


Improving Safety along Route 291

Multimodal Corridor Study

March 2024

Transportation and Community Development Initiative
Delaware County, Pennsylvania

Improving Safety along Route 291

Delaware County, Pennsylvania

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March 2024

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Executive Summary

This Executive Summary outlines the findings and recommendations of the "Improving Safety along Route 291: Multimodal Corridor Study." The study focuses on enhancing safety and multimodal accessibility along Route 291 in the City of Chester. It was driven by community and stakeholder input. Delaware County initiated this study in December 2022 in partnership with the Pennsylvania Department of Transportation (PennDOT) to perform analyses and engagement to assess a road diet and other multimodal improvements along Route 291. Using Transportation and Community Development Initiative (TCDI) grant funding from the Delaware Valley Regional Planning Commission (DVRPC), this Multimodal Corridor Study evaluates tradeoffs such that Route 291 can be transformed into a safe, shared corridor that celebrates and serves the City of Chester. An element of this study includes reviewing options for the East Coast Greenway gap from Stewart Avenue to Darby Creek in Ridley Township. This study is developed in partnership between the County, residents, business owners, the City of Chester, PennDOT, and other key local community leaders and organizations.

This study includes the review and analysis of existing conditions, including previous plans and studies, demographic data, existing infrastructure, traffic data, and crash data. A comprehensive multimodal toolkit was developed and comprised of various treatments categorized into six groups: greenway, traffic calming, multimodal access, signals and intersections, placemaking, and truck route enhancements. These tools, tailored to local needs, serve as a resource for future design phases. The study also examines large- and small-scale multimodal improvements at various intersections along Route 291. Key analysis results include crash reduction estimates, intersection evaluations, and traffic operation assessments.

Four alternatives (A, B, A2, and B2) were evaluated, each offering differing roadway configurations and safety measures. Based on analysis results, Alternative B2 emerged as the preferred choice, combining safety enhancements with considerations for traffic flow and ongoing projects. Two alternatives (Option 1 and Option 2) for filling the East Coast Greenway gap in Ridley Township were developed and assessed, with Option 1 generally preferred due to feasibility and potential cost effectiveness.

The Route 291 study seeks to create a safer, more inclusive corridor that celebrates Chester's history and fosters economic prosperity. Continued community engagement and strategic funding allocation will be vital to achieving the project's goals and ensuring lasting benefits for residents and stakeholders. Implementing a project of this scale and complexity requires cross-agency collaboration and community partnerships. Subsequent phases of the project's delivery should involve ongoing engagement with Delaware County, DVRPC, and additional community leaders to ensure local context remains relevant. Funding opportunities through the State's

Transportation Improvement Program (TIP) and/or the Reconnecting Communities grant initiative are anticipated to advance the project into the Preliminary Design phase.

Introduction

Chester residents say that SR 0291 (also called Route 291 or 2nd Street) feels "like a highway through a community." The wide, high-speed roadway creates a barrier between a marginalized community and the developing Delaware riverfront.

Route 291 was widened in the early 2000s to increase capacity for vehicular commuters and truck traffic. Residents who have lived in Chester for a long time will tell you that the corridor (also called 2nd Street) was once lined with houses and businesses; it was part of the neighborhood. Now, 85th percentile motor vehicle speeds are 45-50 mph along Route 291 in Chester, where the speed limit is 35 mph. There are an average of about 70 crashes per year along the corridor, with at least 1-2 people dying every year. Many residents have harrowing stories of deadly crashes on 2nd Street. One woman drives by the location where her father was killed on his motorcycle, the telephone pole still scarred black from the crash. Another resident remembers a Christmas Day when her family was preparing food and a car crashed into their front yard, striking a gas line such that a whole block of families needed to evacuate until it could be repaired. Another woman says her mother's house has a gaping hole in it from where two people crashed and died. A City employee describes diving from his driver's seat into the passenger seat to avoid dying in a head-on collision.

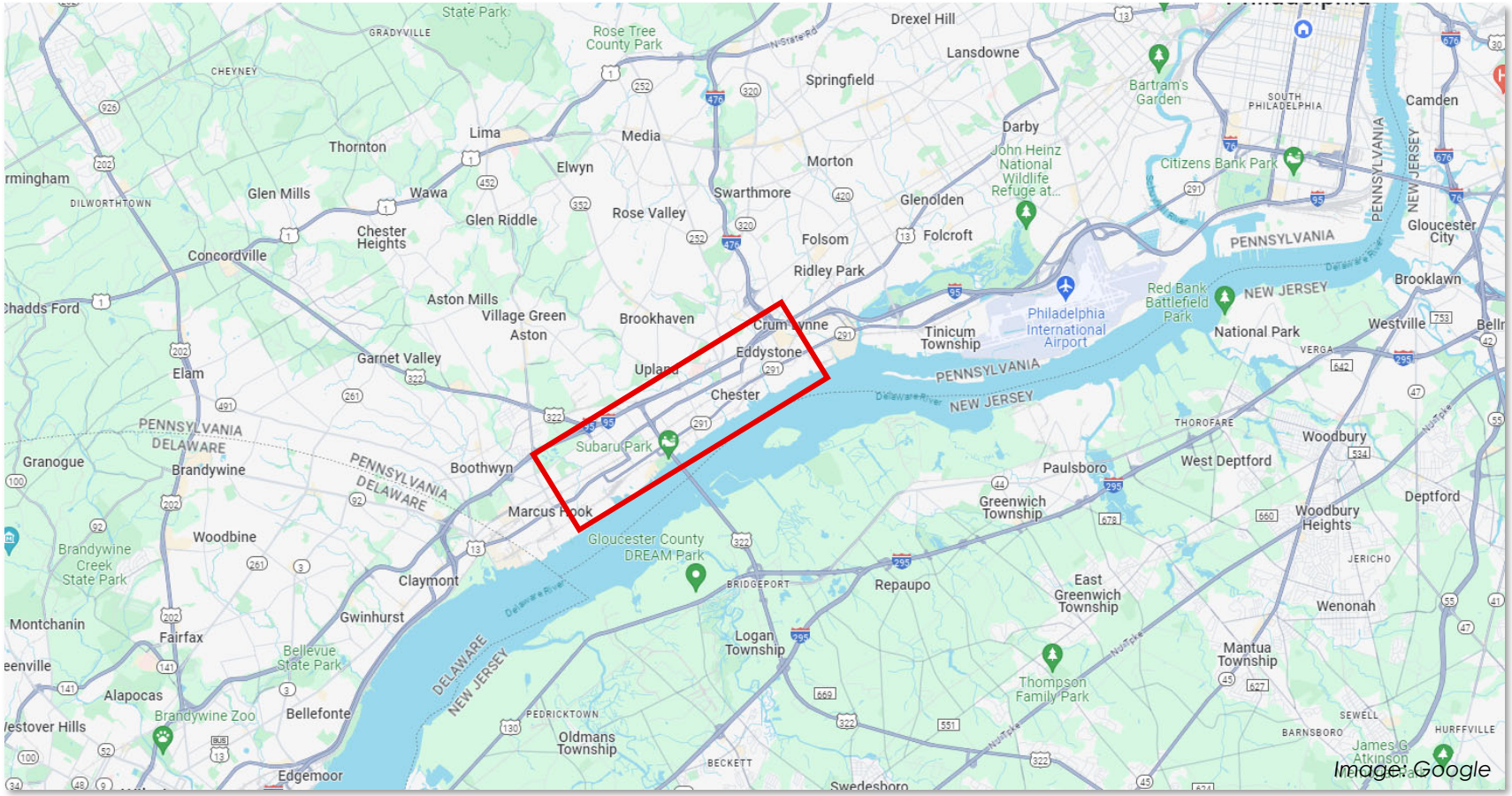
Improving safety on Route 291 requires tradeoffs. The roadway is currently serving many important automotive-centric needs, including providing vehicular access to homes and businesses, carrying industrial truck traffic, serving local and regional commuters, providing a parallel relief valve for I-95 closures, carrying emergency vehicles, and serving the Philadelphia Union Stadium. However, as currently designed, Route 291 does not provide safe multimodal mobility and access. The corridor facilitates speeds that are unsafe for pedestrians and bicyclists, and it lacks marked, well-lit, controlled pedestrian crossings. It has narrow, deteriorated sidewalks, and it does not provide a dedicated bicycle facility as part of the East Coast Greenway network.

Delaware County (the County) initiated this study in December 2022 in partnership with the Pennsylvania Department of Transportation (PennDOT) to perform additional analyses and engagement to assess a road diet and other multimodal improvements along Route 291. Using Transportation and Community Development Initiative (TCDI) grant funding from the DVRPC, this Multimodal Corridor Study evaluates tradeoffs such that this street can be transformed into a safe, shared corridor that celebrates and serves the City of Chester. This study is developed in partnership between the County, residents, business owners, the City of Chester, PennDOT, and other key local community leaders and organizations.

Objectives

The purpose of this study is to assess multimodal safety improvements along Route 291 in the City of Chester, Delaware County, from Irving Street to Ridley Creek. It also makes recommendations for the dedicated East Coast Greenway facility through Chester City and Ridley Township. As shown below in Figure 1, the City of Chester is located between Philadelphia and Wilmington along the Delaware River.

Figure 1: Study Area (Zoomed Out)



This study includes an existing conditions analysis, community and local leadership engagement, and alternative development and evaluation. It focuses on delivering the technical results needed to draw conclusions and make decisions about tradeoffs. It also aims to build partnerships such that engineering phases of the project can be funded and advanced.

The following objectives were developed over the course of the analysis and through the engagement involved in this study:

Improve Safety for All

People in Chester want to reduce crashes along Route 291, particularly those that cause fatalities and serious injuries. People want this to be a safer place to walk, bike, drive, and live.

Create Connections for Walking & Biking

As the riverfront continues to develop, people in Chester want to walk and bike along and across Route 291. A dedicated bicycle facility is needed as part of the East Coast Greenway.

Optimize Roadway Operations

Route 291 is an important connection in the vehicular transportation network, especially when there are delays on the neighboring interstate highway. The community does not want to see increased congestion that disperses cars and trucks onto the residential street network. Commuters also hope to continue travelling efficiently along Route 291.

Balance Residential and Industrial Needs

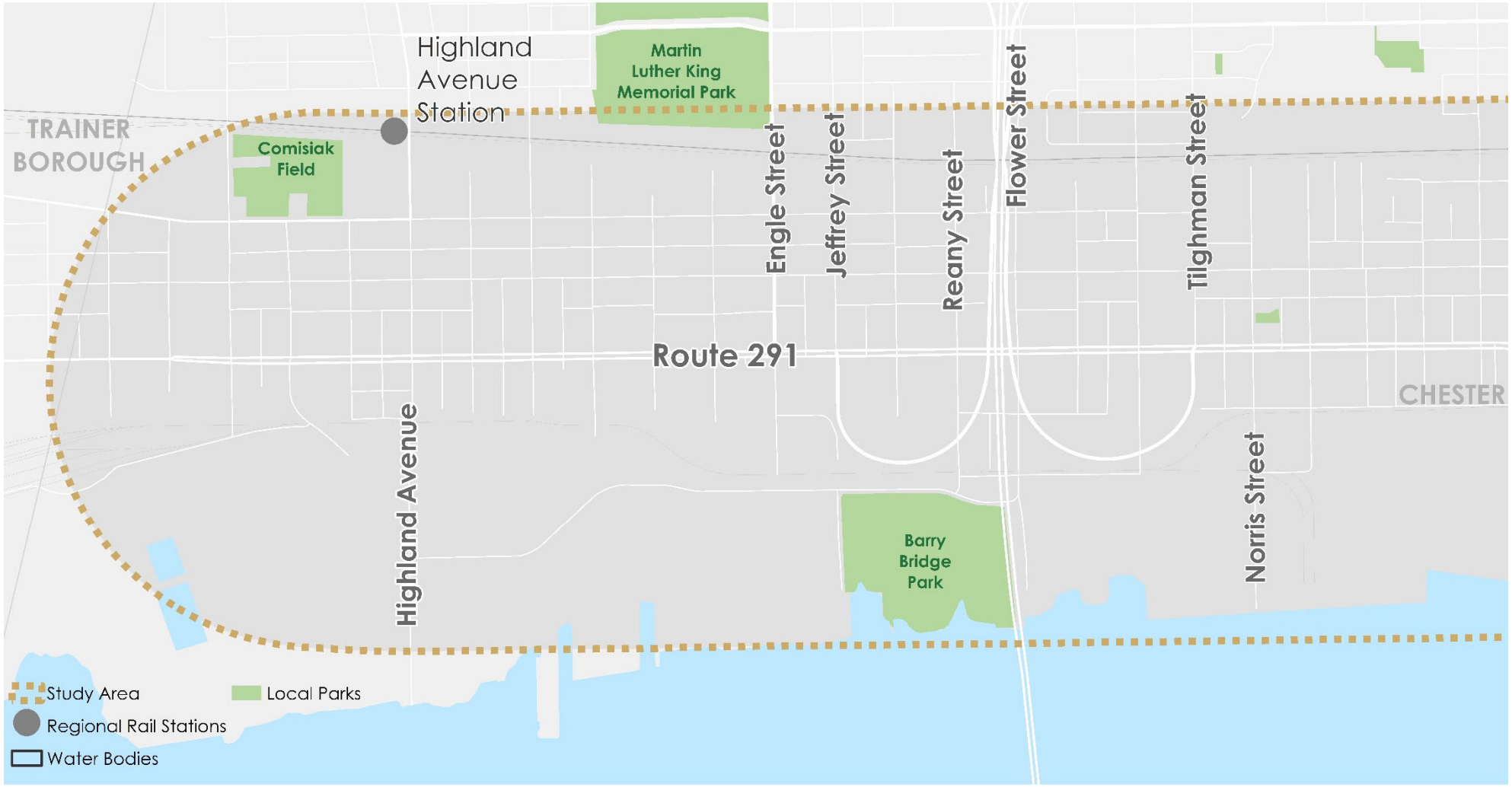
Many people live along or near Route 291. The corridor also serves several large industrial sites that serve the local economy. There is a need to balance truck access with a healthy, sustainable living environment for residents.

