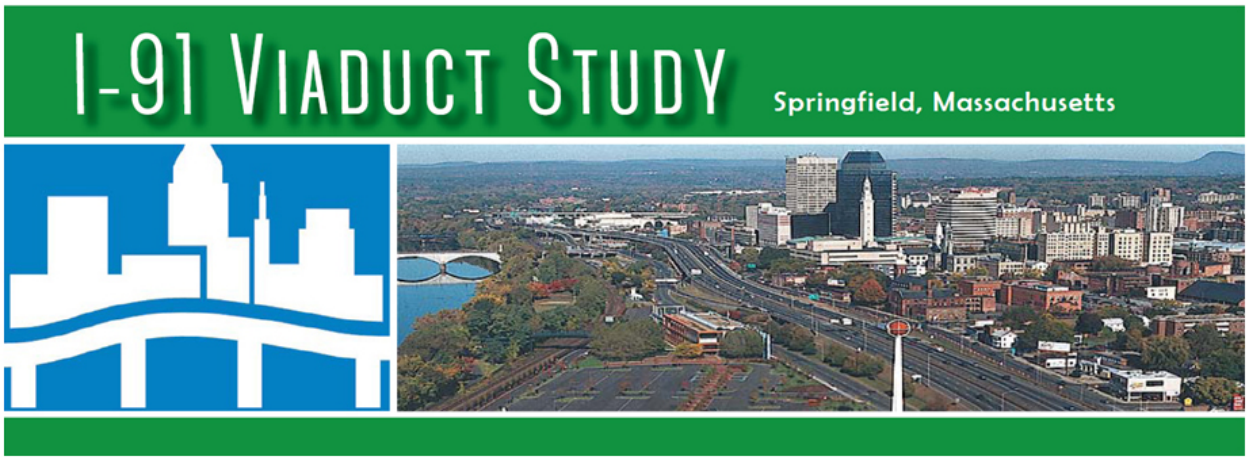

INTERSTATE 91 VIADUCT STUDY

CHAPTER II

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

October 2018

MMI #3869-16-6

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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.

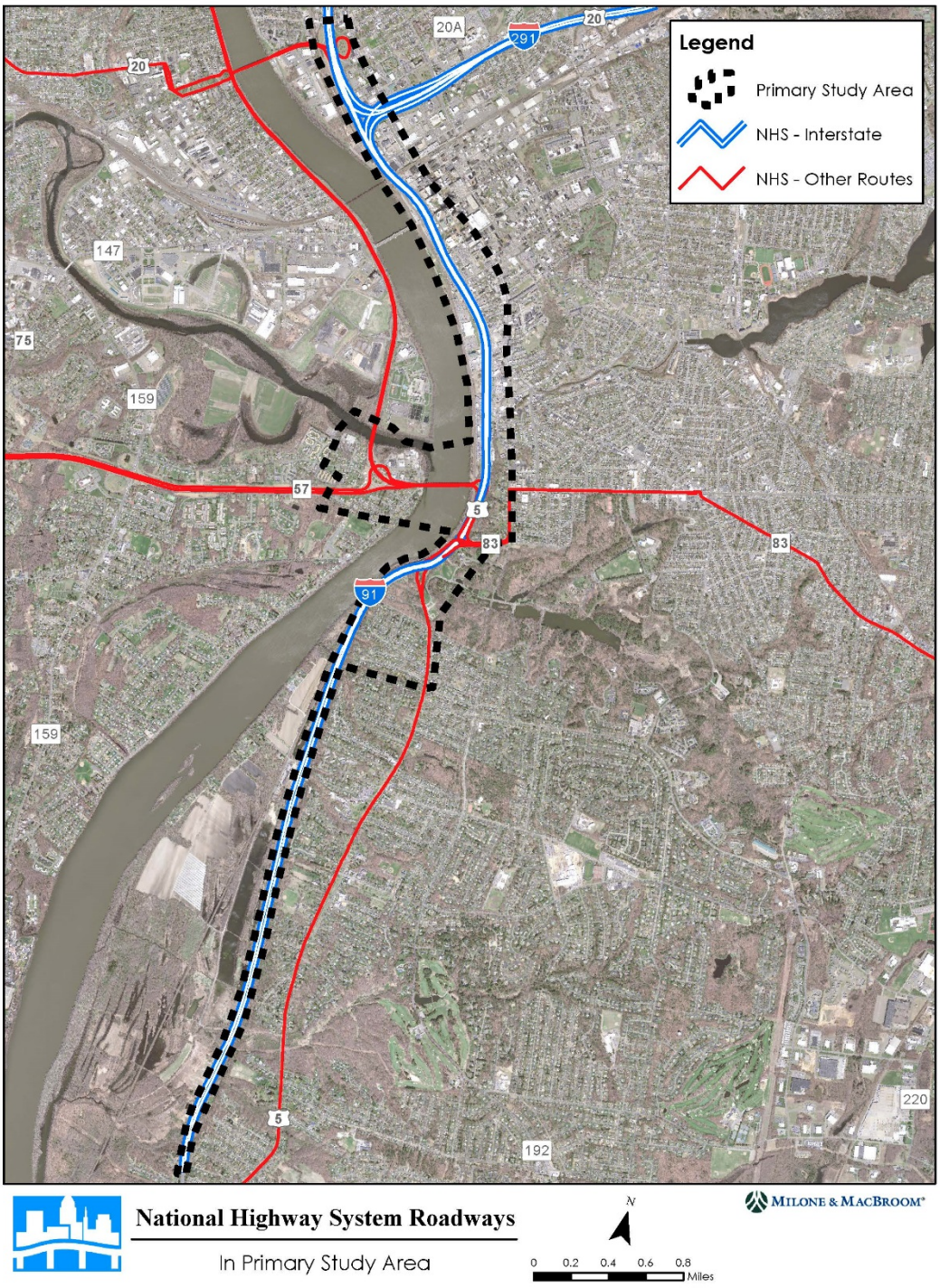


Figure 2-1: NHS Roadways within the Regional Study Area

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.

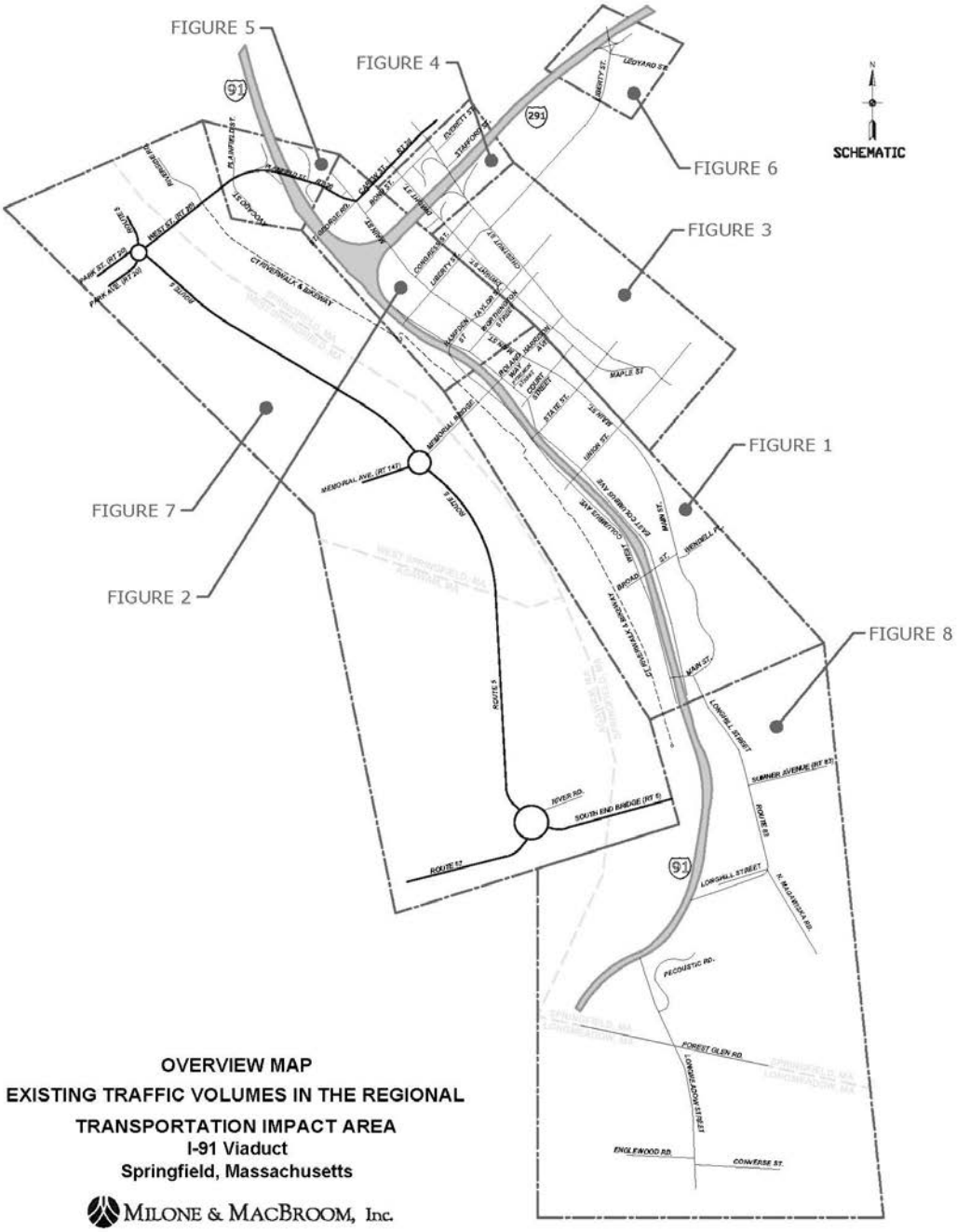


Figure 2-2: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Areas – Overview Map

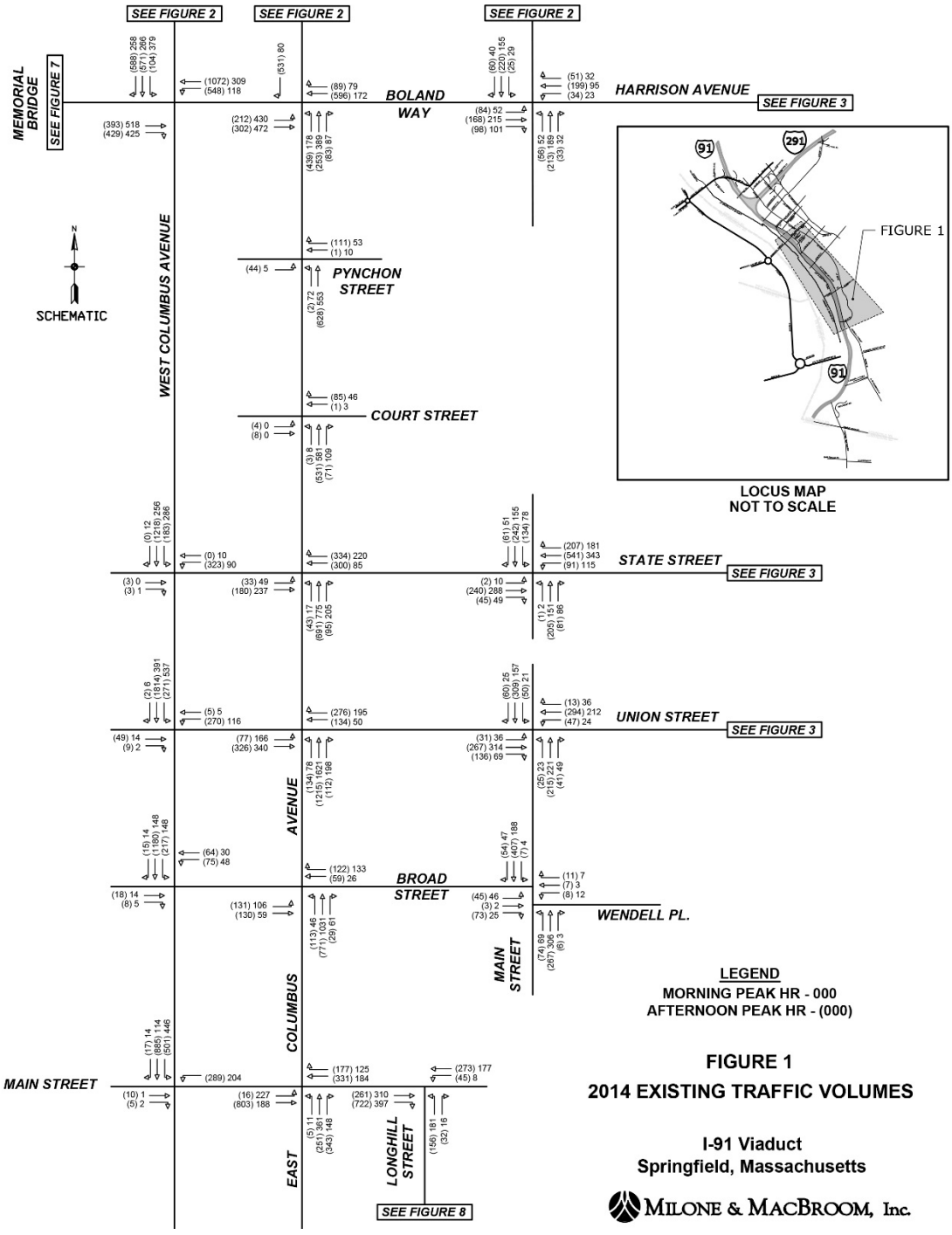


Figure 2-3: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #1

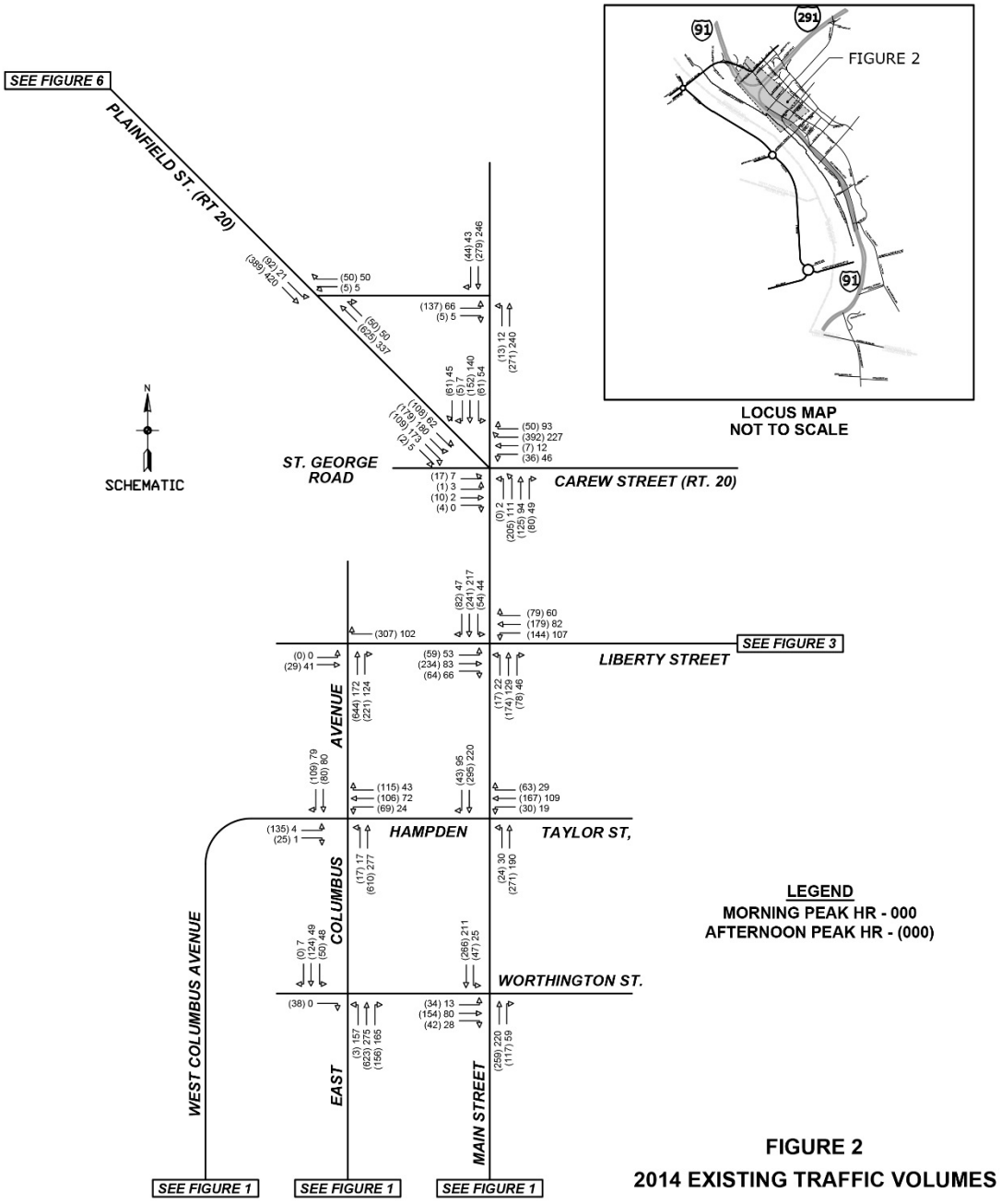


Figure 2-4: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #2

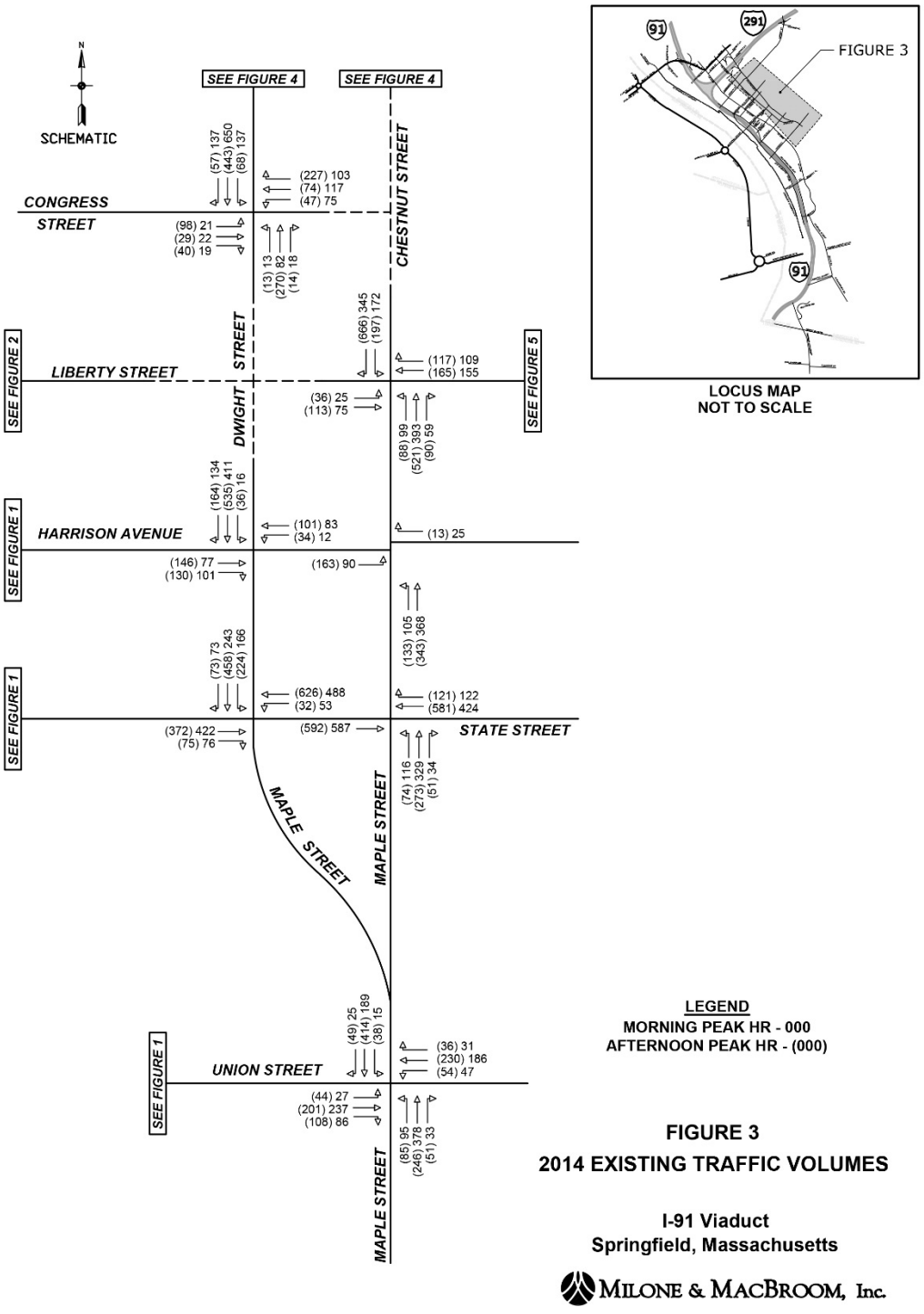


Figure 2-5: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #3

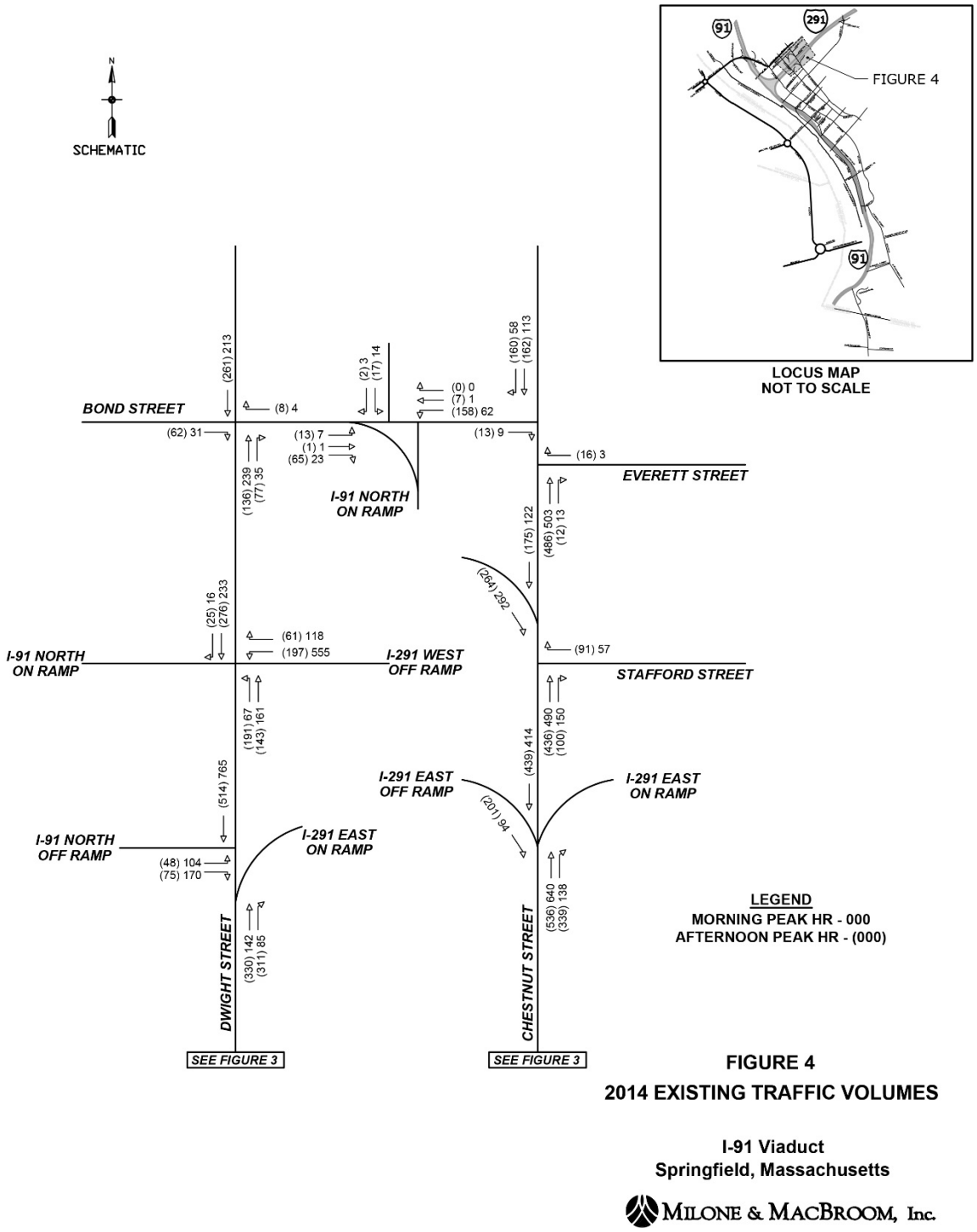


Figure 2-6: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #4

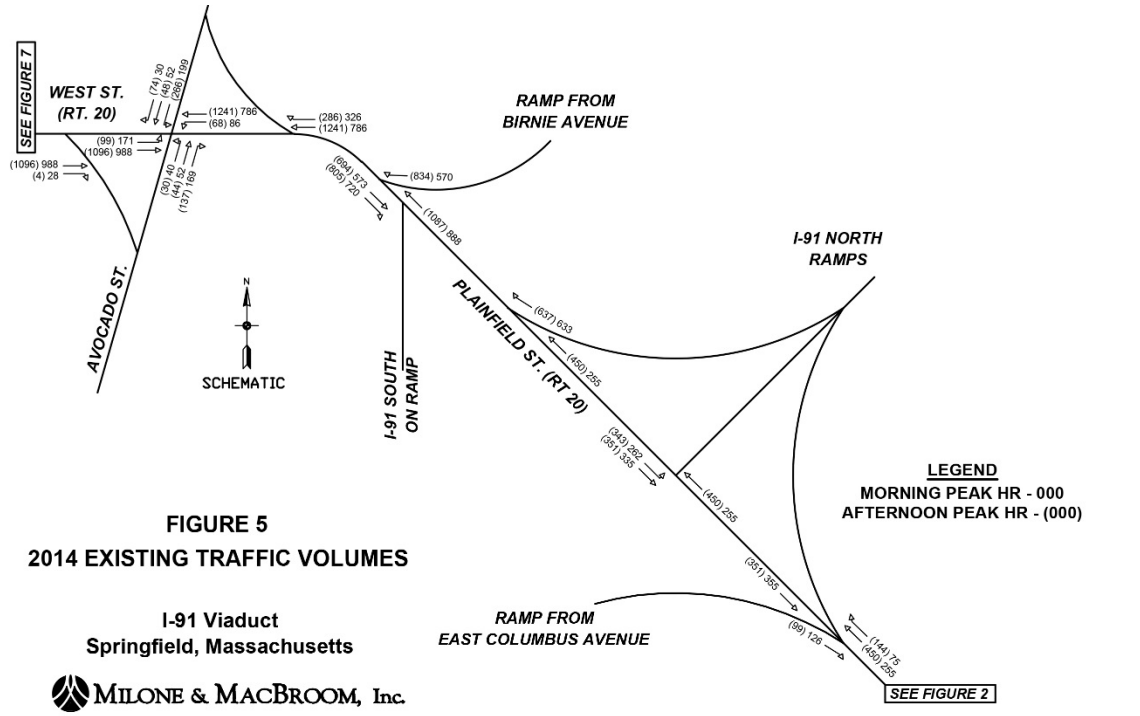


FIGURE 5
2014 EXISTING TRAFFIC VOLUMES

I-91 Viaduct
Springfield, Massachusetts

MILONE & MACBROOM, Inc.

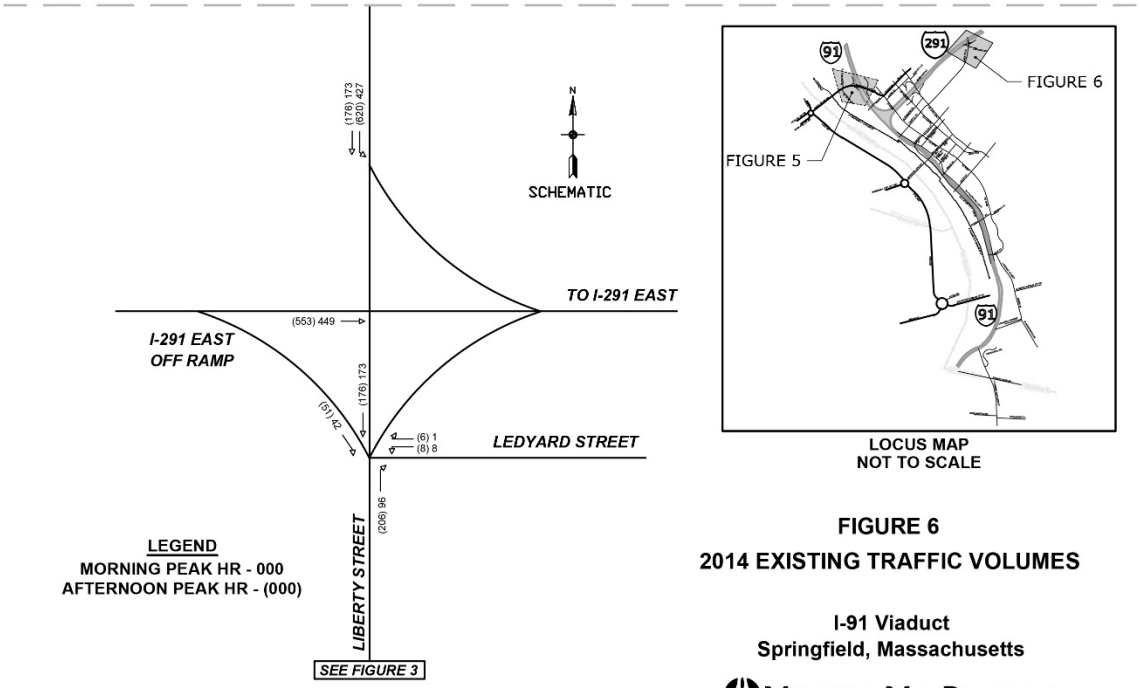


FIGURE 6
2014 EXISTING TRAFFIC VOLUMES

I-91 Viaduct
Springfield, Massachusetts

MILONE & MACBROOM, Inc.

