Route 161 Corridor Study
Volume II
Concept Plan

Prepared for the Southeastern Connecticut Council of Governments

August 2023

BETA SCCOG

CONNECTICUT DEPARTMENT OF TRANSPORTATION

TOWN OF EAST LYME CONNECTICUT

Town of East Lyme

Route 161 Corridor Study

State Project #044-0159

August 2023

CONCEPT PLAN

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1.0 Introduction

The Southeastern Connecticut Council of Governments (SCCOG), in cooperation with the Town of East Lyme and the Connecticut Department of Transportation (CTDOT) initiated the Route 161 Corridor Study to develop a conceptual transportation plan for a 3.7-mile-long section of Route 161 extending from the intersection of Route 156 (Main Street) northerly to East Lyme High School. The transportation plan aims to improve the Route 161 corridor by alleviating traffic congestion during peak travel hours, improving mobility for pedestrians and bicyclists, promoting healthy and environmentally friendly modes of travel, enhancing transit ridership, and improving safety for all users.

During the initial phase of the project, existing conditions were analyzed. This included a review of geometric characteristics, traffic volumes, travel speeds, vehicle classification, pedestrian and bicycle infrastructure, transit operations, crash history, environmental constraints, and traffic operations. Future traffic operations were also analyzed by forecasting peak hour traffic volumes for the year 2042 using CTDOT's Statewide travel demand model which estimates regional traffic demands based on anticipated changes in future land use and demographics throughout the region and state along with planned transportation projects impacting the corridor. These analyses were summarized in the Existing and Future Conditions Report.

Public input was critical to understanding the corridor's challenges and opportunities. Throughout the study process a wide range of strategies were utilized to engage residents, commuters, businesses, and other stakeholders. These included regular meetings with a Project Advisory Committee consisting of staff from SCCOG, the Town, CTDOT, transit districts, and residents; a project website with an interactive mapping tool, a virtual meeting room, and two public meetings. Findings of the Existing and Future Conditions Report were presented at the first public meeting on October 27, 2022. At that meeting participants were invited to provide input on what features are working well along the corridor and what challenges they would most like to see addressed from the perspective of a driver, pedestrian, or bicyclist. At the second public meeting, held on April 27, 2023, the project team shared proposed improvements in draft format and solicited feedback from attendees which was then used to refine the proposed improvements discussed herein. Minutes from the public meeting and a summary of comments submitted through the project website are included in Appendix A.

The proposed improvements for the Route 161 corridor took into account major infrastructure upgrades associated with State Project #044-0156 which will address vehicular safety on I-95 at Interchange 74 as well as traffic operational concerns and safety for all roadway users on Route 161 in the vicinity of the exit

74 interchange ramps. State Project #044-0156's improvements include full reconstruction and widening of I-95 to accommodate revised ramp configurations, auxiliary lanes between exits 74 and 75 in each direction and the full replacement of the bridge over Route 161. The project will also address safety and traffic operations on Route 161 between Industrial Park Road and U.S. Route 1 (Boston Post Road) via full reconstruction and widening to provide turn lanes, wider shoulders, and sidewalk connectivity within the project limits. Construction on State Project #044-0156 began on April 3, 2023.

2.0 PROPOSED IMPROVEMENTS

Recommended transportation improvements were developed for each of the seven segments shown in Figure 1. The recommendations are separated into near-term (those that can be implemented within three-years), mid-term (three to seven year implementation timeline), and long-term (seven-plus year implementation timeline) improvements based on their complexity, cost, and benefit. Typical cross sections were developed for each segment. Conceptual plans and renderings were prepared for several key recommendations.

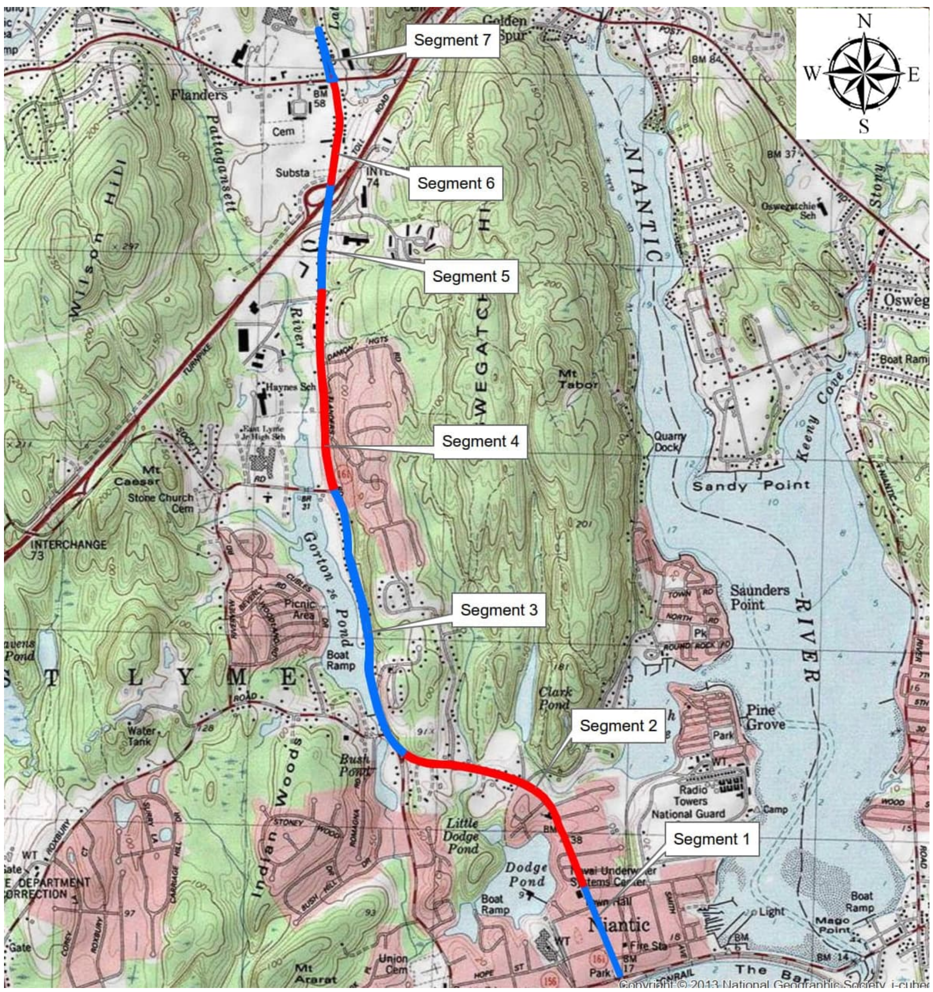


Figure 1: Project Area

2.1 Segment 1 – Route 156 (Main Street) to Smith Street

Figures 2 and 3 show the improvements developed for the Route 161 corridor segment between Route 156 (Main Street) and Smith Street. The improvements include:

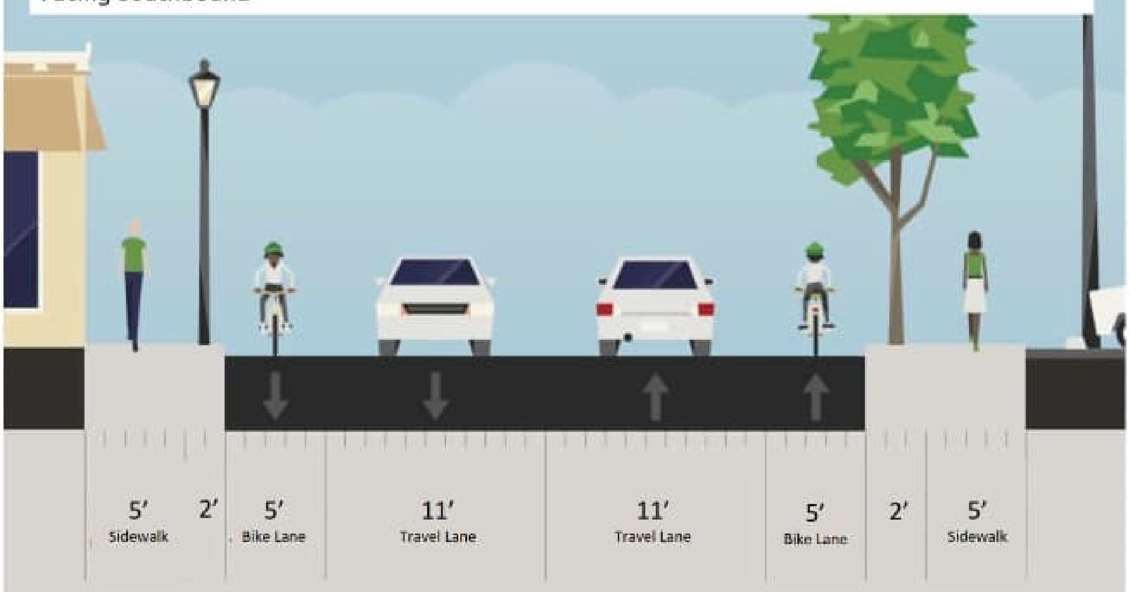
Near-Term Improvements

- Stripe on-street parking spaces on Hope Street to better accommodate parking demand from visitors to local businesses.
- Install crosswalks across side streets with high pedestrian volumes including Grand Street, Hope Street, State Street, and Lincoln Street to enhance pedestrian safety.
- Install a new traffic signal at the Route 161 and Route 156 (Main Street) intersection. Incorporate retroreflective backplates to enhance visibility and mitigate rear end collisions, and accessible pedestrian signals to improve accessibility for visually impaired pedestrians.

Mid-Term Improvements

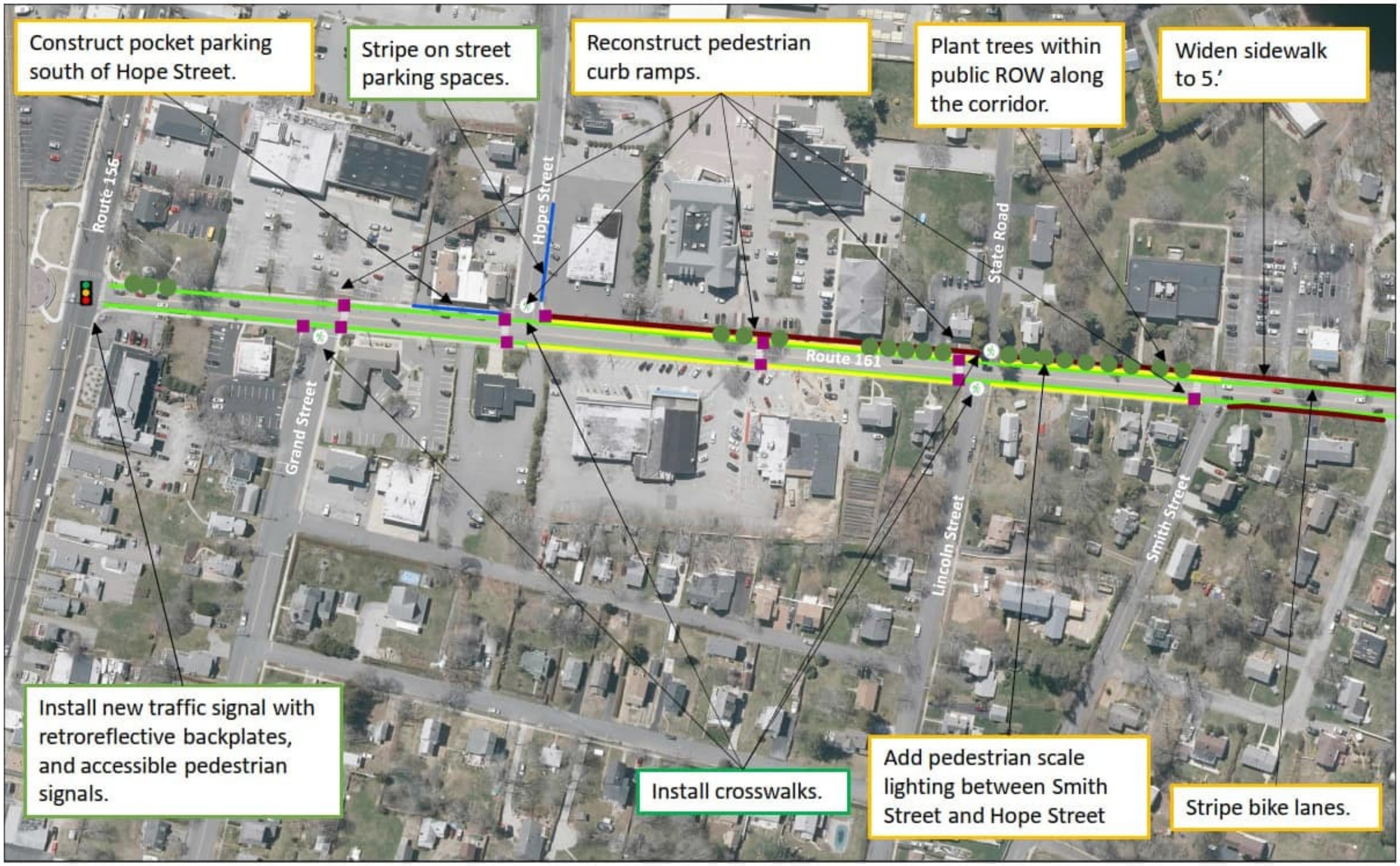
- Stripe bike lanes along both sides of Route 161 to promote bicycle use and enhance safety for bicyclists. (See Appendix B for a concept plan and Figure 4 for a rendering of the bike lanes)
- Construct a pocket parking area on the west of the corridor, just south of Hope Street, shifting the existing on-street parking outside of the existing curb line to accommodate the proposed bike lanes. The pocket parking area will also improve sight distances at the intersection and allow drivers to have a clearer view of oncoming traffic before executing left turns out of Hope Street. (See Appendix B for a concept plan and Figure 4, for a rendering of the pocket parking area.)

Figure 2: Segment 1 - Route 156 (Main Street) to Smith Street
Facing Southbound



Credit: Streetmix

- Install pedestrian scale lighting between Smith Street and Hope Street to enhance pedestrian visibility and walkability.
- Widen the existing sidewalk on the west side of Route 161 to provide suitable passing spaces and enhance walkability and mobility for all users.
- Plant street trees within the public right-of-way to enhance the aesthetics of the downtown Niantic area and promote survival of local pollinators.
- Reconstruct pedestrian curb ramps at various locations in accordance with the U.S. Access Board's Proposed Public Rights-of-Way Accessibility Guidelines to improve mobility for all users.



Imagery from 2019 Spring Aerial Imagery by UConn CTECO

Green Comment: Near Term Improvement
Orange Comment: Mid-Term Improvement
Blue Comment: Long-Term Improvement

Feet
0 125 250

Figure 3
Segment 1 - Route 156 (Main Street) to Smith Street

June 2023

Figure 4: Downtown Niantic Bike Lanes and Pocket Parking

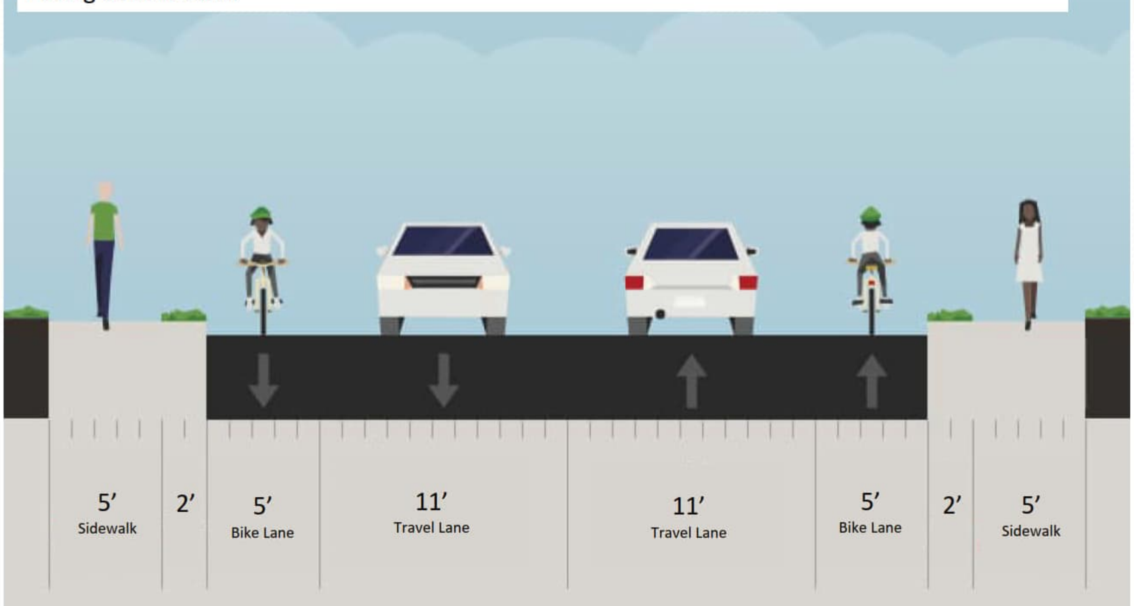
2.2 Segment 2 – Smith Street to East Pattagansett Road

Figures 5 and 6 show the improvements developed for the Route 161 corridor segment between Smith Street and East Pattagansett Road. The improvements include:

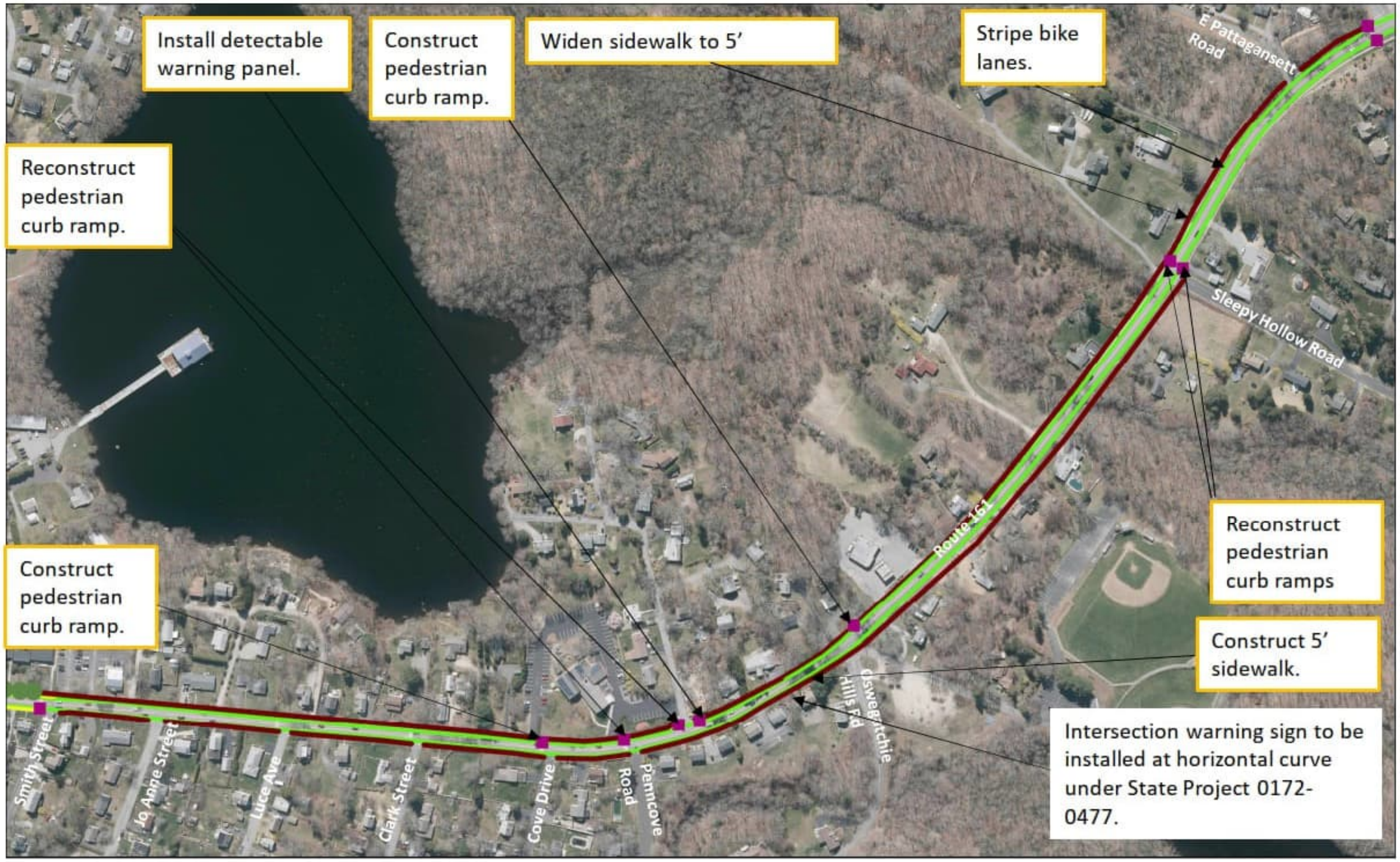
Mid-Term Improvements

- Construct pedestrian curb ramps where none are provided including the Clark Street and Oswegatchie Hills Road crossings to improve mobility for all users.
- Reconstruct pedestrian curb ramps and install detectable warning panels at various locations in accordance with the U.S. Access Board's Proposed Public Rights-of-Way Accessibility Guidelines to improve mobility for all users.
- Stripe bike lanes along both sides of Route 161 to promote bicycle use and enhance safety for bicyclists.
- Construct new sidewalk along the east side of Route 161 between Smith Street and Sleepy Hollow Road to create an improved pedestrian connection between Veterans Memorial Field, Oswegatchie Hills Nature Preserve, and the downtown Niantic area.
- Widen the existing sidewalk along the west side of Route 161 to provide suitable passing spaces and enhance walkability and mobility for all users.

Figure 5: Segment 2 - Smith Street to East Pattagansett Road
Facing Southbound



Credit: Streetmix



Imagery from 2019 Spring Aerial Imagery by UConn CTECO

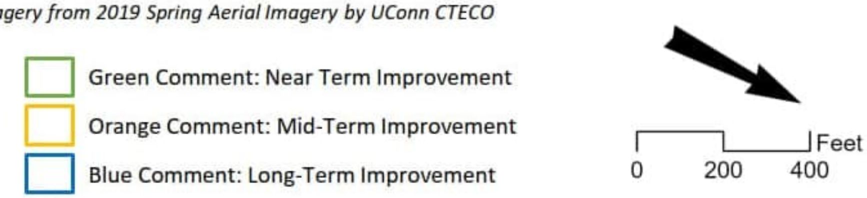


Figure 6
Segment 2 - Smith Street to East Pattagansett Road

June 2023

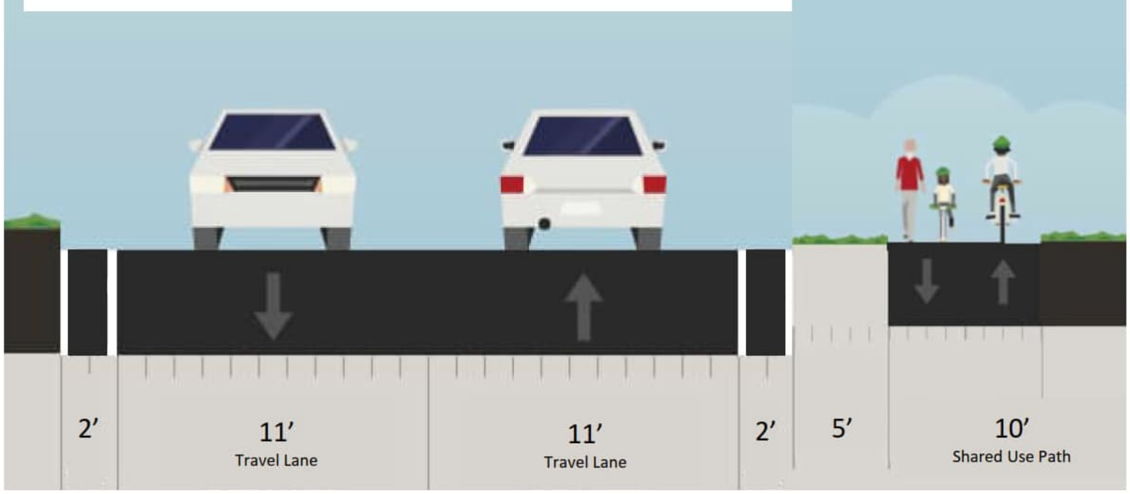
2.3 Segment 3 –East Pattagansett Road to Society Road

Figures 7 and 8 show the improvements developed for the Route 161 corridor segment between East Pattagansett Road and Society Road. The improvements include:

Mid-Term Improvements

- Install speed feedback signs to discourage speeding.
- Restripe the existing shoulder with 6"-wide shoulder markings to mitigate crashes involving pedestrians, bicyclists and older drivers, and to discourage speeding.
- Reconstruct pedestrian curb ramps at various locations in accordance with the U.S. Access Board's Proposed Public Rights-of-Way Accessibility Guidelines to improve mobility for all users.
- Install new traffic signals at the Route 161/East Pattagansett Road and Route 161/Roxbury Road intersections. Provide separate traffic signal controllers at each intersection allowing each signal to operate independently, improving traffic operations, and reducing delay. Incorporate Leading Pedestrian Interval (LPI) phasing and accessible pedestrian signals at each intersection to enhance pedestrian safety and improve mobility for all users. At the Roxbury Road signal install a dedicated northbound left turn lane and a bicycle box to facilitate transition from the bicycle lanes south of the intersection to the shared use path north of the intersection.
- *A roundabout was also considered for the Route 161/East Pattagansett Road intersection to improve operations, reduce speeds, and create a gateway into downtown Niantic. Traffic signal improvements were selected, however, as the preferred alternative in part due to concern that the roundabout would eliminate metering created by the traffic signal and result in fewer gaps where residents downstream of the intersection could safely make a left turn maneuver out of their driveways.* (*See Appendix B for a concept plan and rendering of the proposed roundabout*.)

Figure 7: Segment 3 - East Pattagansett Road to Society Road
Facing Southbound

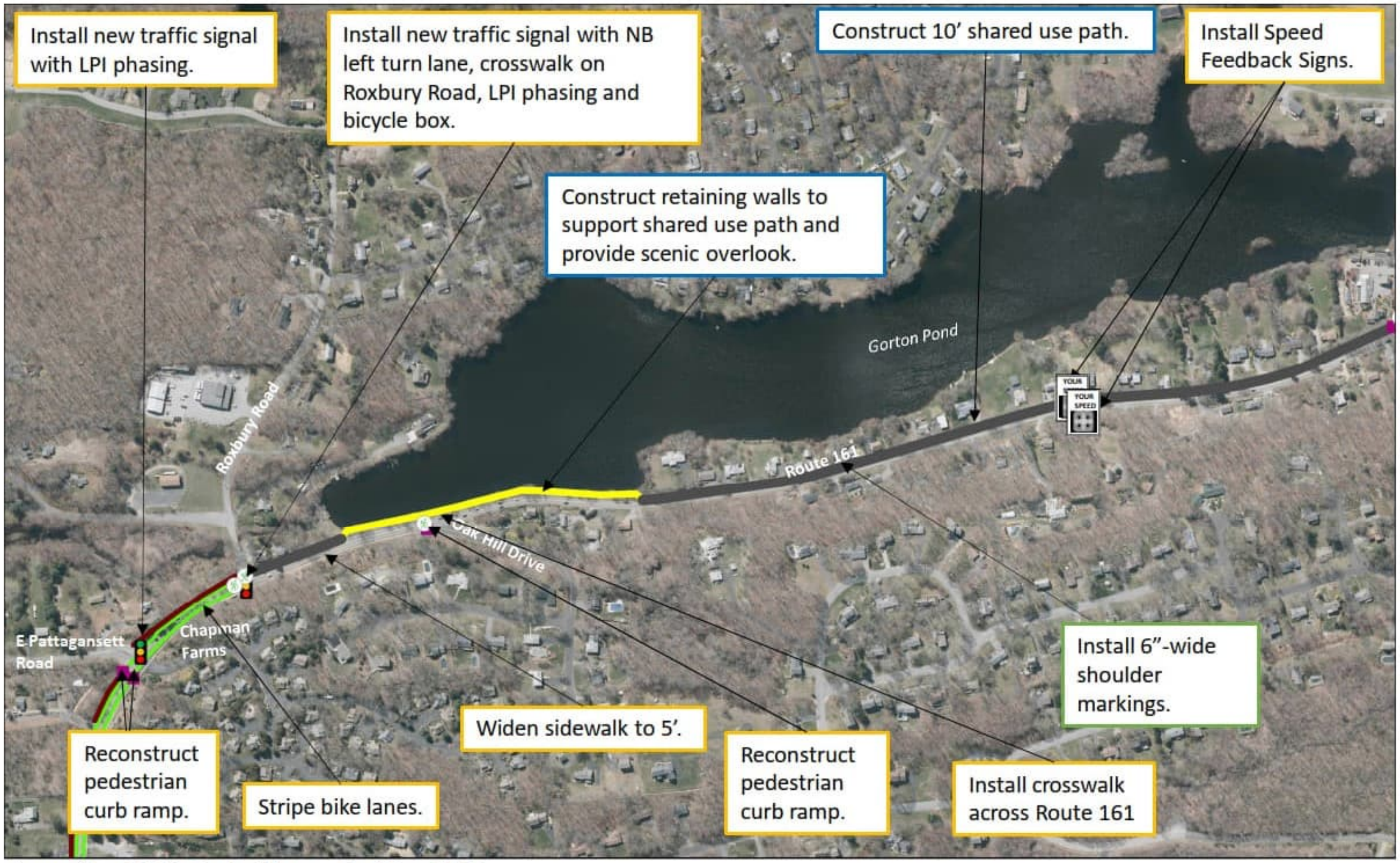


Credit: Streetmix

- Install crosswalks across both roadways at the intersection of Route 161 and Roxbury Road to enhance pedestrian safety.
- Install a crosswalk across Route 161 at Oak Hill Drive to improve access to the proposed sidewalk and overlook area at Gorton Pond.
- Widen the existing sidewalk along the east side of Route 161 to provide suitable passing spaces and enhance walkability and mobility for all users.

Long-Term Improvements

- Install a 10'-wide shared use path along the west side of Route 161 to promote nonmotorized modes of travel such as walking and biking. Retaining walls will be necessary to support the shared use path along the south end of Gorton Pond. An overlook area is recommended to accommodate fishing, sight-seeing, or other recreational activities. (See Appendix B for a concept plan and Figures 9 and 10 for renderings of the proposed shared use path.)



Imagery from 2019 Spring Aerial Imagery by UConn CTECO

Green Comment: Near Term Improvement
Orange Comment: Mid-Term Improvement
Blue Comment: Long-Term Improvement

Feet
0 250 500

Figure 8
Segment 3 - East Pattagansett Road to Society Road

June 2023

Figure 9: Shared Use Path at Gorton Pond

Figure 10: Scenic Overlook at Gorton Pond

2.4 Segment 4 – Society Road to Industrial Park Road

Figures 11 and 12 show the improvements developed for the Route 161 corridor segment between Society Road and Industrial Park Road. The improvements include:

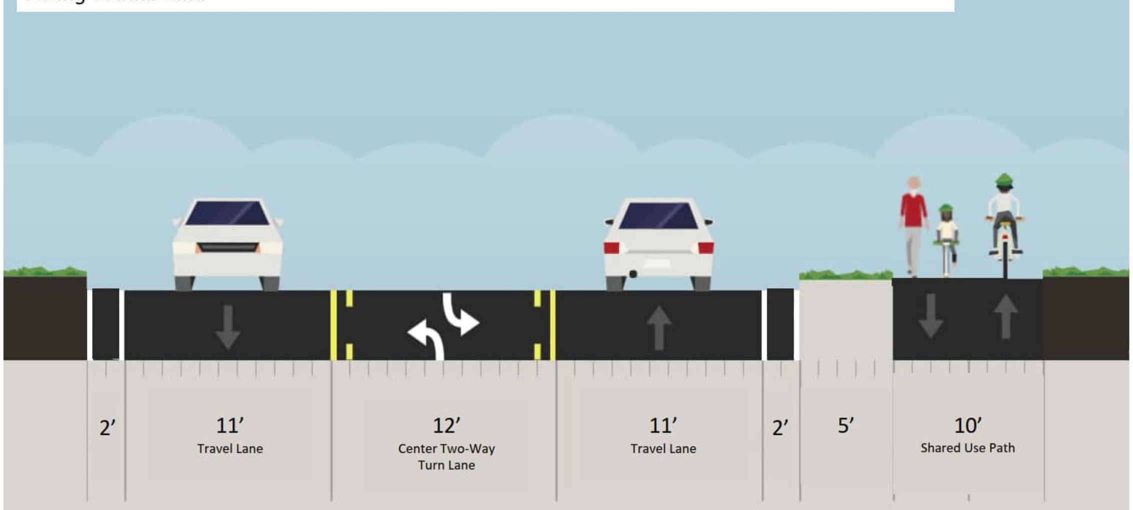
Mid-Term Improvements

- At the intersection of Route 161 and Society Road install accessible pedestrian signals, implement Leading Pedestrian Interval (LPI) phasing, and stripe a crosswalk across Society Road to improve pedestrian safety and mobility for all users.
- Construct pedestrian curb ramps where none are provided including the Laurel Hill Drive and Damon Heights Road crossings to improve mobility for all users.
- Reconstruct pedestrian curb ramps and install detectable warning panels at various locations in accordance with the U.S. Access Board's Proposed Public Rights-of-Way Accessibility Guidelines to improve mobility for all users.
- Install an intersection warning sign on the northbound approach to Laurel Hill Drive to alert drivers to the presence of an intersection with limited sight distances and improve safety.
- Restripe the roadway to incorporate a two-way left turn lane to improve flow and reduce crashes.
- Realign the Laurel Hill Drive approach to Route 161 approximately 150 feet southward to reduce the skewed angle, improve sight distance, and mitigate crashes.
- Widen the existing sidewalk along the east side of Route 161 to provide suitable passing spaces and enhance walkability and mobility for all users.

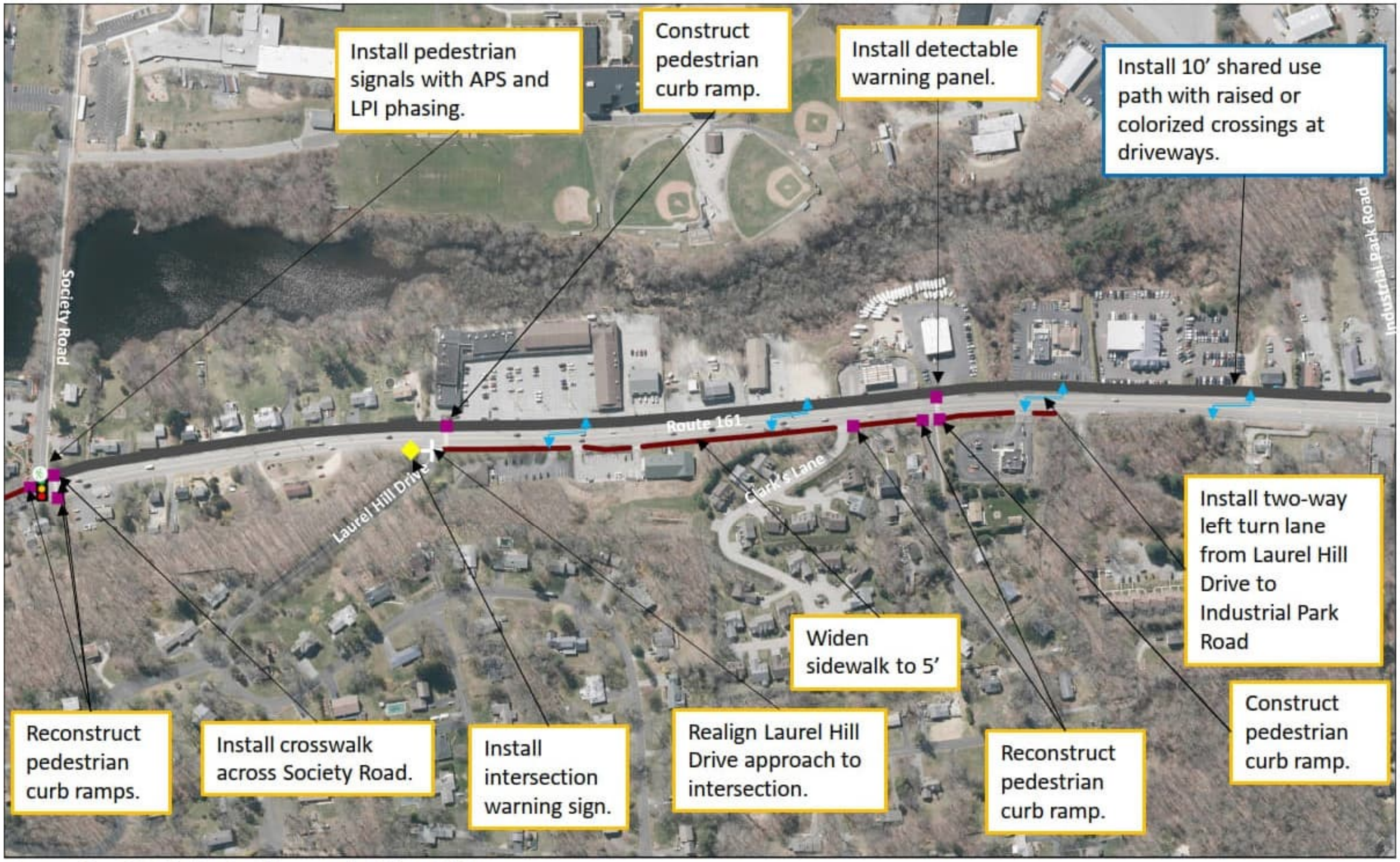
Long-Term Improvements

- Install a 10'-wide shared use path along the west side of Route 161 to promote nonmotorized modes of travel such as walking and biking. Replace the existing culvert south of Dunkin' to accommodate the shared use path.

Figure 11: Segment 4 - Society Road to Industrial Park Road
Facing Southbound



Credit: Streetmix



Imagery from 2019 Spring Aerial Imagery by UConn CTECO

Green Comment: Near Term Improvement

Orange Comment: Mid-Term Improvement

Blue Comment: Long-Term Improvement

0 175 350 Feet

Figure 12
Segment 4 - Society Road to Industrial Park Road

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2.5 Segment 5 – Industrial Park Road to Frontage Road

Figures 13 and 14 show the improvements developed for the Route 161 corridor segment between Industrial Park Road and Frontage Road. The improvements include:

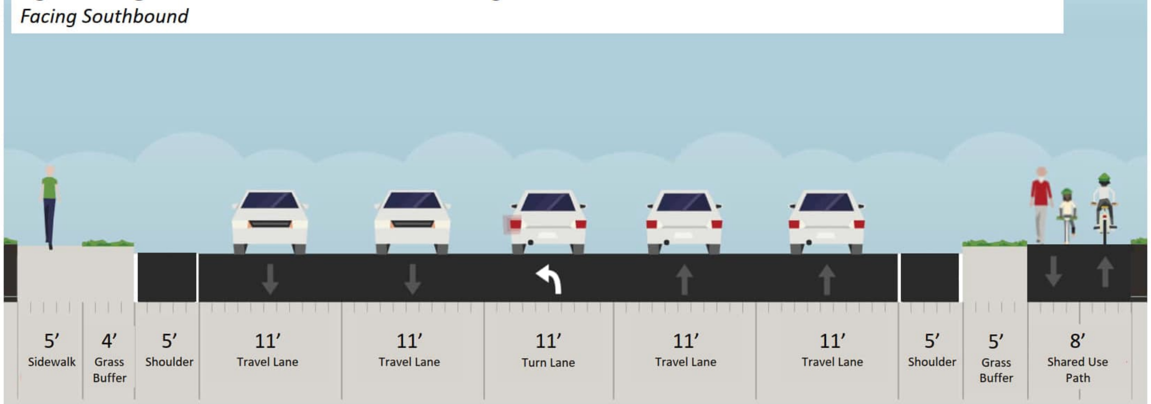
Mid-Term Improvements

- Install a crosswalk with pedestrian signals across Industrial Park Road and implement concurrent pedestrian phasing to improve pedestrian safety.
- Incorporate adaptive signal control at the new traffic signals to be installed at Industrial Park Road, the Exit 74 Off Ramp, and King Arthur Drive under the I-95 Interchange 74 Improvement project. Adaptive signal control can allow the signals to better respond to changing traffic volumes and reduce delay on the Route 161 corridor when traffic volumes increase due to incidents on I-95 or seasonal tourism.
- Install a bus shelter northeast of Chapman Wood Road to promote transit use.

