM	Saturday	PD
5	6/17/2016	9:49 AM	Friday	PD
6	7/7/2016	11:48 AM	Thursday	PD
7	9/16/2016	6:02 PM	Friday	PD
8	8/22/2016	6:12 PM	Monday	PD
9	6/2/2017	10:44 AM	Friday	PD
10	6/16/2017	4:19 PM	Friday	PD
11	8/14/2017	9:24 AM	Monday	PD
12	8/28/2017	9:52 AM	Monday	PD
13	9/15/2017	10:47 PM	Friday	PD
14	11/11/2017	6:39 PM	Saturday	PI
15	1/11/2018	8:53 AM	Thursday	PD
16	1/19/2018	3:01 PM	Friday	PD
17	5/4/2018	8:08 AM	Friday	PD
18	5/6/2018	4:12 PM	Sunday	PD
19	10/7/2018	4:29 PM	Sunday	PD
20	11/19/2018	9:35 PM	Monday	PD
21	12/4/2018	1:09 PM	Tuesday	PD
22	12/24/2018	5:19 PM	Monday	PD
23	8/13/2019	4:14 PM	Tuesday	PD
24	8/10/2019	8:53 PM	Saturday	PD
25	8/30/2019	3:16 PM	Friday	PD
26	1/8/2020	3:12 PM	Wednesday	PD
27	6/17/2020	2:58 PM	Wednesday	PI
28	9/28/2020	12:14 PM	Monday	PD
29	10/7/2020	7:40 PM	Wednesday	PD
30	3/21/2021	3:25 PM	Sunday	PD
31	7/13/2022	3:53 PM	Wednesday	PD
32	9/5/2022	6:24 PM	Monday	PD
33	12/3/2022	10:21 PM	Saturday	PD
34	3/28/2023	1:13 AM	Tuesday	PD
A1	11/3/2015	6:41 AM	Tuesday	PD
A2	5/22/2018	4:17 PM	Tuesday	PD
A3	10/16/2019	5:34 PM	Wednesday	PD
A4	6/18/2020	11:17AM	Thursday	PD
A5	9/20/2021	12:35 PM	Monday	PD
A6	12/19/2022	5:13 PM	Monday	PD

Appendix D: Previous Redesign Options Assessment Matrix

	Fellner	Rob Smith	Centerbridge	Fuss & O'Neill
Pedestrian Access	2 crosswalks (widened one closer to Opera)	2 existing crosswalks, but one way traffic improves safety	Says to implement improved pedestrian crosswalks but does not show where; widen sidewalk; create bike lane	2 adjacent crosswalks in front of Gelston; 3 additional crosswalks outside EHVD on Rte 149, Rt 82 just after intersection
ADA Accessibility	No improvements to drop off/handicap	No improvements to drop off/handicap	Widened sidewalk but no improvements to drop off/handicap	Added drop off lane in front of Gelston house, but removed any handicapped parking there
Roadway congestion	No improvements	One way traffic; Rt 149 W, RT 82 east no stopping needed; RTE 149 W to Rt 82 east would need to go thru EHVD	No improvements; may incentivize more traffic	Reduced with drop off lane, additional roadway to parking off Lumber yard road
Roadway Safety	No improvements	One way traffic; safer entrances/exits to parking area	"implement traffic calming measures"	Drop off area; "traffic calming measures"
Parking	Added parking in NE corner; new entrance on RTE 149	More parking N and S of new roadway	No improvements, may actually reduce total spots	Expanded parking on town-owned parcel; added entrance on RTE 149; added parking at new actor housing in NE & on Lumberyard/on new path between Lumberyard and creamery
Grading	Significant grading needed to place new parking lot, new buildings south of broom road	Roadway cuts straight through, would need to be graded	Multiple new structures and green space would need grading	Grading needed for new parking lot and entrance to Rt. 149; grading needed around new Lumberyard Road
Redevelopment Space	More on town-owned parcel	Limited; most areas used for parking	Purchase land from Goodspeed/other owners, used for retail, housing, green space, river walk	Limited; created either new theatre or mixed use next to Gelston House; mainly expanded parking
Rt. 149 and Rt. 82 Intersection	Added parking entrance on RT 149 prior to	Rt. 149 entrance to Rt. 82 westbound, Rt. 82 eastbound no stopping	Added parking entrance on RT 149 prior to intersection	No improvements; added crosswalks; added parking entrance on RT 149 prior to