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

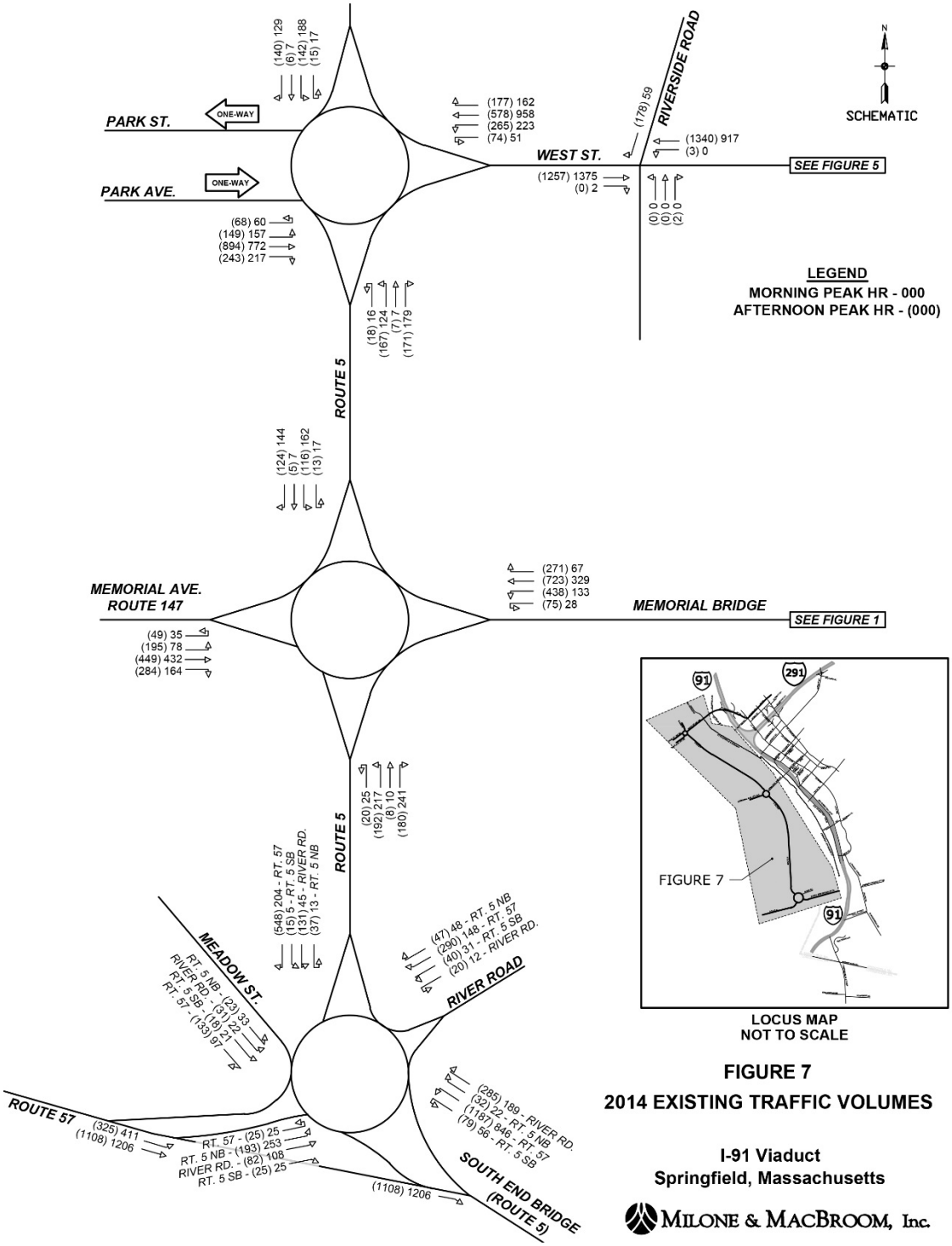


Figure 2-8: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #7

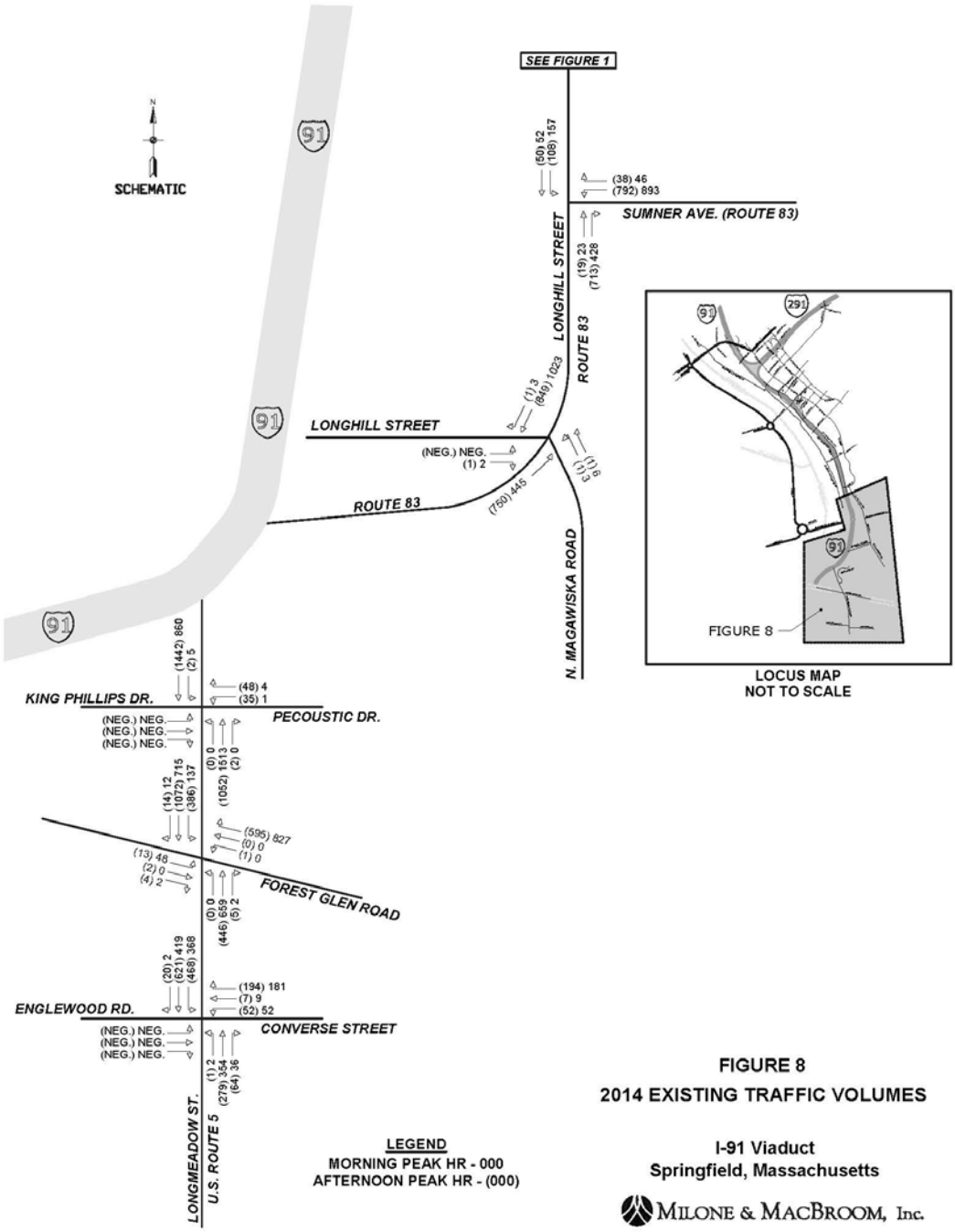


Figure 2-9: Eight-Part Schematic Map Series Showing Existing Traffic Volumes in the Primary and Regional Study Area – #8

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 (50th percentile) and maximum acceptable queue length (95th 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 50th percentile queues are 302' and 299' while the 95th 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 50th and 95th percentile queues are 232' and 257, respectively. The 50th and 95th 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]

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

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

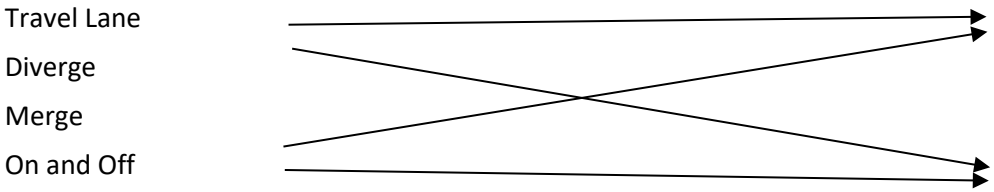
FREEWAY SEGMENTS	AM Peak Hour		PM Peak Hour	
	LOS	Density (pc/mi/ln)	LOS	Density (passenger car per mile per lane)
US- 5 Southbound				
US-5 SB north of Memorial Bridge	A	8.3	A	8.8
US-5 SB south of Memorial Bridge	A	7.7	B	12.1
Route 57 - Agawam				
Route 57 NB - west of Editha Avenue	A	6.1	A	8
Route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



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.

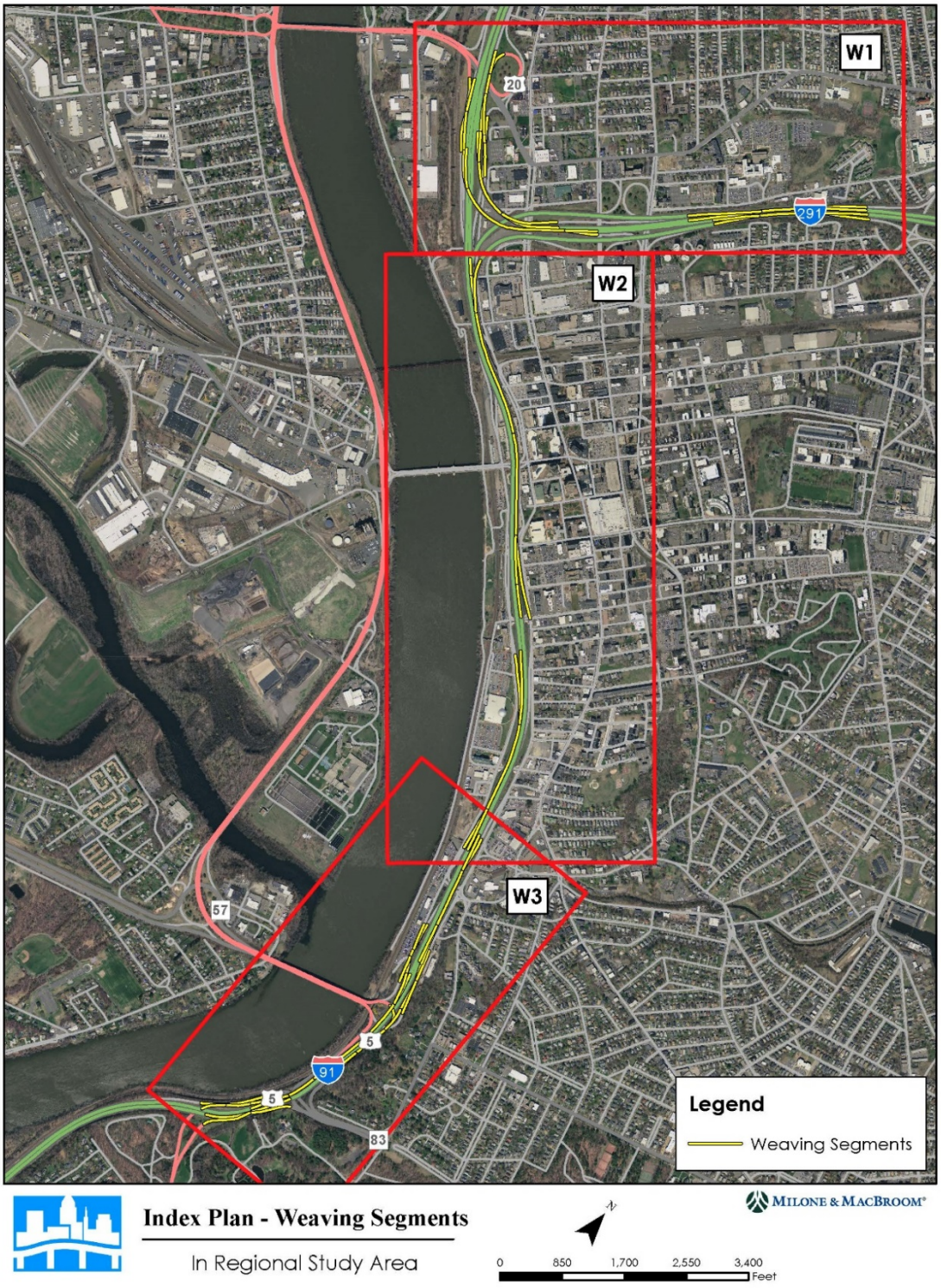


Figure 2-10: Index Plan – Weaving Segments

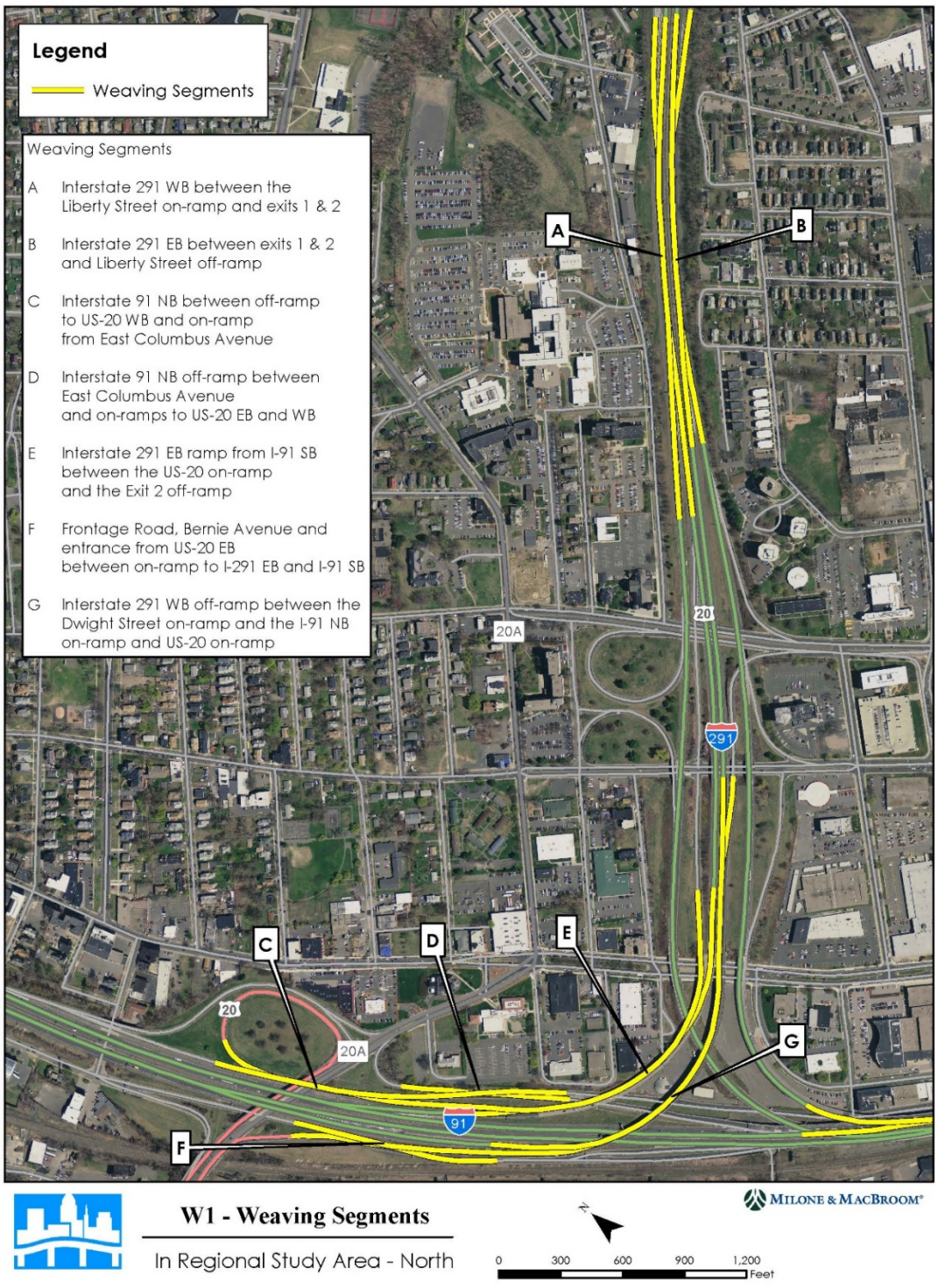


Figure 2-11: W1 – Weaving Segments

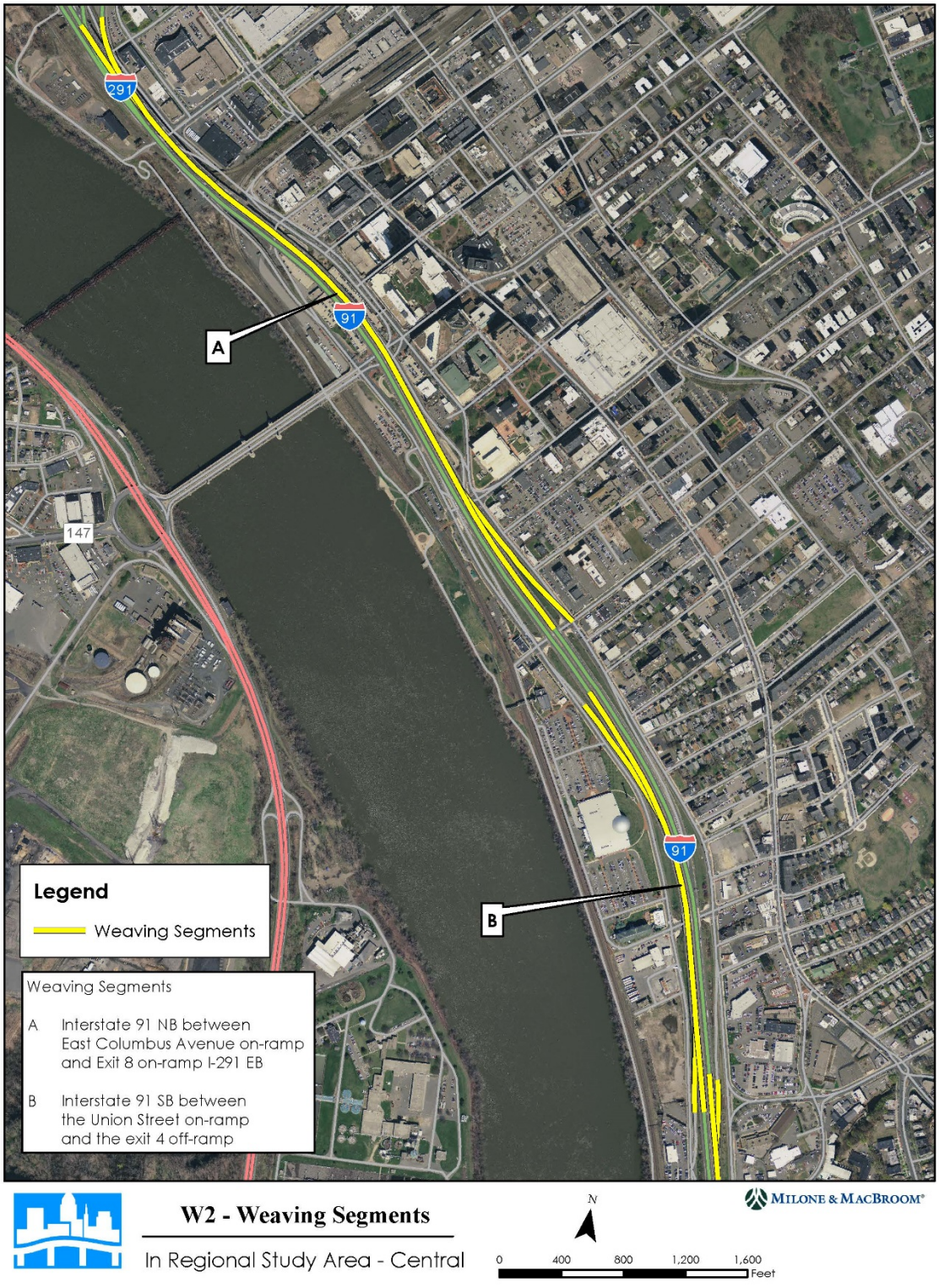


Figure 2-12: W2 – Weaving Segments

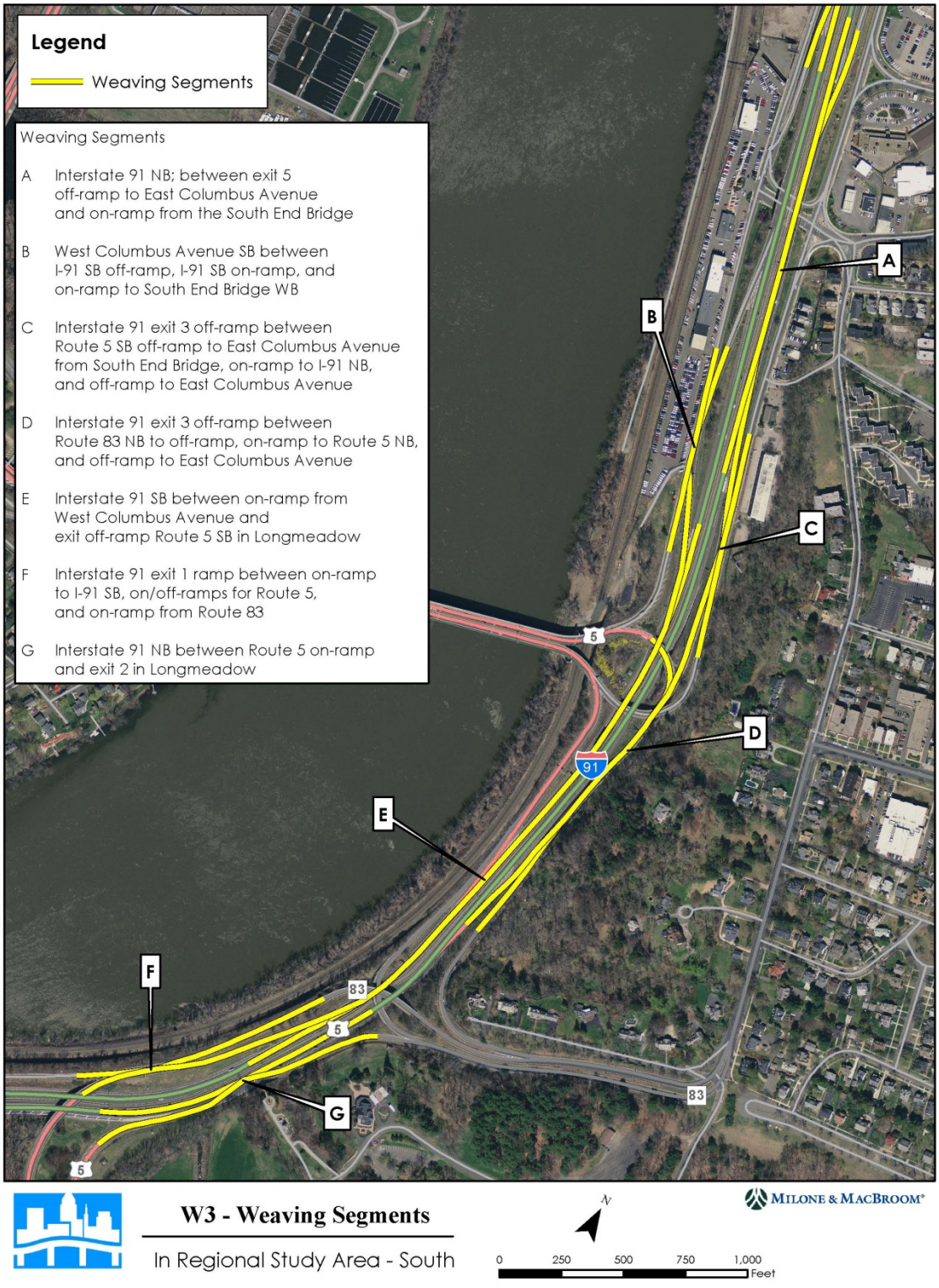


Figure 2-13: W3 – Weaving Segments

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.

