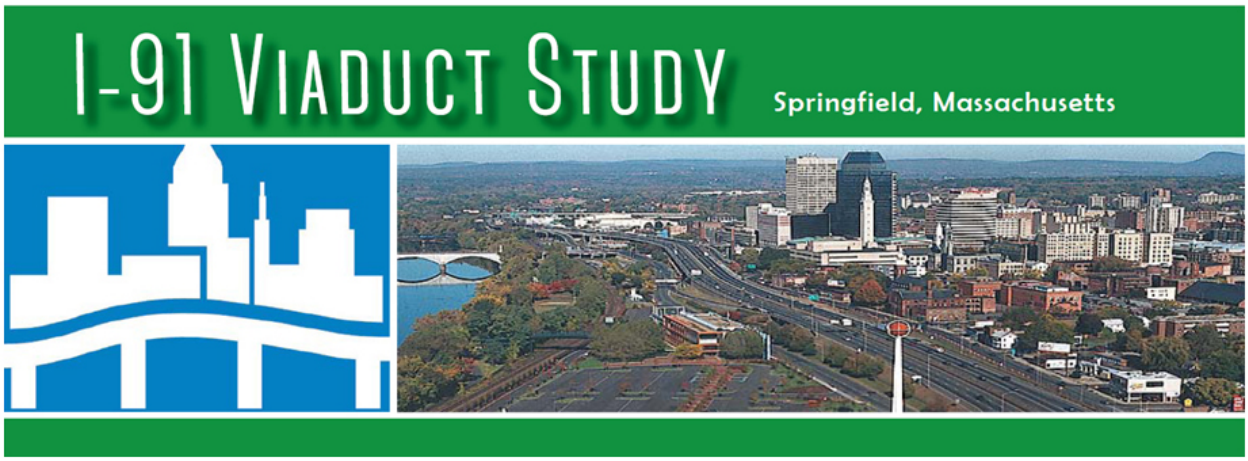

INTERSTATE 91 VIADUCT STUDY

CHAPTER IV

ALTERNATIVES ANALYSIS

August 2018

MMI #3869-16-6

massDOT
Massachusetts Department of Transportation

MILONE & MACBROOM

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4.1 INTRODUCTION

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

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

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

4.2 EVALUATION CRITERIA

4.2.1 EVALUATION CRITERIA DEVELOPMENT

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

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

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

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

In response to Working Group feedback, the Massachusetts Department of Transportation (MassDOT), and Massachusetts Department of Public Health (DPH) feedback on the initial criteria, the Evaluation Matrix was constructed and the number of subject areas and criteria adjusted to capture key areas of

concern and to logically organize the criteria to facilitate evaluation and interpretation. A small number of additional changes were made following the selection of alternatives for Task IV. These changes were made as warranted over the course of the evaluation and analysis steps described in section 4.3 in cases where the relevant and analytically feasible metrics available no longer aligned with the draft Evaluation Matrix as it was originally envisioned. The final set of evaluation criteria is described below in section 4.2.2 while the structure of the Evaluation Matrix is described in section 4.2.3.

4.2.2 EVALUATION CRITERIA DESCRIPTIONS

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

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

1.1 Roadway Operational Functionality

1.1.1 Intersection Level of Service

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

1.1.2 Volume-to-Capacity Ratio

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

1.1.3 Queue Length

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

1.1.4 LOS Merge, Diverge, and Weave Locations

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

1.1.5 LOS Ramps and Highway Segments

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

1.2 Travel Time

1.2.1 Travel Time Along I-91 Corridor

Travel time is the length in time it will take to get to one point from another. The travel time is typically in minutes and seconds. Travel time is equal to the running

time plus delay, which can be along a pathway or at a signalized and/or unsignalized intersection. Speed limit is a factor. For this case, the distance or path considered is along I-91 from the Connecticut state line to just north of the Plainfield Street overpass, which covers a distance of 6.68 miles in both directions.

1.2.2 Travel Time Through Primary Study Area

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

1.3 Pedestrian and Bicycle Functionality and Connectivity

1.3.1 Improve Access to the Riverfront from Downtown Core

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

1.3.2 Improve Access to Community Services and Social Services

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

1.3.3 Improve Access to Retail and Commerce

This section is presented to evaluate the number of commercial businesses, goods, employment centers, and public and institutional properties for which bicyclists and pedestrians are likely to benefit from enhanced access in the Primary Study Area. Any property within ¼ mile of an enhanced bicycle or pedestrian connection is defined as experiencing an improvement in access. No differentiation between levels of pedestrian or bicycle connection quality is provided (as changes in levels of

quality are contingent on design decisions not addressed in this conceptual-level study). Areas that are gauged include roadways within the Primary Study Area, immediately surrounding the Downtown Springfield core, I-91, and I-291.

1.3.4 Improve Connections to Union Station

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

1.3.5 Regional Bicycle and Pedestrian Connectivity

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

1.4 Mode Shift

1.4.1 Increase Transit Mode Share

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

1.4.2 Increase Bicycle and Pedestrian Mode Share

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

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

2.1 Pedestrian and Bicycle Safety

2.1.1 Improve Bicycle and Pedestrian Safety – Minimize Conflicts

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

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

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

2.1.3 Improve Bicycle and Pedestrian Safety – Safe Crossing Accommodations

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

2.1.4 Improve Bicycle and Pedestrian Safety – Improve Crossing Times

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

2.1.5 Improve Bicycle and Pedestrian Safety – Provide Separated Facilities

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

2.2 Vehicular Safety

2.2.1 Improve Interaction and Roadway Safety – Conflict Points

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

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

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

2.3 Public Safety

2.3.1 Improve Public Safety

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

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

3.1 Sustainability

3.1.1 Impacts on Environmental Resources

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

3.1.2 Inclusion of Low Impact Development Standards

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

3.1.3 Reduction of Pavement Footprint

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

3.2 Air Quality

3.2.1 Health Impacts on Vehicle Occupants, Bicyclists, and Pedestrians

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

3.2.2 Reduction of Greenhouse Gas Emissions

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

3.3 Noise

3.3.1 Noise Impacts – Decibel Levels

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

3.3.2 Noise Impacts – Impacted Receptors

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

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

4.1 Economic Development Potential

4.1.1 Parcel Growth

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

4.1.2 Improve Accessibility to Potential and Existing Development Parcels

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

4.1.3 Improve Bicycle and Pedestrian Infrastructure

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

4.1.4 Increase Density

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

4.1.5 Incur New Tax Generation

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

4.2 Socioeconomic Impacts

4.2.1 Increase Employment

This section quantifies the estimated impacts on jobs within the Primary Study Area based on the development scenarios associated with each of Alternatives 1 through 3. The potential increase in jobs in the Primary Study Area is based on the size of

commercial and industrial developments and average ratios of building size to employment across sectors.

