Chapter 3 Alternatives Development and Analysis

This chapter documents the process for identifying project alternatives to address existing and future transportation deficiencies in the I-495/Route 9 Interchange study area. As shown in the previous chapter, traffic congestion and safety are critical transportation issues in the study area. In addition, transit availability, pedestrian access, and bicycle access were identified as issues. The land use and traffic projections developed for this study (see Chapter 2) show that without improvements, these traffic congestion, safety, and multimodal access issues will worsen over time.

The development of alternatives was driven by key stakeholders in the study area, including MassDOT, the Central Massachusetts Regional Planning Commission (CMRPC) and the Metropolitan Area Planning Council (MAPC), the towns of Westborough and Southborough, the Worcester and MetroWest Regional Transit Authorities, the Massachusetts Bay Transportation Authority (MBTA), members of the business community, and elected officials. These stakeholders served as the Study Advisory Group (SAG) and provided input and comment on alternatives for consideration based on their local understanding of the study area conditions.

This chapter discusses the alternatives development and analysis process in detail including:

- Issues identification,
- Alternatives development and analysis methodology,
- Preliminary alternatives screening,
- Selection of alternatives for further evaluation, and
- Results of the alternatives evaluation.

3.1 Issues Identification

A number of issues were identified through the analysis of existing conditions, projections of future conditions, and discussion with SAG members, local staff, and agency staff. While there are several specific operational problems or deficiencies on the study area roadways, the following general set of overriding issues in the study area were identified:

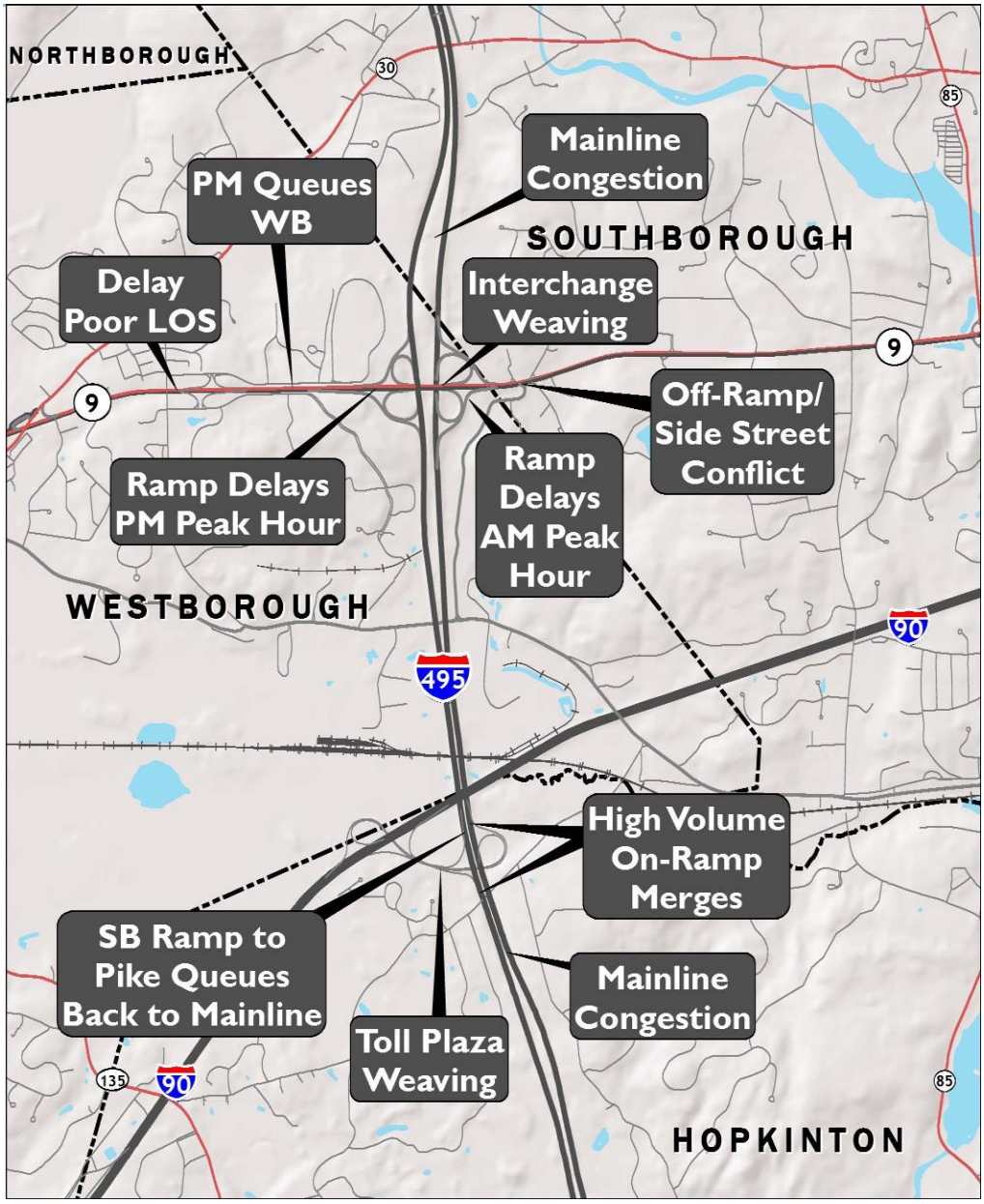
- High peak period commuter traffic volumes,
- Substandard existing roadway geometry,
- High traffic crash rates,
- Traffic congestion during peak periods,
- Poor pedestrian and bike facilities, and
- Lack of fixed route public transit.

Key traffic issues in the study area are illustrated in Figure 3.1-1.

The evaluation of the study area's commercial real estate market showed that the existing amount of vacant commercial and industrial space exceeds the short-term (2011-2016) demand. However, the study area has been designated as a Priority Development Area (PDA), making it a focus area for

development and redevelopment over the long term. Within the horizon year of this study (2035), the traffic demand associated with future economic development is projected to increase, which will increase traffic congestion and may exacerbate safety issues, given the existing transportation infrastructure

Figure 3.1-1: Existing Traffic Issues



3.2 Alternatives Development Methodology

A range of multi-modal alternatives were developed through the study process to address the existing and future transportation deficiencies as documented in Chapter 2. Alternatives for the I-495/I-90 interchange were developed as part of this study due to its proximity and potential interactions with the I-495/Route 9 interchange, and due to the fact that some potential improvements for the I-495/Route 9

interchange would require changes to the I-495/I-90 interchange. As a result, specific alternatives were developed that looked at the interchanges jointly, as well as individually.

Alternatives were also developed for the Route 9 mainline, as well as for the intersections within the Route 9 corridor. The alternatives development process also focused on identifying options to travel by single-occupancy vehicle, such as new transit services and opportunities for walking and biking. The focus of the alternatives development process was to identify a number of alternatives that could address specific study area issues and locations, with the understanding that no single alternative could address all of them. Instead, the goal was to develop a comprehensive list of feasible alternatives that collectively could work together to meet the needs of the I-495 & Route 9 Study area, and that could be implemented over time in a manner that reflects the level of complexity and cost for the needed improvements.

The alternatives development process used the *2009 CMRPC/MAPC I-495 Study: I-290 to I-90* as a source to identify a number of initial concepts for consideration. Through discussions with the SAG, an initial set of improvement measures were identified within the study area to address traffic congestion, safety, and multimodal access issues. Environmental constraints, most notably in the vicinity of the I-495/I-90 interchange, were taken into consideration in the development of alternatives, with efforts made to avoid the potential for impact by keeping the alternative within the existing right-of-way to the greatest extent possible.

This preliminary set of alternatives was screened based on a set of criteria developed by the SAG to reflect the study goals and objectives that are summarized in Chapter 1. This screening eliminated any alternatives that were:

- Inconsistent with study goals; or
- Considered infeasible for one or more of the following reasons:
    - Engineering/design feasibility,
    - Constructability,
    - Right-of-way impacts, or
    - Cost.

The preliminary screening process included review and comment by the SAG. Based on input and feedback received by the SAG, the list of improvements was revised and further defined. The list of preliminary alternatives was then condensed into 24 alternatives through discussions and input from SAG members. The alternatives were grouped into three main categories:

- Highway/Traffic Improvements,
- Transit/Travel Demand Management, and
- Walking and Bicycling

A description and screening evaluation of the initial set of alternatives is provided in Table 3.2.1

Conceptual plans and cost estimates of the alternatives that remained after the preliminary screening process were developed, and the impacts on traffic operations were analyzed based on the 2035 morning

and evening peak period traffic for the 2035 Regional Transportation Plan (RTP) and Priority Development Area (PDA) scenarios. Each alternative was also evaluated to assess its potential for environmental and community impacts.

3.3 Preliminary Alternatives Screening

Each alternative was compared against the screening criteria developed for this study to correspond to the project goals identified in Chapter 1 as follows:

Goals	Screening Criteria
Develop Viable Transportation Improvements	• Meets AASHTO, FHWA and MassDOT design standards (with at most minor exceptions), • Consistent with existing/proposed investment in public infrastructure, and • Consistent with existing and future conditions and transportation needs within the project study area.
Reduce Traffic Congestion and Improve Air Quality	• Reduces vehicle delay and improve travel time, and • Provides additional capacity where needed, i.e. capacity that addresses a system bottleneck.
Improve Highway Safety and Operations	• Addresses high crash locations, and • Addresses identified safety issues and/or reduces conflicts.
Enhance Mobility by Increasing Transportation Choices	• Provides alternate transportation modes, and • Reduces single occupancy vehicle (SOV) use,
Support Economic Development and Smart Growth	• Improves transportation access/infrastructure to designated development areas.

Each alternative was qualitatively rated for each of the preliminary screening criteria as follows:

✓ Supports goal
✖ Does not support the goal
O Neutral
N/A Not applicable

Table 3.2-1 shows the results of the preliminary alternatives screening.

Table 3.2-1: Preliminary Alternatives Screening

		Preliminary Screening Criteria											
		Develop Viable Transportation Alternatives			Reduce Traffic Congestion and Improve Air Quality		Improve Highway Safety and Operations		Enhance Mobility by Increasing Transportation Choices		Support Economic Development and Smart Growth		
Alternative		**Meets AASHTO, FHWA and MassDOT design standards with only minor exceptions.**	**Consistent with existing/proposed investment in public infrastructure**	**Can be developed based on analysis of existing and future conditions within the project study area.**	**Reduces vehicle delay and improve travel time**	**Provides additional capacity**	**Addresses high crash locations**	**Addresses identified safety issues and reduces conflicts**	**Provides alternate transportation modes**	**Reduces single occupancy vehicle (SOV) use**	**Improves transportation access/infrastructure for designated development areas**	**Selected for Further Development and Evaluation**	**Notes**
Highway/Traffic													
HT 1	Reconstruct I-495 to provide a collector-distributor (C-D) road, which is a parallel roadway designed to remove weaving from the highway mainline and to reduce the number of mainline entrances and exits.	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	YES	Short and long option C-D roads will be evaluated.
A	Short Option C-D Road (just at the Route 9 interchange)												
B	Long Option C-D Road (through both the Route 9 and I-90 interchanges)												
HT 2	Extend and flatten ramps at Route 9 interchange to improve substandard geometry and design speed	O	✓	✓	O	O	O	O	✖	✖	O	NO	Would provide minimal improvement .Given the constraints on the interchange corners, the ability to extend and flatten the ramps appear to be limited. This may not be a cost effective alternative to address the existing interchange concerns.
HT-3	Replace existing ramps at Route 9 interchange with a braided ramp, which separates merging and diverging traffic by creating a bridge to elevate one ramp over the other, thereby eliminating the mainline weave.	✓	✓	✓	✓	O	✓	✓	✖	✖	O	YES	Would eliminate the weave condition for vehicles getting on and off I-495 at Route 9.
HT-4	Eliminate southeast and northwest loop ramps at Route 9 interchange and signalize at intersection with Route 9 to form a partial cloverleaf configuration. The northeast and southwest loop ramps would remain to serve the high volumes of commuters exiting I-495 at Route 9 in the morning peak. A partial cloverleaf is a modification of a cloverleaf interchange which reduces the number of ramps to remove weaving. This type of interchange requires signalized intersections with Route 9 to allow for left turns.	✓	✓	✓	✖	✖	✓	O	✖	✖	O	NO	Adding additional signals to Route 9 adds to delay for east-west travel during peak hours.
HT-5	Widen Route 9 westbound west of I-495 to add one lane	✓	✓	✓	✓	✓	✓	✓	✖	✖	✓	YES	Eliminates the need for traffic exiting onto Computer Drive to merge with Route 9 mainline traffic.
HT-6	Remove access from Park Central Drive to Route 9 Westbound and relocate access to Flagg Road	O	O	✓	O	O	O	✓	✖	✖	O	YES	Requires coordination between private land owners and Town of Southborough.

Alternative		Preliminary Screening Criteria: Develop Viable Transportation Alternatives: Meets AASHTO, FHWA and MassDOT design standards with only minor exceptions.	Develop Viable Transportation Alternatives: Consistent with existing/proposed investment in public infrastructure	Develop Viable Transportation Alternatives: Can be developed based on analysis of existing and future conditions within the project study area.	Reduce Traffic Congestion and Improve Air Quality: Reduces vehicle delay and improve travel time	Reduce Traffic Congestion and Improve Air Quality: Provides additional capacity	Improve Highway Safety and Operations: Addresses high crash locations	Improve Highway Safety and Operations: Addresses identified safety issues and reduces conflicts	Enhance Mobility by Increasing Transportation Choices: Provides alternate transportation modes	Enhance Mobility by Increasing Transportation Choices: Reduces single occupancy vehicle (SOV) use	Support Economic Development and Smart Growth: Improves transportation access/infrastructure for designated development areas	Selected for Further Development and Evaluation	Notes
HT-7	Consolidate the number of driveways on Route 9 east of I-495	O	O	✓	O	O	O	✓	✖	✖	O	YES	Requires coordination between private land owners and Town of Southborough.
HT-8	Improve peak hour operations at intersections on Research Drive and Connector Road; Includes signal optimization, signal coordination, addition of NB right-turn lane on Connector Road and WB right-turn lane on Research Drive	O	✓	✓	✓	✓	O	O	✖	✖	✓	YES	
HT-9	Improve safety at the I-90/I-495 interchange by adding signage, and flattening the curve on the I-90 ramp to I-495 northbound	O	✓	✓	O	O	O	✓	✖	✖	O	YES	
HT-10	Reconfigure the I-90/I-495 Interchange, including construction of a more direct interstate to interstate connection, elimination of the weaves at the toll plaza, increased capacity, and acceleration/deceleration lane improvements.	O	✓	✓	✓	✓	✓	✓	✖	✖	✓	YES	This concept was developed with consideration of constraints posed by wetlands surrounding the existing interchange and recognition that future tolling changes are part of broader decision-making process beyond the scope of the current study.
HT-11	Improve the Route 9/ Crystal Pond Road intersection to accommodate future development	✓	✓	✓	O	O	✓	✓	✖	✖	✓	YES	
HT-12A	Add ITS signage on I-495	✓	✓	O	O	O	O	O	✖	✖	O	YES	MassDOT is implementing an ITS system on I-495 between Hopkinton and Andover Andover as part of the Interstate 495 Transportation Management (ATMS) project though a design-build contract that will include: • 27 closed circuit television cameras • Two Variable Message Signs (VMS) • Two Dual Use Traffic Counting Stations • Two Weigh-In Motion Counting Stations • Fiber optic lines The exact location of these elements has yet to be determined. Construction is anticipated to begin in the late winter/spring of 2014.