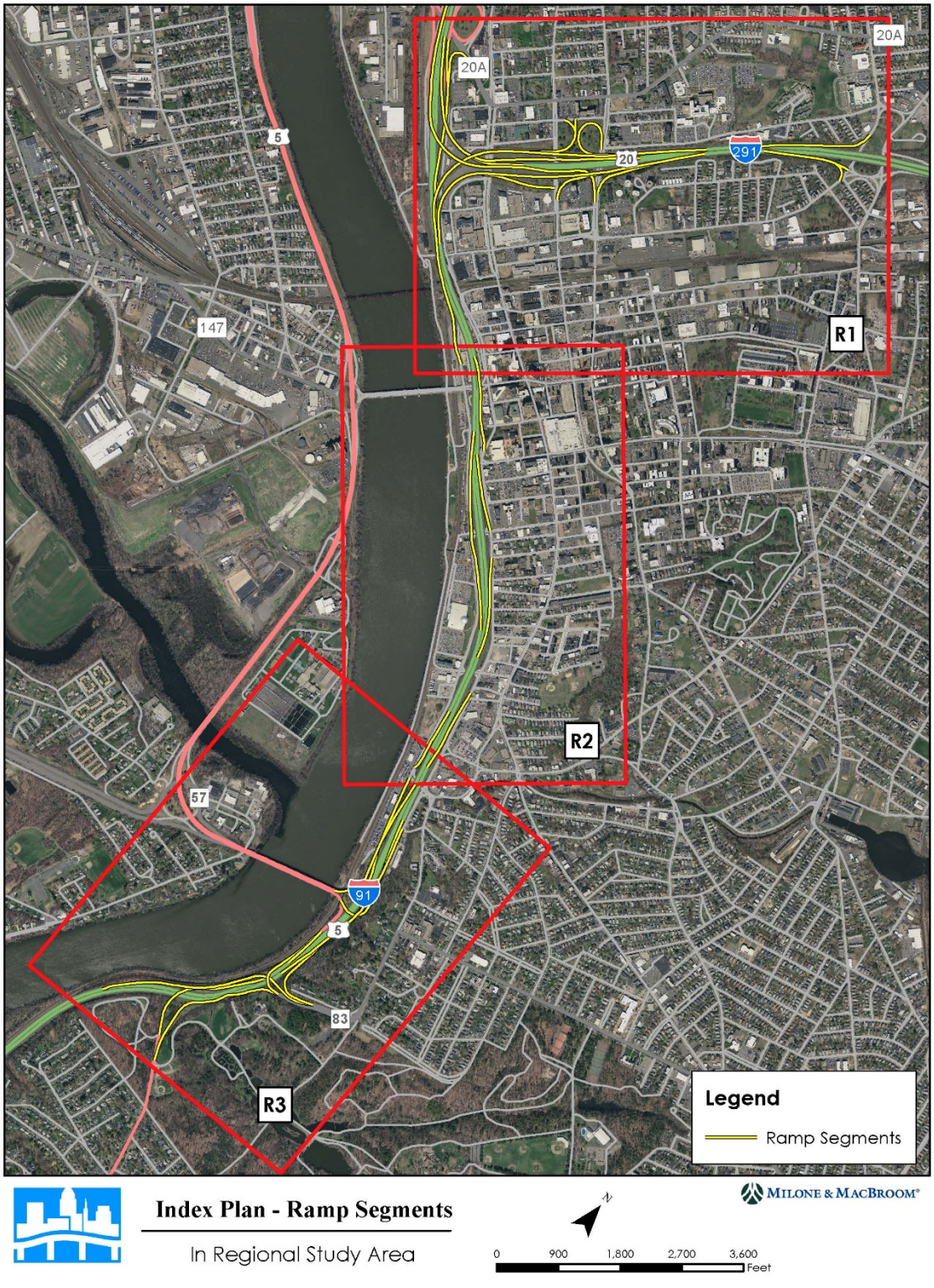


Figure 2-14: Index Plan – Ramp Segments

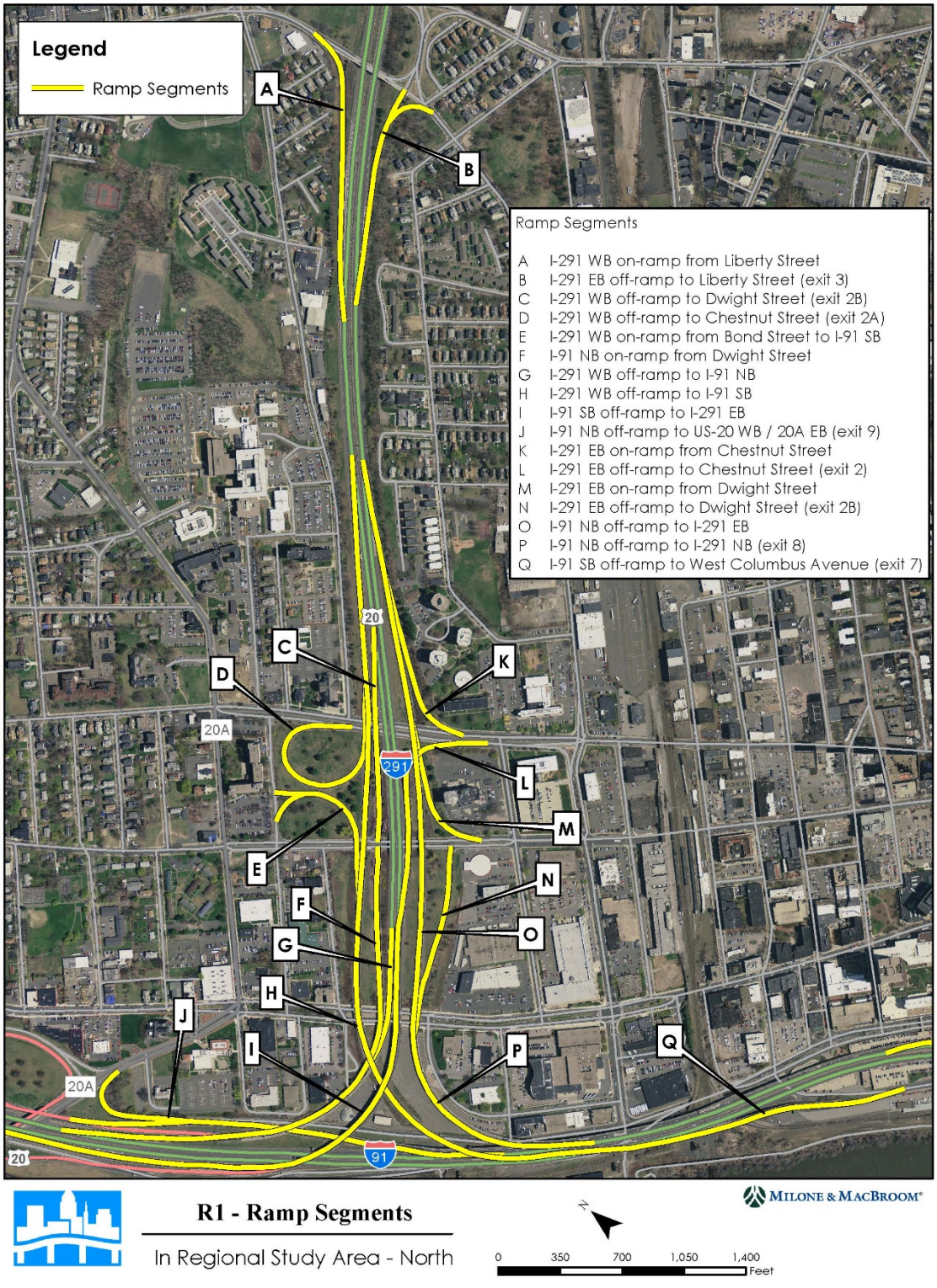


Figure 2-15: R1 Ramp Segment

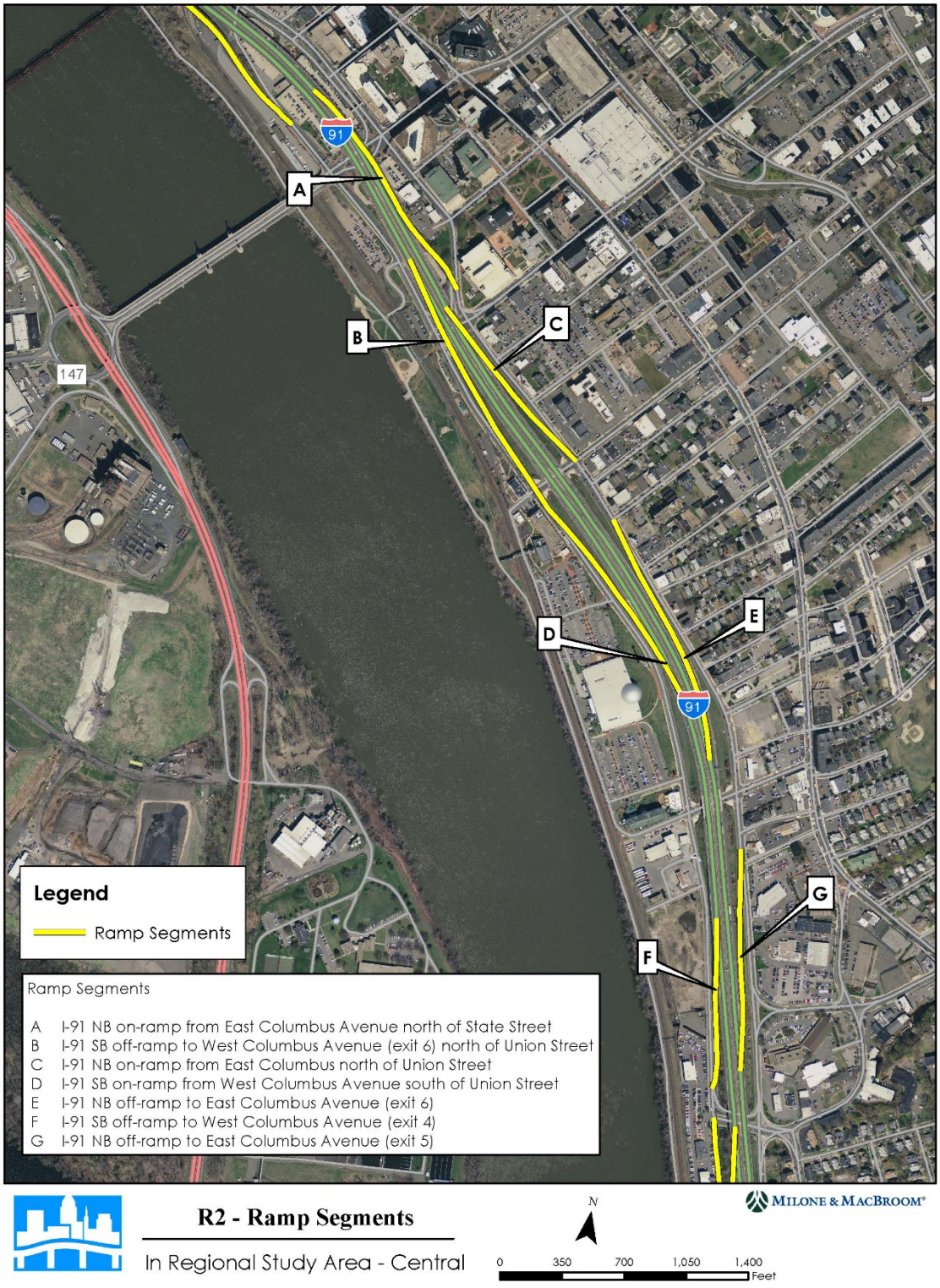


Figure 2-16: R2 Ramp Segements

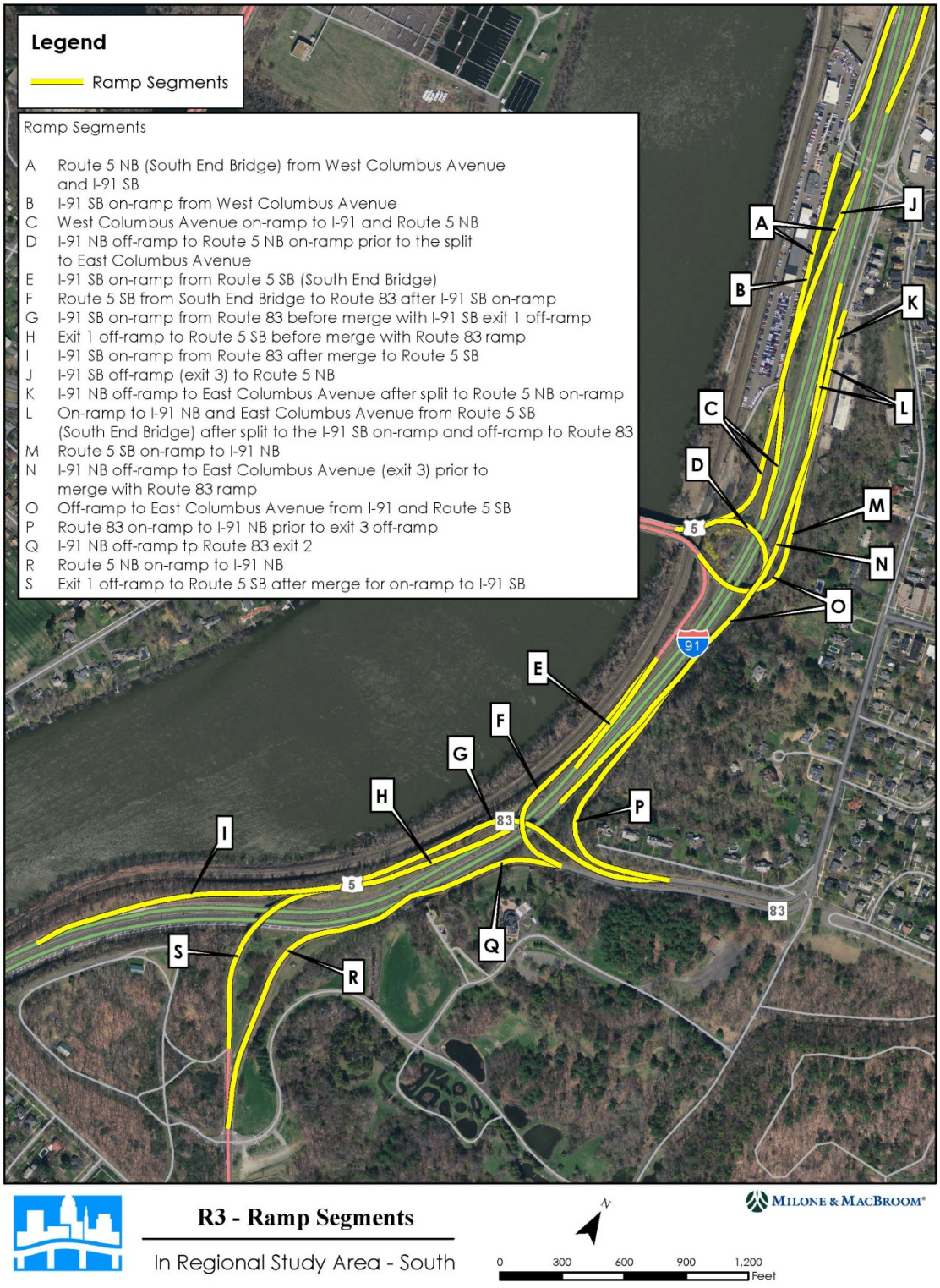


Figure 2-17: R3 Ramp Segments

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.

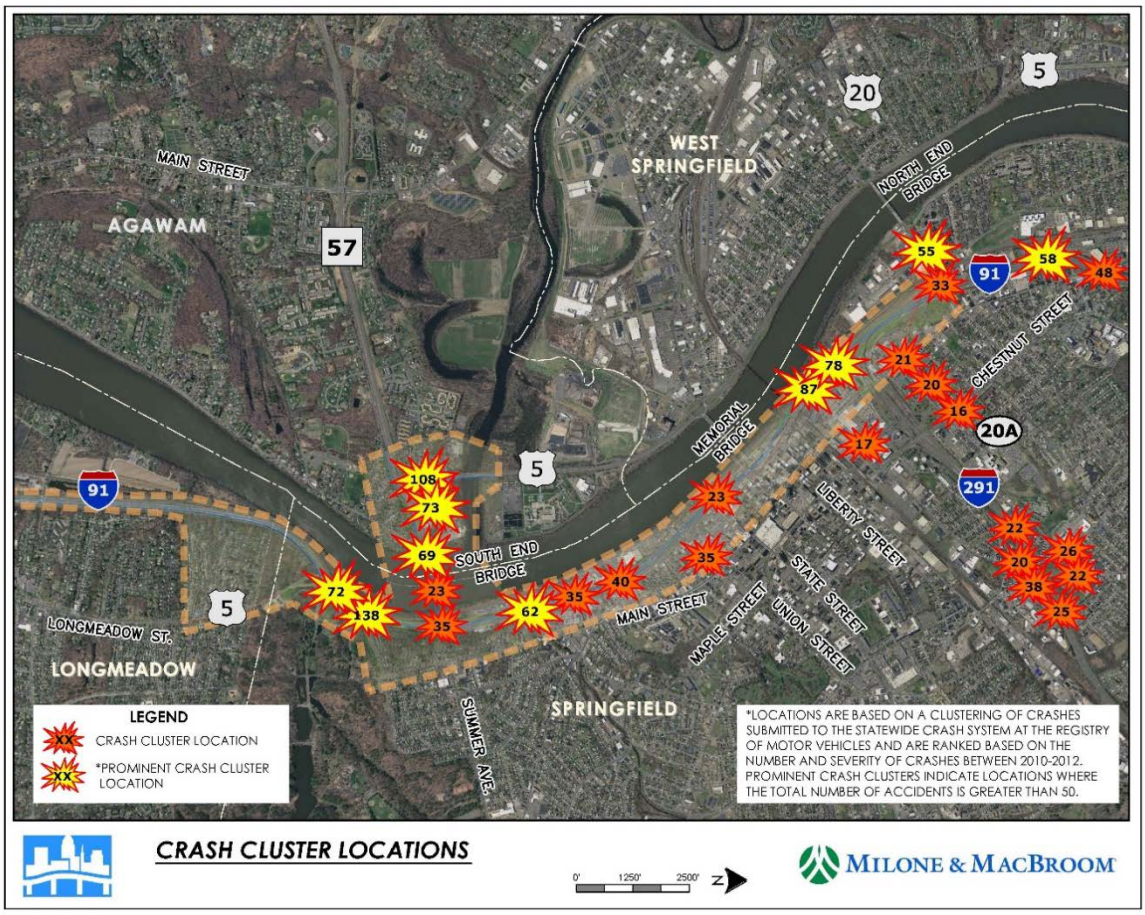


Figure 2-20: Crash Clusters

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.

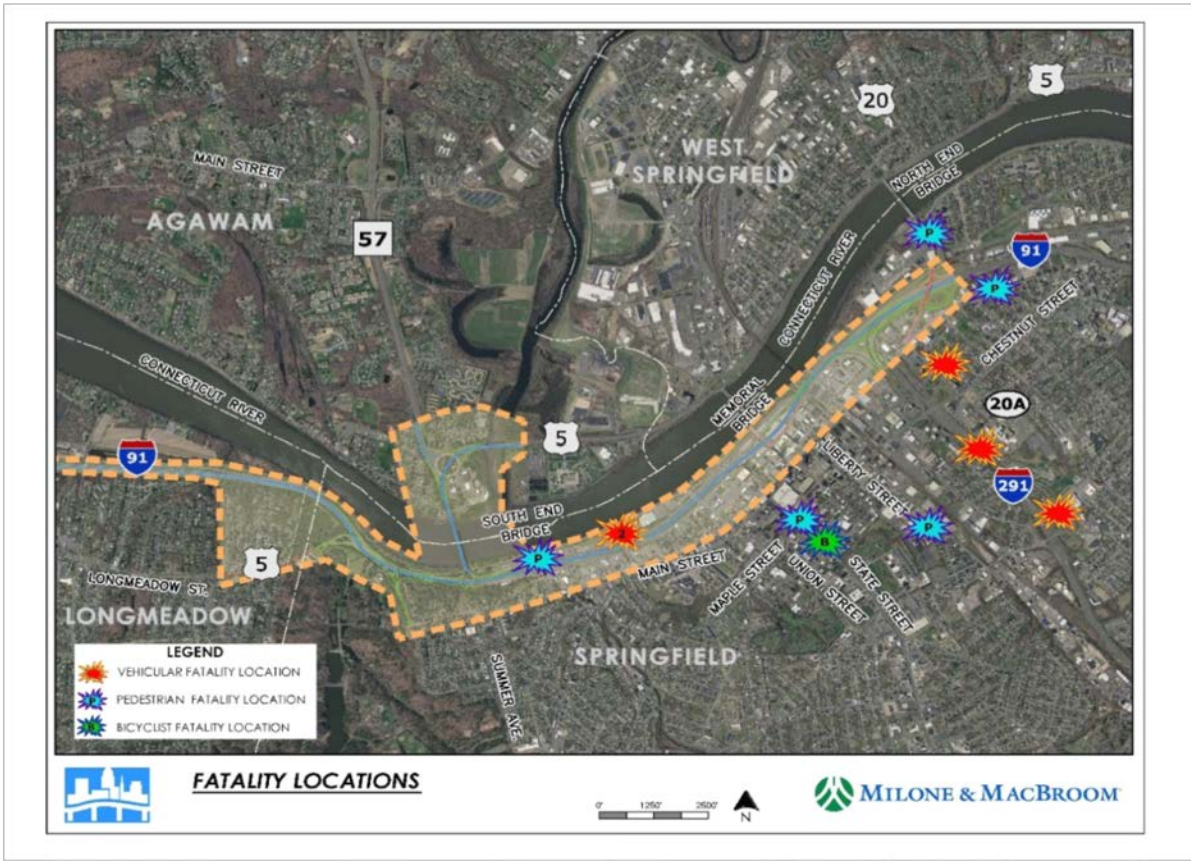


Figure 2-21: Fatality Locations

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	-

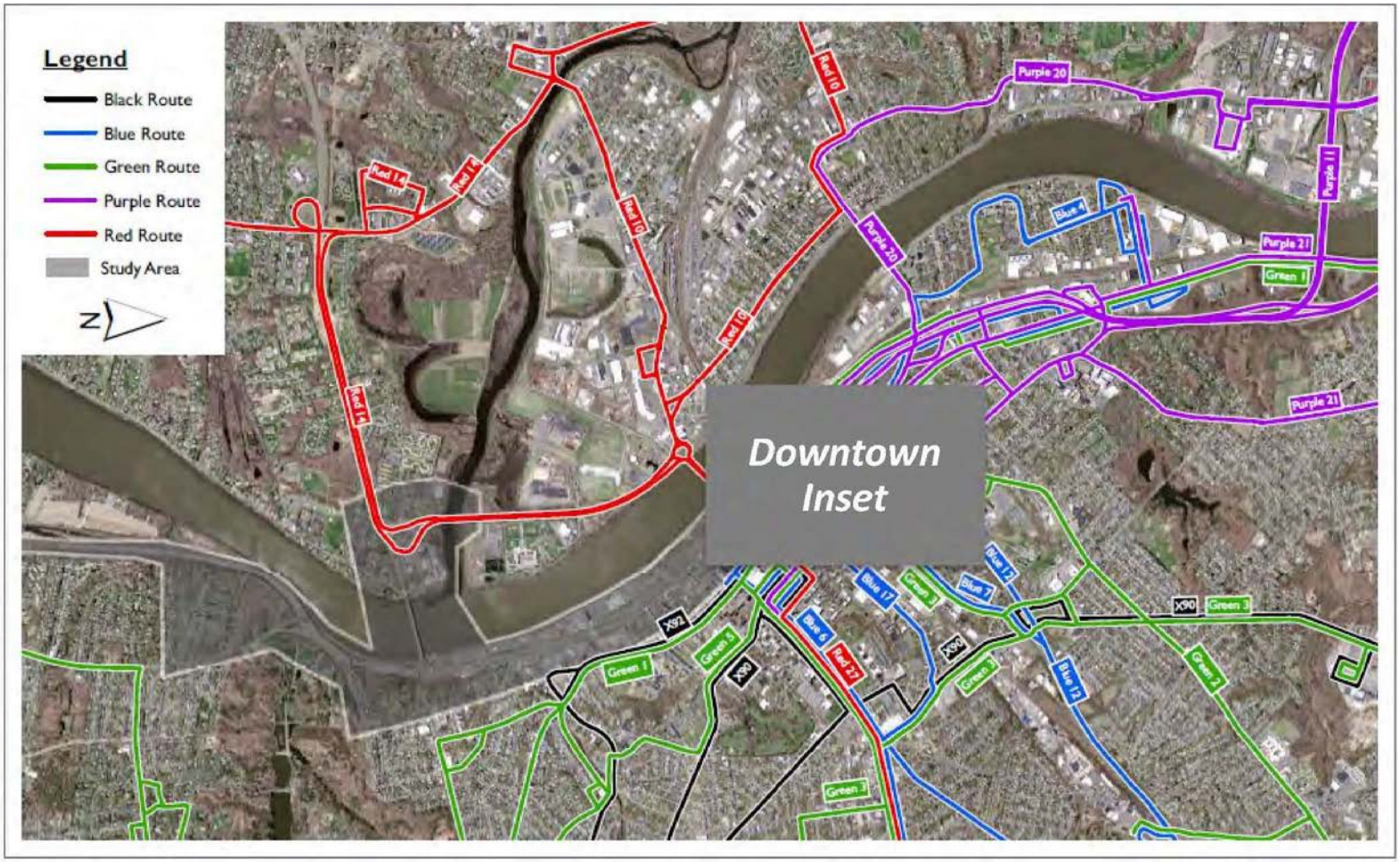


Figure 2-22: PVTA Springfield Routes

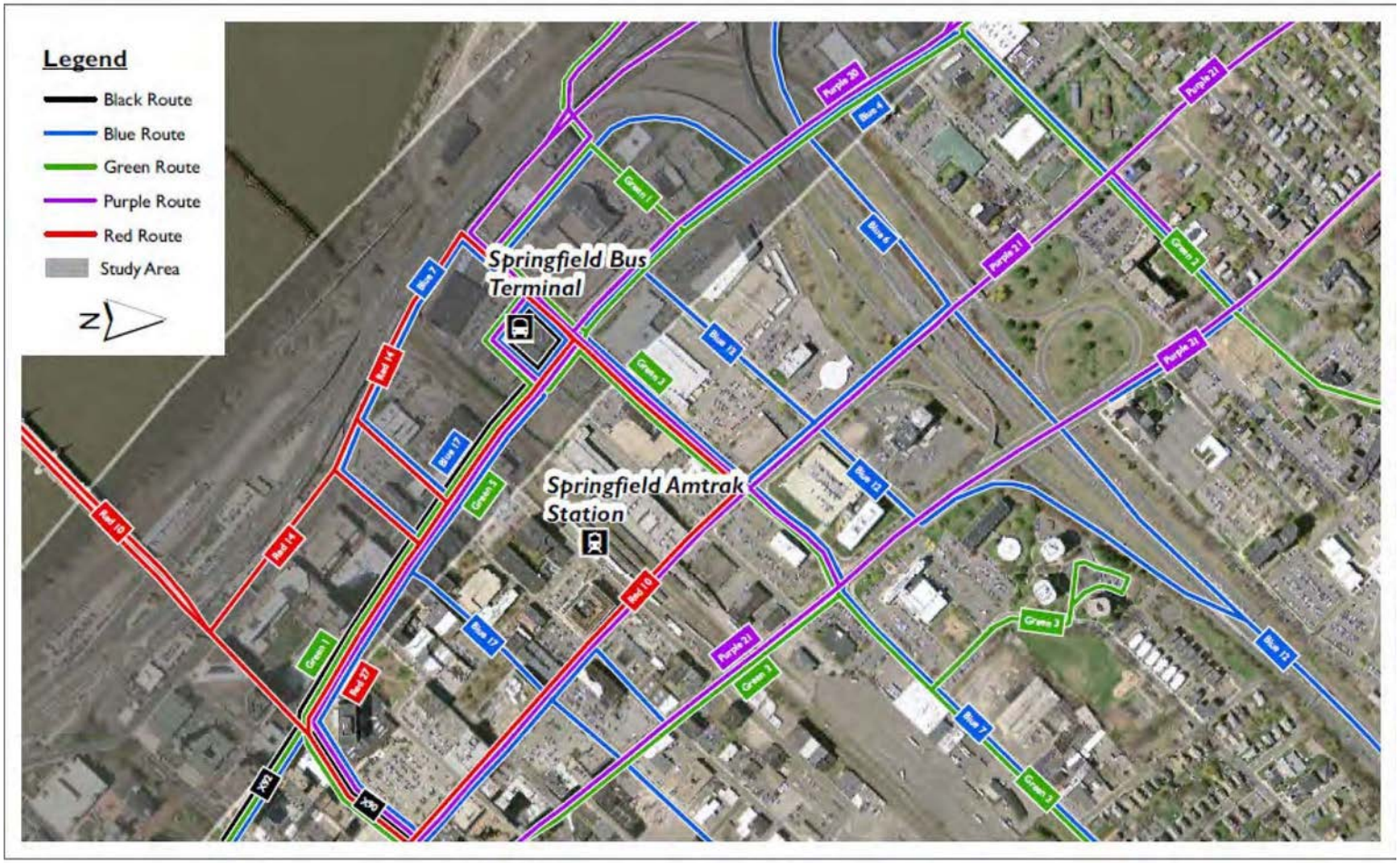


Figure 2-23: PVTA Springfield Routes (Downtown Inset)

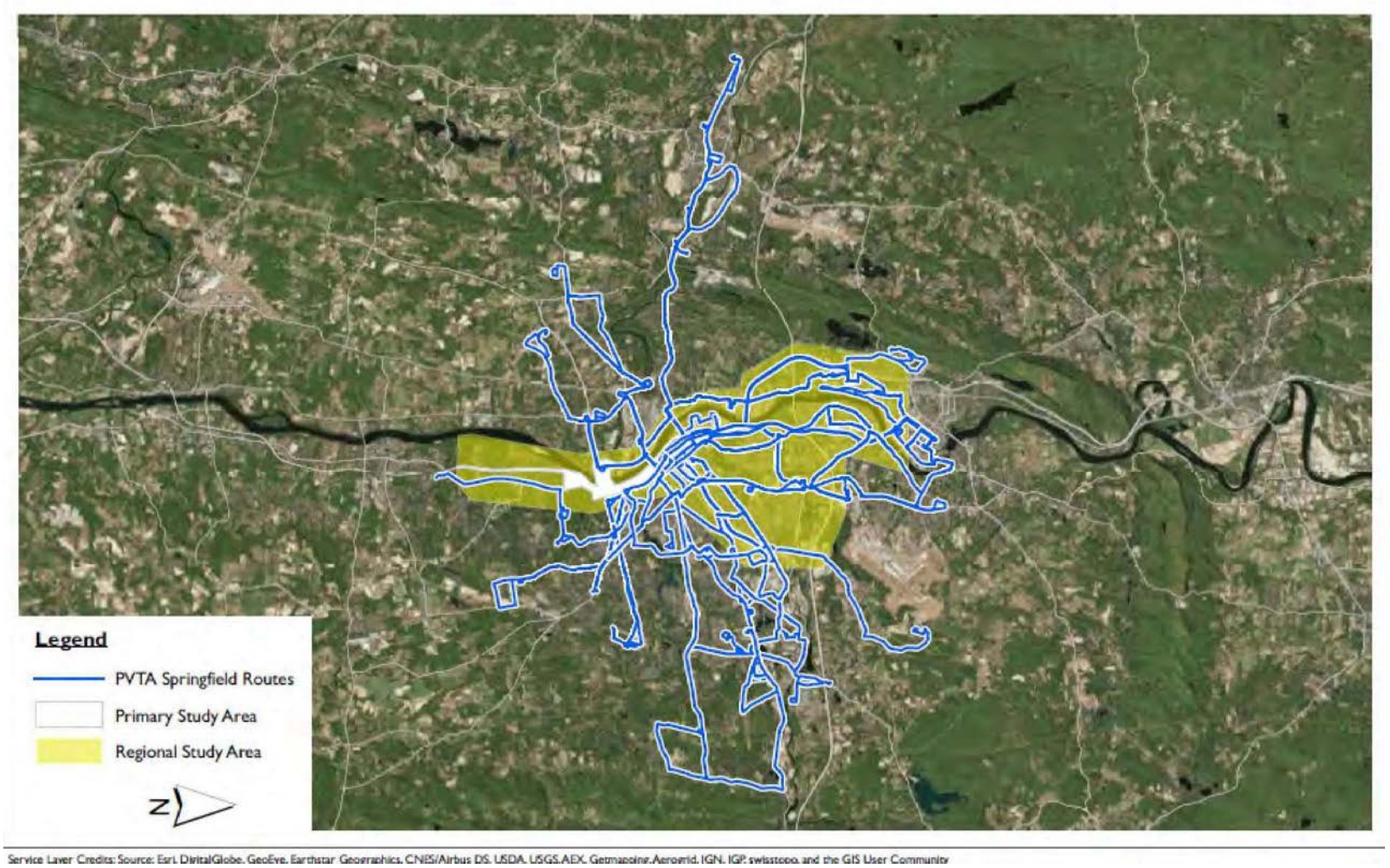


Figure 2-24: PVTA Regional Extent (covers both the Regional Study Area and Primary Study Area)

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.