4.2.2 Increase Population

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

4.2.3 Increase Housing

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

4.2.4 Improve Affordability – Housing in Proximity to Transit

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

4.2.5 Improve Public Service Provision

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

4.2.6 Promote Reduced Travel Costs

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

4.2.7 Improve Social Cohesion

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

4.3 Freight Rail Impacts

4.3.1 Operational Impacts

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

4.3.2 Implementation Costs

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

4.4 Parking Impacts

4.4.1 Impacts to Parking Under I-91

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

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

5.1 Visual Impacts

5.1.1 Visual Perception of I-91 Viaduct

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

5.2 Construction Impacts

5.2.1 Construction Duration

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

5.2.2 Lane Closures and Detours

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

5.2.3 Maintenance of Access to Abutters

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

5.2.4 Disruption of Local Businesses

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

5.3 Compatibility

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

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

5.3.2 Consistency with MassDOT Goals, Policies, and Directives

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

5.4 Environmental Justice (EJ) Impacts

5.4.1 Availability of Jobs in EJ Areas

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

5.4.2 Availability of Education and Health Services in EJ Areas

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

5.4.3 Mobility Impacts in EJ Areas

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

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

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

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

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

5.4.6 Improve Access to Retail and Commerce in EJ Areas.

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

5.4.7 Environmental Impacts in EJ Areas

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

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

6.1 Construction Costs