		Preliminary Screening Criteria											
		Develop Viable Transportation Alternatives			Reduce Traffic Congestion and Improve Air Quality		Improve Highway Safety and Operations		Enhance Mobility by Increasing Transportation Choices		Support Economic Development and Smart Growth		
Alternative		**Meets AASHTO, FHWA and MassDOT design standards with only minor exceptions.**	**Consistent with existing/proposed investment in public infrastructure**	**Can be developed based on analysis of existing and future conditions within the project study area.**	**Reduces vehicle delay and improve travel time**	**Provides additional capacity**	**Addresses high crash locations**	**Addresses identified safety issues and reduces conflicts**	**Provides alternate transportation modes**	**Reduces single occupancy vehicle (SOV) use**	**Improves transportation access/infrastructure for designated development areas**	**Selected for Further Development and Evaluation**	**Notes**
HT-12B	Add ITS signage on Route 9.	✓	✓	O	O	O	O	O	✖	✖	O	YES	One of the goals of the MassDOT ITS Program is to integrate arterial management with freeway management. As part of the I-495 ITS project, new ITS infrastructure would be provided at/near the Route 9 interchange. Potential locations to serve Route 9 would be near Route 30 in Westborough west of I-495 and near Route 85 in Southborough east if I-495. Both of these locations are outside of the study area. As MassDOT continues work on the ITS Program and Strategic Plan, the Route 9 arterial could be considered for ITS communications infrastructure.
HT-13	Consider alternate toll collection technologies	✓	✓	O	✓	✓	✓	O	✖	✖	O	YES	Needs to be evaluated in the context of tolling operations for the entire Massachusetts Turnpike (I-90). Subsequent to the start of this study, MassDOT began implementation of All Electronic Tolling (AET) statewide.
HT-14	Provide a connection to Flanders Road from the proposed C-D Road	✖	O	✓	✓	✓	O	O	✖	✖	✓	NO	Does not meet FHWA interchange spacing standard of 1-mile.
Transit/Transportation Demand Management													
TR-1	Provide a connection between WRTA and MWRTA transit service to connect MetroWest communities and Worcester to the job centers around the I-495/Route 9 interchange	**N/A**	✓	✓	**N/A**	**N/A**	**N/A**	**N/A**	✓	✓	✓	YES	WRTA and MWRTA working on a concept. Potential location for transfer locations within study area to be identified.
TR-2A	Provide shuttle service to the Westborough commuter rail station	**N/A**	✓	✓	**N/A**	**N/A**	**N/A**	**N/A**	✓	✓	✓	YES	Potential location for transfers within study area to be identified.
TR-2A	Provide shuttle service to the Southborough commuter rail station	**N/A**	✓	✓	**N/A**	**N/A**	**N/A**	**N/A**	✓	✓	✓	YES	Potential locations for transfers within study area to be identified.
TR-3	Develop a Park-and-Ride lot to serve as a transit hub for the study area and to promote carpooling/vanpooling along I-495.	✓	✓	✓	**N/A**	**N/A**	**N/A**	**N/A**	✓	✓	O	YES	Potential location within study area to be identified.
TR-4	Expand TMA participation	**N/A**	✓	✓	**N/A**	**N/A**	**N/A**	**N/A**	✓	✓	✓	YES	
TR-5	Provide Bus Rapid Transit service on I-495	✓	O	✖	✓	✓	**N/A**	**N/A**	✓	✓	O	NO	See Table 3.2-2.

Alternative		Preliminary Screening Criteria: Develop Viable Transportation Alternatives – Meets AASHTO, FHWA and MassDOT design standards with only minor exceptions.	Develop Viable Transportation Alternatives – Consistent with existing/proposed investment in public infrastructure	Develop Viable Transportation Alternatives – Can be developed based on analysis of existing and future conditions within the project study area.	Reduce Traffic Congestion and Improve Air Quality – Reduces vehicle delay and improve travel time	Reduce Traffic Congestion and Improve Air Quality – Provides additional capacity	Improve Highway Safety and Operations – Addresses high crash locations	Improve Highway Safety and Operations – Addresses identified safety issues and reduces conflicts	Enhance Mobility by Increasing Transportation Choices – Provides alternate transportation modes	Enhance Mobility by Increasing Transportation Choices – Reduces single occupancy vehicle (SOV) use	Support Economic Development and Smart Growth – Improves transportation access/infrastructure for designated development areas	Selected for Further Development and Evaluation	Notes
TR-6	Include the Mega Station at the I-495/Route 9 Interchange as proposed in the CMRPC/MAPC study. The Mega Station facility is assumed to provide a large number of parking spaces (approximately 2500+) and would be a transfer point for commuter/express bus service to Boston, local transit buses and the MBTA commuter rail. Given the known environmental constraints in the area, the "mega station" was placed within the air rights over the i-90/i-495 highway interchange, as well as the Framingham/Worcester commuter rail line with direct ramping to and from I-90 west and through existing interchanges ramps to I-90 east and I-495. Other locations in proximity to the interchange may be possible.	✖	✖	✓	O	O	✖	✖	✓	✓	O	NO	See Table 3.2-2.
Walking and Bicycling Improvements													
WB-1	**Improve pedestrian connections:** • Install sidewalks and improve on-site pedestrian amenities within private developments. • Provide better sidewalk connections from business parks north and south of Route 9 to public sidewalks on Computer Drive and Research Drive. • Accommodate pedestrians where transit service is provided. • Upgrade pedestrian signals at Route 9/Crystal Pond Road in conjunction with the intersection improvements under HT-11 • Upgrade pedestrian signal equipment in conjunction with intersection improvements at Research Drive HT 8. • Upgrade/install handicap ramps at intersections and driveways as sites along Route 9 are reconstructed as part of redevelopment projects.	✓	✓	✓	O	O	O	O	✓	✓	✓	YES	Pedestrian improvements will be incorporated within the recommended highway/traffic and transit improvements to the extent possible. Given the nature of the study area, pedestrian improvements should be considered as private property/local roads are developed/ redeveloped.

		Preliminary Screening Criteria											
		Develop Viable Transportation Alternatives			Reduce Traffic Congestion and Improve Air Quality		Improve Highway Safety and Operations		Enhance Mobility by Increasing Transportation Choices		Support Economic Development and Smart Growth		
Alternative		**Meets AASHTO, FHWA and MassDOT design standards with only minor exceptions.**	**Consistent with existing/proposed investment in public infrastructure**	**Can be developed based on analysis of existing and future conditions within the project study area.**	**Reduces vehicle delay and improve travel time**	**Provides additional capacity**	**Addresses high crash locations**	**Addresses identified safety issues and reduces conflicts**	**Provides alternate transportation modes**	**Reduces single occupancy vehicle (SOV) use**	**Improves transportation access/infrastructure for designated development areas**	**Selected for Further Development and Evaluation**	**Notes**
WB-2	Improve options for bicycling commuting • Improve options for bicycling commuting at business parks and park-and-ride lots such as dedicated all-weather parking, storage, and showers. • Investigate the feasibility of the bike path proposed by the Town of Westborough along the former Boston and Worcester trolley alignment that extends from Park Street on the west to West Park Drive on the east. A section of this former trolley line is located in the study area, within the Walkup Robinson Memorial Reservation Park abutting Friberg Parkway. • Do not preclude potential future bicycle routes connections as development/redevelopment occurs. • Encourage towns to consider providing bike accommodations (lanes, shoulders) where appropriate on local roadways connecting with the study area, i.e. Flanders Road. • Coordinate with TMA.	✓	✓	O	O	O	O	O	✓	✓	✓	YES	Bicycle improvements will be incorporated within the recommended highway/traffic and transit improvements to the extent possible; Given the nature of the study area, bicycle improvements have more opportunity to be improved as private property/local roads are developed/ redeveloped.

LEGEND:

✓ Supports goal

O Neutral

✖ Does not support goal

N/A Not applicable

Based on the preliminary alternatives screening evaluation, the following alternatives were recommended for further analysis:

Highway/Traffic Improvements

- HT-1 Reconstruct I-495 to provide collector-distributor (C-D) roads (short and long options),
- HT-3 Replace existing ramps at Route 9 interchange with a braided design,
- HT-5 Widen Route 9 westbound to add a lane,
- HT-6 Remove access from Park Central Drive to Route 9 Westbound and relocate access to Flagg Road,
- HT-7 Consolidate the number of driveways on Route 9 east of I-495,
- HT-8 Improve peak hour operations at intersections on Research Drive and Connector Road,
- HT-9 Improve safety at the I-90/I-495 interchange by adding signage, and flattening the curve on the I-90 ramp to I-495 northbound,
- HT-10 Reconfigure the I-90/I-495 Interchange, including construction of a more direct interstate to interstate connection, elimination of the weaves at the toll plaza, increased capacity, and acceleration/deceleration lane improvements, and
- HT-11 Improve the Route 9/ Crystal Pond Road intersection by providing three through lanes in both directions on Route 9 and re-aligning the Verizon site driveway to form a 4-way intersection, adding a second westbound left turn lane to Route 9, and adding an eastbound jug-handle to eliminate the existing Route 9 eastbound-to-westbound u-turn.

Transit/Transportation Demand Management

- TR-1 Provide a connection between WRTA and MWRTA transit service,
- TR-2A Provide shuttle service to the Westborough commuter rail station,
- TR-2B Provide shuttle service to the Southborough commuter rail station,
- TR-3 Develop a Park-and-Ride lot to serve as a transit hub for the study area and to promote carpooling/vanpooling along I-495., and
- TR-4 Expand Transportation Management Association (TMA) participation.

Walking and Bicycling Improvements

- WB-1 Improve pedestrian connections
    - Install sidewalks and improve on-site pedestrian amenities within private developments,
    - Provide better sidewalk connections from business parks north and south of Route 9 to public sidewalks on Computer Drive and Research Drive,
    - Accommodate pedestrians in all areas other than limited-access highways, with a priority for areas where transit service is provided,
    - Encourage towns to adopt a “Complete Streets” design policy – which calls for safe and convenient accommodation of all roadway users, including pedestrians, bicyclists, and public transit riders – for all municipal infrastructure projects and for improvements built by developers;
    - Upgrade pedestrian signals at Route 9/Crystal Pond Road in conjunction with the intersection improvements (HT-11),
    - Upgrade pedestrian signal equipment in conjunction with intersection improvements on Connector Road and Research Drive (HT 8), and
    - Upgrade/install handicap ramps as intersections and driveways are reconstructed as part of redevelopment projects along Route 9.

- WB-2 Improve options for bicycling commuting
    - Encourage businesses to improve options for bicycling commuting by providing facilities such as dedicated all-weather parking, storage, and showers;
    - Investigate the feasibility of the bike path proposed by the Town of Westborough along the former Boston and Worcester trolley alignment ROW that extends from Park Street on the west to West Park Drive on the east. A section of this former trolley line is located in the study area, within the Walkup Robinson Memorial Reservation Park abutting Friberg Parkway.
    - Do not preclude potential future bicycle connections as development/redevelopment occurs;
    - Encourage towns to adopt a "Complete Streets" design policy – which calls for safe and convenient accommodation of all roadway users, including pedestrians, bicyclists, and public transit riders – for all municipal infrastructure projects and for improvements built by developers;
    - Encourage towns to consider providing bike accommodations (lanes, shoulders) where appropriate on local roadways connecting with the study area, i.e. Flanders Road; and
    - Coordinate with the TMA.

(See Figures 3.4-1 through 3.4-14 in Section 3.4 for an illustration of the Highway/Traffic and Transit Alternatives).

The following preliminary alternatives were found not to meet the screening evaluation criteria and were not recommended for further analysis:

Table 3.3-1: Alternatives Eliminated from Further Consideration

Alternative	Reason for Elimination
HT-2: Extend and flatten ramps at Route 9 interchange	Given the constraint on the interchange corners due to the proximity of adjacent development, the ability to extend and flatten the ramps appears to be limited. This does not appear to be a cost effective alternative to address the existing interchange concerns because this measure would only slightly improve the geometry of the ramp, and would not result in measureable improvements to traffic operations or safety.
HT-4: Eliminate southeast and northwest inner loop ramps at Route 9 interchange and signalize at intersection with Route 9 to form a partial cloverleaf configuration.	Adding additional signals to Route 9 adds to delay for east-west travel during peak hours, and could increase crashes, particularly rear-end crashes. An analysis of traffic operations indicated PM peak volumes are over capacity, which resulted in a Level of Service (LOS) F at the signalized intersections and long delays on Route 9. Adding additional delay to peak period travel on Route 9 was not acceptable to the Study Advisory Group (SAG) and therefore this alternative was eliminated.
HT-14: Provide a connection to Flanders Road from the proposed C-D Road	Only provides spacing of approximately 0.5 miles between interchanges, far less than FHWA interchange spacing standard of 1 mile (urban interchange) or 3 miles (rural

Alternative	Reason for Elimination
	interchange).
TR-5: Provide Bus Rapid Transit service on I-495	Requires an evaluation of the origin and destination of commuter trips on I-495 within the broader MetroWest region. The three-mile section of I-495 within the study area is not sufficient to adequately develop and evaluate this alternative. Such a study could be undertaken jointly by the Boston and Central Massachusetts Metropolitan Planning Organizations.
TR-6: Include the Mega Station at the I-495/I-90 Interchange as proposed in the CMRPC MAPC study[1]	Due to environmental constraints, would need to be built on air-rights over the I-90/I-495, requiring rebuilding the entire I-90/I-495 interchange to be able to accommodate a complex set of grade-separated ramps for all movements. Even if a design over the area can be developed, the ramp merges, diverges, and weaves may not operate efficiently and may require significant design exceptions Does not meet FHWA interchange spacing standard of 1 mile (urban interchange) or 3 miles (rural interchange). The proposed 2,500+ parking spaces would probably increase traffic, exacerbating current and projected future operating deficiencies. The projected ridership increase may not justify level of infrastructure needed. The stand-alone station would only generate 600 new daily users; the rest (4,700) would divert from existing stations[2], negating investment in the Westborough and Southborough commuter rail stations.

3.4 Alternatives Analyzed

The alternatives that passed the initial screening were further evaluated for their potential effect on traffic operations and safety, as well as their potential for environmental impacts. Concept sketches of the alternatives were developed and construction cost estimates (2012 $) were prepared. This section provides a description of each alternative and a summary of the findings of the alternatives analysis. A more detailed discussion of the traffic analysis is presented in Section 3.5 and the environmental analysis is discussed in Section 3.6.

3.4.1 Collector-Distributor Road (HT1)

A collector-distributor (C-D) road is a parallel roadway designed to remove weaving from the highway mainline and to reduce the number of mainline entrances and exits. Speeds on C-D roads are also lower than those on expressway mainlines, which ameliorates the negative effects of substandard ramp designs.

[1] I-495 Study I-290 to I-90, Central Massachusetts Regional Planning Commission and Metropolitan Area Planning Council, 2009
[2] Ibid.

The alternative proposed for this study would create the C-D road from the existing I-495 northbound and southbound travel lanes by shifting the mainline into the highway median as shown in Figure 3.4-1. Two options were considered:

Short C-D Road (HT1A) – would move the weaving maneuvers off of the I-495 mainline serving the I-495/Route 9 interchange as shown in Figure 3.4-2. It would be approximately 1.25 miles in length.

Long C-D Road (HT1B) - would move the weaving maneuvers off of the I-495 mainline at the I-495/Route 9 interchange and the I-495/I-90 interchange as shown in Figure 3.4-3. It would be approximately 2.75 miles in length.

The analysis found that both the Short and the Long versions of the C-D road would affect the I-495 highway mainline in the same manner for the following segments:

I-495 north of Route 9

- Level of Service (LOS) D in both directions for AM and PM peak hours.