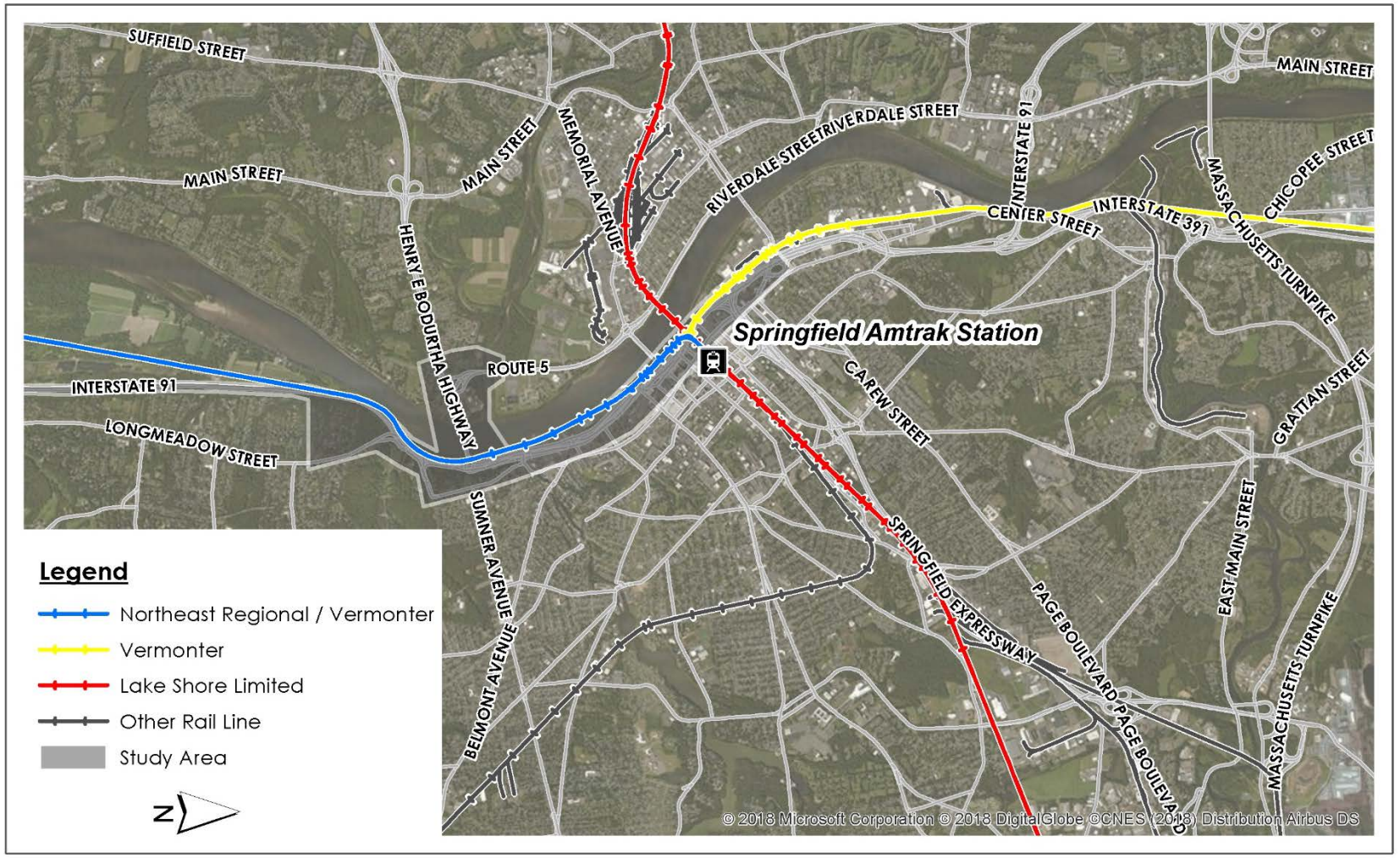


Figure 2-26: Existing Rail Routes

Source: Amtrak

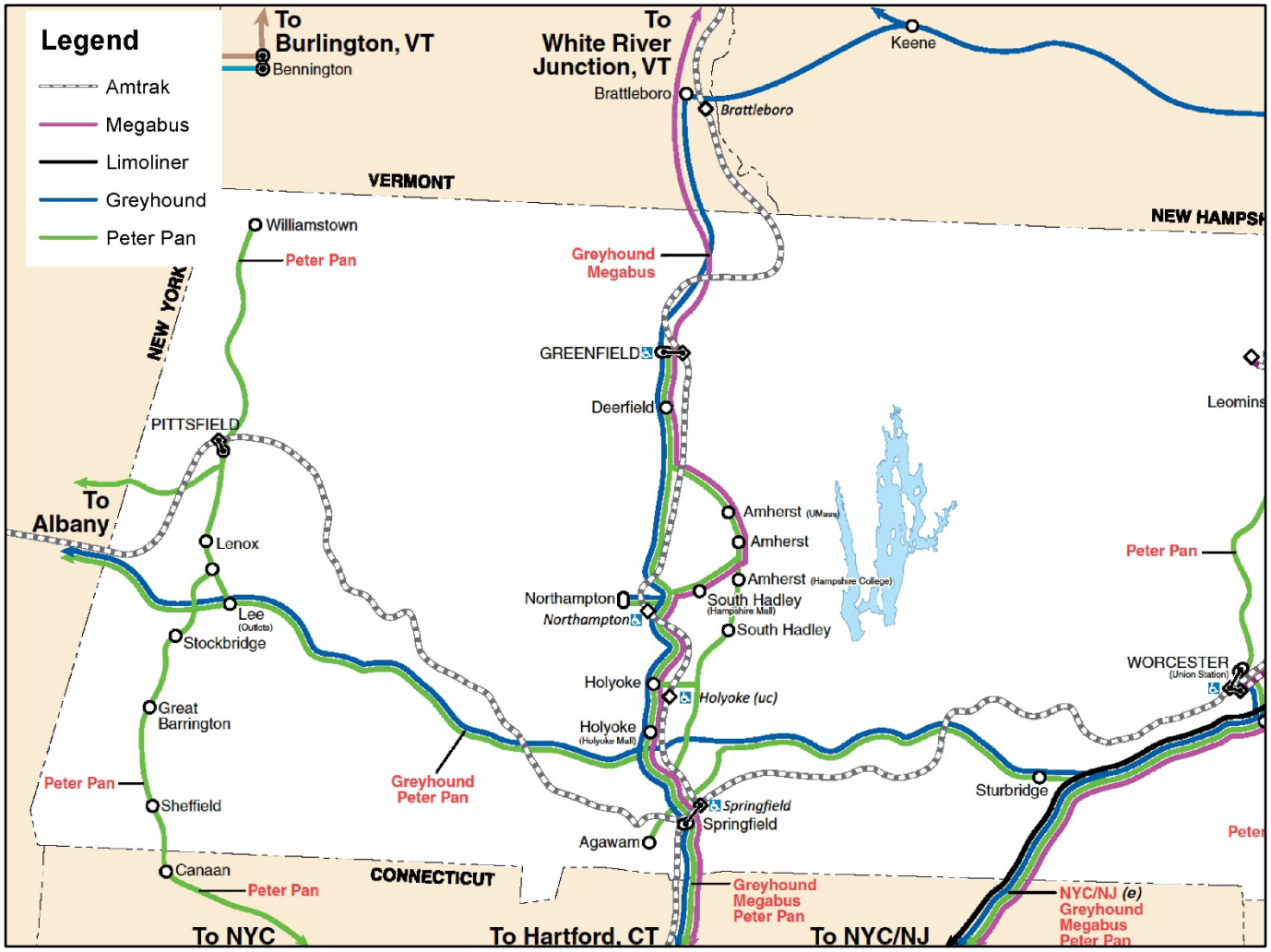


Figure 2-27: Regional Rail and Bus Service

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]

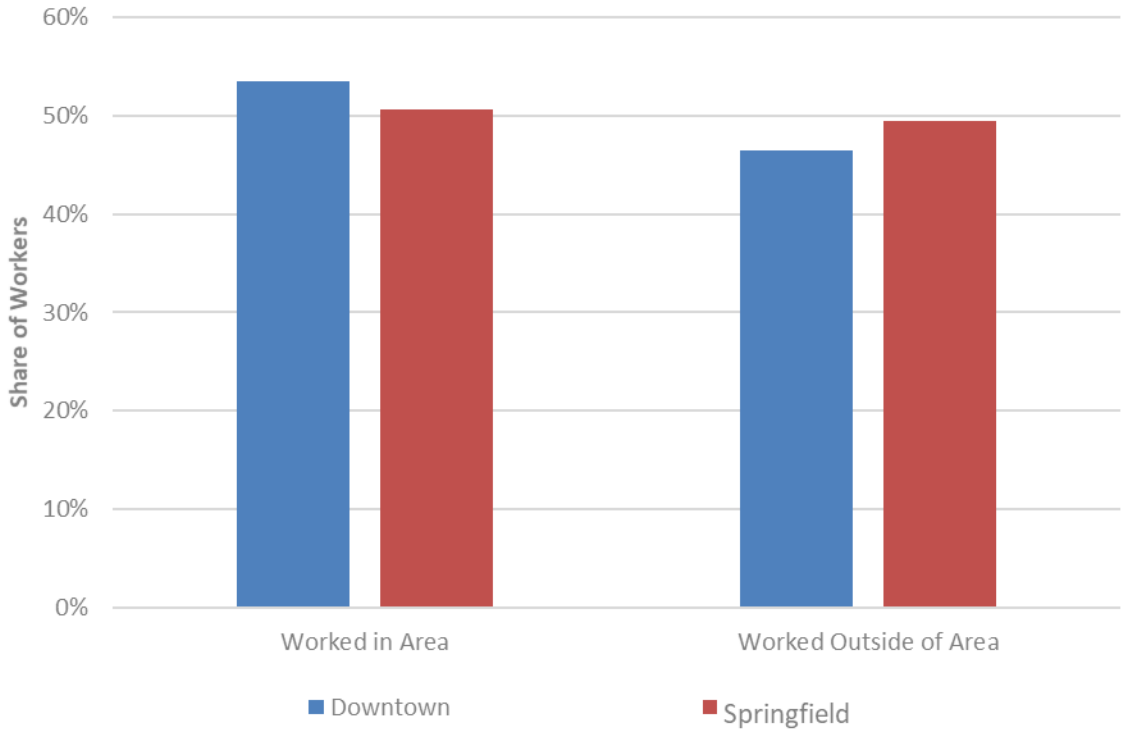


Figure 2-28: Place of Work of Residents – Downtown Census Tracts and Springfield as a Whole

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.

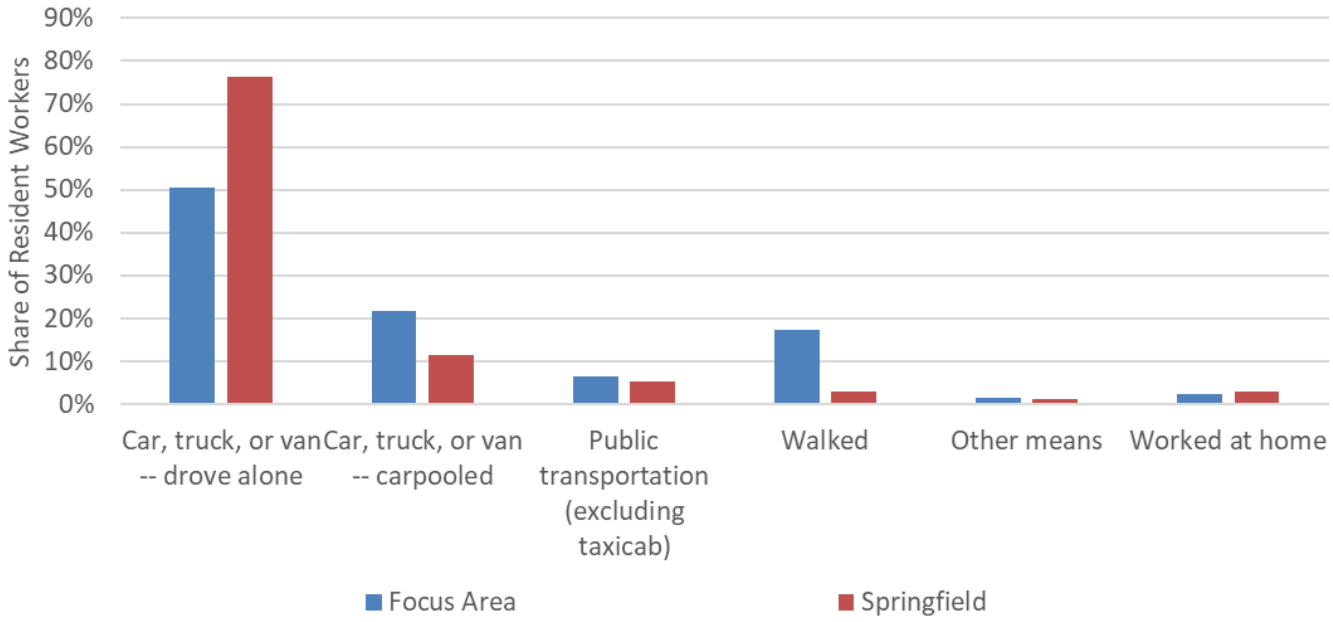


Figure 2-29: Journey to Work by Travel Mode – Downtown Census Tracts and Springfield Residents

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

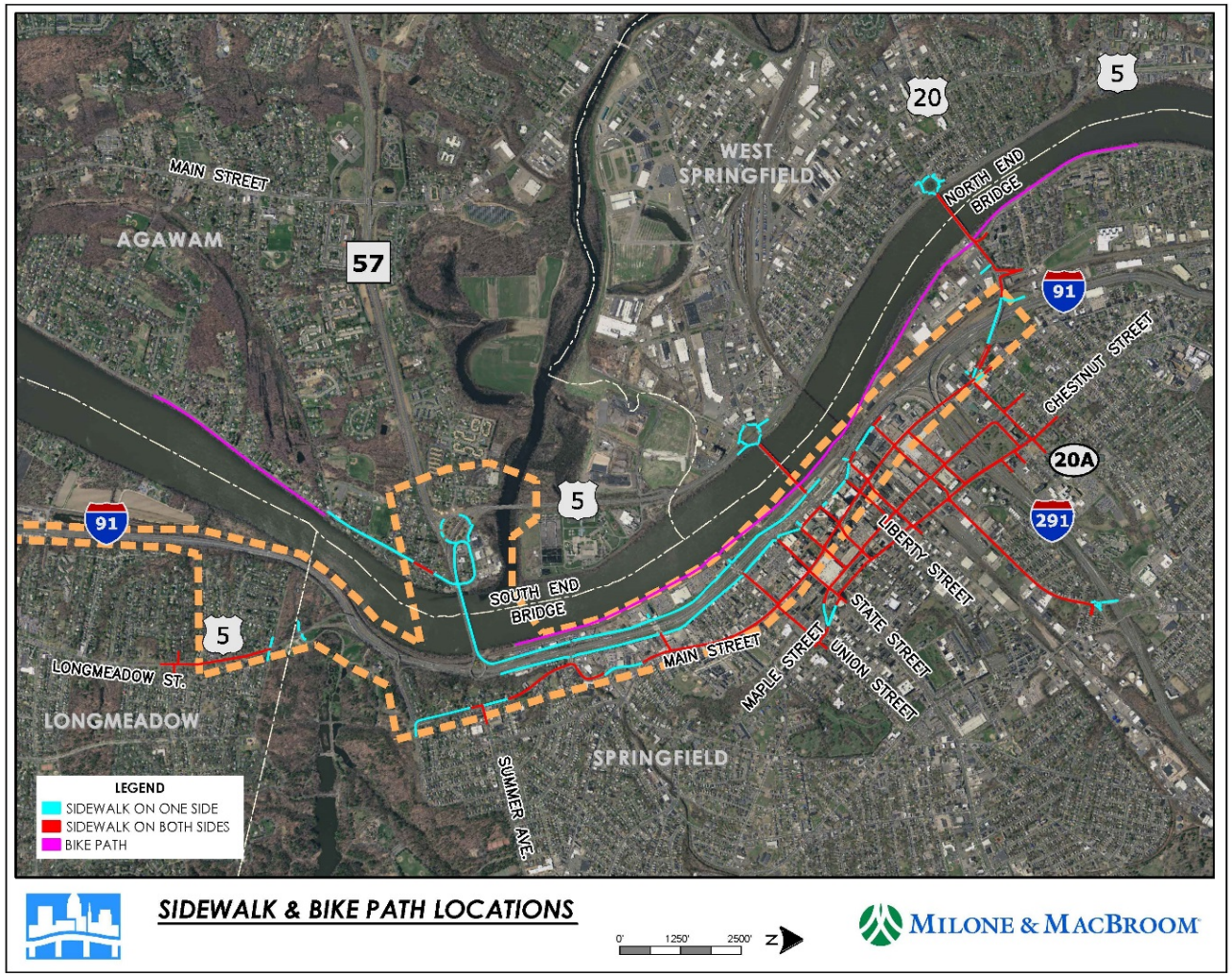


Figure 2-36: Sidewalk and Bike Path Locations

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 functional since 2013 in the warm weather months,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

There are three freight lines within the study areas. The East-West rail corridor is owned by CSX, known as the Berkshire Subdivision, includes CSX freight and limited trackage rights for CT Central Railroad and Pan Am Railroad. The southern line, owned by Amtrak and known as the Springfield Line, is operated by the CT Central Railroad and may include limited trackage rights for an additional operator. The northern line is owned by MassDOT and known as the Connecticut River Main Line.

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.

