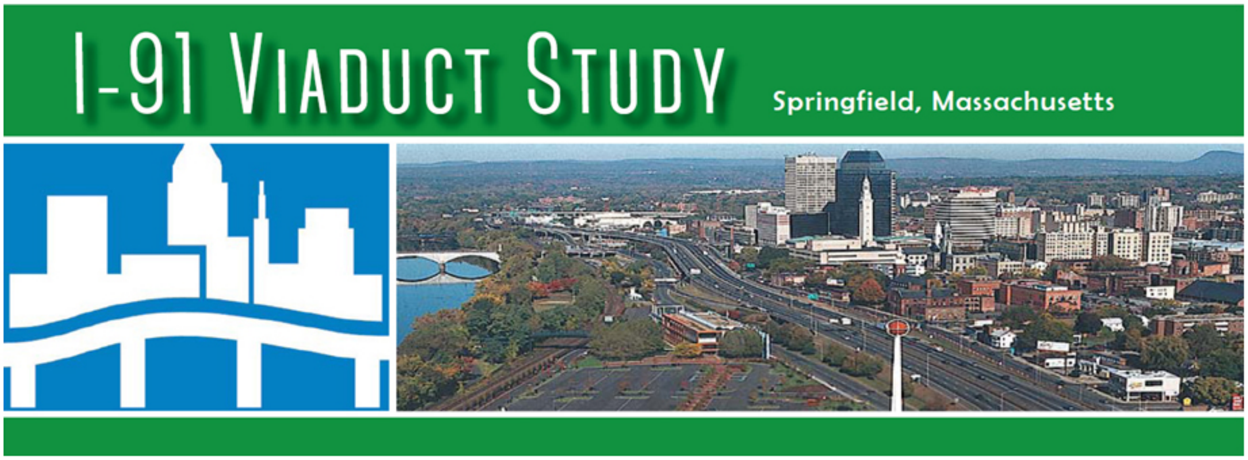

INTERSTATE 91 VIADUCT STUDY

August 2018

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The Massachusetts Department of Transportation

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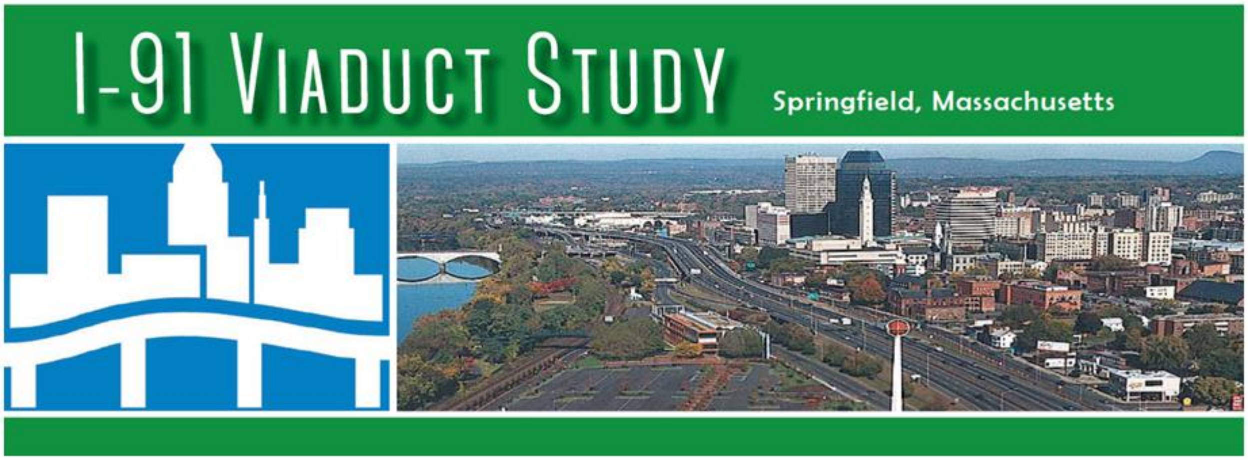

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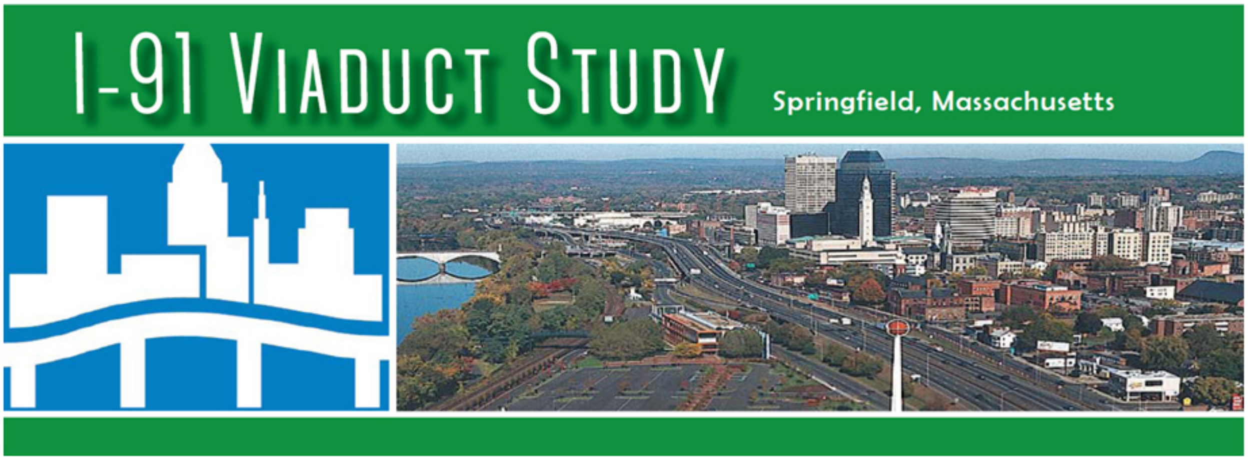

INTERSTATE 91 VIADUCT STUDY

CHAPTER I

STUDY AREA, GOALS AND OBJECTIVES, EVALUATION CRITERIA, AND PUBLIC PARTICIPATION

August 2018

MMI #3869-16-6

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1.1 PURPOSE AND NEED

The Interstate 91 Viaduct Study was initiated by the Massachusetts Department of Transportation (MassDOT) to address issues related to the elevated portion of Interstate 91 (I-91) known as the Viaduct, which parallels the Connecticut River in the city of Springfield. The Viaduct, along with the railroad, stands as a visual and physical divide between Downtown Springfield and the river. The Viaduct has historically required and will continue to require significant and costly ongoing repairs. To address the structural, financial, and socioeconomic issues that have become associated with the Viaduct, MassDOT initiated the present study. This study aims to develop and evaluate well-supported conceptual alternatives that focus on the issue of structural deficiency in the I-91 Viaduct while maintaining the efficiency of I-91 through the project corridor. Successful alternatives will improve overall safety and increase multimodal connectivity and accessibility between the Downtown Springfield urban core and the riverfront. Alternatives studied should consider the following:

- The I-91 Viaduct, along with the existing rail line, creates a physical and visual barrier between the city's neighborhoods, Downtown Springfield, and the riverfront, limiting access and adversely affecting quality of life for residents and the business community.
- Enhanced waterfront access and associated development can be expected to benefit both the local and regional economies.
- Ongoing maintenance costs associated with continual Viaduct repair need to be addressed.
- Local and regional economic growth is likely to occur as a result of the relocation of the Viaduct as newly available parcels are redeveloped and the land is repurposed, posing increased growth opportunities.

Concurrently with this study, MassDOT is initiating the replacement of the deck of the I-91 Viaduct between State Street and Interstate 291 (I-291) to address urgent safety needs as part of the I-91 Viaduct Rehabilitation Project. The deck replacement project is intended to ensure that the Viaduct remains a safe structure serving the city and region while a long-term vision for I-91 can be developed, evaluated, and subsequently implemented following this study.

1.2 STUDY BACKGROUND

Throughout Springfield's history, the area surrounding the I-91 Viaduct, the elevated segment of the interstate between State Street and the I-291 interchange, has been a residential, transportation, and economic center for the city. Initially, the primacy of the area was derived from its proximity to the Connecticut River, which provided a major north-south access route that connected Springfield, Holyoke, and Chicopee with Hartford to the south and Vermont to the north.

Development around the Viaduct area intensified in the railroad age when several rail lines crisscrossed the area. In the early 20th century, the transportation patterns of the area continued to evolve as U.S. Route 5 was routed along the east bank of the Connecticut River, crossing the river into West Springfield at the Memorial Bridge near Union Station. As automobile ownership rates increased, city dwellers began moving into the suburbs, further driving demand for roadway improvements between communities.

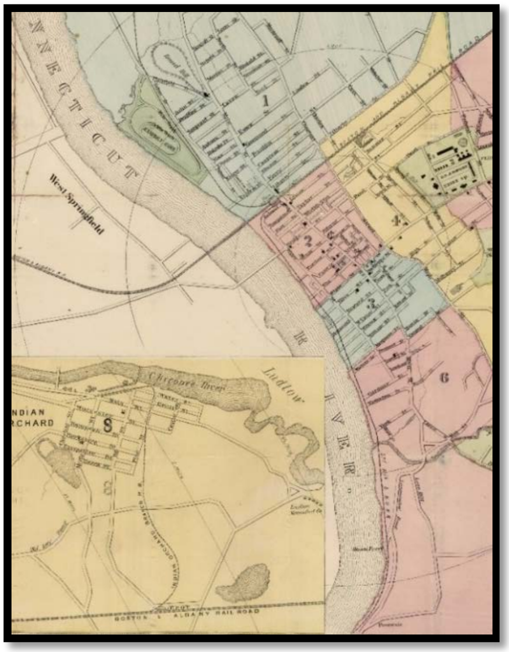

Figure 1-1: 1868 Bowles Map of the Primary Study Area

On the federal level, the new concept of limited access expressways grew in prominence as traffic planners and politicians believed that these significant road improvements would aid economic growth, provide much-needed construction jobs, and facilitate national defense goals. Traffic volumes and congestion grew along U.S. Route 5 through the 1940s, and in 1953, the Massachusetts Department of Public Works and the Federal Bureau of Public Roads jointly planned major improvements to U.S. Route 5 that would include its relocation out of Downtown Springfield. [1]The new alignment had U.S. Route 5 cross the river at the South End Bridge and run alongside the west bank of the Connecticut River in West Springfield. After the passage of the Federal Highway Act of 1956, the plans for highway development throughout the Pioneer Valley were altered to include a new superhighway, I-91.

Routing the interstate was a complicated and highly contentious matter that involved stakeholders from around New England and Washington, D.C. It was known that whatever alignment was chosen would potentially impact property values, natural resources, economic opportunities, and the community life of every municipality in and around its path. Initially, I-91 was planned to run along the west side of the Connecticut River for its entire length; however, several influential residents in a few neighboring Connecticut towns did not want the highway to run through their rural communities and lobbied officials heavily to back the plan to instead run the highway on the eastern side of the river, closer to the economic hub of the city of Springfield. The eastern highway route, which would run alongside the existing railroad, was opposed by many in the Springfield area that were concerned that the new alignment would require the demolition of an unnecessarily large number of residences and businesses within the city.

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[1] Pioneer Valley Planning Commission. Interstate Route I-91 Corridor Planning Study, Springfield, Massachusetts: Interchanges 1 Through 5. Springfield, MA: Pioneer Valley Planning Commission, 2015. Digital resource: http://www.pvpc.org/sites/default/files/I91ExistingConditionsE1toE5July15.pdf

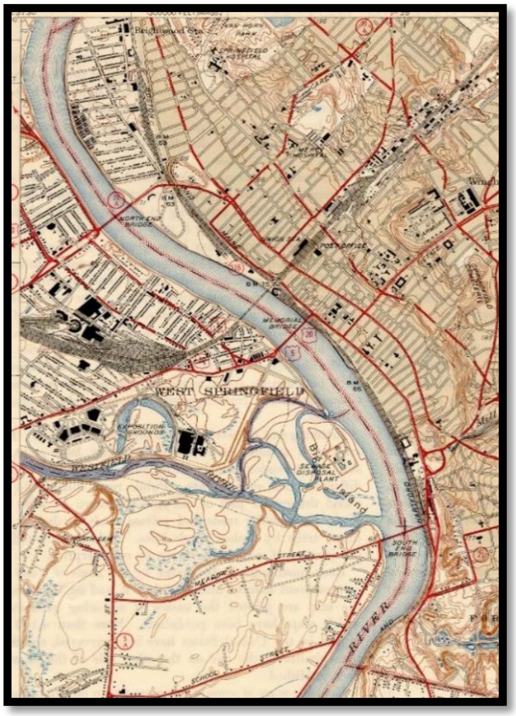


Figure 1-2: 1946 USGS Map of the Primary Study Area

Figure 1-3: 1958 USGS Map of the Primary Study Area

Other communities further north also opposed the east side alignment, such as the town of Whately on the west side of the river, where an abandoned section of rail line provided a highly suitable right-of-way for the interstate. Depending on their location, layout, demographic profile, and other factors, some other municipalities objected to or favored a proposed I-91 route through their community.

The Pioneer Valley Planning Commission's 2013 Existing Conditions Report for the *Interstate Route I-91 Corridor Planning Study* records the discussion in Springfield thusly:

"Concerned residents of the Forest Park neighborhood and Longhill Street took their case to court to protect the park and historic buildings from being torn down by the highway project. The result was that the interchange was pushed back to Longhill Street and the city received a settlement from the state for the land and museum building that was demolished to make room for the highway exit. A big debate about the routing of the highway through Springfield's North End neighborhood focused on the conflict it created with an urban renewal project already in place. Other restrictions included an existing major pumping station along the river's northern city section. The mayor was concerned about the potential displacement of 5,000 residents by the state's proposed freeway routing in the North End. The Columbus Avenue section of the highway used the right-of-way of the railyard to reduce demolition. The location of the bridge between Springfield and West Springfield was debated to maximize benefits of connecting to the Massachusetts Turnpike."

Controversy, complications, and the large populations involved caused the Springfield section of I-91 to be the last one completed, on December 8, 1970, at a cost of $155 million.

Figure 1-4: 1958 Sunoco Road Map of the Primary Study Area

With the highway routing set, construction of the Viaduct was initiated with the demolition of a one-block-wide corridor between Downtown Springfield, the railroad, and the adjacent Connecticut River. The high water table in Downtown Springfield along the river made construction of a depressed highway inconceivable and unfeasible at that time, thus the expressway was elevated through the area, creating a physical and visual barrier between the city and its riverfront. This 4,000-linear-foot elevated highway section, the Viaduct, is the primary subject of this study.

During the construction in the months and years that followed, I-91 brought tremendous changes to Springfield and the communities that surrounded it. In its first year of operation, traffic along the highway increased daily and was up 50% by the close of the year. Although traffic volumes and efficiencies increased on the highway, many long-standing retail and commercial establishments as well as residents who had the means to do so frequently relocated away from the highway. The city transitioned into a 9-to-5 business community, leaving higher levels of poverty, low-income housing, and building deterioration in the Downtown Springfield area.

All was not lost, however, as in the areas near to the new highway new and modern buildings were built, including the Civic Center, the post office, and the Baystate West Mall. New small-scale developments coalesced around the newly created highway exits, further decentralizing commercial activity away from Downtown Springfield. However, increased traffic noise and emissions encroached on the once-serene Forest Park and historic residential neighborhoods, and the character of Downtown Springfield was significantly altered by the physical prominence of the vertical highway infrastructure. Traffic was routed onto the new highway, away from the old highway and local arterials, which in turn reduced congestion on local roads. However this negatively impacted local businesses by reducing the number of patrons and customers.

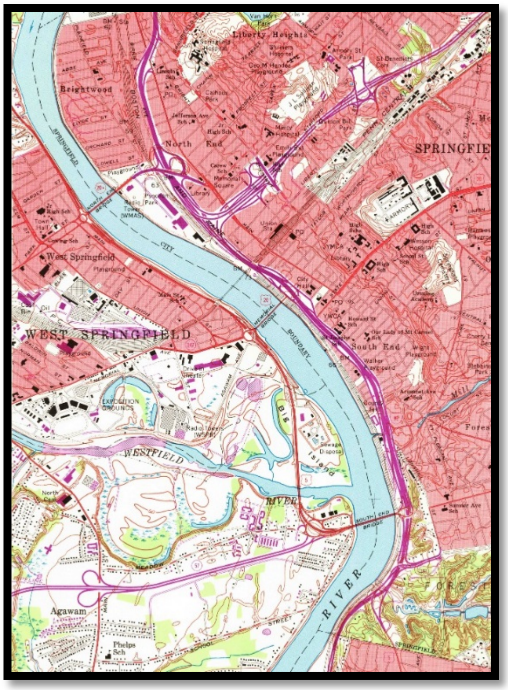


Figure 1-5: 1970 USGS Map of the Primary Study Area

In the decades since its construction, harsh New England winters have taken a toll on the Viaduct. Over the past 25 years, several rehabilitation projects have been completed on the Viaduct's structures; however, MassDOT has recently concluded that based on recent inspections the Viaduct's bridge decks now require wholesale replacement. The ongoing repairs that the Viaduct has required since its construction have entailed significant costs and have not achieved the maximum desired service life for this portion of the interstate.

As this study is being conducted, MassDOT is carrying out a major rehabilitation of the I-91 Viaduct in Springfield to be completed in 2018. Primarily, the project will include the complete replacement of the bridge decks, but it will also entail the painting and repair of structural steel, the replacement of bearings, improvements to the bridge drainage and highway lighting, comprehensive traffic management, and other safety improvements in problem areas such as the I-291/I-91 merge. This deck replacement project will keep the Viaduct safe and serviceable for the immediate future while the planning for the extended future of the corridor is carried out.

In addition to these ongoing structural issues, the Viaduct's overall physical presence has also not remained consistent with the City of Springfield's vision for these neighborhoods or the community as a whole. In recent years, the city has embarked on a number of studies exploring opportunities to redevelop its urban core and riverfront. Overall, these studies have concluded that I-91's current alignment adversely impacts tourism and creates a disconnect between the city's neighborhoods, Downtown Springfield, and the riverfront. Concurrently, the New Haven-Hartford-Springfield rail corridor is being improved and modernized, and Union Station has been renovated. One important aspect of these improvements is enhancing pedestrian and bicycle mobility and safety as well as intermodal connectivity around the station. Some of the studies examining these ongoing issues include the following:

- *From the Quadrangle to the River: Revitalizing the Heart of Downtown Springfield – UMASS, Amherst Scholar Works*
- *An Advisory Services Panel Report – Springfield Massachusetts – Urban Land Institute*

1.3 STUDY AREA

The Study Area is a vital component of this study's framework. The Study Area for the I-91 Viaduct Study consists of two levels: (1) the Primary Study Area (Figure 1-6), which includes the area where potential physical transportation system improvements are being considered, and (2) the larger Regional Study Area (depicted along with the Primary Study Area in Figure 1-7), which includes major roadways, intersections, interchanges, transit facilities, and land uses that affect the Primary Study Area and may be impacted by any of the developed alternatives. At the outset of the study, the Primary Study Area included only the I-91 Viaduct and its adjacent streets within the city of Springfield. The Primary and Regional Study Areas were discussed extensively at the initial Working Group Meeting on November 5, 2014, where a number of Working Group members advocated for the Primary and Regional Study Areas to be extended southerly to the Connecticut state line to include the section of I-91 known as the "Longmeadow Curve" and its related on and off ramps. The Longmeadow Curve presents considerable operational issues for the corridor, and the potential realignment of the Viaduct could impact the Curve.

1.3.1 PRIMARY STUDY AREA

The limits of the Primary Study Area include the I-91 highway corridor from the I-291 interchange in the north to the Connecticut state line in the south, plus the roadways immediately surrounding the interstate to the north, east, and west: Bond Street and Route 20 to the north, Chestnut Street to the east, and U.S. Route 5 to the west. The Primary Study Area also includes the Connecticut Riverwalk and Bikeway and expands west over the South End Bridge (U.S. Route 5) into the town of Agawam, including the Route 57 rotary. Throughout the study process, the study team will evaluate motor vehicle, pedestrian, and bicycle transit operations as well as other transportation forms under a range of roadway configurations and development scenarios within the Primary Study Area.

Roadway segments in the Primary Study Area include the following:

- I-91
- I-291
- West Columbus Avenue
- East Columbus Avenue
- Main Street
- Dwight Street
- Chestnut Street
- State Street

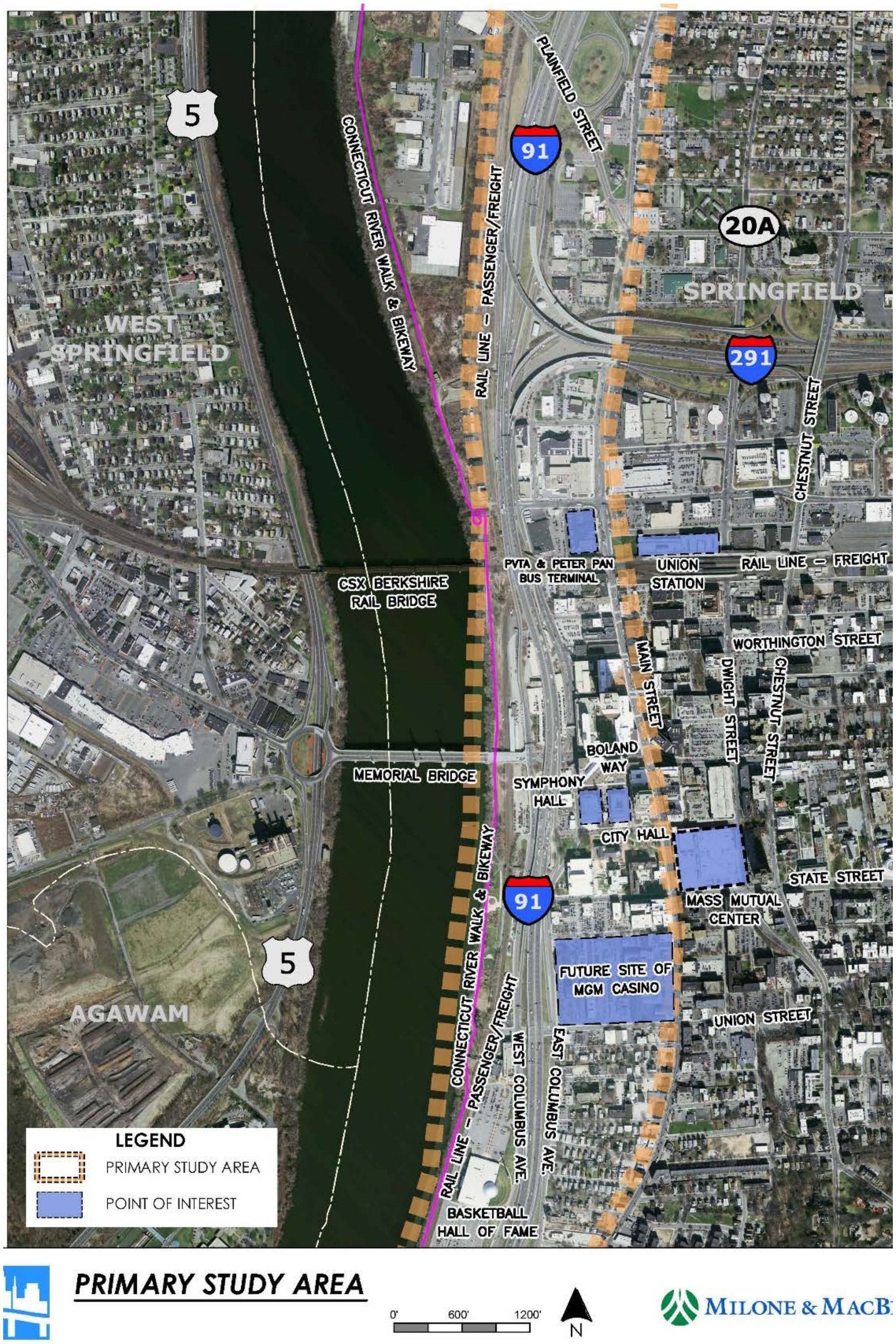


Figure 1-6 : Primary Study Area

1.3.2 REGIONAL STUDY AREA

The purpose of establishing the Regional Study Area is to enable the study team to do the following:

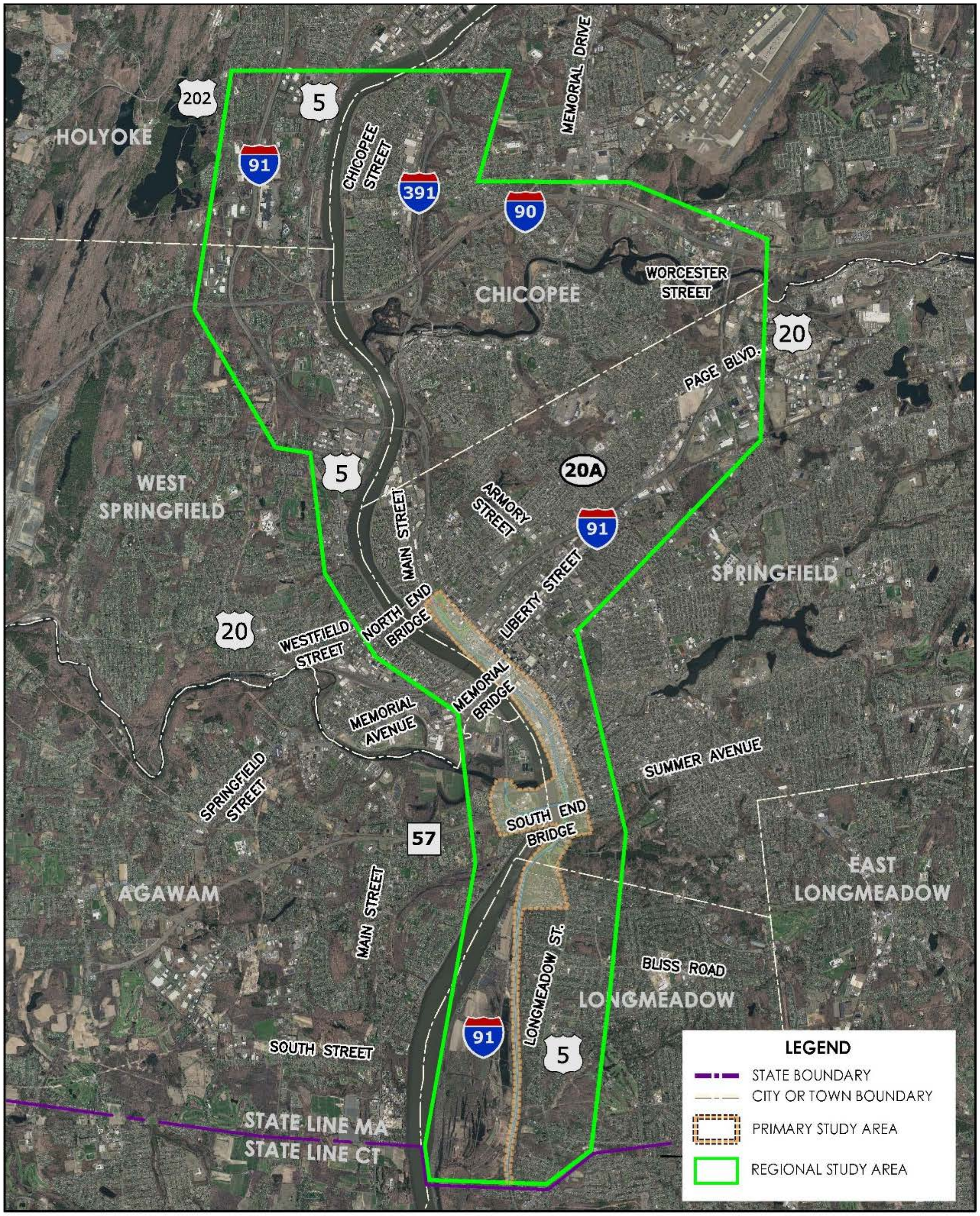
- Identify the role and function of the transportation infrastructure within the Primary Study Area as it relates to the regional multimodal transportation network
- Evaluate the indirect impacts of study alternatives beyond the Primary Study Area

The larger regional element of the analysis is measured primarily in terms of vehicular level of service at major roadways, interchanges, and intersections as well as in measures of systemwide efficiency such as vehicle miles traveled and vehicle hours traveled. The Regional Study Area is roughly bounded by the following:

- I-91 from the Connecticut state line in the south to Exit 16 (Route 202) in the city of Holyoke to the north
- I-90 from Exit 4 (I-91) in the town of West Springfield to the west to Exit 6 (I-291) in the city of Chicopee to the east
- I-391 for its entire length from I-91 in the city of Springfield to High Street in the city of Holyoke
- I-291 for its entire length from I-91 in the city of Springfield to Burnett Road in the city of Chicopee
- U.S. Route 5 from the Connecticut state line in the south to I-91 Exit 13 in the city of West Springfield to the north

Within the boundary described above, the Regional Study Area includes roadway facilities, intersections, and interchanges along the following roads:

- U.S. Route 5 between the Connecticut state line and Route 202 in Agawam, West Springfield, and Holyoke
- I-91 between the Connecticut state line and Exit 14 in West Springfield
- I-90 between Exits 4 and 6 in Chicopee and West Springfield
- I-291 between I-91 and I-90 in Springfield and Chicopee
- I-391 between I-91 and High Street in Holyoke and Chicopee
- Routes 20 and 20A from U.S. Route 5 in West Springfield to I-291 in Springfield
- Route 141 from Route 116/Chicopee Street to I-291 in Chicopee and Springfield
- Route 33 (Memorial Drive) between Route 141 and I-90 in Chicopee
- State Street from I-91 to Boston Road in Springfield
- Chestnut Street from I-291 to Maple Street in Springfield
- Dwight Street from I-291 to Maple Street in Springfield
- Main Street from ALT 20 to I-91 and West Columbus Avenue in Springfield
- Route 20 from Park Street in West Springfield to Main Street in Springfield



PRIMARY & REGIONAL STUDY AREAS

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Figure 1-7: Primary and Regional Study Areas

1.4 GOALS AND OBJECTIVES

Goals and objectives for the study were developed by the study team in conjunction with the Working Group. The goals are meant to summarize and define favorable outcomes of the study. The objectives define how the goals will be achieved. Jointly, the goals and objectives outline the study's structure, which directs the progress and assessment of conceivable transportation improvements.

The goals and objectives for the study area are listed below:

GOAL 1:

Maintain and improve the safe and efficient function of I-91 and the local street network within the project study area while significantly improving the connection between the Downtown Springfield urban core and riverfront.

OBJECTIVES:

- Maintain or improve highway operations and safety: I-91 north and south, I-91 and I-291 interchange, I-291 on and off ramps within the Primary Study Area.
- Maintain or improve functionality, level of service, and safety at key intersections within both the Primary and Regional Study Areas.
- Enhance entrances/access points to the city of Springfield from the west (Memorial Bridge) and the riverfront.
- Enhance and create new Americans with Disabilities Act (ADA)-compliant pedestrian (walking, jogging, bicycling, rollerblading, strollers, etc.) connections from Downtown Springfield (neighborhoods and business center) to the riverfront as well as to the Hall of Fame and Union Station.
- Coordinate with the Knowledge Corridor improvements and operations.

GOAL 2:

Improve the quality of life for city residents in surrounding neighborhoods, existing/future business owners, daily commuting workforce, and visitors to the city of Springfield and surrounding communities.

OBJECTIVES:

- Create multimodal accommodations at street level for safe mobility to and from key destinations in conjunction with corridor improvements.
- Create more attractive, economically viable waterfront connection(s).
- Enhance access to existing development parcels and create new development parcels.
- Minimize environmental impacts (air, water, noise).
- Provide fair and equitable treatment for Environmental Justice populations.

- Enhance intermodal connectivity (passenger vehicle, bus, rail, and parking).
- Improve the overall visual presence of the interstate for the community(s) traversed or served.

1.5 EVALUATION CRITERIA

The evaluation criteria are specific considerations or measures of effectiveness used to assess benefits and impacts of the different alternatives established during this study. The evaluation criteria are based on the defined goals and objectives. As shown in Table 1-1, eight general evaluation categories were established and confirmed by the Working Group to be consistent with the study goals and objectives.

TABLE 1-1 Evaluation Criteria, Categories, and Corresponding Goals

Evaluation Criteria Category	Corresponding Project Goal
Mobility and Safety	Maintain or improve the safe and efficient function of I-91 and the local street network within the Regional Study Area while significantly improving the connection between the Downtown Springfield urban core and the riverfront.
Health and Environmental Effects	Improve the quality of life for city residents in surrounding neighborhoods, existing/future business owners, daily commuting workforce, and visitors to Springfield and surrounding communities.
Connectivity/Accessibility	Maintain or improve the safe and efficient function of I-91 and the local street network within the Regional Study Area while significantly improving the connection between the Downtown Springfield urban core and the riverfront.
Land Use and Economic Development	Improve the quality of life for city residents in surrounding neighborhoods, existing/future business owners, daily commuting workforce, and visitors to Springfield and surrounding communities.
Community Effects	Improve the quality of life for city residents in surrounding neighborhoods, existing/future business owners, daily commuting workforce, and visitors to Springfield and surrounding communities.
Cost	A key factor supporting both project goals and objectives

These evaluation criteria, which are based on measurable and specific measures of effectiveness, will be used to determine the best results for the defined goals and objectives. The detailed list of evaluation criteria and corresponding measures of effectiveness is presented in Table 1-2.

TABLE 1-2: Evaluation Criteria

Evaluation Criteria	Measure of Effectiveness
Mobility	
Roadway Operational Functionality	• Intersection delay and level of service • Volume to capacity ratio • Calculated 50th and 95th percentile queues • Merge, diverge, and weaving level of service • Highway and ramp level of service
Travel Time	• Vehicle hours traveled • Average travel time through the Primary Study Area • Average travel time within the Regional Study Area • Overall network delay
Safety	
Bicycle Safety	• Provision of designated facilities • Number of conflicts with vehicles
Pedestrian Safety	• ADA compliance • Intersection crossing times • Number of conflicts with vehicles
Vehicular Safety	• Conformance with American Association of State Highway and Transportation Officials (AASHTO) and MassDOT standards • Emergency vehicle access
Health and Environmental Effects	
Sustainability	• Impacts to environmental resources • Impervious area – net changes • Low impact design standards (LID) • Areas of open space/development • Tree impacts lost versus gained
Air Quality	• Total emissions
Noise	• Vertical positioning of alternatives
Connectivity/Accessibility	
Mobility	• Vehicular connectivity between landmarks • Walkability between landmarks
Land Use and Economic Development	
Land Use Patterns	• Mixture of land use created
Economic Development Potential	• Acres of vacant land can be reversed. • Square footage of existing space redeveloped • Spillover development generated by riverfront and landmark connectivity
Socioeconomic Impacts	• Number of new jobs • Number of new residents

	• Change in consumer spending • Change in household income/earnings
Enhancements	• Square footage of public green space • Changes to built form (quantitative)
Fiscal Impacts	• Generated disposable income • Property tax generation/revenue
Community Effects	
Pedestrian and Bicycle Accommodations	• Access points to riverfront and landmarks • Pedestrian delay • Linear feet of sidewalks • Linear feet of bike paths • Increased safety measures for pedestrians and bicyclists
Vehicular Accommodations	• Connections from Downtown Springfield to the riverfront • Redistribution of daily traffic and peak hours
Visual Impacts	• River and skyline views • Landscaping opportunities • Open space • Recreational opportunities
Multimodal Travel	• Increased transportation choices • Decreased traffic congestion • Modal conflict net changes • Conflicts with transit routes • Modal split
Construction Impacts	• Duration • Closure and detours • Right-of-way impacts • Effects on local businesses including access
Parking	• Reduction in parking areas • Add parking spaces or facilities
Compatibility	• Cohesiveness with in-place local and regional plans
Cost	
Construction Costs	• Arterial route upgrades • Right-of-way impacts • Order-of-magnitude implementation costs • Maintenance costs • Utility impacts

1.6 PUBLIC INVOLVEMENT PLAN

A public involvement plan was developed with the goals of soliciting input, garnering public support, and resulting in a project completed to the community's satisfaction. A transparent, inclusive, and responsive public involvement program is intended to advance the project in a timely manner and avoid obstacles caused by lack of information or opportunities to participate. The goals of the plan include the following:

- Reaching out early and frequently so people can participate in the study process
- Developing and maintaining positive relationships with community leaders, residents, and stakeholders
- Providing opportunities for public involvement, including information gathering, promptly responding to questions/inquiries, and offering an opportunity to submit comments
- Communicating study news and updates across several platforms in easy-to-understand and accessible formats. Translations into Spanish and additional languages or formats will be utilized to reach all populations. All materials posted to the website will be compliant with Web Content Accessibility Guidelines (WCAG) 2.0 and Section 508.
- Collaborating with community and advocacy groups, businesses, residents, and local officials to effectively broaden the public involvement program in part by convening a Working Group consisting of local, state, regional, legislative, federal, and business community representatives
- Encouraging and maintaining project support and involvement by providing continuous and meaningful opportunities for all potentially affected communities to participate and provide feedback

1.6.1 STAKEHOLDER DATABASE

The study team's stakeholder database for the project includes the local business community, elected and local officials, community groups, media, individuals and groups who have attended public meetings or hearings, property owners within the Primary Study Area, planning commissions, industry organizations, agency departments, and community organizations. These stakeholders include entities located in and around Springfield, West Springfield, Chicopee, Agawam, Holyoke, and Longmeadow (a complete list of stakeholders is included as inAppendix K to this report.)

1.6.2 INTERNET COMMUNICATIONS

Study updates, meeting announcements, and other project information are communicated electronically via the project website, e-blasts, and social media. The project website (www.massdot.state.ma.us/i91viaductstudy/home.aspx) is continually updated with documents, meeting announcements and materials, and graphics as they are created.

1.6.3 PUBLIC MEETINGS

The project's public involvement plan includes three public meetings to be held at dates that correspond with major project milestones. At these public meetings, attendees have an opportunity to view data, maps, and other materials; ask questions of the study team; and provide feedback.

1.6.4 WORKING GROUP MEETINGS

A critical component of the study is the Working Group, a group of stakeholders representing local, regional, and federal organizations, with a strong focus on neighborhood and community groups, business and local advocacy groups, planning organizations in the Pioneer Valley, and transit agencies such as Amtrak, Amtrak Railroad, Pioneer Valley Transit Authority (PVTA), and Peter Pan Bus. Given the diverse needs and objectives that are encompassed by the organizations represented, the members of the group are tasked with the challenge of providing balanced viewpoints within the ongoing study and serving as communication conduits to the communities and entities that they represent.

The study time line includes 10 Working Group Meetings that correspond to key project milestones. The purpose of these meetings is to solicit input from the members and afford them an opportunity to provide feedback on work completed. Below are the Working Group meeting topics:

Figure 1-8: Working Group Meeting Topics

Working Group Meeting	Topic	Meeting Date
1	Study area limits, goals and objectives, evaluation criteria, public involvement plan, the task milestones, and overall schedule	November 5, 2014
2	Existing conditions (draft)	April 9, 2015
3	Existing conditions (final), future No-Build conditions, issues evaluation components, task milestones, and overall schedule	August 3, 2015
4	Future-year conditions, project milestones, and overall schedule	mid November, 2015
5	Constraints identification and strategy for Public Meeting #1	December 15, 2015
6	Alternatives development components and strategy for next public meeting	October 26, 2016
7	Elements of alternatives analysis and cost analysis components	June 20, 2017
8	Study recommendations as a result of the analysis	May 31, 2018
9	Final report	August, 2018

1.6.5 PRESS OUTREACH

Springfield area press representatives are included in the public outreach database that receives general information via ongoing email blasts. The study team provides draft media and press releases to MassDOT Public Affairs for distribution to broadcast, online, and print media outlets and in response to press inquiries.

1.6.6 COORDINATION WITH OTHER PROJECTS

The study team partners with MassDOT's I-91 Viaduct Rehabilitation Project Team to avoid public confusion and coordinate outreach efforts whenever possible.

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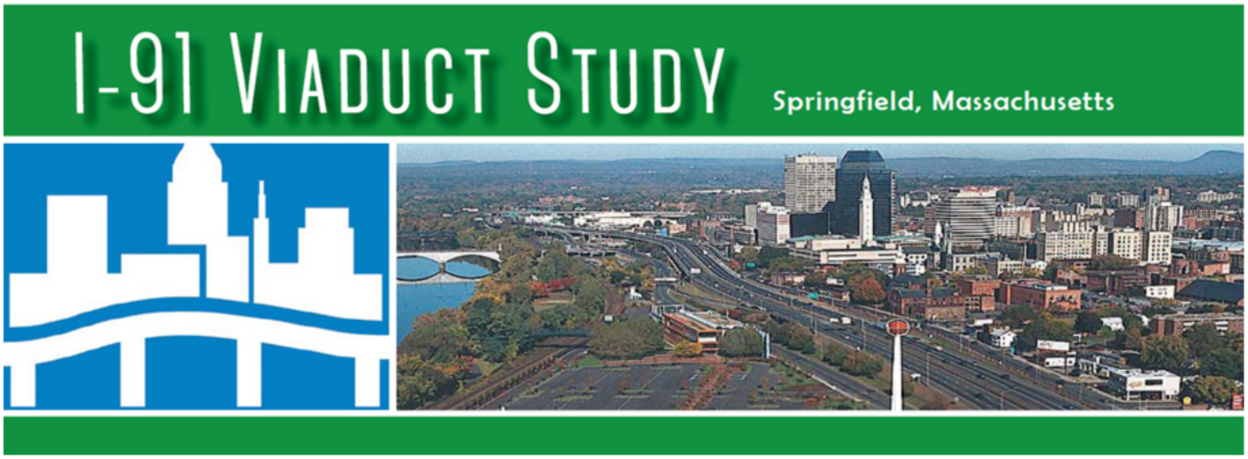

INTERSTATE 91 VIADUCT STUDY

CHAPTER II

EXISTING CONDITIONS, FUTURE NO-BUILD CONDITIONS, AND ISSUES EVALUATION

August 2018

MMI #3869-16-6

massDOT Massachusetts Department of Transportation

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2.1 INTRODUCTION

The Interstate 91 Viaduct Study is an effort by the Massachusetts Department of Transportation (MassDOT) to embark on a thorough review of the transportation network surrounding the Interstate 91 (I-91) Viaduct and to evaluate potential alternatives to the existing Viaduct structure. Review of these features and systems will be carried out on two levels: in a Primary Study Area immediately surrounding the current Viaduct and in a Regional Study Area that includes the larger transportation system immediately surrounding the Viaduct that may be impacted by any developed alternatives.

Prior to the development of any alternatives and any evaluation of those alternatives, the study must first understand the details of the I-91 corridor and the context in which it is situated today. This chapter summarizes the existing conditions into manageable and relevant topics within the Primary and Regional Study Areas, including transportation, land use, environmental, and public health. Issues, opportunities, and constraints relevant to each of the four major topics were derived from this analysis. Within each of these major categories, data on existing conditions within the Primary and Regional Study Areas were collected, synthesized, and analyzed in order to provide a basis for future year evaluations. A compiled base year was utilized incorporating detailed information from 2012, 2014, and 2015. The future-year conditions were then projected for the year 2040 utilizing a travel demand model based on the Massachusetts Statewide Travel Demand Forecasting Model maintained by MassDOT. The future-year conditions (No-Build) model incorporated much of the data and analysis performed during this task and will be used as the benchmark for evaluation of any future alternatives developed.

2.2 TRAFFIC AND TRANSPORTATION

2.2.1 EXISTING CONDITIONS, DATA COLLECTION, AND ANALYSIS

This data collection and analysis effort provides the basis for a detailed understanding of the current circulation of all modes of transportation within the I-91 corridor, which will inform the development of feasible alternatives responsive to local needs and enable a detailed evaluation of those alternatives. This section analyzes and presents information on the location, times, and causes of congested traffic conditions and safety issues across the Primary and Regional Study Areas. The data collection and analysis of the existing traffic and transportation conditions within the Primary and Regional Study Areas canvassed a wide variety of topics, including the following:

- traffic volumes, turning movements, and crash data
- the availability and ridership of transit services
- the availability and ridership of intercity passenger services
- freight rail operations, including information on customer destinations, existing or planned regional intermodal freight facilities, and freight volumes
- bicycle counts and connections between bike routes
- pedestrian counts

The traffic and transportation data was collected from a variety of sources, including MassDOT, the Pioneer Valley Metropolitan Planning Organization (PVMPO) [1], the individual municipalities within the Primary and Regional Study Areas (Agawam, Longmeadow, Springfield, West Springfield, Chicopee, and Holyoke), the Pioneer Valley Transit Authority (PVTA), Peter Pan intercity bus service, and Amtrak. This data was analyzed with respect to the Primary and Regional Study Areas to determine traffic volumes and levels of service, the relative safety of different routes and transportation modes, and the overall level of transit services.

NATIONAL HIGHWAY SYSTEM ROADWAYS

The National Highway System (NHS) consists of roadways essential to national economics, defense, and mobility. The NHS includes interstates, principal arterials, and intermodal connectors, which provide access between major intermodal facilities and other NHS roadways. Within the Regional Study Area, I-91, I-291, I-391, and I-90 are classified in the NHS as Interstates, as seen in Figure 2-1. U.S. Route 5, East Columbus Avenue, West Columbus Avenue, and US-20 are considered part of the urban principal arterial system within the NHS. Portions of Dwight Street and Congress Street

[1] The Pioneer Valley MPO is staffed by employees of the Pioneer Valley Planning Commission (PVPC) but is composed of different members and is a separate agency. The activities of these two entities will be treated as separate, and each agency will be referred to independently in this report.

between I-291 and State Street are classified as urban principal arterials by the NHS as well. The Memorial, South End, and North End Bridges are designated as principal arterial roadways. The NHS classifies Liberty Street and Armory Street as urban minor arterial roadways.

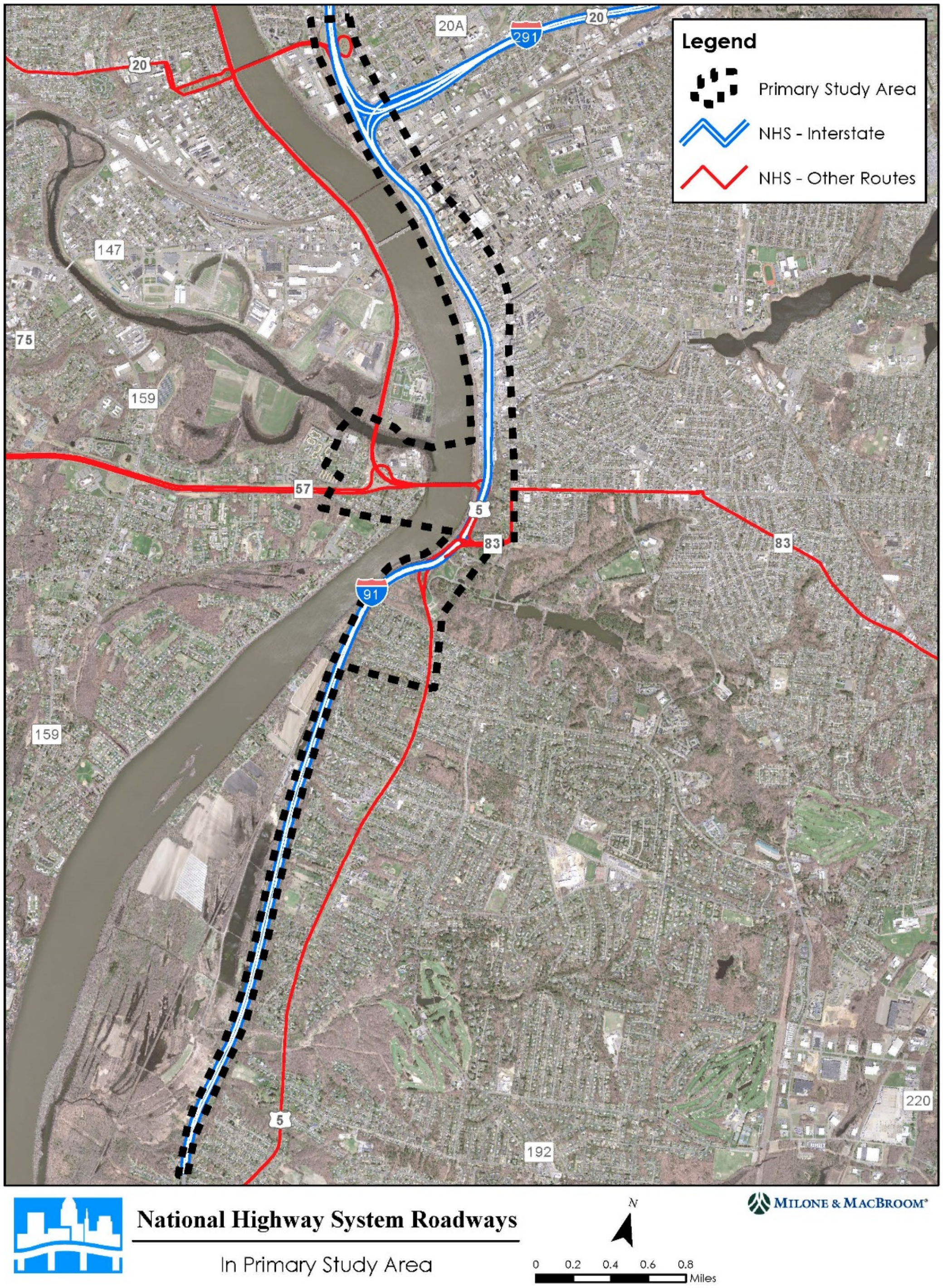


Figure 2-1: NHS Roadways within the Regional Study Area

REGIONAL STUDY AREA

Significant roadways within the Regional Study Area include the following:

INTERSTATES

INTERSTATE 90 (MASSACHUSETTS TURNPIKE)

Within the Regional Study Area, Interstate 90 has a speed limit of 65 miles per hour (mph) with two lanes of traffic in each direction that are separated by a grass median. Traffic in the eastbound lanes uses Exit 6 in Chicopee to enter Interstate 291 as a means of reaching the Downtown Springfield area. This interstate also connects to I-91 and U.S. Route 5 at Exit 4 in West Springfield.

INTERSTATE 91

This interstate runs north-south with three lanes in each direction throughout most of the Regional Study Area and two lanes in each direction through the .84-mile segment known as the "Longmeadow Curve." Northbound lanes of the roadway are separated from southbound lanes with grass medians, concrete barriers, and guardrails. It connects to Interstates 291, 391, and 90 and serves the communities of Longmeadow, Springfield, Chicopee, West Springfield, and Holyoke. Its speed limit through much of the Regional Study Area is 55 mph but reduces to 50 mph at the interchange with I-391.

INTERSTATE 291 (SPRINGFIELD EXPRESSWAY)

This east-west interstate with a grass median protected by a steel guardrail provides three lanes in each direction throughout much of the Regional Study Area. The speed limit of this roadway is 55 mph. It includes unnumbered exit ramps to Liberty Street, St. James Avenue, Page Boulevard, and Fuller Road in Chicopee. In the area between St. James Avenue and Interstate 90, there is a lane reduction from three lanes of traffic to two lanes. I-291 is a connection between Interstates 90 and 91.

INTERSTATE 391

This north-south interstate provides three lanes in each direction with a concrete barrier median and a speed limit of 55 mph. Interstate 391 originates in Chicopee at an intersection with I-91, continuing north across the Connecticut River to the city of Holyoke. It is approximately 5 miles long, serving Routes 116 and 141 in Chicopee and terminating at Resnic Boulevard in Holyoke. Resnic Boulevard connects I-391 to US-202.

URBAN PRINCIPAL ARTERIALS

U.S. ROUTE 5

Within the Regional Study Area, U.S. Route 5 runs parallel with I-91 from the Connecticut and Massachusetts state line, northerly into Holyoke where it eventually intersects with US-202. At the southernmost section of U.S. Route 5, through Longmeadow, it is primarily one lane in each direction and includes auxiliary lanes at intersections traversing existing residential neighborhoods. Once U.S. Route 5 crosses into Springfield, heading northerly, it merges with I-91 for a short distance and then travels west over the Connecticut River via the South End Bridge and into Agawam and West Springfield. From the South End Bridge northerly into Holyoke, the roadway generally parallels the Connecticut River's western banks as a two-lane roadway in each direction. Between the South End Bridge and the North End Bridge, U.S. Route 5 is a limited-access highway separated by a guardrail median. North of the North End Bridge and East Elm Street, the median breaks, and the roadway provides access to numerous residential streets and driveways (southbound) as well as providing access (northbound and southbound) to many commercial and retail businesses. This section of roadway also includes Exit 13 with I-91 and Exit 4 with I-90. As the roadway heads northerly into Holyoke, beyond the commercial corridor, the roadway transitions into one lane in each direction.

PRIMARY STUDY AREA

Significant roadways within the Primary Study Area include the following (refer to Chapter 1 for mapping, Figure 1-6):

INTERSTATES

INTERSTATE 91

Within the Primary Study Area, the I-91 corridor runs north from south of the Longmeadow Curve at the Connecticut state line to the US-20 (Plainfield Street) overpass. It includes interchanges 1 through 9 in both the northbound and southbound directions. It provides three lanes in each direction, with the exception being the area of the Longmeadow Curve and U.S. Route 5 interchange, where a lane drop from three lanes to two lanes occurs in both directions to accommodate the merging. The 4,000-foot-long Viaduct extends from State Street to the I-291 interchange. Two-level parking garages exist below the Viaduct in two locations, north and south of the Memorial Bridge and Boland Way intersection. Northbound, the speed limit drops from 65 mph to 45 mph prior to entering the Longmeadow Curve, is signed at 50 mph within the area of the Viaduct, and increases to 55 mph north of the Viaduct and Primary Study Area. Southbound, the speed limit drops from 55 mph to 50 mph at the I-291 interchange, remains at 50 mph along the Viaduct, drops to

45 mph prior to the Longmeadow Curve, and eventually increases to 65 mph south of the Curve. Guardrail and a narrow left shoulder separate the northbound and southbound directions. I-91 is flanked by East and West Columbus Avenues, which parallel the highway from the South End Bridge to the I-291 interchange. East and West Columbus Avenues act as frontage roads and are described under Urban Principal Arterials below.

URBAN PRINCIPAL ARTERIALS

EAST COLUMBUS AVENUE

East Columbus Avenue operates as a one-way and surface frontage road in the northbound direction running along the eastern side and parallel to I-91. West Columbus Avenue parallels the roadway west of I-91, balancing the split traffic flow. East Columbus Avenue is mainly a two-lane roadway, an urban minor arterial, with auxiliary lanes at signalized intersections. The roadway connects the South End and Forest Park neighborhoods to Downtown Springfield and further points north. The posted speed limit is 35 mph. A sidewalk is present on the east side of the roadway. Land uses along East Columbus Avenue are primarily commercial, including both retail and office uses.

WEST COLUMBUS AVENUE (HALL OF FAME AVENUE)

West Columbus Avenue operates as a one-way and surface frontage road in the southbound direction running along the western side and parallel to I-91. East Columbus Avenue parallels the roadway east of I-91, balancing traffic flow. West Columbus Avenue is mainly a two-lane roadway, an urban minor arterial, with auxiliary lanes at signalized intersections. The roadway provides an access connection from the Brightwood neighborhood to Downtown Springfield as well as connections to various bridges such as the Memorial Bridge and South End Bridge. The posted speed limit is 35 mph. A sidewalk is present on the west side of the roadway. Land uses along West Columbus Avenue consist of retail, commercial, and recreational uses including the Basketball Hall of Fame.

MAIN STREET

US-20 (Main Street) is primarily a two-lane roadway that runs from the Chicopee line to the South End of Springfield with auxiliary lanes located at some signalized intersections. Main Street is an urban minor arterial with no posted speed limit. Travel speeds run approximately between 25 and 30 mph. Between Carew Street, US-20A, and the railroad tracks just north of Gridiron Street, Main Street is two lanes in each direction divided by a grass median strip. Sidewalks are located on both sides, and on-street parking is available on both sides for almost its entirety within the Primary Study Area. Land use consists of retail, commercial, residential, and office space. Main Street is the primary connector of both the North End and South End Neighborhoods into Downtown Springfield.

PORTIONS OF CHESTNUT STREET AND DWIGHT STREET

The portions of Chestnut Street and Dwight Street that run between I-291 and State Street, and parallel to East and West Columbus Avenues, are classified as principal arterials due to their high traffic volume. These high volumes are a result of traffic merges onto and off of I-291. Chestnut Street has a posted speed limit of 25 mph and is one way northbound with two lanes of travel. Dwight Street runs parallel to Chestnut Street and has a posted speed limit of 25 mph. It is a one-way southbound roadway with two lanes of travel.

AUTOMATIC TRAFFIC RECORDER (ATR) COUNTS

An Automatic Traffic Recorder (ATR) is a traffic counter that is placed at a specific location to record the distribution and variation of traffic flow by hour of the day, day of the week, and/or month of the year. ATRs can also record vehicle speed and classification. MassDOT collected traffic counts at numerous locations throughout both the Primary and Regional Study Areas using ATRs as part of its Traffic Data Collection Program. The counts used in this study were conducted in December 2012 and August 2014. Traffic data utilized for this study were a combination of counts previously obtained for the I-91 Viaduct Rehabilitation Project and new counts performed at required additional locations pertinent to this study. The counts were conducted continuously over a 48-hour period, typically on a Tuesday through Thursday.

INTERSECTION TURNING MOVEMENT COUNTS

Intersection Turning Movement Counts were conducted by MassDOT's Traffic Data Collection unit and included vehicular, pedestrian, and bicycle activity at signalized intersections, unsignalized intersections, and rotaries. For example, for each approach on a standard four-legged intersection, the left-turn movements, through movements, and right-turn movements are collected for all vehicles entering each intersection. Bicycles and pedestrians were also counted at each approach. Counts were collected at these locations twice daily, between 7:00 – 9:00 AM, and then again between 4:00 – 6:00 PM. Counts are typically collected in 15-minute intervals, and the peak hour is generated from these intervals. The results are depicted in a series of eight schematic maps, Figures 2-2 - 2-9. AM and PM counts are shown for every movement at each intersection, with PM counts placed in parentheses to differentiate the two numbers. Actual turning movement counts were not conducted at the rotaries. ATRs collected traffic volumes at each leg of the rotaries, with the volumes entering and exiting utilized to determine approximate vehicle destinations.

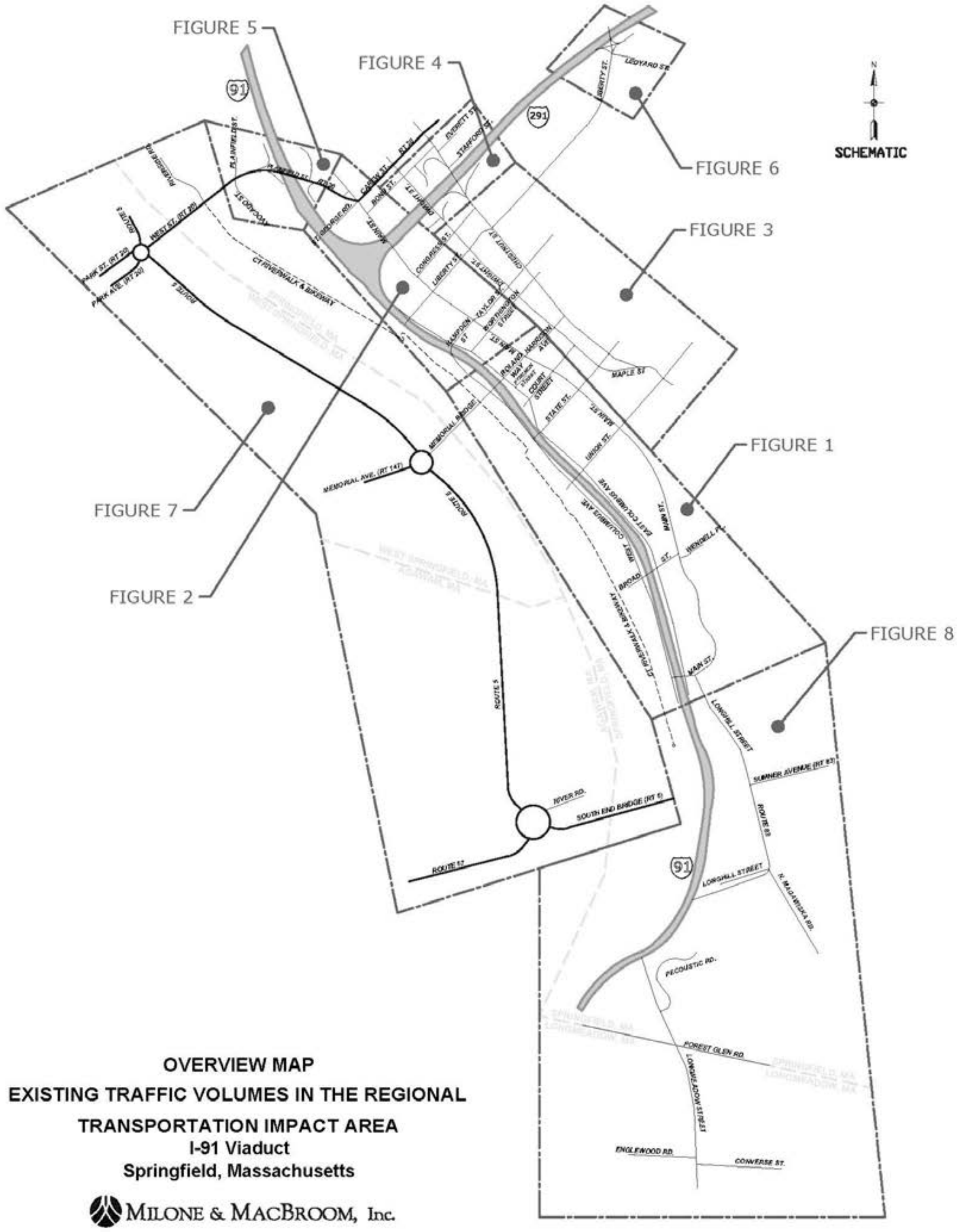


Figure 2-2: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Areas – Overview Map

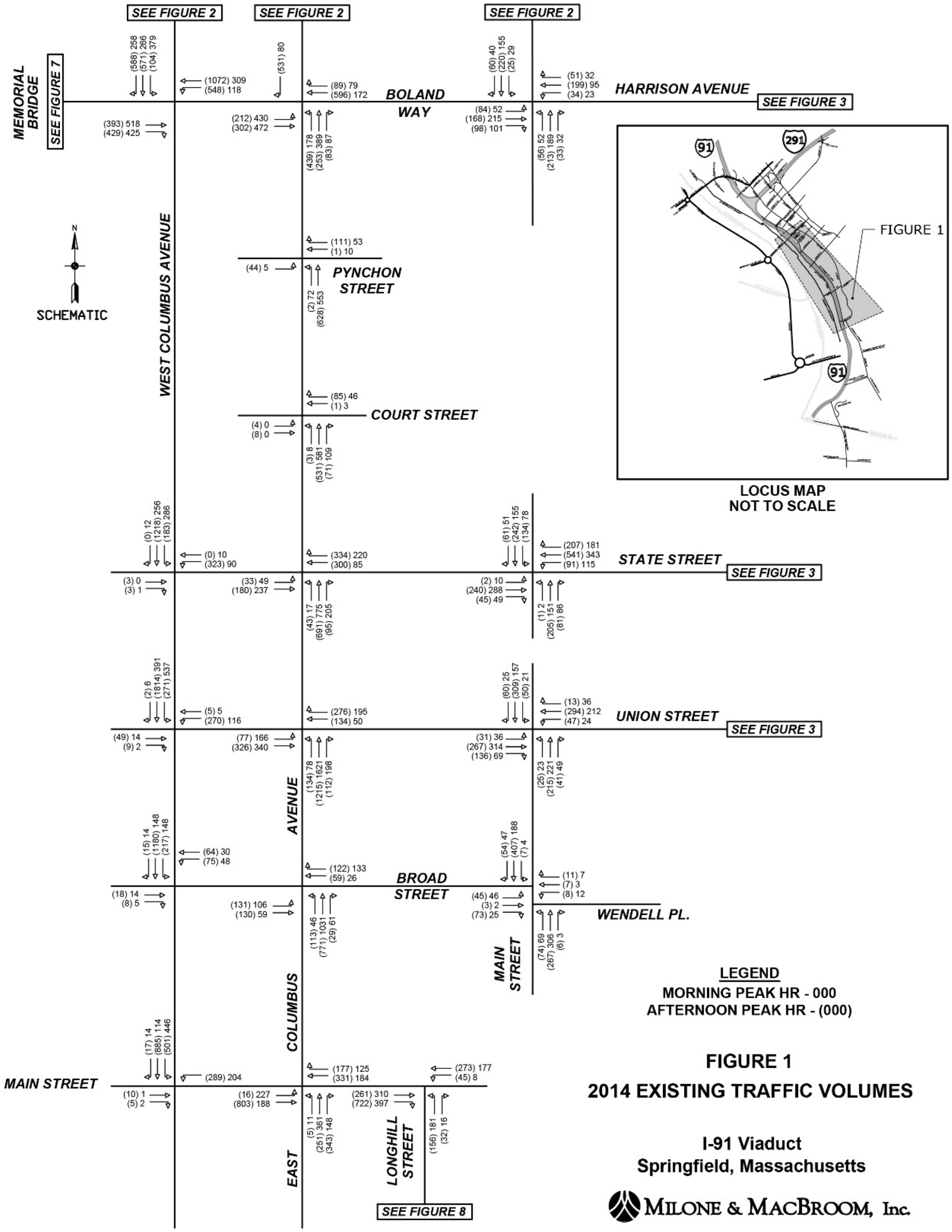


Figure 2-3: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #1

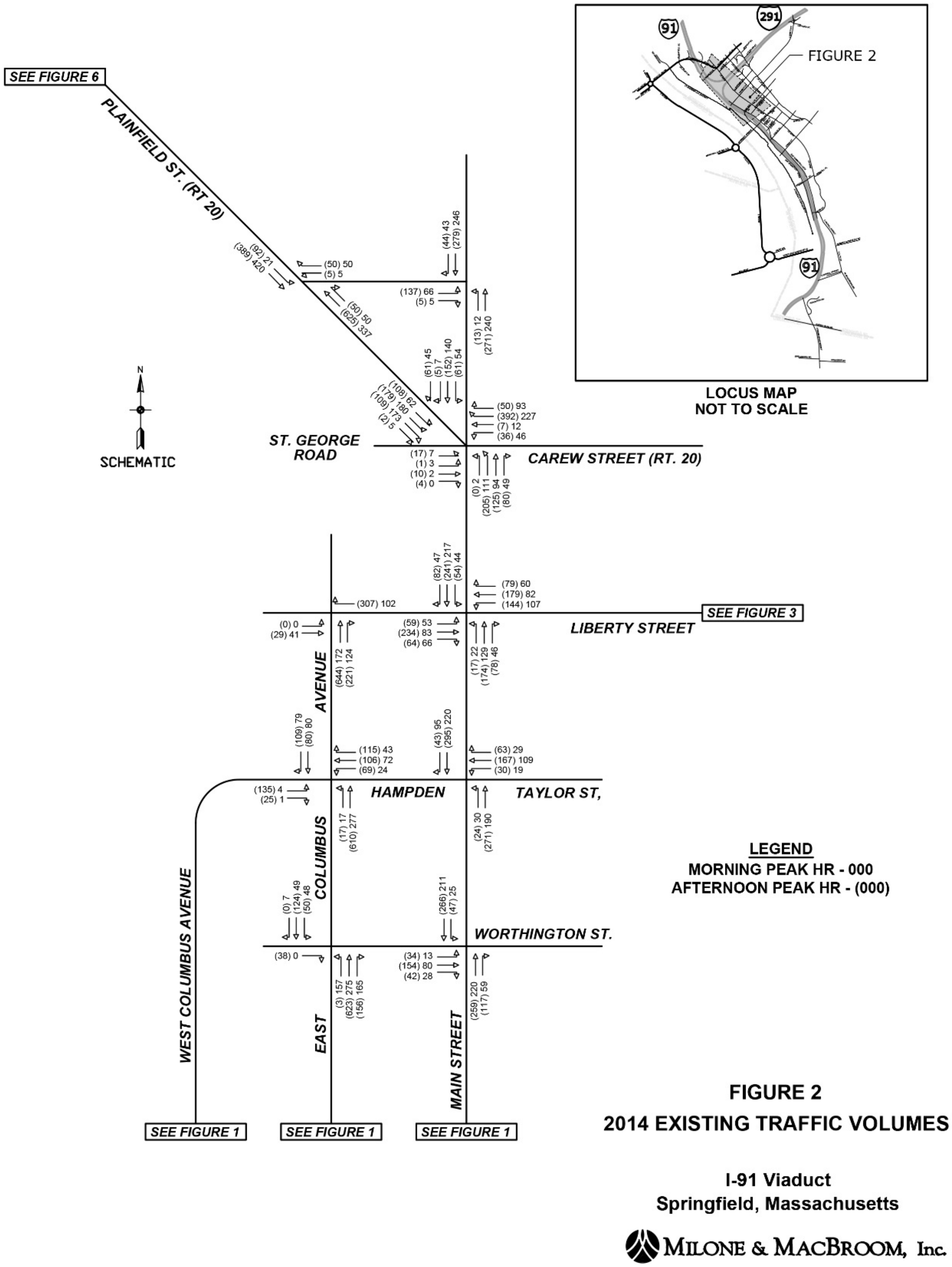


Figure 2-4: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #2

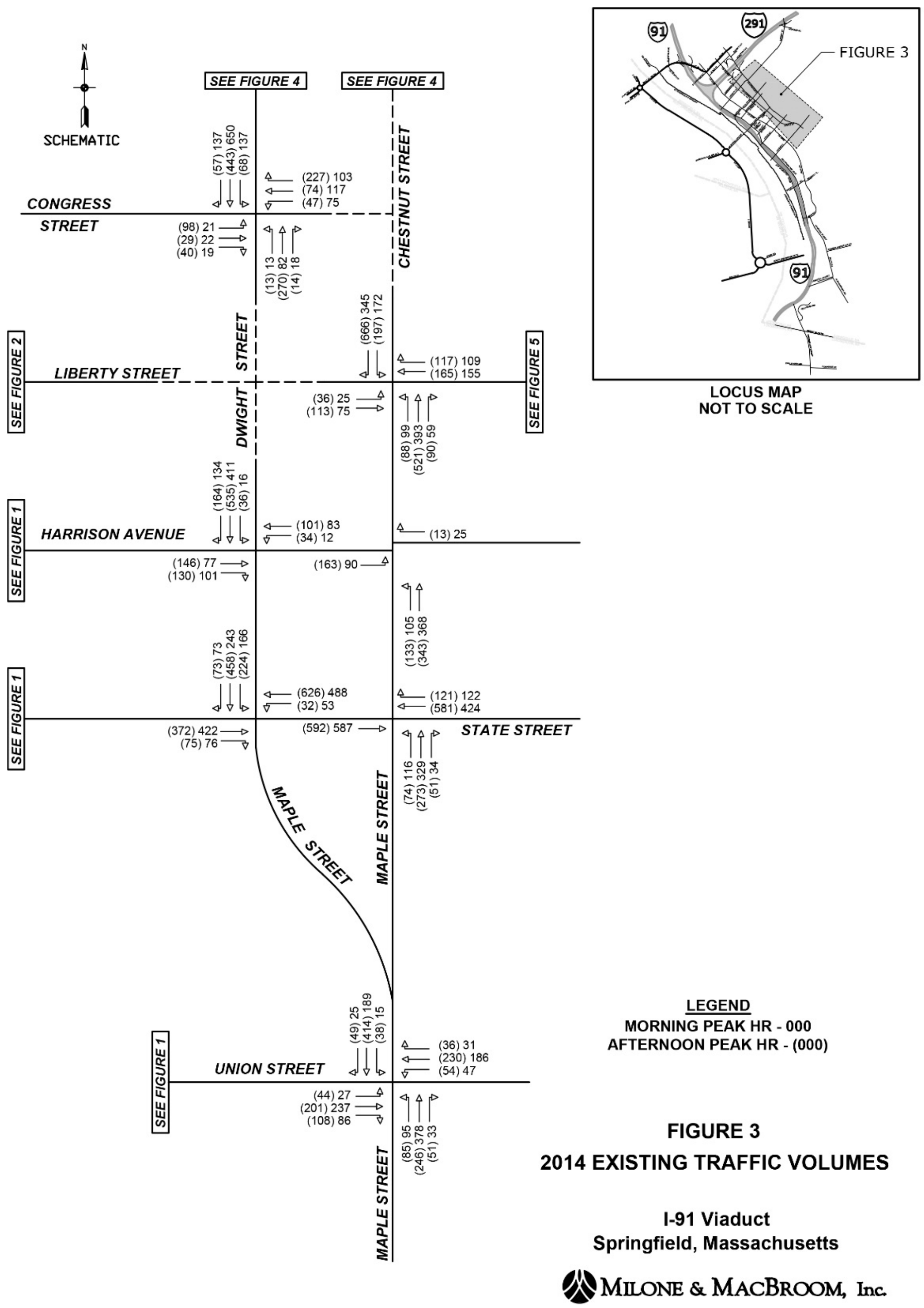


Figure 2-5: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #3

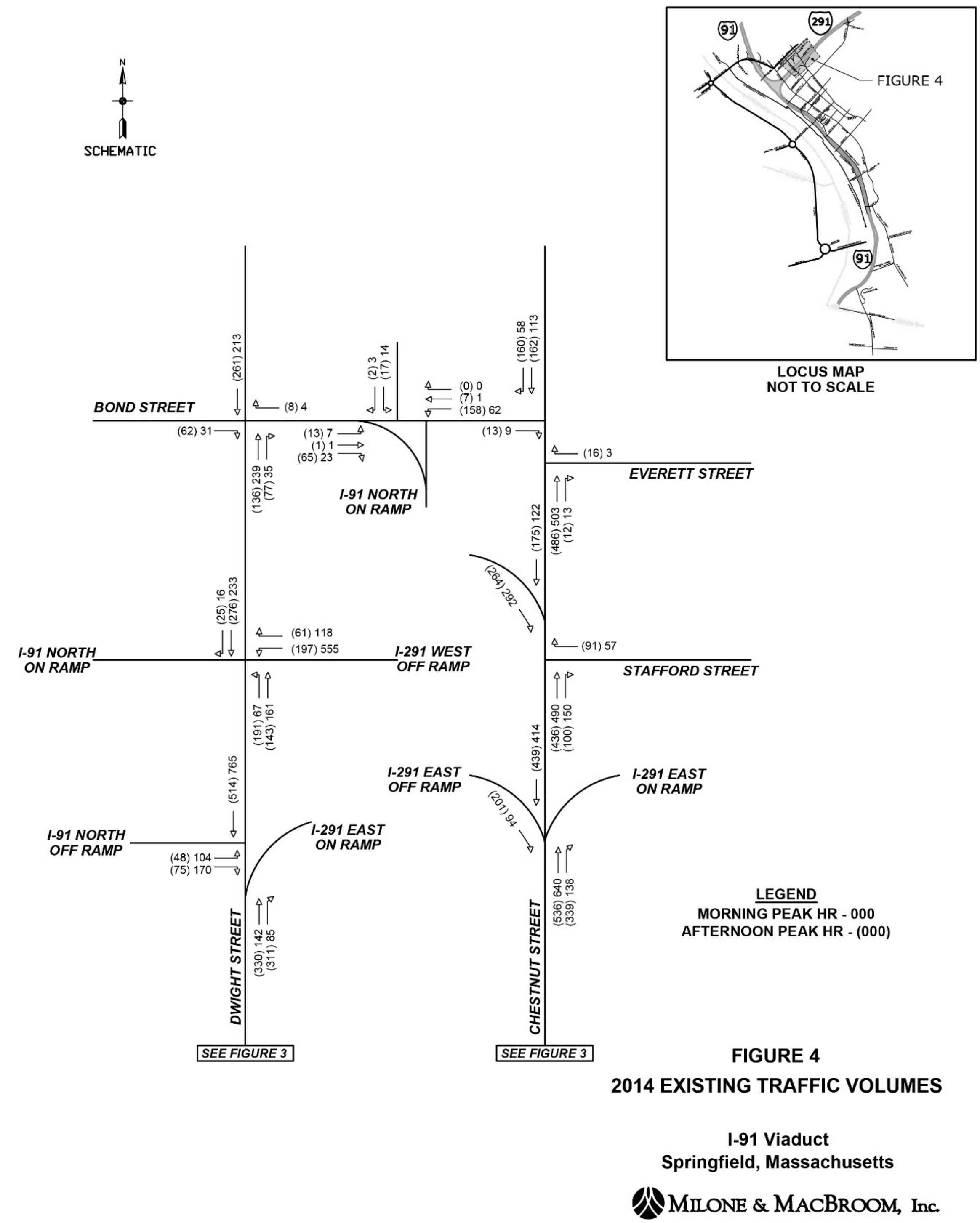


Figure 2-6: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #4

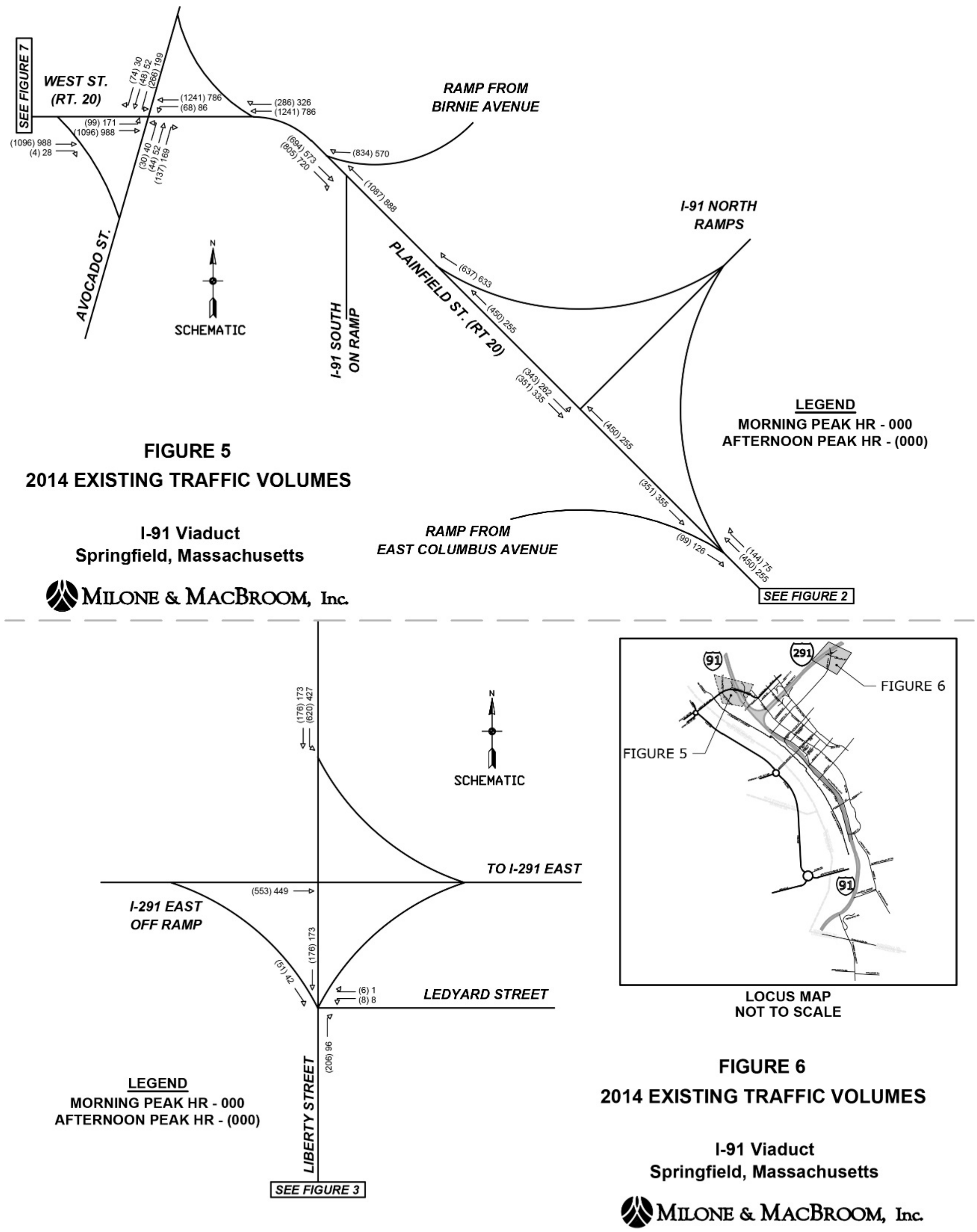


Figure 2-7: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #5 and #6

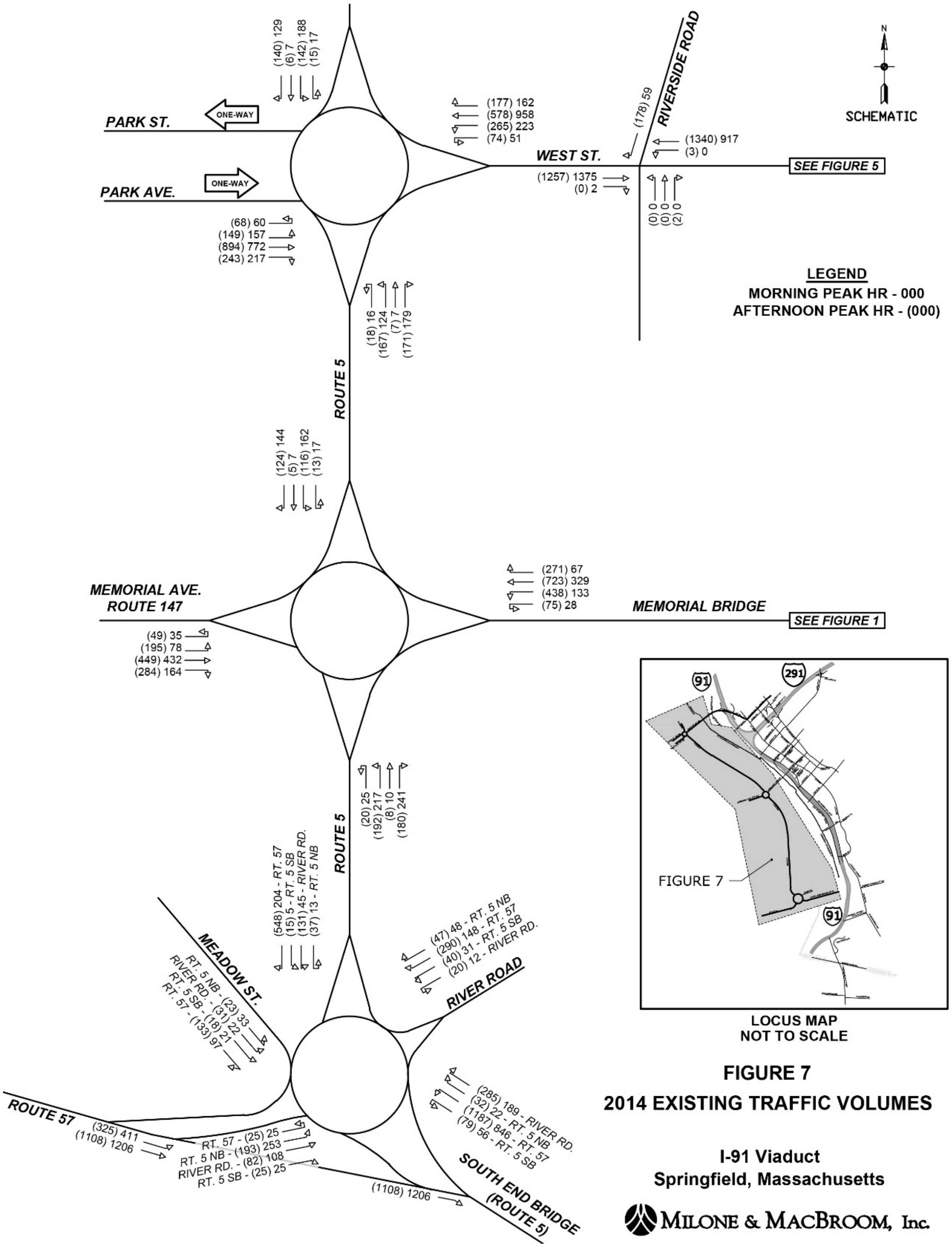


Figure 2-8: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #7

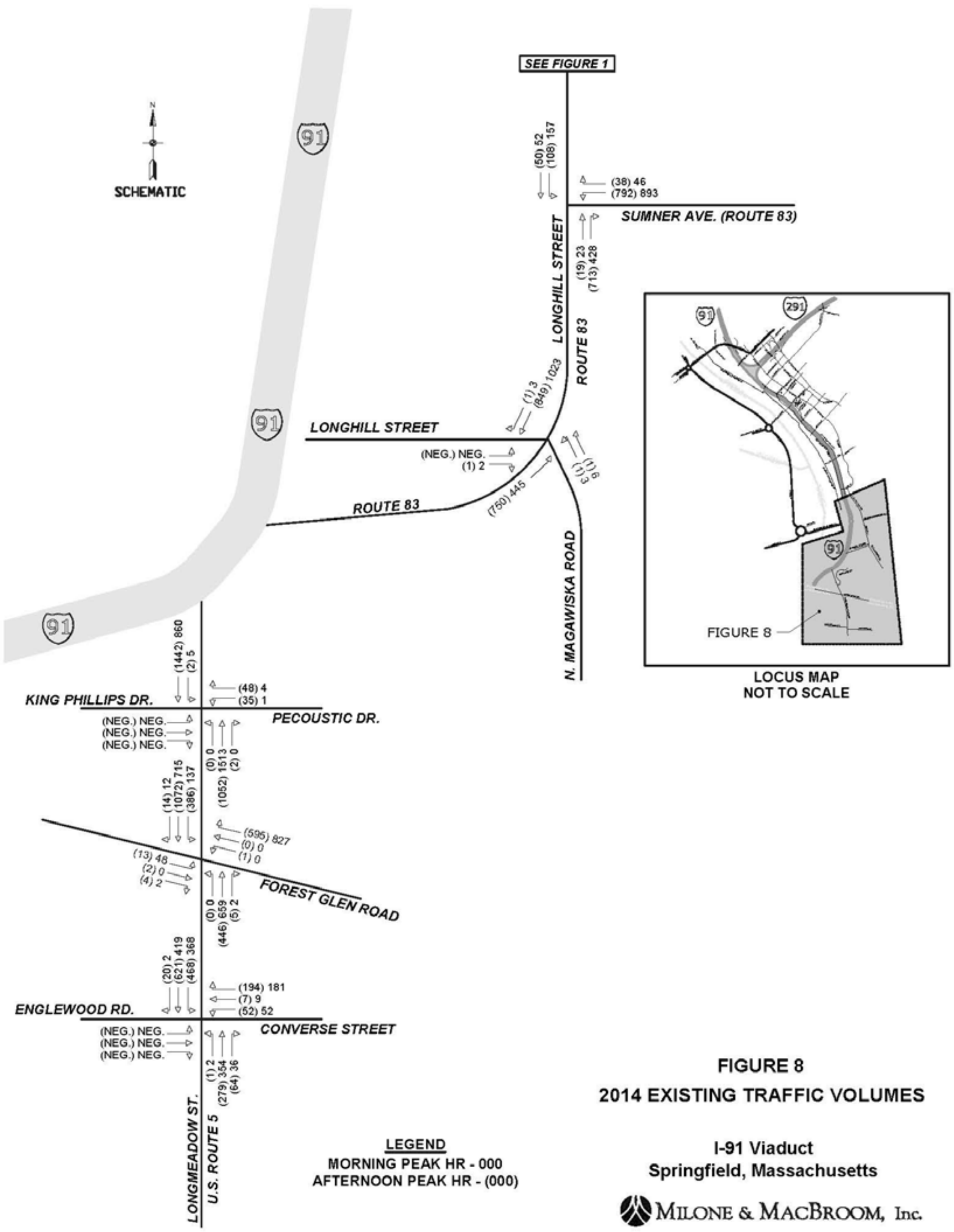


Figure 2-9: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #8

TRAFFIC OPERATIONS ASSESSMENT

Roadway operating levels of service (LOS) are calculated using techniques and practices defined in the 2010 *Highway Capacity Manual*. Analysis of existing traffic within these intersections utilized the basic operation gauges of LOS, volume to capacity ratio, delay in seconds, and queue length. LOS is a term used to describe the quality of traffic flow on a roadway facility over a particular period of time. Operating levels are conveyed on a scale of A to F, with LOS A representing free flow or uncongested conditions with little or no delay to motorists and LOS F representing forced-flow conditions with long delays and traffic demands exceeding roadway capacity. For intersections, the operating LOS is a function of vehicle delay. For freeway facilities, the operating LOS is a function of density (passenger cars per mile per lane). Table 2-1 includes the LOS criteria for each of these roadway features.

TABLE 2-1: Level of Service Criteria

Level of Service (LOS)	Intersections Delay per Vehicle, sec.		Freeway Facilities Density (passenger car per mile per lane)
	Unsignalized	Signalized	
A	≤ 10.0	≤ 10.0	≤ 11
B	10.1 to 15.0	10.1 to 20.0	> 11 - 18
C	15.0 to 25.0	20.0 to 35.0	> 18 - 26
D	25.0 to 35.0	35.0 to 55.0	> 26 - 35
E	35.0 to 50.0	55.0 to 80.0	> 35 - 45
F	> 50.0	> 80.0	> 45 or v/c > 1

Source: *Highway Capacity Manual*, Fifth Edition, Transportation Research Board, National Research Council, Washington, D.C. 2010.

Operations assessments for intersections were initially reviewed on the basis of whether they were signalized, unsignalized, or rotaries (see Tables 2-2, 2-3, and 2-4 below). Data was collected on 37 signalized intersections, 11 unsignalized intersections, and three rotaries. Data was also collected on 43 freeway segments, 16 weaving areas, and 42 on ramps and off ramps.

SIGNALIZED INTERSECTIONS

Thirty-seven signalized intersections were analyzed in both the Regional Study Area and the Primary Study Area in Longmeadow and Springfield. Two of these, S-9 and S-30, were complex to a degree that they were categorized and analyzed as being composed of two separate parts, noted as A and B.

These 37 signalized intersections provide both local and regional access, interconnecting both major and minor roadways and providing entry to the interstates. Table 2-2 provides an overview of the existing conditions of each intersection, focusing on its signalization, pedestrian features including sidewalks, Americans with Disabilities Act (ADA) compliance, and LOS grades and delays (in seconds). Detailed traffic operations data for each approach to each intersection are noted in Appendix B.

The majority of signalized intersections within the Primary Study Area operate at LOS D or better, which is an acceptable overall LOS for a signalized intersection in an urban area. By contrast, signals that operate at a LOS of E and F contain long delays per vehicle. These long delays are usually due to overcapacity, timing changes at the signals, or geometric deficiencies such as inadequate provision of turn lanes. The following four intersections operate at a LOS below D during certain peak periods, indicating that additional attention may be warranted in later stages of the study.

S-6: BOLAND WAY AND EAST COLUMBUS AVENUE

In the PM peak period, the Boland Way and East Columbus Avenue intersection operates at LOS E. Rather large queue lengths form at this intersection during the PM peak period. Queue length, typically measured in feet, is a measurement of the actual space that vehicles (25 feet per vehicle) will occupy while waiting to proceed through an intersection. Average queue length (50^{th} percentile) and maximum acceptable queue length (95^{th} percentile) are both commonly used when analyzing intersections. During the PM peak period at this location, the northbound left lane from East Columbus Avenue, along with the westbound through-right lane, are over capacity. The 50^{th} percentile queues are 302' and 299' while the 95^{th} percentile queues are 337' and 404', respectively. As a result of these conditions, the northbound left-lane queue extends back into the signalized intersection of Pynchon Place and East Columbus Avenue.

S-23: MEMORIAL BRIDGE AND BOLAND WAY AT WEST COLUMBUS AVENUE

In the PM peak period, the intersection of Memorial Bridge and Boland Way at West Columbus Avenue operates at LOS F. In the PM peak period, the westbound left lane 50^{th} and 95^{th} percentile queues are 232' and 257, respectively. The 50^{th} and 95^{th} percentile queues for the southbound through-right movement are 552' and 685', respectively.

S-30A: US-20A (PLAINFIELD STREET) AT MA-116 (MAIN STREET), ST. GEORGE ROAD, AND US-20 (CAREW STREET)

In the AM and PM peak periods, the US-20A (Plainfield Street) at MA-116 (Main Street), St. George Road, and US-20 (Carew Street) intersection operates at LOS F. During these peak periods, most of the approaches are at capacity. The southbound left-turn lane from Plainfield Street to Carew Street sees 50th percentile queue lengths of 386' during the AM period and 416' during the PM period. The 95th percentile queue lengths are 536' and 613', respectively. The southbound through-right movement on Plainfield Street is also over capacity, with a 50th percentile queue length of 237' and a 95th percentile queue length of 393' during the AM period.

S-36: FOREST GLEN ROAD AND WESTERN AVENUE AT U.S. ROUTE 5 (LONGMEADOW STREET)

In the AM peak period, the Forest Glen Road and Western Avenue at U.S. Route 5 (Longmeadow Street) intersection operates at LOS F. During this period, the heavy traffic movements at Forest Glen Road and Western Avenue at U.S. Route 5 (Longmeadow Street) are northbound and westbound. The destination for these movements is the on ramp to I-91 northbound. 50th percentile queues are 311', 303', and 214' for the northbound, westbound, and southbound through-right lanes, respectively. 95th percentile queues are particularly long for the northbound, westbound, and southbound through-right lanes, at 500', 503', and 411', respectively.

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-1	SPFLD	Harrison Ave	Chestnut St	Fully actuated. Two phases.	Crosswalks and pedestrian signals across each leg of the intersection. Ramps do not meet ADA standards.	This is a T - intersection. Harrison Ave is approx. 100' south of and opposite Mattoon St, which is included in this listing. Mattoon St is stop-controlled with a flashing red beacon.	A	8.8	B	11.5
S-2	SPFLD	Liberty St	Chestnut St	Fully actuated & coordinated. Four phases.	Crosswalks and pedestrian signals across each leg of the intersection. Ramps do not meet ADA standards.		C	21.4	C	25.4
S-3	SPFLD	Congress St	Dwight St	Fully actuated & coordinated. Five phases.	Crosswalks and pedestrian signals across each leg of the intersection. Ramps do not meet ADA standards.		D	54.2	D	42.7

[2] More extensive tabular data on each of these intersections, and every approach to each intersection, including LOS grades, delays, volume/capacity, 50th % queues, and 95th % queues, are available in Appendix B. "Municipality" field: SPFLD = Springfield.