6.1.1 Order-of-Magnitude/Implementation Cost

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

6.1.2 Right-of-Way Impact

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

6.2 Maintenance Costs

6.2.1 Anticipated Annual Maintenance Costs

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

6.2.2 Life-Cycle Cost-Benefit Analysis

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

4.2.3 EVALUATION MATRIX: INTERPRETATION AND DEFINITIONS

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

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

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

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

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

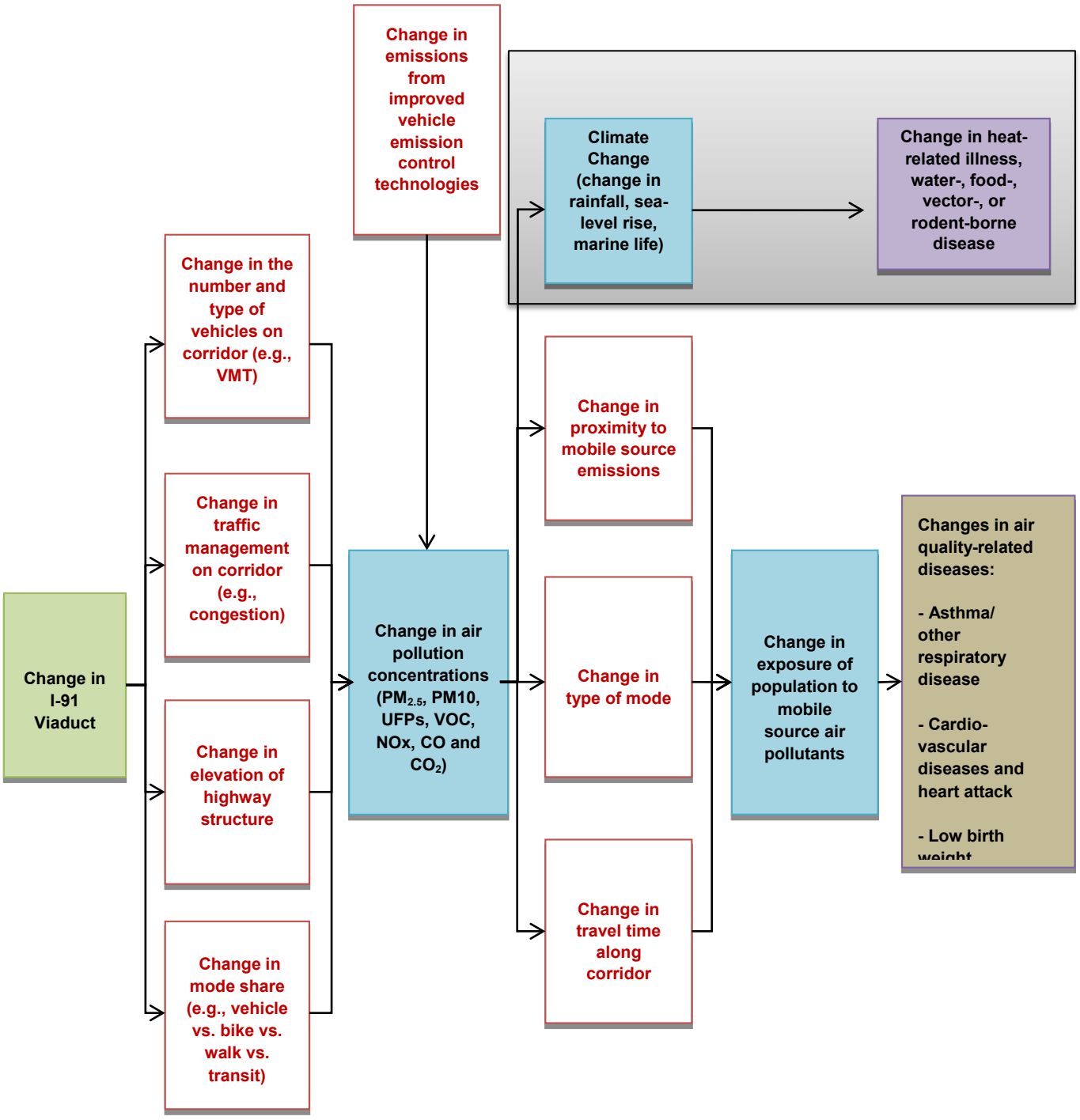


Figure 4-1: Air Quality Pathway

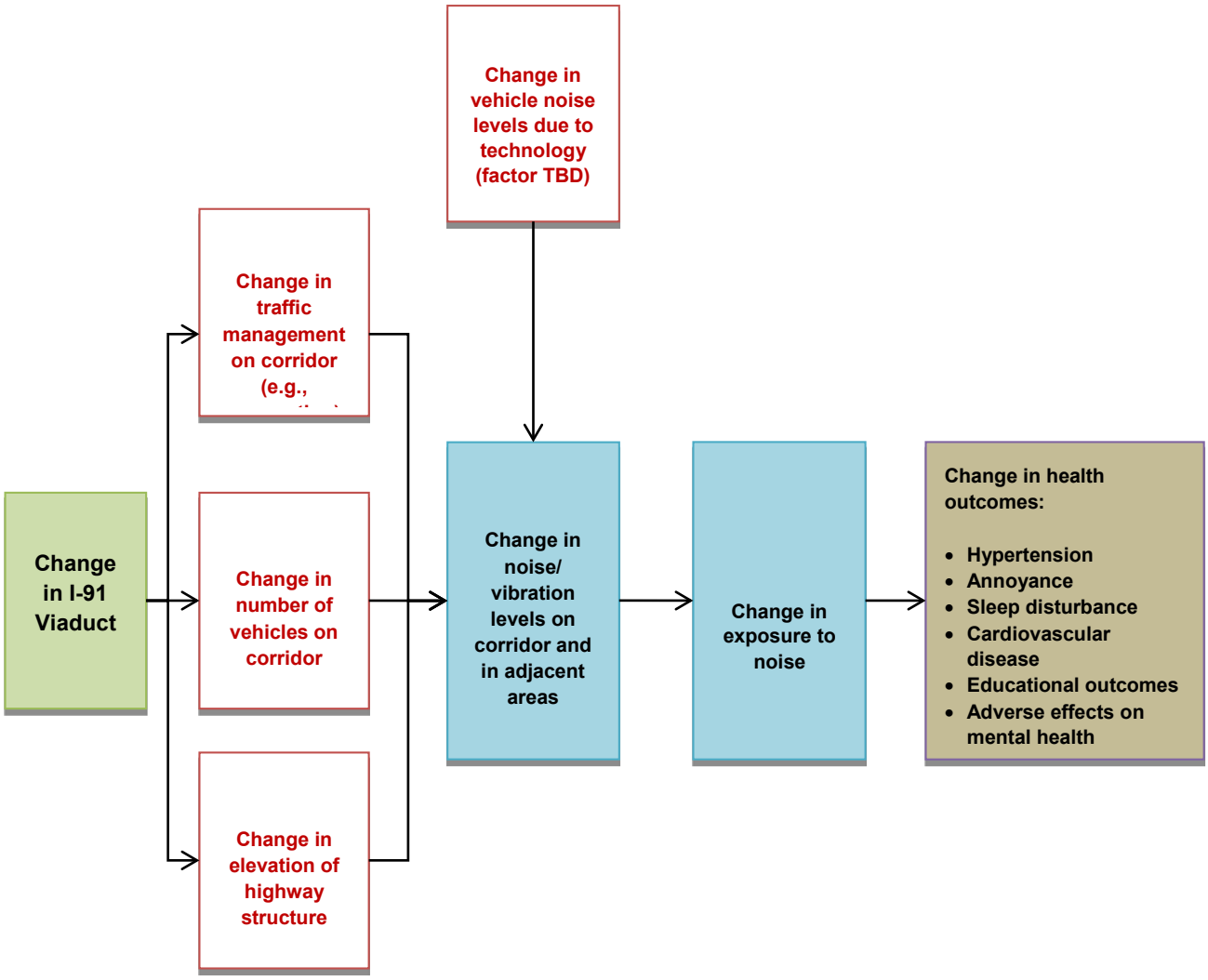


Figure 4-2: Noise Pathway

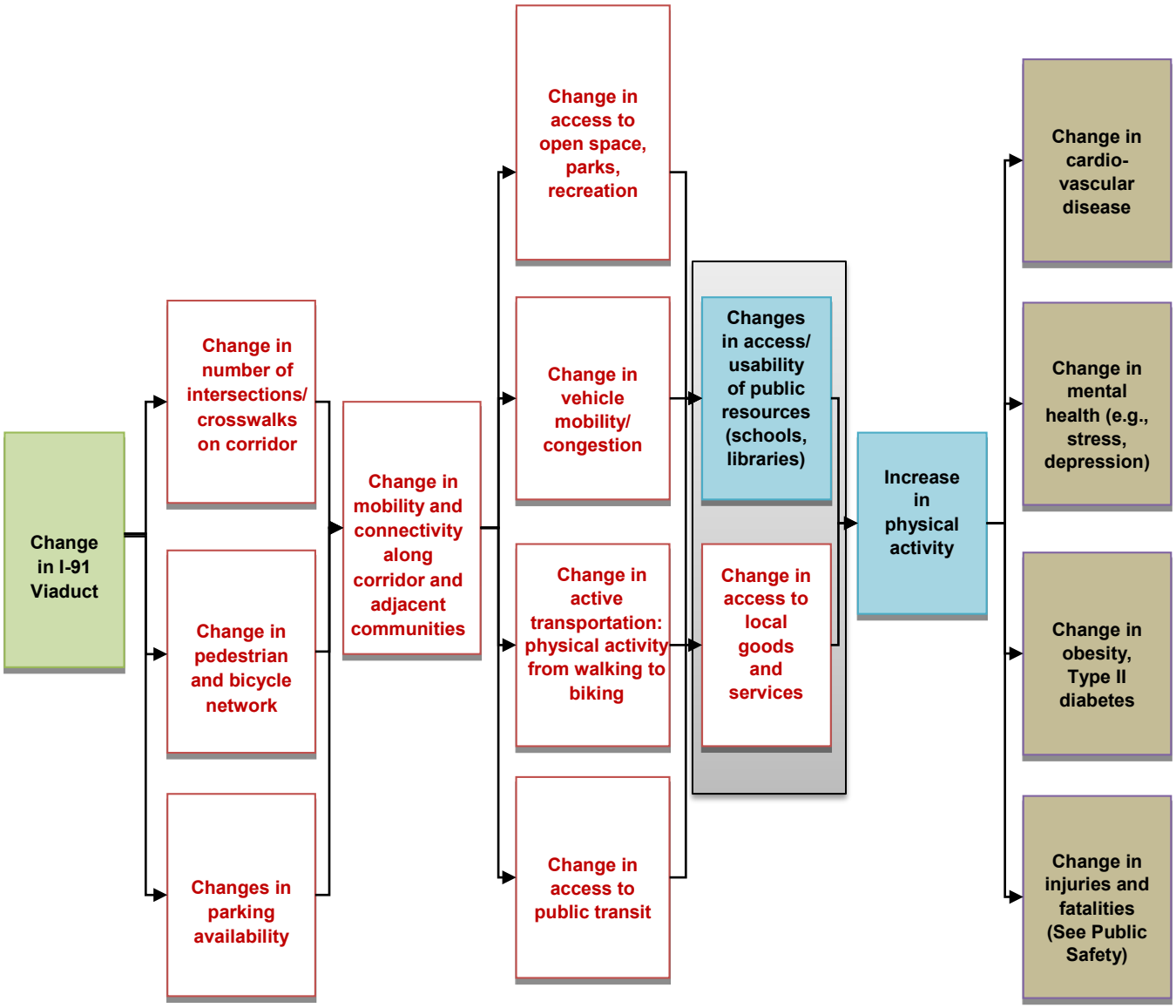


Figure 4-3: Mobility and Connectivity Pathway

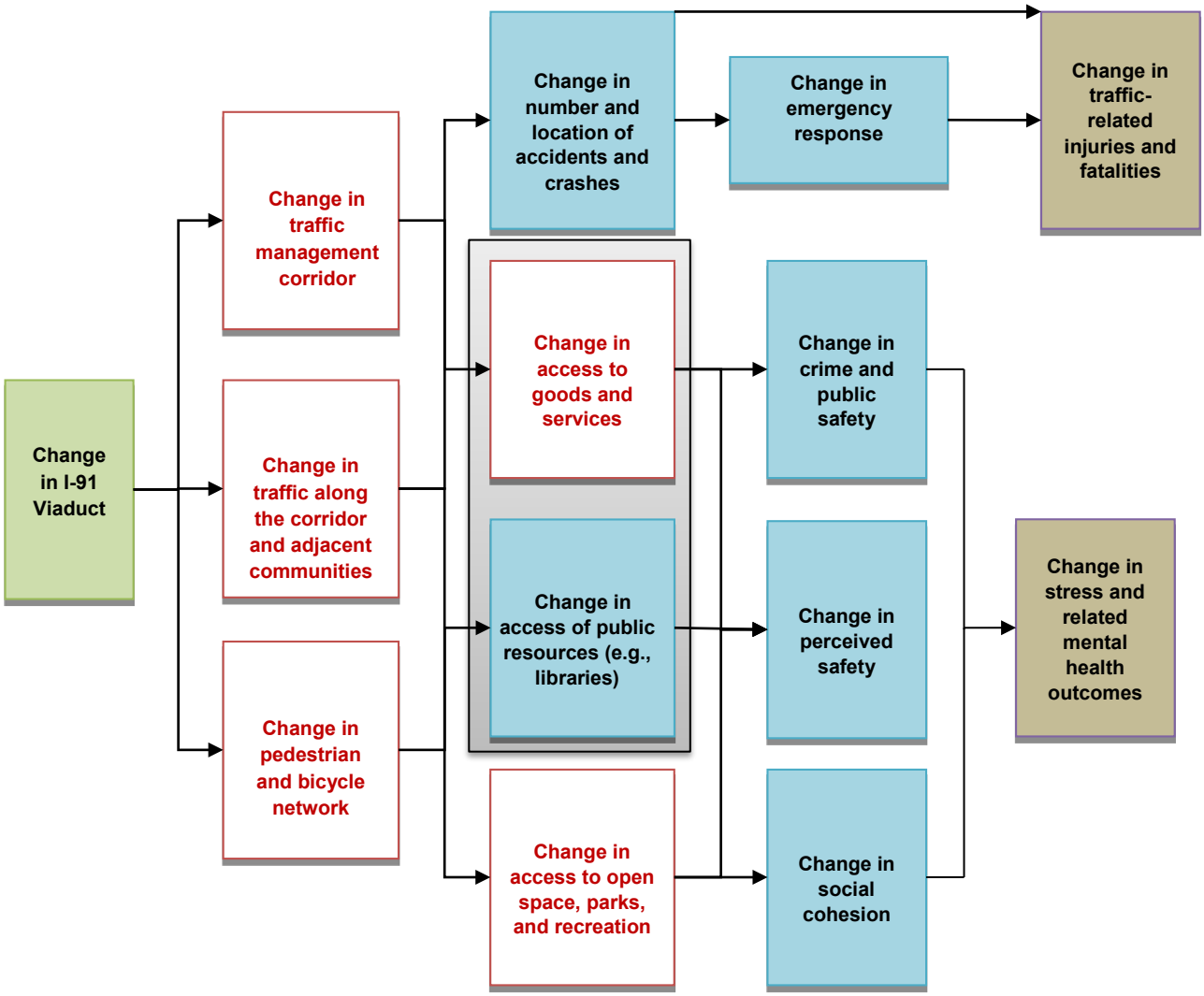


Figure 4-4: Public Safety Pathway

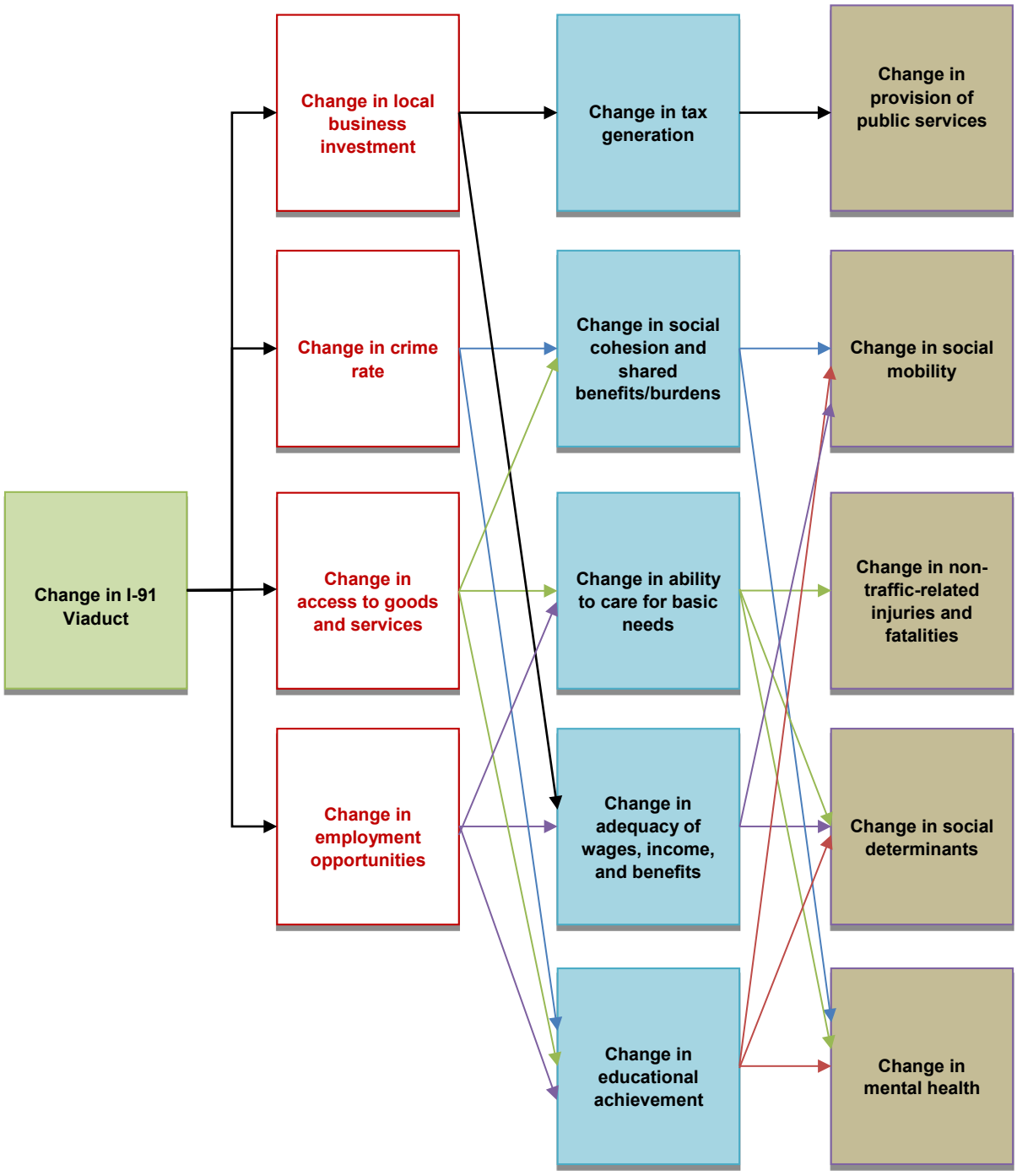


Figure 4-5: Socioeconomic Pathway

4.3 EVALUATION METHODOLOGIES

4.3.1 METHODOLOGICAL OVERVIEW

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

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

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

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

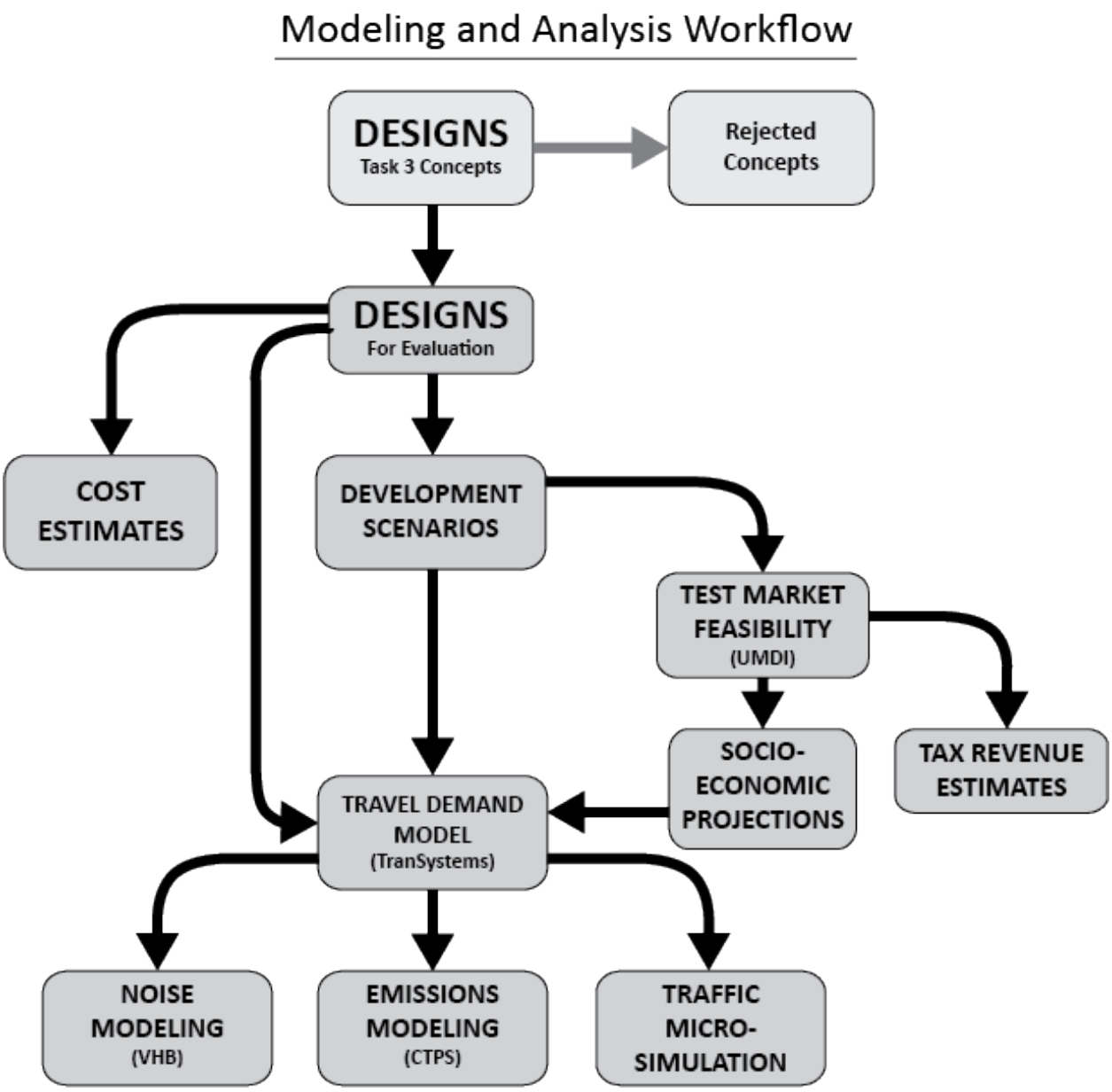


Figure 4-6: Overview of Evaluation Workflow

4.3.2 DESIGN OVERVIEW AND CONSIDERATIONS

The process of developing detailed conceptual alternatives from the very simplistic "line drawings" prepared in the previous chapter included several iterations of highway design and engineering drawings as well a more detailed planning and landscaping look into the creation and transformation of green space, riverfront connectivity, and urban redevelopment. Utilizing Alternative 1 as an example, the following set of figures depicts the process that each of the three alternatives underwent to create

the three detailed conceptual alternative plans. The first step in the process involved a deeper, more technical look into the actual horizontal and vertical highway geometry, lane widths and configurations, ramp locations and configurations, intersection design, open space planning, and constraints defined in Chapter II.

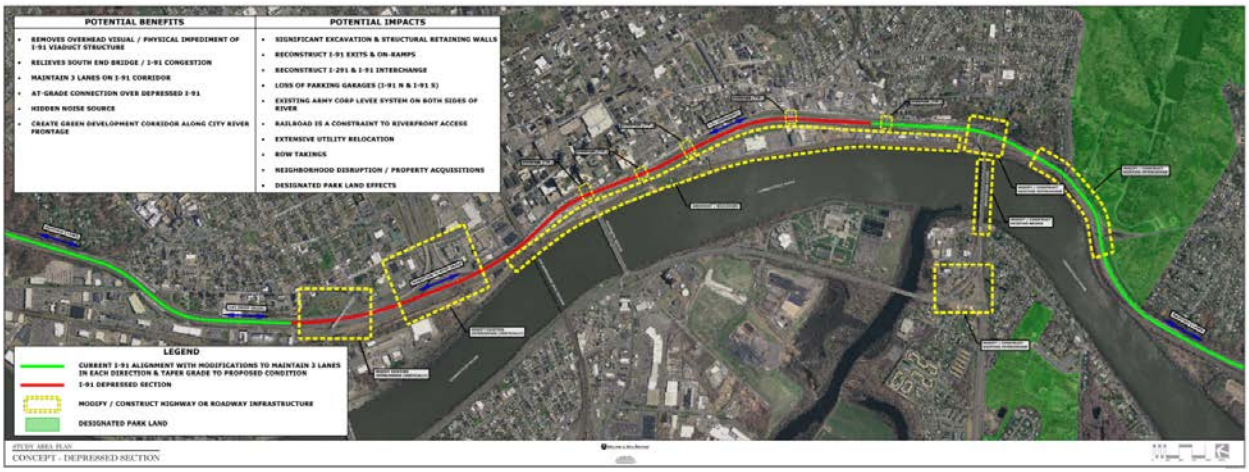


Figure 4-7: Original "Line Drawings" developed as part of the early alternatives development process