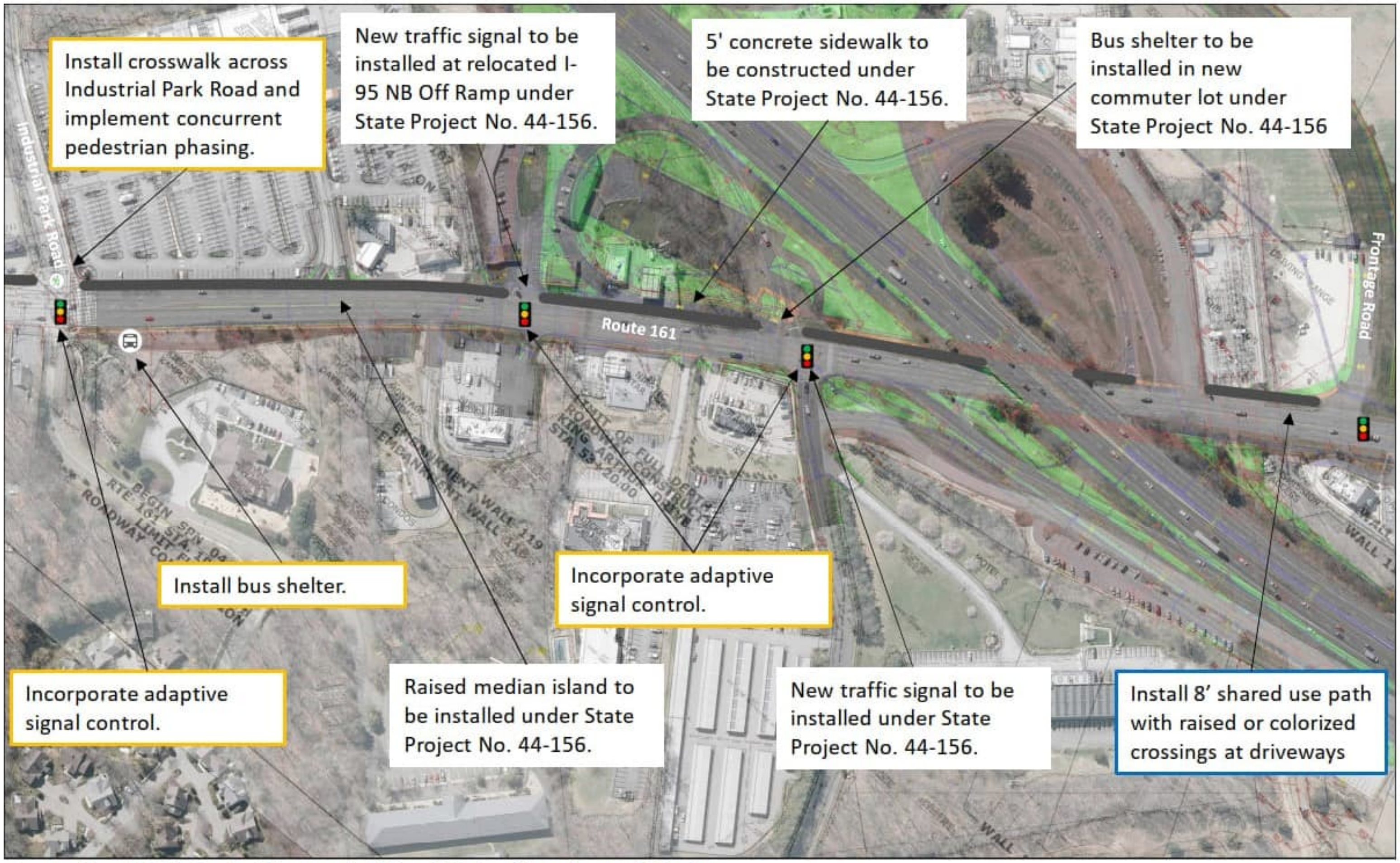
Long-Term Improvements

- Install an 8'-wide shared use path along the west side of Route 161 to promote nonmotorized modes of travel such as walking and biking. A narrower shared use path is recommended within this segment due to limited width below the I-95 bridge and to minimize impacts to commercial parking areas.

Figure 13: Segment 5 - Industrial Park Road to Frontage Road
Facing Southbound



Credit: Streetmix



Imagery from 2019 Spring Aerial Imagery by UConn CTECO and Interchange 74 Plan Set

- Green Comment: Near Term Improvement
- Orange Comment: Mid-Term Improvement
- Blue Comment: Long-Term Improvement

0 125 250 Feet

Figure 14
Segment 5 - Industrial Park Road to Frontage Road

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2.6 Segment 6 –Frontage Road to U.S. Route 1 (Boston Post Road)

Figures 15 and 16 show the improvements developed for the Route 161 corridor segment between Frontage Road and U.S. Route 1 (Boston Post Road). The improvements include:

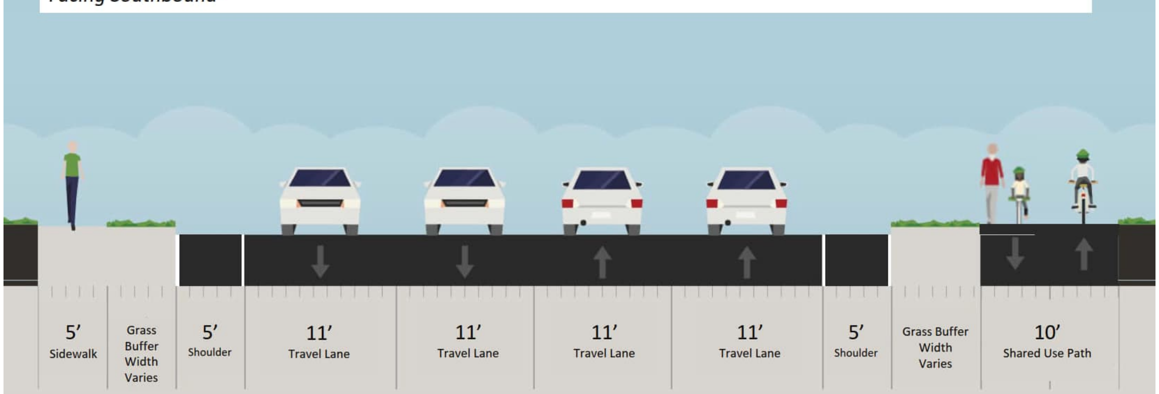
Mid-Term Improvements

- Incorporate adaptive signal control at the new traffic signal to be installed at Frontage Road under the I-95 Interchange 74 Improvement project. Adaptive signal control can allow the signal to better respond to changing traffic volumes and reduce delay on the Route 161 corridor when traffic volumes increase due to incidents on I-95 or seasonal tourism.
- Install fiber optic interconnect to facilitate communication between the traffic signal at U.S. Route 1 (Boston Post Road) and the signals at Frontage Road, King Arthur Drive, the I-95 Exit 74 Off Ramp, and Industrial Park Road.
- Construct a new 5'-wide concrete sidewalk on the east side of the corridor in front of Latimer Brook Commons to fill a gap in the existing sidewalk network and improve pedestrian connectivity.
- Install bus pull outs on both sides of the corridor just south of U.S. Route 1 (Boston Post Road) where buses can pick up and drop off passengers without impeding the flow of traffic. Install a bus shelter at each pull out to promote transit use. (See Appendix B for a concept plan and Figure 17 for a rendering of the proposed bus pull outs and shelters.)
- Construct a raised median island on the southern leg of the Route 161/U.S. Route 1 (Boston Post Road) intersection to enhance pedestrian safety between the proposed bus shelters. Restripe the northbound approach to include an exclusive left turn lane and shared through/right turn lane to accommodate the median island.

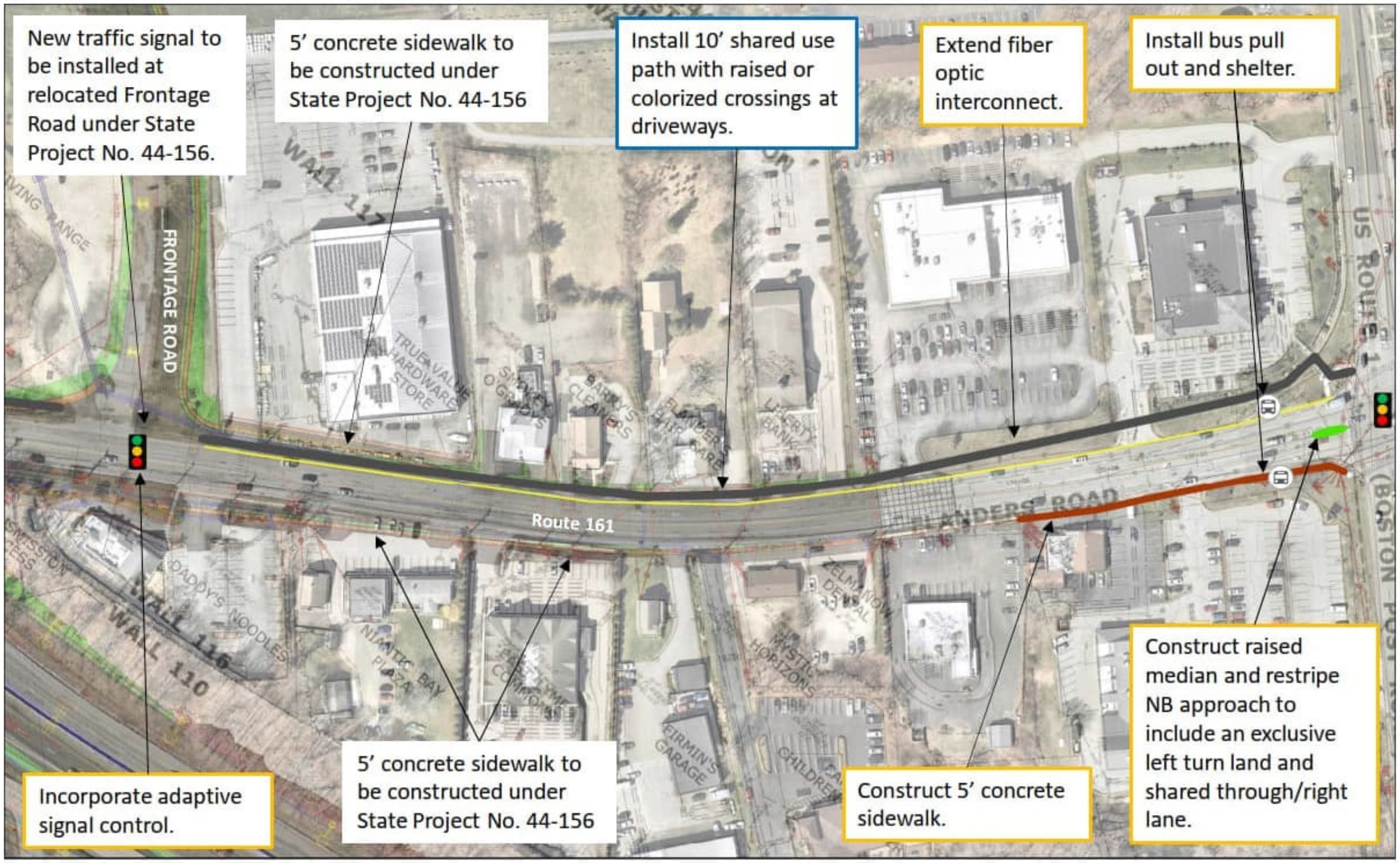
Long-Term Improvements

- Install a 10'-wide shared use path along the west side of Route 161 to promote nonmotorized modes of travel such as walking and biking. (See Appendix B for a concept plan and Figure 17 for a rendering of the proposed shared use path.)

Figure 15: Segment 6 - Frontage Road to U.S. Route 1 (Boston Post Road)
Facing Southbound



Credit: Streetmix



Imagery from Nearmap and Interchange 74 Plan Set

Green Comment: Near Term Improvement

Orange Comment: Mid-Term Improvement

Blue Comment: Long-Term Improvement

0 0.01 0.03 Miles

Figure 16

Segment 6 – Frontage Road to U.S. Route 1 (Boston Post Road)

June 2023

Figure 17: Shared Use Path and Bus Pull Out, South of U.S. Route 1 (Boston Post Road)

2.7 Segment 7 –U.S. Route 1 (Boston Post Road) to East Lyme High School

Figures 18 and 19 show the improvements developed for the Route 161 corridor segment between U.S. Route 1 (Boston Post Road) and East Lyme High School. The improvements include:

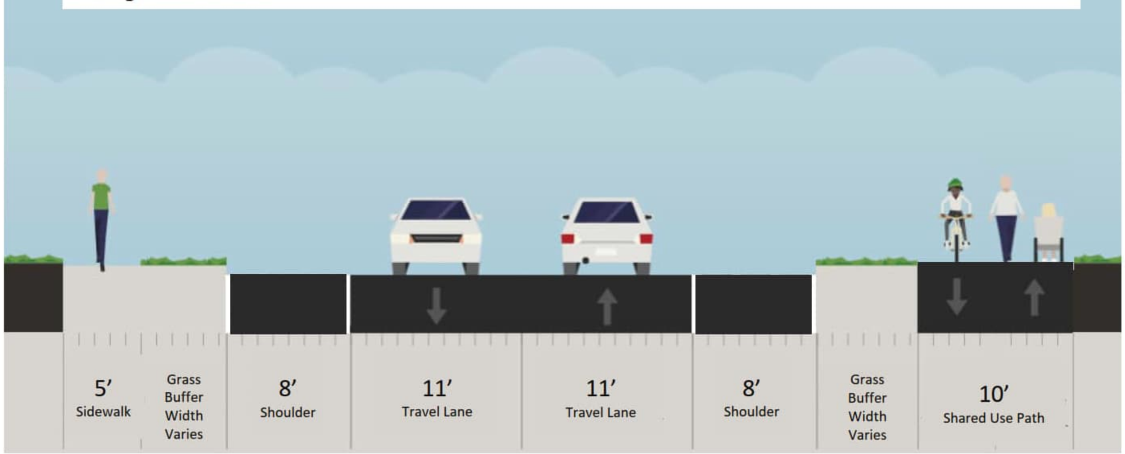
Mid-Term Improvements

- Implement a left-turn lane on the northbound approach to East Lyme High School to mitigate delay and enhance safety during the morning arrival period.
- Incorporate adaptive signal control at the Route 161/U.S. Route 1 (Boston Post Road) traffic signal. Adaptive signal control can allow the signal to better respond to changing traffic volumes and reduce delay on the Route 161 corridor when traffic volumes increase due to incidents on I-95 or seasonal tourism.

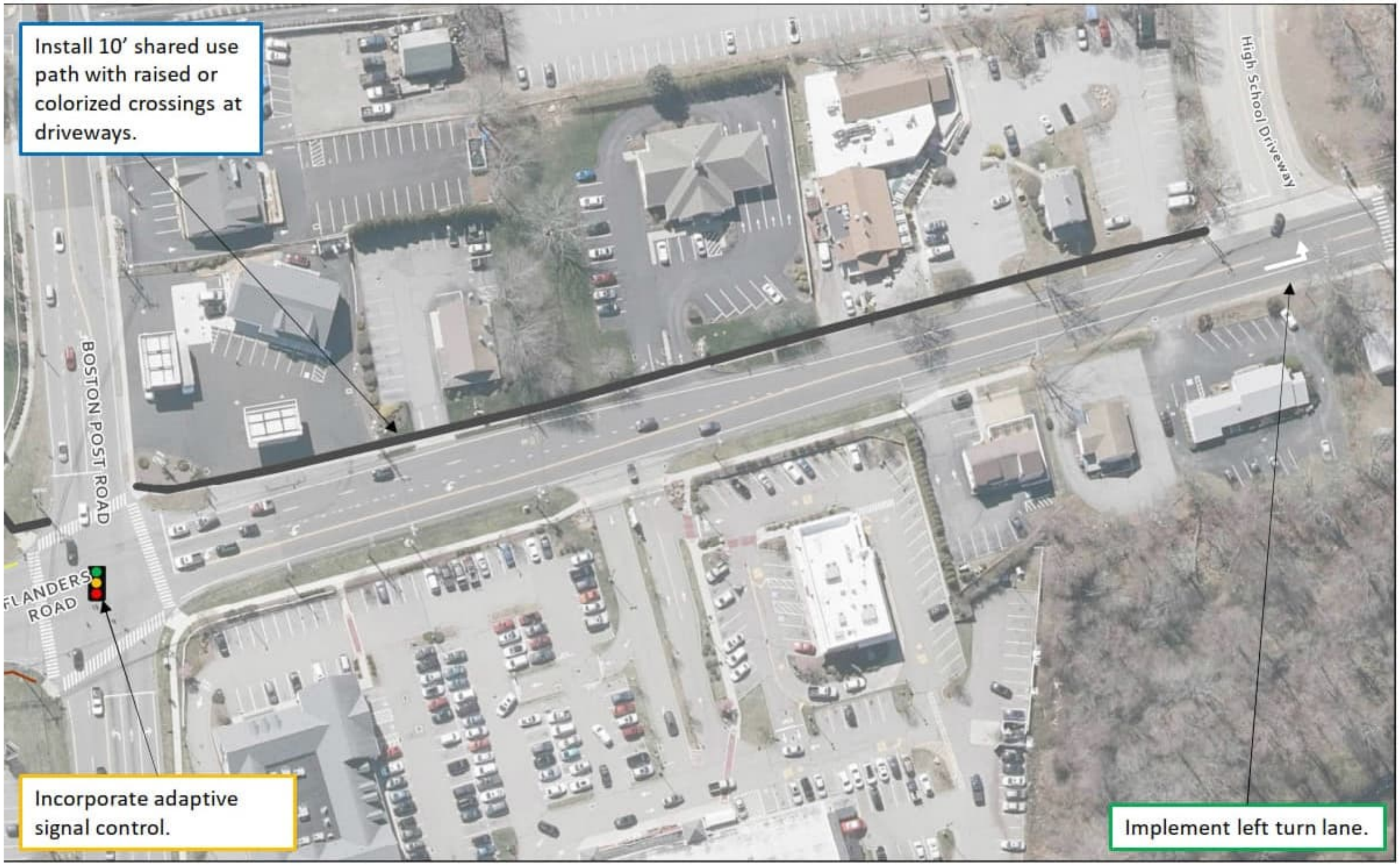
Long-Term Improvements

- Install a 10'-wide shared use path along the west side of Route 161 to promote nonmotorized modes of travel such as walking and biking.

Figure 18: Segment 7 - U.S. Route 1 (Boston Post Road) to East Lyme High School
Facing Southbound



Credit: Streetmix



Green Comment: Near Term Improvement
Orange Comment: Mid-Term Improvement
Blue Comment: Long-Term Improvement

Miles
0 0.01 0.01

Figure 19
Segment 7 –U.S. Route 1 (Boston Post Road) to East Lyme High School

June 2023

3.0 Traffic Operations

Existing and Future No Build traffic models were previously developed using Synchro software (Version 11) and summarized in the Existing and Future Conditions report. The Existing conditions model evaluated traffic operations at fourteen corridor intersections to assess the level of traffic delays and congestion that are currently being experienced during the weekday afternoon and Saturday midday peak hours. The Future No Build conditions model evaluated traffic congestions during these peak periods for the year 2042, taking into account anticipated changes in future land use and demographics as well as planned transportation projects impacting the corridor.

The Existing and Future Conditions Report included a summary of Level of Service and delay for each intersection and each peak period. For intersections, six levels of service (LOS), "A"-"F", have been established with "A" representing very good operation and "F" representing very poor operation. For signalized and unsignalized intersections, level of service is defined in terms of average delay per vehicle and is computed for individual intersection lane groups. Delay is a measure of driver discomfort, frustration, fuel consumption, and lost travel time. The relationship for unsignalized and signalized intersections are summarized in Table 1 and Table 2, respectively.

Table 1: Level of Service Criteria for Unsignalized Intersections

LOS	Unsignalized Intersection Criteria Average Total Delay (Seconds per Vehicle)	General Description
A	< 10.0	Free Flow
B	10.1 to 15.0	Stable flow (slight delays)
C	15.1 to 25.0	Stable flow (acceptable delays)
D	25.1 to 35.0	Approaching unstable flow (tolerable delay)
E	35.1 to 50.0	Unstable flow (intolerable delay)
F	> 50.0	Forced flow (jammed)

Table 2: Level of Service Criteria for Signalized Intersections

LOS	Signalized Intersection Criteria Average Total Delay (Seconds per Vehicle)	General Description
A	< 10.0	Free Flow
B	10.1 to 20.0	Stable flow (slight delays)
C	20.1 to 35.0	Stable flow (acceptable delays)
D	35.1 to 55.0	Approaching unstable flow (tolerable delay)
E	55.1 to 80.0	Unstable flow (intolerable delay)
F	> 80.0	Forced flow (jammed)

The proposed improvements identified in Chapter 2 were evaluated as part of the Future Build traffic model which examines their impact on Level of Service and delay during each peak period under year

2042 traffic conditions. Level of Service and delay for the Existing, Future No Build, and Future Build traffic models are summarized in Table 3 (Weekday PM Peak) and Table 4 (Saturday Midday Peak). For signalized locations the overall intersection Level of Service and delay are shown. For unsignalized locations the Level of Service and delay for the stop-controlled approach are shown. Future Build capacity analysis (Synchro) reports are provided in Appendix C.

Table 3 - Weekday PM Peak LOS and Delay

Intersecting Street	Existing	Future No Build	Future Build
Route 156 (Main Street)	C (30)	D (42)	D (37)
Hope Street - Eastbound Approach	C (19)	C (24)	C (24)
State Road - Eastbound Approach	C (20)	C (23)	C (23)
Lincoln Street - Westbound Approach	C (17)	C (19)	C (19)
Oswegatchie Hills Road - Southbound Approach	C (18)	C (23)	C (23)
Sleepy Hollow Road - Southbound Approach	C (19)	C (22)	C (22)
East Pattagansett Road and Chapman Woods Road	B (14)	C (20)	B (15)
Roxbury Road	C (33)	F (92)	B (17)
Society Road	B (18)	C (24)	B (19)
Laurel Hill Drive - Westbound Approach	D (32)	E (47)	E (44)
Industrial Park Road and Chapman Woods Road	B (18)	C (25)	C (25)
I-95 NB Exit Ramp and Burger King Driveway	N/A	B (14)	B (14)
King Arthur Drive	C (21)	A (7)	A (7)
Frontage Road to I-95 SB Ramps	B (17)	B (13)	B (13)
U.S. Route 1 (Boston Post Road)	C (29)	D (36)	D (45)
East Lyme High School - Eastbound Approach	C (23)	D (29)	D (30)

Table 4 - Saturday Midday Peak LOS and Delay

Intersecting Street	Existing	Future No Build	Future Build
Route 156 (Main Street)	C (31)	D (41)	C (34)
Hope Street - Eastbound Approach	C (24)	D (26)	D (26)
State Road - Eastbound Approach	C (21)	C (24)	C (24)
Lincoln Street - Westbound Approach	C (16)	C (18)	C (18)
Oswegatchie Hills Road - Southbound Approach	C (19)	C (25)	C (25)
Sleepy Hollow Road - Southbound Approach	C (17)	C (18)	C (18)
East Pattagansett Road and Chapman Woods Road	B (13)	B (15)	B (11)
Roxbury Road	C (22)	D (45)	A (9)
Society Road	B (18)	B (20)	B (20)
Laurel Hill Drive - Westbound Approach	D (28)	E (42)	E (42)
Industrial Park Road and Chapman Woods Road	B (14)	B (12)	B (12)
I-95 NB Exit Ramp and Burger King Driveway	N/A	B (13)	B (13)
King Arthur Drive	C (21)	A (6)	A (6)
Frontage Road to I-95 SB Ramps	B (17)	B (13)	B (13)

U.S. Route 1 (Boston Post Road)	C (24)	C (27)	D (36)
East Lyme High School - Eastbound Approach	C (17)	C (18)	C (17)

At the Route 156 (Main Street) intersection, installing a new traffic signal with optimized timings improves traffic operations from a LOS D with 42 seconds of average delay to a LOS D with 34 seconds of average delay during future conditions for the weekday afternoon peak hour. Traffic operations are improved from a LOS D with 41 seconds of average delay to a LOS C with 32 seconds of average delay during future conditions for the Saturday midday peak hour.

At the East Pattagansett Road and Chapman Woods Road intersection installing a new traffic signal that operates independently from Roxbury Road improves traffic operations from a LOS C with 20 seconds of average delay to a LOS B with 15 seconds of average delay during future conditions for the weekday afternoon peak hour. Traffic operations are improved from a LOS B with 15 seconds of average delay to a LOS B with 11 seconds of average delay during future conditions for the Saturday midday peak hour. *With a roundabout this intersection would operate at LOS C with 19 seconds of average delay during future conditions for both the weekday afternoon and Saturday midday peak hours.*

At the Roxbury Road intersection installing a new traffic signal that incorporates a northbound left turn lane improves traffic operations from a LOS F with 92 seconds of average delay to a LOS B with 17 seconds of average delay during future conditions for the weekday afternoon peak hour. Traffic operations are improved from a LOS D with 45 seconds of average delay to a LOS A with 9 seconds of average delay during future conditions for the Saturday midday peak hour.

At the Route U.S. Route 1 (Boston Post Road) intersection eliminating a turn lane on the northbound approach to accommodate the proposed pedestrian refuge island worsens traffic operations from a LOS D with 36 seconds of average delay to a LOS D with 45 seconds of average delay during future conditions for the weekday afternoon peak hour. Traffic operations worsen with from a LOS C with 27 seconds of average delay to a LOS D with 36 seconds of average delay for the Saturday midday peak hour. Although traffic operations worsen the proposed pedestrian refuge island is expected to facilitate safer crossings for pedestrians.

4.0 Constraints

Potential constraints associated with implementation of the proposed improvements identified in Chapter 2 include rights of way, utilities, and permitting.

4.1 Rights of Way

The proposed improvements for the Route 161 corridor are generally included within the existing rights of way. Rights of way boundaries are located as close as 4-feet as far as 125-feet from the existing curb on the west side of the corridor. Along the east side of the corridor the rights of way boundary varies from 3-feet to 90-feet from the existing curb. Improvements involving traffic signals, pavement markings, signage, bus shelters, parking, or modifications to existing sidewalks can generally be implemented without easements. However, the following easements are anticipated to accommodate the proposed shared use path, new sidewalks, and roadway realignment:

Table 5 – Anticipated Easements

Segment	Proposed Improvement	Impacted Property	Approximate Easement (sf)
2	5' Sidewalk	143 Pennsylvania Ave (Residential)	200 s.f.
2	5' Sidewalk	149 Pennsylvania Ave (Residential)	150 s.f.
2	5' Sidewalk	151 Pennsylvania Ave (Residential)	175 s.f.
2	5' Sidewalk	165 Pennsylvania Ave (Residential)	500 s.f.
2	5' Sidewalk	167 Pennsylvania Ave (Residential)	200 s.f.
2	5' Sidewalk	171 Pennsylvania Ave (Residential)	300 s.f.
2	5' Sidewalk	175 Pennsylvania Ave (Residential)	200 s.f.
2	5' Sidewalk	177 Pennsylvania Ave (Residential)	500 s.f.
2	5' Sidewalk	181 Pennsylvania Ave (Residential)	550 s.f.
3	10' Shared Use Path	4 Flanders Road (Residential)	100 s.f.
3	10' Shared Use Path	44 Flanders Road (Residential)	100 s.f.
3	10' Shared Use Path	48 Flanders Road (Residential)	240 s.f.
3	10' Shared Use Path	56 Flanders Road (Residential)	700 s.f.
3	10' Shared Use Path	64 Flanderes Road (Residential)	500 s.f.
3	10' Shared Use Path	68 Flanders Road (Residential)	300 s.f.
3	10' Shared Use Path	72 Flanders Road (Residential)	700 s.f.
3	10' Shared Use Path	76 Flanders Road (Residential)	1000 s.f.
3	10' Shared Use Path	78 Flanders Road (Residential)	250 s.f.
3	10' Shared Use Path	84 Flanders Road (Residential)	400 s.f.
3	10' Shared Use Path	88 Flanders Road (Residential)	150 s.f.

Segment	Proposed Improvement	Impacted Property	Approximate Easement (sf)
3	10' Shared Use Path	106 Flanders Road (Residential)	150 s.f.
3	10' Shared Use Path	108 Flanders Road (Residential)	100 s.f.
4	10' Shared Use Path	170 Flanders Road LLC (Midway Plaza)	500 s.f.
4	10' Shared Use Path	222 Flanders Road (Monaco Ford)	350 s.f.
4	10' Shared Use Path	226 Flanders Road (Iliano's)	275 s.f.
4	10' Shared Use Path	228 Flanders Road (Iliano's)	425 s.f.
4	10' Shared Use Path	230 Flanders Road (Future Car Wash)	350 s.f.
4	Realign Laurel Hill Drive	155 Flanders Road (Residential)	450 s.f.
5	8' Shared Use Path	248 Flanders Road (Stop & Shop)	400 s.f.
5	8' Shared Use Path	250 Flanders Road (L&L East Lyme)	1300 s.f.
5	8' Shared Use Path	252 Flanders Road (Monro and Stop & Shop Gas)	650 s.f.

Additionally, rights to grade and rights to construct driveways may be required at various locations to facilitate construction of the proposed sidewalks and shared use path.

4.2 Utilities

Overhead and underground utilities including electrical, cable, telephone, water, and sewer lines are located throughout the Route 161 corridor. It is desirable to minimize or avoid impacts to utilities to minimize project costs and streamline construction schedules. The following utility relocations are anticipated to be necessary to accommodate the proposed improvements discussed in Chapter 2:

Table 6 – Anticipated Utility Relocations

Segment	Proposed Improvement	Location	Approximate Easement (sf)
2	5' Sidewalk	Luce Avenue to Penncove Road (east side)	Relocate 6 utility poles and overhead cables
2	5' Sidewalk	Oswegathcie Hills Road to Sleepy Hollow Road (north side)	Relocate 6 utility poles and overhead cables
3	10' Shared Use Path	Roxbury Road to Society Road (west side)	Relocate 5 hydrants, 3 utility poles, and overhead cables
3	10' Shared Use Path	Society Road to Industrial Park Road (west side)	Relocate 5 utility poles and overhead cables
3	Realign Laurel Hill Dr.	Laurel Hill Dr. (south side)	Relocate 1 utility pole and overhead cables

Segment	Proposed Improvement	Location	Approximate Easement (sf)
5	8' Shared Use Path	Industrial Park Road to Frontage Road (west side)	Relocate 1 utility pole and overhead cable
7	10' Shared Use Path	U.S. Route 1 to East Lyme High Scholl (west side)	Relocate 2 utility poles and overhead cable

4.3 PERMITTING

Below is a brief overview of the environmental context of each of the segments in the project area and the project's impacts to various environmental resources. A field visit was conducted to confirm the presence of wetlands along the Corridor on March 17, 2023. Table 7 provides a summary of the various environmental resources present within each segment.

Table 7 - Environmental Impact Summary

	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7
Wetlands and Watercourses		✓*	✓	✓*			
Upland Review Area	✓	✓	✓	✓	✓	✓	✓
NDDB Habitat	✓	✓	✓				
Floodplain			✓				
Aquifer Protection Area			✓	✓	✓	✓	✓
Historic Structures**							
Coastal Management Area	✓						

*Segments marked with an asterisk require a formal delineation to confirm whether the project will impact wetlands or watercourses.

** To determine the presence of historic structures in the project corridor, the Historic Property Database provided by the State Historic Preservation Office (SHPO) was consulted.

Given the impacts associated with the proposed improvements and because it is anticipated that CTDOT funding will be pursued for implementation, the following environmental permits will be required to complete permitting for each of the Project segments.

- Town of East Lyme Inland Wetlands Permit for <u>all</u> Segments;
- Self-Verification Notification Form or Pre-Construction Notification under the US Army Corps of Engineers Section 404 Connecticut General Permits 17A for Segment 3, and potentially Segments 2 and 4, depending on final impacts;
- Submission of the Land and Water Resource Division (LWRD) License Application (Form L) to CTDEEP for Inland Wetlands and Watercourses and required attachments for Segment 3, and potentially Segments 2 and 4. Coordination with CTDEEP will be conducted during preliminary design to confirm CTDEEP filing requirements;
- NDDB Consultation Submission for Segments 1, 2 and 3;

- DEEP Stormwater Permit for the Project as a whole, as earth disturbance is anticipated to exceed two acres;
- Coastal Management Act Site Plan Review for Segment 1;
- East Lyme Floodplain Development Permit Application for Segment 3; and
- As a state-funded Project, the work will require review and confirmation that the Project will not have an effect or adverse effect on historic and / or archaeological resources. A Project Notification Form is required to be submitted to CT State Historic Preservation Office (SHPO), as required for state-funded projects, to comply with the Connecticut Environmental Policy Act (CEPA).

Additional information on the environmental context, impacts and considerations associated with each segment is included in the Environmental Permitting Overview memorandum in Appendix D.

5.0 Implementation Plan

The proposed improvements identified in Chapter 2 may be implemented through a series of ten potential projects. An implementation timeline has been developed based on the complexity, cost, and benefit of each project with each project being categorized as near-term, mid-term, or long-term.

Approximate construction costs have been identified for each project based on comparable projects and similar work. The planning-level construction costs are reported in 2023 dollars. Itemized construction cost estimates were developed for projects for which concept plans and renderings were developed. Itemized construction costs are included in Appendix E.

5.1 Near-Term Program

The near-term program includes two projects that could be implemented within a three-year timeline. A summary of the project including lead agency and approximate construction cost is provided below.

Project 1 – Traffic Signal Improvements – Route 156 (Main Street)	Mid-term
Summary: Traffic signal improvements at the intersection of Route 161 and Route 156 (Main Street).	Lead Agency: CTDOT Cost: $320,000

This project includes:

- Installing a new traffic signal at the Route 161 and Route 156 (Main Street) intersection. The existing traffic signal is scheduled to be replaced under State Project #0172-0501 during the 2024 and 2025 construction seasonsRetroreflective backplates will be installed to enhance visibility and mitigate rear end collisions. Accessible pedestrian signals to improve accessibility for visually impaired pedestrians.

Project 2 – Pavement Marking and Signing Improvements – by the Town of East Lyme	Near-term
Summary: Various pavement marking and signing improvements implemented and maintained by the Town of East Lyme.	Lead Agency: Town of East Lyme Cost: $45,000

This project includes:

- Striping crosswalks across side streets with high pedestrian volumes including Grand Street, Hope Street, State Street, and Lincoln Street to enhance pedestrian safety.
- Striping on-street parking spaces on Hope Street to better accommodate parking demand from visitors to local businesses.
- Installing speed feedback signs between Roxbury Road and Society Road to discourage speeding.

The approximate cost assumes that pavement markings will be installed in conjunction with routine pavement rehabilitation. Milling, paving, and related costs are therefore not included.

5.2 Mid-Term Program

The mid-term program includes seven projects that could be implemented within a three to seven-year timeline. A summary of each project including lead agency and approximate construction cost is provided below.

Project 3 – Bus Facility and Pocket Parking Improvements	Mid-Term
Summary: Modify existing curb geometry to accommodate bus pull outs and pocket parking. Install bus shelters and pedestrian refuge island between shelters.	Lead Agency: Town of East Lyme/CTDOT Cost: $700,000

This project includes:

- Constructing a pocket parking area on the west of the corridor, just south of Hope Street to accommodate bike lanes and improve sight distance.
- Installing a bus shelter northeast of Chapman Wood Road.
- Installing bus pull outs on both sides of the corridor just south of U.S. Route 1 (Boston Post Road) where buses can pick up and drop off passengers without impeding the flow of traffic.

Constructing a raised median island on the southern leg of the Route 161/U.S. Route 1 (Boston Post Road) intersection to enhance pedestrian safety between the proposed bus shelters and restriping the northbound approach to include an exclusive left turn lane and shared through/right turn lane.

Project 4 – Pavement Marking and Signing Improvements – by CTDOT	Mid-term
Summary: Various pavement marking and signing improvements implemented and maintained by CTDOT.	Lead Agency: CTDOT Cost: $75,000

This project includes:

- Striping bike lanes along both sides of Route 161 between Route 156 (Main Street) and East Pattagansett Road to promote bicycle use and enhance safety for bicyclists.
- Restriping the existing shoulder between Roxbury Road and Society Road with 6”- wide shoulder markings to mitigate crashes involving pedestrians, bicyclists, and older drivers and to discourage speeding.

- Installing a crosswalk across Route 161 at Oak Hill Drive to improve access to the proposed sidewalk and overlook area at Gorton Pond.
- Restriping the roadway between Laurel Hill Drive and Industrial Park Road to incorporate a two-way left turn lane to improve traffic flow and reduce crashes.
- Installing an intersection warning sign on the northbound approach to Laurel Hill Drive to alert drivers to the presence of an intersection with limited sight distances and improve safety.
- Implementing a left-turn lane on the northbound approach to East Lyme High School to mitigate delay and enhance safety during the morning arrival period.

The proposed pocket parking area south of Hope Street identified as part of Project 2 should be constructed prior to restriping to accommodate installation of the bike lanes.

The approximate cost assumes that pavement markings will be installed in conjunction with routine pavement rehabilitation. Milling, paving, and related costs are therefore not included.

Project 5 – Traffic Signal Improvements – East Pattagansett Road to Society Road	Mid-term
Summary: Various upgrades to traffic signals between East Pattagansett Road and Society Road.	Lead Agency: CTDOT Cost: $730,000

This project includes:

- Installing new traffic signals at the Route 161/East Pattagansett Road and Route 161/Roxbury Road intersections. Provide separate traffic signal controllers at each intersection allowing each signal to operate independently, improving traffic operations, and reducing delay. Incorporate Leading Pedestrian Interval (LPI) phasing and accessible pedestrian signals at each intersection to enhance pedestrian safety and improve mobility for all users. At the Roxbury Road signal install a dedicated northbound left turn lane and a bicycle box to facilitate transition from the bicycle lanes south of the intersection to the shared use path north of the intersection.
- At the intersection of Route 161 and Society Road install accessible pedestrian signals, implement leading pedestrian interval (LPI) pedestrian phasing, and stripe a crosswalk across Society Road to improve pedestrian safety and mobility for all users.

Project 6 – Traffic Signal Improvements – Industrial Park Road to U.S. Route 1 (Boston Post Road)	Mid-term
Summary: Various upgrades to traffic signals between Industrial Park Road and U.S. Route 1 (Boston Post Road).	Lead Agency: CTDOT Cost: $300,000

This project includes:

- Install a crosswalk with pedestrian signals across Industrial Park Road and implement concurrent pedestrian phasing to improve pedestrian safety.
- Incorporate adaptive signal control at the new traffic signals to be installed at Industrial Park Road, the Exit 74 Off Ramp, King Arthur Drive, and Frontage Road under the I-95 Interchange 74 Improvement project.
- Install fiber optic interconnect to facilitate communication between the traffic signal at U.S. Route 1 (Boston Post Road) and the signals at Frontage Road, King Arthur Drive, the I-95 Exit 74 Off Ramp, and Industrial Park Road.
- Incorporate adaptive signal control at Route 161/U.S. Route 1 (Boston Post Road) traffic signal.

Project 7 – Pedestrian Connectivity Improvements	Mid-Term
Summary: Provide new sidewalk facilities to improve connectivity and create a more walkable corridor.	Lead Agency: Town of East Lyme/CTDOT Cost: $900,000

This project includes:

- Constructing new sidewalk along the east side of Route 161 between Smith Street and Sleepy Hollow Road to create an improved pedestrian connection between Veterans Memorial Field, Oswegatchie Hills Nature Preserve, and the downtown Niantic area.
- Construct new sidewalk on the east side of the corridor in front of Latimer Brook Commons to fill a gap in the existing sidewalk network and improve pedestrian connectivity.

Project 8 – Upgrade Existing Sidewalk Facilities	Mid-Term
Summary: Install sidewalk ramps at locations where they are missing, replace existing sidewalk ramps with PROWAG-compliant ramps as required, and widen narrow sidewalks to 5—feet. Provide additional streetscape amenities.	Lead Agency: Town of East Lyme/CTDOT Cost: $1,600,000

This project includes:

- Construct pedestrian curb ramps where none are provided.
- Reconstruct pedestrian curb ramps and install detectable warning panels at various locations in accordance with the U.S. Access Board's Proposed Public Rights-of-Way Accessibility Guidelines.
- Widen the existing sidewalk along the west side of the corridor between Hope Street and East Pattagansett Road, along the east side of the corridor between Sleepy Hollow Road and Oak Hill Drive, and along the east side of the corridor between Laurel Hill Drive and Dunkin' Donuts.

- Installing pedestrian scale lighting between Smith Street and Hope Street to enhance pedestrian visibility and walkability.
- Plant street trees within the public right-of-way to enhance the aesthetics of the downtown Niantic area and promote survival of local pollinators.

Project 9 – Laurel Hill Drive Realignment	Mid-Term
Summary: Realign the Laurel Hill Drive approach to Route 161.	Lead Agency: Town of East Lyme/CTDOT Cost: $215,000

This project includes:

- Realigning the Laurel Hill Drive approach to Route 161 approximately 150 feet southward to reduce the skewed angle, improve sight distance, and mitigate crashes.

5.3 Long-Term Program

The long-term program includes one project that could take seven years or longer to implement. A summary of the project including lead agency and approximate construction cost is provided below.

Project 10 – Shared Use Path – Roxbury Road to East Lyme High School	Long-term
Summary: Install a shared use path along the west side of Route 161 from Roxbury Road to East Lyme High School	Lead Agency: Town of East Lyme/CTDOT Cost: $5,400,000

This project includes:

- Installing a shared use path along the west side of Route 161 to promote nonmotorized modes of travel such as walking and biking. Construct retaining walls to support the shared use path along the south end of Gorton Pond. Provide an overlook area to accommodate fishing, sight-seeing, or other recreational activities. Extend the existing culvert south of Dunkin' to accommodate the shared use path.

5.4 Program Summary

Time frame, lead agency, approximate construction cost, study segments, right-of-way acquisitions, utility relocations, and permitting requirements for each of the projects are summarized in Table 8.