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-4	SPFLD	Harrison Ave	Dwight St	Fully actuated & coordinated. Two phases.	Crosswalks and pedestrian signals across each leg of the intersection. Ramps do not meet ADA standards.		A	10.0	B	11.8
S-5	SPFLD	I-291 Ramp	Dwight St	Fully actuated & coordinated. Two phases.	Crosswalks across both I-291 ramps. No pedestrian signals. Ramps do not meet ADA standards.		B	17.9	B	19.3
S-6	SPFLD	Boland Way	East Columbus Ave	Fully actuated & coordinated. Three phases.	Crosswalks and pedestrian signals across each leg of the intersection. Ramps do not meet ADA standards.		C	35.0	E	72.7
S-7	SPFLD	Broad St	East Columbus Ave	Fully actuated & coordinated. Six phases.	Crosswalks and pedestrian signals across the southern and eastern sides of the intersection only. Signal provides both concurrent movements for pedestrians and an exclusive pedestrian phase. Southwest corner of the intersection meets ADA standards; other corners do not.	Certain signal phases operate at different times of the day.	C	30.8	C	27.2

TABLE 2-2: Signalized Intersections Summary Table[2]

<table>
<tr><th rowspan="2">ID #</th><th rowspan="2">Municipality</th><th rowspan="2">Street 1</th><th rowspan="2">Street 2</th><th rowspan="2">Signal</th><th rowspan="2">Crosswalks, Pedestrian Signals, Wheelchair Ramps</th><th rowspan="2">Notes</th><th colspan="2">AM Peak Hour</th><th colspan="2">PM Peak Hour</th></tr>
<tr><th>LOS</th><th>Delay</th><th>LOS</th><th>Delay</th></tr>
<tr><td>S-8</td><td>SPFLD</td><td>Hampden St/ West Columbus Ave</td><td>East Columbus Ave</td><td>Fully actuated & coordinated. Three phases.</td><td>Crosswalks and pedestrian signals across each leg of the intersection. Ramps do not meet ADA standards.</td><td>Hampden St is one-way westbound and continues as West Columbus Ave southwest of intersection.</td><td>B</td><td>13.5</td><td>C</td><td>30.3</td></tr>
<tr><td>S-9A</td><td>SPFLD</td><td>Main St</td><td>East Columbus Ave</td><td rowspan="2">Fully actuated & coordinated. Runs in unison with the intersection of Main St at West Columbus Ave. Six phases.</td><td rowspan="2">Crosswalks across Longhill St, across East Columbus Ave south of Main St, and across Main St. Pedestrian signal for northbound traffic on East Columbus Ave. Ramps do not meet ADA standards.</td><td></td><td>D</td><td>40.9</td><td>B</td><td>10.7</td></tr>
<tr><td>S-9B</td><td>SPFLD</td><td>Main St</td><td>Longhill St</td><td></td><td>C</td><td>23.6</td><td>C</td><td>20.0</td></tr>
</table>

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-10	SPFLD	Pynchon St	East Columbus Ave	Fully actuated & coordinated. Three phases.	Crosswalks and pedestrian signals across Pynchon St and across the northbound leg of East Columbus Ave only. Ramps do not meet ADA standards.	Pedestrian push button is broken across from Pynchon St, so exclusive pedestrian phase is called every cycle.	A	4.3	A	5.7
S-11	SPFLD	State St	East Columbus Ave	Fully actuated & coordinated. Six phases.	Crosswalks and pedestrian signals across each leg of the intersection, except for the northeastbound leg where there are none across State St. Ramps on east side of East Columbus Ave meet ADA standards, but ramps on west side do not.		C	26.5	B	18.8
S-12	SPFLD	Union St	East Columbus Ave	Fully actuated & coordinated. Five phases.	Crosswalks and pedestrian signals across westbound approach on Union St and across northbound approach of East Columbus Ave. Ramp on southwest corner of intersection meets ADA standards, but other ramps do not.	Signal coordinated with the intersection of Union St at West Columbus Ave.	B	15.4	B	19.1

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-13	SPFLD	Boland Way / Harrison Ave	Main St	Fully actuated & coordinated. Four phases.	Crosswalks and pedestrian signals across each leg of the intersection. All crosswalks meet ADA standards.		C	26.8	C	28.9
S-14	SPFLD	Broad St / Wendell Place	Main St	Fully actuated & coordinated. Five phases.	Crosswalks and pedestrian signals across both side streets, and one across Main St. Includes radial wheel chair ramps. All crosswalks meet ADA standards.		B	11.2	C	21.1
S-15	SPFLD	Hampden St / Taylor St	Main St.	Fully actuated & coordinated. Five phases.	Crosswalks and pedestrian signals across each leg of the intersection. All crosswalks meet ADA standards.		C	23.3	D	39.0
S-16	SPFLD	Liberty St	Main St		Crosswalks and pedestrian signals across each leg of the intersection. All crosswalks meet ADA standards.	Raised median partially protrudes into the crosswalk on the northbound approach on Main St, compromising ADA accessibility.	C	22.0	C	28.3
S-17	SPFLD	Union St	Main St	Fully actuated & coordinated. Five phases.	Crosswalks and pedestrian signals across each leg of the intersection. All crosswalks meet ADA standards.		C	28.5	C	29.2

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-18	SPFLD	Worthing-ton St	Main St	Fully actuated & coordinated. Three phases.	Crosswalks and pedestrian signals across each leg of the intersection. All crosswalks meet ADA standards.		C	31.5	C	31.6
S-19	SPFLD	Union St	Maple St	Fully actuated & coordinated. Three phases.	Crosswalks and pedestrian signals across each leg of the intersection. Wheelchair ramp on northeast corner meets current ADA standard. All other pedestrian ramps do not.		B	13.9	B	17.2
S-20	SPFLD	Chestnut St / Maple St	State St	Fully actuated & coordinated. Four phases.	Crosswalks and pedestrian signals across each leg of the intersection. All ramps meet ADA standards.	Maple St continues one-way as Chestnut St north of the intersection.	D	36.0	C	29.5
S-21	SPFLD	Dwight St	State St	Fully actuated & coordinated. Four phases.	Crosswalks and pedestrian signals across each leg of the intersection. All ramps meet ADA standards.		C	26.1	D	36.5
S-22	SPFLD	Main St	State St	Fully actuated & coordinated. Four phases	Crosswalks and pedestrian signals across each leg of the intersection. Pedestrians have an exclusive pedestrian phase for all crosswalks with countdown timers. All crosswalks meet ADA standards.		C	20.7	C	22.5

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-23	SPFLD	Boland Way / Memorial Bridge	West Columbus Ave	Fully actuated & coordinated. Three phases	Crosswalks and pedestrian signals only on southbound approach on West Columbus Ave and westbound approach of Boland Way. Also includes faded crosswalk across Memorial Bridge, but no pedestrian signals for this crossing. Ramps do not meet ADA standards.	No sidewalks on the east side of West Columbus Ave along the I-91 corridor.	B	18.2	F	123.1
S-24	SPFLD	Broad St	West Columbus Ave	Fully actuated & coordinated. Six phases	Crosswalks and pedestrian signals across West Columbus Ave south of the intersection, and on eastbound approach from the private driveway across from Broad St. Pedestrians have an exclusive pedestrian phase. Crosswalk in southwest corner meets ADA standards. All other ramps do not.	No sidewalks on the east side of West Columbus Ave along the I-91 corridor.	B	14.7	C	22.4

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-25	SPFLD	Main St	West Columbus Ave	Fully actuated & coordinated. Six phases	Crosswalks and pedestrian signals for crossing southbound traffic, south of the intersection. Pedestrians have an exclusive pedestrian phase. Ramps do not meet ADA standards.	No sidewalks on the east side of West Columbus Ave. This signal runs in tandem with the signal at Main St, East Columbus Ave, and Longhill St.	D	47.9	D	44.7
S-26	SPFLD	State St	West Columbus Ave	Fully actuated & coordinated. Six phases	Crosswalks and pedestrian signals for crossing West Columbus Ave on both sides of State St. Ramps on east side of West Columbus meet ADA standards. All other ramps do not.	Signal runs in tandem with the intersection of State St at East Columbus Ave.	B	18.3	D	37.7

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-27	SPFLD	Union St	West Columbus Ave	Fully actuated & coordinated. Five phases	Crosswalks across West Columbus Ave south of Union St., and across the private driveway across from Union St. Intersection runs in tandem with intersection of Union St at East Columbus Ave. Pedestrians have exclusive pedestrian phase. Ramp on southeast corner meets ADA standards. All others do not.	No sidewalks along the east side of West Columbus Ave.	B	18.2	D	47.6
S-28	SPFLD	Riverside Road/ CT Riverwalk / Bikeway	US-20 (West St)	Fully actuated & coordinated. Three phases	Crosswalks across US-20 (West St) and Riverside Road. Pedestrian signal across West St, but not across Riverside Road. Ramps do not meet ADA standards.	The crosswalk across West St links the CT Riverwalk and Bikeway on both sides of West St.	B	13.5	B	13.5

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-29	SPFLD	Avocado St / Plainfield St	US-20 (West St and Plainfield St)	Actuated & coordinated. Four phases	Crosswalks across northbound leg of Avocado St and eastbound leg of US-20 (West St). Pedestrian signal for crosswalk across West St, but not across Avocado St Ramps do not meet ADA standards. West side of southbound approach has wheelchair ramp but no crosswalk.		D	39.6	D	36.5
S-30A	SPFLD	Plainfield St (US-20A) / Main St (Route 116) / George St	Carew St (US-20A)	Actuated & coordinated. Six phases	Crosswalks and pedestrian signals across each leg of the intersection. Pedestrians have an exclusive pedestrian phase for all crosswalks with countdown timers. All crosswalks meet ADA standards.		F	187.3	F	132.2
S-30B	SPFLD	Main St (MA116)	Bradford St				C	25.3	C	32.3

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-31	SPFLD	Worthing-ton St	East Columbus Ave	Actuated & coordinated. Two phases. Runs in tandem with Bridge St	Crosswalks run across Worthington St and Bridge St, and East Columbus Ave south of both Bridge and Worthington Streets.	Sidewalks on both sides of Worthington St and Bridge St. Sidewalk along only east side of East Columbus Ave.	A	0.6	A	0.8
S-32	SPFLD	Interstate 291 off ramp	Liberty St	Fully actuated signal. Two phases.	Crosswalks on southern and western legs. No pedestrian signal heads. No pedestrian phasing. All crosswalks meet ADA standards.		B	18.5	C	30.0
S-33	SPFLD	Pecousic Dr / Park Entrance	Columbus Ave (U.S. Route 5)	Fully actuated signal. Four phases.	Crosswalk across northern leg of intersection only. Includes pedestrian signals. Crosswalks do not meet ADA standards.		B	14.0	C	23.2
S-34	SPFLD	Longhill St (Rt 83)	Summer Ave (Rt 83)	Fully actuated signal. Three phases.	Crosswalks and pedestrian signals across each leg of intersection. Crosswalks do not meet ADA standards.		C	27.9	B	19.6
S-35	SPFLD	Longhill St (Rt 83)	I-91 Ramp Connector and Magawiska St	Semi-actuated signal. Three phases.	Pedestrian signals across Longhill St on north side of intersection. No crosswalk or wheelchair ramps for pedestrian signals.		D	38.2	C	29.1

TABLE 2-2: Signalized Intersections Summary Table[2]

ID #	Municipality	Street 1	Street 2	Signal	Crosswalks, Pedestrian Signals, Wheelchair Ramps	Notes	AM Peak Hour		PM Peak Hour	
							LOS	Delay	LOS	Delay
S-36	SPFLD	Forest Glen Rd / Western Dr	Longmeadow St (U.S. Route 5)	Semi-actuated signal. Three phases.	No pedestrian signals for crosswalk perpendicular to U.S. Route 5 and south of Western Ave and Forest Glen Rd. Ramps do not meet ADA standards.		F	95.6	D	51.4
S-37	Longmeadow	Converse St	Longmeadow St (Rt 5)	Semi-actuated signal. Three phases.	Crosswalks across each leg of the intersection. No pedestrian signals. Ramps do not meet ADA standards.		D	40.8	C	20.5

UNSIGNALIZED INTERSECTIONS

Eleven unsignalized intersections were analyzed, all of which are located within the city of Springfield. One of these, the intersection of Bond Street and Everett Street with Chestnut Street (ID# U-2 in the chart below), was complex to a degree that it was categorized and analyzed as being composed of two separate parts, noted as A and B. These unsignalized intersections provide both local and regional access, interconnecting both major and minor roadways as well as entry to the interstates.

Table 2-3 provides an overview of the existing conditions of each intersection, focusing on its method of stop control, pedestrian features including sidewalks, ADA compliance, and LOS grades and delays (in seconds). Detailed traffic operations data for each approach to each intersection are noted in Appendix B. Unlike signalized intersections, queue length is only analyzed for the 95th percentile.

All but one of the unsignalized intersections within the Primary Study Area operate at LOS D or better, which is an acceptable overall LOS for an unsignalized intersection in an urban area. The following intersection, however, operates at LOS F during the AM and PM peak periods and will require attention in the 2040 No-Build alternative to determine what mitigation measures can be initiated to improve the situation.

U-11: I-91 SB ON/OFF RAMPS AT US-20 (PLAINFIELD STREET)

In the PM peak period, the I-91 southbound on/off ramps at US-20 (Plainfield Street) operate at LOS F. At the intersection of Bernie Avenue, the I-91 southbound on ramp, and Plainfield Street, the right-turn movement from Bernie Avenue onto US-20 (Plainfield Street) achieves queues of 605' during the AM peak period and 1,648' during the PM peak period.

TABLE 2-3: Unsignalized Intersections Summary Table[3]

ID #	Town	Street 1	Street 2	Crosswalks, Wheelchair Ramps, Sidewalks	Notes	AM Peak Hour		PM Peak Hour	
						LOS	Delay	LOS	Delay
U-1	SPFLD	Interstate 91 on ramps	Bond St	Crosswalks across both entrances to the I-91 South on ramps. Ramps do not meet ADA standards. Sidewalks on both sides of Bond St but in poor condition near the I-91 South on ramps.	There are separate entrances to the I-91 South on ramps for northbound and southbound traffic, both south of Bond St.	A	6.6	A	7.1
U-2A	SPFLD	Bond St	Chestnut St	Crosswalks across Everett St, Bond St, and Chestnut St. Ramps do not meet ADA standards across Bond St or Chestnut St but meet standards across Everett St. No ramps present on west side of crosswalk across Chestnut St. Sidewalks present in all directions.	Two-way stop-controlled intersection. Everett St meets Chestnut St to the east at a T-intersection.	A	0.2	A	0.2
U-2B	SPFLD	Everett St				A	0.2	A	0.2
U-3	SPFLD	Interstate 291 Ramps	Chestnut St	Crosswalks available across both I-291 ramps. No crosswalk across Chestnut St. Ramps do not meet ADA standards. No ramps present at crosswalk across the I-291 off ramp. Sidewalks present on both sides of Chestnut St.	YIELD-sign controlled at the off ramp from I-291 and uncontrolled at the on ramp to I-291.	A	0.8	A	1.6

[3] More extensive tabular data on each of these intersections, and every approach to each intersection, including LOS grades, delays, volume/capacity, 50th % queues, and 95th % queues, are available in Appendix B.

ID #	Town	Street 1	Street 2	Crosswalks, Wheelchair Ramps, Sidewalks	Notes	AM Peak Hour		PM Peak Hour	
						LOS	Delay	LOS	Delay
U-4	SPFLD	Stafford St and Interstate 291 WB Off ramp	Chestnut St	Crosswalks available across the I-291 ramp, Stafford St, and Chestnut St. Ramps do not meet the ADA standards, except for north side of the crosswalk across Stafford St. No ramps for the crosswalks across Chestnut St and the I-291 off ramp. Sidewalks present on both sides of Chestnut St.	Controlled by a STOP-sign on Stafford St and a yield condition on the I-291 off ramp. Interstate 291 off-ramp merges with Chestnut St in the eastbound direction but is not controlled by a YIELD-sign.	A	0.6	A	1.0
U-5	SPFLD	Bond St	Dwight St	Crosswalks across both sides of Bond St. None across Dwight St. Ramps do not meet ADA standards. No ramp on the south side of crosswalk across Bond St east of Dwight St. Sidewalks present in all directions.	Controlled by STOP-signs on Bond St	A	0.7	A	1.3
U-6	SPFLD	Interstate 291 Ramps	Dwight St	Crosswalks across both I-291 ramps connecting sidewalks on both sides of Dwight St. No crosswalk across Dwight St. No ramps at crosswalk at I-291 on ramp. Ramps at crosswalk across I-291 off ramp do not meet ADA standards.	Controlled by a STOP-sign on the I-291 off ramp	C	21.2	A	1.4
U-7	SPFLD	Court St	East Columbus Ave	Crosswalks across East Columbus Ave north of Court St. Crosswalk across Court St east of East Columbus Ave. Ramps do not meet ADA standards, except for ramp located in the northeast corner of intersection.	Controlled by a STOP-sign on Court St and on a private driveway directly across.	A	1.0	A	2.3

ID #	Town	Street 1	Street 2	Crosswalks, Wheelchair Ramps, Sidewalks	Notes	AM Peak Hour		PM Peak Hour	
						LOS	Delay	LOS	Delay
U-8	SPFLD	Liberty St	East Columbus Ave	No crosswalks or pedestrian ramps	Controlled by STOP-signs on Liberty St and on the I-91 off ramp extension opposite Liberty St. The road across from Liberty St is accessible via a service road from Birnie Ave and from Plainfield St (US-20) and allows thru movements across East Columbus Ave to Liberty St.	A	4.0	C	15.3
U-9	SPFLD	Ledyard St and Interstate 291 off ramp	Liberty St	Sidewalks, crosswalks, and ramps are present. Crosswalk present across I-291 off ramp and across Liberty St northwest of intersection. Ramps but no crosswalk across Ledyard St. Ramps for crossing the I-291 off ramp and Ledyard St do not meet ADA standards. Ramp for crossing Liberty St meets ADA standards.	STOP-sign controlled on both Ledyard St and the Interstate 291 off ramp. Northbound traffic on Liberty St must continue to the northeast and has a Yield condition to merge with traffic from the I-291 off ramp and continue to Armory St.	A	0.5	A	0.7
U-10	SPFLD	Interstate 91 NB On/Off Ramps	US-20 (Plainfield St)	Crosswalk across the off ramp. Ramps do not meet ADA standards. Sidewalk runs along south side of Plainfield St only.	YIELD-controlled at the off ramp from Interstate 91 northbound. Interstate 91 southbound on ramp has two entrances, which merge about 200 feet from their entrance onto the ramp.	B	13.7	D	25.3

ID #	Town	Street 1	Street 2	Crosswalks, Wheelchair Ramps, Sidewalks	Notes	AM Peak Hour		PM Peak Hour	
						LOS	Delay	LOS	Delay
U-11	SPFLD	Interstate 91 SB Ramps	US-20 (Plainfield St)	Crosswalk across I-91 southbound on ramp with ramps that meet ADA standards. Sidewalk present along south side of Plainfield St. Sidewalk along north side of Plainfield St continues northerly along ramp from Birnie Ave. No sidewalk along the north side of Plainfield St east of the intersection.	YIELD-controlled at the ramp from Birnie Ave US-20 (Plainfield St)	D	29.2	F	127.5

ROTARIES/ROUNDABOUTS

Within the Regional Study Area, west of the Connecticut River along U.S. Route 5 in the cities of Agawam and West Springfield, there are three rotaries/roundabouts that provide both local and regional access and interconnectivity. Each of these was originally constructed as a rotary but has since been restriped to operate as a modern roundabout. Table 2-4 provides an overview of the existing conditions of each rotary/roundabout, focusing on access points, pedestrian features including sidewalks and crosswalks, ADA compliance, and LOS grades and delays (in seconds). Detailed traffic operations data for each approach to each rotary/roundabout are noted in Appendix B. Similar to an unsignalized intersection, the analysis of a rotary includes only the 95th percentile queue.

All three of these rotaries/roundabouts operate at a LOS below D.

R-1: NORTH END BRIDGE US-20 ROTARY

The North End Bridge US-20 Rotary operates at LOS F during both the AM and PM peak periods. During these peak periods, long queue lengths occur for both the eastbound and westbound traffic. In all instances, queuing is due to lack of storage lanes and roadways operating over capacity during peak periods.

R-2: MEMORIAL BRIDGE ROTARY

The Memorial Bridge Rotary operates at LOS E during the PM peak period. The westbound movement entering the rotary from the Memorial Bridge sees long queues in the PM peak period, where the 95th percentile queue is 620'. This location was analyzed using the current pavement markings, which are more in line with the striping of a roundabout rather than a traditional rotary.

R-3: ROUTE 57 AND SOUTH END BRIDGE ROTARY

The Route 57 and South End Bridge Rotary operates at LOS F during both the AM and PM peak periods. U.S. Route 5 northbound and southbound ramps at the Route 57 and South End Bridge Rotary experience long 95th percentile queues during both peak periods, but queues were particularly long during PM peak periods. The extensive PM queues typically reach across the South End Bridge and into the I-91 interchange ramps. This location was analyzed using the current pavement markings, which are more in line with the striping of a roundabout rather than a traditional rotary.

TABLE 2-4: Rotaries and Roundabouts Summary Table[4]

ID #	Town	Location	Crosswalks	Sidewalks	Notes	AM Peak Hour		PM Peak Hour	
						LOS	Delay	LOS	Delay
R-1	West Springfield	US-20 (North End Bridge) and Park Ave / St at US-5 Ramps	No crosswalks across any rotary access points. Sidewalks around the entirety of the rotary. West of the rotary has crosswalks at Main St intersections with Park St and Park Ave.		Provides access to and from North End Bridge, U.S. Route 5 ramps, Park St, Park Ave, and U.S. Route 5 ramps. Rotary includes gas station with access between U.S. Route 5 and Park St, and restaurant with access between Park Ave and U.S. Route 5. U.S. Route 5 continues below the rotary.	F	207.5	F	304.0

[4] More extensive tabular data on each of these rotaries, and every approach to each intersection, including LOS grades, delays, volume/capacity, 50th % queues, and 95th % queues, are available in Appendix B

ID #	Town	Location	Crosswalks	Sidewalks	Notes	AM Peak Hour		PM Peak Hour	
						LOS	Delay	LOS	Delay
R-2	West Springfield	Memorial Bridge and Memorial Ave at US-5 On/Off Ramps	Rotary has no crosswalks across any access points. Sidewalks present around the entirety of the rotary and continue on both sides of the Memorial Bridge.		Provides access to and from Memorial Bridge, U.S. Route 5 ramps, State Rt 147 (Memorial Ave), and Rt 5 ramps. Currently under construction - Memorial Ave Rotary Bridge Superstructure Replacement Project – Bridge No. W-21-025(15C) & W-21-025(15D). Project consists of replacing bridge superstructures, improving functionality and safety for all modes of transportation, and aesthetic improvements. Currently, rotary has no explicitly striped lanes. Striping will be revised and the rotary will be provided crosswalks, wheelchair ramps, and more of a "roundabout impression."	C	19.4	E	46.5
R-3	Agawam	River Rd / Meadow St / Route 57 Ramps at US-5 Ramps	Sidewalk present along River Rd and continues east on north side of South End Bridge. No crosswalks present across any leg of the rotary. Stairs present from River Rd up to the South End Bridge.		Provides access to and from U.S. Route 5, Meadow St, Route 57, South End Bridge (U.S. Route 5), and River Rd. There is an option to bypass the rotary traveling from Route 57 east to U.S. Route 5. The overall pavement markings for the rotary represent a traditional roundabout.	F	98.7	F	364.0

FREEWAYS LEVEL OF SERVICE (LOS)

Traffic operations data for existing conditions along freeway segments within both the Regional Study Area and Primary Study Area are provided in Table 2-5. Analysis of these segments demonstrated that overall the freeway segments operate at LOS C or better with two general exceptions. The first can be found along I-90 traveling eastbound in the vicinity of Exit 4 in West Springfield and Exit 5 in Chicopee during the PM peak period. These locations operate at LOS D during the PM peak period, indicating that some congestion is present during that time period. Although these two locations are located outside of the Primary Study Area. They were analyzed in the context of evaluating and understanding the regional traffic operations. The second location can be found along the segment of I-90 commonly referred to as the Longmeadow Curve. Although actual counts have not been taken within this segment of highway, the congestion on I-91 is readily apparent for drivers, and corroborated by field observations, in both directions during peak periods of travel. This congestion can be attributed to several factors. The primary contributor to congestion in this area is the reduction in lanes from three to two, which is referred to as a lane drop, which is exacerbated by the existence of several closely spaced on and off ramps. Together, these factors result in significant merging and congestion along I-91 in this area.

TABLE 2-5: Existing Conditions of LOS Grades Along Freeway Segments

FREEWAY SEGMENTS	AM Peak Hour		PM Peak Hour	
	LOS	Density (pc/mi/ln)	LOS	Density (passenger car per mile per lane)
I-91 Northbound				
I-91 NB north of Bark Haul Road (Longmeadow)	B	11.7	B	12.5
I-91 NB just south of the Longmeadow Curve (Longmeadow)	B	11.9	B	14.2
I-91 NB between the US-5 and Route 147 (South End and Memorial Bridges) - Springfield	C	18.7	B	15.8
I-91 NB north of Noble Street overpass (Springfield)	B	12.4	C	18.7
I-91 NB over CT River (Chicopee / West Springfield line)	B	13.8	C	19.9
I-91 NB south of Whitney Avenue overpass	A	9.7	B	14.9
I-91 NB north of Whitney Avenue overpass	B	11.1	B	16.4
I-91 NB north of Interchange 15	A	9.1	B	14.0
I-91 Southbound				
I-91 SB north of Bark Haul Road (Longmeadow)	B	14.6	B	12.7
I-91 SB just south of the Longmeadow Curve (Longmeadow)	B	14.9	B	12.6
I-91 SB between the US-5 and Route 147 (South End and Memorial Bridges) - Springfield	C	20.9	C	22.9
I-91 SB north of Noble Street overpass (Springfield)	B	16.4	B	14.6
I-91 SB over CT River (Chicopee / West Springfield line)	B	17.3	B	15.3
I-91 SB north of Whitney Avenue overpass	B	12.3	B	11.6

FREEWAY SEGMENTS	AM Peak Hour		PM Peak Hour	
	LOS	Density (pc/mi/ln)	LOS	Density (passenger car per mile per lane)
I-291 Northbound				
I-291 south of Liberty Street	A	10.9	B	14.6
I-291 north of Exit 3	B	12.2	B	16.5
I-291 north of Exit 4	B	16.2	C	22.2
I-291 north of Exit 5	A	10.0	C	18.1
I-291 Southbound				
I-291 SB south of Liberty Street	A	8.0	A	6.5
I-291 SB north of Exit 3	B	17.7	B	12.3
I-291 SB north of Exit 4	B	11.3	A	7.6
I-291 SB north of Exit 5	B	18.0	A	10.9
I-90 Eastbound				
I-90 EB west of Exit 6 (Chicopee)	A	10.0	B	14.5
I-90 EB east of Exit 6 (Chicopee)	B	11.3	C	19.3
I-90 EB west of Exit 5 (Chicopee)	C	21.6	D	28.9
I-90 EB west of Exit 4 (Chicopee)	C	22.5	D	27.4
I-90 Westbound				
I-90 WB west of Exit 6 (Chicopee)	B	12.9	B	11.3
I-90 WB east of Exit 6 (Chicopee)	C	19.7	B	15.4
I-391 Northbound (Chicopee)				
I-391 NB between Exit 1A and Exit 2	A	6.2	A	9.2
I-391 NB south of Exit 3 (Route 116 Chicopee Street)	A	7.4	A	8.7
I-391 NB south of Exit 4 (Grattan Street)	A	5.7	A	7.7
I-391 Southbound				
I-391 SB south of Exit 5 (Main Street - Chicopee/Holyoke)	A	8.6	A	6.5
I-391 SB south of Exit 4 (Grattan Street - Chicopee)	A	7.4	A	6.1
I-391 SB south of Exit 3 (Route 116 Chicopee Street - Chicopee)	A	9.3	A	8.7
I-391 SB between Exit 1A and Exit 2	A	10.2	A	9.7
I-391 SB south of Exit 1B	A	8.4	A	7.4
US-5 Northbound				
US-5 NB north of North End Bridge	B	11.1	B	16.4
US-5 NB north of Memorial Bridge	A	6.8	A	10.2
US-5 NB south of Memorial Bridge	A	8.6	A	8.4

FREEWAY SEGMENTS	AM Peak Hour		PM Peak Hour	
	LOS	Density (pc/mi/ln)	LOS	Density (passenger car per mile per lane)
US- 5 Southbound				
US-5 SB north of Memorial Bridge	A	8.3	A	8.8
US-5 SB south of Memorial Bridge	A	7.7	B	12.1
Route 57 - Agawam				
Route 57 NB - west of Editha Avenue	A	6.1	A	8
Route 57 SB - west of Editha Avenue	A	9.7	A	8.7

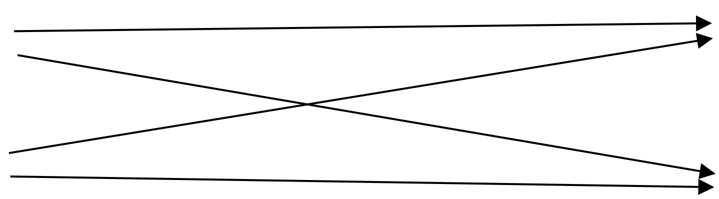
WEAVING SEGMENTS LOS

The Federal Highway Administration User's Guide titled "Procedure for Analysis and Design of Weaving Sections" notes that:

Weaving is the crossing of traffic streams moving in the same general direction, accomplished by successive merging and diverging. In the design and operation of freeways, weaving sections are formed by closely spaced interchanges or ramps which tend to produce adverse effects on traffic. Weaving maneuvers are especially prevalent on urban freeways and must be carefully examined to ensure a reasonably balanced design and a uniform level of service over the length of the freeway.

Weaving is a function of both capacity, the number of vehicles within the traffic streams of merging and diverging traffic, and the distance between the origin and destination points. A simple weaving illustration is shown below.

Travel Lane
Diverge
Merge
On and Off



A total of 16 weaving areas within the Regional and Primary Study Areas were studied for both the AM and PM peak periods, as depicted on the mapping on the following pages.

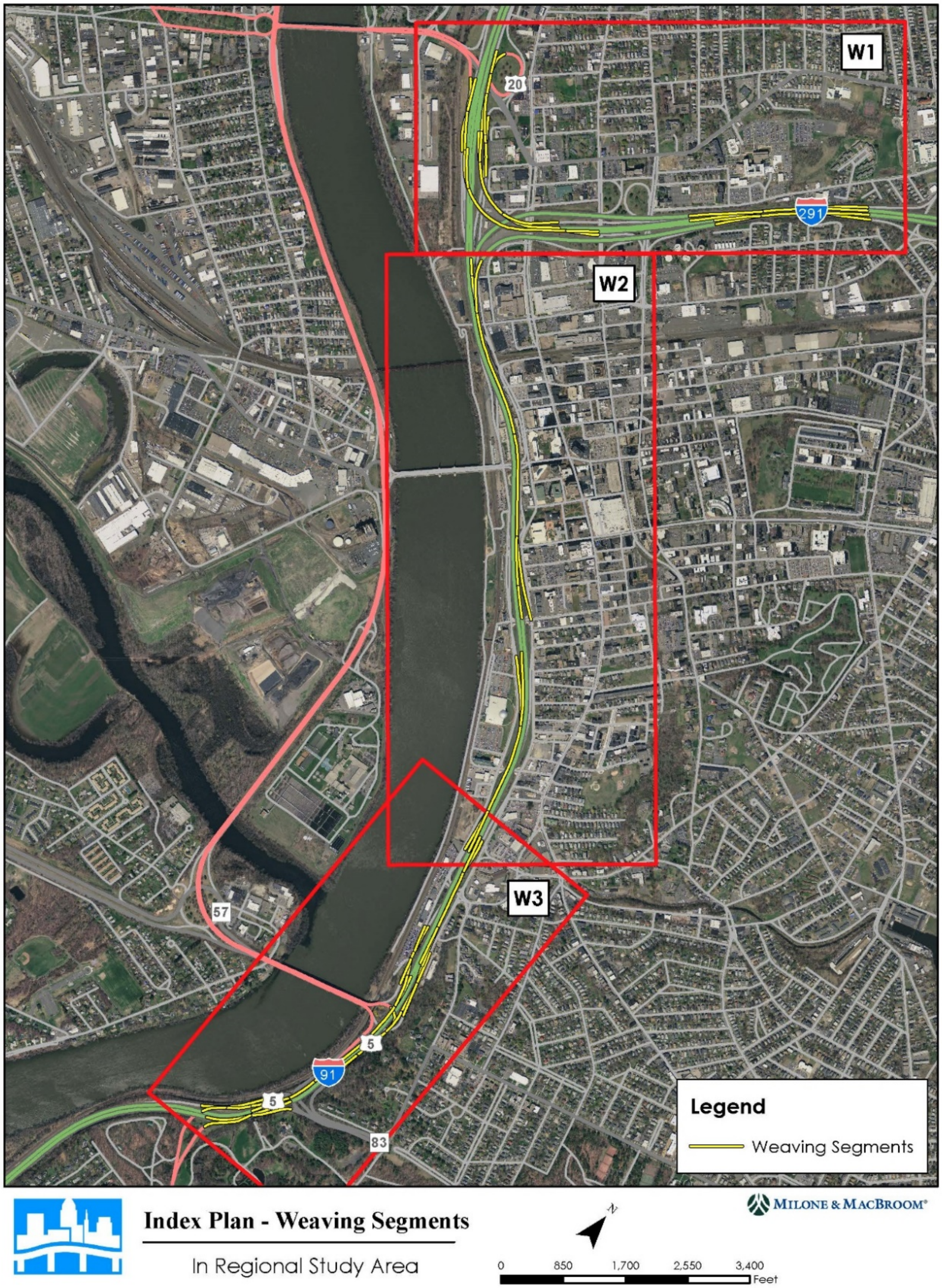


Figure 2-10: Index Plan – Weaving Segments

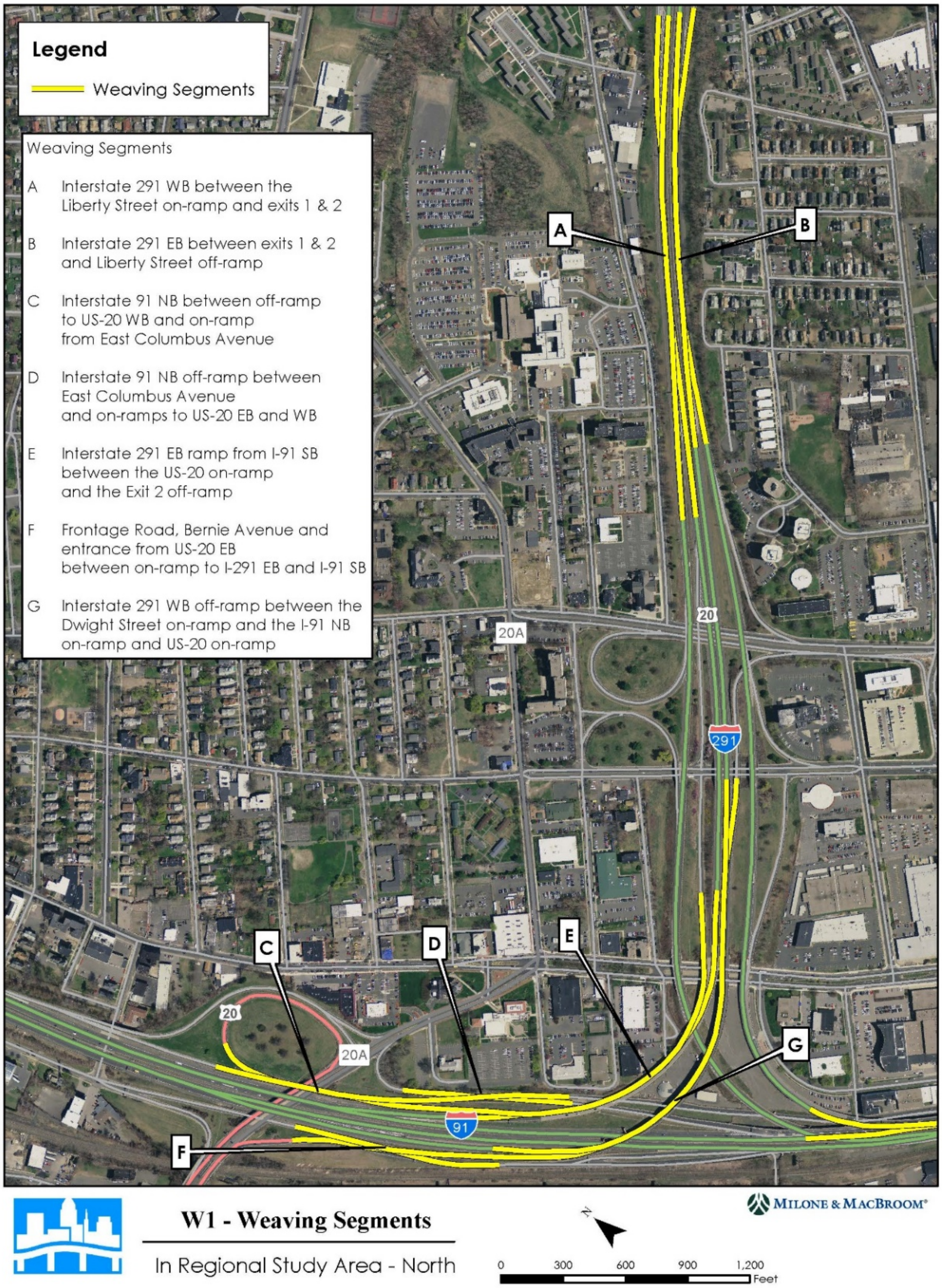


Figure 2-11: W1 – Weaving Segments

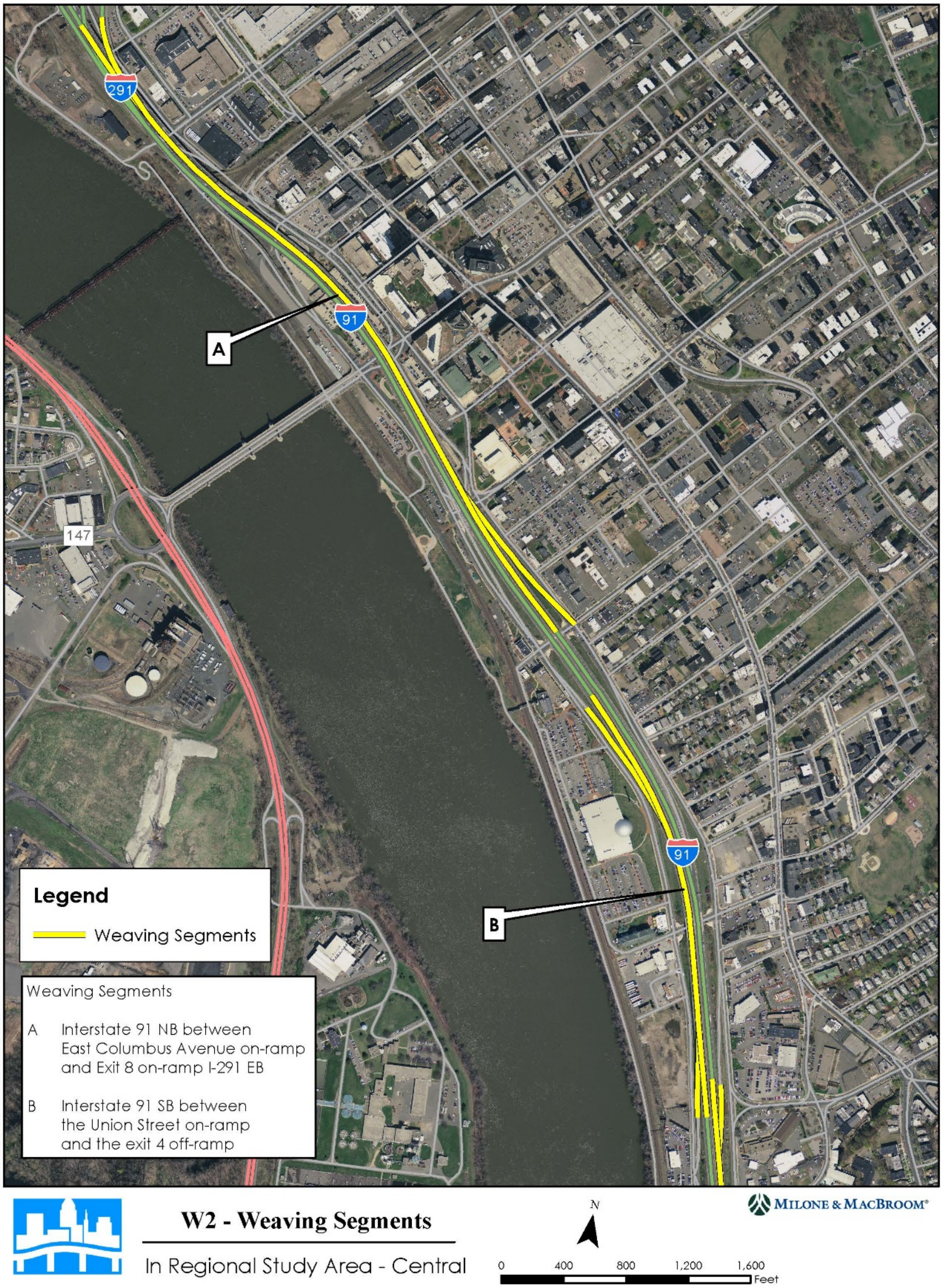


Figure 2-12: W2 – Weaving Segments

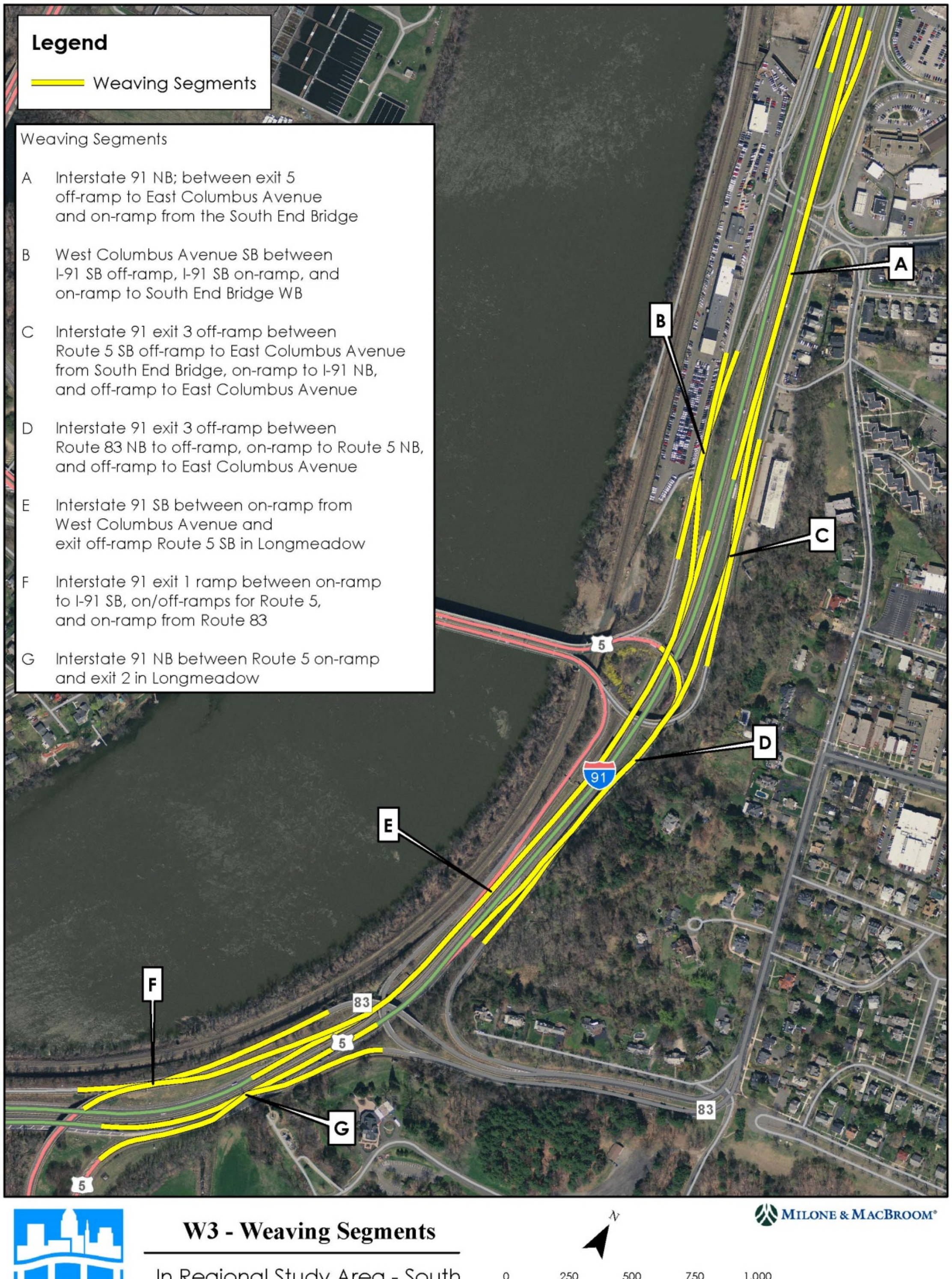


Figure 2-13: W3 – Weaving Segments

The weaving analysis demonstrates that the freeway weaving segments operate at a range of LOS from B to F in the AM and PM peak periods. In the AM peak period, six of the weaving sections operate at a LOS D or worse. In the PM peak period, 10 of the weaving sections operate at a LOS D or worse. The poor LOS can be attributed to the ramps along I-91 and I-291 that are too closely spaced to one another. This highlights a safety issue that will be reinforced in later sections of this chapter by the number of crashes that occur along I-91. Providing an adequate balance of speed and spacing between ramps is key to maintaining unconstrained operation where highway weaving segments exist. It will be essential to investigate ways to improve on the weaving segments during the alternatives analysis portion of this study. Consolidation or elimination of ramps within the Primary Study Area will create a much safer and efficient means of travel along I-91 and I-291. Traffic operations data for freeway weaving segments are provided in Table 2-6.

TABLE 2-6: Existing Conditions of LOS Grades Along Freeway Weaving Segments

WEAVING SEGMENTS	**AM Peak Hour**			**PM Peak Hour**			**Map and Segment**
	LOS	Volume/ Capacity	Density (pc/mi/ln)	LOS	Volume/ Capacity	Density (pc/mi/ln)	
Interstate 91 NB between U.S. Route 5 on ramp and exit 2 in Longmeadow	D	0.691	30.2	D	0.726	33.7	Map W3, Segment G
Interstate 91 exit 1 ramp between on ramp to I-91 SB, on/off ramps for U.S. Route 5, and on ramp from Route 83	B	0.385	19.8	C	0.502	26.7	Map W3, Segment F
Interstate 91 exit 3 off ramp between Route 83 NB to off ramp, on ramp to U.S. Route 5 NB, and off ramp to East Columbus Avenue	C	0.471	21.7	C	0.486	23.4	Map W3, Segment D
Interstate 91 exit 3 off ramp between U.S. Route 5 SB off ramp to East Columbus Avenue from South End Bridge, on ramp to I-91 NB, and off ramp to East Columbus Avenue	E	0.948	38.2	D	0.675	30.6	Map W3, Segment C
West Columbus Avenue SB between I-91 SB off ramp, I-91 SB on ramp, and on ramp to South End Bridge WB	B	0.435	16.5	D	0.682	30.6	Map W3, Segment B
Interstate 91 NB; between exit 5 off ramp to East Columbus Avenue and on ramp from the South End Bridge	C	0.689	24.4	C	0.579	21	Map W3, Segment A
Interstate 91 SB between the Union Street on ramp and the exit 4 off ramp	D	0.641	29.9	D	0.653	29.4	Map W2, Segment B
Interstate 291 WB between the Liberty Street on ramp and exits 1 & 2	B	0.632	14.8	B	0.549	12.9	Map W1, Segment A
Interstate 291 EB between exits 1 & 2 and Liberty Street off ramp	C	0.437	20.4	D	0.661	31.7	Map W1, Segment B
Interstate 291 EB ramp from I-91 SB between the US-20 on ramp and the exit 2 off ramp	E	0.867	54.9	E	0.992	66.1	Map W1, Segment E

WEAVING SEGMENTS	AM Peak Hour			PM Peak Hour			Map and Segment
	LOS	Volume/ Capacity	Density (pc/mi/ln)	LOS	Volume/ Capacity	Density (pc/mi/ln)	
Interstate 291 WB off ramp between the Dwight Street on ramp and the I-91 NB on ramp and US-20 on ramp	C	0.469	24.3	C	0.500	25.6	Map W1, Segment A
Interstate 91 NB off ramp between East Columbus Avenue and on ramps to US-20 EB and WB	B	0.267	11.5	C	0.592	23.3	Map W1, Segment D
Frontage Road, Bernie Avenue, and entrance from US-20 EB between on ramp to I-291 EB and I-91 SB	B	0.41	17.6	D	0.686	33.6	Map W1, Segment F
Interstate 91 NB between off ramp to US-20 WB and on ramp from East Columbus Avenue	B	0.323	14.3	D	0.607	28.1	Map W1, Segment C
Interstate 91 NB between East Columbus Avenue on ramp and exit 8 on ramp I-291 EB	E	0.751	37.6	E	0.825	42.3	Map W2, Segment A
Interstate 91 SB between on ramp from West Columbus Avenue and exit off ramp U.S. Route 5 SB in Longmeadow	E	0.986	49.9	F	1.088	-	Map W3, Segment E

RAMP LOS

A total of 42 on-ramp and off-ramp areas were studied for both the AM and PM peak periods. Ramps were analyzed to determine how they function in terms of merging (vehicles entering the I-91 mainline) and diverging (vehicles exiting the freeway) traffic. The density of the traffic along the freeway facility was compared to the density of the traffic on the freeway ramp. Ramp LOS is a function of speed and density or volume among other factors such as number of lanes, lane width, and vehicle types. It is important to analyze the ramps because there are so many within a relatively short distance. The elimination of some ramps can provide an overall safer means of travel, lowering the amount of conflict points.

The analysis showed that the majority of freeway ramps operate at LOS C or better during the AM and PM peak periods. During the AM peak period, 24% of the ramp sections operate at LOS D or worse. During the PM peak period, 21% of the ramp sections operate at LOS D or worse. During the alternatives evaluation process, ramp length, horizontal and vertical curvature, and flare considerations were reviewed. It should be noted that the I-291 southbound ramp onto I-91 northbound has a LOS F for both the AM and PM peak periods due to capacity. Traffic operations data for freeway ramp segments and locations within the Regional Study Area and the Primary Study Area are provided in the following tables.

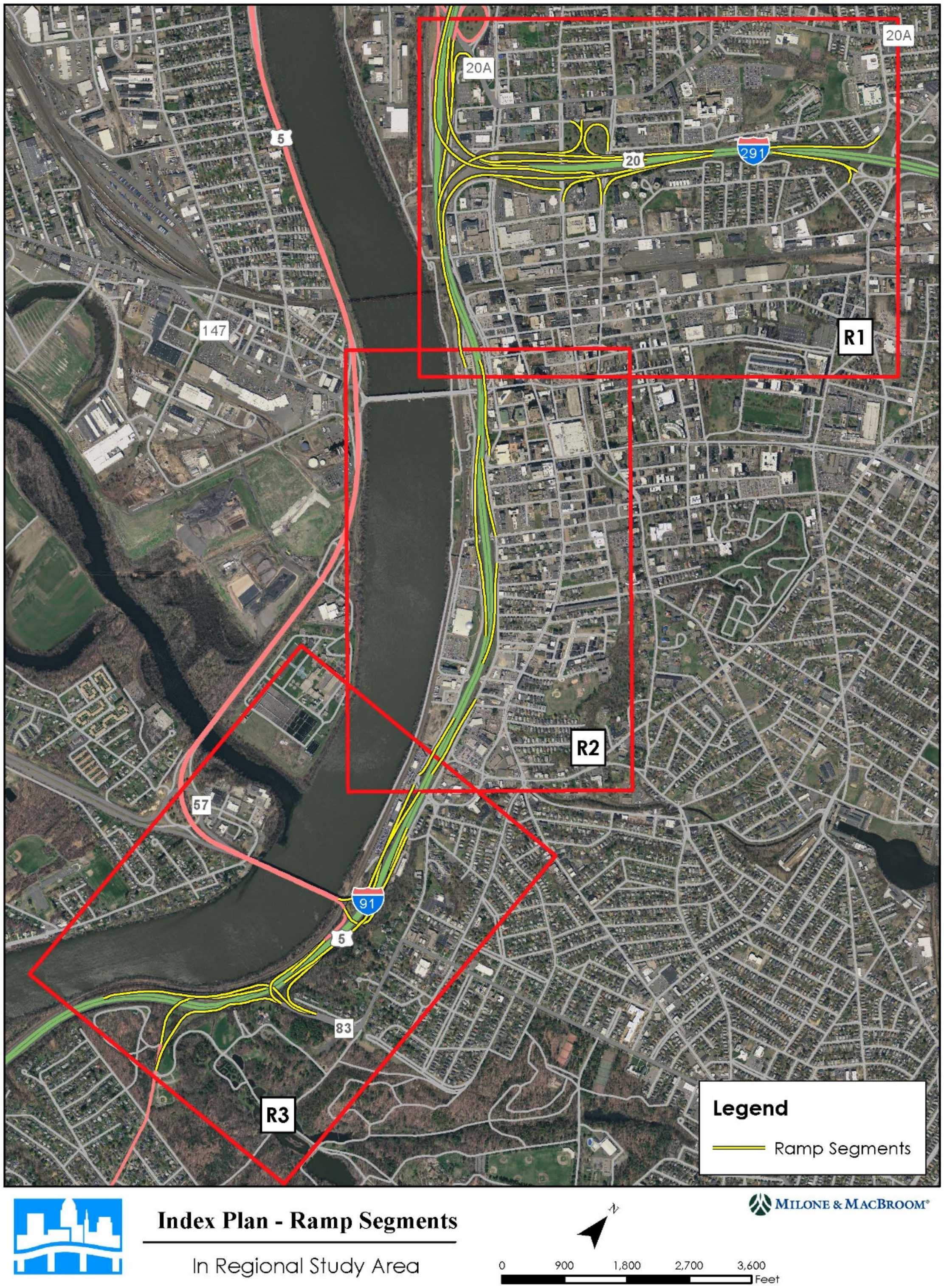


Figure 2-14: Index Plan – Ramp Segments

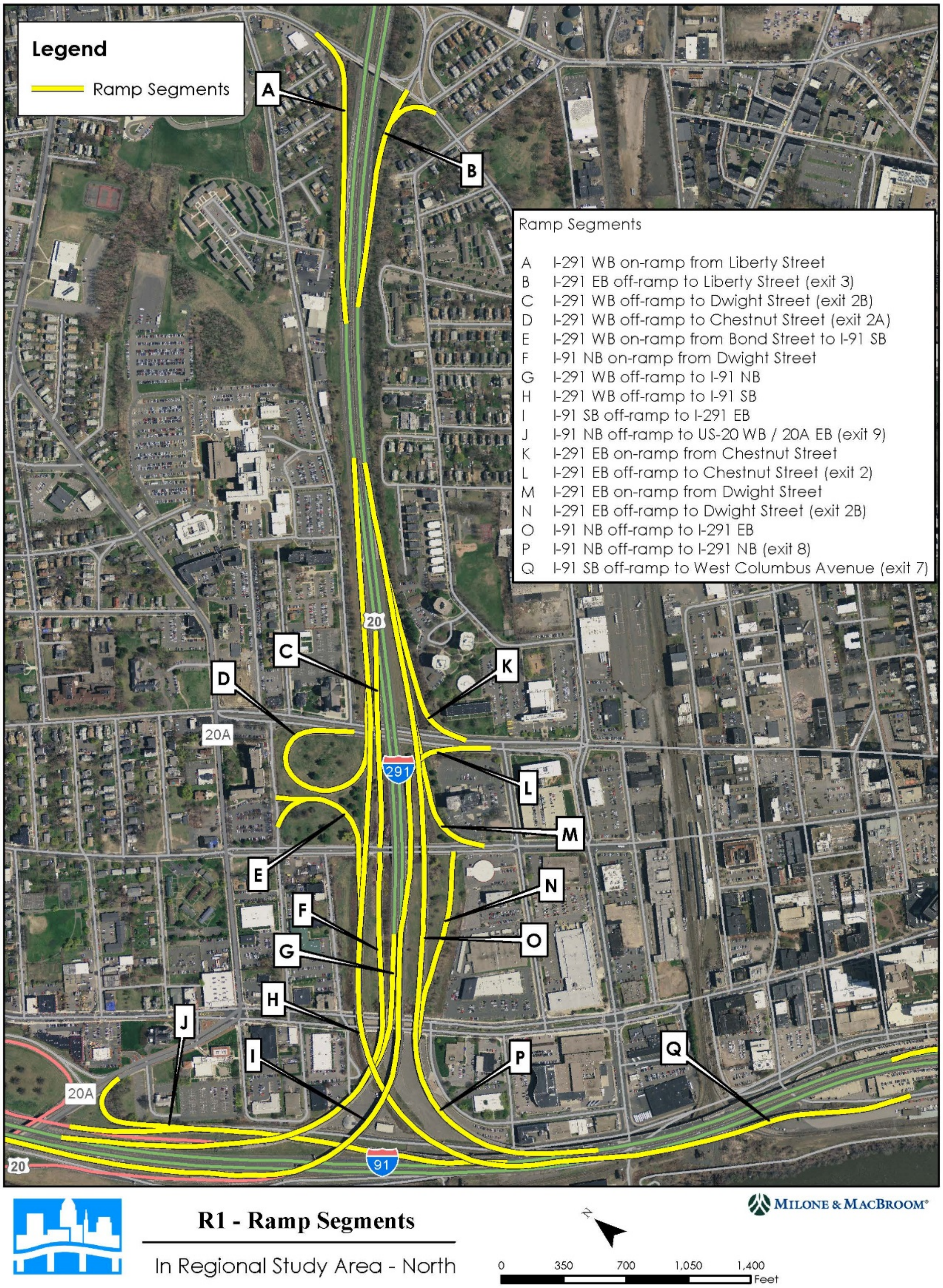


Figure 2-15: R1 Ramp Segment

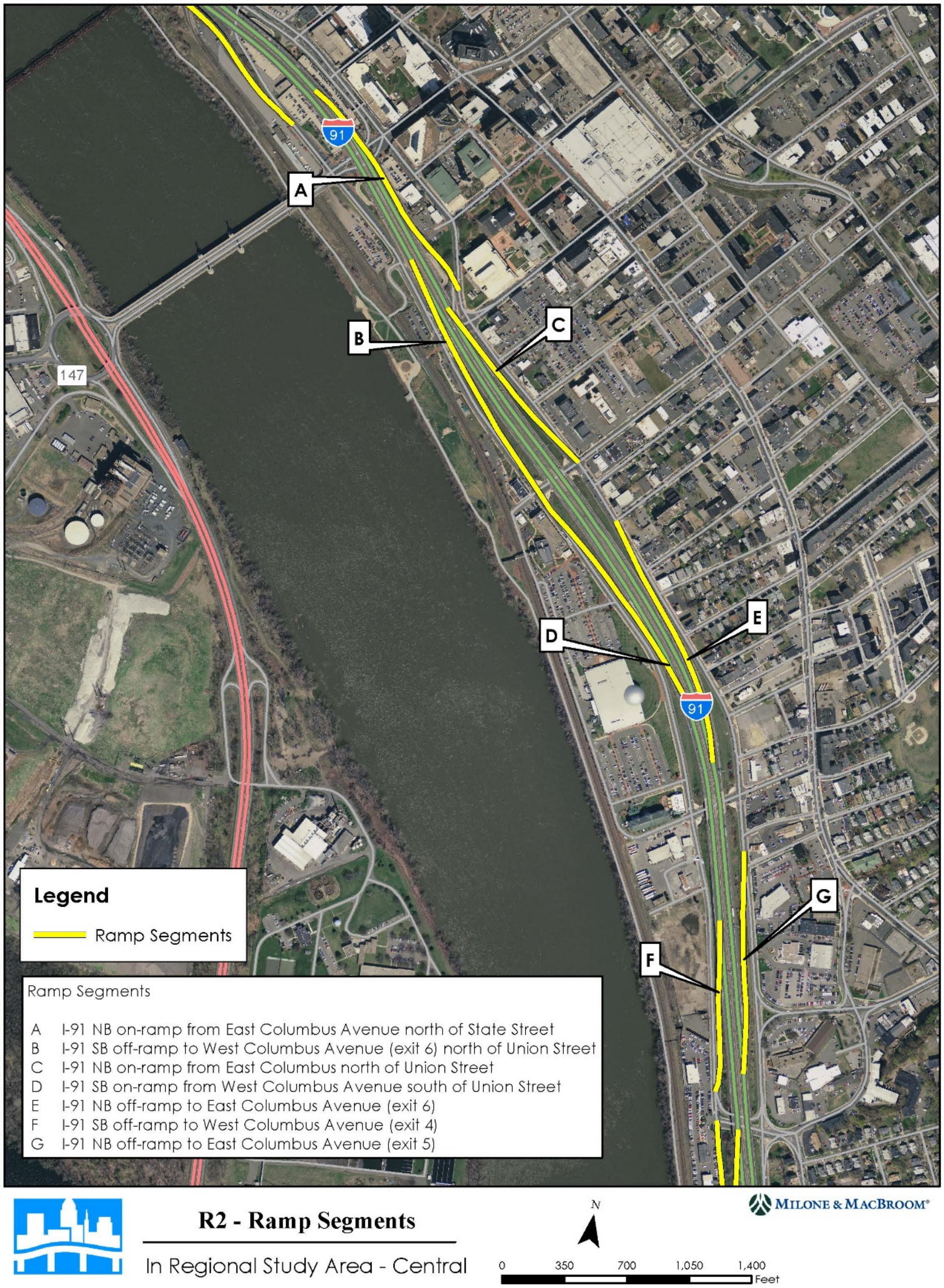


Figure 2-16: R2 Ramp Segements

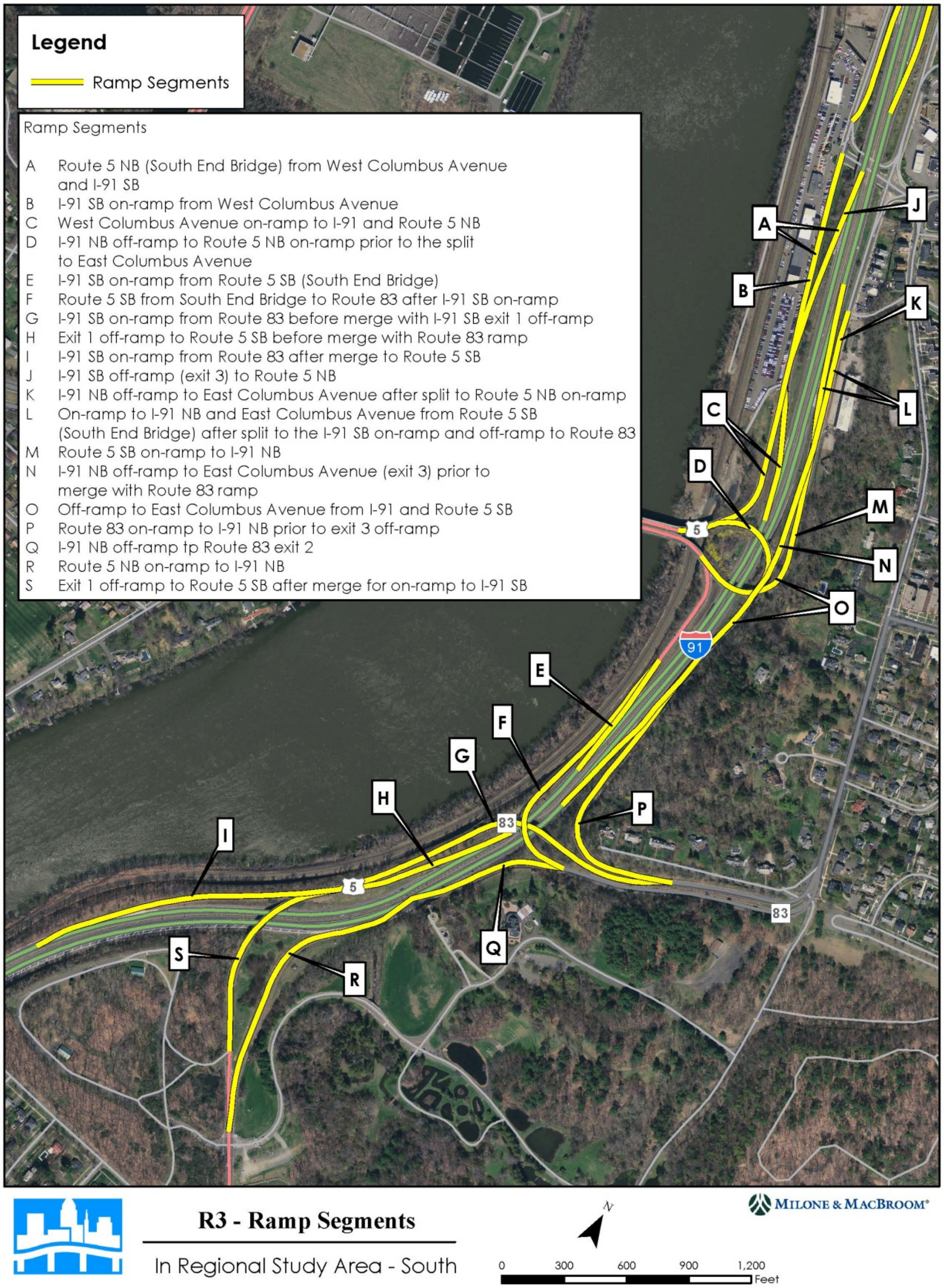


Figure 2-17: R3 Ramp Segments

TABLE 2-7: Existing Conditions of LOS Grades Along Freeway Ramp Segments

Ramp Segments	AM Peak Hour		PM Peak Hour	
	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
Interstate 91 and Exit 1 & 2 Interchange (U.S. U.S. Route 5 - Longmeadow, MA)				
U.S. Route 5 NB on ramp to I-91 NB	D	29.0	D	32.7
Exit 1 off ramp to U.S. Route 5 SB before merge with Route 83 ramp	C	24.1	C	22.8
Exit 1 off ramp to U.S. Route 5 SB after merge for on ramp to I-91 SB	B	15.6	B	19.5
I-91 SB on ramp from Rte. 83 after merge to Rte. 5 SB	C	21.4	B	18.6
I-91 SB on ramp from Rte. 83 before merge with I-91 SB exit 1 off ramp	B	18.8	C	21.9
I-91 NB off ramp to Rte. 83 Exit 2	C	25.8	D	30.2
U.S. Route 5 SB from South End Bridge to Rte. 83 after I-91 SB on ramp	A	4.5	A	6.8
Rte. 83 on ramp to I-91 NB prior to exit 3 off ramp	C	21.3	C	24.0
I-91 SB on ramp from U.S. Route 5 SB (South End Bridge)	D	29.3	C	25.4
Interstate 91 and Exit 3 Interchange (U.S. Route 5 and South End Bridge)				
U.S. Route 5 SB on ramp to I-91 NB	C	24.7	B	19.6
West Columbus Avenue on ramp to I-91 and U.S. Route 5 NB	B	15.4	C	22.6
I-91 SB off ramp (Exit 3) to U.S. Route 5 NB	C	23.2	C	21.1
Off ramp to East Columbus Avenue from I-91 NB and U.S. Route 5 SB	C	21.7	B	18.7
I-91 SB on ramp from West Columbus Avenue	D	28.3	F	38.6
U.S. Route 5 NB (South End Bridge) from West Columbus Avenue and I-91 SB	B	12.0	B	15.3
I-91 NB off ramp to East Columbus Avenue after split to U.S. Route 5 NB on ramp	B	15.5	B	15.2
I-91 NB off ramp to U.S. Route 5 NB on ramp prior to the split to East Columbus Avenue	C	26.5	D	31.6
On ramp to I-91 NB and East Columbus Avenue from U.S. Route 5 SB (South End Bridge) after split to the I-91 SB on ramp and off ramp to Rte 83	D	33.3	D	29.5
I-91 NB off ramp to East Columbus Avenue (Exit 3) prior to merge with Rte. 83 ramp	B	14.0	B	17.2
Interstate 91 NB and Exit 5 Interchange (Springfield, MA)				
Off ramp to East Columbus Avenue	C	26.3	C	23.4
Interstate 91 SB and Exit 4 Interchange (Springfield, MA)				
Off ramp to West Columbus Avenue	B	20.7	B	17.4

TABLE 2-7: Existing Conditions of LOS Grades Along Freeway Ramp Segments

Ramp Segments	AM Peak Hour		PM Peak Hour	
	LOS	Density (pc/mi/ln)	LOS	Density (pc/mi/ln)
Interstate 91 NB and Exit 6 Interchange (Springfield, MA)				
Off ramp to East Columbus Avenue	C	26.2	C	22.7
On ramp to I-91 SB south of Union Street	C	21.3	C	21.9
Interstate 91 SB and Exit 6 Interchange (Springfield, MA)				
I-91 SB off ramp to West Columbus Avenue north of Union Street	C	22.7	B	19.4
I-91 NB on ramp from East Columbus Avenue north of Union Street	D	29.7	D	29.1
Interstate 91 SB and Exit 7 Interchange (Springfield, MA)				
I-91 SB off ramp to West Columbus Avenue (Exit 7)	C	21.6	C	21.7
I-91 NB on ramp from East Columbus Avenue north of State Street	D	29.7	D	29.1
Interstate 91 Northbound				
Exit 8 off ramp to I-291 NB	B	15.0	B	12.2
Exit 9 off ramp to US-20 WB/20A EB	C	23.1	C	20.3
Interstate 291 NB from I-91 NB and SB				
Exit 2B off ramp to Dwight Street	E	35.7	C	25.8
On ramp to I-291 NB from Dwight Street	A	4.0	B	11.5
On ramp to I-291 NB from Chestnut Street	C	24.2	D	32.3
Exit 3 I-291 off ramp to Liberty Street	B	14.1	B	17.5
Interstate 291 SB to I-91 NB and SB				
On ramp to I-291 SB from Liberty Street	B	12.7	B	12
Exit 2A I-291 off ramp to Chestnut Street	B	13.6	A	7.5
Exit 2B off ramp to Dwight Street	E	35.7	C	25.8
I-91 NB on ramp from Dwight Street	B	18.2	C	20.1
I-291 SB ramp to I-91 NB	F	Capacity (+)	F	Capacity (+)
I-291 on ramp from Bond Street to I-91 SB	B	17.7	B	18
I-291 SB off ramp to I-91 SB	D	28.7	C	22.3
I-291 SB off ramp to I-91 NB	A	5.9	A	8.7
I-91 NB off ramp to I-291 NB	C	23.8	C	20.9

Capacity (+) – meets or exceeds the maximum capacity per lane

PARKING WITHIN THE PRIMARY STUDY AREA

Existing off-street and on-street parking conditions were determined and analyzed within the Primary Study Area, with a focus on Downtown Springfield.

OFF-STREET PARKING

Existing off-street parking conditions were determined by studying parking garages and surface lots in Downtown Springfield. The following 18 parking facilities were contacted between August and October of 2014 to obtain the total number of parking spaces, the busiest time of day, and the number of parked cars during the busiest time of day:

TABLE 2-8: Off-Street Parking Facilities

Name	Owner	Address
I-91 North Garage	Executive Parking	1870 East Columbus Avenue
I-91 South Garage	Executive Parking	1600 East Columbus Avenue
Columbus Center Garage	Executive Parking	150 Bridge Street
Civic Center Garage	Executive Parking	41 Harrison Avenue
Taylor Street Garage	Executive Parking	33 Taylor Street
Dwight Street Lot	Executive Parking	339 Worthington Street
Apremont Triangle Lot	Executive Parking	33 Pearl Street
Morgan Square Lot	Executive Parking	20 Taylor Street
Winter Street Lot	Executive Parking	451 Worthington Street
Propark at Monarch Garage	Propark America	1 Monarch Place
Propark at Falcon's Way	Propark America	22 East Court Street
Propark at Worthington	Propark America	215 Worthington Street
Propark at TD Banknorth	Propark America	230 Dwight Street
Tower Square Parking Garage	Standard Parking	1500 Main Street
Ken's Parking Lot	Ken's Parking	73 Taylor Street
Valet Park of America	Valet Park of America	185 Spring Street
Valet Park of America	Valet Park of America	200 Taylor Street
Valet Park of America	Valet Park of America	32 Hamden Street

Based upon information provided, eight other parking locations within the Downtown Springfield area have been eliminated due to the casino redevelopment project construction; they have not been included in this inventory. Additionally, it should be noted that the Morgan Square Lot is a short-term metered parking lot for transit patrons. The Trolley Park, historically used as parking, is currently being utilized by MassDOT for maintenance purposes. Ken's Parking Lot, due to its close proximity to the train station, is typically used by patrons for Amtrak, but this lot is not exclusive to Amtrak users. Information provided by the owner of each parking facility is summarized below in Table 2-9. Volumes are based upon weekly volumes and have been provided by their respective owners/operators; they have not been field verified for accuracy. These volumes do not take into account singular events that occur at the Mass Mutual Center, Springfield Symphony Hall, City Stage, Basketball Hall of Fame, and Riverfront Park. A map indicating the locations of the off-street parking is included on the following page:

Figure 2-18: Off-Street Parking In Downtown Springfield

TABLE 2-9: Downtown Springfield Off-Street Parking Capacity Summary

Parking Facility	# Parking Spaces	Busiest Time	% Occupied	Available	
I-91 North Garage	1,098	1:00 PM	66%	34%	373
I-91 South Garage	670	10:30 AM	23%	77%	516
Columbus Center Garage	493	1:30 PM	24%	76%	375
Civic Center Garage	1,232	12:00 PM	41%	59%	727
Taylor Street Garage	380	10:00 AM	14%	86%	327
Dwight Street Lot	135	N/A	56%	44%	59
Apremont Triangle Lot	35	N/A	40%	60%	21
Morgan Square Lot	36	N/A	Transit only	N/A	N/A
Winter Street Lot	115	N/A	13%	87%	100
Propark at Monarch Garage	185	10:00 AM	85%	15%	28
Propark at Falcon's Way	85	10:00 AM	85%	15%	13
Propark at Worthington	150	10:00 AM	60%	40%	60
Propark at TD Banknorth	255	10:00 AM	70%	30%	77
Tower Square Parking Garage	1,203	8:30 AM – 5:00 PM	90%	10%	120
Ken's Parking Lot	55	SUN – SAT ALL DAY	100%	0%	0
Valet Park of America	175	8:30 AM – 5:30 PM	25%	75%	131
Valet Park of America	200	N/A	3%	97%	194
Valet Park of America	90	10:00 AM – 2:00 PM	65%	35%	32
Total	**6,592**				**3,153**

Based on the information provided by the owners/operators, an average of approximately 3,153 spaces are unused and available on a daily basis. The construction of the casino will result in the displacement of approximately 700 of these parking spaces based on the *MGM Final Environmental Impact Repor*t. It should be noted that if the alternatives developed as part of this study result in the removal of the I-91 North and South Garages this will result in the displacement of 1,768 off-street parking spaces within the immediate Downtown Springfield area. A new parking garage opened in 2017, the Union Station garage, which provides approximately 377 parking spaces mainly for transit-oriented purposes. In addition, the MGM Casino garage is under construction and anticipated to open at the same time as the casino itself, in fall 2018. The final allocation of parking between casino users and general public parking, and parking fees (if any), has not yet been finalized as of July 2018; however, much of that garage should be expected to be occupied by new casino users. Based on this review of current parking conditions and anticipated changes in parking availability, the average supply of unused parking under alternatives that include the removal of the I-91 North and South Garages would contract to fewer than 700 spaces.

ON-STREET PARKING

A field review was performed to locate existing metered and unmetered on-street parking spaces in Downtown Springfield.

There are approximately 60 unmetered parking spaces available on the following streets:

- The east side of Main Street north of US-20
- Both sides of Dwight Street between Liberty Street and the Amtrak overpass
- The west side of Chestnut Street between Harrison Avenue and Lyman Street
- The north side of Liberty Street between East Columbus Avenue and Main Street
- Both sides of Pynchon Street

There are approximately 710 metered parking spaces available on the following streets:

- The north side of State Street between East Columbus Avenue and Main Street, both sides, along the majority of Main Street
- Both sides of Dwight Street between the Amtrak overpass and State Street
- The west side of Chestnut Street between State Street and Harrison Avenue
- Both sides of Chestnut Street between Harrison Avenue and Lyman Street
- The west side of Chestnut Street between Lyman Street and Frank B. Murray Street
- Both sides of Liberty Street between Main Street and Dwight Street
- The south side of Taylor Street between Chestnut Street and Dwight Street
- Both sides of Taylor Street between Dwight Street and Kaynor Street
- The south side of Taylor Street between Kaynor Street and Main Street
- Both sides of Hampden Street between East Columbus Avenue and Main Street
- The north side of Worthington Street between East Columbus Avenue and Main Street
- Both sides of Worthington Street between Main Street and Dwight Street
- The south side of Worthington Street between Dwight Street and Chestnut Street
- Both sides of Harrison Avenue between Chestnut Street and Main Street
- Both sides of Court Street between Main Street and East Columbus Avenue
- The south side of State Street between East Columbus Avenue and Dwight Street

Parking meters, within the metered zones, require payment to park every day between the hours of 8:00 AM and 6:00 PM unless otherwise specified by the Springfield City Council and indicated on the meters. Parking space duration varies depending upon location from 1 hour to 2 hours maximum. The parking meters do not operate on Sundays and during legal holidays. Metered and unmetered parking spaces are generally full within the Downtown Springfield area during weekday time periods. The Parking Authority heavily monitors these on-street spaces with meter attendants, thus promoting on-street parking.

PARK-AND-RIDE PROGRAM

Within both the Regional and Primary Study Areas there are no park-and-ride facilities according to the latest Congestion Management System (CMS) provided either by MassDOT or the Pioneer Valley Metropolitan Planning Organization. The park-and-ride locations relative to this study are currently located outside the Primary and Regional Study Areas. These existing lots appear to be utilized as a means of travel to Boston, Hartford, and other points east and south rather than to travel into Downtown Springfield. There is no clear evidence that there is a need to establish a park-and-ride facility within the Primary or Regional Study Areas to promote ride sharing. However, this will be a consideration in development of the alternatives should the opportunity present itself to promote ride sharing.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS)

Within the Regional and Primary Study Areas, an Intelligent Transportation System (ITS) exists. ITS involves the application of advanced communication technologies and management strategies that are incorporated to improve on the efficiency and the safety of a surface transportation system. Several ITS components are located along I-90, I-91, I-291, and I-391. The ITS components and/or field devices include the following:

- Closed-Circuit Television (CCTV) Cameras – also known as video surveillance – are utilized to view sections of roadway. The cameras transmit a signal to a specific place on a limited set of monitors.

- Variable Message Signs (VMS) – are electronic traffic signs to provide travelers information regarding congestion, work zones, crashes, etc.

- Count Stations – are typically detectors within roadway pavement that have the ability to collect data on vehicles that go over or cross the counter, such as speed, volume, and classification.

In order for the applications defined above to be of any service, they need to communicate with one another. A 288-strand fiber optic cable that runs along I-91 from Connecticut to Vermont, as well as fiber running along the entirety of I-291, achieves this. This fiber optic cable is linked to the I-90 fiber and the operating centers at MassDOT District 2 in Northampton, the MassDOT Highway Operations Center, and State Police Operation Centers in Northampton, Springfield, and Shelburne. Information provided by the CCTVs allows the appropriate messages to be applied to the VMSs providing drivers with useful information such as congestion, crashes, and detours. A section of the fiber optic cable that runs along the I-91 corridor is attached to the west side of the Viaduct, north of State Street in the Primary Study Area, as seen in Figure 2-19.

Figure 2-19: Fiber Optic Cable Attachment on I-91

MassDOT developed the I-91 corridor as a shared resource program to promote broadband communications in Western Massachusetts by constructing the conduits, handholes, and manholes for a shared resource fiber optic network. It will be essential to keep this fiber optic cable and the network intact during any construction of the chosen alternative as well as being defined as a constraint for the development of any of the alternatives. The alternatives will consider additional ITS field devices to improve the overall ITS within the Primary and Regional Study Areas.

ROAD SAFETY

CRASH RATES

Queried crash data was obtained from the MassDOT Crash Records Database for a two-year period, 2011 and 2012, for the Primary Study Area. Although this data is typically analyzed over three-year periods, the City of Springfield did not provide the Registry of Motor Vehicles electronic files prior to 2011.

Crash rates, which are the number of collisions per one million vehicles entering the intersection, were determined for each intersection shown in Table 2-10. Crash rates are computed to compare the difference between intersections. For example, two intersections with similar geometry that contain the same amount of crashes per year may have different crash rates. The reason the two intersections have different crash rates is that they have different traffic flow entering each intersection. Based on the number of intersections in the Primary Study Area, a sample set of intersections was chosen within the Primary Study Area, with several identified as crash clusters by the 'Top High Crash Locations' portion of the MassDOT website's Crash Clusters Interactive Map. These crash clusters were developed based on a comprehensive analysis of crashes at certain locations, taking into account fatalities, injuries, and property damage. Springfield is located in MassDOT Highway Division District 2, where districtwide the signalized intersection average crash rate is 0.82 crashes per million vehicles, and the unsignalized average is 0.68 crashes per million vehicles. The statewide average crash rate for signalized intersections is 0.8 crashes per million vehicles, and the unsignalized average is 0.6 crashes per million vehicles.

Crash cluster data are generated by crashes submitted to the Registry of Motor Vehicles and located to a geographical point. The clusters are ranked based on the weighting of the number and severity of crashes. Figure 2-20 depicts crash clusters located within the Primary Study Area.

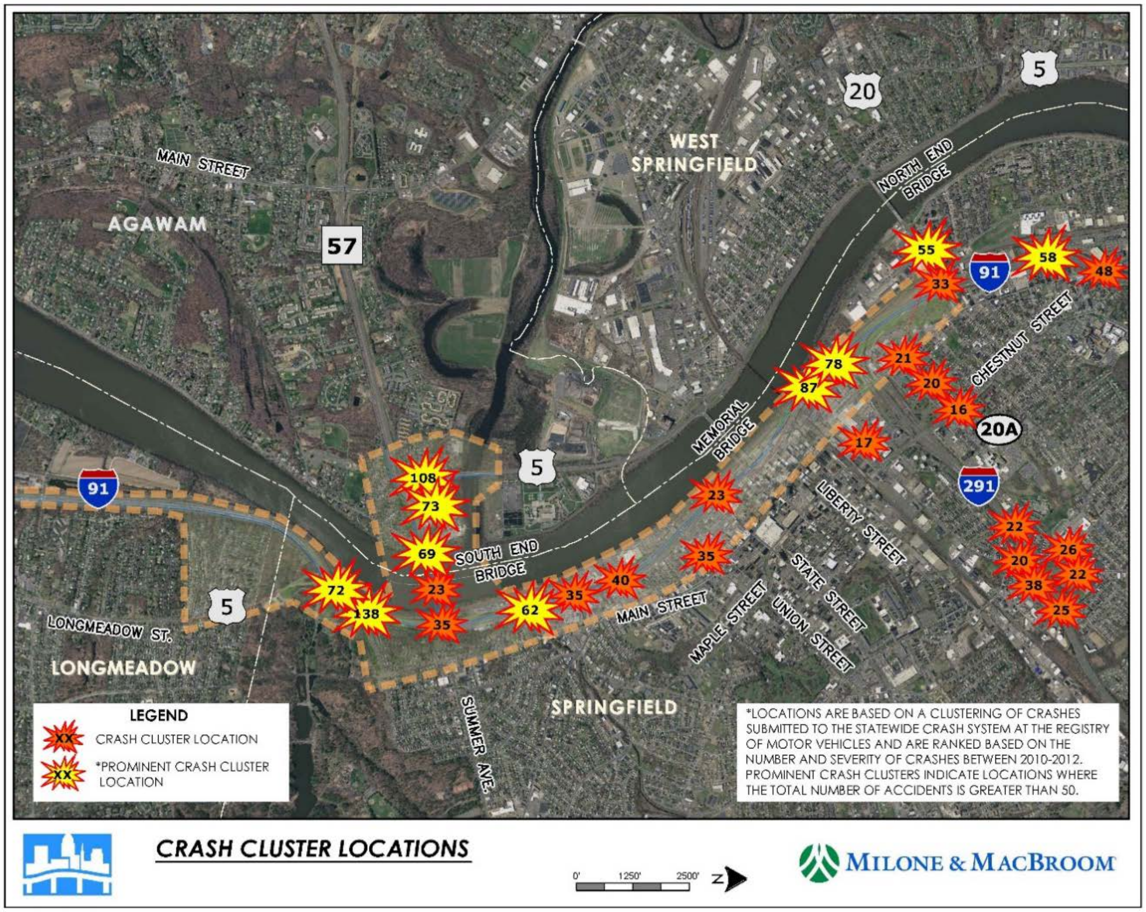


Figure 2-20: Crash Clusters

TABLE 2-10: 2011 and 2012 Crash Data for Primary Study Area Sample Set

Location	Signalized	Total Crashes in 2-Year Period	Average Crashes per Year	Crash Rate (per million vehicle miles)	Higher than	
					State	District 2
Avocado and Plainfield Streets at US-20 (West Street)	Yes	27	13.5	0.98	Yes	Yes
Main Street and St. George Road at Carew and Plainfield Streets (US-20A)	Yes	23	11.5	1.78	Yes	Yes
State Street at East Columbus Avenue	Yes	10	5	0.74	No	No
State Street at West Columbus Avenue	Yes	1	0.5	0.07	No	No
Union Street at East Columbus Avenue	Yes	27	13.5	1.26	Yes	Yes
Union Street at West Columbus Avenue	Yes	7	3.5	0.36	No	No
State Street at Main Street	Yes	15	7.5	1.00	Yes	Yes
Memorial Bridge and Boland Way at West Columbus Avenue	Yes	7	3.5	0.23	No	No
Boland Way at East Columbus Avenue	Yes	16	8	0.79	No	No
Union Street at Maple Street	Yes	22	11	1.74	Yes	Yes

Five of the ten sample intersections within the Primary Study Area have crash rates higher than both the statewide and District 2 averages. Intersection crash rate worksheets are included as Appendix A.

Roadway segments were also analyzed to calculate the number of collisions per one million vehicle miles traveled. Three roadway segments were analyzed:

- The South End Bridge (urban minor arterial)
- The elevated section of the I-91 Viaduct from State Street to the I-291 interchange (urban interstate)
- The "Longmeadow Curve" from the I-91 northbound two-lane section to the South End Bridge (urban interstate)

The statewide average crash rates for an urban roadway or urban interstate highway are 2.08 crashes per million vehicle miles while the average crash rate for an urban minor arterial is 3.62 crashes per million vehicle miles. Table 2-11 indicates the results for the roadway segments.

TABLE 2-11: Roadway Segment Crash Data in Primary Study Area

Location - Roadway	Number of Years Analyzed	Total Crashes	Average Crashes per Year	Crash Rate	Segment Length	Exceeds Average		
						State Roadway	Urban Minor Arterial	Urban Interstate
South End Bridge	3	86	28.67	4.82	0.3 miles	Yes	Yes	-
Elevated Section of I-91 (Viaduct)	2	157	78.5	3.82	0.76 miles	Yes	-	Yes
Longmeadow Curve	2	134	67	1.74	0.84 miles	Yes	-	Yes

COLLISION MAPPING

Collison diagrams and related data tables included in this section were prepared for the *Roadway Safety Audit – Interstate 91 Viaduct through Downtown Springfield, City of Springfield April 2014*, prepared by Howard Stein Hudson Associates. The collision diagrams in the report were generated by Vanasse Hangen Brustlin, Inc. (VHB). The three-year period of crash data includes 2009 to 2011. See Figures 2-20 and 2-21 for these collision diagrams and Tables 2-12 and 2-13 for related crash information.

Appendix A contains collision diagrams and related data tables drawn from for the *Roadway Safety Audit – Interstate 91 Viaduct through Downtown Springfield, City of Springfield April 2014*, prepared by Howard/Stein-Hudson Associates. The 3-year period of crash data includes the years 2009 to 2011 for the I-91 Viaduct segment, northbound and southbound, within the Primary Study Area. The segment is from the I-291/Route 20 interchange to Exit 6. There were 147 crashes including 47 injury crashes within the time period studied. The safety issues identified with the Roadway Safety Audit include the following:

- Congestion and travel speeds
- Roadway/interchange/ramp geometry
- Close proximity of on and off ramps
- Signage
- Pavement markings
- Drainage
- Lighting
- Roadway surface

SAFETY REVIEW

The MassDOT *2012 Top Crash Locations Report*, dated September 2014, was reviewed to determine whether any locations within the Primary or Regional Study Areas were identified as top crash locations. Four locations listed among the top 200 crash locations in Massachusetts are located in the Regional Study Area, with one top crash location located in the Primary Study Area.

TABLE 2-12: Top Crash Locations within the Regional and Primary Study Areas

Rank	Town	Location	Total Crashes	Fatal Crashes	Injury Crashes	Study Area	
						Regional	Primary
24	Chicopee	Broadway Street & East Main Street	78	0	22	x	
30	Agawam	South End Bridge	69	0	21		x
100	Springfield	Mill Street & Locus Street	40	0	17	x	
131	Springfield	Plainfield Street & West Street (US-20)	34	0	17	x	
145	Holyoke	Lower Westfield Road and Whitings Farm Road	51	0	12	x	

Fatalities within the Primary Study Area were identified using additional crash statistics. Queried between 2007 and 2014, a total of 11 fatalities occurred within the Primary Study Area. Of the 11 fatalities, five involved pedestrians, and one involved a bicyclist. The locations of these fatalities are depicted in Figure 2-21.

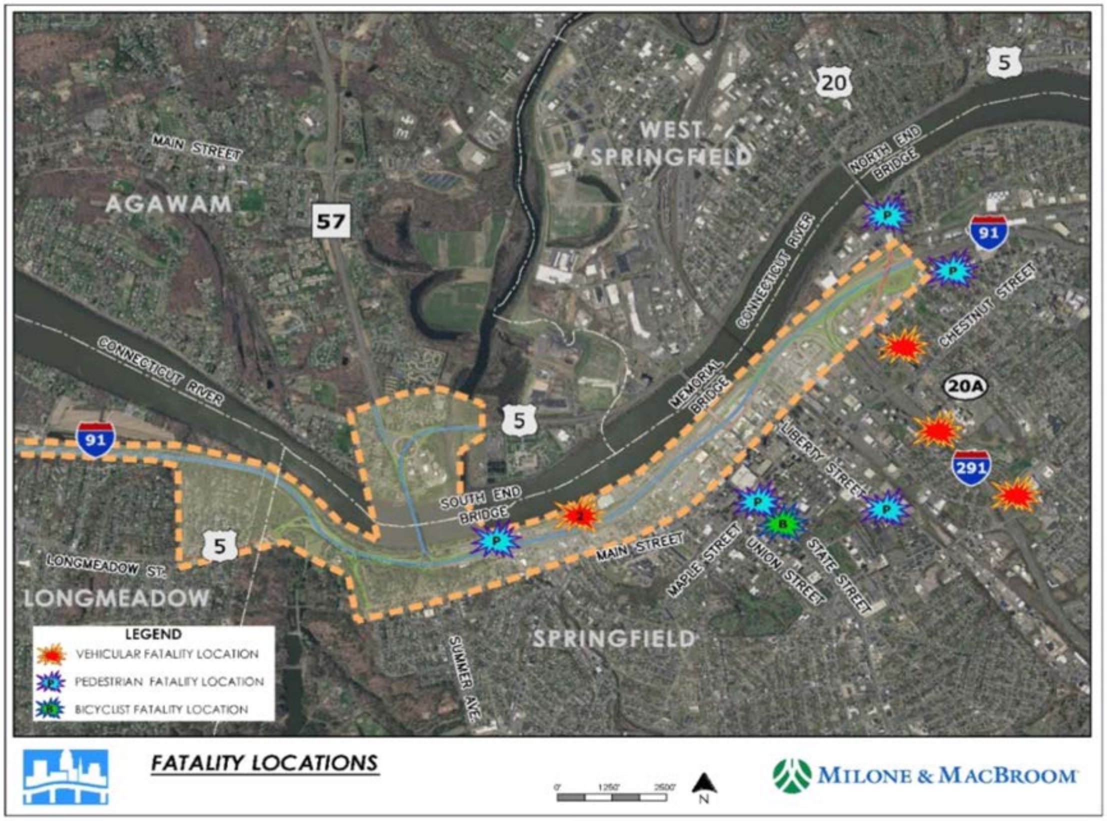


Figure 2-21: Fatality Locations

The PVMPO also compiles a list of the top 100 crash locations in the Pioneer Valley Region, which was queried for the years 2007 to 2009. A review of this list determined that 14 of the 2007 to 2009 top crash locations were located in the Primary Study Area.

TABLE 2-13: Primary Study Area Locations Listed Among the Top 100 High Crash Intersections in the Pioneer Valley in 2007-2009

Rank	City	Intersection	Total Crashes	Fatal Crashes	Injury Crashes
8	Springfield	Dwight Street / State Street	57	0	10
14	Springfield	Federal Street / State Street / Walnut Street	44	0	21
15	Springfield	East Columbus Avenue / Union Street	55	0	18
19	Springfield	Plainfield Street (US-20A) / Main Street / Carew Street (US-20A) / St. George Street	40	0	20
34	Springfield	Carew Street (US-20A) / Bartlett Street / Cass Street	36	0	17
38	Springfield	Carew Street (US-20A) / Dwight Street	38	0	16
43	Springfield	East Columbus Avenue / Main Street / Longhill Street	42	0	14
46	Springfield	Memorial Bridge / W. Columbus / Boland Way	36	0	14
54	Springfield	West Street (US-20) / Plainfield Street	34	0	14
61	Springfield	Dwight Street / Worthington Street	47	0	10
67	Springfield	Maple Street / Union Street	33	0	12
69	Springfield	Chestnut Street / Worthington Street	24	0	14
72	Springfield	Main Street / Union Street	30	0	12
86	Springfield	Main Street / State Street	26	0	11

The PVMPO also compiled a list of the top 25 high crash roadway segments queried between 2007 and 2009 for the Regional Study Area. Thirteen of these high crash roadway segments were located in the Regional Study Area, including the number one site. These ranked high crash roadway segments are identified in Table 2-14. The full text of the Top 25 High Crash Roadway Segments in the Pioneer Valley Region 2007-2009 is included as Appendix A.

TABLE 2-14: Primary Study Area Locations Listed Among the Top 25 High Crash Roadway Segments in the Pioneer Valley in 2007-2009

Rank	City	Roadway Segment Name	Location Description
1	Agawam	The western arc of the Agawam Rotary	The high crash location begins along the rotary at the U.S. Route 5 northern underpass and continues to the Route 57 westbound off ramp. It includes U.S. Route 5 crashes and the U.S. Route 5 off ramp to the rotary.
8	Holyoke	I-91 at Exit 15	This segment consists of the northbound and southbound segments of Interstate 91 in the vicinity of Exit 15.
9	Agawam	Midsection of South End Bridge	This segment includes an approximately 0.13-mile-long section almost at the center of the South End Bridge.
10	Springfield	South End Bridge / South End Bridge On Ramp / I-91	Starts approximately 600 feet west of the South End Bridge's on ramp to I-91 southbound and continues over the ramp for I-91 south and East Columbus Avenue. This segment includes crashes along I-91.
13	Chicopee	I-90 Exit 6	Includes eastbound and westbound travel lanes on I-90 in the vicinity of Exit 6.
14	Chicopee	Montgomery Street / Memorial Drive / Bridge Street	Begins on Montgomery Street approximately 600 feet north of the above intersection. It includes segments along Memorial Drive and Bridge Street.
15	Springfield	I-91 at Exits 1 and 2	This segment includes northbound and southbound travel lanes along I-91 in the vicinity of Exits 1 and 2. It includes crashes on the on ramp from Longhill Street.
16	Springfield	I-291 at Exit 4	Includes travel lanes in both directions on I-291 in the vicinity of the St. James Avenue overpass.
18	Springfield	I-91 at Intersection with I-291	Includes a segment along I-91 that begins south of Exit 8 southbound and also contains crashes along East Columbus Avenue and West Columbus Avenue ramps.
19	West Springfield	I-91 at Exit 13A and 13B	Includes northbound, southbound, and ramps traffic in the vicinity of Exit 13.
20	Springfield	I-291 at Exit 3	Includes eastbound and westbound traffic between the I-291 on and off ramps at Exit 3.
22	Springfield	I-91 at Exit 8 Northbound	This segment includes traffic lanes in both directions along I-91 in the vicinity of its northbound Exit 8 for I-291.
24	Springfield	I-91 at Exit 4 Southbound	Includes northbound and southbound traffic in the vicinity of Exit 4.

This examination of roadway safety within the Primary and Regional Study Areas highlighted several safety concerns along this project corridor as documented both in this study and several prior analyses. The opportunity exists to develop short-, mid-, and long-term alternatives to improve the function and safety of those specific areas discussed in this section.

TRANSIT

Multimodal transportation is provided throughout the Primary and Regional Study Areas by means of bus routes, passenger and freight rail, sidewalks, bike paths, and bicycle access on local roadways. Overall, although the existing transportation system within the study areas offers many modes of transportation, it does include gaps and missing links that are identified in the following sections.

PVTA SERVICE

Local transit service in the Springfield area is provided by the Pioneer Valley Transit Authority (PVTA). The PVTA is the largest of 15 regional transit authorities in Massachusetts and the fourth largest in New England. PVTA offers both fixed-route service and paratransit service for the elderly and disabled. The routes that operate with the Primary and Regional Study Areas are listed below in Table 2-15, which shows each route's headway (or the time in minutes between bus arrivals on the same route) across weekday and weekend time periods as of 2015. The routes shown in Table 2-15 are mapped in Figures 2-22 and 2-23. A ridership table is included (Table 2-16) indicating high ridership figures especially within the city of Springfield on routes such as Blue 6, Blue 7, Green 1, Green 2, and Purple 20. Hubs within the Regional Study Area include the Springfield Bus Terminal located on Main Street and the Holyoke Intermodal Center located on Maple Street in Holyoke.