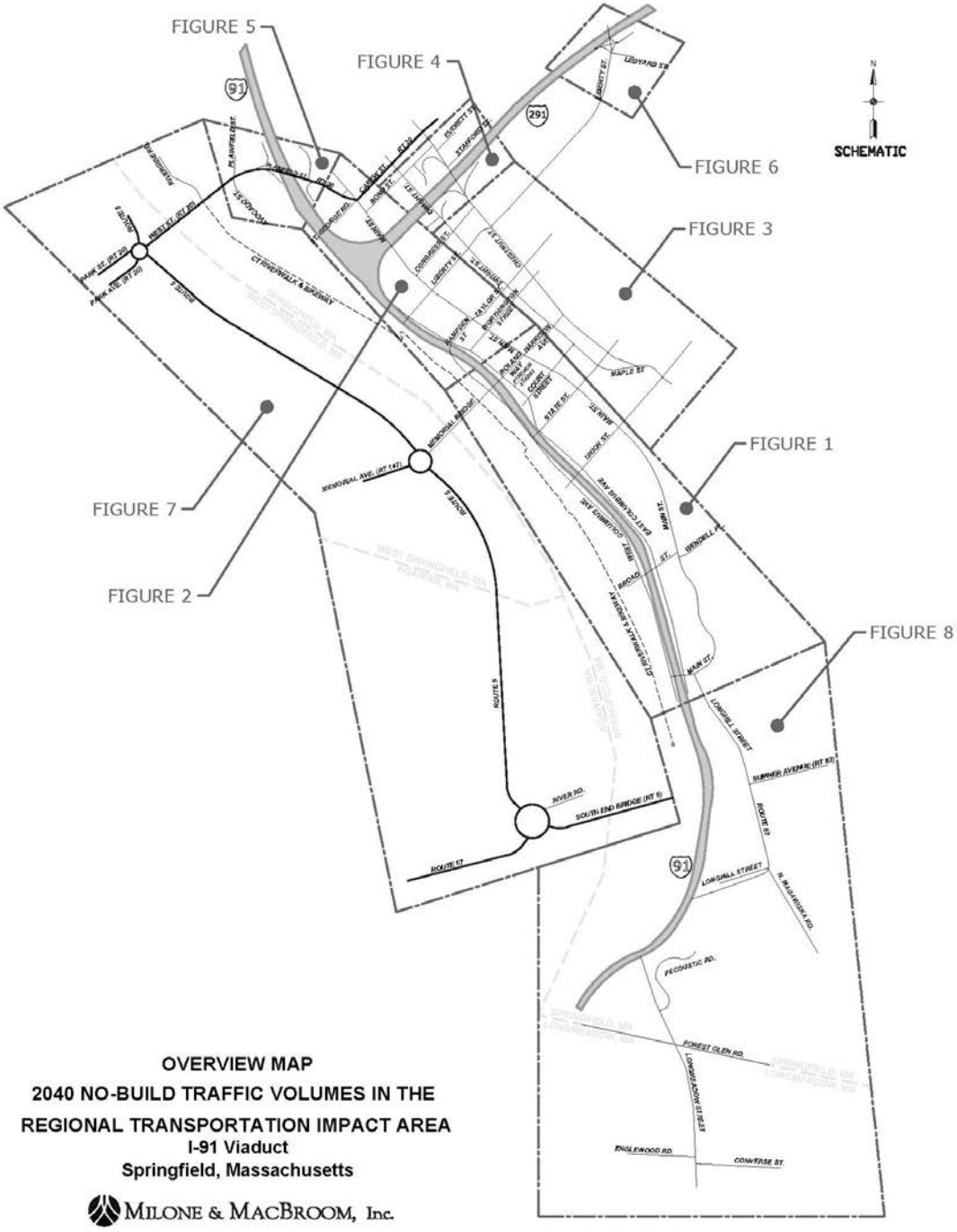


Figure 2-44: 2040 No-Build Traffic Volumes – Overview Map

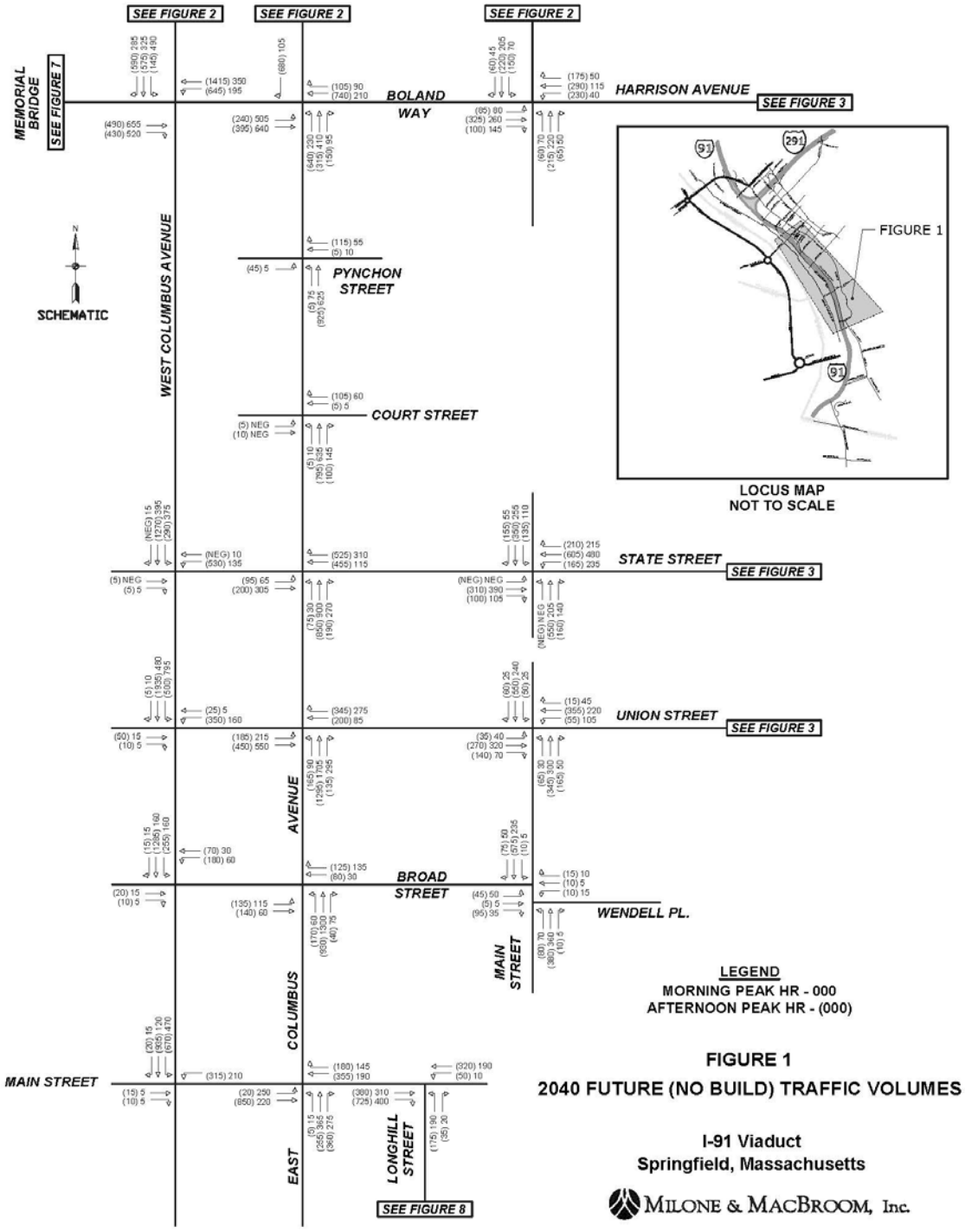


Figure 2-45: 2040 No-Build Traffic Volumes Map – #1

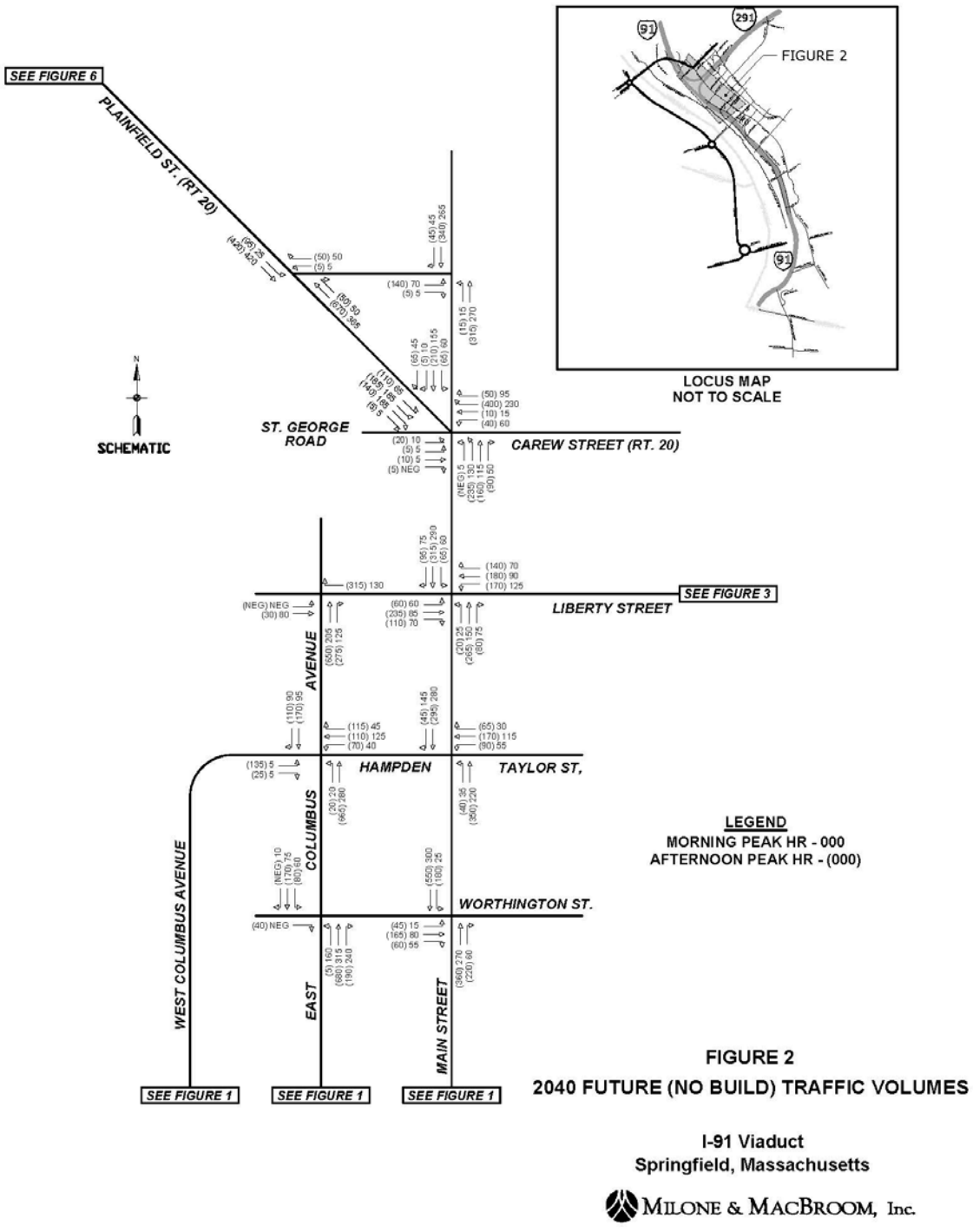


Figure 2-46: 2040 No-Build Traffic Volumes Map – #2

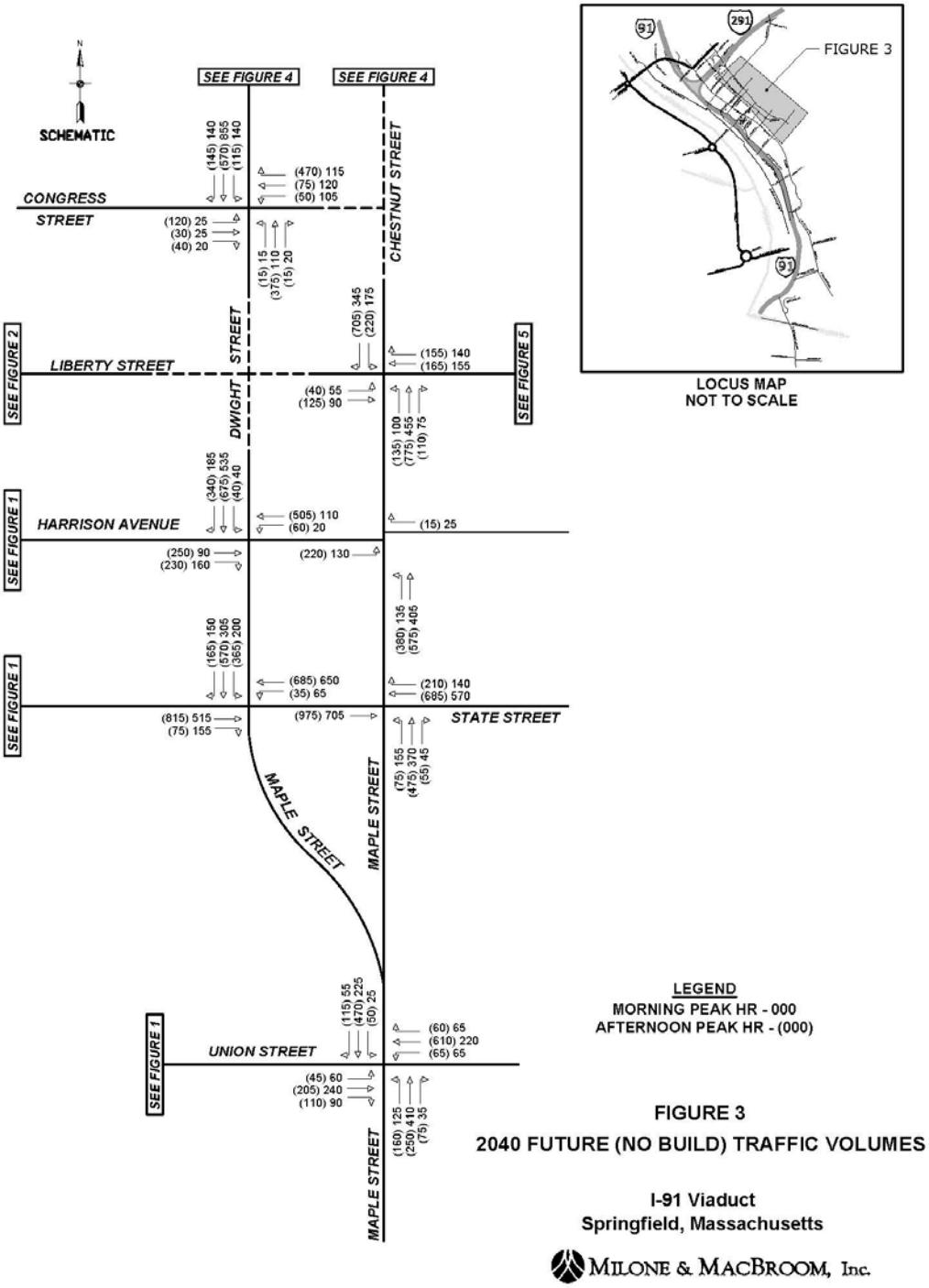


Figure 2-47: 2040 No-Build Traffic Volumes Map – #3

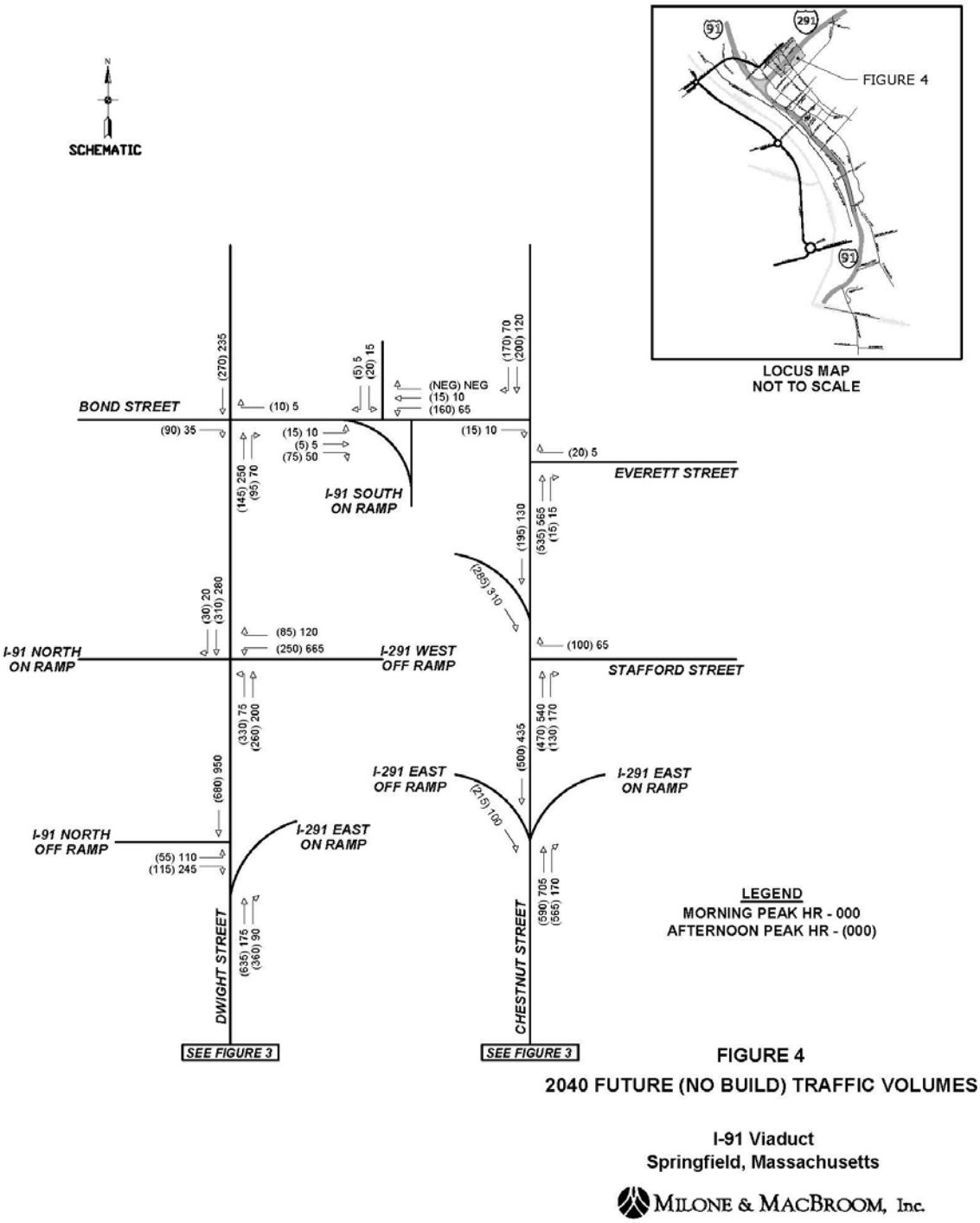


Figure 2-48: 2040 No-Build Traffic Volumes Map – #4

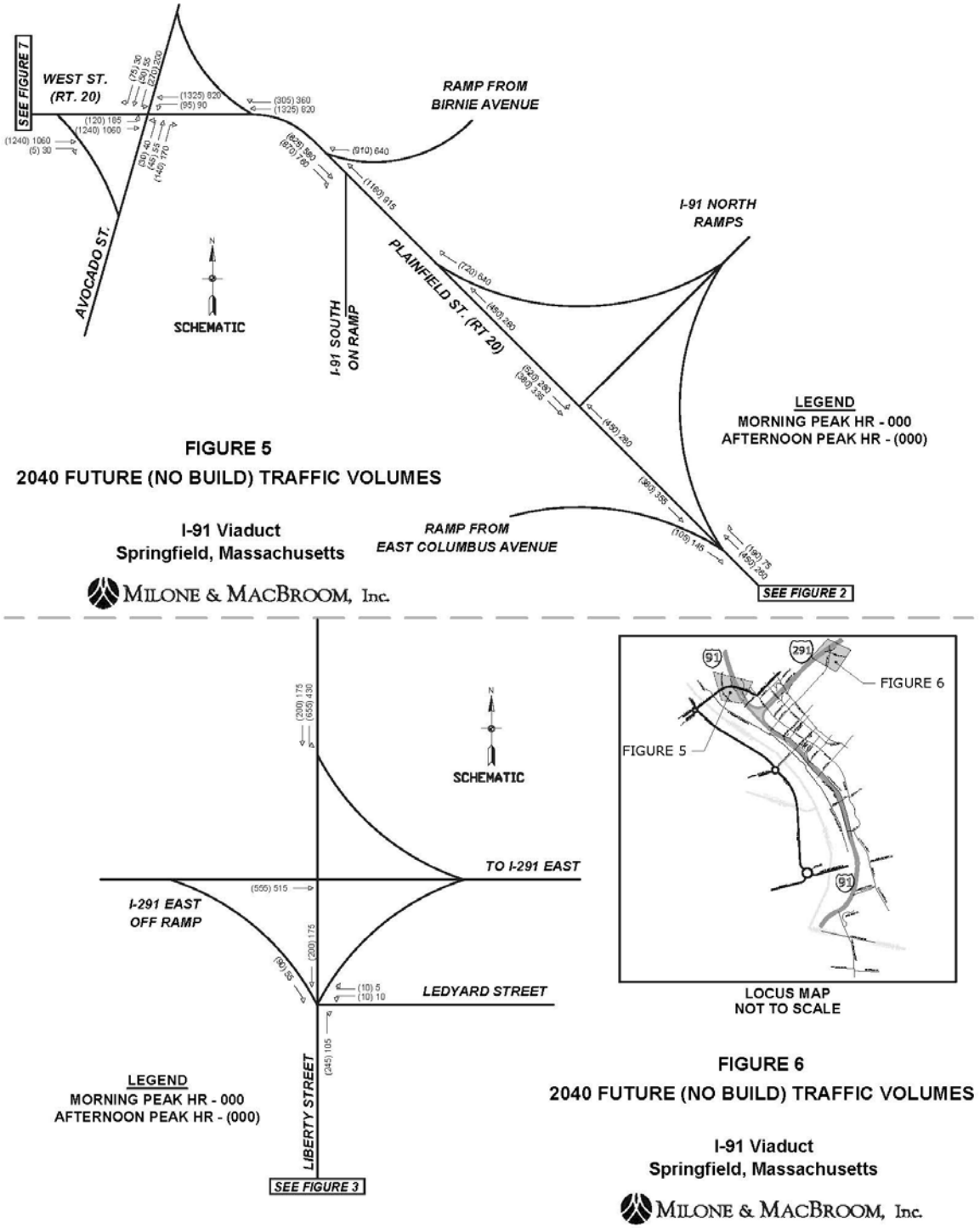


Figure 2-49: 2040 No-Build Traffic Volumes Map – #5 and #6

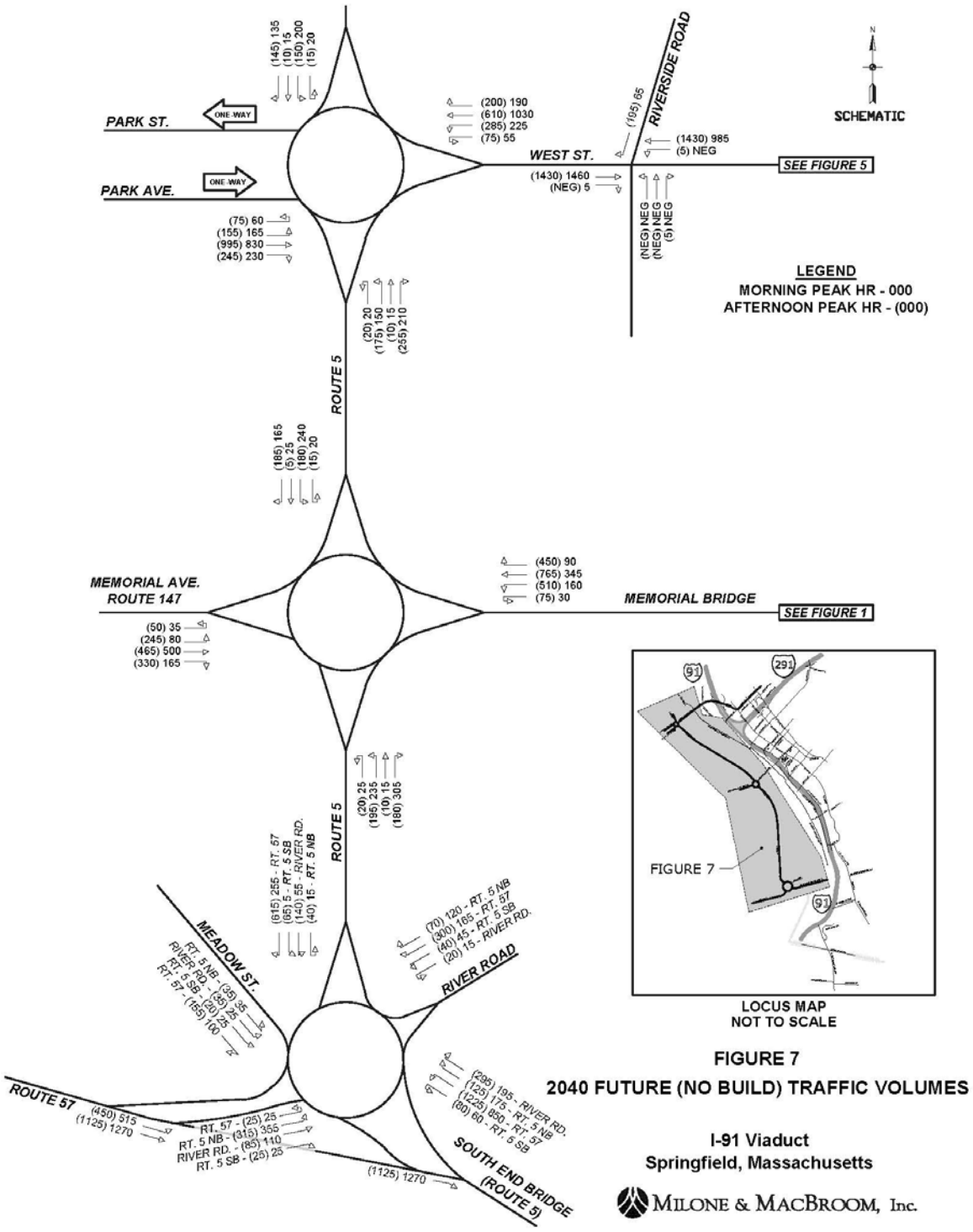


Figure 2-50: 2040 No-Build Traffic Volumes Map – #7

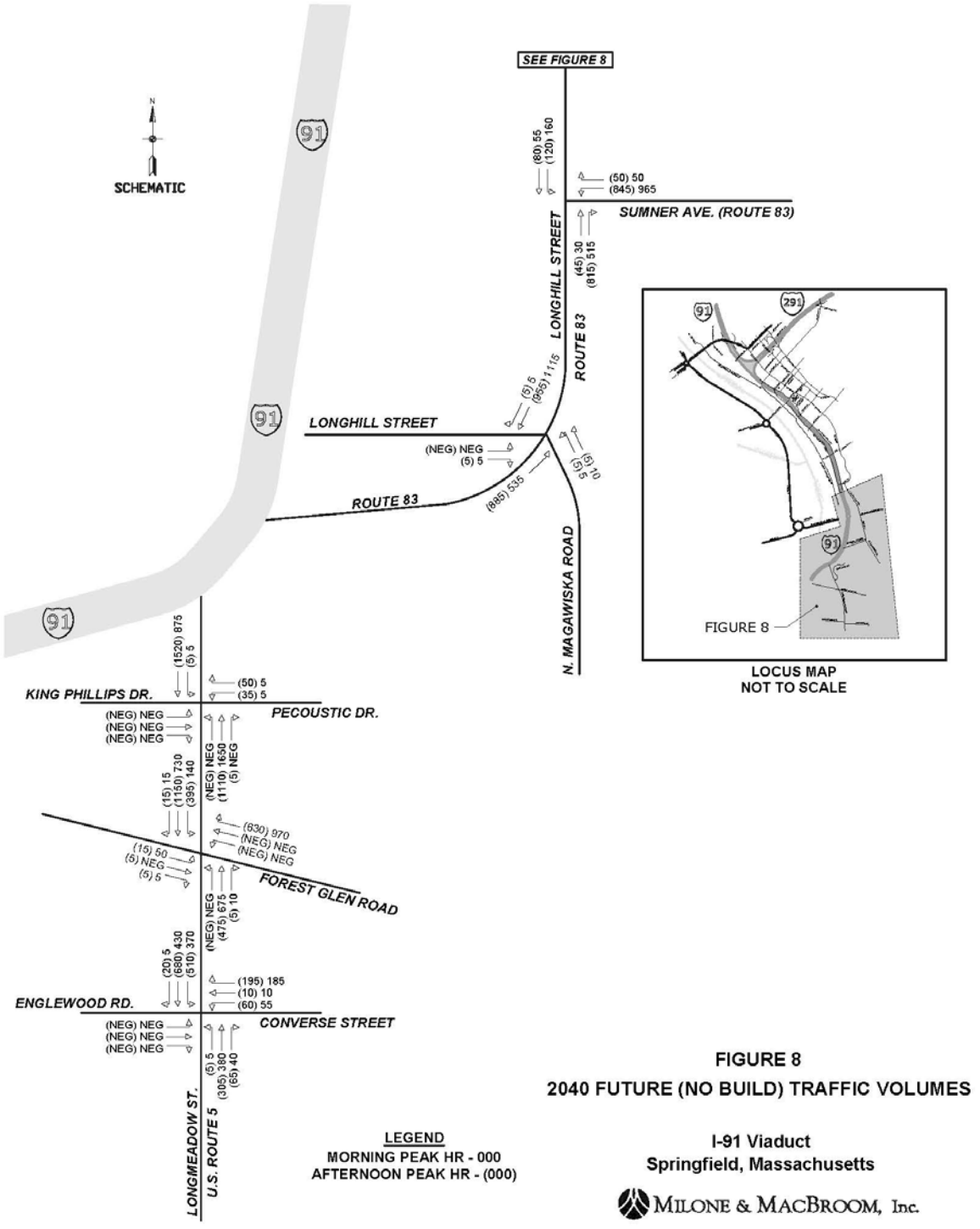


Figure 2-51: 2040 No-Build Traffic Volumes Map – #8

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.

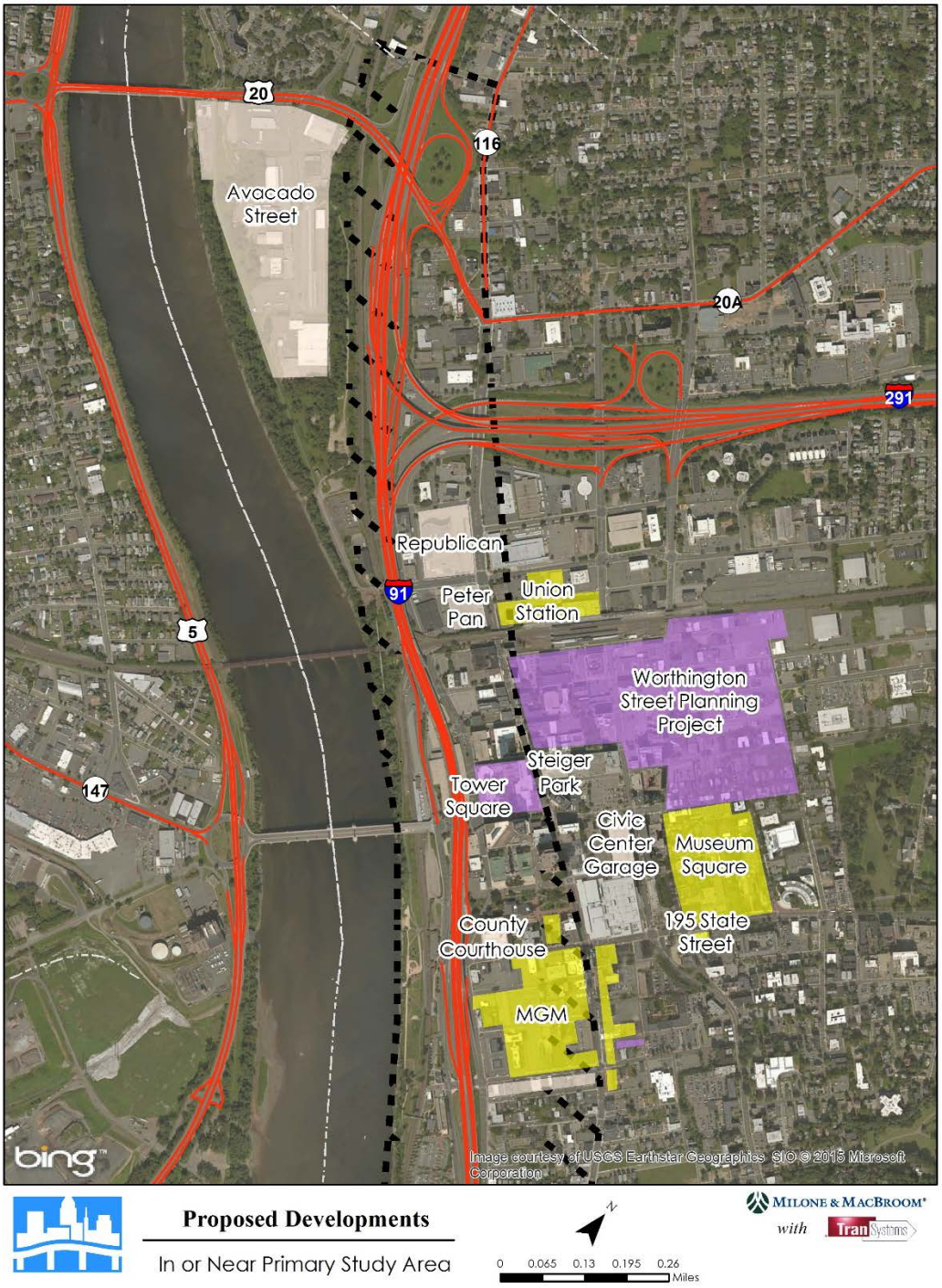


Figure 2-52: Proposed Development Projects in the Vicinity of the Primary Study Area

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.

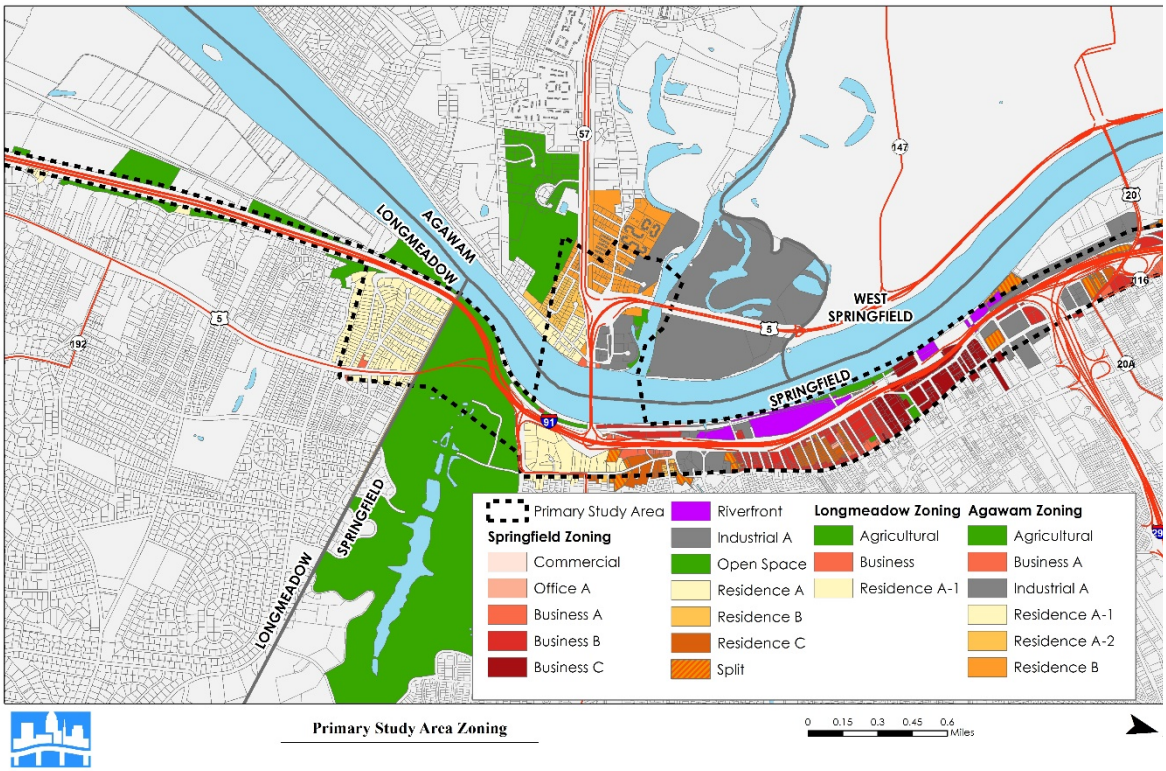


Figure 2-54: Primary Study Area Zoning

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."

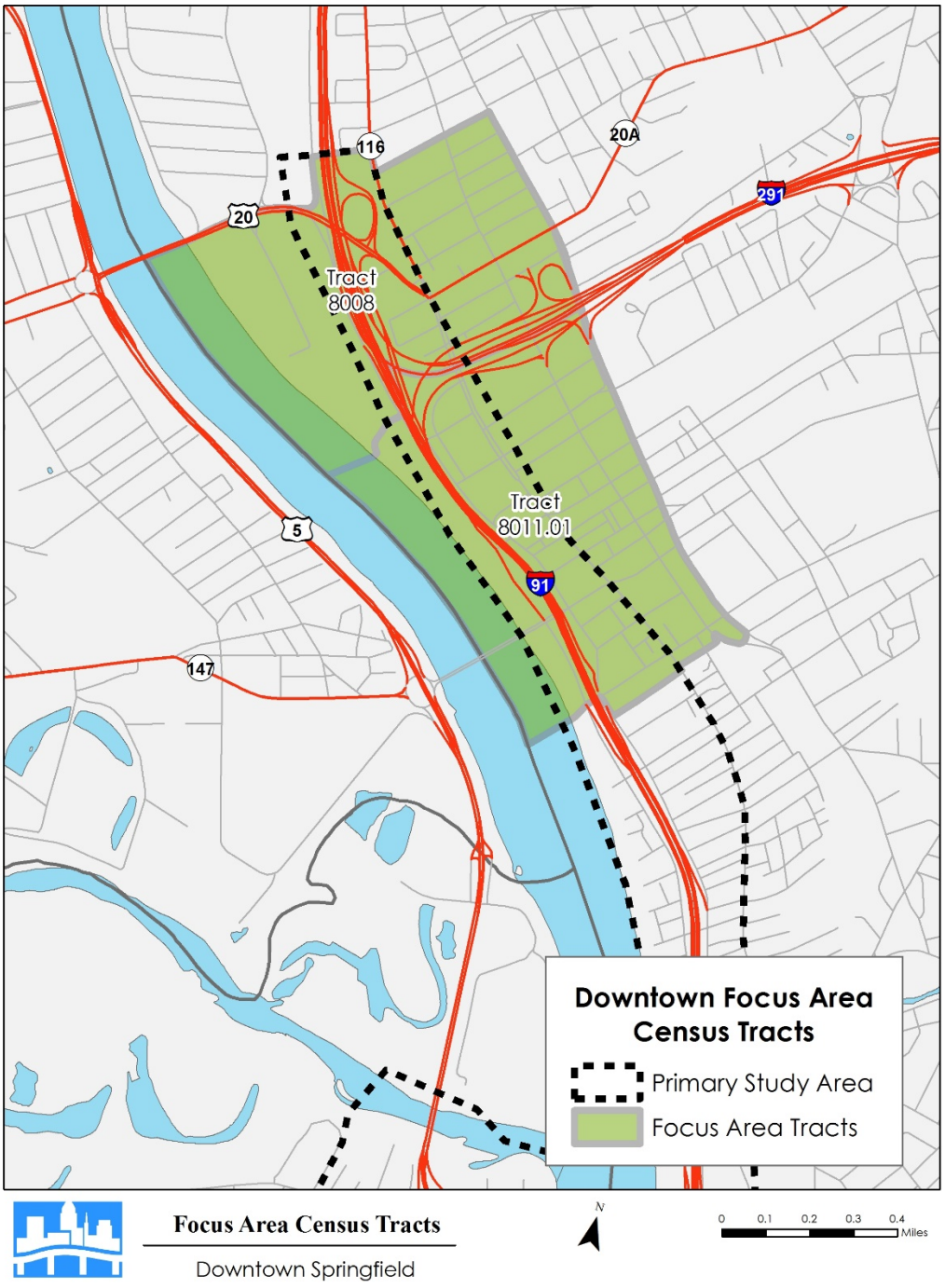


Figure 2-55: Map of Downtown Census Tracts, Encompassing Tracts 8008 and 8011.01

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.

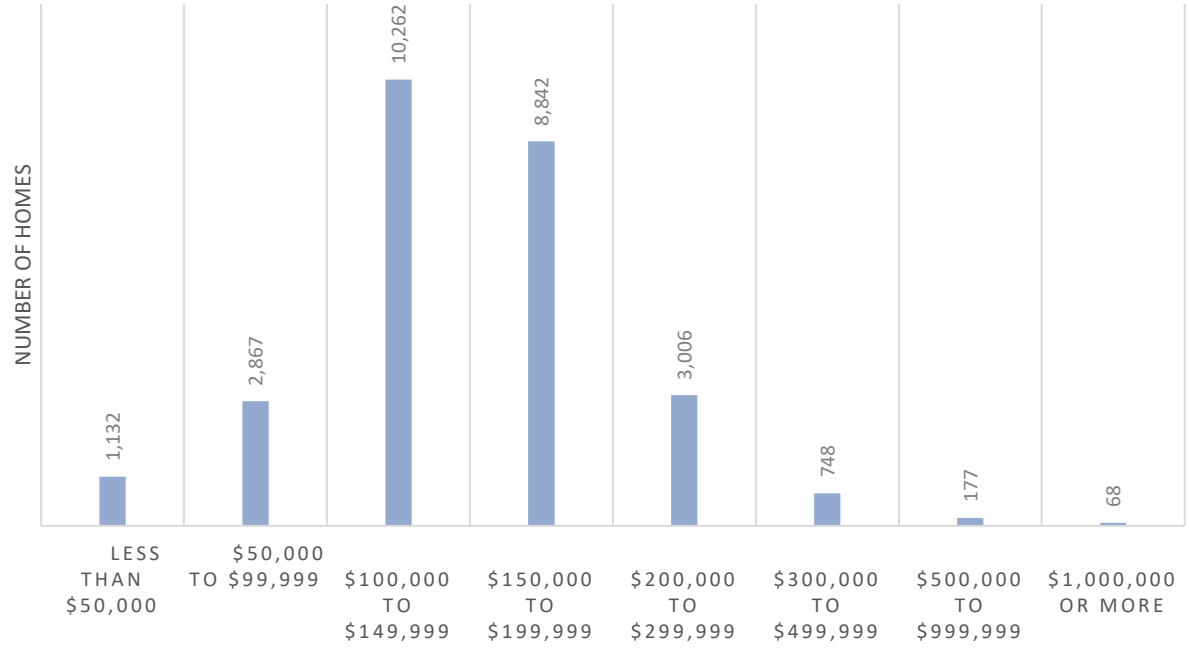


Figure 2-56: Housing Values – City of Springfield

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.