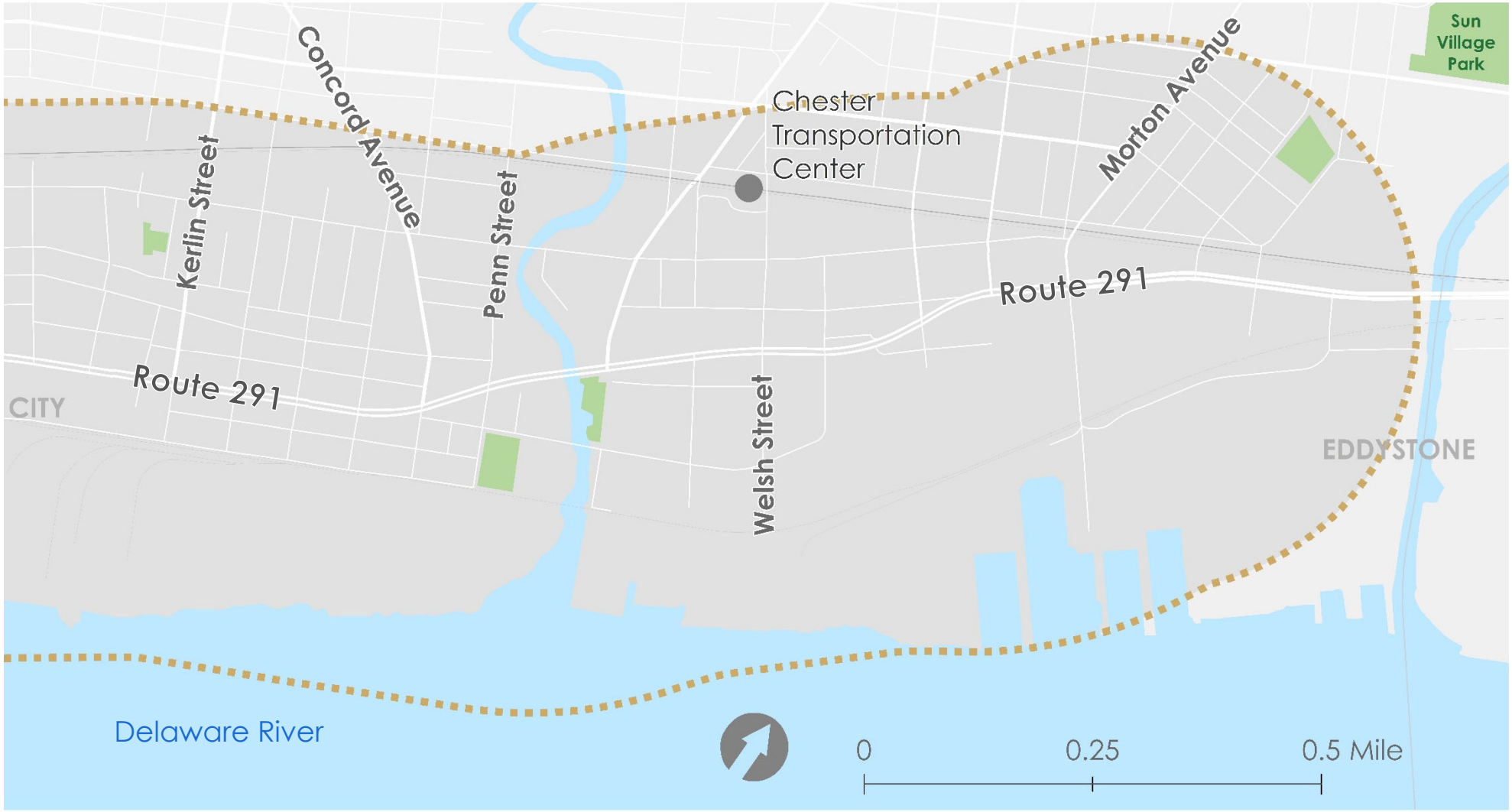
Plan for Implementation

There have been many plans and studies conducted in Chester. Residents and community leaders want to see this study move into the implementation of needed short-term and long-term roadway improvements.

The study area is shown on the next two pages as Figure 2.

Figure 2: Study Area (Zoomed In)




Sun Village Park
Chester Transportation Center
Morton Avenue
Concord Avenue
Kerlin Street
Penn Street
Route 291
Route 291
Welsh Street
CITY
EDDYSTONE
Delaware River
0
0.25
0.5 Mile

Engagement

The fundamental principles for community engagement, as part of this Multimodal Corridor Study, include:

Meet People Where They Are. Stakeholders and community members should not have to jump through hoops to make their concerns or vision known. Engagement for this study includes a mix of in-person, on-site, and virtual engagement events. Meeting people where they are also means accommodating other barriers, such as language, class schedules, childcare needs, or disabilities.

Communicate Clearly and Concisely. Transportation networks are complex. The materials developed for this effort aim to equitably educate and inform the community, which helps open the door for diverse and informed discussion.

Equitable Outreach. The Chester community has endured negative impacts as the City has shifted fiscally over the years. Engagement for this study delivers consistent messaging and elevates the voices of people most impacted by Route 291 improvements. With an attention to equity, this study has included creative engagement strategies, persistence, and compassion.

Community engagement activities include:

- Three steering committee meetings.
- One public listening session.
- An online comment map.
- An online webpage.
- One public workshop.
- An online and in-person survey.
- Attendance at community events.

Steering Committee

To advance this Multimodal Corridor Study, a project Steering Committee was assembled, and included representatives from the Delaware County Planning Department, Delaware County Council, City of Chester, PennDOT, Riverfront Alliance, DVRPC, East Coast Greenway, Pennsylvania Environmental Council, Bicycle Coalition of Greater Philadelphia, Subaru Park, Omega Psi Phi Fraternity, and Laborers Local 413. Over the course of three meetings, the members of the Steering Committee shared their insight into outreach channels, venues, tools, and strategies to capture the perspective and attention of residents, business owners, workers, pedestrians, bicyclists, and travelers in Chester. The Steering Committee reviewed and verified existing conditions analysis results, participated in the

development of alternatives, reacted to evaluation results, guided selection of the preferred alternative, and set parameters for broad-reaching community engagement. Slides and summaries from the three Steering Committee meetings are included in Attachment 1.

Key Takeaways.

The Steering Committee suggested the following:

- Prioritize safety and slow traffic.
- Coordinate with industrial leaders.
- Take direction from residents.
- Connect historic sites and key destinations.
- Build upon the low stress bike network.
- Consider traffic control at the ramp intersections.

The Steering Committee attended a field walk on February 2, 2023.

Community Engagement Phase 1

Engagement was generally broken into two phases. Phase 1 focused on understanding the corridor, and involved gathering information, verifying existing conditions, and understanding the community's concerns. The first public meeting was an interactive Listening Session held on April 13, 2023, to hear directly from community members about their experiences traveling on the Route 291 corridor. Engagement activities and takeaways are summarized below. Additional materials are provided in Attachment 1.

Advertising for Listening Session. To advertise the Listening Session, flyers were distributed to local businesses and organizations on March 31, 2023 (included in Attachment 1). The flyer featured a QR code to an Online Comment Map, as well as details regarding the project. The Steering Committee members also received the flyer and were asked to forward it to their networks to help advertise the Listening Session.

Listening Session Procedures and Agenda. The Listening Session took place at Calvary Baptist Church in Chester, PA, on April 13, 2023, from 6:30 pm to 8:00 pm. The objective of the Listening Session was to gather thoughts and opinions on the project from the community, as well as encourage engagement on the Online Comment Map. Paper comment cards were collected from meeting attendees to gather written feedback.

Listening Session Summary.

- Upon entry, Listening Session attendees were encouraged to sign in and fill out a comment card or the Online Comment Map.
- Dinner was provided by Walnut Street Deli.
- The project team thanked everyone for attending and gave a brief PowerPoint introduction to the project.
- Attendees then participated in discussion circles of six to ten people, with facilitators from the project team, City, County, and DVRPC, as appropriate, to discuss a series of questions around current conditions along the corridor and initial ideas for improvements.

Online Comment Map. An Online Comment Map was developed to gather public comments on mobility and connectivity issues. This was a cloud-based mapping tool. Access to the Online Comment Map was embedded on the County's website and on the Listening Session flyer. Comments collected are included in Attachment 1.

County Website. The Delaware County Planning Department published a page on their website dedicated to this study (https://delaware-county-pa.civilspace.io/en/projects/improving-safety-along-route-291). This webpage includes the project's purpose; background; project updates; and, when live, a link to the Online Comment Map. The webpage also displays a project timeline and additional information on the project corridor.

Key Takeaways. Phase 1 of engagement demonstrated that residents are fearful of traveling via any mode of transportation along Route 291, but especially when walking and biking. Lived experiences were consistent with the crash data in terms of frequent, severe crashes.

Attendees at the Listening Session stressed a desire for solutions that:

- Prioritize residents.
- Address the lack of equity experienced with historic changes made to Route 291.
- Transform Route 291 so that it does not feel like a highway through a community.
- Return to conditions similar to those present pre-widening.
- Reduce speeds and consider speed enforcement options.
- Make lefts onto Route 291 is easier and safer.
- Make getting onto and off US 322 easier and safer.
- Address maintenance and lighting needs.
- Study the impacts and warrants of installing more traffic signals.
- Address concerns about pollution and community health.
- Install more crosswalks and widen sidewalks.

- Represent Chester and beautify the corridor.
- Celebrate and provide access to historic resources.
- Spur mixed use development that benefits the local community.
- Provide a dedicated bike facility.
- Connect people to the riverfront.

Residents discussed their concerns, experiences, and ideas at the Listening Session.

Community Engagement Phase 2

Phase 2 focused on the multimodal toolkit and the development and evaluation of alternatives. Phase 2 occurred from May to November and included a public workshop on October 11, 2023. Engagement activities and takeaways are summarized below. Additional materials are provided in Attachment 1.

Chester Riverfront Festival. The project team and Delaware County staff attended the Chester Riverfront Festival on May 6, 2023, to collect feedback on the multimodal toolkit and to educate residents about how the various treatments might improve safety along the corridor.

Advertising for Public Workshop. To advertise the Public Workshop, flyers were distributed to local businesses and organizations on September 29, 2023. The flyer (included in Attachment 1) featured a QR code that linked to the SurveyMonkey online survey, as well as details regarding the project. The Steering Committee members also received the flyer and were asked to forward it to their networks to help advertise the Public Workshop.

Public Workshop Procedures and Agenda. The Public Workshop took place at Access Community Center in Chester, PA, on October 11, 2023, from 6:30 pm to 8:30 pm. The objective of the workshop was to educate the community on the project's progress, as well as encourage engagement in the project's survey. A QR code to the online survey and paper copies of the survey were available to attendees at the workshop.

Public Workshop Summary.

- Upon entry, attendees of the Public Workshop were encouraged to sign in and participate in the project's survey. Paper survey and comment cards were provided.
- Dinner from Duo Taco was provided for attendees. The meal was sponsored by Journey Tax.
- The project team presented a PowerPoint on the project's progress, details of the Route 291 alternatives, and an overview of analysis results.
- At the end of the formal presentation, the meeting was opened for questions and discussion.
- Attendees were directed to participate in a "build your own" roadway cross section and review the large-scale study area maps and graphics mounted on display boards throughout the room.
- A submission box was placed near the door to collect the paper surveys and comment cards.

Survey to Review Corridor Concepts. The Alternatives Survey was opened online at Surveymonkey.com from September 29, 2023, to October 31, 2023. The survey included 15 questions designed to capture feedback from the community and users of Route 291 to help select a preferred alternative.

Forty-three survey responses (included in Attachment 1) were collected, including 30 online submissions and 13 written submissions collected at the Public Workshop. One written survey was determined invalid since every alternative was selected, and no preference was shown.

Based on survey results, below are key takeaways:

- Of the 40 responses, 14 voted for Alternative A (35%) as preferred, 22 voted for Alternative B (55%) as preferred, and four voted for preferring another alternative (10%). These alternatives are described in detail in subsequent sections of this report.
- Improving safety for all is the clear priority for the project goals.
- When ranking the goals, the top goals were to reduce traffic crashes and provide more and safer pedestrian crossings.
- The riverfront side for the bike lane is preferred; however, there is no clear preference on whether people want a shared or separated path.

Residents learned about and reacted to multimodal tools at the Chester Riverfront Festival.

Other Pop-Up Events. The project team and Delaware County staff attended other community events during Phase 2 of outreach, including a local food truck event and a bike rodeo.

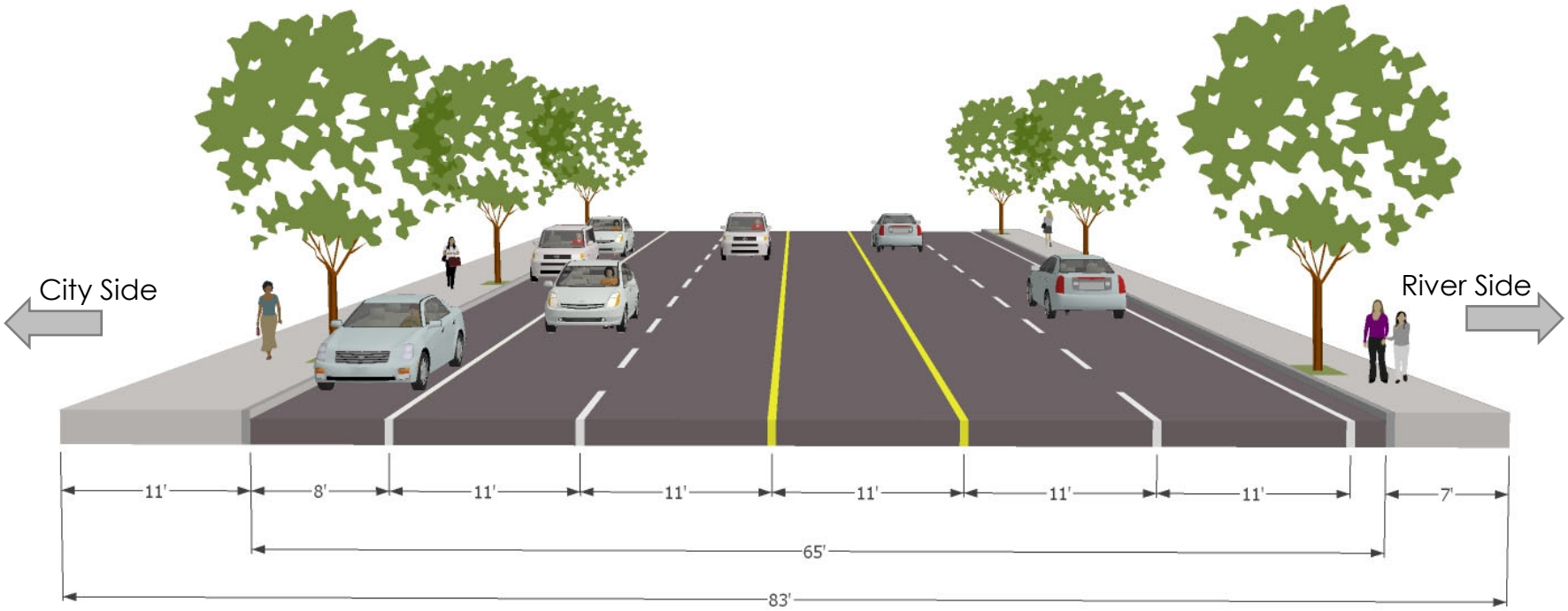
Key Takeaways. Phase 2 of engagement demonstrated that residents are excited about changes that can address safety along Route 291, including urgent maintenance solutions as well as a long-term corridor transformation. While many people supported a smaller cross section that reduces speeds and shortens crossing distance, the community is also concerned about potential traffic impacts.