TABLE 2-15: PVTA Springfield Route Headways (Minutes or Trips Per Day)

Route ID	Description	Monday through Friday			Saturday	Sunday
		Morning	Midday	Afternoon		
Blue 4	Plainfield Street	30	30	30	30	60
Blue 6	Ludlow via Bay	20	20	30	30	60
Blue 7	Walmart - Eastfield Mall	15-20	15 - 20	20-30	15 - 20	30
Blue 12	Stonybrook Express	4 Trips Per Day				
Blue 17	Eastfield Mall - Wilbraham Rd - Parker St	45	45	45 - 60	45	-
Green 1	Chicopee Center - Big Y Sumner - Allen	20	20	20 - 30	30	45
Green 2	Carew - E.Springfield / Belmont - Dwight Rd.	20	20	21 - 30	30	60
Green 3	King - Westford - Hancock / Springfield Plaza	30	30	30	30	60
Green 5	Dickinson - Jewish Home SBT	45 - 60	45 - 60	30 - 45	30 -60	-
Red 10	W Springfield / Westfield / Westfield State U	30	45 - 60	46 - 60	60	60
Red 14	Feeding Hills / Springfield	60	60	60	60	60
Red 14E	Springfield / Agawam Industrial Park	4 Trips Per Day				
Red 27	Wilbraham / Eastfield Mall / Sixteen Acres	5 Trips Per Day				
Purple 11	HCC Express	60	60	2 trips	-	
Purple 20	Holyoke / Springfield via Holyoke Mall - Riverdale	30	15 - 30	30	15 - 30	30
Purple 21	Holyoke / Springfield via Chicopee	30 - 45	30	45	20 - 35	15 - 35
X90	Inner Crosstown	30	30	30	30	60
X92	Mid City Crosstown	45	45	45	45	-

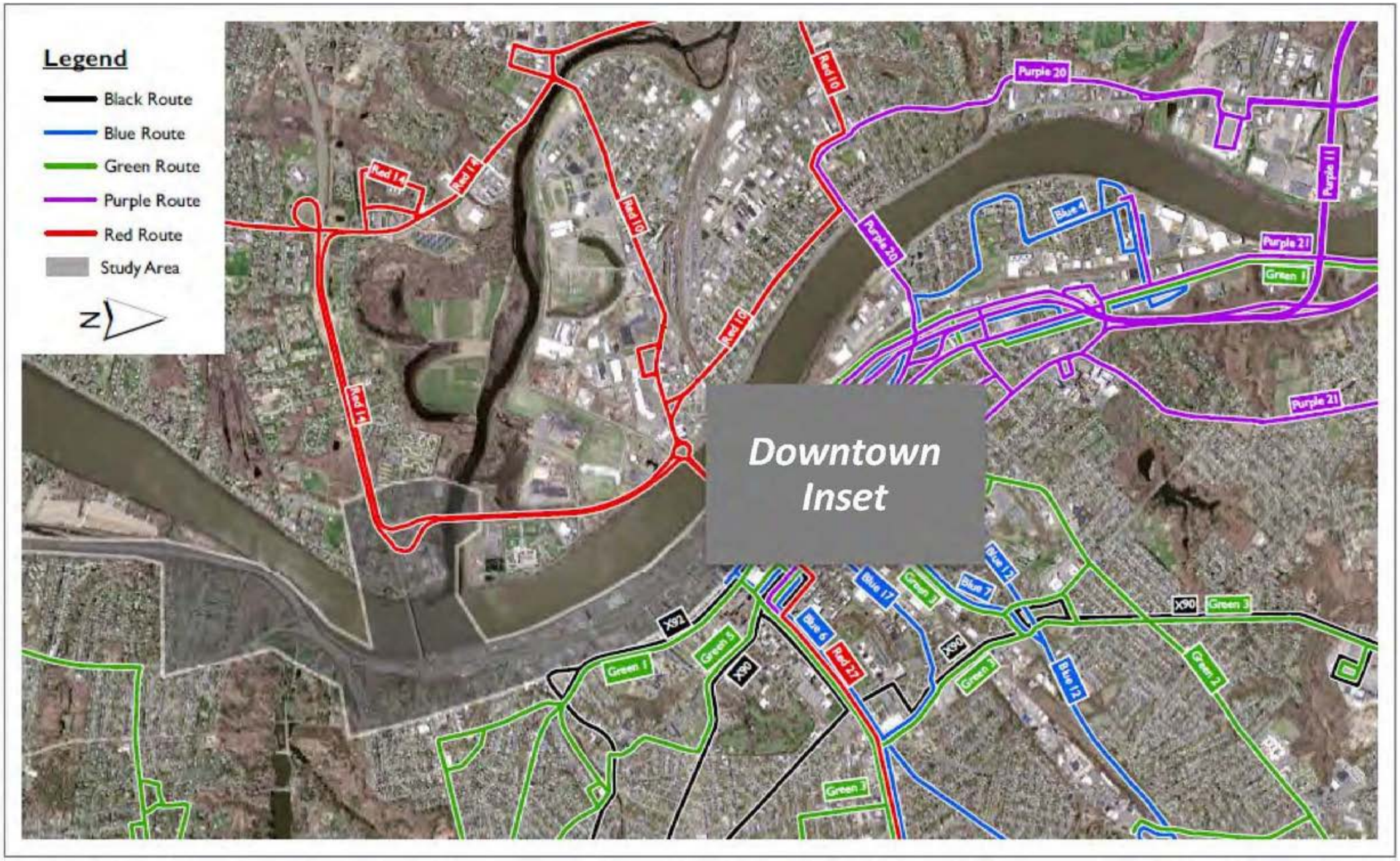


Figure 2-22: PVTA Springfield Routes

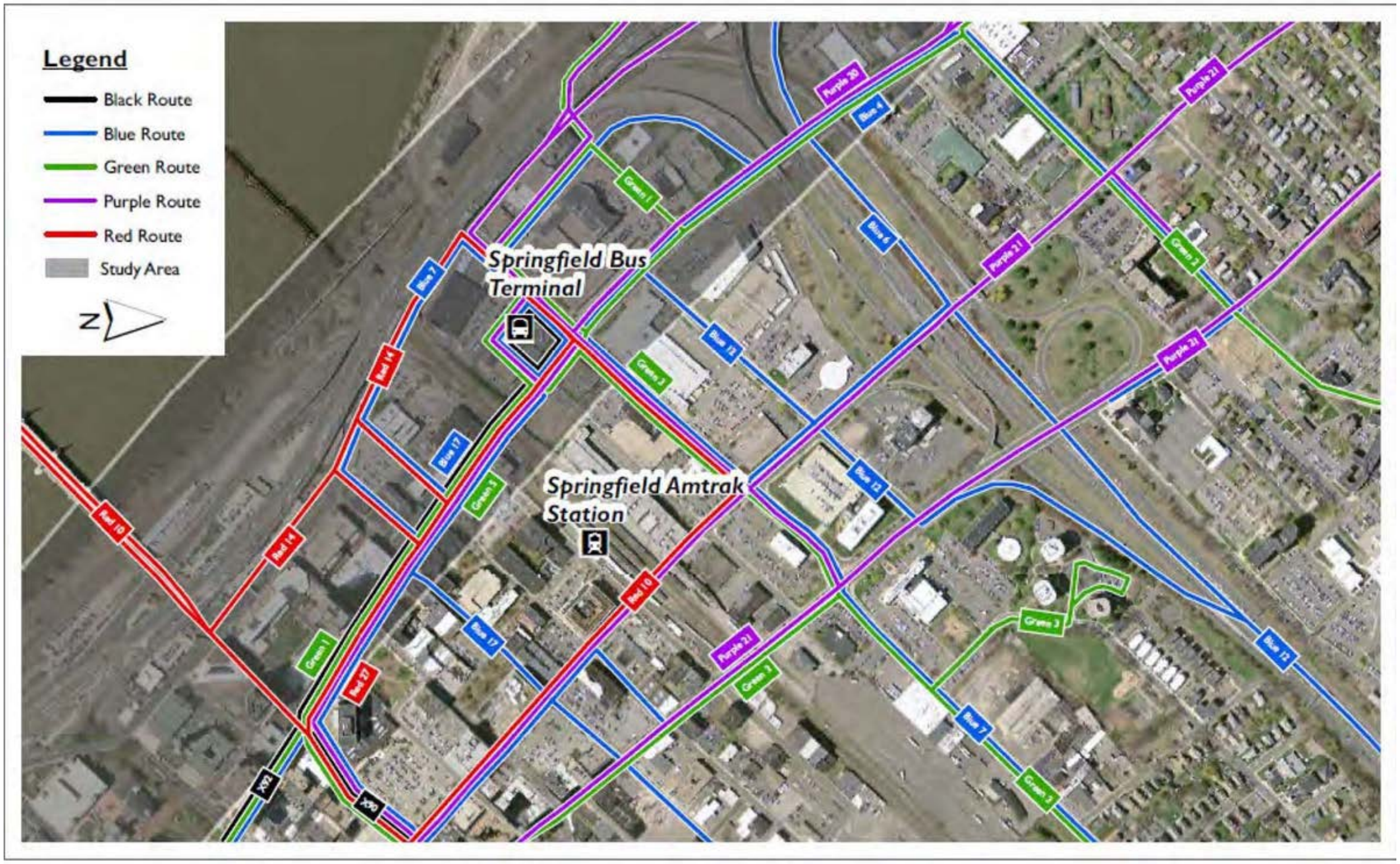
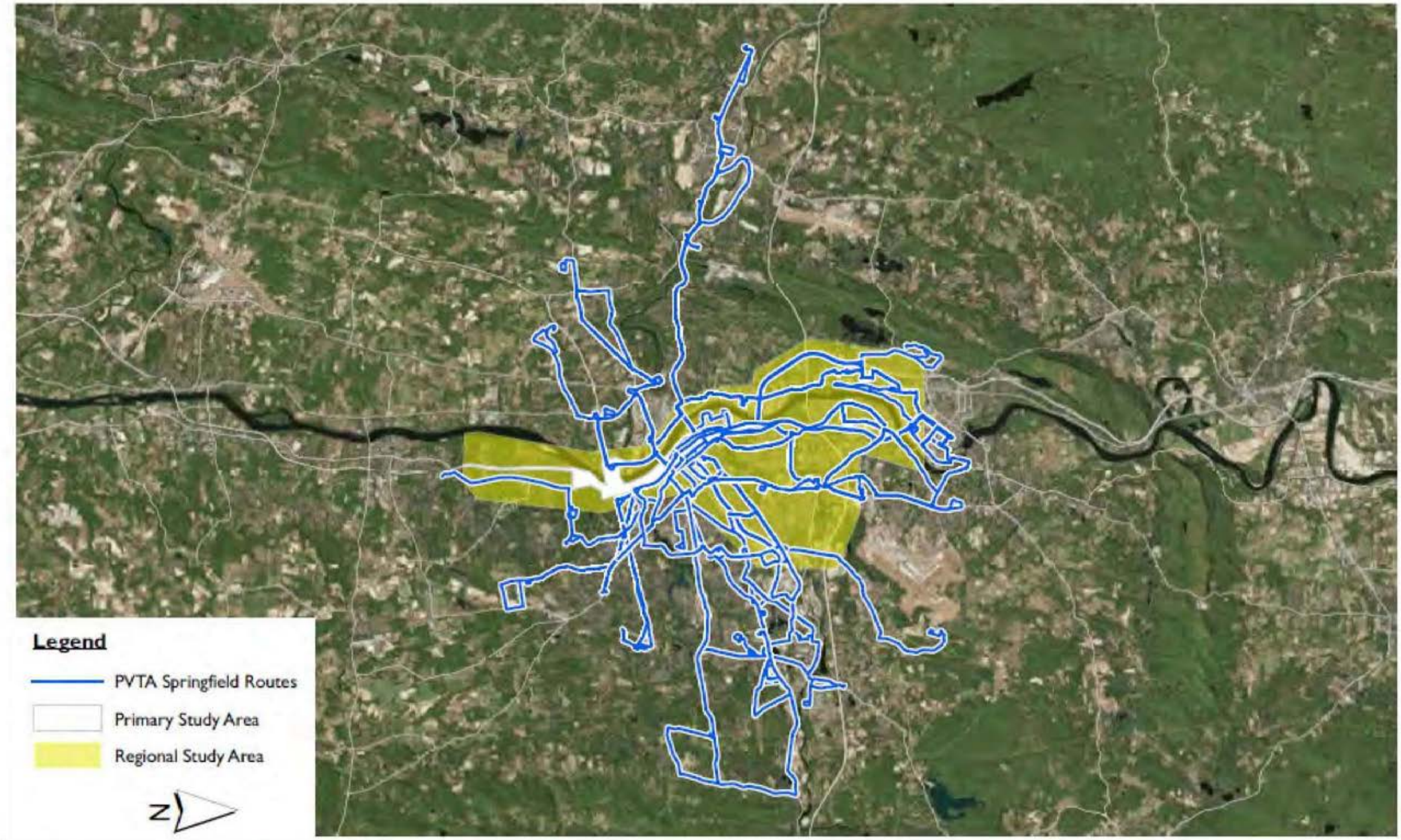


Figure 2-23: PVTA Springfield Routes (Downtown Inset)



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure 2-24: PVTA Regional Extent (covers both the Regional Study Area and Primary Study Area)

TABLE 2-16: 2014 PVTA Ridership (includes ridership for the year 2014, January 1 to December 31, for all routes within the PVTA's system)

Total Ridership Rank	Route	Fare		Total
		Alighting	Boarding	
1	B7	1,293,429	1,349,388	2,642,817
2	G1	1,121,885	1,104,301	2,226,186
3	G2	920,721	948,095	1,868,816
4	30	925,170	918,900	1,844,070
5	P20	912,431	929,553	1,841,984
6	31	865,490	854,668	1,720,158
7	B43	605,076	616,497	1,221,573
8	B6	544,353	557,475	1,101,828
9	G3	432,732	436,353	869,085
10	P21	411,924	439,320	851,244
11	R10	289,507	298,022	587,529
12	38	284,263	272,721	556,984
13	35	238,054	231,512	469,566
14	34	208,894	193,423	402,317
15	B17	196,010	199,650	395,660
16	B4	149,582	149,882	299,464
17	B23	132,186	138,564	270,750
18	B48	132,263	134,562	266,825
19	R14	119,987	124,785	244,772
20	R44	112,728	112,462	225,190
21	G5	101,225	107,079	208,304
22	(X) 37	92,592	91,119	183,711
23	R24	79,063	85,330	164,393
24	39	84,732	79,451	164,183
25	33	75,665	74,057	149,722
26	R22	66,110	69,115	135,225
27	(X) B13	64,148	68,005	132,153
28	(X) G8	63,802	65,355	129,157
29	X90	60,848	64,035	124,883
30	R42	57,525	57,190	114,715
31	R41	57,358	57,217	114,575

Total Ridership Rank	Route	Fare		Total
		Alighting	Boarding	
32	P11	53,128	55,800	108,928
33	(X) B9	48,874	48,845	97,719
34	45	48,852	47,298	96,150
35	(X) G19	38,069	35,890	73,959
36	(X) R25	35,781	37,182	72,963
37	(X) 32	31,971	32,022	63,993
38	(X) M40	28,043	29,974	58,017
39	46	22,097	20,702	42,799
40	(X) R16	20,845	21,356	42,201
41	(X) B15	17,251	18,584	35,835
42	R29	15,594	16,378	31,972
43	B12	13,108	15,051	28,159
44	X92	11,072	11,453	22,525
45	(X) 39E	9,581	9,862	19,443
46	R27	6,889	7,792	14,681
47	X98	2,548	2,833	5,381
48	36	474	478	952
49	C52	407	421	828

According to the PVTA's 2016 annual report, the system provides 12,154,880 rides annually, with operating expenses of $2.77 per passenger trip and an average of 30.4 passenger trips per revenue hour. A 2014 evaluation, the *PVTA Comprehensive Service Analysis Final Report*, characterized the system's operations as "very efficient," and while operating expenses have risen since that time, the PVTA's cost per trip remains substantially below the nationwide average of $4.04 per trip for fixed-route bus transit as reported by the Federal Transit Administration's (FTA) most recent (2015) *National Transit Summaries and Trends* report.

The State Street route within the Primary Study Area currently experiences high levels of demand, leading the PVTA to examine options for increased service along this corridor, including a 2015 study evaluating the feasibility of Bus Rapid Transit. Bus Rapid Transit is a high-capacity transit solution to improve urban mobility by dedicating lanes to buses or specialized vehicles. Its goal is to provide higher capacity and quality of service than traditional bus services at a substantially lower cost than other high-capacity transit modes such as light rail. Although the evaluation was completed in late 2015, a time line for implementation has not been established.

The New Haven-Hartford-Springfield commuter rail service launched in summer 2018, which will increase service to 12 trains daily connecting Springfield to New Haven, Hartford, and destinations in between. Integration of this service with the existing Vermonter and the Lake Shore Limited services, as well as the MGM Casino in Springfield, will provide expanded opportunities to coordinate various complementary transit services.

PVTA and MGM currently intend to partner to implement a Trolley Service/Downtown Circulator for the opening of the MGM Casino. The road trolleys (which are rubber-tired vehicles) will serve Union Station, MGM Springfield, the Basketball Hall of Fame, the Springfield Museums, and Worthington Street. The trolley service will be available to employees, customers, patrons, and visitors of MGM and Downtown Springfield. The service and vehicles will be owned and operated by PVTA and will operate free of charge for riders.

Currently, there are no bus routes along West Columbus and East Columbus Avenues south of the Memorial Bridge. Alternatives developed may create opportunities and/or demand for transit service along East and West Columbus Avenue in the future.

AMTRAK

In addition to transit provided by the PVTA, Springfield Train Station (SPG) on Lyman Street in Springfield offers daily Amtrak services on both weekends and weekdays, including the Vermonter, Northeast Regional, and Lake Shore Limited. Figures 2-25 and 2-26 indicate the extent of Amtrak services for the Springfield area and the location of the Springfield Station and service lines. Union Station is currently under construction and being rehabilitated; while it has been closed and offline for years, the station was completed in June 2017. Ridership data for Amtrak's lines is limited with 141,947 annual Ons/Offs, or an average daily ridership of 389 Ons/Offs.

Currently, there are three routes in which the Springfield station serves as a destination. They are as follows:

- The Lake Shore Limited
- The Northeast Regional
- The Vermonter

The Lake Shore Limited runs from Chicago to Albany and then splits into the New York and Boston branches. Springfield is located on the Boston branch line. Ridership on this line was approximately 353,000 in federal fiscal year (FY) 2015 and 382,200 in federal FY 2016, an 8.3% increase.

The Northeast Regional runs from Boston to Washington with numerous shuttles or spurs along the way. Springfield is a shuttle/spur for this route and connects into New Haven while others consist of Lynchburg, Newport News, and Norfolk all in the state of Virginia. The overall ridership for the Northeast Regional was approximately 8,094,700 in FY 2015 and 8,267,200 for FY 2016; this equates to a 2.1% increase. The shuttle portion of this route's ridership, from Springfield to New Haven, declined substantially in the most recent year of available data, dropping from 346,300 in FY 2015 to 266,400 in 2016, a 23.1% decrease.

The Vermonter rail service runs from St. Albans, Vermont, to Washington, D.C., with major stops including Baltimore, Philadelphia, New York City, Bridgeport, New Haven, Hartford, Springfield, and Brattleboro. Ridership on this line was 91,583 in FY 2015 and 88,006 in FY 2016, a 3.9% decrease. These ridership numbers reflect the recent realignment of the Vermonter service's route. Instead of traveling north from Springfield to Amherst and Brattleboro, the train now crosses to the western side of the Connecticut River to stop in Holyoke, Northampton, and Greenfield en route to Brattleboro.

	Northeast Regional	Vermonter	Lake Shore Limited
Weekday	5 northbound / 5 southbound	1 northbound / 1 southbound	1 eastbound / 1 westbound
Weekend	6 northbound (7 on Sunday) / 6 southbound (7 on Sunday)	1 northbound / 1 southbound	1 eastbound / 1 westbound

Source: Amtrak 2015

Figure 2-25: Amtrak Springfield Station Daily Services

Utilizing the Springfield Amtrak Station, riders have the option to travel up and down the east coast using connections in New York and Washington, D.C. Riders taking advantage of the Lake Shore Limited have the ability to travel from Chicago to points on the West Coast and through the midwest to New Orleans, Louisiana. There is limited daily service at the Springfield Amtrak Station, but based on the ridership data and the renovation of Union Station, there is potential for future growth.

In addition to the PVTA and Amtrak, private bus companies such as Peter Pan and King Ward serve both the Regional and Primary Study Areas. Figure 2-27 indicates the broad range of transit possibilities covering Western Massachusetts.

Peter Pan is one of the largest privately owned motor coach companies in the country, and it is located in Downtown Springfield, Massachusetts. Currently, Peter Pan operations are planned to relocate to operate out of Union Station although plans and a time line for this move have not yet been finalized. Peter Pan provides express services to Boston, New York, Philadelphia, and

Washington, D.C. as well as numerous communities throughout the Northeast. It carries over four million passengers per year.

King Ward is a local bus company located in Chicopee, Massachusetts. King Ward currently has 57-passenger and 38-passenger luxury motor coaches servicing mainly tours to and from specific destinations such as Atlantic City, New Jersey, New York City, Boston, Foxwoods and Mohegan Sun Casinos, and the Bronx Zoo.

Additional private companies utilize the routes within the Primary and Regional Study Areas but do not serve station stops, including Megabus, Limoliner, and Greyhound.

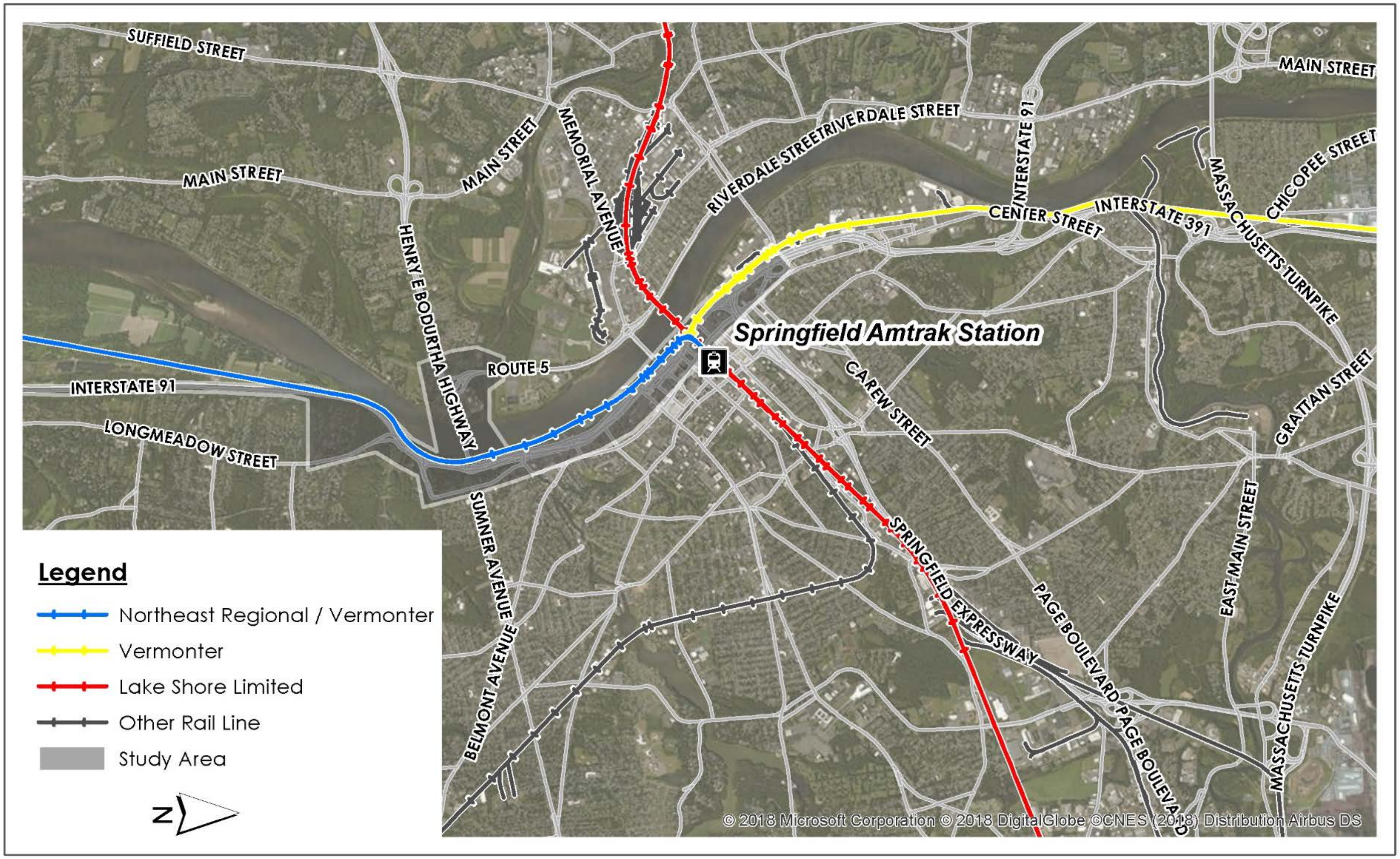


Figure 2-26: Existing Rail Routes

Source: Amtrak

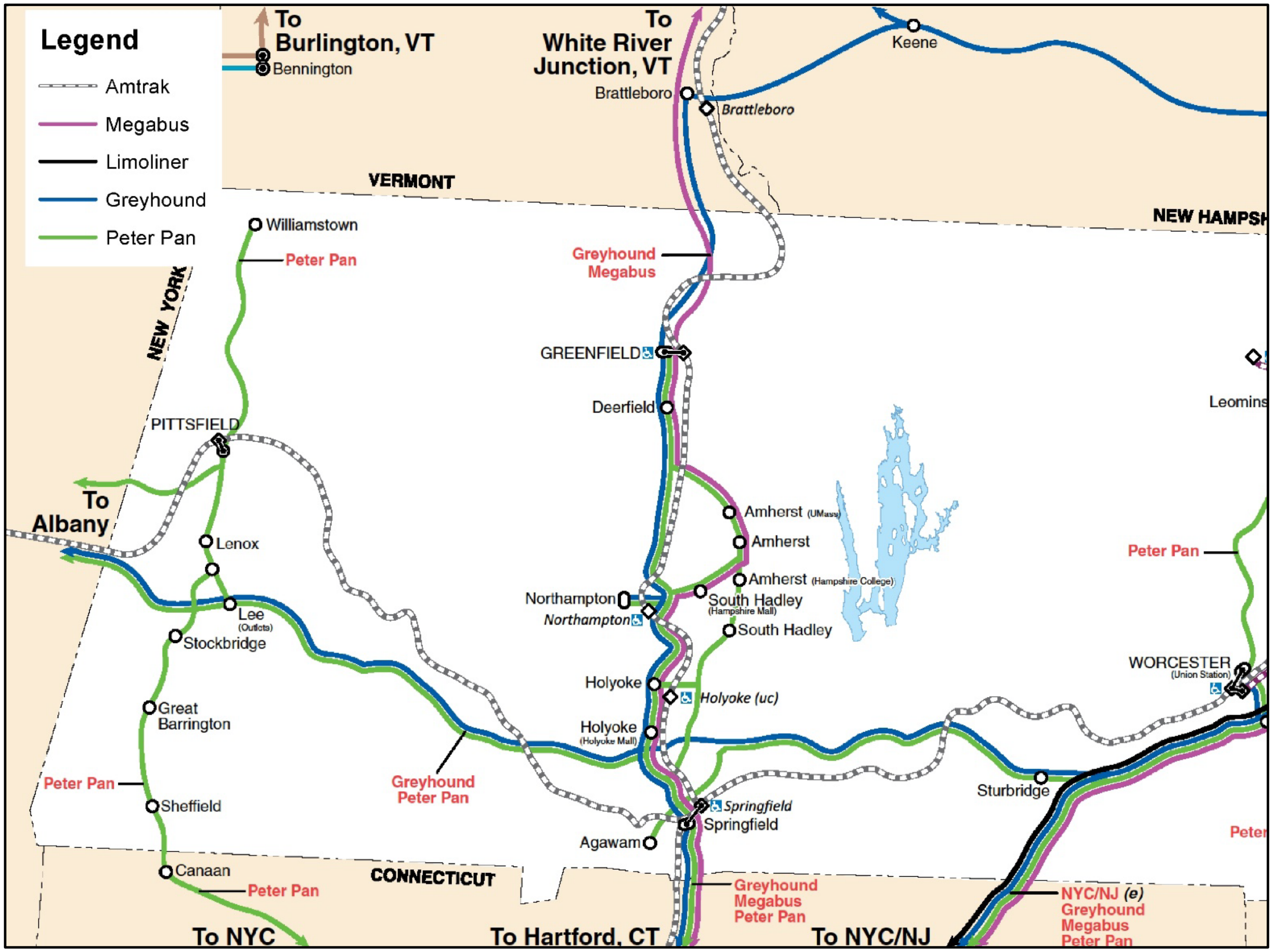


Figure 2-27: Regional Rail and Bus Service

Source: MassDOT (2015)

JOURNEY TO WORK AND MODES OF TRAVEL

The individuals who live and/or work in the Primary and Regional Study Areas currently utilize a variety of commuting modes to travel to their jobs and follow a variety of commuting patterns in and around the Greater Springfield area. Based on American Community Survey (ACS) data, about half of Springfield commuters remain in the city for work. Within the downtown census tracts, corresponding to the area depicted in Figure 2-28, slightly more than half of commuters work at locations in the city of Springfield. Correspondingly, just under half of these residents commute to other cities and towns.[5]

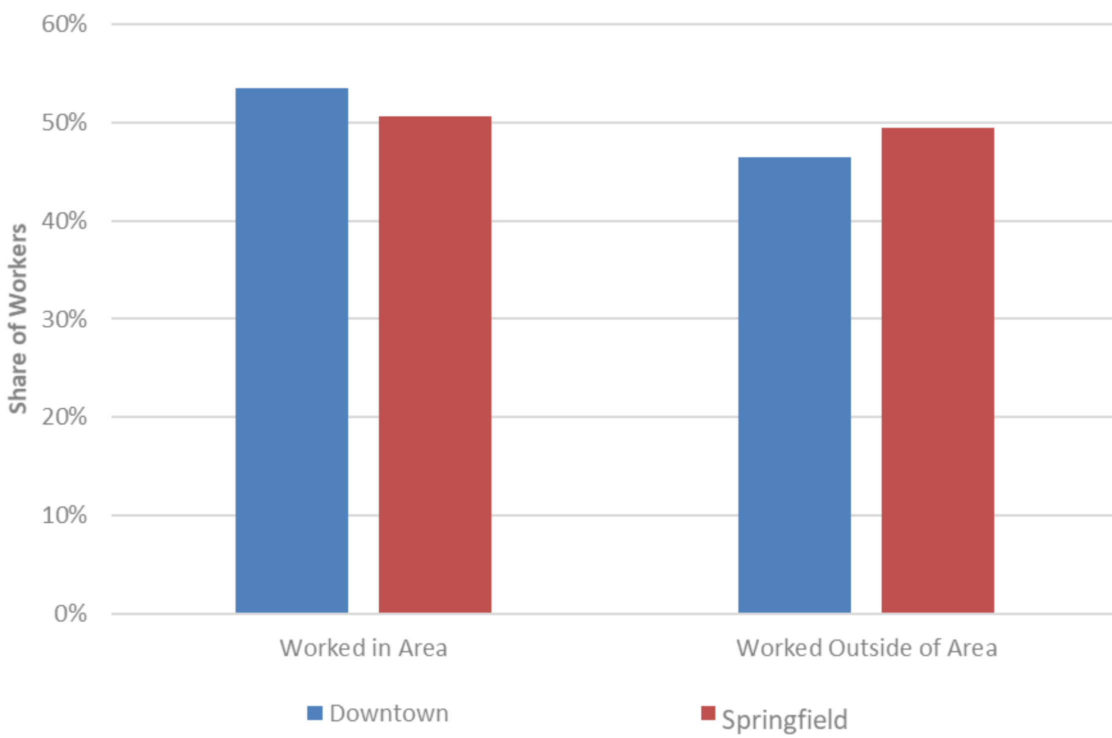


Figure 2-28: Place of Work of Residents – Downtown Census Tracts and Springfield as a Whole

Source: American Community Survey, 2009-2013 Five-Year Estimates

While about half of the employed residents of the downtown census tracts had jobs within Springfield, almost 70% of workers commuted to work by private automobile. Seventeen percent of the workers living within the downtown census tracts walked to their jobs while 7% took public transportation. In Springfield as a whole, workers were even more reliant on private automobiles,

[5] Commuting data derived from self-reports to the U.S. Census have relatively large margins of error. These data should be understood as the midpoint estimates of a large range of possible values.

with 88% of workers commuting by car, 5% using public transportation, and 3% walking. For comparison, approximately 79% of Massachusetts commuters as a whole travel via private automobiles and 86% of all commuters nationally. Springfield's workforce is relatively auto dependent in comparison not only to state and national statistics but also to comparable New England mid-sized cities, such as Hartford, Connecticut, where private automobiles make up 72% of journeys to work, and public transportation, walking, and biking together account for almost a quarter of all commutes. Transportation improvements and redevelopment in Springfield's Downtown core may provide opportunities for current and future residents to take advantage of transportation alternatives.

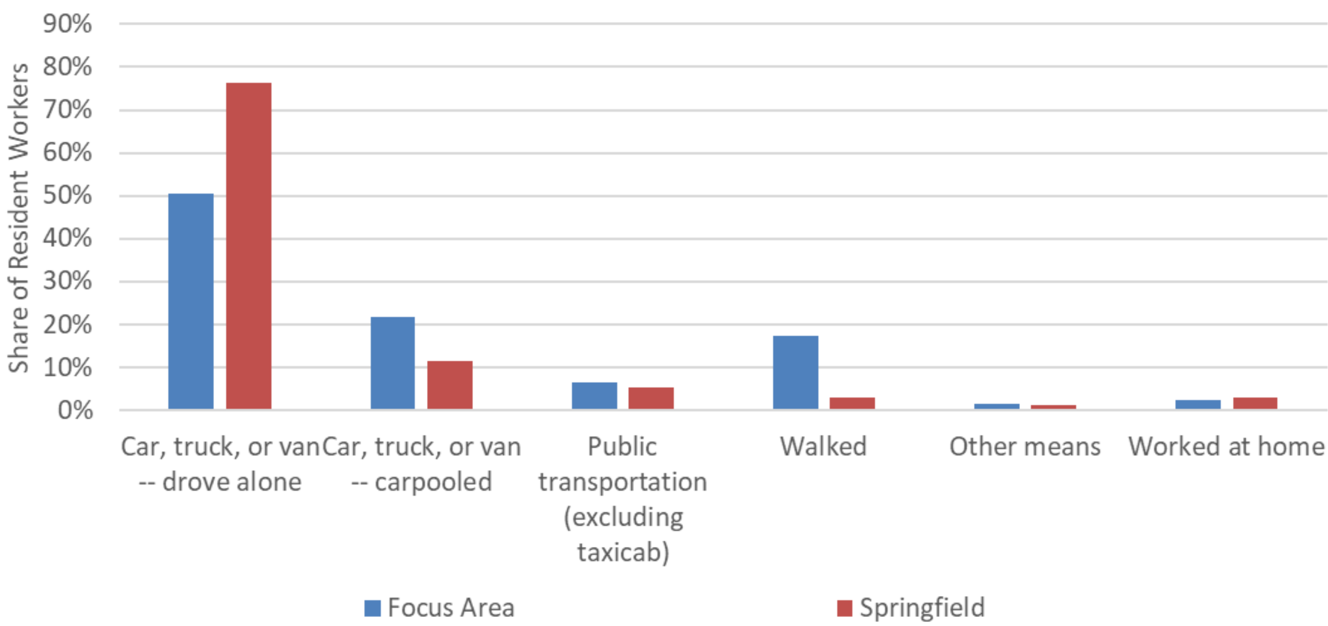


Figure 2-29: Journey to Work by Travel Mode – Downtown Census Tracts and Springfield Residents

Source: American Community Survey, 2009-2013

Examining the origins and destinations of commuting trips helps to shed light on why workers chose certain travel modes over others. Table 2-17 notes the top work municipalities for Springfield residents. Nearly 30,000 workers who reside in Springfield also work in the city, making it the top commuting destination for Springfield residents. Each of the other municipalities in the Primary and Regional Study Areas receives 6 or fewer percent of Springfield-based commuters.

TABLE 2-17: Commuting Destinations for Springfield Residents

Top 10 Commuting Destinations for Springfield Residents	Number of Workers Commuting from Springfield	Percentage of Total
Springfield	29,972	53%
West Springfield	3,313	6%
Chicopee	2,910	5%
Holyoke	2,705	5%
East Longmeadow	2,381	4%
Agawam	1,809	3%
Enfield, CT	1,671	3%
Westfield	1,479	3%
Ludlow	981	2%
Wilbraham	960	2%
All Other	8,740	15%
Total	56,921	100%

Sources: Census, ACS, special tabulation (Residence Minor Civil Division [MCD]/County to Workplace MCD/County Flows for the United States and Puerto Rico Sorted by Workplace Geography, 2006-2010)

BICYCLE AND PEDESTRIAN TRANSPORTATION

Within the Primary Study Area and in the vicinity of the I-91 Viaduct, sidewalks exist on both sides of the roadways with the exception of East Columbus and West Columbus Avenues. See Figure 2-36 for sidewalk and bike path locations.

PEDESTRIAN ACCESSIBILITY

The signalized intersections in the vicinity of the Viaduct provide crosswalks as well as pedestrian signals, including either concurrent or exclusive pedestrian phasing. Most of the pedestrian ramps, however, are not up to current ADA standards. With the exception of Boland Way, all of these crossings are unlit. Within the vicinity of the Connecticut Riverwalk and Bikeway, wayfinding signs point pedestrians and bicyclists toward the Riverwalk. An example of one of those signs is shown in Figure 2-30.

Figure 2-30: Wayfinding Sign along State Street for the Connecticut Riverwalk and Bikeway

Two barriers limit pedestrian access to the Connecticut River in this vicinity: I-91 (including the Viaduct) and the railroad tracks that run along the Connecticut River utilized by both passenger and freight rail. The Connecticut Riverwalk and Bikeway runs along the Connecticut River. There are five east-west pedestrian-accessible connections across I-91 between the South End Bridge (U.S. Route 5) and the Memorial Bridge (State Route 147). These crossings, at Main Street, Broad Street, Union Street, State Street, and Boland Way, span a distance slightly over 1 mile and are depicted in Figures 2-31 to 2-35. Each of these crossings connects East Columbus Avenue with West Columbus Avenue, and they are approximately 1,000' apart. The west side of East Columbus Avenue and the east side of West Columbus Avenue are both adjacent to the highway, where sidewalks are not present.

Figure 2-37 indicates where these crossings or locations exist in relation to I-91, the railroad tracks, and the Connecticut River.

Figure 2-31: Main Street Underpass

Figure 2-32: Broad Street Underpass

Figure 2-33: Union Street Underpass

Figure 2-34: State Street Underpass

Figure 2-35: Boland Way Underpass

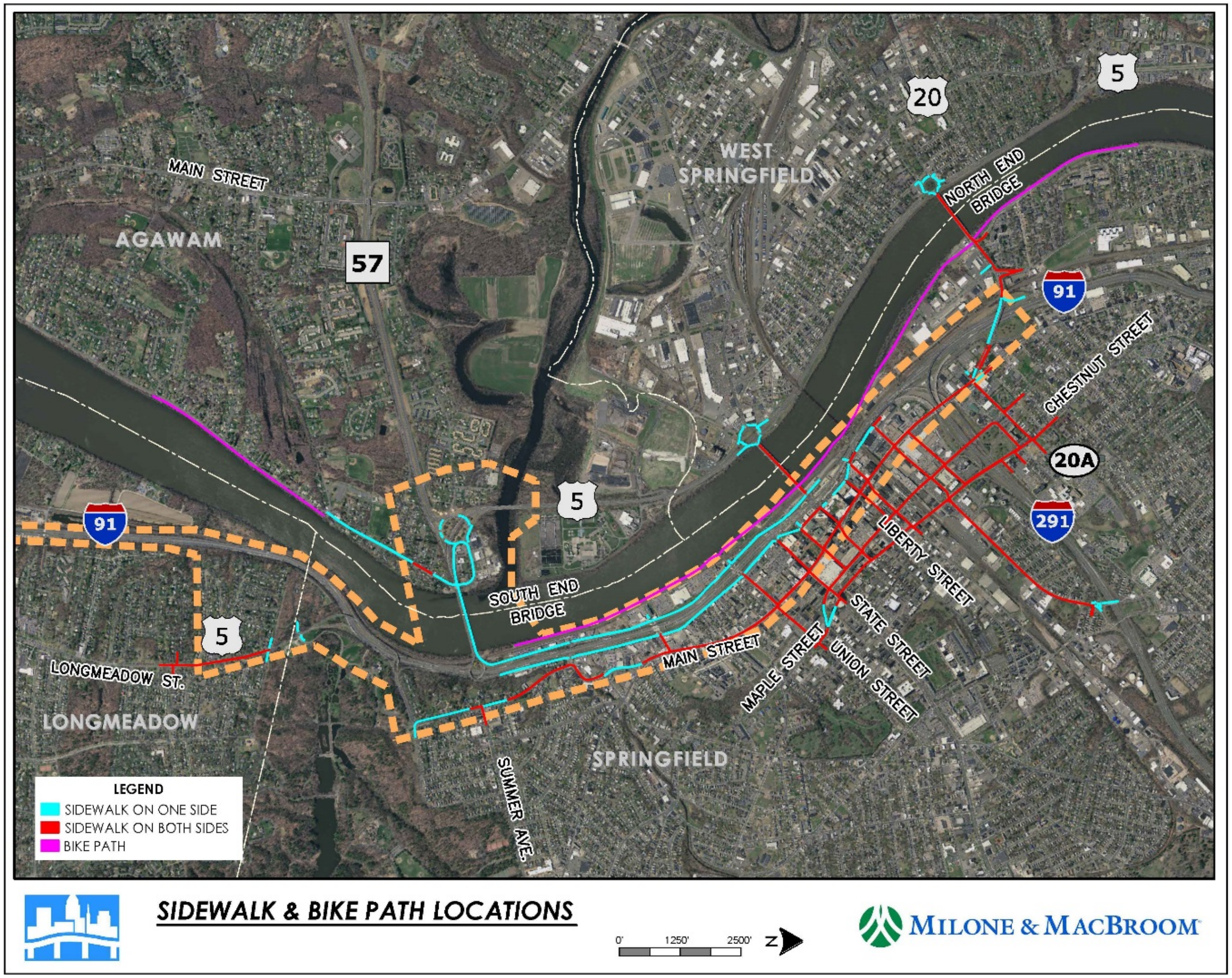


Figure 2-36: Sidewalk and Bike Path Locations

Figure 2-37: Access Points for Pedestrians and Bicyclists Along Interstate 91

Additionally, two parallel rail lines that are utilized by both passenger and freight rail carriers east of West Columbus Avenue lie between Downtown Springfield and the Connecticut River. The tracks are parallel to both the Connecticut River and I-91 within the Primary Study Area limits. Pedestrians are able to cross these rail lines to access the riverfront at three locations between the South End Bridge (U.S. Route 5) and the Memorial Bridge (State Route 147). The locations of these three rail crossing sites are depicted in Figure 2-41.

Figure 2-38: Underpass Below Tracks Off West Columbus Avenue

Figure 2-39: Passive At-Grade Highway-Rail Crossing at Riverfront Park

The northernmost access point is an underpass below the tracks approximately 300' north of State Street (Figure 2-38). This underpass can be accessed off West Columbus Avenue by a driveway and a staircase.

The second access point to the Connecticut River waterfront is a passive at-grade highway rail crossing. This access point is located at the entrance to Riverfront Park, a pedestrian path opposite the beginning of State Street at the intersection with West Columbus Avenue. There are no gates or signals at this crossing, but a stationary stop sign and cross-buck are present at the crossing. The City of Springfield is investigating ways to provide a safer pedestrian access into Riverfront Park by improving the underpass featured in Figure 2-38 and allowing access to the at-grade crossing to emergency vehicles only.

The third means of crossing the tracks is an ADA-accessible pedestrian bridge located approximately 1,250' south of the Riverfront Park at-grade crossing (West Columbus Avenue/State Street). It is located behind the former Basketball Hall of Fame located on West Columbus Avenue. Pedestrians can access the walkway either from West Union Street or the current Basketball Hall of Fame parking lot, as shown in Figure 2-40. This crossing was constructed as part of the Connecticut Riverwalk and Bikeway. It should be noted that this ramp system does include an exterior elevator system; however, the elevator, although recently repaired, has been inoperable for several years and requires significant maintenance.

Figure 2-40: Pedestrian Bridge

Reconnection of Downtown Springfield to the Connecticut Riverfront/Connecticut Riverwalk and Bikeway is a goal of this study as safe, efficient, and inviting connections between these areas are limited under existing conditions. Opportunities for creating safe (grade-separated) pedestrian and bicyclist connections across the railroad tracks and connecting Downtown Springfield to the Connecticut River will be examined in subsequent sections.

Figure 2-41: Rail Crossings for Riverfront Access

BICYCLE ACCESSIBILITY

REGIONAL STUDY AREA

Bicyclists are prohibited from the Regional Study Area's limited-access highways, such as I-90, I-91, I-291, and I-391. Portions of U.S. Route 5 in West Springfield do not allow bicyclists, nor does Route 57 in Agawam from U.S. Route 5 to Route 187 (South Westfield Street).

There are designated bicycle facilities within the Regional Study Area, such as the Connecticut Riverwalk and Bikeway, located immediately along the Connecticut River. This paved route is approximately 3.7 miles in length and runs from the South End Bridge in Springfield to the Chicopee city line. Access to the Connecticut Riverwalk and Bikeway is available at these additional locations in Springfield:

- Signalized Crossing at US-20 (West Street) and Riverside Road
- Riverside Road just south of Plainfield Street near the City of Chicopee line

There is no public access at the southern end of the Connecticut Riverwalk and Bikeway near the South End Bridge. On the west side of the Connecticut River, in Agawam, another portion of the Connecticut Riverwalk and Bikeway begins along River Road in the vicinity of School Street and runs southerly along the east side of River Road to Borgati Park, just north of Main Street. This portion of the Connecticut Riverwalk and Bikeway is approximately 1.7 miles.

Elsewhere in the Regional Study Area, there are plans for new bike paths in Chicopee and West Springfield. In Chicopee, paths under design would connect to and extend the Connecticut Riverwalk and Bikeway. The completed Riverwalk and Bikeway is envisioned as a continuous 21-mile network of multiuse paths and linear parks, running from Agawam north through Springfield and Chicopee to Holyoke. A new bike path is partially completed in Agawam, along School Street, connecting Main Street (Route 159) to River Road; however, the remainder of the path remains in design.

In concert with the casino mitigation measures, including the installation of bike lanes on several adjacent city streets and Memorial Bridge, this project should promote pedestrian and bicyclist connectivity in Downtown Springfield as well as enhance connections within the regional bicycle network.

Figure 2-42: State Street at Main Street – The southbound approach includes both a sign and clear pavement parking symbols.

Figure 2-43: West Columbus Avenue (Hall of Fame Avenue) at Union Street – Pavement marking symbols and interstate shield at the eastbound approach are worn.

PRIMARY STUDY AREA

Most of the roadways in the vicinity of the Viaduct in the Primary Study Area are generally appropriate for bicycling. These roadways typically contain slower urban traffic speeds, frequent traffic signals, and flatter grades. Many also have on-street parking. However, there are few visible amenities specifically designed for bicyclists on these roadways. The majority do not contain any designated bike lanes, painted shoulders are not typically present, and there is little or no shared road signage. However, a majority of the signalized intersections do offer bicycle detection that includes signing for the detection zones, such as at State and Main Streets, Union and Main Streets, Union Street and East Columbus Avenue, and State Street at West Columbus Avenue. In most of these detection zones, pavement marking symbols are worn or not present. There are no "bike-boxes" present within the area.

FREIGHT RAIL

Within the Regional Study Area and Primary Study Area, there are two major freight lines: the Boston Line, which runs east-west, and the New England Central Railroad (NECR) line, which operates north-south. The Boston Line, operated by Amtrak, handles the largest amount of freight rail moving in and out of Massachusetts. It connects Boston, Worcester, Springfield, and Pittsfield, Massachusetts, and Albany, New York. The route runs directly under the I-91 Viaduct. Just west of the Viaduct, the Boston Line crosses the Connecticut River into West Springfield, entering one of the major intermodal freight facilities in the state.

The NECR line parallels I-91 and the Connecticut River within the Primary Study Area. This rail line has a large number of connections with other short lines in the region, playing an important role in regional commerce and providing access to the national rail system. Information on train scheduling and frequency from the freight companies is unavailable for inclusion in this study.

UTILITIES

Within the Primary Study Area, information on utilities, including sanitary sewer, potable water, and drainage, was collected from the City of Springfield and the city's Water and Sewer Commission. The I-91 Viaduct Rehabilitation Project plans have also been reviewed to ascertain utility information. The following utilities are located within the city of Springfield and may be in the vicinity of the I-91 Viaduct:

- Eversource Electric West
- Columbia Gas of Massachusetts
- Verizon
- AT&T Teleport Communications of America
- Comcast
- Five Colleges, Inc.
- Springfield Fire Alarm
- Lightower
- Axia NetMedia Corporations
- Level (3) Communications

Infrastructure associated with each of these utilities would need to be considered as potential constraints if any of the alternatives discussed in Chapters III and IV of this study were to advance to design. Additional data collection, mapping, and evaluation outside the scope of this study would be appropriate at that time. Several of the most significant pieces of infrastructure known to be located in or adjacent to the I-91 alignment are described below.

A set of 48" sanitary sewer trunk lines runs along East and West Columbus Avenues and are served by pump stations at the end of Union Street, State Street, York Street, and Clinton Street. Portions of these trunk lines still include combined storm and sanitary sewers. A 36" water main runs along the entire length of East Columbus Avenue and on West Columbus Avenue from Lombard Street southerly to the South End Bridge. The Springfield Water and Sewer Commission utilizes the I-91 right-of-way (ROW) corridor for a 36" water supply line running southerly from the South End Bridge into Longmeadow.

An electrical substation is located at the western terminus of Clinton Street, between the I-91 corridor and the Connecticut River. An electric duct runs below the I-91 ROW to connect this facility to Downtown Springfield.

A 288-strand fiber optic cable runs continuously along the I-91 Viaduct in order to provide for communication between MassDOT operations centers and various ITSs, including CCTV, variable message signs, and count stations. A more detailed explanation of this utility can be found in the ITS section of this document.

The utilities discussed above bear special consideration in evaluating potential design alternatives for the I-91 corridor due to the substantial effort and cost of any utility relocation that may be required.

2.2.2 FUTURE YEAR CONDITIONS

Future No-Build conditions were developed for the Regional and Primary Study Areas for the year 2040. This assessment of conditions that are likely to occur in the future serves as a baseline for evaluating the alternatives that are developed in Chapter 3 and assessed in Chapter 4. The most important application of these projected conditions is to serve as the basis for modeling of likely traffic conditions under both No-Build conditions and various alternatives. Projected trends in the distribution of population and economic growth across the Regional and Primary Study Areas provide a basis for understanding and anticipating areas where traffic operations may be impacted.

FUTURE NO-BUILD TRAFFIC VOLUMES AND ANALYSIS

Anticipated growth rates and projected changes in employment, population, and households were included in the Transportation Demand Model to determine projected traffic volumes for the year 2040. In addition to accounting for these key variables, the Transportation Demand Model of 2040 No-Build conditions incorporated known changes to transportation infrastructure in the Primary Study Area and in particular the impacts of mitigation measures outlined in the MGM Springfield Final Environmental Impact Report.

Traffic volume diagrams showing peak hourly turning movements for the AM and PM peak periods throughout the Primary and Regional Study Areas are provided in the following figures. The volumes are generated by utilizing the Travel Demand Model (implemented in *TransCAD* software) for the future No-Build 2040 conditions during the AM and PM peak periods. Changes in traffic volumes for individual links were examined individually in order to determine traffic growth or decline at each intersection. Compared to 2014 traffic conditions, the 2040 No-Build scenario showed increased variations throughout the study area.

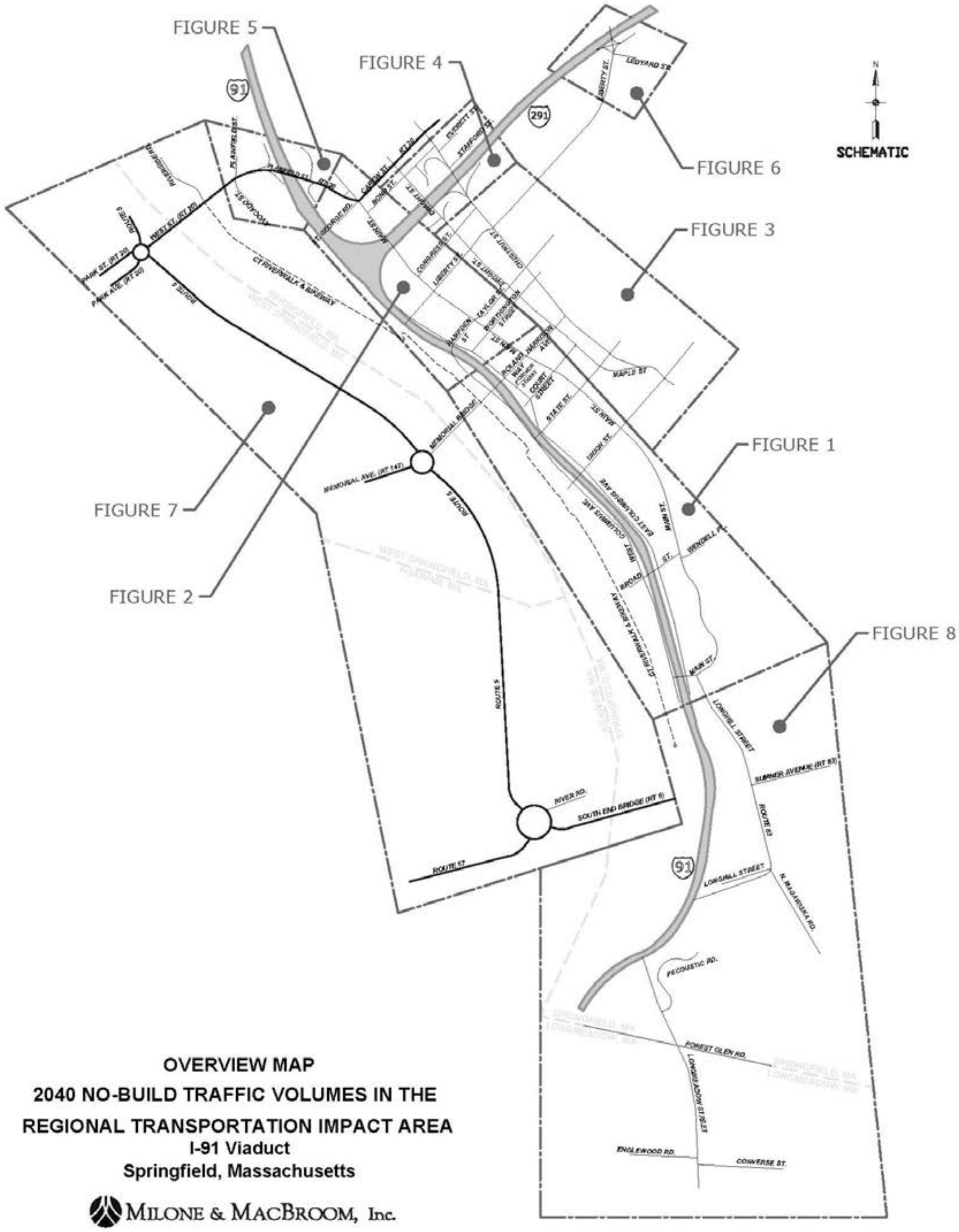


Figure 2-44: 2040 No-Build Traffic Volumes – Overview Map

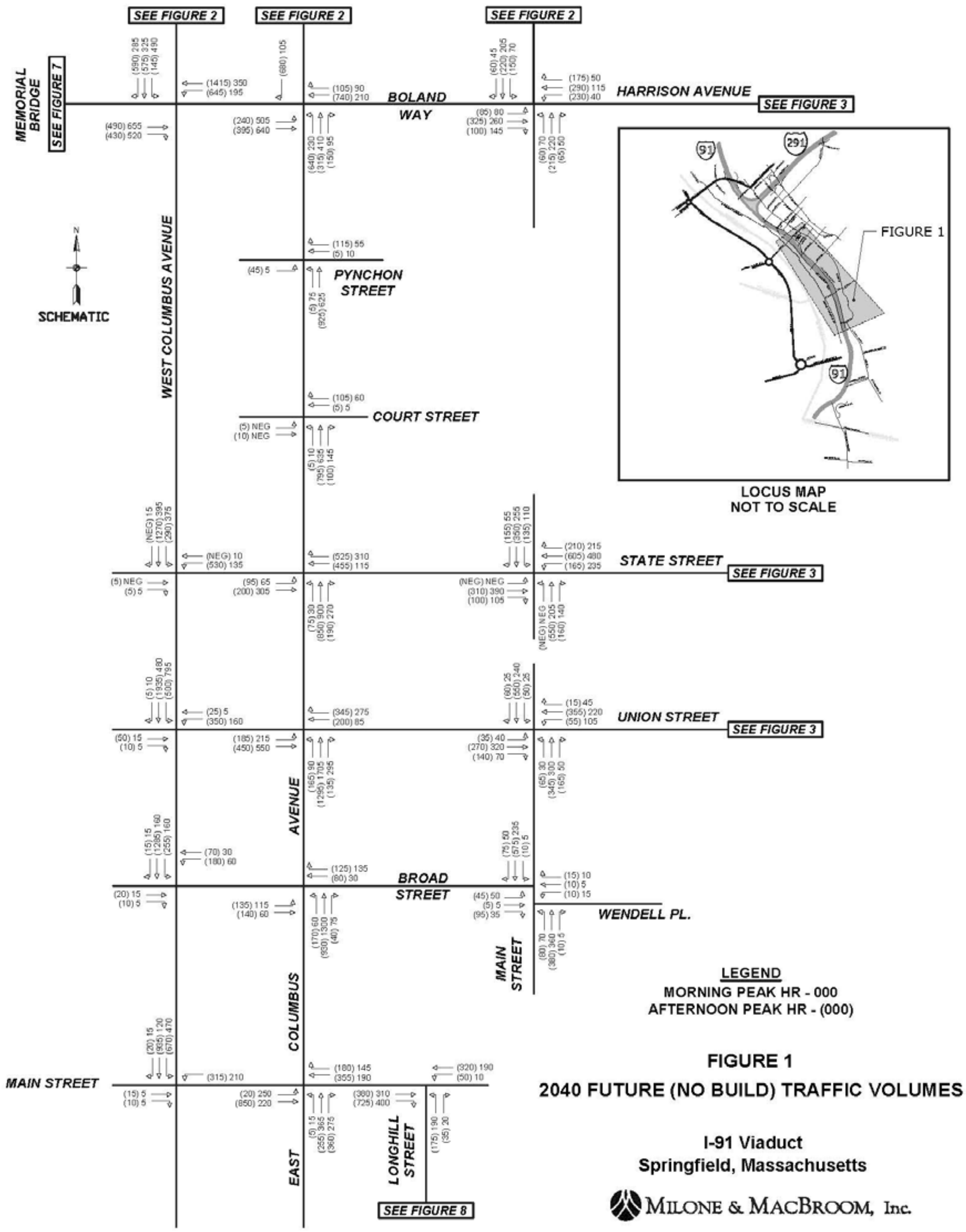


Figure 2-45: 2040 No-Build Traffic Volumes Map – #1

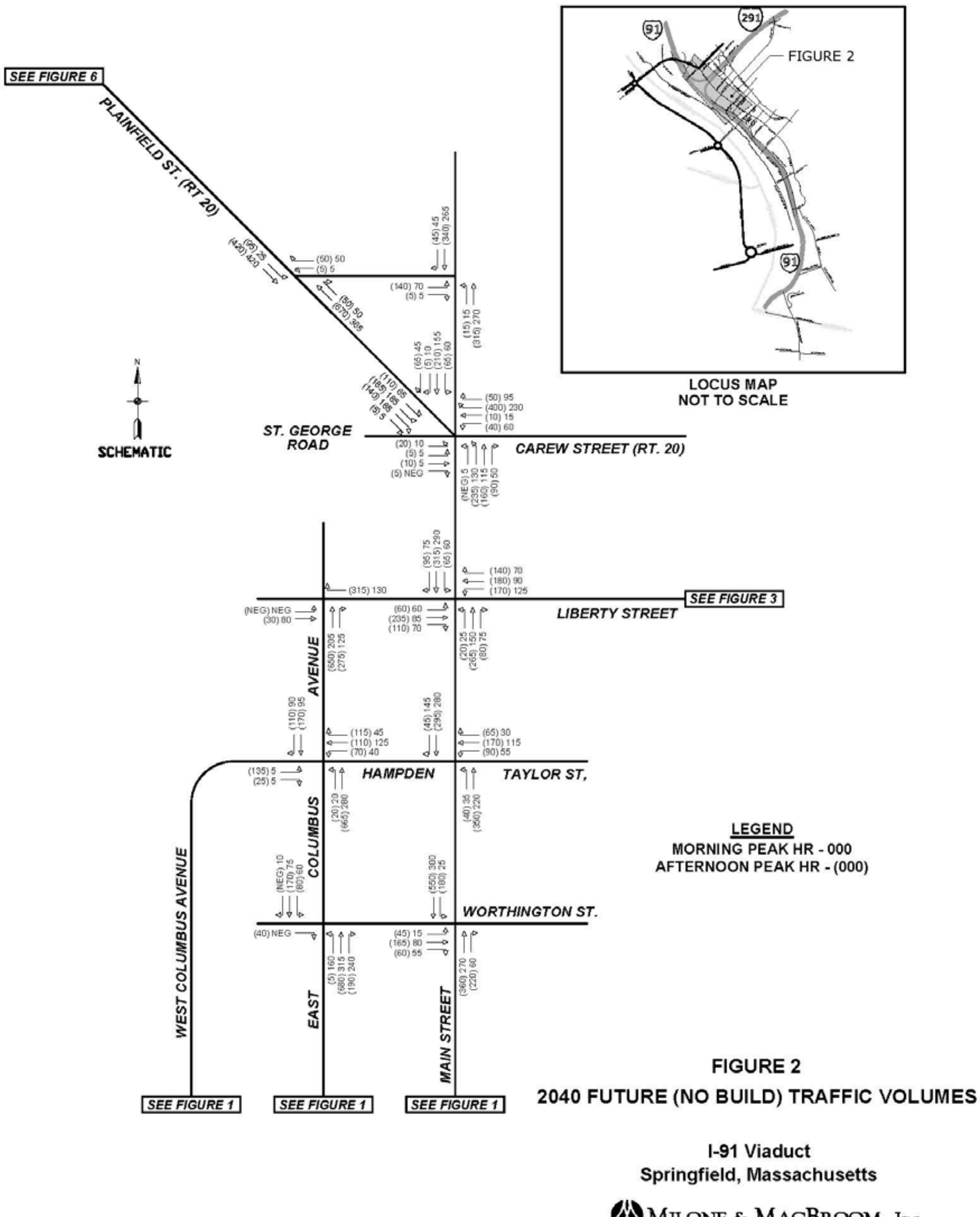


Figure 2-46: 2040 No-Build Traffic Volumes Map – #2

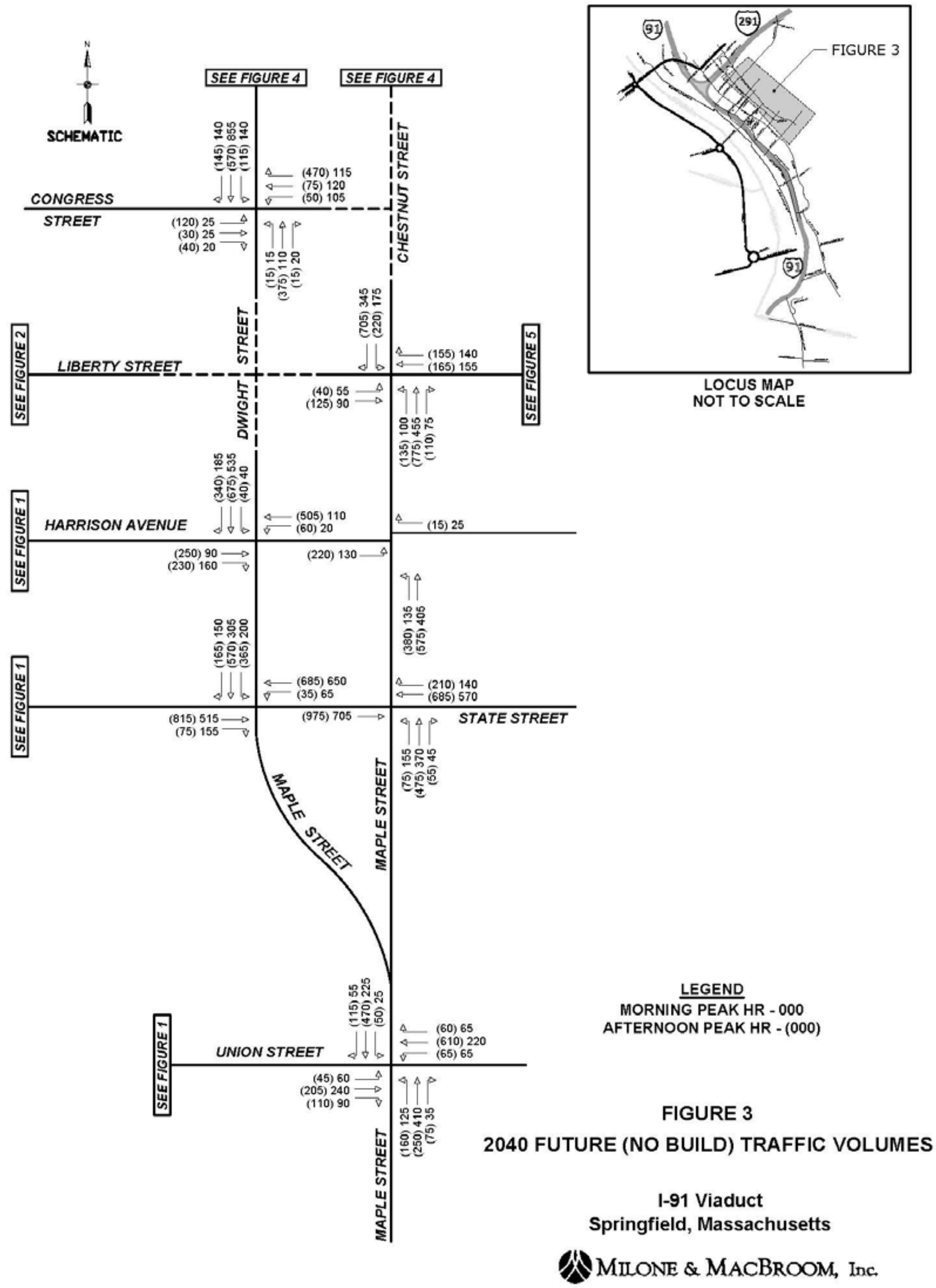


Figure 2-47: 2040 No-Build Traffic Volumes Map – #3

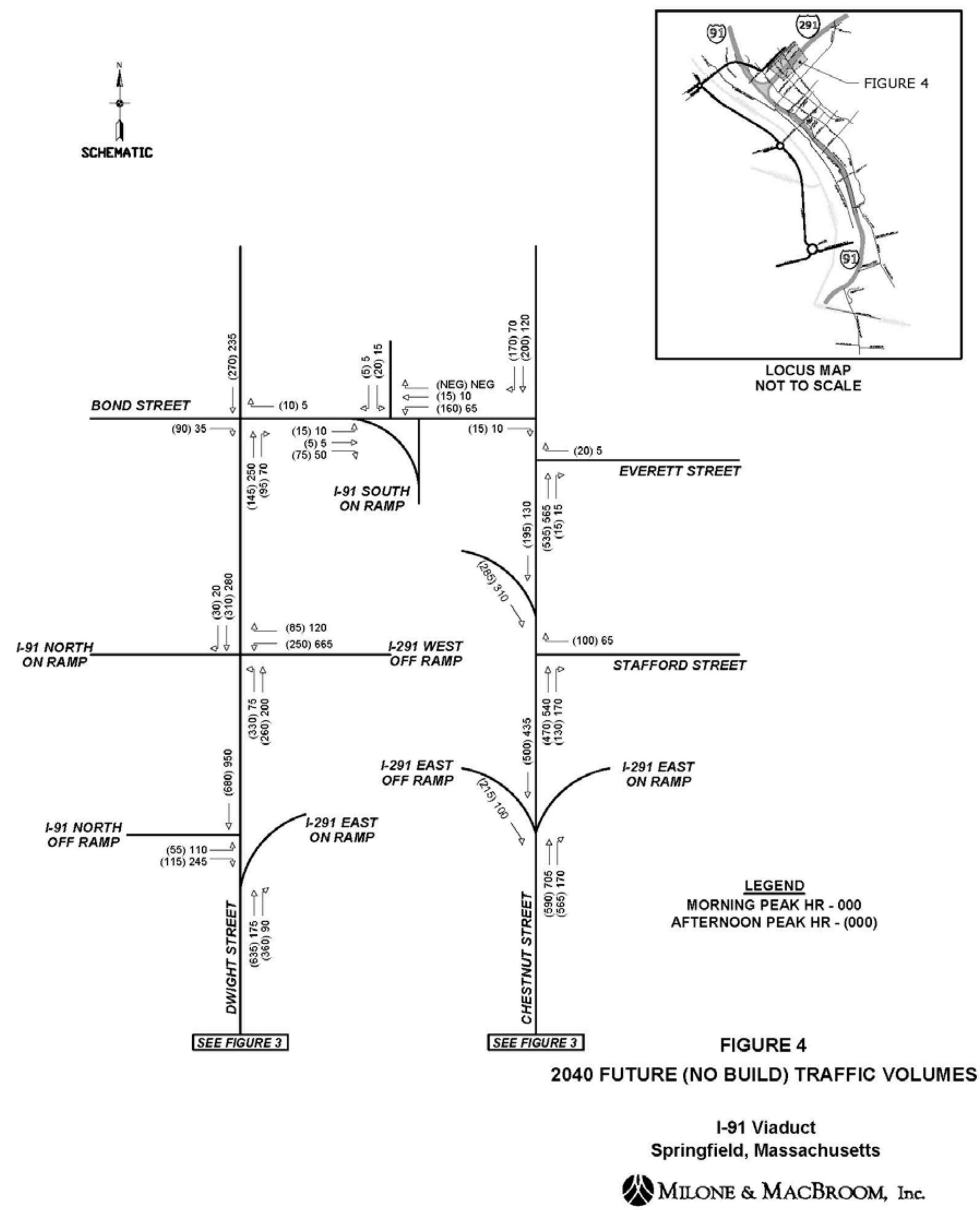
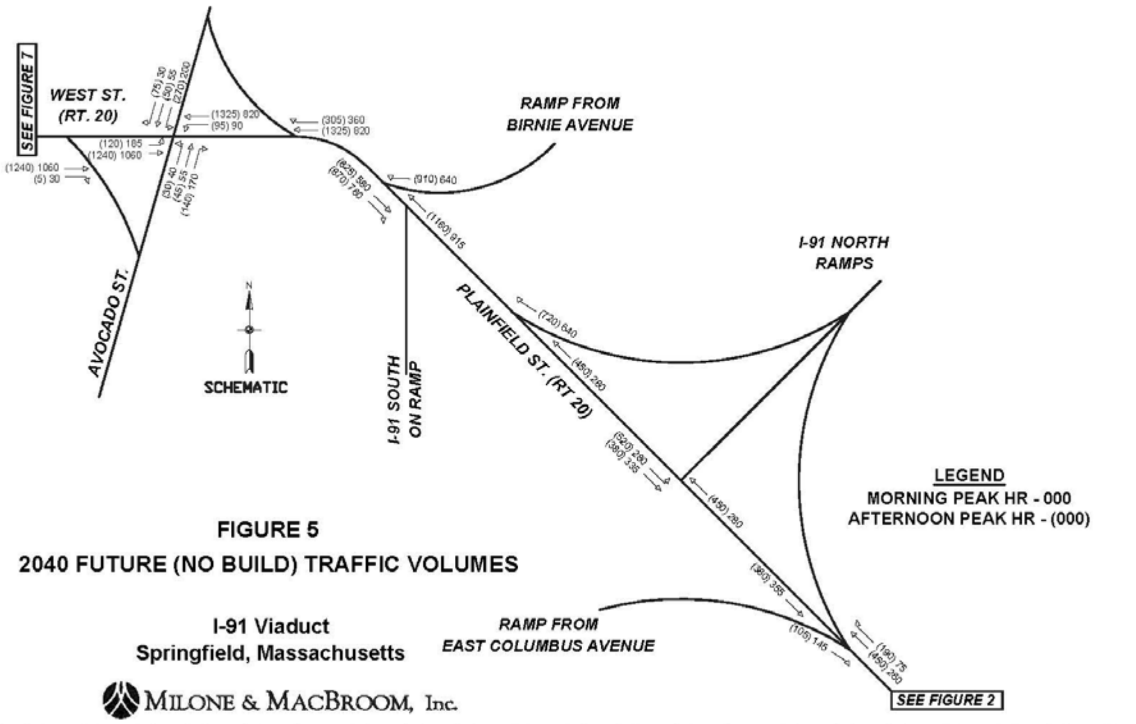


Figure 2-48: 2040 No-Build Traffic Volumes Map – #4



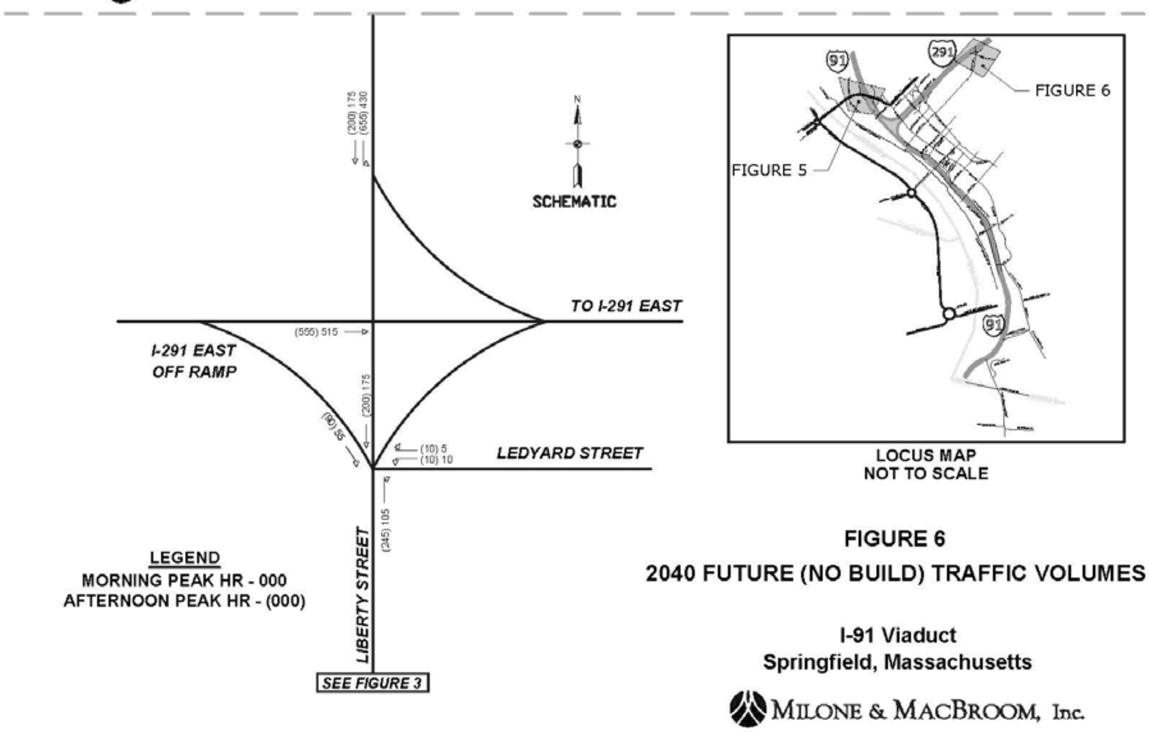


Figure 2-49: 2040 No-Build Traffic Volumes Map – #5 and #6

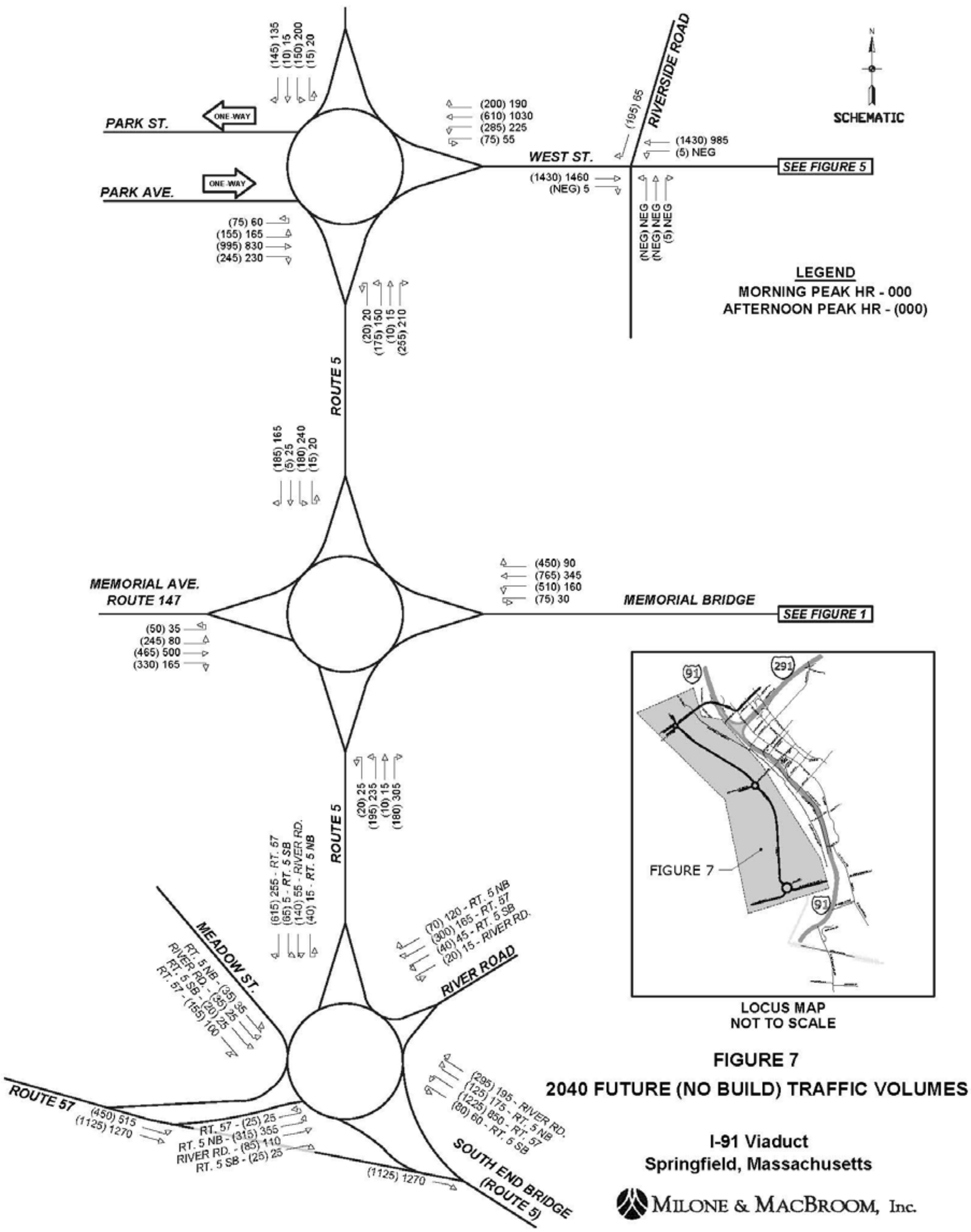


Figure 2-50: 2040 No-Build Traffic Volumes Map – #7

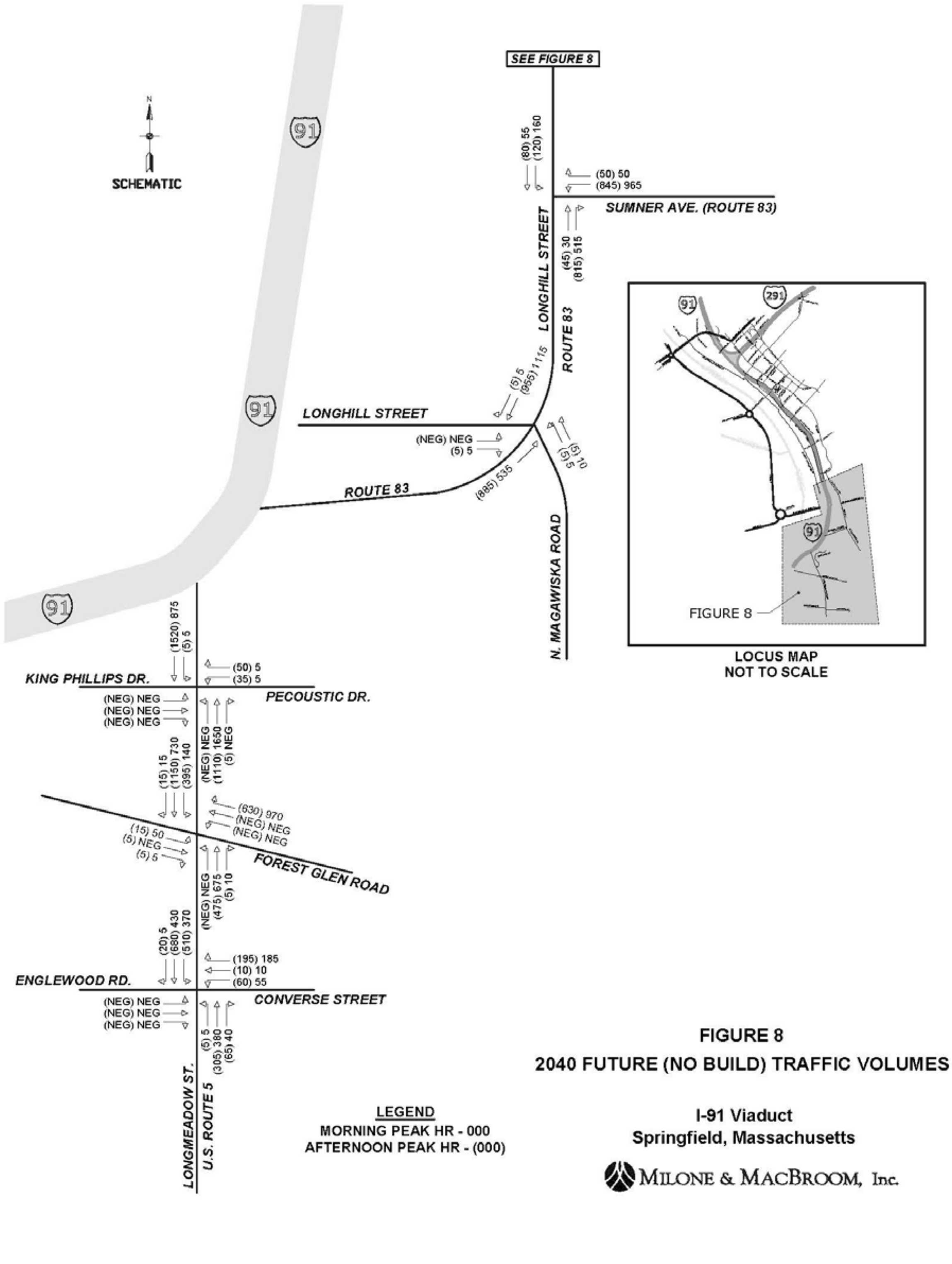


Figure 2-51: 2040 No-Build Traffic Volumes Map – #8

Signalized Intersections

Appendix C contains metrics of traffic congestion at signalized intersections for the 2040 No-Build condition. All mitigation measures that are being incorporated by MGM Springfield were introduced to the locations that are being analyzed within this report. The 2040 No-Build scenario shows a number of signalized intersections in the Primary Study Area where LOS has deteriorated to LOS E or worse in the AM and PM peak periods. These changes in traffic conditions are typically due to an increase in expected traffic volumes without an associated change in the intersection's geometry or signal timings. The following is a list of the signalized intersections with an LOS of E or worse under the 2040 No-Build conditions:

City	Intersection Location	Level of Service
Longmeadow	Forest Glen Road and Western Avenue at US-5	F (AM peak), E (PM peak)
Springfield	Longhill Street and Magawiska Street at Route 83 (On/Off Ramps to I-91)	E (AM peak)
Springfield	State Street at Main Street	E (PM peak)
Springfield	Broad Street and East Columbus Avenue	E (AM peak)
Springfield	Harrison Avenue and Boland Way at Main Street	E (PM peak)
Springfield	Worthington Street at Main Street	F (PM peak)
Springfield	Hampden and Taylor Streets at Main Street	E (PM peak)
Springfield	Boland Way and East Columbus Avenue	E (PM peak)
Springfield	Memorial Bridge/Boland Way at West Columbus Avenue	E (PM peak)
Springfield	Congress Street and Dwight Street	F (AM and PM peaks)
Springfield	US-20 (Plainfield Street) at Main Street and Carew Street	F (AM and PM peaks)

Potential mitigation measures for these locations, such as geometric improvements or timing changes, may be examined as appropriate in the alternatives presented in Chapters 3 and 4.

Unsignalized Intersections

Appendix C contains metrics of traffic congestion at unsignalized intersections for the 2040 No-Build condition. All locations are located within the city of Springfield limits, and the results were very similar to the existing condition results. Overall, all intersections for both AM and PM peak periods were at a LOS of D or better with the exception of the following:

- I-91 NB On/Off Ramps at US-20 Plainfield Street in the PM, LOS F
- I-91 NB On/Off Ramps at US-20 Plainfield Street in the AM and PM, LOS E and F, respectively

Potential mitigation measures for these locations, including geometric improvements, may be examined as appropriate in the alternatives presented in Chapters 3 and 4.

Rotaries

Appendix C includes the analysis information for the rotaries that are located in West Springfield and Agawam. The rotaries in West Springfield are located at the end of the North End Bridge and the Memorial Bridge on the west side of the Connecticut River. The rotary in Agawam is located at the interchange of River Road, US-5, and Route 57. All include the same features, lane arrangements, and geometry in the No-Build scenario as they did in the existing conditions portion of this chapter. The results, as expected, worsened due to increased traffic volumes and no geometric roadway improvements. The rotary in Agawam and the North End Bridge rotary in West Springfield both perform at LOS F in both the AM and PM peak periods while the Memorial Bridge rotary performs at LOS E in the AM peak and LOS F in the PM peak.

Freeways

Traffic operations data for the 2040 No-Build conditions along freeway segments within both the Regional Study Area and Primary Study Area are provided in Appendix C. Similar to existing conditions, modeling of these segments demonstrated that the freeway segments generally operate at LOS C or better with several exceptions.

LOS D conditions exist on I-90 traveling eastbound in the vicinity of Exit 4 in West Springfield and Exit 5 in Chicopee during the PM peak period, indicating that some congestion is present during that time. These two locations are located outside of the Primary Study Area but were analyzed in the context of evaluating wider regional traffic operations. The PM peak period along I-91 southbound between the Memorial Bridge and South End Bridge also operates at a LOS D in the 2040 future No-Build conditions.

Lastly, challenging conditions will continue to exist along I-91 in the vicinity of the Longmeadow Curve section during AM and PM peak periods in the 2040 No-Build scenario. The width of I-91 decreases from three lanes to two lanes in this section in both the northbound and southbound directions. Simultaneously, there are a series of on and off ramps within a relatively short distance of one another. The combined effect of these geometric conditions is a worsening of traffic conditions to LOS D during peak hours.

Weaving

Traffic modeling shows that the freeway weaving segments operate at a range of LOS from B to F in the AM and PM peak periods for the No-Build 2040 future conditions. In the AM peak period, six of the weaving sections operate at a LOS D or worse. In the PM peak period, 11 of the weaving sections operate at a LOS D or worse, an increase of one location compared to the existing conditions. In both AM and PM peak periods, segments currently operating at LOS D degraded to LOS E. Within the

Primary Study Area, the ramps remain the same as existing conditions in the future and along I-91 and I-291 are still within close proximity of one another. Many of the ramps are too close to one another. This remains a safety issue. Providing an adequate balance of speed and spacing between ramps is key to maintaining unconstrained operation on highway weaving segments. It will be essential to improve on the weaving segments during the alternatives analysis. Eliminating ramps within the Primary Study Area will create a much safer and efficient means of travel along I-91 and I-291. Traffic operations data for freeway weaving segments is included in Appendix C.

Ramps

Forty-two on-ramp and off-ramp areas were studied for both the AM and PM peak periods for the 2040 No-Build scenarios. The analysis for the 2040 No-Build scenario showed that the majority of freeway ramps operate at LOS C or better during the AM and PM peak periods. During the AM peak period, 26% of the ramp sections operate at LOS D or worse, an increase of 4% from the existing conditions. During the PM peak period, 26% of the ramp sections operate at LOS D or worse, a 5% increase from the existing conditions. Appendix C includes a table that profiles the LOS and Density (pc/mi/ln) for each ramp during the AM and PM peak periods. During the alternatives evaluation process, ramp length, horizontal and vertical curvature, and flare considerations will be examined for opportunities to improve LOS at these locations.

MULTIMODAL TRANSPORTATION

Under future 2040 No-Build conditions, it is assumed that none of the pedestrian, bicycle, or public transit accommodations will be changed with the exception of the mitigation measures described by MGM Springfield's Environmental Impact Report (EIR) and the opening of Union Station.

Proposed Bicycle and Pedestrian Improvements

Within Downtown Springfield, MGM Springfield will be implementing bike lanes along public roadways and improving pedestrian features at numerous signalized intersections. Some of these improvements include the following:

- Bike lanes across the Memorial Bridge
- Bike lanes along State Street under I-91 between East and West Columbus Avenues
- Bike lanes along Union Street under I-91 between East and West Columbus Avenues
- Optimized pedestrian timings and new pedestrian signal equipment at Union Street and East Columbus Avenue
- Optimized pedestrian timings and new pedestrian signal equipment at Union Street and Main Street. Upgraded wheelchair ramps to meet the current ADA standards
- Widened sidewalks along the MGM site frontage
- Bicycle wayfinding along Union Street and State Street
- Sharrow lane markings and bicycle signage along Union Street

- Upgraded pedestrian push buttons and wheelchair ramps at the intersection of State Street and Main Street
- Bike boxes at the intersection of Dwight Street and State Street
- Bike lane on the east side of Main Street from Union Street northerly to just past Lyman Street
- Bike boxes at State Street and Main Street
- Bike lanes in both directions along Lyman Street between Main Street and Dwight Street
- Upgraded pedestrian signal equipment at Court Street and Main Street
- Upgraded pedestrian signal equipment at Harrison Avenue and Boland Way and Main Street
- Sidewalk reconstruction along US-20 (Plainfield Street) easterly side as well as ramps and pedestrian crossing features
- New pedestrian signal equipment at US-20 at Plainfield Street and Avocado Street

Proposed Public Transit Improvements

Mentioned earlier in this chapter, the PVTA is in the process of studying bus rapid transit service along State Street. Additionally, MGM Springfield will be providing a trolley service that will operate under the PVTA and will serve several destinations in the Downtown Springfield area. The trolley service will be free for patrons and employees. An additional element of the MGM project that may impact transportation in Downtown Springfield may be proposed alterations to bus stops along Main Street between Union Street and State Street, which will be relocated and improved with new bus shelters and proper bus stop lengths. Details of these proposed improvements are described in the MGM Springfield Final EIR document.

2.3 LAND USE AND PLANNING

This section describes current land uses, as well as land use planning and regulations, in place across the Primary Study Area and (to a lesser extent) the Regional Study Area. Current economic conditions within and surrounding each of the Study Areas were also analyzed to better develop and understand the Future No-Build scenario.

Most of the Primary Study Area lies within the city of Springfield with additional portions located in the towns of Longmeadow and Agawam. The town of West Springfield is immediately adjacent to the Primary Study Area. All of these towns lie within Hampden County. Intermunicipal planning activities in these communities are carried out by the Pioneer Valley Planning Commission.

The larger Regional Study Area also runs through Springfield, Agawam, Longmeadow, and West Springfield but is also comprised of portions of the cities of Holyoke and Chicopee.

Data utilized to analyze land use, planning, and economic development conditions in the study areas included the following data types and sources:

- Local comprehensive planning documents
- Previous conceptual planning studies
- Land-use patterns
- Zoning regulations
- Right-of-way
- Property values
- Tax revenue data
- Regional employment data sources
- Elevation and visibility information
- Public facilities and utilities

2.3.1 EXISTING CONDITIONS, DATA COLLECTION, AND ANALYSIS

MUNICIPAL COMPREHENSIVE PLANS

A municipal comprehensive plan guides policy toward community-derived goals for future land use, development, and conservation in a community. Typically, comprehensive plans include information about current housing stock, utilities, roads, parks and recreational facilities, and other valuable resources as well as strategies for how those features should be improved or maintained in future years. In Massachusetts, town comprehensive plans are typically called "Master Plans." The Master Plans of each community lying within or adjacent to the boundary of the Primary Study Area were reviewed and analyzed to assess the municipalities' goals and objectives within the Study Areas. The analysis focused on existing and planned land use, transportation, and other infrastructure.

CITY OF SPRINGFIELD

REBUILD SPRINGFIELD PLAN (2012)

This plan was initiated in response to the tornado that struck Springfield in 2011 but evolved into a comprehensive plan for the city. District One of the Rebuild plan includes the Metro Center neighborhood that lies southeast of the intersection of I-91 and I-291 and the South End neighborhood that lies immediately south of Metro Center. Key initiatives proposed in the plan affect housing, commercial and retail, community institutions, public spaces, the urban character, and historic resources directly adjacent to I-91.

The plan specifically focuses on improving connections between the river and Downtown Springfield, noting the following issues:

- The Riverfront and the Naismith Memorial Basketball Hall of Fame are currently isolated and underutilized.
- Improving the integration of these resources with Downtown Springfield is a key goal; the I-91 Viaduct currently acts as an obstacle between them.
- Pedestrian access and visible sight lines to the riverfront should be improved.

In addition, the plan establishes six major goals for the city, which it refers to as "Domains." All of these Domains include recommendations and action steps related to resources within the Primary or Regional Study Area and potential improvements that could be realized as part of a Viaduct reconfiguration. They are listed in Table 2-18 below.

TABLE 2-18: Domains, Recommendations, and Action Steps from the Rebuild Springfield Plan

Domain	Recommendation/Action Step	Relation to Primary or Regional Study Area
1. Focus transportation resources to better serve and connect Springfield residents.	Create bikeways/walkways throughout the city to connect recreational assets.	Regional Study Area
	Study current bus routes for potential efficiency gains through loop routes.	Primary and Regional Study Areas
2. Develop and harness Springfield's role as the economic heart of the Pioneer Valley.	Complete high-priority development projects such as: Union Station Redevelopment State Street Corridor Court Square Medical District Springfield Data Center Civic Center Parking Garage South End Main Street	Primary and Regional Study Areas

3. Make Springfield's Downtown a focus of economic development efforts.	Improve access to and activity at the riverfront through improved pedestrian access and visibility.	Primary Study Area
	Increase boating-related activities.	Regional Study Area
4. Build on existing physical assets to celebrate Springfield's unique and diverse aesthetic character.	Modernize zoning regulations, including the introduction of design standards.	Primary and Regional Study Areas
	Improve neighborhood connections, traffic calming, and the efficiency and impact of street lighting.	Primary and Regional Study Areas
5. Increase access to health and wellness services.	Connect leaders and citizens to efforts to enhance walkability, hiking, and biking in specific neighborhoods.	Primary and Regional Study Areas
6. Improve the reality and perception of public safety in Springfield.	Actions under this strategy focus on law enforcement procedures and programming; however, a reconfiguration of the Viaduct could impact perceived and actual safety in the surrounding area.	Primary and Regional Study Areas

TOWN OF LONGMEADOW

The Town of Longmeadow does not currently have a Master Plan but in 2004, the town did adopt a Community Development Plan called "Longmeadow Faces the Future: The Longmeadow Long Range Plan." The plan was created under Massachusetts Executive Order 418, which offered planning funds to Massachusetts communities to create plans that linked housing with economic development, transportation, open space, and resource protection while considering existing infrastructure, its economy, and the need to preserve the town's unique character.

LONGMEADOW FACES THE FUTURE: THE LONGMEADOW LONG RANGE PLAN

The Longmeadow Long Range Plan made several recommendations related to locations within the Regional Study Area. In the Environmental & Resource Protection section of the plan, it recommended the development of a riverfront park on Anthony Road between the Connecticut River and I-91. The Housing section of the plan recommended the adoption of less restrictive zoning on Longmeadow Street in conjunction with design guidelines and historic preservation measures to facilitate the adaptive reuse of large homes. With respect to transportation issues, residents of Longmeadow were primarily concerned with safety, speeding, and traffic. The plan noted that traffic delays in Longmeadow are largely due to regional traffic patterns and must be addressed at a regional level. In particular, the U.S. Route 5 corridor, which provides direct access to I-91, experiences severe rush hour traffic delays.

TOWN OF AGAWAM

Agawam's Master Plan dates from 1977. Although there are clear limits to what insight a document of this age can have for an evolving community, it was reviewed to determine what development and land use goals it established for the Primary or Regional Study Areas. The town also utilizes two more recent documents, a Community Development Plan and an Economic Development Plan, which together serve some of the same purposes as an updated Master Plan.

TOWN OF AGAWAM, MASSACHUSETTS, MASTER PLAN (1977)

The plan lays out existing conditions in Agawam with regard to population distribution, housing, and economic conditions. The plan records that much of the Primary and Regional Study Areas are floodplain, and as such, residential developments should be restricted to densities of two families per acre. In 1977, the area was primarily industrial or mixed industrial/commercial.

Bondi's Island, a 110-acre site near the South End Bridge in the Regional Study Area, was planned as a recreational area. The 2010 Economic Development Plan singles this same site out for potential industrial development.

COMMUNITY DEVELOPMENT PLAN (2004)

Like Longmeadow's 2004 plan, Agawam's Community Development Plan was also created under Massachusetts Executive Order 418 and primarily addresses the town's affordable housing needs. The plan also examines demographic changes, open space and resource protection, and transportation, with a cursory look at land use changes. The plan notes that the town underwent significant development over the preceding decades, resulting in significant increases in residential and industrial land uses and a reduction in agricultural and forested land. Seeking strategies to slow this loss of open space is one of the plan's primary aims.

The transportation section of the plan identifies the South End Bridge, which connects Agawam to I-91 in Springfield in the Regional Study Area, as being the location of a high number of traffic accidents. The plan states that the connection between the South End Bridge and the Agawam rotary is complex, with a "fairly complicated structure of ramps and bridges connecting the rotary to U.S. Route 5, Route 57, River Road, Meadow Street and the South End Bridge." The plan identifies this complicated structure as resulting in traffic conflicts in the rotary.

ECONOMIC DEVELOPMENT PLAN (2010)

The Economic Development Plan outlines existing economic conditions in Agawam and lists development goals for the town. The plan developed five "Priority Areas" for potential new commercial or industrial development in town. Priority Area 5 is Bondi's Island, located at 147 M Street in the Regional Study Area. The plan states that the vacant 110-acre Bondi's Island site is a brownfield with limited wetlands that is zoned Industrial A. The development strategy established for the area is large-scale commercial, recommending approximately 500,000 square feet of retail.

Although the plan included conceptual designs for some of the other, larger Priority Areas, no designs for Bondi's Island were included.

TOWN OF WEST SPRINGFIELD

WEST SPRINGFIELD MASTER PLAN (2009)

West Springfield's Master Plan comprehensively addresses West Springfield's physical, political, and economic environment. Several of the plan's goals and recommendations are related to locations within the Regional Study Area.

The Land Use section of the plan recommends developing pedestrian and bicycle walkways in conjunction with neighboring communities, implementing and enforcing traffic calming measures, and exploring recreational development of the Riverfront area. The Open Space and Recreation section of the plan recommends improving access to the Connecticut River at the Agawam town line near the Big E and constructing a Connecticut Riverwalk/Bikeway and Riverfront Park. The Natural and Cultural Resources section of the plan recommends identifying and preserving critical parcels for scenic views along the Connecticut and Westfield Rivers. The Transportation and Circulation section of the plan recommends investigating ways to reduce traffic congestion and determining if the town's rotaries are sized adequately for their current level and type of traffic.

SUMMARY

A couple of overarching themes emerged from this review of local plans in the Primary Study Area. The first is a general goal for most communities to increase recreational access and use along the Connecticut River and generally capitalize on the value of this significant natural resource for recreational and economic development potential. The second overarching goal is to reduce traffic congestion in the region, especially along principal arterials, and improve traffic safety.

REVIEW OF PREVIOUS CONCEPTUAL PLANNING STUDIES

Municipalities, developers, and other nongovernmental entities produce conceptual planning studies for individual properties or parcel groups as a component of a development plan.

The following plans, studies, and/or project descriptions detail development projects that could potentially impact the selection of an alternate alignment for the Viaduct. Projects within or adjacent to the Primary Study Area are depicted in Figure 2-52.

PRIMARY STUDY AREA

While developments within and immediately adjacent to the Primary Study Area would potentially be impacted by changes to the Viaduct alignment and could play a role in determining alignment alternatives, developments in the outer portions of the Regional Study Area were not included in this analysis because they would not contribute substantially to the consideration of potential alignments.

COURT SQUARE REDEVELOPMENT, SPRINGFIELD

This proposed $25 million renovation of 3-7 Elm Street and 13-31 Elm Street aims to transform this six-story historic structure into a center for commerce and business, with upper floor Class A office space and ground floor retail. The original 3-7 Elm Street portion of the building was constructed in 1835 and is one of the oldest buildings in Springfield. The 13-31 Elm Street portion of the building was constructed in 1892 and connected to the original structure in 1900. The University of Massachusetts has committed to locating an Urban Design Center on the site. The Springfield Redevelopment Authority recently reviewed new conceptual plans to turn the block into a boutique hotel associated with the MGM Grand Casino project. Planning for the site is ongoing.

STATE STREET CORRIDOR REDEVELOPMENT PROGRAM (2008)

State Street is Springfield's major east-west connector, and this program included the entire 3.2-mile corridor, from I-91 in the east to Berkshire Avenue and Boston Road in the west. The program identified market opportunities and potential redevelopment sites along the corridor. The new federal courthouse opened in 2008 on State Street, and significant roadway improvements have been made along the corridor. The goal of the program is for State Street to continue to be a vital link between residents, local businesses, and area institutions. The program envisions State Street as an urban boulevard with strong visual appeal, acting as a front door to neighborhoods, key institutions, and employers.

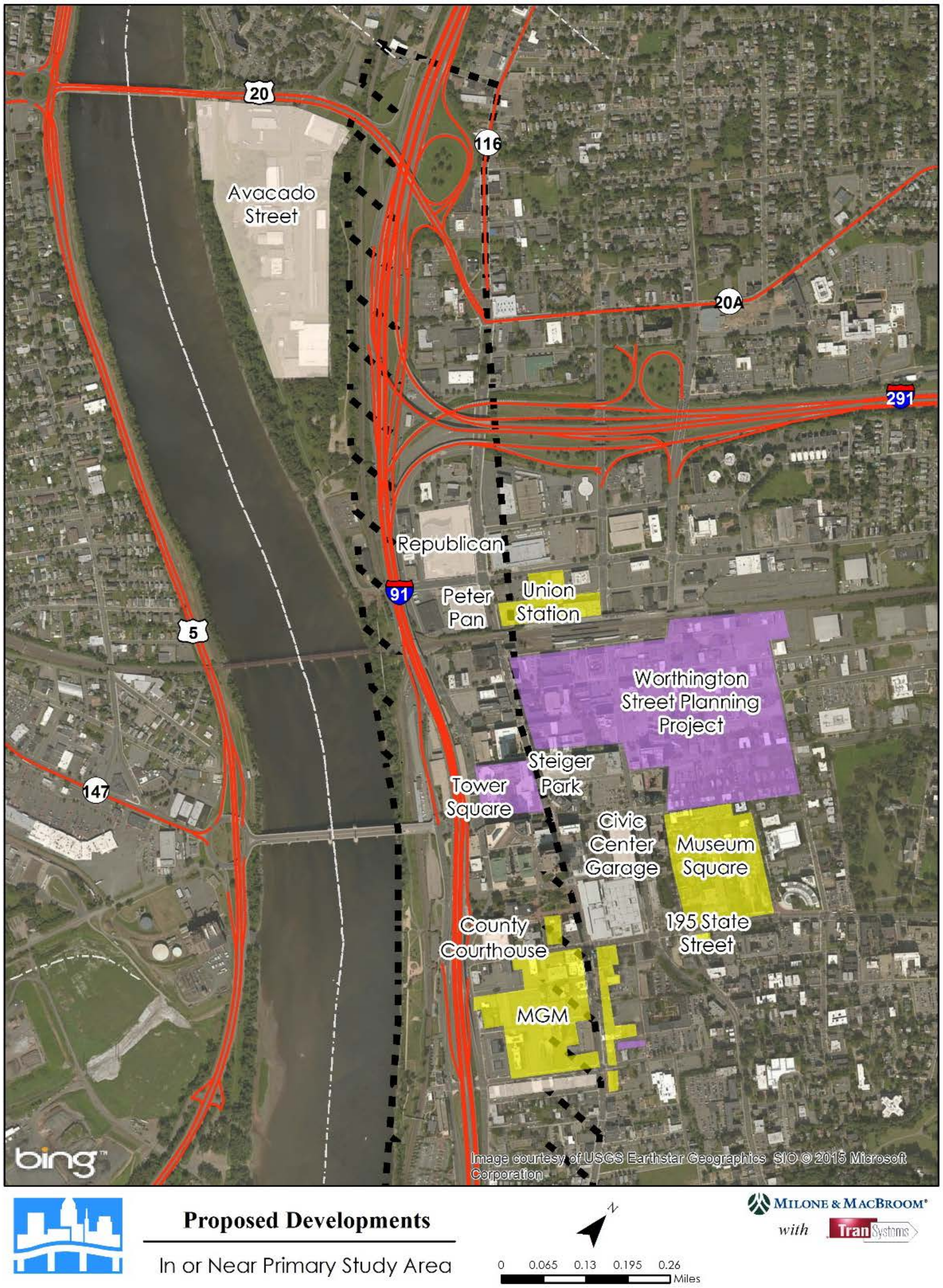


Figure 2-52: Proposed Development Projects in the Vicinity of the Primary Study Area

REGIONAL STUDY AREA

SMITH AND WESSON INDUSTRIAL PARK (ONGOING)

The Springfield Smith and Wesson Industrial Park is an 85-acre industrial park site located immediately south of I-291 on Roosevelt Avenue in the East Springfield neighborhood, approximately 2.5 miles from I-91. The area is owned by the Springfield Redevelopment Authority (SRA) and is being developed in conjunction with MassDevelopment. Two major developments have occurred with a food distribution center and a plumbing supply warehouse relocating to the park. The park can produce a maximum buildout of 650,000 square feet and is zoned for industrial, commercial, and/or general office use.

UNION STATION RESTORATION (ONGOING)

Springfield's historic Union Station is being restored as part of a collaboration between the SRA and the Massachusetts Historical Commission, restoring the building's historic facade and major public interior areas while modernizing its structure to improve safety, accessibility, and environmental performance. The project aims to integrate multiple modes of transportation in a convenient, functional, mixed-use complex linking local and intercity buses; Amtrak, intercity, and New Haven-Hartford-Springfield commuter rail; as well as taxi, bicycle, and pedestrian travel services.

This project also seeks to do the following:

- Reactivate Union Station as a regional landmark.
- Create a multimodal gateway to the city and the region.
- Capitalize on investment in Union Station as a catalyst for further development around the station.
- Reconnect the North End, north blocks, and historic core of Downtown; Springfield.
- Create significant employment opportunities.