Table 8 – Program Summary

Project	Time Frame	Lead Agency	Approximate Construction Cost	Study Segments	ROW Acquisition	Utility Relocation	Permits
1 - Traffic Signal Improvements - Route 156 (Main Street)	Near	CTDOT	$320,000	1	-	-	NDDB Habitat, Upland Review Area, Coastal Management Area
2 - Pavement Marking and Signing Improvements - by the Town of East Lyme	Near	Town	$45,000	1,3	-	-	Wetlands and Watercourses, Upland Review Area, NDDB Habitat, Floodplain, Aquifer Protection Area
3 - Bus Facility and Pocket Parking Improvements	Mid	Town/CTDOT	$700,000	1,6	-	-	Upland Review Area
4 - Pavement Marking and Signing Improvements - by CTDOT	Mid	CTDOT	$75,000	1,2,3,4,7	-	-	Wetlands and Watercourses, Upland Review Area, NDDB Habitat, Floodplain, Aquifer Protection Area, Coastal Management Area
5 - Traffic Signal Improvements - East Pattagansett Road to Society Road	Mid	CTDOT	$730,000	3,4	-	-	Wetlands and Watercourses, Upland Review Area, NDDB, Floodplain, Aquifer Protection Area
6 - Traffic Signal Improvements - Industrial Park Road to	Mid	CTDOT	$300,000	5,6,7	-	-	Upland Review Area, Aquifer Proteciton Area

Project	Time Frame	Lead Agency	Approximate Construction Cost	Study Segments	ROW Acquisition	Utility Relocation	Permits
U.S. Route 1 (Boston Post Road)							
7 - Pedestrian Connectivity Improvements	Mid	Town/CTDOT	$900,000	1,2,6	✓	✓	Wetlands and Watercourses, Upland Review Area, NDDB Habitat
8 - Upgrade Existing Sidewalk Facilities	Mid	Town/CTDOT	$1,600,000	1,2,3,4	-	-	Wetlands and Watercourses, Upland Review, NDDB Habitat, Floodplain, Aquifer Protection Area, Coastal Management Area
9 - Laurel Hill Drive Realignment	Mid	Town/CTDOT	$215,000	4	✓	✓	Wetlands and Watercourses, Upland Review, Aquifer Protection Area
10 - Shared Use Path - Roxbury Road to East Lyme High School	Long	Town/CTDOT	$5,400,000	3,4,5,6,7	✓	✓	Wetlands and Watercourses, Upland Review, NDDB Habitat, Floodplain, Aquifer Protection Area

5.5 Funding Opportunities

The following funding programs have been identified as potential sources for financing the projects:

- Community Connectivity Grant Program – The Community Connectivity Program seeks to improve accommodations for bicyclists and pedestrians in urban, suburban, and rural community centers. The goal of the Community Connectivity Program is to make conditions safer and more accommodating for pedestrians and bicyclists, thereby encouraging more people to use these healthy and environmentally sustainable modes of travel.
- Congestion Mitigation and Air Quality (CMAQ) Program – The Congestion Mitigation and Air Quality Improvement (CMAQ) program provides a funding source for State and local governments to fund transportation projects and programs to help meet the requirements of the Clean Air Act (CAA) and its amendments.
- Congressionally Directed Spending/Community Project Funding – Members of Congress may request funding for specific projects. These requests are reviewed by the Appropriations subcommittee and approved requests are included in the Consolidated Appropriations Act and the accompanying joint explanatory statement. These requests are called Congressionally Directed Spending in the Senate and Community Project Funding in the House of Representatives.
- Connecticut Recreational Trails Program – The Connecticut Department of Environmental Protection's Recreational Trails Grant Program was established to provide funding to any private nonprofit organizations, municipalities, state departments, and tribal governments in support of trail projects.
- Local Capital Improvement Program (LoCIP) – LoCIP distributes formula-based entitlement funds to municipalities to reimburse the cost of eligible local capital improvement projects such as road, bridge or public building construction activities.
- Local Transportation Capital Improvement Program(LOTCIP) – The purpose of the LOTCIP is to provide State monies to urbanized area municipal governments in lieu of Federal funds otherwise available through the Federal transportation legislation. The LOTCIP allows eligible municipalities to perform capital infrastructure improvements with less burdensome requirements and minimizes the number and level of State resources involved in the oversight of municipal infrastructure improvements.
- Safe Streets and Roads for All Grant – The Safe Streets and Roads for All (SS4A) Grant issued by USDOT funds planning, infrastructure, behavioral, and operational initiatives to eliminate fatalities and serious injury on roads and streets involving all roadway users, including pedestrians; bicyclists; public transportation, personal conveyance, and micromobility users; motorists; and commercial vehicle operators.
- Small Town Economic Assistance Program (STEAP) – STEAP funds economic development, community conservation and quality-of-life capital projects for localities that are ineligible to receive Urban Action bonds. This program is managed by the Office of Policy and Management, and the grants are administered by various state agencies.

- Surface Transportation Program (STP) – The STP provides flexible funding that may be used by States and localities for projects to preserve and improve the conditions and performance on any Federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals.

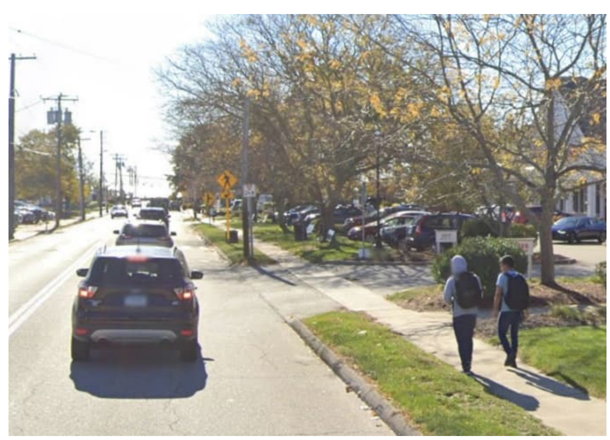
Many funding programs require local participation – typically 10% to 20% of the overall construction cost. The Town's capital improvement program may also be used to finance projects approved during the annual budget approval process. Additional pedestrian and bicycle funding opportunities for which the proposed projects may be eligible are summarized in Appendix F.

6.0 ACCESS MANAGEMENT

Multimodal conflicts and safety issues are present when closely spaced driveways and continuous access result in vehicular turning movements interfering with through movements for people driving, walking, and biking. Access management is a tool cities and towns can use to reduce conflicts using strategies like closing driveways, consolidating driveways, and modifying traffic patterns within a site. Access management strategies are most often associated with high density residential, commercial, or institutional driveways with a higher volume of turning movements.

An Access Management Plan was developed to assist the Town as they work with property owners to make modifications and incorporate improvements during future redevelopment. A more detailed description of each strategy considered for the Route 161 Corridor Study is described below.

- *Access Closure*: When one development has multiple driveways, there is an opportunity to close redundant driveways.
- *Relocate Access:* When driveways are closed, the access to the site can be relocated and realigned to an existing driveway or a new entrance and exit location.
- *Create shared driveway:* When multiple businesses have driveways placed close to one another, creating a shared driveway can channel all vehicle turning movements for the businesses into a single driveway.
- *Provide vehicular interconnection*: When multiple driveways are combined into one single driveway, access between the businesses may need to be added between the sites through access roadways.
- *Define Entrance*: Often, commercial driveways are built wider than necessary or do not have defined entrances and exits. In these situations, vehicles pull in and pull out in an unstructured manner, increasing conflict. Defining the driveway refers to the narrowing and channeling of vehicles at driveways with overly wide or undefined entrances and exits. The narrowing of driveways also reduces pedestrian exposure to vehicles in the sidewalk.



- *Continue sidewalk access across driveways:* When sidewalks continue across driveways, drivers are alerted to the presence of pedestrians.
- *Create one-way driveways:* Creating one-way driveways restricts exiting or exiting

from certain driveways by dedicating certain driveways for entering and other driveways for exiting. This reduces the number of turning conflicts out of a site.

- *Maximize sight lines:* When through moving and turning vehicles cannot easily see one another, there is a greater opportunity for collisions. Maximizing sight lines can include moving access to a site to a location with better sight lines, cutting vegetation or removing or relocating obstructions.

The access management plan for the Route 161 Corridor focuses on closing, relocating or consolidating driveways along the parts of the corridor with closely spaced, frequent, and sometimes redundant driveways. The majority of the recommendations focus on the sections of roadway between East Lyme High School and Laurel Hill Drive, and between East Lyme Town Hall and Route 156, as these areas have the most frequent driveways and turning conflicts. Figures 20 through 28 show the proposed access management improvements along the corridor. Additional approvals may be required for strategies impacting privately owned roadways such as Chapman Woods Road.

Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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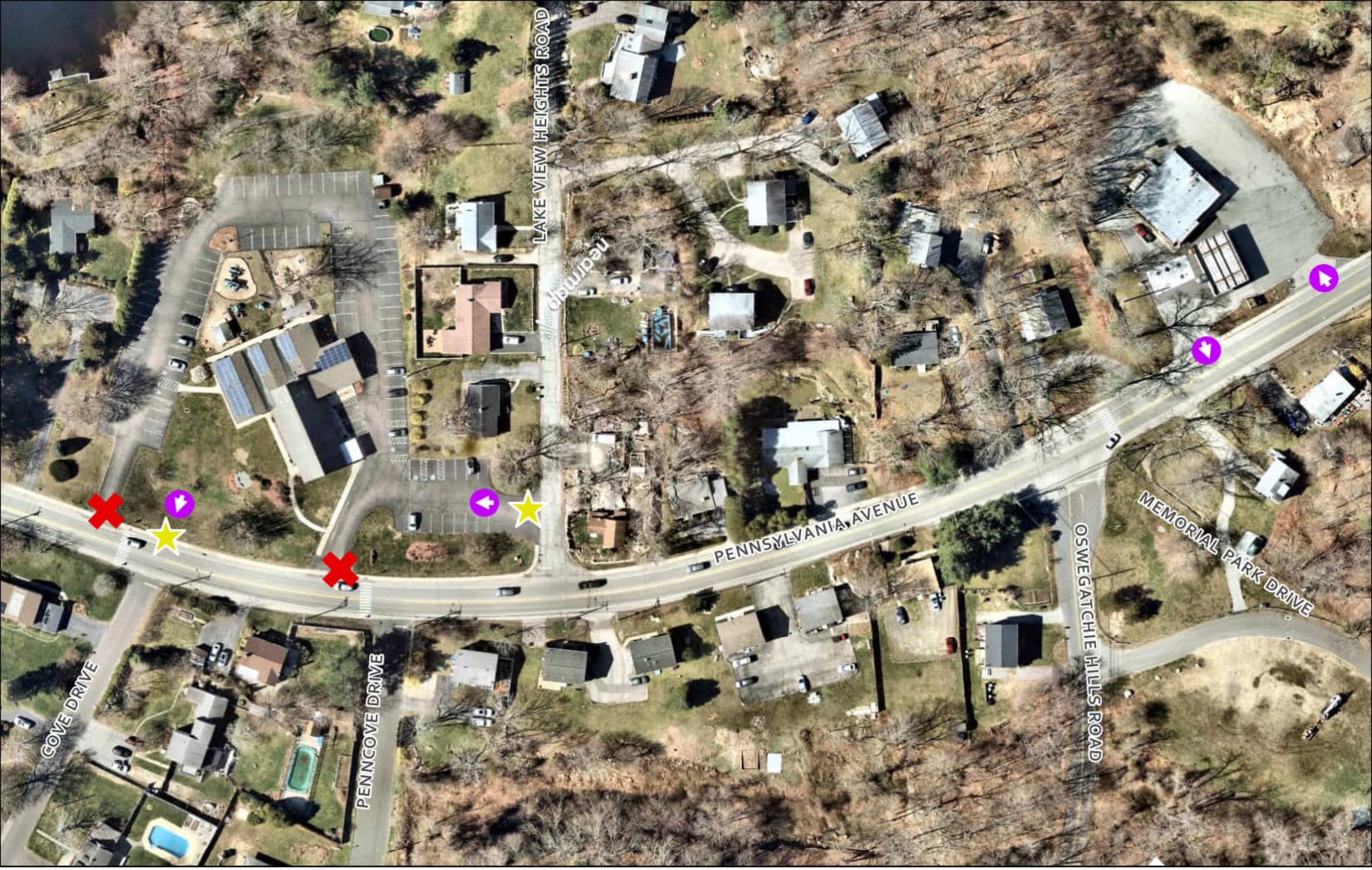
Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 20
Access Management Plan
Downtown Niantic



Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 21
Access Management Plan
Near Oswegatchie Hills Road

Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 22
Access Management Plan
Near East Patagansett Road

Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 23
Access Management Plan
Society Road to Laurel Hill Drive

Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 24
Access Management Plan
Laurel Hill Drive to Damon Heights Road

Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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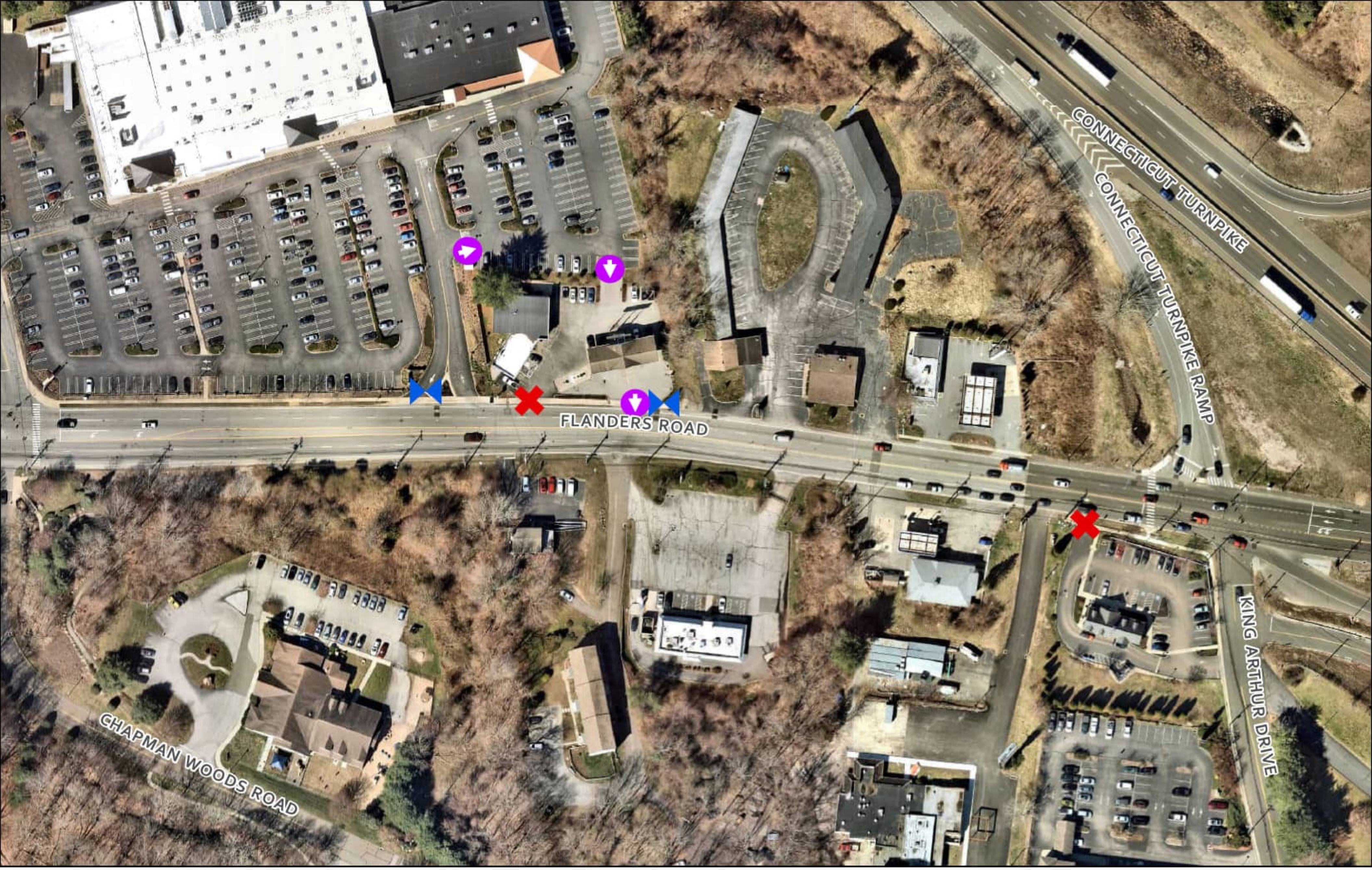
Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 25

Access Management Plan
Damon Heights Road to Industrial Park Road



Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

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Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 26
Access Management Plan
Industrial Park Road to King Arthur Drive

Legend

- Maximize Sight Lines
- Access Closure
- Continue Sidewalk Across Driveway
- Create Shared Driveway
- Provide Vehicular Interconnection
- Redefine Entrance; Define Entrance
- Relocated Access
- One Way

0 62.5 125
Feet

Date: June 15, 2023
Basemap: Nearmap Imagery and Interchange 74 Plans

Figure 27

Access Management Plan

Frontage Road to U.S. Route 1 (Boston Post Road)

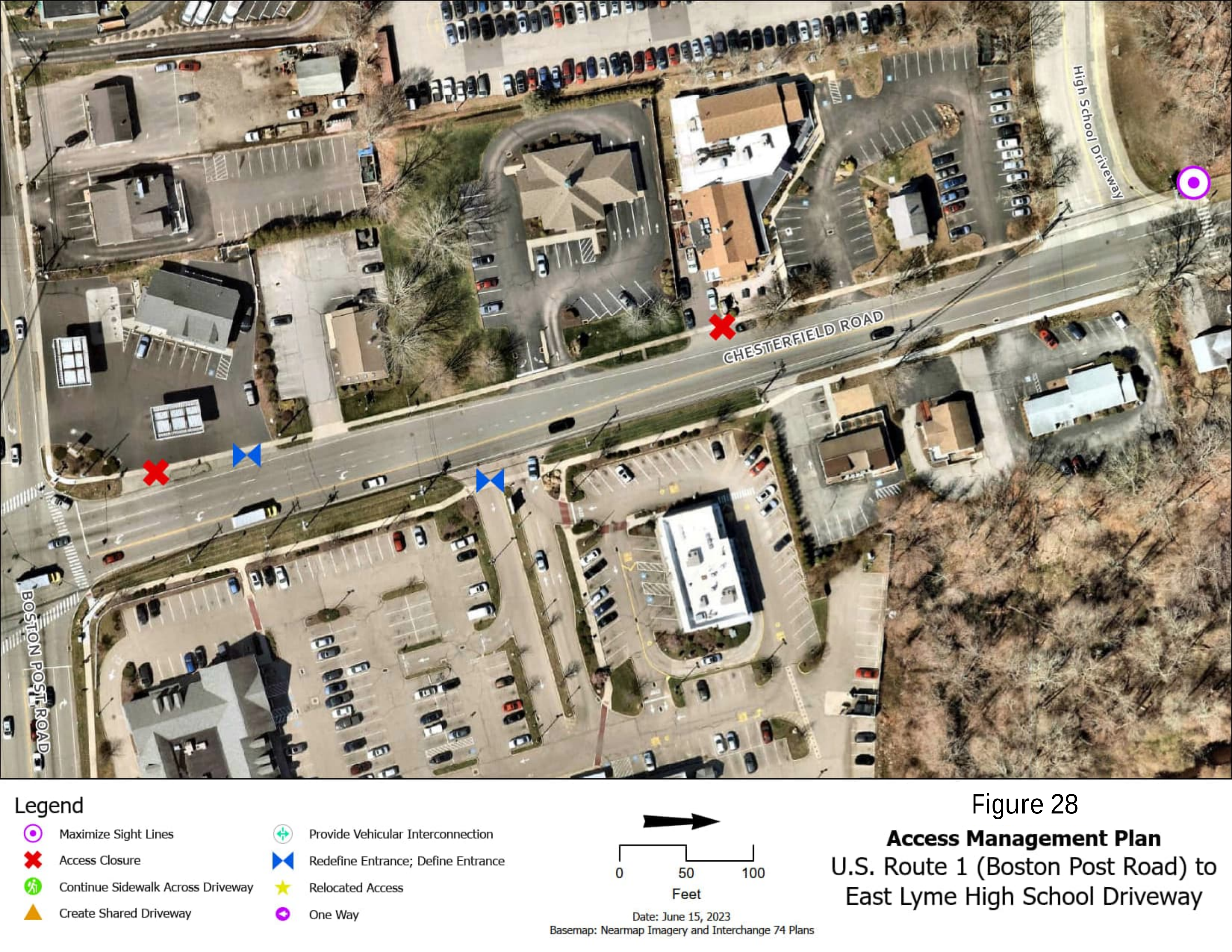


Figure 28

Access Management Plan

U.S. Route 1 (Boston Post Road) to East Lyme High School Driveway

APPENDIX A
MEETING MINUTES & PUBLIC COMMENTS

IMPROVING COMMUNITIES TOGETHER

RECORD OF MEETING

Client:	SCCOG	Date:	Tuesday, November 1, 2022
Meeting Date:	Thursday, October 27, 2022	Prepared By:	Katey Curran
Meeting Location:	East Lyme High School Auditorium	Job Number:	10369
Meeting Topic:	Route 161 Corridor Study		

ATTENDEES:

See attached sign in sheet.

RECORD OF MEETING MINUTES:

I. Introduction from the Southeastern Connecticut Council of Government's (SCCOG's) Senior Advisor, Jim Butler
   A. SCCOG received a grant from the Connecticut Department of Transportation (CTDOT) last year. This grant was used to hire BETA Group Inc. (BETA) to perform the Route 161 Corridor Study.

II. Introduction from East Lyme's First Selectman, Kevin Seery
   A. For the past several months the Town, SCCOG, CTDOT, transit providers, and BETA have had bimonthly virtual meetings to discuss the corridor study.

III. PowerPoint presentation
   A. Joe Rimiller, BETA's Project Manager, gave a presentation that included a project introduction, discussion of previous studies and upcoming projects, existing and future corridor conditions, and next steps. A recording of the presentation has been posted on the project website (www.route161corridorstudy.com).

IV. Break Out Sessions
   A. Following the presentation attendees were asked to a series of stations and discuss three topics with BETA's engineers and planners. These topics, spin-off questions from BETA, and responses provided by the community are summarized below.
   B. What is working well on the Route 161 corridor?
      1. What destinations do you like to visit?
         a. Downtown
         b. Village Café (190 Flanders Road)
      2. What streetscape or landscape features do you like?
         a. Streetlights
      3. What is your overall vision for the corridor?
         a. A roundabout at the Oswegatchie Hills Road intersection.
         b. A roundabout at the East Pattagansett Road intersection.
   C. What challenges or opportunities would you like to see addressed from the perspective of a pedestrian, bicyclist, or transit user?
      1. Are there areas where sidewalks are needed?
         a. East Pattagansett Road needs a sidewalk.

   b. Extend sidewalk on the east side of Route 161 between Penncove Road and Route 156 to better serve the residents of these streets.
   c. Sidewalks are needed near Gorton Pond
   d. Sidewalks are needed on the east side of the corridor in Niantic
   e. Better walkability is needed
2. Are there areas where you have difficulty crossing the roadway?
   a. Rectangular Rapid Flashing Beacons (RRFBs) are needed in the Downtown Niantic section.
   b. The Industrial Park Road/Chapman Woods Road intersection needs a pedestrian signal head.
3. Are there areas where bicycle facilities are needed?
   a. Realign/restripe Boston Post Road for better bike access.
   b. Bike lanes are needed throughout the corridor.
   c. Bike lanes should be considered in the four-lane section of the corridor between the high school and the Ford dealership.
4. Are there any improvements you would like to see made to transit services?
   a. Improvements are needed at the bus stop at Stop & Shop (248 Flanders Road)

D. What challenges or opportunities would you like to see addressed from the perspective of a driver?
1. Are there areas where safety is a concern?
   a. Drivers exiting the driveway for the liquor store at the Industrial Park Road/Chapman Woods Road intersection don't have a traffic signal and drivers aren't sure when to go.
   b. Consider jughandles to eliminate challenging left turn.
   c. Drivers turning right out of Citgo at 200 Flanders Road don't look for oncoming traffic. Consider eliminating or improving a driveway.
   d. Drivers exiting the Stop and Shop driveway onto Route 161 ignore the right turn only designation. Consider installing bollards to prevent unsafe left turns.
   e. The southbound left turn lane from Route 161 onto Chapman Woods Road does not provide sufficient storage for queued vehicles.
   f. There are two traffic signals on the Society Road approach to Rt 161. Are they both needed?
   g. An exclusive left turn lane with protected traffic signal phasing is needed at the northbound left turn from Route 161 onto the Frontage Road to the I-95 ramps. Drivers currently make unexpected left turns. There is also too much delay for this movement.
2. Are there areas where vehicular congestion frustrates you?
   a. The number of lanes on I-395/I-95 SB heading towards U.S. Route 1 drops from three to one. It is confusing for motorists and congested.
   b. When there is congestion or an issue on I-95 drivers use U.S. Route 1. They tend to be more aggressive due to frustration and more prone to cause crashes. More police enforcement would help. The upcoming improvements at the I-95 Exit 74 Interchange may also help.

c. During the summer I-95 is more congested so drivers use U.S. Route 1 instead and there is excessive backup near the Route 161 intersection. Left turn storage lanes fill up and left turning traffic obstructs through lanes.
d. The traffic signals at the East Pattagansett Road and Roxbury Road intersections aren't always responsive to drivers.
e. It is difficult to turn out of Oak Hill Drive due to congestion and speeding.
f. Better traffic signal coordination is needed along the corridor.

3. Are there areas where you have difficulty parking?
    a. Parking is challenging at Sift Bake Shop on Route 156 (185 Main Street).
4. Are there any destinations that you have difficulty accessing?
    a. It is a challenge making left turns out of businesses on the west side of the corridor between Industrial Park Road and Society Road.
    b. It is difficult to make a left turn out of the Citgo Station at 200 Flanders Road.
    c. A traffic signal needed is needed at the Laurel Hill Drive/Gateway Plaza intersection.
    d. It is difficult to make an eastbound left turn from Hope Street onto Route 161 due to heavy volumes and limited gaps in traffic.
    e. Trying to get in or out of driveways at Flanders Commons is difficult, especially when making a left turn. It is hard to find a gap in traffic on Route 161 or Route 1.
    f. There are long delays for drivers trying to make a left turn from Clarks Lane onto Route 161. There is a 55+ community on Clarks Lane.
    g. The signals on the Frontage Road near Costco are closely spaced but this will be addressed by the I-95 Interchange 74 project.

E. General comments
- Better stormwater management is needed to prevent salt used to treat roads from getting into aquifers and ground water. This includes storm drains and tree filtration systems.
- Native plants are needed to help pollinators.
- More open space is needed for large trees to help with carbon reduction.

BETA
IMPROVING COMMUNITIES TOGETHER

RECORD OF MEETING

Client:	SCCOG	Date:	Friday, April 28, 2023
Meeting Date:	Thursday, April 27, 2023	Prepared By:	Joe Rimiller
Meeting Location:	East Lyme High School Auditorium	Job Number:	10369
Meeting Topic:	Route 161 Corridor Study		

RECORD OF MEETING MINUTES:

I. Introductions
   A. Jim Butler from the Southeastern Connecticut Council of Governments (SCCOG) and First Selectman Kevin Seery introduced the project and thanked attendees for participating in the study.

II. PowerPoint presentation
   A. Joe Rimiller, BETA's Project Manager, gave a presentation that included a project introduction, recap of the existing & future conditions assessment, summary of stakeholder input, overview of the draft alternative recommendations, review of access management strategies, and discussion of the next steps in the study process. A recording of the presentation and draft recommendations have been posted on the project website (www.route161corridorstudy.com).

III. Public Input
   A. The following comments were provided by members of the community during the Q&A period following the presentation and in more intimate conversations that occurred at the various exhibits that were displayed:

- Consider rerouting bicyclists down Hope Street since conflicts could occur with adjacent vehicles parked to the south of Hope Street.
- Bicyclists should be encouraged to stay on Route 161 in the downtown area as that is where many of the businesses and amenities that they would like to visit are located.
- Additional traffic calming measures beyond the proposed speed radar signs should be considered in the area between Roxbury Road and Society Road. Speeds are excessive.
- Consider modified fog lines between Roxbury Road and Society Road.
- Although a roundabout at the East Pattagansett Road intersection may help reduce speeds and improve intersection safety, residents in this area already have difficulty pulling out of their driveways. They rely on the traffic signal to create gaps in oncoming traffic that allow them to enter Route 161. There may be an increase in accidents downstream of the intersection if a roundabout is implemented and gaps are harder to come by.
- The alternative bike route that was suggested along Roxbury Road, Riverview Road, and Society Road includes challenging terrain. Most bicyclists will have too much difficulty using this route and continue down Route 161 instead.

- Some bicyclists may not be comfortable using bike lanes or a shared use path due to high volumes and speeds.
- Reconsider relocating the Cartier Optical driveway from Route 161 to Chapman Woods Road. Chapman Woods Road is a private roadway which may make such a relocation impractical.
- Mr. Seery indicated that the town would be responsible for snow removal at new sidewalks and paths installed along Route 161.
- Consider widening the roadway if necessary.
- Cross traffic between Citizen's Bank and Hope Street can be hazardous.
- Better pedestrian accommodations are needed along Route 156. Residents would like to walk to the beach but streets along the Route 156 corridor lack sidewalks, are narrow, and don't have shoulders.
- Consider making East Pattagansett Road one-way southbound and adding a bicycle lane. This would simplify operations at the Route 161, Bush Hill Drive, and Hope Street intersections.
- Construction costs for improvements involving pavement marking restriping may be higher than estimated if the improvement is not implemented as part of a VIP program. If this is the case, milling and paving will also be required.
- Consider a wider sidewalk or bike facility along Gorton Pond. Can an 8' path be accommodated? Consider providing handrails on both sides and widening to at least 6'.

IV. Voting

A. Residents were asked to vote for a preferred alternative at four locations where multiple alternatives were under consideration. The following votes were received:

1. Route 161 at East Pattagansett Road intersection
   a. Roundabout – 5 votes
   b. Traffic Signal Replacement – 17 votes
2. South end of Gorton Pond
   a. Concrete Sidewalk – 19 votes
   b. Timber Boardwalk – 0 votes
3. Society Road to Industrial Park Road
   a. Shared Use Path – 8 votes
   b. Buffered Bike Lanes – 5 votes
4. Boston Post Road to East Lyme High School
   a. Shared Use Path – 5 votes
   b. Buffered Bike Lanes – 2 votes

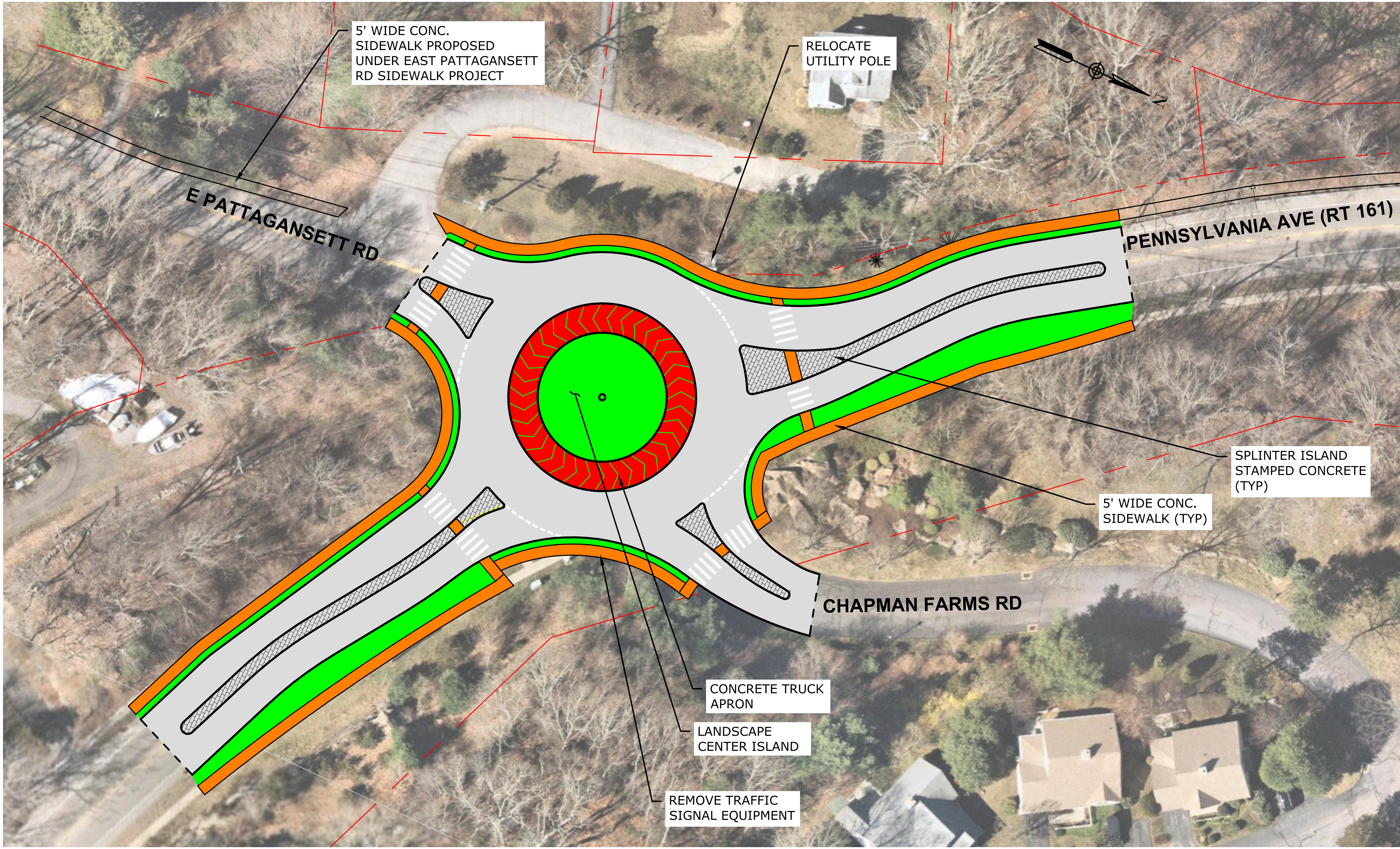
Location	Comment
General	Roundabouts are needed at corridor intersections.
General	Turning left out of businesses on the east side of Route 161 is difficult.
General	Add Sidewalk on 'resident' side of road.
General	Extend the lamp post lighting that exists downtown further up to Oswegatchie to increase safe walking/transit at night and extend 'downtown access feel'.
General	I would like to see street trees being added.
General	The corridor needs to have a walkable route (on one side or the other) running all the way from ELHS to Route 156/Main Street. This includes the area along Gorton Pond.
General	Bury the utility lines, eliminating down poles / wires during severe weather events.
General	Too much road salt in the winter by the State, the Town & private contractors while a good portion of Rt 161 is in an aquifer / wet lands.
General	Provide bus service between East Lyme High School and Main Street
General	The proposed senior housing development may increase traffic volumes and noise levels
Downtown Niantic	Many of these business have dedicated entry/exit points and increases turning/traffic concerns.
Hope Street Intersection	Turning left from Hope Street to Penn Avenue is difficult with the liquor store parking lot, crosswalk, bank exits, and oncoming traffic. Parked vehicles in front of Grace obstruct sight lines.
State Road Intersection	Utilize this area as the main entry/egress from the Town Hall to take turning traffic off of main drag and terminate it at a stop sign.
State Road Intersection	Turning from this intersection is a bit blind to the north due to the trees.
Jo Anne Street	Jo Anne St is the only side street in downtown Niantic that does not have a cross walk.
Lake View Heights	It is difficult to cross Route 161 near Lake View Heights as a pedestrian because drivers rarely yield.
Lake View Heights	It is difficult to make a left turn out of Lake View Heights due to the curve in the roadway and speeding. Many Lake View Residents use the church parking lot to make the left turn.
Niantic Community Church (170 Pennsylvania Ave)	Consider removal of this entry/exit point on main road to filter traffic to Lakeview (at stop sign) and increase distance from traffic turning at that intersection

Oswegatchie Hills Road Intersection	Consider use of Roundabout in this location to break-up the speeding that occurs from both directions.
Oswegatchie Hills Road Intersection	Install a pedestrian activated RRFB to improve safety at this crossing.
Sunoco (188 Pennsylvania Avenue)	Turning out of the Sunoco Lot is a blind turn. Increased visibility needed for oncoming traffic.
Sleepy Hollow Road	Install a pedestrian activated RRFB to provide a higher level of safety for residents and visitors to cross the street in this location.
East Pattagansett Road	Consider use of roundabout in this location.
East Pattagansett Road Intersection	A roundabout is unnecessary at the intersectino of East Pattagansett Road. Residents relay on the traffic signal to provide gaps allowing them to turn from driveways.
Roxbury Road Intersection	The traffic going north before the Roxbury Road light almost always stays in the left lane. This triggers the signal for the southbound light to turn red, even though the northbound traffic doesn’t want to turn left.
Roxbury Road Intersection	We need a left turn lane for northbound cars turning into Roxbury Road.
Society Road to Roxbury	Sidewalks are needed near Gorton Pond.
Society Road to Roxbury	Scare to ride a bike here. Need bike path to Society Road
Gorton Pond	Piles of tree limbs are blocking pedestrian access along Gorton Pond.
Gorton Pond	There is a lack of parking available for visitors to Gorton Pond.
Gorton Pond	Consider widening the proposed boardwalk near Gorton Pond to better accommodate bicyclists. A crosswalk at Oak Hill Drive would improve access to the boardwalk.
Oak Hill Drive Intersection	There needs to be a light at Roxbury Raod that halts traffic to allow left and right turns from Oak Hill Dirve.
Oak Hill Drive Intersection	It is difficult exiting from Oak Hill Drive due to the timing of the traffic signal at Roxbury Road and East Pattagansett Road.
Oak Hill Drive Intersection	It is difficult to exit from Oak Hill Drive due to timing patterns of the lights at Roxbury and East Pattagansett.
Society Road Intersection	Difficulty crossing by foot.
Society Road to Oak Hill Dr	Would love to have the sidewalk extended along the length of Flanders Road here.
Citgo (200 Flanders Road)	Turning out of CITGO is difficult due to traffic in both directions.
Stop & Shop (248 Flanders	Many drivers turn left despite road design.
Industrial Park Road/Chapman Woods	A pedestrian signal head and button are needed on the north side of the intersection.
Chapman Woods Road	Chapman Woods Road is privately owned and relocating the Cartier Optical access from Route 161 Road would require resident approval.

Chapman Woods Road Intersection	Residents of Chapman Woods Road may be reluctant to use the proposed bus shelter near the intersection due to Chapman Woods Road being on a steep hill. Sight lines for vehicles making right turns out of Chapman Woods Road should be taken into consideration if a bus shelter is added.
Boston Post Road Intersection	Drivers turning south onto Route 161 are the cause for much congenstion in this area.
East Lyme High School Intersection	Put a stop light in at the high school to assist with left turns and help backup trying to get into ELHS.
East Lyme High School	Area optimal for roundabout.