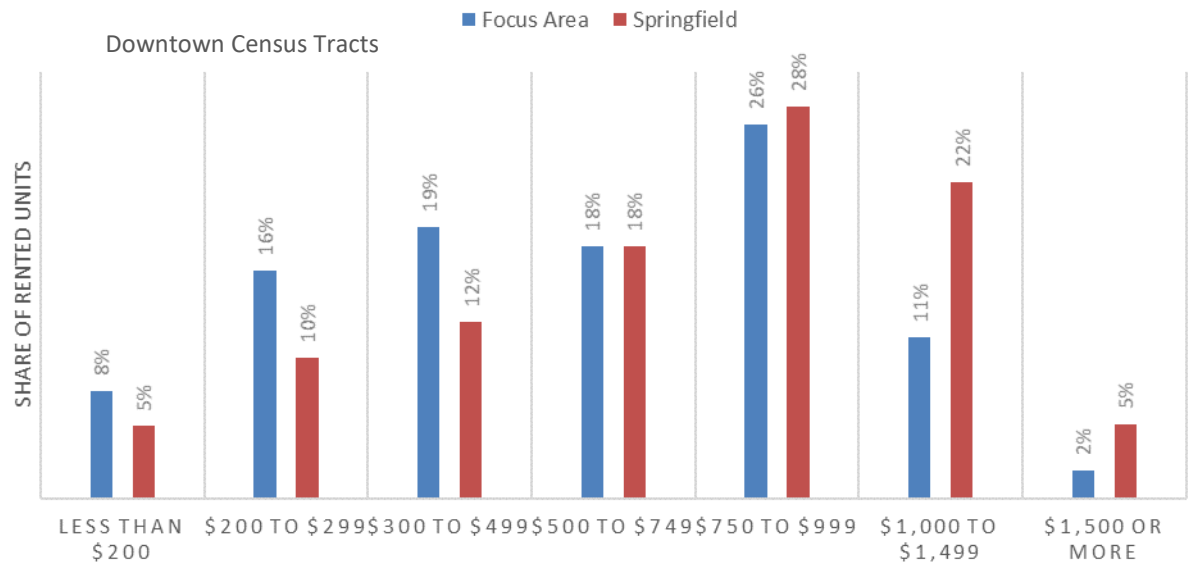


Figure 2-57: Gross Rent in Downtown Census Tracts and City of Springfield

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.

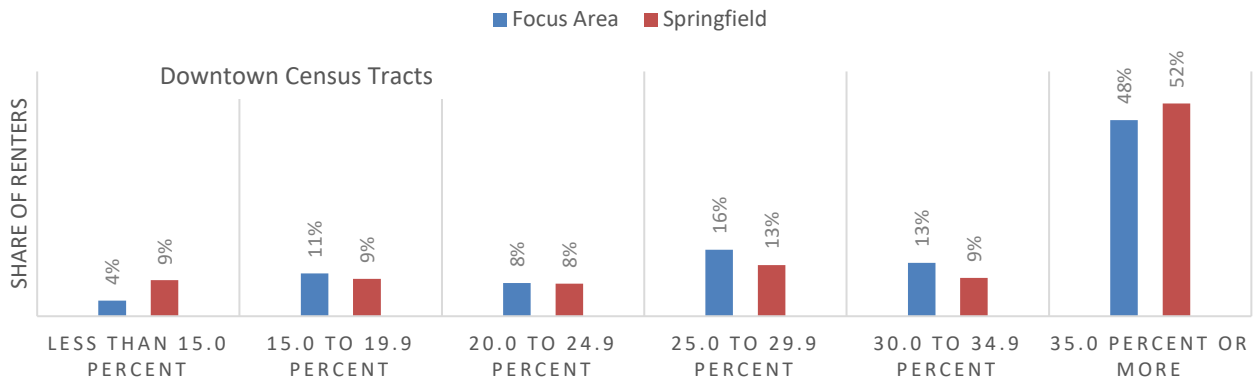


Figure 2-58: Gross Rent as a Percentage of Income

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%).

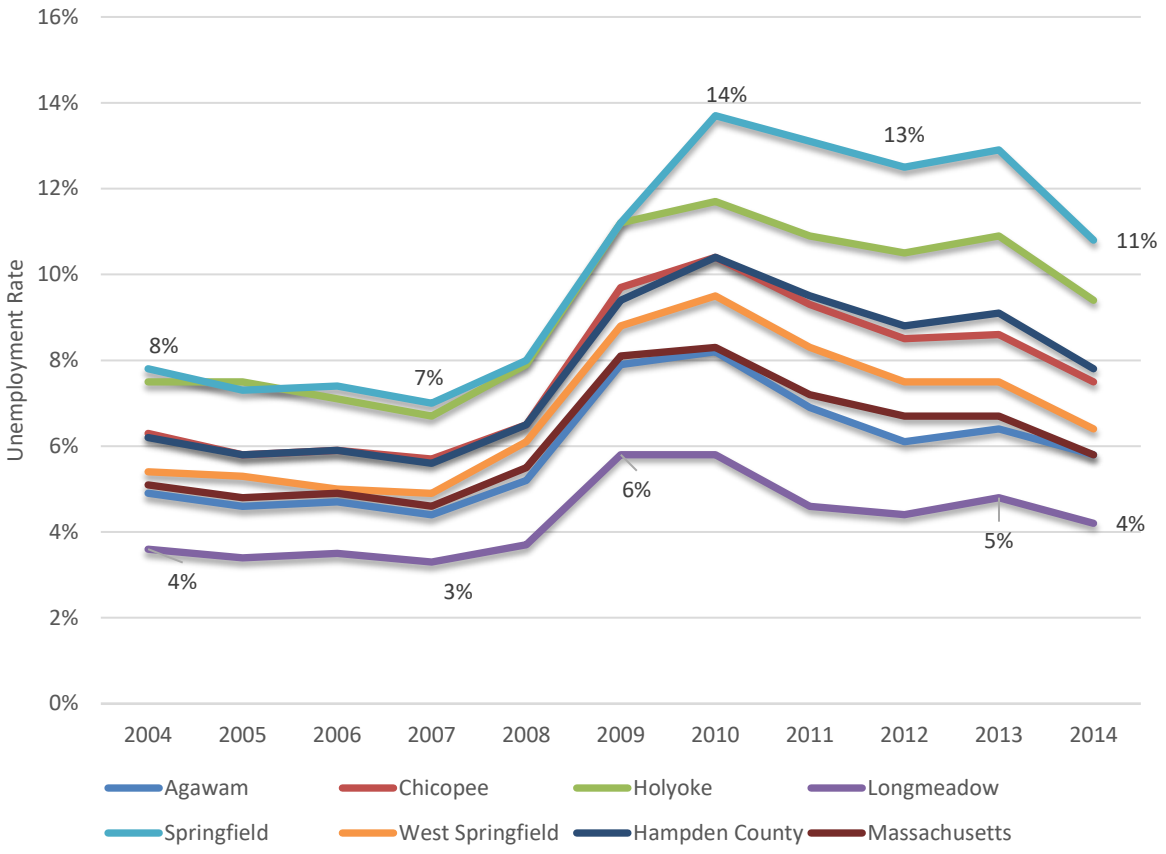


Figure 2-59: Unemployment Rate for Springfield and Other Areas

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%

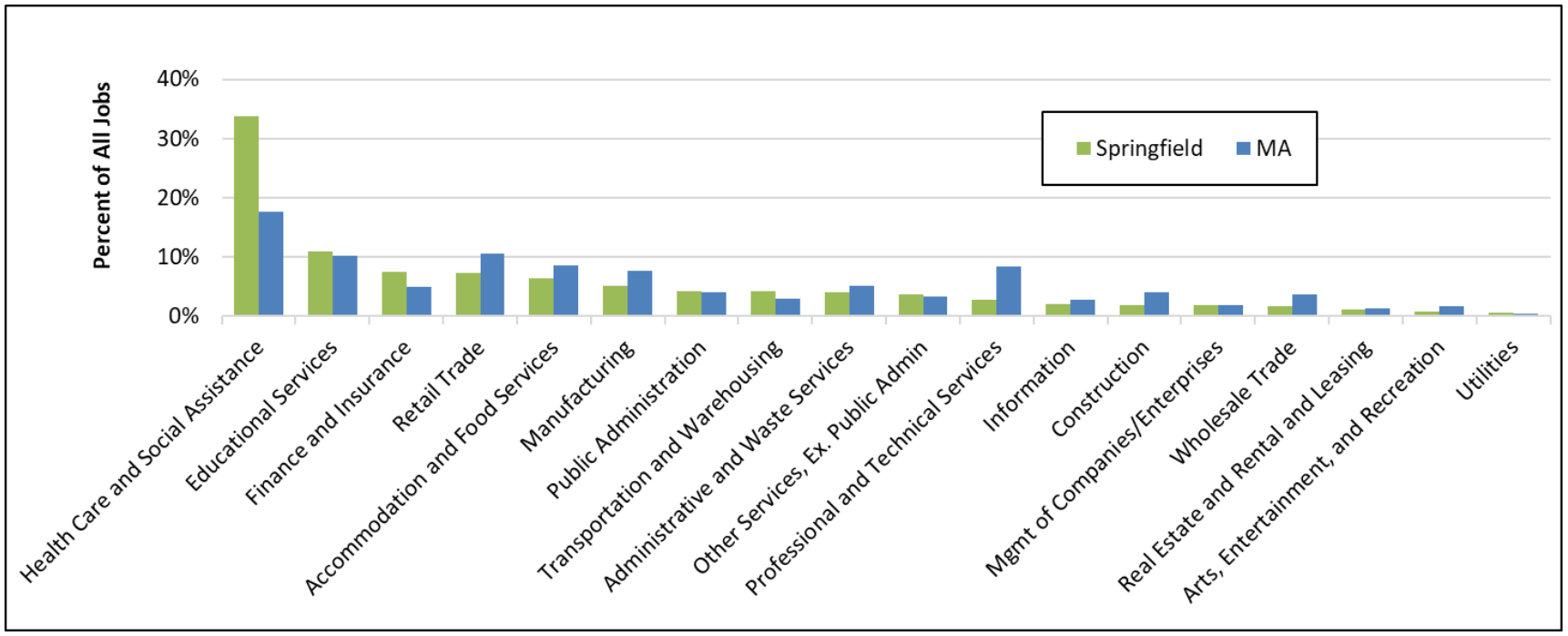
Source: MA Executive Office of Labor and Workforce Development, Annual Estimates

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.

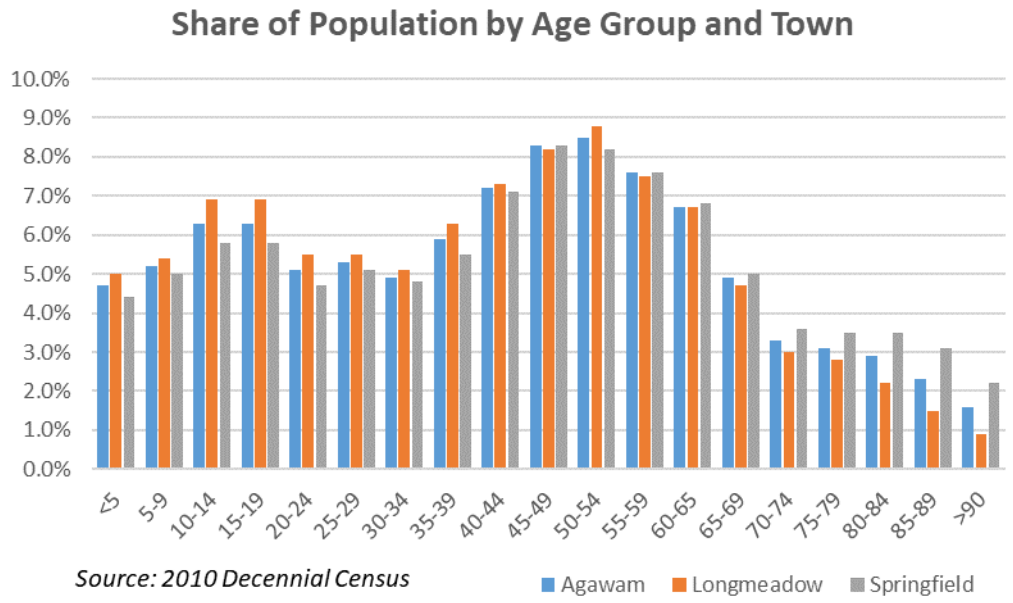


Figure 2-61: Percent of Population by Age Group

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.

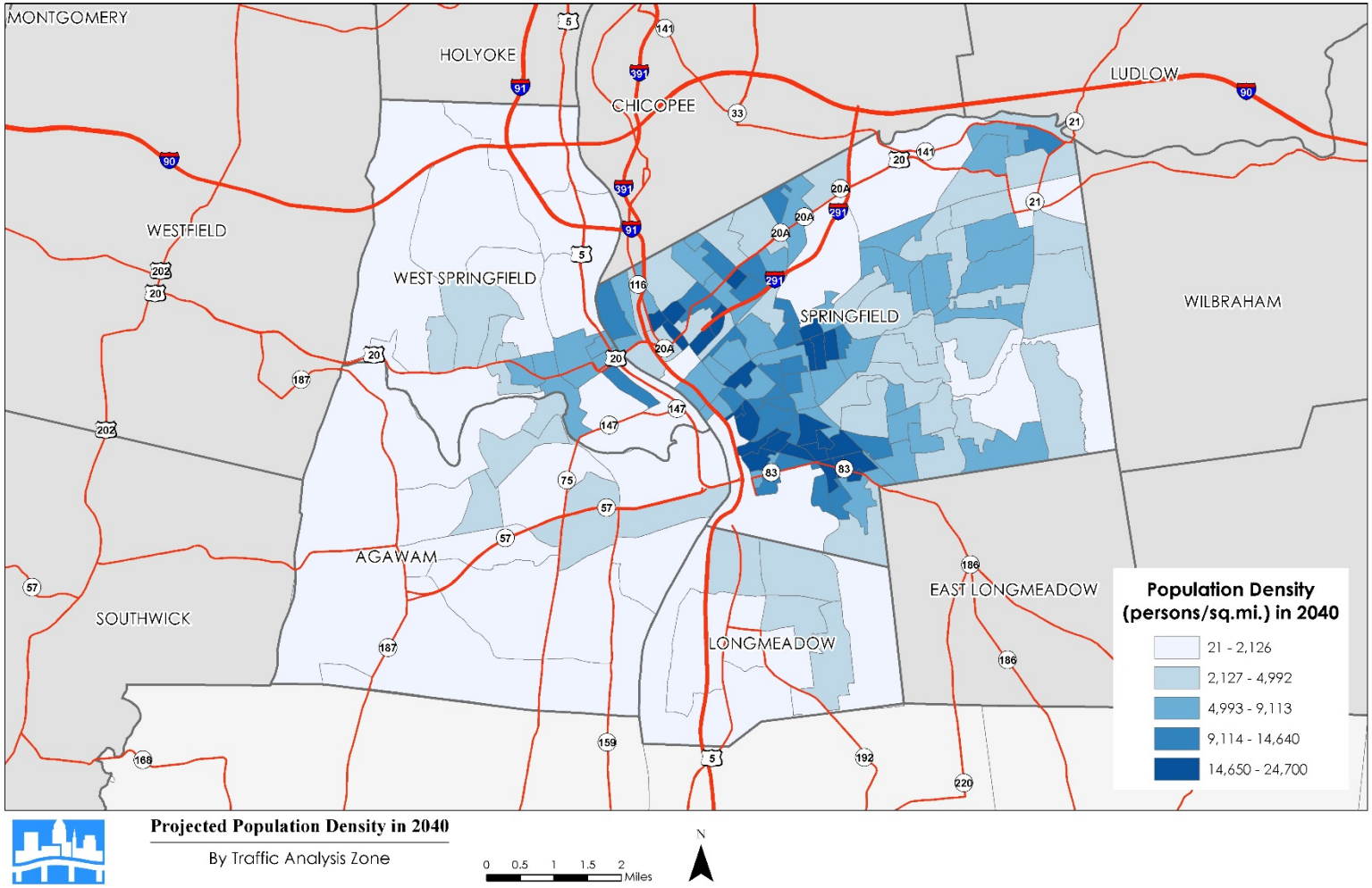


Figure 2-62: Projected Population in 2040, By Traffic Analysis Zone

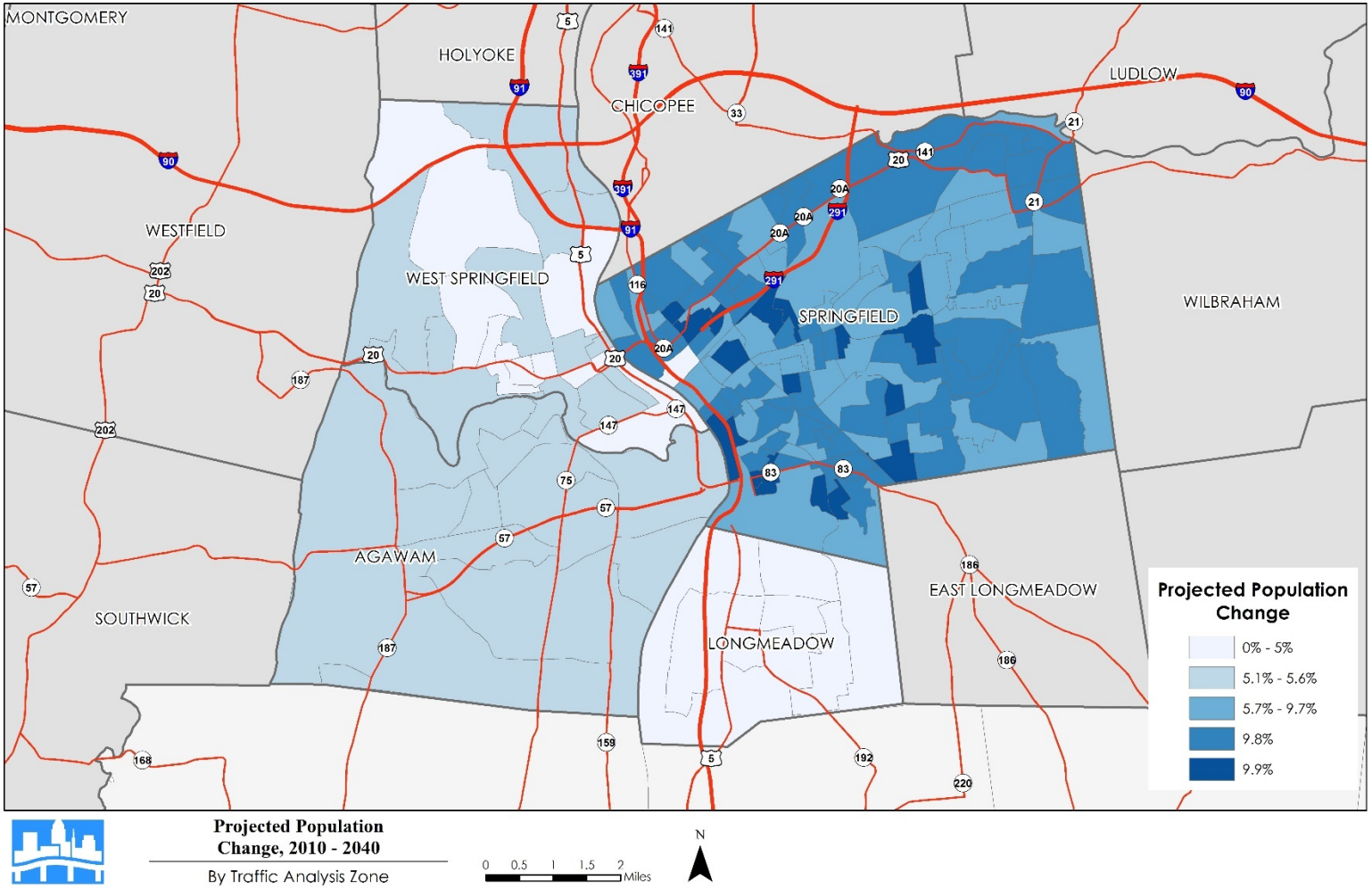


Figure 2-63: Projected Population Change, By Traffic Analysis Zone

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.

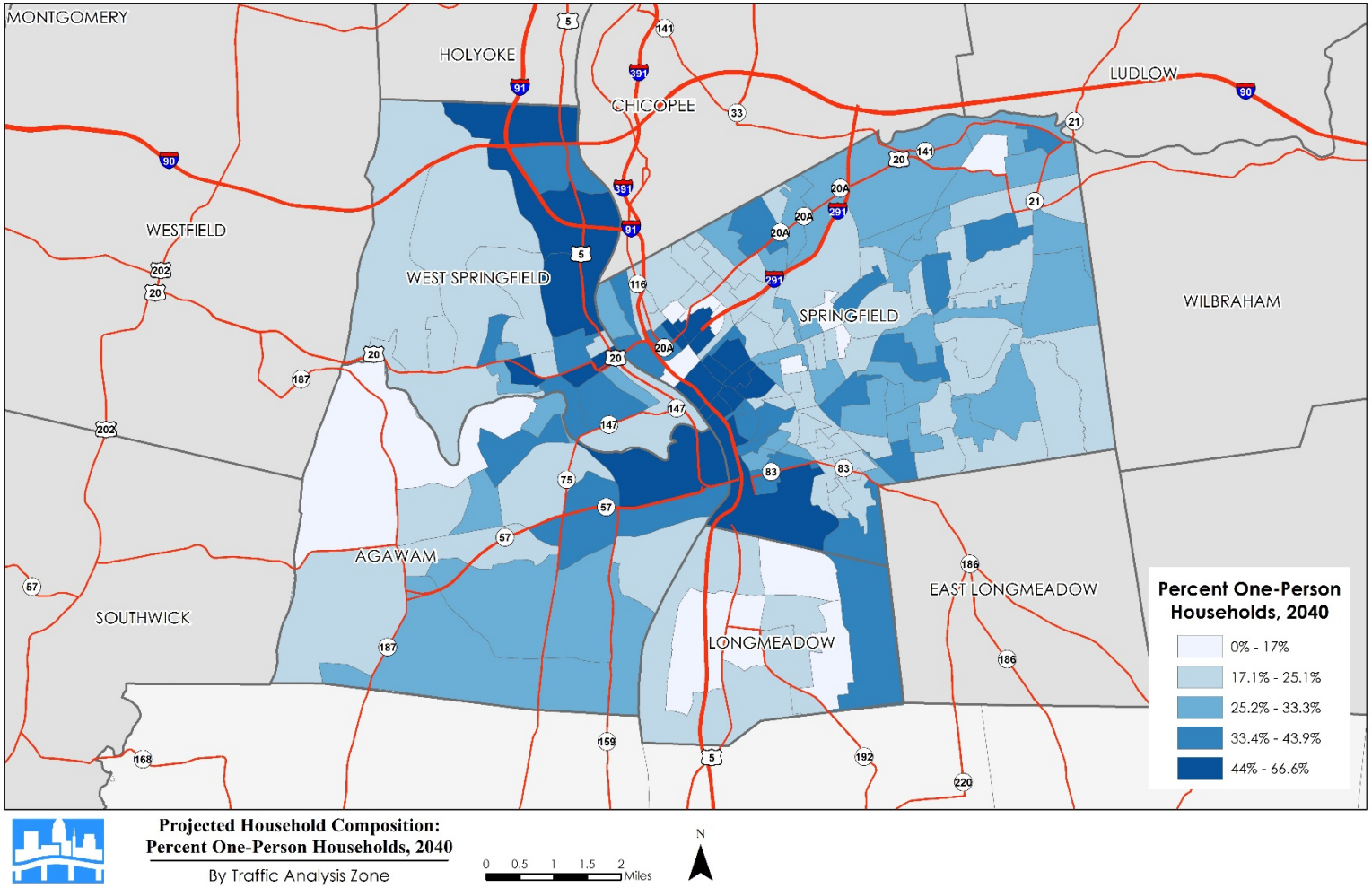


Figure 2-64: Projected Household Composition, Percent One-Person Households in 2040, By Traffic Analysis Zone

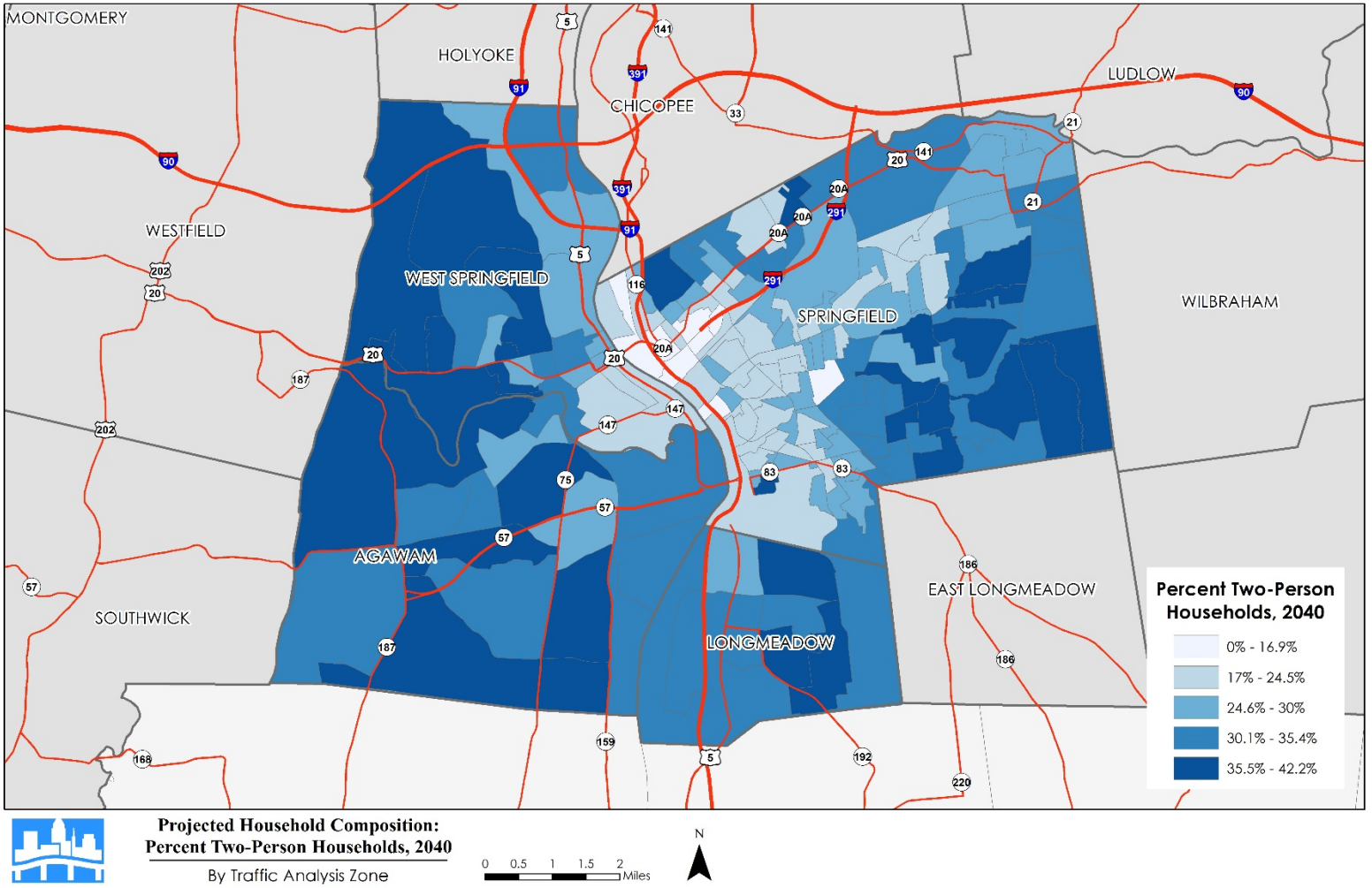


Figure 2-65: Projected Household Composition, Percent Two-Person Households in 2040, By Traffic Analysis Zone