People discussed potential alternatives at the Public Workshop.

Existing Conditions

Route 291 is a PennDOT roadway. It is classified as an "Other Principal Arterial Route," and is identified on the National Highway System. It runs parallel to I-95 and provides connectivity to US 322 and I-495. The posted speed limit is 35 mph, and the existing cross section typically has a curb-to-curb width of 65 feet and includes five vehicular travel lanes, each 11 feet in width: two eastbound lanes, two westbound lanes, and a center lane marked as a two-way left turn lane. It also typically includes a 2-foot shoulder along the riverside, an 8-foot parking lane along the city side, a 7-foot sidewalk along the riverside, and an 11-foot sidewalk along the city side. The back-of-sidewalk to back-of-sidewalk dimension ranges from about 83 feet to 87 feet wide. The existing typical cross section is shown below in Figure 3. Route 291 is primarily tangent on the western half, with a series of reversing horizontal curves in the vicinity of Chester Creek.

Figure 3: Existing Cross Section (Facing North/East)



Metrics for Evaluation

This study includes review and analysis of previous plans and studies, demographic data, existing infrastructure, traffic data, and crash data. A series of metrics have been considered based on the objectives of the study. These are described in the context of existing conditions below. The presentation on existing conditions is included in Attachment 2.

Reduce All Crashes. Consistent with PennDOT's Toward Zero Deaths Initiative, improving safety along Route 291 means reducing and ultimately eliminating all types of crashes occurring along the corridor in this historically underserved community. According to the PennDOT Crash Information Tool, there were 290 crashes along Route 291 in the City of Chester from 2017 to 2021. During that time, there were 7 fatal crashes. Figure 4 (on the next page) shows injury and fatal crashes along the corridor. Severe crashes are most concentrated between Engle Street and Kerlin Street. Figure 5 shows bicyclist and pedestrian crashes along the corridor between 2017 and 2021, including 2 fatal crashes involving vulnerable road users.

A predictive crash analysis, using PennDOT's Highway Safety Manual (HSM) Tool A, estimates that 58 crashes are likely to occur annually under existing roadway conditions. Of those predicted crashes, 40 crashes are predicted to kill or injure people. By 2050, that equates to 1,566 total predicted crashes, including 1,080 severe crashes that might kill or permanently impact people. The highest density of crashes along Route 291 is between Engle Street and Kerlin Street.

Reduce Fatal and Serious Injury Crashes. Delaware County is currently developing a Vision Zero Action Plan, while PennDOT has recently developed a Statewide Vulnerable Road User Safety Assessment. Consistent with these local and statewide initiatives, the priority is to eliminate the crashes that kill people and/or prevent them from working or taking care of themselves or their families. Crashes involving vulnerable road users (VRUs), such as pedestrians and bicyclists, tend to be more severe. Additionally, crashes involving higher speed vehicles contribute to more deadly outcomes. PennDOT's statewide Strategic Highway Safety Plan (SHSP) includes speeding and aggressive driving as a safety focus area. The SHSP especially prioritizes addressing pedestrian safety. As shown in Figure 4, from 2017 to 2021 along Route 291 in the study area, fatal crashes occurred at Trainer Street, Tilghman Street, Norris Street, Pennell Street, Fulton Street, Concord Avenue, and Hinkson Street.

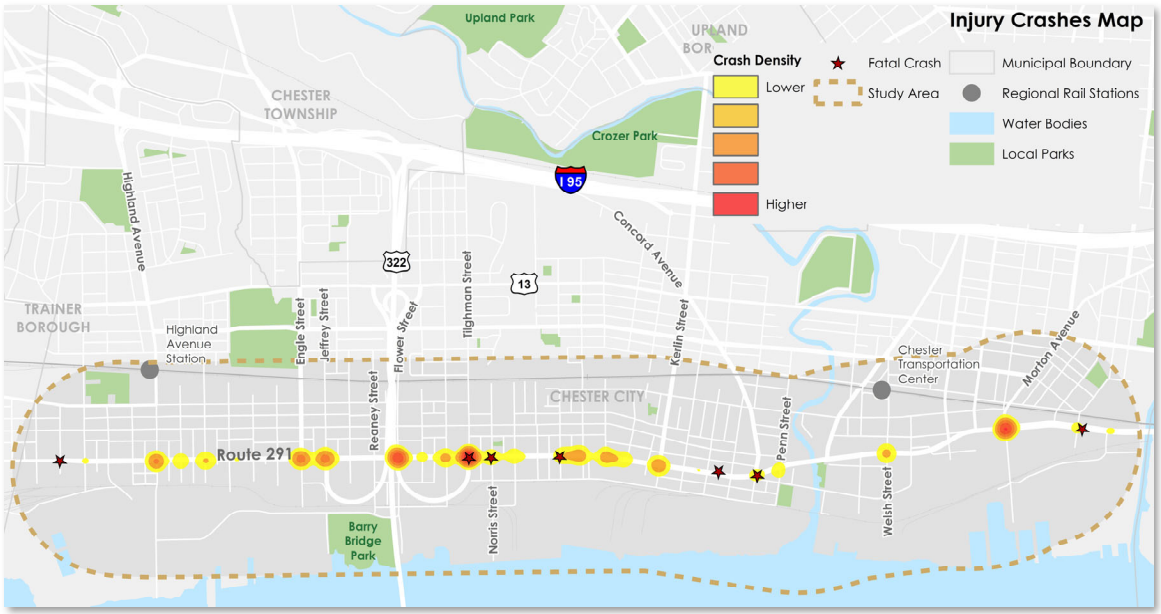


Figure 4: Fatal and Injury Crashes (2017–2021)

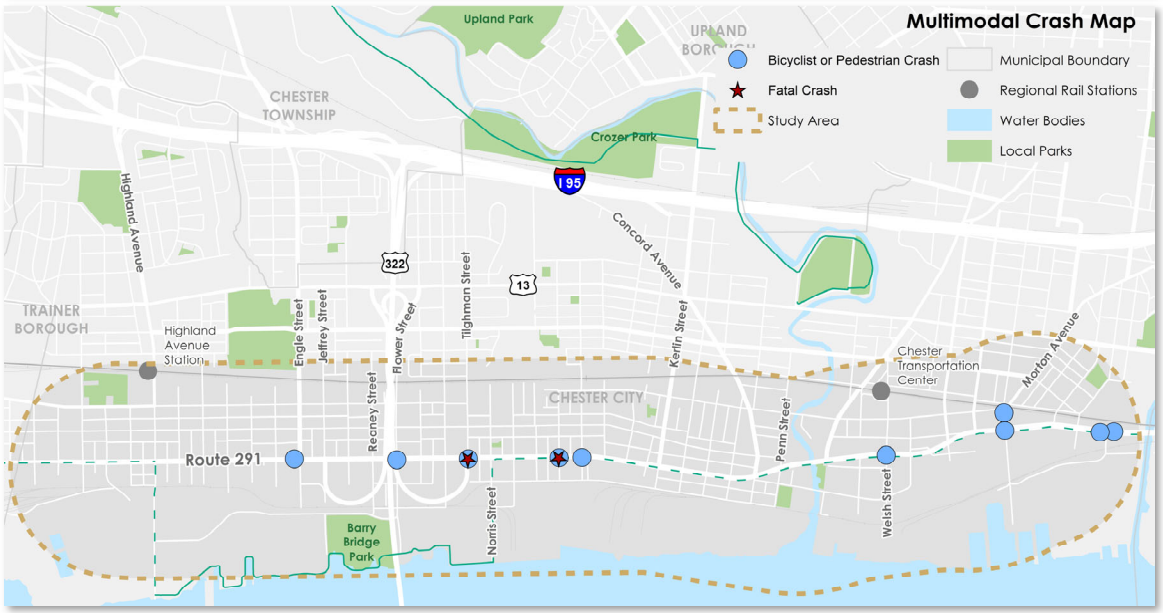


Figure 5: Bicyclist and Pedestrian Crashes (2017–2021)

Reduce Vehicular Speeds. Research shows that speed kills. According to the Federal Highway Administration's (FHWA's) Appropriate Speed Limits for All Road Users (FHWA-SA-21-034), a driver that travels at 30 mph and hits a pedestrian has a 45% chance of killing or seriously injuring them. At 20 miles per hour, that percentage drops to 5%. According to tube count data recorded in January 2023, most people are currently driving over 40 mph along Route 291. The 85th percentile speeds are 45 mph west of the Commodore Barry Bridge, and 50 mph east of the Commodore Barry Bridge. The speed limit is 35 mph, but the roadway is not currently designed such that 35 mph is the maximum speed that drivers can reach. Tube count data is included in Attachment 2. Residents have also pointed out that the corridor lacks speed limit signs and corresponding markings.

Improve Pedestrian Crossings. The existing signalized intersections do not include marked crosswalks or pedestrian signal phases. Some intersections lack accessible ramps. There are long distances between these signalized crossings, including more than 1 mile between Flower Street and Penn Street. People must traverse 65 feet of concrete, including five lanes of traffic, to get from one side to the other. Residents have stressed the need to increase intersection visibility, improve pedestrian crossings, provide better light on the street, and provide more traffic signals. According to the FHWA's Crosswalk Visibility Enhancements (FHWA-SA-21-049), high-visibility crosswalks can reduce pedestrian injury crashes up to 40%.

Improve Pedestrian Level of Comfort. Pedestrian Level of Comfort (PLOC) along a corridor is a function of sidewalk width, the width of the buffer between the sidewalk and vehicular traffic, roadway speed, and sidewalk condition (per the methodology used by the Montgomery County Maryland Planning Department). On-street parking improves the PLOC because it creates a physical barrier between pedestrians and vehicular traffic. At intersections, the PLOC is measured by the functional class of the roadway, the number of marked crosswalks, and the number of corners with Americans with Disabilities Act-accessible (ADA-accessible) ramps. Existing PLOC along Route 291 is poor, based on high 85th percentile speeds, narrow sidewalk widths, poor sidewalk maintenance, and the lack of marked crosswalks. Residents say that it does not feel like a safe place to walk.

Provide a Separated Greenway. This corridor serves as an important link within the East Coast Greenway network, but it lacks a separate, dedicated space for bicyclists. Residents say that Route 291 is not currently a street upon which they would feel comfortable biking.

Reduce Bicycle Level of Traffic Stress. Existing bicycle level of traffic stress (LTS) along Route 291 is LTS 4 - highly stressful. Very few people would feel comfortable riding in the street alongside high-speed cars and trucks. As shown above in Figure 5, between 2017 and 2021, bicyclist and/or pedestrian crashes occurred at Engle Street, Flower Street, Tilghman Street, Pennell Street, Lloyd Street, Welsh Street, Morton Avenue, and Harrah's Boulevard. Two of those crashes were fatal.

Minimize Vehicular Traffic Delays. One potential tradeoff of improving safety is increasing congestion. Under existing conditions, all signalized intersections along Route 291 in the City of Chester typically operate at level of service (LOS) A overall in the morning (AM)

and evening (PM) peak hours, except for Morton Avenue, which operates at LOS B in the morning (AM) peak hour and LOS C in the evening (PM) peak hour. According to PennDOT's Policies and Procedures for Transportation Impact Studies, LOS D is typically considered an acceptable condition for signalized intersections in an urban context.

Traffic counts along Route 291 were conducted in January 2023 east and west of the Commodore Barry Bridge (the Bridge). Those counts along with historic counts from PennDOT's Traffic Information Repository (TIRe) tool are provided below in Table 1. The counts from 2023 generally indicate traffic volumes in between the pre-Pandemic (2017) and mid-Pandemic (2020) values.

East of the Bridge, the traffic directional factor was 70 in 2020, which is high compared to similar roadways. Based on the January 2023 counts, the directional factor was 60. Per those counts, 9,500 vehicles per day were moving in the westbound direction, while 6,300 vehicles per day were moving eastbound east of the Bridge.

Table 1: Traffic Count Data

	Historic Counts* AADT	January 2023 Counts ADT
West of Bridge	4,400 vpd	10,500 vpd
East of Bridge	20,100 vpd	15,800 vpd

*Historic counts west of the Bridge are from 2020 and counts east of the Bridge are from 2017.
vpd = vehicles per day
AADT = Average Annual Daily Traffic (Bi-Directional)
ADT = Average Daily Traffic (Bi-Directional)

Minimize Vehicular Traffic Signal Queues. Queuing analysis results for existing conditions are included in the analysis files in Attachment 4. The longest existing maximum queue length for the signalized intersections along Route 291 in the City of Chester is 428 feet at the westbound approach of the intersection of Route 291 and Morton Avenue in the evening (PM) peak hour. The maximum existing queue at the intersection of Route 291 and Madison Street is 344 feet in the evening (PM) peak hour. Average queues for those two conditions are about half the length. In the morning (AM) peak hour and at other intersections in the evening (PM) peak hour, vehicular queues generally do not exceed existing capacity.

Minimize Traffic on Neighborhood Streets. There are several neighborhood streets that parallel Route 291, including 3rd Street, 4th Street, 7th Street, and US 13 Business (9th Street). Residents have expressed concerns about increased traffic volumes on these streets. These streets tend to be narrower and less connected compared to Route 291.

Maintain Emergency Access and I-95 Diversion Route. According to the DVRPC Interactive Detour Route Mapping (IDRuM) Tool (https://www.dvrpc.org/webmaps/idrum/), Route 291 serves as a detour route for I-95 during closures and emergencies. Residents

agree that when something happens along the interstate, they see increased traffic on Route 291. Residents want to avoid traffic being diverted to other neighborhood streets. Route 291 is also an emergency route and so it must provide smooth access for emergency vehicles.

Accommodate Stadium Traffic. The Philadelphia Union Major League Soccer team plays at Subaru Park near the intersection of Route 291 and Reaney Street. The stadium hosts about 25 home games per year, as well as other large-scale events. Traffic typically trickles into the area for evening games, but when the game ends, a flood of traffic is dumped onto the local transportation network. There are currently limited options for getting to the stadium besides by car. The stadium does not have an established event management plan but is constantly looking to improve operations.

Accommodate Truck Turns. Route 291 is nicknamed the Industrial Highway. While it is bordered by residential land use along the city side, it is bordered by industrial land use along the river side. Major industrial sites include Kimberly-Clark; Delcora; Covanta; Riverbridge; Penn Terminals; and in Ridley Township, Boeing. Route 291 is designated as a primary truck route in the 2018 Truck Wayfinding Study. Highland Avenue, Flower Street, Morton Avenue, and US 13 Business (9th Street) are designated as secondary truck routes. Major industrial access points include Booth Street, Harwick Street, Norris Street, Broomall Street, Lamokin Street, Lloyd Street, Avenue of the States, Welsh Street, Crosby Street, Madison Street, and Morton Street. These streets are labeled in the presentation in Attachment 2.