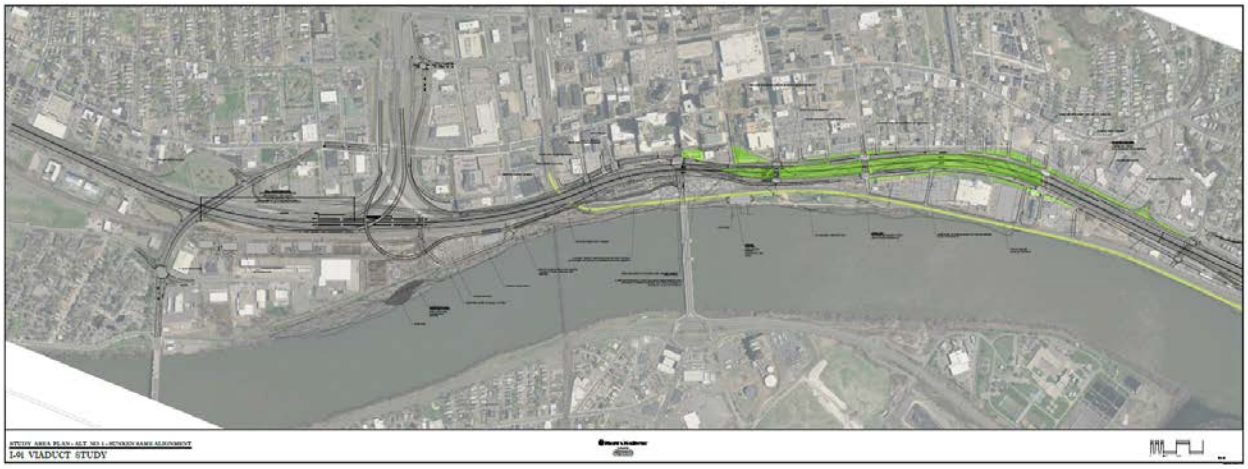


Figure 4-8: Initial development of highway and roadway alignment, lane widths, ramp locations, and green space

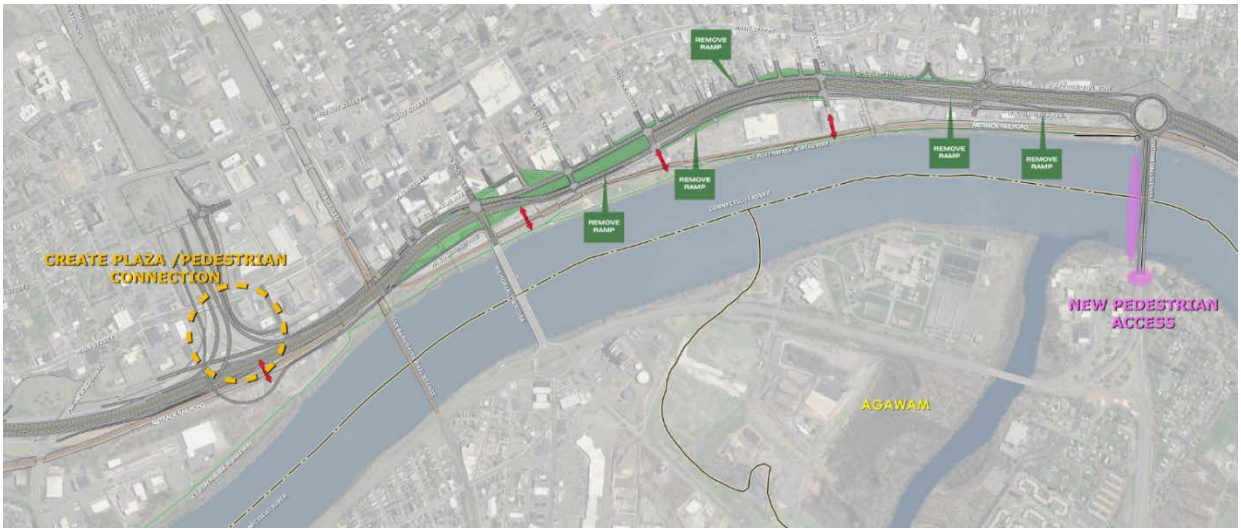


Figure 4-9: More detail is included as the alternatives begin to take shape; impacts and opportunities begin to be better defined for the purposes of the evaluation process to follow.

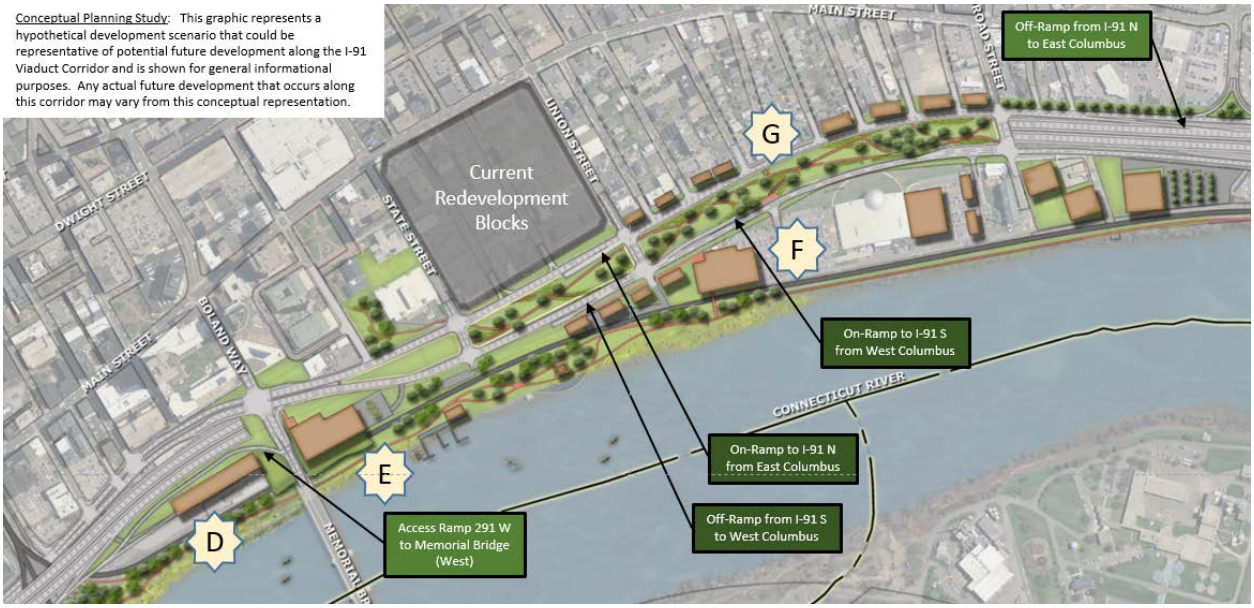


Figure 4-10: Final detailed conceptual alternative plans are developed for all three alternatives. The level of detail developed for each option is commensurate with the level of detail required to complete the evaluation criteria.

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

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

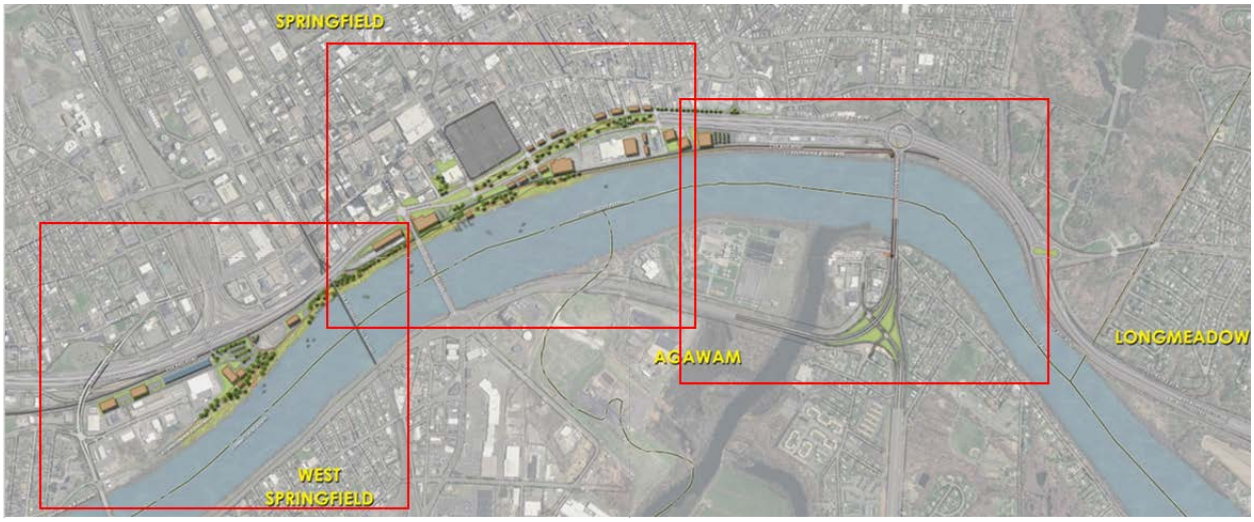


Figure 4-11: Index Plan (Alternative 1)

Figure 4-12: Alternative 1 - North Plan

Alternative 1 – North Plan

Mainline

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

Interstates 91 and 291 Interchange

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

Plainfield Street Area

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

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

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

East and West Columbus Avenues

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

Bicycle and Pedestrian Accommodations

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

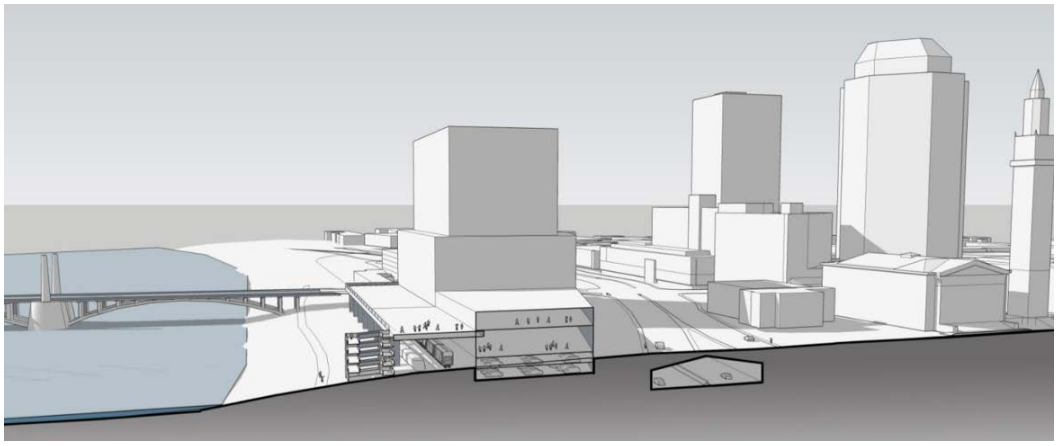
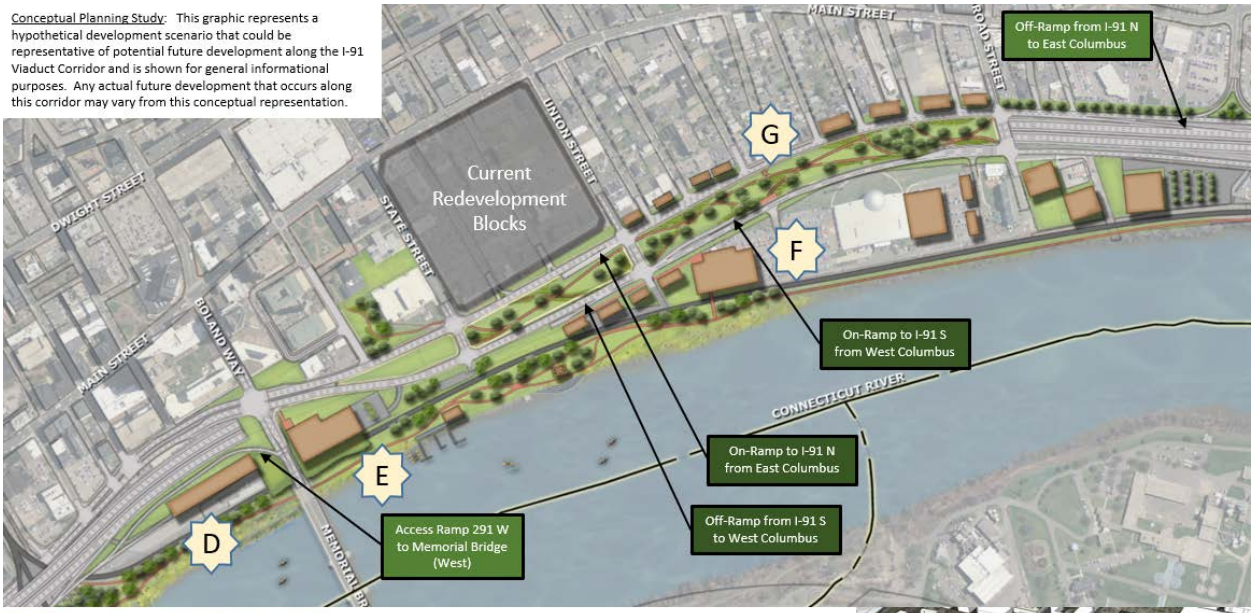