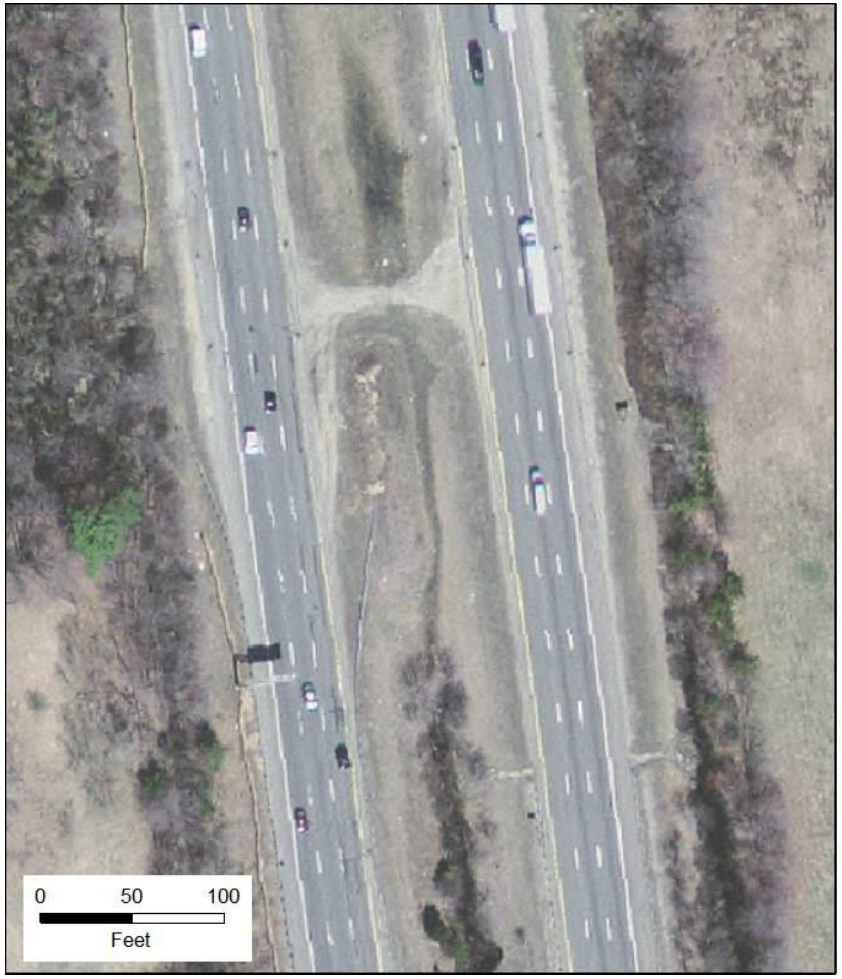
I-495 south of Route 9

- LOS C or better in both directions for AM and PM peak hours.

I-495 south of I-90

- Northbound LOS F in AM peak hour,
- Northbound LOS D in PM peak hour,
- Southbound LOS C in AM peak hour, and
- Southbound LOS F in PM peak hour.

Figure 3.4-1: HT-1 - Collector – Distributor (C-D) Road Concept



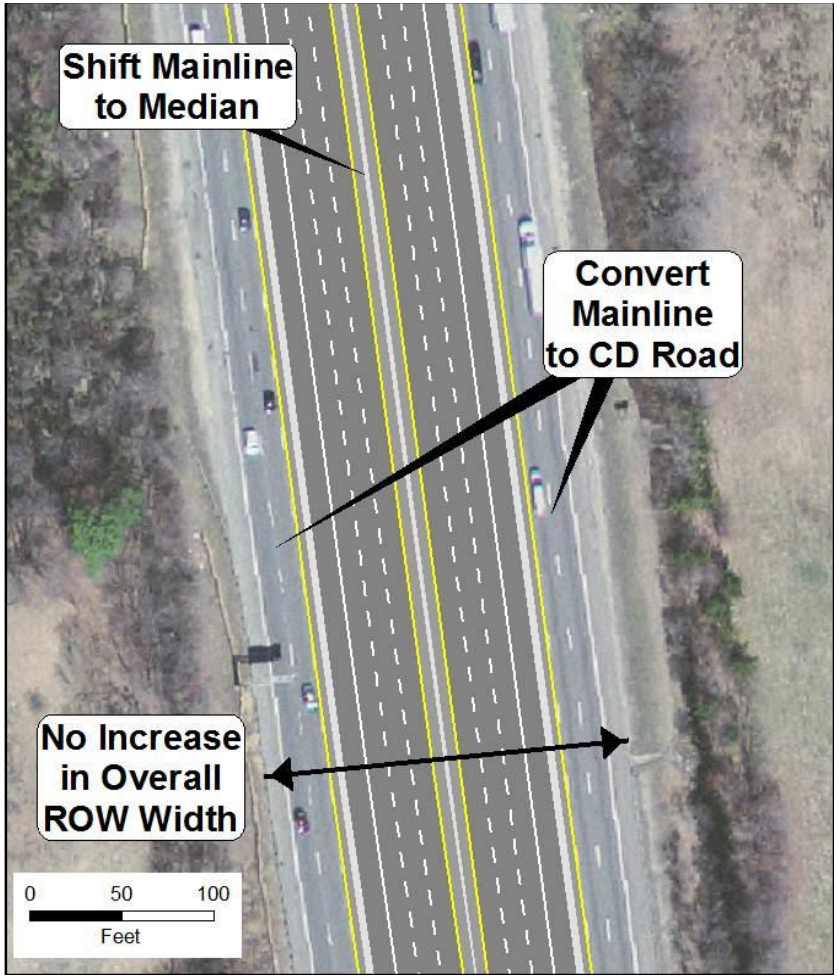


Figure 3.4-2: Collector-Distributor (C-D) Road – Short Option

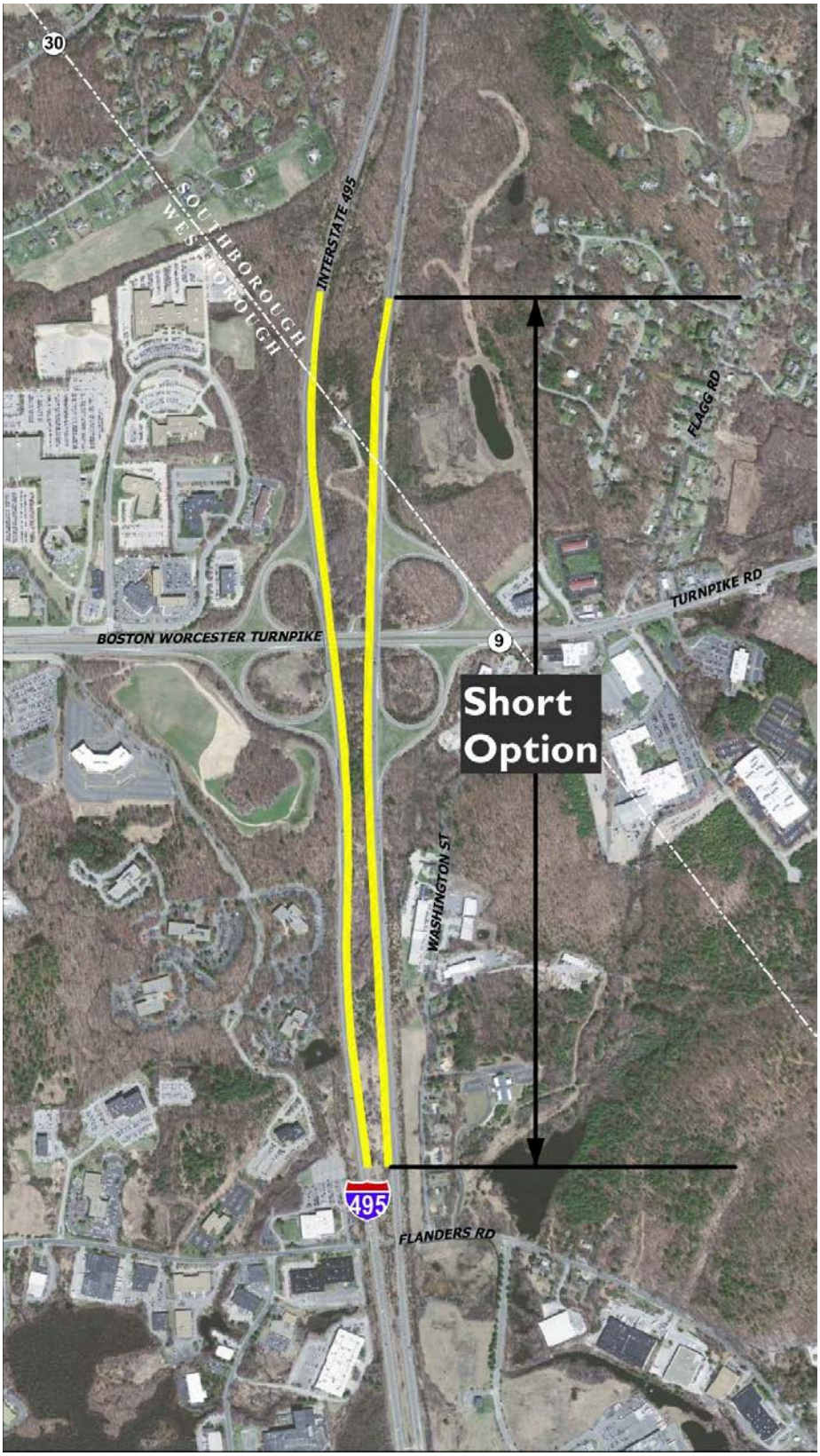


Figure 3.4-3: Collector-Distributor Road – Long Option

In addition, the interchange ramp analysis found the following for the **Short C-D road:**

- The I-495 mainline weaves at Route 9 are eliminated, thereby improving mainline operations. A C-D road weave is created in both directions which will operate at LOS B in both directions and both peak hours, except northbound during the PM peak hour which will operate at LOS F.

- I-495/Route 9 interchange – most ramps improve in the AM, but the diverge for the northbound C-D road from the I-495 mainline is LOS F in the AM peak hour

- I-495/Route 9 interchange – most ramps improve in the PM, but the C-D road merge southbound with the I-495 mainline is LOS F in the PM peak hour

The interchange ramp analysis found the following for the **Long C-D road**:

- Due to the large amount of exiting and entering traffic, the Long C-D road will carry more traffic than the I-495 mainline for both peak hours in most sections: over 4,000 vehicles in the AM peak hour and over 3,600 vehicles in the PM peak hour.
- The I-495 mainline weave is eliminated; a C-D road weave is created.
- I-495/Route 9 (AM) – most ramps improve; all ramps are LOS E or better.
- I-495/Route 9 (PM) – most ramps improve, but the C-D road northbound weave is LOS F.
- I-495/I-90 (AM) – I-495 northbound off-ramp to the C-D road and the C-D road northbound off-ramp to I-90 is LOS F. The southbound off-ramp to I-90 is LOS F.
- I-495/I-90 (PM) – northbound off-ramp to I-90, southbound off-ramp to I-90, and the southbound C-D road on-ramp to I-495 are all LOS F.

The analysis results show that both C-D road alternatives will improve operations on I-495 between Route 9 and I-90 to acceptable conditions. However, I-495 south of I-90 will continue to operate at or above capacity (LOS F) in peak directions regardless of the alternative.

This alternative could be constructed within the existing highway right-of-way. Impacts associated with the C-D road are due primarily to the shift of the mainline into the median, and includes impacts to wetlands in the median north of Flanders Road and the need to relocate the access road to the cell tower located in the median to the north of Route 9. These impacts are associated with both the Short and Long C-D Road options.

The estimated cost for the **Short C-D** road option is $56 million. The estimated cost for the **Long C-D** road option is $150 million.

3.4.2 I-495/Route 9 Braided Ramps (HT-3)

A braided ramp separates merging and diverging traffic by creating a bridge to elevate one ramp over the other. This would eliminate the weaves on I-495. For I-495 northbound, the Route 9 westbound off-ramp would go over the on-ramp from Route 9 eastbound. Similarly, for I-495 southbound, the Route 9 eastbound off-ramp would go over the Route 9 westbound on-ramp. The I-495 northbound and southbound off-ramps to Route 9 would be two lanes, until they split into the Route 9 eastbound and westbound ramps. See Figure 3.4-4 for an illustration of the I-495/Route 9 Braided Ramps alternative.

Figure 3.4-4: HT-3 - I-495/Route 9 Braided Ramps

The interchange ramp analysis found that the I-495/Route 9 Braided Ramps alternative would:

- Eliminate the I-495 northbound and southbound weaving sections, thereby improving safety,
- For the I-495/Rt. 9 interchange (AM) – all ramps improve except for the northbound off-ramp, which continues to operate at LOS F, and
- For the I-495/Rt. 9 interchange (PM) – all ramps improve to LOS C or better.

The braided ramps could be constructed within the existing highway right-of way. No environmental impacts were identified at this level of analysis.

The estimated cost of the I-495/Route 9 Braided Ramps is $25 million.

The Braided Ramps improve traffic operations at the interchange at a cost of $25 million without the impacts associated with the C-D Road alternatives. Therefore the braided ramps are the preferred alternative for the I-495/Route 9 Interchange

By comparison, the C-D road alternatives require more extensive construction to move the I-495 mainline into the highway median, including the construction of bridges for the new I-495 northbound and southbound lanes at Route 9 for the Short C-D Road option, and at Route 9, Flanders Road, the MBTA Worcester commuter rail line, and I-90 for the Long C-D Road option. The C-D road option also creates the potential for impacts to wetlands and requires relocation of the cell tower access road in the median. The estimated cost for the Short C-D Road option is $56 million, and the Long C-D Road option is estimated at $150 million

3.4.3 I-495/I-90 Interchange Safety Improvements (HT 9)

This alternative includes the following measures:

- Add advance E-ZPass/Cash-Only lane utilization signage to direct motorists approaching toll plaza, and
- Flatten curve on I-90 ramp to I-495 northbound which is susceptible to truck roll-overs.

These measures would improve safety and operations at the I-495/I-90 interchange, especially given the large number of truck rollovers observed at that location. It is shown in Figure 3.4-5.

Both elements of this alternative are within the existing right-of-way and could be constructed independently. No impacts have been identified for the additional signage proposed by this alternative. While no direct environmental impacts are anticipated, the I-495 northbound on-ramp is in close proximity to wetlands.

The estimated cost of the additional signage is $60,000, while the ramp improvement is estimated to cost approximately $3 million.

Figure 3.4-5: HT-9 - I-495/I-90 Short-Term Safety Improvements

3.4.4 I-495/I-90 Interchange Ramp Modifications (HT 10)

TheI-495/I-90 interchange was included as part of this study due to its proximity and potential interaction with the I-495/Route 9 interchange. The analysis of future year 2035 capacity under the Priority Development Area (PDA) scenario indicates that the I-495 mainline will operate at LOS F between Route 9 and I-90 northbound in the AM and southbound in the PM. There are similar interchange ramp capacity issues with the I-495 NB ramps with I-90 in the AM, and with the I-495 SB ramps and I-90 in the PM. (See Chapter 2, Section 2.4.11 for additional discussion of 2035 capacity issues.) The environmental constraints posed by the close proximity of the Cedar Swamp Area of Critical Environmental Concern to the I-495/I-90 interchange limits the ability to develop multiple feasible alternatives to address the capacity and safety issues identified for this interchange.

The conceptual ramp modifications for the I-495/I-90 interchange proposed below minimize the potential impacts to abutting wetlands and other environmental resources within the Cedar Swamp Area of Critical Environmental Concern by keeping the modifications within the existing highway right-of–way to the greatest extent possible. A comprehensive set of alternatives for the interchange, such as new ramp configurations on alternate alignments, were not evaluated in this study due to the environmental constraints at this location.