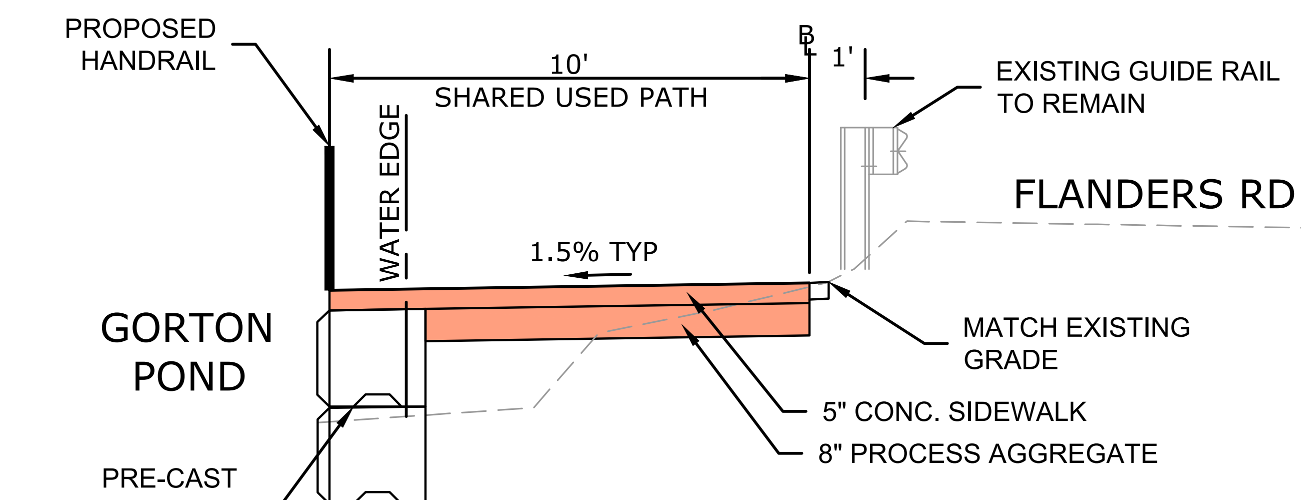
APPENDIX B
CONCEPT PLANS

BIKE LANES AND POCKET PARKING
ROUTE 161 - ROUTE 156 (MAIN STREET)
TO HOPE STREET
SCALE: 1"=50'

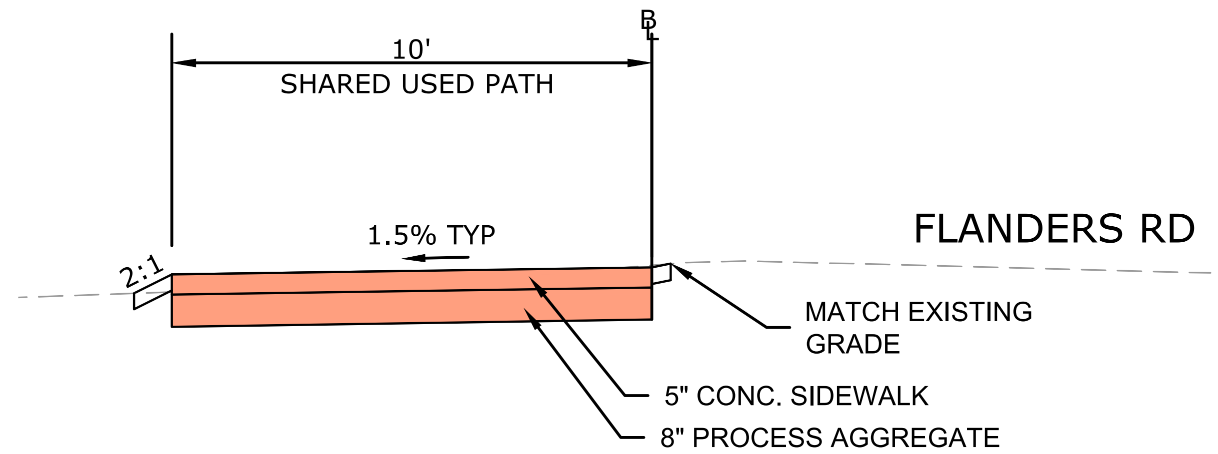


ROUNDABOUT
ROUTE 161 AT EAST PATTAGANSETT ROAD &
CHAPMAN FARMS RD
SCALE: 1"=40'

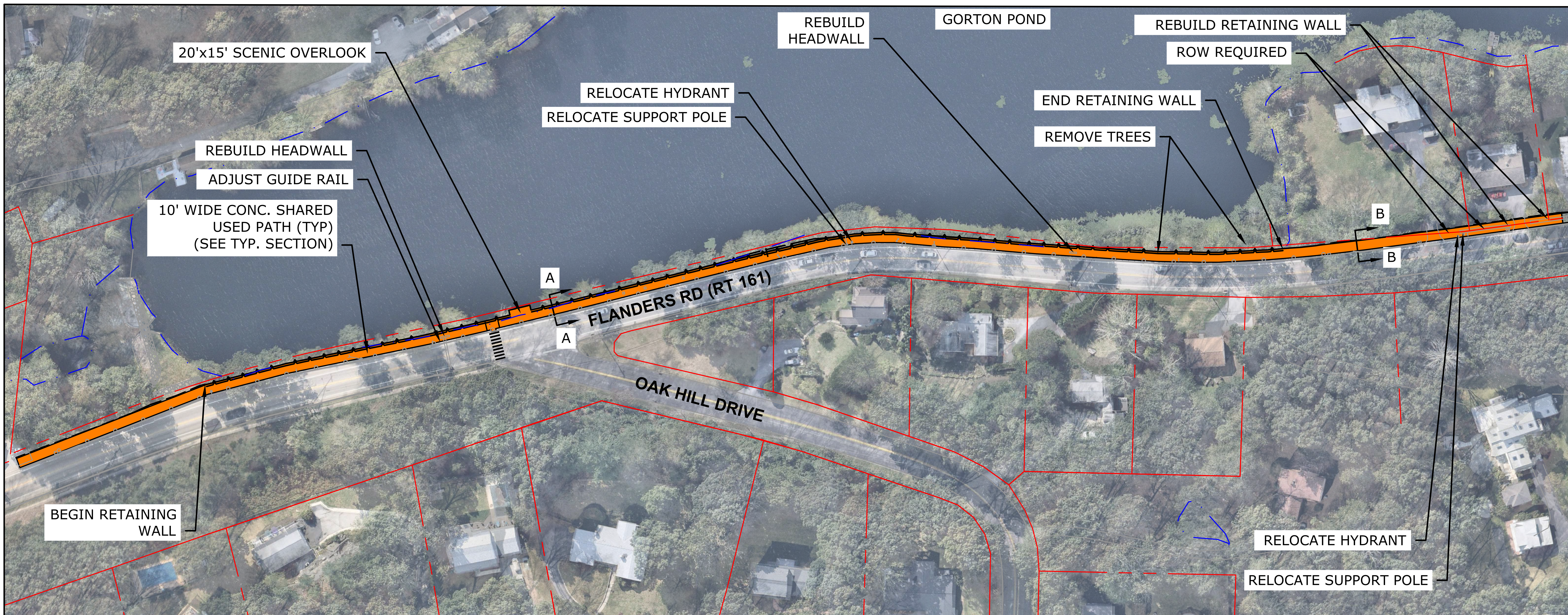
East Pattagansett Road Roundabout



TYPICAL SHARED USED PATH SECTION AA

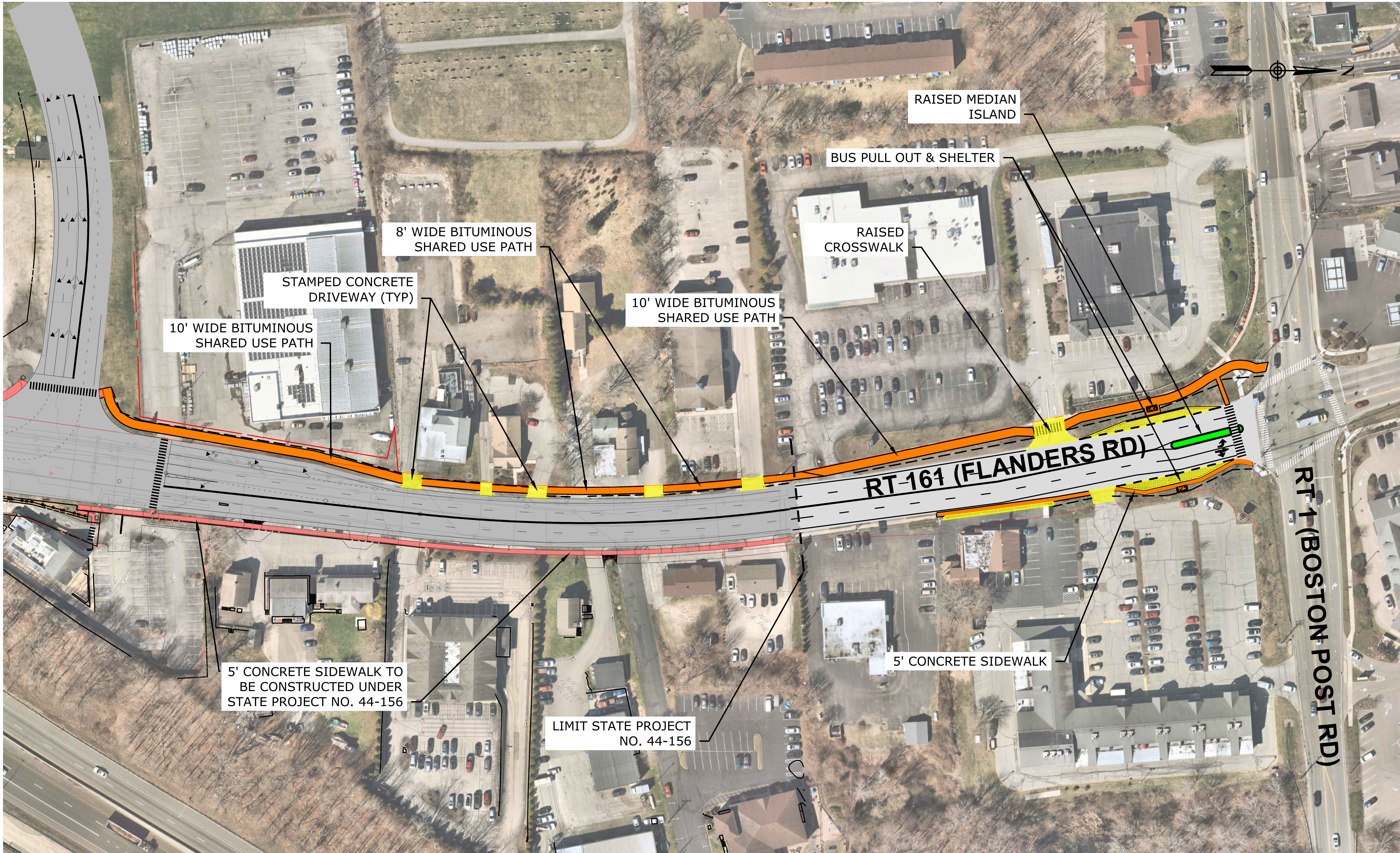


TYPICAL SHARED USED PATH SECTION BB



SHARED USE PATH AND RETAINING WALLS ROUTE 161 AT GORTON POND

SCALE: 1"=100'



SHARED USE PATH, BUS SHETLERS, AND PEDESTRIAN REFUGE ISLAND ROUTE 161 - FRONTAGE ROAD TO U.S. ROUTE 1 (BOSTON POST ROAD)

SCALE: 1"=100'

APPENDIX C
CAPACITY ANALYSIS REPORTS

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	170	280	410	230	220	190
Future Volume (vph)	170	280	410	230	220	190
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	12	11	11	13	13
Total Lost time (s)	4.0	5.8	5.8	5.8	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	0.93	0.96	
Flpb, ped/bikes	1.00	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	1.00	0.85	0.94	
Flt Protected	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (prot)	1724	1881	1818	1444	1728	
Flt Permitted	0.19	1.00	1.00	1.00	0.97	
Satd. Flow (perm)	347	1881	1818	1444	1728	
Peak-hour factor, PHF	0.92	0.92	0.80	0.80	0.91	0.91
Adj. Flow (vph)	185	304	512	288	242	209
RTOR Reduction (vph)	0	0	0	166	32	0
Lane Group Flow (vph)	185	304	513	122	419	0
Confl. Peds. (#/hr)	31			31	31	31
Heavy Vehicles (%)	1%	1%	1%	1%	0%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	
Protected Phases	1	2	2		4	
Permitted Phases	2			2		
Actuated Green, G (s)	32.4	27.2	27.2	27.2	21.7	
Effective Green, g (s)	32.4	27.2	27.2	27.2	21.7	
Actuated g/C Ratio	0.39	0.33	0.33	0.33	0.26	
Clearance Time (s)	4.0	5.8	5.8	5.8	4.0	
Vehicle Extension (s)	1.5	2.5	2.5	2.5	1.5	
Lane Grp Cap (vph)	223	620	599	476	454	
v/s Ratio Prot	c0.05	0.16	c0.28		c0.24	
v/s Ratio Perm	0.27			0.08		
v/c Ratio	0.83	0.49	0.86	0.26	0.92	
Uniform Delay, d1	20.8	22.1	25.8	20.3	29.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	20.9	0.4	11.4	0.2	23.9	
Delay (s)	41.7	22.6	37.3	20.5	53.4	
Level of Service	D	C	D	C	D	
Approach Delay (s)		29.8	31.2		53.4	
Approach LOS		C	C		D	

Intersection Summary			
HCM 2000 Control Delay	36.6	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	82.5	Sum of lost time (s)	17.8
Intersection Capacity Utilization	67.6%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	185	304	513	288	451
v/c Ratio	0.80	0.48	0.84	0.45	0.92
Control Delay	46.7	26.8	41.9	7.8	55.8
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	46.7	26.8	41.9	7.8	55.8
Queue Length 50th (ft)	68	146	287	17	~270
Queue Length 95th (ft)	#175	227	#389	54	#460
Internal Link Dist (ft)		576	456		584
Turn Bay Length (ft)	170			170	
Base Capacity (vph)	232	675	653	675	492
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.80	0.45	0.79	0.43	0.92

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	60	60	50	370	370	80
Future Volume (Veh/h)	60	60	50	370	370	80
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.87	0.87	0.84	0.84	0.91	0.91
Hourly flow rate (vph)	69	69	60	440	407	88
Pedestrians	19			19	19	
Lane Width (ft)	14.0			16.0	16.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	2			2	2	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				664		
pX, platoon unblocked						
vC, conflicting volume	1049	489	514			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1049	489	514			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	70	88	94			
cM capacity (veh/h)	229	557	1034			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	138	500	495
Volume Left	69	60	0
Volume Right	69	0	88
cSH	324	1034	1700
Volume to Capacity	0.43	0.06	0.29
Queue Length 95th (ft)	51	5	0
Control Delay (s)	24.1	1.6	0.0
Lane LOS	C	A	
Approach Delay (s)	24.1	1.6	0.0
Approach LOS	C		

Intersection Summary			
Average Delay	3.7		
Intersection Capacity Utilization	67.4%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		✣			✣			✣			✣	
Traffic Volume (veh/h)	20	0	10	10	0	10	0	410	10	10	450	10
Future Volume (Veh/h)	20	0	10	10	0	10	0	410	10	10	450	10
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.78	0.78	0.78	0.75	0.75	0.75	0.91	0.91	0.91	0.88	0.88	0.88
Hourly flow rate (vph)	26	0	13	13	0	13	0	451	11	11	511	11
Pedestrians		19			19			19			19	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		2			2			2			2	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1046	1038	554	1046	1038	494	541			481		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1046	1038	554	1046	1038	494	541			481		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	86	100	97	93	100	98	100			99		
cM capacity (veh/h)	189	222	516	187	220	554	1014			1067		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	39	26	462	533
Volume Left	26	13	0	11
Volume Right	13	13	11	11
cSH	240	280	1014	1067
Volume to Capacity	0.16	0.09	0.00	0.01
Queue Length 95th (ft)	14	8	0	1
Control Delay (s)	22.9	19.2	0.0	0.3
Lane LOS	C	C		A
Approach Delay (s)	22.9	19.2	0.0	0.3
Approach LOS	C	C		

Intersection Summary			
Average Delay	1.5		
Intersection Capacity Utilization	47.1%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	60	440	450	50	40	70
Future Volume (Veh/h)	60	440	450	50	40	70
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.86	0.86	0.90	0.90	0.83	0.83
Hourly flow rate (vph)	70	512	500	56	48	84
Pedestrians		6	6		6	
Lane Width (ft)		11.0	11.0		11.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		1	1		1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	562				1192	540
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	562				1192	540
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	93				75	84
cM capacity (veh/h)	1009				192	540

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	582	556	132
Volume Left	70	0	48
Volume Right	0	56	84
cSH	1009	1700	326
Volume to Capacity	0.07	0.33	0.41
Queue Length 95th (ft)	6	0	47
Control Delay (s)	1.8	0.0	23.4
Lane LOS	A		C
Approach Delay (s)	1.8	0.0	23.4
Approach LOS			C

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	71.3%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
25: Route 161 & Sleepy Hollow Rd

06/01/2023

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	470	480	20	20	10
Future Volume (Veh/h)	20	470	480	20	20	10
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.69	0.69
Hourly flow rate (vph)	22	516	527	22	29	14
Pedestrians		4	4		4	
Lane Width (ft)		11.0	11.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		853				
pX, platoon unblocked					0.79	
vC, conflicting volume	553				1106	546
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	553				1003	546
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				86	97
cM capacity (veh/h)	1018				205	530

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	538	549	43
Volume Left	22	0	29
Volume Right	0	22	14
cSH	1018	1700	256
Volume to Capacity	0.02	0.32	0.17
Queue Length 95th (ft)	2	0	15
Control Delay (s)	0.6	0.0	21.9
Lane LOS	A		C
Approach Delay (s)	0.6	0.0	21.9
Approach LOS			C

Intersection Summary			
Average Delay	1.1		
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	450	350	20	470	10	290	10	30	10	10	10
Future Volume (vph)	10	450	350	20	470	10	290	10	30	10	10	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	13	13	13	12	12	12	12	12	12	16	16	16
Grade (%)		0%			0%			2%			-4%	
Total Lost time (s)		6.1	6.1		6.1			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00			1.00	1.00		1.00	
Frpb, ped/bikes		1.00	0.98		1.00			1.00	0.97		0.99	
Flpb, ped/bikes		1.00	1.00		1.00			0.99	1.00		1.00	
Frt		1.00	0.85		1.00			1.00	0.85		0.95	
Flt Protected		1.00	1.00		1.00			0.95	1.00		0.98	
Satd. Flow (prot)		1942	1614		1871			1763	1538		2041	
Flt Permitted		0.99	1.00		0.97			0.70	1.00		0.89	
Satd. Flow (perm)		1917	1614		1820			1302	1538		1854	
Peak-hour factor, PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.92	0.92	0.92	0.75	0.75	0.75
Adj. Flow (vph)	11	500	389	21	495	11	315	11	33	13	13	13
RTOR Reduction (vph)	0	0	101	0	1	0	0	0	20	0	8	0
Lane Group Flow (vph)	0	511	288	0	526	0	0	326	13	0	31	0
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		2			2			5 6			5 6	
Permitted Phases	2		2	2			5 6		5 6	5 6		
Actuated Green, G (s)		27.9	27.9		27.9			24.7	24.7		24.7	
Effective Green, g (s)		27.9	27.9		27.9			24.7	24.7		24.7	
Actuated g/C Ratio		0.44	0.44		0.44			0.39	0.39		0.39	
Clearance Time (s)		6.1	6.1		6.1							
Vehicle Extension (s)		3.0	3.0		3.0							
Lane Grp Cap (vph)		853	718		809			512	605		730	
v/s Ratio Prot												
v/s Ratio Perm		0.27	0.18		c0.29			c0.25	0.01		0.02	
v/c Ratio		0.60	0.40		0.65			0.64	0.02		0.04	
Uniform Delay, d1		13.2	11.8		13.6			15.4	11.6		11.7	
Progression Factor		1.00	1.00		1.00			1.00	1.00		1.00	
Incremental Delay, d2		1.1	0.4		1.9			1.9	0.0		0.0	
Delay (s)		14.3	12.1		15.5			17.3	11.6		11.7	
Level of Service		B	B		B			B	B		B	
Approach Delay (s)		13.4			15.5			16.8			11.7	
Approach LOS		B			B			B			B	

Intersection Summary			
HCM 2000 Control Delay	14.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	62.7	Sum of lost time (s)	14.1
Intersection Capacity Utilization	73.3%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	SET	SER	NWT	NET	NER	SWT
Lane Group Flow (vph)	511	389	527	326	33	39
v/c Ratio	0.60	0.48	0.65	0.64	0.05	0.05
Control Delay	17.7	9.0	19.1	23.1	4.6	10.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	17.7	9.0	19.1	23.1	4.6	10.2
Queue Length 50th (ft)	126	43	133	88	0	5
Queue Length 95th (ft)	286	135	306	219	14	21
Internal Link Dist (ft)	476		773	540		361
Turn Bay Length (ft)		50			50	
Base Capacity (vph)	1219	1093	1158	723	872	1038
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.42	0.36	0.46	0.45	0.04	0.04

Intersection Summary

Intersection	
Intersection Delay, s/veh	18.9
Intersection LOS	C

Approach	SE	NW	NE	SW
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	900	527	359	39
Demand Flow Rate, veh/h	909	532	362	39
Vehicles Circulating, veh/h	47	340	529	839
Vehicles Exiting, veh/h	831	551	427	33
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	3	3	3	3
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	22.6	16.2	14.5	8.4
Approach LOS	C	C	B	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	909	532	362	39
Cap Entry Lane, veh/h	1078	804	666	488
Entry HV Adj Factor	0.990	0.991	0.991	1.000
Flow Entry, veh/h	900	527	359	39
Cap Entry, veh/h	1067	796	660	488
V/C Ratio	0.844	0.662	0.544	0.080
Control Delay, s/veh	22.6	16.2	14.5	8.4
LOS	C	C	B	A
95th %tile Queue, veh	11	5	3	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	30	50	60	740	790	60
Future Volume (vph)	30	50	60	740	790	60
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	12	12
Grade (%)	2%			0%	0%	
Total Lost time (s)	4.0		4.0	6.1	6.1	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.98		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.92		1.00	1.00	0.99	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1572		1728	1818	1860	
Flt Permitted	0.98		0.09	1.00	1.00	
Satd. Flow (perm)	1572		172	1818	1860	
Peak-hour factor, PHF	0.79	0.79	0.92	0.92	0.93	0.93
Adj. Flow (vph)	38	63	65	804	849	65
RTOR Reduction (vph)	58	0	0	0	3	0
Lane Group Flow (vph)	43	0	65	804	911	0
Confl. Peds. (#/hr)	3	3	3			3
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%
Turn Type	Prot		D.P+P	NA	NA	
Protected Phases	5		6	2 6	2	
Permitted Phases			2			
Actuated Green, G (s)	6.0		57.6	61.6	42.3	
Effective Green, g (s)	6.0		57.6	57.6	42.3	
Actuated g/C Ratio	0.08		0.74	0.74	0.54	
Clearance Time (s)	4.0		4.0		6.1	
Vehicle Extension (s)	1.5		1.5		3.0	
Lane Grp Cap (vph)	121		433	1347	1012	
v/s Ratio Prot	c0.03		0.03	c0.44	c0.49	
v/s Ratio Perm			0.08			
v/c Ratio	0.35		0.15	0.60	0.90	
Uniform Delay, d1	34.0		9.4	4.7	15.8	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	0.7		0.1	0.7	10.9	
Delay (s)	34.7		9.4	5.4	26.7	
Level of Service	C		A	A	C	
Approach Delay (s)	34.7			5.7	26.7	
Approach LOS	C			A	C	

Intersection Summary			
HCM 2000 Control Delay	17.4	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	77.7	Sum of lost time (s)	14.1
Intersection Capacity Utilization	63.7%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	101	65	804	914
v/c Ratio	0.49	0.15	0.54	0.89
Control Delay	24.3	2.8	5.1	32.1
Queue Delay	0.0	0.0	0.5	0.0
Total Delay	24.3	2.8	5.5	32.1
Queue Length 50th (ft)	17	4	101	382
Queue Length 95th (ft)	51	13	232	#765
Internal Link Dist (ft)	1120		476	697
Turn Bay Length (ft)		150		
Base Capacity (vph)	279	545	1473	1025
Starvation Cap Reductn	0	0	274	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.12	0.67	0.89

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	130	100	100	640	740	140
Future Volume (vph)	130	100	100	640	740	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	14	14
Grade (%)	0%			0%	3%	
Total Lost time (s)	4.0		4.0	4.0	5.6	5.6
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frpb, ped/bikes	0.99		1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.94		1.00	1.00	1.00	0.85
Flt Protected	0.97		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1628		1727	1818	1977	1642
Flt Permitted	0.97		0.14	1.00	1.00	1.00
Satd. Flow (perm)	1628		253	1818	1977	1642
Peak-hour factor, PHF	0.76	0.76	0.86	0.86	0.91	0.91
Adj. Flow (vph)	171	132	116	744	813	154
RTOR Reduction (vph)	33	0	0	0	0	46
Lane Group Flow (vph)	270	0	116	744	813	108
Confl. Peds. (#/hr)	3	3	3			3
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	4		1	1 2	2	
Permitted Phases			1 2			2
Actuated Green, G (s)	16.2		54.4	58.4	44.4	44.4
Effective Green, g (s)	16.2		54.4	58.4	44.4	44.4
Actuated g/C Ratio	0.19		0.65	0.69	0.53	0.53
Clearance Time (s)	4.0		4.0		5.6	5.6
Vehicle Extension (s)	3.0		1.5		2.5	2.5
Lane Grp Cap (vph)	313		338	1260	1042	865
v/s Ratio Prot	c0.17		0.04	c0.41	c0.41	
v/s Ratio Perm			0.18			0.07
v/c Ratio	0.86		0.34	0.59	0.78	0.13
Uniform Delay, d1	32.9		11.0	6.7	16.0	10.1
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	20.9		0.2	0.5	3.7	0.0
Delay (s)	53.8		11.2	7.2	19.7	10.1
Level of Service	D		B	A	B	B
Approach Delay (s)	53.8			7.7	18.2	
Approach LOS	D			A	B	

Intersection Summary			
HCM 2000 Control Delay	19.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	84.2	Sum of lost time (s)	13.6
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	303	116	744	813	154
v/c Ratio	0.88	0.34	0.57	0.78	0.17
Control Delay	55.3	6.9	8.2	22.9	4.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	55.3	6.9	8.2	22.9	4.9
Queue Length 50th (ft)	137	16	167	332	14
Queue Length 95th (ft)	#198	30	231	492	43
Internal Link Dist (ft)	1539		3382	952	
Turn Bay Length (ft)		105			120
Base Capacity (vph)	361	343	1295	1042	911
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.84	0.34	0.57	0.78	0.17

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	30	790	20	50	890
Future Volume (Veh/h)	10	30	790	20	50	890
Sign Control	Stop		Free			Free
Grade	-3%		0%			0%
Peak Hour Factor	0.89	0.89	0.89	0.89	0.95	0.95
Hourly flow rate (vph)	11	34	888	22	53	937
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)			1032			
pX, platoon unblocked	0.75	0.75			0.75	
vC, conflicting volume	1942	899			910	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2089	699			714	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	73	90			92	
cM capacity (veh/h)	40	330			669	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	45	910	53	937
Volume Left	11	0	53	0
Volume Right	34	22	0	0
cSH	164	1700	669	1700
Volume to Capacity	0.27	0.54	0.08	0.55
Queue Length 95th (ft)	26	0	6	0
Control Delay (s)	43.7	0.0	10.8	0.0
Lane LOS	E		B	
Approach Delay (s)	43.7	0.0	0.6	
Approach LOS	E			

Intersection Summary			
Average Delay	1.3		
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	240	10	120	10	10	50	90	750	20	50	900	140
Future Volume (vph)	240	10	120	10	10	50	90	750	20	50	900	140
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	13	14	14	14	11	12	13	11	11	11
Grade (%)		2%			-4%			0%			0%	
Total Lost time (s)	4.4	5.0			5.0		4.0	6.2		4.0	6.0	
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.86			0.90		1.00	1.00		1.00	0.98	
Flt Protected	0.95	1.00			0.99		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3285	1536			1854		1711	3526		1711	3352	
Flt Permitted	0.95	1.00			0.93		0.15	1.00		0.29	1.00	
Satd. Flow (perm)	3285	1536			1740		264	3526		514	3352	
Peak-hour factor, PHF	0.86	0.86	0.86	0.76	0.76	0.76	0.90	0.90	0.90	0.91	0.91	0.91
Adj. Flow (vph)	279	12	140	13	13	66	100	833	22	55	989	154
RTOR Reduction (vph)	0	123	0	0	58	0	0	2	0	0	11	0
Lane Group Flow (vph)	279	29	0	0	34	0	100	853	0	55	1132	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Prot	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	4	8			8		1	6		5	2	
Permitted Phases		8		8			6			2		
Actuated Green, G (s)	5.6	9.3			9.3		42.0	37.1		39.2	35.8	
Effective Green, g (s)	5.6	9.3			9.3		42.0	37.1		39.2	35.8	
Actuated g/C Ratio	0.07	0.12			0.12		0.56	0.49		0.52	0.48	
Clearance Time (s)	4.4	5.0			5.0		4.0	6.2		4.0	6.0	
Vehicle Extension (s)	2.5	1.5			1.5		1.5	2.5		1.5	2.5	
Lane Grp Cap (vph)	245	190			215		242	1744		322	1600	
v/s Ratio Prot	c0.08	0.02					c0.03	0.24		0.01	c0.34	
v/s Ratio Perm					c0.02		0.20			0.08		
v/c Ratio	1.14	0.15			0.16		0.41	0.49		0.17	0.71	
Uniform Delay, d1	34.7	29.3			29.4		9.7	12.6		9.0	15.5	
Progression Factor	1.00	1.00			1.00		1.00	1.00		0.42	0.30	
Incremental Delay, d2	100.1	0.1			0.1		0.4	1.0		0.1	2.2	
Delay (s)	134.8	29.5			29.5		10.1	13.6		3.9	6.8	
Level of Service	F	C			C		B	B		A	A	
Approach Delay (s)		97.6			29.5			13.3			6.7	
Approach LOS		F			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	24.5	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	19.6
Intersection Capacity Utilization	60.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	279	152	92	100	855	55	1143
v/c Ratio	1.14	0.49	0.34	0.37	0.47	0.15	0.70
Control Delay	135.3	12.9	16.1	9.8	13.6	3.2	6.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	135.3	12.9	16.1	9.8	13.6	3.2	6.9
Queue Length 50th (ft)	~79	5	11	16	136	2	41
Queue Length 95th (ft)	#142	49	37	36	201	m7	82
Internal Link Dist (ft)		619	594		240		743
Turn Bay Length (ft)	150			200		100	
Base Capacity (vph)	245	605	624	273	1821	378	1644
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	1.14	0.25	0.15	0.37	0.47	0.15	0.70

Intersection Summary

~ Volume exceeds capacity, queue is theoretically infinite.
Queue shown is maximum after two cycles.
95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
m Volume for 95th percentile queue is metered by upstream signal.

HCM Signalized Intersection Capacity Analysis
40: Route 161 & I-95 NB Exit Ramp/Burger King Driveway

06/01/2023

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	280	20	90	30	0	60	0	1080	20	50	1100	0
Future Volume (vph)	280	20	90	30	0	60	0	1080	20	50	1100	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		4.0		4.0		7.0		4.5	7.0	
Lane Util. Factor	0.97	1.00		1.00		1.00		0.95		1.00	0.95	
Frt	1.00	0.88		1.00		0.85		1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95		1.00		1.00		0.95	1.00	
Satd. Flow (prot)	3433	1635		1770		1583		3529		1770	3539	
Flt Permitted	0.95	1.00		0.95		1.00		1.00		0.11	1.00	
Satd. Flow (perm)	3433	1635		1770		1583		3529		200	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	304	22	98	33	0	65	0	1174	22	54	1196	0
RTOR Reduction (vph)	0	82	0	0	0	60	0	2	0	0	0	0
Lane Group Flow (vph)	304	38	0	33	0	5	0	1194	0	54	1196	0
Turn Type	Split	NA		Prot		Perm		NA		pm+pt	NA	
Protected Phases	4	4		8				6		5	2	
Permitted Phases						8				2		
Actuated Green, G (s)	12.0	12.0		5.7		5.7		32.7		40.9	40.9	
Effective Green, g (s)	12.0	12.0		5.7		5.7		32.7		40.9	40.9	
Actuated g/C Ratio	0.16	0.16		0.08		0.08		0.44		0.55	0.55	
Clearance Time (s)	5.4	5.4		4.0		4.0		7.0		4.5	7.0	
Vehicle Extension (s)	3.0	3.0		3.0		3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	549	261		134		120		1538		186	1929	
v/s Ratio Prot	c0.09	0.02		c0.02				c0.34		0.01	c0.34	
v/s Ratio Perm						0.00				0.14		
v/c Ratio	0.55	0.14		0.25		0.04		0.78		0.29	0.62	
Uniform Delay, d1	29.0	27.1		32.6		32.1		18.0		11.1	11.7	
Progression Factor	1.00	1.00		1.00		1.00		0.76		0.72	0.41	
Incremental Delay, d2	1.2	0.3		1.0		0.1		2.0		0.8	1.3	
Delay (s)	30.2	27.3		33.6		32.3		15.8		8.8	6.1	
Level of Service	C	C		C		C		B		A	A	
Approach Delay (s)		29.4			32.7			15.8			6.2	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	14.3	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	20.9
Intersection Capacity Utilization	63.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	304	120	33	65	1196	54	1196
v/c Ratio	0.55	0.35	0.20	0.20	0.72	0.22	0.61
Control Delay	32.7	11.6	34.1	1.4	18.9	8.1	6.5
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.7	11.6	34.1	1.4	18.9	8.1	6.5
Queue Length 50th (ft)	68	9	15	0	150	5	64
Queue Length 95th (ft)	100	50	39	0	m#364	m13	108
Internal Link Dist (ft)		426			743		431
Turn Bay Length (ft)	250					240	
Base Capacity (vph)	823	466	162	328	1659	244	1966
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.37	0.26	0.20	0.20	0.72	0.22	0.61

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	30	0	20	90	0	50	0	1360	60	60	1190	10
Future Volume (vph)	30	0	20	90	0	50	0	1360	60	60	1190	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	12	12	12	12	8	11	11	11
Total Lost time (s)		4.2			4.2	4.0		6.6		4.0	6.1	
Lane Util. Factor		1.00			1.00	1.00		0.91		1.00	0.95	
Frpb, ped/bikes		0.99			1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes		1.00			0.99	1.00		1.00		1.00	1.00	
Frt		0.95			1.00	0.85		0.99		1.00	1.00	
Flt Protected		0.97			0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)		1677			1743	1549		5048		1711	3416	
Flt Permitted		0.81			0.80	1.00		1.00		0.12	1.00	
Satd. Flow (perm)		1406			1477	1549		5048		213	3416	
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.96	0.96	0.96	0.98	0.98	0.98
Adj. Flow (vph)	33	0	22	99	0	55	0	1417	62	61	1214	10
RTOR Reduction (vph)	0	44	0	0	0	38	0	0	0	0	0	0
Lane Group Flow (vph)	0	11	0	0	99	17	0	1480	0	61	1224	0
Confl. Peds. (#/hr)	4		4	4		4	4		4	4		4
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type	Perm	NA		Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4	4		8		8	2			6		
Actuated Green, G (s)		15.0			15.0	20.6		39.6		49.7	49.7	
Effective Green, g (s)		15.0			15.0	20.6		39.6		49.7	49.7	
Actuated g/C Ratio		0.20			0.20	0.27		0.53		0.66	0.66	
Clearance Time (s)		4.2			4.2	4.0		6.6		4.0	6.1	
Vehicle Extension (s)		1.5			1.5	2.5		2.5		2.5	2.5	
Lane Grp Cap (vph)		281			295	425		2665		252	2263	
v/s Ratio Prot						0.00		0.29		0.02	c0.36	
v/s Ratio Perm		0.01			c0.07	0.01				0.14		
v/c Ratio		0.04			0.34	0.04		0.56		0.24	0.54	
Uniform Delay, d1		24.2			25.7	20.0		11.8		5.8	6.7	
Progression Factor		1.00			1.00	1.00		0.51		0.76	0.65	
Incremental Delay, d2		0.0			0.2	0.0		0.7		0.3	0.2	
Delay (s)		24.2			26.0	20.0		6.7		4.7	4.5	
Level of Service		C			C	B		A		A	A	
Approach Delay (s)		24.2			23.8			6.7			4.5	
Approach LOS		C			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	7.0	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.53		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.8
Intersection Capacity Utilization	61.8%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBT	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	55	99	55	1480	61	1224
v/c Ratio	0.15	0.34	0.11	0.54	0.21	0.54
Control Delay	1.7	29.5	6.4	6.8	4.4	5.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	1.7	29.5	6.4	6.8	4.4	5.3
Queue Length 50th (ft)	0	40	1	67	4	187
Queue Length 95th (ft)	6	82	23	72	m8	66
Internal Link Dist (ft)	104	603		431		69
Turn Bay Length (ft)			110			
Base Capacity (vph)	418	350	495	2720	286	2264
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.13	0.28	0.11	0.54	0.21	0.54

Intersection Summary

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	0	630	0	0	0	220	670	0	0	630	230
Future Volume (vph)	150	0	630	0	0	0	220	670	0	0	630	230
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	12	12	12	12	12	12	12	12	12
Total Lost time (s)	5.9		5.9				4.0	5.5			7.0	5.9
Lane Util. Factor	1.00		0.88				0.97	0.95			0.95	1.00
Frpb, ped/bikes	1.00		1.00				1.00	1.00			1.00	0.99
Flpb, ped/bikes	1.00		1.00				1.00	1.00			1.00	1.00
Frt	1.00		0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1728		2814				3433	3539			3539	1568
Flt Permitted	0.95		1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1728		2814				3433	3539			3539	1568
Peak-hour factor, PHF	0.95	0.92	0.95	0.92	0.92	0.92	0.96	0.96	0.92	0.92	0.93	0.93
Adj. Flow (vph)	158	0	663	0	0	0	229	698	0	0	677	247
RTOR Reduction (vph)	0	0	350	0	0	0	0	0	0	0	0	91
Lane Group Flow (vph)	158	0	313	0	0	0	229	698	0	0	677	156
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Heavy Vehicles (%)	1%	2%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		pt+ov			Prot	Prot	NA		pm+pt	NA	pm+ov
Protected Phases	8		8 1	4	4	4	1	6		5	2	8
Permitted Phases										2		2
Actuated Green, G (s)	13.7		30.3				10.7	49.9			33.7	47.4
Effective Green, g (s)	13.7		30.3				10.7	49.9			33.7	47.4
Actuated g/C Ratio	0.18		0.40				0.14	0.67			0.45	0.63
Clearance Time (s)	5.9						4.0	5.5			7.0	5.9
Vehicle Extension (s)	2.5						2.5	2.5			2.5	2.5
Lane Grp Cap (vph)	315		1136				489	2354			1590	990
v/s Ratio Prot	c0.09		0.11				c0.07	0.20			c0.19	0.03
v/s Ratio Perm												0.07
v/c Ratio	0.50		0.28				0.47	0.30			0.43	0.16
Uniform Delay, d1	27.6		15.0				29.5	5.2			14.1	5.6
Progression Factor	1.00		1.00				0.72	1.07			1.00	1.00
Incremental Delay, d2	0.9		0.1				0.5	0.0			0.8	0.1
Delay (s)	28.5		15.1				21.7	5.6			14.9	5.7
Level of Service	C		B				C	A			B	A
Approach Delay (s)		17.7			0.0			9.6			12.4	
Approach LOS		B			A			A			B	

Intersection Summary			
HCM 2000 Control Delay	13.1	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	51.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	158	663	229	698	677	247
v/c Ratio	0.50	0.46	0.47	0.30	0.43	0.22
Control Delay	32.3	3.1	23.6	6.5	16.7	1.2
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.3	3.1	23.6	6.5	16.7	1.2
Queue Length 50th (ft)	67	12	38	47	108	0
Queue Length 95th (ft)	110	36	51	161	192	19
Internal Link Dist (ft)				824	1287	
Turn Bay Length (ft)						160
Base Capacity (vph)	355	1389	508	2355	1590	1132
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.45	0.48	0.45	0.30	0.43	0.22

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	260	200	280	430	220	220	460	150	200	370	120
Future Volume (vph)	110	260	200	280	430	220	220	460	150	200	370	120
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	11	11	11	11	11	11	11	12	12
Total Lost time (s)	4.0	5.5		4.0	5.0	5.0	4.0	5.5		4.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00		1.00	0.99	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.93		1.00	1.00	0.85	1.00	0.96		1.00	0.96	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1694	3147		1710	1801	1495	1710	1728		1694	3357	
Flt Permitted	0.21	1.00		0.24	1.00	1.00	0.38	1.00		0.10	1.00	
Satd. Flow (perm)	373	3147		431	1801	1495	676	1728		174	3357	
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.94	0.94	0.94	0.97	0.97	0.97
Adj. Flow (vph)	117	277	213	315	483	247	234	489	160	206	381	124
RTOR Reduction (vph)	0	127	0	0	0	112	0	11	0	0	28	0
Lane Group Flow (vph)	117	363	0	315	483	135	234	638	0	206	477	0
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	2%	2%	2%	3%	3%	3%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases	6			2		2	8			4		
Actuated Green, G (s)	27.5	22.2		42.5	33.2	33.2	54.2	41.8		52.3	41.1	
Effective Green, g (s)	27.5	22.2		42.5	33.2	33.2	54.2	41.8		52.3	41.1	
Actuated g/C Ratio	0.25	0.20		0.39	0.30	0.30	0.49	0.38		0.48	0.37	
Clearance Time (s)	4.0	5.5		4.0	5.0	5.0	4.0	5.5		4.0	5.0	
Vehicle Extension (s)	2.0	2.5		2.0	2.5	2.5	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	156	635		350	543	451	449	656		237	1254	
v/s Ratio Prot	0.04	0.12		c0.13	0.27		0.06	c0.37		c0.09	0.14	
v/s Ratio Perm	0.15			c0.22		0.09	0.20			0.32		
v/c Ratio	0.75	0.57		0.90	0.89	0.30	0.52	0.97		0.87	0.38	
Uniform Delay, d1	35.6	39.6		26.6	36.6	29.5	16.8	33.6		27.3	25.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	16.3	3.7		24.6	19.2	1.7	0.5	28.2		26.1	0.1	
Delay (s)	51.9	43.3		51.2	55.9	31.2	17.3	61.8		53.5	25.2	
Level of Service	D	D		D	E	C	B	E		D	C	
Approach Delay (s)		45.0			48.6			50.0			33.4	
Approach LOS		D			D			D			C	

Intersection Summary			
HCM 2000 Control Delay	45.0	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.96		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	89.5%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	117	490	315	483	247	234	649	206	505
v/c Ratio	0.72	0.64	0.89	0.89	0.44	0.51	0.97	0.87	0.40
Control Delay	52.0	31.1	53.9	56.5	13.6	18.5	62.5	60.0	24.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	52.0	31.1	53.9	56.5	13.6	18.5	62.5	60.0	24.6
Queue Length 50th (ft)	52	112	161	321	45	87	431	97	125
Queue Length 95th (ft)	#124	170	#283	#494	113	135	#674	#249	177
Internal Link Dist (ft)		985		299			1287		769
Turn Bay Length (ft)	90		310		140	190		260	
Base Capacity (vph)	162	782	356	556	572	495	678	237	1278
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.72	0.63	0.88	0.87	0.43	0.47	0.96	0.87	0.40

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	30	60	50	700	540	20
Future Volume (Veh/h)	30	60	50	700	540	20
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.96	0.96	0.90	0.90
Hourly flow rate (vph)	36	72	52	729	600	22
Pedestrians	5			5	5	
Lane Width (ft)	13.0			12.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	1			0	0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				849		
pX, platoon unblocked	0.72					
vC, conflicting volume	1454	621	627			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1436	621	627			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	63	85	95			
cM capacity (veh/h)	98	477	950			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1
Volume Total	36	72	52	729	622
Volume Left	36	0	52	0	0
Volume Right	0	72	0	0	22
cSH	98	477	950	1700	1700
Volume to Capacity	0.37	0.15	0.05	0.43	0.37
Queue Length 95th (ft)	37	13	4	0	0
Control Delay (s)	61.8	13.9	9.0	0.0	0.0
Lane LOS	F	B	A		
Approach Delay (s)	29.9		0.6		0.0
Approach LOS	D				

Intersection Summary			
Average Delay	2.4		
Intersection Capacity Utilization	48.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (vph)	200	290	300	180	250	200
Future Volume (vph)	200	290	300	180	250	200
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	12	11	11	13	13
Total Lost time (s)	4.0	5.8	5.8	5.8	4.0	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	
Frpb, ped/bikes	1.00	1.00	1.00	0.92	0.97	
Flpb, ped/bikes	0.99	1.00	1.00	1.00	1.00	
Frt	1.00	1.00	1.00	0.85	0.94	
Flt Protected	0.95	1.00	1.00	1.00	0.97	
Satd. Flow (prot)	1718	1881	1818	1426	1741	
Flt Permitted	0.29	1.00	1.00	1.00	0.97	
Satd. Flow (perm)	522	1881	1818	1426	1741	
Peak-hour factor, PHF	0.92	0.92	0.80	0.80	0.91	0.91
Adj. Flow (vph)	217	315	375	225	275	220
RTOR Reduction (vph)	0	0	0	166	30	0
Lane Group Flow (vph)	217	315	375	59	465	0
Confl. Peds. (#/hr)	31			31	31	31
Heavy Vehicles (%)	1%	1%	1%	1%	0%	0%
Turn Type	pm+pt	NA	NA	Perm	Prot	
Protected Phases	1	2	2		4	
Permitted Phases	2			2		
Actuated Green, G (s)	27.6	21.3	21.3	21.3	25.1	
Effective Green, g (s)	27.6	21.3	21.3	21.3	25.1	
Actuated g/C Ratio	0.34	0.26	0.26	0.26	0.31	
Clearance Time (s)	4.0	5.8	5.8	5.8	4.0	
Vehicle Extension (s)	1.5	2.5	2.5	2.5	1.5	
Lane Grp Cap (vph)	271	495	478	375	540	
v/s Ratio Prot	c0.06	0.17	0.21		c0.27	
v/s Ratio Perm	c0.21			0.04		
v/c Ratio	0.80	0.64	0.78	0.16	0.86	
Uniform Delay, d1	22.5	26.4	27.7	22.9	26.3	
Progression Factor	1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	14.7	2.3	8.0	0.1	12.9	
Delay (s)	37.2	28.7	35.6	23.1	39.1	
Level of Service	D	C	D	C	D	
Approach Delay (s)		32.2	30.9		39.1	
Approach LOS		C	C		D	