Figure 4-13: Conceptual view of proposed Downtown Springfield waterfront conditions possible as part of Alternative 1



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

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

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

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

Figure 4-14: Alternative 1 - Central Plan

Alternative 1 – Central Section

Mainline Tunnel

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

Frontage Roads

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

Access to I-91

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

Bicycle and Pedestrian Accommodations

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

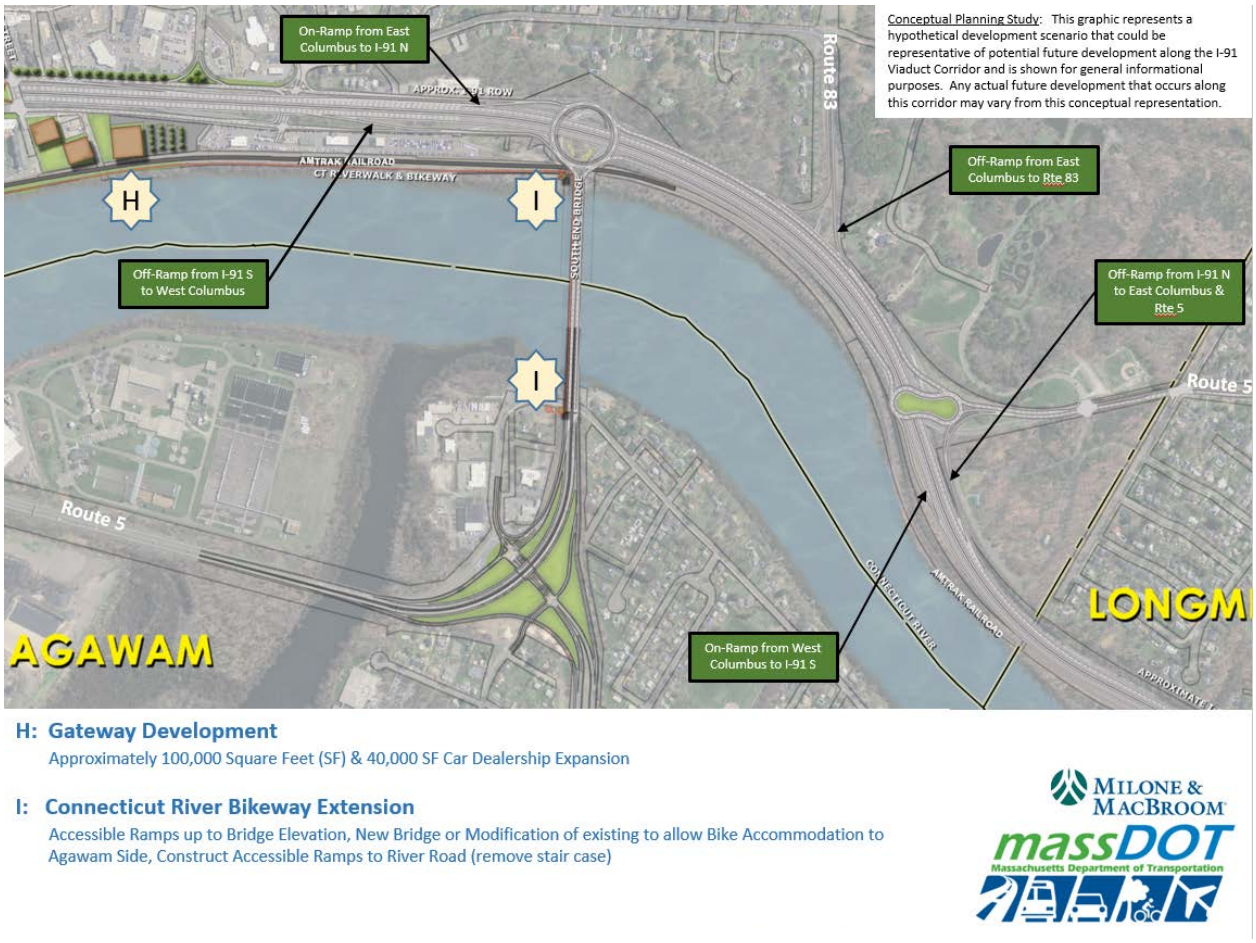


Figure 4-15: Alternative 1 - South Plan

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

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

I-91 Mainline

The existing interstate alignment in the "Longmeadow Curve" narrows from three lanes to two lanes in each direction between a point approximately 2,500' south of the U.S. Route 5 interchange (Exit 1) and extending approximately 450' south of Broad Street. The most significant change in the proposed

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

Collector/Distributor Roadway System

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

Interchanges

U.S. Route 5 and Interstate 91

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

The "peanut" roundabout would provide full access between I-91, the collector/distributor roadway system, and U.S. Route 5 and would contain two circulating lanes. Utilizing the collector/distributor roadway, this connects to a larger roundabout/rotary at the South End Bridge. At this location, the

roundabout would contain two circular lanes with slip lanes at the approaches. Full access would be provided at this location to I-91, U.S. Route 5, and Route 57 in Agawam; access would also be provided to East Columbus Avenue and from West Columbus Avenue. Between the two roundabouts, access would also be provided to Route 83 on the east side. The connection between the two roundabouts would create a loop to allow for entering and exiting each of the major roadways in this area, including both northbound and southbound directions on I-91, U.S. Route 5, and Route 83 as well as connections to East and West Columbus Avenues.

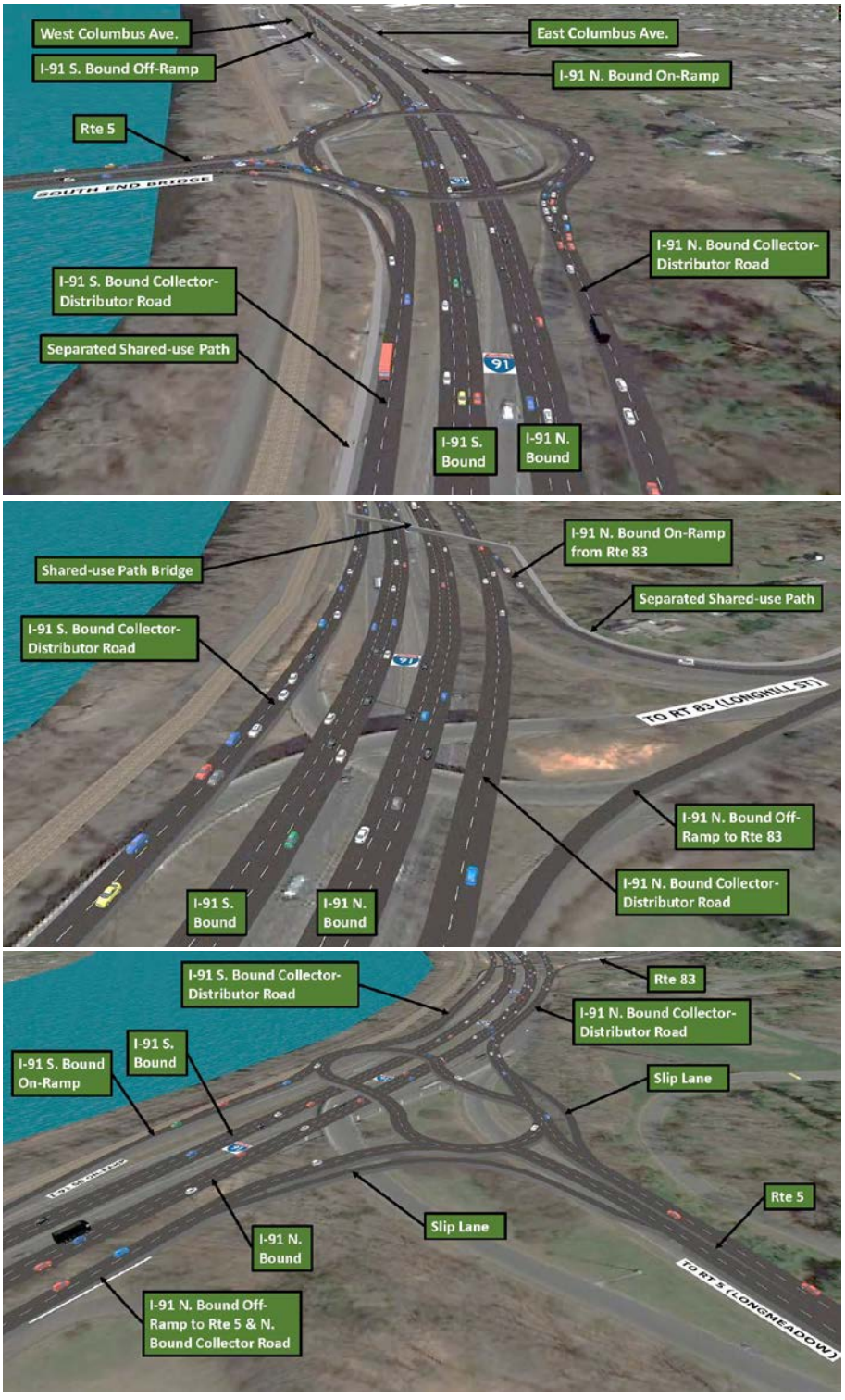


Figure 4-16: Interchange Concept for I-91 and U.S. Route 5

U.S. Route 5 and Route 57

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

<u>South End Bridge and U.S. Route 5 Bridge over the Westfield River Replacement</u>

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

<u>Pedestrian and Bicycle Features</u>

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

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

Alternative 2

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

Figure 4-17: Alternative 2 - North Plan

Alternative 2 – North Section

Mainline

Under Alternative 2, the proposed I-91 mainline would descend through a depressed portion through Downtown Springfield for a distance of approximately 4,300'. At the north end, the depressed

alignment would reemerge at street level just north of the proposed roundabout at the Memorial Bridge and Boland Way. From this point, it would continue to elevate at a five percent grade in order to pass over the rail lines and East/West Columbus Avenues in the area between Gridiron Street and Worthington Street. Three lanes would be maintained in each direction prior to entering the interchange with I-291.