Truck counts along Route 291 are provided below in Table 2. Counts from 2023 indicate a higher volume of trucks west of the Bridge, compared to historic counts; and a lower volume of trucks east of the Bridge, compared to historic counts.

Table 2: Truck Counts

	Historic Counts (trucks per day)		January 2023 Counts (trucks per day)	
	Eastbound	Westbound	Eastbound	Westbound
West of Bridge	248*	248	654***	699
East of Bridge	532**	787	399	564

*Historic truck counts west of the Bridge are from 2020.

**Historic truck counts east of the Bridge are from 2017.

***Truck counts for 2023 are specific to five-axle double trucks

Accommodate On-Street Parking. The existing cross section includes an 8-foot parking lane along the city side. Residents have repeatedly indicated that the on-street parking is important to the people that live along or near Route 291. They have stressed that getting into and out of parked vehicles along Route 291 feels unsafe alongside the fast-moving traffic. Residents suggested that a buffer is needed to create space for accessing parked vehicles.

Celebrate Chester as a Place. The City of Chester has a rich history. William Penn's actual landing spot is in Chester. A plaque commemorates that historic moment in a park near the intersection of Route 291 and Edgemont Avenue. Martin Luther King, Jr. also spent three years at the Calvary Baptist Church, which is located along Route 291 near Baker Street. Residents want Chester to be celebrated as its own place with its own value.

Incorporate Green Infrastructure. The existing Route 291 cross section includes a significant swath of impervious surface. Residents say flooding occurs, particularly near Chester Creek. Residents want to see more greenery along the corridor, but also want to ensure that street trees are maintained to preserve visibility.

Spur Community-Sensitive Development. The City of Chester is home to many marginalized people. According to Social Explorer Data (https://www.socialexplorer.com/) for the census tract that includes Route 291 through Chester, 45% of families have a household income below the poverty line, 67% of the housing units are renter occupied, 79% of people are Black or African American, and 37% of households do not own a vehicle. Many residents in Chester hope to see development occur along the riverfront that can bring economic prosperity to the city and to existing and generational residents of Chester.

Build Upon Previous Plans & Current Projects. The Chester community has lent its voices to several plans and studies, often without seeing improvements implemented in return. The City of Chester currently has a project in preliminary design to implement a shared use path along the river side of Route 291 from around Highland Avenue to around Norris Street. This project also includes marked crosswalks, curb extensions, and medians, as well as new traffic signals at Jeffrey Street and at Tilghman Street. New bicycle facilities are being designed along Highland Avenue and Norris Street. Another project along Reaney Street is installing a Rectangular Rapid Flashing Beacon (RRFB) at the intersection of Reaney Street and Route 291. PennDOT has recently implemented a quick build improvement project, funded through an On Demand Safety contract, including signs and pavement markings intended to calm traffic around the western edge of the study corridor. PennDOT also has a drainage project along Route 291 in Ridley Township that includes construction of part of the East Coast Greenway facility.

Previous plans in Chester recommend improving multimodal access to the riverfront, and focusing on safety. Previous plans include:

- Chester Waterfront Master Plan (2021).
- Resilience through Recreation (2018).
- Truck Wayfinding in the City of Chester (2018).
- City of Chester Green Stormwater Infrastructure Plan (2017).
- PA 291 Area Study (2015).
- Delaware County Open Space, Recreation, and Greenway Plan (2015).

- Chester Riverfront & Community Rail Access Study (2014).
- Landscape & Signage Guidelines (2005).
- A River Reconnected (2021).
- ECG Alignment and ROW Analysis (2018).
- ECG Alignment and ROW Analysis (2020).
- The City of Chester (2019).
- ECG Implementation Plan (2018).
- PA Active Transportation Plan (2019).

Reduce Property Impacts. When the roadway was widened in the early 2000s, minority families were displaced. Houses, businesses, and community resources were demolished. Further property takes to improve safety along Route 291 could repeat that history and further burden marginalized people. In 2018, a study (ECG Alignment and ROW Analysis) showed that 69 property easements would be needed between Norris Street and Ethel Waters Park to position a greenway facility outside of the existing curb-to-curb along Route 291. In this section of the corridor, much of the property is not owned by PennDOT. Additional analysis in 2020 (ECG Alignment and ROW Analysis) confirmed these impacts. These analyses recommended that a facility outside of the curb-to-curb not be pursued, given the potential impacts to marginalized people, as well as the implications for implementation timeline and feasibility.

Manage Construction Costs. Construction costs are often a tradeoff of street improvements. Some streets are widened at a significant cost, while others are narrowed at a similar cost. A project that improves safety along Route 291 may require grant funding to be implemented.

Manage Maintenance Costs. The City of Chester is under-resourced and does not have the staff capacity, nor funding for extensive street maintenance. Residents stressed the need to replace signs and pavement markings along the corridor, as well as improving lighting, trimming overgrown trees, and fixing deteriorated sidewalk. Short-term maintenance solutions may be required, in addition to long-term improvements.

Multimodal Toolkit

The multimodal toolkit includes a menu of treatments for improving safety and addressing access for pedestrians, bicyclists, drivers, and bus riders along the corridor. The toolkit is broken into six categories: greenway treatments, traffic calming, multimodal access, signals and intersections, placemaking, and truck route treatments. These tools are sensitive to the local context and the outcomes desired by residents and stakeholders. They serve as a resource to the County and PennDOT in subsequent phases of design.

The toolkit has been populated using state and national resources. One resource is FHWA's collection of Proven Safety Countermeasures. FHWA has determined that these tools are effective strategies for reducing severe crash outcomes. The multimodal toolkit draws upon PennDOT Design Manual 2, which outlines context based design solutions. It also stems from guidance distributed by the National Association of City Transportation Officials (NACTO). While the toolkit is not all-encompassing of treatments or strategies that can be implemented to improve safety along Route 291, it serves as a foundation for developing and refining alternatives.

The treatments in the toolkit are applied as part of various alternatives, which are described herein, to best balance tradeoffs and meet the objectives of the study. The toolkit is shown below in Figure 6. It is also included in Attachment 3.

IMPROVING SAFETY ON ROUTE 291

TRUCK ROUTE TREATMENTS

PLACEMAKING

SIGNALS & INTERSECTIONS

MULTIMODAL ACCESS

TRAFFIC CALMING

GREENWAY TREATMENTS

SEPARATED BIKE LANE

A separated bike lane is within the street right-of-way and separated from motor vehicle traffic by a physical barrier, such as planters, flexible delineator posts, parked cars, landscape median, or a mountable curb.

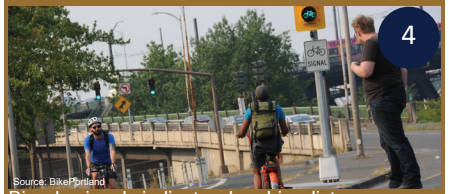
SHARED USE PATH / TRAIL

This facility is shared between people biking and walking. A shared use path (SUP) or trail provides the highest level of separation and the lowest level of traffic stress for cyclists.

GREEN PAINT

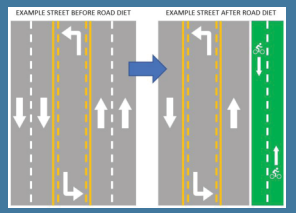
Green and/or white pavement markings draw attention to cyclists moving through or past conflict areas, including intersections and driveways.

BICYCLE SIGNAL



Bicycle signals indicate when bicyclists can cross. They also restrict conflicting vehicle movements. Bicycle-only signals can be used at intersections to provide a separate signal phase that is dedicated to bicyclists.

ROAD DIET



A road diet involves reducing or repurposing lanes to change the purpose, width, directionality, or other characteristics of the roadway. This can slow vehicles and make room for a bicycle facility.

RAISED MEDIAN

A raised median provides horizontal deflection to slow vehicles along a roadway. Raised medians provide an opportunity to incorporate a pedestrian refuge or green stormwater infrastructure.

CURB EXTENSION / BULBOUT

Curb or sidewalk extended into the street, either at an intersection or mid-block, narrows the street width, reduces pedestrian crossing distance, improves visibility of pedestrians, and reduces right-turning vehicle speeds.

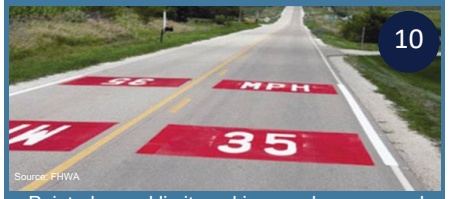
INTERSECTION VISIBILITY

Marking off areas using pavement markings, flexible delineator posts, or other visual or physical elements delineates space where on-street parking is restricted. This maintains visibility at driveways and intersections.

SPEED / RED LIGHT CAMERAS

Speed or red light running cameras can reduce motorist speeds and impact driver behavior where physical infrastructure is less feasible or effective. Additional legislation and certification might be needed to implement.

SPEED LIMIT MARKINGS & SIGNS

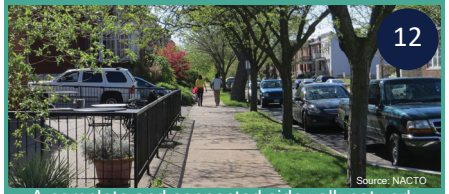


Painted speed limit markings and more speed limit signs provide a visual reminder of the desired and allowable roadway speed. Speed limits can also be reduced where appropriate.

BUFFERS & RUMBLE STRIPS

Buffers and/or rumble strips can be used to separate different modes of traffic traveling in opposite directions. These treatments can enforce separation between fast-moving traffic and a parking lane, bike lane, or turn lane.

SIDEWALK WIDENING

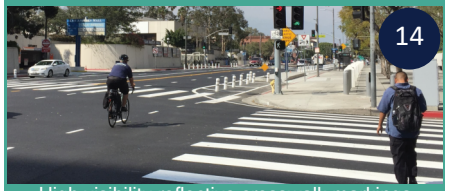


A complete and connected sidewalk network increases pedestrian access and safety. Along an urban corridor, the sidewalk clear width should be at least 6-ft wide, or ideally wider.

PEDESTRIAN REFUGE

A pedestrian median refuge island provides added protection for pedestrians and bicyclists crossing at an intersection or mid-block. The refuge improves pedestrian visibility, reduces conflict points, and reduces crossing distance.

MARKED CROSSWALK



High visibility reflective crosswalk markings should be incorporated at controlled intersections and at priority mid-block crossings. According to FHWA, “a high-visibility marked crosswalk can reduce pedestrian crashes up to 40%.”

CROSSWALK VISIBILITY

Signage and warning beacons can be used in advance of marked pedestrian crossings to increase driver yielding.

INTERSECTION MARKINGS

Pavement markings visually separate modes to reduce pedestrian and bicyclist exposure. Separate signal phases for bicyclists and pedestrians eliminate conflict points.

IMPROVING SAFETY ON ROUTE 291

TRUCK ROUTE TREATMENTS

PLACEMAKING

SIGNALS & INTERSECTIONS

MULTIMODAL ACCESS

TRAFFIC CALMING

GREENWAY TREATMENTS

FLASHING PEDESTRIAN SIGNAL

Rectangular Rapid Flash Beacons (RRFBs) include a flasher that lets motorists know pedestrians are crossing. These are especially applicable at uncontrolled, mid-block, or trail crossings.

PEDESTRIAN COUNTDOWN SIGNAL

A pedestrian countdown signal includes an accessible push button, appropriate signage, and a pedestrian signal that indicates remaining walk time. Fixed, rather than actuated, signals are most preferred in urban areas.

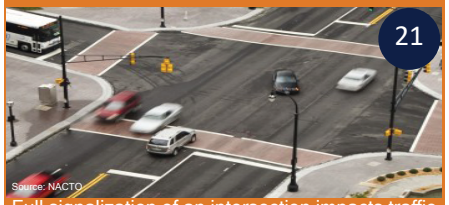
EXTRA PEDESTRIAN CROSSING TIME

A leading pedestrian interval (LPI) gives pedestrians advance signal time to begin crossing before conflicting vehicles start turning. LPIs are especially helpful at wide, busy intersections.

TRANSIT AMENITIES

Transit amenities include shelters, benches, kiosks, and access to other services and amenities. There should be sidewalk access and safe roadway crossings near transit stops.

TRAFFIC SIGNALS AT INTERSECTIONS

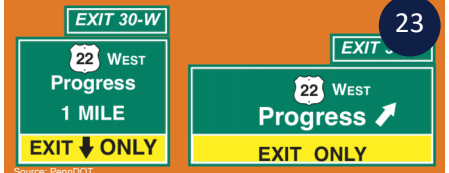


Full signalization of an intersection impacts traffic operations and controls the movements of all road users. This can slow traffic, improve mobility, and accommodate pedestrians and bicyclists.

ROUNDABOUT

A roundabout is an intersection treatment with channelized approaches that reduce speeds. Roundabouts minimize conflict points and maintain a safe flow of traffic.

DIRECTIONAL SIGNAGE



Providing clear signs and pavement markings along a corridor can reduce confusion and direct motorists to key destinations.

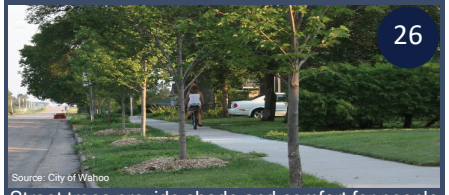
TRAFFIC SIGNAL TIMING

Traffic signal timing changes can optimize traffic operation and reduce queueing and congestion. Signal timing might also provide priority to different modes, such as transit vehicles.

STREET LIGHTING

Pedestrian-scale lighting improves pedestrian security and comfort, especially at crossings, key destinations, and transit stops. Street lights improve visibility for drivers.

STREET TREES

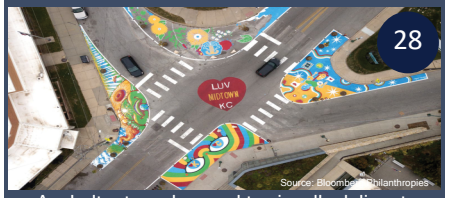


Street trees provide shade and comfort for people on the sidewalk. They also contribute to a lively sense of place. Street trees must be placed and maintained to allow for motorist visibility.

GREEN STORMWATER INFRASTRUCTURE

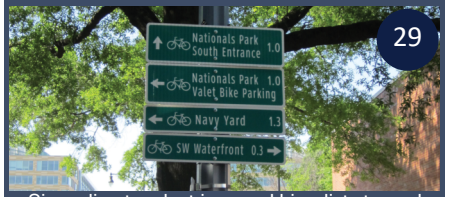
Green Stormwater Infrastructure (GSI) in sidewalks, medians, and curb extensions collects stormwater runoff and filters it through special soil and plants before it soaks into the ground or is released slowly back into the sewer system.