Intersection Summary			
HCM 2000 Control Delay	33.8	HCM 2000 Level of Service	C
HCM 2000 Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	80.9	Sum of lost time (s)	17.8
Intersection Capacity Utilization	65.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	WBR	SBL
Lane Group Flow (vph)	217	315	375	225	495
v/c Ratio	0.76	0.62	0.77	0.41	0.86
Control Delay	41.3	34.5	41.7	6.7	43.7
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	41.3	34.5	41.7	6.7	43.7
Queue Length 50th (ft)	88	165	206	0	266
Queue Length 95th (ft)	#202	257	#268	36	#474
Internal Link Dist (ft)		576	456		584
Turn Bay Length (ft)	170			170	
Base Capacity (vph)	285	572	553	589	597
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.76	0.55	0.68	0.38	0.83

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	60	80	60	340	400	90
Future Volume (Veh/h)	60	80	60	340	400	90
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.87	0.87	0.84	0.84	0.91	0.91
Hourly flow rate (vph)	69	92	71	405	440	99
Pedestrians	19			19	19	
Lane Width (ft)	14.0			16.0	16.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	2			2	2	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				664		
pX, platoon unblocked						
vC, conflicting volume	1074	528	558			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1074	528	558			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	68	83	93			
cM capacity (veh/h)	218	530	996			

Direction, Lane #	EB 1	NB 1	SB 1
Volume Total	161	476	539
Volume Left	69	71	0
Volume Right	92	0	99
cSH	328	996	1700
Volume to Capacity	0.49	0.07	0.32
Queue Length 95th (ft)	64	6	0
Control Delay (s)	26.1	2.0	0.0
Lane LOS	D	A	
Approach Delay (s)	26.1	2.0	0.0
Approach LOS	D		

Intersection Summary			
Average Delay	4.4		
Intersection Capacity Utilization	69.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (veh/h)	10	0	0	10	0	10	0	360	10	10	460	0
Future Volume (Veh/h)	10	0	0	10	0	10	0	360	10	10	460	0
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.78	0.78	0.78	0.75	0.75	0.75	0.91	0.91	0.91	0.88	0.88	0.88
Hourly flow rate (vph)	13	0	0	13	0	13	0	396	11	11	523	0
Pedestrians		19			19			19			19	
Lane Width (ft)		12.0			12.0			12.0			12.0	
Walking Speed (ft/s)		3.5			3.5			3.5			3.5	
Percent Blockage		2			2			2			2	
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	998	990	561	984	984	440	542			426		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	998	990	561	984	984	440	542			426		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	94	100	100	94	100	98	100			99		
cM capacity (veh/h)	205	237	512	212	237	595	1013			1118		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	13	26	407	534
Volume Left	13	13	0	11
Volume Right	0	13	11	0
cSH	205	312	1013	1118
Volume to Capacity	0.06	0.08	0.00	0.01
Queue Length 95th (ft)	5	7	0	1
Control Delay (s)	23.8	17.6	0.0	0.3
Lane LOS	C	C		A
Approach Delay (s)	23.8	17.6	0.0	0.3
Approach LOS	C	C		

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	46.9%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	70	480	440	40	40	60
Future Volume (Veh/h)	70	480	440	40	40	60
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.86	0.86	0.90	0.90	0.83	0.83
Hourly flow rate (vph)	81	558	489	44	48	72
Pedestrians		6	6		6	
Lane Width (ft)		11.0	11.0		11.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		1	1		1	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume	539				1243	523
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	539				1243	523
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	92				73	87
cM capacity (veh/h)	1029				177	552

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	639	533	120
Volume Left	81	0	48
Volume Right	0	44	72
cSH	1029	1700	299
Volume to Capacity	0.08	0.31	0.40
Queue Length 95th (ft)	6	0	46
Control Delay (s)	2.0	0.0	24.9
Lane LOS	A		C
Approach Delay (s)	2.0	0.0	24.9
Approach LOS			C

Intersection Summary			
Average Delay	3.3		
Intersection Capacity Utilization	72.3%	ICU Level of Service	C
Analysis Period (min)	15		

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Traffic Volume (veh/h)	20	540	470	20	10	20
Future Volume (Veh/h)	20	540	470	20	10	20
Sign Control		Free	Free		Stop	
Grade		0%	0%		0%	
Peak Hour Factor	0.91	0.91	0.91	0.91	0.69	0.69
Hourly flow rate (vph)	22	593	516	22	14	29
Pedestrians		4	4		4	
Lane Width (ft)		11.0	11.0		12.0	
Walking Speed (ft/s)		3.5	3.5		3.5	
Percent Blockage		0	0		0	
Right turn flare (veh)						
Median type		None	None			
Median storage veh)						
Upstream signal (ft)		853				
pX, platoon unblocked					0.77	
vC, conflicting volume	542				1172	535
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	542				1075	535
tC, single (s)	4.1				6.4	6.2
tC, 2 stage (s)						
tF (s)	2.2				3.5	3.3
p0 queue free %	98				92	95
cM capacity (veh/h)	1028				181	538

Direction, Lane #	EB 1	WB 1	SB 1
Volume Total	615	538	43
Volume Left	22	0	14
Volume Right	0	22	29
cSH	1028	1700	327
Volume to Capacity	0.02	0.32	0.13
Queue Length 95th (ft)	2	0	11
Control Delay (s)	0.6	0.0	17.7
Lane LOS	A		C
Approach Delay (s)	0.6	0.0	17.7
Approach LOS			C

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	55.9%	ICU Level of Service	B
Analysis Period (min)	15		

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Traffic Volume (vph)	10	520	280	20	480	10	260	0	30	10	10	10
Future Volume (vph)	10	520	280	20	480	10	260	0	30	10	10	10
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	13	13	13	12	12	12	12	12	12	16	16	16
Grade (%)		0%			0%			2%			-4%	
Total Lost time (s)		6.1	6.1		4.0			4.0	4.0		4.0	
Lane Util. Factor		1.00	1.00		1.00			1.00	1.00		1.00	
Frpb, ped/bikes		1.00	0.98		1.00			1.00	0.97		0.99	
Flpb, ped/bikes		1.00	1.00		1.00			0.99	1.00		1.00	
Frt		1.00	0.85		1.00			1.00	0.85		0.95	
Flt Protected		1.00	1.00		1.00			0.95	1.00		0.98	
Satd. Flow (prot)		1942	1615		1871			1757	1540		2042	
Flt Permitted		0.99	1.00		0.97			0.73	1.00		0.88	
Satd. Flow (perm)		1921	1615		1826			1354	1540		1835	
Peak-hour factor, PHF	0.90	0.90	0.90	0.95	0.95	0.95	0.92	0.92	0.92	0.75	0.75	0.75
Adj. Flow (vph)	11	578	311	21	505	11	283	0	33	13	13	13
RTOR Reduction (vph)	0	0	71	0	1	0	0	0	23	0	9	0
Lane Group Flow (vph)	0	589	240	0	536	0	0	283	10	0	30	0
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Heavy Vehicles (%)	1%	1%	1%	1%	1%	1%	1%	1%	1%	0%	0%	0%
Turn Type	Perm	NA	Perm	Perm	NA		Perm	NA	Perm	Perm	NA	
Protected Phases		2			6			4			8	
Permitted Phases	2		2	6			4		4	8		
Actuated Green, G (s)		26.5	26.5		28.6			15.0	15.0		15.0	
Effective Green, g (s)		26.5	26.5		28.6			15.0	15.0		15.0	
Actuated g/C Ratio		0.51	0.51		0.55			0.29	0.29		0.29	
Clearance Time (s)		6.1	6.1		4.0			4.0	4.0		4.0	
Vehicle Extension (s)		3.0	3.0		1.5			1.5	1.5		1.5	
Lane Grp Cap (vph)		986	829		1012			393	447		533	
v/s Ratio Prot												
v/s Ratio Perm		c0.31	0.15		0.29			c0.21	0.01		0.02	
v/c Ratio		0.60	0.29		0.53			0.72	0.02		0.06	
Uniform Delay, d1		8.8	7.2		7.3			16.4	13.1		13.2	
Progression Factor		1.00	1.00		1.00			1.00	1.00		1.00	
Incremental Delay, d2		1.0	0.2		0.2			5.4	0.0		0.0	
Delay (s)		9.8	7.4		7.5			21.8	13.1		13.2	
Level of Service		A	A		A			C	B		B	
Approach Delay (s)		9.0			7.5			20.9			13.2	
Approach LOS		A			A			C			B	

Intersection Summary			
HCM 2000 Control Delay	10.7	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	51.6	Sum of lost time (s)	10.1
Intersection Capacity Utilization	69.9%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	SET	SER	NWT	NET	NER	SWT
Lane Group Flow (vph)	589	311	537	283	33	39
v/c Ratio	0.60	0.35	0.53	0.73	0.07	0.09
Control Delay	13.4	6.1	11.0	28.8	5.3	11.9
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	13.4	6.1	11.0	28.8	5.3	11.9
Queue Length 50th (ft)	107	23	84	67	0	6
Queue Length 95th (ft)	281	86	238	178	14	21
Internal Link Dist (ft)	476		773	540		361
Turn Bay Length (ft)		50			50	
Base Capacity (vph)	1690	1438	1648	784	909	1071
Starvation Cap Reductn	5	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.35	0.22	0.33	0.36	0.04	0.04

Intersection Summary

Intersection	
Intersection Delay, s/veh	18.6
Intersection LOS	C

Approach	SE	NW	NE	SW
Entry Lanes	1	1	1	1
Conflicting Circle Lanes	1	1	1	1
Adj Approach Flow, veh/h	900	537	316	39
Demand Flow Rate, veh/h	909	542	319	39
Vehicles Circulating, veh/h	47	297	608	817
Vehicles Exiting, veh/h	809	630	348	22
Follow-Up Headway, s	3.186	3.186	3.186	3.186
Ped Vol Crossing Leg, #/h	3	3	3	3
Ped Cap Adj	1.000	1.000	1.000	1.000
Approach Delay, s/veh	22.6	15.1	14.7	8.2
Approach LOS	C	C	B	A

Lane	Left	Left	Left	Left
Designated Moves	LTR	LTR	LTR	LTR
Assumed Moves	LTR	LTR	LTR	LTR
RT Channelized				
Lane Util	1.000	1.000	1.000	1.000
Critical Headway, s	5.193	5.193	5.193	5.193
Entry Flow, veh/h	909	542	319	39
Cap Entry Lane, veh/h	1078	840	615	499
Entry HV Adj Factor	0.990	0.991	0.991	1.000
Flow Entry, veh/h	900	537	316	39
Cap Entry, veh/h	1067	831	609	499
V/C Ratio	0.844	0.646	0.519	0.078
Control Delay, s/veh	22.6	15.1	14.7	8.2
LOS	C	C	B	A
95th %tile Queue, veh	11	5	3	0

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	60	60	50	700	750	50
Future Volume (vph)	60	60	50	700	750	50
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	12	12
Grade (%)	2%			0%	0%	
Total Lost time (s)	4.0		4.0	6.1	4.0	
Lane Util. Factor	1.00		1.00	1.00	1.00	
Frpb, ped/bikes	0.99		1.00	1.00	1.00	
Flpb, ped/bikes	1.00		1.00	1.00	1.00	
Frt	0.93		1.00	1.00	0.99	
Flt Protected	0.98		0.95	1.00	1.00	
Satd. Flow (prot)	1599		1728	1818	1863	
Flt Permitted	0.98		0.16	1.00	1.00	
Satd. Flow (perm)	1599		293	1818	1863	
Peak-hour factor, PHF	0.79	0.79	0.92	0.92	0.93	0.93
Adj. Flow (vph)	76	76	54	761	806	54
RTOR Reduction (vph)	45	0	0	0	3	0
Lane Group Flow (vph)	107	0	54	761	857	0
Confl. Peds. (#/hr)	3	3	3			3
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%
Turn Type	Prot		pm+pt	NA	NA	
Protected Phases	4		5	2	6	
Permitted Phases			2			
Actuated Green, G (s)	7.0		43.1	43.1	37.4	
Effective Green, g (s)	7.0		43.1	43.1	37.4	
Actuated g/C Ratio	0.12		0.72	0.72	0.62	
Clearance Time (s)	4.0		4.0	6.1	4.0	
Vehicle Extension (s)	1.5		1.5	3.0	1.5	
Lane Grp Cap (vph)	185		300	1301	1157	
v/s Ratio Prot	c0.07		0.01	c0.42	c0.46	
v/s Ratio Perm			0.12			
v/c Ratio	0.58		0.18	0.58	0.74	
Uniform Delay, d1	25.2		6.5	4.2	8.0	
Progression Factor	1.00		1.00	1.00	1.00	
Incremental Delay, d2	2.7		0.1	0.7	2.3	
Delay (s)	27.9		6.6	4.9	10.3	
Level of Service	C		A	A	B	
Approach Delay (s)	27.9			5.0	10.3	
Approach LOS	C			A	B	

Intersection Summary			
HCM 2000 Control Delay	9.4	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.72		
Actuated Cycle Length (s)	60.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.3%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBL	NBT	SBT
Lane Group Flow (vph)	152	54	761	860
v/c Ratio	0.55	0.14	0.57	0.69
Control Delay	27.3	3.3	6.9	13.8
Queue Delay	0.0	0.0	0.0	0.0
Total Delay	27.3	3.3	6.9	13.8
Queue Length 50th (ft)	30	4	108	216
Queue Length 95th (ft)	94	13	235	497
Internal Link Dist (ft)	1120		476	697
Turn Bay Length (ft)		150		
Base Capacity (vph)	427	396	1704	1646
Starvation Cap Reductn	0	0	88	0
Spillback Cap Reductn	0	0	0	0
Storage Cap Reductn	0	0	0	0
Reduced v/c Ratio	0.36	0.14	0.47	0.52

Intersection Summary

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (vph)	110	90	60	700	720	130
Future Volume (vph)	110	90	60	700	720	130
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Lane Width	11	11	11	11	14	14
Grade (%)	0%			0%	3%	
Total Lost time (s)	4.0		4.0	4.0	5.6	5.6
Lane Util. Factor	1.00		1.00	1.00	1.00	1.00
Frpb, ped/bikes	0.99		1.00	1.00	1.00	0.98
Flpb, ped/bikes	1.00		1.00	1.00	1.00	1.00
Frt	0.94		1.00	1.00	1.00	0.85
Flt Protected	0.97		0.95	1.00	1.00	1.00
Satd. Flow (prot)	1626		1727	1818	1977	1641
Flt Permitted	0.97		0.12	1.00	1.00	1.00
Satd. Flow (perm)	1626		211	1818	1977	1641
Peak-hour factor, PHF	0.76	0.76	0.86	0.86	0.91	0.91
Adj. Flow (vph)	145	118	70	814	791	143
RTOR Reduction (vph)	39	0	0	0	0	41
Lane Group Flow (vph)	224	0	70	814	791	102
Confl. Peds. (#/hr)	3	3	3			3
Heavy Vehicles (%)	2%	2%	1%	1%	1%	1%
Turn Type	Prot		pm+pt	NA	NA	Perm
Protected Phases	4		1	1 2	2	
Permitted Phases			1 2			2
Actuated Green, G (s)	15.6		46.6	50.6	34.5	34.5
Effective Green, g (s)	15.6		46.6	50.6	34.5	34.5
Actuated g/C Ratio	0.21		0.61	0.67	0.46	0.46
Clearance Time (s)	4.0		4.0		5.6	5.6
Vehicle Extension (s)	3.0		1.5		2.5	2.5
Lane Grp Cap (vph)	334		371	1213	899	746
v/s Ratio Prot	c0.14		0.03	c0.45	c0.40	
v/s Ratio Perm			0.09			0.06
v/c Ratio	0.67		0.19	0.67	0.88	0.14
Uniform Delay, d1	27.7		11.0	7.6	18.8	12.0
Progression Factor	1.00		1.00	1.00	1.00	1.00
Incremental Delay, d2	5.2		0.1	1.2	9.8	0.1
Delay (s)	33.0		11.1	8.7	28.5	12.1
Level of Service	C		B	A	C	B
Approach Delay (s)	33.0			8.9	26.0	
Approach LOS	C			A	C	

Intersection Summary			
HCM 2000 Control Delay	19.6	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	75.8	Sum of lost time (s)	13.6
Intersection Capacity Utilization	65.3%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	263	70	814	791	143
v/c Ratio	0.71	0.19	0.65	0.88	0.18
Control Delay	33.0	6.4	11.0	33.7	8.0
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	33.0	6.4	11.0	33.7	8.0
Queue Length 50th (ft)	93	9	181	323	17
Queue Length 95th (ft)	131	27	365	#639	57
Internal Link Dist (ft)	1539		3382	952	
Turn Bay Length (ft)		105			120
Base Capacity (vph)	570	374	1250	899	787
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.46	0.19	0.65	0.88	0.18

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Traffic Volume (veh/h)	10	30	800	10	30	840
Future Volume (Veh/h)	10	30	800	10	30	840
Sign Control	Stop		Free			Free
Grade	-3%		0%			0%
Peak Hour Factor	0.89	0.89	0.89	0.89	0.95	0.95
Hourly flow rate (vph)	11	34	899	11	32	884
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)		1				
Median type			None			None
Median storage veh)						
Upstream signal (ft)			1032			
pX, platoon unblocked	0.69	0.69			0.69	
vC, conflicting volume	1852	904			910	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	2011	637			645	
tC, single (s)	6.4	6.2			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	74	90			95	
cM capacity (veh/h)	43	329			652	

Direction, Lane #	WB 1	NB 1	SB 1	SB 2
Volume Total	45	910	32	884
Volume Left	11	0	32	0
Volume Right	34	11	0	0
cSH	174	1700	652	1700
Volume to Capacity	0.26	0.54	0.05	0.52
Queue Length 95th (ft)	25	0	4	0
Control Delay (s)	41.5	0.0	10.8	0.0
Lane LOS	E		B	
Approach Delay (s)	41.5	0.0	0.4	
Approach LOS	E			

Intersection Summary			
Average Delay	1.2		
Intersection Capacity Utilization	54.2%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	150	10	100	10	0	10	100	780	10	10	850	90
Future Volume (vph)	150	10	100	10	0	10	100	780	10	10	850	90
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	13	14	14	14	11	12	13	11	11	11
Grade (%)		2%			-4%			0%			0%	
Total Lost time (s)	4.4	5.0			5.0		4.0	6.2		4.0	6.0	
Lane Util. Factor	0.97	1.00			1.00		1.00	0.95		1.00	0.95	
Frt	1.00	0.86			0.93		1.00	1.00		1.00	0.99	
Flt Protected	0.95	1.00			0.98		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3285	1540			1881		1711	3533		1711	3372	
Flt Permitted	0.95	1.00			0.77		0.18	1.00		0.31	1.00	
Satd. Flow (perm)	3285	1540			1480		327	3533		562	3372	
Peak-hour factor, PHF	0.86	0.86	0.86	0.76	0.76	0.76	0.90	0.90	0.90	0.91	0.91	0.91
Adj. Flow (vph)	174	12	116	13	0	13	111	867	11	11	934	99
RTOR Reduction (vph)	0	105	0	0	23	0	0	1	0	0	8	0
Lane Group Flow (vph)	174	23	0	0	3	0	111	877	0	11	1026	0
Heavy Vehicles (%)	2%	2%	2%	0%	0%	0%	2%	2%	2%	2%	2%	2%
Turn Type	Prot	NA		Perm	NA		pm+pt	NA		pm+pt	NA	
Protected Phases	4	8			8		1	6		5	2	
Permitted Phases		8		8			6			2		
Actuated Green, G (s)	5.6	7.4			7.4		46.4	41.4		38.5	37.5	
Effective Green, g (s)	5.6	7.4			7.4		46.4	41.4		38.5	37.5	
Actuated g/C Ratio	0.07	0.10			0.10		0.62	0.55		0.51	0.50	
Clearance Time (s)	4.4	5.0			5.0		4.0	6.2		4.0	6.0	
Vehicle Extension (s)	2.5	1.5			1.5		1.5	2.5		1.5	2.5	
Lane Grp Cap (vph)	245	151			146		296	1950		303	1686	
v/s Ratio Prot	c0.05	c0.02					c0.03	0.25		0.00	c0.30	
v/s Ratio Perm					0.00		0.21			0.02		
v/c Ratio	0.71	0.16			0.02		0.38	0.45		0.04	0.61	
Uniform Delay, d1	33.9	30.9			30.5		7.6	10.0		9.0	13.5	
Progression Factor	1.00	1.00			1.00		1.00	1.00		0.42	0.30	
Incremental Delay, d2	8.7	0.2			0.0		0.3	0.8		0.0	1.4	
Delay (s)	42.6	31.1			30.5		7.9	10.8		3.7	5.5	
Level of Service	D	C			C		A	B		A	A	
Approach Delay (s)		37.7			30.5			10.4			5.5	
Approach LOS		D			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	12.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	19.6
Intersection Capacity Utilization	52.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBT	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	174	128	26	111	878	11	1033
v/c Ratio	0.71	0.44	0.08	0.34	0.41	0.03	0.58
Control Delay	51.5	13.2	0.5	8.5	9.8	2.5	5.6
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	51.5	13.2	0.5	8.5	9.8	2.5	5.6
Queue Length 50th (ft)	41	5	0	18	103	0	39
Queue Length 95th (ft)	#79	46	0	38	196	m1	67
Internal Link Dist (ft)		619	594		240		743
Turn Bay Length (ft)	150			200		100	
Base Capacity (vph)	245	590	606	329	2149	415	1773
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.71	0.22	0.04	0.34	0.41	0.03	0.58

Intersection Summary

\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	240	20	60	30	0	60	0	980	20	50	980	0
Future Volume (vph)	240	20	60	30	0	60	0	980	20	50	980	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	5.4	5.4		4.0		4.0		7.0		4.5	7.0	
Lane Util. Factor	0.97	1.00		1.00		1.00		0.95		1.00	0.95	
Frt	1.00	0.89		1.00		0.85		1.00		1.00	1.00	
Flt Protected	0.95	1.00		0.95		1.00		1.00		0.95	1.00	
Satd. Flow (prot)	3433	1654		1770		1583		3528		1770	3539	
Flt Permitted	0.95	1.00		0.95		1.00		1.00		0.14	1.00	
Satd. Flow (perm)	3433	1654		1770		1583		3528		269	3539	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	261	22	65	33	0	65	0	1065	22	54	1065	0
RTOR Reduction (vph)	0	55	0	0	0	60	0	2	0	0	0	0
Lane Group Flow (vph)	261	32	0	33	0	5	0	1085	0	54	1065	0
Turn Type	Split	NA		Prot		Perm		NA		pm+pt	NA	
Protected Phases	4	4		8				6		5	2	
Permitted Phases						8				2		
Actuated Green, G (s)	11.2	11.2		5.8		5.8		33.2		41.6	41.6	
Effective Green, g (s)	11.2	11.2		5.8		5.8		33.2		41.6	41.6	
Actuated g/C Ratio	0.15	0.15		0.08		0.08		0.44		0.55	0.55	
Clearance Time (s)	5.4	5.4		4.0		4.0		7.0		4.5	7.0	
Vehicle Extension (s)	3.0	3.0		3.0		3.0		3.0		3.0	3.0	
Lane Grp Cap (vph)	512	246		136		122		1561		227	1962	
v/s Ratio Prot	c0.08	0.02		c0.02				c0.31		0.01	c0.30	
v/s Ratio Perm						0.00				0.12		
v/c Ratio	0.51	0.13		0.24		0.04		0.70		0.24	0.54	
Uniform Delay, d1	29.4	27.7		32.5		32.0		16.8		9.8	10.6	
Progression Factor	1.00	1.00		1.00		1.00		0.76		0.47	0.38	
Incremental Delay, d2	0.8	0.2		0.9		0.1		1.2		0.5	1.0	
Delay (s)	30.2	27.9		33.5		32.2		14.0		5.1	5.0	
Level of Service	C	C		C		C		B		A	A	
Approach Delay (s)		29.6			32.6			14.0			5.0	
Approach LOS		C			C			B			A	

Intersection Summary			
HCM 2000 Control Delay	13.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	20.9
Intersection Capacity Utilization	59.5%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

Lane Group	EBL	EBT	WBL	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	261	87	33	65	1087	54	1065
v/c Ratio	0.51	0.29	0.20	0.20	0.64	0.19	0.53
Control Delay	32.7	13.7	33.8	1.3	16.5	5.2	5.4
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.7	13.7	33.8	1.3	16.5	5.2	5.4
Queue Length 50th (ft)	58	9	15	0	114	4	43
Queue Length 95th (ft)	89	45	39	0	#346	m12	92
Internal Link Dist (ft)		426			743		431
Turn Bay Length (ft)	250					240	
Base Capacity (vph)	823	446	164	330	1686	283	1999
Starvation Cap Reductn	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0
Reduced v/c Ratio	0.32	0.20	0.20	0.20	0.64	0.19	0.53

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	100	0	60	0	1210	70	70	1110	0
Future Volume (vph)	0	0	0	100	0	60	0	1210	70	70	1110	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	12	12	12	12	8	11	11	11
Total Lost time (s)					4.2	4.0		6.6		4.0	6.1	
Lane Util. Factor					1.00	1.00		0.91		1.00	0.95	
Frpb, ped/bikes					1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes					0.99	1.00		1.00		1.00	1.00	
Frt					1.00	0.85		0.99		1.00	1.00	
Flt Protected					0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)					1742	1549		5037		1711	3421	
Flt Permitted					0.76	1.00		1.00		0.15	1.00	
Satd. Flow (perm)					1388	1549		5037		265	3421	
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.96	0.96	0.96	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	110	0	66	0	1260	73	71	1133	0
RTOR Reduction (vph)	0	0	0	0	0	38	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	110	28	0	1333	0	71	1133	0
Confl. Peds. (#/hr)	4		4	4		4	4		4	4		4
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type				Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4	4		8		8	2			6		
Actuated Green, G (s)					15.0	20.6		39.6		49.7	49.7	
Effective Green, g (s)					15.0	20.6		39.6		49.7	49.7	
Actuated g/C Ratio					0.20	0.27		0.53		0.66	0.66	
Clearance Time (s)					4.2	4.0		6.6		4.0	6.1	
Vehicle Extension (s)					1.5	2.5		2.5		2.5	2.5	
Lane Grp Cap (vph)					277	425		2659		283	2266	
v/s Ratio Prot						0.00		0.26		0.02	c0.33	
v/s Ratio Perm					c0.08	0.01				0.15		
v/c Ratio					0.40	0.07		0.50		0.25	0.50	
Uniform Delay, d1					26.1	20.1		11.4		5.4	6.4	
Progression Factor					1.00	1.00		0.55		0.62	0.48	
Incremental Delay, d2					0.3	0.0		0.6		0.3	0.1	
Delay (s)					26.4	20.1		6.8		3.7	3.2	
Level of Service					C	C		A		A	A	
Approach Delay (s)		0.0			24.1			6.8			3.2	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.8
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	110	66	1333	71	1133
v/c Ratio	0.40	0.13	0.49	0.22	0.50
Control Delay	31.1	7.7	6.9	3.9	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	7.7	6.9	3.9	3.9
Queue Length 50th (ft)	45	4	68	4	46
Queue Length 95th (ft)	91	29	63	9	58
Internal Link Dist (ft)	603		431		69
Turn Bay Length (ft)		110			
Base Capacity (vph)	329	496	2711	318	2266
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.33	0.13	0.49	0.22	0.50

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	0	0	100	0	60	0	1210	70	70	1110	0
Future Volume (vph)	0	0	0	100	0	60	0	1210	70	70	1110	0
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	12	12	12	11	12	12	12	12	8	11	11	11
Total Lost time (s)					4.2	4.0		6.6		4.0	6.1	
Lane Util. Factor					1.00	1.00		0.91		1.00	0.95	
Frpb, ped/bikes					1.00	0.99		1.00		1.00	1.00	
Flpb, ped/bikes					0.99	1.00		1.00		1.00	1.00	
Frt					1.00	0.85		0.99		1.00	1.00	
Flt Protected					0.95	1.00		1.00		0.95	1.00	
Satd. Flow (prot)					1742	1549		5037		1711	3421	
Flt Permitted					0.76	1.00		1.00		0.15	1.00	
Satd. Flow (perm)					1388	1549		5037		265	3421	
Peak-hour factor, PHF	0.92	0.92	0.92	0.91	0.91	0.91	0.96	0.96	0.96	0.98	0.98	0.98
Adj. Flow (vph)	0	0	0	110	0	66	0	1260	73	71	1133	0
RTOR Reduction (vph)	0	0	0	0	0	38	0	0	0	0	0	0
Lane Group Flow (vph)	0	0	0	0	110	28	0	1333	0	71	1133	0
Confl. Peds. (#/hr)	4		4	4		4	4		4	4		4
Heavy Vehicles (%)	3%	3%	3%	3%	3%	3%	2%	2%	2%	2%	2%	2%
Turn Type				Perm	NA	pm+ov	pm+pt	NA		pm+pt	NA	
Protected Phases		4			8	1	5	2		1	6	
Permitted Phases	4	4		8		8	2			6		
Actuated Green, G (s)					15.0	20.6		39.6		49.7	49.7	
Effective Green, g (s)					15.0	20.6		39.6		49.7	49.7	
Actuated g/C Ratio					0.20	0.27		0.53		0.66	0.66	
Clearance Time (s)					4.2	4.0		6.6		4.0	6.1	
Vehicle Extension (s)					1.5	2.5		2.5		2.5	2.5	
Lane Grp Cap (vph)					277	425		2659		283	2266	
v/s Ratio Prot						0.00		0.26		0.02	c0.33	
v/s Ratio Perm					c0.08	0.01				0.15		
v/c Ratio					0.40	0.07		0.50		0.25	0.50	
Uniform Delay, d1					26.1	20.1		11.4		5.4	6.4	
Progression Factor					1.00	1.00		0.55		0.62	0.48	
Incremental Delay, d2					0.3	0.0		0.6		0.3	0.1	
Delay (s)					26.4	20.1		6.8		3.7	3.2	
Level of Service					C	C		A		A	A	
Approach Delay (s)		0.0			24.1			6.8			3.2	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM 2000 Control Delay	6.3	HCM 2000 Level of Service	A
HCM 2000 Volume to Capacity ratio	0.51		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	14.8
Intersection Capacity Utilization	59.3%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	WBT	WBR	NBT	SBL	SBT
Lane Group Flow (vph)	110	66	1333	71	1133
v/c Ratio	0.40	0.13	0.49	0.22	0.50
Control Delay	31.1	7.7	6.9	3.9	3.9
Queue Delay	0.0	0.0	0.0	0.0	0.0
Total Delay	31.1	7.7	6.9	3.9	3.9
Queue Length 50th (ft)	45	4	68	4	46
Queue Length 95th (ft)	91	29	63	9	58
Internal Link Dist (ft)	603		431		69
Turn Bay Length (ft)		110			
Base Capacity (vph)	329	496	2711	318	2266
Starvation Cap Reductn	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0
Reduced v/c Ratio	0.33	0.13	0.49	0.22	0.50

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	130	0	530	0	0	0	250	570	0	0	650	280
Future Volume (vph)	130	0	530	0	0	0	250	570	0	0	650	280
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	12	12	12	12	12	12	12	12	12	12	12
Total Lost time (s)	5.9		5.9				4.0	5.5			7.0	5.9
Lane Util. Factor	1.00		0.88				0.97	0.95			0.95	1.00
Frpb, ped/bikes	1.00		1.00				1.00	1.00			1.00	0.99
Flpb, ped/bikes	1.00		1.00				1.00	1.00			1.00	1.00
Frt	1.00		0.85				1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00				0.95	1.00			1.00	1.00
Satd. Flow (prot)	1728		2814				3433	3539			3539	1568
Flt Permitted	0.95		1.00				0.95	1.00			1.00	1.00
Satd. Flow (perm)	1728		2814				3433	3539			3539	1568
Peak-hour factor, PHF	0.95	0.92	0.95	0.92	0.92	0.92	0.96	0.96	0.92	0.92	0.93	0.93
Adj. Flow (vph)	137	0	558	0	0	0	260	594	0	0	699	301
RTOR Reduction (vph)	0	0	336	0	0	0	0	0	0	0	0	113
Lane Group Flow (vph)	137	0	222	0	0	0	260	594	0	0	699	188
Confl. Peds. (#/hr)	3		3	3		3	3		3	3		3
Heavy Vehicles (%)	1%	2%	1%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Turn Type	Prot		pt+ov			Prot	Prot	NA		pm+pt	NA	pm+ov
Protected Phases	8		8 1	4	4	4	1	6		5	2	8
Permitted Phases										2		2
Actuated Green, G (s)	12.6		29.8				11.3	51.0			34.2	46.8
Effective Green, g (s)	12.6		29.8				11.3	51.0			34.2	46.8
Actuated g/C Ratio	0.17		0.40				0.15	0.68			0.46	0.62
Clearance Time (s)	5.9						4.0	5.5			7.0	5.9
Vehicle Extension (s)	2.5						2.5	2.5			2.5	2.5
Lane Grp Cap (vph)	290		1118				517	2406			1613	978
v/s Ratio Prot	c0.08		0.08				c0.08	0.17			c0.20	0.03
v/s Ratio Perm												0.09
v/c Ratio	0.47		0.20				0.50	0.25			0.43	0.19
Uniform Delay, d1	28.2		14.8				29.3	4.6			13.8	6.0
Progression Factor	1.00		1.00				0.71	1.18			1.00	1.00
Incremental Delay, d2	0.9		0.1				0.5	0.0			0.9	0.1
Delay (s)	29.1		14.8				21.4	5.5			14.7	6.1
Level of Service	C		B				C	A			B	A
Approach Delay (s)		17.7			0.0			10.3			12.1	
Approach LOS		B			A			B			B	

Intersection Summary			
HCM 2000 Control Delay	13.0	HCM 2000 Level of Service	B
HCM 2000 Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	22.0
Intersection Capacity Utilization	51.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR
Lane Group Flow (vph)	137	558	260	594	699	301
v/c Ratio	0.47	0.40	0.50	0.25	0.43	0.27
Control Delay	32.8	2.1	23.7	6.3	16.3	1.3
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	32.8	2.1	23.7	6.3	16.3	1.3
Queue Length 50th (ft)	59	0	41	45	108	0
Queue Length 95th (ft)	101	25	60	96	193	22
Internal Link Dist (ft)				824	1287	
Turn Bay Length (ft)						160
Base Capacity (vph)	343	1368	530	2406	1614	1149
Starvation Cap Reductn	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0
Reduced v/c Ratio	0.40	0.41	0.49	0.25	0.43	0.26

Intersection Summary

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	110	240	200	300	280	120	190	340	150	190	420	100
Future Volume (vph)	110	240	200	300	280	120	190	340	150	190	420	100
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Lane Width	11	11	12	11	11	11	11	11	11	11	12	12
Total Lost time (s)	4.0	5.5		4.0	5.0	5.0	4.0	5.5		4.0	5.0	
Lane Util. Factor	1.00	0.95		1.00	1.00	1.00	1.00	1.00		1.00	0.95	
Frpb, ped/bikes	1.00	0.99		1.00	1.00	0.98	1.00	1.00		1.00	1.00	
Flpb, ped/bikes	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.93		1.00	1.00	0.85	1.00	0.95		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1692	3136		1710	1801	1495	1710	1711		1694	3389	
Flt Permitted	0.57	1.00		0.28	1.00	1.00	0.35	1.00		0.14	1.00	
Satd. Flow (perm)	1014	3136		512	1801	1495	636	1711		255	3389	
Peak-hour factor, PHF	0.94	0.94	0.94	0.89	0.89	0.89	0.94	0.94	0.94	0.97	0.97	0.97
Adj. Flow (vph)	117	255	213	337	315	135	202	362	160	196	433	103
RTOR Reduction (vph)	0	130	0	0	0	90	0	16	0	0	19	0
Lane Group Flow (vph)	117	338	0	337	315	45	202	506	0	196	517	0
Confl. Peds. (#/hr)	2		2	2		2	2		2	2		2
Heavy Vehicles (%)	3%	3%	3%	2%	2%	2%	2%	2%	2%	3%	3%	3%
Turn Type	pm+pt	NA		pm+pt	NA	Perm	pm+pt	NA		pm+pt	NA	
Protected Phases	1	6		5	2		3	8		7	4	
Permitted Phases	6			2		2	8			4		
Actuated Green, G (s)	32.1	24.7		47.6	36.2	36.2	47.1	35.6		49.2	36.9	
Effective Green, g (s)	32.1	24.7		47.6	36.2	36.2	47.1	35.6		49.2	36.9	
Actuated g/C Ratio	0.29	0.22		0.43	0.33	0.33	0.43	0.32		0.45	0.34	
Clearance Time (s)	4.0	5.5		4.0	5.0	5.0	4.0	5.5		4.0	5.0	
Vehicle Extension (s)	2.0	2.5		2.0	2.5	2.5	2.0	2.0		2.0	2.0	
Lane Grp Cap (vph)	341	704		421	592	491	384	553		274	1136	
v/s Ratio Prot	0.02	0.11		c0.13	0.17		0.05	c0.30		c0.08	0.15	
v/s Ratio Perm	0.08			c0.21		0.03	0.17			0.24		
v/c Ratio	0.34	0.48		0.80	0.53	0.09	0.53	0.92		0.72	0.45	
Uniform Delay, d1	29.6	37.1		23.1	30.0	25.5	20.8	35.8		22.9	28.7	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.2	2.3		9.9	3.4	0.4	0.6	19.6		7.2	0.1	
Delay (s)	29.9	39.4		33.0	33.4	25.9	21.4	55.3		30.1	28.8	
Level of Service	C	D		C	C	C	C	E		C	C	
Approach Delay (s)		37.5			31.9			45.8			29.1	
Approach LOS		D			C			D			C	

Intersection Summary			
HCM 2000 Control Delay	35.9	HCM 2000 Level of Service	D
HCM 2000 Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	19.0
Intersection Capacity Utilization	83.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

Lane Group	EBL	EBT	WBL	WBT	WBR	NBL	NBT	SBL	SBT
Lane Group Flow (vph)	117	468	337	315	135	202	522	196	536
v/c Ratio	0.33	0.56	0.79	0.53	0.23	0.51	0.92	0.71	0.46
Control Delay	24.8	28.4	37.7	35.5	6.1	20.8	56.3	33.4	28.0
Queue Delay	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total Delay	24.8	28.4	37.7	35.5	6.1	20.8	56.3	33.4	28.0
Queue Length 50th (ft)	52	107	174	197	1	74	329	71	138
Queue Length 95th (ft)	90	160	#259	274	43	122	#503	#172	192
Internal Link Dist (ft)		985		299			1287		769
Turn Bay Length (ft)	90		310		140	190		260	
Base Capacity (vph)	359	874	448	617	600	405	629	281	1242
Starvation Cap Reductn	0	0	0	0	0	0	0	0	0
Spillback Cap Reductn	0	0	0	0	0	0	0	0	0
Storage Cap Reductn	0	0	0	0	0	0	0	0	0
Reduced v/c Ratio	0.33	0.54	0.75	0.51	0.23	0.50	0.83	0.70	0.43

Intersection Summary

95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.

Movement	EBL	EBR	NBL	NBT	SBT	SBR
Lane Configurations						
Traffic Volume (veh/h)	10	30	30	460	610	10
Future Volume (Veh/h)	10	30	30	460	610	10
Sign Control	Stop			Free	Free	
Grade	0%			0%	0%	
Peak Hour Factor	0.83	0.83	0.96	0.96	0.90	0.90
Hourly flow rate (vph)	12	36	31	479	678	11
Pedestrians	5			5	5	
Lane Width (ft)	13.0			12.0	12.0	
Walking Speed (ft/s)	3.5			3.5	3.5	
Percent Blockage	1			0	0	
Right turn flare (veh)						
Median type				None	None	
Median storage veh)						
Upstream signal (ft)				849		
pX, platoon unblocked						
vC, conflicting volume	1234	694	694			
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	1234	694	694			
tC, single (s)	6.4	6.2	4.1			
tC, 2 stage (s)						
tF (s)	3.5	3.3	2.2			
p0 queue free %	93	92	97			
cM capacity (veh/h)	184	434	897			

Direction, Lane #	EB 1	EB 2	NB 1	NB 2	SB 1
Volume Total	12	36	31	479	689
Volume Left	12	0	31	0	0
Volume Right	0	36	0	0	11
cSH	184	434	897	1700	1700
Volume to Capacity	0.07	0.08	0.03	0.28	0.41
Queue Length 95th (ft)	5	7	3	0	0
Control Delay (s)	26.0	14.1	9.2	0.0	0.0
Lane LOS	D	B	A		
Approach Delay (s)	17.0		0.6		0.0
Approach LOS	C				

Intersection Summary			
Average Delay	0.9		
Intersection Capacity Utilization	44.3%	ICU Level of Service	A
Analysis Period (min)	15		

APPENDIX D
ENVIRONMENTAL PERMITTING OVERVIEW

BETA
IMPROVING COMMUNITIES TOGETHER

MEMORANDUM

Date:	July 7, 2023	Job No.:	22.10369
To:	James S. Butler, AICP, SCCOG Senior Advisor, Project Manager		
Cc:			
From:	Joe Rimiller, PE, PTOE, LEED AP, BETA Laura Krause, BETA Elyse Tripp, BETA		
Subject:	Environmental Permitting Overview Route 161 Corridor Improvement Project – East Lyme, Connecticut		

BETA has been retained by the Southeastern Connecticut Council of Governments (SCCOG), in cooperation with the Town of East Lyme and the Connecticut Department of Transportation (CTDOT), to participate in the Connecticut State Route 161 Corridor Study to assess existing and forecasted conditions on the corridor and develop a comprehensive plan to guide future transportation improvements along the corridor.

The purpose of this memorandum is to provide an overview of the anticipated environmental impacts and required environmental permitting associated with conceptual plans developed to improve the Route 161 Corridor.

Project / Site Description

Route 161 is a major north-south arterial that is vital to transportation in the Town of East Lyme. The Corridor Study included an approximately 3.7-mile section of Route 161 from Route 156 (Main Street) to the driveway of East Lyme High School (Figure 1). Proposed pedestrian improvements along the Project Corridor have been broken up into the following seven segments, starting from the south:

Segment 1 – Route 156 (Main Street) to Smith Street

This segment starts at the intersection of Pennsylvania Avenue (Route 161) and Main Street (Route 156) and ends at Smith Street. Improvements proposed within this segment include:

- Stripe on-street parking spaces and bike lanes;
- Install a new traffic signal at the Route 161 and Route 156 (Main Street) intersection;
- Install crosswalks across side streets with high pedestrian volumes including Grand Street, Hope Street, State Street, and Lincoln Street;
- Reconstruct pedestrian curb ramps at various locations;
- Construct a pocket parking area on the west of the corridor, just south of Hope Street;
- Install pedestrian scale lighting between Smith Street and Hope Street;
- Plant street trees within the public right-of-way; and
- Widen the existing sidewalk along the west side of Route 161.