The proposed ramp modifications for the I-495/I-90 interchange include the following elements:

- Constructing a new I-495 direct northbound off-ramp to I-90 eastbound that would not pass through the existing toll booths. The I-495 northbound on-ramp from I-90 would cross over the new I-90 eastbound on-ramp;
- Widening of the I-495 southbound on-ramp to two lanes;
- Extending the merge distance for the I-495 southbound on-ramp;
- Creating an auxiliary lane for the I-495 southbound off-ramp to I-90 that would extend to just north of the I-495 bridge over the Worcester mainline tracks;
- Separating movements at the toll plaza to eliminate vehicle weaving maneuvers; and
- Modifying the I-495 southbound on-ramp from I-90 westbound approaching the existing toll plaza so that it crosses over the I-495 on-ramp from I-90 eastbound on a bridge, removing the conflict with traffic from the I-90 eastbound ramp. These two ramps would then converge at the two-lane on-ramp to I-495 southbound.

The interchange ramp modifications are shown in Figure 3.4-6, while Figure 3.4-7 illustrates the extent of modifications to the I-495 mainline to accommodate the interchange modifications. This alternative assumes that the existing three-span bridges over I-495 carrying Fruit Street and the I-90 ramps remain in place.

Figure 3.4-6: HT-10 - I-495/I-90 Ramp Modifications

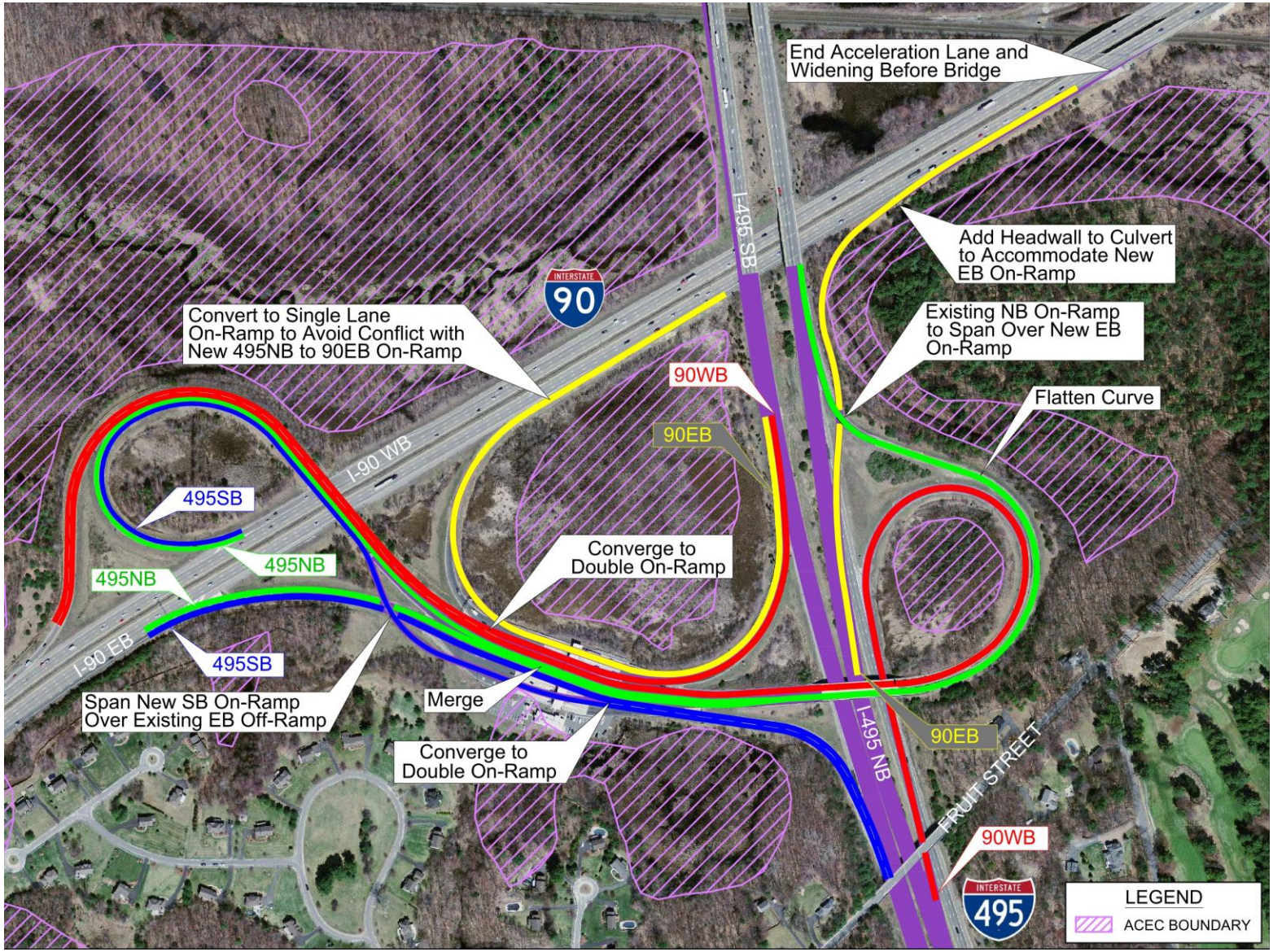
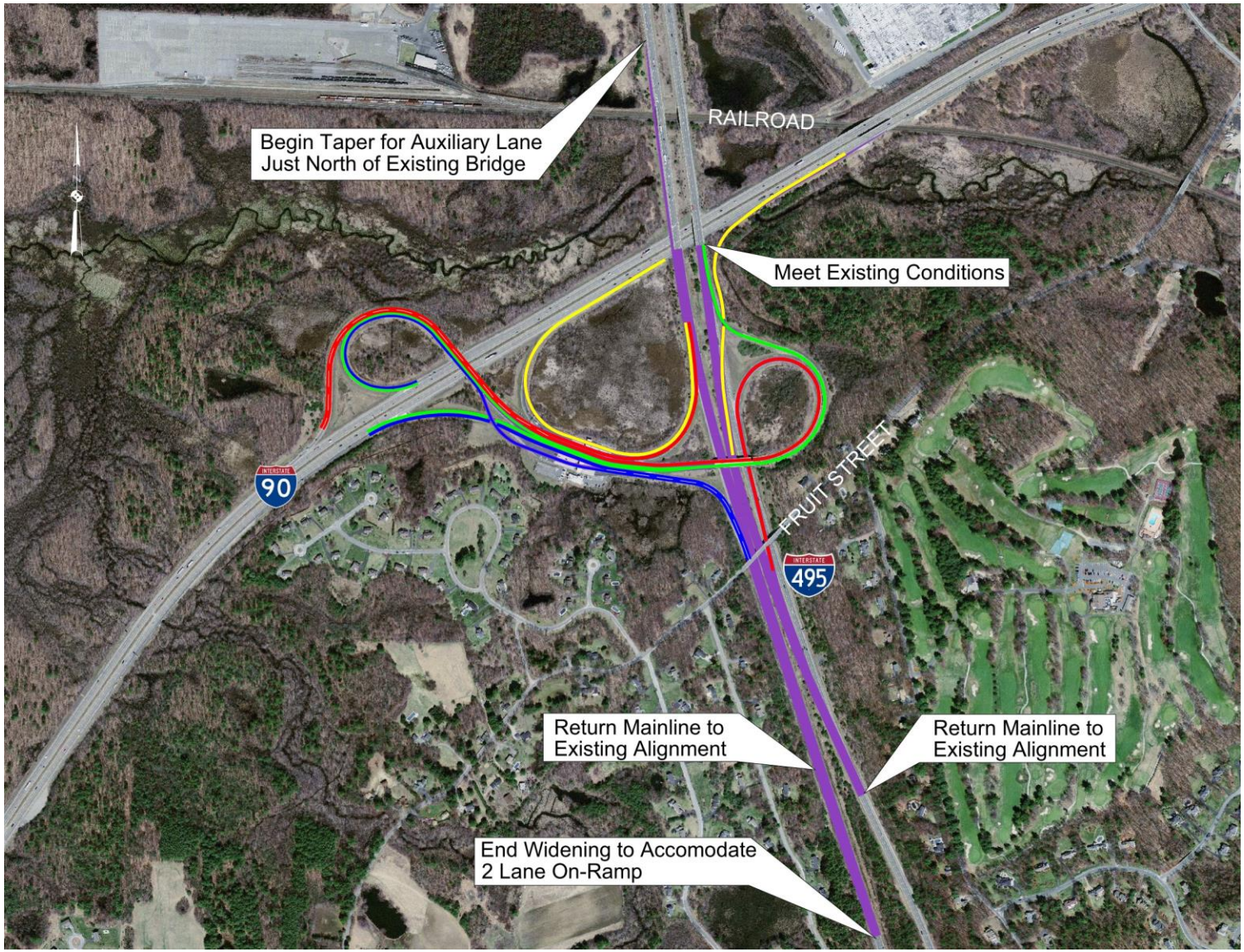


Figure 3.4-7: HT-10 - I-495/I-90 Interchange Ramp Modifications



Note: Ramp colors correspond to those in Figure 3-6.

Analysis of the I-495/I-90 Ramp Modifications alternative found that this alternative would improve safety and traffic operations at the interchange as follows:

- The new I-495 northbound off-ramp to I-90 eastbound will reduce toll congestion because it removes approximately 1,800 vehicles in the AM peak hour and 750 vehicles in the PM peak hour from the toll plaza area, based on estimated 2035 traffic volumes;

- The I-495 northbound diverge to I-90 eastbound will improve from LOS F to E in the AM peak hour and F to C in the PM peak hour, due to the new ramp.

- I-495 northbound off-ramp (AM) – new ramp to I-90 eastbound operates at LOS E, existing ramp to I-90 westbound remains LOS F;

- I-495 northbound off-ramp (PM) – new ramp to I-90 eastbound operates at LOS C, existing ramp to I-90 westbound improves to LOS E;

- Additional ramp capacity is provided for the I-495 southbound off-ramp and the I-495 southbound on-ramp. The I-495 southbound off-ramp will improve from LOS F to A in the AM peak hour and F to B in the PM peak hour. The I-495 southbound on-ramp will improve from LOS C to B in the AM peak hour and F to B in the PM peak hour**.**

- The weave from I-90 off-ramps to toll plaza is eliminated;

- I-495 southbound off-ramp (AM) - improves to LOS A;

- I-495 southbound off-ramp (PM) - improves to LOS B; and

- I-495 southbound on-ramp improves to LOS B for both AM and PM.

The proposed alternative would remain within the footprint of the existing interchange to the greatest extent possible to minimize impacts to adjacent environmental resources. However there is a potential for wetland and water resource impacts associated with the new I-495 northbound ramp to I-90 eastbound, as this ramp abuts a wetland for much of its length. The existing culvert carrying the Sudbury River under I-90 would also need to be modified to accommodate this new ramp. No direct impacts to this resource area are apparent based on the current level of analysis. However, given the close proximity of the rare species habitat to the proposed modifications, there is a potential for environmental impacts.

Numerous parcels within the Great Cedar Swamp ACEC and Sudbury River Watershed abutting the I-495/I-90 interchange have been identified as open space owned by the Massachusetts Department of Conservation and Recreation, as well as various land trusts. No direct impacts to these properties have been identified at this level of analysis.

The Great Cedar Swamp Archeological District abuts the I-495/I-90 interchange. No direct impacts to archaeological resources have been identified at this level of analysis. No other historic districts or properties have been identified within the study area.

A residential neighborhood in is located to the south of the toll plaza in Hopkinton. Grade separating the I-495 southbound on-ramp from I-90 westbound will raise the vertical alignment of the ramp that could potentially create noise impacts for the abutting neighborhood.

The cost of the I-495/I-90 Ramp Modifications is estimated to be at least $100 million.

3.4.5 Consider Alternate Tolling Technologies (HT 13)

The proposed I-495/I-90 Ramp Modifications would work with the existing toll booths in place, but each lane would require its own toll booth(s) for both E-ZPass and cash operations, limiting the efficiency of the toll plaza. A new, isolated toll booth or other tolling technology would be required for the new I-495 northbound lane to I-90 eastbound. However, the proposed interchange modifications would work more effectively if the toll booths were eliminated and replaced with electronic toll collection.

Subsequent to the development of alternatives for the *I-495/Route 9 Interchange Study,* MassDOT began work to implement statewide All-Electronic Tolling (AET) to replace the existing toll plazas on the Massachusetts Turnpike, Tobin Bridge, and Harbor Tunnels with overhead gantries to be installed along the highways. Cash will be eliminated from the system entirely, as all transactions will be conducted using either the current E-ZPass system or through video tolling (in which invoices are sent to customers whose license plates are recorded by the AET camera system). This concept will lessen congestion, improve air quality, and reduce operating costs.

3.4.6 Route 9 Widening (HT 5)

This alternative would widen Route 9 to three lanes westbound from Computer Drive in Westborough to Deerfoot Road in Southborough. It retains the merge of the I-495 southbound off-ramp with Route 9 westbound. Route 9 eastbound would be widened from Coslin Drive (Southborough) to Deerfoot Road. Most of the widening would occur within the existing right-of-way by widening in the median to accommodate the third travel lane in each direction. The Route 9 widening can be constructed separately but would be designed to tie into the proposed Route 9/Crystal Pond Road intersection improvements (See Section 3.4.7). Figures 3.4-8, 3.4-9, and 3.-4-10 illustrate the proposed Route 9 widening.

The analysis found the following:

- The Route 9 westbound mainline west of I-495 will improve to LOS D in AM and LOS C in PM with Route 9 widening;
- Route 9 westbound mainline weave between the I-495 ramps will improve to LOS B in both AM and PM;
- The additional westbound lane on Route 9 will improve operations east of I-495 by balancing through traffic more evenly in three lanes which will provide more gaps for side street traffic. This will reduce delay for side street traffic waiting to turn onto Route 9 westbound;
- The Route 9 westbound on-ramp merge from I-495 southbound will improve to LOS D in AM and LOS C in PM;
- Route 9 westbound off-ramp to Computer Drive improves to LOS B in AM and LOS A in PM;
- The Route 9 westbound off-ramp to I-495 northbound will operate at LOS C in both AM and PM; and
- East of I-495, the added lane on Route 9 eastbound provides additional weaving capacity and increases the vehicle gaps for exiting side street traffic to enter Route 9, reducing their delay.