Interstates 91 and 291 Interchange

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

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

Plainfield Street Area

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

The rebuilt bridges would incorporate a third lane of traffic for U.S. Route 20A in the westbound direction. A boulevard-type roadway would still be incorporated to provide an island between the eastbound and westbound movements. New pedestrian improvements would include new wheelchair ramps, sidewalks along both sides of the structure, and crossings at the on and off ramps to the frontage roads and interstate. These ramps would also include sufficient merging and gore areas. Under current conditions, the area is in need of bicycle and pedestrian improvements, with no bicycle facilities in either

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

East and West Columbus Avenues

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

Bicycle and Pedestrian Accommodations

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

Figure 4-18: Alternative 2 - Central Plan

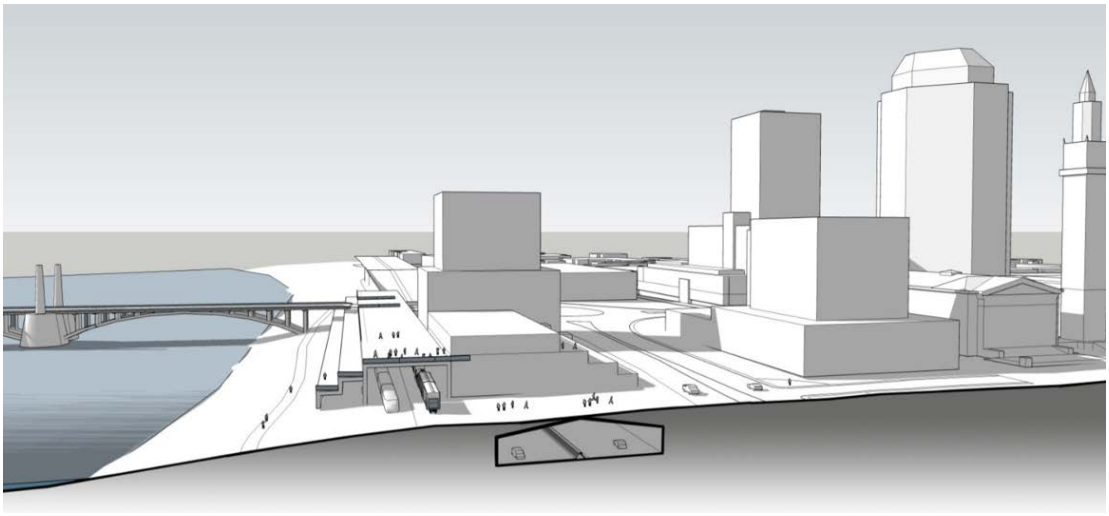


Figure 4-19: Conceptual view of proposed Downtown Springfield riverfront conditions possible as part of Alternative 2

Alternative 2 – Central Section

Mainline Tunnel

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

The major difference between Alternatives 1 and 2 is that the mainline would be realigned to a right-of-way directly adjacent to the railroad. This realignment would also allow for the removal of some of the curvature of the mainline as compared to existing conditions, providing a longer tangent between curves from Union Street to the I-291 interchange. As a result of this realignment, the total quantity and location of land above the depressed highway differs between Alternatives 1 and 2. These differences are reflected in the design concepts for open space and development for Alternatives 1 and 2 and are discussed further in section 4.3.3 below.

Frontage Roads

East and West Columbus Avenues would be at the same elevation as they are today. However, instead of being separated by the I-91 Viaduct structure, these roadways would be separated only by the area of open space on the depressed alignment's cap. Each roadway would be primarily two lanes in each direction. The two frontage roads would be separated by open space from Broad Street and eventually converge at Boland Way, where a two-lane roundabout is proposed at the intersection of Boland Way, Memorial Bridge, and East and West Columbus Avenues. The intersection of State Street and Broad Street would remain signalized. The connection between Union Street and West Columbus Avenue/Hall of Fame Avenue would be removed. U-turn lanes would be provided at State Street to go from northbound to southbound and at Broad Street to reverse direction from southbound to northbound.

Access to I-91

Under Alternative 2, I-91 northbound would have an off ramp that would provide access to East Columbus Avenue just south of Union Street. An off ramp for I-91 southbound is proposed for State Street. Within this section of I-91, there are currently six on and off ramps within a short distance, creating weaving issues and elevated numbers of crashes. With the removal of four of these ramps, there would be substantially fewer opportunities for crashes with merging and diverging vehicles.

Bicycle and Pedestrian Accommodations

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

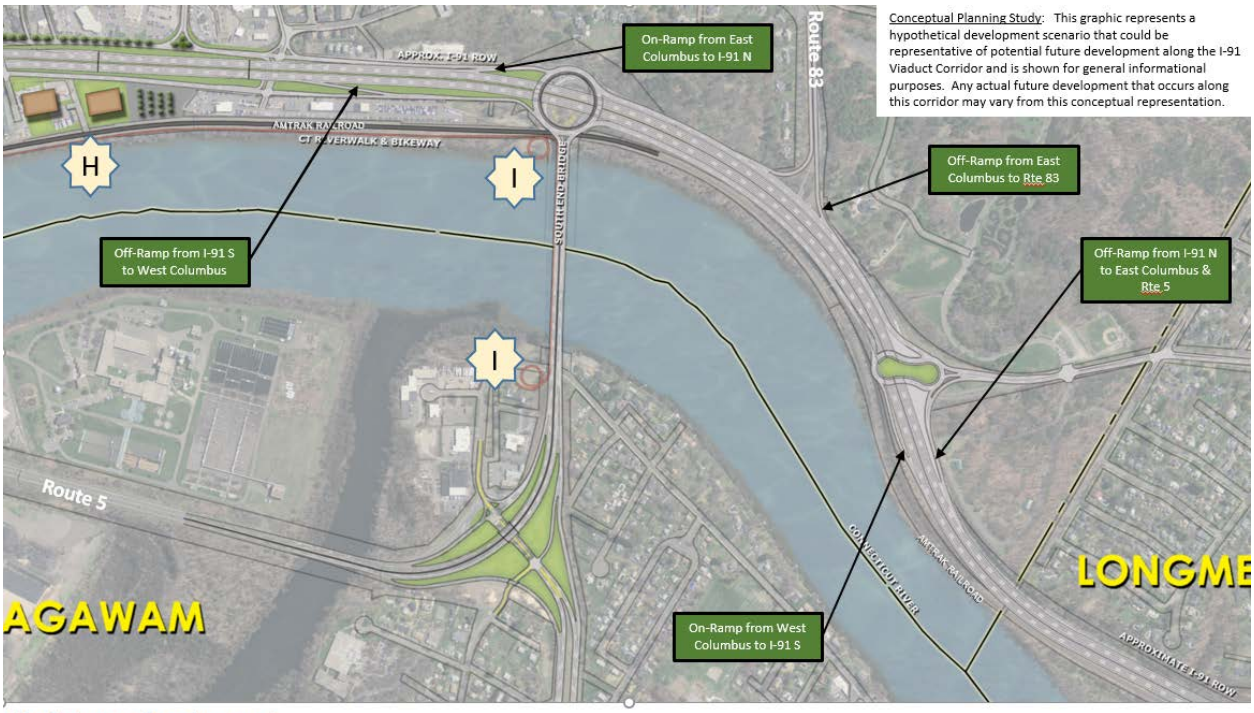


Figure 4-20: Alternative 2 - South Plan

Alternative 2 – South Plan

As stated in Alternative 1, the South Plan is identical for each of the three alternatives. See Alternative 1 – South Plan for a full description.

Alternative 3

Alternative 3 has been similarly divided into three sections, north (I-291 Interchange), central (Downtown Springfield Core), and the south (Longmeadow Curve).

Figure 4-21: Alternative 3 - North Plan

Alternative 3 – North Plan

Mainline

The mainline would continue to be elevated through this area before descending and touching down prior to the Plainfield Street overpass. Three lanes would be maintained in each direction prior to entering the interchange with I-291.

I-91 and I-291 Interchange

Full access between I-91 and I-291 would be preserved under this design, with a very similar ramp structure to what exists today. As with Alternatives 1 and 2, this design would alter the connection between I-291 southbound and I-91 southbound. In place of the existing connection from I-291 to I-91, which routes traffic onto the left side of the mainline, a redesigned flyover would continue over the entire I-91 alignment and ramps and connect to the right side of the southbound mainline. Along with providing access to the right side of the mainline, the ramp would split to provide connection to the Memorial Bridge in the westbound direction. As with Alternative 2, an eastbound on ramp at Plainfield Street would provide access to I-291; eastbound traffic could also access I-291 by following Plainfield Street to East/West Columbus Avenues (which pass below the I-91 mainline in this area) to access Emery Street. In addition, the Emery Street on ramp to I-291 would also be configured to provide a bridge connecting Main Street and Dwight Street and merging with a reconfigured I-91 northbound off ramp. This intersection would be reconfigured and signalized, providing access to I-291 northbound from East and West Columbus Avenues and Plainfield Street.

Plainfield Street Area

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

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

East and West Columbus Avenues

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

Bicycle and Pedestrian Accommodations

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

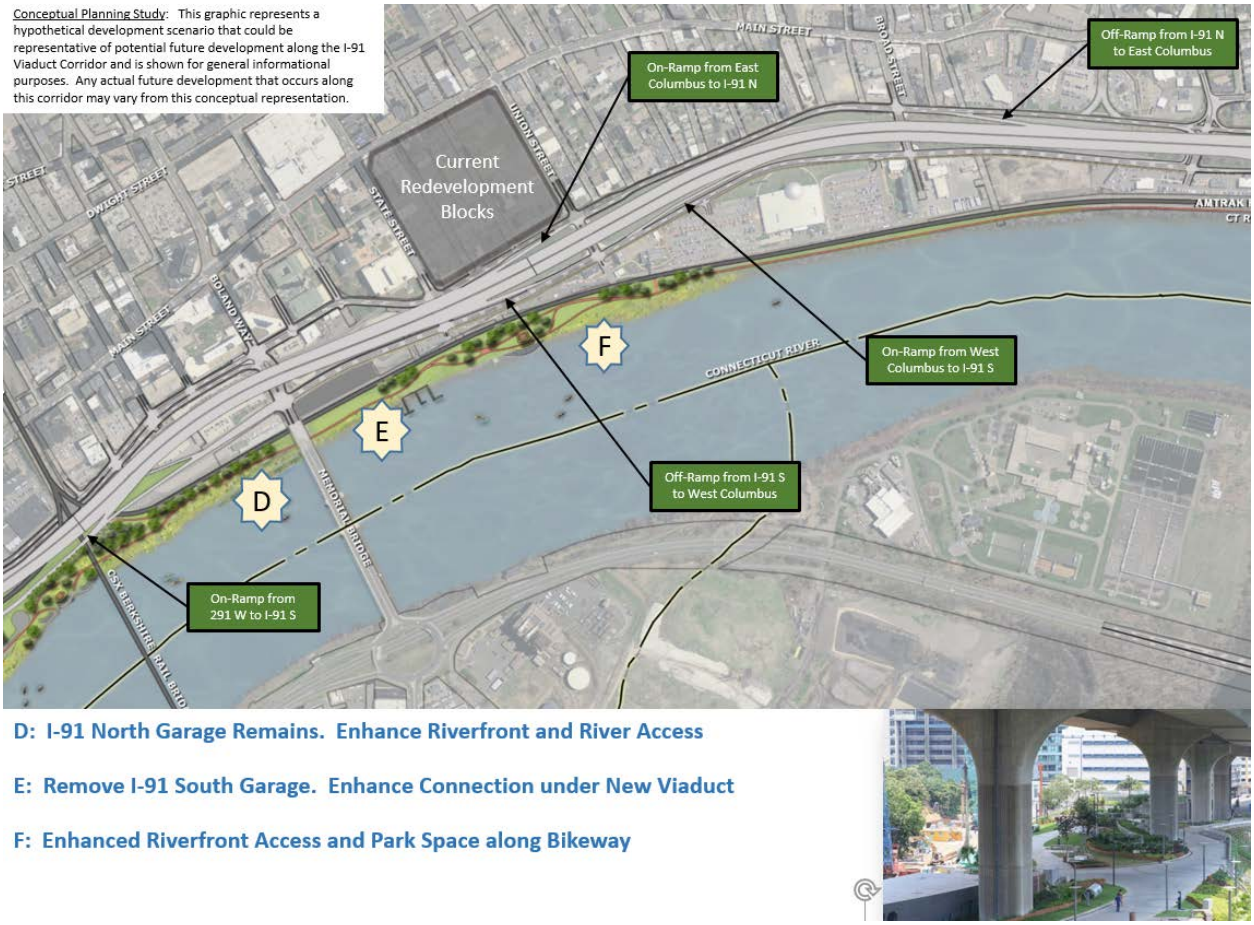


Figure 4-22: Alternative 3 - Central Plan

Alternative 3 – Central Section

Mainline Viaduct

The proposed mainline would be similar to the existing condition under this alternative, utilizing a viaduct structure and the same alignment. The major difference between the existing and proposed design is that an "elevated viaduct" design would be implemented with current technology and structural features. The structure would be elevated to a maximum height approximately 10 feet above the height of the existing structure to provide more light underneath and greater sense of openness. The conditions below the viaduct would be further improved by wider spacing between the columns holding up the roadway, further improving the pedestrian experience below the viaduct. On the I-91 mainline in this area, three lanes would be maintained along both the northbound and southbound directions. The shoulders and median on the viaduct would also be greater than under the existing design.