ASPHALT ART



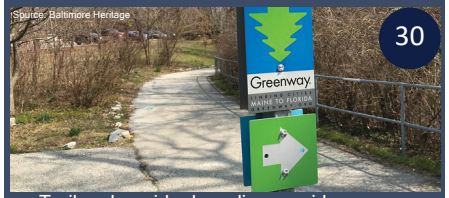
Asphalt art can be used to visually delineate space in the roadway to improve safety and revitalize public space.

TRAIL WAYFINDING & AMENITIES



Signs direct pedestrians and bicyclists toward destinations in the area, typically including distance and average walking or biking times. Other amenities might include benches, shelters, trees, and art.

CORRIDOR BRANDING



Trail and corridor branding provide a sense of place and direct users to destinations. This branding can connect various facilities within a greater region.

TRUCK SIGNAGE

Signs and pavement markings can be used to direct and restrict truck traffic. Through-movement truck traffic can be discouraged, while trucks accessing industry along the corridor can be directed to make safe, slow movements.

TRUCK APRON

A truck apron is mountable by trucks or buses, but not by smaller vehicles. This means that the radius at intersections or driveways can be tightened to improve safety for pedestrians, while still allowing wider truck turning movements.

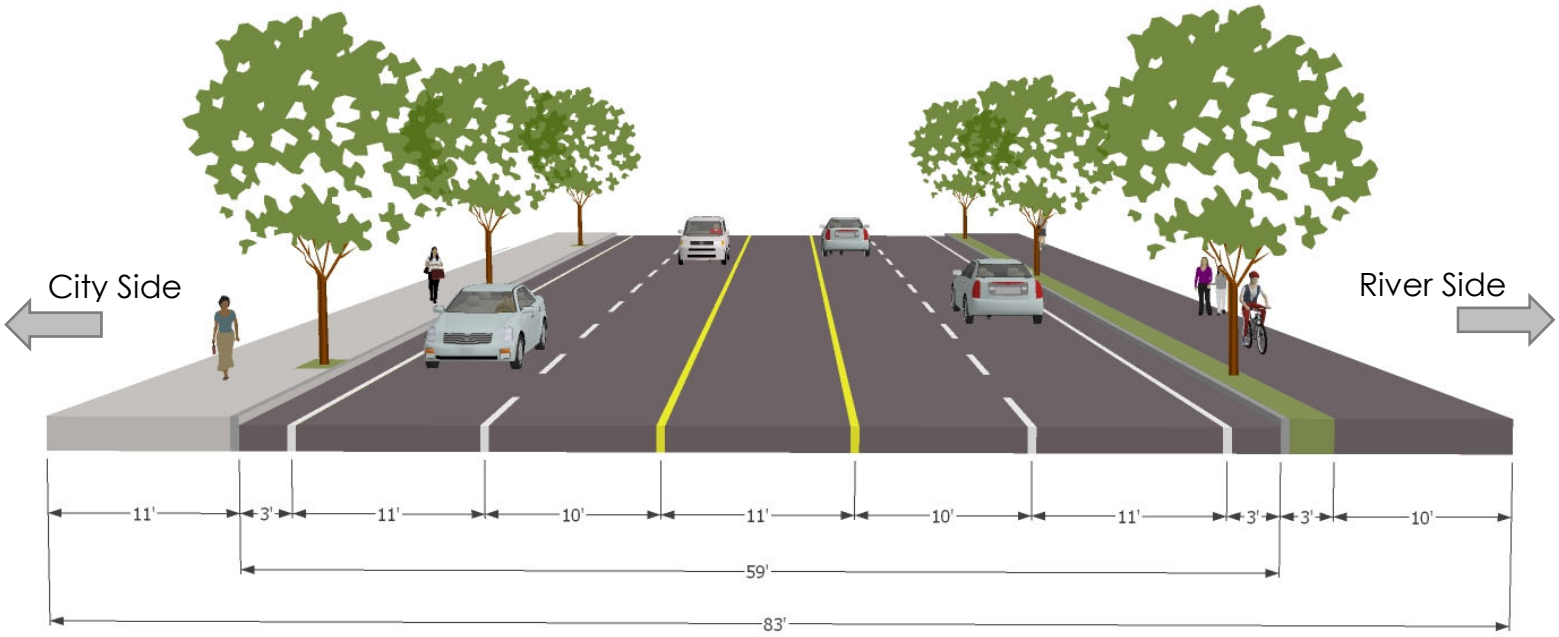
Alternatives

This study was initiated in response to concerns about safety along Route 291. Alternatives for improving safety are developed to balance established objectives. They strongly focus on slowing vehicular speeds, reducing driver confusion, improving pedestrian crossings, and creating safe space for bicyclists and pedestrians.

To address the concerns that were heard, two main alternatives were evaluated along Route 291, including:

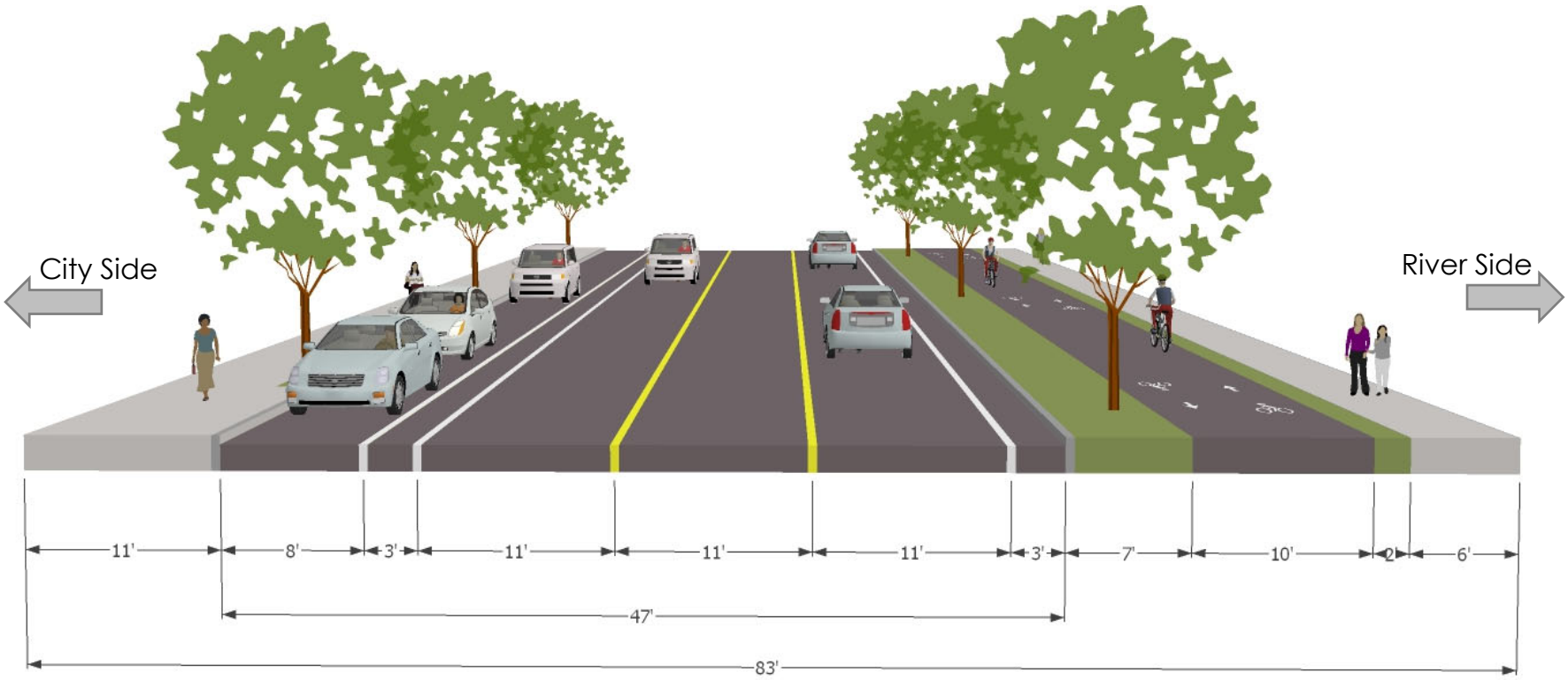
Alternative A, which maintains five lanes of traffic on Route 291 and includes safety improvements, such as center medians, pedestrian refuge islands, improved crosswalks, a shared use path, the signalization of Kerlin Street (if warranted), and street lighting upgrades. As shown in Figure 7, Alternative A involves eliminating the on-street parking lane and reducing the curb-to-curb width of the street to avoid property impacts. The shared use path in Alternative A is narrower than in other alternatives. As regulation allows, automated enforcement can also be a tool considered in conjunction with this alternative to slow motor vehicles speeds along the corridor.

Figure 7: Alternative A



Alternative B reduces the street section to three lanes of traffic on Route 291 and includes safety improvements, such as curb extensions, center medians, pedestrian refuge islands, improved crosswalks, a shared use path, the signalization of Kerlin Street (if warranted), and street lighting upgrades. As shown in Figure 8, Alternative B maintains the parking lane and adds a 3-foot wide parking lane buffer. The parking lane provides space for curb extensions, and the movement of the curb allows for a wide greenway facility, which can be a shared path for bicyclists and pedestrians or two separate facilities for the different trail users.

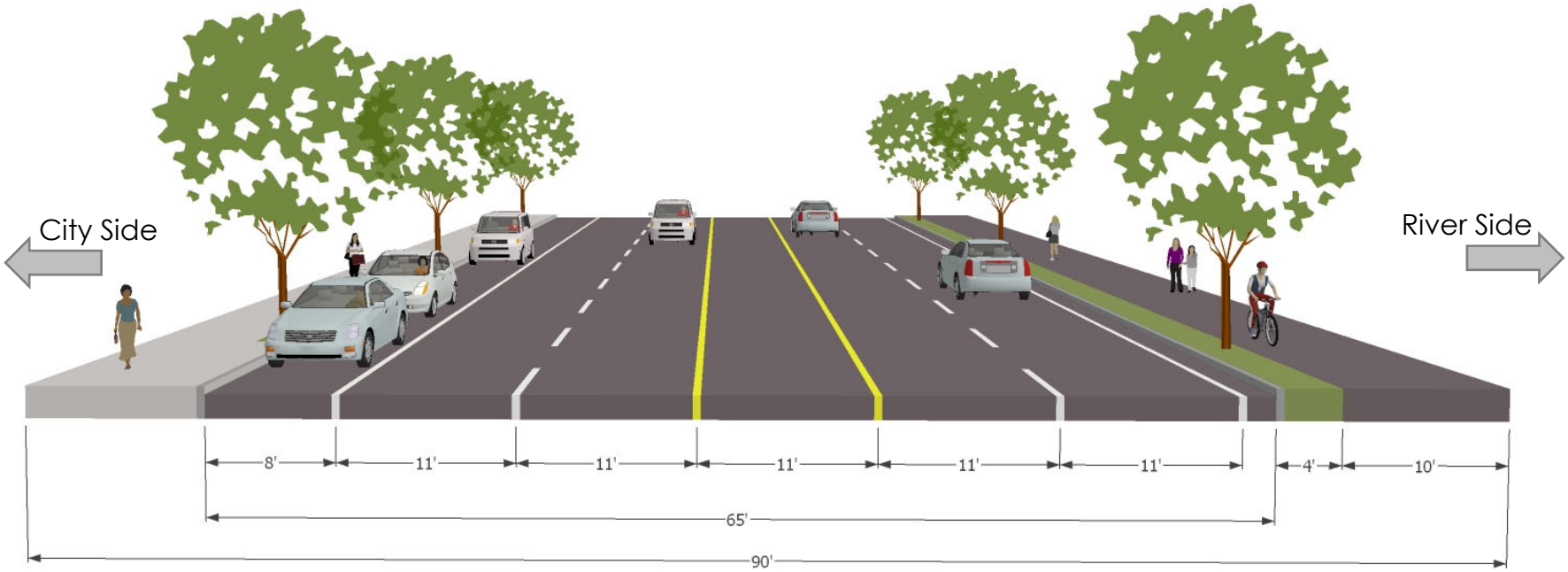
Figure 8: Alternative B



Based on further discussion with project partners, two additional alternatives were considered, including:

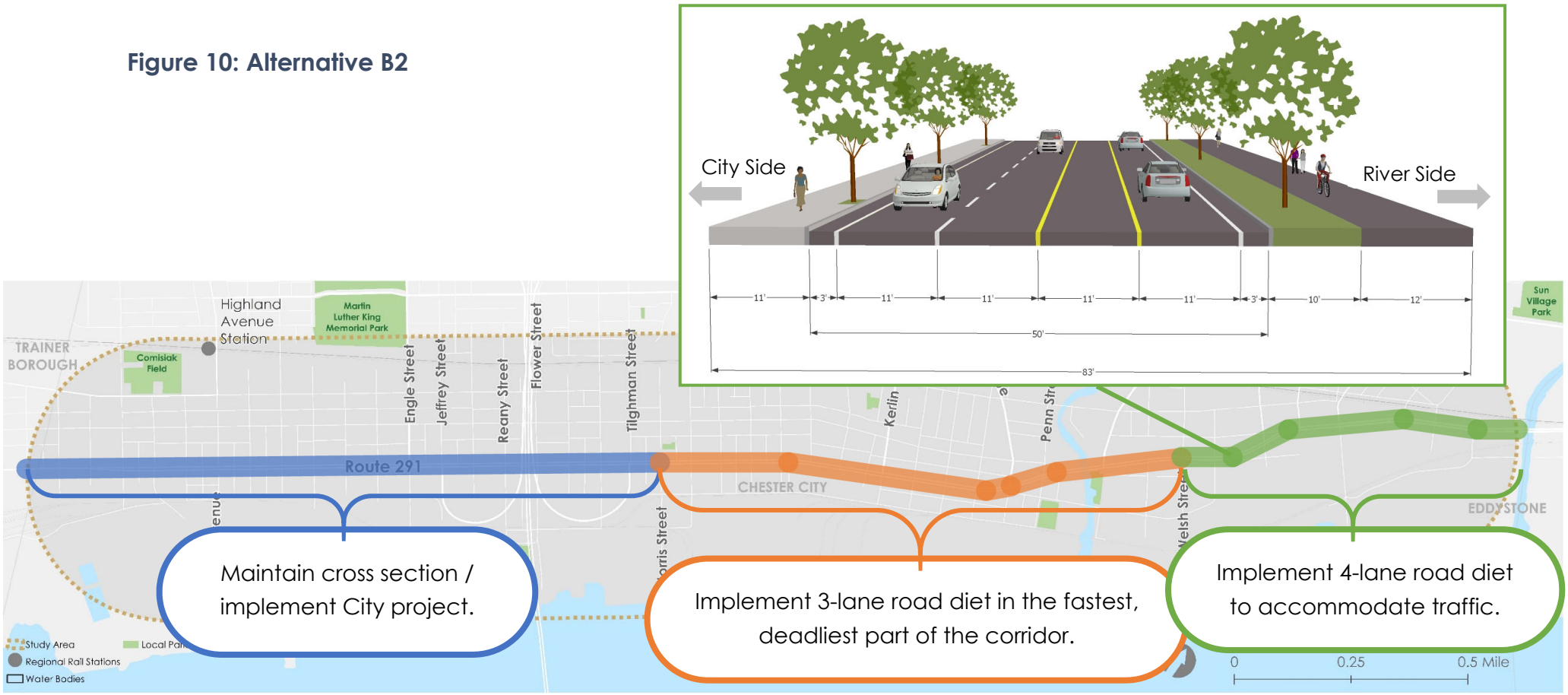
Alternative A2, which is similar to Alternative A in that it maintains five lanes of traffic on Route 291 and includes safety improvements, such as center medians, pedestrian refuge islands, improved crosswalks, a shared use path, the signalization of Kerlin Street (if warranted), and street lighting upgrades. As shown in Figure 9, the key difference with Alternative A2 is that it does not adjust the curb-to-curb width and instead implements the shared use path by taking additional right-of-way. The width of that path can be narrower or wider, resulting in different property impacts. Alternative A2 maintains the parking lane, and thus can also include curb extensions. As regulation allows, automated enforcement can also be a tool considered in conjunction with this alternative to slow motor vehicles speeds along the corridor.