Figure 3.4-8: HT-5 - Route 9 Westbound Widening West of I-495

Figure 3.4-9: HT-5 - Route 9 Westbound Widening East of I-495 and Eastbound Widening East of Coslin Drive

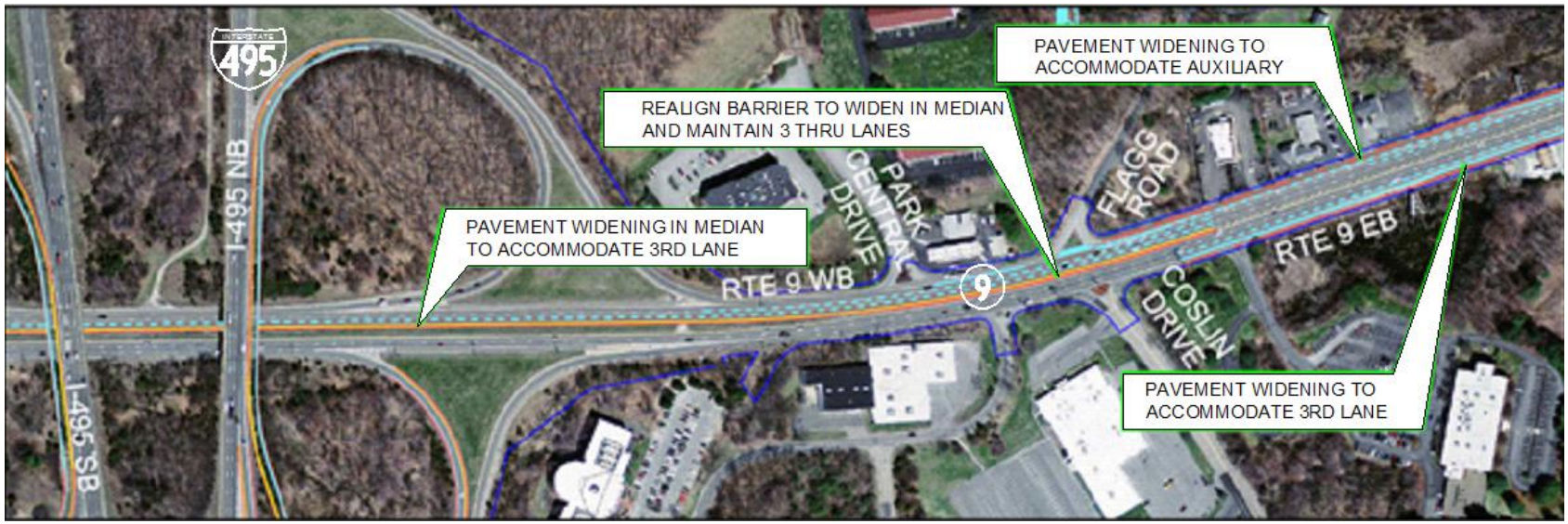
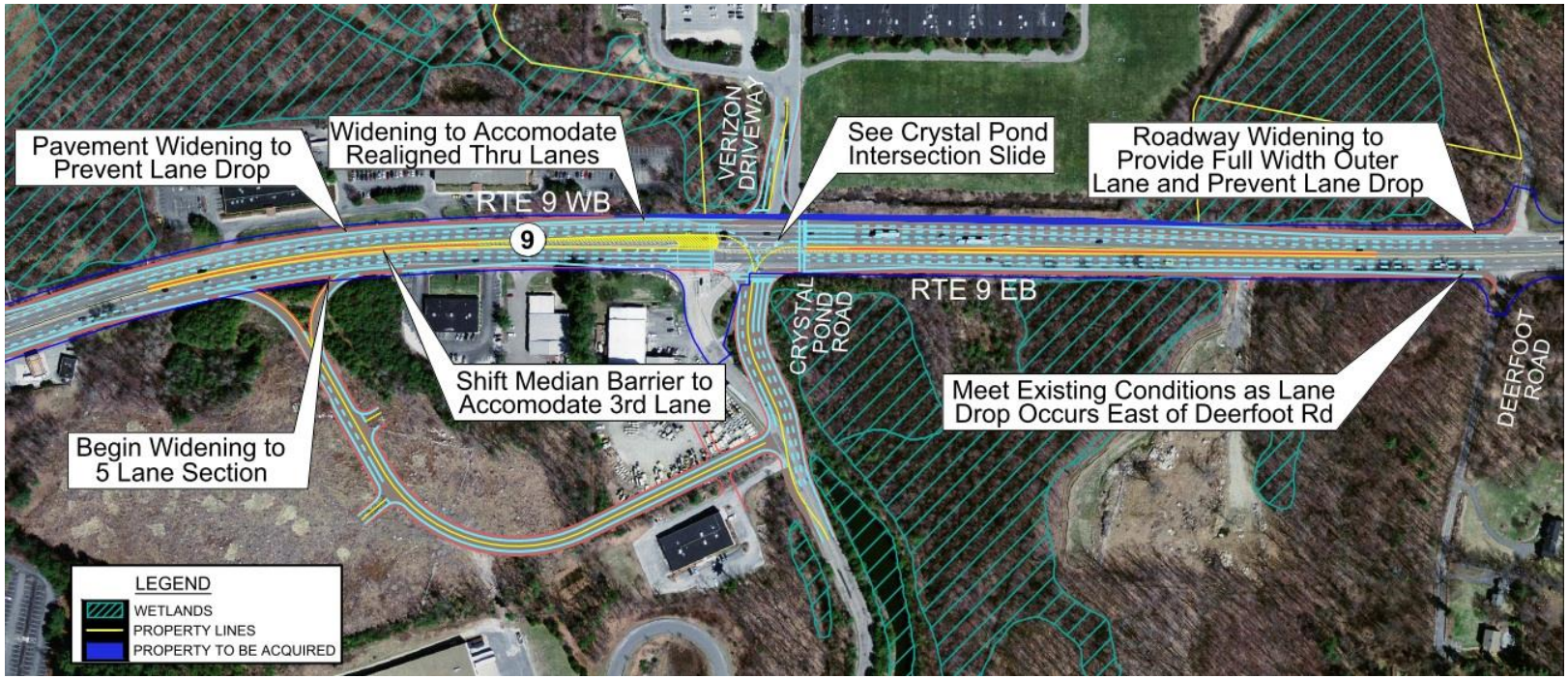


Figure 3.4-10: HT-5 - Route 9 Widening East of I-495 (continued)



Most of the widening in this alternative can be accommodated within the existing right-of-way and avoids environmental impacts by widening toward the median. However, the area needed for additional right-of-way for the westbound widening at the Verizon site (approximately ¼ acre) is predominantly wetlands, and construction of the additional lane in this area will result in direct impacts to wetlands resources.

The estimated cost of this alternative is approximately $9.2 million.

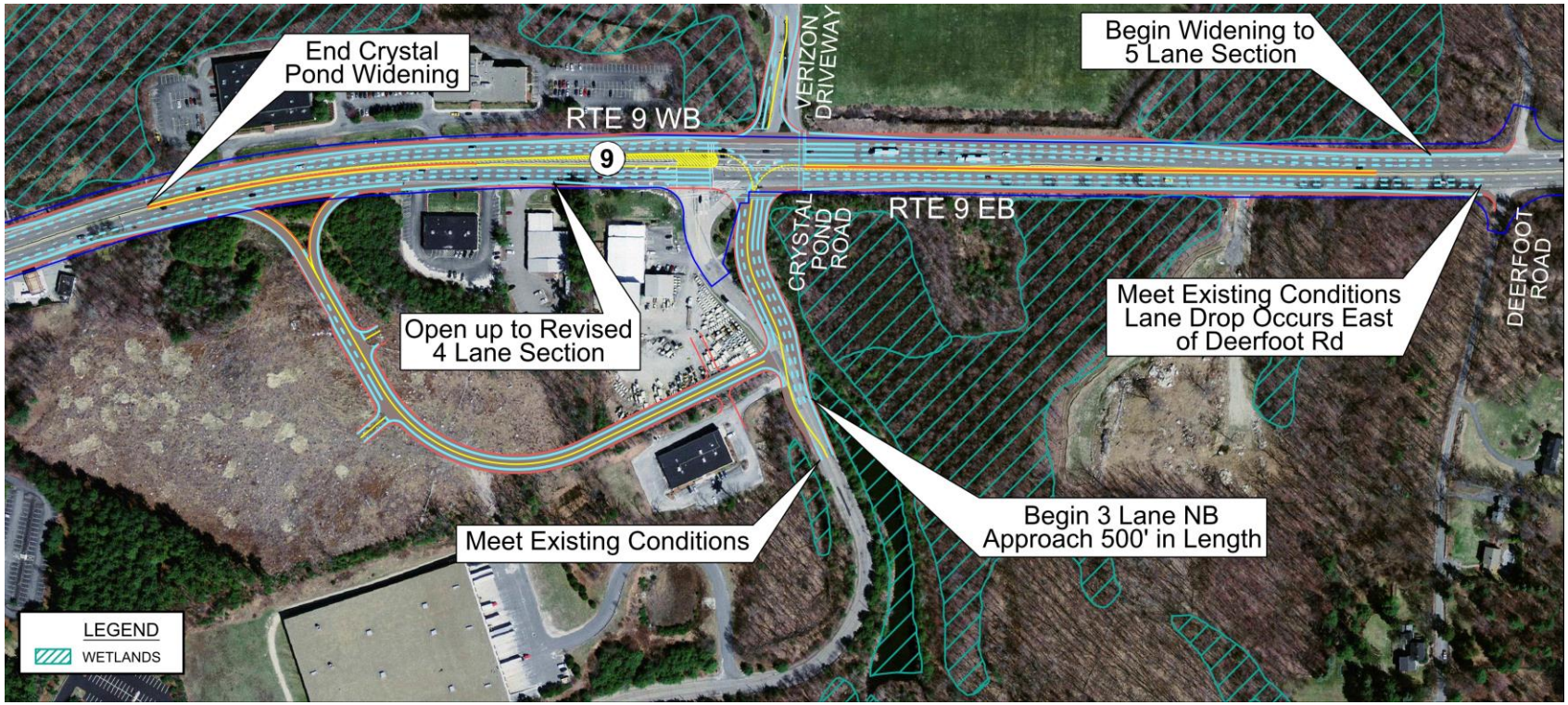
3.4.7 Route 9/Crystal Pond Road Intersection Improvements (HT-11)

Crystal Pond Road is the first signalized intersection on Route 9 east of the interchange with I-495. It serves as the primary access to several businesses south of Route 9. The analysis found that with no changes, the intersection would continue to operate at LOS F with the 2035 traffic volumes predicted by the 2035 PDA scenario. EMC has also proposed to develop the vacant land off of Crystal Pond Road into additional office space which is expected to generate a large number of new vehicle trips in the future and lead to congestion issues. The intersection improvements developed would realign and reconstruct the Crystal Pond Road intersection with Route 9 in Southborough to accommodate the added traffic anticipated. It would provide three through lanes in both directions on Route 9 and re-align the Verizon site driveway to form a 4-way intersection. A second westbound left turn lane would be added to Route 9 which would result in five westbound approach lanes at the intersection (two left turn and two through lanes and one shared through-right lane). An eastbound jug-handle would be added to eliminate the existing Route 9 eastbound-to-westbound u-turn. The Route 9 eastbound approach would include three through lanes and one right turn lane. The jug-handle would also provide access to the Verizon property on the north side of Route 9. Three northbound approach lanes would be provided – two left-turn lanes and one shared through-right turn lane (see Figure 3.4-11).

It is estimated that the improvements identified for this alternative could accommodate up to approximately 500,000 square feet of new development south of Route 9 as proposed by EMC, with the intersection operating at LOS E in both peak hours. There is approximately 700,000 square feet of existing development on Crystal Pond Road and Coslin Drive.[3] Therefore the Route 9/Crystal Pond Road intersection improvements would accommodate 1.2 million total square feet of development, which includes replacement or modification of existing buildings as originally contemplated in the EMC proposal[4]. Accommodating additional growth beyond 1.2 million square feet would require extensive additional improvements such as construction of a grade-separated intersection at Crystal Pond Road, with the potential to affect access for existing businesses on Route 9 in the vicinity of Crystal Pond Road. These measures should be considered if and when full build-out of the EMC property south of Route 9 is imminent.

[3] Town of Southborough Assessors Records, FY 2013
[4] Supplemental Final Environmental Impact Report, EMC Southborough/Westborough Campus, 2007

Figure 3.4-11: HT-11 - Route 9 / Crystal Pond Road Intersection Improvements



This alternative would require acquisition of new right-of-way for the jug-handle and for the realignment of Crystal Pond Road. The developer of the proposed Madison Place 40B residential development has agreed to provide the right-of way for the jug-handle[5], a portion of which will initially be developed as the access road to the development from Crystal Pond Road. The right-of-way required for the realignment of Crystal Pond Road includes areas of wetlands, resulting in direct impact to wetland resources. Field delineation of wetland resources and development of engineering drawings are required to determine the extent of wetland impacts.

The estimated cost of the Route 9/Crystal Pond Road intersection improvements is approximately $2.1 million.

3.4.8 Research Drive/Connector Road Improvements (HT-8)

This alternative includes improvements to Research Drive in Westborough at Connector Road and at the Route 9 Eastbound Ramps as shown in Figure 3.4-12.

Connector Road/Research Drive

- This element will add a new northbound right turn lane and upgrade the traffic signal by installing detection equipment, optimizing signal timing and phasing patterns, and signage and pavement markings.

- Traffic operation improves to LOS D in the AM and remains at LOS F in the PM (although with lower delay and queue lengths) because the addition of an exclusive right-turn lane changes the signal phasing and timings. The overall intersection delay is reduced by 16 seconds and delay for individual movements is also reduced. This intersection will continue to process high turning volumes in both peak hours.

- Currently there are no pedestrian signals and only one painted crosswalk across the Research Drive approach to Connector Road. Bicycle signal loop detectors are provided. Pedestrian signals and additional crosswalks could be implemented in the future if development occurs on the west side of the intersection. These improvements should be included as a condition of approval for any new development near or adjacent to this intersection.

- There is currently little or no shoulder on Connector Road and Research Drive near the intersection. A wider shoulder for bicycle accommodation can be considered in conjunction with the recommendation to provide a separate northbound right-turn lane on Connector Road approaching Research Drive.

Research Drive and Route 9 Eastbound Ramps

- This element will install a second westbound right turn lane and upgrade the traffic signal by installing detection equipment, optimizing signal timing and phasing patterns, and signage and pavement markings.

- Traffic operations improves to LOS B in the AM and LOS D in the PM.

[5] On approved plans referenced in Grant of Comprehensive Permit, Madison Place Southborough, LLC, approved by the Town Of Southborough Board of Appeals, June 27, 2012.

- No pedestrian facilities are currently provided at this intersection. A sidewalk is provided on the south side of Research Drive. Future pedestrian facilities are not needed as there is no need for pedestrians to be on the north side of Research Drive.

- There are very narrow shoulders on Research Drive near the intersection. These are not acceptable for bicycle accommodation. There are three options to provide bicycle accommodation in this area: 1) install a shared-lane marking (known as a sharrow) in the center of the travel lane to indicate that bicyclists may use it, 2) construct separate bike path, and 3) allow bikes on the existing sidewalk. Providing sharrows in this area may not be appropriate due to high traffic volumes and high vehicle speed. It appears there may be room to construct a separate bicycle path, but may require taking private property. Allowing bicycles to share the sidewalk in this area may be the best option as the pedestrian volumes are low, and the bicycle accommodation would be low cost, only requiring minimal signage.

Extending the eastbound right turn lane on Computer Drive at the Route 9 Westbound ramps was originally considered as part of this alternative. However, the traffic analysis showed that this had no effect on intersection operations, and this element was eliminated from this alternative.

A small amount of additional right-of way is required for the new right turn lane at Connector Road/Research Drive. The improvements at the Route 9 eastbound ramps are within the existing right-of-way. No environmental impacts are anticipated for either of the Research Drive improvements.

The estimated cost of the Research Drive improvements is $685,000.

3.4.9 Route 9/Park Central Drive Egress Modification (HT-6)

This alternative provides a new connector road between Park Central Drive and Flagg Road and prohibits egress from Park Central Drive onto Route 9 westbound, as shown in Figure 3.4-13.

Due to its proximity to the I-495 northbound on-ramp, the southbound right turn from Park Central Drive to Route 9 will be eliminated to improve safety. This eliminates the existing weave, and the resulting Rt. 9 diverge to Park Central will operate LOS C in both AM/PM.

The southbound right turn from Flagg Road to Route 9 will continue to operate at LOS F in both peak hours with significant delay and queues. However, delay and queuing would improve with the addition of the Route 9 widening alternative which will provide an additional auxiliary lane in this area.

The connector road will require new right-of-way. Left turns from the new connector road would be prohibited to reduce traffic on Flagg Road, which is a narrow roadway that serves a residential neighborhood. The left turns would be restricted by both geometric channelization and signage. The alternative concept as presented in Figure 3.4-13 would cross an unnamed stream at two locations, creating the potential for environmental impacts.

The estimated cost of the Route 9/Park Central Drive Egress Modification is approximately $1.5 million.