Frontage Roads

Under Alternatives 1 and 2, East/West Columbus Avenues would be realigned and relocated above the depressed highway structure. By contrast, Alternative 3 would retain East and West Columbus Avenues in their existing alignments. During the course of implementing the elevated viaduct concept, upgrades such as auxiliary lanes at the signalized intersections, new traffic signal equipment, and timing and coordination changes would all be implemented at these locations. Capacity and safety improvements for vehicles, pedestrians, and bicycles would be implemented at East/West Columbus Avenues intersections with State Street, Union Street, Broad Street, Main Street, and Boland Way.

Access to I-91

On ramps to the I-91 mainline under this design would be located to the north and south of Union Street off East Columbus Avenue (northbound direction) and West Columbus Avenue/Hall of Fame Avenue (southbound direction). Off ramps are proposed for Union Street (southbound direction) and for Broad Street (northbound direction). The off ramp at Union Street in the northbound direction would be removed as would the northbound on ramp north of State Street. This reconfiguration would remove two ramps in this section, reducing opportunities for crashes with merging and diverging vehicles.

Bicycle and Pedestrian Accommodations

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

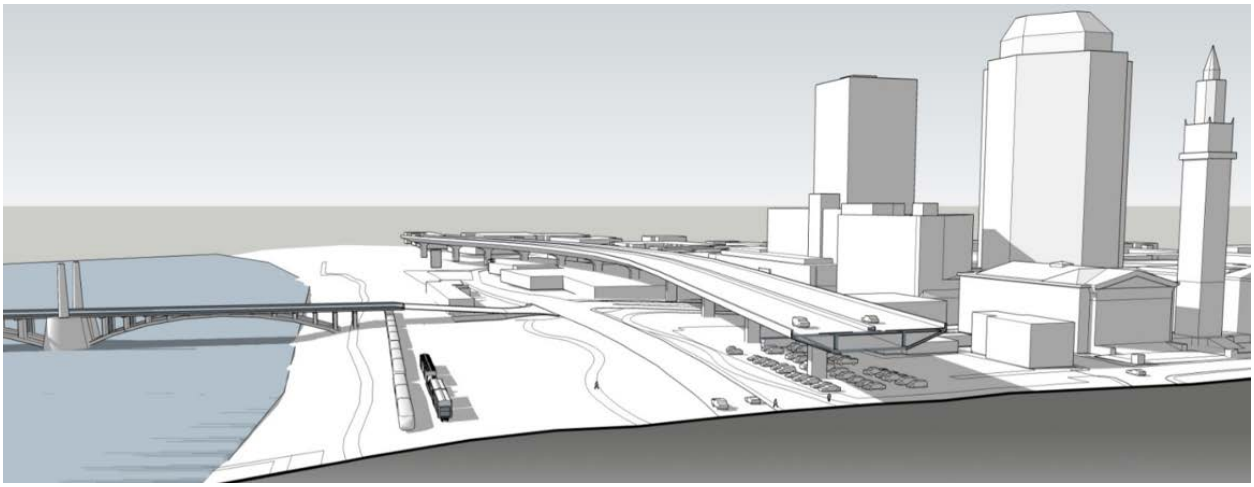


Figure 4-23: Conceptual view of proposed Downtown Springfield riverfront conditions possible as part of Alternative 3

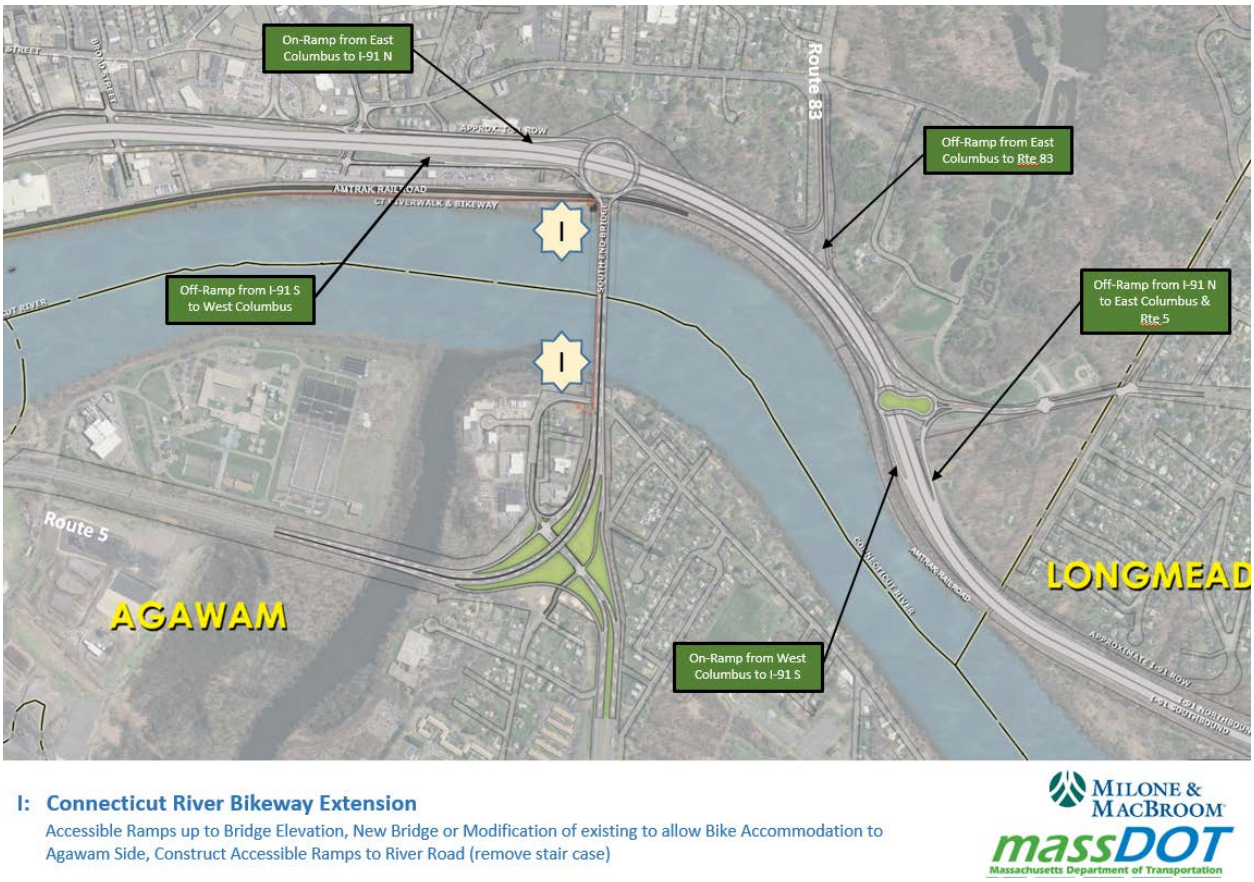


Figure 4-24: Alternative 3 - South Plan

Alternative 3 – South Plan

As stated in Alternatives 1 and 2, the proposed South Plan is identical for each of the three alternatives and also could be considered a stand-alone project. See Alternative 1 for description.

NEAR-TERM IMPROVEMENTS

As the development of more defined alternatives progressed, it became apparent that several components of the alternatives could be viewed as potential stand-alone improvement projects. Due to their lower cost and reduced permitting requirements, the following improvements could be implemented as part of the three alternatives or as stand-alone projects independently of the major elements of those alternatives. All of the following projects could be considered for enhancement of a No-Build scenario.

Enhanced Under-Viaduct Pedestrian Plazas – Safety Upgrades and Health and Aesthetic Improvements

The following are examples of under-viaduct improvement projects that can be designed and constructed without the need for extensive permitting and construction funding.

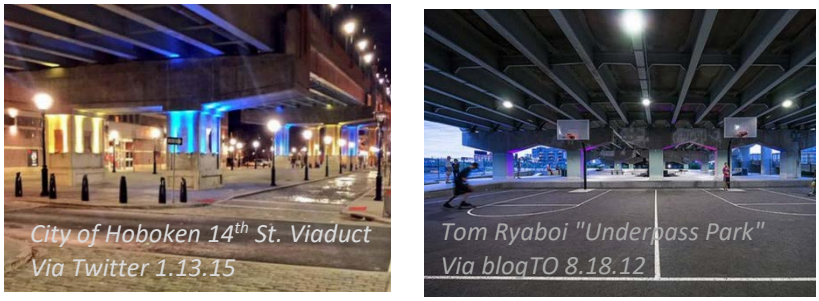


Figure 4-25: Under-Viaduct Enhancement Examples

Specific under-viaduct enhancements could range from creation of urban park space, decorative safety lighting, play courts, playgrounds, skate parks, seating, public art, and decorative pier treatments. The two following renderings depict two areas under the I-91 Viaduct and the possibilities for near-term improvement projects. These concepts envision addressing lighting and safety deficiencies in this area in order to make the space more inviting. Key elements include lighting improvements; sidewalks and paths; and inviting landscape and hardscape features that enhance the sense of security in the area, provide amenities to attract pedestrian foot traffic, and improve connections between Downtown Springfield and the Connecticut River. Attractive amenities such as a dog park for local residents could also provide similar benefits to this area.

Figure 4-26: Conceptual Rendering of I-91 Under-Viaduct Enhancements

Figure 4-27: Conceptual Rendering of I-91 Pedestrian Improvements to Rail Crossings/Connecticut Riverwalk and Bikeway

Bicycle and Pedestrian Improvements

Two access points between West Columbus Avenue and the Connecticut Riverfront Park and Connecticut Riverwalk and Bikeway currently exist. One is a passive at-grade rail crossing just south of State Street, which is not equipped with gates or lights to signal approaching trains. The second is a vehicular path below a rail overpass approximately 200 feet north of State Street. Pedestrian access to the riverfront is possible via adjacent stairs, but neither a dedicated pedestrian path nor any ADA accommodations are present at this crossing. Safety improvements to these crossings would enhance access for pedestrians and cyclists.