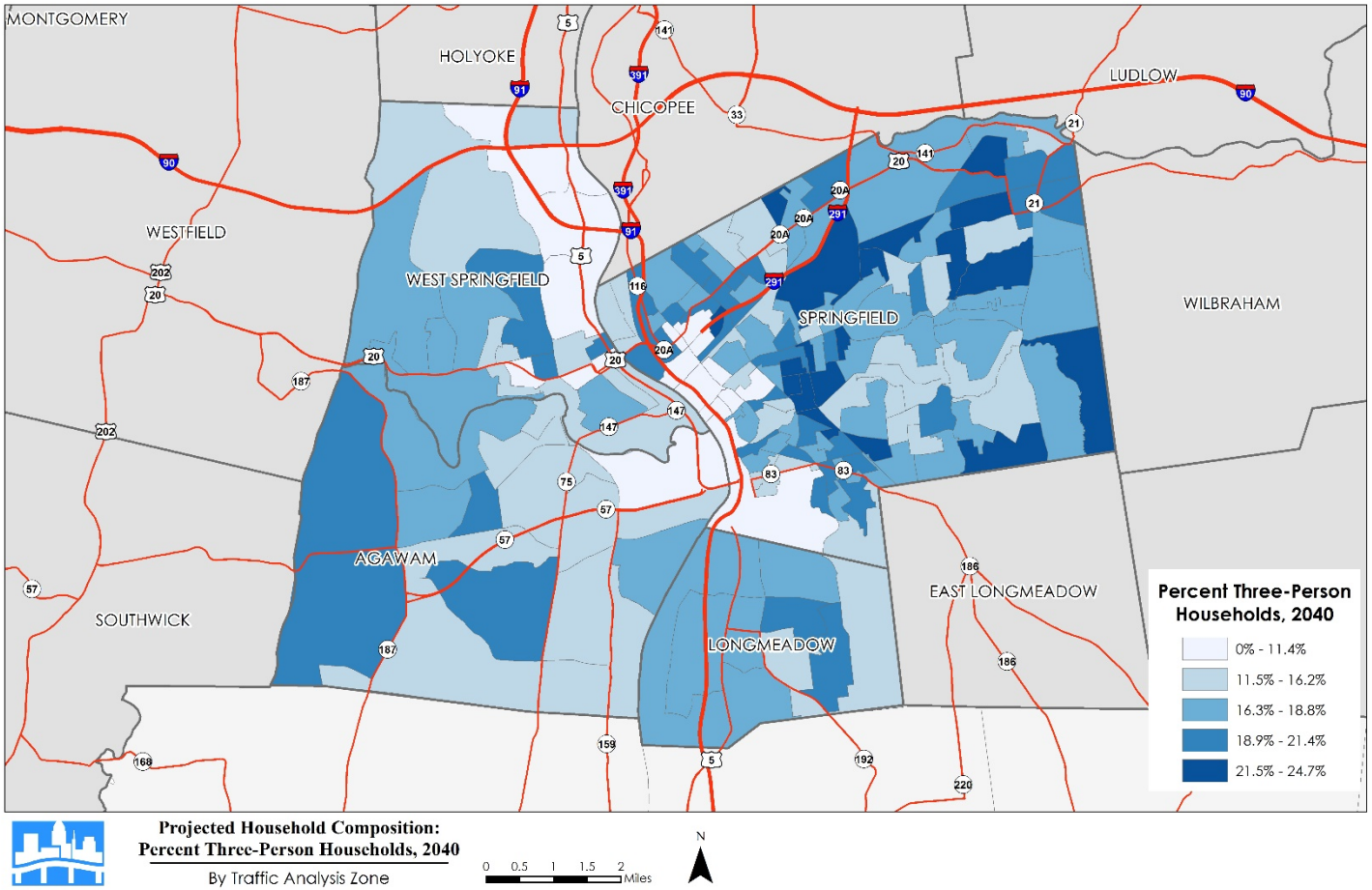


Figure 2-66: Projected Household Composition, Percent Three-Person Households in 2040, By Traffic Analysis Zone

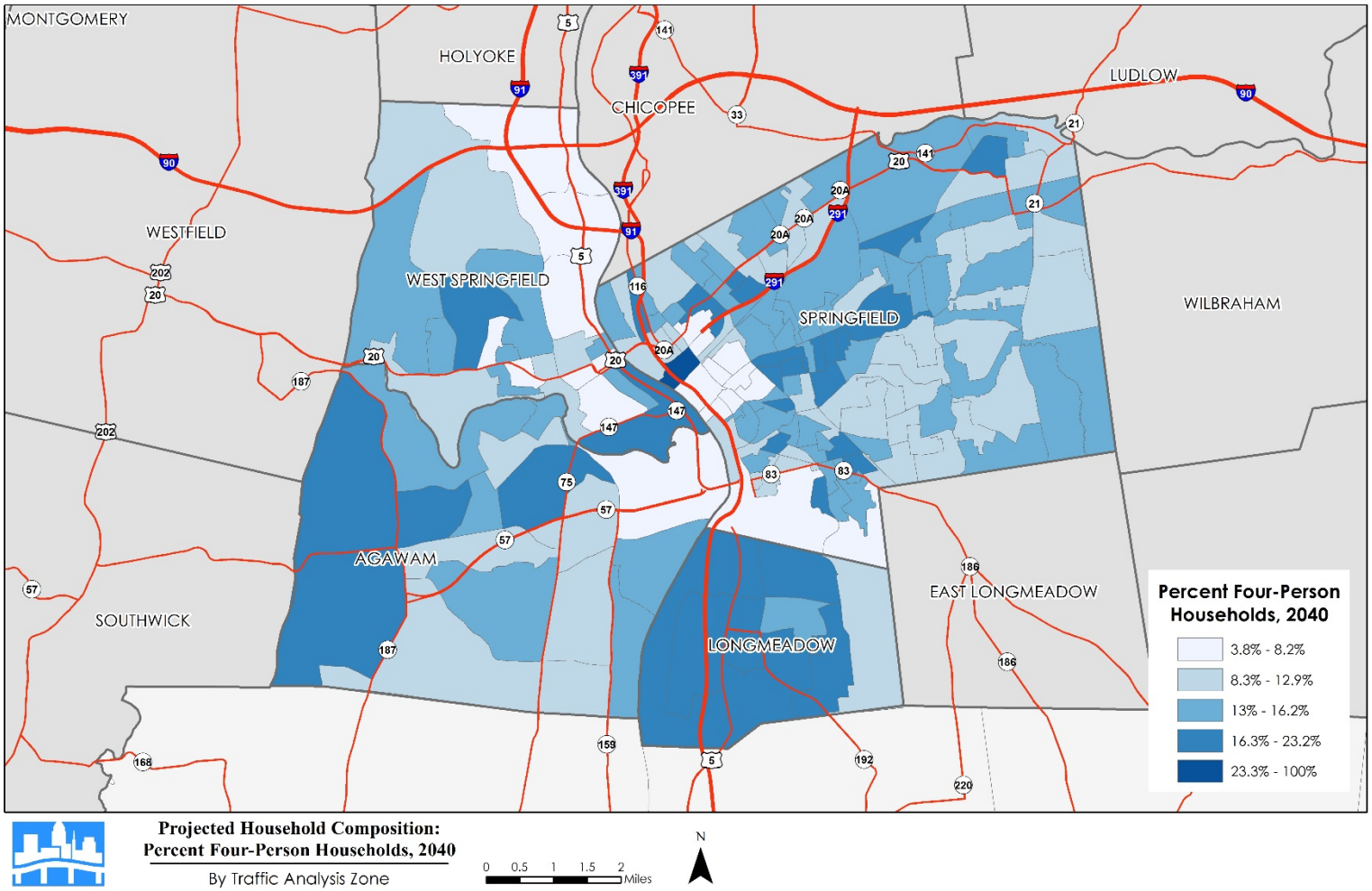


Figure 2-67: Projected Household Composition, Percent Four-Person Households in 2040, By Traffic Analysis Zone

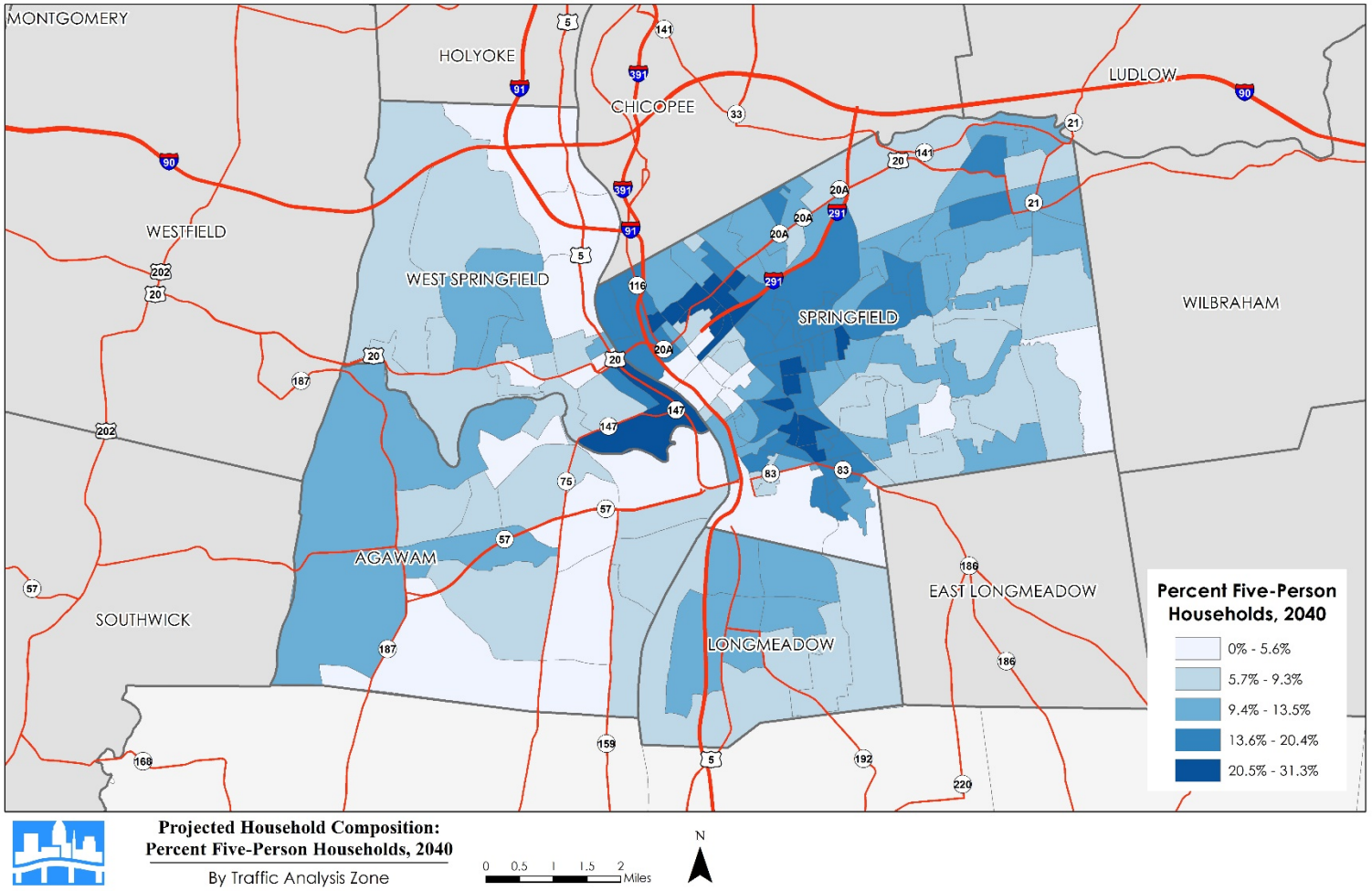


Figure 2-68: Projected Household Composition, Percent Five-Person Households in 2040, By Traffic Analysis Zone

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.

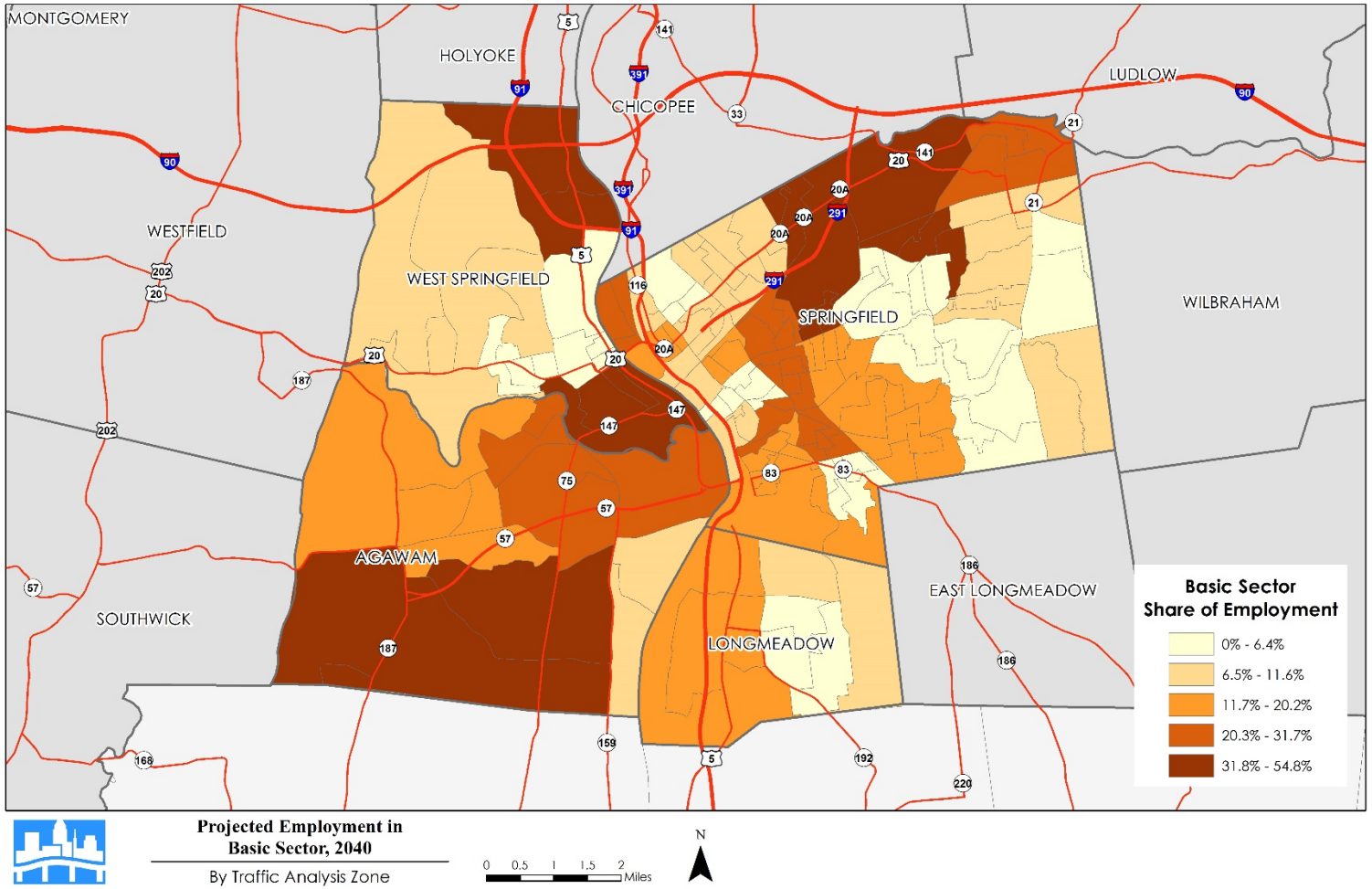


Figure 2-69: Projected Employment, Basic Sector Employment in 2040, By Traffic Analysis Zone

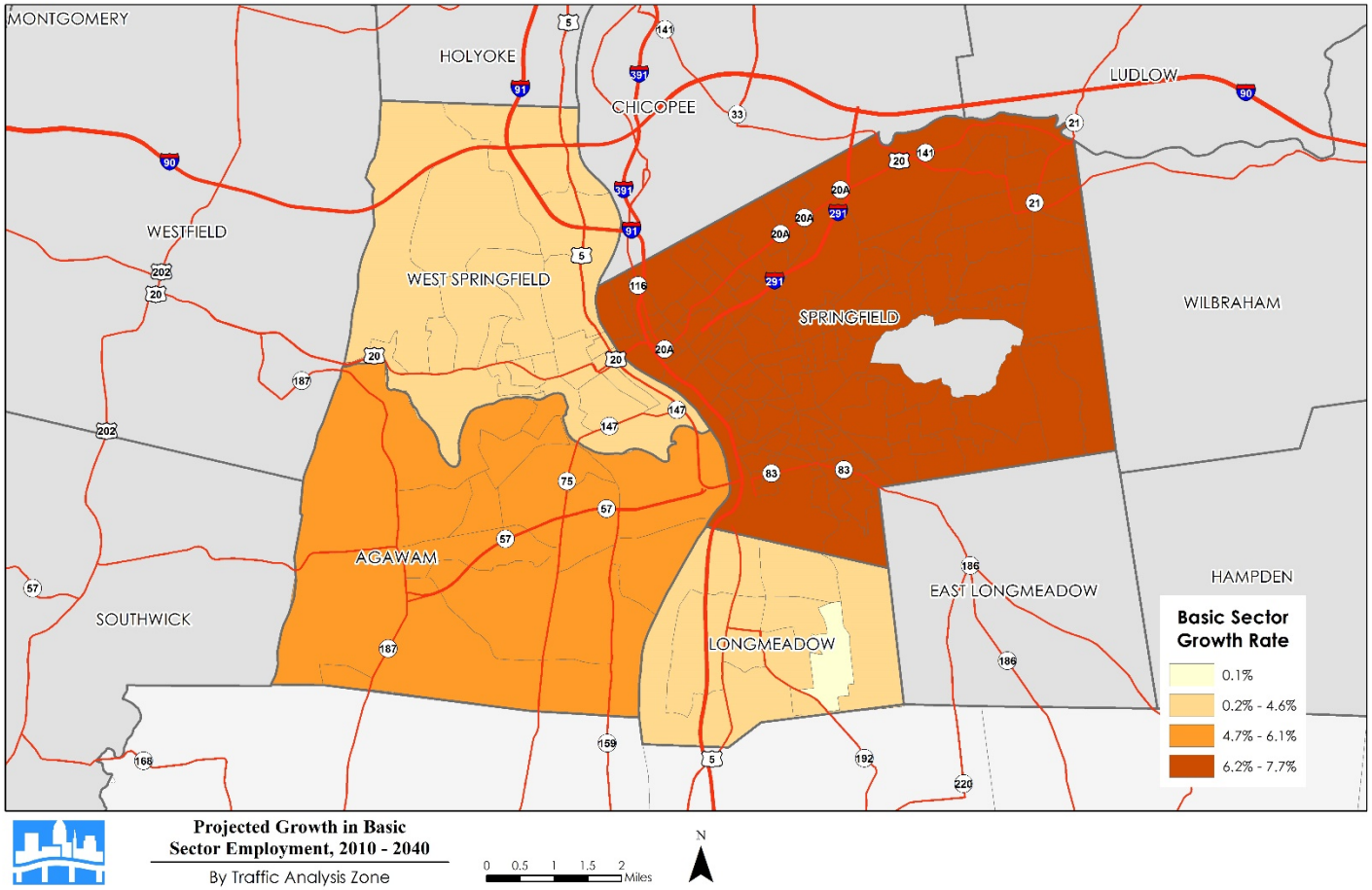


Figure 2-70: Projected Growth in Basic Sector Employment, 2010 - 2040, By Traffic Analysis Zone

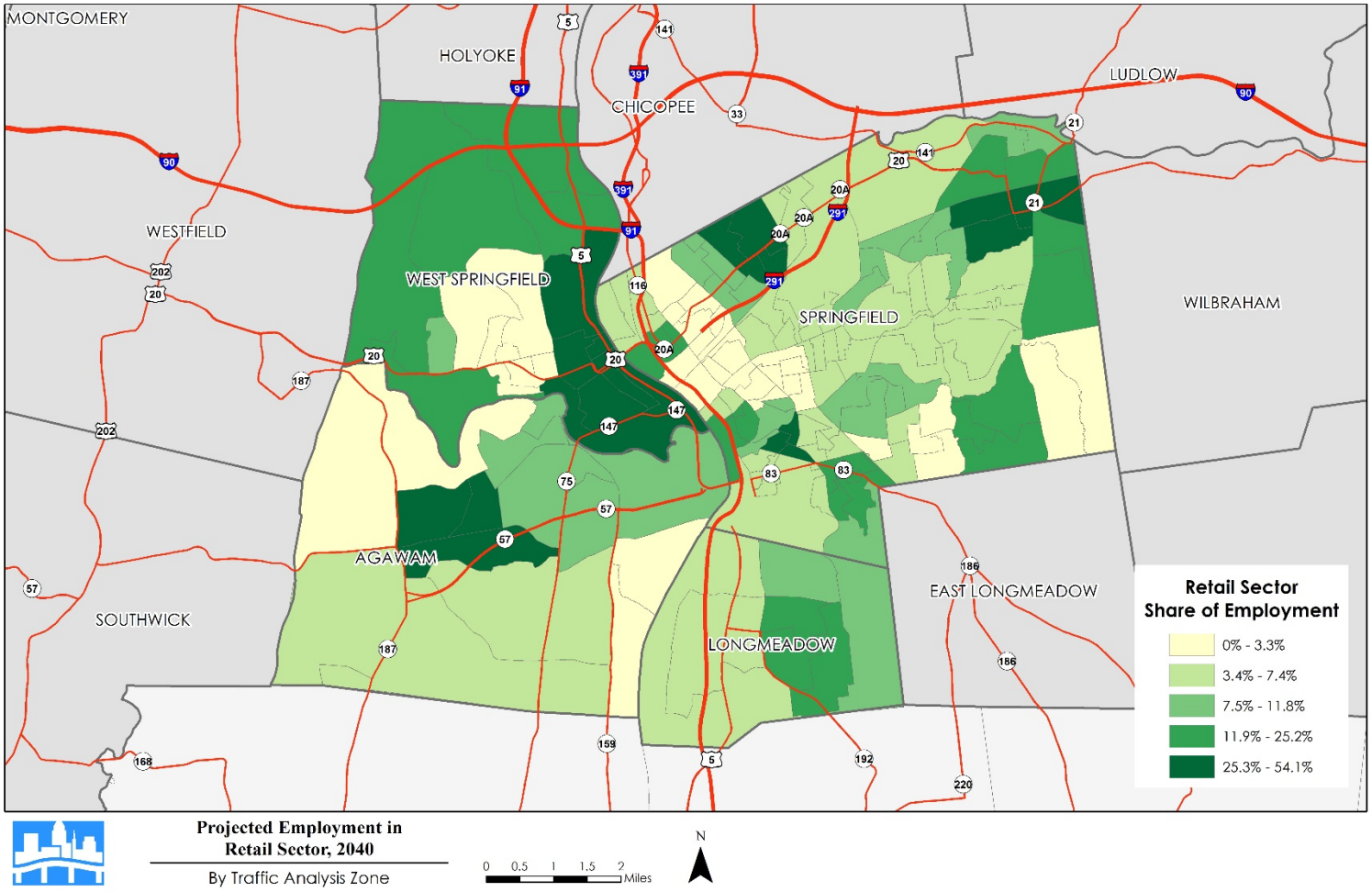


Figure 2-71: Projected Employment, Retail Sector Employment in 2040, By Traffic Analysis Zone

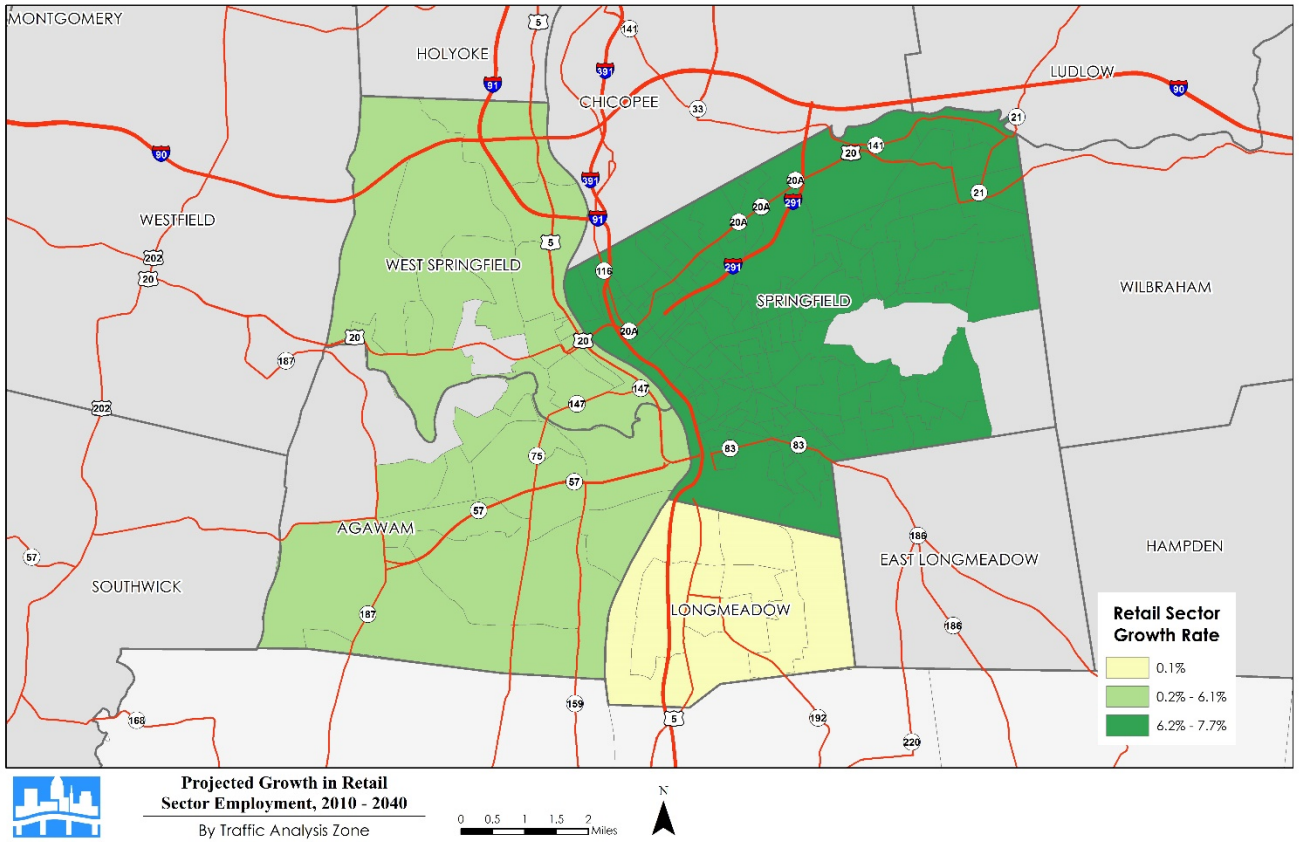


Figure 2-72: Projected Growth in Retail Sector Employment, 2010 - 2040, By Traffic Analysis Zone

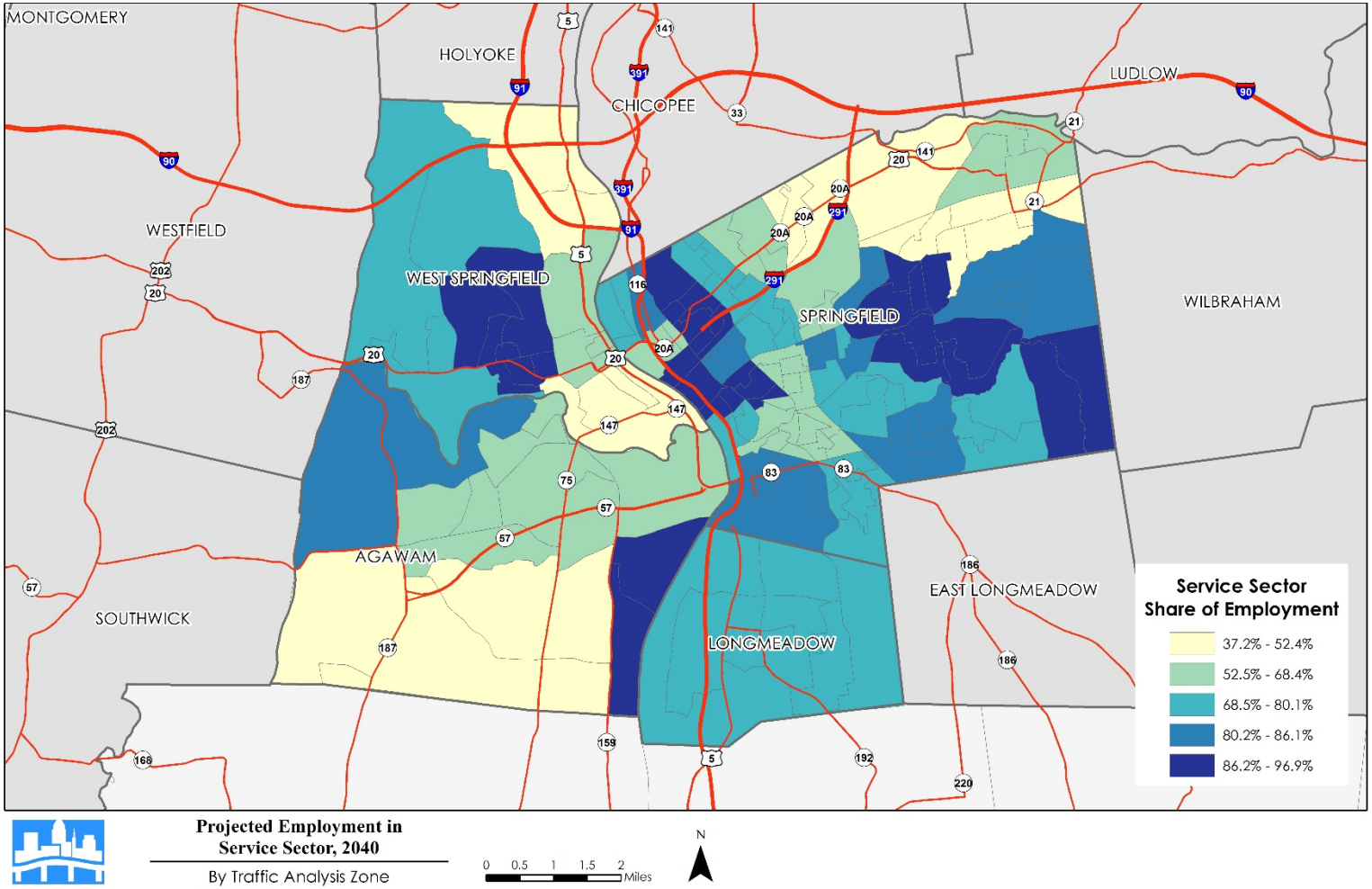


Figure 2-73: Projected Service Sector Employment, 2010 - 2040, By Traffic Analysis Zone

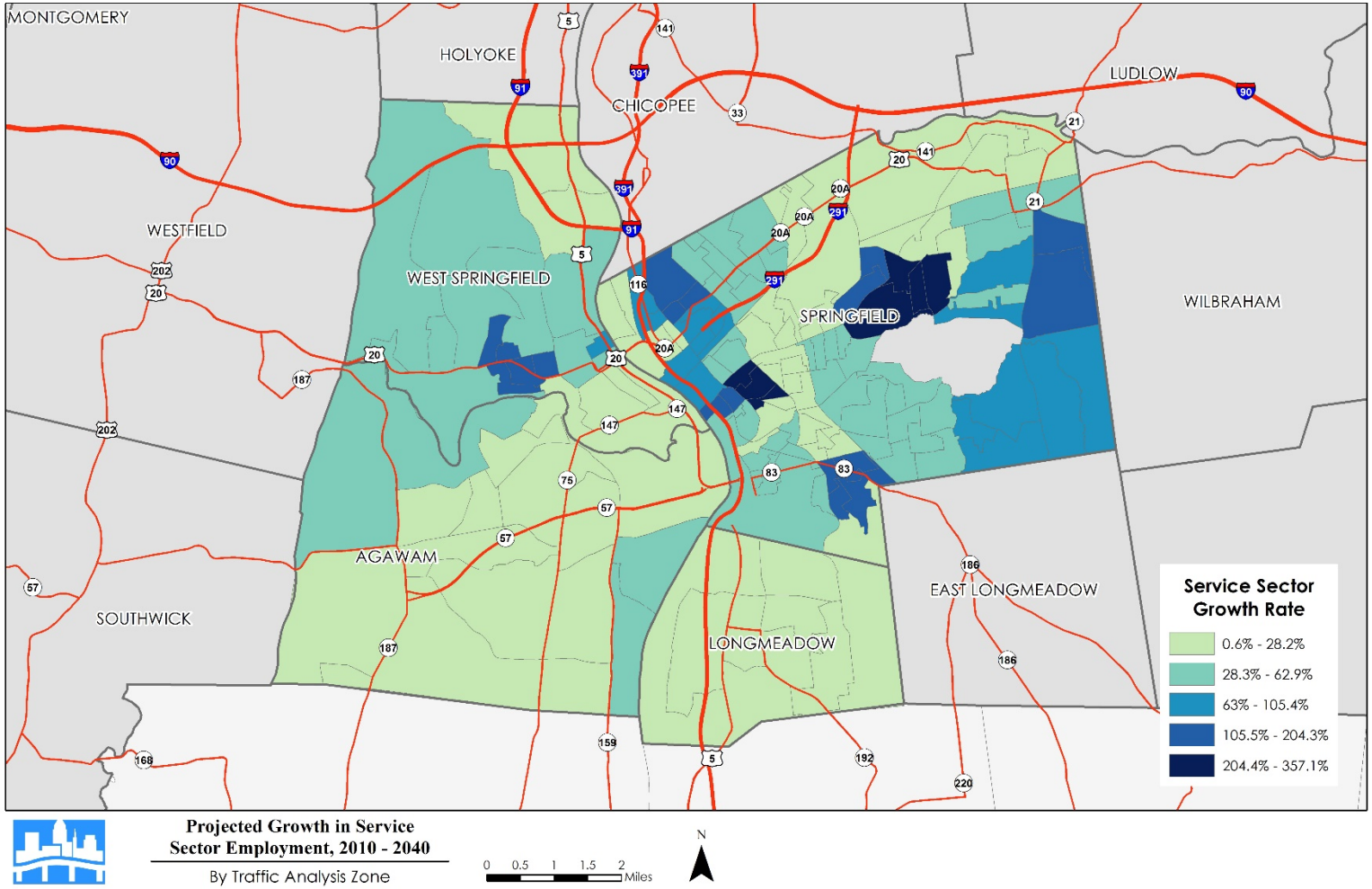


Figure 2-74: Projected Service Sector Employment, 2010 - 2040, By Traffic Analysis Zone

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.