Figure 9: Alternative A2



Alternative B2, which is similar to Alternative B in that it reduces the street section to three lanes of traffic on Route 291 and includes safety improvements, such as curb extensions, center medians, pedestrian refuge islands, improved crosswalks, a shared use path, the signalization of Kerlin Street (if warranted), and street lighting upgrades. The key difference with Alternative B2 is that it implements the road diet only from approximately Norris Street to approximately Welsh Street. West of Norris Street, it is assumed that the current City project will be implemented and maintained. East of Welsh Street, Alternative B2 recommends a four-lane cross section, including two westbound traffic lanes to reduce peak hour vehicle queues and delays in that section of the corridor. The breakdown of cross sections and the four-lane cross section of Alternative B2 is shown below in Figure 10.

Figure 10: Alternative B2



Analysis

The alternatives are assessed as per the metrics for evaluation. Attachment 4 includes the analysis files, including completed forms and program output files for the predictive crash analysis, intersection control evaluation, and traffic operations analysis. Attachment 4 also includes PowerPoint slides with graphics pertaining to the traffic analysis results.

Key Takeaways

Based on the analysis performed, key takeaways that may be most pertinent to the discussion and selection of a preferred alternative are provided below.

Crash Analysis

- Maintaining five lanes of traffic and making other safety improvements is estimated to reduce predicted annual fatal and serious injury crashes by about 40%, from about 40 predicted severe crashes to about 24 predicted severe crashes.
- Reducing the roadway to three lanes of traffic and making other safety improvements is estimated to reduce predicted annual fatal and serious injury crashes by about 63%, from about 40 predicted severe crashes to about 15 predicted severe crashes.
- Over the course of the next 26 years to the future year of 2050, a total of 1,080 severe crashes are predicted with no changes to the roadway, 648 severe crashes are predicted for Alternative A (with five lanes), and 405 severe crashes are predicted for Alternative B (with three lanes).

Intersection Control Evaluation

- Signalized control at the intersection of Route 291 and Kerlin Street is predicted to reduce crashes and minimize impacts to operations during the peak hour. Signal warrants analysis is recommended in Preliminary Engineering.

Traffic Operations Analysis

- Acceptable LOS (LOS D or better) is estimated for the study intersections for Alternatives A and A2 (five lanes) in 2050.
- Acceptable LOS (LOS D or better) is estimated for the study intersections for Alternative B (three lanes) in 2050 when using volumes that are predicted for the three-lane roadway.
- Acceptable LOS (LOS D or better) is estimated for most study intersections for Alternative B (three lanes) in 2050 when using volumes that are predicted for a five-lane roadway.
    - LOS F is estimated in the evening (PM) peak hour at the intersections of Route 291 and Madison Street, and Route 291 and Morton Avenue for Alternative B (three lanes) in 2050 when using volumes that are predicted for a five-lane roadway.

- Acceptable LOS (LOS D or better) is estimated for the study intersections for Alternative B2 (partially three/four/five lanes) in 2050 when using volumes that are predicted for a five-lane roadway.
- With the new signals at Jeffrey Street, Tilghman Street, and Kerlin Street (if warranted); and with signal timing and phasing optimization, drivers are not anticipated to experience a significant change in congestion along Route 291 in 2050, as compared to today for any alternative.
- Some local traffic is anticipated to divert to parallel neighborhood streets with the reduction of Route 291 from five lanes to three lanes; however, the lack of long-distance connectivity within the neighborhood street network will only likely draw localized trips and not end-to-end corridor trips looking to bypass Route 291.

I-95 Diversion Analysis

- About twice as much traffic is estimated to divert to Route 291 as compared to US 13 Business (9th Street) in the event of a closure on I-95.
- Depending on the extremity of the closure, demand on Route 291 and US 13 Business (9th Street) may exceed capacity and extend the peak hour.

Alternatives Comparison Matrix

The below matrix provides a comparison summary of the alternatives based on the study metrics. The matrix includes colors that represent the following:

Red represents a significant misalignment and/or obstacle for achieving the project objective.

Orange represents a moderate misalignment and/or obstacle for achieving the project objective.

Yellow represents a moderate alignment and/or opportunity for achieving the project objective.

Green represents a significant alignment and/or opportunity for achieving the project objective.

Colors are labeled in each box to ensure accessible viewing.

Table 3: Alternative Comparison Matrix

Goal	Metric	No-Build	**Alternative A –** 5 Lanes, No ROW Take	**Alternative A2 –** 5 Lanes, ROW Takes	**Alternative B –** 3 Lanes, No ROW Take	**Alternative B2 –** Hybrid 3 to 5 Lanes, No ROW Take
Improve Safety for All	Reduce All Crashes	58 predicted annual crashes (no reduction). (red)	34 predicted annual crashes (41% less). (orange)	34 predicted annual crashes (41% less). (orange)	24 predicted annual crashes (59% less). (green)	Analysis not performed. Predicted crashes likely between Alternatives A and B. (yellow)
	Reduce Fatal & Serious Injury Crashes	40 predicted annual fatal & serious injury crashes (no reduction). (red)	24 predicted annual fatal & serious injury crashes (40% less). (orange)	24 predicted annual fatal & serious injury crashes (40% less). (orange)	15 predicted annual fatal & serious injury crashes (63% less). (green)	Analysis not performed. Predicted crashes likely between Alternatives A and B. (yellow)
	Reduce Vehicular Speeds	No reduction of vehicular speeds (existing 85th percentile speeds = 45 - 50 mph). (red)	Medians and narrower lanes are expected to provide some speed reduction. (orange)	Curb extensions, medians, and narrower lanes are expected to provide some speed reduction. (orange)	Curb extensions, medians, and road diet are expected to significantly reduce speeds. (green)	Curb extensions, medians, and road diet are expected to significantly reduce speeds in the speediest section. (yellow)
Create Connections for Biking and Walking	Improve Pedestrian Crossings	Very few existing marked/controlled crossings. (red)	Marked/controlled crossings proposed. Pedestrians cross 5 lanes of traffic. (orange)	Marked/controlled crossings proposed. Pedestrians cross 5 lanes of traffic. (orange)	Marked/controlled crossings proposed. Pedestrians cross 3 lanes of traffic. (green)	Marked/controlled crossings proposed. Pedestrians cross 3 to 5 lanes of traffic. (yellow)
	Improve Pedestrian Level of Comfort[1]	Poor pedestrian level of comfort. (red)	Improved crossings and pathway/buffer. High speeds retained. (orange)	Improved crossings and pathway/buffer. High speeds retained. (orange)	Improved crossings and pathway/buffer. High speeds reduced. (green)	Improved crossings and pathway/buffer. High speeds reduced for much of corridor. (yellow)
	Provide a Separated Greenway	No separated facility provided. (red)	Minimum width shared use path and buffer provided. (yellow)	Minimum width shared use path and buffer provided. (yellow)	Wide separated shared use path and buffer provided. (green)	Wide separated shared use path and buffer provided. (green)
	Reduce Bicycle Level of Traffic Stress	No improvements (LTS 4). (red)	Shared use path reduces stress (LTS 1) but crossing to path is challenging. (yellow)	Shared use path reduces stress (LTS 1) but crossing to path is challenging. (yellow)	Shared use path reduces stress (LTS 1). (green)	Shared use path reduces stress (LTS 1). (green)

1) Pedestrian Level of Comfort based on Montgomery County Maryland Planning Department methodology

Goal	Metric	No-Build	**Alternative A –** 5 Lanes, No ROW Take	**Alternative A2 –** 5 Lanes, ROW Takes	**Alternative B –** 3 Lanes, No ROW Take	**Alternative B2 –** Hybrid 3 to 5 Lanes, No ROW Take
Optimize Roadway Operations	Minimize Vehicular Traffic Delays[1]	No improvement or degradation of LOS (typically LOS A, B, or C). (green)	No improvement or degradation of LOS (typically LOS A, B, or C). (green)	No improvement or degradation of LOS (typically LOS A, B, or C). (green)	Degradation of LOS in peak hour (typically LOS A, B, C, or D; LOS F in PM peak hour at Madison & Morton intersections). (orange)	Limited degradation of LOS with added WB lane from Welsh Street to Harrah's Blvd (typically LOS A, B, C, D). (yellow)
	Minimize Vehicular Traffic Signal Queues	No reduction or extension of queues. (largest max. queue = 428 ft; largest avg. queue = 226 ft). (green)	Minor extension of queues (largest max. queue = 456 ft; largest avg. queue = 326 ft). (green)	Minor extension of queues (largest max. queue = 456 ft; largest avg. queue = 326 ft). (green)	Extension of queues in peak hour (largest max. queue = 1,411 ft; largest avg. queue = 1,066 ft). (orange)	Extension of queues in peak hour (largest max. queue = 1,122 ft; largest avg. queue = 978 ft). (yellow)
	Minimize Neighborhood Street Traffic	No expected diversion of traffic. (green)	No expected diversion of traffic. (green)	No expected diversion of traffic. (green)	Some potential for traffic diversion. (orange)	Some potential for traffic diversion. (yellow)
	Maintain Emergency Access & I-95 Diversion Route	Existing access and capacity maintained. (green)	Existing access and capacity maintained. (green)	Existing access and capacity maintained. (green)	Less capacity for access during I-95 events. (orange)	Less capacity for access during I-95 events along parts of the corridor. (yellow)
	Accommodate Stadium Traffic[2]	No impacts to the accommodation of stadium traffic. (green)	No impacts to the accommodation of stadium traffic. (green)	No impacts to the accommodation of stadium traffic. (green)	Road diet near stadium may reduce capacity. (orange)	No impacts to the accommodation of stadium traffic. (green)
Balance Residential and Industrial Needs	Accommodate Truck Turns	Existing access management to businesses retained. (green)	Existing access management to businesses mostly retained (medians may impact). (yellow)	Existing access management to businesses mostly retained (medians may impact). (yellow)	Existing access management to businesses mostly retained (medians may impact). (yellow)	Existing access management to businesses mostly retained (medians may impact). (yellow)
	Accommodate On-Street Parking	Existing on-street parking retained, but unsafe to access. (yellow)	Existing on-street parking eliminated. Parking needs to be accommodated elsewhere. (orange)	Existing on-street parking retained, but unsafe to access. (yellow)	Existing on-street parking retained, buffer provided for improved access (speeds reduced). (green)	Existing on-street parking retained where most needed, buffer provided for improved access (speeds reduced). (green)

1) Vehicular traffic delay for all alternatives is based on five-lane future volumes.
2) Some improvements anticipated for all alternatives with City project (signalizing intersections).

Goal	Metric	No-Build	**Alternative A –** 5 Lanes, No ROW Take	**Alternative A2 –** 5 Lanes, ROW Takes	**Alternative B –** 3 Lanes, No ROW Take	**Alternative B2 –** Hybrid 3 to 5 Lanes, No ROW Take
Balance Residential and Industrial Needs	Celebrate Chester as a Place	Remains a "highway through community." (red)	Pavement markings, medians, and greenway improve sense of place, but street section remains wide. (yellow)	Pavement markings, medians, and greenway improve sense of place, but street section remains wide. (yellow)	Curb extensions, pavement markings, medians, greenway, and road diet improve sense of place. (green)	Curb extensions, pavement markings, medians, greenway, and road diet improve sense of place. (green)
	Incorporate Green Infrastructure	Extensive existing pavement and narrow planting strips. (red)	Limited space for planting and green infrastructure. Much of existing pavement retained. (orange)	Limited space for planting and green infrastructure. Much of existing pavement retained. (orange)	Ample space to incorporate planting space and green infrastructure. (green)	Ample space along much of corridor to incorporate planting space and green infrastructure. (green)
	Spur Community-Sensitive Development	Existing street may contribute to ongoing vacancies. (red)	Safety improvements may spur development. (yellow)	Safety improvements may spur development, but impacts are not community sensitive. (orange)	Road diet and safety improvements may spur development. (green)	Road diet and safety improvements may spur development. (green)
Plan for Implementation	Build Upon Previous Plans & Current Projects	No conflicts with current projects, but no implementation of previous plans. (yellow)	No conflicts with current projects, but limited implementation of previous plans. (yellow)	No conflicts with current projects, but limited implementation of previous plans. (yellow)	Implementation of previous plans, but potential conflicts with current City project. (yellow)	Builds upon previous plans and current City project. (green)
	Reduce Property Impacts	No property takes. (green)	Minimal property takes anticipated. (yellow)	Extensive property takes anticipated (significantly affecting marginalized communities). (red)	No property takes anticipated. (green)	No property takes anticipated. (green)
	Manage Construction Costs	No construction cost. (green)	Estimated construction cost = $26M. Much of the existing curb must be moved. (orange)	Estimated construction cost = $23M. Much of the existing curb is maintained. (yellow)	Estimated construction cost = $28M. Much of the existing curb must be moved. (orange)	Estimated construction cost = $17M. Some existing curb must be moved. (yellow)
	Manage Maintenance Costs	Maintain existing maintenance costs. (yellow)	Some increases in maintenance costs. (yellow)	Some increases in maintenance costs. (yellow)	Some increases in maintenance costs. (yellow)	Some increases in maintenance costs. (yellow)

Preferred Alternative

Typically, transportation infrastructure projects require tradeoffs to achieve desired outcomes within various constraints. As such, the alternatives are compared based upon how well they meet the study objectives set forth by the community and local stakeholders.