Figure 3.4-12: HT-8 - Research Drive & Connector Road Improvements

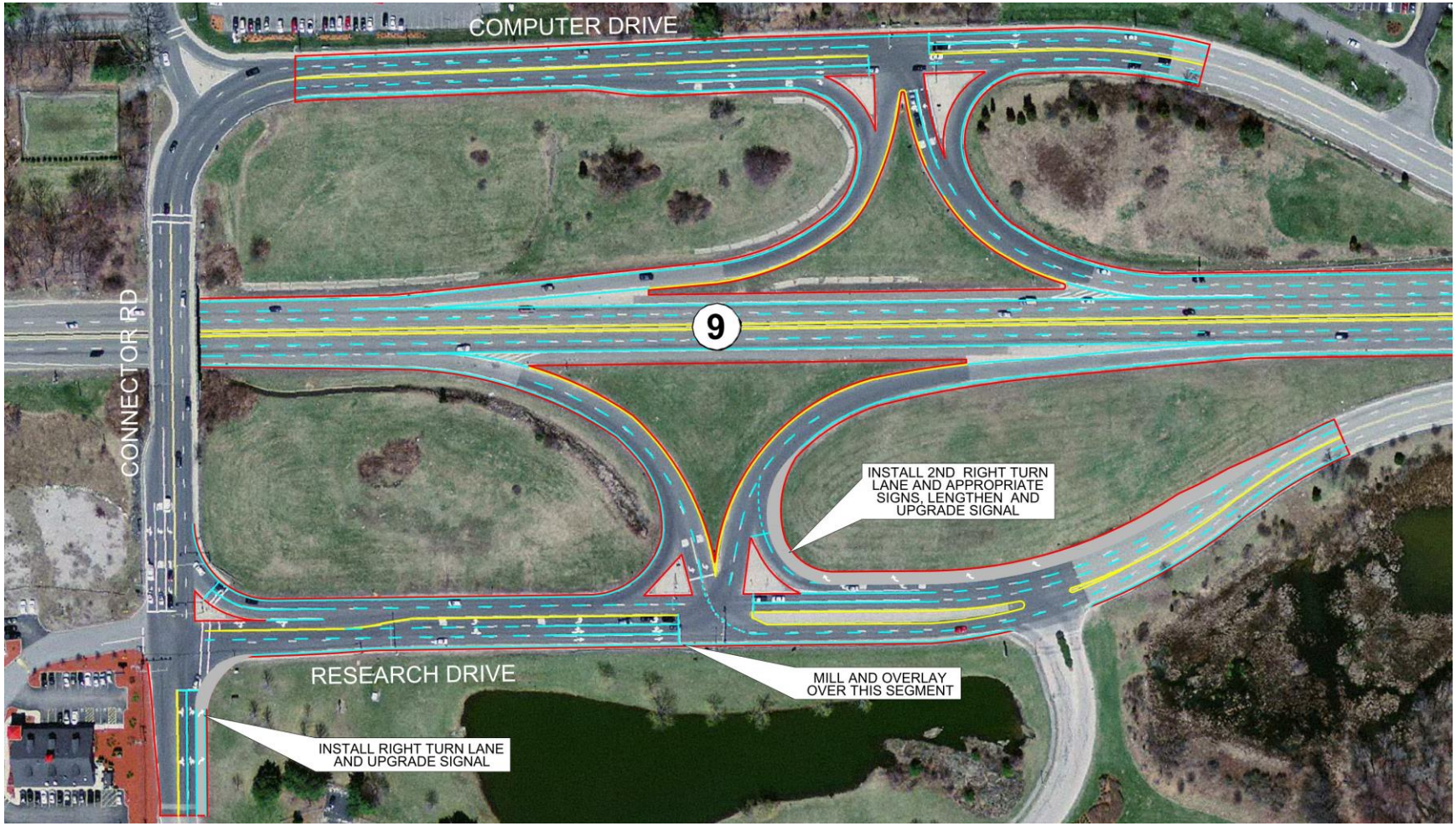


Figure 3.4-13: HT-6 - Park Central Drive and Flagg Road Improvements

3.4.10 Consolidate Driveways on Route 9 east of I-495 (HT-7)

There are many closely-spaced driveways on Route 9 east of I-495 which do not meet current spacing standards (see Chapter 2). This situation creates safety issues for motorists and can exacerbate delay and operations that impact Route 9 traffic. Consolidation of driveways will reduce the number of conflicting movements, improve operations, improve sight lines, and improve traffic safety overall. The consolidation of driveways is best done when private properties are developed or redeveloped. This would allow the town and MassDOT to coordinate with adjacent land owners to develop joint-driveways that would serve access and egress for multiple parcels.

Construction cost estimates and potential impacts associated with driveway consolidation would vary according to the specific location and design concept proposed.

3.4.11 Worcester Regional Transit Authority (WRTA)/MetroWest Regional Transit Authority (MWRTA) Route 9 Connector Service (TR1)

This alternative would provide fixed route bus service along Route 9. The WRTA and MWRTA would each operate a service on Route 9 that would meet in Westborough to allow passengers to transfer between the routes to continue their journey beyond each RTA's service area. The connector service would also provide access to jobs within the Westborough office and industrial parks within the study area.

Subsequent to the development of the alternatives for the I-495/Route 9 Interchange Study, the WRTA announced plans to start shuttle service between the Westborough MBTA Commuter Rail Station and business parks at Computer and Technology Drives along Route 9 in Westborough. This service is planned to start in the fall of 2013. (See section 3.4.12 for additional information). The MWRTA also received a Job Access and Reverse Commute (JARC) grant from the MassDOT Community Transit Grant Program to fund an extension of their Route 1 Green Line Shuttle to the Westborough Technology Park, which is within the WRTA service area. This service will connect to the WRTA commuter rail shuttle service, and will begin operations in the fall of 2013 once the WRTA service is operating. Route 9 connector service will be provided when these two services are in operation.

3.4.12 Westborough (TR2A) and Southborough Commuter Rail Shuttles (TR2B)

Access to the job centers in the study area via commuter rail would be provided by bus shuttles between the commuter rail stations in Westborough and Southborough. The WRTA plans on starting shuttle service between the Westborough MBTA Commuter Rail Station and business parks at Computer and Technology Drives along Route 9 in Westborough in the fall of 2013. The service would run two peak morning trips, a midday trip and two peak evening trips. Funding for the service will be provided by the Town of Westborough MBTA assessment which the WRTA can access to support the service. The MWRTA will include a stop at the Southborough station on their extended Route 1 Green Line Shuttle (See section 3.4.11).

The Southborough commuter rail station is better positioned to serve reverse commutes from Boston, as it offers a shorter train ride. However, at the moment there is only one reverse commute trip offered on the MBTA Framingham/ Worcester Commuter Rail line in the morning peak period, and two reverse commute trips offered in the afternoon peak period. Additional reverse commute trips would be required to make this a more attractive service.

3.4.13 Park-and-Ride Facility (TR3)

This facility would provide a park-and–ride lot as well as a location for fixed route and shuttle bus services to pick-up and discharge passengers. Provision of a facility with a coffee concession or other suitable business would offer amenities for waiting passengers as well as an opportunity of a public/private partnership to support the facility. The preferred location for the facility would be in the vicinity of Research Drive and Connector Road to provide easy access to Route 9. An analysis prepared by the CMRPC indicates that approximately 5,300 vehicle trips occur on Route 9 west of I-495[6] in the AM period. Of those trips, 42% of them are 30 minutes or more, indicating that the proposed location would be attractive for a park-and-ride facility. A specific site for the facility would need to be selected via a competitive selection process.

Each of the transit alternatives provides an opportunity to reduce the use of single occupancy vehicles (SOV) and enhance mobility options, particularly for those without an automobile. The WRTA/MWRTA bus service and the shuttle service would operate along existing right-of-way. A site would have to be acquired, however, to develop the park-and-ride facility. No environmental impacts are projected for the connector bus and shuttle services. Environmental impacts from the proposed park-and–ride facility would be determined when a specific site is identified.

Transit improvements are shown in Figure 3.4-14.

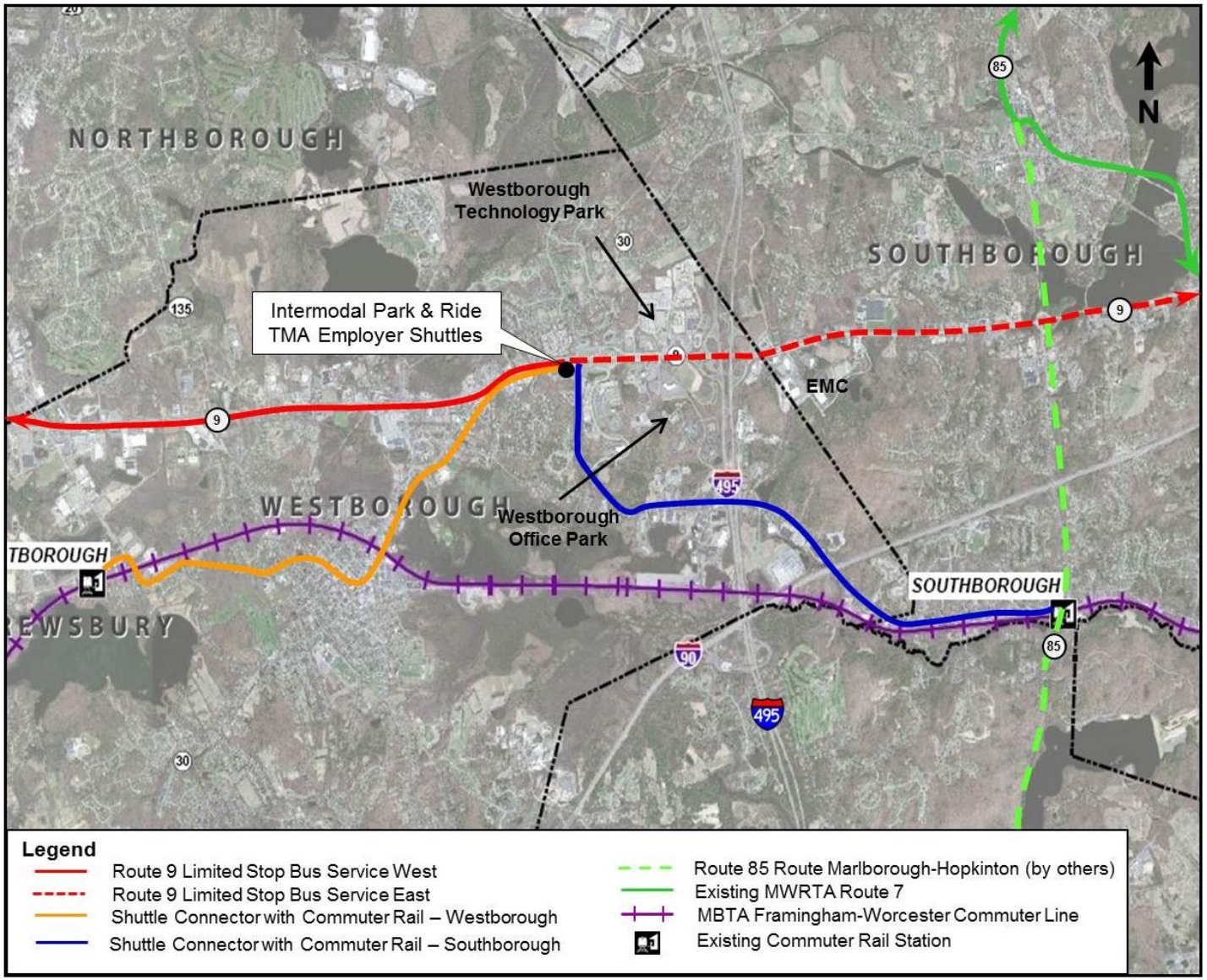
3.4.14 Pedestrian Improvements

Pedestrians are an important element of a multi-modal transportation system, and a key component of the Massachusetts GreenDOT policy which has among its goals the design of a multi-modal transportation system and promotion of healthy transportation and livable communities. While pedestrians are prohibited on the interstate highway system, improvements can be made along Route 9 and local streets with development sites to enhance pedestrian connectivity and safety. Among the improvements considered are:

- Accommodate pedestrian connections between transit stops and adjacent properties,
- Install sidewalks and improve on-site pedestrian amenities conditions within private developments and provide better sidewalk connections from business parks north and south of Route 9 to public sidewalks on Computer Drive and Research Drive,
- Provide better sidewalk connections from business parks north and south of Route 9 to public sidewalks on Computer Drive and Research Drive,
- Upgrade pedestrian signals at Route 9/Crystal Pond Road in conjunction with overall intersection improvements (HT 11),
- Upgrade pedestrian signals at Research Drive/Connector Road in conjunction with overall intersection improvements (HT 8), and

[6] Central Massachusetts Regional Planning Commission *AM Peak Period (6-9AM) Analysis,* provided by Rich Rydant, CRMPC to Callida Cenizal, MassDOT via e-mail, June 28, 2012.

Figure 3.4-14: Transit Improvements



- Upgrade/install handicap ramps as intersections and driveways are reconstructed as part of redevelopment projects along Route 9.

While pedestrian improvements are not expected to have a measureable effect on peak period traffic operations in the study area due to the longer distance nature of many trips on I-495 and Route 9, they nonetheless can play a role in reducing local vehicle trips and off-peak trips in the study area.

3.4.15 Bicycle Improvements

As with pedestrian facilities, bicycle facilities are an important element of a multi-modal transportation system. Bicyclists are prohibited on the interstate highway system, and because of high speeds, trucks and merges and weaves along Route 9, bicycle accommodations were not recommended on this corridor. However, improvements can be considered for local streets to enhance bicycle mobility and safety. Among the improvements considered are:

- Improve options for bicycle commuting at business parks and park-and-ride lots such as dedicated all-weather parking, storage, and showers;
- Encourage participation in MetroWest/495 TMA bike programs, which include MassRides/NuRides bicycle commuter tracking program, Bike to Work Week, and encouraging employers to provide safe and secure bicycle parking.
- Incorporate bicycle routes/connections into study area properties as development/redevelopment occurs;
- Investigate the feasibility of a bike path proposed by the Town of Westborough Bicycle and Pedestrian Advisory Committee along the former Boston and Worcester Street Railway alignment that ran through the study area from Park Street in Westborough on the west, to Cordaville Road (Route 85) in Southborough on the east. The construction of I-495 bisected the former trolley line. A section of this former trolley line is located within the Walkup Robinson Memorial Reservation Park abutting Friberg Parkway. However, the remainder of the former ROW was incorporated within abutting private properties.
- Encourage towns to provide bike accommodations (bicycle lanes preferred) on local roadways connecting with the study area, including Flanders Road, Connector Road, and Washington Street in Westborough, and Southville Road in Southborough.
- Incorporate bicycle storage facilities at the proposed park-and-ride facility (TR 3).

3.5 Summary of Traffic Impacts

Traffic operations were analyzed for the highway alternatives for the morning and evening peak traffic volumes and compared to the future 2035 No-Build alternative traffic operations to evaluate their impact. The CTPS regional travel demand model was used to develop year 2035 weekday traffic volumes in the study area for the project alternatives. The potential for an alternative to affect travel demand was also considered, where appropriate.

3.5.1 2035 Traffic Volumes

The additional capacity along I-495 provided by the Short and Long Collector-Distributor (C-D) Road Alternatives (HT-1A and HT-1B) may attract motorists from other routes, and therefore had the potential to change the traffic assignment between the No-Build and Build Alternatives. The CTPS travel model was run for the two C-D Road alternatives using the Regional Transportation Plan (RTP) and Priority Development Area (PDA) land use projections as described in Chapter 2. (See the CTPS Technical Memorandum in the Appendix or additional information.) The model displayed the following modest shifts in peak hour traffic volumes from the RTP and PDA 2035 No-Build scenarios to the C-D Road alternatives as follows:

Short C-D Road

- I-495 southbound (+2%),
- I-495 northbound (+1%),
- I-90 westbound (+3-12%),
- I-90 eastbound (+6%), and
- Rt. 9 eastbound to I-90 eastbound (7-14%).