Segment 2 – Smith Street to East Pattagansett Road

This segment of Route 161 starts at Smith Street and ends at East Pattagansett Road. Improvements proposed within this segment include:

- Construct pedestrian curb ramps where none are provided;
- Reconstruct pedestrian curb ramps and install detectable warning panels at various locations;

- Stripe bike lanes along both sides of Route 161;
- Construct a new sidewalk along the east side of Route 161 between Smith Street and Oswegatchie Hills Road;
- Construct a new sidewalk along the north side of Route 161 between Oswegatchie Hils Road and Sleepy Hollow Road; and
- Widen the existing sidewalk along both sides of Route 161.

Segment 3 – East Pattagansett Road to Society Road

This segment starts at East Pattagansett Road and ends at Society Road. Improvements proposed within this segment include:

- Install speed feedback signs to discourage speeding;
- Restripe the existing shoulder with 6"- wide shoulder markings;
- Reconstruct pedestrian curb ramps at various locations;
- Install new traffic signals at the Route 161/East Pattagansett Road and Route 161/Roxbury Road intersections;
- Install a dedicated northbound left turn lane at the Roxbury Road signal;
- Install crosswalks across both roadways at the intersection of Route 161 and Roxbury Road;
- Install a crosswalk across Route 161 at Oak Hill Drive to improve access to the proposed sidewalk;
- Widen the existing sidewalk along the east side of Route 161; and
- Install a 10'-wide shared use path along the west side of Route 161. Retaining walls will be necessary to support the sidewalk along the south end of Gorton Pond.

Segment 4 – Society Road to Industrial Park Road

This segment starts at Society Road and ends at Industrial Park Road. Improvements proposed within this segment include:

- Install accessible pedestrian signals, implement exclusive pedestrian phasing, and stripe a crosswalk across Society Road at the intersection of Route 161 and Society Road;
- Construct pedestrian curb ramps where none are provided including the Laurel Hill Drive and Damon Heights Road crossings;
- Reconstruct pedestrian curb ramps and install detectable warning panels at various locations;
- Install an intersection warning sign on the northbound approach to Laurel Hill Drive;
- Restripe the roadway to incorporate a two-way left turn lane;
- Install a 10'-wide shared use path along the west side of Route 161;
- Realign the Laurel Hill Drive approach to Route 161; and
- Widen the existing sidewalk along the east side of Route 161.

Segment 5 – Industrial Park Road to Frontage Road

This segment starts at Industrial Park Road and ends at Frontage Road. Improvements proposed within this segment include:

- Install a crosswalk with pedestrian signals across Industrial Park Road and implement exclusive pedestrian phasing;
- Incorporate adaptive signal control at the new traffic signals to be installed at Industrial Park Road, the Exit 74 Off Ramp, and King Arthur Drive under the I-95 Interchange 74 Improvement project;
- Install a bus shelter northeast of Chapman Wood Road; and
- Install an 8'-wide shared use path along the west side of Route 161.

Segment 6 – Frontage Road to U.S. Route 1 (Boston Post Road)

This segment starts at Frontage Road and ends at U.S. Route 1 (Boston Post Road). Improvements proposed within this segment include:

- Incorporate adaptive signal control at the new traffic signal to be installed at Frontage Road under the I-95 Interchange 74 Improvement project;
- Install fiber optic interconnect to facilitate communication between the traffic signal at U.S. Route 1 (Boston Post Road) and the signals at Frontage Road, King Arthur Drive, the I-95 Exit 74 Off Ramp, and Industrial Park Road;
- Construct a new 5'-wide concrete sidewalk on the east side of the corridor in front of Latimer Brook Commons;
- Install bus pull outs on both sides of the corridor just south of U.S. Route 1 (Boston Post Road);
- Install a bus shelter at each pull out to promote transit use;
- Construct a raised median island on the southern leg of the Route 161/U.S. Route 1 (Boston Post Road) intersection;
- Restripe the northbound approach to include an exclusive left turn lane and shared through/right turn lane to accommodate the median island; and
- Install a 10'-wide shared use path along the west side of Route 161.

Segment 7 - U.S. Route 1 (Boston Post Road) to East Lyme High School

This segment starts at U.S. Route 1 (Boston Post Road) and ends at East Lyme High School. Improvements proposed within this segment include:

- Implement a left-turn lane on the northbound approach to East Lyme High School;
- Incorporate adaptive signal control at Route 161/U.S. Route 1 (Boston Post Road) traffic signal; and
- Install a 10'-wide shared use path along the west side of Route 161.

Environmental Context, Impacts and Considerations

Below is a brief overview of the environmental context of each of the segments described above and the Project's Impacts to various environmental resources. BETA also conducted a field visit to confirm the presence of wetlands along the Corridor on March 17, 2023. Table 1 provides a summary of the various environmental resources present within each segment.

Table. 1 Environmental Impact Summary

	Seg. 1	Seg. 2	Seg. 3	Seg. 4	Seg. 5	Seg. 6	Seg. 7
Wetlands and Watercourses		✓*	✓	✓*			
Upland Review Area	✓	✓	✓	✓	✓	✓	✓
NDDB Habitat	✓	✓	✓				
Floodplain			✓				
Aquifer Protection Area			✓	✓	✓	✓	✓
Historic Structures**							
Coastal Management Area	✓						

*Segments marked with an asterisk require a formal delineation to confirm whether the Project will impact wetlands or watercourses.

** To determine the presence of historic structures in the Project Corridor, the Historic Property Database provided by the State Historic Preservation Office (SHPO) was consulted.

Segment 1 – Route 156 (Main Street) to Smith Street

This segment is within a primarily commercial area north of Niantic Bay (Figure 2a). Segment 1 is located within the Coastal Management Area until just north of Hope Street. Additionally, NDDB mapped habitat extends into the intersection of Main Street (Route 156) and Route 161 at the southern limit of this segment. No other environmentally sensitive or wetland resource areas were identified within or adjacent to Segment 1.

Work proposed within Segment 1 will be partially within NDDB Habitat, Coastal Management Area, and Upland Review Area. Work within 300 feet of wetlands and watercourses, known as the Upland Review Area, would be considered a Regulated Activity[1] under the Town of East Lyme Bylaw (the "Bylaw") and is subject to jurisdiction under Section 4.3 of the Bylaw. The Upland Review Area extends into the intersection of Main Street (Route 156) and Route 161 but is not present in any other portion of this segment. Additionally, work proposed at the southern end of this segment is partially within mapped NDDB habitat, and Coastal Management Area. Work within the Upland Review Area is not anticipated to impact any vegetated wetlands or watercourses.

Segment 2 – Smith Street to East Pattagansett Road

This segment is within a residential area east of Bush Pond and the Pattagansett River (Figure 2b). NDDB mapped habitat is present within the corridor north of Cove Drive and continues through Segment 2 and into Segment 3. An unnamed watercourse was observed during field review that flows underneath Pennsylvania Avenue east of 202 Pennsylvania Avenue. Vegetated wetlands were also observed on either side of the roadway associated with this watercourse, and additional vegetated wetlands were observed west of 202 Pennsylvania Avenue abutting the roadway.

Vegetated wetlands, as well as a Coastal Management Area, are mapped east of Pennsylvania Avenue between Penncove Drive and Oswegatchie Hills Road; however, these wetlands are located at the rear of multiple residential parcels and as such field confirmation of approximate limits could not be evaluated.

Work proposed within Segment 2 will be partially within NDDB Habitat and within Upland Review Area. Upland Review Area is present associated with the unnamed watercourse and associated vegetated wetlands on either side of Route 161 east of 202 Pennsylvania Avenue (Route 161) and the vegetated wetlands observed west of 202 Pennsylvania Avenue abutting the roadway. Widening of the existing sidewalk as well as the construction and reconstruction of pedestrian curb ramps will impact the Upland Review Area and NDDB habitat in some locations within Segment 2. This work may also impact wetlands; however, a formal wetland and watercourse delineation, as well as design plans are required to evaluate impacts.

Additionally, construction of the new sidewalk along the east side of Route 161 may also be within Upland Review Area associated with vegetated wetlands observed at the rear of the residential properties

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[1] A Regulated Activity as defined in Section 2 of the Bylaw means *any operation within or use of a wetland or watercourse involving removal or deposition of material, or any obstruction, construction, alteration or pollution, of such wetlands or watercourses [...] Furthermore, any clearing, grubbing, filling, grading, paving, excavating, constructing, depositing or removing of material and discharging storm water on the land within 300-feet measured horizontally from the boundary of any wetland or watercourse is a regulated activity.*

between Penncove Drive and Oswegatchie Hills Road. Work within the Upland Review Area is not anticipated to impact any vegetated wetlands or watercourses.

Segment 3 – East Pattagansett Road to Society Road

This segment is within a residential area east of Gorton Pond, the Pattagansett River, and associated bordering wetlands (Figure 2c). A concrete dam is present at the southern end of Gorton Pond where it becomes the Pattagansett River and continues to flow south towards Bush Pond. During field review, BETA observed that the bank/ordinary high water of Gorton Pond was located less than 10 feet from the edge of pavement of Route 161 (Flanders Road) from north of 6 Flanders Road at the concrete dam to 44 Flanders Road. BETA also observed vegetated wetlands along the bank of Gorton Pond.

According to the FEMA Flood Insurance Rate Map (FIRM) community panel number 09011C0479J, dated effective August 5, 2013, Segment 3 from East Pattagansett Road to 143 Flanders Road is adjacent to, and may be partially within, a Flood Hazard Zone AE with a Base Flood Elevation (BFE) ranging from 25 to 27.6' (NAVD88).

Segment 3 is located almost entirely within a Primary Aquifer Protection District, and an Aquifer Protection Area is present at the northern end of this segment. Additionally, NDDB habitat is mapped within the corridor until just south of 143 Flanders Road. No other sensitive or wetland resource areas were identified within or adjacent to Segment 3.

Work proposed within Segment 3 will occur within vegetated wetlands, a Watercourse, Upland Review Area, NDDB Habitat, an Aquifer Protection Area and may also occur within floodplain. An Upland Review Area is present throughout Segment 3 associated with Gorton Pond, the Pattagansett River, and associated vegetated wetlands present to the west of the roadway. Construction of the new sidewalk west of Route 161, widening of the existing sidewalk east of Route 161, as well as the construction and reconstruction of pedestrian curb ramps will impact the Upland Review Area.

Additionally, impacts to vegetated wetlands, a watercourse (Gorton Pond), and floodplain is anticipated to construct a shared use path along the western side of Route 161. This sidewalk is proposed to be supported by a retaining wall. Anticipated impacts include approximately 1,775 sf of vegetation clearing, a cut of 650 cubic yards (CY) of material and the use of 175 CY of fill.

Segment 4 – Society Road to Industrial Park Road

This segment transitions from residential to primarily commercial properties (Figure 2d). The Pattagansett River and Gorton Pond are present along the entire length of this segment, generally located at the rear of existing residences and commercial properties west of the Route 161. Although these watercourses were only observable from the public right of way, it appeared during field review that vegetated wetlands bordering the watercourses were also present as mapped by the Town of East Lyme GIS maps.

Additionally, a small stream with associated vegetated wetlands was observed in the field, directly abutting the roadway north of 208 Flanders Road. This segment is outside of the floodplain but is located entirely within an Aquifer Protection Area. No other sensitive or wetland resource areas were identified within or adjacent to Segment 4.

Work proposed within Segment 4 will occur within Upland Review Area and an Aquifer Protection Area. Upland Review Area appears to be present throughout Segment 4 associated with Gorton Pond, the Pattagansett River, and associated vegetated wetlands present to the west of the roadway. Installation of an ten-foot wide shared use path, as well as the construction and reconstruction of pedestrian curb ramps will impact the Upland Review Area. Additionally, the proposed shared use path may impact the unnamed watercourse and associated vegetated wetlands that abut the roadway north of 208 Flanders Road;

however, a formal wetland and watercourse delineation, as well as design plans are required to evaluate impacts.

Segment 5 – Industrial Park Road to Frontage Road

This segment is within a commercial area surrounding the I-95 interchange (Figure 2e). A stone lined drainage swale visible from the roadway was observed during the field review. This swale is mapped as a stream by the Town of East Lyme GIS maps along Chapman Woods Road and was observed to be dry. This channel appears to be connected to a larger stream complex east of the Project Corridor; however, the presence of associated vegetated wetlands could not be confirmed. Where intermittent flow within this channel could not be confirmed nor denied, the channel would meet the definition of a watercourse under the Bylaw[2].

Another series of stormwater drainage features, consisting of three (3) connected drainage swales, was observed south of Frontage Road between the overpass and the roadway. These drainages ditches also meet the definition of a watercourse. Although no flow was observed at the time of the field review, evidence of flow, including scour and sediment deposition, was observed. This segment is outside of the floodplain but is located entirely within an Aquifer Protection Area. No other sensitive or wetland resource areas were identified within or adjacent to Segment 5.

Work proposed within Segment 5 will occur within Upland Review Area and an Aquifer Protection Area. Upland Review Area within this segment is associated with watercourses observed along Chapman Woods Road and south of Frontage Road. Work to install a bus shelter and the eight-foot wide shared use path will impact Upland Review Area. Work within the Upland Review Area is not anticipated to impact any vegetated wetlands or watercourses.

Segment 6 – Frontage Road to U.S. Route 1 (Boston Post Road)

This segment is within a commercial area (Figure 2f). Vegetated wetlands are mapped within the Project Corridor at the northern end of this segment between Flanders Donut & Bake Shop and Latimer Brook Commons. This wetland area is located at the rear of existing commercial businesses, accordingly, a visual inspection during field review was not feasible. This segment is outside of the floodplain but is located partially within an Aquifer Protection Area. No other sensitive or wetland resource areas were identified within or adjacent to Segment 6.

Work proposed within Segment 6 will occur within Upland Review Area and an Aquifer Protection Area. Upland Review Area appears to be present associated with vegetated wetlands at the northern end of this segment between Flanders Donut & Bake Shop and Latimer Brook Commons. Work to install the shared used path west of Route 161, construct the sidewalk east of Route 161, and install bus pull out shelters and pull outs may be within Upland Review Area. Work within the Upland Review Area is not anticipated to impact any vegetated wetlands or watercourses.

Segment 7 - U.S. Route 1 (Boston Post Road) to East Lyme High School

This segment is within commercial area that transitions to residential areas north of this segment (Figure 2g). A mapped vegetated wetland associated with Latimer Brook was observed east of this segment located at the rear of residential and commercial properties. An Aquifer Protection Area is mapped along the western side of this segment but remains outside of the Project Corridor. This segment is outside of

[2] A Watercourse as defined in Section 2 of the Bylaw means *rivers, streams, brooks, waterways, lakes, ponds, marshes, swamps, bogs, and all other bodies of water, natural or artificial, vernal or intermittent, public or private, which are contained within, flow through, or border upon the Town…*

the floodplain, and no other sensitive or wetland resource areas were identified within or adjacent to Segment 7.

Work proposed within Segment 7 will occur within Upland Review Area and an Aquifer Protection Area. Upland Review Area associated with the vegetated wetlands is present at the northern extent of this segment. Installation of the shared use path west of Route 161 will partially be within the Upland Review Area. Work within the Upland Review Area is not anticipated to impact any vegetated wetlands or watercourses.

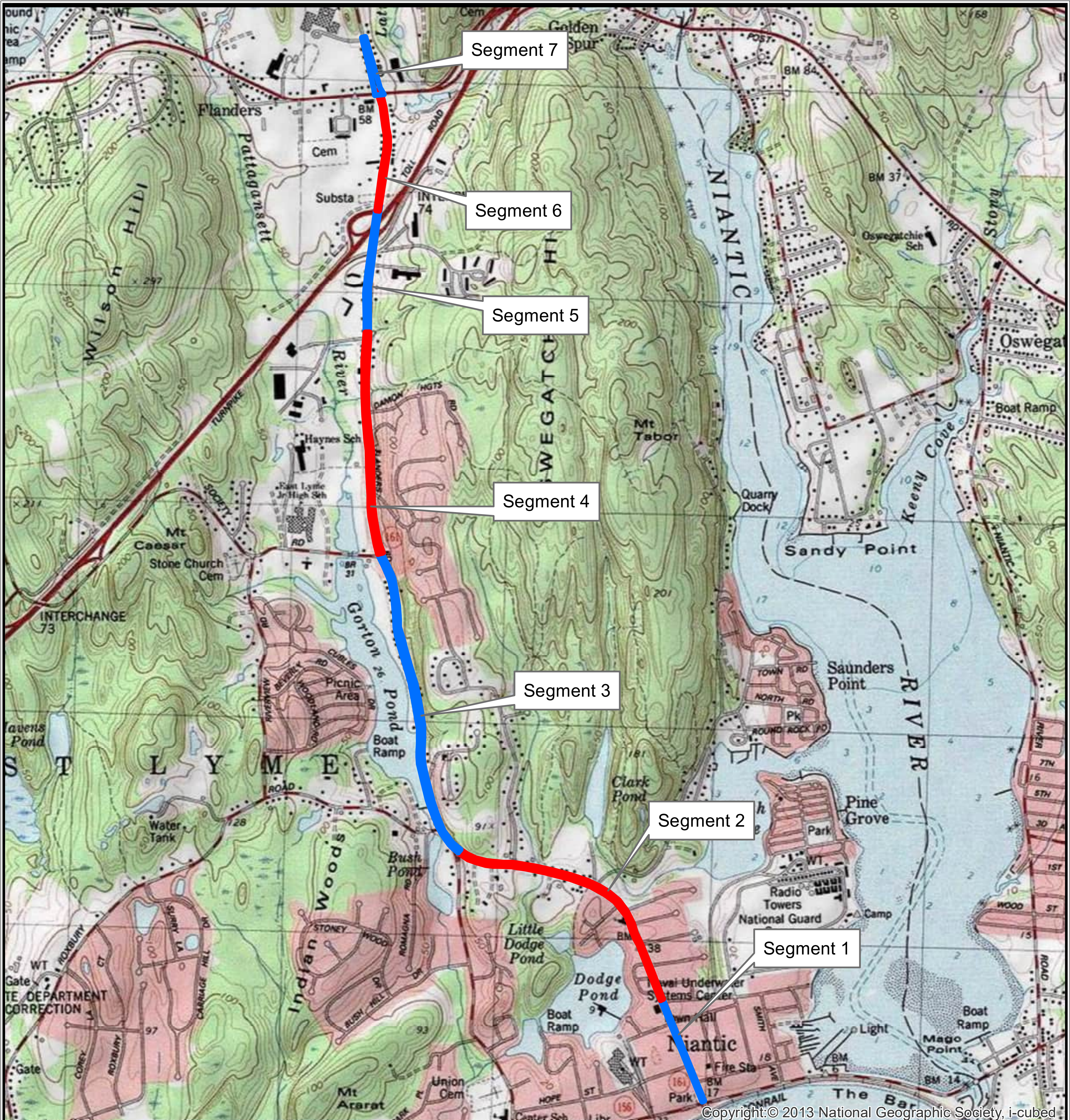
ENVIRONMENTAL PERMITS REQUIRED

Given the impacts associated with the proposed improvements and because it is anticipated that CTDOT funding will be pursued for implementation, the following environmental permits will be required to complete permitting for each of the Project segments.

- Town of East Lyme Inland Wetlands Permit for all Segments;
- Self-Verification Notification Form or Pre-Construction Notification under the US Army Corps of Engineers Section 404 Connecticut General Permits 17A for Segment 3, and potentially Segments 2 and 4, depending on final impacts;
- Submission of the Land and Water Resource Division (LWRD) License Application (Form L) to CTDEEP for Inland Wetlands and Watercourses and required attachments for Segment 3, and potentially Segments 2 and 4. Coordination with CTDEEP will be conducted during preliminary design to confirm CTDEEP filing requirements;
- NDDB Consultation Submission for Segments 1, 2 and 3;
- DEEP Stormwater Permit for the Project as a whole, as earth disturbance is anticipated to exceed two acres;
- Coastal Management Act Site Plan Review for Segment 1;
- East Lyme Floodplain Development Permit Application for Segment 3; and
- For state-funded projects, the work will require review and confirmation that the project will not have an effect or adverse effect on historic and / or archaeological resources. A Project Notification Form is required to be submitted to CT State Historic Preservation Office (SHPO), as required for state-funded projects, to comply with the Connecticut Environmental Policy Act (CEPA).

Attachments:

1. Figure 1: Site Locus
2. Figure 2a to 2g: Environmental Resource Maps
3. Figure 3: FEMA Flood Maps



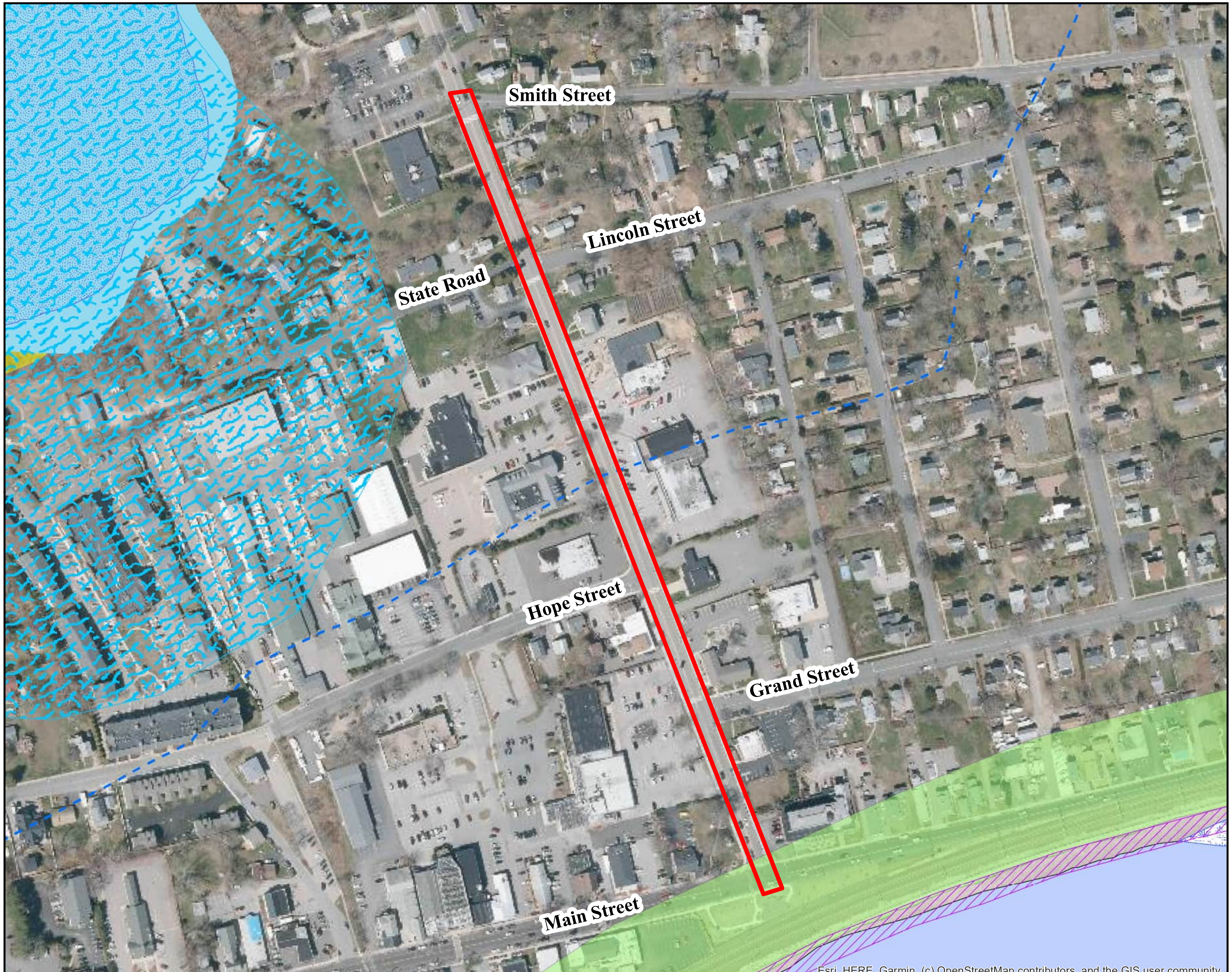
IMPROVING COMMUNITIES TOGETHER

Figure 1
Overview Map
Route 161
East Lyme, CT

Legend

Site Locus

Figure 2a
Environmental Resources Map Segment 1
Route 156 to Smith Street
East Lyme, CT



Legend

- Site Locus - Segment 1
- Coastal Area Boundary
- Aquifer Protection Area
- Critical Habitat
- Natural Diversity Database Area

National Wetlands Inventory

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Lake

CTDEP Wetlands

- Water

FEMA Floodplains

- 0.2% Annual Flood Hazard
- VE

N
W E
S

0 200 400 Feet

1 inch = 200 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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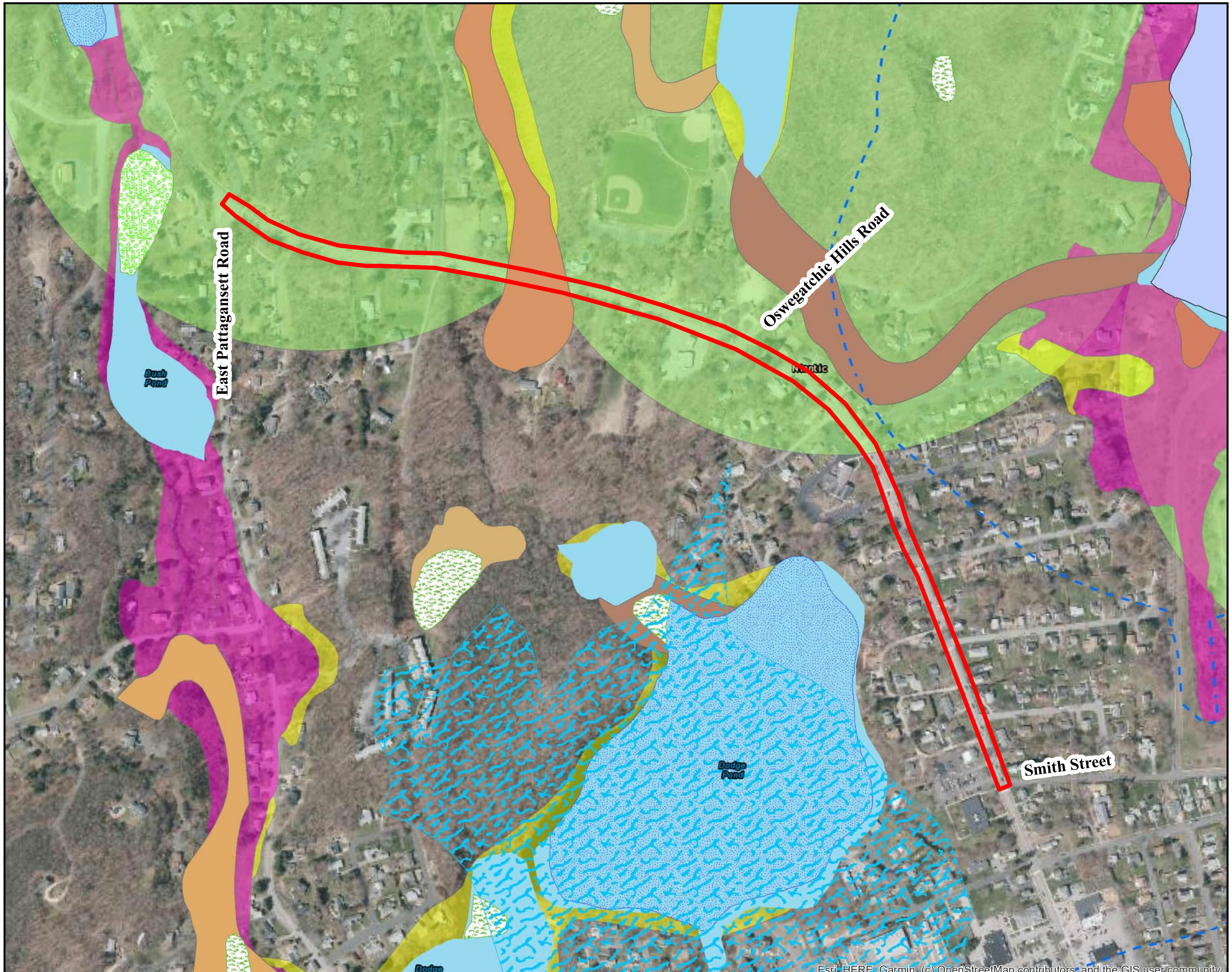
Figure 2b
Environmental Resources Map Segment 2
Smith Street to East Pattagansett Road
East Lyme, CT



Legend

- Site Locus - Segment 2
- Coastal Area Boundary
- Aquifer Protection Area
- Natural Diversity Database Area

National Wetlands Inventory

- Estuarine and Marine Deepwater
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake

CTDEP Wetlands

- Ipswich mucky peat
- Raypol silt loam
- Ridgebury, Leicester, and Whitman soils, extremely stony
- Scarboro muck
- Timakwa and Natchaug soils
- Water

FEMA Floodplains

- 0.2% Annual Flood Hazard
- AE

N
W E
S

0 400 800 Feet

1 inch = 396 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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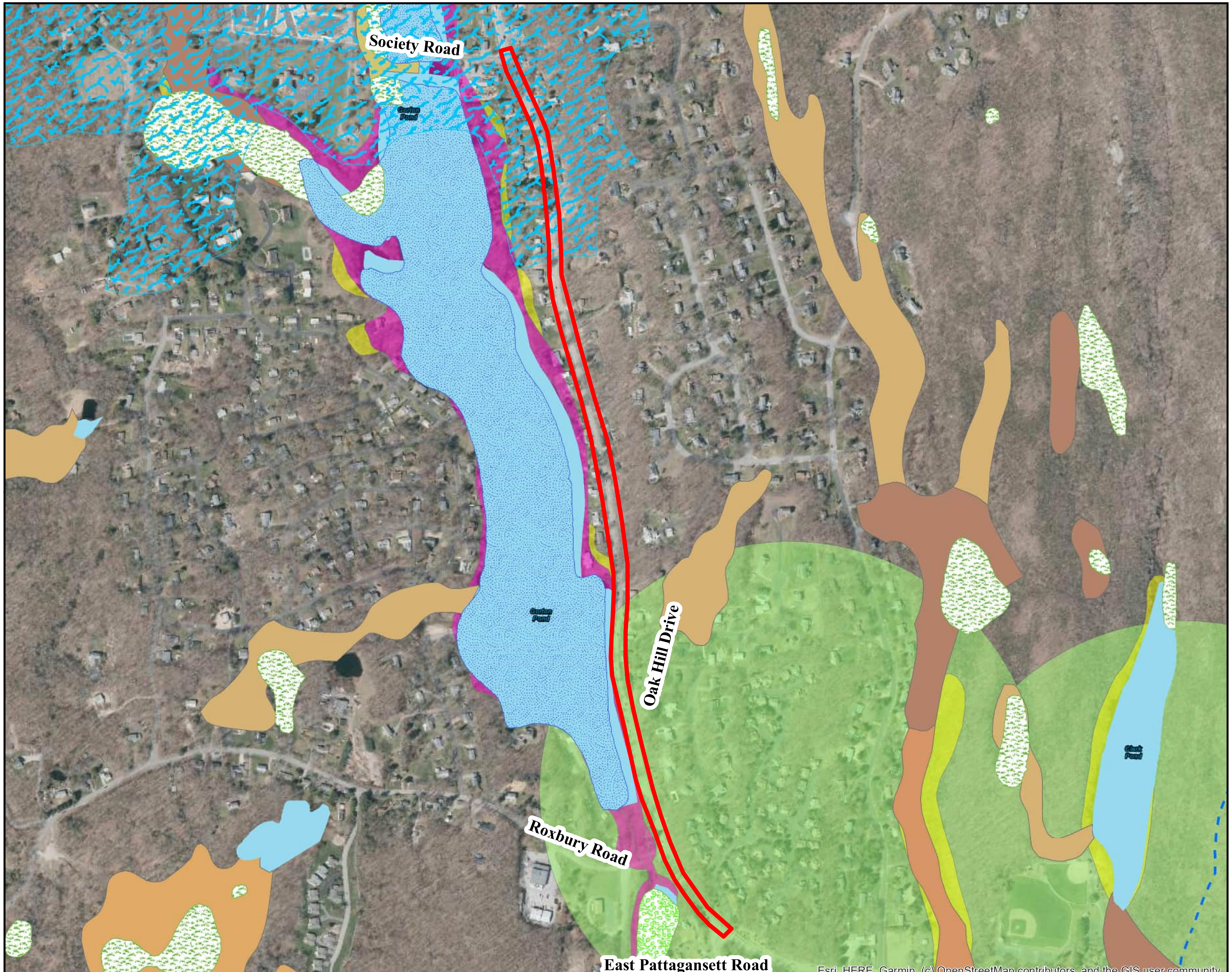
Figure 2c
Environmental Resources Map Segment 3
East Pattagansett Road to Society Road
East Lyme, CT



Legend

- Site Locus - Segment 3
- Aquifer Protection Area
- Coastal Area Boundary
- Natural Diversity Database Area

National Wetlands Inventory

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake

CTDEP Wetlands

- Raypol silt loam
- Ridgebury, Leicester, and Whitman soils, extremely stony
- Scarboro muck
- Timakwa and Natchaug soils
- Walpole sandy loam
- Water

FEMA Floodplains

- 0.2% Annual Flood Hazard
- AE

N S W E

0 500 1,000 Feet

1 inch = 520 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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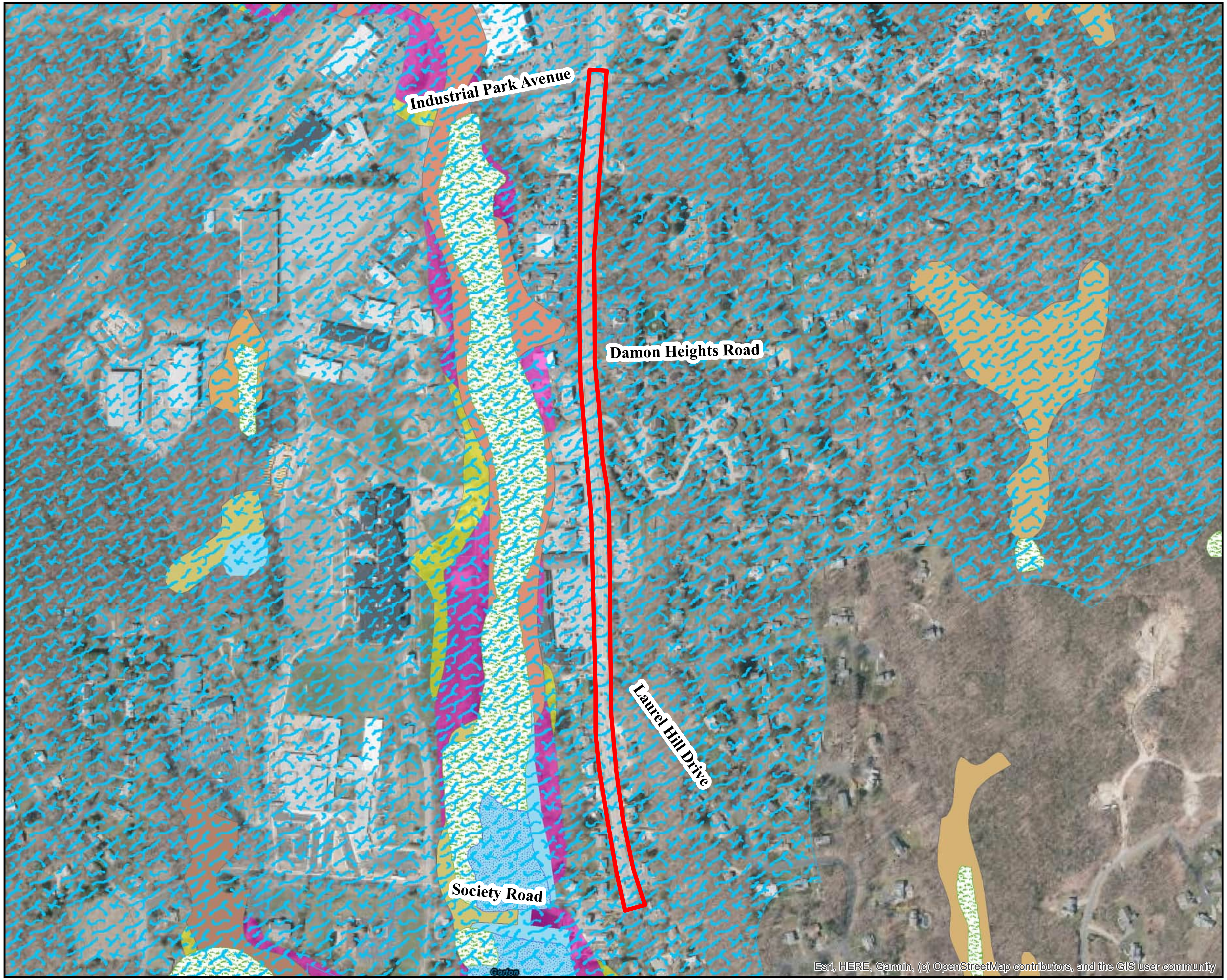
Figure 2d
Environmental Resources Map Segment 4
Society Road to Industrial Park Road
East Lyme, CT



Legend

- Site Locus - Segment 4
- Aquifer Protection Area

National Wetlands Inventory

- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake

CTDEP Wetlands

- Ridgebury, Leicester, and Whitman soils, extremely stony
- Rippowam fine sandy loam
- Scarboro muck
- Timakwa and Natchaug soils
- Walpole sandy loam
- Water

FEMA Floodplains

- 0.2% Annual Flood Hazard
- AE

N
W E
S

0 400 800 Feet

1 inch = 400 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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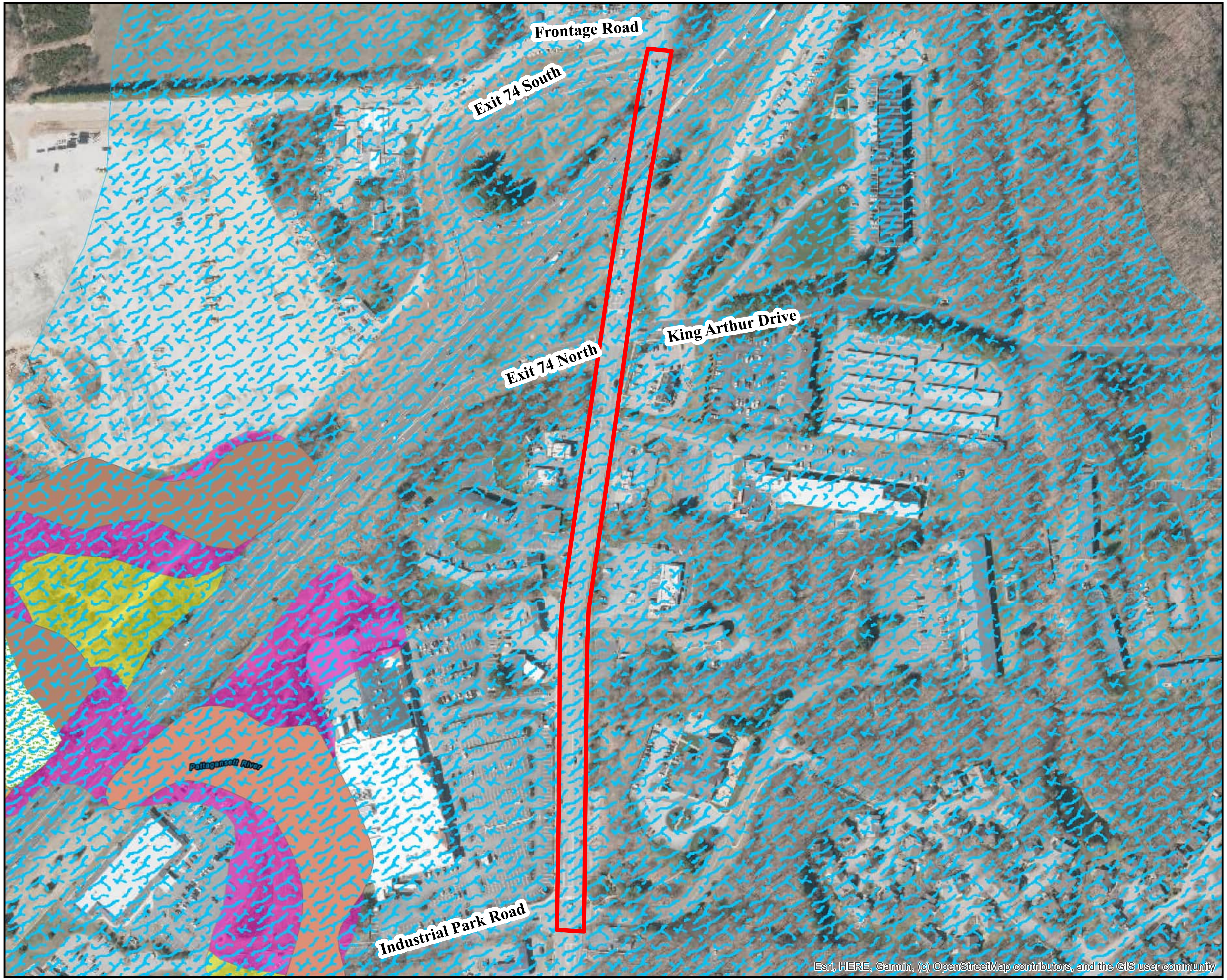
Figure 2e
Environmental Resources Map Segment 5
Industrial Park Road to Frontage Road
East Lyme, CT