OPEN SPACE & RECOVERY ACTION PLAN 2008-2015

Issued by the Springfield Planning Board and the city's Office of Planning & Economic Development, the plan presents a 7-year program of open space improvements and outlines improvements for several parks and resources in the Regional Study Area. Broadly, the plan recommends initiating programs that promote recreational use of the Connecticut Riverwalk and Bikeway, encouraging connections between the Riverwalk and other destinations, and promoting the recreational use of the Connecticut River at the renovated Riverfront Park and elsewhere.

More specifically, the plan recommends a number of specific improvements to Forest Park. At Barney Mausoleum in the park, the plan recommends installing an atrium. At the Walker Grandstand in the park, the plan recommends performing cosmetic renovations and creating new classroom spaces. At Pynchon Plaza, located between Dwight and Chestnut Streets, the plan recommends repairing an elevator and fountain and improving pedestrian access.

MGM SPRINGFIELD: FINAL ENVIRONMENTAL IMPACT REPORT (2014) AND NOTICE OF PROJECT CHANGE 10-15-15

The 2014 Final Environmental Impact Report provides extensive detail on the MGM Casino project planned adjacent to I-91 in Springfield, in the Regional Study Area. The project is proposed as a mixed-use site comprising retail, casino, hotel, movie theater, restaurant, and associated uses on a previously developed site (see figure 2-53). The project is being undertaken by Blue Tarp reDevelopment, LLC.

In October 2015, Blue Tarp reDevelopment submitted a Notice of Project Change to the Massachusetts Executive Office of Energy & Environmental Affairs. The notice describes many changes to the project, most notably that the proposed housing units would be relocated off site, the proposed hotel would be relocated and reduced to six stories rather than 25, and the proposed parking garage would be reduced by one level.

As revised, the $950 million project would comprise 14 acres, including 13.7 acres of impervious area, a 102-foot-tall structure including 759,000 square feet of space, 54 housing units located at a secondary site, and a 3,375-space parking garage. As of January 2018, the Massachusetts Gaming Commission described the construction as proceeding on schedule with an expected opening date of September 2018.

Figure 2-53: 2015 Rendering of the Revised Plans for the MGM Springfield Project

SUMMARY

All of these potential developments serve to strengthen Springfield's draw as the economic hub of the region. Even recreational improvements along the Connecticut River in Springfield will likely increase visitors and therefore serve as catalysts for economic development. The casino project will affect traffic patterns in terms of both volumes and peak periods through a significant increase in visitors from a large region. Improvements to the transit network, both bus and rail, could help reduce the impacts of the anticipated increase in visitors to Springfield and I-91.

EXISTING LAND USE AND ZONING

The zoning regulations of each of the four municipalities within or abutting the Primary Study Area were reviewed by the project team in order to understand the types of land uses currently permitted under existing regulations. Uses permitted within the Primary Study Area range from low-density residential and agricultural uses to high-density downtown office, retail, and high-rise housing, to overlay districts with additional design standards. See Figure 2-54 for a composite (graphic) map of the Primary Study Area existing zoning information.

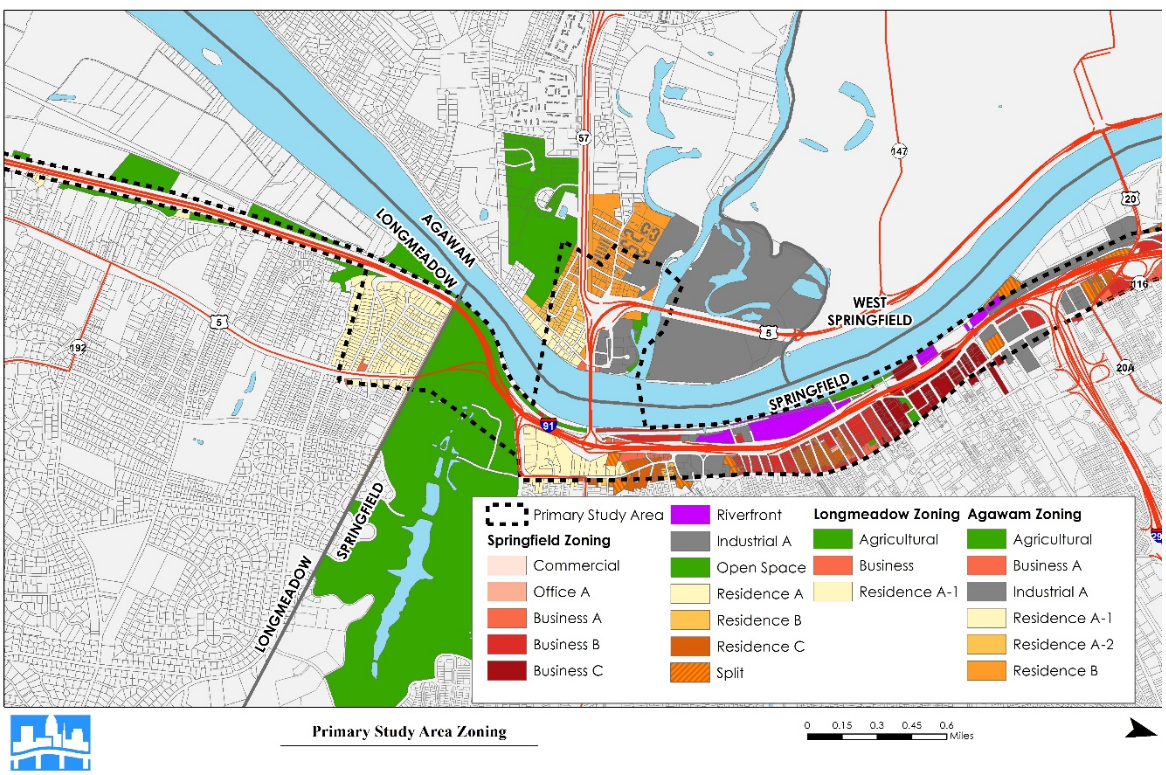


Figure 2-54: Primary Study Area Zoning

Each municipality provides for low- to moderate-density residential uses and neighborhood or community retail and service uses in the neighborhoods adjacent to I-91. Agawam and Longmeadow are less densely developed communities than Springfield and West Springfield, and their zoning provides for agricultural uses as well. Agawam and West Springfield zone for moderate density residential uses (such as two- to four-family housing) and a range of industrial uses. West Springfield's business districts allow for an additional increment of density and a mixture of residential and commercial uses. Downtown Springfield, as the urban core of the region, provides the greatest range of zoning districts and the highest allowable density of land use, including downtown business and dense multifamily housing.

Key features of each zoning district within the Primary Study Area are summarized by municipality in the tables below. Key terms include the following:

- *Approximate FAR* refers to the maximum permitted floor-area ratio (FAR), a measure of density calculated from the maximum allowable building footprint and height.
- *Approximate Residential Density* refers to the maximum number of dwelling units permitted per buildable acre of land.
- *Height Limit* refers to the maximum allowable height of any building (with some exemptions for architectural features such as bell towers, cornices, and the like).
- *Dwelling Unit (DU)* refers to a structure or part of a structure that is used as a residence by one or more persons.

SPRINGFIELD

Springfield's 2013 zoning ordinance update introduced a variety of modernized standards, new and consolidated zoning districts, and new provisions for mixed-use development. The regulation provides for three levels of development review, with administrative review of simple site plans, Planning Board review of more complex site plans, and City Council review of special permit uses. The Primary Study Area cuts through a variety of zones and uses, including the most densely developed Downtown Springfield corridor (between East Columbus Avenue and Main Street), various commercial and industrial districts, and neighborhoods of varying density. The West Columbus and Riverfront zones adopted with the 2013 ordinance revisions are of particular relevance to planning for the I-91 Viaduct. Each district is intended to facilitate the redevelopment of lands directly adjacent to the Connecticut River, including existing industrial lands and surface parking adjacent to the Basketball Hall of Fame. See Table 2-19 for a summary of all the city's zoning districts within the Primary Study Area.

TABLE 2-19: Springfield's Zoning Districts in the Primary Study Area

Springfield	Approximate FAR	Approximate Residential Density	Height Limit	Typical Uses	Other Notes
Business A	3.00	32 DU/acre	60 ft	Shopping district, residential allowed	
Business B	3.20	150 DU/acre	60 ft	General business	
Business C	25.33	150 DU/acre	400 ft	Downtown business, residential allowed	
Commercial A	1.10	N/A	30 ft	Neighborhood retail and services	
Riverfront	*Not specified*			Mixed use, medium density residential, recreation and entertainment	
Industrial A	6.33	N/A	100 ft	Business/industrial uses	
Office A	1.10	N/A	35 ft	Offices (residential conversions)	
Open Space	N/A	N/A		Active/passive recreation	
Residential A	N/A	6 DU/acre	35 ft	Low-density residential (single family)	
Residential B	N/A	11 DU/acre	35 ft	Moderate-density residential (one-two family)	
Residential C	N/A	17.5 DU/acre	35 ft	High-density residential (one, two, and multifamily)	
West Columbus	*As per underlying zoning*			Retail, commercial, recreation and entertainment	Redevelopment area with additional design standards

AGAWAM

Agawam's zoning within the Primary Study Area provides for relatively low levels of residential density; the Residence B district provides for up to four-family residences but restricts such housing to densities below four units per acre. An area of Industrial A zoning north of the South End Bridge/U.S. Route 5 provides for both small-scale industrial uses and limited neighborhood retail and services. It also includes a small area zoned Agricultural although no agricultural or forestry uses are currently active in the area. See Table 2-20 for a summary of all the town's zoning districts within the Primary Study Area.

TABLE 2-20: Agawam's Zoning Districts in the Primary Study Area

Agawam	Approximate FAR	Approximate Residential Density	Height Limit	Typical Uses	Other Notes
Agricultural	N/A	2 DU/acre	35-50 ft	Low-density residential (single family), agriculture and forestry	
Business A	1.50	4 DU/acre	45 ft	Moderate-density residential (one-two family), retail and services	
Industrial A	1.00	N/A	40 ft	Industrial, agricultural, commercial	
Residence A-1	N/A	2.5 DU/acre	35 ft	Low-density residential (single family)	
Residence A-2	N/A	3 DU/acre	35 ft	Low-density residential (single family)	
Residence B	N/A	3.5 DU/acre	35-50 ft	Moderate-density residential (one-four family)	

LONGMEADOW

Much of Longmeadow's land in the vicinity of I-91 and the Connecticut River is dedicated conservation land, and zoning in this area of the town emphasizes compatible low-density residential and agricultural uses. A small area zoned for business uses is also present at the north end of Longmeadow on U.S. Route 5. See Table 2-21 for a summary of all the town's zoning districts within the Primary Study Area.

TABLE 2-21: Longmeadow's Zoning Districts in the Primary Study Area

Longmeadow	Approximate FAR	Approximate Residential Density	Height Limit	Typical Uses	Other Notes
Agriculture	N/A	2.5 DU/acre	35 ft	Low-density residential (single family), agriculture	
Business	*Not specified*	2.5 DU/acre	35 ft	Low-density residential (single family), retail, services, and offices	
Residence A-1	N/A	2.5 DU/acre	35 ft	Low-density residential (single family)	

WEST SPRINGFIELD

Zoning districts proximate (within 0.5 mile) to the North End Bridge in West Springfield provide for both residential neighborhoods and a mix of institutional and commercial uses as is prevalent along Park Avenue and Elm Street. Commercial uses in these zones are restricted to moderate densities appropriate for a smaller-scale town center. In addition, industrial uses are zoned for the area southwest of Park Avenue and Union Street. See Table 2-22 for a summary of all the town's zoning districts nearest to the Primary Study Area.

TABLE 2-22: West Springfield's Zoning Districts Most Proximate to the Primary Study Area (Within 0.5 Mile of the North End Bridge)

West Springfield	Approximate FAR	Approximate Residential Density	Height Limit	Typical Uses	Other Notes
Residence B	N/A	8.5 DU/acre	40 ft	Higher-density residential (one-two family)	
Residence C	N/A	8.5 DU/acre	60 ft	Higher-density residential, professional office	Higher residential densities permitted in 6+ DU buildings
Neighborhood Business	1.88	N/A	40 ft	Neighborhood retail and services	
Business A	3.60	N/A	60 ft	Retail and services corridors	
Business A-1	3.00	N/A	75 ft	Mixed institutional, commercial, office, and multifamily residential uses	
Business B	2.40	N/A	60 ft	Commercial and industrial	
Central Business	3.60	N/A	60 ft	Mixed services, retail, and commercial	Pedestrian oriented, character area
Industrial	2.40	N/A	60 ft	High-density industrial	

SOCIOECONOMICS

Data regarding existing economic and demographic conditions and trends in the Primary Study Area regarding employment, businesses, commuting, population, housing, and the local real estate market were compiled by the University of Massachusetts Donahue Institute's Economic and Public Policy Research group (EPPR). The data include both a detailed, local analysis of Downtown Springfield (the development area most likely impacted by I-91 Viaduct alternatives) as well as economic and demographic data for the city of Springfield, nearby cities and towns, and Hampden County. A set of summary indicators for towns located within the Regional Study Area is provided on Table 2-23 below.

TABLE 2-23: Demographic Characteristics of Agawam, Chicopee, Holyoke, Longmeadow, Springfield, and West Springfield[6]

Demographic Characteristics	Agawam	Chicopee	Holyoke	Longmeadow	Springfield	West Springfield
Total Population	28,555	55,478	40,029	15,835	153,428	28,498
Percent White	93.1%	85.8%	82.3%	90.7%	52.5%	86.4%
Percent Black or African American	1.6%	3.5%	4.2%	0.8%	21.7%	3.9%
Percent Hispanic or Latino (of any race)	4.8%	15.3%	48.3%	4.0%	40.5%	8.4%
Median Household Income	$63,609	$46,709	$31,628	$106,173	$34,311	$54,126
Per capita Personal Income	$29,857	$24,810	$19,968	$53,767	$18,133	$27,853

POPULATION DISTRIBUTION AND DENSITY

The most recent population data available for Springfield and the surrounding metropolitan area are from the ACS, an ongoing survey conducted by the U.S. Census Bureau that provides up-to-date estimates of the population of communities throughout the United States. Because the ACS is a survey of a representative sample of the population and not a complete count of every individual, it contains a margin of error that is higher than the decennial census. This higher margin of error makes the ACS unsuitable for providing year-by-year data on small geographies such as Census tracts with fewer than 20,000 inhabitants. For this reason, ACS only provides 5-year estimates for

[6] Source: 2009-2013 American Community Survey 5-Year Estimates

individual census tracts. Where ACS 5-year estimates are used, the year named refers to the five-year period ending in that year, for example, 2013 refers to 2009-2013.

While some economic and employment data are best analyzed at the municipal or regional level, for other types of data the area immediately surrounding the project in Downtown Springfield is the most relevant. For this smaller geographic area immediately surrounding the project, data were collected on the two downtown census tracts (8008 and 8011.01) that most closely correspond to the Primary Study Area, depicted in Figure 2-55. Together, these two downtown census tracts cover approximately 0.78 square miles. The boundaries of these two census tracts are not precisely the same as the Primary Study Area that is referred to throughout this I-91 Viaduct Study but represent the closest possible approximation using existing Census geographies. Because their boundaries are not identical, this study will refer to these two tracts as "the downtown census tracts" rather than "the Primary Study Area."

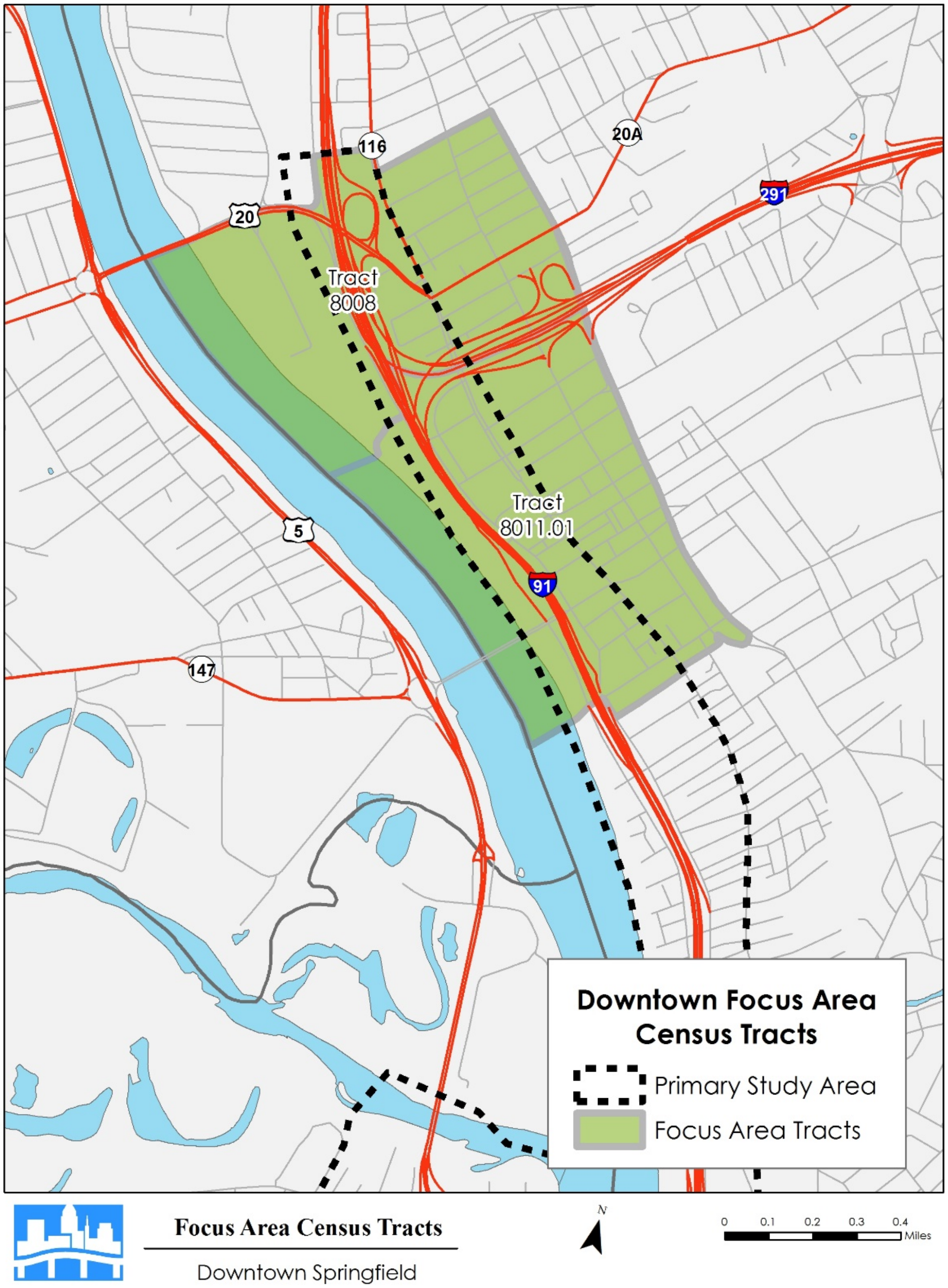


Figure 2-55: Map of Downtown Census Tracts, Encompassing Tracts 8008 and 8011.01

Over the past decade, Springfield and the other municipalities that comprise the Regional Study Area have experienced very modest population growth. None of the cities and towns in the region grew by more than 1.5% from 2004 to 2014 while Massachusetts statewide grew by 5.2% (and has been growing more quickly than any other state in the Northeast). While growth was slow compared to state trends, none of the six cities and towns lost population during this time.

TABLE 2-24: Selected Years' Population and 10-Year Growth – Springfield, Surrounding Cities and Towns, and Massachusetts

Area	2004	2010	2014	% Change 2004-2014
Agawam	28,365	28,438	28,772	1.4%
Chicopee	55,113	55,298	55,795	1.2%
Holyoke	39,988	39,880	40,124	0.3%
Longmeadow	15,751	15,784	15,882	0.8%
Springfield	152,936	153,060	153,991	0.7%
West Springfield	28,210	28,391	28,627	1.5%
Massachusetts	6,412,281	6,547,629	6,745,408	5.2%

Source: U.S. Census Bureau, Annual Estimates

HOUSEHOLDS AND HOUSING UNITS

Intrinsically linked to an area's population is its number of households and its number of housing units. The U.S. Census Bureau defines a housing unit as a house, an apartment, a mobile home, a group of rooms, or a single room that is occupied or intended for occupancy as separate living quarters. The residents of each occupied housing unit are considered by the Census Bureau to be a household whether or not they are related and whether the housing unit is occupied by one person or a dozen. Each set of occupants in a housing unit equals one household.

Springfield's downtown is typical of many urban core areas in the northeast – predominantly rental housing serving lower-income households. The total number of housing units in the downtown census tracts and in Springfield as a whole are shown in Table 2-25. The downtown census tracts have roughly 3.7% of Springfield's total housing units and 2.7% of the city's population, indicating that household sizes are smaller in the Downtown Springfield area than in the city as a whole. The average household size is 1.98 people per occupied housing unit in Downtown Springfield, which is well below the city average of 2.74 people. The average household size in the Commonwealth of Massachusetts is 2.61 people.

TABLE 2-25: Number of Housing Units

	Focus Area		Springfield	
	Total Housing Units	%	Total Housing Units	%
Occupied	2,057	90.6%	55,894	90.4%
Vacant	213	9.4%	5,943	9.6%
Total	2,270	100.0%	61,837	

Source: American Community Survey, 2009-2013 Five-Year Estimates

Of the 2,270 housing units in the downtown census tracts, only 181 of them, or 8%, are owner occupied. This is typical for an urban core, where rental units are more common. In the city as a whole, 27,102 housing units out of 61,837, 44%, are owner occupied. The median value of these ownership units is $86,304 in the downtown census tracts and $147,000 in Springfield as a whole.

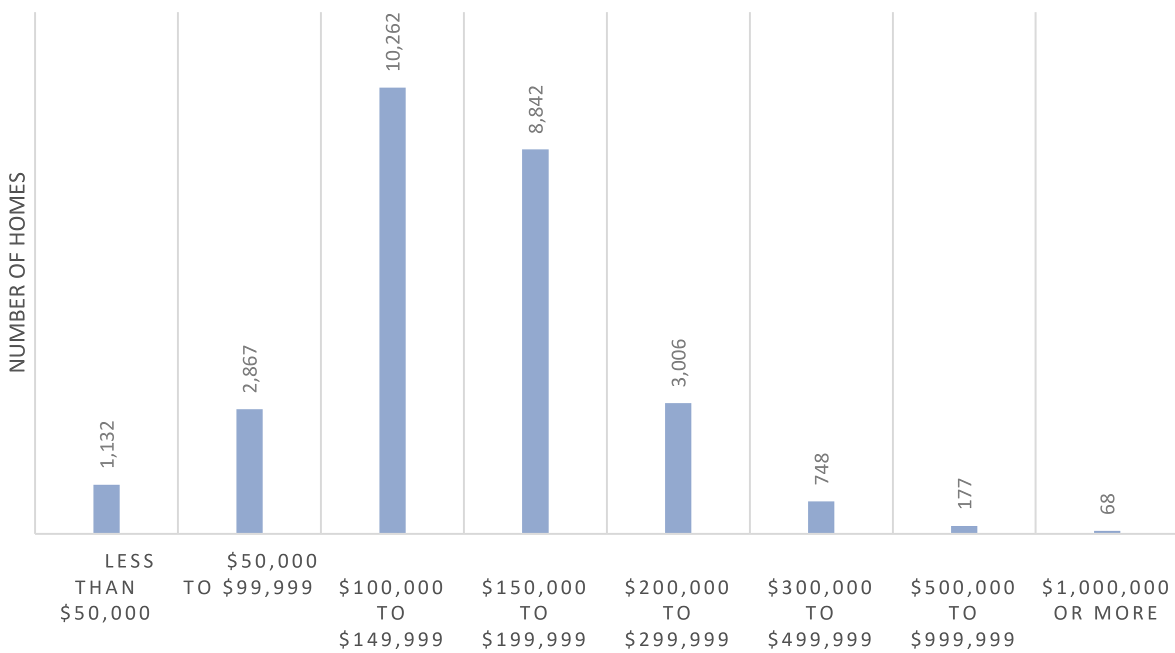


Figure 2-56: Housing Values – City of Springfield

Source: American Community Survey, 2009-2013 Five-Year Estimates

The majority of the housing units in the downtown census tracts, 83% (1,876 of 2,270 units), are offered for rent. In Springfield as a whole, only 45% (27,966 of 61,837 units) are rented. Median rent is $673 in the downtown census tracts and $804 in Springfield as a whole.

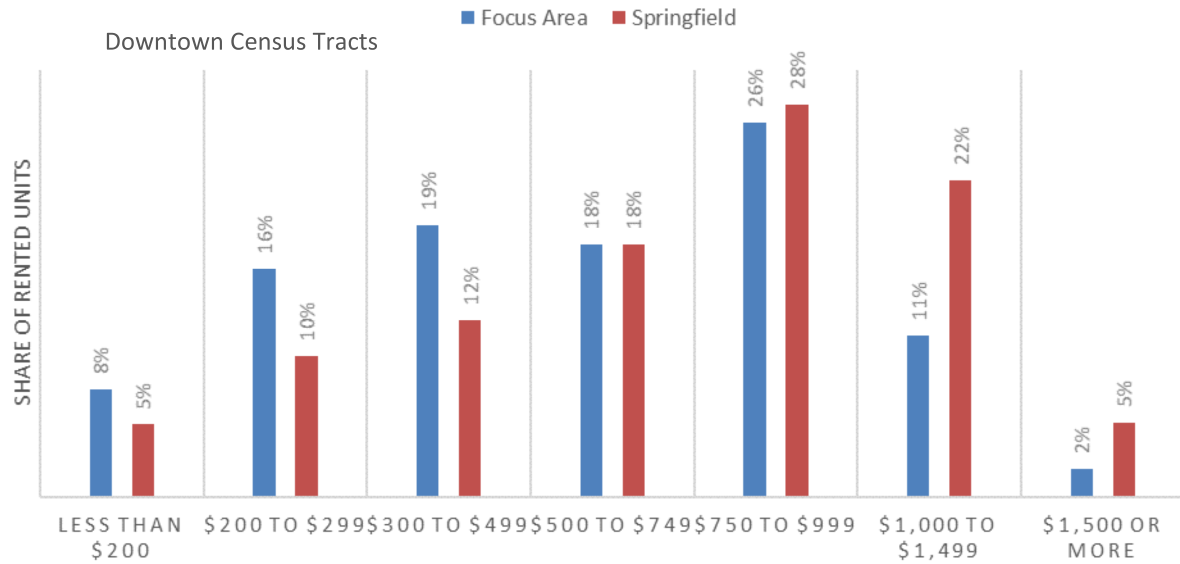


Figure 2-57: Gross Rent in Downtown Census Tracts and City of Springfield

Source: American Community Survey, 2009-2013 Five-Year Estimates

The rents in both the downtown census tracts and Springfield as a whole are high relative to the household income of renters. These rates are of particular concern because roughly half of households in the downtown census tracts and the city as a whole pay over 35% of their income to rent.

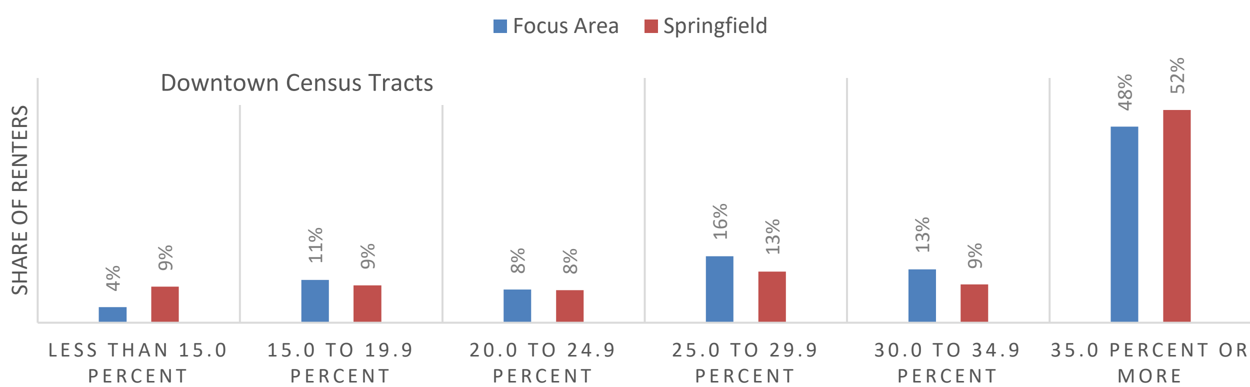


Figure 2-58: Gross Rent as a Percentage of Income

Source: American Community Survey, 2009-2013 Five-Year Estimates

EMPLOYMENT AND LABOR FORCE

UNEMPLOYMENT

Like much of the U.S., Springfield-area employment rates fell as a result of the recession that began in the late 2000s, and although rates have climbed since 2009, much of the region has not fully regained the lost jobs. The labor force is defined as the population age 16 and over that is employed or actively seeking employment. Meanwhile, the labor force participation rate is the share of the labor force relative to the over-16 population. For reasons such as school, old age, illness, and disability, the percentage of those participating in the labor force is never 100% and as of April 2015 is 62.8% at the nationwide level.

Focusing on the ACS five-year estimate for 2013, the unemployment rate in the downtown census tracts was 25% while in Springfield as a whole it was 15%. The higher unemployment rate in the downtown census tracts is mirrored by lower rates of labor force participation in the downtown census tracts (41%) than in the city as a whole (58%). The ACS data also shows that the median age for the downtown census tracts does not differ substantially from Springfield as a whole, suggesting that some factor other than age is responsible for the lower participation rate. These characteristics could include workers who choose to withdraw from the workforce after prolonged unemployment, workers whose skills match poorly with available jobs, or other reasons.

Category	Downtown Census Tracts	City of Springfield
Total Population	4,066	153,428
Population 16 and Over	3,252	117,214
Civilian Labor Force	1,328	67,443
Employed	998	57,361
Unemployed	330	10,082
Labor Force Participation Rate	41%	58%
Unemployment Rate	25%	15%

TABLE 2-26: Summary Employment and Labor Force – Downtown Census Tracts and Springfield as a Whole

Source: American Community Survey, 2009-2013 Five-Year Estimates

When using ACS data, the unemployment rate in the downtown census tracts (25%) is considerably higher than that for the whole city of Springfield, its neighboring cities, Hampden County, and Massachusetts. Springfield and Holyoke have unemployment rates of 15% while all the other areas are below 10%. However, the most widely used data on unemployment rates in Massachusetts is from the Massachusetts Executive Office of Labor and Workforce Development (EOLWD) and is only available at the municipal level and higher. When assessing that data (available on an annual basis through 2014), the rates tend to be a bit lower than the ACS. Figure 2-59 shows the unemployment rates for Springfield and other areas from 2004 to 2014, with Springfield and Holyoke having the highest unemployment rates (still near 10%).

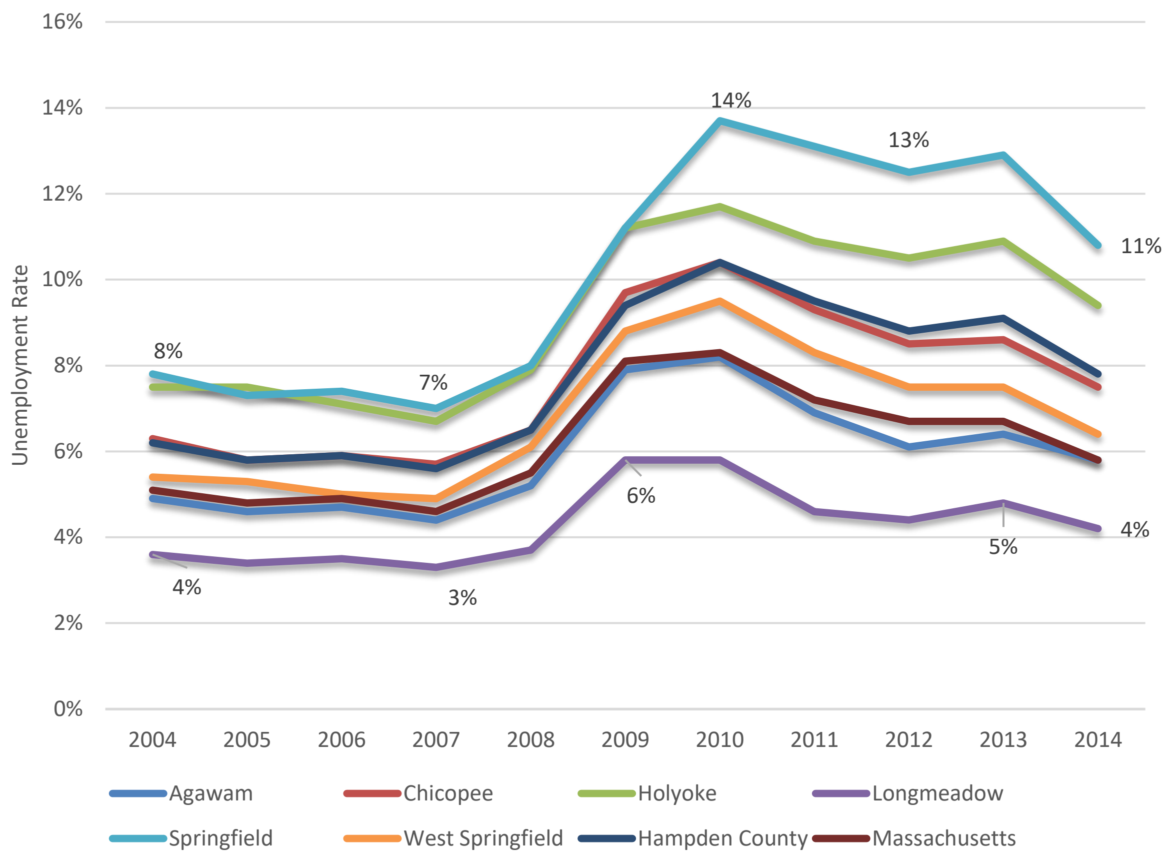


Figure 2-59: Unemployment Rate for Springfield and Other Areas

Source: MA EOLWD, Annual Estimates

EMPLOYMENT

As is to be expected from a downtown area, the total number of jobs in the downtown census tracts far exceeds the labor force. Dun and Bradstreet estimates that in 2014 there were 1,211 business establishments in Downtown Springfield, which employed 13,930 total workers (by place of work).[7] At the same time, this area is home to 3,250 people age 16 and over, with only 1,336 actually in the labor force, indicating that the vast majority of workers in Downtown Springfield do not live

[7] While establishment-based data like that from Dun and Bradstreet have limitations, these numbers do provide a good approximation of the total employment in the immediate Downtown Springfield area.

downtown. The majority of workers who reside in the area are employed in service, sales, production, and transportation occupations. The major employment sectors are transportation, professional and technical services, public administration, and administrative and support services.

TABLE 2-27: Summary Employment Data for Springfield and Surrounding Areas

City or Town	2001	2009	2013	% Change 2001-2013	% Change 2009-2013
Agawam	11,862	11,562	11,850	-0.1%	2.5%
Chicopee	20,560	18,803	18,764	-8.7%	-0.2%
Holyoke	24,045	20,949	21,679	-9.8%	3.5%
Longmeadow	3,261	3,353	3,699	13.4%	10.3%
Springfield	79,927	74,280	77,122	-3.5%	3.8%
West Springfield	18,085	16,777	17,382	-3.9%	3.6%
Hampden County	204,824	192,032	198,402	-3.1%	3.3%

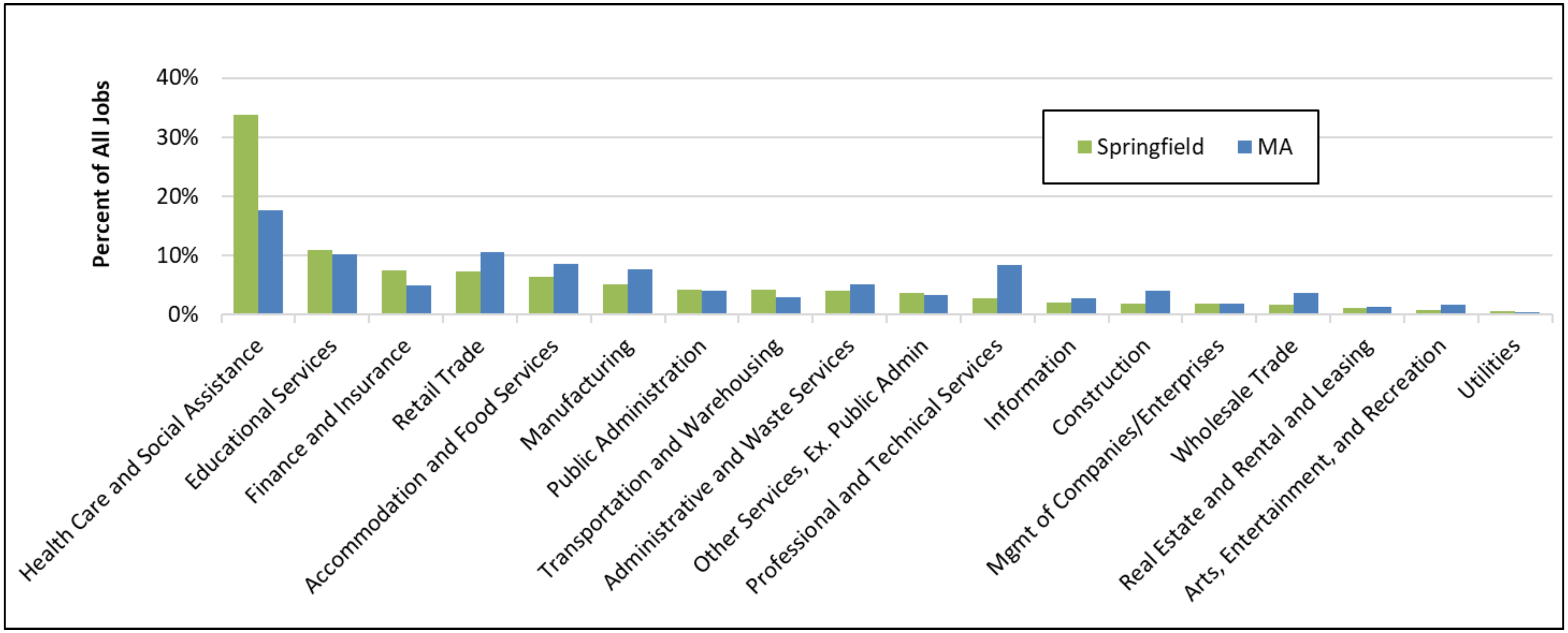
Source: MA Executive Office of Labor and Workforce Development, Annual Estimates

Table 2-27 provides a summary of employment changes across the Regional Study Area between 2001 and 2013. Most of the areas shown had their highest rate of employment in 2001, meaning that they were already in a relative state of decline prior to bottoming out during the recession years of 2008 and 2009. Only Longmeadow experienced a higher rate of employment in 2013 than it did in 2001, possibly due to the overall economic strength and desirability of the town and relatively high percentages of highly skilled professionals such as business executives, physicians, and attorneys.[8]

Employment rates in most municipalities have rebounded from the lows of 2009, however, showing that some employment growth has occurred since the bottom was reached. As of 2013 according to unemployment rates provided by the Massachusetts Executive Office of Labor and Workforce Development, employment rates had risen above the recessionary lows in every municipality except Chicopee. Total employment for municipalities in the Primary and Regional Study Areas IS shown in Table 2-27.

The relative composition of employing industries in Springfield differs notably from those found in the state as a whole. In Figure 2-60, the primary industries driving employment in Springfield are, in descending order, Healthcare and Social Assistance (representing nearly 34% of the city's total employment), Educational Services (11%), Finance and Insurance (8%), and Retail Trades (7%). The Healthcare and Social Assistance, Educational Services, and Finance and Insurance sectors comprise a larger share of the total number of jobs in Springfield than they do in Massachusetts as a whole.

[8] http://datausa.io/profile/geo/longmeadow-ma/



Source: EOLWD, 2013[9]

Figure 2-60: Industry Composition of Employment – Springfield and Massachusetts

[9] QCEW/ES-202 data at the industry detail level are subject to suppression and are therefore sometimes lower than the total. These data at the 2-digit level may underestimate the employment and number of firms in the individual industries presented.

Springfield's Health Care and Social Assistance sector has experienced particularly strong growth over the last 10 years. Since 2003, the number of jobs in this industry has increased by 42% to a total of 26,014 jobs. Other industries that have experienced job growth over the past 10 years include Accommodations and Food Services (+4%), Public Administration (+9%), Administrative and Waste Services (+9%), and Management of Companies and Enterprises (+5%). Other sectors—including Information; Construction; Real Estate, Rental, and Leasing; and Arts, Entertainment, and Recreation — have lost jobs over the past 10 years. Representing only 3 percent of employment in the city, the Professional and Technical Services sector is vastly underrepresented in Springfield despite this being a strong sector for the state overall. Given that this sector contains much of the state's Research & Development and many high-wage jobs, this is a large structural difference from the rest of the state and a challenge to local economic conditions.

Top 10 Residences for Springfield Workers	Workers Commuting to Springfield	Percentage
Springfield	29,972	39%
Chicopee	5,540	7%
Agawam	3,434	5%
Westfield	3,162	4%
West Springfield	3,110	4%
Ludlow	2,872	4%
East Longmeadow	2,605	3%
Wilbraham	2,530	3%
Longmeadow	2,139	3%
Holyoke	1,894	3%
All Other	18,858	25%
Total	76,116	100%

TABLE 2-28: Place of Residence of Those Working in Springfield

Sources: Census, ACS, special tabulation (Residence MCD/County to Workplace MCD/County Flows for the United States and Puerto Rico Sorted by Workplace Geography, 2006-2010)

Springfield is a major regional employment center and attracts workers from around the region. The place of residence of those working in Springfield is shown in Table 2-28, which demonstrates that there are significant ties between local jobs and residents. Of all jobs in Springfield, 39% are held by city residents, 36% by the residents of other cities and towns within the region, and 25% by residents of all other areas.

INCOME

Income data for the downtown census tracts, Springfield as a whole, the Primary Study Area communities, and the Commonwealth of Massachusetts demonstrate wide income disparities between these various communities and geographies. The U.S. Department of Housing and Urban Development (HUD) has established guidelines for categorizing the relative incomes of households within a county or metropolitan area based on the median income of the area. In 2013, HUD's estimate of the median family income for a four-person household in the Springfield Metropolitan Statistical Area (MSA) was $66,100. In 2013, four-person households in the Springfield MSA making less than $64,400 were classified as low income, those making less than $40,950 were classified as very low income, and those making less than $24,550 were classified as extremely low income. Although the ACS does not track the sizes of households as compared to their income, over three-quarters of households in the downtown census tracts would fall below this standard threshold for extremely low-income households. Incomes in Springfield as a whole are significantly higher, with much lower proportions of the population in this extremely low-income category.

Household Income Over Previous 12 Months	Downtown Census Tracts (% of total)	Downtown Census Tracts (absolute)	**All of Springfield (% of total)**	**MA (% of total)**
Less than $10,000	30.4%	625	14.5%	6.2%
$10,000 to $14,999	24.2%	498	10.3%	5.2%
$15,000 to $24,999	21.7%	446	14.7%	8.6%
$25,000 to $34,999	5.6%	115	11.3%	7.8%
$35,000 to $49,999	8.4%	173	13.4%	10.8%
$50,000 to $74,999	5.5%	113	15.4%	16.1%
$75,000 to $99,999	3.0%	61	9.8%	12.9%
$100,000 to $149,999	1.3%	26	7.4%	16.6%
$150,000 to $199,999	0.0%	0	2.0%	7.8%
$200,000 or more	0.0%	0	1.2%	7.9%

TABLE 2-29: Household Income Ranges for Downtown Census Tracts, Springfield as a Whole, and the Commonwealth of Massachusetts

Source: American Community Survey, 2009-2013 Five-Year Estimates

These income disparities are also evident in the median household income data for these geographies. In census tract 8008, the median household income is $16,250, and in tract 8011.01 the median household income is $11,752.[10] These income levels compared to the citywide figures reflect a very small percentage of the city's overall housing stock and population in an area where unemployment is particularly high. The median household income in Springfield as a whole is $34,311. The mean household income within the Downtown Springfield study area is $22,235 while the mean household income in Springfield as a whole is $47,677.

Although residents of Springfield as a whole have significantly higher incomes than residents within the downtown census tracts, when compared to the surrounding communities in the Primary Study Area Springfield residents have the lowest median incomes. The median income in West Springfield is $54,126, meaning that more than half of the households in the town would be considered low income under HUD's four-person household standard. The town of Agawam has a higher median household income at $63,609; however, more than half of their households would also be considered low income under this same HUD standard. Standing far apart from the rest of these communities is Longmeadow, which has a median household income of $106,173, over 60% higher than the median income of the Springfield MSA.

Municipality	Median Income
Agawam	$63,609
Longmeadow	$106,173
Springfield	$34,311
West Springfield	$54,126
Massachusetts	$66,866

TABLE 2-30: Median Incomes for Towns in Regional Study Area and the Commonwealth of Massachusetts

Source: American Community Survey, 2009-2013 Five-Year Estimates

[10] The Census Bureau does not provide access to individual values for income data, and those original data points would be necessary to calculate the median household income for both downtown census tracts.

2.3.2 FUTURE YEAR CONDITIONS

SOCIOECONOMICS

Projections of the prevailing socioeconomic conditions in and beyond the Regional Study Area were prepared at the Traffic Analysis Zone (TAZ) level from 2020 to 2040 by the PVPC's Transportation section. Calculation of these projections was based on data from the 2010 Census and earlier. Key socioeconomic parameters of the model are population counts, counts of households by size, and employment across major economic sectors.

POPULATION DISTRIBUTION AND DENSITY

Across Agawam, Longmeadow, Springfield, and West Springfield, total population is projected to increase by 17,998 persons from 2010 to 2040, for a 30-year growth rate of approximately 8%. The greatest concentrations of population are projected to be located in central and western Agawam; northern, eastern, and western Longmeadow; eastern and the far northwestern tip of Springfield; and central and northwestern West Springfield.

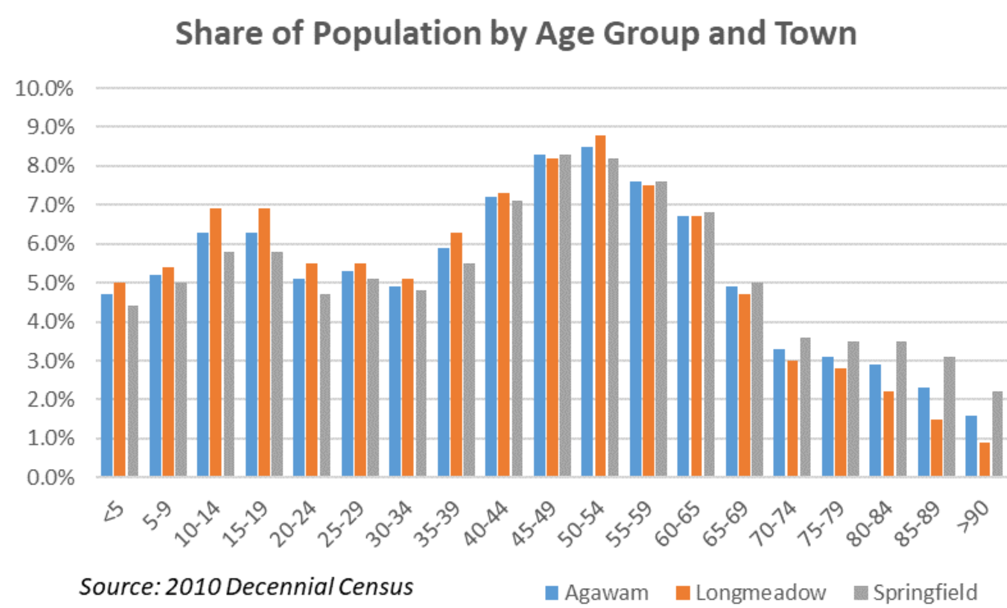


Figure 2-61: Percent of Population by Age Group

Growth in population by 2040 is expected to be low (under 6%) throughout Agawam, Longmeadow, and West Springfield due to recent trends. Across Springfield, by contrast, a number of neighborhoods are expected to experience 9 to 10% population growth, including McKnight, northern Forest Park, East Forest Park, the South End, Upper Hill, and subareas of eastern Springfield such as residential neighborhoods along Breckwood Boulevard. The projected increase within these Springfield neighborhoods can be attributed to the large population of 10 to 24 year olds, who will have aged to age 30 to 44 and will have increased the city's population with their children. Other factors, including migration by age group, also affect future population projections, but the age profiles within these specific areas are the key drivers behind the projection differences. Of note is that Springfield's relatively young age profile is not typical for Massachusetts as a whole. This can be explained by its diverse population, with the Hispanic population in the U.S. generally younger than the non-Hispanic population and the immigrant population likewise younger, on average, than the native population.

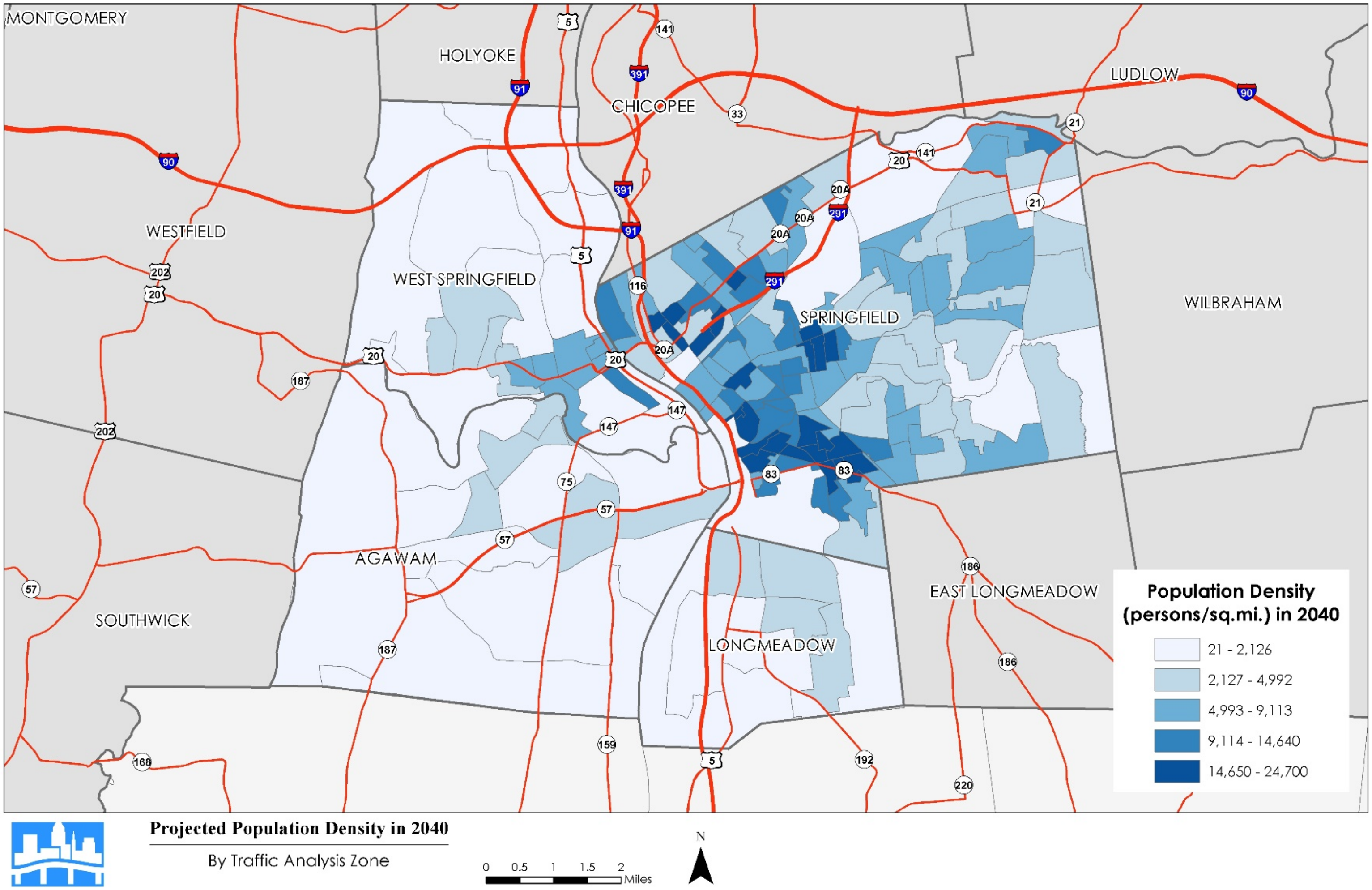


Figure 2-62: Projected Population in 2040, By Traffic Analysis Zone

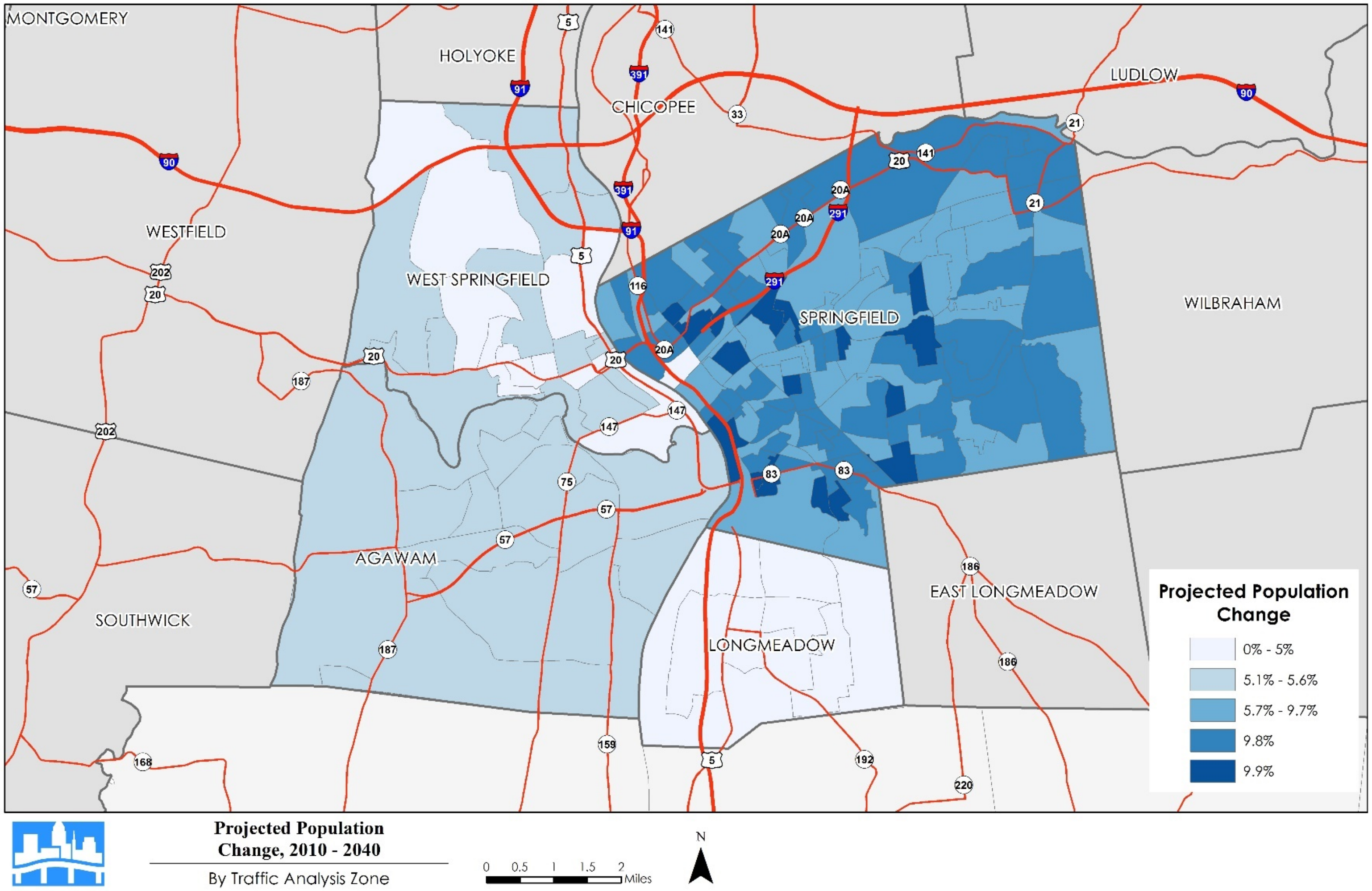


Figure 2-63: Projected Population Change, By Traffic Analysis Zone

HOUSEHOLDS AND HOUSING STOCK

The total number of households in the four-community region was projected to increase by 6,815 households from 2010 to 2040, an increase of approximately 7.9%. With the number of households growing at approximately the same pace as population, the average household size is not anticipated to change significantly.

Single-person households are expected to make up as much as 66% of all households in the neighborhoods closest to Downtown Springfield, including northeastern Agawam, eastern West Springfield, and the downtown and Forest Park neighborhoods of Springfield.

Two-person households are projected to make up a significant portion of the population (up to 42%) in many outlying areas. While this household segment is partially made up of cohabitating individuals and young couples, "empty nesters" and retired couples are likely to make up a significant portion of this subpopulation.

Three-person and four-person households are projected to constitute smaller shares of all households across the area. These household types represent only a small share of households in and around Downtown Springfield and are more common in outlying areas including eastern Springfield, Longmeadow, western Agawam, and West Springfield. These households constitute less than a quarter each of the population of each TAZ (excluding the small absolute change in four-person households in Downtown Springfield).

Five-person and larger households make up a relatively small share of households in most neighborhoods, but several neighborhoods just outside Springfield's downtown core serve as an exception, including parts of Liberty Heights, Old Hill, Forest Park, and southeastern West Springfield between U.S. Route 5 and Union Street.

Based on these projections, any housing opportunities created through the I-91 alternatives should be steered toward a smaller household market – smaller unit sizes, less parking required per unit, etc. In addition, these projections indicate little change in commuting patterns into and out of Springfield with a relatively small proportion of population located in close proximity to the large Downtown Springfield employment center. Therefore, alternatives should strive to improve ease and time of travel for commuters in and around Downtown Springfield to enhance the city's overall economic development.

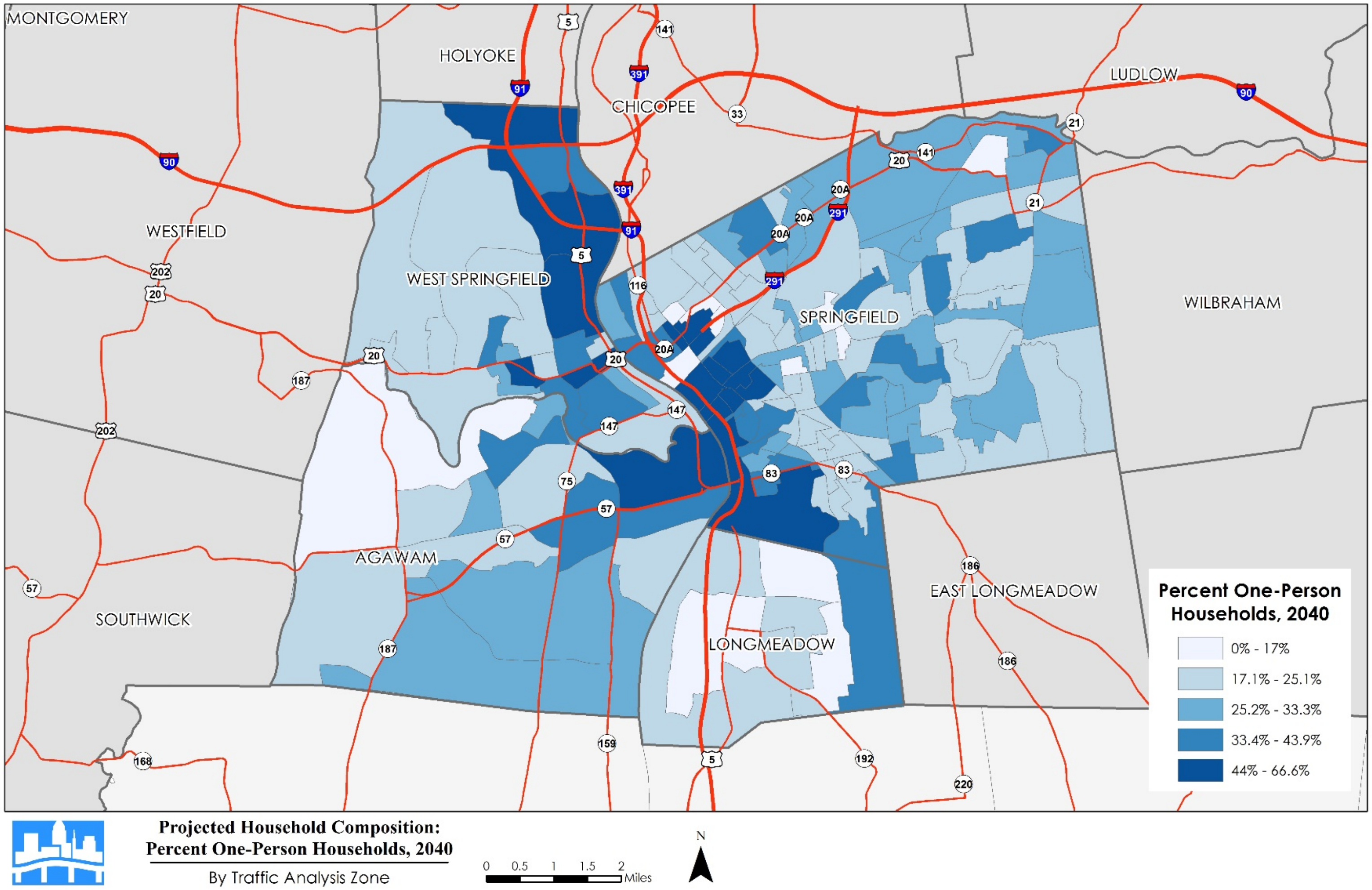


Figure 2-64: Projected Household Composition, Percent One-Person Households in 2040, By Traffic Analysis Zone

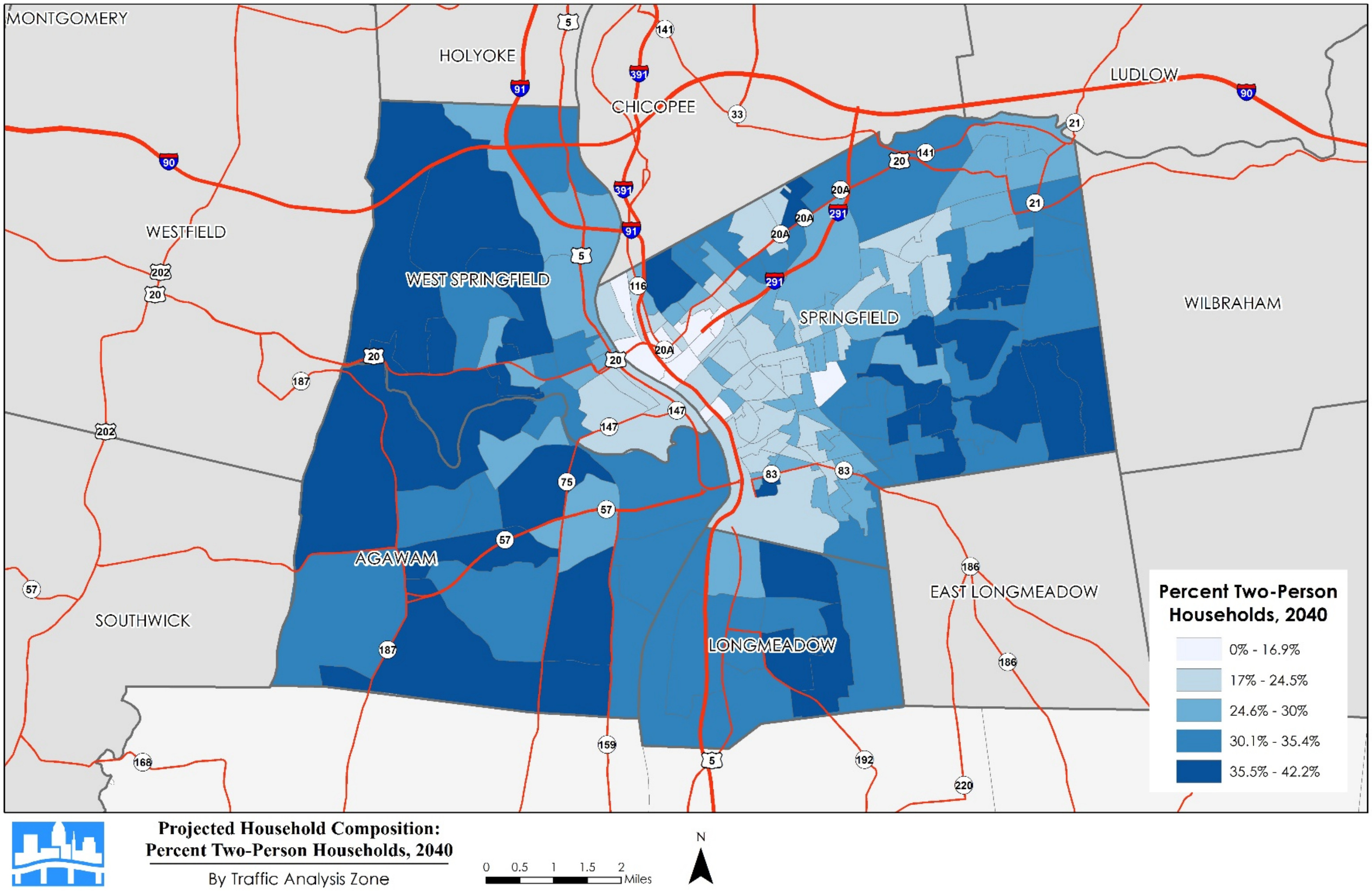


Figure 2-65: Projected Household Composition, Percent Two-Person Households in 2040, By Traffic Analysis Zone

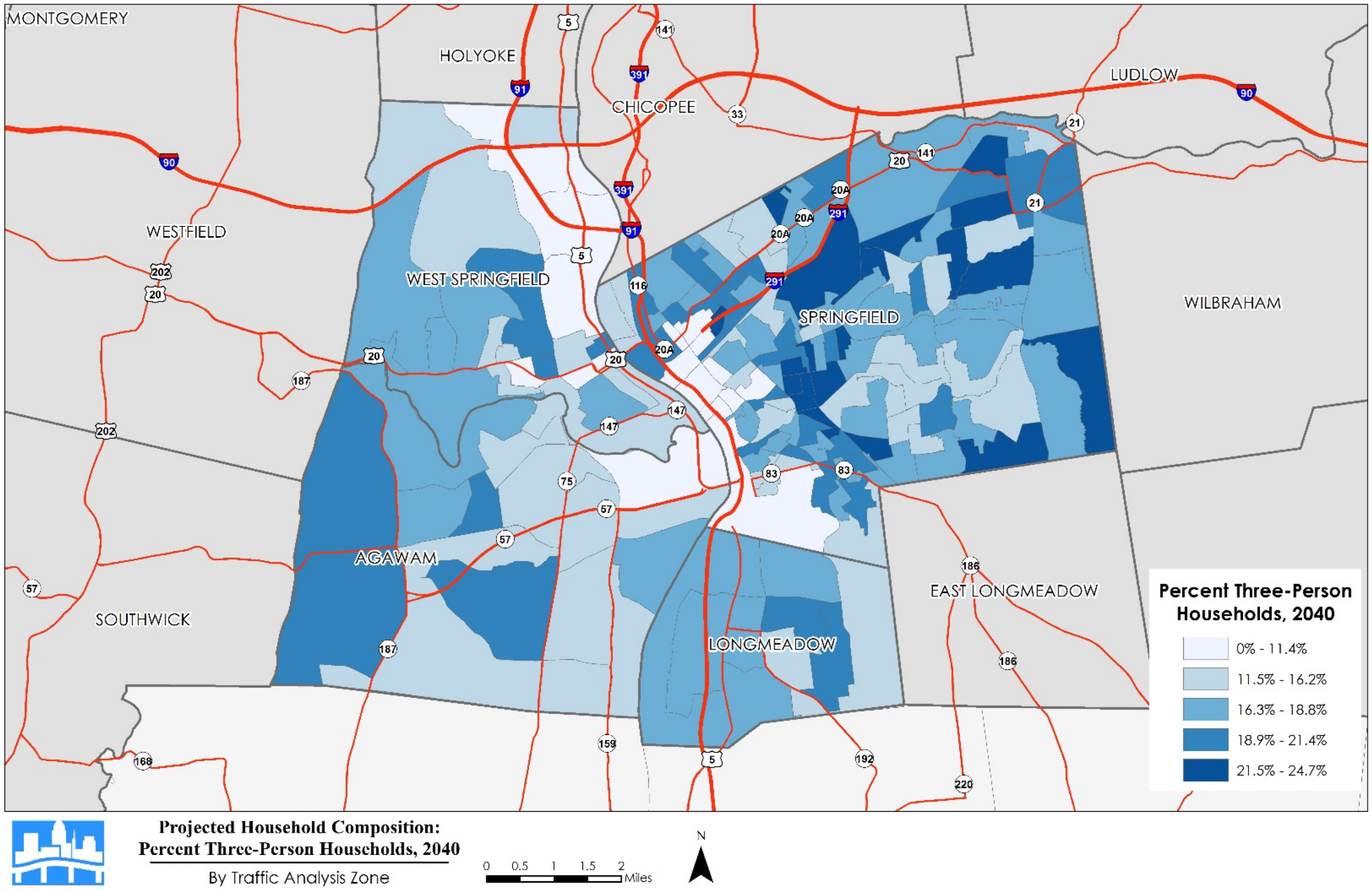


Figure 2-66: Projected Household Composition, Percent Three-Person Households in 2040, By Traffic Analysis Zone

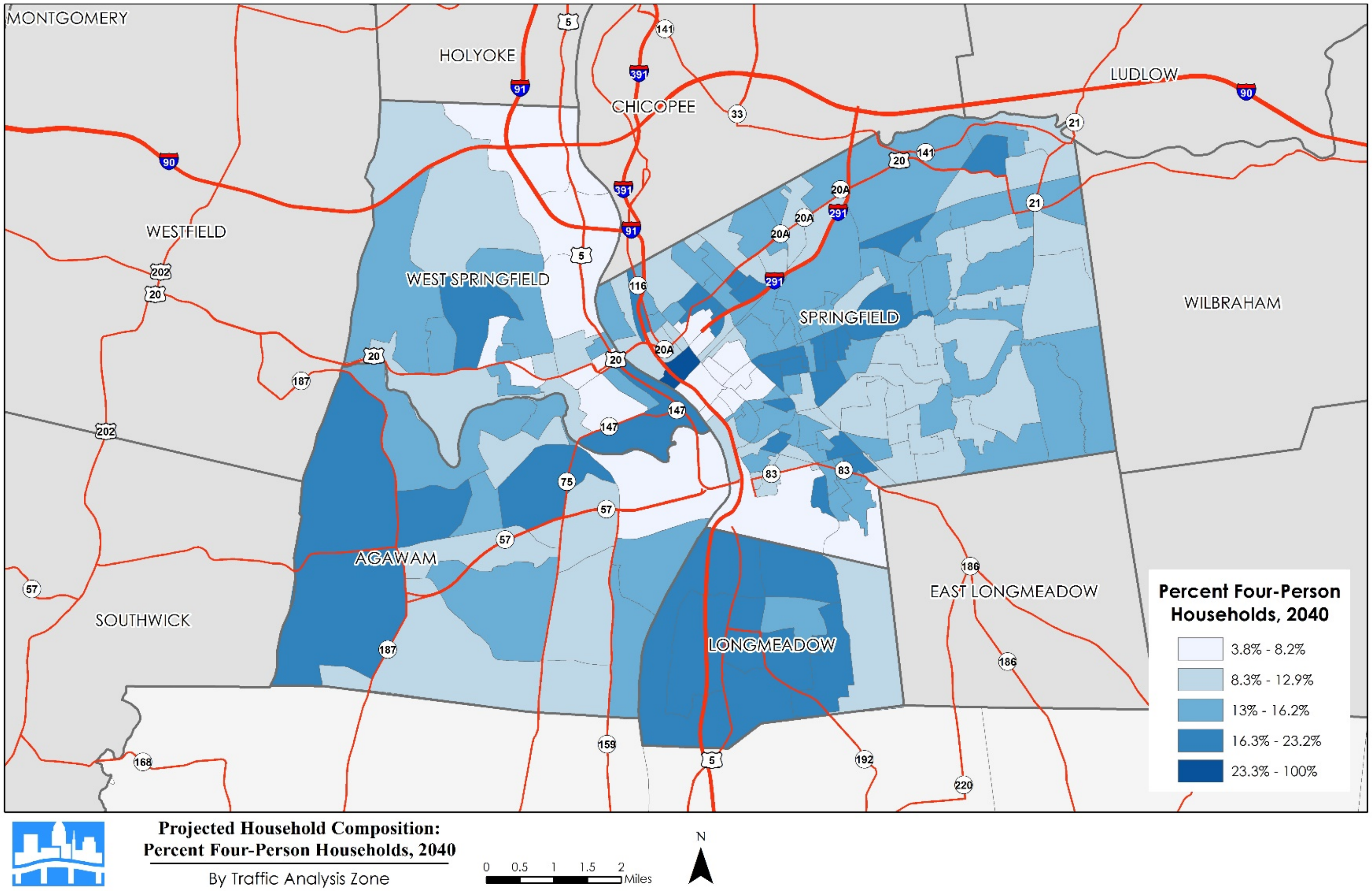


Figure 2-67: Projected Household Composition, Percent Four-Person Households in 2040, By Traffic Analysis Zone

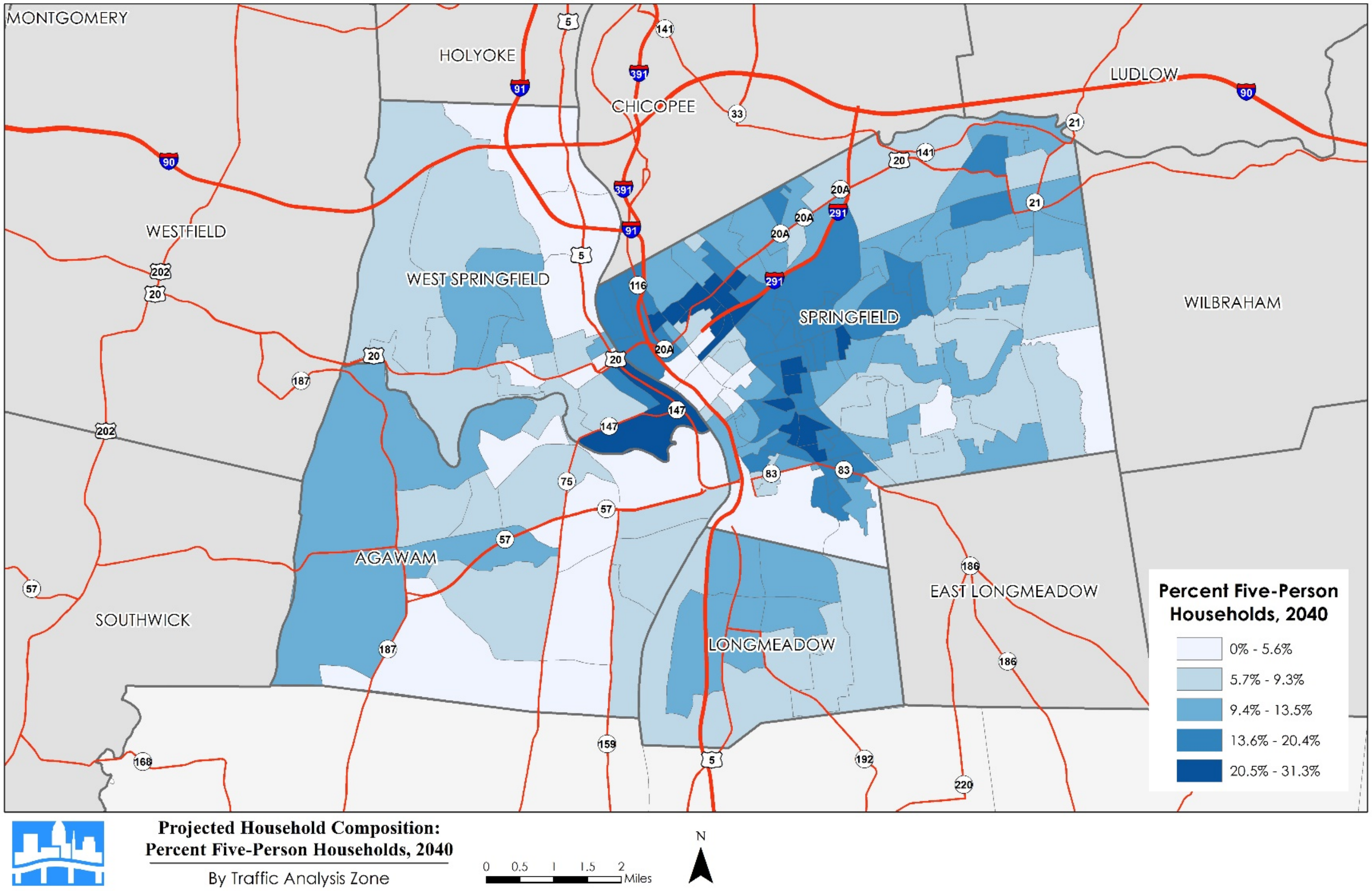


Figure 2-68: Projected Household Composition, Percent Five-Person Households in 2040, By Traffic Analysis Zone

EMPLOYMENT AND LABOR FORCE

Future employment by industry sector is projected for each TAZ, providing an estimate of the types of jobs likely to be available in the region by 2040. Employment is broken into three broad sectors: basic sector employment (including agriculture, mining, utilities, construction, wholesale trades, and primary manufacturing), retail sector employment (including various types of retail trades), and service sector employment (including various professional, management, healthcare, entertainment, and government services).

Basic sector employment is concentrated in areas with large tracts of industrial lands, including northern Springfield's industrial parks south of I-291 and US-20A; industrial lands south of Route 147 and along the northernmost stretch of U.S. Route 5 in West Springfield; and industrial and agricultural land across southern Agawam. Growth in basic sector employment is projected to remain flat or low (from 0% to 7%) throughout the projection window.

Retail sector employment makes up a strong share of jobs in West Springfield's town center, the Feeding Hills neighborhood of Agawam, and the neighborhoods surrounding Springfield Plaza and Eastfield Mall. As with basic sector employment, retail employment is not projected to increase substantially in the projection window.

As the most diverse of the three projected employment categories, service sector employment makes up the largest share of employment in most areas of the four municipalities, and most TAZs in each town have a majority of their projected jobs in this sector. While growth in this sector is projected to occur unevenly across the region, a number of neighborhoods in Springfield are expected to see service-sector jobs grow by over 100% by 2040.

Some of the strongest growth in service sector employment is projected in close proximity to the Primary Study Area and is related to the anticipated MGM Casino project. Entertainment industry jobs, such as those associated with the anticipated casino, tend to offer lower wages. While employment growth in this area will improve opportunities for Downtown Springfield residents, these jobs will likely attract new workers from the region and the entire city to the area, precipitating even greater need for improved transit connections.

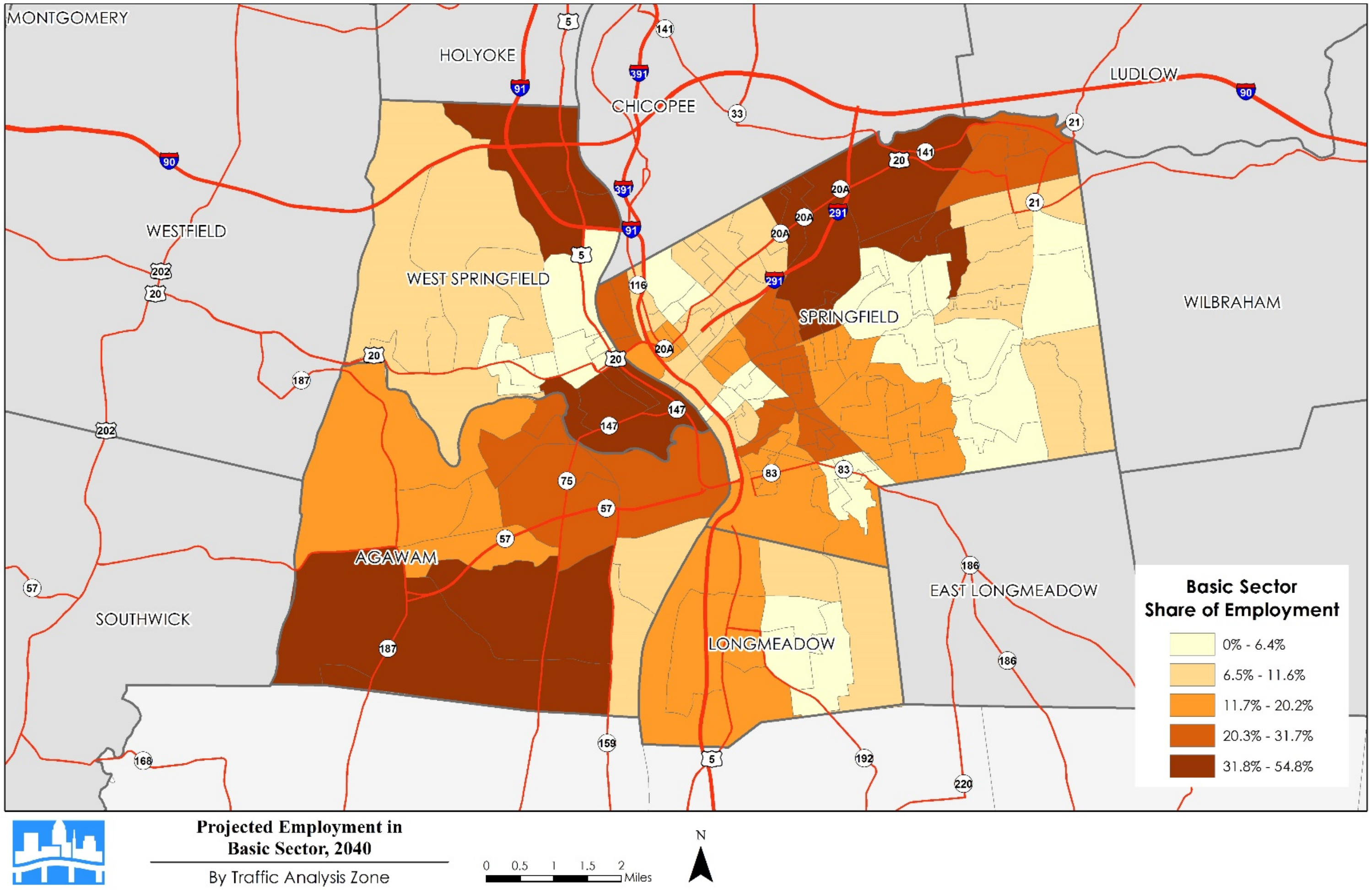


Figure 2-69: Projected Employment, Basic Sector Employment in 2040, By Traffic Analysis Zone

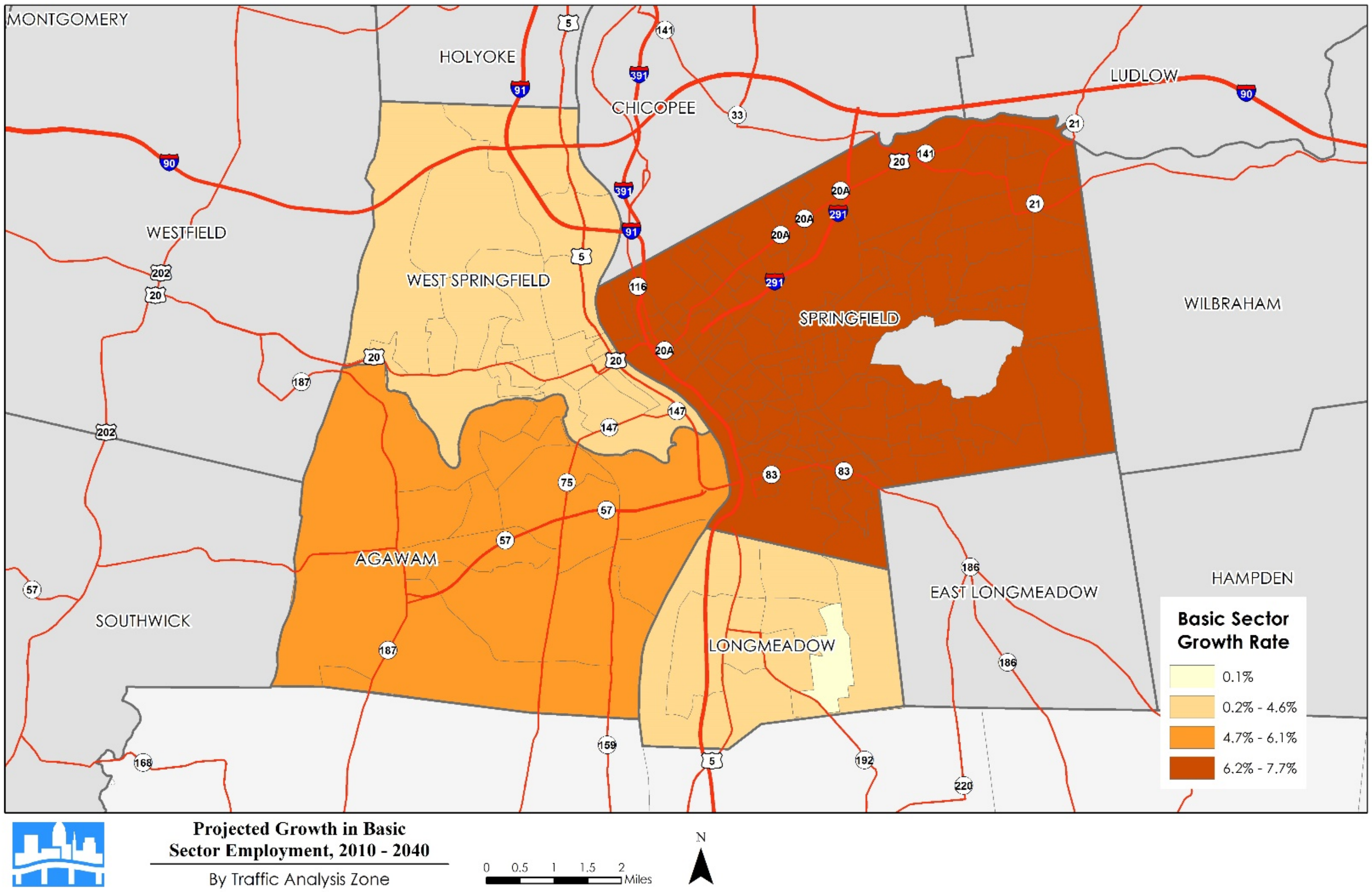


Figure 2-70: Projected Growth in Basic Sector Employment, 2010 - 2040, By Traffic Analysis Zone

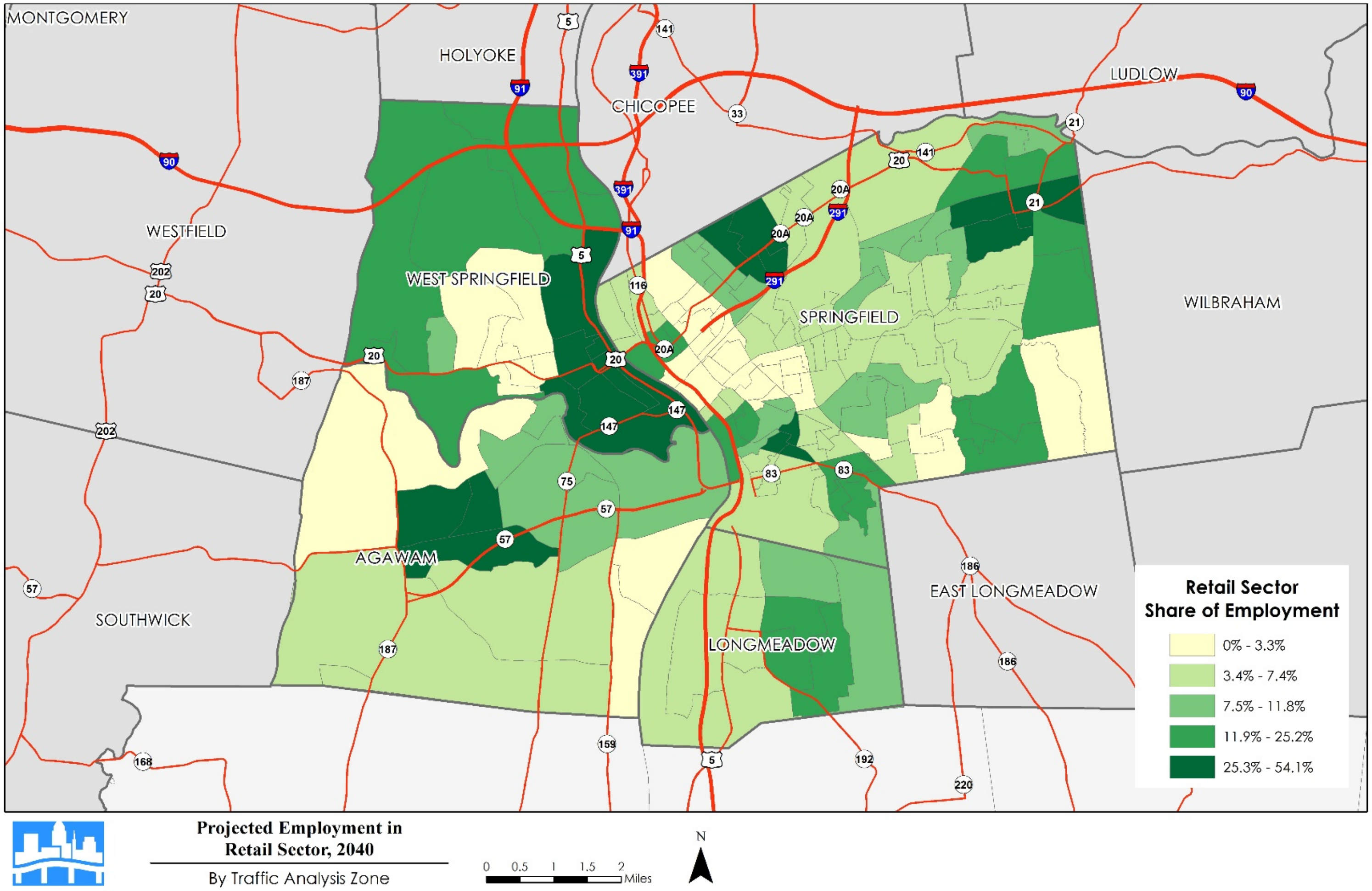


Figure 2-71: Projected Employment, Retail Sector Employment in 2040, By Traffic Analysis Zone

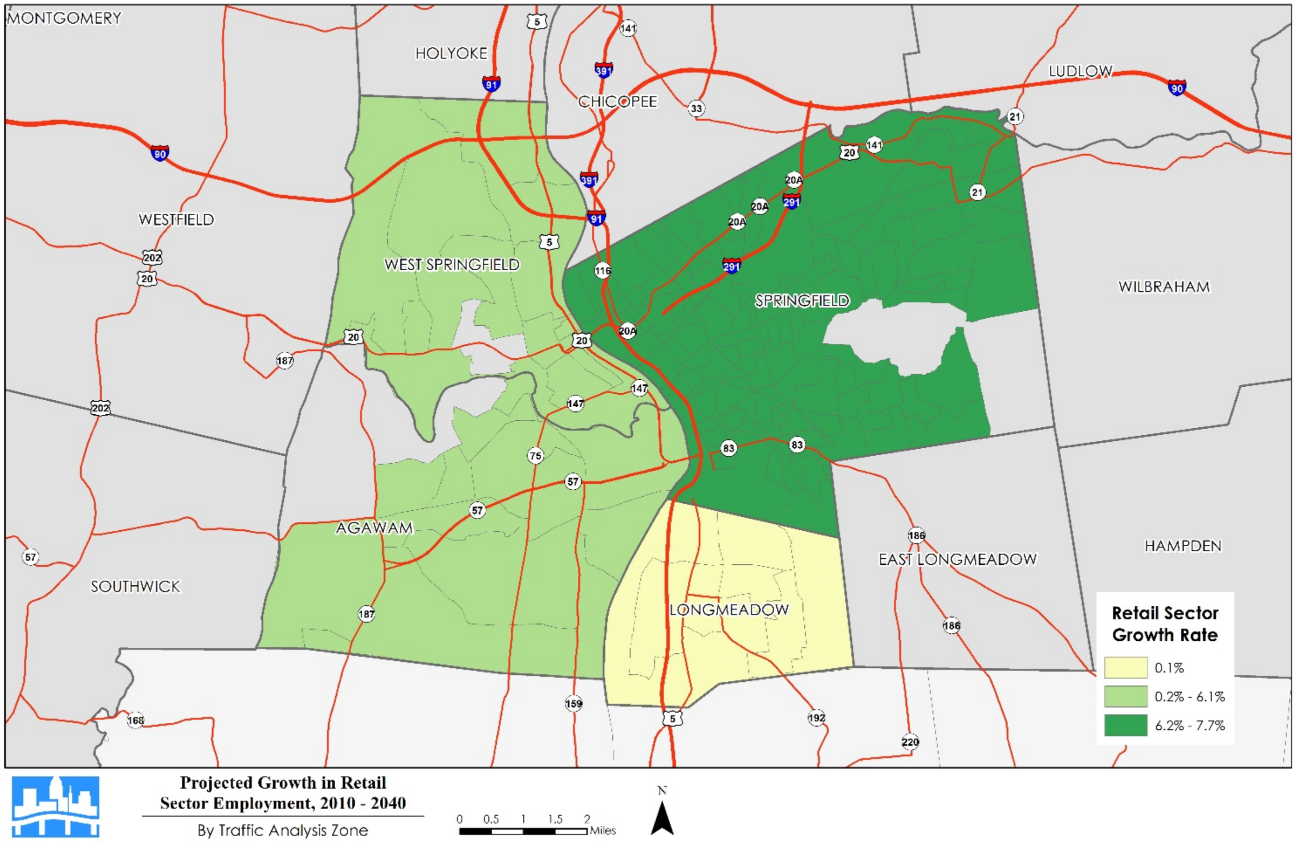


Figure 2-72: Projected Growth in Retail Sector Employment, 2010 - 2040, By Traffic Analysis Zone

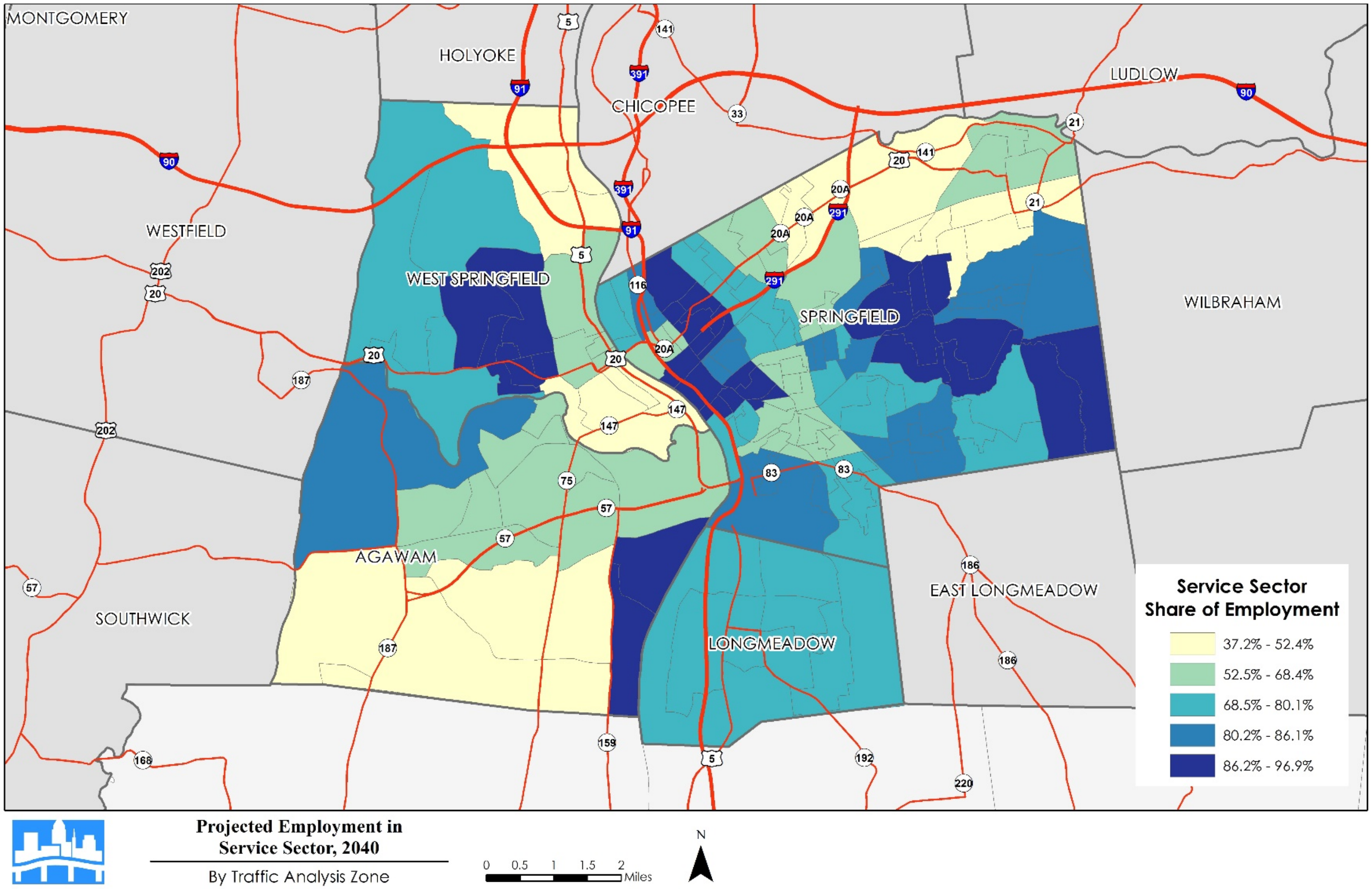


Figure 2-73: Projected Service Sector Employment, 2010 - 2040, By Traffic Analysis Zone

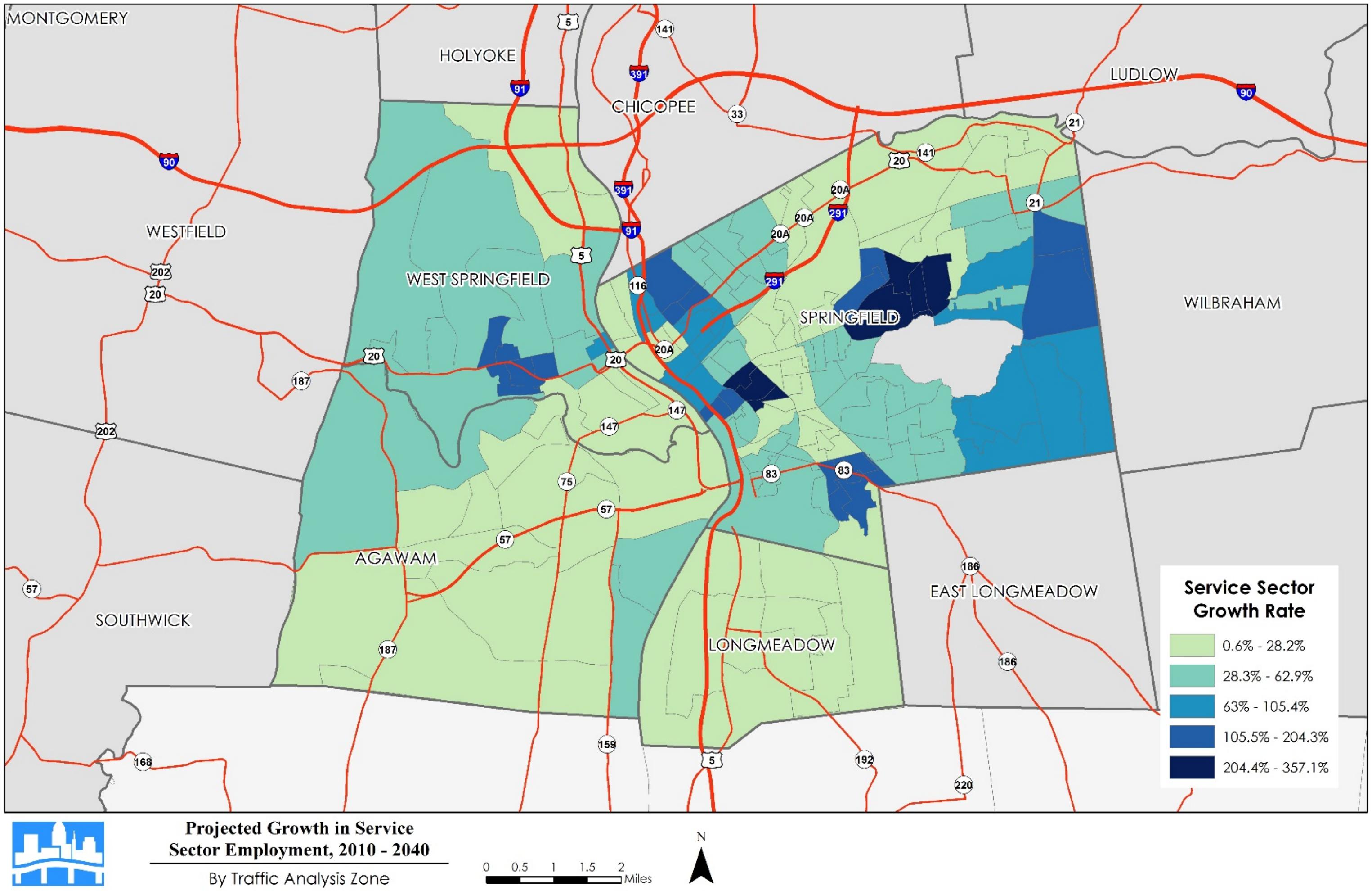


Figure 2-74: Projected Service Sector Employment, 2010 - 2040, By Traffic Analysis Zone

2.4 ENVIRONMENTAL CONDITIONS

2.4.1 EXISTING CONDITIONS, DATA COLLECTION, AND ANALYSIS

This section documents the inventory and analysis of existing environmental conditions within the study area. To determine existing environmental conditions in the study area, data was obtained from numerous sources, including existing municipal mapping. However, the maps in this section are based on Office of Massachusetts Geographic Information (MassGIS) database layers and the latest available orthophotographic imagery of the project study area unless otherwise noted. Additional information regarding project area environmental conditions was obtained from Massachusetts Historical Commission (MHC), Massachusetts Natural Heritage and Endangered Species Program (NHESP), Massachusetts Executive Office of Energy and Environmental Affairs, National Park Service, and the United States Army Corps of Engineers.