Alternative A is anticipated to have less reduction of predicted fatal and serious injury crashes; some improvement to multimodal mobility; fewer impacts to traffic flow and industrial access; loss of the parking lane; and significant cost due to moving the curb.

Alternative B is anticipated to have larger reduction of predicted fatal and serious injury crashes; greater improvement to multimodal mobility; greater impacts to peak hour traffic flow and industrial access; maintenance of the parking lane; and significant cost due to moving the curb.

Alternative A2 is anticipated to have less reduction of predicted fatal and serious injury crashes; some improvement to multimodal mobility; fewer impacts to traffic flow and industrial access; maintenance of the parking lane; and less cost by maintaining the curb. The fatal flaw with Alternative A2 is the significant impacts to properties.

Alternative B2 is anticipated to have larger reduction of predicted fatal and serious injury crashes in the fastest portion of the corridor; greater improvement to multimodal mobility; fewer impacts to peak hour traffic flow and industrial access; maintenance of the parking lane; and less cost by partially maintaining the curb.

Alternative B and Alternative B2 are recommended to be explored further as the project progresses. Both of these alternatives address safety in the fastest and deadliest portion of the corridor by implementing a road diet that is anticipated to slow speeds and shorten crossings. While Alternative B recommends a road diet along the entire Route 291 corridor, Alternative B2 is a hybrid solution. Specifically, Alternative B2 accommodates westbound PM peak hour traffic volumes in the portion of the corridor with the potential for longer vehicular queues and delays. Alternative B2 also streamlines implementation by building upon the current City project from Highland Avenue to Norris Street. Alternative B2 maintains capacity around the stadium, preserves the parking lane in portions of the corridor where it currently exists, and includes a wide shared use path without anticipated property impacts.

Both Alternative B and Alternative B2 include additional safety improvements that are consistent with those being implemented as part of the current City project. These include curb extensions, medians, pedestrian refuges, high visibility marked crosswalks, pedestrian countdown signals, leading pedestrian intervals, and signalization of the intersection of Route 291 and Kerlin Street (if warranted). Refer to Figure 11 for a conceptual layout of Alternative B2 improvements. Refinement of the locations of treatments, extents of cross section

changes, and other design details will be established during Preliminary Engineering. In subsequent phases of this project, further vetting of Alternative B and Alternative B2 will occur. The stakeholders and the community will be involved in the vetting of the preferred alternative to be sure it achieves the desired outcomes.

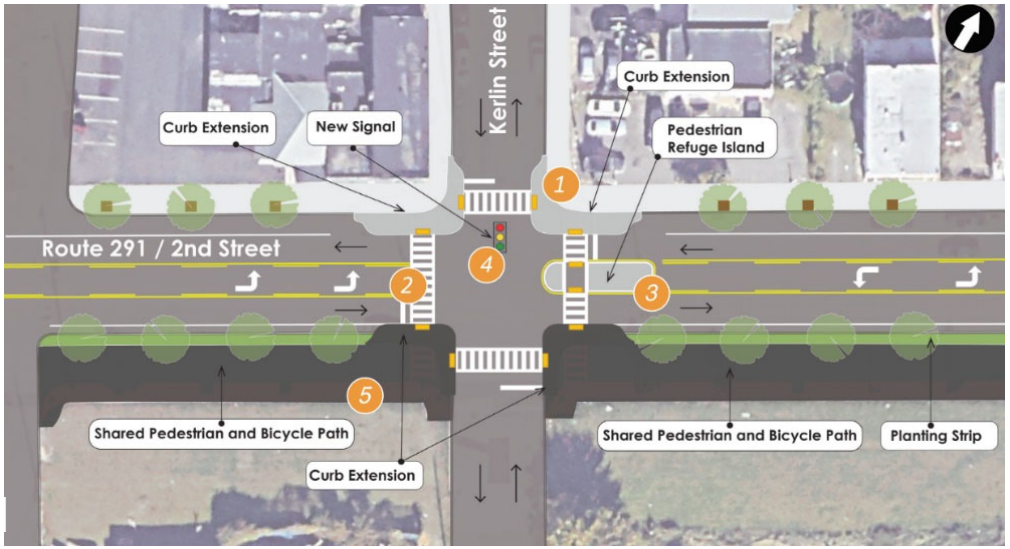
Figure 11: Alternative B2


Larger-scale intersection improvements (typical)
Smaller-scale intersection improvements (typical)
Signalize if warranted.
Implement 3-lane section.
Implement 4-lane section.
Concord Avenue
Kerlin Street
Penn Street
Welsh Street
Morton Avenue
Chester Transportation Center
Sun Village Park
CITY
EDDYSTONE
Delaware River

Signalized control at the intersection of Route 291 and Kerlin Street is predicted to reduce crashes and minimize impacts to operations during the peak hour. Signal warrants analysis is recommended during Preliminary Engineering.

Larger-scale multimodal improvements are recommended where Route 291 intersects with Penn Street, Welsh Street, Madison Street, and Morton Avenue. At these signalized intersections, high visibility crosswalks, pedestrian countdown signals, and leading pedestrian intervals should be installed across all intersection approaches. Curb extensions should be installed where there is a parking lane, and medians with pedestrian refuges should be installed where the center turn lane along Route 291 is not critical for turning movements and access. The details of these improvements should be determined during subsequent design phases. Figure 12 below shows potential typical larger-scale intersection improvements.

Figure 12: Typical Larger-Scale Intersection Improvements for both Alternative B and Alternative B2




1 Curb Extension


2 Crosswalks & Pedestrian Signals

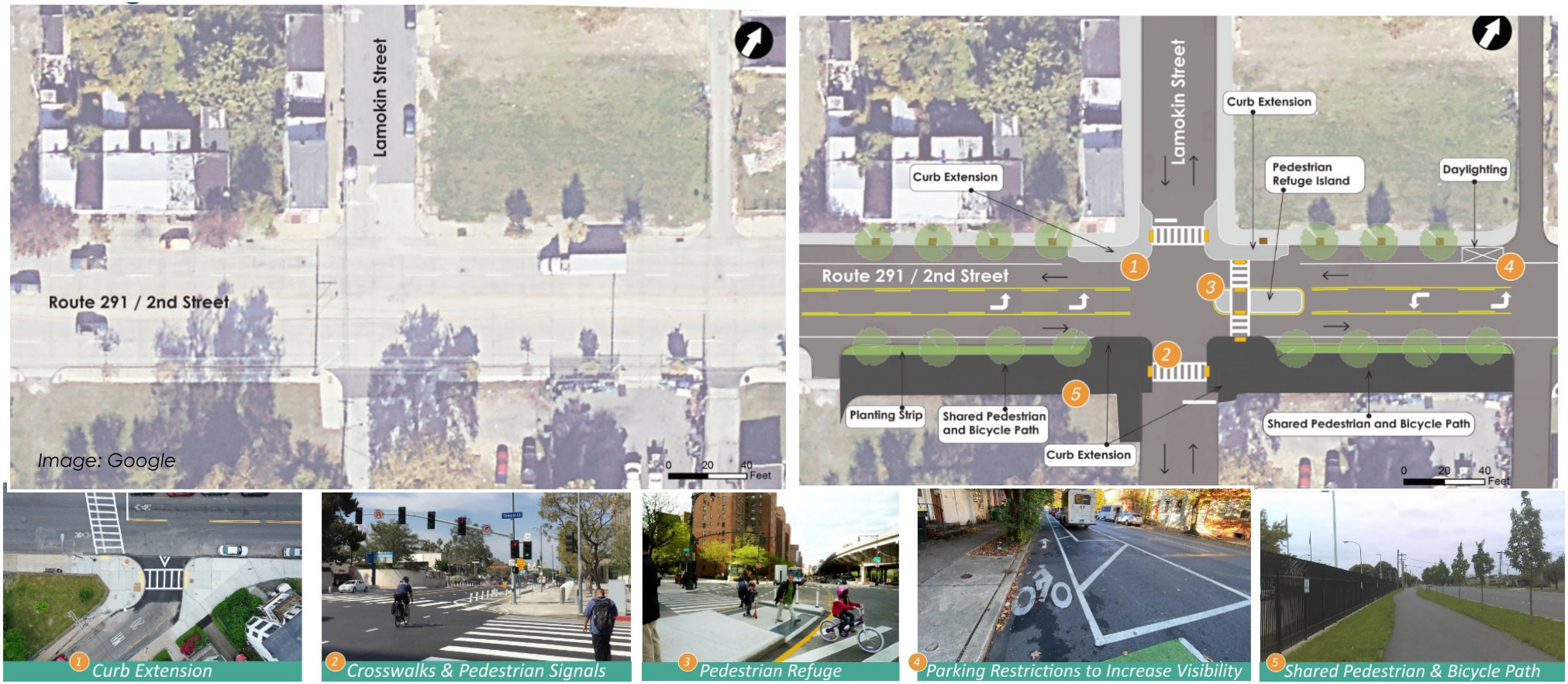

3 Pedestrian Refuge


4 Install Traffic Signal


5 Shared Pedestrian & Bicycle Path

Smaller-scale multimodal improvements are recommended where Route 291 intersects with Lamokin Street, Lloyd Street, Concord Avenue, Edgemont Avenue, Crosby Street, and Harrah's Boulevard. Uncontrolled pedestrian crossings can be considered at these non-signalized intersections. To facilitate safer crossings, improvements should include high visibility crosswalks, curb extensions where there is a parking lane, and a median with pedestrian refuge where the turn lane is determined to not be critical for turning movements and access. Where turning movements are deemed critical, a high visibility crosswalk without a pedestrian refuge can be implemented. Or the intersection leg can be signed for no pedestrian crossing. An RRFB can also be considered where drivers are frequently not yielding to crossing pedestrians. Daylighting is another tool that can be implemented at intersections along the corridor to improve visibility.

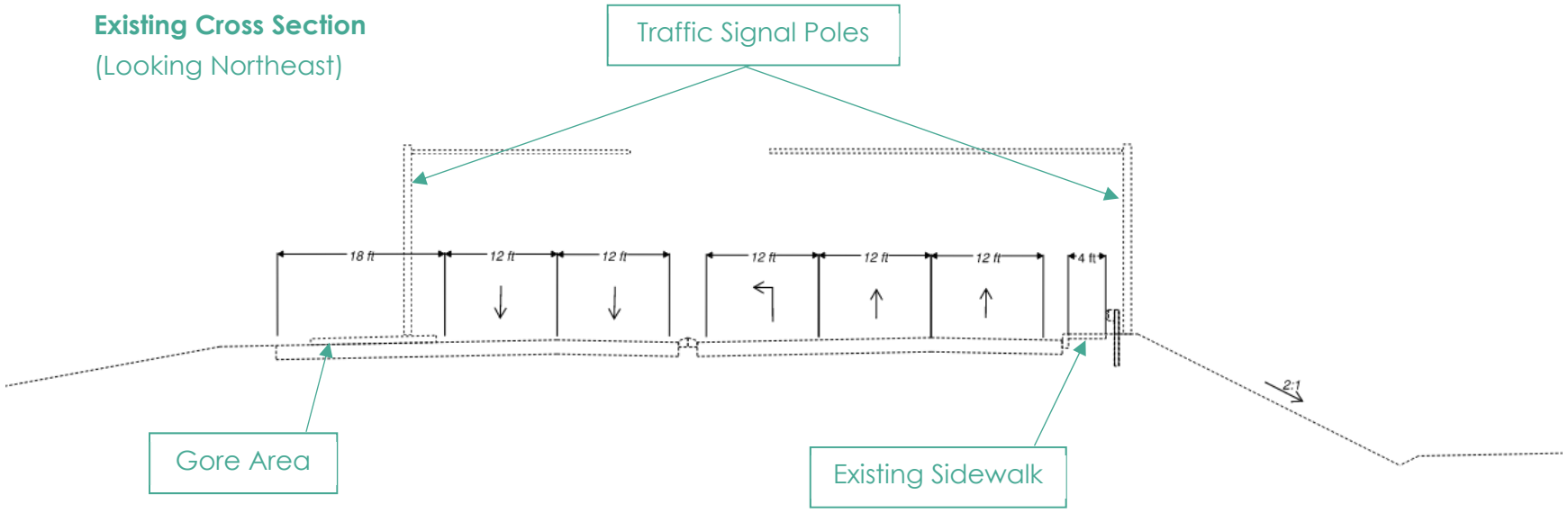
Figure 13: Typical Smaller-Scale Intersection Improvements for both Alternative B and Alternative B2



Greenway Gap in Ridley Township

This study includes an evaluation of alternatives for filling the East Coast Greenway gap in Ridley Township, about 1.75 miles northeast of the City of Chester. There is a PennDOT project underway that will construct the shared use path facility between Eddystone and Stewart Avenue in Ridley Township. This leaves a gap in the network from the Stewart Avenue intersection to where the path picks up in Tinicum, just after the bridge over Darby Creek. This 1,000-foot stretch is constrained by steep topography and the width of the existing bridge. The existing cross section includes two vehicular lanes in each direction and one center turn lane. There is a narrow sidewalk along the southeast side of the roadway. Along the northwest side of the roadway is a wide gore area. Drainage structures are located along the center of the roadway. A small concrete median divides the shared left-turn lanes. The existing cross section is shown in Figure 14.

Figure 14: Existing Cross Section in Ridley Township



Two (2) alternatives have been developed and evaluated, including:

Option 1: Construct the trail to the outside and south of the existing cartway. This involves widening the existing 4-foot sidewalk to a 10-foot shared use path. Given the adjacent slope, a retaining wall or boardwalk structure is needed to accommodate the trail.

Option 2: Construct the trail to the inside and shift the existing cartway north. This involves taking advantage of the gore area along the northwest side of the roadway.

Refer to Figure 15 for an aerial view of the area. Figures 16 and 17 provide cross sections for Options 1 and 2.