Legend

- Site Locus - Segment 5
- Aquifer Protection Area

National Wetlands Inventory

- Freshwater Forested/Shrub Wetland

CTDEP Wetlands

- Rippowam fine sandy loam
- Scarboro muck
- Timakwa and Natchaug soils

FEMA Floodplains

- 0.2% Annual Flood Hazard
- AE

N W E S

0 225 450 Feet

1 inch = 225 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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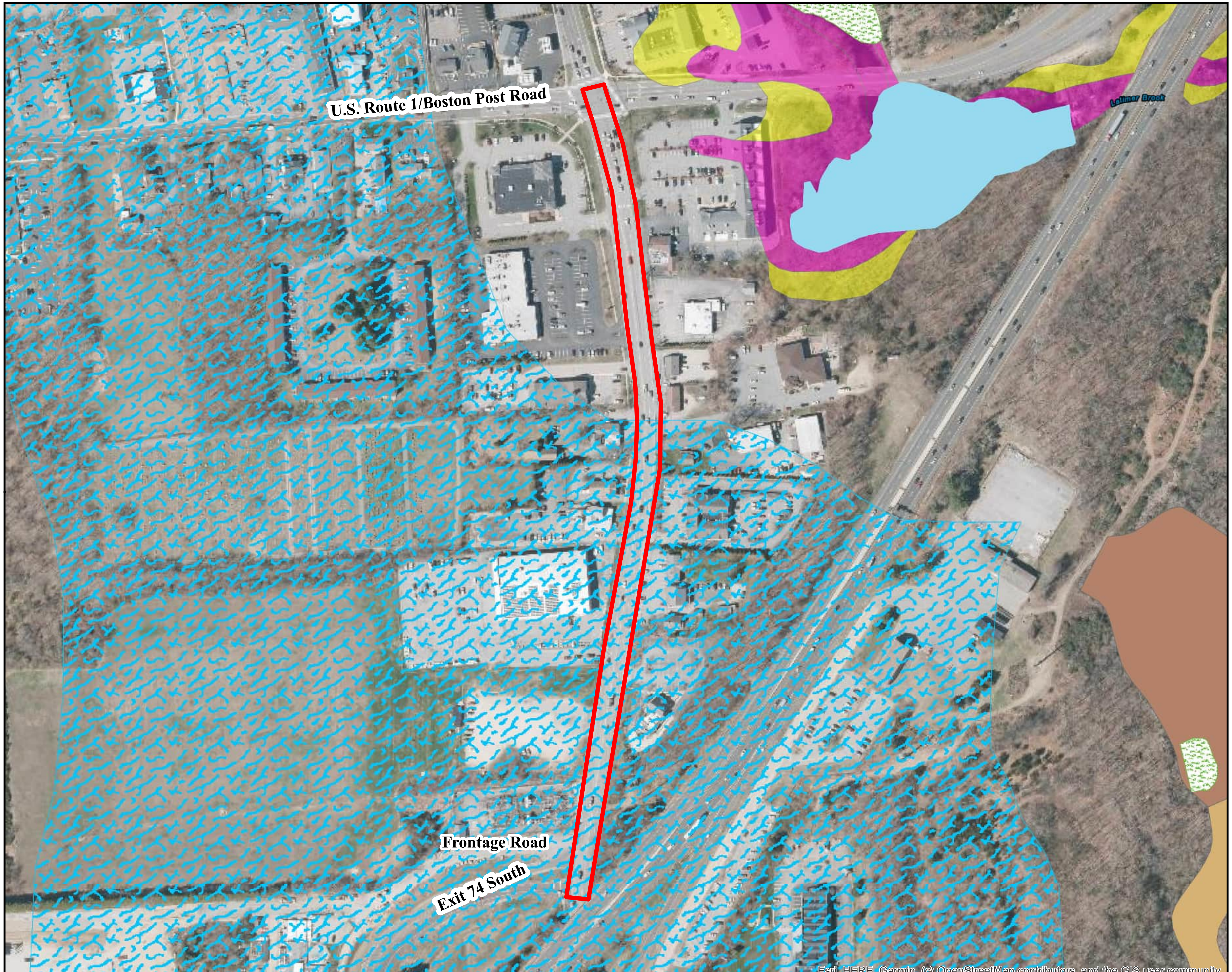
Figure 2f
Environmental Resources Map Segment 6
Frontage Road to U.S. Route 1
East Lyme, CT



Legend

- Site Locus Segment 6
- Aquifer Protection Area

National Wetlands Inventory

- Freshwater Forested/Shrub Wetland
- Freshwater Pond

CTDEP Wetlands

- Ridgebury, Leicester, and Whitman soils, extremely stony
- Rippowam fine sandy loam
- Timakwa and Natchaug soils
- Water

FEMA Floodplains

- 0.2% Annual Flood Hazard
- AE

N
W E
S

0 225 450 Feet

1 inch = 225 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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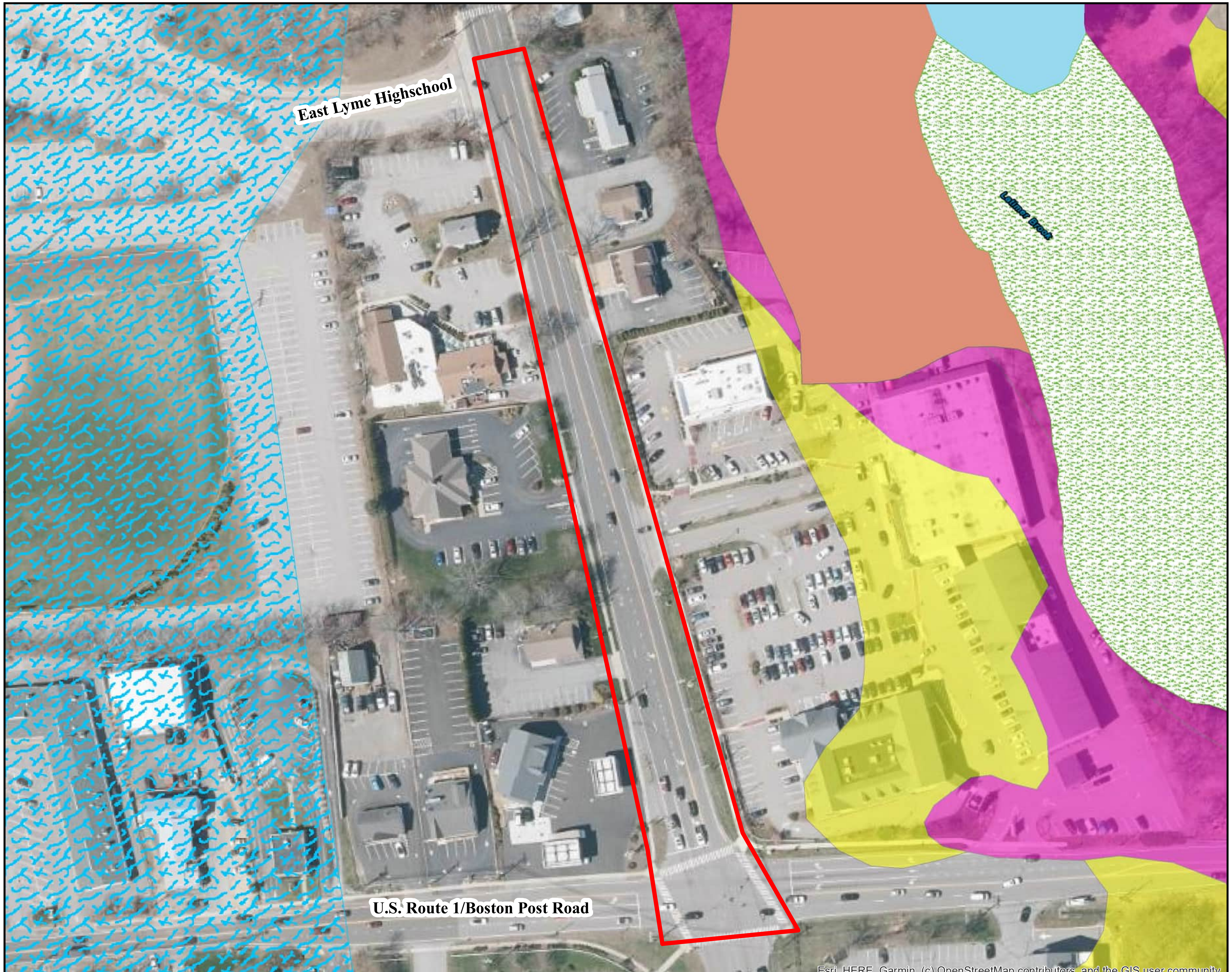
Figure 2g
Environmental Resources Map Segment 7
U.S. Route 1 to East Lyme High School
East Lyme, CT



Legend

- Site Locus - Segment 7
- Aquifer Protection Area

National Wetlands Inventory

- Freshwater Forested/Shrub Wetland
- Freshwater Pond

CTDEP Wetlands

- Rippowam fine sandy loam

FEMA Floodplains

- 0.2% Annual Flood Hazard
- AE

N
W E
S

0 100 200 Feet

1 inch = 99 feet

Data Source: MassGIS USGS Color Ortho Imagery (2014), MassDEP Wetlands (1:12000) (2009), NHESP Potential Vernal Pools (2000), NHESP Certified Vernal Pools, NHESP Priority Habitats of Rare Species (2008), NHESP Estimated Habitats of Rare Species (2008), Areas of Critical Environmental Concern (2009), FEMA National Flood Hazard Layer (2014),

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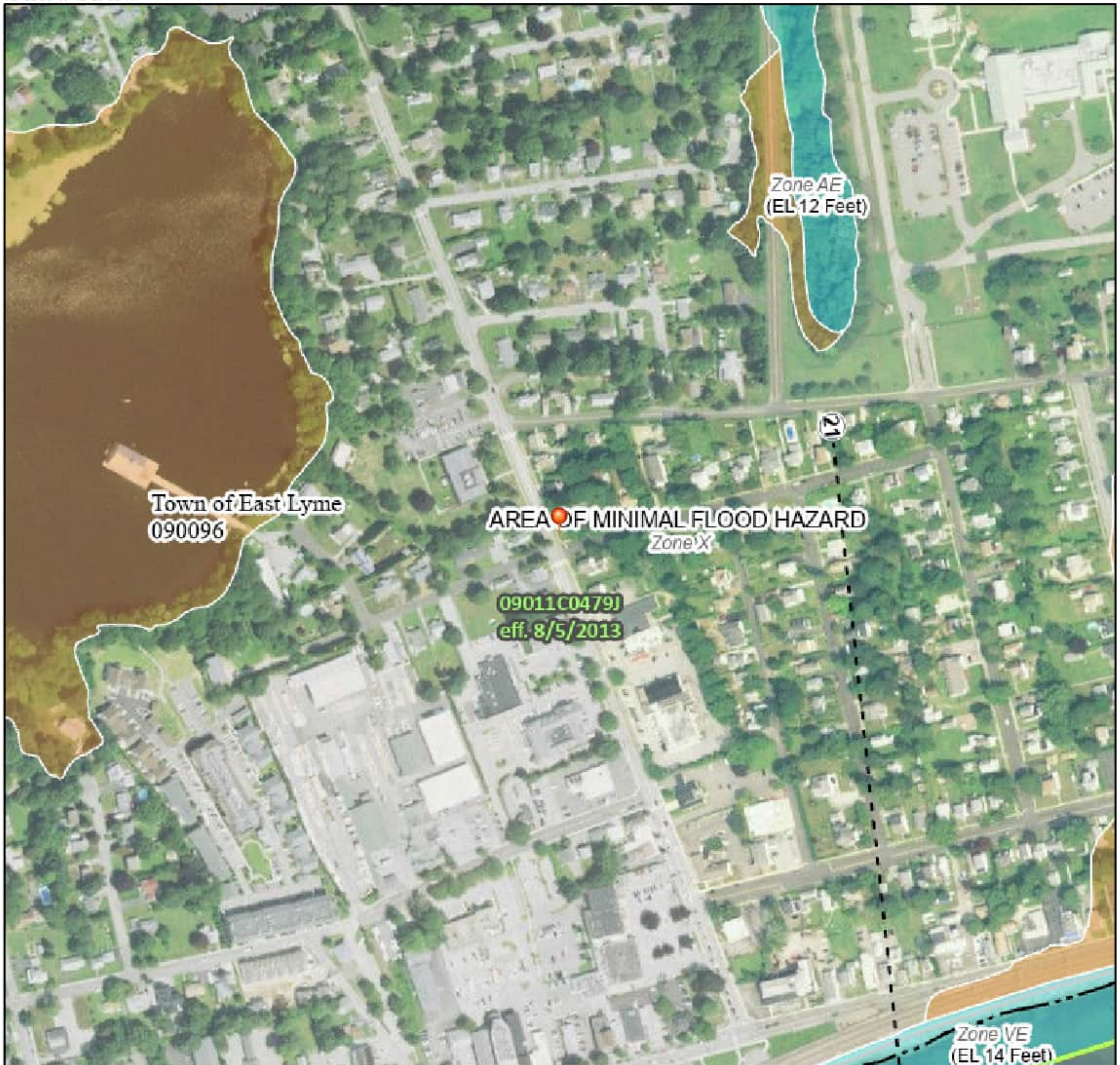
National Flood Hazard Layer FIRMette

FEMA

72°11'56"W 41°19'51"N



72°11'18"W 41°19'24"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

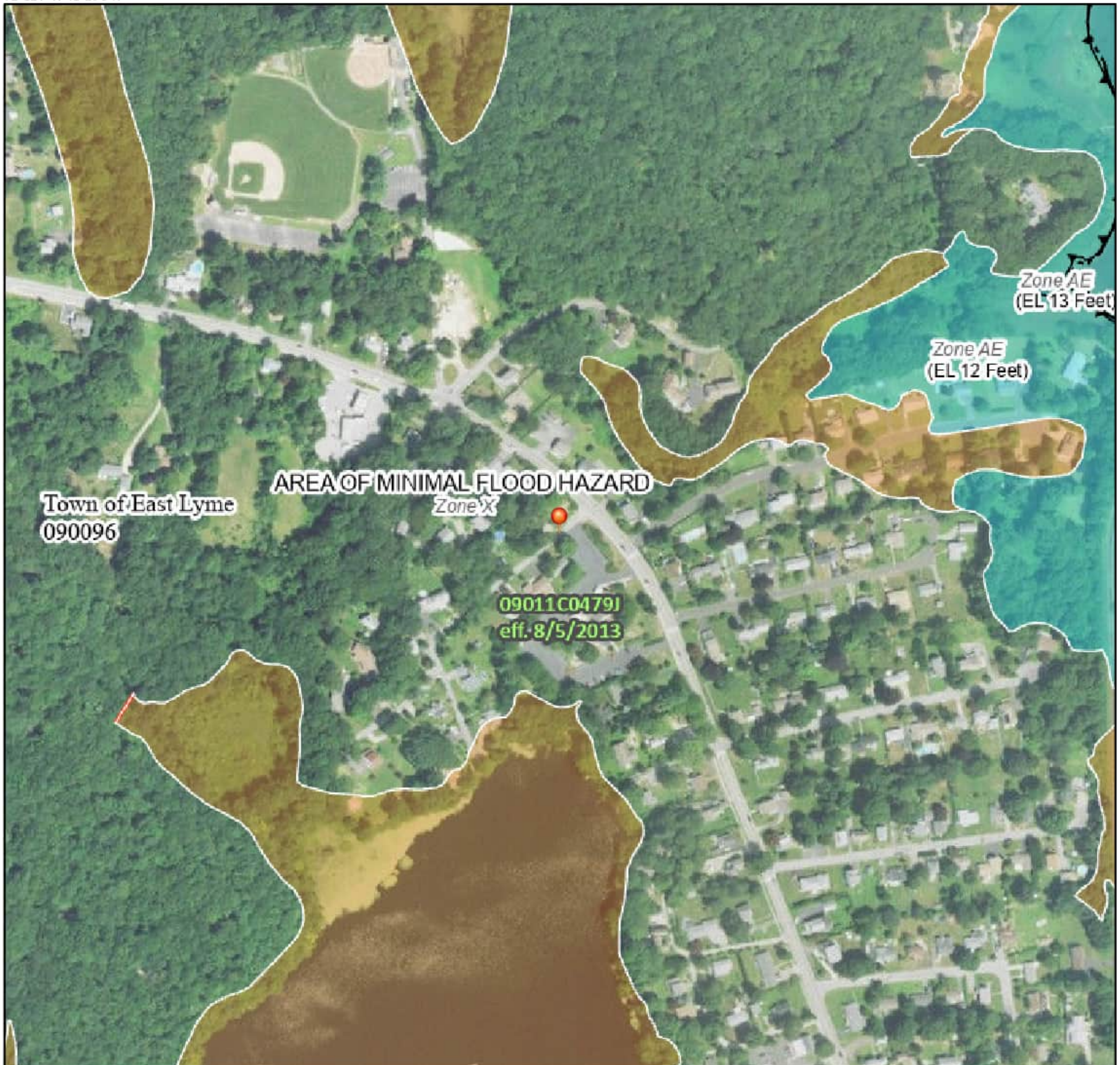
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/12/2023 at 2:40 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

72°12'7"W 41°20'8"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

72°11'30"W 41°19'41"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

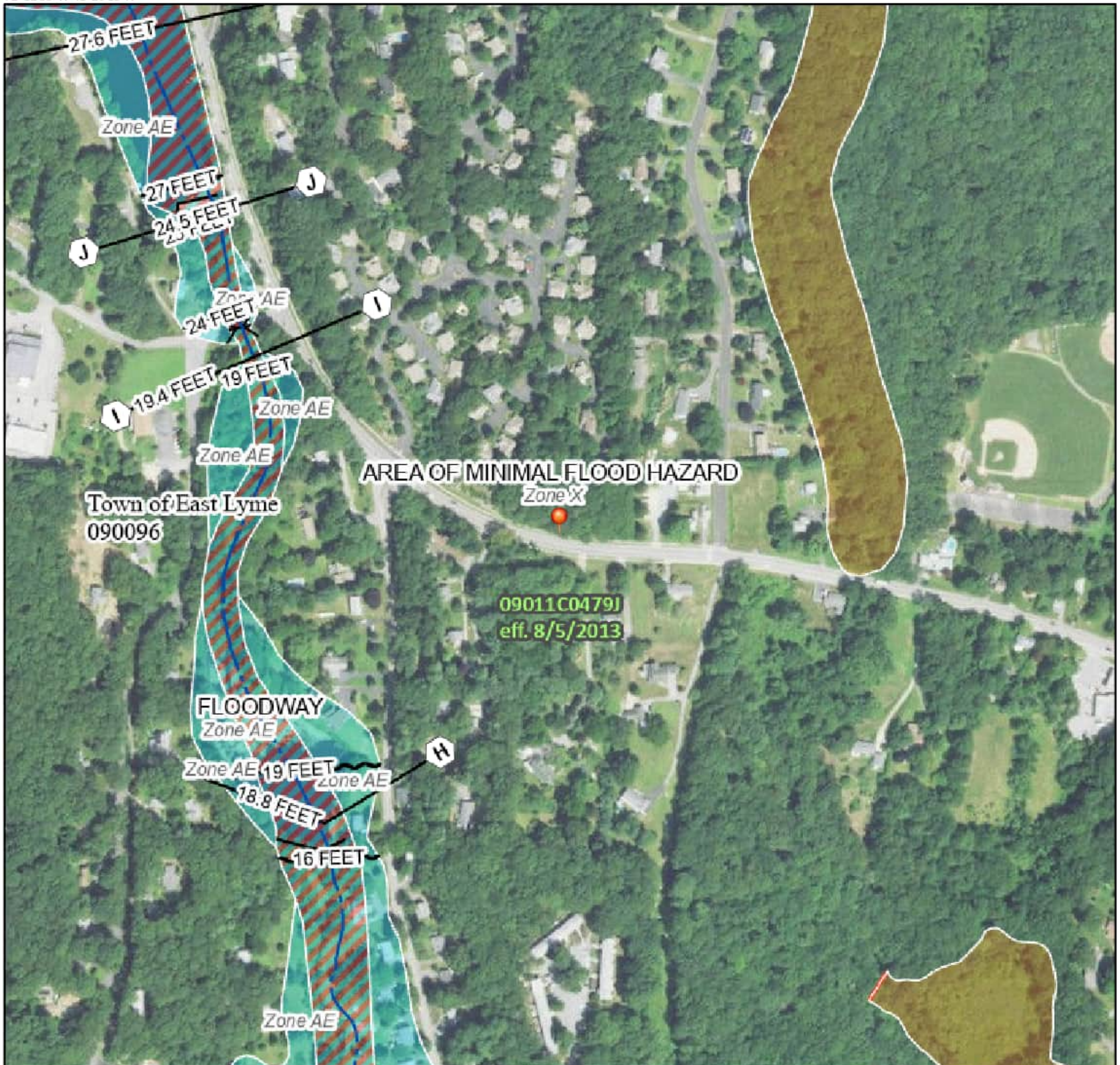
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/12/2023 at 2:45 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

72°12'33"W 41°20'15"N



72°11'55"W 41°19'48"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/12/2023 at 2:45 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

72°12'46"W 41°20'33"N

72°12'8"W 41°20'6"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

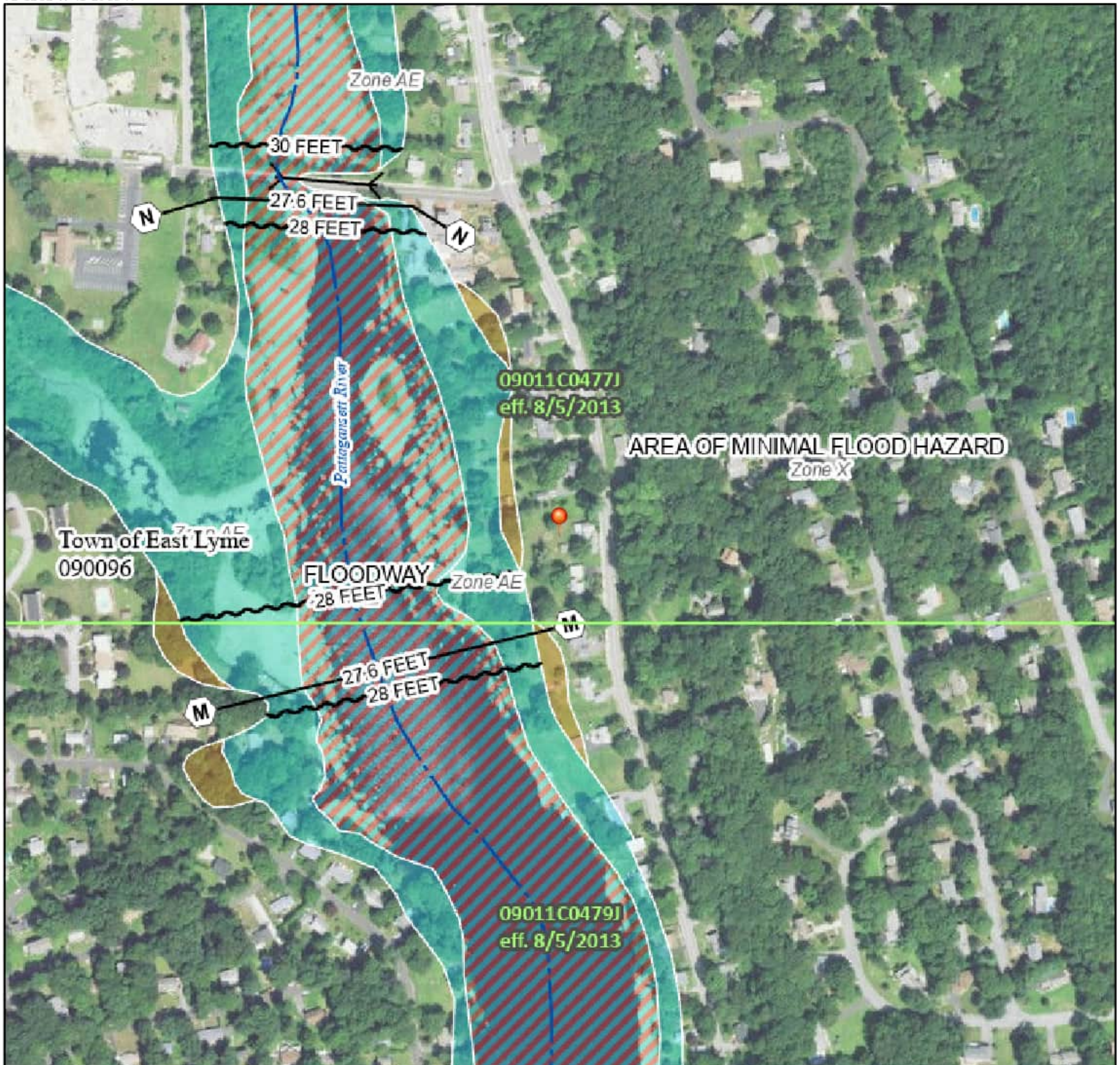
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/12/2023 at 3:04 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

72°12'52"W 41°20'53"N



72°12'15"W 41°20'26"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

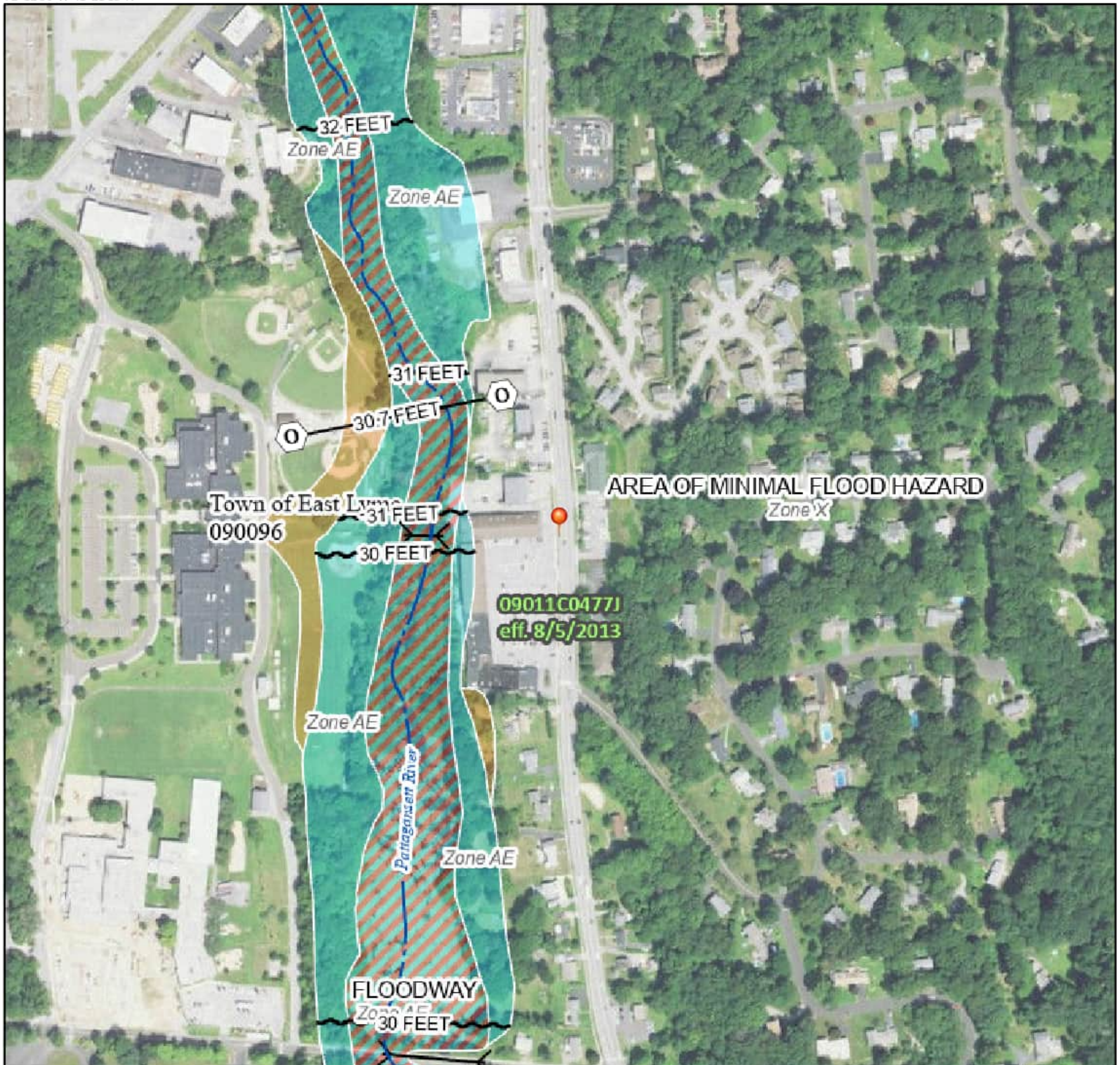
The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/12/2023 at 3:05 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

National Flood Hazard Layer FIRMette

FEMA

72°12'56"W 41°21'15"N



72°12'18"W 41°20'48"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

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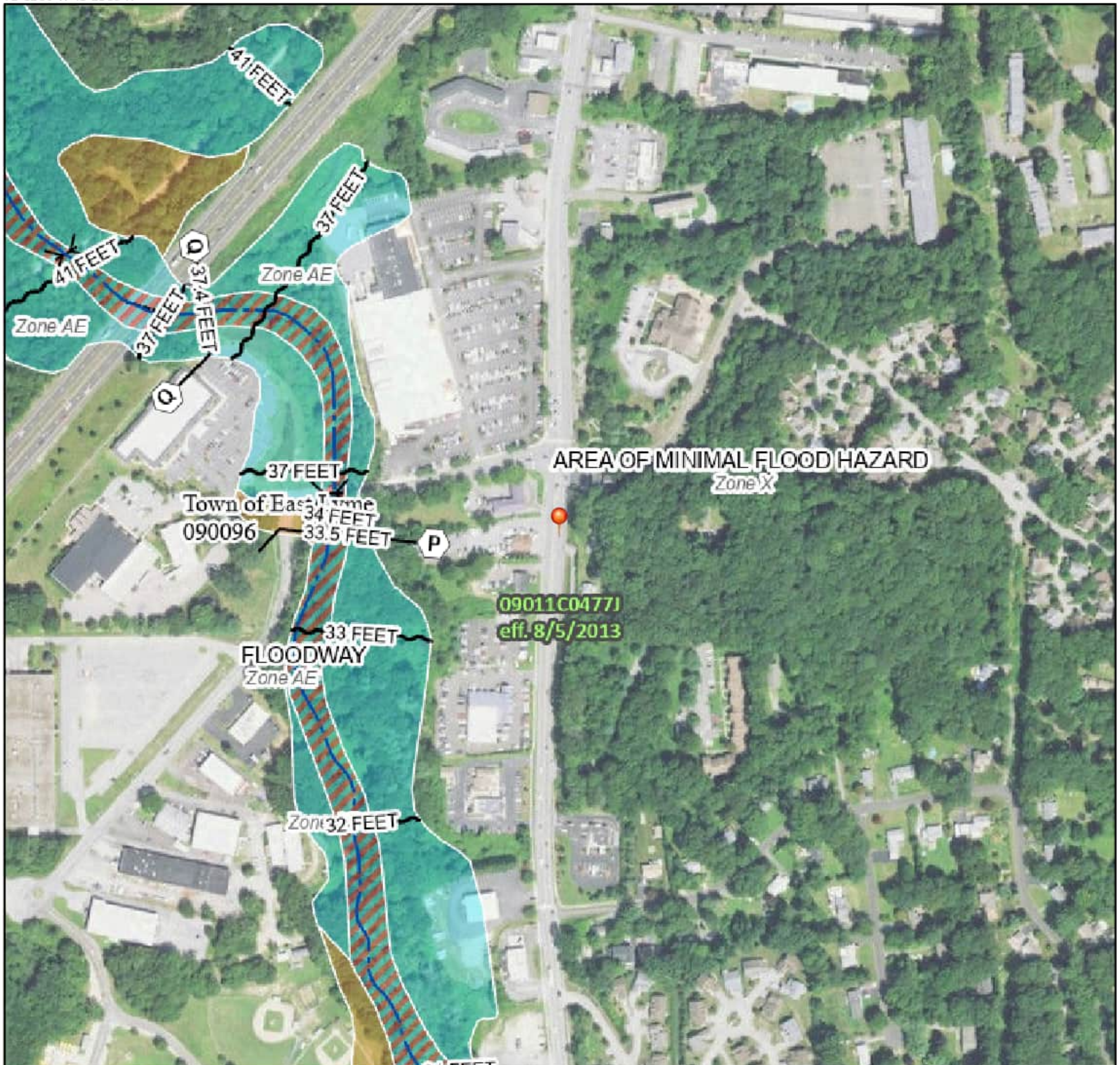
National Flood Hazard Layer FIRMette

FEMA

72°12'56"W 41°21'33"N



72°12'18"W 41°21'6"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99* With BFE or Depth *Zone AE, AO, AH, VE, AR* Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X* Future Conditions 1% Annual Chance Flood Hazard *Zone X* Area with Reduced Flood Risk due to Levee. See Notes. *Zone X* Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN Area of Minimal Flood Hazard *Zone X* Effective LOMRs Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES	Channel, Culvert, or Storm Sewer Levee, Dike, or Floodwall
OTHER FEATURES	20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation Coastal Transect Base Flood Elevation Line (BFE) Limit of Study Jurisdiction Boundary Coastal Transect Baseline Profile Baseline Hydrographic Feature
MAP PANELS	Digital Data Available No Digital Data Available Unmapped

N

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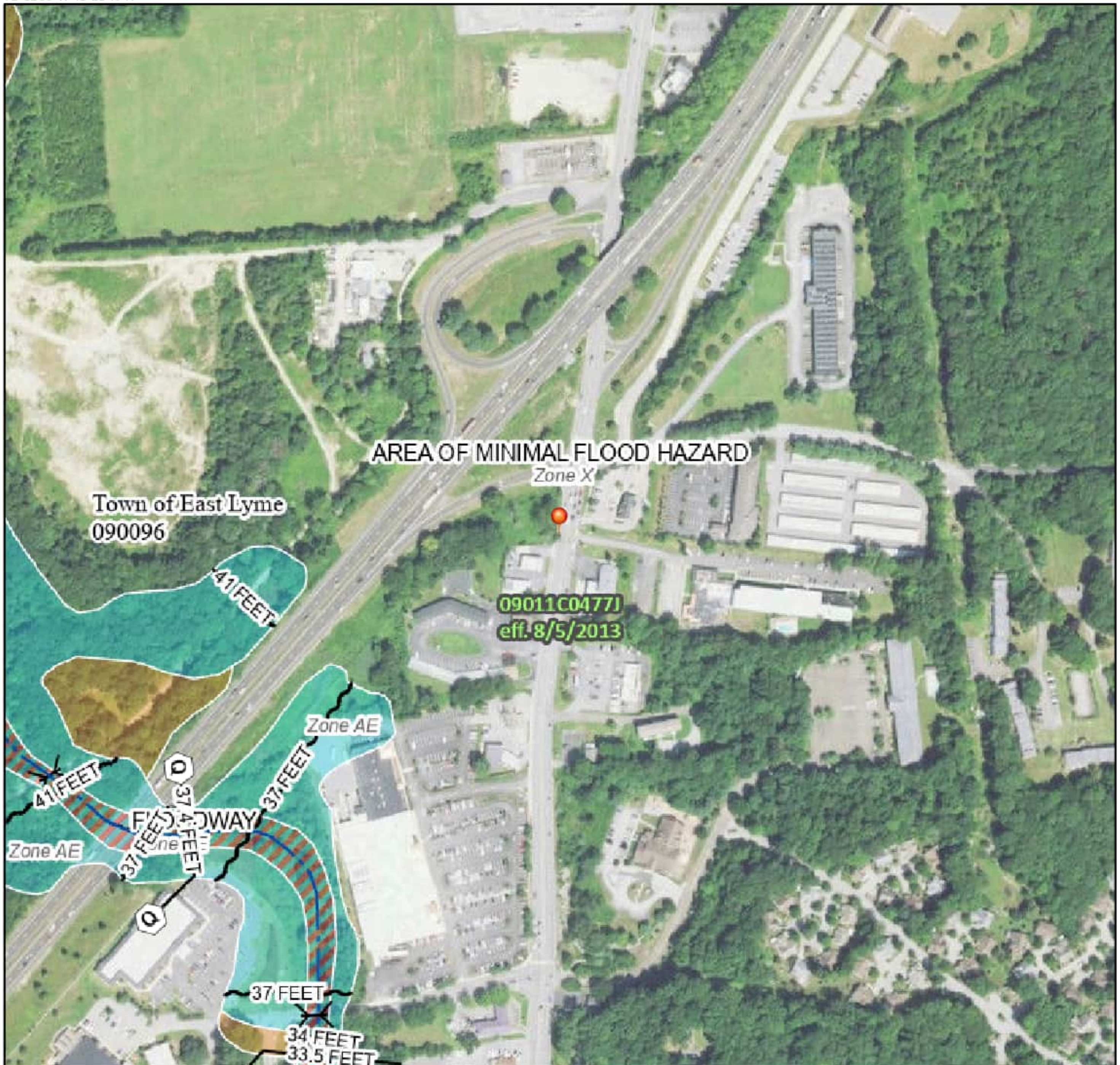
National Flood Hazard Layer FIRMette

FEMA

72°12'55"W 41°21'46"N



72°12'18"W 41°21'19"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) *Zone A, V, A99*
		With BFE or Depth *Zone AE, AO, AH, VE, AR*
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
		Future Conditions 1% Annual Chance Flood Hazard *Zone X*
		Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
		Area with Flood Risk due to Levee *Zone D*
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

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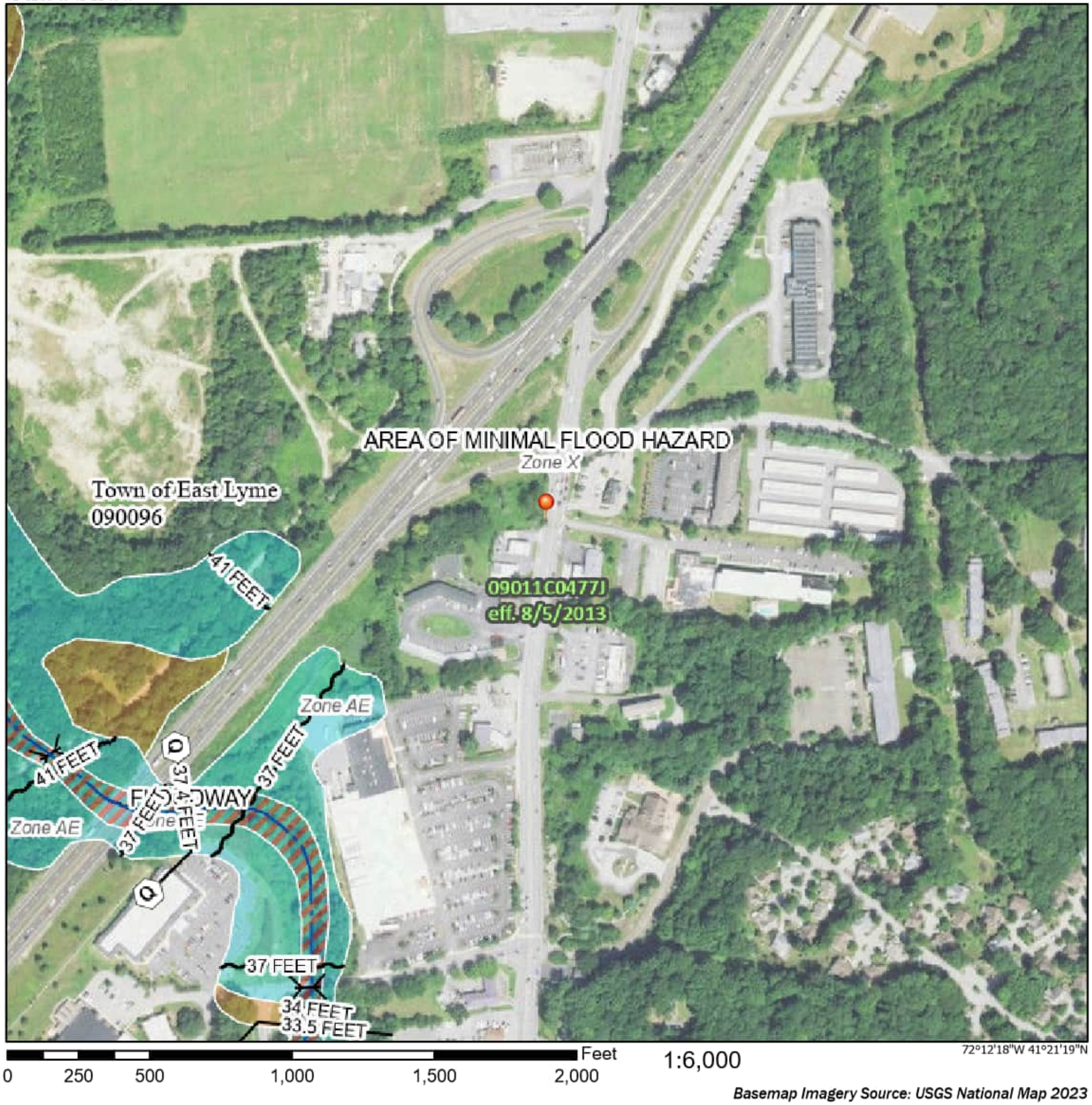
National Flood Hazard Layer FIRMette

FEMA

72°12'55"W 41°21'46"N



72°12'18"W 41°21'19"N

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS		Without Base Flood Elevation (BFE) Zone A, V, A99
		With BFE or Depth Zone AE, AO, AH, VE, AR
		Regulatory Floodway
OTHER AREAS OF FLOOD HAZARD		0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile Zone X
		Future Conditions 1% Annual Chance Flood Hazard Zone X
		Area with Reduced Flood Risk due to Levee. See Notes. Zone X
		Area with Flood Risk due to Levee Zone D
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard Zone X
		Effective LOMRs
		Area of Undetermined Flood Hazard Zone D
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	20.2 / 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
		Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