The information collected as part of the task has been categorized into the following topic headings and will be utilized in the evaluation of the alternatives developed in future sections of this study. This data will be utilized as reference materials, guiding the development of alternatives to the extent feasible to avoid further impacts to any sensitive areas, mitigate any detrimental prior impacts to these areas, and provide opportunity to enhance any of these areas through creation of improved access to valuable environmental resources within the study areas.

SURFACE WATER RESOURCES

The Connecticut River, the primary surface water resource within both the Primary and Regional Study Areas, runs along the western side of the I-91 transportation corridor, forming the western municipal boundary between the city of Springfield and the cities of Agawam and West Springfield. The Westfield River meets the western bank of the Connecticut River at the southerly end of the Primary Study Area. Several tributaries flow to the Connecticut River from the east, including Cooley Brook in the north end of Longmeadow; Pecousic Brook, which drains from Porter Lake in Forest Park; and the Mill River, which drains from Watershops Pond. The Mill River and Pecousic Brook are conveyed through a series of underground viaducts located under I-91 and the railroad. As shown on Figure 2-75, the Primary Study Area is located within the Connecticut River Watershed.

FLOODPLAINS

Federal Emergency Management Agency (FEMA) mapping and MassGIS data layers were obtained to review both the 100-year and 500-year floodplains, and regulated floodways along the project corridor. Both the Connecticut and Westfield Rivers lie within flood zone AE, a classification given to areas that are subject to inundation by 1-percent-annual-chance flood events. Floodplains are located along both sides of the Connecticut and Westfield Rivers, as shown in Figure 2-75. Figure 2-75 also depicts base flood elevations (BFEs) and regulated floodways for both rivers; regulated floodways are those designated areas within the floodplain that cannot be encroached upon without affecting the BFE. A flood control levee is located on the east side of the Connecticut River from approximately the South End Bridge to the city of Chicopee to protect adjacent populated areas from flood inundation.

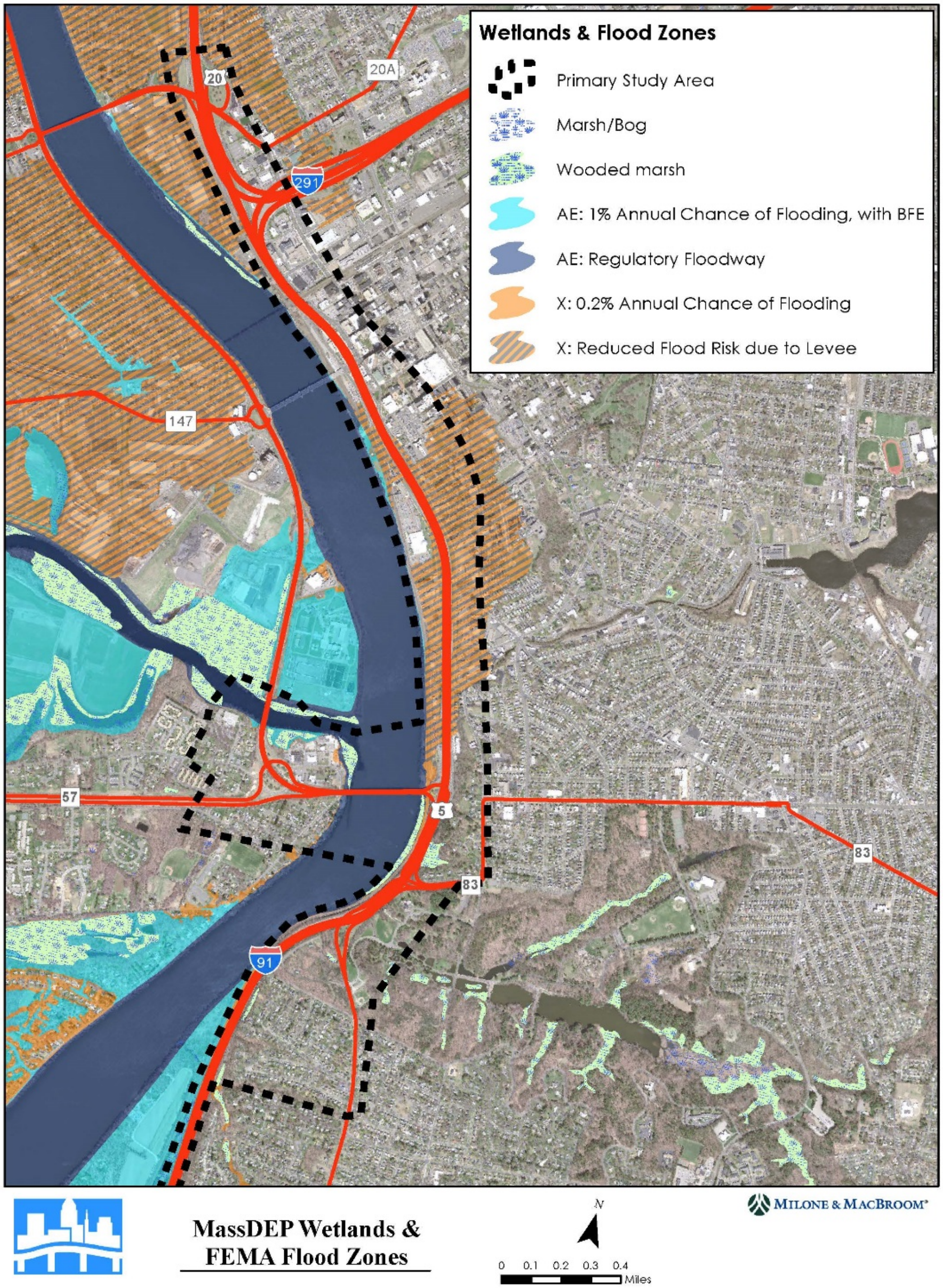


Figure 2-75: Wetlands and FEMA Flood Hazard Area

WETLANDS

The Department of Environmental Protection Wetlands data layer from the MassGIS database was obtained to show the extent of wetland resource areas within the project corridor, as shown in Figure 2-75. Wetland resource areas are primarily associated with the Connecticut River floodplain in the southwest portion of the Primary Study Area and the Westfield River in the western portion of the Regional Project Area. The majority of the wetland resources that have any potential to be impacted with the development of alternatives are located southwesterly of the Longmeadow Curve and in the vicinity of the confluence of the Westfield and Connecticut Rivers. The extents of impacts to these areas will be assessed during the evaluation of any alternatives developed as part of this study. The potential exists that a preferred alternative may require significant detailed wetlands assessments and reporting, including but not limited to National Environmental Policy Act (NEPA) and Massachusetts Environmental Policy Act (MEPA) regulatory permitting.

EXISTING SURFICIAL GEOLOGY

Information about surficial geology within the Primary Study Area was obtained from MassGIS data layers. As shown in Figure 2-76, alluvial deposits largely cover the entire Connecticut River Valley, including the Primary Study Area. Due to the significant amount of construction activities that have taken place over the past century within the city and this transportation corridor, including the railroad, bridges, and the I-91 Viaduct, there is a high percentage of urban lands consisting of a variety of impervious man-made structures including pavements and buildings. One benefit of the built environment is the availability of existing information regarding subsurface conditions and guidance as to implications of construction requirements for any future alternatives to consider. It is expected that detailed geotechnical investigations would be carried out under a future design phase of this project to determine relevant subsurface conditions in the vicinity of any preferred alignment.

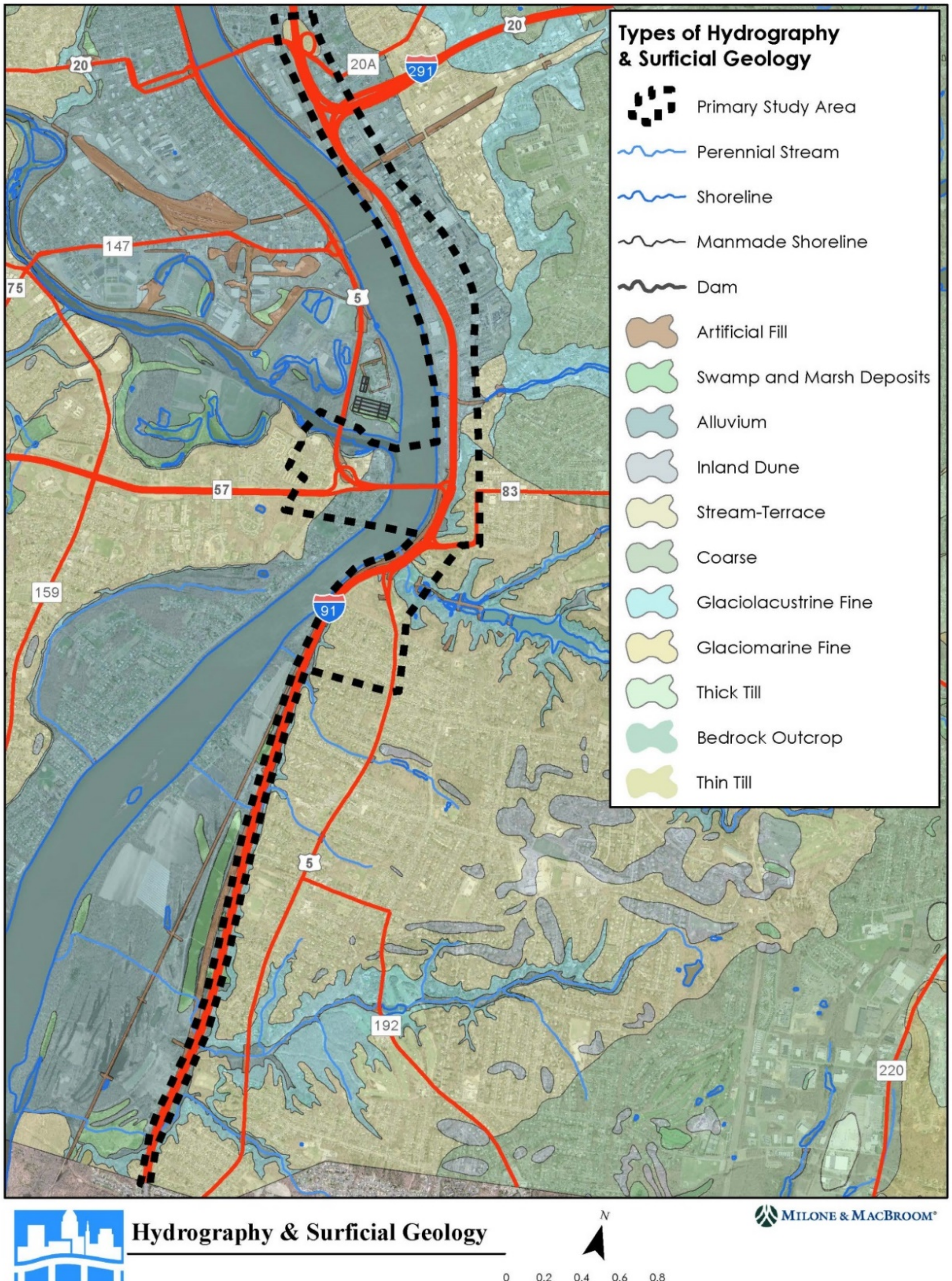


Figure 2-76: Surficial Geology

STORMWATER MANAGEMENT

A cursory review was conducted of existing stormwater management controls and systems within the Primary Study Area based on record information, plans of the I-91 corridor, and municipal Geographic Information System (GIS) data layers. Generally, these collection systems drain stormwater runoff utilizing a series of standard catch basins and manholes that connect to piping. These pipes let out at various locations within the Primary Study Area and drain toward the Connecticut River. This data has been collected and will be utilized in the development and analysis of the alternatives. Any alternative alignments for the Viaduct should give consideration to addressing stormwater management controls and stormwater quality enhancements. Pursuant to the objectives and requirements of the Massachusetts Department of Environmental Protection (MassDEP) stormwater management guidelines, watercourses and wetland resource areas adjacent to the project must be protected.

PROTECTED OPEN SPACE

Data regarding areas of protected open space within the Primary Study Area was obtained from MassGIS, as depicted in Figure 2-77. The Connecticut Riverwalk and Bikeway, located along the east side of the Connecticut River just south of Memorial Bridge, is a key open space resource located in the Primary Study Area. Other resources located wholly or partially within the Primary Study Area include Forest Park and King Phillip's Stockade in Springfield and School Street Park in Agawam, which is south of the South End Bridge. The City of Springfield's Riverfront Park sits along the banks of the Connecticut River at the midpoint of the Primary Study Area. Overall protection of and improvement of access to this existing open space is critically important. Coordination of improved existing connections and creation of new connections to Riverfront Park and all other recreational and open space resources noted should be considered paramount in the development of alternatives for this study.

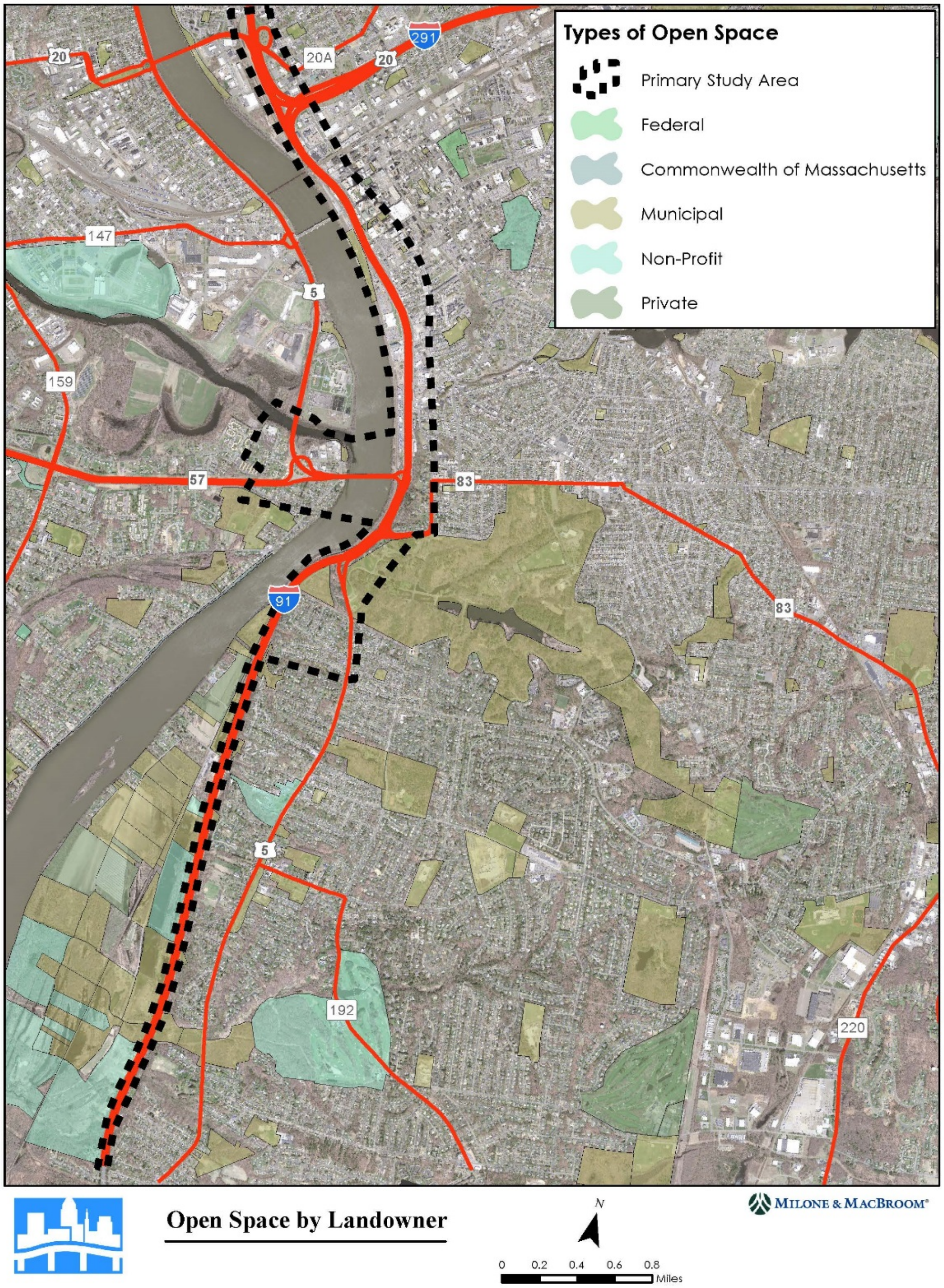


Figure 2-77: Open Space

AREAS OF CRITICAL ENVIRONMENTAL CONCERN (ACEC)

A cursory review of MassGIS data layers showed no Areas of Critical Environmental Concern (ACEC) within the Primary Study Area.

HAZARDOUS MATERIAL SITES

Figure 2-78 shows the locations of several activity and use limitation (AUL) sites in Springfield and West Springfield in and around the Primary Study Area. AUL sites have restrictions placed on them to limit visitors' potential exposure to hazardous materials of concern. Two sites were also identified in Longmeadow, to the south, and one in Agawam, near the Connecticut – Massachusetts border. Neither verification nor detailed review of these areas will take place as part of this study. However, these sites should be considered a constraint requiring further detailed investigations should any alternatives developed be unable to feasibly avoid impacts to one or more of these sites.

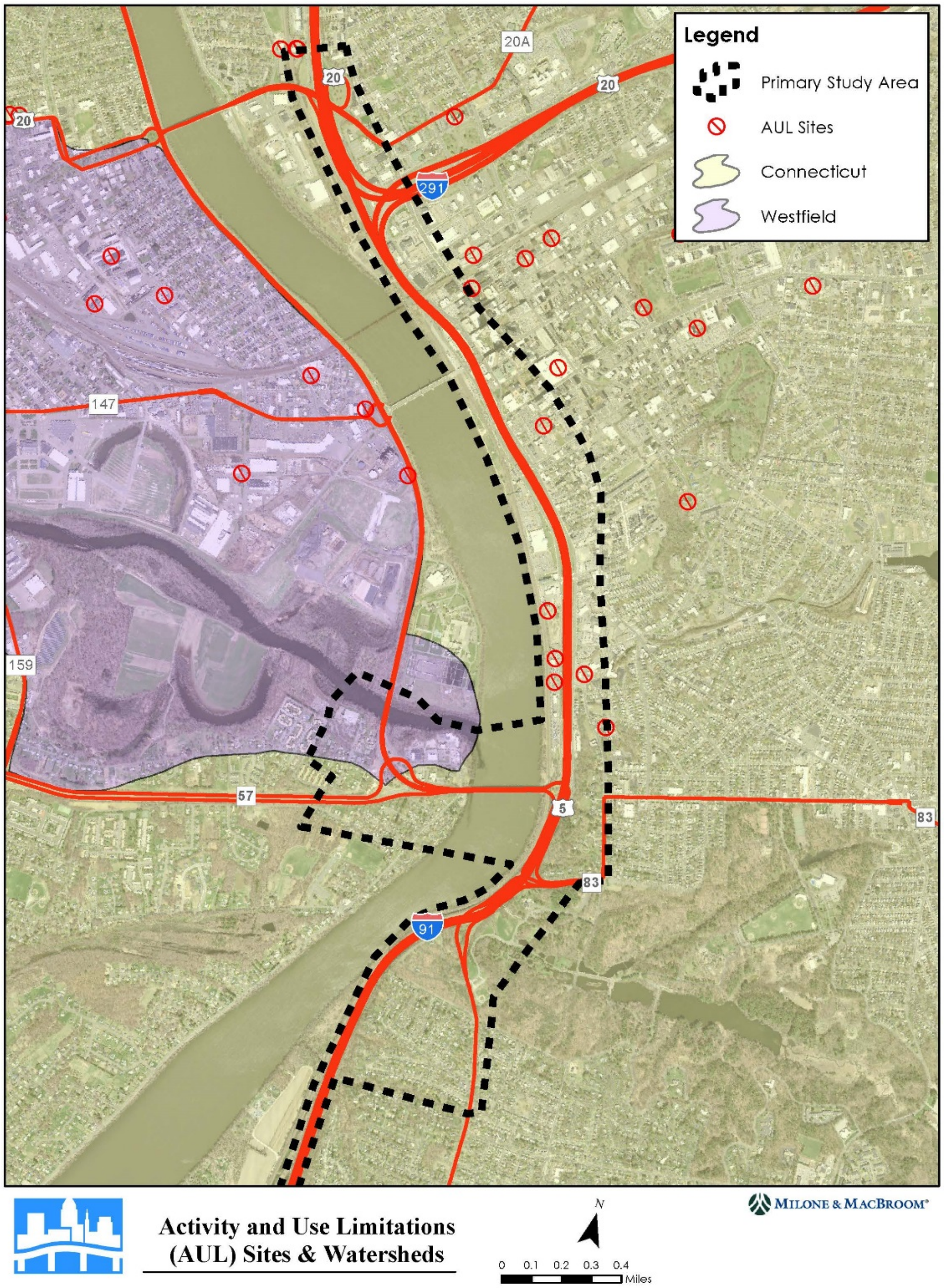


Figure 2-78: MassDEP AUL Sites & Watershed Delineations

NOISE LEVELS

The three major generators of noise within this corridor are the railroad, existing highway corridors (I-91 and I-291), and the surface roadways within the project areas. As traffic volumes and speeds of these three generators increase, so do the noise levels associated with each. No specific levels of noise were obtained or analyzed as part of this study. Interestingly, the elevated nature of the Viaduct structure both amplifies and buffers sound coming from the highway onto and into the surrounding areas and the Riverfront. The Viaduct also creates a "sound tube" effect, reflecting traffic noise from the surface roads crossing under the structure off the steel and concrete underside of the elevated highway. Unfortunately, the main pedestrian crossings of the I-91 corridor from the city to the Riverfront coincide exactly with these areas of focused noise pollution.

Land use areas sensitive to noise include residential districts, hotels, institutional areas where excessive noise levels would negatively impact humans, and special status wildlife species habitats. The Primary Study Area is primarily a mixed-use urban area that includes uses that would be sensitive to excessive noise. MassDOT has developed a noise barrier program based on Federal Highway Administration (FHWA) noise abatement requirements. The Type I noise barrier program includes the installation of noise barriers associated with the construction of major highways. These projects typically require the filing of an EIR to comply with NEPA and MEPA requirements. The need and feasibility of noise barriers will be evaluated in the development of any alternatives. No specific noise data was collected or analyzed as part of this study.

AIR QUALITY

Like noise levels, air quality within the study areas should be considered as a significant factor in evaluation of alternatives developed as part of this study. The Clean Air Act of 1970 and subsequent amendments (1990) established National Ambient Air Quality Standards (NAAQS) for "criteria pollutants" as indicators of air quality and has established for each of these criteria pollutants a maximum concentration above which adverse effects on human health may occur. The six criteria pollutants are carbon monoxide (CO), nitrogen dioxide (NO^2), sulfur dioxide (SO^2), lead (Pb), ozone, and particulate matter (PM). Although no specific air quality measurements were taken as part of this study, for planning purposes it is known that there are concerns regarding air quality in and around the Primary Study Area. It is also known that areas of higher levels of traffic and congestion lead to higher levels of air pollutants, thus leading to higher health risks including respiratory disease in the immediate populations. The development of alternatives should consider ways in which to reduce the quantities of air pollutants generated and/or to mitigate exposure to air pollution that cannot be avoided by the transportation corridor. Any project that advances from recommendations made as part of this study would require detailed analysis and assessment of impacts on air quality.

As of October 1, 2015, Hampden County, Massachusetts, was no longer classified as "nonattainment" for any criteria pollutants. If a particular region of a state exceeds any NAAQS, that region is classified as being at "nonattainment" for that pollutant, and the state must develop an air quality plan, called a State Implementation Plan (SIP), that will bring that region into compliance.

CULTURAL, HISTORICAL AND ARCHAEOLOGICAL RESOURCES

Figure 2-79 identifies cultural resources that exist in or immediately around the Primary Study Area, as recorded in MassGIS data layers and the files of the MHC. Pursuant to the National Historic Preservation Act, any federally funded project must assess potential impacts and/or effects on districts, sites, structures, and objects that are eligible for inclusion or listed on the National Register of Historic Places. Several areas of historical and cultural significance exist within both the Primary and Regional Study Areas. These areas are highlighted below and should be considered constraints in development of any alternatives. However, the existence of these resources also provides opportunities to enhance or improve access to these areas or features.

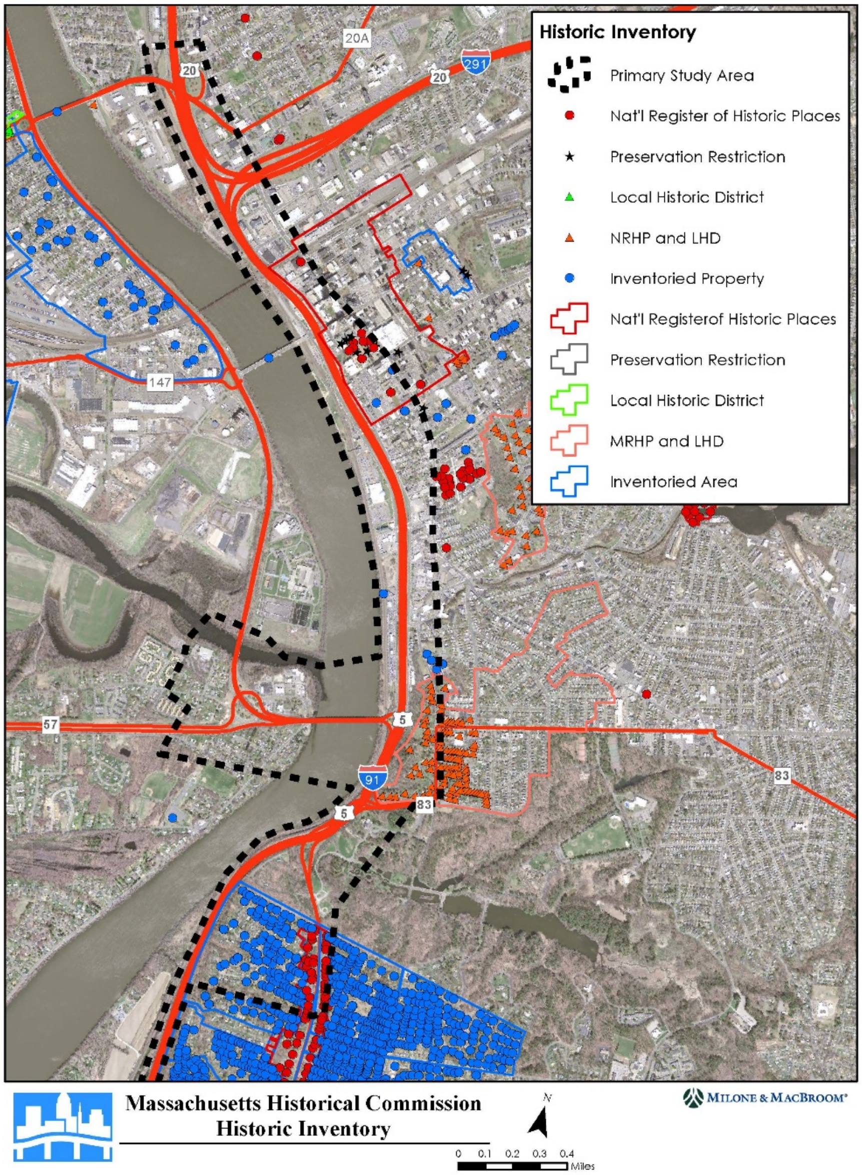


Figure 2-79: MHC Historic Inventory

THREATENED AND ENDANGERED SPECIES

Massachusetts NHESP data available for areas in and around the Primary Study Area was mapped using MassGIS data layers (see Figure 2-80). NHESP Regulated Areas, mapped NHESP Priority Habits of Rare Species, and NHESP Estimated Habitats of Rare Wildlife are present within the Connecticut River and Westfield River watercourse areas. The areas of concern are specifically related to the Westfield and Connecticut Rivers and their immediate riverbanks. Given the close proximity of these watercourses to the Primary Study Area, care should be taken to avoid or mitigate any impacts within these areas during the development of any alternatives. Impacts, mitigation, or enhancement of these areas will be assessed through the evaluation of alternatives section of the study. The advancement of any preferred alternative would require further assessment of these areas and coordination with the Massachusetts Department of Environmental Management (DEM) during the NEPA and MEPA environmental review process.

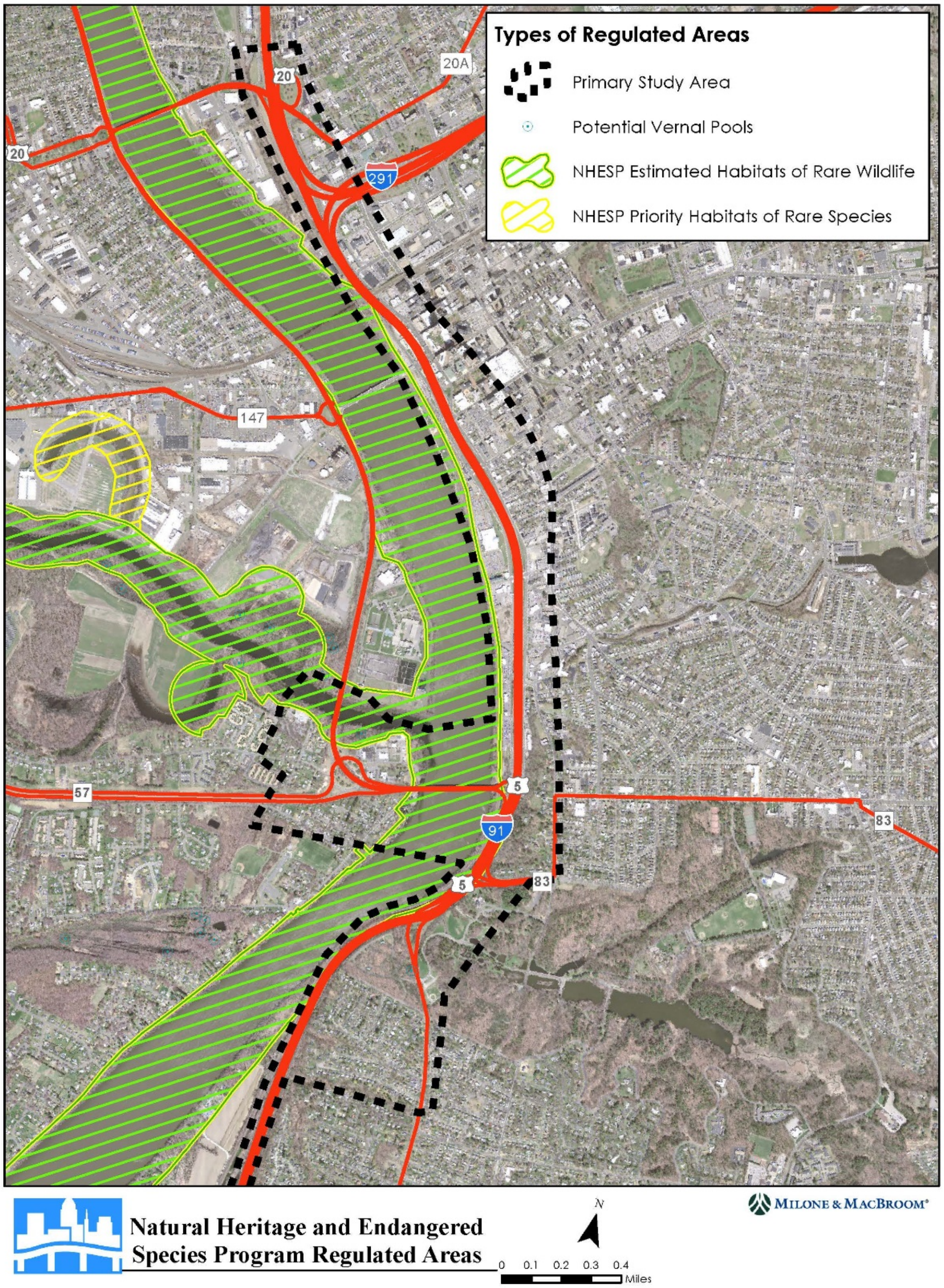


Figure 2-80: NHESP Regulated Areas

2.5 PUBLIC HEALTH

2.5.1 BACKGROUND

Section 33 of the 2009 *Act Modernizing the Transportation Systems in the Commonwealth* instituted requirements for assessing the health impacts and benefits of potential transportation projects to better inform transportation planning decisions in the Commonwealth. In 2012, the Department of Public Health (DPH) worked with MassDOT to pilot a Health Impact Assessment (HIA) of MassDOT's Grounding McGrath study in Somerville. While available resources precluded a similar level of effort for this study, health information has been incorporated into the planning process through the following:

- Working with stakeholders to identify health concerns in the study area, including participation in I-91 Viaduct Working Group, participating in public meetings, and the conducting of key informant interviews
- Analyzing baseline health conditions in the study area using readily available data
- Evaluating an approach to include health-based indicators in the Evaluation Criteria of this study
- Proposing health-based recommendations for each of the areas evaluated in this study (e.g., mobility and accessibility, safety, environmental effects, land use and economic development, and community effects)

The following section summarizes the findings of the key informant interviews and baseline health data. Recommendations from the key informant interviews are provided at the end of this chapter. Chapter IV summarizes the initial work in evaluating an approach to include health-based indicators into a transportation planning study.

2.5.2 KEY INFORMANT INTERVIEWS

Stakeholder engagement serves to engage impacted populations in conversation and share in actual decision-making about a project. It occurs on a spectrum from "informing" stakeholders to true "community-led/community driven" processes.[11] DPH facilitated, through the implementation of a graduate course in Health Impact Assessments at the University of Massachusetts-Amherst, a series of key informant interviews. The purpose of these interviews was two-fold:

- Add to the community engagement methods employed both for the I-91 Viaduct Study and as an example for future transportation studies. These types of in-depth and structured

[11] http://www.mass.gov/eohhs/docs/dph/quality/don/guidelines-community-engagement.pdf

conversations focused on health impacts helps ground the transportation planning study in the lived experience of community members.

- Examine the I-91 Viaduct evaluation criteria for community relevance seeking stakeholder perceptions around five groupings of evaluation criteria (Mobility and Accessibility, Safety, Environmental Effects, Land Use and Economic Development, Community Effects) in order to ensure that the alternatives analysis includes the community voice. Interview questions focused on how the interviewees understood the relevance of the evaluation criteria buckets to the community.

The interview process focused on the following topics:

- The impact of the I-91 Viaduct on access to:
    - Goods and services (both in how improving bikeability/walkability can lead to economic development and the types of stores available to the community as well as accessing critical services such as health care)
    - Open spaces
    - Space for community programming
    - Public transit (a repeated theme and a critical issue for Springfield residents)
- Connectivity that could emerge from big changes to the I-91 Viaduct:
    - Strategic placement of resources such as parking facilities that encourage active living, one-stop shopping, etc.
    - Bicycle and pedestrian infrastructure improvements which are focused on networks and connections to goods, services, public transportation, etc.
- Impact of I-91 Viaduct on safety in two ways:
    - Perception of crime and physical safety
    - Traffic-related injuries
- Environmental quality
    - Air pollution exposure from transport-related air pollutants especially given the high rate of pre-existing respiratory and cardiovascular disease
    - Noise pollution
    - Focus on housing and schools in close proximity to the Viaduct and with a focus on exposure to air pollutants
- How changes to the I-91 Viaduct could improve quality of life for:
    - Children
    - People of Color
    - People with pre-existing conditions
    - Low-income communities
    - Residents of the North End of Springfield (a neighborhood physically isolated by the highway)
- Economic implications
    - Housing units created/destroyed

- Jobs
- Project cost

Interviewees also commented on community engagement strategies being used for the I-91 Viaduct study and offered two general suggestions for improving representation of community members in the planning process:

- General media and government websites do not reach community members sufficiently
- To increase community representation use methods that 'meet people where they are at', e.g. go to existing meetings/gatherings of community members to gain input and feedback

A summary of the key health-related recommendations is summarized in Table 2-31.

TABLE 2-31: Key Health-Related Recommendations for I-91 Viaduct Study

	Key Areas	Recommendation
Access	Access to goods and services	Support meeting physical activity guidelines; important for study alternatives to address how residents would access health care facilities
	Open spaces	Important to access open space including waterfront will have positive health benefits
	Space for community programs	Community venues can support social connectedness of residents
	Public Transit	Improving public transit is a high priority
Connectivity	Strategic Placement of Resources	Place parking to support physical activities; need for train and bus system to connect to larger transit system
	Bicycle and Pedestrian Infrastructure	Importance of biking and walking infrastructure to knit the community back together; consider pedestrian zone; Economic benefits of bikeable environments on local business; all of which can improve the quality of life, access to open spaces, social relationships, and economic development
Safety	Perceptions of crime	Need to get rid of obstructions and dark corners that the viaduct creates; crime needs to be considered in the design and development
	Traffic-related injuries	Safety considerations needs to be in the forefront in development process
Environmental Quality	Air Pollution	Major concern of residents; question whether proposed changes will improve air quality; important to target neighborhoods where exposure is significant (North End); modeling needs to show where projected changes will occur.
	Noise Pollution	Noise is a major health concern and evaluation needs to consider cumulative impacts of cars and train

	Focus on Housing and Schools	Need to assess impacts to housing and schools particularly with exposure to air pollution
	Environmental Quality during Construction	Concerns about the air quality and noise during construction period especially to vulnerable populations and added stress from multiple years of disruption
	Key Areas	Recommendation
Vulnerable Populations	General	Concern generally due to geographic proximity to roadway. Equity regarding who will benefit the most or will be harmed by the proposal needs to be addressed. Economic and physical solation of North End needs to be addressed; South End is especially vulnerable to transport-related air pollution and noise due to proximity to I-91.
	Children	Could be most impacted
	People of Color	Need to be explicitly evaluated in the study
	People with pre-existing conditions	Need to include assessment of alternatives
	Low-Income communities	Both in terms of geographic proximity to roadway, access to goods and services
Economic Implications	Housing Units created/destroyed	Need to address historical record of not replacing housing
	Jobs	Question how changes to I-91 would increase jobs
	Cost of the Project	Need to consider the cost of the project for the life-cycle rather than just construction costs;
Community Engagement	I-91 Viaduct Study	Suboptimal involvement in stakeholder process; meetings not well advertised
	Media is not enough	I-91 website is not sufficient to outreach
	Meet people where they are at	Improve involvement by partnering with community organizations and going to their meetings; and direct outreach door-to-door

The full report produced by the graduate course detailing the findings of these key informant interviews can be found in Appendix L.

2.5.3 EXISTING CONDITIONS, DATA COLLECTION, AND ANALYSIS

Baseline health assessments provide an understanding of current conditions and quality of life for residents that will be impacted by a transportation decision. The baseline health assessment consisted of providing rates of disease and health-related behaviors in each community in the Primary Study Area compared to the statewide rates; environmental data (air quality, water quality projected climate change impacts); and demographic and social factors relevant to health. Comparison of community rates to statewide rates provides an understanding of health inequities in the affected communities. Public health data was collected from a variety of sources for each of the communities in the Primary Study Area.

The indicators chosen for the baseline health assessment (Table 2-32) are those that directly or indirectly relate to transportation and land-use decisions. The baseline health assessment provides an understanding of the following:

- The potential change in the underlying disease burden in the community from the transportation decision
- Populations, or type of people, that should be prioritized for community engagement activities
- Issues that should be prioritized in the design of alternatives
- The current health status and structural inequities experienced by impacted populations

The available baseline health data include emergency department (ED) visits; inpatient hospitalization data for asthma and myocardial infarction; pediatric and adult obesity rates; rates of pediatric and adult diabetes (both Type I and Type II); pediatric asthma rates; injuries and fatalities related to automobile crashes; and other health-related behaviors reported from the Behavioral Risk Factor Surveillance System (BRFSS) survey. Table 2-32 o provides the geographic extent of available data sets, the sources of health data, and the methods used to calculate rates of disease. Specific health data for each of the municipalities within the Primary and Regional Study Areas are included in Appendix L.

TABLE 2-32: Health Data, Geography, Data Sources, and Methods Useful for Transportation-Related Health Impact Assessments

Health Data	Geography	Data Sources	Methods
Hospitalizations for Asthma and Myocardial infarction (Inpatient and Emergency Department Visits)	Municipality	MDPH/Bureau of Environmental Health (BEH) EPHT Portal (1,2)	Rate of health outcomes in study area by community for 2010-2012
Adult Obesity Data Adult Hypertension Adult Diabetes No Exercise Eats 5 Fruits And Vegetables/Day	Zip code	BRFSS (3)	Small area estimated rate of health outcomes in study area for select zip codes (i.e., 01105; 01107; 01106)
Childhood Lead Poisoning	Municipality; Census tract	MDPH/BEH EPHT Portal	Rate per 1000 of children Birth to six years
Pediatric Asthma (Grades K-8)	By School, Municipality and by grade in each Municipality	MDPH/BEH EPHT Portal	Prevalence rates 2009—2012 School Years
Low Birth Weight	Municipality	MDPH/BEH EPHT Portal	Average Annual Count Over 5-Year Period from 2004-2008
Cancer	Municipality; Census tract	MDPH/BEH EPHT Portal	Standardized Incidence Ratio (SIR) of observed cancer diagnoses in an area to the expected 2005-2009

Sources:

1, 2 Hospitalization data provided by the Massachusetts Center for Health Information and Analysis https://matracking.ehs.state.ma.us/home.html

3. Behavioral Risk Factor Surveillance System (BRFSS) is an annual survey of health issues, health conditions, risk factors, and behaviors. Data are provided by Bureau of Community Health and Prevention (BCHAP)

The following two tables present a summary of health indicators and health behaviors that illustrate the important regional differences that need to be considered when evaluating a transportation-related project across affected communities.

TABLE 2-33: Statistical Significance of Rates of Hospitalizations for Asthma, Heart Attack, and Prevalence of Pediatric Asthma Compared to the Statewide Rates in 2012

	Hospitalizations for Asthma	Emergency Department Visits for Asthma	Hospitalizations for Heart Attack	Pediatric Asthma Prevalence	Childhood Lead Poisoning
Agawam	LOWER	LOWER	NO DIFFERENCE	**HIGHER**	NO DIFFERENCE
Chicopee	**HIGHER**	**HIGHER**	NO DIFFERENCE	**HIGHER**	NO DIFFERENCE
Holyoke	**HIGHER**	**HIGHER**	**HIGHER**	**HIGHER**	**HIGHER**
Longmeadow	NS	LOWER	NO DIFFERENCE	LOWER	NO DIFFERENCE
Springfield	**HIGHER**	**HIGHER**	**HIGHER**	**HIGHER**	**HIGHER**
West Springfield	NO DIFFERENCE	**HIGHER**	NO DIFFERENCE	NO DIFFERENCE	NO DIFFERENCE

TABLE 2-34: Select Health Behavior Indicators by Select Zip Codes in the I-91 Primary Study Area

ADULTS WHO REPORT THEY HAVE:	PERCENT		
	01105	**01107**	**01106**
Obesity	33	29.6	14.5
Hypertension	32	32	25
Diabetes	13.2	15.2	NS
Do not engage in physical activity	63.5	62.7	50
Consume at least 5 fruits or vegetables per day	21.2	18.3	33

In summary, strong and consistent evidence over time indicates that Springfield residents experience inequitable health-related outcomes relative to the state and relative to their regional neighbors. Whether it is affecting someone's daily commute, ability to reach a grocery store, or the air quality near their homes, schools and work places, decisions related to the I-91 Viaduct, a major feature in the City, has an important role to play in addressing these inequities.

ENVIRONMENTAL JUSTICE POPULATIONS

The Massachusetts Environmental Justice Policy states that Environmental Justice (EJ) is based on the principle that all people have a right to be protected from environmental pollution and to live in and enjoy a clean and healthful environment. EJ is defined as the equal protection and meaningful involvement of all people with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies and the equitable distribution of environmental benefits. The Commonwealth's Executive Office of Energy and Environmental Affairs (EEA) established an Environmental Justice Policy to help address the disproportionate share of environmental burdens experienced by lower-income people and communities of color who, at the same time, often lack environmental assets in their neighborhoods.

The EJ criteria used in this study are based on the 2002 Environmental Justice Policy[12]; please note that this policy was updated in 2017 following analysis for this study. The 2017 criteria are as follows: (1) median annual household income is at or below 65 percent of the statewide median income for Massachusetts; or (2) 25 percent of the residents are minority; or (3) 25 percent of the residents are lacking English language proficiency (English Isolation). The 2002 EJ criteria used for this study are as follows: (1) the median annual household income is at or below 65 percent of the statewide median income for Massachusetts; or (2) 25 percent of the residents are minority; or (3) 25 percent of the residents are foreign born, or (4) 25 percent of the residents are lacking English language proficiency. With the exception of peripheral portions of the study areas within Longmeadow and Agawam, the entirety of the Primary and the majority of the Regional Study Area are currently classified as Environmental Justice Populations based upon the MassGIS 2010 Census information. The basis of these classifications is depicted in Figure 2-81 below.

The Primary Study Area Environmental Justice Population within the city of Springfield is predominantly classified by factors relating to minority, income, and English language proficiency. Although the I-91 corridor does not bisect individual neighborhoods within the EJ areas, it does provide a physical and visual barrier to the Riverfront and recreational open space. I-291 bisects the

[12] https://www.mass.gov/service-details/environmental-justice-policy

North End neighborhoods, including two hospitals and several schools from the Downtown Springfield central business district as well as South End neighborhoods and points south. Alternatives developed should consider improving all environmental and connectivity aspects as they relate to these areas. The evaluation criteria developed for this study will assess the alternatives developed with respect to mobility, safety, health and environmental effect, connectivity and accessibility, land use and economic development, and community effects.

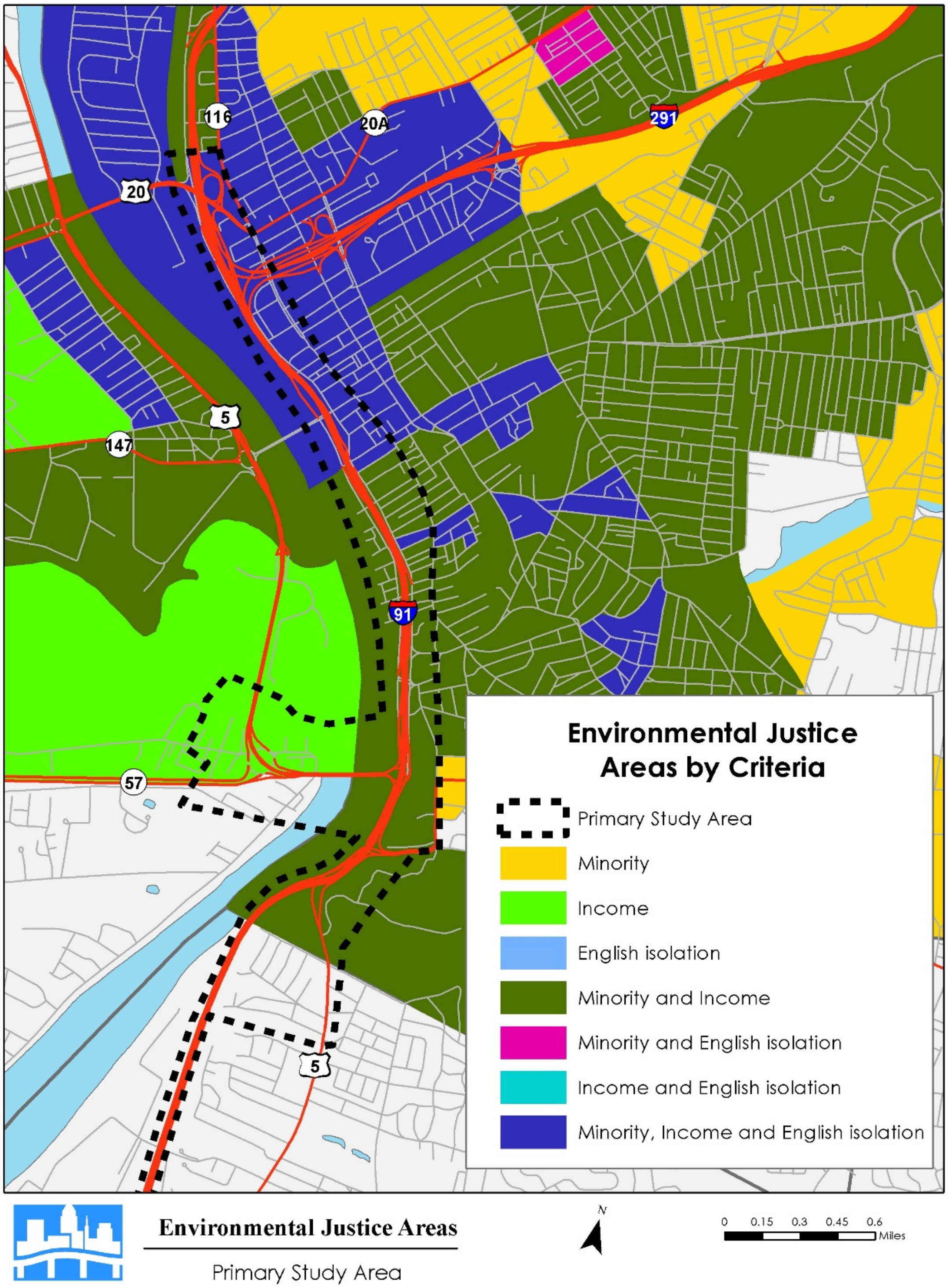


Figure 2-81: Environmental Justice Areas by Criteria

2.6 DEFINITION, INVENTORY, AND EVALUATION OF ISSUES AND OPPORTUNITIES

The analysis of existing and future No-Build conditions of the Primary and Regional Study Areas has identified numerous issues, constraints, and opportunities that impact the viability and design of potential alternatives for the I-91 Viaduct. Issues represent concerns relating to the current I-91 structure and its surroundings that may be addressed through alternatives while opportunities represent goals for an alternative layout of the Viaduct to achieve. Issues and opportunities frequently overlap as they are both focused on improvements whereas constraints represent potential impediments to alternatives. Consistent with the Evaluation Criteria provided in Section 4.4, these issues, constraints, and opportunities are categorized into the following sections: Mobility and Accessibility, Safety, Environmental Effects, Land Use and Economic Development, and Community Effects.

2.6.1 ISSUES

MOBILITY AND ACCESSIBILITY

There are several issues within the Primary Study Area in regard to Mobility and Accessibility, which are listed below:

- Lack of designated provisions for bicycles
- Signalized and unsignalized intersections and rotaries/roundabouts with poor LOS
- No direct connection to the Memorial Bridge from I-291 WB
- Limited connections to the Connecticut Riverwalk and Bikeway within the Downtown Springfield area
- Crosswalk and pedestrian ramps do not meet current ADA standards.
- Gaps and low frequencies of transit service
- Too many on and off ramps in a short distance along the Viaduct section of I-91

Within the Primary Study Area, many signalized intersections provide bicycle detection, and many roadways have adequate shoulder width for bicyclists and vehicles, such as West Columbus Avenue. However, roadways within the Primary Study Area do not provide bike lanes connecting between the signalized intersections. It would be advantageous to provide more bike lanes and bicycle facilities within the Primary Study Area. Alternatives should utilize a Complete Streets approach within the Primary Study Area.

Figure 2-82: Existing Bicycle Detection - State Street at Main Street

The lack of a direct connection to Memorial Bridge from I-291 westbound is a mobility issue that also raises safety concerns (discussed below). Due to the lack of a direct connection, many vehicles take the on ramp to I-91 southbound from I-291 westbound (entering on the left) and attempt to quickly maneuver to the right-side exit ramp to West Columbus Avenue and the Memorial Bridge. Consideration in the alternatives will be made to providing a direct connection to I-291 westbound to the Memorial Bridge.

Within the Downtown Springfield core and Primary Study Area, the Connecticut River, Connecticut Riverwalk and Bikeway, and Riverfront Park are separated from the rest of the city by I-91 and the Amtrak Railroad. There are only three places for pedestrian and bicyclists to cross the railroad tracks and five underpasses below I-91 between East and West Columbus Avenues. These crossings are described in detail in the pedestrian and bicycle section of this chapter. The underpasses are typically dark and are not welcoming to pedestrians. The crossings of the railroad tracks are either inconvenient or unsafe. As a result of these factors, the riverfront area has remained an underutilized asset for residents and visitors to Downtown Springfield.

Figure 2-83: Underpass I-91 over State Street

In addition to the difficulties noted above for pedestrians attempting to access the Connecticut River and its recreational amenities, numerous intersections within the Downtown Springfield area lack fully up-to-date and ADA-compliant pedestrian amenities. Deficiencies include missing or nonstandard wheelchair ramps, missing or nonstandard crosswalks, and in a smaller number of cases gaps in the sidewalk network. Correcting these deficiencies may enhance pedestrian mobility, particularly for individuals with mobility challenges. Additionally, desire lines, including the removal of fence segments, within the study area indicate that pedestrian connectivity in reasonable locations could improve the connectivity and safety for residents.

PVTA service in Downtown Springfield provides fixed-route and paratransit service for a number of major routes. However, only four bus routes (Ludlow via Bay, Walmart – Eastfield Mall, Chicopee Center – Big Y Sumner – Allen, and Carew – E. Springfield/Belmont – Dwight Rd.) provide service at headways of 20 minutes or less on weekdays. Headways of 30 minutes or more on other routes may limit the utility of these routes to potential riders. Additionally, the lack of service on East/West Columbus Avenues south of Memorial Bridge is a notable gap in the service network.

Numerous roadway features are operating over capacity, particularly in the PM peak period, with LOS grades below D at five intersections and all three rotaries. Approximately one-third to one-half of weaving segments examined operate at LOS D or below during peak periods as do one-fifth to one-quarter of on and off ramps. Specific intersections suffering from a poor LOS include Boland Way and East Columbus Avenue; Memorial Bridge and Boland Way at West Columbus Avenue; US-20A at MA-116, St. George Road, and US-20; Forest Glen Road and Western Avenue at U.S. Route 5; and I-91 SB on/off ramps at US-20.

Many mobility and connectivity deficiencies present in the Primary Study area limit the opportunities for residents, workers, and visitors in the area to be physically active, as well as access local goods and services without using a personal vehicle. These conditions can lead to undesirable public health outcomes, such as increased rates of cardiovascular disease, obesity, mental health disorders, and injuries and fatalities from motor vehicle collisions.

SAFETY

Although there are many individual safety improvements that will be considered with the development of alternatives, there are three key safety issues within the Primary Study Area: the perception of crime, the number of pedestrian fatalities, and the number of vehicle crashes. In terms of the perception of crime as an issue, Working Group members identified that the Viaduct area is perceived as unsafe for pedestrians due to obstructions and poor lighting under and around the Viaduct structure. This can lead to a reduction in social cohesion among local neighborhoods, with a deterioration in real or perceived safety increasing stress and resulting in poor mental health outcomes for residents. Concerns were also raised regarding sections of the Connecticut Riverwalk and Bikeway where perceptions of unsafe conditions exist due to sight line obstructions such as walls and corners near bridge abutments.

Figure 2-84: Unsafe Connection to Connecticut Riverwalk and Bikeway

The number of pedestrian fatalities within the Primary Study Area in recent years is unacceptable. There have been five pedestrian fatalities within the Primary Study Area between 2010 and 2014. As part of Goal 1 in Chapter 1, it is imperative to improve the safety within the Primary Study Area. Limiting the number crashes with fatalities and injury is of the utmost importance. Some of these fatalities occurred during the evening hours where roadway lighting could be a factor. Incorporation of improved highway lighting into any alternative that may be implemented in the future is warranted to reduce fatality crashes in this area. Additionally, incorporating knowledge gained from residents and community members about the most appropriate locations for connections should reduce pedestrians creating the aforementioned pedestrian desire lines, which may place them at increased risk for injury.

In addition, there are three roadway segments that contain high crash rates, which include the South End Bridge (US-5), the Longmeadow Curve (I-91), and the I-91 Viaduct from I-291 to Union Street. The crash rates were 4.82, 3.03, and 3.82 crashes per million vehicle miles traveled (MVMT), respectively. These figures are much higher than the statewide and district crash rates of 2.08 and

0.54 MVMT, respectively. Five signalized intersection locations contained crash rates that were higher than the state and districtwide averages (0.8 and 0.82 crashes per million entering vehicles (MEV), respectively. These are as follows:

Avocado Street at Plainfield Street – 0.98/MEV

Numerous rear-end crashes occur at this location due to poor visibility of the signal heads and short clearance intervals. Updating signal head locations and revising the clearance intervals would provide safer conditions at this location.

Carew Street at Main Street – 1.78/MEV

The intersection of Carew Street at Main Street contains numerous angle crashes. Although signalized, angle crashes are occurring due to short clear intervals, intersection geometry, and mainly congestion. Updating the clearance intervals and possibly the length of the clearance phase may result in fewer angle crashes.

Union Street at East Columbus Avenue – 1.26/MEV

There were numerous angle and sideswipe crashes for vehicles traveling northbound on East Columbus Avenue at this location. These crashes are attributable to inconsistencies between signal indications for East Columbus Avenue and the lane designations, leading to driver confusion. Updating signal heads and pavement markings to be consistent with one another may result in fewer angle and sideswipe crashes.

State Street at Main Street – 1.00/MEV

Elevated crash rates at this intersection may be attributable to inconsistencies in turn restrictions and signal heads. There are left-turn restrictions on both sides of State Street and Main Street Northbound; however, the eastbound movement from State Street's indication is a green ball instead of providing through and right arrows. Replacement of signal heads to include through and right arrows on this approach may enhance compliance with turn restrictions and reduce crash rates.

Union Street at Maple Street – 1.74/MEV

The intersection of Union and Maple Streets contains mainly angle crashes. Angle-type crashes occur at signalized locations when there are shorter clearance intervals. Therefore, reviewing and updating the clearance intervals at this intersection may alleviate these issues. Traveling northbound along Maple Street, trees obstruct drivers' views of signal heads until drivers are relatively close to the intersection. This location only provides one signal head over the travel lanes, and sight distance is poor due to short distances to adjacent buildings.

An additional signal head and improved street tree maintenance may enhance safety at this intersection.

In addition to the roadway segments above that experience elevated crash rates, the I-91 mainline contains areas in which vehicular crash rates occur due to design deficiencies. Within the vicinity of the I-91 Viaduct, which runs approximately 4000' between State Street and the I-291 interchange, there are eight on and off ramps. When ramps, whether merging and/or diverging, are within this close of a proximity to one another, there is an elevated potential for more crashes. Limiting the number of ramps along I-91 within the Primary Study Area would provide a means of safe travel along the interstate. A prime example is the on ramp to I-91 southbound from I-291 westbound. This particular ramp enters I-91 southbound on the left-hand side. Within a short distance, the exit ramp on the right-hand side of I-91 for West Columbus Avenue and the Memorial Bridge exists. Although striped for the traffic coming onto I-91 from I-291 to stay in the left lane for a distance past the exit to West Columbus Avenue and the Memorial Bridge, vehicles still try to make this maneuver due to the connectivity to the Memorial Bridge. Consideration in the alternatives will be made to consolidating the number of on and off ramps within the Primary Study Area and providing a direct connection to I-291 westbound to the Memorial Bridge.

ENVIRONMENTAL EFFECTS

While there are numerous urban parklets and small open space parks within the study areas, a lack of connectivity currently exists between residential neighborhoods and job and activity centers to several of the larger open spaces. In particular, connectivity to the Connecticut Riverfront is limited by the lack of access points and accessibility and safety concerns (e.g., poor lighting, perception of crime, and historically high pedestrian fatality rate) associated with existing access points. The proximity of the major surface roads to recreational spaces, such as the Connecticut Riverwalk and Bikeway, provides further disincentive to use these green space assets. Additionally, the poor pedestrian and bicycling infrastructure reduces the likelihood of utilitarian walking or biking, contributing to limited physical activity rates and the high existing baseline disease burden (e.g., lack of exercise, higher rates of obesity, diabetes, and hypertension).

In addition to the mobility, accessibility, and safety issues discussed above, the elevated highway corridor and congested surface roads create significant noise and air pollution, with potentially detrimental effects on the health of residents, workers, and visitors to Downtown Springfield. Exposure to transportation-related air pollution – particularly within an exposure zone ranging from 300 to 500 meters from the roadway - is associated with a wide range of health effects including cardiovascular- and respiratory-related illnesses and diseases (e.g., exacerbation of asthma) as well as other emerging health effects (e.g., adverse birth outcomes, neurological effects).

Currently within the City of Springfield, the Springfield Water and Sewer Commission maintains a combined sewer system within the Primary Study Area limits. Stormwater collection systems around the Primary Study Area are piped to areas that ultimately drain toward the Connecticut River, impacting water quality.

Over a dozen AUL sites are located in and immediately around the Primary Study Area. AUL sites have restrictions placed on them to limit visitors' potential exposure to hazardous materials of concern. These sites should be considered a constraint requiring further detailed investigations should any alternatives developed be unable to feasibly avoid impacts to one or more of these sites.

ASTHMA

For Springfield, the pediatric asthma prevalence was statistically significantly higher for the most recent three school years examined (2012-2015 school years). Springfield has statistically significantly higher rates of asthma hospitalizations and Emergency Department (ED) visits for asthma compared to the state. Given that there is a causal relationship between exposure to traffic-related pollutants and exacerbation of asthma, increases in current levels of motor vehicle emissions in the Primary Study Area could further exacerbate asthma rates.

HEART ATTACK

Rates of myocardial infarction for people 35 years and older (Table 7) were statistically significantly elevated in Springfield in 2011 and 2012 but not elevated in 2010 compared to the state as a whole. There are several factors that can contribute to cardiovascular disease including reduced physical activity that may be related to poor mobility and connectivity within the Primary Study Area and impacts from and exposure to air pollution.

BLOOD LEAD LEVELS

Springfield has the highest rates of elevated blood lead levels in children among all of the Primary and Regional Study Area communities. The rates based on the average annual prevalence of children screened (9 - <48 months of age) with confirmed Blood Lead Levels >= 5 ug/dL are statistically significantly higher than statewide rates.

ENVIRONMENTAL JUSTICE

Health disparities are differences in health outcomes between groups that reflect social inequalities, which are reflected in this report in EJ criteria. Within the city of Springfield, EJ populations are present throughout virtually the entire Primary Study Area, representing minority, income, and English isolation criteria. In most locations, two or three of these criteria are present in the same block groups at the same time.

LAND USE AND ECONOMIC DEVELOPMENT

Land use and economic development issues revolve around existing barriers, low incomes and unemployment for those living in and near the Primary Study Area, and housing choice.

PHYSICAL AND VISUAL BARRIERS

The riverfront, the Connecticut Riverwalk and Bikeway, Riverfront Park, and the Naismith Memorial Basketball Hall of Fame and associated retail/commercial businesses are currently isolated and underutilized. I-91 acts as a barrier between these resources and Downtown Springfield.

Access to the riverfront by pedestrians is difficult. Again, I-91 acts as a barrier to significant recreational opportunities.

I-91 presents a significant visual barrier between Downtown Springfield and the riverfront, exacerbating the isolation and underutilization of resources located west of the interstate.

INCOME AND EMPLOYMENT DISPARITIES

Residents in the Primary Study Area have incomes that are significantly lower than those of Springfield as a whole or the larger region. Participation in the labor force is also significantly lower among Downtown Springfield residents, and unemployment is more prevalent. Lower incomes and reduced employment rates reduce these residents' ability to fully benefit from all the amenities provided by the Downtown Springfield neighborhood. The extent that I-91 alternatives can enhance employment opportunities through new development and improve transit and pedestrian accessibility could aid Downtown Springfield residents.

Additionally, these low levels of employment play into an increased need for coupling strong engagement with any investment activities in the area. If economic opportunities increase leading to changes in property values and other changes, displacement of current residents is possible and needs to be monitored and addressed.

HOUSING AFFORDABILITY

Although housing costs in the Primary Study Area are significantly lower than those elsewhere in the city, incomes in the Primary Study Area are also considerably lower, resulting in over half of renters in the Primary Study Area paying rents that are at unaffordable levels (as defined by HUD, more than 30% of household income for a household making 80% of area median income).

UNDERREPRESENTATION IN PROFESSIONAL AND TECHNICAL SERVICES SECTOR

Although the professional and technical services employment sector is well represented in Massachusetts, jobs in this high-wage sector are vastly underrepresented in Springfield, presenting a challenge to the city's economy. The extent that alternatives for I-91 enhance development opportunities, accessibility, and the attractiveness of Springfield for businesses could boost the city's overall economy and promote job creation both within and beyond these sectors. This approach needs to be coupled with continued support and workforce pipeline to ensure those gains are shared among all residents.

DOWNTOWN PARKING AVAILABILITY

Off-street parking in Downtown Springfield is currently modestly utilized, with approximately 3,150 spaces typically available out of almost 6,600 spaces distributed across the Downtown Springfield area. However, the construction of the MGM Springfield Casino and potential removal of the I-91 North and South Garages under some alternatives discussed in this study may substantially reduce the supply of available parking, with the average supply of unused parking under those alternatives contracting to fewer than 700 spaces. Assessment of potential need for additional off-street parking would be warranted if such alternatives are pursued.

COMMUNITY EFFECTS

Currently, I-91 acts as a visual and physical barrier between the city of Springfield and the Connecticut River as there are a limited number of east-west crossings between the Downtown Springfield area and the river. The railroad running along the Connecticut River west of I-91 also represents a physical barrier. There are only three crossings to the riverfront within the limits of the downtown area. The Connecticut Riverwalk and Bikeway is underutilized because of the limited access points. The southern beginning/end of the bikeway (near the South End Bridge) is an isolated dead end with no public access. This "dead end" is also isolated between the railroad tracks and the Connecticut River.

There are limited bicycle accommodations with the Primary Study Area. Although many signalized intersections do include bicycle detection within the Primary Study Area, there are no designated bike lanes. Other than signalized intersections along Main Street, the remaining signalized intersections do not provide countdown pedestrian signals. Pedestrians would benefit from countdown pedestrian signal heads at the intersections within the Primary Study Area. Numerous ADA ramps do not meet the current ADA standards, many of which are lacking required tactile warning strips.

2.6.2 CONSTRAINTS

Within the study areas, numerous constraints will guide the development of the alternatives. In addition to the constraints listed below, each of the alternatives must consider and limit impacts to park lands and green space, the environment, existing homes, businesses, and traffic and consider and limit air pollutants, greenhouse gases, and noise.

MOBILITY AND ACCESSIBILITY

The Primary Study Area connectivity to the Connecticut River is limited by both the railroad and the I-91 corridor, which runs adjacent to and north-south along the Connecticut River, raising a clear need for additional separated crossings for pedestrians and bicyclists if access to the riverfront is to be improved. A 288-strand fiber optic cable is attached to the west side of the existing I-91 Viaduct, which is used to display traffic-related messaging along the I-91 corridor, and impacts to the functionality of this infrastructure must be considered in implementing any of the proposed alternatives.

SAFETY

Emergency vehicle access is essential in the alternatives development. Bay State Medical Center and Mercy Hospital both flank the Primary Study Area. The developed alternatives will consider the identified safety topics and improve upon them and will comply with the latest American Association of State Highway and Transportation Officials (AASHTO), ADA, and MassDOT standards.

LAND USE AND ECONOMIC DEVELOPMENT

Some planned and existing developments in the Primary Study Area and adjacent neighborhoods serve as constraints insofar as they are dense and successful components of the city's overall economy and must be protected, if not enhanced, in any alternative scenario.

The region's relatively low population density and dispersed employment centers are constraints on the public transit system and in regard to providing a robust set of transportation alternatives. Because the region's population is more diffuse than in a major metropolitan region, Springfield and the region face greater financial and logistical challenges in providing transit service that adequately links a dispersed network of origins and destinations. This reality is an ongoing issue for Springfield's long-term planning for transportation alternatives as well as a constraint on feasible approaches to solving transportation challenges in the area.

COMMUNITY EFFECTS

The new planned projects of the renovated Union Station and the MGM Casino are large economic regenerators for the city and the region, and their impacts and footprints need to be considered as physical constraints during the development of alternatives.

CULTURAL, HISTORICAL, AND ARCHAEOLOGICAL RESOURCES

A large number of sites that are listed on or eligible for the National Register of Historic Places are located throughout the Primary Study Area. Potential impacts to these properties brought about by federally funded projects must be reviewed in accordance with the National Historic Preservation Act. Similarly, projects that receive funding from the U.S. Department of Transportation require a determination and mitigation of potential impacts to these properties.

2.6.3 OPPORTUNITIES

This analysis has uncovered numerous opportunities to incorporate in the alternatives. Several ongoing redevelopment projects could be supported through alternatives. The riverfront could become a regional draw for commercial, residential, and retail development. The reconfiguration or realignment of I-91 could improve traffic safety and congestion, which would have far-reaching positive impacts on the study areas.

MOBILITY AND ACCESSIBILITY

Revamping or consolidating the number of on and off ramps throughout the Primary Study Area would provide for safer and more efficient travel along the I-91 corridor. The creation of a more defined frontage road system would promote vehicles exiting the highway at strategic and fewer locations within the Primary Study Area, thus reducing weaving issues and enhancing vehicular safety.

High levels of demand for transit service along the State Street corridor have led to consideration of implementing Bus Rapid Transit on this corridor. If implemented, this service would be an important complement to mobility enhancements in the Primary and Regional Study Areas. The establishment of Union Station as a multimodal transit hub similarly provides an opportunity for better-coordinated transit service complementary to the alternatives explored in this document.

An improved bicycle and pedestrian network in the Primary Study Area would facilitate greater rates of walking and bicycling activity, which achieves public health benefits. Allowing residents, workers, and visitors of the Primary Study Area, particularly within EJ neighborhoods, to access goods and services without an automobile improves social mobility opportunities.

SAFETY

As mentioned above, consolidating the number of on and off ramps would provide safer means of travel along I-91. This consolidation would limit weaving sections while geometric improvements along the "Longmeadow Curves" would potentially have a favorable impact on the number of crashes in this area.

Key opportunities posed by any modifications to the I-91 Viaduct are to provide additional east-west access points across the transportation corridor of I-91 and the railroad and to enhance the actual and perceived safety of existing access points. This would enhance access to the Connecticut River, the Connecticut Riverwalk and Bikeway, and Springfield's Riverfront Park.

Within the Primary Study Area, additional countdown pedestrian signal heads can be considered at intersections as well as introducing ADA-compliant crossings and APS (accessible pedestrian signal) push buttons. Reducing the number of serious and fatal injuries within the Primary Study Area, particularly among vulnerable road users such as pedestrians, is a critical objective of any future project.

In addition, it will be imperative to remove the perception of crime in these areas so that pedestrians feel that these are safe and reasonable areas to travel, improving social cohesion.

ENVIRONMENTAL EFFECTS

Contemplated enhancements to the I-91 Viaduct provide opportunities to create new green spaces, open space, and pedestrian-friendly environments and corridors, coupled with improved connections and linkages to critical destinations within the study area. Specific opportunities include linking portions of the Riverwalk in Agawam and Springfield and linking Forest Park to the Riverwalk; the expansion and linkage of these green spaces could draw visitors from the greater Springfield region. Improvements in air quality from reductions in motor vehicle-related emissions from fleet turnover and reductions in noise levels in the Primary Study Area would result in several positive public health outcomes, including decreased rates of cardiovascular disease, hypertension, and asthma and other respiratory diseases.

The introduction of Low Impact Design (LID) and Best Management Practices (BMP) for drainage will be crucial to the development of alternatives as they will be directly adjacent to the Connecticut River. LID is an all-embracing approach to stormwater management modeled after nature by detaining, infiltrating, filtering, storing, and evaporating runoff. Instead of collecting water in piped facilities, stormwater could be treated with small landscaped features where applicable. BMPs will also be used in order to treat runoff. BMPs are improvements that help reduce the quantity and improve the quality of stormwater runoff.

LAND USE AND ECONOMIC DEVELOPMENT

UNION STATION IMPROVEMENTS

Stronger links could be established between the refurbished train station and surrounding transportation and community resources. The redevelopment of Union Station is a high priority for the City of Springfield. The selected alternative should improve connections within the city as well as the region for Springfield residents and workers.

NAISMITH MEMORIAL BASKETBALL HALL OF FAME

The selected alternative should seek to better integrate the Basketball Hall of Fame with Downtown Springfield in order to increase utilization of this key city resource.

RIVERFRONT

The selected alternative should improve the integration and utilization of the riverfront, including increasing pedestrian access and visible sight lines and creating and/or enhancing recreational uses including boating.

ECONOMIC DEVELOPMENT

Improved multimodal transportation connections, service levels, and street-level amenities would better serve recent, ongoing, and proposed projects, such as the Court Square development, the MGM Springfield project, the Medical District, the Springfield Data Center, South End Main Street improvements, State Street Corridor improvements, the Smith and Wesson Industrial Park, and the proposed Bondi's Island commercial development.

Improvements within the Primary Study Area could advance Springfield's goal of making Downtown Springfield a focus of future economic development efforts by improving riverfront access, visibility, and pedestrian orientation. This should be coupled with activities that are used to ensure no harm is being done to existing residents and the benefits of these improvements are used to reduce the inequitable access to opportunity experienced by residents of Springfield.

PEDESTRIAN AND CYCLING IMPROVEMENTS

Greater connectivity between the Connecticut Riverwalk and Bikeway, surrounding neighborhoods, and recreational trails in adjacent communities would enhance the public health and recreational goals of Springfield and surrounding municipalities.

PUBLIC SAFETY

Alternatives for the Viaduct should seek improvements to public safety amenities in the area, such as street lighting, pedestrian safety features, and other measures designed to create welcoming and safe streets.

TRANSIT USER EXPERIENCES

The selected alternative should seek to improve the transit network within the city as well as the region for Springfield residents and workers.

LIVE/WORK NEIGHBORHOODS

Although Downtown Springfield is the regional employment center of the Pioneer Valley, there is a mismatch between the number of jobs located within the Primary Study Area and the employment and income levels of the residents who live there. Recent national trends have seen more workers moving to city centers to take advantage of proximity to jobs, entertainment, and transportation options. Alternatives should seek to increase opportunities for providing quality housing options in close proximity to employment and transit centers in order to capitalize on this cultural trend.

REINVESTMENT IN DOWNTOWN RESIDENTIAL AREAS

I-91 alternatives should seek opportunities in the Primary Study Area to provide quality housing options in Downtown Springfield. Enhanced housing choice and opportunities through new development could have beneficial economic effects for Downtown Springfield residents and businesses.

COHESIVE REDEVELOPMENT

Alternatives to the Viaduct should seek to ensure that any newly created development opportunities are well integrated with existing and ongoing redevelopment projects through multimodal connections, logical site layouts, and appropriate treatment of the waterfront. Just south of Avocado Street near Clinton Street, there is an underutilized parcel of land that is adjacent to the Connecticut Riverwalk and Bikeway that provides an opportunity for new development that can capitalize on and/or contribute to the amenity value of the Connecticut Riverwalk and Bikeway. Such redevelopment is further supported by Springfield's 2013 zoning ordinance revisions intended to support redevelopment of lands proximate to the Connecticut River.

COMMUNITY EFFECTS

Connecting the Connecticut Riverwalk and Bikeway to the west across the Connecticut River would be advantageous for Agawam and West Springfield. There is a shared-use path in Agawam along River Road that would benefit from this connection. Also providing bike lanes along Sumner Avenue, Longhill Street, southern Main Street and West Columbus Avenue along with providing access to the Connecticut Riverwalk and Bikeway on the southern end would allow for a connection to Forest Park.

CHAPTER II - SUMMARY OF FINDINGS

This chapter focuses on the raw data collection and generation of issues, constraints, and opportunities that will guide the development of alternatives in the next chapter. In summary, the Primary Study Area can be described as being largely composed of a culturally vibrant urban downtown that serves as the foremost employment center of the Pioneer Valley. At the center of the Primary Study Area is the I-91 Viaduct, a raised highway that has proven expensive to maintain and has a subpar traffic safety record. Since its construction in the 1950s, the Viaduct has negatively impacted the Downtown Springfield area through which it runs, physically and visually separating the downtown core from the Connecticut River. Reconceptualization of the Viaduct area should go hand-in-hand with ongoing improvements and investments in Springfield's Downtown and the region, such as improvements to the historic Union Station, Court Square, and the MGM Springfield development. The area is well connected by a variety of transportation modes, including a robust and varied roadway system, public buses, an improving rail service, and an intact system of sidewalks and crosswalks. Project alternatives that improve pedestrian amenities, including ADA accessibility, would well serve existing and future populations attracted to Downtown Springfield because of easy access to jobs, goods, services, and recreational opportunities. Road safety and traffic issues are major concerns to residents throughout the Primary and Regional Study Areas, particularly along the Longmeadow Curve, all three rotaries, the South End Bridge, U.S. Route 5, and the Viaduct.

Alternatives that would change the operation and connections of these roadways could have major impacts on residents and businesses in the Study Areas and require close examination before implementation to ensure that proposed changes would positively impact the lives and livelihoods of area stakeholders. Many Primary Study Area residents have extremely low incomes and high levels of unemployment, and the area has high rates of racial minority and non-English proficient populations. Springfield residents as a whole have relatively low health levels as measured by state standards, and because negative health outcomes frequently mirror poverty rates, these high levels of sickness are likely to be even more pronounced in the Primary Study Area. This population could be left particularly vulnerable during a large-scale redevelopment project, so ensuring that EJ populations are not unduly burdened by dislocation or other negative impacts will be a critical component of planning any project alternatives.

The Connecticut River is an untapped resource that is waiting to be reclaimed by the region's people and municipalities. In addition to transportation routes, the river is a link among regional communities. Project alternatives that physically and visually reconnect the river to the city of Springfield could help return the river to its historic position of prominence in the region, underscoring Springfield's identity as a fully realized place, both environmentally and economically. Enhancing Downtown Springfield's connection to the river and the recreational opportunities it presents has the potential to positively impact the city and its residents economically, socially, and physically. Visual de-emphasis of the highway in this area corresponds with the goals of surrounding municipalities, which also seek to enhance the visual appeal and recreational utility of their riversides.

Given the growing prominence of bicycling both as a means of exercise, recreation, and transportation, the Primary Study Area is relatively underserved by bicycle facilities. Improvements in this area present a tremendous opportunity to fulfill regionwide goals and aspirations for creating safe bicycle routes (both dedicated trails and those integrated into roadways) that would permit cyclists to navigate Springfield and connect to surrounding communities. Encouraging increased bicycle use as a means of navigating the Primary and Regional Study Areas could serve the Springfield community in terms of improving health outcomes, decreasing traffic congestion, and generally making the city's streets a more walkable and desirable place to be.

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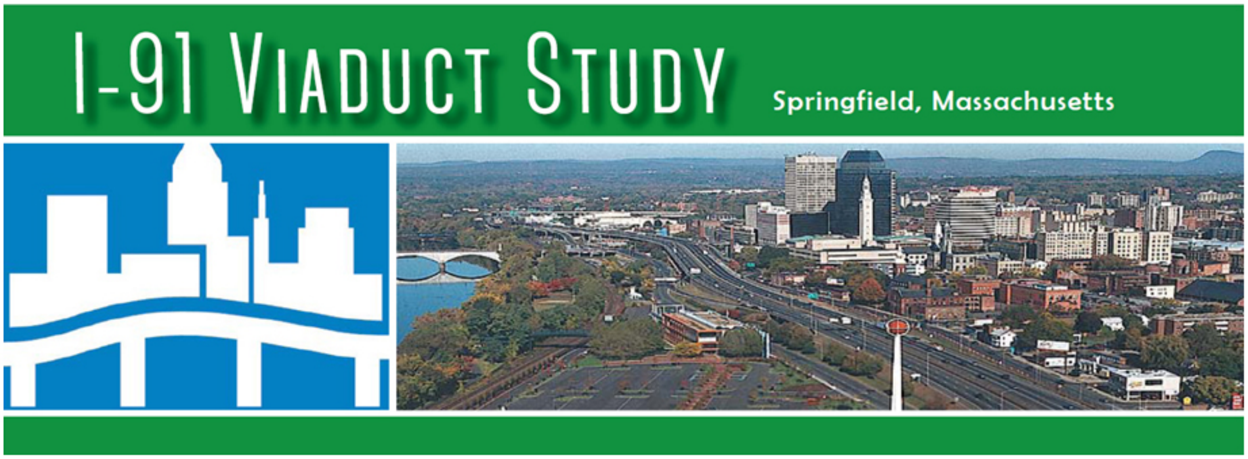


INTERSTATE 91 VIADUCT STUDY

CHAPTER III

ALTERNATIVES DEVELOPMENT

August 2018

MMI #3869-16-6

massDOT
Massachusetts Department of Transportation

MILONE & MACBROOM

CONTENTS

3.1 INTRODUCTION

Chapter I of the Interstate 91 Viaduct Study presented the Primary and Regional Study Areas, introduced the purpose and need for the study, and outlined its goals and objectives. Chapter II provided a detailed investigation into the existing conditions within the Primary and Regional Study Areas as well as the projected No-Build conditions in the year 2040. Chapter II also identified the relevant issues and constraints facing the Primary and Regional Study Areas under the 2040 No-Build scenario and discussed opportunities that should be considered in the development of any and all future alternatives. Building on that foundation, Chapter III describes the process of developing the initial alternatives that were considered over the course of several strategic Working Group meetings. The alternatives discussed in this chapter attempt to address many of the existing issues identified while responding to the opportunities discussed in previous chapters. Preliminary alternative schematics were developed, discussed, and assessed on their individual merits and ability to achieve the study's goals and objectives. Through the preliminary assessment of the schematic alternatives, several concepts were determined to either have significant adverse impacts or simply fall short of meeting the goals and objectives of the study; these concepts were removed from further consideration in the alternatives development process.

In addition to depicting major alterations to the Interstate 91 (I-91) alignment, many of the schematic alternatives included smaller alterations and improvements, which could be considered as shorter-term or mid-term improvement projects for the Primary and Regional Study Areas. Summaries of these potential stand-alone projects are included within this chapter's discussion.

PROJECT OPPORTUNITIES

A summary of the opportunities that have been considered in preparation of the alternatives listed in this chapter is listed below:

> Link Forest Park to Riverwalk: With Forest Park being one of the premier parks in the region, it would be advantageous to connect it to the Connecticut Riverwalk and Bikeway. The Riverwalk is part of a series of paths that are proposed along the Connecticut River in cities such as Chicopee, West Springfield, and Agawam.
>
> Link Riverwalk in Springfield to Agawam: With the Connecticut Riverwalk and Bikeway ending near the South End Bridge with no public access, it would be advantageous to provide access in this area and provide a shared-use path along the South End Bridge into Agawam, eventually connecting it to the shared-use path along the west side of the river adjacent to River Road.

Longmeadow Curve Improvements: The Longmeadow Curve has been considered a nuisance for years in Western Massachusetts, with lane drops from three to two lanes in both directions, numerous on and off ramps, curve radii that require lower interstate speeds, and weaving areas that do not provide safe distances for vehicular traffic. Improvements to all of these factors in this area could provide benefits under any of the alternatives that will move forward to the analysis stage; improvements to the Longmeadow Curve could also be considered as a separate project.

Link to the New Union Station: Multimodal travel in the Downtown Springfield area would be enhanced by creating linkages and improving connections to the newly renovated Union Station. The role of the station as a new transportation "hub" for Western Massachusetts, with connections to transportation throughout the northeast, can best be complemented through design measures that expedite access to the station for users in and around Downtown Springfield.

Expand Local and Regional Draw to the Connecticut Riverfront: Access from the downtown core area of the City of Springfield within the Primary Study Area to the Connecticut Riverfront is currently impeded by both the I-91 viaduct and the railroad corridor. Undeveloped waterfronts are a great asset for communities and are often used as a civic or recreational focal point within an urban environment. The Connecticut River waterfront should be the focus of future place making strategies to enhance and revitalize the existing community. A better connection can spur economic development and meet the needs of the community, utilizing this natural resource in an opportunistic and environmentally sensitive way.

Improve Multimodal Travel: Under current conditions, residents and visitors to Downtown Springfield do not have a wide variety of convenient mobility options for completing their trips within and beyond the downtown area. The study aims to enhance both vehicular travel options and to improve access to other transportation alternatives, including travel by bike, foot, bus, train or other modes.

Create Opportunities for Transit Oriented Development: With the newly renovated Union Station only a half-mile from the center of the viaduct corridor and within a half-mile of the MGM Casino, consideration should be given to creation of possible new areas of transit-oriented development (TOD). TOD is typically focused around urban transportation hubs and corridors and is a pattern of development that translates well to the Primary Study Area. In both existing and potential new development parcels, opportunities exist to create areas of mixed uses that are walkable and in close proximity to convenient transit service and that provide an array of opportunities where the public can live, work, and play. A TOD could generate increased ridership on existing and expanded transit services, reduce vehicular traffic and congestion, increase the range of housing and lifestyle options for local and regional residents, increase foot traffic and customers for area businesses, and reduce environmental impacts.

Promote Economic Development: Providing better access to the riverfront as an urban amenity increases the viability of revitalization and redevelopment in the surrounding area. Building on or near the waterfront generally boosts activity and creates more active and vibrant public spaces. Alternatives should consider both indoor and outdoor uses, incorporate green corridor connections throughout Downtown Springfield, enhance connections to existing uses and destinations, and generate new areas for development and open space.

3.2 DEVELOPMENT OF PRELIMINARY ALTERNATIVES

Development of the preliminary alternatives was the first step in considering highway and roadway realignments and creation of improved pedestrian linkages. The following goals provided high-level guidance in shaping the design of each alternative.

MAINTAIN AND IMPROVE THE SAFE AND EFFICIENT FUNCTION OF I-91.

MAINTAIN AND IMPROVE THE SAFE AND EFFICIENT FUNCTION OF THE LOCAL STREET NETWORK IN THE PRIMARY STUDY AREA.

IMPROVE THE CONNECTION BETWEEN THE RIVERFRONT AND THE DOWNTOWN SPRINGFIELD URBAN CORE.

IMPROVE THE QUALITY OF LIFE FOR THE FOLLOWING:

- **CITY RESIDENTS IN SURROUNDING NEIGHBORHOODS**
- **EXISTING/FUTURE BUSINESS OWNERS**
- **DAILY COMMUTING WORKFORCE**
- **VISITORS TO THE CITY OF SPRINGFIELD AND SURROUNDING COMMUNITIES**

With the goals and objectives at the forefront, data collection and analysis complete, and a solid understanding of the 2040 No-Build conditions intact, the first schematic concepts for the I-91 Viaduct Study were developed. The schematic concepts are referred to as "line drawings," and each concept depicts a generalized alignment presented at a level of detail sufficient to allow an informative discussion of the potential benefits and impacts on the Primary and Regional Study Areas. The Working Group discussed and weighed the potential of each alternative with regard to highway alignment, highway elevation, and impacts and opportunities at Working Group Meetings 4, 5, and 6. Each of these initial schematic alternatives is presented below, along with their key benefits and impacts noted by the project team and Working Group members.

It should be noted that the current MGM Casino is slated for completion in fall 2018. Therefore, the planned improvements to traffic and infrastructure within the Primary Study Area were researched and included within this study. Based on the Final Environmental Impact Report published by MGM Casino in 2014, numerous changes and mitigation measures within both the Primary and Regional Study Areas were required prior to approval. Many of these improvements fall within the Primary Study Area and would be considered short-term improvements if they were not part of the MGM Casino.

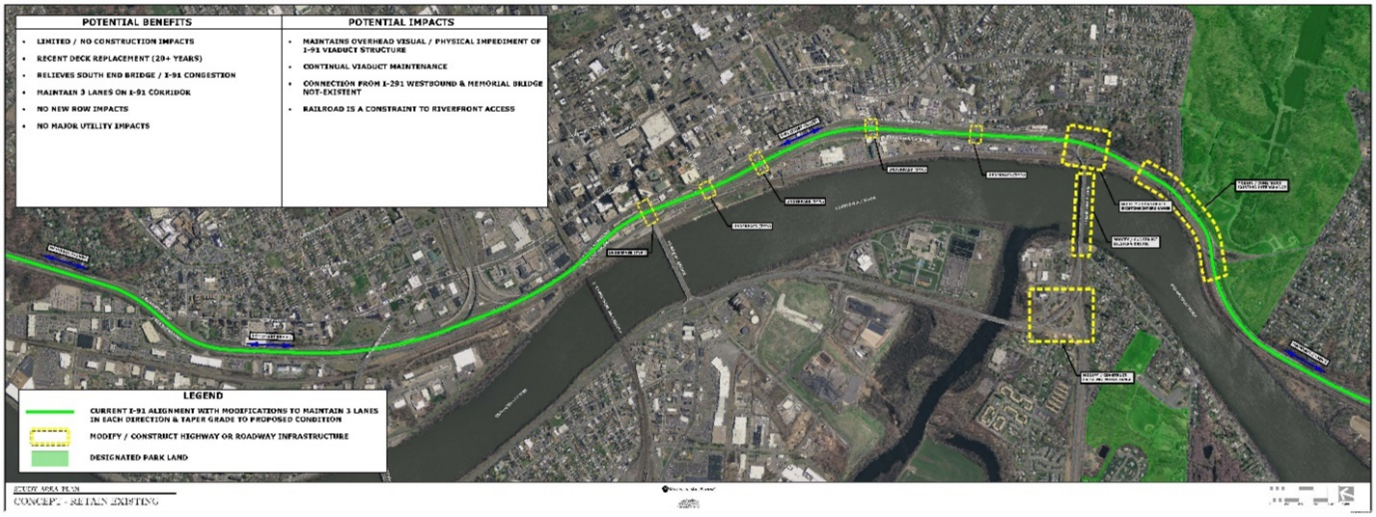


Figure 3-1: Existing Elevated Viaduct Concept

RETAIN EXISTING ELEVATED VIADUCT

Description: The "retain existing" option proposed to not alter the current elevation or alignment of the viaduct as it exists from State Street to the interchange with Interstate 291. However, the alternate would consider improvements to the highway system that would alleviate the existing traffic and safety issues within the Longmeadow Curve section. Eventually, the viaduct would require restoration in the form a deck **replacement and potentially pier replacements.**

Benefits: This alternative would include very limited impacts on existing utilities within the corridor, limited impacts on the surrounding neighborhoods and businesses, limited impacts on the right-of-way, and no upfront engineering or construction costs other than yearly maintenance costs, prior to a long-term deck and/or pier replacement project(s).

Impacts: The visual and physical impediment of the viaduct structure and existing railroad alignment between Downtown Springfield and the waterfront is not modified under this alternative. The cost of continued maintenance, as well as future costs of eventual restoration, remains a consideration.

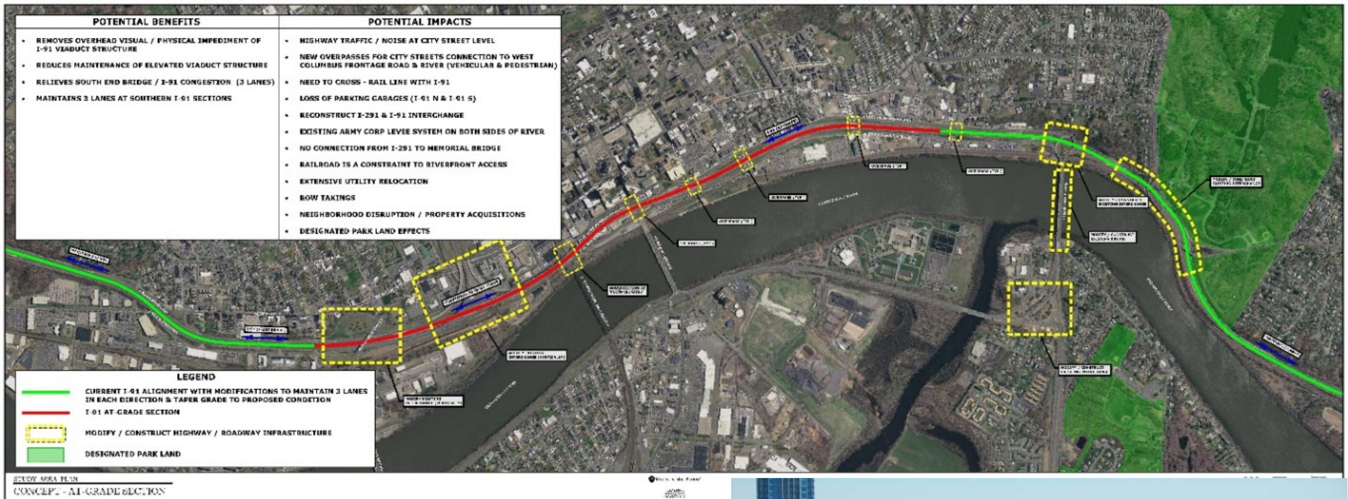


Figure 3-2: At-Grade Alignment Concept

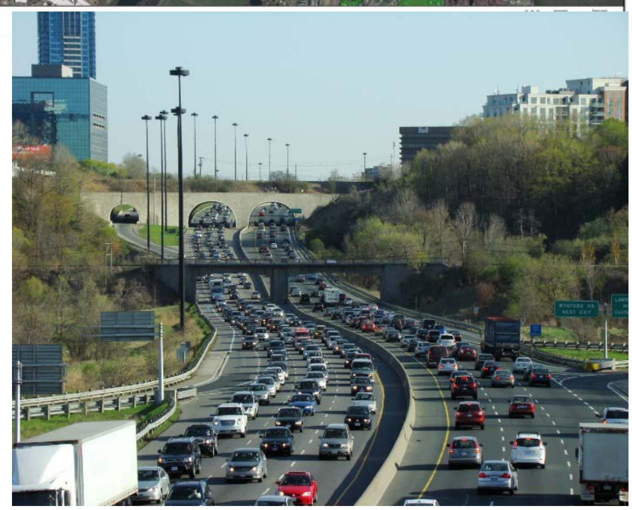


Figure 3-3: Example At-Grade Urban Highway

AT-GRADE SECTION

Description: In this alternative, I-91 would stay within in its current alignment; however, the elevation would be lowered, bringing the highway down to approximately the existing grade of East and West Columbus Avenues. This alternative would remove the elevated portion of the viaduct within the Downtown Springfield core, thus removing the visual impediment and dark underpass connections to West Columbus Street and the riverfront. Removing the viaduct would bring highway traffic to the city street level, significantly increasing noise and potentially negatively impacting air quality. An at-grade design would also cut off east-west vehicular movements, including on Boland Way, State Street, Union Street, and Broad Street. If these streets were to be reconnected, they would need to go up and over the at-grade, lowered highway. The proposed grading and ramping required to achieve this up-and-over condition would involve significant slopes, making universal accessibility challenging if not impossible. The earthwork and walls required to connect the roadways would also significantly impact the surrounding properties.

Benefits: This alternative would remove the elevated viaduct and its negative aesthetic and environmental impacts as well as reduce maintenance costs of the structure.

Impacts: Potential impacts include property impacts and takings, neighborhood disruptions, utility relocation, limitations on accessibility, negative impacts on air quality, no improved connection from I-291 southbound to the Memorial Bridge, increased noise levels, continued railroad impediments to accessing the riverfront, as well as a conflict with the railroad tracks running easterly/westerly north of Boland Way.

DEPRESSED SECTION

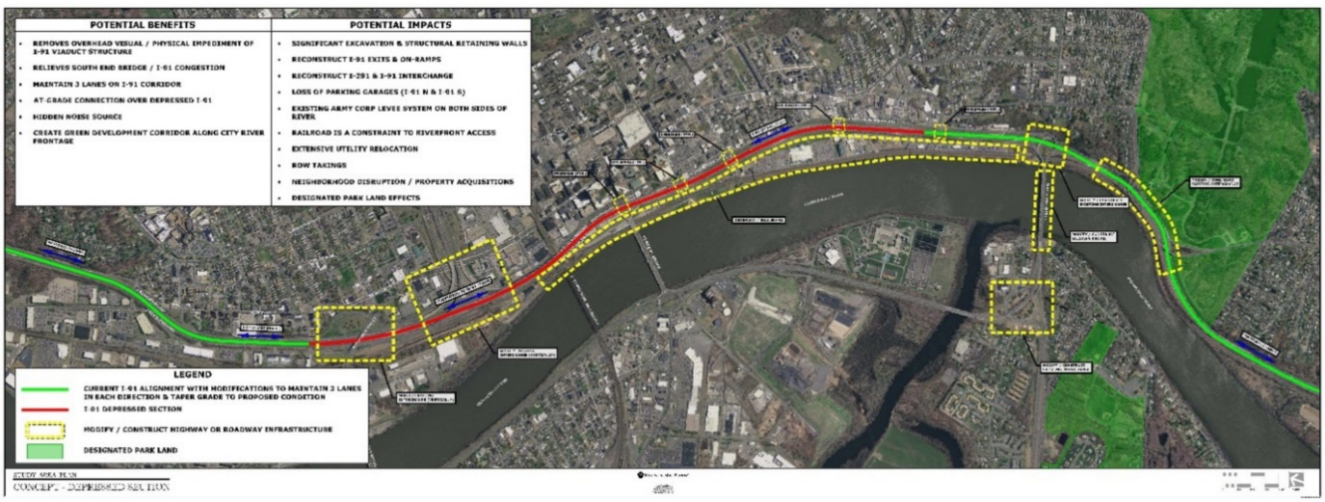


Figure 3-4: Depressed Alignment Concept

Description: This alternative considers depressing or sinking a portion of the elevated viaduct below East and West Columbus Avenues, following the same highway alignment that exists today. Several variations of this alternative could feasibly be pursued. For instance, the highway could be sunken and covered, allowing for park space, new cross streets, and/or new development sites. Alternatively, the highway could be sunken, leaving the top open and only allowing for cross streets to be connected over the top. Examples of these scenarios are included below.

Benefits: At-grade cross streets connection could be provided over the highway rather than under (e.g., Boland Way, State Street, Union Street, and Broad Street). The viaduct would be removed, no longer creating a visual and physical barrier that inhibits riverfront access. Noise would be reduced by sinking the highway below grade and potentially further muted by physical barriers if capped by a park or developable space. The resulting project would better match the goals of the project, creating a safer, more attractive connection to the riverfront parcels. If sections of the sunken viaduct were to be covered, it would also afford the opportunity to create new pedestrian linkages, neighborhood connections, and potential redevelopment and/or open space areas.

Impacts: Impacts of the removal of the elevated viaduct would include considerable construction impacts and utility relocations, and the cost would be substantial. Both parking garages currently underneath I-91 would be eliminated. The presence of the railroad would continue to pose potential obstacles to accessing the Connecticut River waterfront.