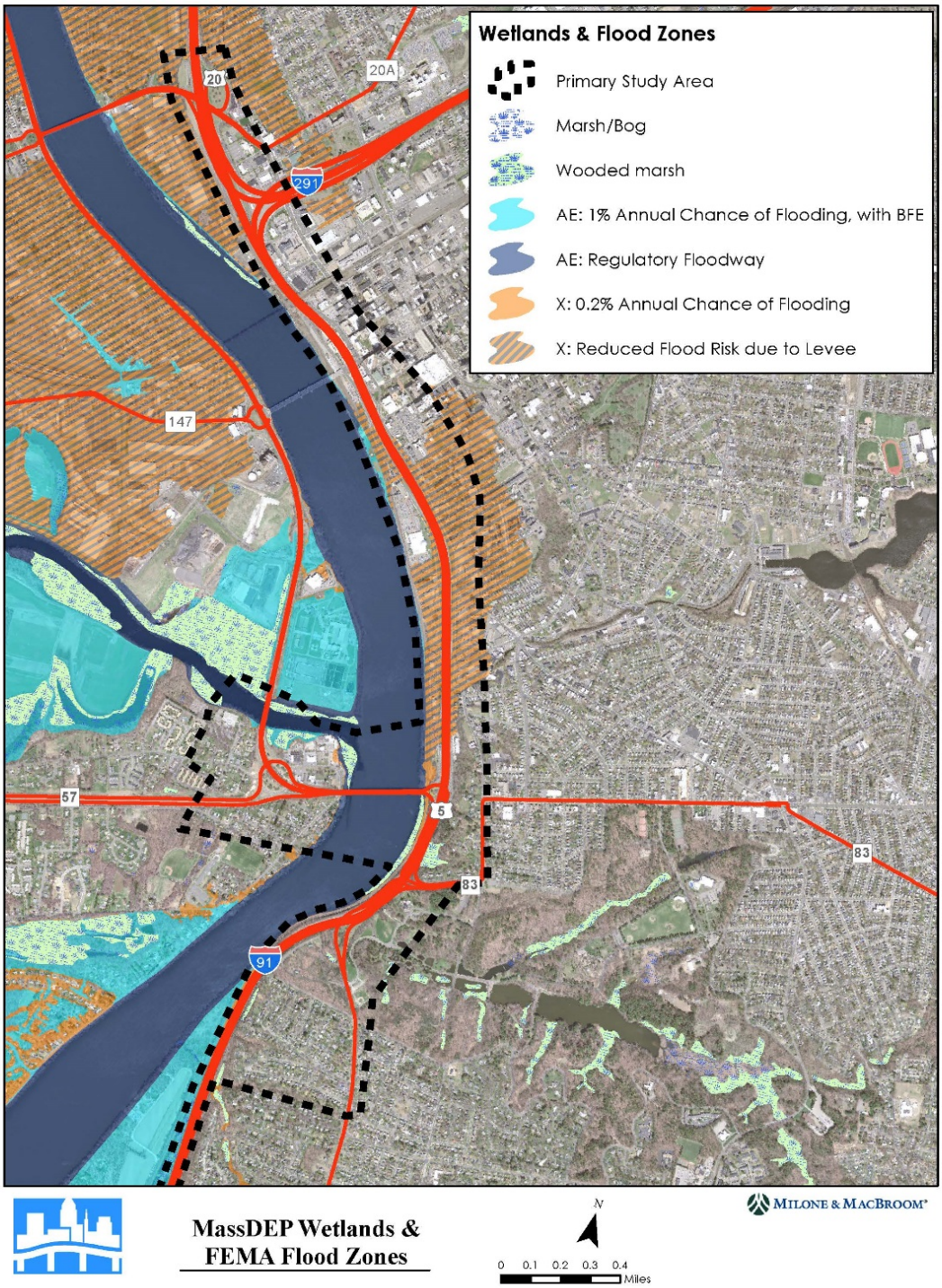


Figure 2-75: Wetlands and FEMA Flood Hazard Area

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.

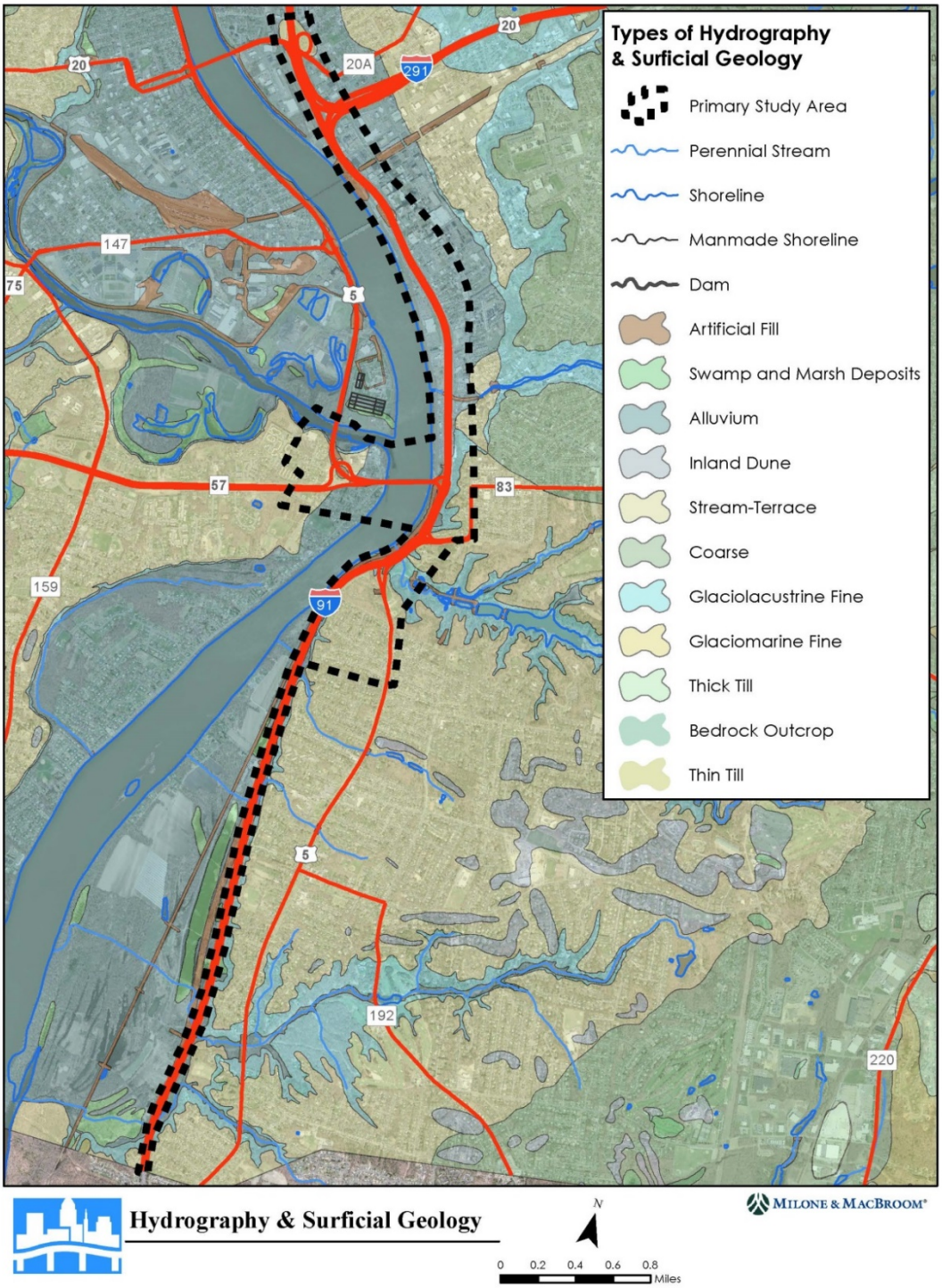


Figure 2-76: Surficial Geology

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.

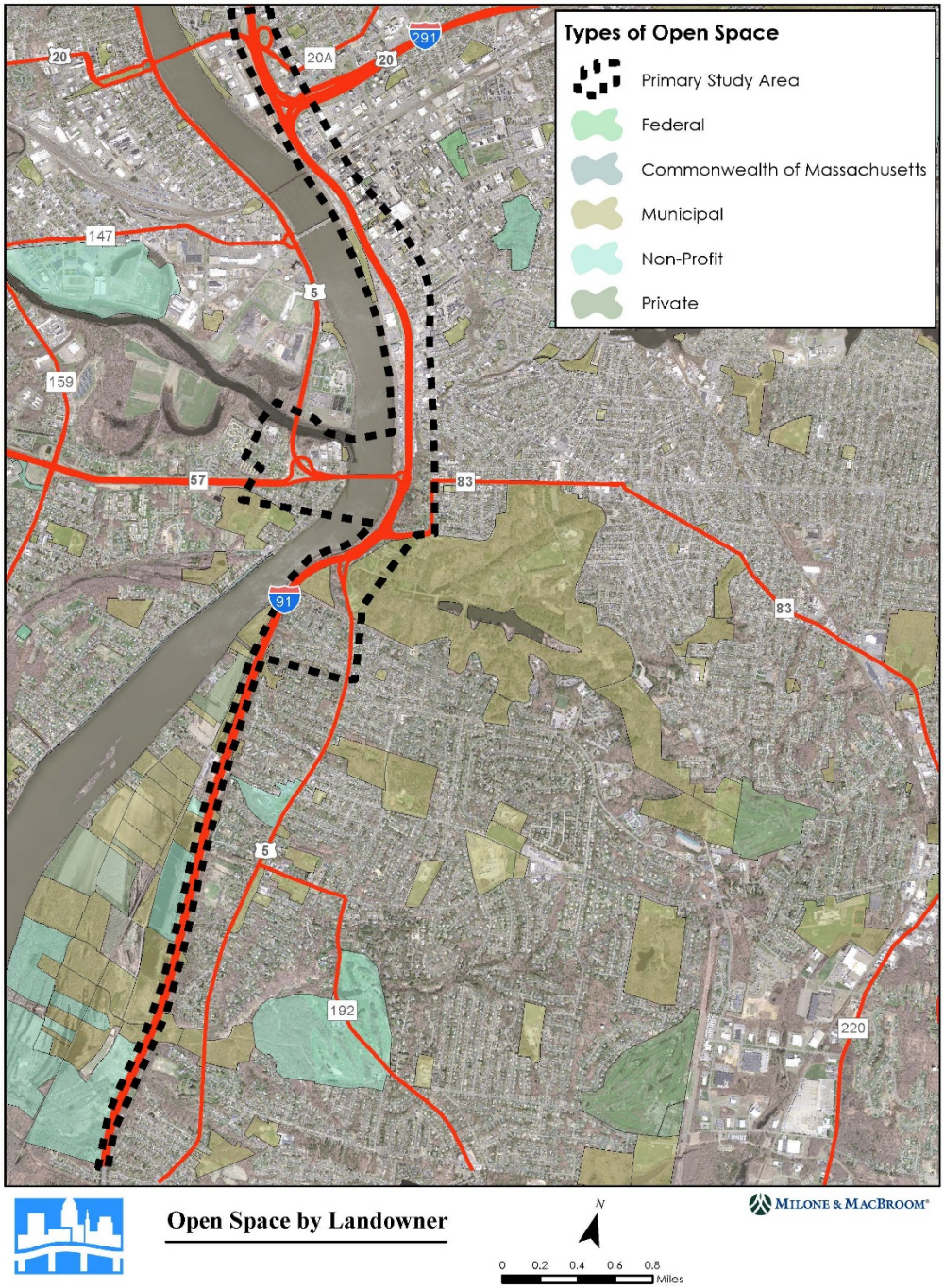


Figure 2-77: Open Space

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.

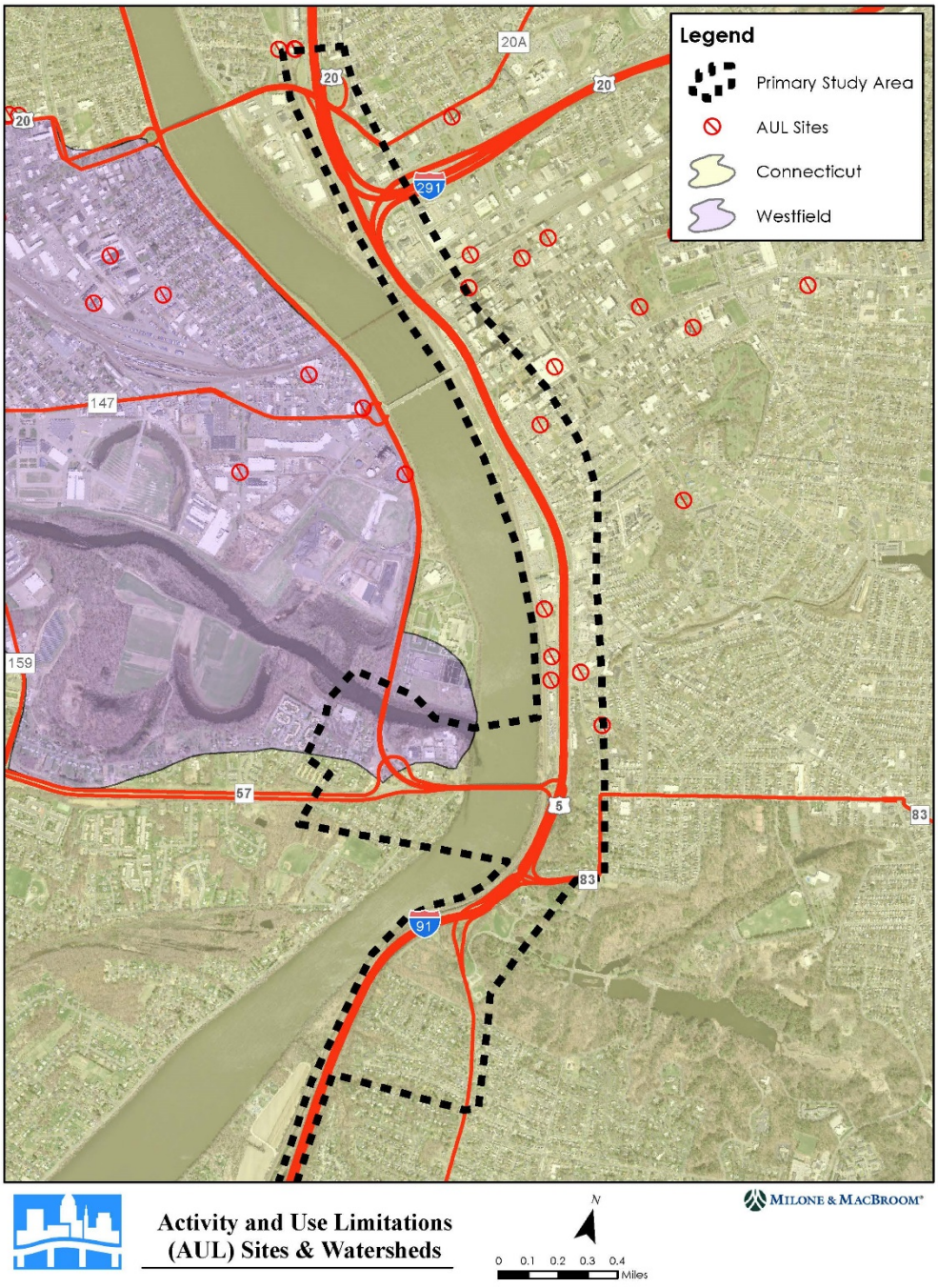


Figure 2-78: MassDEP AUL Sites & Watershed Delineations

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.

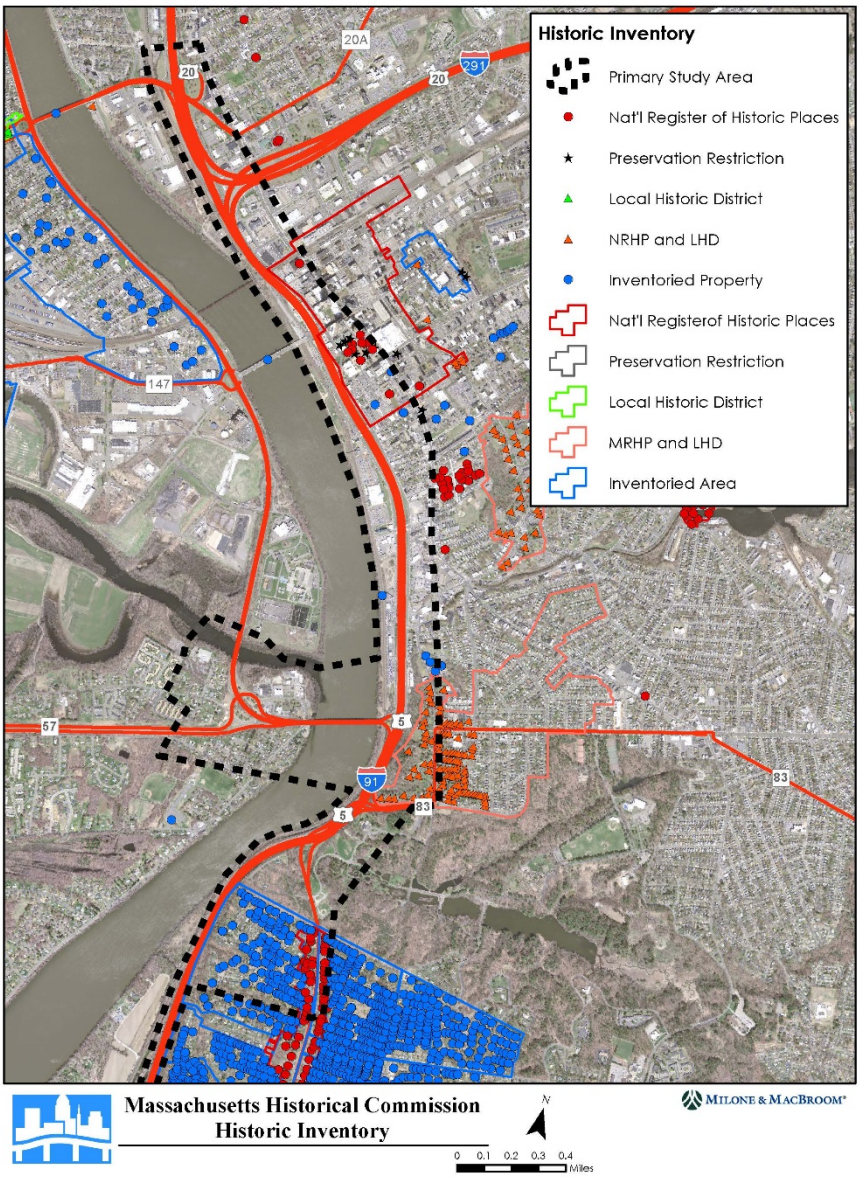


Figure 2-79: MHC Historic Inventory

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.

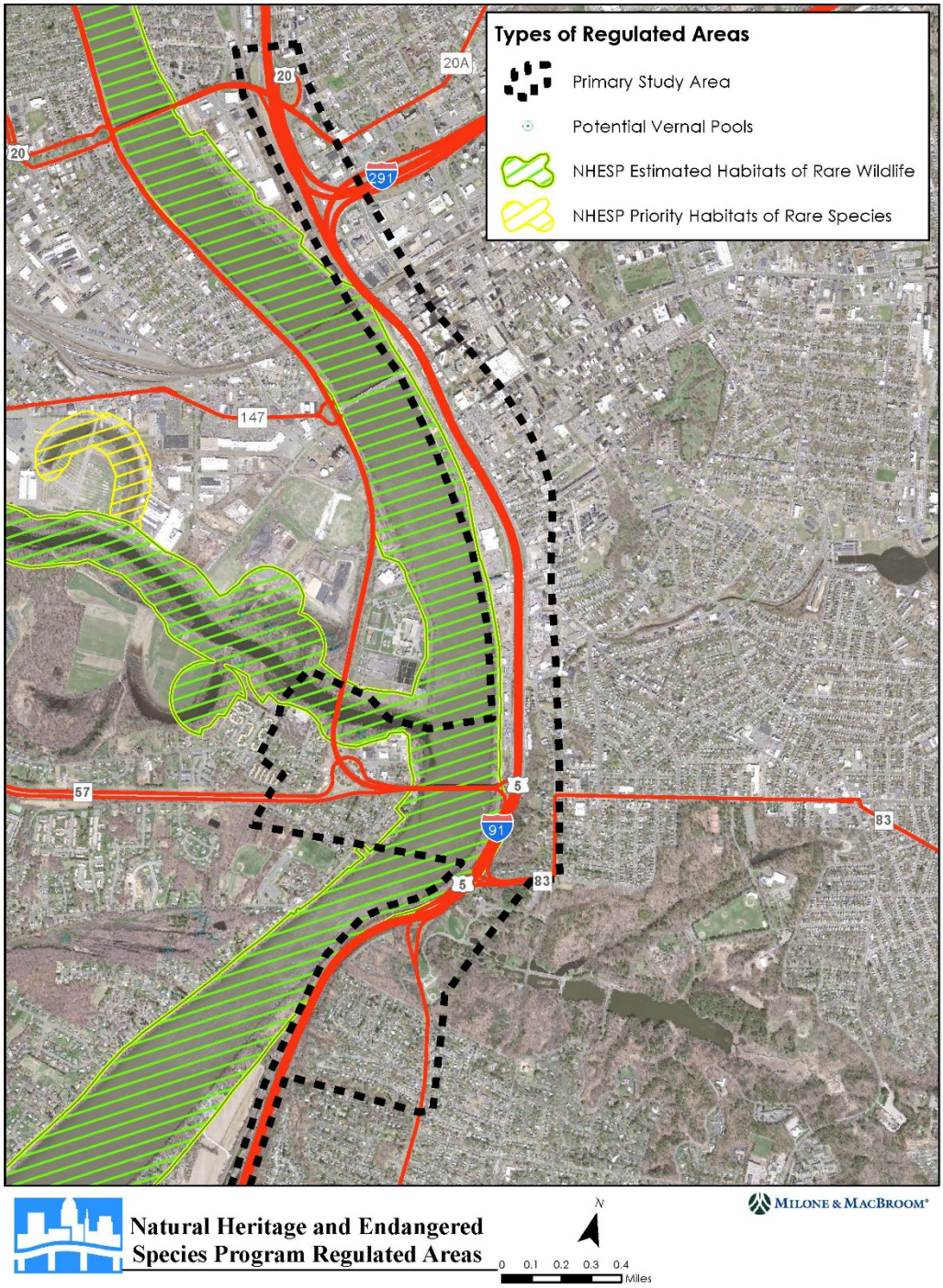


Figure 2-80: NHESP Regulated Areas

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.

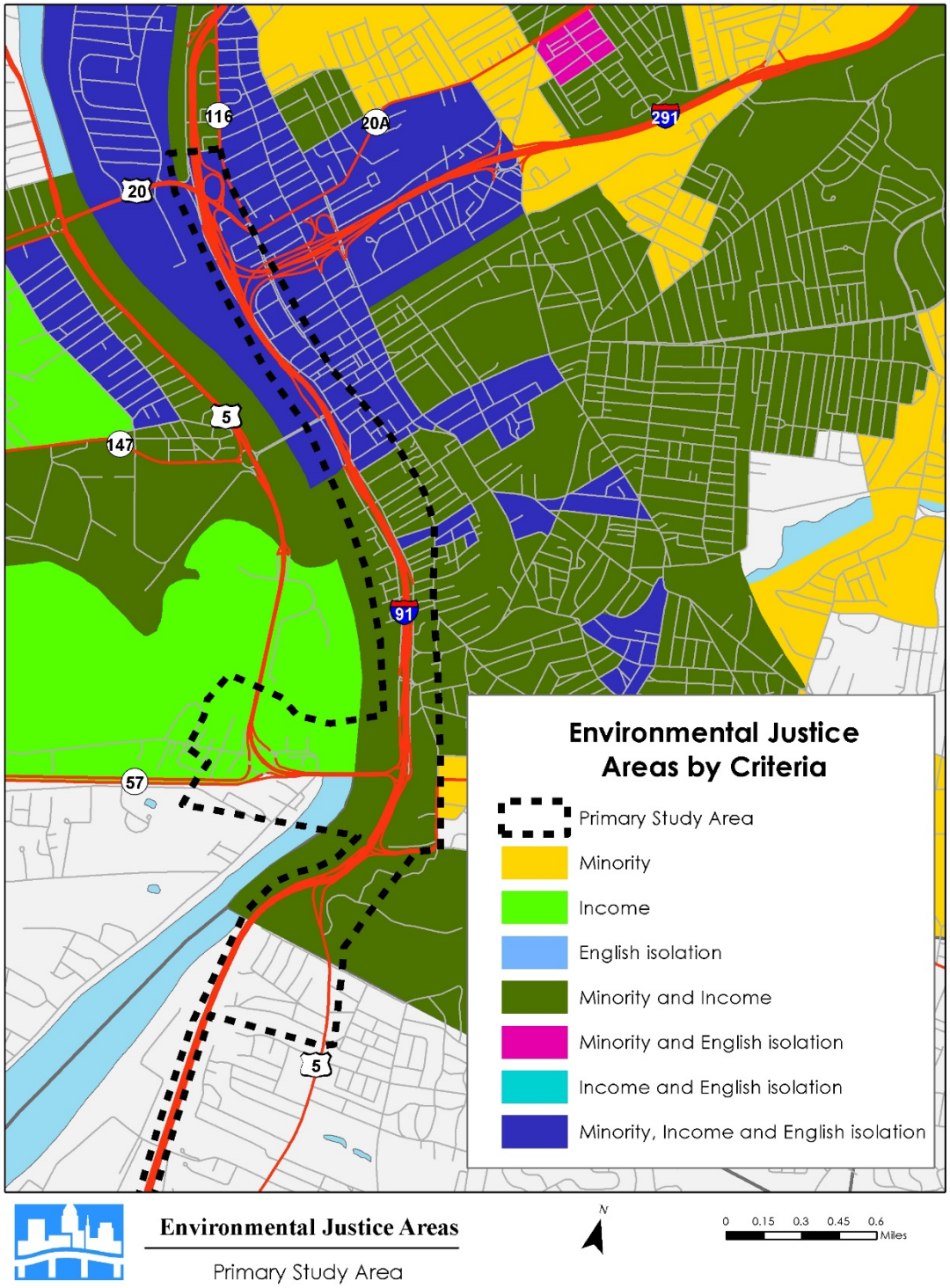


Figure 2-81: Environmental Justice Areas by Criteria

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.

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

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.

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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