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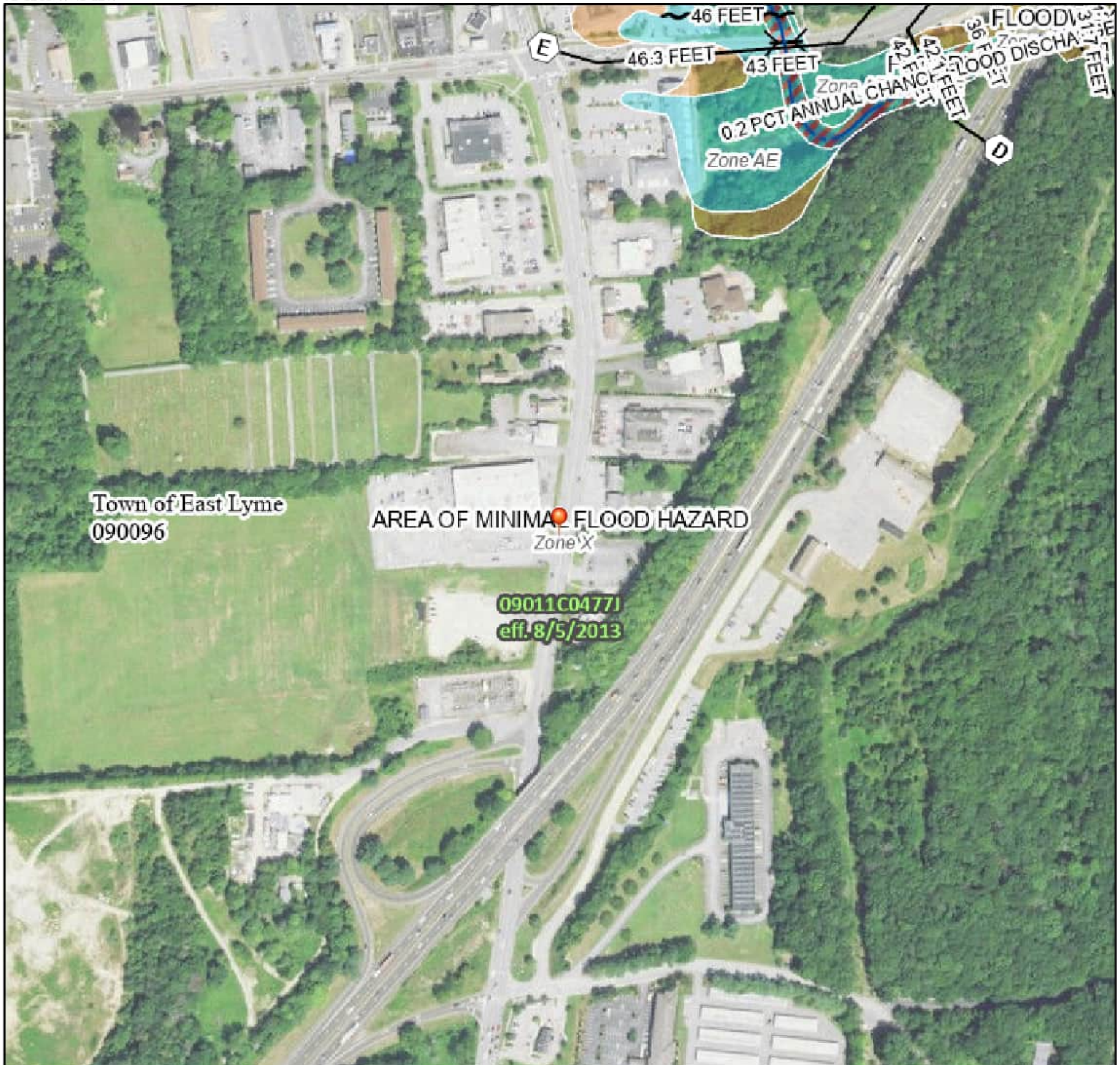
National Flood Hazard Layer FIRMette

FEMA

72°12'53"W 41°22'N



72°12'15"W 41°21'33"N

0 250 500 1,000 1,500 2,000 Feet

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- 20.2 / 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- Coastal Transect
- Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

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The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/12/2023 at 3:22 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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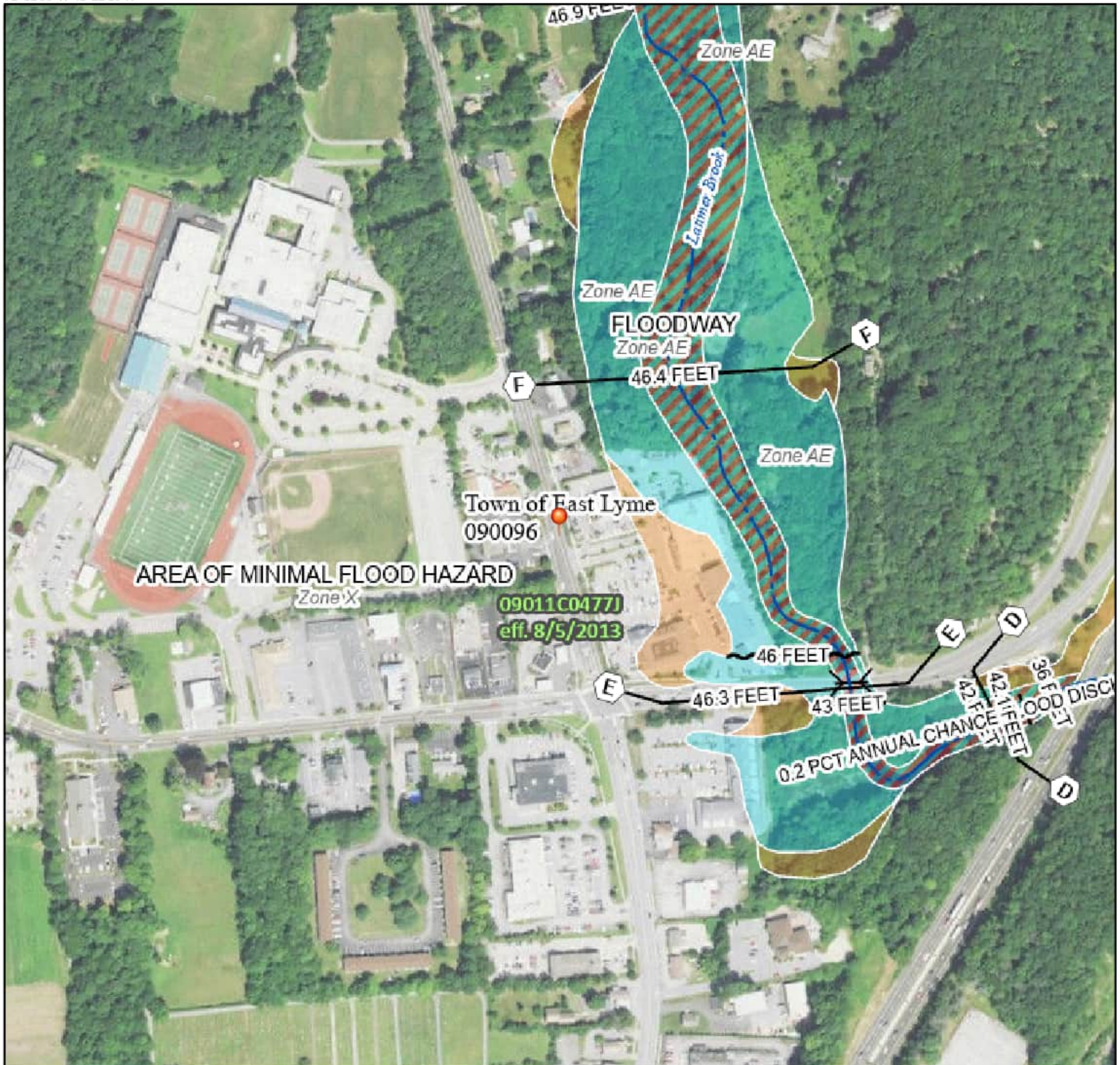
National Flood Hazard Layer FIRMette

FEMA

72°12'55"W 41°22'16"N



0 250 500 1,000 1,500 2,000 Feet

1:6,000

72°12'17"W 41°21'49"N

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS	Without Base Flood Elevation (BFE) *Zone A, V, A99*	
	With BFE or Depth *Zone AE, AO, AH, VE, AR*	
	Regulatory Floodway	
OTHER AREAS OF FLOOD HAZARD	0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*	
	Future Conditions 1% Annual Chance Flood Hazard *Zone X*	
	Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*	
	Area with Flood Risk due to Levee *Zone D*	
OTHER AREAS	NO SCREEN	Area of Minimal Flood Hazard *Zone X*
		Effective LOMRs
		Area of Undetermined Flood Hazard *Zone D*
GENERAL STRUCTURES		Channel, Culvert, or Storm Sewer
		Levee, Dike, or Floodwall
OTHER FEATURES	B 20.2 17.5	Cross Sections with 1% Annual Chance Water Surface Elevation
	8	Coastal Transect
	513	Base Flood Elevation Line (BFE)
		Limit of Study
		Jurisdiction Boundary
		Coastal Transect Baseline
		Profile Baseline
		Hydrographic Feature
MAP PANELS		Digital Data Available
		No Digital Data Available
		Unmapped

N

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APPENDIX E
CONSTRUCTION COST ESTIMATES

Bike Lanes and Pocket Parking
Route 161 - Route 156 (Main Street) to Hope Street
Construction Cost Estimate

Major and Minor Contract Items

Item No.	Item	Unit	Quantity	Unit $	Total Cost
0202000	EARTH EXCAVATION	CY	720	$ 25.00	$ 18,000.00
0209001	FORMATION OF SUBGRADE	SY	32	$ 3.30	$ 105.60
0304002	PROCESSED AGGREGATE BASE	CY	11	$ 60.00	$ 660.00
0406170	HMA S1	TON	7	$ 150.00	$ 1,050.00
0406171	HMA S0.5	TON	7	$ 128.00	$ 896.00
0406236A	MATERIAL FOR TACK COAT	GAL	3	$ 8.00	$ 24.00
0586600	RESET CATCH BASIN	EA	5	$ 1,500.00	$ 7,500.00
0813012	5" X 18" GRANITE STONE CURBING	LF	140	$ 42.00	$ 5,880.00
0921001A	CONCRETE SIDEWALK	SF	380	$ 14.00	$ 5,320.00
0921005A	CONCRETE SIDEWALK RAMP	SF	285	$ 28.00	$ 7,980.00
0921048A	DETECTABLE WARNING STRIP	EA	2	$ 72.00	$ 144.00
0970006A	TRAFFICPERSON (MUNICIPAL POLICE OFFICER)	ALL	1	$ 12,500.00	$ 12,500.00
0970007A	TRAFFICPERSON (UNIFORMED FLAGGER)	HR	80	$ 75.00	$ 6,000.00
Major Items Subtotal					$ 66,060
Minor Items Subtotal		20	% of Line "A"		$ 13,212
Major and Minor Contract Items Subtotal (A + B)					$ 79,272
Other Item Allowances					
0971001A M & P of Traffic (suggested 2% - 5%)		2	% of Line "C"		$ 1,585
0975004 Mobilization (suggested 4% - 10%)		5	% of Line "C"		$ 3,964
0980001 Construction Staking (suggested 1% - 2%)		1	% of Line "C"		$ 793
Other Items Subtotal					$ 6,342
CONTRACT SUBTOTAL (C + D)					$ 85,614
Inflation Costs (Simple Method)					
Date of Estimate (provide date of estimate)		Mar-23			
Anticipated Bid Date (provide anticipated bid date)					
Annual Inflation (4% annually)					
Inflation Subtotal		0.0%	of Line "E"		$ -
TOTAL CONTRACT COST ESTIMATE (E + F) (Rounded to nearest $1000)					$ 86,000

LOTCIP Project Costs Summary		
Contract Cost Estimate (Line "G")		$ 86,000
Contingencies	25%	$ 21,500
Incidentals	20%	$ 17,200
ROW	LS	$ -
Utilities	LS	$ -
TOTAL PROJECT COST		$ 124,700

Roundabout
Route 161 at East Pattagansett Road
Construction Cost Estimate

Major and Minor Contract Items

Item No.	Item	Unit	Quantity	Unit $	Total Cost
0202000	EARTH EXCAVATION	CY	2470	$ 25.00	$ 61,750.00
0202529A	CUT BITUMINOUS CONCRETE PAVEMENT	LF	150	$ 4.00	$ 600.00
0209001	FORMATION OF SUBGRADE	SY	3690	$ 3.40	$ 12,546.00
0212000	SUBBASE	CY	1230	$ 52.00	$ 63,960.00
0304002	PROCESSED AGGREGATE BASE	CY	440	$ 60.00	$ 26,400.00
0406170	HMA S1	TON	916	$ 150.00	$ 137,400.00
0406171	HMA S0.5	TON	628	$ 123.00	$ 77,244.00
0406236A	MATERIAL FOR TACK COAT	GAL	272	$ 8.00	$ 2,176.00
0406999A	ASPHALT ADJUSTMENT COST	EST	4	$ 10,000.00	$ 40,000.00
0601020	STAMPED CONCRETE	SF	3380	$ 27.00	$ 91,260.00
0811001	CONCRETE CURBING	LF	3110	$ 42.00	$ 130,620.00
0921001A	CONCRETE SIDEWALK	SF	5390	$ 14.00	$ 75,460.00
0921005A	CONCRETE SIDEWALK RAMP	SF	425	$ 28.00	$ 11,900.00
921013	CONCRETE DRIVEWAY APRON (AT ROUNDABOUT)	SF	2924	$ 19.00	$ 55,556.00
0921048A	DETECTABLE WARNING STRIP	EA	16	$ 72.00	$ 1,152.00
0944000A	FURNISHING AND PLACING TOPSOIL	SY	1570	$ 7.50	$ 11,775.00
0950019	TURF ESTABLISHMENT - LAWN	SY	1570	$ 3.00	$ 4,710.00
0970006A	TRAFFICPERSON (MUNICIPAL POLICE OFFICER)	ALL	1	$ 24,500.00	$ 24,500.00
0970007A	TRAFFICPERSON (UNIFORMED FLAGGER)	HR	137	$ 75.00	$ 10,275.00
1118012A	REMOVAL AND/OR RELOCATINO OF TRAFFIC SIGNAL EQUIPMENT	LS	1	$ 8,000.00	$ 8,000.00
	DRAINAGE IMPROVEMENTS	EST	1	$ 160,000.00	$ 160,000.00
Major Items Subtotal					$ 1,007,284
Minor Items Subtotal		20	% of Line "A"		$ 201,457
Major and Minor Contract Items Subtotal (A + B)					$ 1,208,741
Other Item Allowances					
0971001A M & P of Traffic (suggested 2% - 5%)		2	% of Line "C"		$ 24,175
0975004 Mobilization (suggested 4% - 10%)		5	% of Line "C"		$ 60,437
0980001 Construction Staking (suggested 1% - 2%)		1	% of Line "C"		$ 12,087
Other Items Subtotal					$ 96,699
CONTRACT SUBTOTAL (C + D)					$ 1,305,440
Inflation Costs (Simple Method)					
Date of Estimate (provide date of estimate)		Mar-23			
Anticipated Bid Date (provide anticipated bid date)					
Annual Inflation (4% annually)					
Inflation Subtotal		0.0%	of Line "E"		$ -
TOTAL CONTRACT COST ESTIMATE (E + F) (Rounded to nearest $1000)					$ 1,305,000

LOTCIP Project Costs Summary		
Contract Cost Estimate (Line "G")		$ 1,305,000
Contingencies	25%	$ 326,250
Incidentals	10%	$ 130,500
ROW	LS	$ -
Utilities	LS	$ -
TOTAL PROJECT COST		$ 1,761,750

Shared Used Path and Retaining Walls
Route 161 at Gorton Pond
Construction Cost Estimate

Major and Minor Contract Items

Item No.	Item	Unit	Quantity	Unit $	Total Cost
0202000	EARTH EXCAVATION	CY	680	$ 25.00	$ 17,000.00
0201009	REMOVAL OF TREE - 12" TO 24" CALIPER	EA	11	$ 1,200.00	$ 13,200.00
0601445A	EMBANKMENT WALL	LS	1	$ 900,000.00	$ 900,000.00
0686000.XXX	CULVERT HEADWALL REBUILT	EA	3	$ 10,000.00	$ 30,000.00
0905002	REBUILD STONE WALL	LF	95	$ 86.00	$ 8,170.00
0921001A	CONCRETE SIDEWALK	SF	16960	$ 14.00	$ 237,440.00
0921005A	CONCRETE SIDEWALK RAMP	SF	125	$ 28.00	$ 3,500.00
0921048A	DETECTABLE WARNING STRIP	EA	2	$ 72.00	$ 144.00
0922501	BITUMINOUS CONCRETE DRIVEWAY	SY	28	$ 65.00	$ 1,820.00
0944000A	FURNISHING AND PLACING TOPSOIL	SY	560	$ 7.50	$ 4,200.00
0950019	TURF ESTABLISHMENT - LAWN	SY	560	$ 3.00	$ 1,680.00
0970006A	TRAFFICPERSON (MUNICIPAL POLICE OFFICER)	ALL	1	$ 12,500.00	$ 12,500.00
0970007A	TRAFFICPERSON (UNIFORMED FLAGGER)	HR	80	$ 75.00	$ 6,000.00
Major Items Subtotal					$ 1,235,654
Minor Items Subtotal		20	% of Line "A"		$ 247,131
Major and Minor Contract Items Subtotal (A + B)					$ 1,482,785
Other Item Allowances					
0971001A M & P of Traffic (suggested 2% - 5%)		2	% of Line "C"		$ 29,656
0975004 Mobilization (suggested 4% - 10%)		5	% of Line "C"		$ 74,139
0980001 Construction Staking (suggested 1% - 2%)		1	% of Line "C"		$ 14,828
Other Items Subtotal					$ 118,623
CONTRACT SUBTOTAL (C + D)					$ 1,601,408
Inflation Costs (Simple Method)					
Date of Estimate (provide date of estimate)		Mar-23			
Anticipated Bid Date (provide anticipated bid date)					
Annual Inflation (4% annually)					
Inflation Subtotal		0.0%	of Line "E"		$ -
TOTAL CONTRACT COST ESTIMATE (E + F) (Rounded to nearest $1000)					$ 1,601,000

LOTCIP Project Costs Summary		
Contract Cost Estimate (Line "G")		$ 1,601,000
Contingencies	25%	$ 400,250
Incidentals	20%	$ 320,200
ROW	LS	$ -
Utilities	LS	$ 6,000
TOTAL PROJECT COST		$ 2,327,450

Shared Use Path, Bus Shelters, and Pedestrian Refuge Island
Route 161 - Frontage Road to U.S. Route 1 (Boston Post Road)
Construction Cost Estimate

Major and Minor Contract Items

Item No.	Item	Unit	Quantity	Unit $	Total Cost
0202000	EARTH EXCAVATION	CY	710	$ 25.00	$ 17,750.00
0202529A	CUT BITUMINOUS CONCRETE PAVEMENT	LF	310	$ 4.00	$ 1,240.00
0209001	FORMATION OF SUBGRADE	SY	245	$ 3.40	$ 833.00
0212000	SUBBASE	CY	80	$ 52.00	$ 4,160.00
0304002	PROCESSED AGGREGATE BASE	CY	45	$ 60.00	$ 2,700.00
0406170	HMA S1	TON	85	$ 150.00	$ 12,750.00
0406171	HMA S0.5	TON	60	$ 123.00	$ 7,380.00
0406236A	MATERIAL FOR TACK COAT	GAL	25	$ 8.00	$ 200.00
0406999A	ASPHALT ADJUSTMENT COST	EST	1	$ 10,000.00	$ 10,000.00
0601020	STAMPED CONCRETE	SF	590	$ 27.00	$ 15,930.00
0811001	CONCRETE CURBING	LF	490	$ 42.00	$ 20,580.00
0921001A	CONCRETE SIDEWALK	SF	1830	$ 14.00	$ 25,620.00
0922001	BITUMINOUS CONCRETE SIDEWALK	SY	1370	$ 61.00	$ 83,570.00
0922501	BITUMINOUS CONCRETE DRIVEWAY	SY	465	$ 67.00	$ 31,155.00
0921048A	DETECTABLE WARNING STRIP	EA	6	$ 72.00	$ 432.00
0944000A	FURNISHING AND PLACING TOPSOIL	SY	1190	$ 7.50	$ 8,925.00
0947303	BUS SHELTER - TYPE - A	EA	2	$ 33,000.00	$ 66,000.00
0950019	TURF ESTABLISHMENT - LAWN	SY	1190	$ 3.00	$ 3,570.00
0970006A	TRAFFICPERSON (MUNICIPAL POLICE OFFICER)	ALL	1	$ 24,500.00	$ 24,500.00
0970007A	TRAFFICPERSON (UNIFORMED FLAGGER)	HR	137	$ 75.00	$ 10,275.00
TRAFFIC SIGNAL	TRAFFIC SIGNAL MODIFICATIONS	EST	1	$ 80,000.00	$ 80,000.00
DRAINAGE	DRAINAGE	EST	1	$ 15,500.00	$ 15,500.00
Major Items Subtotal					$ 443,070
Minor Items Subtotal		20	% of Line "A"		$ 88,614
Major and Minor Contract Items Subtotal (A + B)					$ 531,684

Other Item Allowances			
0971001A M & P of Traffic (suggested 2% - 5%)	2	% of Line "C"	$ 10,634
0975004 Mobilization (suggested 4% - 10%)	5	% of Line "C"	$ 26,584
0980001 Construction Staking (suggested 1% - 2%)	1	% of Line "C"	$ 5,317
Other Items Subtotal			$ 42,535
CONTRACT SUBTOTAL (C + D)			$ 574,219
Inflation Costs (Simple Method)			
Date of Estimate (provide date of estimate)	Mar-23		
Anticipated Bid Date (provide anticipated bid date)			
Annual Inflation (4% annually)			
Inflation Subtotal	0.0%	of Line "E"	$ -
TOTAL CONTRACT COST ESTIMATE (E + F) (Rounded to nearest $1000)			$ 574,000

LOTCIP Project Costs Summary		
Contract Cost Estimate (Line "G")		$ 574,000
Contingencies	25%	$ 143,500
Incidentals	10%	$ 57,400
ROW	LS	$ -
Utilities	LS	$ -
TOTAL PROJECT COST		$ 774,900

APPENDIX F
BICYCLE & PEDESTRIAN FUNDING OPPORTUNITIES

Pedestrian and Bicycle Funding Opportunities: U.S. Department of Transportation Transit, Safety, and Highway Funds

September 9, 2022

This table indicates potential eligibility for pedestrian and bicycle activities and projects under U.S. Department of Transportation surface transportation funding programs. Activities and projects need to meet program eligibility requirements. See notes and basic program requirements below, with links to program information. Project sponsors should integrate the safety, accessibility, equity, and convenience of walking and bicycling into surface transportation projects.

Pedestrian and Bicycle Funding Opportunities: U.S. Department of Transportation Transit, Safety, and Highway Funds

Key: $ = Activity may be eligible. Restrictions may apply, see program notes and guidance. ~$ = Eligible, but not competitive unless part of a larger project.

	OST Programs							Federal Transit				NHTSA		Federal Highway Administration															
Activity or Project Type	RAISE	INFRA	RCP	SS4A	Thrive	RRIF	TIFIA	FTA	ATI	TOD	AoPP	402	405	BFP BIP BRR	CRP	CMAQ	HSIP	RHCP	NHPP	PROTECT	STBG	TA	RTP	SRTS	PLAN	NSBP	FLTTP	TTP	TTPSF
Access enhancements to public transportation (benches, bus pads)	$	$	$	$		~$	~$	$	$		~$				$	$			$	$	$	$				$	$	$	
Americans with Disabilities Act (ADA)/504 Self Evaluation / Transition Plan				$	TA					$	$				$						$	$	$		$		$	$	
Barrier removal for ADA compliance	$	$	$	$		~$	~$	$	$	~$	~$			$	$				$	$	$	$	$	$		$	$	$	
Bicycle plans			~$	$				$		$	$				$					$	$	$		$	$		$	$	$
Bicycle helmets (project or training related)												$									$	$SRTS		$				$	
Bicycle helmets (safety promotion)																					$	$SRTS		$				$	
Bicycle lanes on road	~$	~$	$	$		~$	~$	$	$		~$				$	$	$	$	$	$	$	$		$			$	$	$
Bicycle parking (see Bicycle Parking Solutions)	~$	~$	$	$		~$	$	$	$		~$				$	$			$		$	$	$	$		$	$	$	
Bike racks on transit	~$		$	~$			~$	$	$		~$				$	$					$	$					$	$	
Bicycle repair station (air pump, simple tools)	~$		$	~$		~$	~$	$	$						$						$	$					$	$	
Bicycle share (capital and equipment; not operations)	~$	~$	$	~$		~$	~$	$	$						$	$			$		$	$					$	$	
Bicycle storage or service centers (example: at transit hubs)	~$		$	~$		~$	$	$	$						$	$					$	$					$	$	
Bridges / overcrossings for pedestrians and/or bicyclists	$	$	$	$		~$	~$	$	$					$	$	$	$	$	$	$	$	$	$	$			$	$	$
Bus shelters and benches	$	$	$	~$		~$	~$	$	$						$	$			$	$	$	$				$	$	$	
Coordinator positions (State or local) (limits on CMAQ and STBG)				$							$					$					$	$SRTS		$				$	
Community Capacity Building (develop organizational skills/processes)				$	TA					$	$														$			$	
Crosswalks for pedestrians, pedestrian refuge islands (new or retrofit)	$	$	$	$		~$	~$	$	$						$	~$	$	$	$	$	$	$	$	$		$	$	$	$
Curb ramps	$	$	$	$		~$	~$	$	$					$	$	~$	$	$	$	$	$	$	$	$		$	$	$	$
Counting equipment		$	$	$			~$	$	$								$		$		$	$	$	$	$		$	$	$
Data collection and monitoring for pedestrians and/or bicyclists	$	$	$	$			~$	$	$	$	$				$		$		$		$	$	$	$	$		$	$	$
Emergency and evacuation routes for pedestrians and/or bicyclists	$	$	$	~$			$	$	$	~$	~$				$				$	$	$	$	$	$			$	$	
Historic preservation (pedestrian and bicycle and transit facilities)	~$		~$	~$		~$	~$	$	$		~$				$						$	$				$	$	$	
Landscaping, streetscaping (pedestrian/bicycle route; transit access); related amenities (benches, water fountains); usually part of larger project	~$	~$	~$	~$		~$	~$	$	$	~$	~$				$				~$	$	$	$					$	$	
Lighting (pedestrian and bicyclist scale associated with pedestrian/bicyclist project)	$	$	$	$		~$	~$	$	$		~$				$	~$	$	$	$	$	$	$	$	$		$	$	$	$
Maps (for pedestrians and/or bicyclists)				$				$	$	$	~$				$	$					$	$		$	$	$		$	
Micromobility projects (including scooter share)	$		$	~$		~$	~$				~$				$	$					$	$					$	$	
Paved shoulders for pedestrian and/or bicyclist use	$	~$	$	$		~$	~$							$	$	$	$	$	$	$	$	$		$		$	$	$	$
Pedestrian plans	$	~$	~$	$				$		$	$				$					$	$	$		$	$		$	$	$
Rail at-grade crossings	$	$	$	~$		$	$	$	$						$		$	$	$	$	$	$	$	$			$	$	$
Recreational trails	$		$	~$			~$													$	$	$	$			$	$	$	
Resilience Improvements for pedestrians and bicyclists	$	$	$	~$		~$	~$			$	~$			~$	~$	~$			$	$	$	$	$	$		$	$	$	
Road Diets (pedestrian and bicycle portions)	$	$	$	$		~$	$								$	$	$		$	$	$	$		$			$	$	$

Pedestrian and Bicycle Funding Opportunities: U.S. Department of Transportation Transit, Safety, and Highway Funds

Key: $ = Activity may be eligible. Restrictions may apply, see program notes and guidance. ~$ = Eligible, but not competitive unless part of a larger project.

	OST Programs							Federal Transit				NHTSA		Federal Highway Administration															
Activity or Project Type	RAISE	INFRA	RCP	SS4A	Thrive	RRIF	TIFIA	FTA	ATI	TOD	AoPP	402	405	BFP BIP BRR	CRP	CMAQ	HSIP	RHCP	NHPP	PROTECT	STBG	TA	RTP	SRTS	PLAN	NSBP	FLTTP	TTP	TTPSF
Road Safety Assessment for pedestrians and bicyclists			$	$	TA		~$				~$						$	$			$	$			$		$	$	$
Safety education and awareness activities and programs to inform pedestrians, bicyclists, and motorists on ped/bike traffic safety laws				$							~$	$	$				$				$SRTS	$SRTS		$	$			$	
Safety education positions				$							~$	$									$SRTS	$SRTS		$				$	
Safety enforcement (including police patrols)				$								$	$				$				$SRTS	$SRTS		$				$	
Safety program technical assessment (for peds/bicyclists)			$	~$	TA						~$	$					$				$SRTS	$SRTS		$	$		$	$	
Separated bicycle lanes	$	$	$	$		~$	~$	$	$		~$			$	$	$	$	$	$	$	$	$		$		$	$	$	$
Shared use paths / transportation trails	$	$	$	$		~$	~$	$	$		~$				$	$	$	$	$	$	$	$	$	$		$	$	$	$
Sidewalks (new or retrofit)	$	$	$	$		~$	~$	$	$	~$	~$			$	$	$	$	$	$	$	$	$	$	$		$	$	$	$
Signs, signals, signal improvements (incl accessible pedestrian signals) see note	$	$	$	$		~$	~$	$	$	~$	~$				$	$	$	$	$	$	$	$		$		$	$	$	$
Signing for pedestrian or bicycle routes	$	$	$	$		~$	~$	$	$		~$				$	$	$		$	$	$	$		$		$	$	$	$
Spot improvement programs (for pedestrian and bicycle facilities)	$	$		$		~$	~$	$			~$				$		$	$	$		$	$	$	$			$	$	$
Stormwater impacts related to pedestrian and bicycle project impacts	$	$	$	~$		~$	~$	$	$								$	$	$	$	$	$	$	$			$	$	$
Traffic calming	$	$	$	$		~$	~$	$							$		$		$	$	$	$		$			$	$	$
Trail bridges	$	$	$	~$		~$	$								$	~$	$	$	$	$	$	$	$	$			$	$	$
Trail construction and maintenance equipment				~$		~$	~$								$						$	$	$				~$	~$	~$
Trail/highway crossings and intersections	$	$	$	$		~$	~$							$	$	~$	$	$	$	$	$	$	$	$		$	$	$	$
Trailside/trailhead facilities (restrooms, water, not general park amenities)	~$					~$	~$								~$						$	$	$			$	$	$	
Training				$	TA						~$	$				$	$				$	$	$	$	$			$	
Training for law enforcement on ped/bicyclist safety laws				~$								$	$			~$	$				$SRTS	$SRTS		$				$	
Tunnels / underpasses for pedestrians and/or bicyclists	$	$	$	$		$	$	$	$						$	$	$	$	$	$	$	$	$	$			$	$	$
Vulnerable Road User Safety Assessment			$	$	TA												$				$	$		$	$			$	$

Abbreviations

ADA/504: Americans with Disabilities Act of 1990 / Section 504 of the Rehabilitation Act of 1973
RAISE: Rebuilding American Infrastructure with Sustainability and Equity
INFRA: Infrastructure for Rebuilding America Discretionary Grant Program
RCP: Reconnecting Communities Pilot Program
SS4A: Safe Streets and Roads for All
Thrive: Thriving Communities Initiative (TA: Technical Assistance)
RRIF: Railroad Rehabilitation and Improvement Financing (loans)
TIFIA: Transportation Infrastructure Finance and Innovation Act (loans)
FTA: Federal Transit Administration Capital Funds
ATI: Associated Transit Improvement (1% set-aside of FTA)
TOD: Transit-Oriented Development
AoPP: Areas of Persistent Poverty Program
NHTSA 402: National Highway Traffic Safety Administration State and Community Highway Safety Grant Program
NHTSA 405: National Highway Traffic Safety Administration National Priority Safety Programs (Nonmotorized safety)
BFP: Bridge Formula Program; BIP: Bridge Investment Program; BRR: Bridge Replacement and Rehabilitation Program
CRP: Carbon Reduction Program
CMAQ: Congestion Mitigation and Air Quality Improvement Program
HSIP: Highway Safety Improvement Program
RHCP: Railway-Highway Crossings (Section 130) Program
NHPP: National Highway Performance Program
PROTECT: Promoting Resilient Operations for Transformative, Efficient, and Cost Saving Transportation
STBG: Surface Transportation Block Grant Program
TA: Transportation Alternatives Set-Aside (formerly Transportation Alternatives Program, Transportation Enhancements)
RTP: Recreational Trails Program
SRTS: Safe Routes to School Program (and related activities)
PLAN: Statewide Planning and Research (SPR) or Metropolitan Planning funds
NSBP: National Scenic Byways Program
FLTTP: Federal Lands and Tribal Transportation Programs: Federal Lands Access Program, Federal Lands Transportation Program, Tribal Transportation Program, Federal Lands Planning Program and related programs for Federal and Tribal lands such as the Nationally Significant Federal Lands and Tribal Projects program.
TTP: Tribal Transportation Program
TTPSF: Tribal Transportation Program Safety Fund

Cross-cutting notes

This table indicates potential eligibility for pedestrian, bicycle, and micromobility activities and projects under U.S. Department of Transportation surface transportation funding programs. Activities and projects must meet program eligibility requirements. See notes and links to program information below. Although the primary focus of this table is stand-alone activities and projects, programs also fund pedestrian and bicycle facilities as part of larger projects. Project sponsors are encouraged to consider Complete Streets and Networks that routinely integrate the safety, accessibility, equity, and convenience of walking and bicycling into surface transportation projects. In these instances, the Federal-aid eligibility of the pedestrian and bicycle elements are considered under the eligibility criteria applicable to the larger highway project. Pedestrian and bicycle activities also may be characterized as environmental mitigation for larger highway projects, especially in response to impacts to a Section 4(f) property or work zone safety, mobility, and accessibility impacts on bicyclists and pedestrians.

- See FHWA Bicycle and Pedestrian Planning, Program, and Project Development (Guidance)
- Bicycle Project Purpose: 23 U.S.C. 217(i) requires that bicycle facilities "be principally for transportation, rather than recreation, purposes". However, 23 U.S.C. 133(b)(7) and 133(h) authorize recreational trails under STBG and the TA Set-Aside, therefore, 23 U.S.C. 217(i) does not apply to trail projects (including for bicycle use) using STBG or TA Set-Aside funds. Section 217(i) applies to bicycle facilities other than trail-related projects, and section 217(i) applies to bicycle facilities using other programs (NHPP, HSIP, CMAQ). The transportation requirement under section 217(i) only applies to bicycle projects, not to any other trail use or transportation mode.
- Signs, signals, signal improvements includes ensuring accessibility for persons with disabilities. See Accessible Pedestrian Signals. See also Proven Safety Countermeasures, such as Crosswalk Visibility Enhancements, Leading Pedestrian Interval signals, Pedestrian Hybrid Beacons, and Rectangular Rapid Flashing Beacons.
- Occasional DOT or agency incentive grants may be available for specific research or technical assistance purposes.
- Aspects of DOT initiatives may be eligible as individual projects. Activities above may benefit safe, comfortable, multimodal networks; environmental justice; and equity.
- The DOT Navigator is a resource to help communities understand the best ways to apply for grants, and to plan for and deliver transformative infrastructure projects and services.
- FHWA's Policy on Using Bipartisan Infrastructure Law Resources to Build a Better America.
- FHWA Links to Technical Assistance and Local Support.

Program-specific notes

Federal-aid and other DOT funding programs have specific requirements that projects must meet, and eligibility must be determined on a case-by-case basis. See links to program guidance for more information.

- RAISE (Infrastructure Investment and Jobs Act (Pub. L. 117-58) (IIJA), also known as the Bipartisan Infrastructure Law (BIL), § 21202): Funds capital and planning grants.
- INFRA (IIJA § 11110): For projects that improve safety, generate economic benefits, reduce congestion, enhance resiliency, and hold the greatest promise to eliminate freight bottlenecks and improve critical freight movements.
- RCP (IIJA § 11509 and div. J, title VIII, Highway Infrastructure Programs, para. (7)): See RCP Program Notice of Funding Opportunity for full details. Planning grants and Capital Construction Grants must relate to a transportation facility that creates a barrier to community connectivity.
- SS4A (IIJA § 24112): Discretionary program funds regional, local, and Tribal initiatives through grants to prevent roadway deaths and serious injuries. Projects must be identified in a comprehensive safety action plan (§ 24112(a)(3)).
- Thrive (Department of Transportation Appropriations Act, 2022 (Pub. L. 117-103, div. L, title I): Technical assistance, planning, and capacity-building support in selected communities.
- RRIF (Chapter 224 of title 49 U.S.C.): Program offers direct loans and loan guarantees for capital projects related to rail facilities, stations, or crossings. Pedestrian and bicycle infrastructure components of "economic development" projects located within ½-mile of qualifying rail stations may be eligible. May be combined with other grant sources.
- TIFIA (Chapter 6 of title 23 U.S.C.): Program offers secured loans, loan guarantees, or standby lines of credit for capital projects. Minimum total project size is $10 million; multiple surface transportation projects may be bundled to meet cost threshold, under the condition that all projects have a common repayment pledge. May be combined with other grant sources, subject to total Federal assistance limitations.
- FTA / ATI (49 U.S.C. 5307): Multimodal projects funded with FTA transit funds must provide access to transit. See Bicycles and Transit, Flex Funding for Transit Access, the FTA Final Policy Statement on the Eligibility of Pedestrian and Bicycle Improvements Under Federal Transit Law, and FTA Program & Bicycle Related Funding Opportunities.
  - Bicycle infrastructure plans and projects must be within a 3-mile radius of a transit stop or station. If more than 3 miles, within a distance that people could be expected to safely and conveniently bike to the particular stop or station.
  - Pedestrian infrastructure plans and projects must be within a ½ mile radius of a transit stop or station. If more than ½ mile, within a distance that people could be expected to safely and conveniently walk to the particular stop or station.
  - FTA funds cannot be used to purchase bicycles for bike share systems.
- FTA TOD: Provides planning grants to support community efforts to improve safe access to public transportation for pedestrians and cyclists. The grants help organizations plan for transportation projects that connect communities and improve access to transit and affordable housing, not for capital purchases.
- FTA AoPP (Further Consolidated Appropriations Act, 2020 (Pub. L. 116-94); Consolidated Appropriations Act, 2021 (Pub. L. 116-260)): Promotes multimodal planning, engineering, and technical studies, or financial planning to improve transit services in areas experiencing long-term economic distress, not for capital purchases.
- NHTSA 402 (23 U.S.C. 402): Project activity must be included in the State's Highway Safety Plan. Contact the State Highway Safety Office for details.
- NHTSA 405 (23 U.S.C. 405): Funds are subject to eligibility, application, and award. Project activity must be included in the State's Highway Safety Plan. Contact the State Highway Safety Office for details. The Bipartisan Infrastructure Law expanded the eligible use of funds for a Section 405 Nonmotorized Safety grant beginning in FY 2024; however, for FY 2023 grants, FAST Act eligible uses remain in place.
- BFP, (IIJA, Div. J, title VIII, para. (1)), BIP (23 U.S.C. 124), BRR (Department of Transportation Appropriations Act, 2022): For specific highway bridge projects and highway bridge projects that will replace or rehabilitate a bridge must consider pedestrian and bicycle access as part of the project and costs related to their inclusion are eligible under these programs.
- CRP (23 U.S.C. 175): Projects should support the reduction of carbon dioxide emissions from on-road highway sources.

- CMAQ (23 U.S.C. 149): Projects must demonstrate emissions reduction and benefit air quality. See the CMAQ guidance at www.fhwa.dot.gov/environment/air_quality/cmaq/ for a list of projects that may be eligible for CMAQ funds. CMAQ funds may be used for shared use paths, but not for trails that are primarily for recreational use.
- HSIP (23 U.S.C. 148): Projects must be consistent with a State's Strategic Highway Safety Plan and (1) correct or improve a hazardous road location or feature, or (2) address a highway safety problem. Certain non-infrastructure safety projects can also be funded using HSIP funds as specified safety projects.
- RHCP (23 U.S.C. 130): Projects at all public railroad crossings including roadways, bike trails, and pedestrian paths.
- NHPP (23 U.S.C. 119): Projects must benefit National Highway System (NHS) corridors and must be located on land adjacent to any highway on the National Highway System (23 U.S.C. 217(b)).
- PROTECT (23 U.S.C. 176): Funds can only be used for activities that are primarily for the purpose of resilience or inherently resilience related. With certain exceptions, the focus must be on supporting the incremental cost of making assets more resilient.
- STBG (23 U.S.C. 133) and TA Set-Aside (23 U.S.C. 133(h)): Activities marked "$SRTS" means eligible only as an SRTS project benefiting schools for kindergarten through 12th grade. Bicycle transportation nonconstruction projects related to safe bicycle use are eligible under STBG, but not under TA (23 U.S.C. 217(a)). There is broad eligibility for projects under 23 U.S.C. 206, 208, and 217.
- RTP (23 U.S.C. 206): Projects for trails and trailside and trailhead facilities for any recreational trail use. RTP projects are eligible under TA Set-Aside and STBG.
- SRTS (23 U.S.C. 208): Projects for any SRTS activity. FY 2012 was the last year for dedicated - funds, but funds are available until expended. SRTS projects are eligible under TA Set-Aside and STBG.
- PLAN (23 U.S.C. 134 and 135): Funds must be used for planning purposes, for example: Maps: System maps and GIS; Safety education and awareness: for transportation safety planning; Safety program technical assessment: for transportation safety planning; Training: bicycle and pedestrian system planning training.
- NSBP (23 U.S.C. 162): Discretionary program subject to annual appropriations. Projects must directly benefit and be close to a designated scenic byway.
- FLTTP (23 U.S.C. 201-204): Projects must provide access to or within Federal or tribal lands. Programs include: Federal Lands and Tribal Transportation Programs (Federal Lands Access Program, Federal Lands Transportation Program, Federal Lands Planning Program) and related programs for Federal and Tribal lands such as the Nationally Significant Federal Lands and Tribal Projects (NSFLTP) program.
  - Federal Lands Transportation Program (23 U.S.C. 203): For Federal agencies for projects that provide access within Federal lands.
  - Federal Lands Access Program (FLAP) (23 U.S.C. 204): For State and local entities for projects that provide access to or within Federal or tribal lands.
- TTP (23 U.S.C. 202): For federally-recognized tribal governments for projects within tribal boundaries and public roads that access tribal lands.
- TTPSF (23 U.S.C. 202(e)(1) and 23 U.S.C. 148(a)(4)): Grants available to federally recognized Indian tribes through a competitive, discretionary program to plan and implement transportation safety projects.

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