John Fernandez "I-70 Final Decision…" Via Front Porch 3.1.16

Figure 3-5: Covered I-70 Concept, Denver, CO

Alex Ihnen "MoDOT Calls I-70 to BLVD Plan…" Via next STL 5.7.12

Figure 3-6: Depressed I-70 Corridor, St. Louis, MO

DEPRESSED SECTION WITH RELOCATED RAILROAD

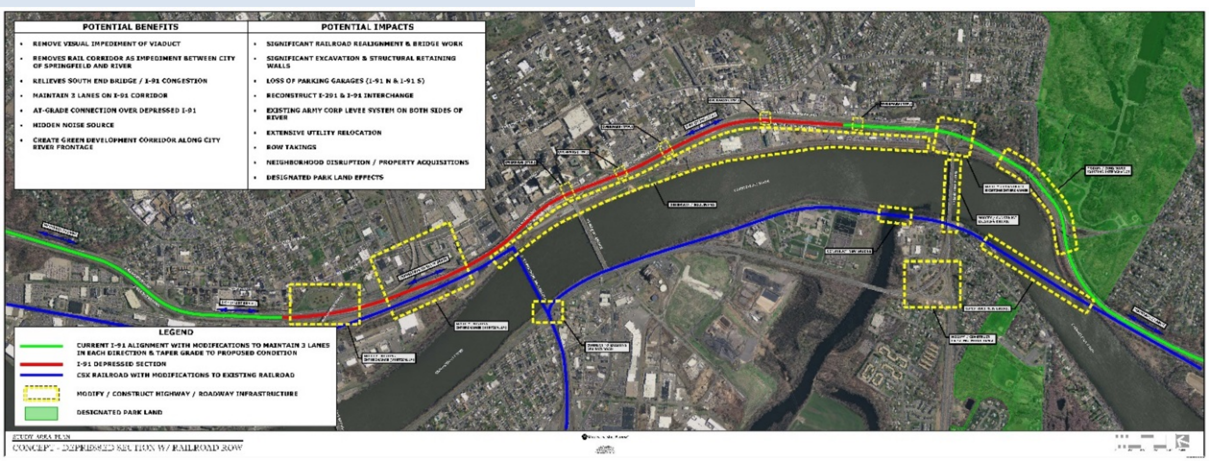


Figure 3-7: Depressed Section with Relocated Railroad

Description: This alternative considered the relocation of the railroad from the east side of the Connecticut River to the west side in the corridor adjacent to U.S. Route 5 in the cities of Agawam and West Springfield. I-91 would utilize its existing alignment and be constructed in a way similar to the previously discussed *Depressed Section* alternative.

Benefits: The most significant potential benefit of this alternative is that it removes the railroad impediment and depresses the highway, thus creating a significantly improved and open connection to the riverfront from Downtown Springfield. It opens up the largest areas of urban land for both development and green space on the Springfield side of the Connecticut River.

Impacts: Although this approach could yield significant benefits for Springfield's downtown core, this alternative would require approval for the railroad realignment, two new railroad bridge crossings of the Connecticut River, one new railroad bridge crossing of the Westfield River, and significant neighborhood disruptions and property acquisitions in the cities of Agawam and West Springfield. The construction of a new bridge would result in extensive environmental impacts.

TUNNEL SECTION

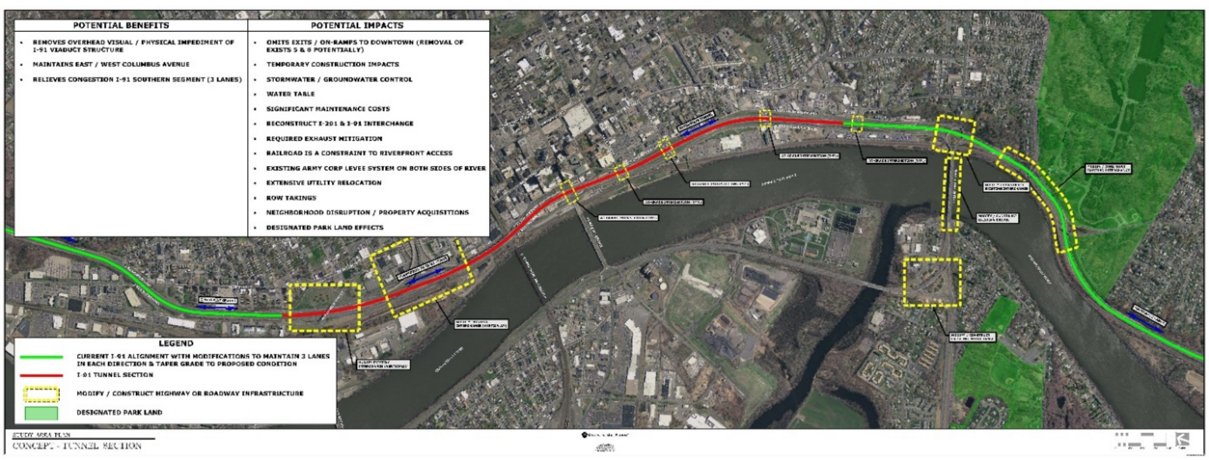


Figure 3-8: Tunnel Section Concept

Description: The Tunnel Section alternative would utilize the existing I-91 viaduct alignment, but the interstate would be placed below grade and capped through the Downtown Springfield corridor. In this alternative, East and West Columbus Avenues would be realigned to be located on top of the interstate in a boulevard fashion.

Benefits: With the two avenues (East and West Columbus) realigned adjacent to one another, additional space is achieved for redevelopment or additional green space. A major benefit of this alternative is that the overhead visual and physical impediment of the viaduct is removed, allowing for much improved visual and physical connections to the riverfront.

Impacts: There are several impacts that are associated with the Tunnel Section concept including construction impacts, stormwater and groundwater control, mitigation methods to control air quality within the tunnel, and possible limited access to the tunnel by hazardous material truck transportation. Below are two illustrative examples of tunnels within urban areas.

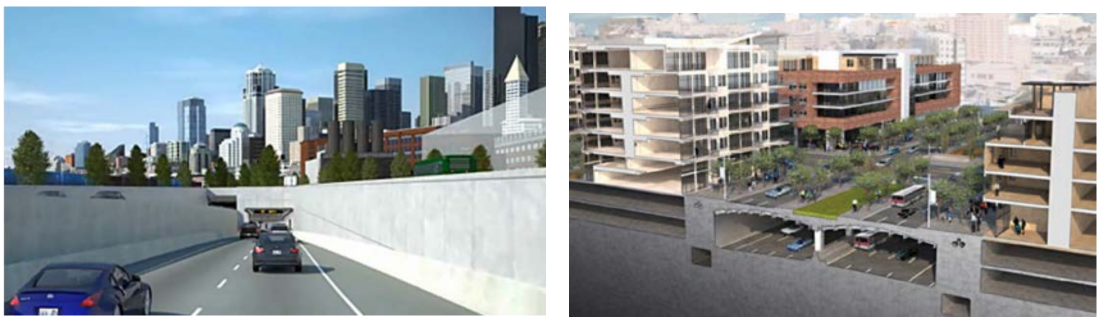


Figure 3-9: Illustrative Examples – Tunneled Interstate Alignments

ELEVATED SECTION (ELEVATED VIADUCT)

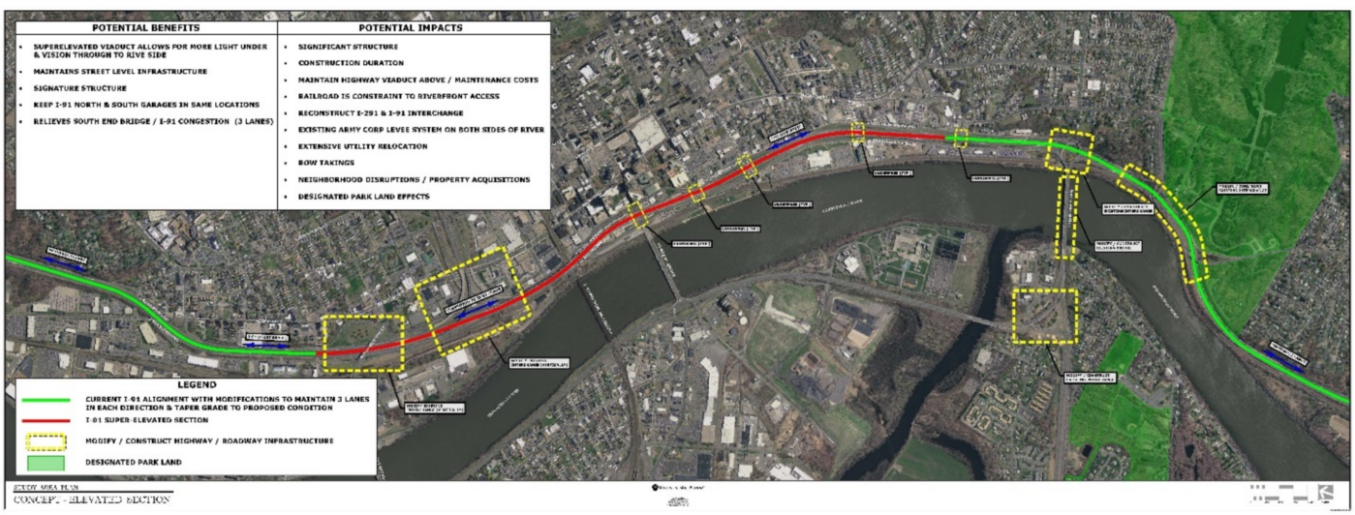


Figure 3-10: Elevated Section Concept

Description: The Elevated Section (Elevated Viaduct) alternative would utilize the current I-91 alignment and completely reconstruct the viaduct with modern construction techniques. The interstate would be rebuilt above ground, higher than its original elevation, allowing more light under the highway.

Benefits: With a more modern approach to design and construction, the spans between supports could be extended, and a longer life span and lower maintenance costs would be feasible. The image below provides an example of the opportunities that may exist under a viaduct that is constructed higher and with cleaner, more modern design features. This alternative could include extension nighttime lighting to promote more active uses of the corridor outside of daytime hours. With potentially fewer piers and a higher elevation, the viaduct could become less of a visual and physical impediment to the riverfront.

Figure 3-11: Elevated Viaduct Example

Impacts: Several potential impacts of this alternative include the long construction duration, significant structural costs, traffic management challenges likely to occur during construction, and the removal and displacement of existing parking garages and parking capacity.

U.S. ROUTE 5 REALIGNMENT

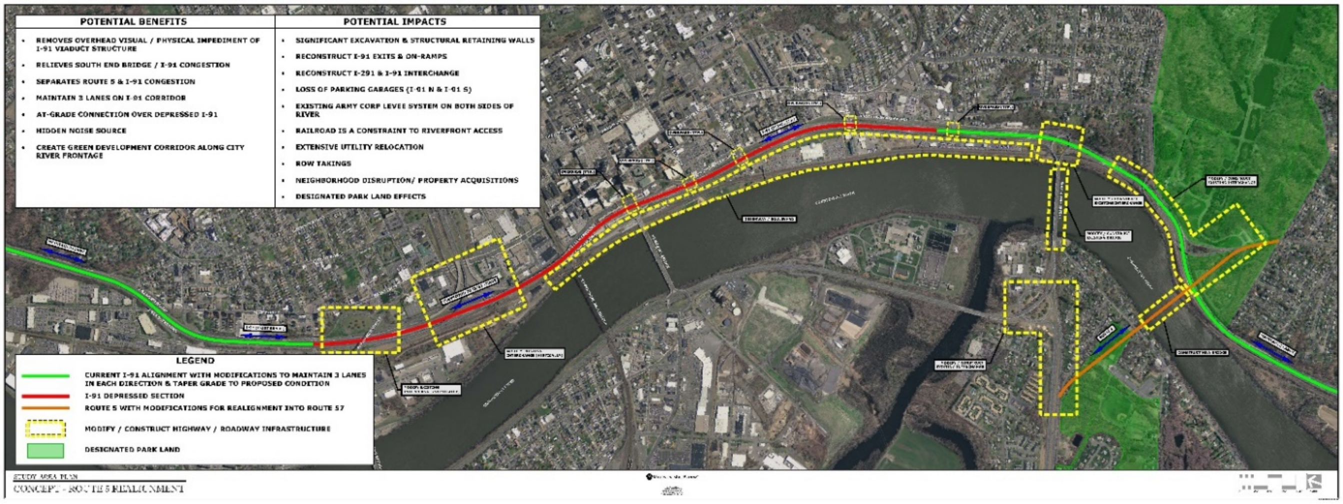


Figure 3-12: U.S. Route 5 Realignment Concept

Description: The U.S. Route 5 Realignment alternative would keep I-91 in its current alignment but proposes to place sections of the highway within a depressed or sunken condition. The benefits and impacts of the depressed condition proposed in this concept are substantially the same as those discussed in relation to the *Depressed Section a*lternative (presented above). A new bridge would be constructed connecting U.S. Route 5 in Longmeadow to Agawam, over the Connecticut River.

Benefits: The benefits of this plan would provide an alternative to alleviating the congestion and safety issues associated with the current lane drop along I-91 in the southern portion of the corridor, the Longmeadow Curve. This alternative would also reduce congestion and weaving of traffic accessing the South End Bridge as it separates U.S. Route 5 traffic to and from Longmeadow and I-91 mainline traffic. Achieving this separation would improve upon current conditions, in which traffic entering I-91 northbound from U.S. Route 5 toward the South End Bridge creates merging issues with I-91 mainline traffic, which is also bound for the South End Bridge.

Impacts: The potential impacts of this alternative include direct impacts on designated parkland—Forest Park in Springfield and School Street Park in Agawam—as well as significant impacts on established neighborhoods in the cities of Agawam and West Springfield. The construction of a new bridge would result in extensive environmental impacts.

I-91 RELOCATION TO WEST SIDE

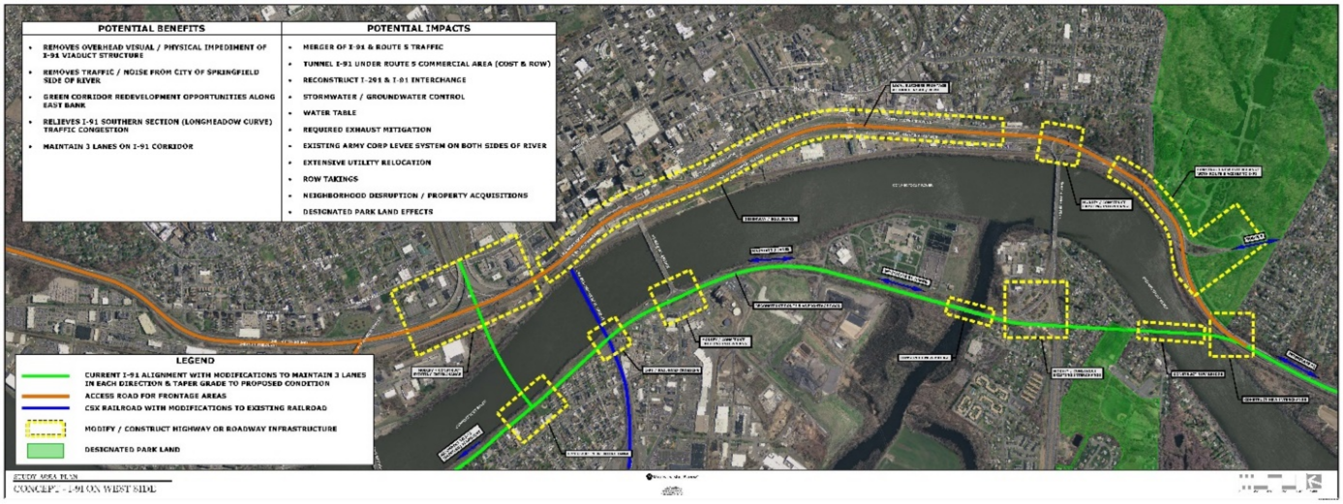


Figure 3-13: I-91 West Side Concept

Description: The I-91 Relocation to West Side alternative would relocate I-91 from the east side of the Connecticut River in Springfield to the west side of the river, following the existing U.S. Route 5 corridor through the towns of Agawam and West Springfield. The new I-91 alignment would rejoin the existing alignment to the north of Downtown Springfield by again crossing the Connecticut River at the I-291 interchange. Relocation to the west side of the river would require three new highway bridges: one over the Connecticut River between Agawam and Longmeadow, a second over the Westfield River, and a third over the Connecticut River from West Springfield to Springfield. In addition, a reconstructed rail bridge over U.S. Route 5 would be required as the existing rail bridge would not meet interstate requirements. A business access frontage road would be constructed following the existing I-91 alignment on the east side of the Connecticut River to provide access to the Downtown Springfield businesses, neighborhoods, and riverfront.

Benefits: The primary benefit of this plan is that it would remove the impediment of the elevated viaduct from the river frontage of Downtown Springfield and create an opportunity to implement open green spaces, enhanced neighborhood connections, and redevelopment parcels where the viaduct once stood.

Impacts: The potential impacts of this alternative include direct impacts on designated parkland, the need to construct several new crossings of both the Connecticut River and the Westfield River, as well as causing significant impacts on established neighborhoods in the cities of Agawam and West Springfield. The construction of a new bridge would result in extensive environmental impacts.

NORTHBOUND & SOUTHBOUND SPLIT

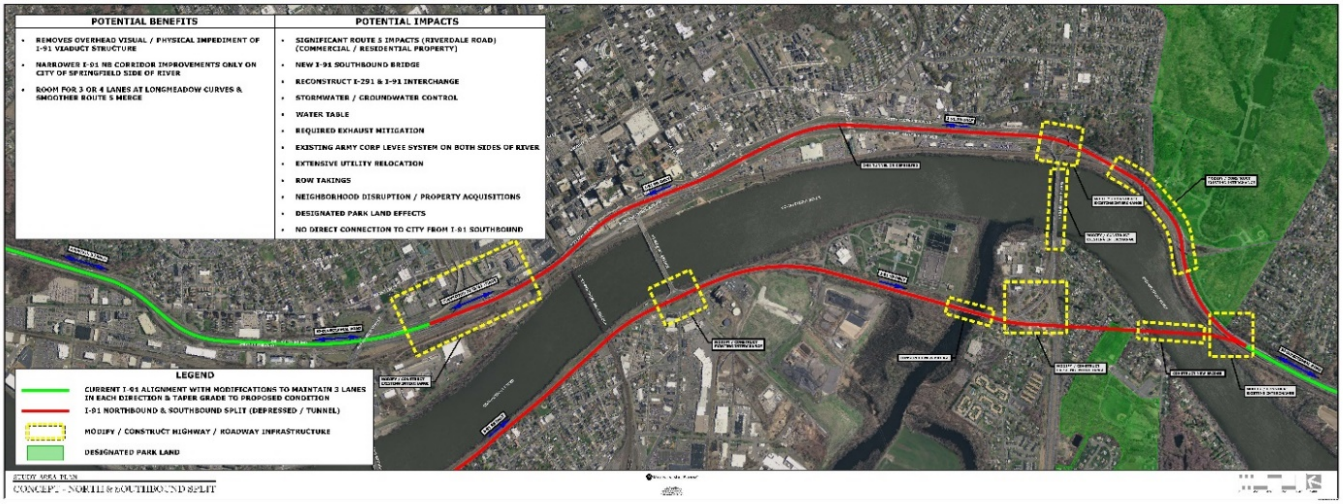


Figure 3-14: Northbound & Southbound Split Concept

Description: Similar to the West Side alternative discussed above, this alternative suggests a relocation of I-91's southbound travel lanes to the west side of the Connecticut River. This approach would preserve the alignment of northbound travel lanes of I-91 on the Springfield side but would depress them below grade.

Benefits: As with the Relocation to West Side alternative, the Northbound & Southbound Split concept would reduce impediments to access between Downtown Springfield and the Connecticut Riverfront. However, the continued presence of the northbound I-91 travel lanes on the eastern side of the river substantially reduces the benefits of this option relative to an alignment fully relocated to the west side of the Connecticut River.

Impacts: Although this option may appear to have less severe impacts on communities on the western side of the river, impacts on properties, neighborhoods, and the environment would be similar to those experienced from relocation of the entirety of I-91 to the west side. This relocation to the west side of the river would require two new highway bridges. A frontage road would be constructed following the existing I-91 mainline right-of-way to carry northbound traffic entering Springfield from points south, providing access to the Downtown businesses, neighborhoods, and riverfront.

RELOCATION OF RAILROAD RIGHT-OF-WAY

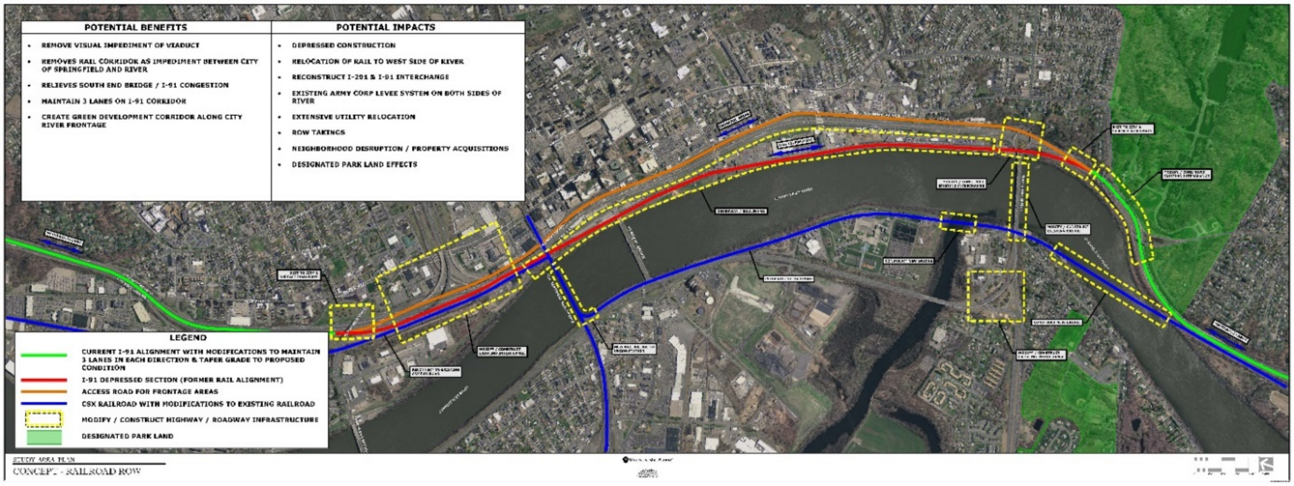


Figure 3-15: Relocation of Railroad Right-of-Way Concept

Description: This alternative considers relocation of I-91 into a depressed section in the location where the current railroad corridor exists today. This would in turn require the relocation of the railroad to the west side of the Connecticut River.

Benefits: The most significant benefit of relocation of the railroad and sinking of significant sections of I-91 in lieu of the at-grade railroad is that it would eliminate all access impediments with the City of Springfield to the Connecticut River.

Impacts: This alternative would have similar significant impacts on both Agawam and West Springfield properties, neighborhoods, and the environment as the relocation of the entirety of I-91 to the west side of the river. Two new railroad bridges to maintain connections to Union Station and points north would be required. The construction of these new bridges would result in extensive environmental impacts.

3.3 REFINEMENT OF ALTERNATIVES

All of the previously mentioned preliminary alternatives and their respective benefits and impacts were discussed in detail at a series of Working Group meetings. A summary of the relevant Working Group meeting is included in this chapter. It was the intent of the alternatives refinement process to discuss the alternatives with the Working Group and make determinations that would narrow the alternatives field to three alternatives that would be further evaluated. The following is a summary of Working Group Meetings 4 and 5.

On December 3, 2015, the fourth Working Group meeting was held at the UMASS Springfield Center in Springfield, Massachusetts. The focal point of the meeting was to present the progress of the alternatives development to the Working Group. The concepts presented were schematic in nature and shown as simple line drawings, and the potential impacts and benefits of each were stated. The main themes of the alternatives were elevated viaducts, relocation of the interstate, depressing and/or tunneling the interstate, implementing an at-grade section, and other railroad considerations. Many discussions were had, and questions, comments, and concerns were raised by the Working Group. Discussions ranged from moving the railroad tracks to provide unobstructed riverfront access, to the legality of hazardous materials being carried by trucks in a tunnel section. All comments and concerns raised provided valuable feedback to the project team and led to the elimination of several schematic alternatives and to the refinement of others. Below are a few more of the specific discussion topics:

- Leaving the viaduct in place would inevitably lead to more maintenance, and more work would be required on the deck in the future; this should be considered a disadvantage.
- Concern over the notion of a new pedestrian bridge over any section of the highway due to the fact there was a pedestrian crossing over I-291, which was never used and since has been removed
- Could the railroad be depressed underground or put underground into a tunnel?
- Could development be proposed over sunken or tunneled sections of highway?
- The idea was raised of placing the interstate above the existing rail line.
- The idea was raised of providing a better connection to the Plainfield Street area and neighborhoods to the north of the I-91 and I-291 interchange.

On January 28, 2016, the fifth Working Group meeting was held at One Financial Plaza, 1350 Main Street in Springfield, Massachusetts. The meeting consisted of two main discussion topics, which were the refinement of the evaluation criteria and the refinement of the schematic alternatives. The impacts and benefits of the alternatives were reassessed based on the discussions from the prior Working Group meeting and led to the elimination and regrouping of the alternatives. Discussions developed in particular as to where I-91 could be located, either remaining on the east side of the Connecticut River or shifting to the west side of the Connecticut River Opposition arose on this topic between Working Group members representing different communities, and many questions, comments, and concerns were raised by the Working Group. Some of the key discussion topics were the following:

- Economic development should be preserved on each side of the river no matter where I-91 is located.
- Several members of the group felt the maximum benefit to Springfield would be for I-91 and the railroad to be moved to the west side.
- The idea was raised of bringing the highway and railroad next to one another in a shared transportation corridor.
- West side alternatives would be beneficial to provide direct access to the Big E from I-91.
- Concerns were brought about the impacts on the operations of the Hall of Fame with some of the alternatives.
- Aesthetics of any viaduct or bridge components are important.
- Interests in splitting local and regional traffic entering the city of Springfield

Other comments provided by the Working Group started to reflect details rather than bigger picture concepts. This more detailed look generated ideas for either mid-term or short-term alternatives such as the following:

- Birds roosting in the elevated "new" viaduct would be a burden; a design that would inhibit birds would need to be chosen.
- Discussion of congestion issues that exist in the North End of Springfield
- Any plaza below a new modern viaduct would need an activity source to bring people in.
- Keys to successful elevated viaducts are to increase lighting and provide "open space" underneath.

Through these two Working Group meetings, several of the preliminary alternatives were determined to have far more and significant detrimental impacts than they had benefits, and hence they were recommended for removal from further analysis. The following alternatives were recommended for removal from further consideration:

- **North and Southbound Split**
- **U.S. Route 5 Realignment**
- **I-91 West Side**
- **Tunnel Section**
- **Relocation of Railroad Right-of-Way**

Discussion Summary of Working Group Meeting No. 6 (March 16, 2016)

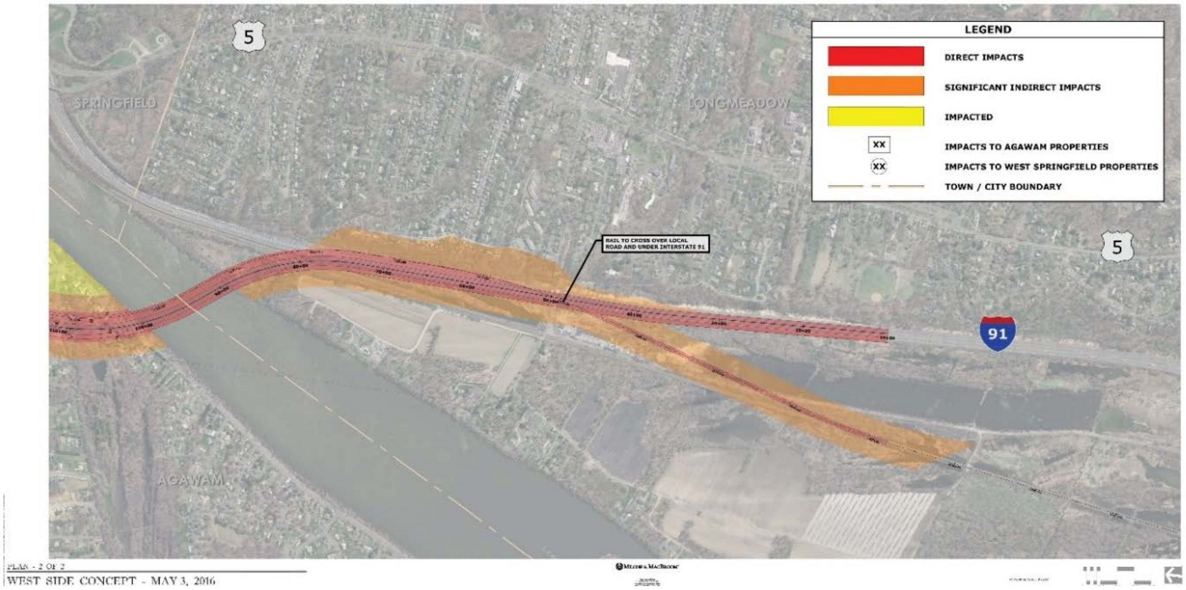
Based upon the feedback received at Working Group meetings 4 and 5, a refined grouping of preliminary alternatives was presented to the Working Group. The refined alternatives presented for further evaluation were as follows:

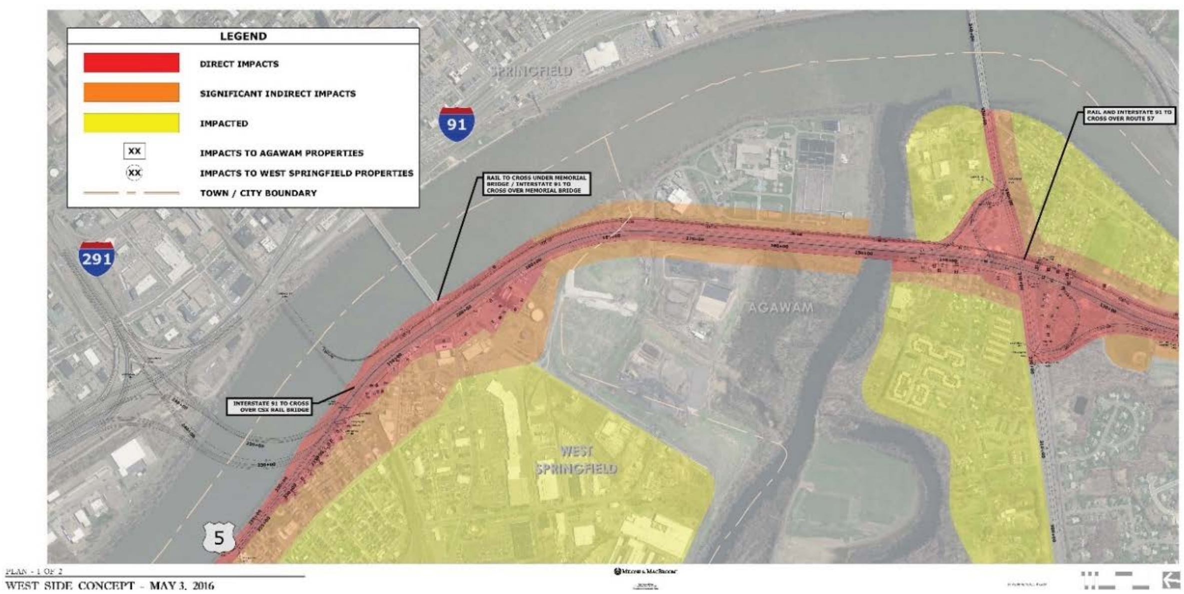
- **Reconstructed Elevated Structure (Modern Viaduct)**
- **Sunken or Tunnel, or Combination Following Various Alignments**
- **Enhanced Existing Viaduct (Short-Term, Mid-term, Long-term)**

Some members of the Working Group felt that removal of the alternatives that called for the interstate and/or railroad to be relocated from the east side of the river to the west side were not fully vetted. To address this concern, a follow-up meeting was held on March 22, 2016, for the Working Group to specifically discuss its concerns regarding the potential to relocate the highway to the west side of the Connecticut River.. Although the benefits of the move to the city of Springfield were understood, it was determined that further analysis of the west side alternatives needed to be completed to fully understand and assess the potential impacts. Thus, a deeper evaluation of the *Relocation to West Side* alternative was advanced in design in order to better understand impacts, operations, permitting, funding, and cost.

With the completion of the additional work for the *Relocation to West Side* alternative, it was deemed unsuitable to be moved forward in the study as one of the final alternatives. The key reasons for removing the alternative were the extensive property and land impacts, lack of community support, access concerns, and cost. These factors are discussed in more detail below.

> ***Property and Land Impacts*** The property impacts associated with the west side alternatives were tabulated on the plans shown below. An analysis of the least impactful alignment would necessitate the taking of 48 structures in West Springfield and 55 structures in Agawam, including businesses, utility structures, and single- and multifamily residences. Additional impacts would be experienced at School Street Park in Agawam, the School Street Barn (a structure listed on the National Register of Historic Places), and wetlands proximate to the Westfield River and the existing U.S. Route 5 alignment; each of these impacts would require additional review, evaluation, permitting, and/or mitigation measures, as mandated by state and federal regulations.





Lack of Community Support: Both the cities of Agawam and West Springfield voiced their opinion of not being in favor of this alternative. The City of West Springfield was concerned with business and development opportunities being affected, the presence of Environmental Justice populations north of the Memorial

Rotary, the ongoing redesign of Memorial Avenue, and impacts on the planned Connecticut Riverwalk and Bikeway connections to existing neighborhoods.

The City of Agawam was concerned that areas of riverfront would be isolated or cut off by a new highway or railroad. These concerns were raised by both the Planning Board and Police Department. Additional impacts raised by city officials consisted of utility impacts, noise issues and air quality impacts, existing Connecticut Riverwalk and Bikeway impacts, and long-term impacts on local businesses.

Access Concerns: On the east side of the river, the new alignment would improve access to the Connecticut River, a locally desirable outcome. However, moving the highway traffic away from businesses that are located in the Downtown Springfield core caused concerns for businesses and regional attractions such as the MGM Casino and the Basketball Hall of Fame.

With a new alignment of I-91, access would not be allowed off of and/or onto the highway for private enterprises. As a result, an interstate in this area would cut off the access to the existing Springfield Water and Sewer Commission property, which includes the sewer treatment plant.

Cost: A cost analysis was not attainable at this juncture in the study without advancing the idea through Alternatives Analysis; however, the cost of this alternative would include a significantly higher number of elements than to confine work to the east side of the river. Some of the elements impacting the cost would include numerous new bridges for both the railroad and interstate, right-of-way impacts and takings, mitigation measures to upgrade surrounding roadways, and utility impacts such as Amtrak requiring significant compensation for disruption of freight services. These impacts would occur on both sides of the Connecticut River.

Selection of Three Preferred Alternatives

After these three Working Group meetings and the subsequent follow-up meeting, the Working Group narrowed the options down to three preferred alternatives. These alternatives would be further developed in design to a level that would allow for the completion of the travel demand modeling, traffic microsimulation modeling, and impact analysis utilizing expanded evaluation criteria. The three alternatives that were selected to move forward were the following:

Depressed Section – Same Alignment

The depressed interstate alternative, which generally follows the existing highway alignment, was chosen for its improved access to the riverfront and the existing Basketball Hall of Fame area. This alternative would be further developed to define connections to local streets, state routes, and US routes; locations of potential green development corridors; access to the city's river frontage; location of new bikeways and walkways; park areas; increased business potential and economic growth for existing parcels; and possible new economic growth opportunities. It also removes the overhead visual and physical impediment of the I-91 Viaduct structure.

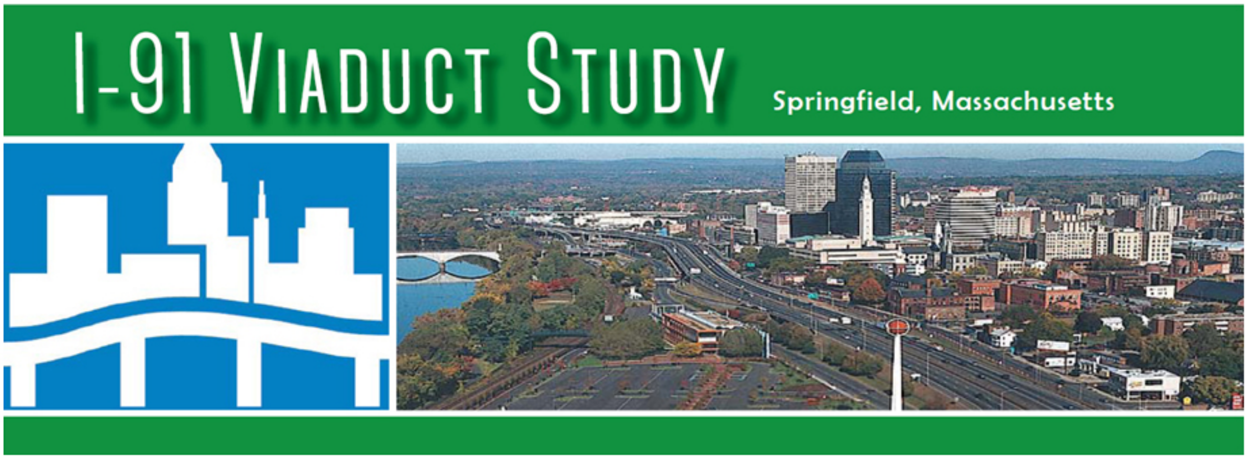
Depressed Section – New Alignment

A second depressed interstate alternative would follow a new alignment, shifting a section of the highway toward and adjacent to the railroad corridor. This alternative was also chosen for its improved access to the riverfront and the existing Basketball Hall of Fame area. This alternative would be further developed to define connections to local streets, interstate and state routes; locations of potential green development corridors; access to the city's river frontage; location of new bikeways and walkways; park areas; increased business potential and economic growth for existing parcels; and possible new economic growth opportunities. It also removes the overhead visual and physical impediment of the I-91 Viaduct structure.

Elevated Section (Modern Viaduct)

The Elevated Section (Modern Viaduct) alternative was chosen based on reduced impacts on other areas of the Primary Study Area (including the ability to maintain the existing street-level infrastructure), opportunities to activate spaces underneath the existing Viaduct structure and enhance connectivity to the Connecticut Riverfront, and reduced yearly maintenance costs relative to other alternatives.

The next chapter, which covers the alternatives Analysis process, further defines the design features of these three alternatives, presents the findings of microsimulation modeling on a local and regional level, and introduces the evaluation criteria by which the three alternatives and a No-Build/Rehab option are rated.



INTERSTATE 91 VIADUCT STUDY

CHAPTER IV

ALTERNATIVES ANALYSIS

August 2018

MMI #3869-16-6

massDOT
Massachusetts Department of Transportation

MILONE & MACBROOM

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Figures:

4.1 INTRODUCTION

The prior chapters of the Interstate 91 Viaduct Study examined the existing conditions of the study area's transportation infrastructure, land use, population, environment, and economy and documented the process of selecting viable alternatives for detailed analysis. As the study continued, at-grade and west side alternatives were removed from consideration, with the remaining options focused on either depressed (below-grade) alignments or an improved viaduct option. The final set of alternatives carried forward from Chapter 3 to the Alternatives Analysis are as follows:

- Alternative 1: Depressed, Same Alignment
- Alternative 2: Depressed, New Alignment
- Alternative 3: Elevated Viaduct

This chapter summarizes the major features of the alternatives chosen for detailed review, the criteria by which each alternative has been evaluated and rated, the methodologies used to determine the impacts of each alternative, and a summary of differentiating factors between the alternatives that are most relevant to determining a recommended alternative. Additionally, a comprehensive evaluation matrix is provided that details the criteria for evaluation, data sources and analytical methods used, and the evaluation result for each criterion and alternative in comparison to projected 2040 No-Build conditions. This future-year conditions (No-Build) model incorporated much of the data and analysis performed during Task 2 and serves as the benchmark for measuring positive and negative effects of Alternatives 1 through 3.

4.2 EVALUATION CRITERIA

4.2.1 EVALUATION CRITERIA DEVELOPMENT

To assess the complex consequences of each alternative carried forward from Chapter III across a variety of impact areas, a list of evaluation criteria was developed that embraces each of the major areas of impact, which vary between alternatives. The full set of criteria allows for a consistent comparison of how each alternative performs in terms of the following subject areas.

- **Mobility and Accessibility**: *Maintain or improve the conveyance of regional traffic through the corridor while enhancing the connectivity of all modes of transportation throughout the region.*
- **Safety**: *Create a safer and more user-friendly pedestrian, bicycle, and vehicular transportation system through and across the transportation corridor.*
- **Environmental Effects**: *Improve the overall environmental quality of the transportation corridor.*
- **Land Use and Economic Development**: *Design transportation-based improvements that create beneficial land use opportunities for the city and the region and promote both access to open space and new opportunities for economic development.*
- **Community Effects**: *Minimize temporary impacts to all stakeholders while understanding and maximizing the future benefits of a completed project.*
- **Cost**: *Development of alternative designs will combine the approach of feasibility, creativity, and long-term sustainability.*

The evaluation criteria are described below in section 4.2.2, and the results of this analysis across each alternative are presented in the Evaluation Matrix document, which allows for direct comparison of alternatives on each criterion. Each criterion depicts both qualitative and/or quantitative data describing its metrics as well as a rating on a five-point scale (-2 to 2), which represents an evaluation of how well each alternative promotes or detracts from the goals and objectives of the criterion relative to the No-Build 2040 alternative.

These criteria were first presented in a simplified format at the Working Group Meeting No. 2 on April 9, 2015, for stakeholder review and feedback. The original set of evaluation criteria differed from the final Evaluation Matrix in several respects. The initial version included health effects as independent evaluation criteria rather than being assessed as an aspect of other criteria. Details of data sourcing and methods provided in the full Evaluation Matrix were not initially present. The "Mobility and Accessibility" subject area was originally conceived as two subject areas, "Mobility" and "Connectivity/Accessibility," before being combined.

In response to Working Group feedback, the Massachusetts Department of Transportation (MassDOT), and Massachusetts Department of Public Health (DPH) feedback on the initial criteria, the Evaluation Matrix was constructed and the number of subject areas and criteria adjusted to capture key areas of concern and to logically organize the criteria to facilitate evaluation and interpretation. A small number of additional changes were made following the selection of alternatives for Task IV. These changes were made as warranted over the course of the evaluation and analysis steps described in section 4.3 in cases where the relevant and analytically feasible metrics available no longer aligned with the draft Evaluation Matrix as it was originally envisioned. The final set of evaluation criteria is described below in section 4.2.2 while the structure of the Evaluation Matrix is described in section 4.2.3.

4.2.2 EVALUATION CRITERIA DESCRIPTIONS

The finalized set of evaluation criteria is described below. These descriptions provide additional context beyond what is presented in the Evaluation Matrix, including the purpose of each criterion, definitions, and methods for measurement or evaluation.

1. **Mobility and Accessibility** – This set of criteria was developed to evaluate each alternative's ability to maintain or improve the conveyance of regional traffic through the corridor while enhancing the connectivity of all modes of transportation into and around the city and its waterfront.

1.1 Roadway Operational Functionality

1.1.1 Intersection Level of Service

Level of service (LOS) is a term used to qualitatively describe the operating conditions of a roadway based on factors such as speed, travel time, maneuverability, delay, and safety. The LOS of a facility is designated with a letter, A to F, with A representing the best operating conditions and F the worst. For this section, the LOS is for signalized intersections. Typically, LOS that performs at a LOS D or better is considered acceptable. In this criterion, only those intersections that scored a LOS E or worse for either the morning (AM) or afternoon (PM) peak periods were used for analysis.

1.1.2 Volume-to-Capacity Ratio

In a volume-to-capacity ratio, the volume (V) is the total number of vehicles passing a point in one hour, and the capacity (C) is the maximum number of cars that can pass a certain point for a reasonable traffic condition. In other words, this measurement of effectiveness deals with the ability of the roadways to handle the number of vehicles expected to be on those roads in 2040. A higher ratio value will be a more negative result.

1.1.3 Queue Length

Queue length is a line of vehicles waiting to proceed through an intersection. Slowly moving vehicles joining the back of the queue are usually considered part of the queue. The internal queue dynamics can involve starts and stops. A faster-moving line of vehicles is often referred to as a moving queue or a platoon. For this criterion, the queues were added for all approaches at all the studied intersections. Any reductions in queue lengths would be a positive result.

1.1.4 LOS Merge, Diverge, and Weave Locations

LOS is a term used to qualitatively describe the operating conditions of a roadway based on factors such as speed, travel time, maneuverability, delay, and safety. The LOS of a facility is designated with a letter, A to F, with A representing the best operating conditions and F the worst. For this section, the LOS is for weaving, where one movement must cross the path of another along a length of facility without any aid of traffic control devices. Merging is when two separate traffic streams form a single lane, and diverge is when one flow of traffic separates to form two separate lanes. Typically, LOS that performs at a LOS D or better is considered acceptable. In this criterion, only those intersections that scored a LOS E or worse for either the morning (AM) or afternoon (PM) peak periods were used for analysis. A lower amount of weaving sections with an LOS of E or worse would be a positive result compared to another alternative.

1.1.5 LOS Ramps and Highway Segments

LOS is a term used to qualitatively describe the operating conditions of a roadway based on factors such as speed, travel time, maneuverability, delay, and safety. The LOS of a facility is designated with a letter, A to F, with A representing the best operating conditions and F the worst. For this section, the LOS is for interstate on and off ramps and interstate segments. Typically, LOS that performs at a LOS D or better is considered acceptable. Locations were listed when their LOS was E or worse for either the AM or PM peak periods. A smaller number of LOS Es or worse would be a positive result.

1.2 Travel Time

1.2.1 Travel Time Along I-91 Corridor

Travel time is the length in time it will take to get to one point from another. The travel time is typically in minutes and seconds. Travel time is equal to the running *time plus delay, which can be along a pathway or at a signalized and/or unsignalized intersection. Speed limit is a factor. For this case, the distance or path considered is along I-91 from the Connecticut state line to just north of the Plainfield Street overpass, which covers a distance of 6.68 miles in both directions.*

1.2.2 Travel Time Through Primary Study Area

Travel time is the length in time it will take to get to one point from another. The travel time is typically in minutes and seconds. Travel time is equal to the running time plus delay, which can be along a pathway or at a signalized and/or unsignalized intersection. Speed limit is a factor. For this case, the distance or path considered was from the intersection of Union Street at East Columbus Avenue to the intersection of Springfield Street and Chestnut Street. These paths cover a distance of 2.37 miles from the intersection of Union Street and East Columbus Avenue and Springfield Street and Chestnut Street and 2.68 miles in the opposite direction.

1.3 Pedestrian and Bicycle Functionality and Connectivity

1.3.1 Improve Access to the Riverfront from Downtown Core

This section is presented to evaluate proposed changes and enhancements (including sidewalk, shared-use paths, crossing improvements, etc.) in connections between the Downtown Springfield urban core and riverfront for bicyclists and pedestrians. Areas that are gauged are the crossings of I-91 and the rail lines.

1.3.2 Improve Access to Community Services and Social Services

This section is presented to evaluate the number and quality of connections to schools, health care, social services, etc. for bicyclists and pedestrians in the Primary Study Area. Areas that are gauged include roadways within the Primary Study Area, immediately surrounding the Downtown Springfield core, I-91, and I-291.

1.3.3 Improve Access to Retail and Commerce

This section is presented to evaluate the number of commercial businesses, goods, employment centers, and public and institutional properties for which bicyclists and pedestrians are likely to benefit from enhanced access in the Primary Study Area. Any property within ¼ mile of an enhanced bicycle or pedestrian connection is defined as experiencing an improvement in access. No differentiation between levels of pedestrian or bicycle connection quality is provided (as changes in levels of *quality are contingent on design decisions not addressed in this conceptual-level study). Areas that are gauged include roadways within the Primary Study Area, immediately surrounding the Downtown Springfield core, I-91, and I-291.*

1.3.4 Improve Connections to Union Station

This section is dedicated to realizing the change in vehicular, bicycle, pedestrian, and transit networks to stimulate connectivity to the renovated Union Station. Each alternative will be examined to determine the extent of new bicycle facilities and additional sidewalks that are or are not being added to improve the connection to the transportation hub at Union Station.

1.3.5 Regional Bicycle and Pedestrian Connectivity

This section provides comparisons of each alternative's ability to promote longer-distance commuting and recreational trips as well as improved access to regional bicycle and pedestrian facilities such as the Connecticut Riverwalk and Bikeway in Springfield, the Connecticut Riverwalk and Bikeway in Agawam, and Forest Park in Springfield. The map series "Bicycle, Pedestrian, and Transit Connectivity and Employment" illustrates proposed connections under each alternative.

1.4 Mode Shift

1.4.1 Increase Transit Mode Share

This section will evaluate the number of improved connections to transit stops within 0.25 miles of each alternative, providing a better means of access to existing transit stops in the area.

1.4.2 Increase Bicycle and Pedestrian Mode Share

In order to evaluate the increase of bicycle and pedestrian mode share, this section will tabulate the change in linear feet of both sidewalk and linear feet of designated bicycle facilities.

2. **Safety** - This set of criteria was developed to evaluate each alternative's ability to create a safer and more user-friendly pedestrian and bicycle system through and across the transportation corridor.

2.1 Pedestrian and Bicycle Safety

2.1.1 Improve Bicycle and Pedestrian Safety – Minimize Conflicts

This section will evaluate whether the alternatives improve bicycle and pedestrian safety by minimizing conflict points based on the number of intersections that are potentially being mitigated and whether the alternatives improve the overall safety for users other than vehicles.

2.1.2 Improve Bicycle and Pedestrian Safety – Americans with Disabilities Act (ADA) compliance

This section will evaluate whether the alternatives improve pedestrian safety by incorporating the latest ADA/Architectural Access Board (AAB) standards at signalized intersections within the Primary Study Area for each alternative. Items that would be included are compliant wheel chair ramps, detectable warning strips, Accessible Pedestrian Signal (APS) push buttons, etc.

2.1.3 Improve Bicycle and Pedestrian Safety – Safe Crossing Accommodations

This section will evaluate whether the alternatives improve bicycle and pedestrian safety where they may come in contact with interstate on and off ramps. A quantitative number of actual crossings for each alternative will be compared.

2.1.4 Improve Bicycle and Pedestrian Safety – Improve Crossing Times

This section will evaluate whether the alternatives improve crossing times for the pedestrians at signalized intersections based on modifications that will take place at existing intersections or implementing the latest ADA/AAB standards at newly designed intersections.

2.1.5 Improve Bicycle and Pedestrian Safety – Provide Separated Facilities

This section will evaluate whether the alternatives improve bicycle and pedestrian safety by reviewing the total number of shared-use paths that are separated from the roadways, such as a typical on-street situation.

2.2 Vehicular Safety

2.2.1 Improve Interaction and Roadway Safety – Conflict Points

This section identifies the number of weaving sections along the I-91 corridor within the Primary Study Area. Within these areas, there are numerous high-crash locations due to the fact that the weaving sections' distances are relatively short, and there are numerous on and off ramps within the Primary Study Area. A reduction in weaving sections and/or lengthening the distance between on and off ramps will mitigate the number of conflict points along the I-91 corridor. A standard four-legged signalized intersection typically consists of 80 conflict points with the inclusion of bicycles and pedestrians. If there are fewer signalized intersections from one alternative to another, generally there would be less conflict points. A tally of the number of signalized intersections is included in this criterion.

2.2.2 Improve Interaction and Roadway Safety – Mitigate High-Crash Locations

This section identifies the number of high-crash locations or clusters within the Primary Study Area that are adjacent to I-91 and I-291. Each alternative will list whether any of the high-crash cluster intersections will be mitigated, which will include design changes, to improve intersection and roadway safety.

2.3 Public Safety

2.3.1 Improve Public Safety

This section compares the levels of how each alternative will improve public safety or the perception thereof. Each alternative may minimize factors that would contribute to increased crime or the fear of crime. Poorly lit areas, confined spaces, isolated areas, and types of land use typically create an unsafe feeling for pedestrians, bicyclists, and even motorists. This section will present a qualitative review of improvements to sight lines, lighting, open spaces, etc.

3. **Environmental Effects** - This set of criteria was developed to evaluate each alternative's ability to improve the overall environmental quality of the transportation corridor.

3.1 Sustainability

3.1.1 Impacts on Environmental Resources

This section compares the impacts of each alternative on relevant natural resources, including the 100-foot and 500-foot Federal Emergency Management Agency (FEMA) floodways, Natural Heritage & Endangered Species Program (NHESP) priority habitat areas, and Department of Environmental Protection (DEP) wetlands.

3.1.2 Inclusion of Low Impact Development Standards

This section depicts total gain in pervious surface as a result of inclusion of low impact development (LID) standards and improvements as well as creation of additional open space for recreation on or adjacent to the existing viaduct footprint.

3.1.3 Reduction of Pavement Footprint

This section compares the differences in total pervious area within the I-91 corridor between East and West Columbus Avenues within the Primary Study Area.

3.2 Air Quality

3.2.1 Health Impacts on Vehicle Occupants, Bicyclists, and Pedestrians

This section presents estimates of criteria pollutant emissions as modeled by the Central Transportation Planning Staff (CTPS). Differences in vehicle miles traveled (VMT) and associated estimates of oxides of nitrogen (NOx), Volatile Organic Compounds (VOC), and carbon monoxide (CO) emissions during AM and PM peaks from the 2040 No-Build scenario are presented for each alternative.

3.2.2 Reduction of Greenhouse Gas Emissions

This section compares estimated greenhouse gas emissions (specifically carbon dioxide [CO2]) between each alternative. Differences in VMT and associated estimates of CO2 emissions during AM and PM peaks from the 2040 No-Build scenario are presented for each alternative.

3.3 Noise

3.3.1 Noise Impacts – Decibel Levels

Noise impacts of each alternative are measured in terms of the modeled distances from the highway alignment experiencing decibel (dB) levels above Noise Abatement Criteria levels (66 dB for residential uses, 71 dB for commercial uses). Distances are expressed as a range as the distance at which given levels of noise are experienced varies based on terrain. Distance estimates are from the I-91 Springfield Conceptual Level Noise Assessment prepared by VHB.

3.3.2 Noise Impacts – Impacted Receptors

This section provides estimates of the number of receptors (residences or commercial properties) experiencing noise levels above those specified by Noise Abatement Criteria (66 dB for residential uses, 71 dB for commercial uses) under each alternative. Estimates of impacted receptors are from the I-91 Springfield Conceptual Noise Assessment prepared by VHB.

4. **Land Use and Economic Development** - This set of criteria was developed to evaluate each alternative's ability to include transportation-based improvements that create beneficial land use opportunities for the city of Springfield and the region and promote both access to open space and new opportunities for economic development.

4.1 Economic Development Potential

4.1.1 Parcel Growth

This section quantifies the estimated area of lands that will be made available for new development or green space. This space includes both lands made available through enhanced access to currently constrained waterfront parcels and the creation of new green space and/or developable areas within the existing I-91 right-of-way under the depressed alignments presented in Alternatives 1 and 2.

4.1.2 Improve Accessibility to Potential and Existing Development Parcels

This section identifies the number and quality of connections to the waterfront and development areas. High-quality connections are assessed as being those with complete streets elements that provide for safe accommodations for pedestrians and bicyclists as well as vehicular traffic.

4.1.3 Improve Bicycle and Pedestrian Infrastructure

This section will evaluate whether the alternatives improve bicycle and pedestrian facilities, specifically with the evaluation of complete streets elements within the Primary Study Area, which include improved bicycle and pedestrian accommodations.

4.1.4 Increase Density

This section quantifies the estimated impacts on population, households, and jobs within the study area based on the development scenarios associated with Alternatives 1 through 3. Potential increases in population and households are derived from the number of housing units proposed for each scenario at full buildout, average occupancy rates, and average household sizes of comparable units. The potential increase in jobs is based on the size of commercial and industrial developments and average ratios of building size to employment across sectors. As the study area geography remains static across alternatives and through time, any increase in population, households, or jobs results in an increase in residential/employment density.

4.1.5 Incur New Tax Generation

This section provides estimates of the potential property tax generation that would accrue to the City of Springfield under each of the development scenarios associated with Alternatives 1 through 3. Estimates of tax generation are derived separately for residential units and commercial/industrial development. Residential tax revenues are based on local comps for condo sales with an upward adjustment to account for the likely price premium for new waterfront units and are calculated on a per-unit basis. Commercial/industrial tax revenues are based on local comps for office/retail and industrial properties in the waterfront area, with upward adjustment for building age and condition; these revenues are calculated on a square-footage basis. All values are based on 2016 property values and tax rates in the City of Springfield and are expressed in 2016 dollars.

4.2 Socioeconomic Impacts

4.2.1 Increase Employment

This section quantifies the estimated impacts on jobs within the Primary Study Area based on the development scenarios associated with each of Alternatives 1 through 3. The potential increase in jobs in the Primary Study Area is based on the size of *commercial and industrial developments and average ratios of building size to employment across sectors.*

4.2.2 Increase Population

This section quantifies the estimated impacts on population within the Primary Study Area based on the development scenarios associated with each of Alternatives 1 through 3. Potential increases in population in the Primary Study Area are derived from the number of housing units proposed for each scenario at full buildout, average occupancy rates, and average household sizes of comparable units.

4.2.3 Increase Housing

This section quantifies the estimated number of housing units within the Primary Study Area based on the development scenarios associated with each of Alternatives 1 through 3. The number of housing units added to the Primary Study Area associated with each development scenario is based on developable land available under the design alternatives as well as potential market demand.

4.2.4 Improve Affordability – Housing in Proximity to Transit

This section compares the quantity of housing generated within ¼ mile of Union Station, a major transportation hub for Downtown Springfield. Expansion of housing stock near Union Station can provide an increase in housing options that allows households to meaningfully decrease costs, e.g., by reducing vehicle ownership and reducing combined housing and transportation costs.

4.2.5 Improve Public Service Provision

This section quantifies the extent to which additional public services may be enabled by incremental tax revenue generated within the Primary Study Area and accruing to the City of Springfield by the development scenarios associated with Alternatives 1 through 3. Estimates of tax generation are derived separately for residential units and commercial/industrial development. Residential tax revenues are based on local comps for condo sales with an upward adjustment to account for the likely price premium for new waterfront units and are calculated on a per-unit basis. Commercial/industrial tax revenues are based on local comps for office/retail and industrial properties in the waterfront area, with upward adjustment for building age and condition; these revenues are calculated on a square-footage basis. All values are based on 2016 property values and tax rates in the City of Springfield and are expressed in 2016 dollars.

4.2.6 Promote Reduced Travel Costs

This section provides a qualitative assessment of design, environmental, and population-based factors that may act to reduce travel costs (including time and safety) for travel via modes other than single-occupancy vehicles. Because no changes in transit service are contemplated under Alternatives 1 through 3 vs. the No-Build option, potential improvements in first/last mile connections based on enhancements to bicycle and pedestrian infrastructure may benefit transit users and transit ridership.

4.2.7 Improve Social Cohesion

This section inventories the transportation and open space impacts of each of the alternatives with respect to factors that may increase opportunities for social and recreational travel between neighborhoods and improve connections to open space areas suited for recreation, community events, and socialization between residents of different neighborhoods and backgrounds.

4.3 Freight Rail Impacts

4.3.1 Operational Impacts

This section identifies whether there will be any operational impacts on freight rail based on the mitigation measures in each alternative. Each alternative assumes that if any direct impacts may occur mitigation measures will be made to the rail in order not to impact any freight rail operations.

4.3.2 Implementation Costs

This section identifies whether there will be any operational impacts on freight rail based on the mitigation measures in each alternative. Each alternative assumes that if any direct impacts may occur mitigation measures will be made to the rail in order not to impact any freight rail operations (for example, temporary tracks, etc.). This section identifies how the mitigation measures required to the rail will be categorized (from no-impacts to severe impacts). Actual implementation costs are not depicted with a monetary value.

4.4 Parking Impacts

4.4.1 Impacts to Parking Under I-91

Currently, there are two parking garages controlled by the Springfield Parking Authority, the North and South Garages underneath the I-91 Viaduct between State Street and Hampden Street. There are approximately 1,760 parking spaces available underneath I-91 in these two garages, approximately 1,100 in the North Garage and 660 in the South Garage. This section is being looked at to understand the impacts each alternative will have on these garages and whether they will be removed and/or maintained as many individuals in the Downtown Springfield core area utilize these garages.

5. **Community Effects** - This set of criteria was developed to evaluate each alternative's ability to minimize temporary impacts on all stakeholders while understanding and maximizing the future benefits of a completed project

5.1 Visual Impacts

5.1.1 Visual Perception of I-91 Viaduct

The visual perception of the I-91 Viaduct is being reviewed in this section to assess the vertical location and horizontal alignment in number of feet relative to activity center proxies. This is important to understand and evaluate as each alternative will influence a person's opinion on safety, connection to the riverfront, aesthetics, etc. based on the location of the interstate vertically and horizontally.

5.2 Construction Impacts

5.2.1 Construction Duration

Construction duration is the time estimated for the completion of construction of each alternative; typically the value/time frame will be in years for a potential project of this magnitude. This is primarily evaluated to understand the hardships, burdens, and effects that the construction will place on commuters and directly impacted business owners who utilize these facilities on a daily basis.

5.2.2 Lane Closures and Detours

In order to complete the construction of a project, certain mitigation measures are typically required, in this case lane closures and/or detours. Lane closures and detours may be required to be implemented prior to construction depending on construction staging. Thus, closures and detours are intended to possibly start prior to construction and continue for the duration of the project depending on construction stages and the means and methods of construction.

5.2.3 Maintenance of Access to Abutters

Many businesses, residents, and visitors will be impacted by the construction of each of the alternatives. This section will assume the length (in years) of anticipated closures, temporary and/or permanent for each alternative. The length is determined by anticipated construction stages for different locales and considers all impacts that are required for the construction of each alternative (for example, mitigation measures needed prior to the start of the actual construction of the viaduct and other features in the overall alternative design). Access to a potential business and/ or residence may be reduced and/or detoured for certain periods of time.

5.2.4 Disruption of Local Businesses

Many businesses and their visitors will be impacted by the construction of each of the alternatives. This section will assume the length (in years) of anticipated closures, temporary and/or permanent for each alternative. The length is determined by anticipated construction stages for different locales and considers all the impacts that are required for the construction of each alternative (for example, mitigation measures needed prior to the start of the actual construction of the viaduct and other features in the overall alternative design). Access to a potential business may be reduced and/or detoured for certain periods of time. This may have an effect on both vehicles and/or foot traffic.

5.3 Compatibility

5.3.1 Compatibility with Local and Regional Transportation Plans, Strategies, and Conservation and Development

This section takes into consideration regional and local transportation plans, strategies, and conservation and development. Alternatives were reviewed to see if they in fact support or differentiate from the plans and developments that the City of Springfield and surrounding communities have.

5.3.2 Consistency with MassDOT Goals, Policies, and Directives

MassDOT currently has certain goals, policies, and directives for designs to follow, particularly for transportation projects. An example would be to provide pedestrian and bicycle accommodations for all roadway projects. Each alternative will be reviewed in this section to determine whether the conceptual design meets and follows the latest goals, policies, and directives.

5.4 Environmental Justice (EJ) Impacts

5.4.1 Availability of Jobs in EJ Areas

Because the entirety of the Primary Study Area geography is classified as EJ areas, the increase in availability of jobs within EJ areas is identical to the increase in jobs discussed in section 4.2.1.

5.4.2 Availability of Education and Health Services in EJ Areas

Because the entirety of the Primary Study Area geography is classified as EJ areas, the increase in availability of education and health services within EJ areas is identical to the increase in availability of those services discussed in section 1.3.2.

5.4.3 Mobility Impacts in EJ Areas

Because the entirety of the Primary Study Area geography is classified as EJ areas, mobility impacts within EJ areas are identical to the impacts discussed in section 4.1.3.

5.4.4 Improve Local Access from Urban Core to Riverfront in EJ Areas.

Because the entirety of the Primary Study Area geography is classified as EJ areas, enhanced access from the urban core to the riverfront in EJ areas is identical to the impacts discussed in section 4.1.2.

5.4.5 Improve Access to Community Resources and Social Services in EJ Areas.

Because the entirety of the Primary Study Area geography is classified as EJ areas, improved access to community resources and social services in EJ areas is identical to the increase in availability of those services discussed in section 1.3.2.

5.4.6 Improve Access to Retail and Commerce in EJ Areas.

Because the entirety of the Primary Study Area geography is classified as EJ areas, improved access to retail and commerce in EJ areas is identical to the impacts discussed in section 1.3.3.

5.4.7 Environmental Impacts in EJ Areas

Because the entirety of the Primary Study Area geography is classified as EJ areas, environmental impacts in EJ areas will be identical to the impacts identified in Section 3.2.

6. **Cost** - This set of criteria was developed to evaluate the level of each alternative's combined approach of feasibility, creativity, and long-term sustainability.

6.1 Construction Costs

6.1.1 Order-of-Magnitude/Implementation Cost

An order-of-magnitude/implementation cost estimation process will consider a high-level overview of anticipated construction cost. This estimation process utilizes a combination of design take-offs (i.e., actual dimensions and quantities), relevant past/recent similar project costs, and larger overall project contingencies in order to develop a feasibility-level understanding of expected costs to implement each alternative.

6.1.2 Right-of-Way Impact

This section quantifies the estimated impacts on parcels that are abutting the mitigation measures for each alternative based on Geographic Information System (GIS) mapping. The measured amount in this case would be square footage, which would then be converted to acreage for comparison purposes.

6.2 Maintenance Costs

6.2.1 Anticipated Annual Maintenance Costs

Each alternative will require yearly maintenance costs for general upkeep of the alternative. Key elements when considering annual maintenance costs are structural maintenance of elevated structures, tunnels, and at-grade roadways. Without annual maintenance costs, the life cycle for each alternative will be reduced significantly.

6.2.2 Life-Cycle Cost-Benefit Analysis

Life-cycle cost-benefit analysis is a method for assessing the total cost of the ownership of an alternative. Items considered are operation and maintenance costs and repair and replacement costs. The initial costs may be different for each alternative, but yearly maintenance costs, future replacement, etc. will have an overall effect on the life cycle of each alternative. This evaluation combines several criteria in order to develop a singular rating to be used for comparison purposes. The higher the score value, the more positive the alternative's life-cycle analysis should be. Also included for comparison purposes is an assumed quantitative life-cycle overall cost of each alternative and the No-Build scenario until the year 2075.

4.2.3 EVALUATION MATRIX: INTERPRETATION AND DEFINITIONS

The evaluation matrix presented in section 4.4 provides detailed information on each evaluation criterion, including data sources and analytical tools, rankings, and other information relating to each alternative. Each column in the Evaluation Matrix is described below.

- **Criteria**: numeric code for each evaluation criterion item
- **Measure**: the broad goal or outcome to be measured by the evaluation criteria
- **Description**: a description of the specific metric or indicator being used as the basis for analysis and evaluation
- **Data:** the type, granularity, and units of data used to evaluate the metric or indicator across alternatives
- **Source/Tool**: the specific source of data and/or analytical tool used to analyze impacts across alternatives; this may include secondary sources (e.g., census, municipal, or regional databases), mapping, analytical or simulation software packages, or standards or comparable metrics from peer communities or professional guidelines.

- **Alternatives**: Evaluation results are organized by alternative, including the Future No-Build, Depressed/Same Alignment, Depressed/New Alignment, and Elevated Viaduct alternatives.
  - **Ranking**: a graphical depiction of how each criterion has been evaluated, ranging from best (+2 or ● to -2 or ○)
  - **Discussion**: specific quantitative and/or qualitative indicators, metrics, or simulation results that form the primary basis for the criteria ranking, along with any references to additional information, such as mapping, that illustrates the impact of a specific alternative on a given criterion

Public Health Evaluation: Over the course of the study, MassDOT, DPH, and the study's consultant, Milone & MacBroom, Inc., developed an approach to integrate health metrics into the Evaluation Criteria matrix using conceptual health pathways. Conceptual health pathway for health outcomes associated with air quality, noise, mobility and connectivity, public safety, and socioeconomics are shown in Figures 4-1 through 4-5. In these diagrams the proposed project decision on the far left leads to the next series of proposed changes evaluated in the I-91 Viaduct Study, followed by health-related changes, and associated health outcomes.

While the team was able to identify health indicators associated with each of the evaluation measures, it was determined that the additional methods and analytical tools needed to assess public health impacts or benefits of project elements were unavailable and outside the scope of this study. DPH is currently working with MassDOT to develop guidelines for consultants to assess health indicators from data generated from travel demand models and other sources of information generated as part of a transportation study. In the interim, baseline health data, overlay maps that identify vulnerable areas and populations (available in Appendix L), and findings of key informant interviews to better inform the decision-making process in selecting alternatives for this study are provided in this report.

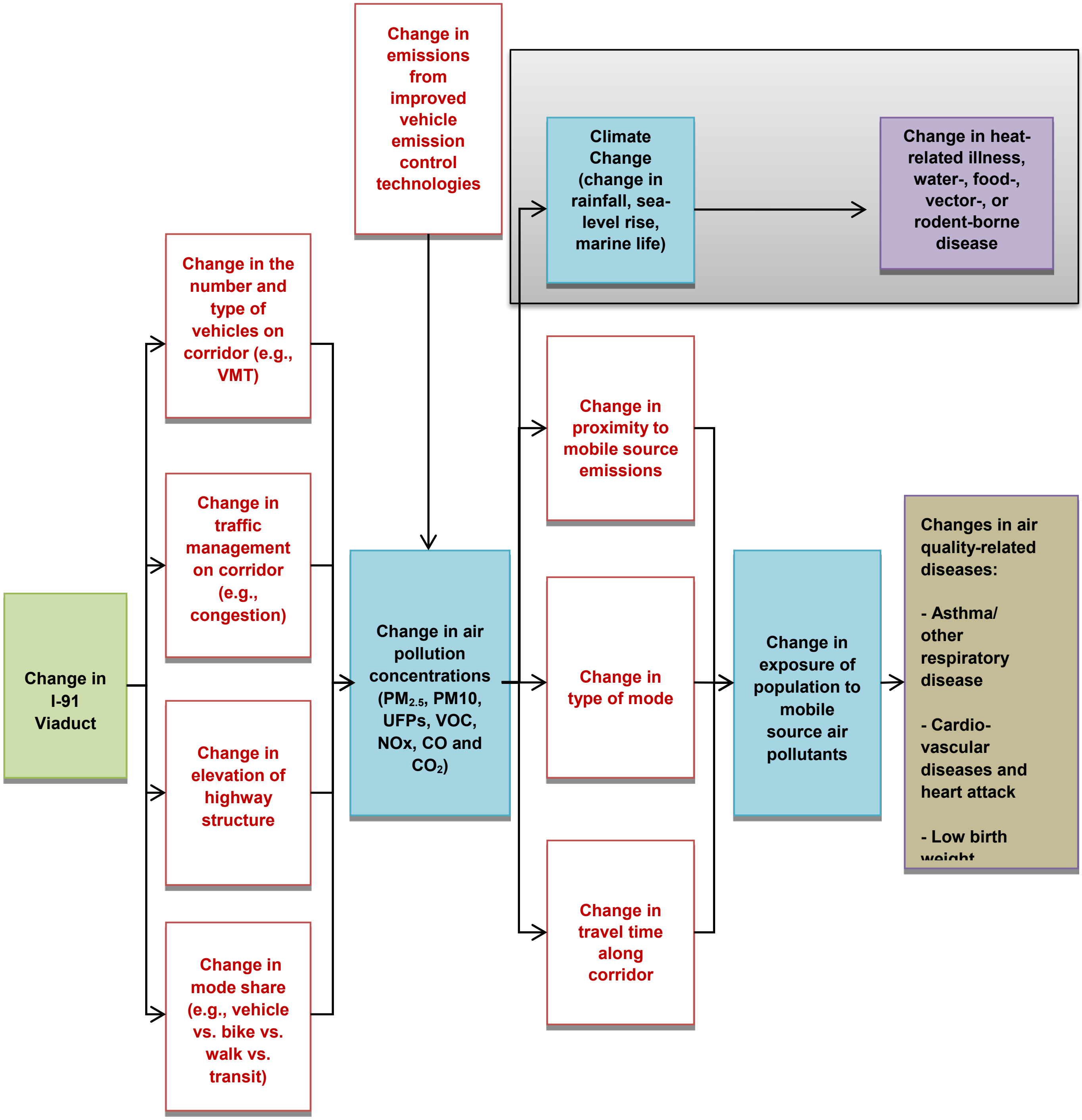


Figure 4-1: Air Quality Pathway

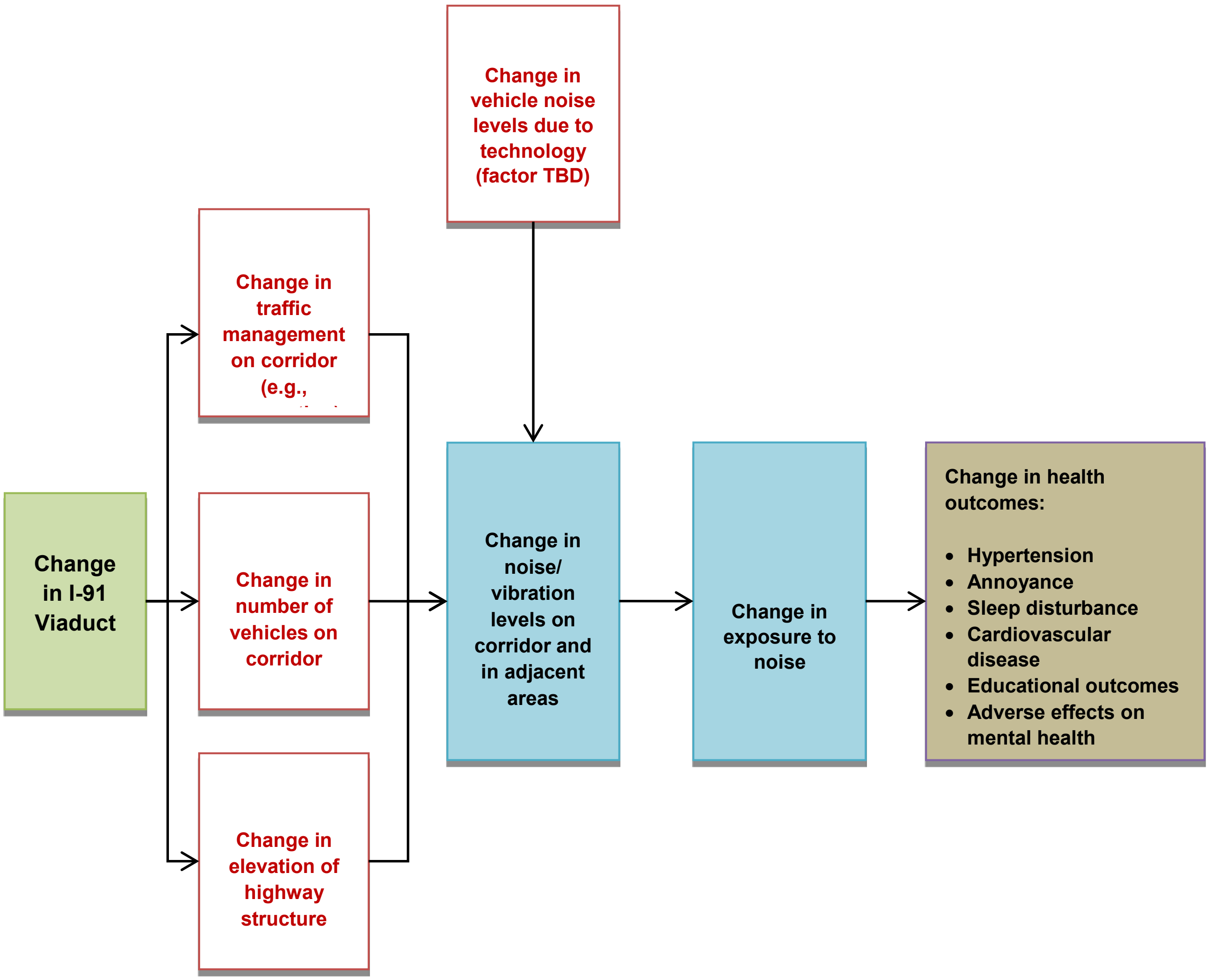


Figure 4-2: Noise Pathway

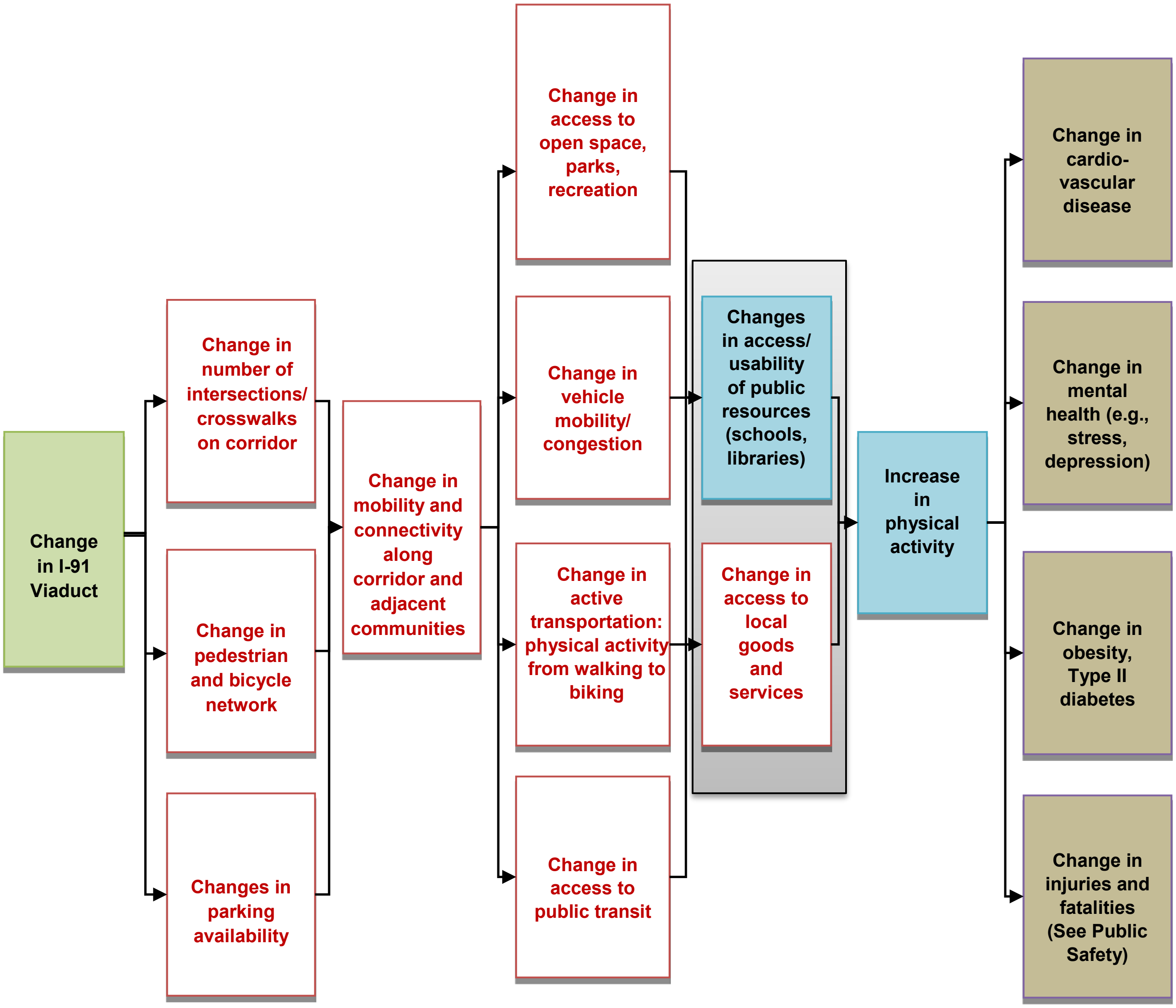


Figure 4-3: Mobility and Connectivity Pathway

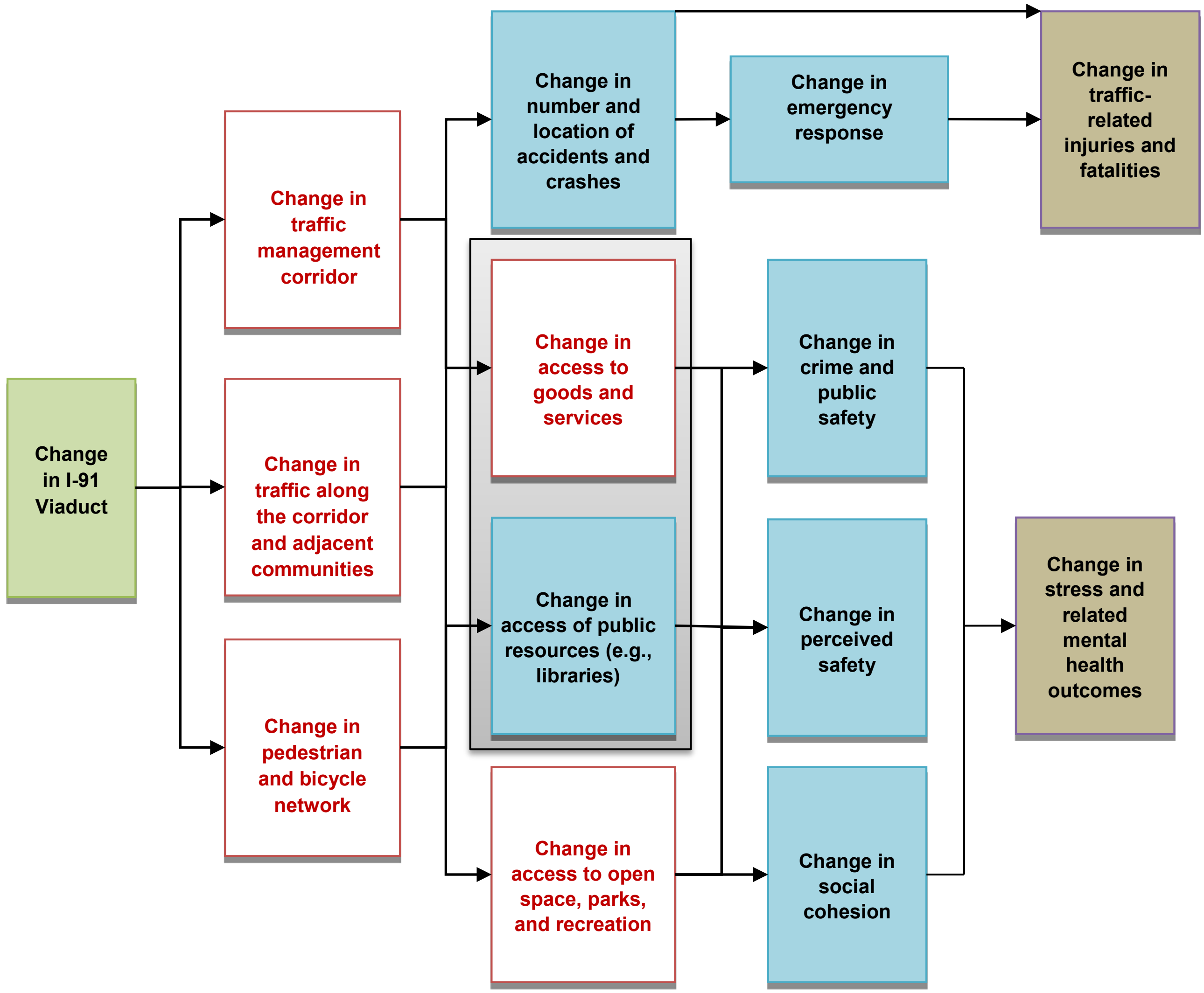


Figure 4-4: Public Safety Pathway

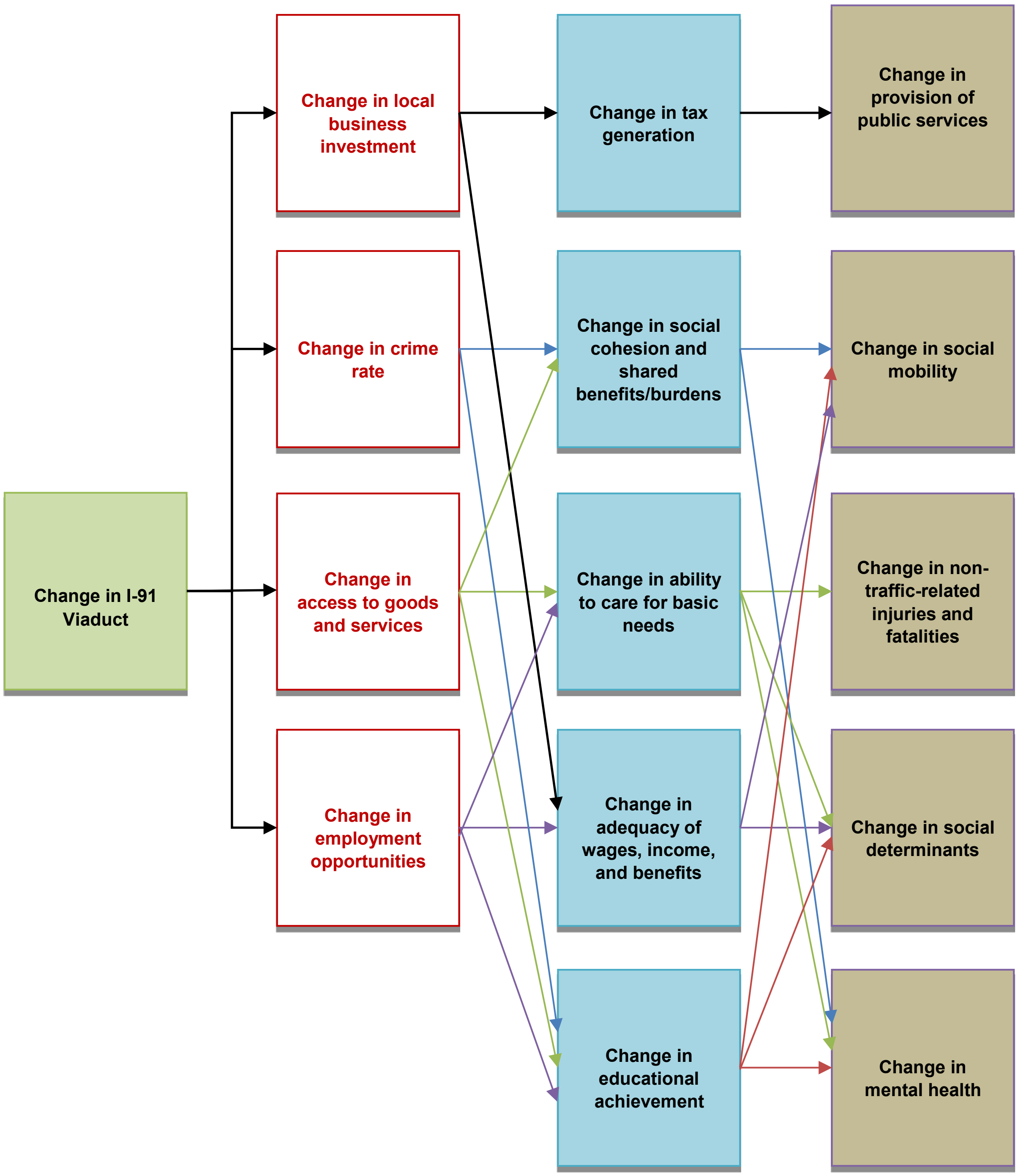


Figure 4-5: Socioeconomic Pathway

4.3 EVALUATION METHODOLOGIES

4.3.1 METHODOLOGICAL OVERVIEW

In order to progress from the initial conceptual designs developed in Chapter 3 to the three fully developed concepts presented in this chapter, a sequential analytical effort was required. The initial design of each alternative served as the starting point in each case, followed by secondary design of potential development scenarios. These development scenarios depicted potential real estate development opportunities that would be created by the implementation of each alternative. Based on an economic analysis of Springfield's current and future residential and commercial real estate markets, these scenarios were translated into changes in residents, jobs, and automobile ownership in Springfield and the balance of the Pioneer Valley region. The direct and indirect effects of these development scenarios are captured in the **Land Use and Economic Development** evaluation criteria in addition to affecting downstream traffic modeling results.

These design concepts and resulting socioeconomic projections formed the basis for additional modeling efforts to fully understand how each alternative would perform in terms of metrics including traffic volumes, levels of service, travel times, and conflict points. This formed the basis for assigning data and ratings to evaluation criteria in the **Mobility and Accessibility** and **Safety** subject areas. Secondary modeling based on projected traffic volumes and conditions was developed to provide generalized estimates of noise and emissions impacts in the Primary Study Area both because of changes in traffic volumes and from potential depressed alignments. These secondary modeling efforts heavily informed evaluation criteria under **Environmental Effects**.

Estimates of property tax revenues that would accrue to the City of Springfield in each alternative were developed as an extension of the development scenarios; these estimates are based on comparable properties in Springfield. Costs of construction and maintenance as well as community impacts during the construction process were also estimated based on a compilation of comparable project costs, quantification of actual project components and unit prices, and allowances for contingencies and inflation. The output of the cost estimation process allowed for a high-level cumulative cost-benefit analysis of each alternative across the project's extended life cycle.

The overall flow of work through the evaluation process, including dependencies between analytical steps, is depicted in the flow chart below (Figure 4-6).

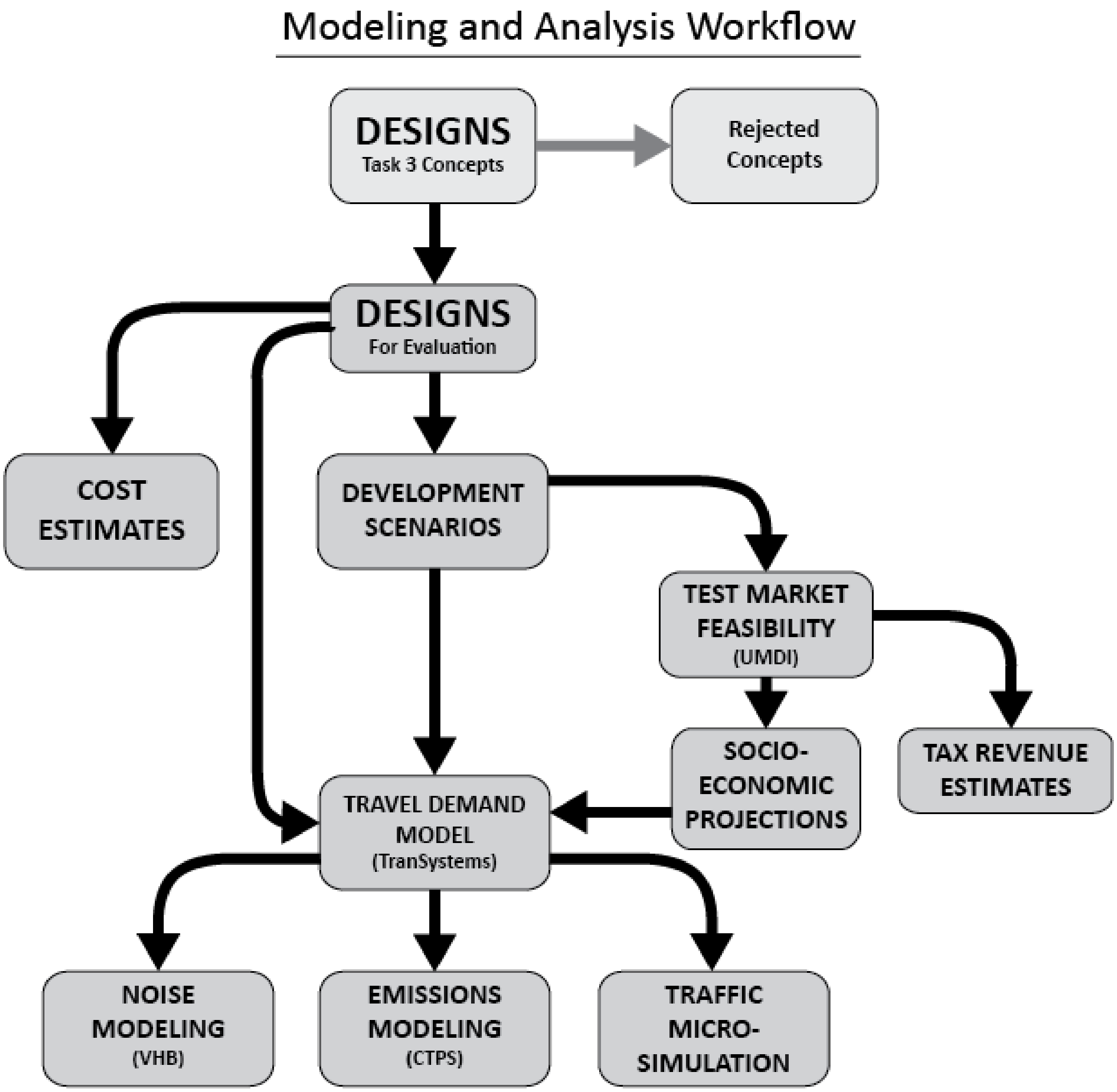


Figure 4-6: Overview of Evaluation Workflow

4.3.2 DESIGN OVERVIEW AND CONSIDERATIONS

The process of developing detailed conceptual alternatives from the very simplistic "line drawings" prepared in the previous chapter included several iterations of highway design and engineering drawings as well a more detailed planning and landscaping look into the creation and transformation of green space, riverfront connectivity, and urban redevelopment. Utilizing Alternative 1 as an example, the following set of figures depicts the process that each of the three alternatives underwent to create the three detailed conceptual alternative plans. The first step in the process involved a deeper, more technical look into the actual horizontal and vertical highway geometry, lane widths and configurations, ramp locations and configurations, intersection design, open space planning, and constraints defined in Chapter II.

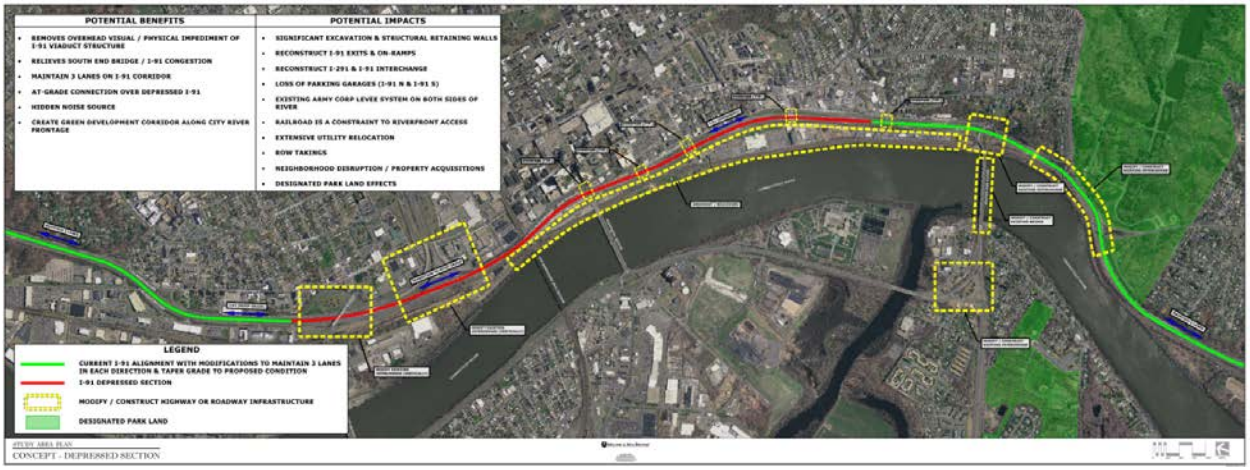


Figure 4-7: Original "Line Drawings" developed as part of the early alternatives development process

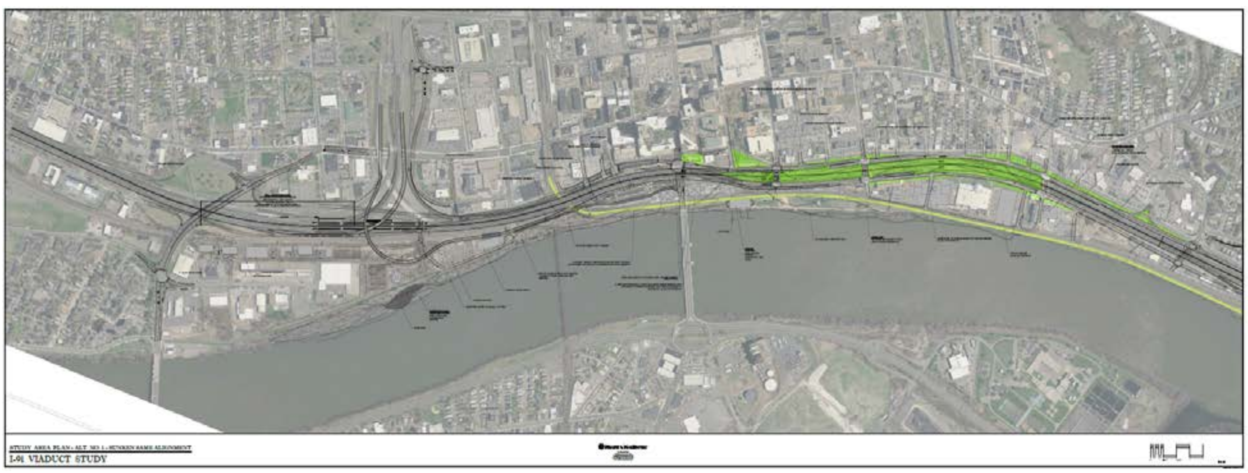


Figure 4-8: Initial development of highway and roadway alignment, lane widths, ramp locations, and green space

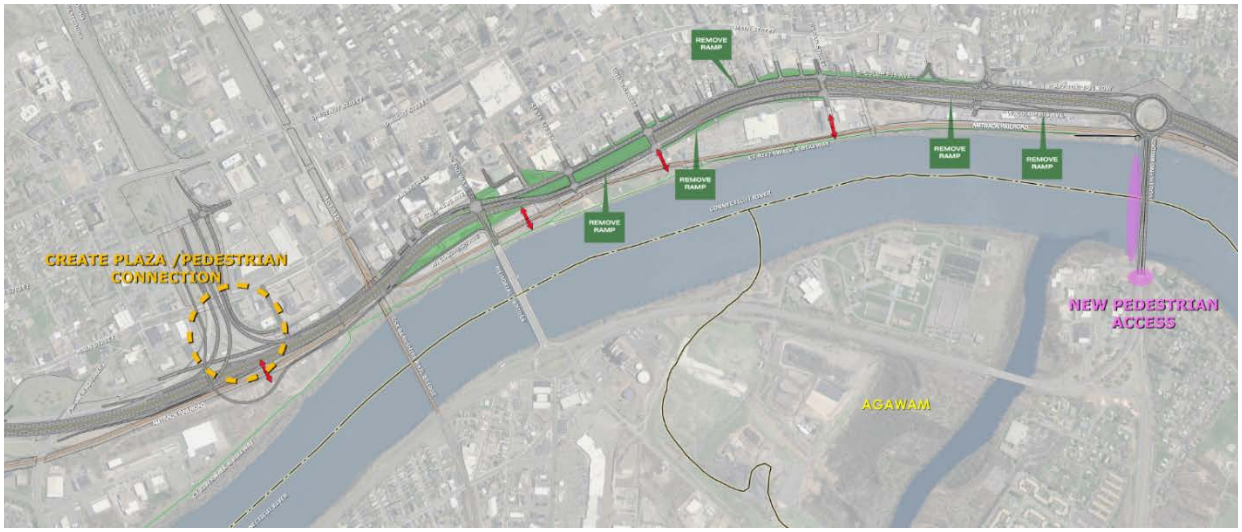


Figure 4-9: More detail is included as the alternatives begin to take shape; impacts and opportunities begin to be better defined for the purposes of the evaluation process to follow.