Long C-D Road

- I-495 southbound (+1-2%),
- I-495 northbound (+1-2%),
- I-90 westbound (+3-12%),
- I-90 eastbound (+4%),
- Rt. 9 eastbound to I-90 eastbound (7-14%), and
- Rt. 9 westbound to I-90 westbound (2-4%).

The remaining alternatives do not add significant roadway capacity and are thus unlikely to attract motorists from other routes. Therefore, the No-Build 2035 peak hour volumes were reassigned only according to the changes in geometrics for each alternative. Figures 3.5-1 and 3.5-2 show the peak hour 2035 traffic volumes used to evaluate the I-495/Route 9 Braided Ramp alternative (HT-3) and the I-495/I-90 Ramp Modifications alternative (HT-10). Volumes for the C-D road alternatives are provided in the Appendix.

3.5.2 Traffic Capacity Analysis

This section summarizes the capacity analysis results for highway alternatives identified for further evaluation. The year 2035 traffic volumes developed for the Priority Development Area (PDA) scenario were used to evaluate the alternatives, as this reflected the preferred development scenario developed through the MetroWest Compact planning process. Traffic capacity analysis was performed for I-495, the I-495/Route 9 and I-495/I-90 interchanges, Route 9, and the affected intersections within the study area. The alternatives were compared with the year 2035 No-Build capacity analysis results to determine their impact on traffic operations. The results for each of these are discussed separately below.

Highways

Capacity analysis was performed for the following highway areas:

- I-495 and Route 9 mainline segments,
- I-495/Route 9 weave, merge, diverge,
- I-495/I-90 merge, diverge, and
- Route 9 merge and diverge.

Table 3.5-1 summarizes the Level of Service (LOS) results for the I-495 and Route 9 mainline highway segments.

Interchange Ramps

Table 3.5-2 shows the results of interchange ramp operations for the respective alternatives.

Intersections

Intersection capacity analysis was performed for unsignalized and signalized study intersections for the alternatives using the year 2035 PDA traffic volumes. Analysis was conducted for the weekday AM and PM peak hours. It is noted that alternatives were not identified for all study intersections. However, several intersections along Route 9 east of I-495 will benefit from the additional capacity as a result of the alternative that adds a lane in both directions on Route 9.

Table 3.5-3 summarizes level of service (LOS), vehicle delay, and queue length for each alternative.

Figure 3.5-1: 2035 PDA Traffic Volumes Used to Evaluate the Braided Ramp Alternative

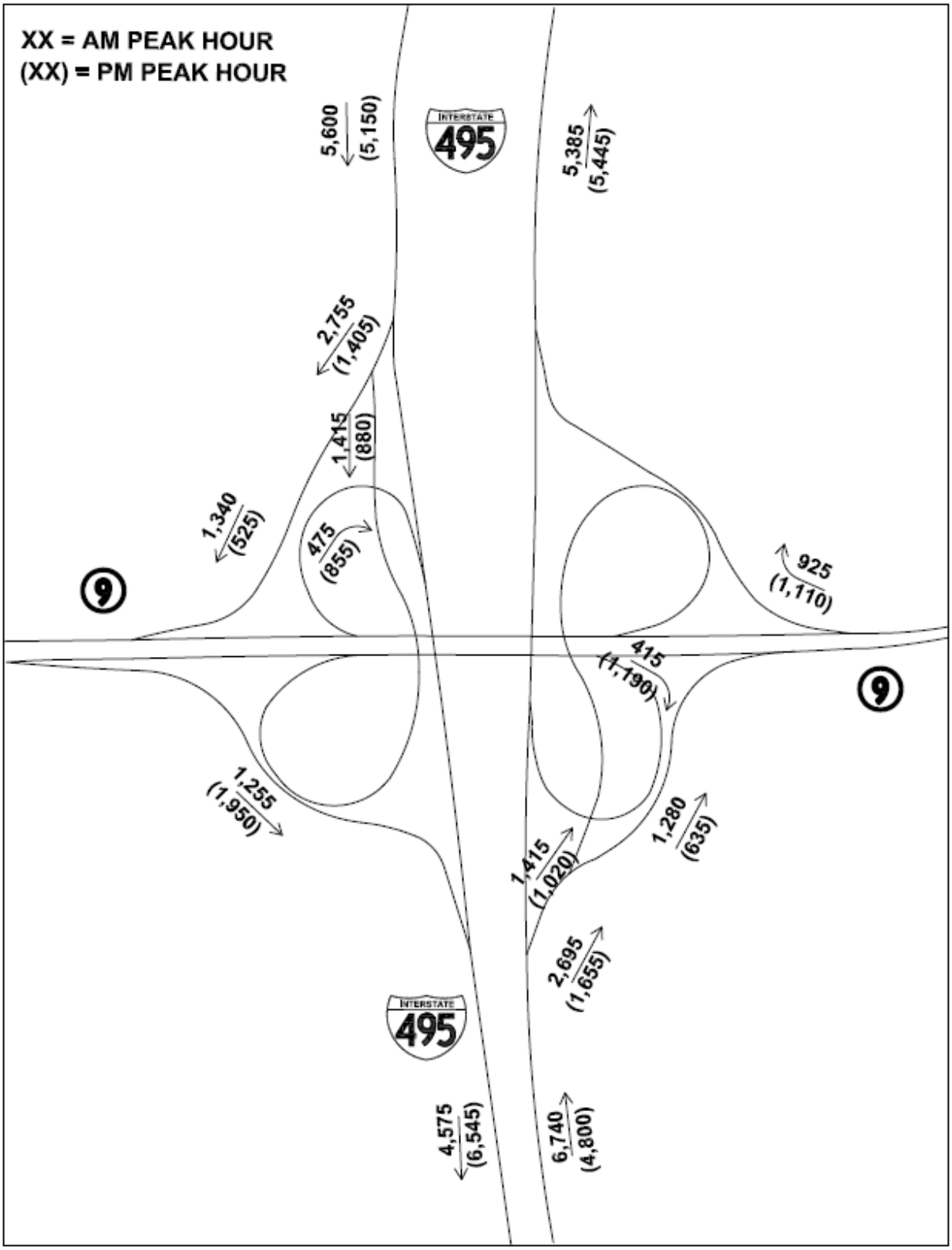


Figure 3.5-2: 2035 PDA Traffic Volumes Used to Evaluate the I-495/Route Interchange Improvements

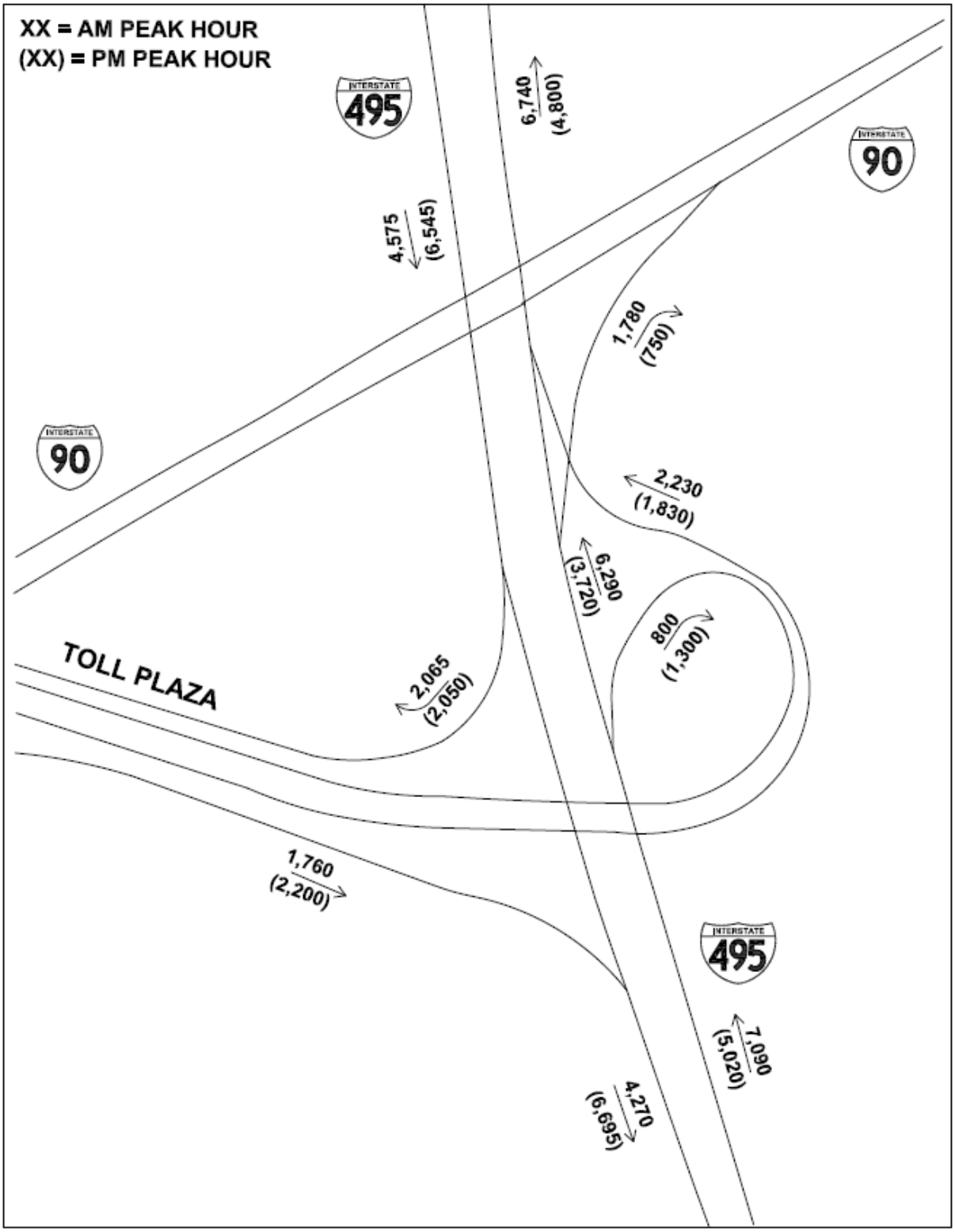


Table 3.5-1: Summary of I-495 Freeway Segment & Route 9 Mainline Segment Weekday Capacity Analysis – 2035 Alternatives

Description	RTP No-Build LOS[1]		PDA No-Build LOS		HT-1A C-D Short		HT-1B C-D Long		Route 9 Widening	
	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
I-495 NB north of Rt.9	D	D	D	D	D	D	D	D	NA	NA
I-495 SB north of Rt.9	D	D	D	D	D	D	D	D	NA	NA
I-495 NB between to Rt. 9 and I-90	E	C	F	D	C	B	C	B	NA	NA
I-495 SB between to Rt. 9 and I-90	C	E	C	F	B	C	A	B	NA	NA
I-495 NB south of I-90	F	D	F	D	F	D	F	D	NA	NA
I-495 SB south of I-90	C	F	C	F	C	F	C	F	NA	NA
Rt.9 WB west of I-495	E	D	F	D	NA	NA	NA	NA	D	C
Rt.9 EB west of I-495	D	E	D	F	NA	NA	NA	NA	NA	NA

Note: (1) Level of Service

Legend: Level of Service Improves from PDA No-Build Level of Service worsens from PDA No-Build

NA = Not Applicable

Table 3.5-2: Summary of I-495 and Route 9 Ramp Capacity Analysis – 2035 Alternatives (Weekday)

	Description	Movement	No-Build (RTP) LOS[1]		No-Build (PDA) LOS		HT-3 Braided Rt.9 Ramps		HT-1A C/D Short		HT-1B C/D Long		HT5 Route 9 Widening	
			AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour	AM Peak Hour	PM Peak Hour
I-495/Rt. 9 Interchange														
	I-495 NB off-ramp to Rt.9 EB	Diverge from I-495	E	C	F	C	F	A	F s/o Rt.9 C to EB	C s/o Rt. 9 B to EB	E to EB	C to EB		
	I-495 NB mainline between on and off-ramps	Weave I-495	E	D	E	D	C NB on-ramp from EB	C NB on-ramp from EB	B	F	C	F		
	I-495 NB on-ramp from Rt.9 WB	Merge to I-495	C	D	D	D			B WB on C n/o Rt.9	B WB on D n/o Rt. 9	B WB on D n/o Rt.9	C WB on D n/o Rt.9		
	I-495 SB off-ramp to Rt. 9 WB	Diverge from I-495	D	D	E	D	B	A	D n/o Rt.9 C to WB	C n/o Rt. 9 B to WB	D n/o Rt. 9 D to WB	C n/o Rt.9 C to WB		
	I-495 SB mainline between on and off-ramps	Weave I-495	C	D	D	D	B SB on-ramp from WB	C SB on-ramp from WB	B	B	C	B		
	I-495 SB on-ramp from Rt. 9 EB	Merge to I-495	C	D	C	E			B EB on C s/o Rt.9	C EB on F s/o Rt.9	C EB on	C EB on		
	Rt.9 EB on-ramp from I-495 NB	Merge to Rt.9	C	B	D	B								
	Rt.9 EB mainline between on and off-ramps	Weave Rt.9	C	C	C	C								
	Rt.9 WB off-ramp to I-495 NB	Diverge from Rt.9	C	D	C	D							C	C
	Rt.9 WB mainline between on and off-ramps	Weave Rt. 9	C	C	D	D							B	B
	RT.9 WB on-ramp from I-495 SB	Merge to Rt. 9	E	D	F	D							D	C
I-495/I-90 Interchange							**HT-10 New I-90 Ramps**				**HT-1B C/D Long**			
	I-495 NB off-ramp to I-90	Diverge from I-495	F	D	F	F	F to WB E to EB	E to WB C to EB			F s/o I-90 F to I-90	C s/o I-90 F to I-90		
	I-90 to I-495 NB on-ramp	Merge to I-495	E	C	F	C					D	C		
	I-495 SB off-ramp to I-90	Diverge from I-495	F	D	F	F	A	B			F	F		
	I-90 to I-495 SB on-ramp	Merge to I-495	C	F	C	F	B	B			B SB on C s/o I-90	C SB on F s/o I-90		
Rt.9/Research Drive/Computer Drive Ramps														
	Rt.9 EB off-ramp to Research Dr	Diverge from Rt.9	D	C	D	C								
	Rt.9 EB mainline between Research Dr and I-495 on-ramp	Weave Rt.9	B	E	C	E								
	Rt.9 WB off-ramp to Computer Dr	Diverge from Rt.9	C	B	F	B							B	A
	Computer Dr to Rt.9 WB on-ramp	Merge to Rt.9	B	D	B	D								

Note: (1) LOS = Level of Service

Legend: NA = Not Applicable

Level of Service Improves from PDA No-Build

Level of Service worsens from PDA No-Build

Table 3.5-3a: Summary of Intersection Capacity Analysis: West of I-495 - 2035 Alternatives

Intersection			RTP No-Build						PDA No-Build						Build Alts					
			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
Description	Approach	Movement	LOS[1]	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)
West of I-495																				
Computer Dr and Route 9 WB Ramps (Signalized)	EB	Thru	D	39	265	C	24	37	D	39	270	C	24	40	No change [2]			No change [2]		
		Right	A	0	0	A	1	0	A	0	0	A	1	0						
	WB	Left/Thru	C	21	100	B	11	216	C	21	105	B	13	239						
	NB	Left	D	51	731	C	25	73	E	64	791	C	25	89						
		Right	A	2	0	A	0	0	A	2	0	A	0	0						
		Overall	**C**	**29**		**A**	**10**		**C**	**35**		**B**	**11**							
Connector Rd Research Dr (Signalized)	NB	L/T/R	D	41	234	D	52	266	D	45	293	F	137	409	F	130	297	F	91	302
		R		NA			NA			NA			NA		C	34	73	C	32	30
	SB	Left	E	63	665	D	37	357	F	86	707	D	39	385	D	42	591	F	93	444
		Thru/Right	A	6	128	A	6	95	A	6	138	A	6	106	A	7	145	B	10	122
	WB	L/T	F	88	265	F	239	331	F	256	407	F	428	439	F	94	300	C	34	313
		Right	B	20	35	C	23	10	C	21	36	C	23	10	C	23	46	F	169	137
	EB	L/T/R	D	46	21	D	47	44	D	46	21	D	48	44	D	48	19	E	55	44
		Overall	**D**	**47**		**D**	**53**		**E**	**60**		**F**	**103**		**D**	**53**		**F[3]**	**87**	
Research Dr and Route 9 EB Ramps (Signalized)	SB	Left	C	32	130	C	29	22	D	35	154	C	29	35	D	43	172	D	47	48
		Right	A	1	0	A	0	0	A	1	0	A	0	0	A	1	0	A	0	0
	WB	Thru	C	33	22	F	169	244	C	31	37	F	200	262	D	49	48	C	29	219
		Right	A	0	0	F	614	889	B	16	22	F	690	962	C	23	14	E	74	499
	EB	Left	B	11	146	C	23	308	B	14	183	C	27	365	A	5	59	C	30	173
		Left/Thru	B	19	456	B	15	181	C	30	501	B	17	217	A	8	149	B	15	137
		Overall	**B**	**16**		**F**	**238**		**C**	**23**		**F**	**259**		**B**	**14**		**D**	**38**	
Connector Rd and Computer Dr	SB	Left/Right	F	1056	436	F	161	153	F	*	*	F	268	189	NA			NA		
Research Dr and Friberg Pkwy	NB	Left/Right	D	31	47	F	414	936	E	38	57	F	677	1140	NA			NA		

Note:

(1) LOS = Level of Service

(2) The alternative of extending the eastbound right turn lane would not have any effect on intersection operation.