Figure 15: Aerial View of Route 291 in Ridley Township

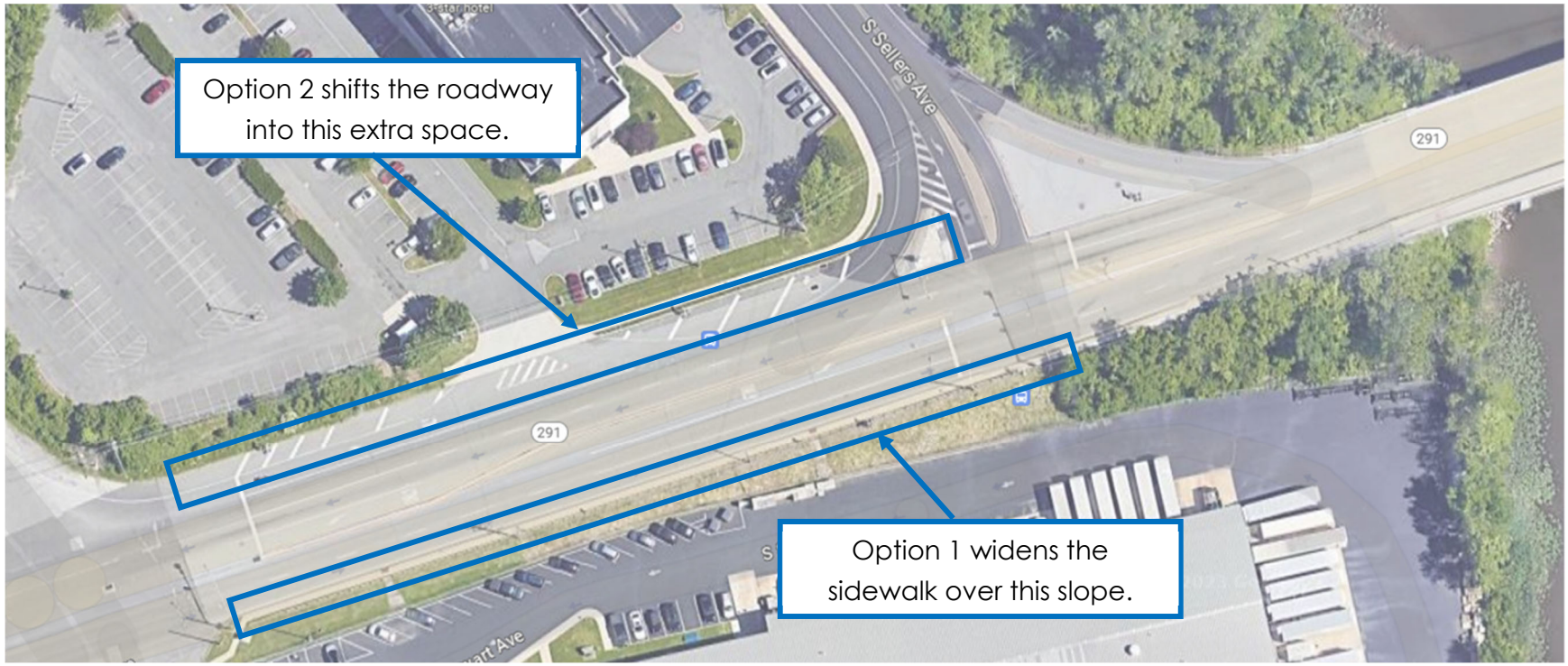


Figure 16: Ridley Township Option 1 Cross Section

Option 1 Cross Section
(Looking Northeast)

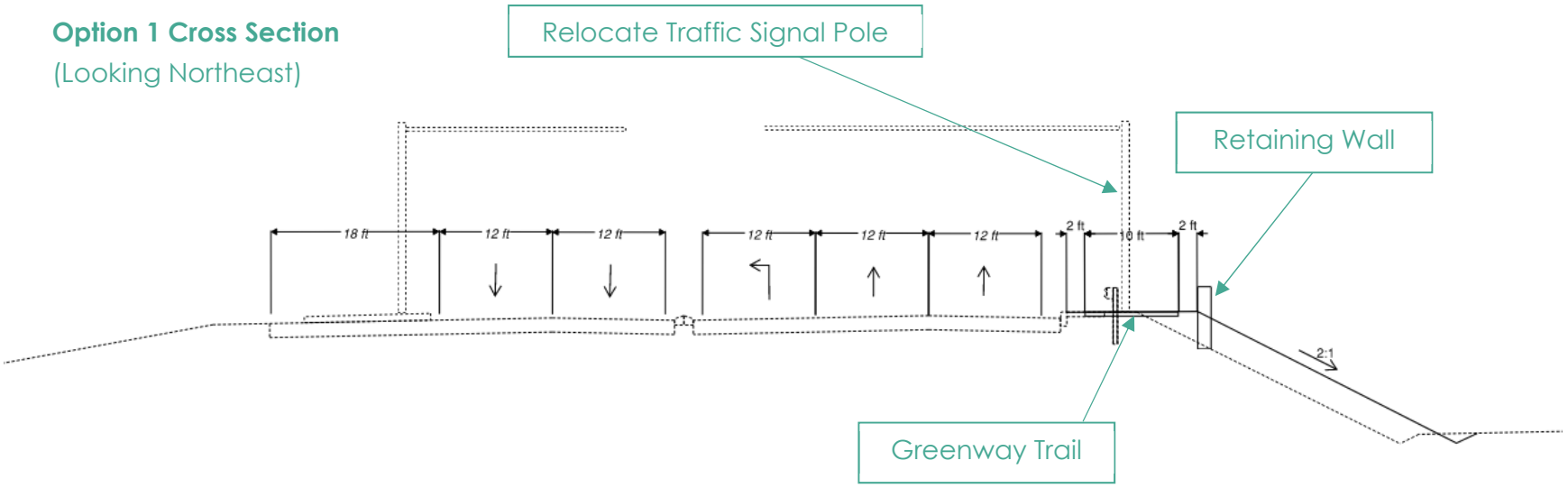
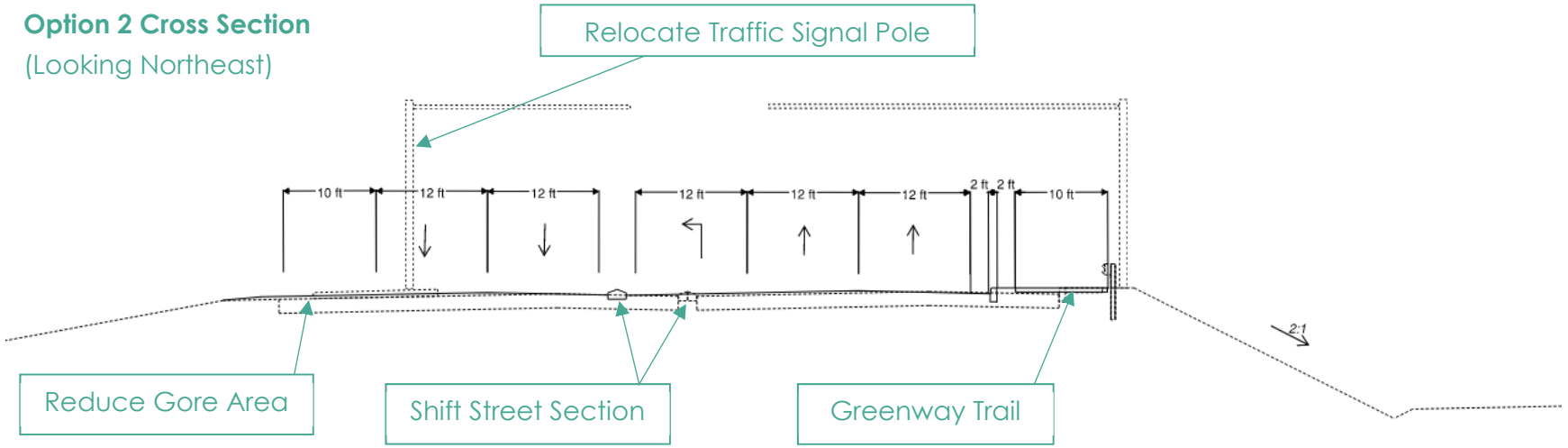


Figure 17: Ridley Township Option 2 Cross Section

Option 2 Cross Section
(Looking Northeast)



As shown above, Option 1 involves constructing a retaining wall and obtaining a potential slope easement to widen the existing 4-foot sidewalk into a 10-foot shared use path. The height of the wall may be significant near the bridge. This option avoids changes to drainage design and maintains the existing roadway cross section. A traffic signal pole would require relocation. In place of a retaining wall, a boardwalk structure could also be considered to carry the trail over the slope. Further evaluation is needed to compare the costs of a wall versus a boardwalk and to better determine potential property impacts and corresponding coordination needs.

Option 2 is anticipated to not impact the slope or require right-of-way impacts or easements. Option 2 requires redesign and relocation of the drainage system. It requires regrading of the roadway, reconstruction of the existing concrete medians, and relocation of a traffic signal pole. For this option, further design analysis will be needed to delineate an alignment between the PennDOT project and the bridge.

Filling this greenway gap is critical to have a link in the East Coast Greenway network upon which most people would feel comfortable biking. Both options may be costly. Option 1 was generally more supported by the Steering Committee, and seems to be generally more feasible and perhaps less costly when compared to Option 2. Further engagement and evaluation are encouraged to pursue filling this gap. A separate study is already underway to further explore these options and progress this portion of the effort toward implementation.

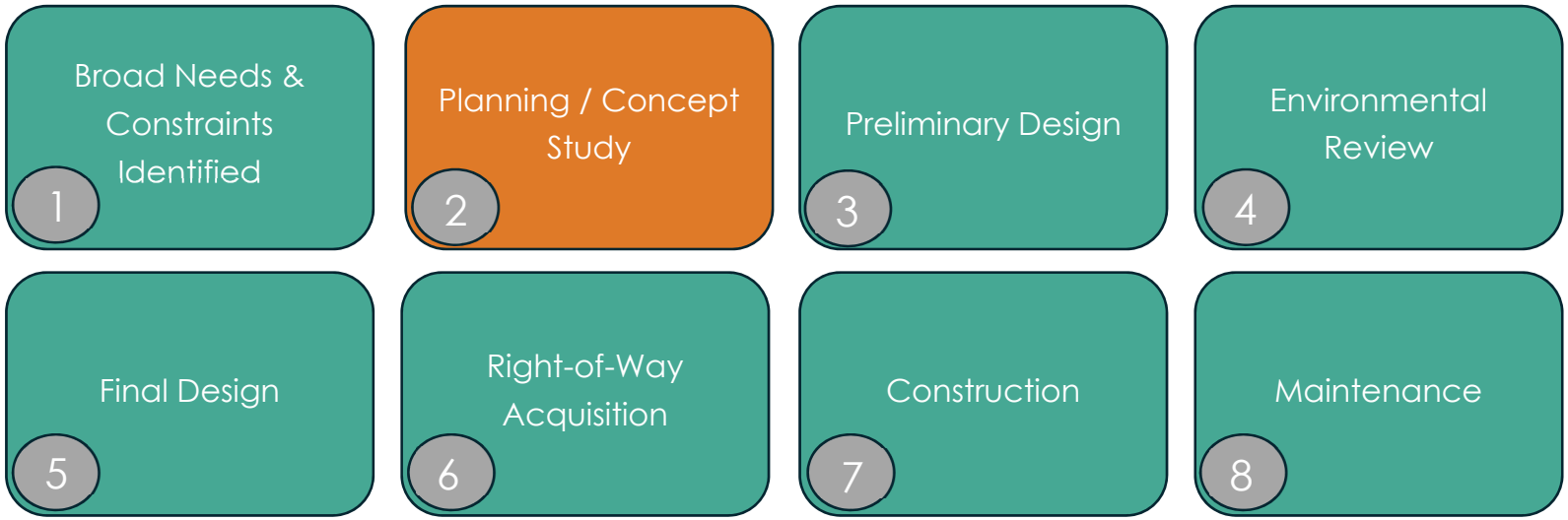
Implementation and Next Steps

Implementing improvements that address safety along Route 291 requires thinking through the project delivery timeline, key partnerships, funding opportunities, and interim maintenance needs.

Project Delivery Timeline

This study serves as a critical step in the overall project delivery timeline, which is shown in Figure 18. For a project of this scale, this project delivery timeline can take several years to complete.

Figure 18: Project Delivery Timeline



Step 1: Broad Needs and Constraints Identified encompasses the previous studies done in the City of Chester, such as identifying right-of-way impacts and considering alternative greenway routes.

Step 2: Planning/Concept Study is this TCDI study, which includes analysis and engagement to rule out alternatives with fatal flaws and to conceptualize potential preferred solutions. This study sets a vision for the engineering process to follow.

Step 3: Preliminary Design is the next step in this process. It includes additional analysis and engagement as needed to refine the preferred alternative and coalesce around design parameters. Key design details and implementation needs should be worked through during this step.

Step 4: Environmental Review includes the regulatory processes for implementing a roadway project, particularly through environmentally sensitive contexts; such is the case for Route 291.

Step 5: Final Design further refines the preferred alternative, such that final plans are produced and vetted. This includes securing appropriate permitting including but not limited to PennDOT, NPDES, and environmental permits items.

Step 6: Right-of-Way Acquisition involves the process to coordinate with property owners and obtain rights and easements. Reducing the amount of property needed and limiting the number of property owners with which to coordinate reduces the overall length of project delivery.

Step 7: Construction involves installation of multimodal safety treatments and the new street cross section(s) along the corridor. Construction of a project on the scale of the preferred alternative might take one to two years.

Step 8: Maintenance encompasses the long-term activity of maintaining pavement, curb, sidewalk, trees, landscaping, signs, and markings.

Key Partnerships

Implementing a project of this scale and complexity requires cross-agency collaboration and community partnerships. Subsequent phases of project delivery are likely to be led by PennDOT. It is important that the Delaware County and DVRPC remain engaged in the engineering process to ensure the local context remains relevant. It is also recommended that the Steering Committee, which guided the development of this TCDI study, remain engaged during subsequent phases of project delivery. The Steering Committee continuously offered astute feedback on the needs and preferences of the Chester community. The participation of local community leaders in the engineering process ensures that engagement is thorough and far reaching, and that design decisions are consistent with residents' needs and desired outcomes.

The DVRPC is a key partner for this project and for other projects in the vicinity. DVRPC is currently funding a project through the Transportation Alternatives Set-Aside Program (TASA) for the Norris Street Trail project. This project will add a 9-foot shared use path along Norris Street from its intersection with Route 291 south to the Delaware River. The project is in the Preliminary Engineering phase.

Funding Opportunities

A project to address safety along Route 291 is likely to be prioritized as part of the State's TIP. This indicates a shared desire to serve the Chester community and prioritize safety across agencies in the region. It is anticipated that this TIP funding can advance the project into the Preliminary Design phase of the project delivery timeline. In a March 15, 2024 press release, Delaware County announced that it was awarded a $2.5 million grant for safety improvements along Route 291. This grant was awarded through the U.S. Department of Transportation's Neighborhood Access and Equity Program, created by the Inflation Reduction Act, to connect communities by supporting neighborhood equity, safety, and affordable transportation access, as well as mitigating negative environmental impacts. This grant award will provide additional funding to move this project forward.

Interim Maintenance Needs

There is an urgent need for improved maintenance along Route 291 in the City of Chester. These maintenance improvements can provide interim safety improvements while the design of a larger-scale project is underway. While interim maintenance improvements are recommended, a phased implementation of the preferred alternative is not recommended. As evidenced by this study, a scaled-back version of improvement does not address the safety and mobility objectives set forth by the community.