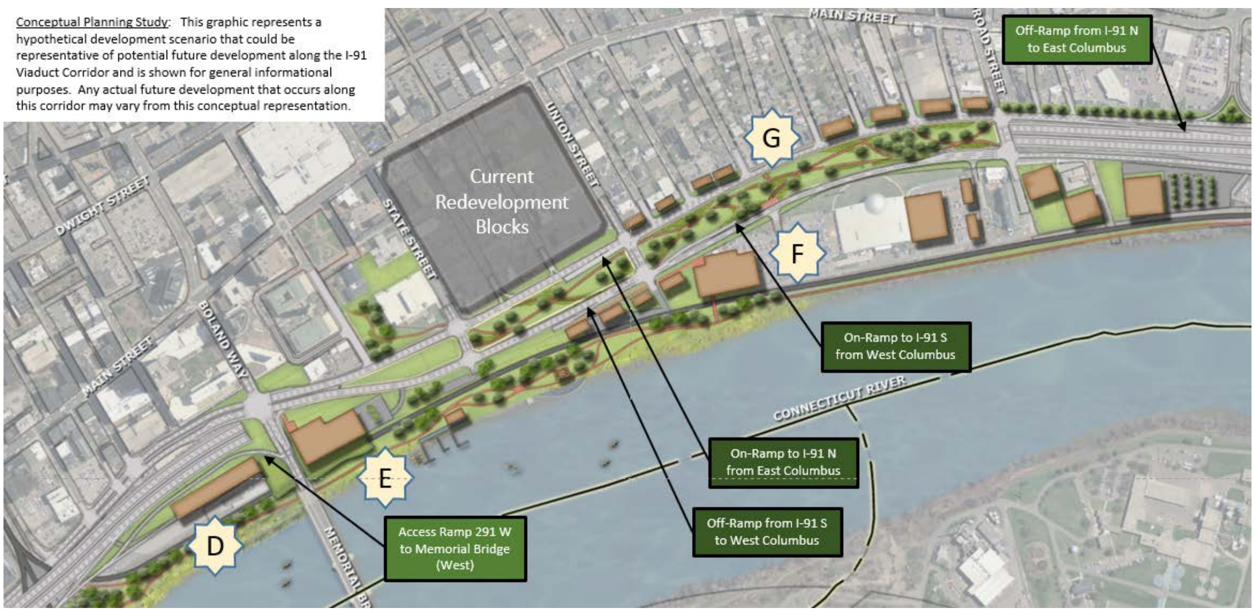


Figure 4-10: Final detailed conceptual alternative plans are developed for all three alternatives. The level of detail developed for each option is commensurate with the level of detail required to complete the evaluation criteria.

The remainder of this section discusses the development of Alternatives 1, 2, and 3 in succession.

Due to the length of the project corridor and the similarity of all three alternatives, the corridor was divided into three sections: a North Plan (from Boland Way past the I-291 Interchange and Plainfield Street), Central Plan (Downtown Springfield Core), and South Plan (the Longmeadow Curve). An Index Plan outlining each of these three areas is presented below (Figure 4-11).

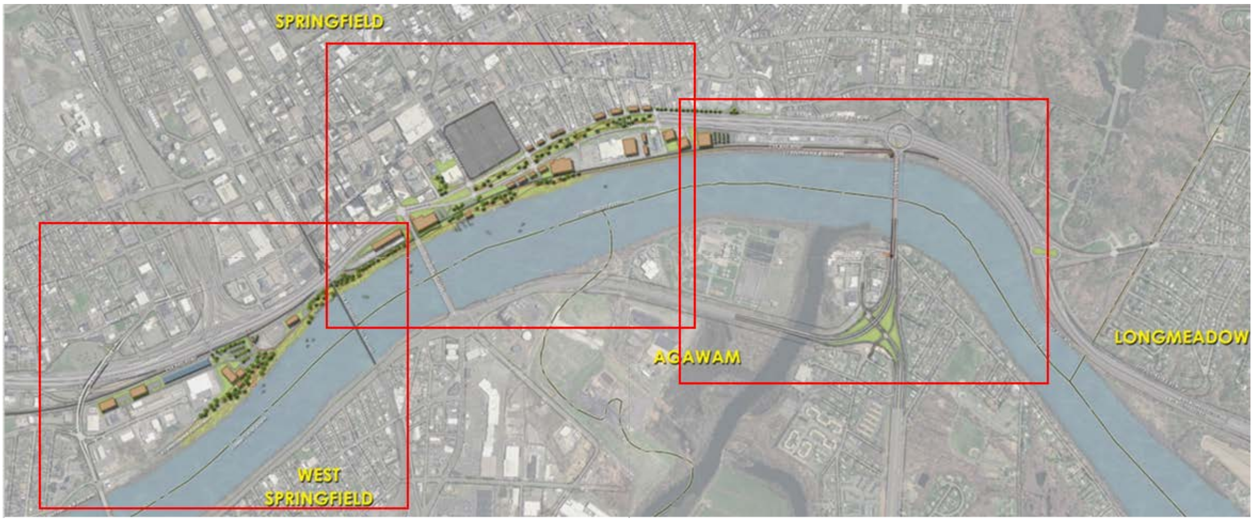


Figure 4-11: Index Plan (Alternative 1)

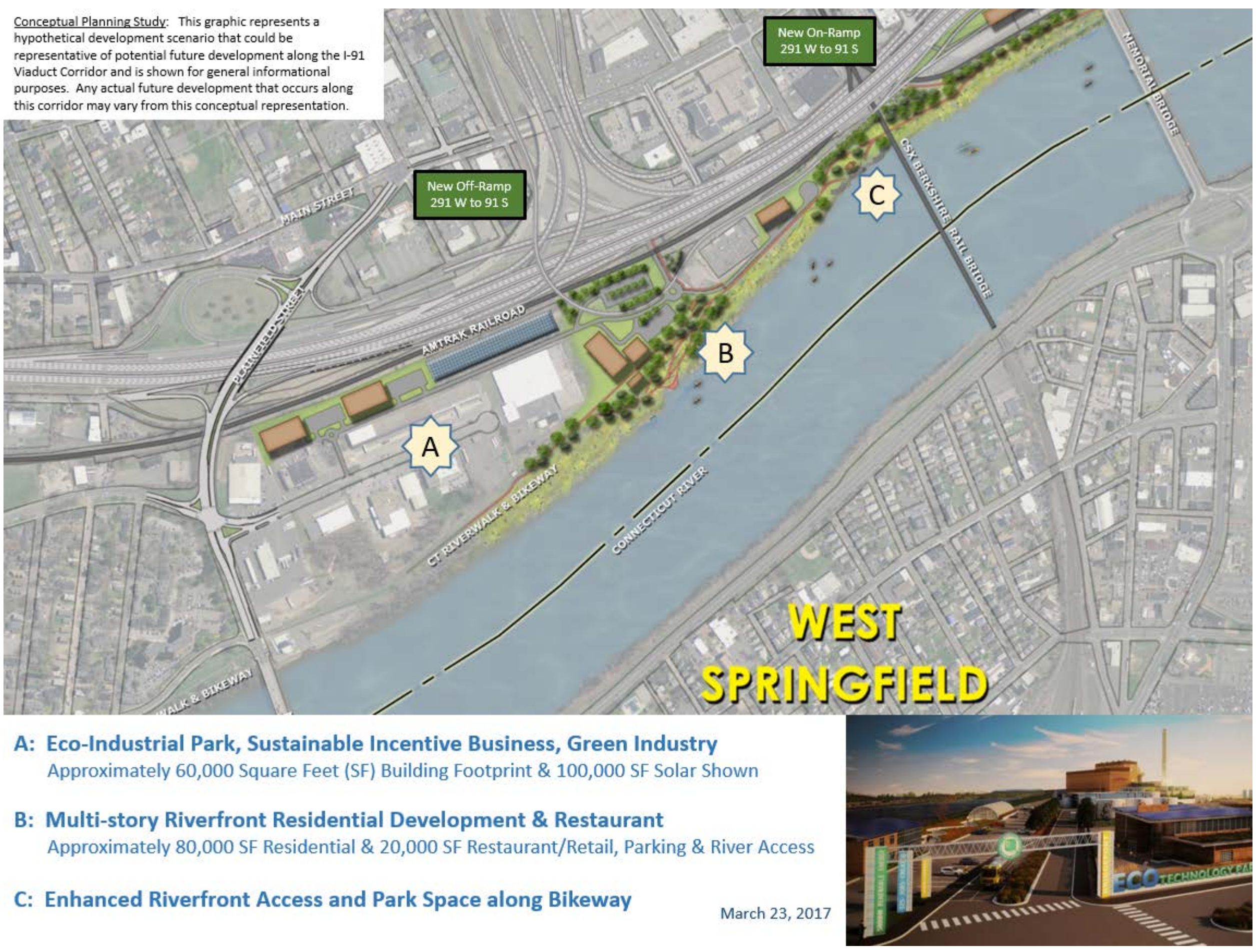


Figure 4-12: Alternative 1 - North Plan

Alternative 1 – North Plan

Mainline

Alternative 1 depicts a depressed alignment of the I-91 mainline through the Downtown Springfield core, which would run below grade for 4,200 feet before reemerging at grade on the northern end just north of Boland Way. The mainline would rise from its depressed depth utilizing a five percent grade such that it could rise over the existing rail lines and the East/West Columbus Avenue frontage roads[1] in the vicinity of Hampden Street and Gridiron Street. Throughout this section, three lanes would be maintained in each direction prior to entering the interchange with I-291.

Interstates 91 and 291 Interchange

Full access between I-91 and I-291 would be preserved under this design with a ramp structure similar to what exists today. The major change proposed for this alternative is a redesigned connection from I-291 southbound to I-91 southbound. In place of the existing connection from I-291 to I-91, which routes traffic onto the left side of the mainline, a redesigned flyover would continue over the entire I-91 alignment and ramps and connect to the right side of the southbound mainline. An additional flyover ramp would provide a direct connection to the Memorial Bridge (via Plainfield Street) in the westbound direction. The connection from Plainfield Street to I-291 northbound would not exist in this alternative; however, eastbound traffic would be able to access I-291 by following Plainfield Street to East/West Columbus Avenues (which pass below the I-91 mainline in this area) to access Emery Street. In addition, the Emery Street on ramp to I-291 northbound would also be configured to provide a bridge connecting Main Street and Dwight Street and merging with a reconfigured I-91 northbound off ramp. This intersection would be reconfigured and signalized, providing access to I-291 northbound from East and West Columbus Avenues and Plainfield Street.

Plainfield Street Area

This portion of the project can be considered as a stand-alone project in itself. A pair of new bridges over the I-91 alignment and adjacent railroad tracks is proposed to replace the existing set of bridges. The rebuilt bridges would incorporate a third lane of traffic for Route 20A in the westbound direction. A boulevard-type roadway would still be incorporated to provide an island between the eastbound and westbound movements. New pedestrian improvements would include new wheelchair ramps, sidewalks along both sides of the structure, and crossings at the on and off ramps to the frontage roads and I-91. These ramps would also include sufficient merging and gore areas. Bike lanes would also be provided on both sides of the roadway. Improvements would be made along Plainfield Street and West

[1] In the context of the Downtown Springfield I-91 alignment, *frontage roads* refer to East and West Columbus Avenue/Hall of Fame Avenues. For simplicity, the combined West Columbus Avenue/Hall of Fame Avenue alignment is periodically referred to as simply "West Columbus Avenue."

Street from Main Street to the North End Bridge. The intersection of Avocado and West Streets at Plainfield Street would be reconstructed to include new auxiliary lanes, bike and pedestrian accommodations, and traffic signal equipment. The intersection of Plainfield Street at Main Street would also be reconstructed. This location would include upgraded traffic signal equipment, bicycle and pedestrian improvements, and additional auxiliary lanes in all four directions to provide capacity improvements.

East and West Columbus Avenues

The northern end of East/West Columbus Avenues would remain very similar to the current condition. Minor differences would include the addition of signalized intersections at Emery Street. Additionally, a connection point near Gridiron Street, which would pass underneath the railroad tracks that are north of the Amtrak Bridge over the Connecticut River, would provide access to land west of the railroad along the Connecticut River. Pedestrian improvements and bicycle accommodations would begin near the access road underneath the railroad. Further north would be considered non-access (designated for vehicular traffic only) as it leads to the interstate. In addition, the existing Clinton Street tunnel under the railway would be widened and provisioned with a small roundabout to improve vehicular, bicycle, and pedestrian access to the riverfront and potential development parcels.

Bicycle and Pedestrian Accommodations

As noted above, enhanced bicycle and pedestrian accommodations are proposed at key improved areas. In the Plainfield Street area, both the Plainfield Street bridges and the intersection of Avocado and West Streets would be reconstructed with additional pedestrian improvements and bike lanes. An additional bicycle and pedestrian connection to the Connecticut Riverwalk and Bikeway would be provided as part of a linkage from East/West Columbus Avenues to a currently inaccessible but developable parcel adjacent to the riverfront, which once connected would be a potential site for redevelopment. At all signalized intersections, the latest ADA/AAB standards would be met.

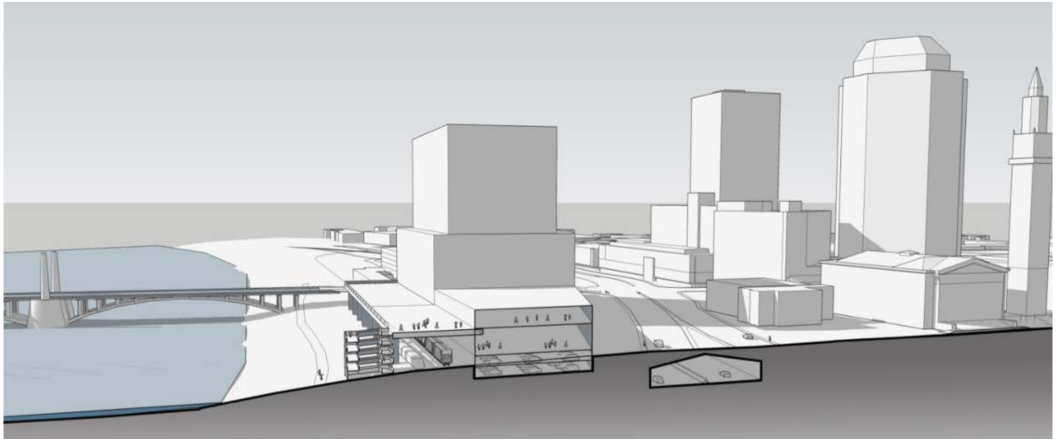
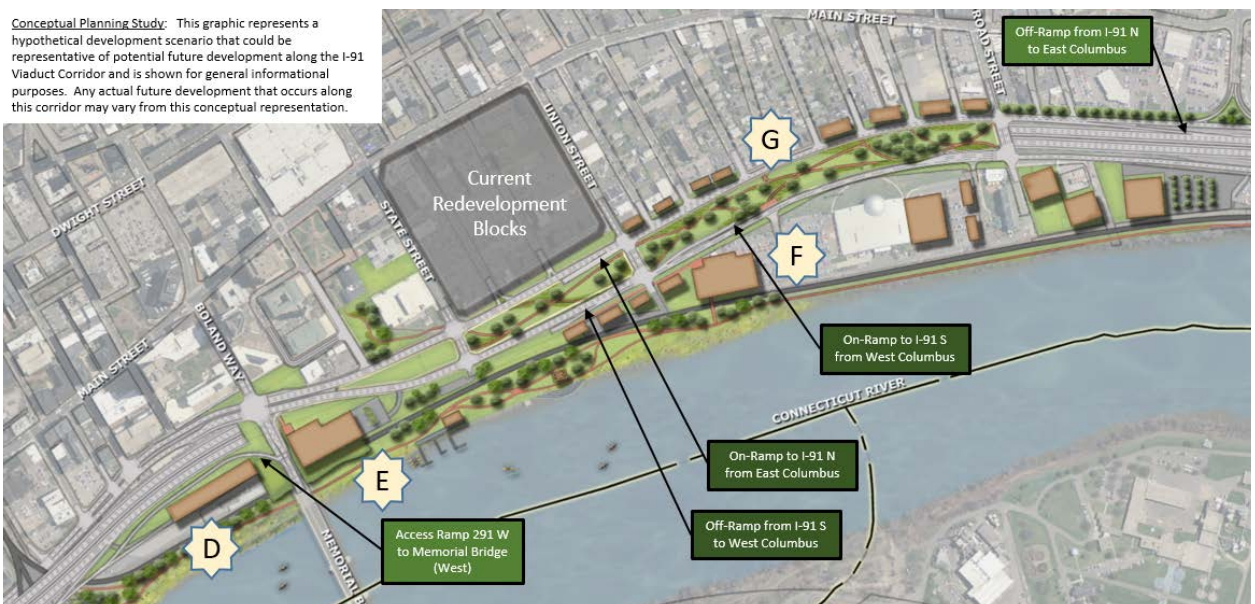


Figure 4-13: Conceptual view of proposed Downtown Springfield waterfront conditions possible as part of Alternative 1



D: Reconstructed I-91 North Garage (80,000 SF Footprint)

E: Multi-story Riverfront Residential Development & Retail
Approximately 120,000 SF Residential & 10,000 SF Restaurant/Retail, Parking Garage, Elevated Green Terrace over Rail, Park Connection to Downtown & Riverfront Park, Marina

F: Parkview & Riverfront Development (West Columbus & Hall of Fame)
New Development along sunken & covered I-91 Park Corridor West (140,000 SF Residential & 127,000 SF Commercial Office/Retail)

G: Parkview Development (East Columbus)
New Development along I-91 Parkview Corridor East Columbus from Union to Broad Street (70,000 SF Residential & 55,000 SF Commercial Retail/Office

Figure 4-14: Alternative 1 - Central Plan

Alternative 1 – Central Section

Mainline Tunnel

I-91 between Broad Street and Boland Way (an alignment approximately 4,200' in length) would be covered and provide three lanes in each direction. Just north of Mill Street, I-91 will start to drop down at a five percent grade, bringing the mainline fully below grade just south of Broad Street. It would remain underground until it starts to rise up so that it returns to street level just north of Boland Way. This would allow for an at-grade connection between the South End and Riverfront Area. The space between East and West Columbus Avenues would be capped and level, creating a direct pedestrian connection across the existing alignment and an open or programmable space with many use options. The tunnel would follow the same alignment as the existing interstate.

Frontage Roads

East and West Columbus Avenues are proposed to remain at the same street level as they currently exist. However, instead of being separated by the I-91 Viaduct structure, these roadways would be separated only by the area of open space on the depressed alignment's cap. Each roadway would be primarily two lanes in each direction with the required auxiliary lanes needed for turning movements at the intersections with Broad Street, Union Street, State Street, and Boland Way. The two frontage roads would be separated by open space from Broad Street to Boland Way, where they would converge as the I-91 mainline rises back to grade from the depressed section. The intersections would be signalized at Broad Street, Union Street, State Street, and Boland Way in order to improve traffic coordination.

Access to I-91

On ramps to the I-91 mainline under this design would be located to the north and south of Union Street off East Columbus Avenue (northbound direction) and West Columbus Avenue/Hall of Fame Avenue (southbound direction). An off ramp for I-91 southbound is proposed to route traffic into Downtown Springfield via State Street. Currently, this section of I-91 provides six on and off ramps within this short distance, creating weaving issues and substantial crashes on this section of the highway. With the removal of three of these ramps, the redesigned alignment would reduce the opportunities for crashes with merging and diverging vehicles.

Bicycle and Pedestrian Accommodations

Sidewalks are proposed along both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue whereas today sidewalks are only located on one side of each roadway. Bicycle lanes are proposed on both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue with a width of five feet along each side. At all signalized intersections, the latest ADA/AAB standards would be met.

Figure 4-15: Alternative 1 - South Plan

Alternative 1 – South Plan (Also Alternative 2 and 3, Enhanced No-Build)

The Alternative 1 – South Plan depicts improvements that may stand alone from the proposed designs for the northern and central plans. Accordingly, the design of this section differs only in minor respects between the two other alternative designs, and the descriptions of major elements presented here may apply to all alternatives and the No-Build scenario. Adjustments between scenarios are made primarily in the design of touchdown points along I-91, U.S. Route 5, and Route 57.

I-91 Mainline

The existing interstate alignment in the "Longmeadow Curve" narrows from three lanes to two lanes in each direction between a point approximately 2,500' south of the U.S. Route 5 interchange (Exit 1) and extending approximately 450' south of Broad Street. The most significant change in the proposed alternatives in this section of I-91 is an expansion to three lanes in each direction. The radius of the turn in this section would be increased, providing more appropriate design speeds for a freeway. The high density of on and off ramps that currently exists in this stretch of I-91 (five ramps in both the northbound and southbound directions) would be reduced by providing a collector/distributor road that would flank both the northbound and southbound lanes of I-91. A full interchange would be provided with U.S. Route 5 at the Longmeadow and Springfield line and I-91, utilizing the collector/distributor road. At the South End Bridge (Buxton Bridge), a full interchange would be provided utilizing the collector/distributor road, connecting I-91 and the South End Bridge. Route 83 would connect with the collector/distributor road, providing access to the South End Bridge to the north, I-91 northbound and southbound, and U.S. Route 5 northbound and southbound. This design would allow for the elimination of the weaving sections; while new weaving sections would be created along the northbound and southbound sections of I-91, the distance between on and off ramps would be increased by 4,800' and 5,000', respectively.

Collector/Distributor Roadway System

The collector/distributor road would flank both sides of I-91 between the U.S. Route 5 interchange and the South End Bridge interchange. Two 12' lanes with adequate left and right shoulders would be provided. This roadway system would operate at reduced speeds relative to the I-91 mainline as it would handle fewer vehicles than the mainline and provide circulation between U.S. Route 5 (which runs from Longmeadow and Springfield to the south to Agawam and West Springfield to the north) and Route 83 (which provides access to the Forest Park section of Springfield to East Longmeadow and beyond). This road would also provide separation between U.S. Route 5 and I-91, which was a theme explored through earlier concepts in Chapter III.

Interchanges

U.S. Route 5 and Interstate 91

A new interchange is proposed to connect I-91 and U.S. Route 5 near the Springfield/Longmeadow town line. Currently, this interchange provides access in a limited set of directions, with access from U.S. Route 5 northbound to I-91 northbound, and from I-91 southbound to U.S. Route 5 southbound. A redesigned interchange would provide full access, utilizing two roundabouts (at the southern connection of U.S. Route 5 and I-91, and at the South End Bridge) and a set of collector/distributor roads. A "peanut" shaped alignment is proposed, which would provide additional curves in order to achieve reduced speeds and include slip lanes where needed. The northern, central, and southern elements of this system of interchanges are depicted in Figure 4-16 below.

The "peanut" roundabout would provide full access between I-91, the collector/distributor roadway system, and U.S. Route 5 and would contain two circulating lanes. Utilizing the collector/distributor roadway, this connects to a larger roundabout/rotary at the South End Bridge. At this location, the roundabout would contain two circular lanes with slip lanes at the approaches. Full access would be provided at this location to I-91, U.S. Route 5, and Route 57 in Agawam; access would also be provided to East Columbus Avenue and from West Columbus Avenue. Between the two roundabouts, access would also be provided to Route 83 on the east side. The connection between the two roundabouts would create a loop to allow for entering and exiting each of the major roadways in this area, including both northbound and southbound directions on I-91, U.S. Route 5, and Route 83 as well as connections to East and West Columbus Avenues.

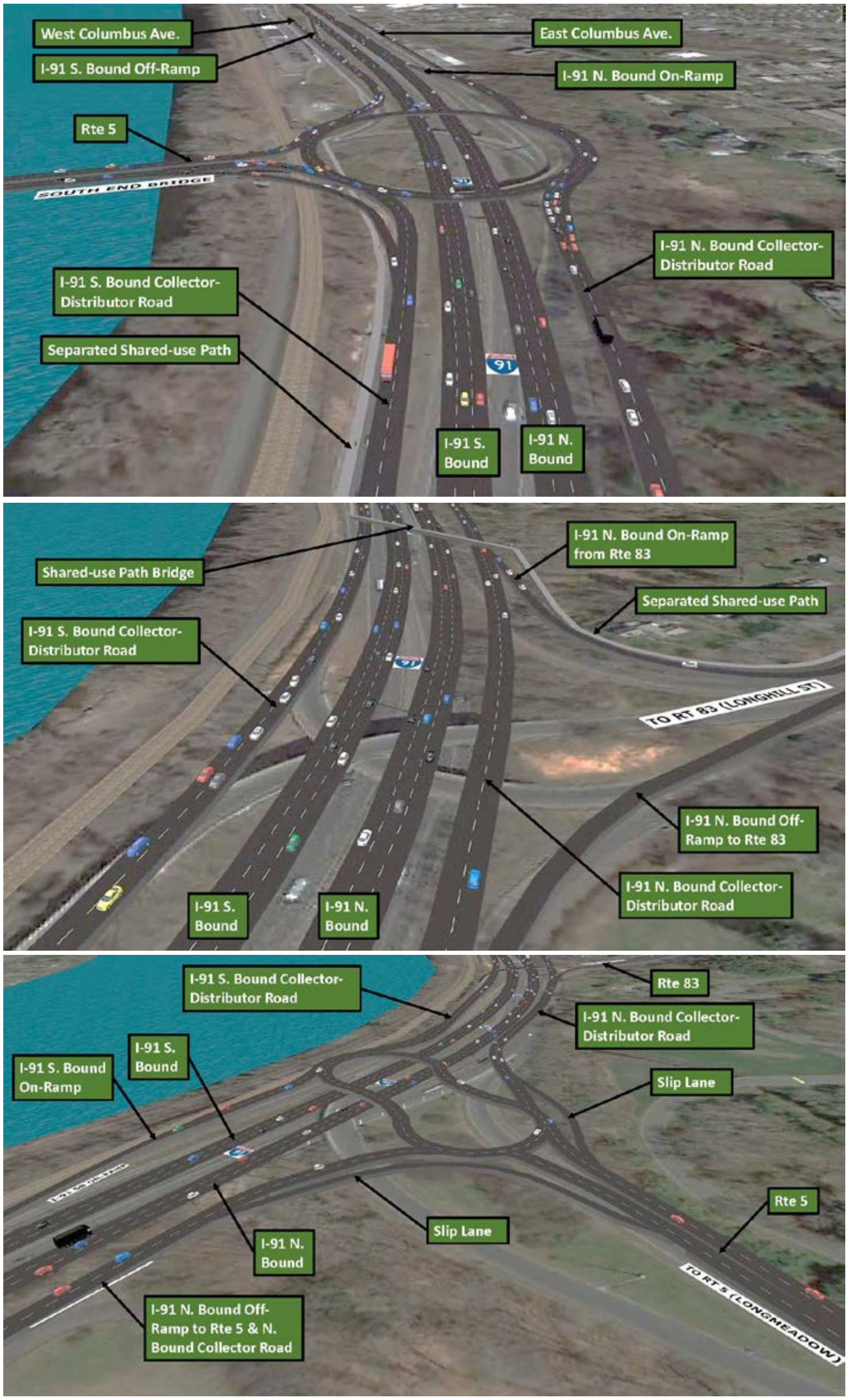


Figure 4-16: Interchange Concept for I-91 and U.S. Route 5

U.S. Route 5 and Route 57

The Agawam Rotary would be replaced with a new interchange for U.S. Route 5 and Route 57. Instead of the existing rotary, a modified version of a diamond interchange is proposed consisting of two coordinated traffic signals as the U.S. Route 5 on/off ramps intersect with River Road and Meadow Street, respectively. Two lanes in each direction along U.S. Route 5 would be provided (see below) as well as an extension of the new South End Bridge to and across a new bridge over the Westfield River. This newly designed interchange would provide a direct connection from U.S. Route 5 southbound to Route 57 westbound. Full access to the Meadow Street neighborhood in Agawam would be provided via an extension of Meadow Street easterly to River Road, which allows for the elimination of the off ramp to Editha Avenue. An exit off the South End Bridge heading northbound would be provided with a similar design to the existing condition, providing access to Route 57 westbound and River Road. River Road would have full access to both U.S. Route 5 and Route 57 in both directions. Route 57 would have full access to U.S. Route 5 in both northbound and southbound directions. Bicycle and pedestrian access is also proposed via a shared-use path along the east side of River Road onto Route 57, which would improve access between the Meadow Street neighborhood and the River Road neighborhood, which currently suffers from limited pedestrian accessibility.

South End Bridge and U.S. Route 5 Bridge over the Westfield River Replacement

Both the South End Bridge and the U.S. Route 5 Bridge over the Westfield River would need to be replaced in this section of the alternatives. In both cases, the existing bridges do not provide adequate merge and diverge areas for traffic entering and exiting the bridges on both sides. Wider shoulders and medians are also proposed to meet current standards. Upgrades are required along the South End Bridge for both pedestrians and bicyclists. For safety reasons, bicyclists would be separated from vehicular traffic utilizing a shared-use path on the northern side of the new bridge, separated from the shoulder by curbing. This design would accommodate these needs at the connection points along both sides of the river.

Pedestrian and Bicycle Features

As mentioned above, a separated bike lane/shared-use path would be provided along the north side of the new South End Bridge. On the western bank of the Connecticut River, the path would touch down near the revised River Road intersection and then run along River Road to the south and extend to the current shared-use path that begins at School Street. Along the east side of the Connecticut River, the proposed path connects to the existing Connecticut Riverwalk and Bikeway, descends beneath the railroad tracks, and continues north to provide a connection to the South End near Main Street. From this point, it would continue along West Columbus Avenue/Hall of Fame Avenue and connect to the proposed shared-use bicycle and pedestrian bridge that would provide access from Forest Park to the

Connecticut Riverwalk and Bikeway. These new proposed connections would provide safe bicycle and pedestrian routes between Agawam, Springfield, and Longmeadow.

Alternative 2

Alternative 2 has been similarly divided into three sections: North (I-291 Interchange), Central (Downtown Springfield Core), and South (Longmeadow Curve).

Figure 4-17: Alternative 2 - North Plan

Alternative 2 – North Section

Mainline

Under Alternative 2, the proposed I-91 mainline would descend through a depressed portion through Downtown Springfield for a distance of approximately 4,300'. At the north end, the depressed alignment would reemerge at street level just north of the proposed roundabout at the Memorial Bridge and Boland Way. From this point, it would continue to elevate at a five percent grade in order to pass over the rail lines and East/West Columbus Avenues in the area between Gridiron Street and Worthington Street. Three lanes would be maintained in each direction prior to entering the interchange with I-291.

Interstates 91 and 291 Interchange

Full access between I-91 and I-291 would be preserved under this design, with a very similar ramp structure to what exists today. As with Alternative 1, the major change proposed for this alternative is a redesigned connection between I-291 southbound and I-91 southbound. In place of the existing connection from I-291 to I-91, which routes traffic onto the left side of the mainline, a redesigned flyover would connect to the southbound I-91 mainline from the right-hand side, as in Alternative 1.

The major distinction between Alternatives 1 and 2 is the geometry of this flyover. A different approach is needed due to the proximity of the realigned mainline to the railroad right-of-way. The flyover connection between I-91 and I-291 southbound would therefore continue up and over the ramps connecting I-91 and I-291 but continue toward the Connecticut River and circle back (in a clockwise direction) to connect to the right side of the mainline, near where Clinton Street passes below the railroad right-of-way. As the mainline is directly adjacent to the railroad, connecting to the Memorial Bridge is not feasible in this option; however, this connection is not provided in the current state. A connection from Plainfield Street to I-291 northbound would also be provided in this alternative. As with Alternative 1, the Emery Street on ramp to I-291 would also be configured to provide a bridge connecting Main Street and Dwight Street and merging with a reconfigured I-91 northbound off ramp. This intersection would be reconfigured and signalized, providing access to I-291 northbound from East and West Columbus Avenues and Plainfield Street.

Plainfield Street Area

The proposed design of the Plainfield Street area improvements is identical between the proposed alternatives. A pair of new bridges over the I-91 alignment and adjacent railroad tracks is proposed to replace the existing set of bridges, which are in need of geometric improvements to lane configurations and storage lengths. Currently, capacity constraints exist in this area, particularly for the intersection of West Street, Avocado Street, and Plainfield Street.

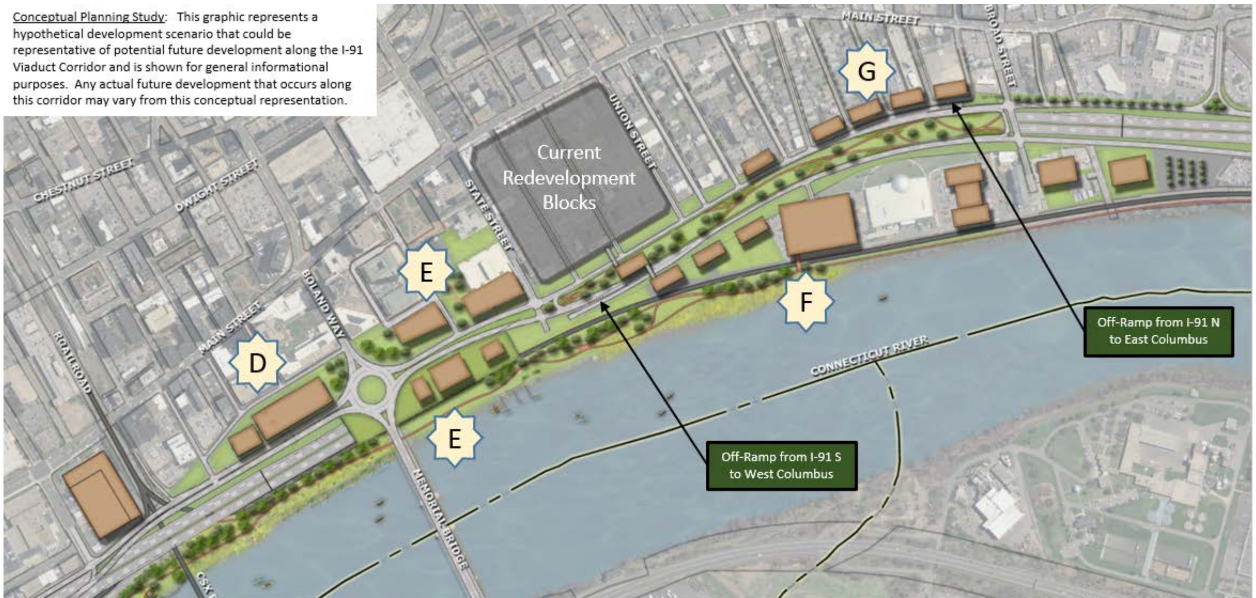
The rebuilt bridges would incorporate a third lane of traffic for U.S. Route 20A in the westbound direction. A boulevard-type roadway would still be incorporated to provide an island between the eastbound and westbound movements. New pedestrian improvements would include new wheelchair ramps, sidewalks along both sides of the structure, and crossings at the on and off ramps to the frontage roads and interstate. These ramps would also include sufficient merging and gore areas. Under current conditions, the area is in need of bicycle and pedestrian improvements, with no bicycle facilities in either direction. Adequate bike lanes would be provided on both sides of the roadway. Improvements would be made along Plainfield Street and West Street from Main Street to the North End Bridge. The intersection of Avocado and West Streets at Plainfield Street would be reconstructed to include new auxiliary lanes, bike and pedestrian accommodations, and traffic signal equipment. The intersection of Plainfield Street at Main Street would also be reconstructed. This location would include upgraded traffic signal equipment, bicycle and pedestrian improvements, and additional auxiliary lanes in all four directions to provide capacity improvements.

East and West Columbus Avenues

The beginning of East and West Columbus Avenues would remain very similar to its current state. Minor differences would include signalized intersections at Emery Street and also at a connection point near Gridiron Street, which would pass underneath the railroad tracks that are north of the Amtrak Bridge over the Connecticut River, to provide access to land west of the railroad along the Connecticut River. Pedestrian improvements and bicycle accommodation would begin near the access road underneath the railroad. Further north would be considered non-access (designated for vehicular traffic only) as these sections provide access to the interstate. In addition, the existing Clinton Street tunnel under the railway would be widened and provisioned with a small roundabout to improve vehicular, bicycle, and pedestrian access to the riverfront and potential development parcels.

Bicycle and Pedestrian Accommodations

As noted above, enhanced bicycle and pedestrian accommodations would be provided at key improved areas. In the Plainfield Street area, both the Plainfield Street bridges and the intersection of Avocado and West Streets would be reconstructed with additional pedestrian improvements and bike lanes. An additional bicycle and pedestrian connection to the Connecticut Riverwalk and Bikeway would be provided as part of a linkage from East/West Columbus Avenues to a potential development parcel on the riverfront. At all signalized intersections, the latest ADA/AAB standards would be met.



D: Multi-story City Center North Development

Approximately 150,000 SF Office 10,000 SF Restaurant/Retail, Parking

E: Bridgeview & Riverfront Development (Memorial Bridge/Riverfront Park)

New Development along and above I-91 Park Corridor with 180,000 SF Office/Retail, and 120,000 SF Residential, Parking Garage under Elevated Green Terrace over Rail, Connection to Downtown & Riverfront

F: Parkview & Hall of Fame Development West

New Development along and above I-91 Park Corridor with 135,000 SF Office, 185,000 Retail, and 85,000 SF Residential, with new Parking Garage at HOF, and Skywalk Connections to Casino from West Columbus

G: Parkview Development (East Columbus)

Development along I-91 Parkview Corridor East Columbus from Union to Broad Street (75,000 SF Retail & 225,000 SF Residential

Figure 4-18: Alternative 2 - Central Plan

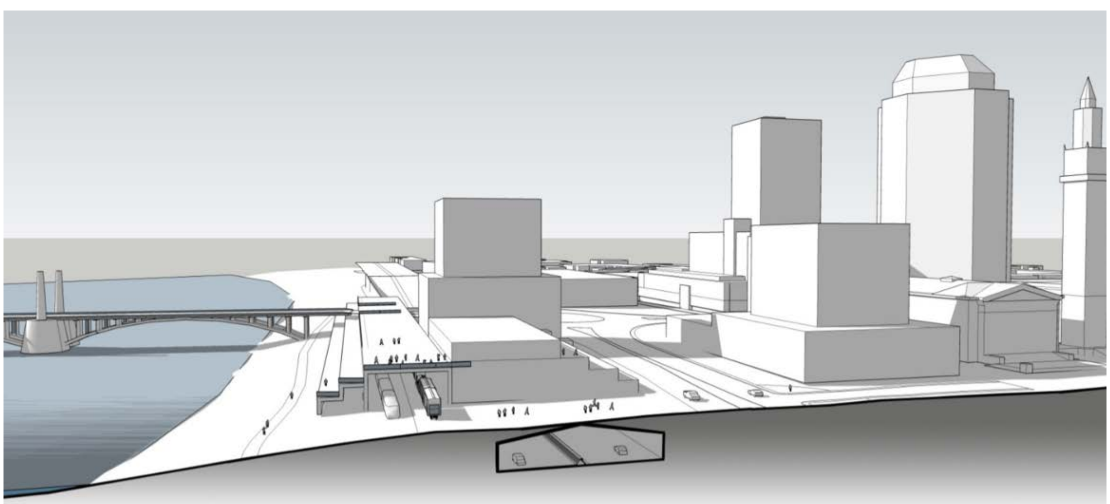


Figure 4-19: Conceptual view of proposed Downtown Springfield riverfront conditions possible as part of Alternative 2

Alternative 2 – Central Section

Mainline Tunnel

I-91 between Broad Street and Boland Way would be covered and provide three lanes in each direction. Just north of Mill Street, I-91 would start to drop down at a five percent grade, bringing the mainline fully below grade just south of Broad Street. It would remain underground until it starts to rise up so that it reaches street level just north of Boland Way. This would allow for a connection between the South End and Riverfront Area. The space between East and West Columbus Avenues would be capped and level, creating a direct pedestrian connection across the existing alignment and an open or programmable space with many use options.

The major difference between Alternatives 1 and 2 is that the mainline would be realigned to a right-of-way directly adjacent to the railroad. This realignment would also allow for the removal of some of the curvature of the mainline as compared to existing conditions, providing a longer tangent between curves from Union Street to the I-291 interchange. As a result of this realignment, the total quantity and location of land above the depressed highway differs between Alternatives 1 and 2. These differences are reflected in the design concepts for open space and development for Alternatives 1 and 2 and are discussed further in section 4.3.3 below.

Frontage Roads

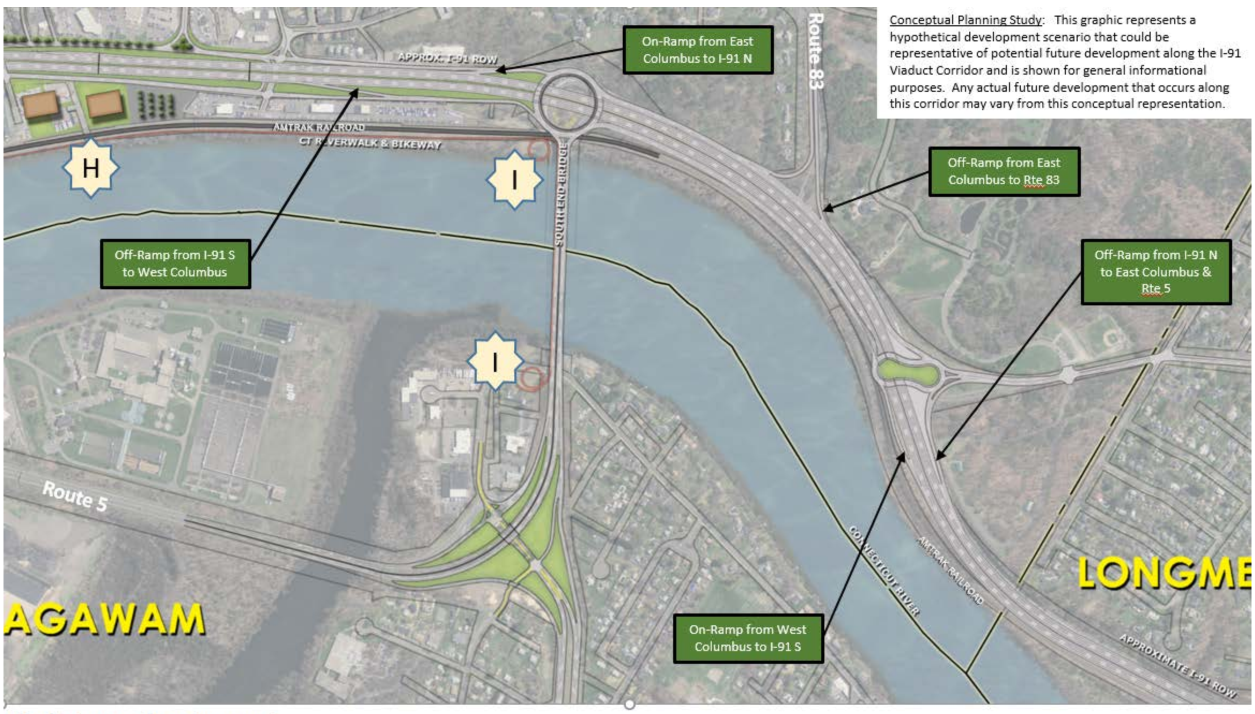
East and West Columbus Avenues would be at the same elevation as they are today. However, instead of being separated by the I-91 Viaduct structure, these roadways would be separated only by the area of open space on the depressed alignment's cap. Each roadway would be primarily two lanes in each direction. The two frontage roads would be separated by open space from Broad Street and eventually converge at Boland Way, where a two-lane roundabout is proposed at the intersection of Boland Way, Memorial Bridge, and East and West Columbus Avenues. The intersection of State Street and Broad Street would remain signalized. The connection between Union Street and West Columbus Avenue/Hall of Fame Avenue would be removed. U-turn lanes would be provided at State Street to go from northbound to southbound and at Broad Street to reverse direction from southbound to northbound.

Access to I-91

Under Alternative 2, I-91 northbound would have an off ramp that would provide access to East Columbus Avenue just south of Union Street. An off ramp for I-91 southbound is proposed for State Street. Within this section of I-91, there are currently six on and off ramps within a short distance, creating weaving issues and elevated numbers of crashes. With the removal of four of these ramps, there would be substantially fewer opportunities for crashes with merging and diverging vehicles.

Bicycle and Pedestrian Accommodations

Sidewalks would be provided along both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue whereas today sidewalks are only located on one side of each roadway. Bicycle lanes would be provided on both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue with a width of five feet along each side. At all signalized intersections, the latest ADA/AAB standards would be met.



H: Gateway Development

Approximately 120,000 Square Feet (SF) Commercial Office/Retail

I: Connecticut River Bikeway Extension

Accessible Ramps up to Bridge Elevation, New Bridge or Modification of existing to allow Bike Accommodation to Agawam Side, Construct Accessible Ramps to River Road (remove stair case)

MILONE & MACBROOM
massDOT
Massachusetts Department of Transportation

Figure 4-20: Alternative 2 - South Plan

Alternative 2 – South Plan

As stated in Alternative 1, the South Plan is identical for each of the three alternatives. See Alternative 1 – South Plan for a full description.

Alternative 3

Alternative 3 has been similarly divided into three sections, north (I-291 Interchange), central (Downtown Springfield Core), and the south (Longmeadow Curve).

Figure 4-21: Alternative 3 - North Plan

Alternative 3 – North Plan

Mainline

The mainline would continue to be elevated through this area before descending and touching down prior to the Plainfield Street overpass. Three lanes would be maintained in each direction prior to entering the interchange with I-291.

I-91 and I-291 Interchange

Full access between I-91 and I-291 would be preserved under this design, with a very similar ramp structure to what exists today. As with Alternatives 1 and 2, this design would alter the connection between I-291 southbound and I-91 southbound. In place of the existing connection from I-291 to I-91, which routes traffic onto the left side of the mainline, a redesigned flyover would continue over the entire I-91 alignment and ramps and connect to the right side of the southbound mainline. Along with providing access to the right side of the mainline, the ramp would split to provide connection to the Memorial Bridge in the westbound direction. As with Alternative 2, an eastbound on ramp at Plainfield Street would provide access to I-291; eastbound traffic could also access I-291 by following Plainfield Street to East/West Columbus Avenues (which pass below the I-91 mainline in this area) to access Emery Street. In addition, the Emery Street on ramp to I-291 would also be configured to provide a bridge connecting Main Street and Dwight Street and merging with a reconfigured I-91 northbound off ramp. This intersection would be reconfigured and signalized, providing access to I-291 northbound from East and West Columbus Avenues and Plainfield Street.

Plainfield Street Area

The proposed design of the Plainfield Street area improvements is identical between the proposed alternatives. A pair of new bridges over the I-91 alignment and adjacent railroad tracks is proposed to replace the existing set of bridges, which are in need of geometric improvements to lane configurations and storage lengths. Currently, capacity constraints exist in this area, particularly for the intersection of West Street, Avocado Street, and Plainfield Street.

The rebuilt bridges would incorporate a third lane of traffic for U.S. Route 20A in the westbound direction. A boulevard-type roadway would still be incorporated to provide an island between the eastbound and westbound movements. New pedestrian improvements would include new wheelchair ramps, sidewalks along both sides of the structure, and crossings at the on and off ramps to the frontage roads and interstate. These ramps would also include sufficient merging and gore areas. Under current conditions, the area is in need of bicycle and pedestrian improvements, with no bicycle facilities in either direction. Adequate bike lanes would be provided on both sides of the roadway. Improvements would be made along Plainfield Street and West Street from Main Street to the North End Bridge. The intersection of Avocado and West Streets at Plainfield Street would be reconstructed to include new auxiliary lanes, bike and pedestrian accommodations, and traffic signal equipment. The intersection of Plainfield Street at Main Street would also be reconstructed. This location would include upgraded traffic signal equipment, bicycle and pedestrian improvements, and additional auxiliary lanes in all four directions to provide capacity improvements.

East and West Columbus Avenues

The northern end of East and West Columbus Avenues would remain very similar to its current state. Minor differences would include the addition of signalized intersections at Emery Street and also at a connection point near Gridiron Street, which would pass underneath the railroad tracks that are north of the Amtrak Bridge over the Connecticut River, to provide access to land west of the railroad along the Connecticut River. Pedestrian improvements and bicycle accommodation are proposed to begin near the access road underneath the railroad. Further north would be considered non-access (designated for vehicular traffic only) as it leads to the interstate. In addition, the existing Clinton Street tunnel under the railway would be widened and provisioned with a small roundabout to improve vehicular, bicycle, and pedestrian access to the riverfront and potential development parcels.

Bicycle and Pedestrian Accommodations

Sidewalks are proposed along both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue whereas today sidewalks are only located on one side of each roadway. Bicycle lanes would also be provided on both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue with a width of five feet along each side. At all signalized intersections, the latest ADA/AAB standards would be met.

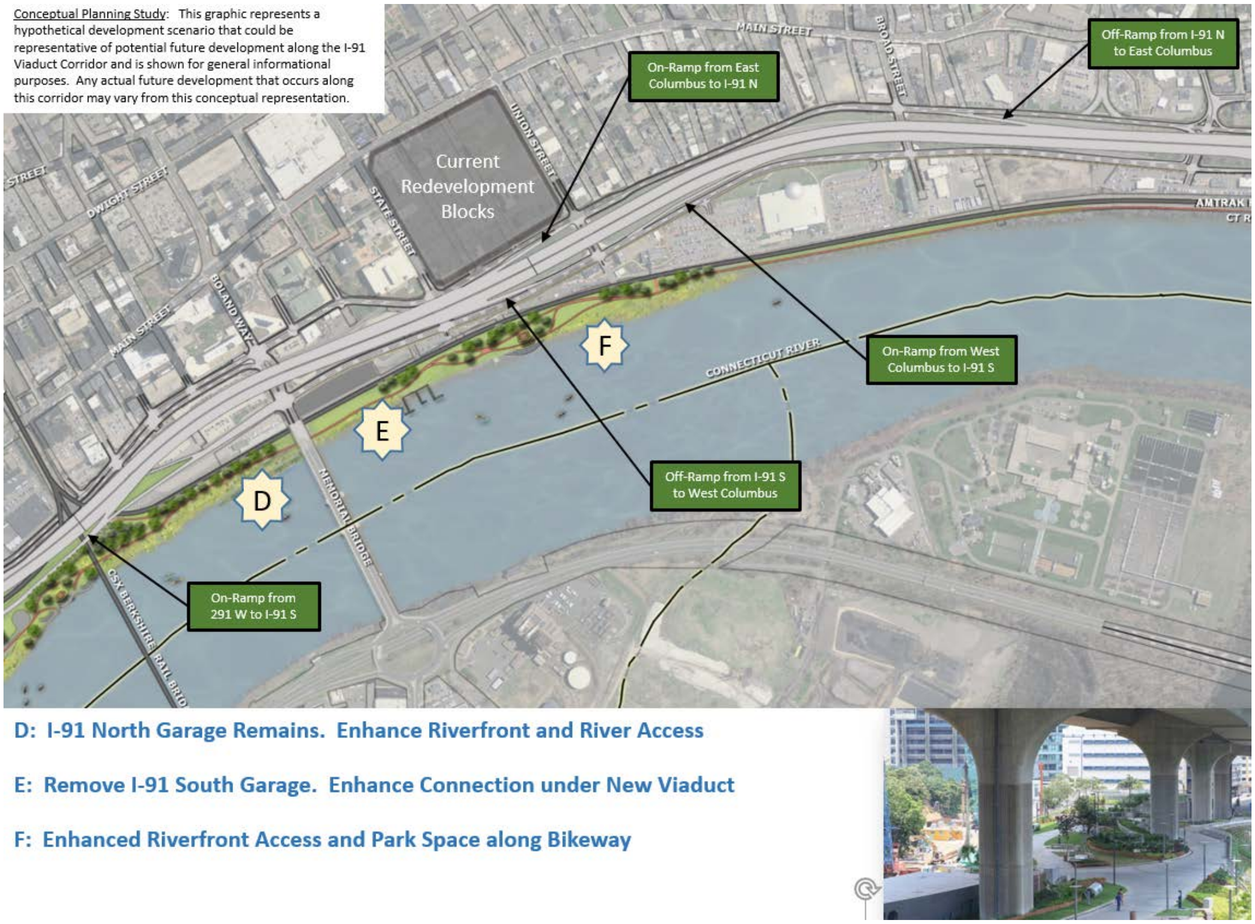


Figure 4-22: Alternative 3 - Central Plan

<u>Alternative 3 – Central Section</u>

<u>Mainline Viaduct</u>

The proposed mainline would be similar to the existing condition under this alternative, utilizing a viaduct structure and the same alignment. The major difference between the existing and proposed design is that an "elevated viaduct" design would be implemented with current technology and structural features. The structure would be elevated to a maximum height approximately 10 feet above the height of the existing structure to provide more light underneath and greater sense of openness. The conditions below the viaduct would be further improved by wider spacing between the columns holding up the roadway, further improving the pedestrian experience below the viaduct. On the I-91 mainline in this area, three lanes would be maintained along both the northbound and southbound directions. The shoulders and median on the viaduct would also be greater than under the existing design.

Frontage Roads

Under Alternatives 1 and 2, East/West Columbus Avenues would be realigned and relocated above the depressed highway structure. By contrast, Alternative 3 would retain East and West Columbus Avenues in their existing alignments. During the course of implementing the elevated viaduct concept, upgrades such as auxiliary lanes at the signalized intersections, new traffic signal equipment, and timing and coordination changes would all be implemented at these locations. Capacity and safety improvements for vehicles, pedestrians, and bicycles would be implemented at East/West Columbus Avenues intersections with State Street, Union Street, Broad Street, Main Street, and Boland Way.

Access to I-91

On ramps to the I-91 mainline under this design would be located to the north and south of Union Street off East Columbus Avenue (northbound direction) and West Columbus Avenue/Hall of Fame Avenue (southbound direction). Off ramps are proposed for Union Street (southbound direction) and for Broad Street (northbound direction). The off ramp at Union Street in the northbound direction would be removed as would the northbound on ramp north of State Street. This reconfiguration would remove two ramps in this section, reducing opportunities for crashes with merging and diverging vehicles.

Bicycle and Pedestrian Accommodations

Sidewalks would be provided along both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue whereas today sidewalks are only located on one side of each roadway. Bicycle lanes would be provided on both sides of West Columbus Avenue/Hall of Fame Avenue and East Columbus Avenue with a width of five feet along each side. At all signalized intersections, the latest ADA/AAB standards would be met.

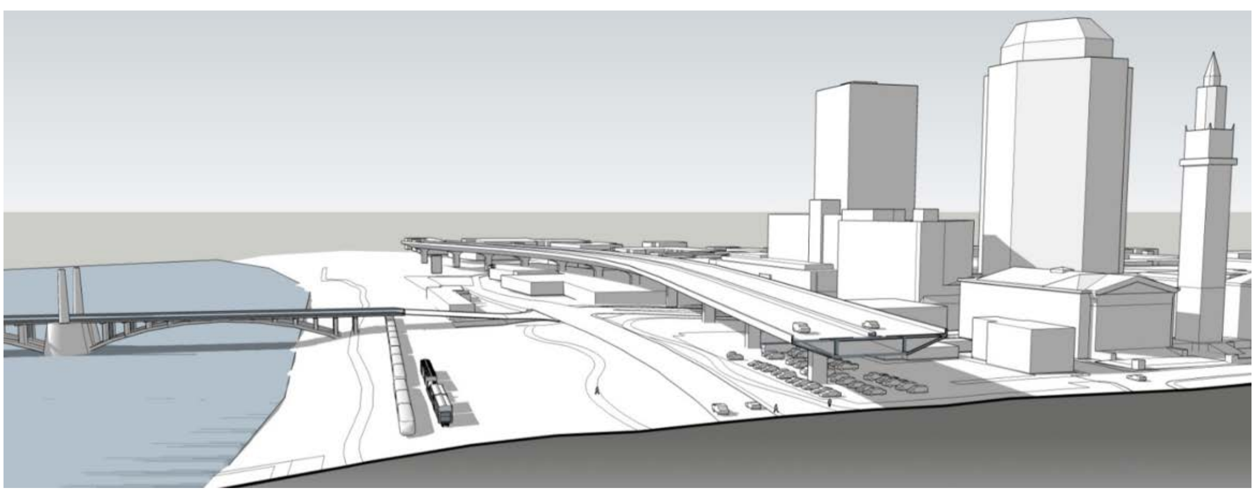


Figure 4-23: Conceptual view of proposed Downtown Springfield riverfront conditions possible as part of Alternative 3

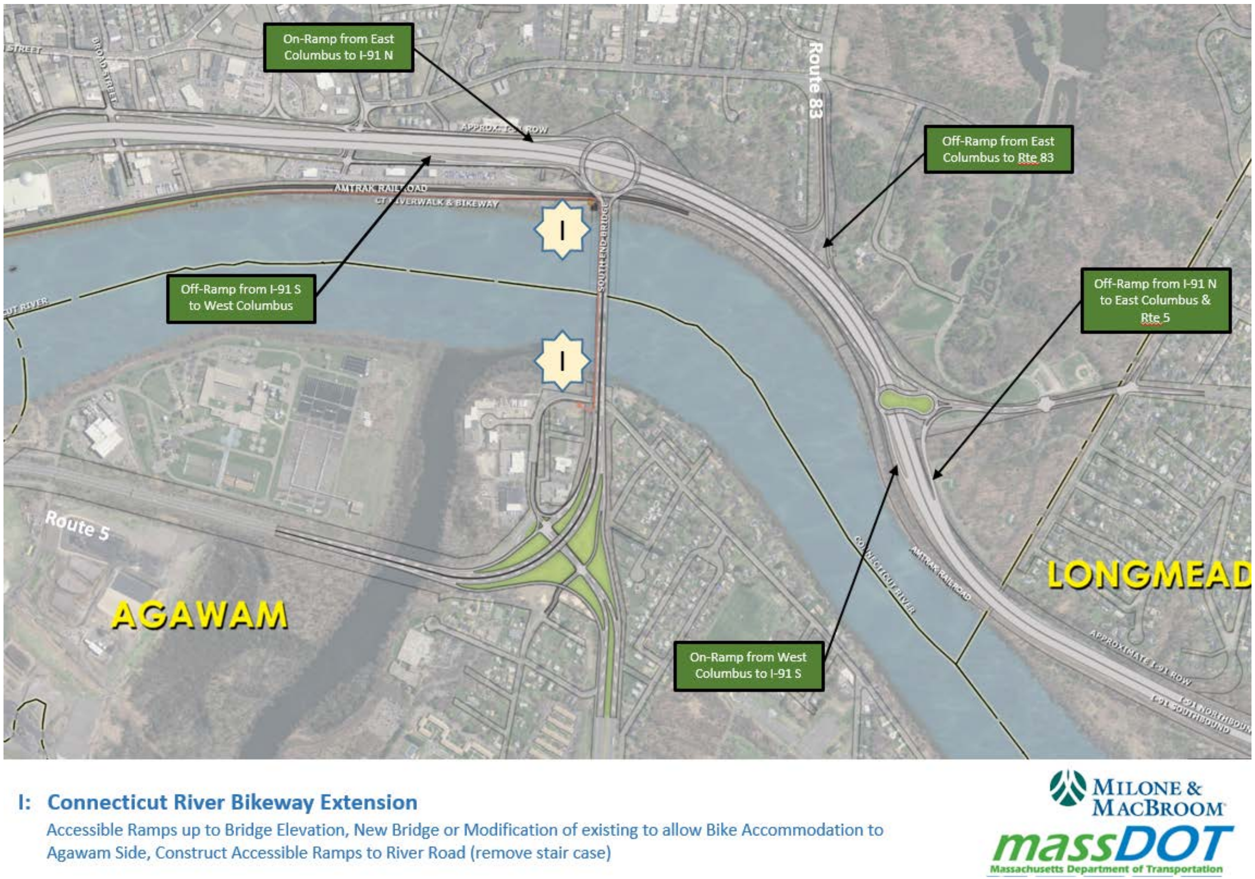


Figure 4-24: Alternative 3 - South Plan

<u>Alternative 3 – South Plan</u>

As stated in Alternatives 1 and 2, the proposed South Plan is identical for each of the three alternatives and also could be considered a stand-alone project. See Alternative 1 for description.

NEAR-TERM IMPROVEMENTS

As the development of more defined alternatives progressed, it became apparent that several components of the alternatives could be viewed as potential stand-alone improvement projects. Due to their lower cost and reduced permitting requirements, the following improvements could be implemented as part of the three alternatives or as stand-alone projects independently of the major elements of those alternatives. All of the following projects could be considered for enhancement of a No-Build scenario.

Enhanced Under-Viaduct Pedestrian Plazas – Safety Upgrades and Health and Aesthetic Improvements

The following are examples of under-viaduct improvement projects that can be designed and constructed without the need for extensive permitting and construction funding.

Figure 4-25: Under-Viaduct Enhancement Examples

Specific under-viaduct enhancements could range from creation of urban park space, decorative safety lighting, play courts, playgrounds, skate parks, seating, public art, and decorative pier treatments. The two following renderings depict two areas under the I-91 Viaduct and the possibilities for near-term improvement projects. These concepts envision addressing lighting and safety deficiencies in this area in order to make the space more inviting. Key elements include lighting improvements; sidewalks and paths; and inviting landscape and hardscape features that enhance the sense of security in the area, provide amenities to attract pedestrian foot traffic, and improve connections between Downtown Springfield and the Connecticut River. Attractive amenities such as a dog park for local residents could also provide similar benefits to this area.

Figure 4-26: Conceptual Rendering of I-91 Under-Viaduct Enhancements

Figure 4-27: Conceptual Rendering of I-91 Pedestrian Improvements to Rail Crossings/Connecticut Riverwalk and Bikeway

Bicycle and Pedestrian Improvements

Two access points between West Columbus Avenue and the Connecticut Riverfront Park and Connecticut Riverwalk and Bikeway currently exist. One is a passive at-grade rail crossing just south of State Street, which is not equipped with gates or lights to signal approaching trains. The second is a vehicular path below a rail overpass approximately 200 feet north of State Street. Pedestrian access to the riverfront is possible via adjacent stairs, but neither a dedicated pedestrian path nor any ADA accommodations are present at this crossing. Safety improvements to these crossings would enhance access for pedestrians and cyclists.

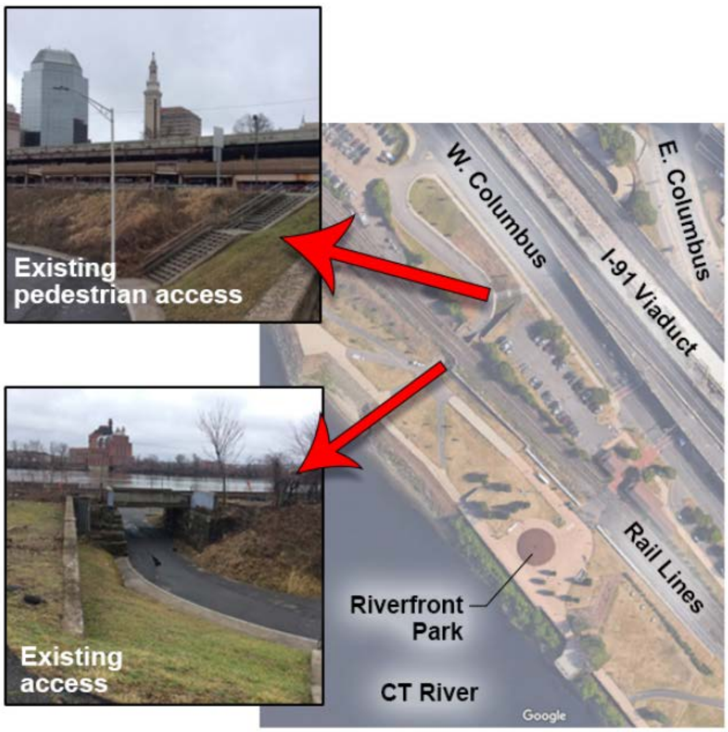


Figure 4-28: Pedestrian Improvements to Rail Crossings and Connections to Connecticut Riverwalk and Bikeway

On the western side of the Connecticut River, a stairway connects the South End Bridge to River Road. This stairway is neither ADA accessible nor bike-friendly. A new ramp or switchback path from the South End Bridge to River Road would provide an improved connection from Riverfront Park and the Connecticut Riverwalk and Bikeway to River Road and the surrounding neighborhood. In addition, maintenance deficiencies further complicate access for pedestrians and cyclists using this route.

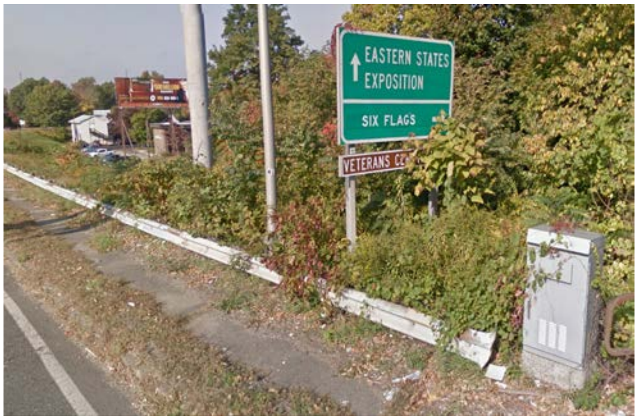


Figure 4-29: Maintenance deficiencies in path and stairway connecting South End Bridge and River Road

Figure 4-30: Opportunity for ADA Accommodations

On the eastern side of the river, an acute bicycle access barrier is the lack of a connection between the southern end of the Connecticut Riverwalk and Bikeway and the South End Bridge. Currently, the bikeway terminates approximately 800' north of the South End Bridge with no access to adjoining streets. A publicly accessible connection to the southern terminus of the Connecticut Riverwalk and Bikeway is needed, which may be accomplished through a possible land taking or easement to allow for a tunnel underneath the railroad tracks.

The existing elevated walkway linking the former Hall of Fame facility and the Connecticut Riverwalk and Bikeway is underutilized and not clearly visible to either drivers or pedestrians walking south along West Columbus Avenue. Providing better, safer, and more visible access to this pedestrian bridge via wayfinding signage or sidewalk and lighting enhancements could make this structure a more useful link to the riverfront. Alternatively, the structure could be relocated to the south, proximate to the current Hall of Fame and associated parking.

Currently, the U.S. Route 5 alignment through Forest Park at the Springfield-Longmeadow border lacks sidewalks for approximately 600' between Laurel Hill Road and Forest Glen Road, creating a disconnect in the area's pedestrian network particularly for users with mobility challenges who may not be able to use unpaved paths in the park. Providing a shared-use path along this section would provide better connections to the park for Longmeadow residents. Adequate space along the existing right-of-way exists for a shared-use path without considerable impacts on adjacent open space and recreational facilities. Figure 4-31 below depicts a potential location for such a shared-use path on the eastern side of U.S. Route 5.

Figure 4-31: Potential Shared-Use Path (Forest Park - Longmeadow)

Local Roads, Signalization, and Miscellaneous Improvements

Currently, some capacity issues occur during the AM and PM peak periods along U.S. Route 5 between Forest Glen Road and Converse Street. Signal coordination and review of timing for these intersections could alleviate these issues. In addition, the provision of a right-turn lane at the westbound approach along Forest Glen Road as it intersects with U.S. Route 5 would add capacity to this intersection and alleviate long queues, which currently extend as far as Laurel Street during peak periods.

In addition to the specific locational improvements noted above, additional spot ADA improvements are warranted across the Primary Study Area. These include sidewalk repair, ADA/AAB ramps, countdown signal heads, and minor timing changes that allow adequate time for pedestrian crossing throughout the Primary Study Area. The addition of these minor improvements would yield increased walkability and pedestrian safety for users across the Downtown Springfield area.

Similarly, interstate symbols on and around the I-91 corridor are currently absent or worn away, causing navigational difficulties and confusion for drivers. Providing interstate symbols on I-91 in the vicinity of the viaduct would help address these issues, potentially reducing crashes resulting from last-minute maneuvers as well as excess vehicle miles traveled.

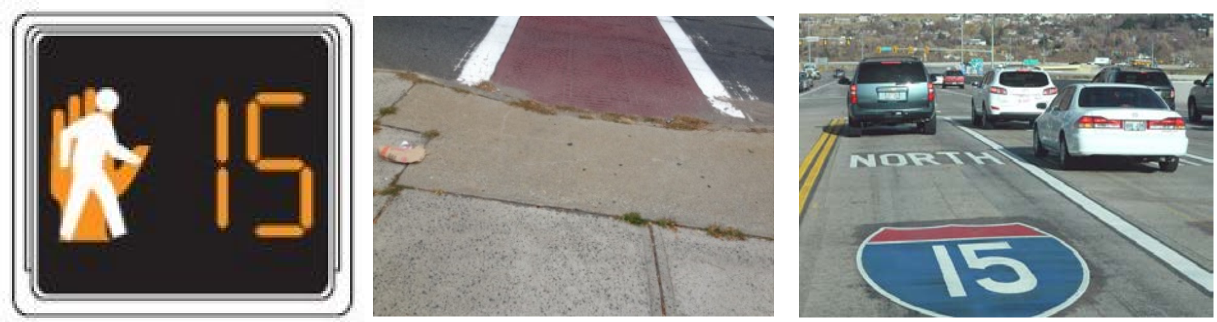


Figure 4-32: Pedestrian-Friendly Countdown Signal; Nonconforming Pedestrian Ramp in Study Area; Interstate Symbol Example

MID-TERM IMPROVEMENT PROJECTS

As with the near-term improvements outlined above, a number of mid- to long-term improvements were identified in the course of developing the alternatives. As with the near-term improvements, these projects could be implemented independently of options for the viaduct. These improvements would incur higher costs, greater permitting requirements, and more extensive construction impacts than the near-term improvements identified above and, therefore, would likely occur farther into the future. All of the following projects could be considered for enhancement of a No-Build scenario.

Longmeadow Curve

The "Longmeadow Curve" is generally located between the South End Bridge and the U.S. Route 5 interchange along I-91. As previously described, the existing conditions in this area—including the lane drop, high density of on and off ramps, and weaving and merging/diverging areas—have yielded problems with vehicular crashes and congestion.

Figure 4-33: Longmeadow Curve

Figure 4-34: South End Bridge and Agawam Rotary

This mid-term solution incorporates the use of collector-distributor roads alongside and separated from the I-91 mainline, as well as a roundabout interchange at I-91 and the South End Bridge and a "peanut" interchange between I-91 and U.S. Route 5. The "peanut" concept is an elongated roundabout with curves introduced on its long axis to control traffic speeds, yielding a peanut shape. The collector-distributor roads would provide a connection between these two structures, as well as access to Route 83 via the east side of the interstate. The collector-distributor roadways act as a loop for each of the connecting points, reducing the number of on and off ramps present in this section and limiting the weaving, merging, and diverging along the interstate.

Finally, I-91 would be redesigned to provide adequate radii in this area and provide continuous use of three lanes in each direction, eliminating the existing lane drop. This set of improvements would address all of the major conditions that currently result in congestion and elevated crash levels, as well as enhance access between I-91 and Routes 5 and 83.

<u>South End Bridge and Agawam Rotary</u>

The South End Bridge and Agawam Rotary area currently suffers from congestion and backups onto the South End Bridge and U.S. Route 5 southbound during peak hours from areas north of the Agawam Rotary, as well as crash clusters in the existing rotary and South End Bridge.

The proposed mid-term solution for these issues is to replace the existing rotary with a modified diamond interchange, which would provide a free-flow movement from U.S. Route 5 southbound to Route 57, eliminating queuing onto U.S. Route 5. This concept would also replace both the South End Bridge and the existing bridge over the Westfield River with new bridges, providing two lanes in each direction and access to and from Meadow Street.

The proposed replacement for the South End Bridge would provide two lanes in each direction with the proper lane merges and gores for exiting where required. The bridge would also include a separated shared-use path for bicycles and pedestrians. The rotary would be replaced with two intersections controlled by traffic signals, which would include adequate auxiliary lanes where needed. U.S. Route 5 would bridge over between the two signalized intersections. A new bridge of the Westfield River for U.S. Route 5 would be constructed, which would also include two lanes in each direction with the proper lane merges and gores for exiting where required. A direct connection from U.S. Route 5 southbound to Route 57 would be implemented. Meadow Street would have full access to the two signalized intersections, providing connections to River Road and U.S. Route 5 in both the southbound and northbound directions. The off ramp from Route 57 westbound to Editha Avenue would be eliminated, but a full connection to and from Meadow Street in both directions provides access to this neighborhood.

Figure 4-35: I-91 & I-291 Interchange

Entrance to I-91 Southbound from I-291 Southbound

Under existing conditions, numerous vehicles entering I-91 southbound from I-291 southbound are required to cut across the interstate to get off at Memorial Bridge (Exit 7). The distance between the two gores of the on and off ramps is approximately 850'. In that short distance, vehicles attempt to merge across two lanes to get to the off ramp. Although a solid white lane was added to extend the gore past the off ramp, many vehicles still attempt to access Exit 7 from the on ramp. Numerous crashes occur in this area as a result.

A new ramp to connect I-291 southbound to I-91 southbound, entering the highway from the right-hand side, would allow vehicles seeking to access Memorial Bridge to do so without merging across the two lanes of traffic. The new ramp would enter I-91 on the right-hand side of the interstate and then split to provide a connection to the Memorial Bridge toward West Springfield. This on ramp would need to bridge over the existing I-91/I-291 interchange to achieve this configuration.

Plainfield Street Section and Main Street

The existing alignment of Plainfield Street, which connects Main Street to the North End Bridge, faces capacity issues and poor levels of service under current conditions that will only worsen without action.

To alleviate these issues, a series of new bridges over the interstate and railroad tracks is proposed to replace the existing bridges in the area. These bridges would incorporate a third lane of traffic for Route 20A in the westbound direction. A boulevard-type roadway is still envisioned, providing an island between the eastbound and westbound movements. Improvements would be made for pedestrians, including new ADA-accessible ramps, sidewalks along both sides of the structure, and crossings at the on and off ramps to the frontage roads and interstate. Adequate bike lanes would also be provided on both sides of the roadway. Currently, no sidewalks or bike lanes exist along the Plainfield Street Bridge over I-91. The proposed ramps would also include sufficient merging and gore areas, which do not currently exist. Improvements will be made along Plainfield Street and West Street from Main Street to the North End Bridge. The intersection of Avocado and West Streets at Plainfield Street would be reconstructed to include new auxiliary lanes and traffic signal equipment. The intersection of Plainfield Street at Main Street would also be reconstructed.

Figure 4-36: Plainfield and Main Streets

4.3.3 DEVELOPMENT SCENARIOS AND SOCIOECONOMIC IMPACTS

Following the development of finalized designs for Task 4, the next step in assessing impacts across alternatives was to examine opportunities created by enhanced connectivity and increased accessibility resulting from changes in proposed highway alignments and new riverfront connections. This phase of the alternatives analysis process was focused on how Downtown Springfield revitalization might take place as private and public actors respond to the new opportunities afforded by each alternative.

Major considerations in the design process included the following:

- The potential to exploit synergies with existing warehousing and distribution facilities at the northern end of the study area, where a widened connection under the I-91 corridor creates opportunities for new development
- Options for expanding recreational amenities along the existing waterfront multiuse trail, providing a greater variety of uses to complement enhanced bicycle, pedestrian, and automobile access between Downtown Springfield and the Connecticut River waterfront
- The opportunity to redefine and enhance land uses proximate to Columbus Avenue, such as by creating an enclosed urban corridor, with master-planned development on both the east and west sides intended to create a defined street wall and urban room
- Beneficial uses for the cap above I-91 in Alternatives 1 and 2
- The opportunities raised by the current MGM Springfield casino development and concomitant increases in vehicular and foot traffic and demand for complementary amenities (e.g., parking, dining, lodging) in the Downtown Springfield core
- Creation of gateway features along major entrances to Downtown Springfield, including along Memorial Bridge and at the southern end of the I-91 Viaduct (in the vicinity of Broad Street)

All three alternatives include an eco-industrial park concept at the northern end of the study area, primarily focused on the currently underutilized lands south of Avocado Street. With the existing cluster of agricultural distribution businesses in this area and an anticipated expansion in demand for local and specialty foods stemming from new entertainment options in Springfield, infill development options such as greenhouses, community gardens, and additional distribution/warehousing facilities are envisioned to capitalize on this existing niche. With the addition of vehicular access under I-91 via Clinton Street, additional development options include a multistory riverfront residential development, commercial units suitable for a restaurant, or a community center. Additional parking and access roads allow an additional route for vehicular access to the riverfront and bikeway. While specific design details vary between alternatives, the eco-industrial park concept is a potential land use present in all three development scenarios. One of the three iterations of this concept is shown in Figure 4-37 (below).

A consistent objective in the depressed alternatives (Alternatives 1 and 2) has been to provide a gateway feature on the Springfield side of Memorial Bridge that creates a sense of arrival into Downtown Springfield and takes advantage of direct access to the at-grade Columbus Avenue corridor. In addition to multistory residential, office, and/or retail commercial development along the riverfront adjacent to Memorial Bridge/Boland Way, both the Alternative 1 and Alternative 2 concepts also depict a green space or terrace above the existing rail lines, providing unobstructed views of the Connecticut River as well as potentially programmable space in a highly prominent location. The addition of this 'green podium' concept also allows for at-grade parking below the podium level for adjacent land uses.

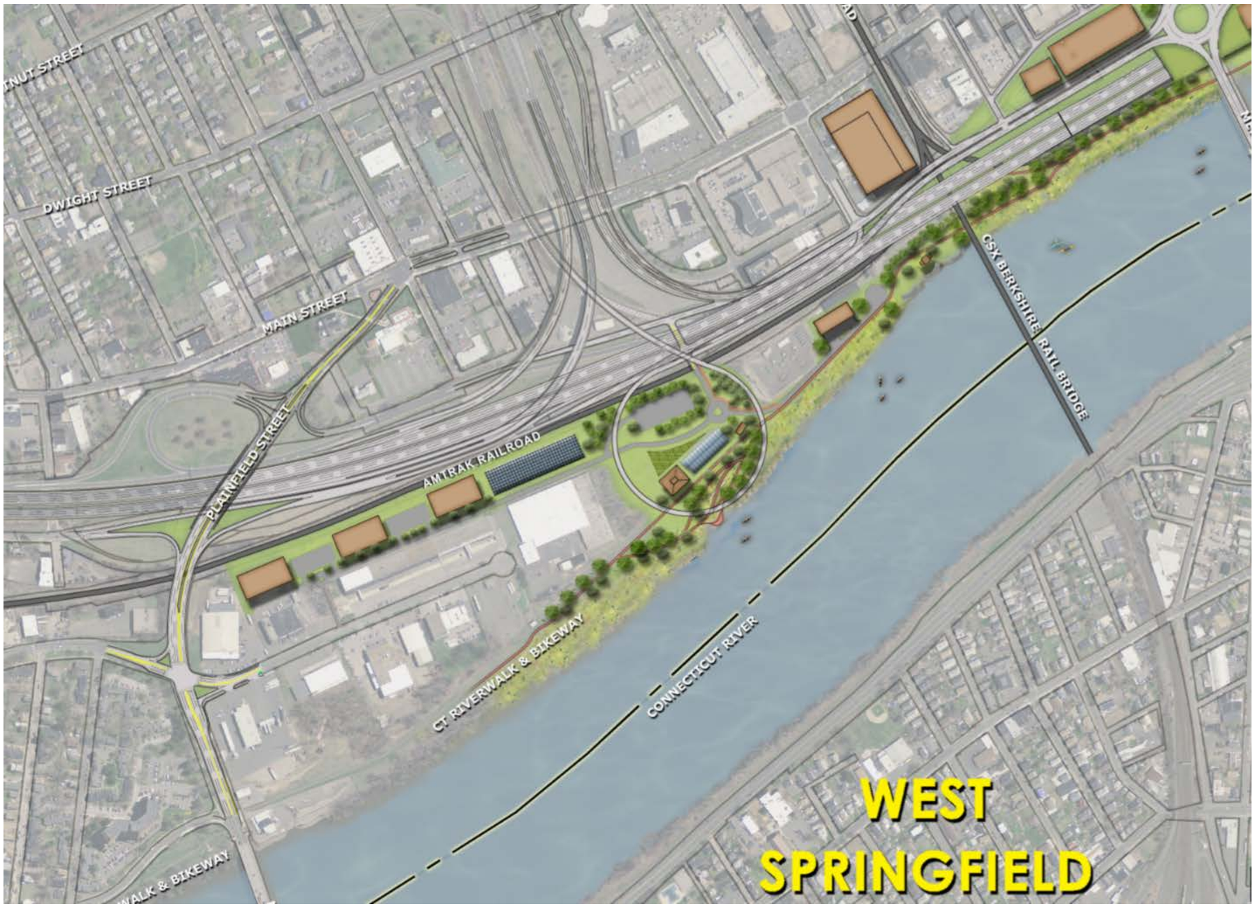


Figure 4-37: Development Concept Example – Avocado Street and Clinton Street

Further south along the I-91 corridor, both the existing and new alignment concepts portrayed in Alternatives 1 and 2 seek to take full advantage of the depressed and capped I-91 to create a high-quality public space bounded by private development. On the eastern side, redevelopment could provide both ground-floor retail units and upper-story residential units. This combination of uses could serve to introduce activity and eyes on the street while taking advantage of potential park and river views. Additional residential, hotel, and commercial development on West Columbus Avenue could provide further definition to the public space and take advantage of both views and development within easy walking distance of key amenities in the area, including the Basketball Hall of Fame and MGM Springfield. The Alternative 2 concept further envisions an elevated pedestrian walkway above the East and West Columbus Greenway to provide a direct connection from the MGM development to complementary amenities on the western side.

The southern end of the Downtown Springfield I-91 corridor also presents an opportunity for a gateway development as the Alternative 1 and Alternative 2 alignments descend into the capped section beginning at Broad Street. The development concepts were oriented around a clustered commercial tower development on currently vacant/underutilized properties. Commercial real estate in this location will be able to take advantage of easy access at Exit 5 as well as enhanced riverfront amenities in the immediate vicinity.

Following the conceptual design process to create each development scenario, approximate square footages of residential, commercial, and office space were calculated. Following feedback and input from the Working Group on how the proposed development might interact with Springfield's current market conditions, the project team drew upon the expertise of the University of Massachusetts Donahue Institute (UMDI) to market-test and evaluate each concept, allowing the project team to modify the development scenarios where warranted.

After finalizing the total quantity and allocation of development across each alternative, the next step was to translate projected development into population, jobs, and socioeconomic impacts, which is the basis for future modeling. The basis for this work was the existing regional socioeconomic and demographic (SED) projections for 2040 prepared by the Pioneer Valley Planning Commission (PVPC). These projections were updated for each traffic analysis zone (TAZ) based on employment and housing multipliers gathered from state and national datasets and normalized to remain consistent with statewide planning estimates.

The SED modeling provides a key intermediate step in the modeling process, allowing for both primary and secondary effects of each alternative to be captured in traffic models and simulations, air quality and noise impact models, estimates of fiscal impacts, and EJ assessments. Direct impacts of each development scenario are enumerated in the Evaluation Matrix (items 4.1.1 through 4.2.7).

4.3.4 TRAFFIC MODELING AND SIMULATION

Simulations and models of both macroscale travel demand and microscale traffic patterns were central to evaluating the performance of each alternative in terms of design feasibility, mobility, safety, and environmental impacts.

Travel Demand Modeling (TDM) was conducted for each alternative, with the TDM corresponding to the 2040 No-Build scenario (developed in Task 2) serving as the baseline for evaluation. Each model incorporates projected demographic/employment changes and changes to the transportation network. The TDM results were provided at the level of individual roadway segments, allowing for interpolation of traffic volumes for each movement at each intersection. These volumes form the basis of further analysis using *Synchro* and *Highway Capacity Software* (HCS).

The future-year (2040) intersections were analyzed for each of the three alternatives using the *Synchro* software package to project key evaluation metrics, including LOS, delay, and queue length. After running initial models, each network was reviewed to determine any locations that would operate at LOS E or F. Timing adjustments or lane configuration changes were tested to try to improve operations at these intersections. The resulting LOS, delays, and queue lengths were tabulated and included in this report.

The future-year (2040) freeway, ramp, and weaving segments were evaluated by means of the HCS package. The major inputs for freeway analysis include the freeway traffic volume (as projected by the TDM), number of lanes, ramp density (in ramps per mile), and freeway speed. Levels of Service were determined for each freeway segment, each merge/diverge (on or off ramp) segment, and each weaving segment.

Lastly, the proposed replacement of existing I-91 interchanges at U.S. Route 5, Route 83, and the South End Bridge with two enlarged roundabouts (including the southern peanut-shaped roundabout described previously in this chapter) connected by collector-distributor roads was evaluated using *PTV VISSIM*. 3D models of the highway, roundabouts, and ramps were created based on conceptual drawings, and traffic volumes were modeled based on TDM results. With these inputs, a video-simulation of the 3D model was created to visually see the impacts of the conceptual freeway and new roundabouts.

Figure 4-38: VISSIM Output Example

Results of each of these traffic models and simulations are incorporated into the Evaluation Matrix (sections 1.1 and 1.2).

4.3.5 AIR QUALITY AND NOISE IMPACT EVALUATION

Future-year traffic volumes modeled by TranSystems formed a basis for estimating several traffic-related impacts in greater detail. Air quality impacts and noise impacts were two areas of emphasis in understanding the environmental impacts of each alternative on the area surrounding the I-91 corridor and the people who live, work, and travel in it.

Air quality modeling work was conducted by the Central Transportation Planning Staff (CTPS) based on AM/PM peak-period traffic volumes for base year 2014, 2040 No-Build, and Alternatives 1 through 3, as well as land use data. The geography under consideration for this model is identical to that used for development of the traffic demand model discussed in section 4.3.4. The modeling process used by CTPS incorporates emissions associated both with VMT (by speed and vehicle type) and with cold starts across four pollutant categories: CO, CO_2, NO_X, and (VOCs).

The modeling procedure also incorporates anticipated changes in technology that may affect vehicle emissions. Comparing the 2014 base year and 2040 No-Build scenarios, this change is apparent in the greatly reduced levels of emissions across all modeled pollutants. Due to the conceptual level of the designs under consideration, this analysis did not include dispersion modeling of pollutants and, therefore, does not provide a basis for determining the geographic distribution of pollutant exposure.

TABLE 7: SUMMARY OF I-91 VIADUCT STUDY AIR QUALITY RESULTS

Scen.	AM/ PM	VMT	VHT (Hrs.)	Ave. Speeds	CO2 (kg)	VOC (kg)	CO (kg)	NOx (kg)
2014	AM	697,549	17,497	39.87	299,913	396	4,689	520
	PM	1,003,910	26,803	37.46	449,137	331	5,854	728
2040 NB	AM	753,940	19,085	39.50	188,445	110.73	1,573	75.55
	PM	1,091,945	29,665	36.81	280,386	75.40	1,753	96.56
2040 Alt1	AM	757,748	19,251	39.36	189,426	110.91	1,576	75.76
	PM	1,101,185	29,908	36.82	282,847	75.64	1,765	97.21
2040 Alt2	AM	760,559	19,450	39.10	190,270	111.05	1,577	75.84
	PM	1,111,613	30,551	36.39	286,364	75.94	1,773	97.70
2040 Alt3	AM	753,908	19,146	39.38	188,511	110.77	1,572	75.51
	PM	1,092,900	29,648	36.86	280,779	75.44	1,756	96.71

Figure 4-39: CTPS Summary of Air Quality Metrics by Scenario

The results of the air quality assessment indicate that reductions in pollutants anticipated from technological changes exceed the differences between alternatives by two to three orders of magnitude. Comparing each alternative to the 2040 No-Build scenario, slight increases in CO_2, VOC, CO, and NO_X are projected for Alternatives 1 and 2. Projected emissions under Alternative 3 increase for AM CO_2 and VOC but decrease for AM CO and NO_X while PM emissions increase by a very small margin. Overall emissions increase along with VMT under all three alternatives albeit by small margins relative to the secular decrease in emissions over time. Additional details on this analysis are available in Appendix H (CTPS Technical Memorandum) and are presented in the Evaluation Matrix (items 3.2.1 and 3.2.2).

An analysis of potential noise impacts under each alternative was conducted by VHB based on the same travel demand model results as discussed in section 4.3.4. This analysis was conducted using the Federal Highway Administration's (FHWA) *Traffic Noise Model v2.5*, a standard method for evaluating noise impacts of transportation projects. Each alternative was assessed relative to 2040 No-Build conditions in terms of the geographical areas affected at threshold noise levels, as well as the number of commercial and residential locations (or 'receptors') that would be impacted. Threshold noise levels were established based on FHWA Noise Abatement Criteria (NAC), which specify that residential uses are classified as impacted at noise levels above 66dB(A) and commercial uses at levels above 71dB(A).

The results of the noise impact model indicated that all three alternatives performed better than the No-Build scenario, impacting fewer residential and commercial receptors and creating sound levels above NAC thresholds for smaller distances. Alternative 2 performed best in terms of both commercial and residential impacts, with Alternative 1 performing better than Alternative 3 in terms of impacted distances and impacted residential receptors but also impacting slightly more commercial receptors. The results of these impacts are included in the Evaluation Matrix (items 3.3.1 and 3.3.2).

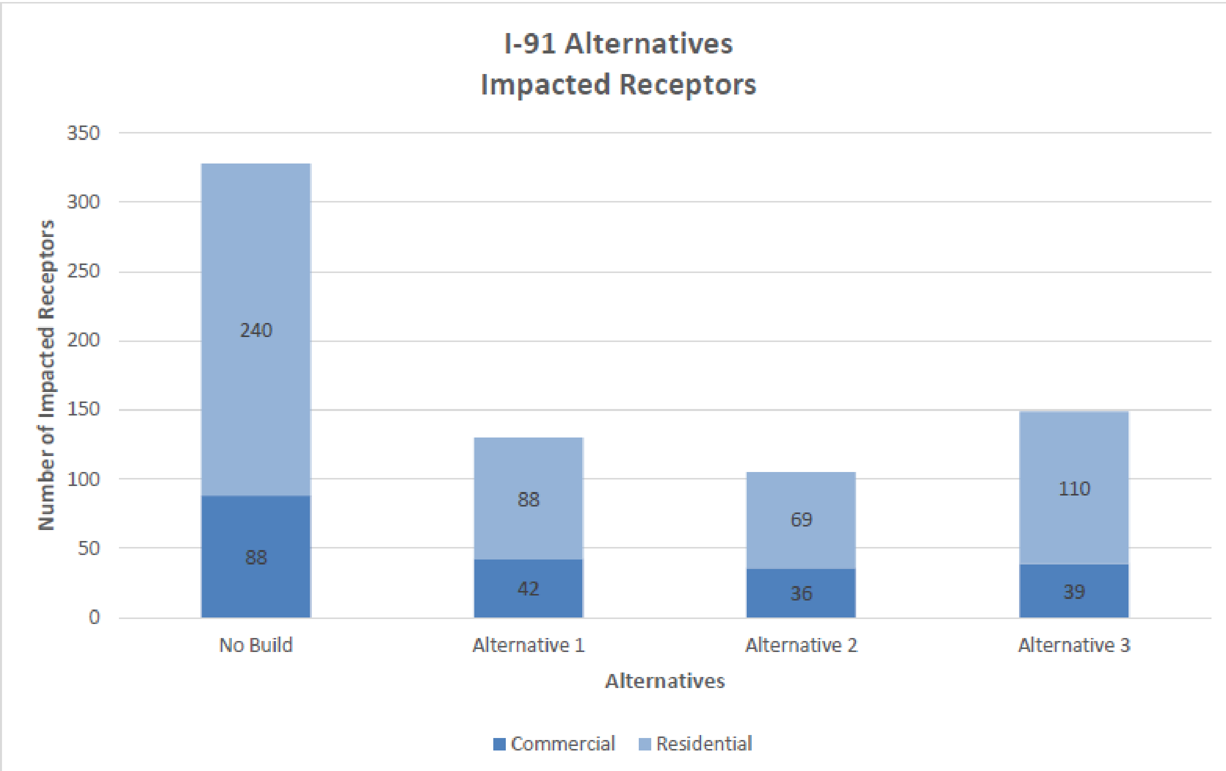


Figure 4-40: VHB Summary of Noise Impacts by Scenario (Draft Result)

4.3.6 ENVIRONMENTAL JUSTICE

In accordance with Title VI of the Civil Rights Act of 1964 and the *Environmental Justice Policy* of the Commonwealth of Massachusetts' Executive Office of Energy and Environmental Affairs, all transportation studies carried out on behalf of MassDOT's Office of Transportation Planning must include an EJ evaluation of proposed alternatives. The purpose of this policy is to ensure that federally funded projects do not discriminate based on race, color, or national origin and require that project proponents demonstrate that proposed projects will not disproportionately impact specific populations vulnerable to discrimination. Accordingly, the evaluation criteria (items 5.2.1 through 5.2.7) examine several dimensions along which potentially disproportionate impacts might occur.

The PVPC has developed a regionally accepted method for identifying geographies with concentrations of EJ population groups. The PVPC currently considers Census block groups with minority populations exceeding the Pioneer Valley regional average of 23.48 percent to be EJ, with minority persons classified as "the population that is not identified by the Census as 'White Non-Hispanic.'" Similar criteria exist for median income levels and limited English proficiency levels.

Per the PVPC's definitions, the entirety of the populated Primary Study Area geography meets at least one of the EJ criteria. Because of this, evaluations of most dimensions of EJ in the evaluation criteria are aligned with aggregate measures, including statistics reported for other evaluation criteria items. Many of the benefits of potential reconstruction alternatives for the I-91 Viaduct would accrue to the disproportionately lower-income, minority, or limited-English-proficiency populations.

Many of the effects that would be concentrated within the Primary Study Area are positive for residents and workers. The development scenarios posited for each of the alternatives yield increases in jobs across retail, office, and industrial sectors, with the magnitude of job gains ranging from 136 to 2,330. The development scenarios posited under Alternatives 1 and 2, which open significant areas of newly connected riverfront land for commercial uses, have much higher estimated job gains. Moreover, these new employment opportunities would be within reasonable walking or bicycling distances of Downtown Springfield residents and would be served by an expanded network of bicycle and pedestrian routes and amenities through the existing downtown and toward the Connecticut River. A parallel benefit of these development scenarios is expanded access to goods and services for residents within the study area, including enhanced bicycle and pedestrian access to businesses as well as existing community amenities, including libraries, a farmer's market, and the South End Middle School.

Environmental impacts within the EJ geography are projected to be mixed in their impacts on the EJ populations identified within the Primary Study Area. Compared to 2014 conditions, both the 2040 No-Build and Alternatives 1 through 3 result in significantly lower concentrations of criteria pollutants due largely to expected changes in technology. The three alternatives score slightly lower than the No-Build scenario due to small net increases in emissions associated with greater VMT through the I-91 corridor. However, the noise impacts associated with Alternatives 1 through 3 compare favorably with the No-Build scenario. In each alternative, the number of businesses and residences impacted by noise levels exceeding FHWA Noise Abatement Criteria declines relative to the No-Build scenario, and the distances at which those noise levels are experienced decline. Alternatives 1 and 2, with a depressed and covered Downtown Springfield alignment, show greater declines in noise levels, but Alternative 3's elevated viaduct also reduces noise impacts. (For further details on the methodology behind these assessments, see section 4.3.5.)

4.3.7 COST AND FINANCIAL IMPACT ESTIMATES

To develop order-of-magnitude estimates of costs for comparison purposes, the project team used a hybrid approach of compiling comparable project costs and actual project quantification and development of unit prices. Each alternative was broken into major sub-items for which costs were quantified in detail. Substantial contingencies and adjustments for inflation were included in all cost estimates. It should be noted that any changes in design or existing conditions prior to project development may have significant impacts on conceptual cost estimates.

Estimated costs were broken down by major project sections to facilitate comparison between alternatives. The No-Build alternative is estimated to cost approximately $1.57 billion. Alternatives 1 and 2 are roughly comparable in terms of overall costs ($3.78 billion and $3.74 billion, respectively) while Alternative 3 is somewhat less costly ($3.18 billion) due to the estimated cost of the elevated viaduct structure in comparison to that of a depressed alignment. All cost estimates are expressed in 2015 dollars. Estimated costs are incorporated into the Evaluation Matrix (item 6.1.1).

Estimated Project Costs by Scenario

Section	No-Build	Alternative 1	Alternative 2	Alternative 3
Longmeadow Curve	$ 212,750,000	$ 212,750,000	$ 212,750,000	$ 212,750,000
Bikeway	$ 19,750,000	$ 19,750,000	$ 19,750,000	$ 19,750,000
South End Bridge	$ 206,250,000	$ 206,250,000	$ 206,250,000	$ 206,250,000
Route 5 / 57 Interchange & Route 5 Bridge	$ 156,600,000	$ 156,600,000	$ 156,600,000	$ 156,600,000
Plainfield Street Improvements	$ 76,000,000	$ 76,000,000	$ 76,000,000	$ 76,000,000
I-91 / I-291 Interchange	$ 152,000,000	$ 413,250,000	$ 407,500,000	$ 424,350,000
Frontage Road Improvements	N/A	$ 159,675,000	$ 155,550,000	$ 158,450,000
I-91 Northern Touchdown	N/A	$ 33,350,000	$ 33,350,000	$ 33,350,000
Viaduct Rehabilitation	$ 750,000,000	N/A	N/A	N/A
I-91 Downtown Core	N/A	$2,500,000,000	$2,475,000,000	$1,850,000,000
TOTAL	$ 1,573,350,000	$ 3,777,625,000	$ 3,742,750,000	$ 3,137,500,000

Figure 4-41: Project Cost Estimates

The development scenarios described in section 4.3.3, to the extent that they are implemented, will generate a flow of property tax revenue to the City of Springfield. In order to provide a complete picture of financial impacts of each alternative, estimates of tax revenue generated were developed based on the development scenarios associated with each alternative.

Estimated Tax Revenues by Scenario

	Alternative 1	Alternative 2	Alternative 3
Units	285	460	54
Est. Unit Value		135,000	
Mill Rate		$19.66	
Est. Tax/Unit		$2,654.10	
Total Est. Tax	$756,419	$1,220,886	$143,321
Office SF	263,000	425,000	0
Retail SF	127,139	205,453	20,000
Office/Retail: $85/SF Est.	$33,161,803	$53,588,466	$1,700,000
Industrial Sq.Ft.	60,000	90,000	60,000
Industrial: $45/SF Est.	$2,700,000	$4,050,000	$2,700,000
Mill Rate		$39.07	
Total Est. Tax	$1,401,121	$2,251,935	$171,908
Grand Total Est. Tax	$2,157,539	$3,472,821	$315,229

Figure 4-42: Tax Revenue Estimates

The number of residential units (apartment/condominium) and office, retail, and industrial square feet of development under each scenario were the starting point of the financial analysis. Estimated per-unit and per-square-foot valuations were drawn of a representative sample of existing properties from the City of Springfield's publicly available assessor's data, with adjustments for property condition. These estimated valuations were multiplied by the quantity of property depicted under each scenario and local mill rates to yield an estimate of annual tax revenue. All tax revenue estimates are based on 2017 mill rates and are expressed in 2017 dollars. These estimates are incorporated into the Evaluation Matrix (item 4.1.5). As with the development scenarios on which these estimates are based, results should be interpreted cautiously as actual realized development may vary significantly from the development scenarios presented should any Alternative move forward in the future.

4.4 EVALUATION MATRIX

The full evaluation matrix is included at the end of this chapter. A summary of the rankings across each of the six areas that were evaluated is provided below to facilitate comparison of the areas in which each alternative outperforms or underperforms the other scenarios.

		Scenario		
TOPIC AREA	**No-Build**	**Alt. 1**	**Alt. 2**	**Alt. 3**
MOBILITY AND ACCESSIBILITY	0	14	10	13
SAFETY	1	13	13	14
ENVIRONMENTAL EFFECTS	0	7	7	3
LAND USE AND ECONOMIC DEVELOPMENT	0	19	18	9
COMMUNITY EFFECTS	0	5	5	6
COST	1	-1	-1	-1
TOTAL	**2**	**57**	**52**	**44**

4.5 ALTERNATIVE SUMMARIES AND COMPARISON

4.5.1 ALTERNATIVE 1: DEPRESSED, SAME ALIGNMENT

Differentiating Factors

In terms of local and regional mobility, Alternative 1 performs well in comparison to the No-Build scenario (as well as Alternatives 2 and 3) across several metrics. At the level of Downtown Springfield's local street grid, AM/PM delay times and intersection LOS are both used as indicators of how the design impacts traffic performance. Alternative 1 shows a marked decline in delay during the AM peak hour (from 9.32 minutes to 2.58 minutes) and similar performance during the PM peak (from 13.99 minutes to 14.16 minutes); likewise, the AM peak hour shows a reduction in the number of intersections operating at LOS E/F from five to two. The reduction in AM delay time for Alternative 1 may be attributed to a slightly more efficient roadway alignment, favorable on and off ramp locations, and the proposed realigned and signalized intersection at Boland Way and East/West Columbus Boulevard.

A related metric of travel time between a representative pair of destinations (East Columbus Avenue at Union Station to Springfield Street and Chestnut Street) also indicates net reductions in travel time. Travel times indicated by the regional travel demand model are faster by 18 to 25 seconds in the AM peak for both northbound and southbound directions; in the PM peak, northbound travel times are estimated to be 15 seconds slower while southbound travel times decline by 53 seconds.

Traffic flow on the I-91 corridor itself also improves relative to projected No-Build conditions under Alternative 1. Average travel times as estimated by the regional travel demand model drop for both northbound and southbound trips in the AM and PM, with reduced travel times between 11 and 56 seconds.