(3) .Level of Service changes are due to changes in signal phasing. While the intersection is still at LOS F, overall traffic operations are better than the PDA No-Build. Build Alternatives were evaluated using PDA traffic volumes.

* Excessive delay, cannot be calculated

Legend:

NA = Not Applicable

Level of Service Improves from PDA No-Build

Level of Service worsens from PDA No-Build

Table 3.5-3b: Summary of Intersection Capacity Analysis East of I-495 – 2035 Alternatives

Intersection			RTP No-Build						PDA No-Build						Build Alts					
			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour			AM Peak Hour			PM Peak Hour		
Description	Approach	Movement	LOS[1]	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)	LOS	Delay (sec / veh)	95th Queue (ft)
East of I-495																				
Rt. 9 and Crystal Pond Rd (Signalized) [2]	NB	Left	D	55	106	E	76	509	E	56	144	F	108	627	F	126	414	F	267	965
	NB	Thru		NA			NA			NA			NA		D	42	119	C	33	113
	WB	Left	F	278	812	F	218	587	F	373	924	F	295	740	F	197	443	F	321	403
		Thru	C	24	1092	E	64	1065	C	28	1122	E	74	1093	C	26	1269	D	49	1215
	EB	U Turn	F	87	307	F	150	495	F	180	431	F	147	506		NA			NA	
		Thru	F	222	2157	F	179	1640	F	249	2208	F	257	1897	F	180	1624	F	181	1403
		Right	B	14	142	B	19	58	B	15	143	B	21	62		NA			NA	
	SB	Left		NA			NA			NA			NA		E	57	20	D	54	20
		Thru/R		NA			NA			NA			NA		E	58	36	E	55	81
		Overall	**F**	**127**		**F**	**118**		**F**	**150**		**F**	**162**		**F[3]**	**109**		**F [3]**	**144**	
Rt.9 and Park Central Dr	SB	Right	F	191	210	F	939	555	F	358	313	F	*	*	A	0	0	A	0	0
Rt.9 and Flagg Rd	SB	Right	F	178	232	F	858	635	F	242	265	F	*	*	F[4]	789	744	F[4]	*	*
															E[5]	39	96	F[5]	225	392
Rt.9 and Washington St	NB	Right								NA			NA			NA			NA	
Rt.9 and Coslin Dr	NB	Right	F	314	356	F	364	776	F	560	444	F	737	1217		NA			NA	
Rt.9 and #352	NB	Right	C	21	1	C	20	18	C	22	1	C	23	21		NA			NA	
Rt. 9 and #325	SB	Right	D	26	40	F	81	263	D	27	43	F	93	283		NA			NA	
Rt.9 and Deerfoot Rd	NB	Right	E	48	17	D	33	7	F	53	19	E	42	10		NA			NA	
	SB	Right	F	83	35	E	37	13	F	93	38	E	40	14		NA			NA	

Note:

(1) LOS = Level of Service

(2) The intersection capacity for the Rt. 9/Crystal Pond Road Intersection for 2035 with 1.2 million square feet of development is:

- AM Peak Hour – LOS E, delay 63.5 sec/veh
- PM Peak Hour – LOS E , delay 66.7 sec/vdeh

(3) This is the best operation that can be achieved for an at-grade configuration, given the magnitude of the future traffic forecast. A grade-separated configuration would be needed to provide additional operational benefits to accommodate the traffic volumes associated with full build out of the EMC site.

(4) The proposed improvements of Park Central Drive and Flagg Road represent both safety and operational improvements. The right-turn movement from Flagg Road onto Rt.9 is projected to improve from LOS E to LOS F during the AM peak hour and remain at LOS F during the PM peak hour, but with less delay than the No-Build. The volume of Route 9 traffic will continue to be heavy in the future necessitating delays for side street traffic.

(5) LOS with Route 9 WB widening alternative

* Excessive delay, cannot be calculated

Legend:

NA = Not Applicable

Level of Service Improves from PDA No-Build

Level of Service worsens from PDA No-Build

3.6 Summary of Environmental Impacts

An analysis was conducted to determine the potential for impacts associated with each of the alternatives on the environmental and community resources identified in Chapter 2. In each case, the proposed alternative was overlaid on the environmental constraint maps to identify potential impacts. It should be noted that the GIS-based data used in the analysis may underestimate the size of the resource area and that field verification of resource boundaries will be required to better determine potential impacts during preliminary engineering for each project.

Major infrastructure projects such as the I-495/I-90 Interchange Modifications (Alternative HT-10), and any project that may affect wetlands or other environmental or community resources, have the most potential for impacts, and will be the most challenging to permit. Other projects such as the WRTA/MWRTA Route 9 Connector Service have little to no impact or permitting requirements. A summary of the potential environmental impacts associated with each of the alternatives as well as their degree of permitting complexity is provided in Table 3.6-1.

Table 3.6-1: Summary of Potential Environmental Impacts

Alternative	Environmental Category								
	Land Use/ROW	**Wetlands & Water Resources**	**Wildlife Habitats & Endangered Species**	**Open Space & Recreation**	**Historic & Archeological Resources**	**Air Quality**	**Noise**	**Environmental Justice**	**Degree of Permitting Complexity**
C-D Road – Long and Short Options (HT 1)	○ In highway ROW; relocation of median cell tower access road required for Long Option	◐ Long and Short options affect wetlands in median north of Flanders Road	○	○	○	√	○	○	Moderate
I-495/Route 9 Braided Ramps (HT3)	○	○	○	○	○	√	○	○	Low
I-495/I-90 Interchange Safety Improvements – add advance signage (HT 9A)	○	○	○	○	○	○	○	○	Low
I-495/I-90 Interchange Safety Improvements – flatten curve on I-90 ramp to I-495 NB (HT 9B)	○	◐ The I-90 ramp to I-495 NB is adjacent to wetlands within the Cedar Swamp ACEC.	○	○	○	○	○	○	Moderate

Alternative	Environmental Category								
	Land Use/ROW	**Wetlands & Water Resources**	**Wildlife Habitats & Endangered Species**	**Open Space & Recreation**	**Historic & Archeological Resources**	**Air Quality**	**Noise**	**Environmental Justice**	**Degree of Permitting Complexity**
I-495/I-90 Interchange Ramp Modifications (HT 10)	○	● The interchange lies within the Cedar Swamp ACEC which contains multiple resource areas including wetlands, water bodies and the headwaters of the Sudbury River. The proposed alternative would remain within the footprint of the existing interchange to the greatest extent possible to minimize impacts. However there is a potential for wetland and water resource impacts associated with the new I-495 northbound ramp to I-90 eastbound, as this ramp abuts a wetland for much of its length. The existing culvert carrying the Sudbury River under I-90 would also need to be modified to accommodate this new ramp.	● The interchange lies within the Cedar Swamp Area of Critical Environmental Concern ACEC which contains vernal pools and rare species habitat abutting the I-495 southbound mainline, and the I-90 westbound on and off ramps. The proposed alternative would remain within the footprint of the existing interchange to the greatest extent possible to minimize impacts, and no direct impacts to this resource area are apparent based on the current level of analysis. However, given the close proximity of the rare species habitat to the proposed modifications, a potential for impact exists.	◐ Numerous parcels within the Great Cedar Swamp ACEC and Sudbury River Watershed abutting the I-495/I-90 interchange have been identified as open space owned by the Massachusetts Department of Conservation and Recreation, as well as various land trusts. No direct impacts to these properties have been identified at this level of analysis.	◐ The Great Cedar Swamp Archeological District abuts the I-495/I-90 interchange. No direct impacts to archaeological resources have been identified at this level of analysis. No other historic districts or properties have been identified within the study area.	√	◐ A residential neighborhood in is located to the south of the toll plaza in Hopkinton. Grade separating I-495 southbound on-ramp from I-90 westbound will raise the vertical alignment of the ramp that could potentially create noise impacts for the abutting neighborhood.	○	High
Consider Alternate Toll Collection Technologies (HT 13)	○	○	○	○	○	√	○	○	Low
Route 9 Widening (HT 5)	◐	● Approximately ¼ acre of new ROW is required for the westbound widening at the Verizon site in Southborough. The new ROW area is predominately wetland.	○	○	○	√	○	○	High

Alternative	Environmental Category								
	Land Use/ROW	**Wetlands & Water Resources**	**Wildlife Habitats & Endangered Species**	**Open Space & Recreation**	**Historic & Archeological Resources**	**Air Quality**	**Noise**	**Environmental Justice**	**Degree of Permitting Complexity**
Route 9/Crystal Pond Road Intersection Improvements (HT 11)	◐ New ROW is required for the realignment of Crystal Pond Road with the Verizon driveway, and for the jug-handle to accommodate u-turns from Route 9 eastbound to Route 9 westbound in Southborough. The developer of the proposed Madison Place 40 B residential development in Southborough has agreed to provide the ROW for the jug-handle. A portion of that ROW would initially be developed to provide access to Crystal Pond Road for the Madison Place Development. The jughandle would be designed to maintain access to this development and therefore no impacts to the residential development are anticipated.	● The new ROW is required for the realignment of Crystal Pond Road with the Verizon would affect wetlands adjacent to Crystal Pond.	○	○	○	√	○	○	High
Research Drive/Connector Road Improvements (HT 8)	◐	○	○	○	○	√	○	○	Low
Park Central Drive /Flagg Road Improvements (HT 6)		◐ The proposed rerouting of the Route 9 egress from Park Central Drive to Flagg Road would require two stream crossings.	○	○	○	○	○	○	Moderate

Alternative	Environmental Category								
	Land Use/ROW	Wetlands & Water Resources	Wildlife Habitats & Endangered Species	Open Space & Recreation	Historic & Archeological Resources	Air Quality	Noise	Environmental Justice	Degree of Permitting Complexity
Consolidate Driveways on Route 9 east of I-495 (HT 7)	TBD	TBD	○	○	○	○	○	○	Permitting complexity would depend on the specific driveway consolidation proposal
WRTA/MWRTA Route 9 Connector Service (TR 1)	○	○	○	○	○	√	○	√	None
Westborough (TR2 A) and Southborough (TR 2B)	○	○	○	○	○	√	○	√	None
Park-and Ride Facility (TR 3)	TBD	TBD	TBD	TBD	TBD	√	○	○	Permitting complexity would depend on the specific site selected
Pedestrian Improvements (WB 1)	TBD	TBD	○	○	○	√	√	○	None
Bicycle Improvements (WB 2)	TBD	TBD	○	○	○	√	√	○	Depends on the specific proposal, Permitting may be required for a bike path.

Legend:

○ No impacts expected

◐ Moderate potential for impacts; additional environmental studies and project design required to determine the extent of impact and potential mitigation measures.

● Higher potential for impacts; additional environmental studies and project design required to determine the extent of impact and potential mitigation measures.

√ Environmental benefit

TBD To be determined

3.7 Conclusion

A set of multi-modal alternatives were developed through the study process. These alternatives were then screened to ensure that they were consistent with the project goals. The alternatives that were advanced after the preliminary screening were further analyzed and were shown to be effective in addressing the transportation deficiencies identified in the study area. Based on a conceptual level of analysis, these alternatives can be implemented within the identified environmental constraints.

The following is a summary of the major issues, and potential methods of addressing these issues, which were then used to develop specific alternatives.

- Congestion on I-495 in the peak period travel direction (northbound in the AM peak and southbound in the PM peak) was identified as a major issue, which is exacerbated by the high volumes of traffic using the Route 9 and I-90 interchange ramps and the substandard highway geometry at these interchanges.

- Sub-standard weaves at the I-495/Route 9 interchange create the need to improve traffic operations at the interchange. The options include collector-distributor roads (lower speed frontage roadways that allow for lower speed weaving and ramp movements) and "braided ramp" alternatives (ramp systems that remove weaving conflicts by grade-separating ramp movements). The braided ramps improve traffic operations at the interchange without the impacts associated with the C-D Road alternatives, and at a lower cost.

- Congestion caused by high volumes of traffic on I-495 northbound heading to I-90 eastbound in the morning peak period – options reviewed include adding a new ramp to provide additional capacity for this move, with an additional lane proposed for the I-90 off-ramp to I-495 southbound to address the reverse move in the evening peak.

- Congestion at the I-90 interchange resulting from weaving and queuing issues at the I-90 toll plaza toll, as well as a history as a high crash location led to consideration of interchange modifications that would place each of the interchange moves into their own lane to eliminate the weaves, as well as a recommendation to consider alternate tolling technologies that would allow elimination of the toll plaza itself. MassDOT has since begun implementation of All Electronic Tolling (AET) statewide, which will replace the existing toll plazas on the Massachusetts Turnpike, Tobin Bridge and Harbor Tunnels with overhead gantries installed along the highways.

- Congestion on Route 9, particularly at the off-ramp from I-495 southbound to Route 9 westbound during the morning peak led to a recommendation to consider an additional lane on Route 9. Long queues and safety issues at the signalized intersection of Route 9 and Crystal Pond Road, as well as a desire for additional development to be accessed via this intersection, led to the development of an intersection improvement alternative at this location. Safety concerns due to the close spacing of Park Central Drive and the I-495 on-ramp from Route 9 prompted consideration of alternatives of that would allow the Route 9 egress to be relocated to a safer location at Flagg Road.

- Because congestion can also be alleviated by reducing travel by single-occupancy vehicle, transit, pedestrian and bicycle alternatives were also developed, including improvements to transit service along Route 9, shuttle service from the Westborough and Southborough commuter rail stations, and a park-and ride facility.