	intersection would worsen traffic	needed; 2-way intersection for Rt. 149 northbound, Rt. 82 westbound	would worsen traffic	intersection would worsen traffic
Rt. 82 and Lumberyard Rd. Intersection	No improvements	One way roads create less congested intersection; added additional road from Lumberyard to creamery	No improvements	Remove island, create T intersection with Lumberyard
EHVD entrance and exit at East Haddam Swing Bridge	No improvements	Eastbound curve the same; westbound is straightened to enter bridge	Slight easement of curve	Widen Route 82 to straighten the alignment and minimize the horizontal curve
Relocation of buildings	Removal of 17 and 19 Main Street buildings to provide additional parking access	Bridge generator needs to be relocated	Relocate: bridge generator, river house, town building	Removal of riverhouse, 19 Main Street and relocation of bridge generator (not specified but necessary)
Environmental concerns	Plans to place parking and new buildings on contaminated soil (removal)	Plans to have roadway and parking on top of contaminated soil (capping)	Plan to have green space on top of contaminated soil (capping)	Plans to have parking on top of contaminated soil (capping)

Appendix E: Full Page Views of New Roadway Redesigns

Appendix F: New Redesign Options Assessment Matrix

	Option 1 (minimal improvements)	Option 2 (Modified Rob Smith Plan)	Option 3 (Through Road with Squared Intersections)
Pedestrian Access	Crosswalks will be lengthened across Rt. 82 and drop-off lane	Drop off lane, Rt. 82 will have pedestrian crosswalks; less traffic in front of Goodspeed buildings	Drop-off lane, Rt. 82 will have pedestrian crosswalks; less traffic in front of Goodspeed Buildings
ADA Accessibility	Added drop-off lane in front of Goodspeed properties	Added drop-off lane in front of Goodspeed properties	Added drop-off lane in front of Goodspeed properties
Roadway congestion	Lower congestion due to drop-off lane	Lower congestion due to traffic circle; Rt. 149 eastbound and Rt. 82 westbound requiring no stoppage	Traffic light at Rt. 149 intersection may cause backup; no delays due to sharp turns or drop-off
Roadway Safety	Poor lines of sight still exist unless Main Street properties moved; eased curve is still sharp; areas with most collisions not removed	Traffic calming measures will be needed with straightened road; addressed areas with most collisions besides Rt. 82 eastbound near bridge	Traffic calming measures will be needed with straightened road; addressed areas with most collisions
Parking	Existing parking on town-owned property can remain and expand if town garage is removed	Area north of roadway could be used; potentially sufficient space for more parking in area between Rt. 82 and drop off lane	Area north of Rt. 82 could be used
Grading	Small amount of cut required (~71.23 cf)	Large amount of cut required (~120,844 cf)	Large amount of cut required (~15,727.98 cf)
Redevelopment Space	Town-owned Parcel, 11-17 Main Street can be utilized as green space or commercial developments with parking incorporated	Largest redevelopment area; in center of Rt. 82 traffic circle to be used for green space or business; area north of road would have to address contaminated area	Area between Rt. 82 and drop-off lane can be used for green space or businesses; area north of road would have to address contaminated area
Rt. 149 and Rt. 82 Intersection	No changes	Rt. 149 northbound, RT 82 eastbound 2-way intersection	Squared off; traffic light will be required
Rt. 82 and Lumberyard Rd. Intersection	Drop off lane connects to Lumberyard Rd. from the west; No changes to Lumberyard Rd. entrance to Rt. 82 heading north	One-way eastbound traffic should allow for easier access to Rt. 82 from Lumberyard Road; Lumberyard Road has entrance to employee road near intersection, may add congestion	Squared off, with Lumberyard Road extended north; stop sign to be used; drop off road connects to Lumberyard from west
EHVD entrance and exit at East Haddam Swing Bridge	Eases sharp curve	Straightened completely westbound; eastbound traffic entering EHVD faces existing curve	Straightened completely, with drop off lane access squared off with Route 82 near bridge
Relocation of buildings	No relocation needed	Rt. 82 goes through generator building; old town building; 17 Main Street building; employee road goes through 24 Lumberyard Road building (Goodspeed)	Rt. 82 goes through generator building; old town building; 11, 15 Main Street buildings
Environmental concerns	No changes to contaminated area	Roadway will go over contamination; capping or soil removal needed	Roadway will go over contamination; capping or soil removal needed