Alternative 1's depressed and covered I-91 alignment transforms the conditions experienced along the western edge of Downtown Springfield. Compared to the No-Build conditions, the Alternative 1 design allows for the development of new green space above the covered tunnel, yielding approximately 468,000 square feet (10.7 acres) of additional space for recreation and community use. The addition of a large quantity of pervious surface in the place of the existing viaduct footprint also facilitates natural stormwater drainage.

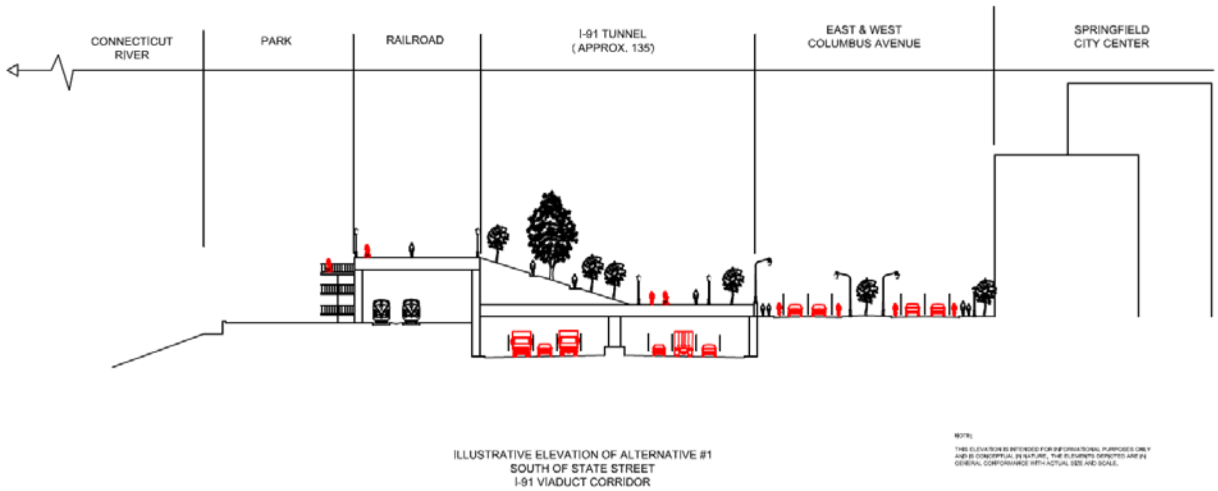


Figure 4-43: Illustrative Elevation - Alternative 1

Compared to the Depressed – New Alignment alternative, Alternative 1 yields a somewhat smaller quantity of green space as depressing I-91 below the existing alignment yields a smaller total quantity of land useable for open space between the Riverfront and Downtown Springfield areas than the revised alignment in Alternative 2.

With a large portion of the Downtown Springfield alignment operating below grade, the noise impacts of Alternative 1 diminish substantially in comparison to No-Build and Alternative 3 conditions. Compared to No-Build conditions, commercial premises affected by noise levels above NAC standards are reduced from 88 to 42, and residences affected are reduced from 240 to 88. A more qualitative consideration in which Alternative 1 provides added value for the surrounding urban neighborhood is the removal of a substantial visual obstruction between the Downtown Springfield core and the Connecticut Riverfront. The removal of this obstruction could increase property values, the aesthetic experience of travelers, and perceptions of safety in this area.

In addition to improving the ambient conditions that pedestrians and cyclists experience in the vicinity of the I-91 corridor, Alternative 1 includes an expansion of sidewalks (over 54,000 linear feet) and bike lanes (over 26,000 linear feet). The largest part of the sidewalk expansion and a substantial portion of new bike lanes in Alternative 1 are driven by the redesign of East and West Columbus Avenues into a combined boulevard that provides new and separated connections throughout the newly created green space corridor.

The development scenario prepared for Alternative 1 drives several sets of economic and land use outcomes that vary across alternatives based on the availability, locations, and connectivity of land adjacent to the Downtown Springfield core. Alternative 1 yields a middle-ground level of new development in the Primary Study Area. An estimated 555 new residents living in 271 households would increase the area's residential density and drive additional demand for services in Downtown

Springfield while 1,325 new jobs across retail, office, and industrial developments would represent substantial new job opportunities for workers of differing skill and educational levels. The opportunities presented by this development scenario would allow the City of Springfield to realize approximately $2.2 million in annual property tax revenue at full buildout.

In terms of costs, Alternative 1 would require the most significant levels of temporary detouring, excavation, dewatering, and significant wall and deck construction in order to build the desired depressed highway corridor.

4.5.2 ALTERNATIVE 2: DEPRESSED, NEW ALIGNMENT

Differentiating Factors

Alternative 2 yields mixed results in terms of metrics of enhanced vehicular mobility through the Primary Study Area. During the AM peak period, levels of service and delay across intersections in Downtown Springfield improve modestly, with declines in total delay of about 2 minutes on average (from 9.32 minutes to 7.29 minutes) and one fewer intersection operating at LOS E/F. However, these gains are negated by a substantial increase in delays during the PM peak (from 13.99 minutes to 23.08 minutes) and an additional intersection operating at a substandard LOS (up to 10 minutes from 9 minutes). A related measure, the volume-to-capacity ratio, rises relative to No-Build conditions from approximately 0.35 to 0.41 in the AM peak and from 0.47 to 0.52 in the PM peak. The decline in PM performance relative to No-Build conditions as well as for Alternatives 1 and 3 may be attributable to a number of different roadway alignments and knock-on effects of the highway realignment. An additional consideration in evaluating the results of Alternative 2 is that this scenario posits the largest increase in both residential population and employment in the Downtown Springfield core among the scenarios under consideration. Accordingly, the greater volume of commuters entering and (especially) exiting the core during peak commuting hours places additional demands on the network.

However, the realigned I-91 mainline under this alternative performs better in terms of the LOS experienced at merge, diverge, and weave locations. While the No-Build scenario and Alternatives 1 and 3 each experience five to six locations with LOS E/F during the AM or PM peaks, the new alignment's configuration reduces this number to just two locations (I-291 eastbound from I-91 to Liberty Street, and I-291 westbound from the Dwight Street on ramp to I-91 northbound), which indicates potential safety benefits from Alternative 2.

Measures of travel time for Alternative 2 on both the I-91 corridor and on local streets indicate that while the southbound traffic experiences improved outcomes relative to the baseline No-Build conditions northbound traffic may experience greater delays. In terms of vehicular travel time on I-91, model results of traffic speeds indicate northbound trips that are 14 seconds slower than the baseline in the AM peak and 12 seconds slower during the PM peak. On local roads, travel times between a representative pair of destinations (East Columbus Avenue at Union Station to Springfield Street and

Chestnut Street) are 29 to 43 seconds faster on southbound trips in the AM and PM, respectively, but 45 seconds slower for AM southbound trips and one minute and 18 seconds slower for PM southbound trips. These results from the TDM are built on a broad set of conditions experienced on local roads, including increased volumes generated by extensive redevelopment activity under this alternative; however, these results indicate potentially worse travel time performance for Alternative 2 than the other scenarios under consideration.

The combination of sinking the I-91 mainline below grade and realigning it closer to the riverfront yields the largest gains in terms of community green space across all three alternatives under consideration. With the additional open space in the Columbus Avenue corridor included, a total of 553,800 square feet (or about 12.7 acres) of green space would be available under this proposed design. This translates into new public amenities for Downtown Springfield, especially toward the southern end of the Columbus Avenue corridor, where a combination of retail and mixed-use development could complement and enclose programmable public space.

Figure 4-44: Plan View of Green Space above Viaduct Footprint (Alternative 2)

With a large portion of the Downtown Springfield alignment operating below grade, Alternative 2's noise impacts are the lowest of the four scenarios. Because the realigned freeway is shifted farther from existing uses as well as being capped, its noise impacts are further reduced relative to Alternative

1. Noise above NAC decibel levels that indicate residential and commercial impacts occurs over a smaller area (65 to 275 feet for commercial and 70 to 615 feet for residential uses) and affects a smaller number of receptors (36 commercial properties and 69 residences). Reduced noise levels would increase the quality of life of those who live, work, and visit Downtown Springfield and would synergize with enhanced public realm amenities in the Downtown Springfield core. In addition, the removal of the visual barrier that the current viaduct imposes on Downtown Springfield could increase perceived safety in the area and may increase property values as well as the aesthetic value of the existing public realm.

The design for Alternative 2 provides extensive coverage of new sidewalk (53,100 linear feet) and bike lane (27,000 linear feet) infrastructure in the study area. Like Alternative 1, the largest part of this sidewalk expansion and a substantial portion of new bike lanes are driven by the redesign of East and West Columbus Avenues into a combined boulevard with substantial new and separated connections throughout the newly created green space corridor. In contrast, the design for Alternative 3 precludes taking advantage of this opportunity, resulting in fewer new routes for active travelers.

The realignment of I-91 in Alternative 2 provided the most useable, viable land in the core area and therefore the most potential for beneficial redevelopment in the Downtown Springfield area. The contemplated development scenario for this alternative yields condominium and apartment housing for an estimated 888 persons in 347 households as well as various types of commercial and industrial space that could employ some 2,330 workers. To a greater extent than the other scenarios, this level of redevelopment would represent a large increase in new job opportunities for workers of differing skill and educational levels in a revitalized Downtown Springfield center. The increase in Springfield's tax base associated with this development would yield annual revenues of approximately $3.5 million for the city, which exceeds Alternative 1's next-highest revenue estimate by about $1.3 million.

In terms of costs, Alternative 2, like Alternative 1, would require the most significant levels of temporary detouring, excavation, dewatering, and significant wall and deck construction in order to build the desired depressed highway corridor. One area of difference between Alternatives 1 and 2 is that the latter would allow for several portions of the new alignment to be constructed offline as the new alignment of the highway will not follow the existing alignment for the northern half of the viaduct corridor. This may result in less cost associated with temporary roadway and highway construction and allow for better overall project phasing.

4.5.3 ALTERNATIVE 3: ELEVATED VIADUCT

Alternative 3 performs similarly to the No-Build scenario in terms of its performance on local road intersections in the study area. During the AM peak, the average intersection would have an estimated 11.19 minutes of delay compared to 9.32 minutes under No-Build conditions. In the PM peak, it would perform slightly better, with 12.18 minutes of delay vs. 13.99 minutes. No change in the number of intersections performing at LOS E/F conditions is projected to occur. Accordingly, Alternative 3 is rated as approximately on par with the No-Build and Alternative 2 scenarios compared to the potential operational improvements expected under Alternative 1. Alternative 3 ranks similarly to the other scenarios with respect to volume-to-capacity ratios (worse than Alternative 1 and comparable to the other scenarios).

Travel times along the I-91 corridor would improve under Alternative 3 in both travel directions and across both the AM and PM peaks by 10 to 56 seconds. It also outperforms the No-Build scenario and Alternative 2 with respect to average travel times through the Downtown Springfield core. During the AM peak, travel times decrease in both the northbound and southbound directions by 42 and 25 seconds, respectively. During the PM peak, the northbound trip is marginally slowed (by four seconds) while the southbound trip is 55 seconds faster than baseline conditions. These improvements in travel times are attributable to this alternative's design details as well as the reduced quantity of new development generating new traffic under this alternative compared to the development scenarios posited for the other alternatives.

The elevated viaduct concept yields a much smaller quantity of potential green space than the two depressed alternatives as the viaduct superstructure would remain in place. However, conditions under the viaduct would be enhanced with additional pedestrian crossings and amenities, reduction or elimination of existing barriers to movement and sight lines, and improved illumination and surveillance. All of these factors would improve the perceived safety of land underneath the reconstructed viaduct (see Figure 4-45).

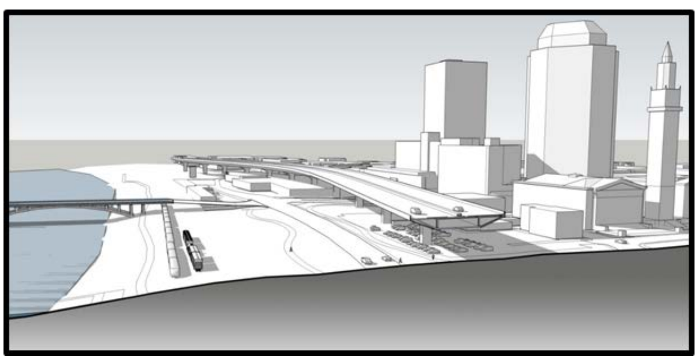


Figure 4-45: Elevated Viaduct Visualization (Conceptual I-91 Viaduct)

The greater heights (approximately 10’ higher than the current maximum) of the elevated viaduct concept would have beneficial impacts on the noise levels experienced in the study area albeit not to the extent projected under Alternatives 1 and 2. Compared to No-Build conditions, Alternative 3 results in a reduction from 88 to 39 impacted commercial properties and from 240 to 110 impacted residences. Compared to Alternatives 1 and 2, the 110 residences likely to remain affected by noise levels exceeding NAC standards is a smaller improvement.

Compared to Alternatives 1 and 2, potential pedestrian and bicycle accommodations in the Primary Study Area are more limited, with only 16,000 linear feet of proposed sidewalk improvements and 19,900 linear feet of bike lanes. As mentioned in the alternative descriptions above, this difference is attributable to the lack of a large green space development and the combined East and West Columbus corridor, which allow for more extensive bike and pedestrian infrastructure.

Another area in which Alternative 3 proposes less extensive changes to the study area than the other alternatives is in the extent of real estate development made feasible. Without the improved access to lands west of the existing alignment, new opportunities for redevelopment, including the creation of 'gateway' features or mixed-use developments that could complement the MGM Springfield casino development, are limited. The Alternative 3 development scenario is primarily concentrated along the northern end of the Primary Study Area and would yield an increase of an estimated 104 persons in 51 households as well as 136 jobs. Likewise, the smaller magnitude of redevelopment expected under this alternative would yield substantially less tax revenue for the City of Springfield, with annual revenues estimated at $300,000.

Compared to Alternatives 1 and 2, the total cost of constructing the elevated viaduct and associated improvements outlined in the Alternative 3 design would be modestly lower. The order-of-magnitude cost estimate for this alternative is $3.14 billion (2017 dollars) compared to approximately $3.7 to $3.8 billion for Alternatives 1 and 2. Maintenance costs are also estimated to be somewhat lower by a margin of roughly $500,000 per year extended out to the year 2075.

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Figure 4-46 - Evaluation Criteria

Criteria	Measure	Description	Data	Source/Tool	Alternatives							
			○ WORSE ◔ ◑ SAME ◕ ● BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
					Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
1	MOBILITY AND ACCESSIBILITY To maintain or improve the conveyance of regional traffic through the corridor, while enhancing the connectivity of all modes of transportation into and around the City and its waterfront.											
1.1	Roadway Operational Functionality											
1.1.1	Provide acceptable intersection level of service	Delay or LOS change in total number of intersections	Change in delay (in minutes) and LOS for intersections with E and F. See Map Nos. 1, 2 and 3.	Synchro (Microsimulation Software), Mapping of intersections	◑	Total AM delay: 9.32 veh-min. Total PM delay: 13.99 veh-min. Intersections LOS E/F: 5in AM, 9 in PM	◕	Total AM delay: 2.58 veh-min. Total PM delay: 14.16 veh-min. Intersections LOS E/F: 2 in AM, 9 in PM	◑	Total AM delay: 7.29 veh-min. Total PM delay: 23.08 veh-min. Intersections LOS E/F: 4 in AM, 10 in PM	◑	Total AM delay: 11.19 veh-min. Total PM delay: 12.18 veh-min. Intersections LOS E/F: 5 in AM, 9 in PM
1.1.2	Provide acceptable intersection level of service	V/C change by total number of intersections	Max. V/C (Volume to Capacity Ratio) at each signalized Intersection	Synchro (Microsimulation Software)	◑	Average App. V/C AM: 0.3571 Average App. V/C PM: 0.4747	◑	Average App. V/C AM: 0.381 Average App. V/C PM: 0.473	◔	Average App. V/C AM: 0.4150 Average App. V/C PM: 0.5220	◑	Average App. V/C AM: 0.376 Average App. V/C PM: 0.475
1.1.3	Provide acceptable intersection levels of service	Queue length changes in total number of intersections - Calculated 50th and 95th percentile queues	Queue length by lane and approach	Synchro (Microsimulation Software)	◑	Total 50th Queue AM: 16,618 LF Total 50th Queue PM: 25,939 LF Total 95th Queue AM: 27,916 LF Total 95th Queue PM: 40,325 LF	◔	Total 50th Queue AM: 22,731 LF Total 50th Queue PM: 32,292 LF Total 95th Queue AM: 36,400 LF Total 95th Queue PM: 49,900 LF	◔	Total 50th Queue AM: 22,860 LF Total 50th Queue PM: 30,928 LF Total 95th Queue AM: 36,029 LF Total 95th Queue PM: 47,217 LF	◔	Total 50th Queue AM: 22,172LF Total 50th Queue PM: 34,011 LF Total 95th Queue AM: 35,620 LF Total 95th Queue PM: 50,846 LF
1.1.4	Provide or maintain acceptable merge, diverge, and weave level of service on I-91 mainline	Change in LOS at merge, diverge and weave locations on limited access roadways	LOS by location	Highway Capacity Software/Manual 2010	◑	LOCATIONS: Interstate 91 NB between Route 5 On-Ramp and Exit 2 - Longmeadow, MA: AM E, PM E Interstate 91 Exit 3 Off-ramp, between Route 5 SB off-ramp to East Columbus Avenue from South End Bridge, on-ramp to I-91 NB, off-ramp to East Columbus Avenue: AM E West Columbus Avenue SB between I-91 SB Off-ramp, I-91 SB On-Ramp and On-ramp to South End Bridge WB: PM F Interstate 291 EB Ramp from I-91SB between the Route 20 On-ramp and the Exit 2 Off-ramp: AM E, PM E Interstate 91 NB between East Columbus Avenue On-ramp and Exit 8 On-ramp I291 EB: AM E, PM E Interstate 91 SB between On-ramp from East Columbus Avenue and Exit Off-ramp Route 5 SB in Longmeadow, MA: AM E, PM F	◑	LOCATIONS: Interstate 91 NB from South End Bridge to Broad Street: AM F, PM F Interstate 91 SB from Union Street to South End Bridge: AM E, PM E Interstate 291 WB from Liberty Street to Exits 1 and 2: AM F Interstate 291 EB from Interstate 91 to Liberty Street: AM F, PM F Interstate 91 NB from Union Street to Interstate 291: AM F, PM F	◕	LOCATIONS: Interstate 291 EB from Interstate 91 to Liberty Street: PM F Interstate 291 WB from Dwight Street on-ramp Interstate 91 NB: AM F, PM F	◑	LOCATIONS: Interstate 91 NB from South End Bridge to Broad Street: AM F, PM F Interstate 91 SB from Union Street to South End Bridge: AM E, PM E Interstate 291 WB from Liberty Street to Exits 1 and 2: AM F Interstate 291 EB from Interstate 91 to Liberty Street: AM F, PM F Interstate 91 NB from Union Street to Interstate 291: AM F, PM F
1.1.5	Provide acceptable I-91 mainline and on and off-ramp levels of service	Change in LOS on limited access ramps and highway segments	LOS by location	Highway Capacity Software/Manual 2010	◑	RAMPS I-91 Exit 1 and 2 Interchange US Route 5 NB On-ramp to I-91 NB: PM E I-91 Exit 3 Interchange I-91 SB On-ramp from West Columbus Avenue: PM F I-91 / I-291 Interchange - I-291 SB Ramp to I-91 NB: AM F, PM F MAINLINE All D or better	◕	RAMPS All LOS D or better MAINLINE All D or better	◕	RAMPS All LOS D or better MAINLINE All D or better	◕	RAMPS All LOS D or better MAINLINE All D or better
1.2	Travel Time											
1.2.1	Average vehicular travel time along I-91 corridor	Change in travel time along I-91 between two points	Travel time in minutes for a given distance during AM and PM peak hours. See Map Nos. 4 and 5.	TransCAD (Macro Travel Demand Model)	◑	NB From CT State Line to Plainfield Street AM = 7 min 43 sec PM = 8 min 42 sec SB From Plainfield Street to CT State Line AM = 7 min 37 sec PM = 7 min 55 sec	●	NB From CT State Line to Plainfield Street AM = 18 seconds faster than No Build PM = 56 seconds faster than No Build SB From Plainfield Street to CT State Line AM = 11 seconds faster than No Build PM = 26 seconds faster than No Build	◑	NB From CT State Line to Plainfield Street AM = 14 seconds slower than No Build PM = 12 seconds slower than No Build SB From Plainfield Street to CT State Line AM = 11 seconds faster than No Build PM = 25 seconds faster than No Build	●	NB From CT State Line to Plainfield Street AM = 18 seconds faster than No Build PM = 56 seconds faster than No Build SB From Plainfield Street to CT State Line AM = 10 seconds faster than No Build PM = 26 seconds faster than No Build

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						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
1.2.2		Average vehicular travel times throughout primary study area	Change in travel time between A to B travel pairs	Travel time in minutes for a given distances for A to B points (through delay reduction). See Map Nos. 6 and 7.	TransCAD (Macro Travel Demand Model)/VISSIM	◑	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM = 3 min 43 sec PM = 4 min 20 sec SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 4 min 11 sec PM = 4 min 17 sec	◕	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM = 18 seconds faster than No Build PM = 15 second slower than No Build SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 25 seconds faster than No Build PM = 53 seconds faster than No Build	◔	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM = 45 seconds slower than No Build PM = 1 min 18 seconds slower than No Build SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 29 seconds faster than No Build PM = 43 seconds faster than No Build	◕	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM =42 seconds faster than No Build PM = 4 seconds slower than No Build SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 25 seconds faster than No Build PM = 55 seconds faster than No Build
1.3	Pedestrian and Bicycle Functionality and Connectivity												
1.3.1		Improve access from the downtown urban core to the riverfront (i.e. Connecticut Riverwalk, open space, environmental resources, and activity centers along)	Change in number of connections between downtown urban core and riverfront	Number of connections from downtown urban core, across I-91 and rail line, to the riverfront. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	Conceptual Plans	◑	Limited Connections - No change	◕	Reconfiguration of Clinton Street & West Columbus Ave to Create Greenspace Development Along Riverfront. Additional 600 LF of Sidewalk Along W. York Street. Improve Bike & Ped Access to Riverfront with Approximately 6000 LF of Shared-Use Paths Along South End Bridge, West Columbus Ave & Broad Street	●	Reconfiguration of Clinton Street & West Columbus Ave to Create Greenspace Development Along Riverfront. Improve Bike & Ped Access to Riverfront with Approximately 6000 LF of Shared-Use Paths Along South End Bridge, West Columbus Ave & Broad Street	●	Reconfiguration of Clinton Street Create Greenspace Development Along Riverfront. Improve Bike & Ped Access to Riverfront with Approximately 6000 LF of Shared-Use Paths Along South End Bridge &West Columbus Ave
1.3.2		Improve access to community resources and social services	Change in number of connections to schools, health care, social services, etc.	Number of connections to schools, health care, social services, etc. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans/GIS data layers for environmental, open space, and activity centers	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See map "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)" See Map No. 8	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See map "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)" See Map No. 8	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See map "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternative 3)" See Map No. 9
1.3.3		Improve access to retail, goods, commercial activity centers	Change in number of connections to goods and employment centers	Number of connections to goods and employment centers. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans GIS data layers for environmental, open space, and activity centers	◑	No change	●	Improvements to bike/ped access (such as enhanced sidewalks, Bike Accomodations, longer walk times, countdown heads, lead pedestrian intervals, and/or exclusive pedestrian phases) within 0.25mi of 313 commercial, industrial, or public/institutional properties within Primary Study Area. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No. 10	●	Improvements to bike/ped access (such as enhanced sidewalks, Bike Accomodations, longer walk times, countdown heads, lead pedestrian intervals, and/or exclusive pedestrian phases) within 0.25mi of 313 commercial, industrial, or public/institutional properties within Primary Study Area. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No.10	●	Improvements to bike/ped access (such as enhanced sidewalks, Bike Accomodations, longer walk times, countdown heads, lead pedestrian intervals, and/or exclusive pedestrian phases) within 0.25mi of 321 commercial, industrial, or public/institutional properties within Primary Study Area. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)" See Map No. 11
1.3.4		Improve connections to Union Station	Change in vehicular, bicycle, pedestrian and transit network to promote connectivity to Union Station	Additional sidewalk, bike path, bicycle facilities, bus stops and amenities. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	●	2,370 LF of Bike Accomodations added within 1/4 mile of Union Station	●	1,690 LF of Bike Accomodations added within 1/4 mile of Union Station	◕	760 LF of Bike Accomodations added within 1/4 mile of Union Station
1.3.5		Provide regional bicycle and pedestrian connectivity	Promote longer distance commuting and recreational trips through improved access to regional bicycle and pedestrian facilities	Change in number of connections (population reached)	ARCGIS Conceptual Plans	◑	No change	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See map "Bicycle, Pedestrian, and Transit Connectivity and Employment (Alternative 1)" See Map No. 12	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See map "Bicycle, Pedestrian, and Transit Connectivity and Employment (Alternative 2)" See Map No. 13	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront; additional north/south connector along waterfront. See map "Bicycle, Pedestrian, and Transit Connectivity and Employment (Alternative 3)" See Map No. 14
1.4	Mode Shift												
1.4.1		Increase transit mode share	Improve access to public transportation or increase in transit services	Change in access to or amount of transit services	ARCGIS Conceptual Plans	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 21 transit stops, providing enhanced first/last mile access to existing transit service. No proposed route/ service changes.	◕	Improved bike/ped access (within 0.25mi) to 21 transit stops, providing enhanced first/last mile access to existing transit service. No proposed route/ service changes.	◕	Improved bike/ped access (within 0.25mi) to 21 transit stops, providing enhanced first/last mile access to existing transit service. No proposed route/ service changes.

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					Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
1.4.2	Increase bicycle and pedestrian mode share	Improve access or quality of bicycle and pedestrian facilities. Increase pedestrian and bicyclist perception of safety	Change in linear feet of sidewalk, linear feet of designated bicycle facilities	ARCGIS Conceptual Plans	◑	No change	●	54,100 LF of Sidewalk, 26,150 LF of Bike Accomodations, 13,180 LF of Shared-Use Paths. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No. 10	●	54,100 LF of Sidewalk, 26,150 LF of Bike Accomodations, 13,180 LF of Shared-Use Paths. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No. 10	●	54,100 LF of Sidewalk, 26,150 LF of Bike Accomodations, 13,180 LF of Shared-Use Paths. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)" See Map No. 11
2	SAFETY To create a safer and more user friendly pedestrian and bicycle system through and across the transportation corridor											
2.1	Pedestrian and Bicycle Safety											
2.1.1	Improve bicycle and pedestrian safety	Minimize conflicts (between Bike/Peds & Vehicles)	Change in number of conflict points between vehicles and bicycles or pedestrians, mapping of conflict points .	Intersection Plans, Conceptual Plans	◑	11 Conflict Points Exist	◕	Conflict Points Reduced to 10 locations	◕	Conflict Points Reduced to 10 locations	◕	Conflict Points Reduced to 10 locations
2.1.2	Improve bicycle and pedestrian safety	ADA compliance	ADA Compliant Ramps at Primary Study Area Intersections, Improvements to ramps and Crossings, Pedestrian Clearance Times at numerous locations	Field observations, measurements	◑	No change	●	RRFBs & Detectable Warning Strips @ Highway Ramps Where Crosswalks Exist. See Map No.1	●	RRFBs & Detectable Warning Strips @ Highway Ramps Where Crosswalks Exist. See Map No.2	●	RRFBs & Detectable Warning Strips @ Highway Ramps Where Crosswalks Exist. See Map No.3
2.1.3	Improve bicycle and pedestrian safety	Provide safe crossing accommodations at I-91 on and off-ramps	Pedestrian and bicyclist crossing provisions at intersections with highway off-ramps	Conceptual Plans	◑	I-91 NB: 6 On-Ramps, 6 Off-Ramps I-91 SB: 6 On-Ramps, 5 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On-Ramps	●	All ramps to be improved with safe crossing accommodations: I-91 NB: 4 On-Ramps, 4 Off-Ramps I-91 SB: 3 On-Ramps, 4 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On Ramps	●	I-91 NB: 2 On-Ramps, 3 Off-Ramps I-91 SB: 3 On-Ramps, 3 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On Ramps	●	I-91 NB: 4 On-Ramps, 4 Off-Ramps I-91 SB: 3 On-Ramps, 4 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On Ramps
2.1.4	Improve bicycle and pedestrian safety	Improve intersection crossing times for bicycles and pedestrians	Improved intersection design and adequate crossing timing	Intersection Plans, Conceptual Plans/Synchro	◑	No change in crossing times	◕	Likely increases in crossing times at 6 intersections	◕	Likely increases in crossing times at 6 intersections	●	Likely increases in crossing times at 7 intersections
2.1.5	Improve bicycle and pedestrian safety	Provision of separated facilities	Additional pedestrian corridors and/or bicycle facilities created and separated from typical on-street situation	Conceptual Plans	◑	No change	●	Addition of 13, 180 LF of Shared-Use Paths	●	Addition of 13, 180 LF of Shared-Use Paths	●	Addition of 13, 180 LF of Shared-Use Paths
2.2	Vehicular Safety											
2.2.1	Improve interaction and roadway safety	Reduction of conflict points - based on the reduction of intersections and weaving segments	Change in number of conflict points between vehicles	Conceptual Plans	◑	16 Weaving Segments, 24 intersections	◕	9 Weaving Segments, 24 Intersections	◕	10 Weaving Segments, 19 intersections	◕	10 Weaving Segments, 24 Intersections
2.2.2	Improve interaction and roadway safety	Mitigate High Crash locations	Existing conditions crash data inventory, new alternatives maps	Conceptual Plans	◑	27 crash clusters identified on/ adjacent to I-91 or I-291	●	15 crash clusters redesigned	●	15 crash clusters redesigned	●	15 crash clusters redesigned
2.3	Public Safety											
2.3.1	Improve public safety	Minimize factors that would contribute to increased crime and fear of crime	Change in lighting, land uses, network isolation (natural surveillance, other environmental factors)	Qualitative review of improvements (i.e. lighting, open spaces, line of sight) to safety/crime of Conceptual Alternative Plans	◕	Improved lighting under viaduct, installation of video surveillance, promote under viaduct recreational or slightly better	●	Remove section overhead viaduct, create green space over depressed viaduct, natural light, redevelopment, connection to river over railroad	●	Remove section overhead viaduct, create green space over depressed viaduct, natural light, redevelopment, connection to, river over railroad	●	New, modern elevated viaduct, improved lighting under viaduct, land-use/redevelopment under less visual obstruction/better visual surveillance
3	ENVIRONMENTAL EFFECTS Improve the overall environmental quality of the transportation corridor											
3.1	Sustainability											
3.1.1	Impacts on environmental resources (i.e. wetlands, floodplains, aquifers)	Specific environmental resources impacted critical resources in study area	Square footage of specific resource impacted or created	ARCGIS Conceptual Plans/GIS data layers for environmental, open space etc.	◑	No change	◔	20,200 SF of 100' FEMA Floodway; 57,100 SF of 500' FEMA Floodway; 1,155,000 SF NHESP Priority Habitat; 26,900 SF of DEP Wetlands. See Maps 015 and 018.	◔	33,900 SF of 100' FEMA Floodway; 57,000 SF of 500' FEMA Floodway; 1,155,000 SF NHESP Priority Habitat; 26,900 SF of DEP Wetlands. See Maps 016 and 018.	◔	20,200 SF of 100' FEMA Floodway; 57,000 SF of 500' FEMA Floodway; 1,155,000 SF NHESP Priority Habitat; 26,900 SF of DEP Wetlands. See Maps 017 and 018.

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3.1.2		Inclusion of Low Impact Development (LID) standards	Net change in pervious surface area to facilitate natural stormwater drainage and runoff	Square footage of pervious surface area created or removed	ARCGIS Conceptual Plans/GIS data layers for environmental, open space etc.	◑	No change	●	Up to 468,800 SF of Greenspace Development Over Existing Viaduct Footprint	●	Up to 553,800 SF of Greenspace Development Over Existing Viaduct Footprint	◕	Up to 13,800 SF of Greenspace Development Under Existing Viaduct Footprint
3.1.3		Reduction of pavement footprint	Net change in impervious surface area within the I-91 Corridor between East and West Columbus Avenue under existing conditions (within the Primary Study Area)	Square footage of impervious surface area created or removed	ARCGIS Conceptual Plans/GIS data layers for environmental, open space etc.	◑	Total Impervious = 136.1 Acres / Total Pervious = 16.9 Acres	●	Total Impervious = 118 Acres / Total Pervious = 34.9 Acres	●	Total Impervious = 124.7 Acres / Total Pervious = 28.3 Acres	◕	Total Impervious = 130.9 Acres / Total Pervious = 22 Acres
3.2	Air Quality												
3.2.1		Improve air quality	Health impact to vehicle occupants, bicyclists, and pedestrians	Change in regional NOx, VOC, CO	CTPS emissions modeling	◑	Model VMT = 753,940 miles AM/ 1,091,945 miles PM Model VOC emissions: 110.73 kg AM/ 75.4 kg PM Model CO emissions: 1,573 kg AM/ 1,753 kg PM Model NOx emissions: 75.55kg AM / 96.56 kg PM	◑	Model change in VMT = +3,808 miles AM/ +9,240 miles PM Model change in VOC emissions: +0.17 kg AM/ + 0.24 kg PM Model change in CO emissions: +2.66 kg AM/ +12.26 kg PM Model change in NOx emissions: +0.21 kg AM / +0.65 kg PM	◑	Model change in VMT = +6,619 miles AM/ +19,668 miles PM Model change in VOC emissions: +0.31 kg AM/ +0.54 kg PM Model change in CO emissions: +3.74 kg AM/ 19.99 kg PM Model change in NOx emissions: +0.30 kg AM / +1.13 kg PM	◑	Model change in VMT = -32 miles AM/ +955 miles PM Model change in VOC emissions: +0.04 kg AM/ +0.05 kg PM Model change in CO emissions: -1.65 kg AM/ +2.84 kg PM Model change in NOx emissions: -0.04 kg AM / +0.15 kg PM
3.2.2		Improve air quality	Reduction of greenhouse gas emissions	Change in CO2 emissions	CTPS emissions modeling	◑	Model VMT = 753,940 miles AM/ 1,091,945 miles PM Model CO2 emissions: 188,445 kg AM/ 280,386 kg PM	◑	Model change in VMT = +3,808 miles AM/ +9,240 miles PM Model change in CO2 emissions: +981 kg AM/ +2,462 kg PM	◑	Model change in VMT = +6,619 miles AM/ +19,668 miles PM Model change in CO2 emissions: +1,825 kg AM/ +5,978 kg PM	◑	Model change in VMT = -32 miles AM/ +955 miles PM Model change in CO2 emissions: +66 kg AM/ +393 kg PM
3.3	Noise												
3.3.1		Noise impacts	Impacts to abutting residences and businesses (Expected change in decibel levels or number of vehicles at corridor intersections)	Expected change in distance from roadway experiencing decibel levels above Noise Abatement Criteria	Conceptual Alternative Plans, VHB Conceptual Level Noise Assessment	◑	Impact distances of 350 - 575 feet (commercial use, **>71dB) and 625 - 800 feet (residential use, >66db).** See Map 019	●	Impact distances of 65 - 300 feet (commercial **use, >71dB) and 70 -730 feet (residential use, >66db). See Map 020**	●	Impact distances of 65 - 275 feet (commercial **use, >71dB) and 70 - 615 feet (residential use, >66db). See Map 021**	◕	Impact distances of 65 - 465 feet (commercial **use, >71dB) and 70 - 800 feet (residential use, >66db). See Map 022**
3.3.2		Noise impacts		Expected change in number and type (commercial/residential) of impacted receptors.	Conceptual Alternative Plans, VHB Conceptual Level Noise Assessment	◑	88 impacted commercial receptors and 240 impacted residential receptors. See Map 019	●	42 impacted commercial receptors and 88 impacted residential receptors. See Map 020	●	36 impacted commercial receptors and 69 impacted residential receptors. See Map 021	◕	39 impacted commercial receptors and 110 impacted residential receptors. See Map 022
4	LAND USE AND ECONOMIC DEVELOPMENT To design transportation based improvements that create beneficial land use opportunities for the City and the region that promote both access to open space and new opportunities for economic development												
4.1	Economic Development Potential												
4.1.1		Parcel growth - increase in available land suitable for private, institutional, or public development	Land area created for development or open space	Change in square feet/acreage by land use type - residential, commercial, recreational, open space. Population reached within a 1/4 mile for walking, (biking for 10 miles where feasible).	ARCGIS Conceptual Plans	◑	No change	●	1,120,800 SF / 25.73 Acres of Accessible Greenspace/Development Land Created	●	1,111,400 SF / 25.51 Acres of Accessible Greenspace/Development Land Created	◕	54,100 SF / 1.24 Acres of Accessible Greenspace/Development Land Created

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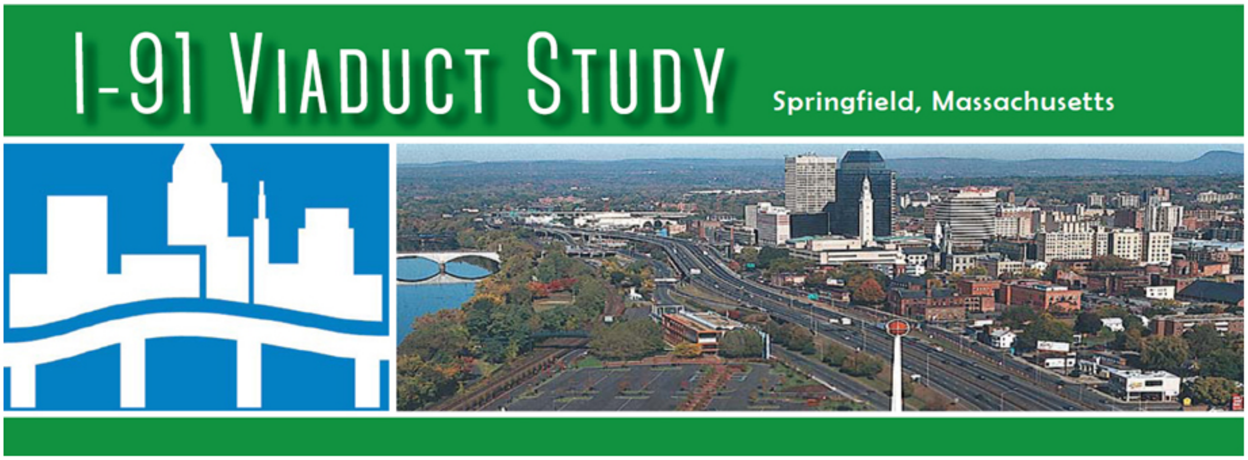
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
4.1.2		Improve accessibility to potential and existing development parcels	Vehicular, bicycle and pedestrian connections to potential development parcels (Studies show that commercial corridors may benefit from bike and ped infrastructure)	Connections to existing and parcels provided	ARCGIS Conceptual Plans	◑	No change	◕	6 additional high-quality bike/ped connections to waterfront area	◕	6 additional high-quality bike/ped connections to waterfront area	●	6 additional high-quality bike/ped connections to waterfront area w/ additional connector along waterfront
4.1.3		Improved bicycle and pedestrian infrastructure	Studies show that commercial corridors may benefit from bike and ped infrastructure	Connections to existing and proposed development parcels provided	ARCGIS Conceptual Plans	◑	No change	●	54,100 LF of Sidewalk & 26,150 LF of Bike Accomodations	●	53,100 LF of Sidewalk & 27,000 LF of Bike Accomodations	◕	16,000 LF of Sidewalk & 19,900 LF of Bike Accomodations
4.1.4		Increase density with more intensified development	More compact, mixed, connected land use development patterns tend to improve overall accessibility, increase agglomeration efficiencies, reduce public service costs	Increases in households, jobs, and businesses within study area	ARCGIS Conceptual Plans	◑	No change	●	Increase of 550 persons, 271 households, and 1325 jobs within study area (vs. no-build)	●	Increase of 888 persons, 347 households, and 2330 jobs within study area (vs. no-build)	◕	Increase of 104 persons, 51 households, and 136 jobs within study area (vs. no-build)
4.1.5		Incur new tax generation	Value of land and buildings, or changes in those values	Increase in property values and property taxes generated within study area (accruing to Springfield)	ARCGIS Conceptual Plans, Municipal records	◑	No change	●	Development scenario yields est. \$2.2M in annual tax revenue for City of Springfield at full buildout	●	Development scenario yields est. \$3.5M in annual tax revenue for City of Springfield at full buildout	◕	Development scenario yields est. \$0.3M in annual tax revenue for City of Springfield at full buildout
4.2	Socio-Economic Impacts												
4.2.1		Increase employment	Change in jobs in area	Net changes in jobs post project	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	●	Increase of 1325 jobs (vs. no-build) within PSA	●	Increase of 2330 jobs (vs. no-build) within PSA	◕	Increase of 136 jobs (vs. no-build) within PSA
4.2.2		Increase population	Change in number of people living in area	Net changes in population post project	Census, Municipal Sources	◑	No change	●	Increase of 550 persons (vs. no-build) within PSA	●	Increase of 888 persons (vs. no-build) within PSA	◕	Increase of 136 persons (vs. no-build) within PSA
4.2.3		Increase housing	Number of new housing units	New housing starts	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Plans	◑	No change	●	Increase of 285 housing units (vs. no-build) within PSA	●	Increase of 460 housing units (vs. no-build) within PSA	◕	Increase of 54 housing units (vs. no-build) within PSA
4.2.4		Improve affordability - housing in proximity to transit	New housing to be developed within close proximity of major transit facilities	Euclidian distance from Union Station (Transportation Hub) to housing units reached within a 1/4 mile for walking	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	◑	No direct change in housing units within 0.25mi walk radius.	◕	160,000 SF development within 0.25mi walk radius could include approx. 100 housing units with bicycle/pedestrian connectivity to Union Station.	◑	No direct change in housing units within 0.25mi walk radius.

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
				○ WORSE ◔ ◑ SAME ◕ ● BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
4.2.5		Improved public service provision	New tax generation	Change in municipal tax revenue	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	●	Development scenario yields est. $2.2M in annual tax revenue at full buildout	●	Development scenario yields est. $3.5M in annual tax revenue at full buildout	◕	Development scenario yields est. $0.3M in annual tax revenue at full buildout
4.2.6		Promote reduced travel costs	Reduced costs for bicycle and pedestrians, and potentially transit users - frees up spending for other purposes like housing, necessities, disposable, etc.	Change in transit mode	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	◕	Significantly improved walkability/ bike-ability, greater extent and continuity of pedestrian environments, greater critical mass of bike/ ped/ and potential transit use	◕	Significantly improved walkability/ bike-ability, greater extent and continuity of pedestrian environments, greater critical mass of bike/ ped/ and potential transit use	◕	Significantly improved walkability/ bike-ability, greater extent and continuity of pedestrian environments, greater critical mass of bike/ ped/ and potential transit use
4.2.7		Improve social cohesion	Potential improved connections (Acre/linear feet Complete Streets or pedestrian corridor) from North End neighborhoods and the Urban Core and Riverfront; Creation of connected/linked open space.	Measurement of connected or linked open spaces (Square Footage/Acreage) from population centers to activity centers.	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	●	2 additional bike/ped connections to North End; 6 additional high-quality bicycle and pedestrian connections to waterfront; additional 468,800 SF of greenspace over existing viaduct footprint	●	2 additional bike/ped connections to North End; 6 additional high-quality bicycle and pedestrian connections to waterfront; additional 553,800 SF of greenspace over existing viaduct footprint	◕	2 additional bike/ped connections to North End; 6 additional high-quality bicycle and pedestrian connections to waterfront; additional 13,800 SF of greenspace over existing viaduct footprint
4.3	Freight Rail Impacts												
4.3.1		Operational impacts	Construction related impacts to freight operations	Displacement or delay on freight movement	ARCGIS Conceptual Plans	◑	Limited impacts to freight operations which may require minor to moderate mitigation measures.	◔	Potential impacts to freight operations which will require mitigation measures (e.g. temporary tracks, flagmen).	○	Greater potential impacts to freight operations based on closer proximity of alignment to railroad ROW which will require more extensive mitigation measures (e.g. temporary tracks, flagmen)	◑	Limited impacts to freight operations which may require minor to moderate mitigation measures.
4.3.2		Implementation costs	Capital or relocation costs	Displacement or delay on freight movement	ARCGIS Conceptual Plans	◑	Limited impacts to freight operations	◔	Moderate impacts based on East/West Columbus Ave. underpass widening and covering of railroad in vicinity of public esplanade	○	Significant impacts based on East/West Columbus Ave underpass widening, alignment change of I-91, covering of railroad in the vicinity of public esplanade	◑	Limited impacts to freight operations
4.4	Parking Impacts												
4.4.1		Impacts to parking under I-91	Reduction/addition of parking spaces	Change in parking spaces	ARCGIS Conceptual Plans (map showing locations of parking spaces)	◑	1,768 existing spaces beneath I-91	◔	Remove highway North & South Garages with new parking location; net reduction of 700 spaces	◔	Remove highway North & South Garages with new parking location; net reduction of 700 spaces	○	Remove highway South Garage, maintain North Garage; net reduction of 1,100 spaces
5	COMMUNITY EFFECTS	Minimize temporary impacts to all stakeholders, while understanding and maximizing the future benefits of a completed project											
5.1	Visual Impacts												
5.1.1		Visual perception of I-91 Viaduct	Vertical location of Viaduct (Visual perception of I-91 Viaduct)	Change in vertical or horizontal alignment in number of feet relative to activity center proxies.	ARCGIS Conceptual Plans	◑	No change - Remains Visual/Physical Barrier	●	25' Below Ground for 1600LF Covered	●	25' Below Ground for 1600LF Covered	◕	Vertical change (TBD), higher than existing, reduced number of vertical piers/columns
5.2	Construction Impacts												
5.2.1		Construction duration	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures	ARCGIS Conceptual Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	10-15 years minimum	○	10-15 years minimum	◔	8-12 years minimum
5.2.2		Lane closures and detours	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures	ARCGIS Conceptual Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	12-15 years minimum	○	12-15 years minimum	◔	10-12 years minimum

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
				○ ◔ ◑ ◕ ● WORSE SAME BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
5.2.3		Maintenance of access to abutters	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures	ARCGIS Conceptual Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	12-15 years minimum	○	12-15 years minimum	◔	10-12 years minimum
5.2.4		Disruption of local businesses	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures(At minimum, the number and location of businesses and number of employees impacted by closure.	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	8-10 years	○	8-10 years	◔	5-8 years
5.3	Compatibility												
5.3.1		Compatibility with local and regional transportation plans, strategic plans and plans of conservation and development	Compatibility with local and regional transportation plans, strategic plans and plans of conservation and development	General Compliance with Local and Regional Plans Qualitative - Yes or no	ARCGIS Conceptual Plans	◑	No change	●	Strongly supports Rebuild Springfield Plan; aligned with Longmeadow, West Springfield, Agawam, and regional plans	●	Strongly supports Rebuild Springfield Plan; aligned with Longmeadow, West Springfield, Agawam, and regional plans	●	Strongly supports Rebuild Springfield Plan; aligned with Longmeadow, West Springfield, Agawam, and regional plans
5.3.2		Consistency with MassDOT goals, policies, and directives	Consistency with MassDOT goals, policies, and directives	General Compliance with MassDOT Qualitative (Yes or No)	ARCGIS Conceptual Plans	◑	No change	◑	Conceptual plans meet the latest goals, policies and directives	◑	Conceptual plans meet the bids & goals, policies and directives	◑	Conceptual plans meet the bids & goals, policies and directives
5.4	Environmental Justice Impacts												
5.4.1		Availability of jobs in EJ areas	Access to jobs	Reduction in travel time from residential area to downtown business center	ARCGIS Conceptual Alternative Plans	◑	No change	●	Increase of 1325 jobs (vs. no-build); See Map No. 010"Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	●	Increase of 2330 jobs (vs. no-build); See Map No. 010 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	◕	Increase of 136 jobs (vs. no-build); See Map No. 011"Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)"
5.4.2		Availability of education and health services in EJ areas	Access to community services	Qualitative assessment - spatial examination of the community assets	ARCGIS Conceptual Alternative Plans	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No.008 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No.8 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No.009 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternative 3)"
5.4.3		Mobility impacts in EJ areas	Access to transportation modes	Qualitative assessment - spatial examination of the transportation modes	ARCGIS Conceptual Alternative Plans	◑	No change	●	54,100 LF of Sidewalk & 26,150 LF of Bike Accomodations	●	53,100 LF of Sidewalk & 27,000 LF of Bike Accomodations	●	16,000 LF of Sidewalk & 19,900 LF of Bike Accomodations

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
○ ◔ ◑ ◕ ● WORSE SAME BETTER					Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
5.4.4		Improve local access from the downtown urban core to the riverfront (i.e. Connecticut Riverwalk), open space, environmental resources, and activity centers (i.e. Basketball Hall of Fame) in EJ areas	Change in number of connections between downtown and riverfront, to open space, environmental resources, retail, goods and social services, and activity centers in EJ areas	Number of connections across I-91 and rail line, to open space, environmental resources, and activity centers in EJ areas. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	◕	6 additional high-quality bike/ped connections to waterfront area	◕	6 additional high-quality bike/ped connections to waterfront area	●	6 additional high-quality bike/ped connections to waterfront area w/ additional connector along waterfront
5.4.5		Improve access to community resources and social services in EJ areas	Change in number of connections to schools, health care, social services, etc. in EJ areas	Number of connections to schools, health care, social services, etc. in EJ areas. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No. 008 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No. 008 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No. 009 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternative 3)"
5.4.6		Improve access to retail, goods, commercial activity centers in EJ areas	Change in number of connections to goods and employment centers in EJ areas	Number of connections to goods and employment centers in EJ areas. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See Map No.010 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See Map No.010 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront; additional north/south connector along waterfront. See Map No. 011 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)"
5.4.7		Environmental Impacts in EJ areas	Environmental Impacts (Improvement of air quality and noise impacts in EJ areas)	Quantitative assessment (Expected change in decibel levels or number of vehicles at corridor intersections in EJ areas. Feet of buffer between vehicular travel and bicycle/pedestrians in EJ areas)	ARCGIS Conceptual Alternative Plans	◑	Model VMT = 753,940 miles AM/ 1,091,945 miles PM Model VOC emissions: 110.73 kg AM/ 75.4 kg PM Model CO emissions: 1,573 kg AM/ 1,753 kg PM Model NOx emissions: 75.55kg AM / 96.56 kg PM Impact distances of 350 - 575 feet (commercial use, **>71dB) and 625 - 800 feet (residential use, >66db)**	◑	Model change in VMT = +3,808 miles (+0.5%) AM/ +9,240 miles (+0.8%) PM Model change in VOC emissions: +0.17 kg AM/ + 0.24 kg PM Model change in CO emissions: +2.66 kg AM/ +12.26 kg PM Model change in NOx emissions: +0.21 kg AM / +0.65 kg PM Impact distances of 65 - 300 feet (commercial **use, >71dB) and 70 -730 feet (residential use, >66db)**	◑	Model change in VMT = +6,619 miles (+0.8%) AM/ +19,668 miles (+1.8%) PM Model change in VOC emissions: +0.31 kg AM/ +0.54 kg PM Model change in CO emissions: +3.74 kg AM/ 19.99 kg PM Model change in NOx emissions: +0.30 kg AM / +1.13 kg PM Impact distances of 65 - 275 feet (commercial **use, >71dB) and 70 - 615 feet (residential use, >66db)**	◑	Model change in VMT = -32 miles (<-0.1%) AM/ +955 miles (<+0.1%) PM Model change in VOC emissions: +0.04 kg AM/ +0.05 kg PM Model change in CO emissions: -1.65 kg AM/ +2.84 kg PM Model change in NOx emissions: -0.04 kg AM / +0.15 kg PM Impact distances of 65 - 465 feet (commercial **use, >71dB) and 70 - 800 feet (residential use, >66db)**
6	COST	Development of Alternative Designs will combine the approach of Feasibility, Creativity, and Long Term Sustainability											
6.1	Construction Costs												
6.1.1		Order of magnitude implementation cost	Estimated capital costs of construction	Value in 2015 dollars	ARCGIS Conceptual Plans	◑	$750 million (assumes structural & piers replacement/repair)	○	$3.78 Billion	○	$3.74 Billion	○	$3.14 Billion
6.1.2		Right-of-way impact	Impact to abutting right-of-way	Square footage/Acres Impacted	ARCGIS Conceptual Plans	◑	No Impact	◕	Approximately 34 AC Affected, See Map No. 023	◕	Approximately 39 AC Affected, See Map No. 024	◕	Approximately 31.4 AC Affected, See Map No. 025
6.2	Maintenance Costs												
6.2.1		Anticipated annual maintenance costs	Estimated cost of maintenance for infrastructure	Value in 2015 dollars	ARCGIS Conceptual Plans	◕	$500,000/year	◔	$1.75 million/year (est.)	◔	$1.75 million/year (est.)	◑	$1.25 million/year (est.)

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
				○ ◔ ◑ ◕ ● WORSE SAME BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
6.2.2		Life-cycle Cost-Benefit Analysis	Cost-Benefit Analysis: Including Construction Cost, Longevity of structure, Environmental, Annual Maintenance, Safety, Redevelopment Potential, Social/EJ	Cumulative Approach to Analysis considering Quantitative and Qualitative assessment of life-cycle elements based upon a value of 1-10, with 10 being extremely positive, 5 being no change and 1 being an extremely negative score when considering all described elements.	ARCGIS Conceptual Plans/Cost opinions Evaluation Criteria	◑	Cost (5) Longevity (3) Environmental (3) Annual Maintenance (5) Safety (2) Redevelopment (2) Social (5) = Total of 25 Approximate Life Cycle Cost (2075): $1.62 Billion	◕	Cost (1) Longevity (7) Environmental (7) Annual Maintenance (4) Safety (7) Redevelopment (8) Social (8) = Total of 42 Approximate Life Cycle Cost (2075): $3.88 Billion	◕	Cost (1) Longevity (7) Environmental (7) Annual Maintenance (4) Safety (6) Redevelopment (8) Social (8) = Total of 41 Approximate Life Cycle Cost (2075): $3.84 Billion	◑	Cost (2) Longevity (4) Environmental (3) Annual Maintenance (6) Safety (5) Redevelopment (4) Social (6) = Total of 30 Approximate Life Cycle Cost (2075): $3.24 Billion



INTERSTATE 91 VIADUCT STUDY

CHAPTER V

RECOMMENDATIONS

August 2018

MMI #3869-16-6

massDOT
Massachusetts Department of Transportation

MILONE & MACBROOM

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5.1 SUMMARY OF RECOMMENDATIONS

The previous chapter of the Interstate 91 Viaduct Study, Alternatives Analysis, examined and evaluated a No-Build scenario and three build alternatives in detail to determine how each alternative performed across a range of evaluation criteria. This chapter concludes the study by summarizing the alternative selection process, detailing near-term and mid-term improvements recommended for project development, and the implementation process for acting on the recommendations of this study.

In selecting the recommended improvements to be made in the Primary Study Area, the most important considerations were how each improvement met the goals and objectives of the study, the evaluation of each alternative against the evaluation criteria outlined in Chapter IV, the input of the Working Group, and the cost effectiveness of improvements.

Of the three Build Alternatives examined in detail in Chapter IV (Alternatives Analysis), it was apparent that Alternatives 1 and 2 would provide tangible local improvements in the immediate area of the sunken or depressed highway alignments. The greatest benefits of these alternatives are derived from reconnection of the urban core to the river with greatly enhanced pedestrian connections, major improvements to the character and visual profile of the Interstate 91 (I-91) alignment through Downtown Springfield, increases in potentially developable land, and an overall increase in open space within the current transportation corridor. By contrast, the extent of local benefits provided by Alternative 3 in terms of improvements to local visual character, reconnection of Downtown Springfield to the riverfront, and additional developable land and open space is substantially reduced compared to Alternatives 1 and 2 while still incurring greatly increased costs compared to the No-Build alternative.

It is also apparent that even with the implementation of any of the three alternatives unimpeded access to the riverfront will continue to be severely limited by the existing, active railroad alignment. Although relocation of the railroad was investigated in several preliminary alternatives discussed in Chapter III, it was determined that such a design would not be feasible. Major impediments to relocating the railroad tracks include recent and planned investments in Hartford Line commuter rail service between New Haven, Hartford, and Springfield (and the associated projected increases in passenger rail ridership) and the high costs and land takings impacts associated with any alternative that relocated the railroad tracks to the west side of the Connecticut River.

Upon consideration of all factors evaluated in this study, including benefits, impacts, and cost, none of the Build Alternatives will be recommended for advancement to the project development process at this time. It is apparent that many of the benefits identified within the alternatives that address current deficiencies or safety concerns within the study area could be fully or partially achieved through near- and mid-term improvements, which are not contingent upon replacement of the existing elevated viaduct structure. Many of the more feasible near- and mid-term improvements combined with a No-Build (rehabilitation) scenario of the actual elevated viaduct may achieve many of the locally desirable benefits outlined in Alternatives 1 through 3 at substantially lower costs. In particular, significant functional traffic and safety improvements are recommended for the section of highway known as the

Longmeadow Curve, which is south of the actual elevated viaduct and the I-291/91 ramp systems, but were not improved with the most recent deck replacement project (2017-2018).

The recommendation of this report is that the No-Build scenario's course of future viaduct rehabilitation be pursued. Additionally, it is recommended that the near- and mid-term improvements discussed in section 5.3 below be considered for advancement to the project development process. These improvements serve to provide cost-effective means of advancing the study's goals of improving the function of I-91 and the local transportation network; enhancing connectivity between Downtown Springfield and the Connecticut River; and preserving and improving quality of life for residents, commuters, businesses, and visitors to Downtown Springfield.

5.2 ALTERNATIVES CONSIDERED

Chapter III outlined the set of initial alternatives assessed in terms of their broad merits, feasibility, and ability to achieve the major goals and objectives of the study while Chapter IV detailed the methodology and results of the alternatives assessment process. The final result of this process was the Evaluation Matrix presented and discussed in sections 4.4 and 4.5, which provides measures of positive and negative impacts of each alternative across 62 criteria. These criteria spanned the categories of Mobility and Accessibility, Safety, Environmental Effects, Land Use and Economic Development, Community Effects, and Cost.

5.2.1 ALTERNATIVES DEVELOPMENT PROCESS

As described in greater detail in Chapters III and IV, the study team developed a set of alternatives based on an initial analysis of potential highway and roadway alignments. This process included a review of high-level goals and development of preliminary schematic concepts. The preliminary set of alternatives was assessed and refined in consultation with the Working Group and public input. Ten alternatives were developed as follows:

- Retain Existing Elevated Viaduct
- At-Grade Section
- Depressed Section
- Depressed Section with Railroad
- Tunnel Section
- Elevated Section
- U.S. Route 5 Realignment
- I-91 West Side
- Northbound and Southbound Split
- Relocation of Railroad Right-of-Way

From this list of alternatives, four (including the No-Build option) were selected as viable and advanced to the alternatives evaluation phase, the methodology and results of which are presented in Chapter IV. In addition to the No-Build alternative, the three scenarios selected for evaluation were the following:

- Alternative 1: Depressed, Same Alignment
- Alternative 2: Depressed, New Alignment
- Alternative 3: Modern Viaduct

5.2.2 SUMMARY OF ALTERNATIVES EVALUATED

The **No-Build conditions** described in Chapter II form the baseline for evaluation of the three alternatives. This scenario depicts projected 2040 conditions, including known and anticipated changes to transportation infrastructure in the Primary and Regional Study Areas. Under this scenario, the I-91

Viaduct Rehabilitation Project (which will be completed in summer 2018) is taken into account as a future viaduct rehabilitation project to be completed circa 2040, which would include both deck replacement and pier rehabilitation of the viaduct structure. The No-Build scenario is fully compatible with all recommended near-term and mid-term improvements discussed below.

Alternative 1 (Depressed, Same Alignment) presents a conceptual design for a depressed I-91 mainline alignment through Downtown Springfield, which would run below grade for approximately 4,200 feet along the existing interstate right-of-way (approximately between Broad Street and Boland Way). Three lanes would be maintained in each direction through the depressed section, with the I-91 mainline running below grade and an at-grade connection between Downtown Springfield and the Riverfront Area, including an area of open space between East and West Columbus Avenues.

An improved interchange between I-91 and I-291 would be provided with a redesigned connection from I-291 to I-91 southbound via a redesigned flyover, as well as reconfigured access to and from adjacent local roads. At the southern approach, the "Longmeadow Curve," U.S. Route 5/I-91 interchange, U.S. Route 5 and Route 57 interchange, and South End Bridge and U.S. Route 5 Bridge over the Westfield River would be improved (as described in section 5.3.2). In the Plainfield Street area, a pair of new bridges over the I-91 alignment and adjacent railroad tracks would be incorporated to enhance traffic operations and bicycle and pedestrian access to and from the North End Bridge and local streets. Bicycle and pedestrian accommodations would be introduced throughout the Primary Study Area as needed. Through Downtown Springfield, a net reduction of three ramps would reduce merging/diverging/ weaving sections and associated crashes.

Alternative 2 (Depressed, New Alignment) depicts a depressed I-91 mainline along a realigned right-of-way directly adjacent to the existing railroad line. This realignment would allow for the removal of some curvature of the mainline compared to the existing alignment, providing additional developable land and open space. As with Alternative 1, the below-grade interstate mainline would allow for an at-grade connection between Downtown Springfield and the Riverfront Area.

The Alternative 2 design also differs from Alternative 1 in the geometry of the I-291 to I-91 southbound flyover ramp due to the proximity of the realigned mainline to the railroad right-of-way; in the alignment of East and West Columbus Avenues as they proceed through Downtown Springfield above the depressed I-91 mainline; and in the removal of an additional Downtown Springfield ramp, with the potential for further reductions in congestion and safety issues associated with merging and diverging vehicles.

Other elements of the Alternative 2 conceptual design, including improvements to the Plainfield Street area, bicycle and pedestrian improvements, and the southern extent of the Primary Study Area, are substantially the same as presented in Alternative 1. At the southern approach, the "Longmeadow Curve," U.S. Route 5/I-91 interchange, U.S. Route 5 and Route 57 interchange, and South End Bridge and U.S. Route 5 Bridge over the Westfield River would be improved (as described in section 5.3.2). In the Plainfield Street area, a pair of new bridges over the I-91 alignment and adjacent railroad tracks would be incorporated to enhance traffic operations and bicycle and pedestrian access to and from the North End Bridge and local streets. Bicycle and pedestrian accommodations would be introduced throughout the Primary Study Area as needed. Through Downtown Springfield, a net reduction of four ramps would reduce merging/diverging/weaving sections and associated crashes.

Alternative 3 (Modern Viaduct) depicts an I-91 mainline similar to existing conditions but with the existing viaduct structure replaced with a "modern viaduct" design running approximately 10 feet higher than the current structure and supported by more widely spaced piers. Both of these design features would allow for more light, open space, and improved pedestrian conditions below the viaduct. As with the previous two alternatives, the mainline would provide three lanes in each direction. The I-291 to I-91 south ramp of the I-291/I-91 interchange would be improved as in Alternatives 1 and 2. However, unlike Alternatives 1 and 2, East and West Columbus Avenues would remain in their existing alignments.

Other elements of the Alternative 3 conceptual design, including improvements to the Plainfield Street area, bicycle and pedestrian improvements, and the southern extent of the Primary Study Area, are substantially the same as presented in Alternative 1. At the southern approach, the "Longmeadow Curve," U.S. Route 5/I-91 interchange, U.S. Route 5 and Route 57 interchange, and South End Bridge and U.S. Route 5 Bridge over the Westfield River would be improved (as described in section 5.3.2). In the Plainfield Street area, a pair of new bridges over the I-91 alignment and adjacent railroad tracks would be incorporated to enhance traffic operations and bicycle and pedestrian access to and from the North End Bridge and local streets. Bicycle and pedestrian accommodations would be introduced throughout the Primary Study Area as needed. Through Downtown Springfield, a net reduction of two ramps would reduce merging/diverging/weaving sections and associated crashes.

5.2.3 EVALUATION CRITERIA

The criteria against which each alternative was evaluated and rated were developed based on the goals and objectives identified as relevant to the study. Conditions for each alternative were compared to the benchmark of projected 2040 No-Build conditions, which are further elaborated on in Chapter II. Evaluation criteria were organized into the following six subject areas, as described in Chapter I:

- **Mobility and Accessibility**: *Maintain or improve the conveyance of regional traffic through the corridor while enhancing the connectivity of all modes of transportation throughout the region.*
- **Safety**: *Create a safer and more user-friendly pedestrian, bicycle, and vehicular transportation system through and across the transportation corridor.*
- **Environmental Effects**: *Improve the overall environmental quality of the transportation corridor.*
- **Land Use and Economic Development**: *Design transportation-based improvements that create beneficial land use opportunities for the city and the region that promote both access to open space and new opportunities for economic development.*
- **Community Effects**: *Minimize temporary impacts to all stakeholders while understanding and maximizing the future benefits of a completed project.*

- **Cost**: *Development of alternative designs will combine the approach of feasibility, creativity, and long-term sustainability.*

Detailed descriptions of each evaluation criterion and the methodologies used to evaluate the alternatives are presented in sections 4.2 and 4.3 while the results of the evaluation process are presented in detail in section 4.4 and summarized with respect to key differentiators in section 4.5.

5.2.4 BENEFIT AND COST DIFFERENTIATORS

Major costs and benefits of each alternative are summarized in Table 5.1 (Alternatives Comparison – Viaduct Only) below. These factors are based on the more detailed Evaluation Matrix presented in section 4.4. Major factors that were identified as differentiating the three Build Alternatives from each other and from the No-Build scenario are outlined in section 4.5 of the study.

Alternative 1 is distinguished from other alternatives by the following factors, with corresponding evaluation criteria noted parenthetically.

- Reduced AM/PM delay times and enhanced level of service (LOS) on Downtown Springfield local streets compared to No-Build and Alternatives 2 and 3 (1.1.1)
- Net reductions in travel times between representative origin/destination pair for northbound and southbound AM peak and southbound PM peak (1.2.2)
- Reduced I-91 average travel times during AM and PM peaks vs. No-Build conditions and Alternative 2 and reductions in the number of weaving segments and crash clusters on the I-91 mainline (1.2.1, 2.2.1, 2.2.2).
- Increase in green space of 10.7 acres, providing space for outdoor recreation and community events as well as enhancing stormwater drainage (3.1.2)
- Diminished noise impacts and noise levels due to below-grade I-91 mainline compared to No-Build and Alternative 3 (3.3.1, 3.3.2)
- Potential positive impacts to Downtown Springfield aesthetic experience, perception of safety, and property values due to removal of viaduct structure relative to No-Build and Alternative 3 (2.3.1, 5.1.1)
- Improved accessibility for pedestrians and bicyclists throughout Downtown Springfield (1.3.1 – 1.3.5, 4.1.3)
- Potential housing and economic development impact made possible by enhanced accessibility of developable land on the order of 285 housing units, 1,325 jobs, and the potential for $2.2 million in annual property tax revenue (4.1.4, 4.1.5, 4.2.1 – 4.2.3)
- Highest estimated costs at $2.95 billion (inclusive of improvements to the viaduct structure, ramps, and adjacent infrastructure only); near- and mid-term projects are excluded. Estimated maintenance costs of $1.75 million per year also exceed expected maintenance costs of either

the existing viaduct or the modern viaduct structure proposed in Alternative 3 (6.1.1, 6.1.2, 6.2.1).

Alternative 2 is distinguished from other alternatives by the following factors:

- Reduced AM peak delay times and enhanced LOS in Downtown Springfield but increased delays and poorer LOS in PM peak compared to No-Build; net impacts are expected to be roughly neutral (1.1.1).
- Travel times between representative origin/destination pairs improve for southbound trips but worsen for northbound trips due to several factors including differing roadway alignments and dispersed effects of the highway realignment (1.2.2).
- Reduced I-91 average travel times for southbound traffic but increased travel times for northbound traffic during both AM and PM peaks; weaving segments and crash clusters on the I-91 mainline are reduced (1.2.1, 2.2.1, 2.2.2).
- Increase in green space of 12.7 acres, providing the greatest amount of space for outdoor recreation and community events as well as enhancing stormwater drainage to the greatest extent of the alternatives (3.1.2)
- Diminished noise impacts and noise levels due to below-grade I-91 mainline compared to No-Build and Alternative 3 (3.3.1, 3.3.2)
- Potential positive impacts to Downtown Springfield aesthetic experience, perception of safety, and property values due to removal of viaduct structure, relative to No-Build and Alternative 3 (2.3.1, 5.1.1)
- Greatest potential housing and economic development impact made possible by enhanced accessibility of developable land on the order of 480 housing units, 2,330 jobs, and the potential for $3.5 million in annual property tax revenue (4.1.4, 4.1.5, 4.2.1 – 4.2.3)
- High estimated costs (at $2.93 billion (inclusive of improvements to the viaduct structure, ramps, and adjacent infrastructure only); near- and mid-term projects are excluded. Estimated maintenance costs of $1.75 million per year also exceed expected maintenance costs of either the existing viaduct or the modern viaduct structure proposed in Alternative 3 (6.1.1, 6.1.2, 6.2.1).

Alternative 3 is distinguished from the other alternatives by the following factors:

- Increased AM peak delay times but decreased PM peak delay times in Downtown Springfield (roughly neutral net impacts) (1.1.1)
- Net reductions in travel times between representative origin/destination pair for northbound and southbound AM peak and southbound PM peak (1.2.2)
- Reduced I-91 average travel times during AM and PM peaks vs. No-Build conditions and Alternative 2 and reductions in the number of weaving segments and crash clusters on the I-91 mainline (1.2.1, 2.2.1, 2.2.2)

- Limited increase in green space (<1 acre) under the existing viaduct alignment, yielding limited additional space for recreation (3.1.2)
- Small reductions in noise impacts and noise levels due to increase in elevation of the modern viaduct concept (3.3.1, 3.3.2)
- Moderate potential positive impacts to Downtown Springfield aesthetic experience, perception of safety, and property values due to less visually imposing viaduct than the existing structure (2.3.1, 5.1.1)
- Limited potential housing and economic development on the order of 54 housing units, 136 jobs, and approximately $300,000 in annual property tax revenue (4.1.4, 4.1.5, 4.2.1 – 4.2.3)
- High estimated costs of $2.31 billion albeit lower than those estimated for Alternatives 1 and 2. (Estimate is inclusive of improvements to the viaduct structure, ramps, and adjacent infrastructure only; near- and mid-term projects are excluded.) Estimated maintenance costs of $1.25 million per year also exceed expected maintenance costs of the No-Build alternative (6.1.1, 6.1.2, 6.2.1).

Table 5-1: Alternatives Comparison (Viaduct Only)

Alternatives Comparison (Viaduct Only)

	No-Build	Alt 1	Alt 2	Alt 3
Mobility				
I-91 Levels of Service	No improvement in ramp or merge/diverge/weave LOS	Improved ramp LOS, slightly improved merge/diverge/weave LOS	Improved ramp LOS, improved merge/diverge/weave LOS	Improved ramp LOS, slightly improved merge/diverge/weave LOS
I-91 Travel Time (vs. No-Build peak hour times)	No improvement in AM/PM travel times	Slightly faster in AM and PM	Slightly slower in AM/slightly faster in PM	Slightly faster in AM and PM
Safety				
Weaving Segments	No change in weaving segments	Removed 7 weaving segments	Removed 6 weaving segments	Removed 6 weaving segments
Crash Clusters	No change in crash clusters	15 crash clusters redesigned to enhance safety	15 crash clusters redesigned to enhance safety	15 crash clusters redesigned to enhance safety
Under-Viaduct Conditions	No change in under-viaduct conditions	Viaduct removed; green space created above depressed alignment	Viaduct removed; green space created above depressed alignment	Modern elevated viaduct with improved lighting, less visual obstruction
Environment				
Physical Footprint	No change in impervious surface	18 fewer acres of impervious surface	11 fewer acres of impervious surface	5 fewer acres of impervious surface
Wetlands Impacts	No wetlands impact	26,900sf wetlands impacts	26,900sf wetlands impacts	26,900sf wetlands impacts
Noise	No change in noise impacts	Significantly reduced noise impacts (198 fewer properties impacted)	Significantly reduced noise impacts (223 fewer properties impacted)	Moderately reduced noise impacts (179 fewer properties impacted)

Alternatives Comparison (Viaduct Only)

	No-Build	Alt 1	Alt 2	Alt 3
Land Use and Economic Development				
Development Scenarios	No new greenspace/ development land available	26 acres of new greenspace/ development land available	26 acres of new greenspace/ development land available	1 acre of new greenspace/ development land available
Economic Impacts	No new housing or jobs from conceptual development	285 housing units, 550 persons 1,325 jobs from conceptual development	460 housing units, 888 persons, 2,330 jobs from conceptual development	54 housing units, 104 persons, 136 jobs from conceptual development
Freight Rail Impacts	No impacts on rail operations	Moderate impacts on rail operations	Significant impacts on rail operations	Limited impacts on rail operations
Parking Impacts	No reduction in parking	Net reduction of 700 spaces	Net reduction of 700 spaces	Net reduction of 1,100 spaces
Community Effects				
Visual Impacts	No change in visual impact of viaduct structure	4,200ft depressed alignment covered	4,300ft depressed alignment covered	Higher viaduct structure than existing; reduced number of vertical piers/columns
Construction Impacts	0 - 5 year maintenance/ rehab duration	10 - 15 year construction duration	10 - 15 year construction duration	8 - 12 year construction duration
Cost				
Construction Costs	$750m	$2.95bn	$2.92bn	$2.31bn
Maintenance Costs	$500,000/year	$1.75m/year	$1.75m/year	$1.25m/year

5.3 NEAR-/MID-TERM IMPROVEMENTS

In addition to the alternatives contemplated for replacement of the I-91 Viaduct, a number of improvements that could be implemented as stand-alone projects were identified over the course of the project. Conceptual estimates of construction costs for each of these projects were developed independently of the viaduct options, allowing for the potential benefits, costs, and feasibility of each of these improvements to be assessed independently. It should be noted that the size and scale of several of these improvements can range significantly, thus the anticipated cost and schedules may also vary from the numbers shown below.

The near- and mid-term improvements discussed below are depicted on the maps below.

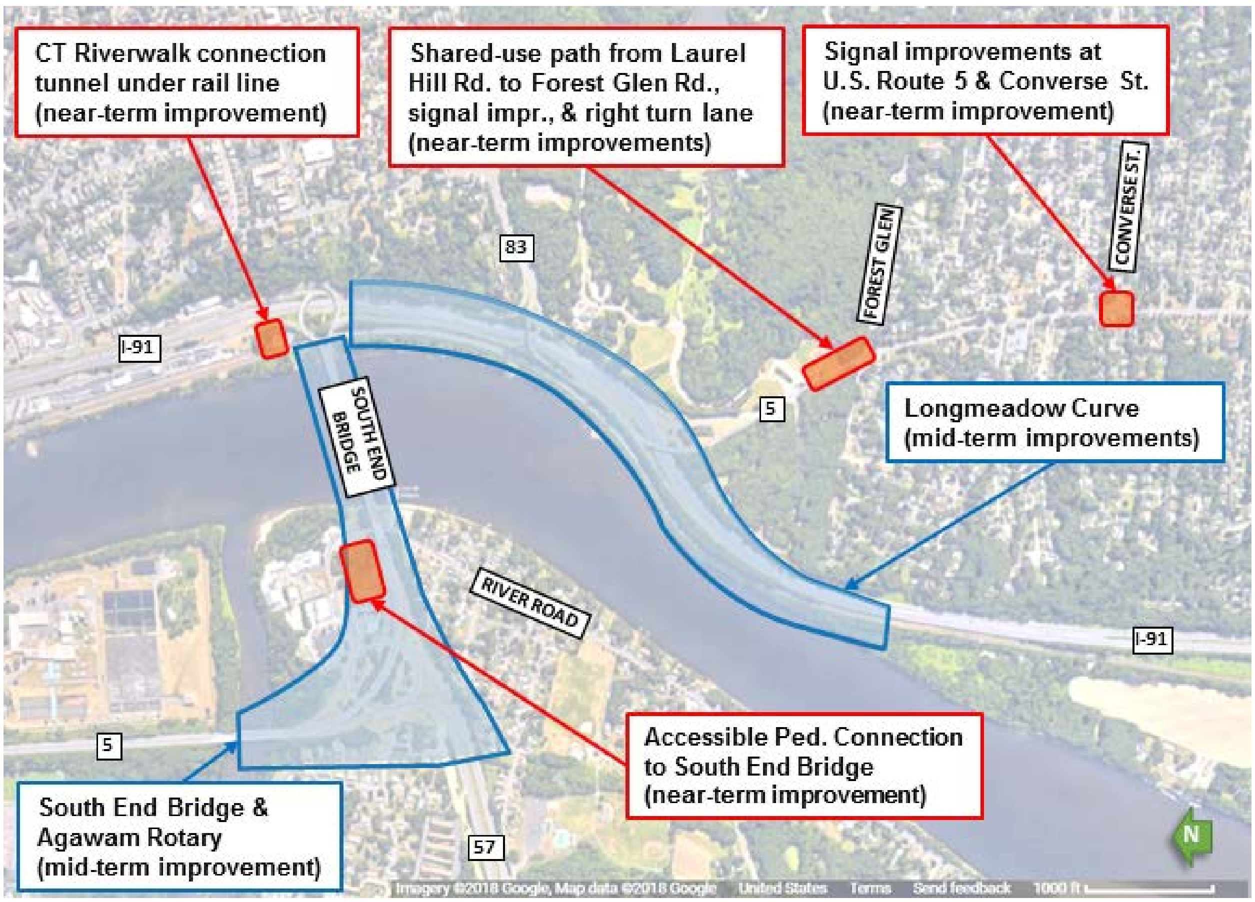


Figure 5-1: Near- and Mid-Term Improvements (South Section)

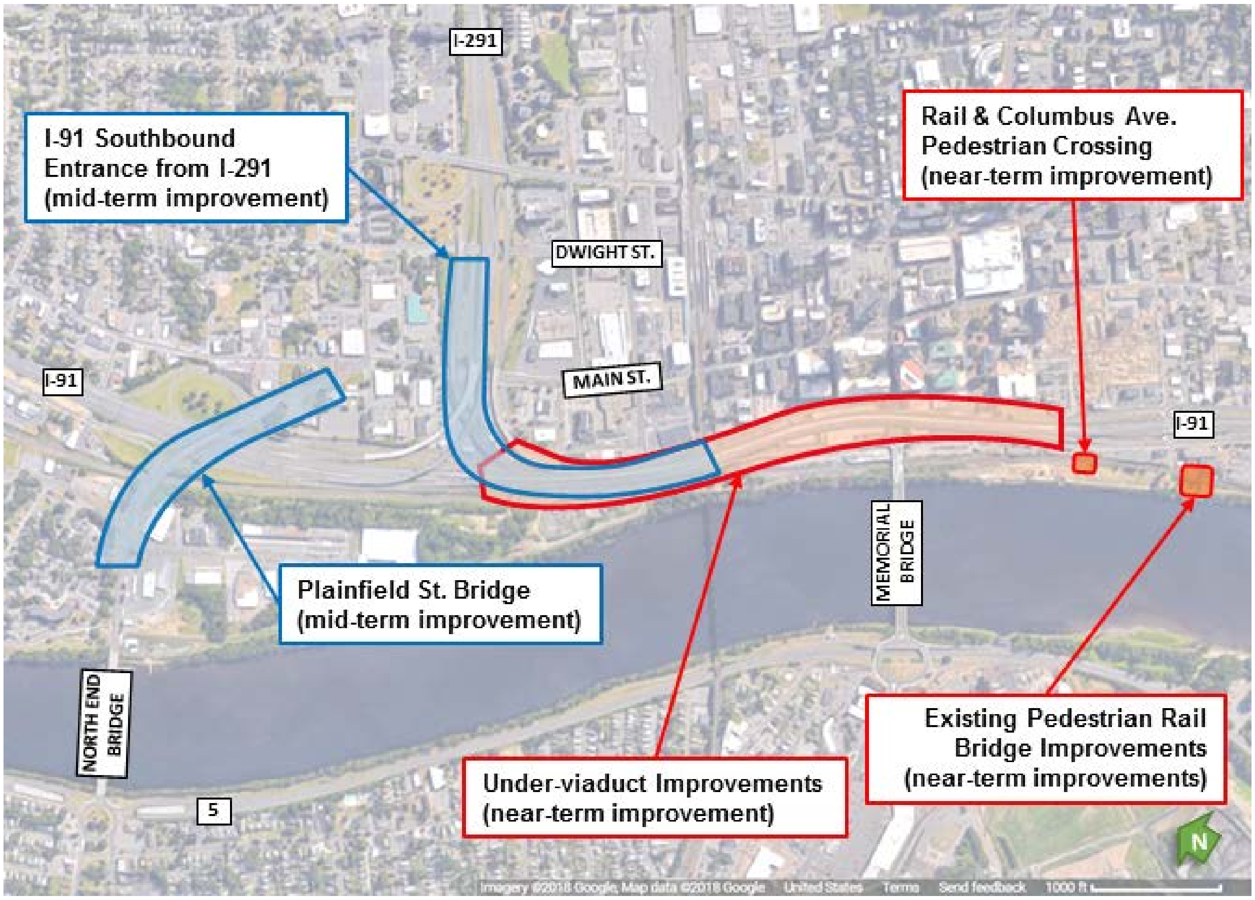


Figure 5-2: Near- and Mid-Term Improvements (North Section)

5.3.1 NEAR-TERM IMPROVEMENTS

The near-term improvements recommended for implementation include the following potential projects. Each project profile describes potential benefits, impacts in terms of traffic operations disruptions and land takings/easements, and costs and time lines for construction (not including design, permitting, or programming for funding).

Enhanced Under-Viaduct Pedestrian Plazas

Description: Installation of park space, decorative safety lighting, recreational amenities, seating, and public art below the existing viaduct structure.
Benefits: Enhanced safety and sense of security due to lighting and increased pedestrian surveillance; amenity benefits for local residents; enhanced connections between Downtown and Connecticut River.
Impacts: Minor impacts on East and West Columbus Avenue, potential impacts on Taylor Street.
Permitting/Design Time: 1-3 Years
Cost & Construction Time: $100,000 to $500,000 / 1-3 years

Figure 5-3: Conceptual Rendering of Under-Viaduct Enhancements

Enhanced Riverfront Bike/Ped Connections

Description: Safety improvements to at-grade pedestrian (rail and street) connections to Connecticut Riverfront Park/Connecticut Riverwalk and Bikeway.
Benefits: Enhanced pedestrian safety and accessibility to Connecticut Riverfront recreational amenities
Impacts: Minor construction impacts on East/West Columbus Avenue.
Permitting/Design Time: 1-2 Years
Cost & Construction Time: \$500,000 - \$1m / 1-2 years

South End Bridge - River Road Bike/Ped Connection

Description: Installation of an accessible bike and pedestrian ramp or switch-back path from South End Bridge to River Road and the adjacent neighborhood.
Benefits: Enhanced bicycle and pedestrian safety and accessibility between Springfield/Longmeadow and the River Road neighborhood.
Impacts: Potential minor construction impacts on South End Bridge and River Road.
Permitting/Design Time: 1-2 Years
Cost & Construction Time: \$1m - \$2m / 1-2 years

Hall of Fame - Riverfront Pedestrian Bridge Improvements

Description: Installation of enhanced wayfinding signage, lighting, and sidewalk design to improve usefulness of pedestrian bridge between Riverfront Park and former Hall of Fame building.
Benefits: Enhanced pedestrian safety and accessibility to Riverfront from Hall of Fame, adjacent businesses, and Downtown Springfield.
Impacts: Potential minor construction impacts on West Columbus Ave, Union Street, and Connecticut Riverwalk and Bikeway
Permitting/Design Time: 6 months - 1 Year
Cost & Construction Time: \$50K-\$100K / 1 year

U.S. Route 5 Shared Use Path

Description: Installation of a shared-use path along the existing gap in the pedestrian network on U.S. Route 5 between Laurel Hill Road and Forest Glen Road.
Benefits: Enhanced bicycle and pedestrian safety and accessibility between Springfield, Longmeadow, and Forest Park.
Impacts: Potential minor construction impacts on U.S. Route 5 and Longmeadow Park.
Permitting/Design Time: 1-2 Years
Cost & Construction Time: \$250K-\$300K / 1 year

Longmeadow Local Roads Improvements

Description: Signal coordination and review of signal timing for the intersections of U.S. Route 5 and Forest Glen Road and U.S. Route 5 and Converse Street; installation of right-turn lane at WB approach along Forest Glen Road as it intersects U.S. Route 5.
Benefits: Improved traffic operations and reduced congestion during AM/PM peak hours.
Impacts: Construction impacts on U.S. Route 5, Forest Glen Road, and Converse Street; minor takings and/or permanent easements.
Permitting/Design Time: 1-2 Years
Cost & Construction Time: $1.25m-$2m / 1-2 years

Downtown Pedestrian and Miscellaneous Improvements

Description: Spot ADA improvements (including sidewalk repairs, ADA/AAB ramps, countdown signal heads, and timing changes) throughout the Primary Study Area, as needed; repainting of interstate symbols and similar pavement markings on roadways adjacent to I-91, as needed.
Benefits: Improved useability and safety for pedestrians, especially pedestrians with mobility or other impairments; reduced congestion and improved downtown traffic operations.
Impacts: Potential minor construction impacts throughout Primary Study Area.
Permitting/Design Time: Approx. 6 months per project
Cost & Construction Time: $50K-$100K per project / 6 months - 1 Year

5.3.2 MID-TERM IMPROVEMENTS

The near-term improvements recommended for implementation include the following items:

Longmeadow Curve

Description: Installation of collector-distributor roads alongside I-91 mainline and roundabouts at South End Bridge and U.S. Route 5; reduction in on/off-ramps; realignment of I-91 mainline; elimination of lane drop.
Benefits: Improvements to interstate geometry, including proper shoulders and adequate curve radii to maintain interstate speeds; safety improvements and reduced congestion due to reduction in weaving/merging/diverging sections and associated elevated crash levels; enhanced access between I-91 and Routes 5 and 83.
Impacts: Construction impacts on I-91, Route 5, Route 83, and Route 57 operations; impacts on entrances to Forest Park; minor takings and/or permanent easements; temporary easements.
Permitting/Design Time: 3-4 Years
Cost & Construction Time: $212.75m, 4-6 year construction timeline.

South End Bridge and Agawam Rotary

Description: Replacement of Agawam Rotary with modified diamond interchange; replacement of South End Bridge and Westfield River bridge to provide two travel lanes in each direction and shared-use path; provision of acceleration and decleration lanes and proper left and right shoulders on both bridges; provide access to/from Meadow Street.
Benefits: Enhanced traffic operations and reduction in congestion/queuing onto South End Bridge; remediation of existing crash clusters; enhanced access to Meadow Street neighborhood; free movement from Route 5 SB directly to Route 57
Impacts: Construction impacts on U.S. Route 5, Route 57, I-91, River Road, Editha Avenue, and Meadow Street traffic operations.
Permitting/Design Time: 4-5 Years
Cost & Construction Time: $362.85m, 6-8 year construction timeline.

Entrance to I-91 Southbound from I-291 Southbound

Description: New flyover ramp connecting left-hand side of I-91 southbound from I-291 southbound in place of current right-hand entrance, with connection to Memorial Bridge towards West Springfield.
Benefits: Provision of currently non-existent movement from I-291 to Memorial Bridge; elimination of hazardous merging condition between existing I-291 to I-91 on-ramp and Exit 7.
Impacts: Construction impacts on I-91/I-291 traffic operations, West Columbus Avenue, Boland Way; visual impact of I-91 flyover; coordination required with railroad.
Permitting/Design Time: 2-3 Years
Cost & Construction Time: $152.0m, 3-5 year construction timeline.

Figure 5-4: I-91/I-291 Interchange Improvements

Plainfield Street Improvements (Main Street to North End Bridge)

Description: Replacement of Plainfield Street bridges over I-91 and railroad tracks with third westbound travel lane; bicycle and pedestrian improvements; reconstruction of Plainfield Street intersections with Avocado Street/West Street and Main Street
Benefits: Enhanced traffic operations and reduction of capacity issues and poor LOS; enhanced access to Avocado Street/West Street; compliance with ADA standards reduce barriers to access for users with mobility limitations; enhanced bicycle and pedestrian access to North End Bridge.
Impacts: Construction impacts on U.S. Route 5, Route 20, Avocado Street, North End Bridge, and Main Street traffic operations; coordination with Railroad.
Permitting/Design Time: 2-3 years
Cost & Construction Time: $76.0m, 3-5 year construction timeline.

Figure 5-5: Plainfield Street Improvements

Connecticut Riverwalk and Bikeway - Forest Park Connection
Description: Installation of bike and pedestrian connection bridge from the Connecticut Riverwalk and Bikeway over I-91 to Forest Park.
Benefits: Enhanced safety and accessibility for pedestrians and bicylists; compliance with ADA standards reduce barriers to access for users with mobility limitations; greater potential utilization of existing recreational assets.
Impacts: Potential minor land takings/easements
Permitting/Design Time: 2-3 Year
Cost & Construction Time: $19.75m (contingent on Longmeadow Curve mid-term improvements), 2-3 year construction timeline.

5.3.3 NEAR- AND MID-TERM RECOMMENDATIONS

It is recommended that the near- and mid-term projects described above be implemented, either as stand-alone projects or in logical groups, dependent upon current project needs and available or programmed funding opportunities. As this study progressed and each alternative, as well as the near- and mid-term projects, were formulated, care was taken to allow for these projects to be considered as stand-alone projects. This study, therefore, has provided cost and conceptual schedules for these significant improvement projects that can be considered in light of the recommendation that the No-Build alternative is an appropriate path forward for Springfield and the region.

Conceptual time lines and budgets provided for these projects could vary significantly and are dependent upon several factors, including but not limited to available funding, community support and priorities, and feasibility of combining individual improvements into coordinated projects.

5.4 IMPLEMENTATION

5.4.1 MASSDOT PROJECT DEVELOPMENT AND DESIGN PROCESS

Development of transportation improvements is a complex decision-making process, with many stakeholders, decision makers, and reviewing agencies involved throughout the project development process. All projects developed by or with the involvement of the MassDOT Highway Division are guided by the eight-step process outlined in Chapter 2 of the MassDOT Highway Division's *Project Development and Design Guide*. This process guides a proposed transportation improvement from concept through construction and is designed to ensure that projects meet their stated goals and objectives.

This project development process is a requirement for all projects involving the MassDOT Highway Division, including projects in which the Highway Division is the project proponent, is responsible for project funding, or controls the infrastructure in question (projects on state highways). In the case of projects involving roadways or other infrastructure and property under the jurisdiction of the City of Springfield, Town of Agawam, Town of Longmeadow, or Town of West Springfield, project development and implementation are the responsibility of the municipality having jurisdiction. Examples of recommendations falling under municipal jurisdiction include local roads and signalization improvements, sidewalk/ADA improvements, public plazas, and drainage and utility upgrades.

The eight major steps that constitute the MassDOT Project Development and Design Process are outlined below and range from the first steps of identifying a project need toward greater refinement of the project's focus, design details, and ultimately toward implementation. The first two steps, Needs Identification and Planning, are addressed in the Interstate 91 Viaduct Study.

Step 1: Needs Identification

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project would be drawn primarily from the Interstate 91 Viaduct Study. At this point in the process, MassDOT also meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division office whose jurisdiction includes the location of the proposed project. For the I-91 Viaduct, this is the District 2 office. MassDOT also sends the PNF to the MPO for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and therefore whether it is ready to move forward into the design phase or whether it should be dismissed from further consideration.

Step 2: Planning

This phase would likely not be required for the implementation of the improvements proposed in the Interstate 91 Viaduct Study as this study should constitute the outcome of this step. However, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained so that the subsequent design and permitting processes are understood.

The level of planning needed varies widely based on the complexity of the project. Typical tasks include the following: define the existing context, confirm the project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make recommendations, and provide report documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design or a recommendation to delay the project or dismiss it from further consideration.

Step 3: Project Initiation

At this point in the process, the proponent, MassDOT Highway Division, completes a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO, in this case the Pioneer Valley MPO. The PRC is composed of the Chief Engineer, each District Highway Director, representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge Departments, and the Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First, the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign a project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

Given transportation funding constraints, prioritization of the recommendations for implementation will need to be established regionally by the Pioneer Valley MPO, Pioneer Valley Planning Commission (PVPC), member communities, and MassDOT, in particular for the mid-term improvements recommended in section 5.3.2 above.

Step 4: Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: Public Outreach, Environmental Documentation and Permitting (varying levels, if required), Design, and Right-of-Way Acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction.

The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach: Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings (conducted at the 25 percent and 100 percent design milestones) but can also include less formal dialogue with those interested in and affected by a proposed project.

Environmental Documentation and Permitting: The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting are often completed in conjunction with the Preliminary Design phase described below.

Design: There are three major phases of design. The first is Preliminary Design, also referred to as the 25 percent submission. The major components of this phase include a full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with Environmental Documentation and Permitting.

The next Phase is Final Design, which is also referred to as the 75 percent and 100 percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of temporary traffic control plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of Plans, Specifications, and Estimates (PS&E) is developed for the project.

Right-of-Way Acquisition: A separate set of Right-of-Way plans is required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

Step 5: Programming (Identification of Funding)

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the project proponent requests that the MPO include a project from the Regional Transportation Plan in the region's annual TIP development process. The proponent requesting the project's listing on the TIP can be the community or one of the MPO member agencies (the Regional Planning Agency, MassDOT, or the Regional Transit Authority). The MPO considers the project in terms of state and regional needs, funding availability, project readiness, evaluation criteria, and compliance with the Regional Transportation Plan. If the MPO decides to include the project in the TIP, it is first included in the Draft TIP for public review and then in the Final TIP. A project does not have to be fully designed for the MPO to program it in the TIP, but generally a project has reached 75 percent design to be programmed in the year-one element of the four-year TIP.

Step 6: Procurement

Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals, which is also often referred to as being "advertised‟ for construction. MassDOT then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

Step 7: Construction

After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a temporary traffic control plan for the construction process.

Step 8: Project Assessment

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Table 5-2 below summarizes the Project Development and Design Process steps detailed above, along with their effect on the project schedule and typical durations associated with each step.

Table 5-2: Project Development Summary

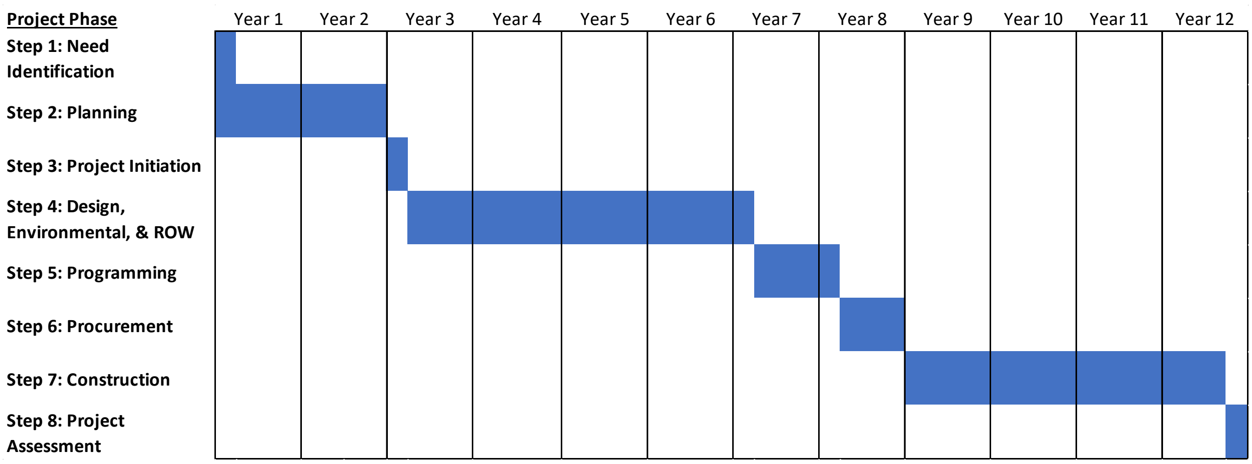
Description	Schedule Influence	Typical Duration
Step 1: Needs Identification **The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT District office, which provides guidance to the proponent on the subsequent steps of the process.**	The PNF has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.	1 to 3 months
Step 2: Planning **Project planning can range from agreement that the problem should be addressed through a clear solution to a more detailed analysis of alternatives and their impacts.**	For some projects, no planning beyond preparation of the PNF is required while other projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects would likely require a detailed alternatives analysis.	Project Planning Report: 3 to 24+ months
Step 3: Project Initiation **The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT District office and formally reviewed by the Project Review Committee (PRC).**	The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, is included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.	1 to 4 months
Step 4: Design, Environmental, and Right of Way **The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right-of-way needed for the project is identified, and the acquisition process begins.**	The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT District and appropriate sections is completed in this step.	3 to 48+ months

Description	Schedule Influence	Typical Duration
Step 5: Programming **The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in its Draft Transportation Improvement Program (TIP), which is then made available for public comment. The TIP includes a project description and funding source.**	The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO would not include a project in its Draft TIP based on its review and approval procedures.	3 to 12+ months
Step 6: Procurement **The project is advertised for construction and a contract awarded.**	Administration of competing projects can influence the advertising schedule.	1 to 12 months
Step 7: Construction **The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.**	The duration of this step is entirely dependent upon project complexity and phasing.	3 to 60+ months
Step 8: Project Assessment **The construction period is complete, and project elements and processes are evaluated on a voluntary basis.**	The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.	1 month

Source: MassDOT Highway Division Project Development and Design Guide

The project development process described previously is based on a conventional project delivery method, commonly referred to as "Design-Bid-Build" (D-B-B). The essence of the D-B-B process is that the project is designed to the PS&E level and then advertised for construction, i.e., the design and construction are carried out sequentially. Under this scenario, the engineer of record (designer) and the construction contractor are two separate contracting entities. A schematic time line illustrating this process, shown in the below figure, and for the purpose of this discussion assumes aggressive durations and that construction funding would be available at the end of the design phase.

Figure 5-6: Schematic Project Development Time Line



5.4.2 ENVIRONMENTAL CONSIDERATIONS

This section provides a summary of the environmental documentation, review, and permitting that would need to be conducted for any alternative to be implemented. Any project will need to follow the project development design process (Step 4), which includes coordination with the Environmental Services section of the MassDOT Highway Division, and will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for MEPA and NEPA. Expected environmental policy acts and permitting application and reviews are discussed below but may vary depending upon actual project design and impacts.

Environmental Policy Acts

Both MEPA and NEPA typically require an evaluation of the project to determine the environmental consequences and mitigation measures for the proposed project improvements. Based on the scope of the anticipated highway improvements, it is anticipated that MEPA review will at least consist of an Environmental Notification Form (ENF) and a Draft and Final Environmental Impact Report (EIR). Similar thresholds apply to NEPA where a full Environmental Assessment (EA) could be warranted for this project.

Environmental Reviews/Permits

Local, state, and federal agency regulatory agencies will review proposed activities with respect to applicable environmental laws and regulations. Specific regulatory agency reviews and permits as applicable to this project would consist of the following:

- Massachusetts Wetlands Protection Act (WPA) – Wetlands Notice of Intent (NOI)
- Section 401 of the Federal Clean Water Act – 401 Water Quality Certification
- National Pollutant Discharge Elimination System (NPDES) Remediation General Permit
- Environmental Protection Agency (EPA) Construction Stormwater General Permit
- Section 404 Permit – U.S. Army Corps of Engineers (USACE) General Permit
- Massachusetts Natural Heritage Estimated and Priority Habitats
- Massachusetts Historical Commission (MHC)
- Massachusetts General Law Chapter 21E and the Massachusetts Contingency Plan (MCP)

5.4.3 IMPLEMENTATION SUMMARY

As part of this study, several near- and mid-term improvement projects have been outlined. It is recommended that all of these improvements should be considered for project development. It is imperative that municipal leadership from Springfield, Agawam, Longmeadow, and West Springfield, as well as members of the broader community, PVPC, and MassDOT, continue to coordinate and further define the most appropriate and urgent projects. In addition, continued support from local and regional stakeholders in advancing high-priority projects is critical to successfully implementing this agenda. These local priorities should inform time lines and programming for each improvement to proceed to project development.

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