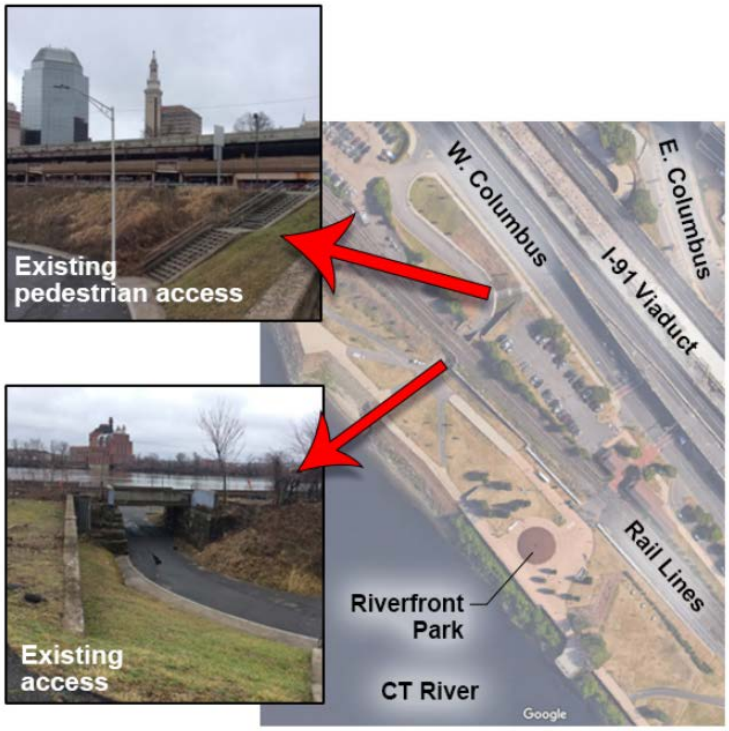


Figure 4-28: Pedestrian Improvements to Rail Crossings and Connections to Connecticut Riverwalk and Bikeway

On the western side of the Connecticut River, a stairway connects the South End Bridge to River Road. This stairway is neither ADA accessible nor bike-friendly. A new ramp or switchback path from the South End Bridge to River Road would provide an improved connection from Riverfront Park and the Connecticut Riverwalk and Bikeway to River Road and the surrounding neighborhood. In addition, maintenance deficiencies further complicate access for pedestrians and cyclists using this route.

Figure 4-29: Maintenance deficiencies in path and stairway connecting South End Bridge and River Road

Figure 4-30: Opportunity for ADA Accommodations

On the eastern side of the river, an acute bicycle access barrier is the lack of a connection between the southern end of the Connecticut Riverwalk and Bikeway and the South End Bridge. Currently, the bikeway terminates approximately 800' north of the South End Bridge with no access to adjoining streets. A publicly accessible connection to the southern terminus of the Connecticut Riverwalk and Bikeway is needed, which may be accomplished through a possible land taking or easement to allow for a tunnel underneath the railroad tracks.

The existing elevated walkway linking the former Hall of Fame facility and the Connecticut Riverwalk and Bikeway is underutilized and not clearly visible to either drivers or pedestrians walking south along West Columbus Avenue. Providing better, safer, and more visible access to this pedestrian bridge via wayfinding signage or sidewalk and lighting enhancements could make this structure a more useful link to the riverfront. Alternatively, the structure could be relocated to the south, proximate to the current Hall of Fame and associated parking.

Currently, the U.S. Route 5 alignment through Forest Park at the Springfield-Longmeadow border lacks sidewalks for approximately 600' between Laurel Hill Road and Forest Glen Road, creating a disconnect in the area's pedestrian network particularly for users with mobility challenges who may not be able to use unpaved paths in the park. Providing a shared-use path along this section would provide better connections to the park for Longmeadow residents. Adequate space along the existing right-of-way exists for a shared-use path without considerable impacts on adjacent open space and recreational facilities. Figure 4-31 below depicts a potential location for such a shared-use path on the eastern side of U.S. Route 5.

Figure 4-31: Potential Shared-Use Path (Forest Park - Longmeadow)

Local Roads, Signalization, and Miscellaneous Improvements

Currently, some capacity issues occur during the AM and PM peak periods along U.S. Route 5 between Forest Glen Road and Converse Street. Signal coordination and review of timing for these intersections could alleviate these issues. In addition, the provision of a right-turn lane at the westbound approach along Forest Glen Road as it intersects with U.S. Route 5 would add capacity to this intersection and alleviate long queues, which currently extend as far as Laurel Street during peak periods.

In addition to the specific locational improvements noted above, additional spot ADA improvements are warranted across the Primary Study Area. These include sidewalk repair, ADA/AAB ramps, countdown signal heads, and minor timing changes that allow adequate time for pedestrian crossing throughout the Primary Study Area. The addition of these minor improvements would yield increased walkability and pedestrian safety for users across the Downtown Springfield area.

Similarly, interstate symbols on and around the I-91 corridor are currently absent or worn away, causing navigational difficulties and confusion for drivers. Providing interstate symbols on I-91 in the vicinity of the viaduct would help address these issues, potentially reducing crashes resulting from last-minute maneuvers as well as excess vehicle miles traveled.

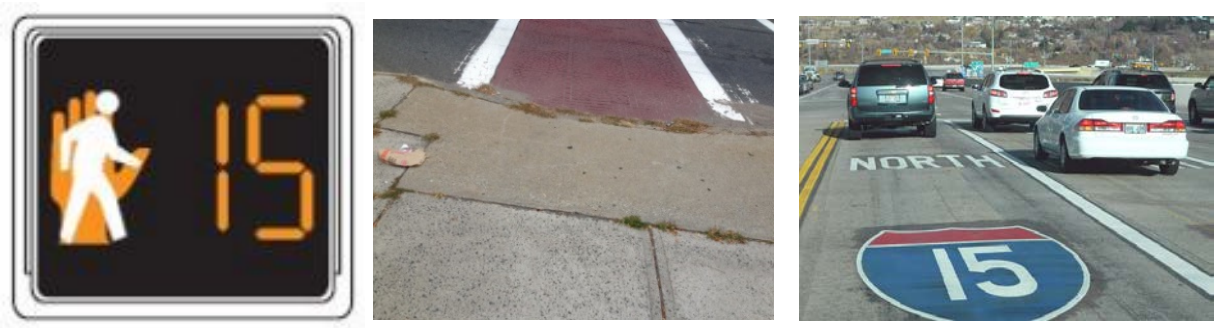


Figure 4-32: Pedestrian-Friendly Countdown Signal; Nonconforming Pedestrian Ramp in Study Area; Interstate Symbol Example

MID-TERM IMPROVEMENT PROJECTS

As with the near-term improvements outlined above, a number of mid- to long-term improvements were identified in the course of developing the alternatives. As with the near-term improvements, these projects could be implemented independently of options for the viaduct. These improvements would incur higher costs, greater permitting requirements, and more extensive construction impacts than the near-term improvements identified above and, therefore, would likely occur farther into the future. All of the following projects could be considered for enhancement of a No-Build scenario.

Longmeadow Curve

The "Longmeadow Curve" is generally located between the South End Bridge and the U.S. Route 5 interchange along I-91. As previously described, the existing conditions in this area—including the lane drop, high density of on and off ramps, and weaving and merging/diverging areas—have yielded problems with vehicular crashes and congestion.

Figure 4-33: Longmeadow Curve

Figure 4-34: South End Bridge and Agawam Rotary

This mid-term solution incorporates the use of collector-distributor roads alongside and separated from the I-91 mainline, as well as a roundabout interchange at I-91 and the South End Bridge and a "peanut" interchange between I-91 and U.S. Route 5. The "peanut" concept is an elongated roundabout with curves introduced on its long axis to control traffic speeds, yielding a peanut shape. The collector-distributor roads would provide a connection between these two structures, as well as access to Route 83 via the east side of the interstate. The collector-distributor roadways act as a loop for each of the connecting points, reducing the number of on and off ramps present in this section and limiting the weaving, merging, and diverging along the interstate.

Finally, I-91 would be redesigned to provide adequate radii in this area and provide continuous use of three lanes in each direction, eliminating the existing lane drop. This set of improvements would address all of the major conditions that currently result in congestion and elevated crash levels, as well as enhance access between I-91 and Routes 5 and 83.

<u>South End Bridge and Agawam Rotary</u>

The South End Bridge and Agawam Rotary area currently suffers from congestion and backups onto the South End Bridge and U.S. Route 5 southbound during peak hours from areas north of the Agawam Rotary, as well as crash clusters in the existing rotary and South End Bridge.

The proposed mid-term solution for these issues is to replace the existing rotary with a modified diamond interchange, which would provide a free-flow movement from U.S. Route 5 southbound to Route 57, eliminating queuing onto U.S. Route 5. This concept would also replace both the South End Bridge and the existing bridge over the Westfield River with new bridges, providing two lanes in each direction and access to and from Meadow Street.

The proposed replacement for the South End Bridge would provide two lanes in each direction with the proper lane merges and gores for exiting where required. The bridge would also include a separated shared-use path for bicycles and pedestrians. The rotary would be replaced with two intersections controlled by traffic signals, which would include adequate auxiliary lanes where needed. U.S. Route 5 would bridge over between the two signalized intersections. A new bridge of the Westfield River for U.S. Route 5 would be constructed, which would also include two lanes in each direction with the proper lane merges and gores for exiting where required. A direct connection from U.S. Route 5 southbound to Route 57 would be implemented. Meadow Street would have full access to the two signalized intersections, providing connections to River Road and U.S. Route 5 in both the southbound and northbound directions. The off ramp from Route 57 westbound to Editha Avenue would be eliminated, but a full connection to and from Meadow Street in both directions provides access to this neighborhood.

Figure 4-35: I-91 & I-291 Interchange

Entrance to I-91 Southbound from I-291 Southbound

Under existing conditions, numerous vehicles entering I-91 southbound from I-291 southbound are required to cut across the interstate to get off at Memorial Bridge (Exit 7). The distance between the two gores of the on and off ramps is approximately 850'. In that short distance, vehicles attempt to merge across two lanes to get to the off ramp. Although a solid white lane was added to extend the gore past the off ramp, many vehicles still attempt to access Exit 7 from the on ramp. Numerous crashes occur in this area as a result.

A new ramp to connect I-291 southbound to I-91 southbound, entering the highway from the right-hand side, would allow vehicles seeking to access Memorial Bridge to do so without merging across the two lanes of traffic. The new ramp would enter I-91 on the right-hand side of the interstate and then split to provide a connection to the Memorial Bridge toward West Springfield. This on ramp would need to bridge over the existing I-91/I-291 interchange to achieve this configuration.

Plainfield Street Section and Main Street

The existing alignment of Plainfield Street, which connects Main Street to the North End Bridge, faces capacity issues and poor levels of service under current conditions that will only worsen without action.

To alleviate these issues, a series of new bridges over the interstate and railroad tracks is proposed to replace the existing bridges in the area. These bridges would incorporate a third lane of traffic for Route 20A in the westbound direction. A boulevard-type roadway is still envisioned, providing an island between the eastbound and westbound movements. Improvements would be made for pedestrians, including new ADA-accessible ramps, sidewalks along both sides of the structure, and crossings at the on and off ramps to the frontage roads and interstate. Adequate bike lanes would also be provided on both sides of the roadway. Currently, no sidewalks or bike lanes exist along the Plainfield Street Bridge over I-91. The proposed ramps would also include sufficient merging and gore areas, which do not currently exist. Improvements will be made along Plainfield Street and West Street from Main Street to the North End Bridge. The intersection of Avocado and West Streets at Plainfield Street would be reconstructed to include new auxiliary lanes and traffic signal equipment. The intersection of Plainfield Street at Main Street would also be reconstructed.

Figure 4-36: Plainfield and Main Streets

4.3.3 DEVELOPMENT SCENARIOS AND SOCIOECONOMIC IMPACTS

Following the development of finalized designs for Task 4, the next step in assessing impacts across alternatives was to examine opportunities created by enhanced connectivity and increased accessibility resulting from changes in proposed highway alignments and new riverfront connections. This phase of the alternatives analysis process was focused on how Downtown Springfield revitalization might take place as private and public actors respond to the new opportunities afforded by each alternative.

Major considerations in the design process included the following:

- The potential to exploit synergies with existing warehousing and distribution facilities at the northern end of the study area, where a widened connection under the I-91 corridor creates opportunities for new development
- Options for expanding recreational amenities along the existing waterfront multiuse trail, providing a greater variety of uses to complement enhanced bicycle, pedestrian, and automobile access between Downtown Springfield and the Connecticut River waterfront
- The opportunity to redefine and enhance land uses proximate to Columbus Avenue, such as by creating an enclosed urban corridor, with master-planned development on both the east and west sides intended to create a defined street wall and urban room
- Beneficial uses for the cap above I-91 in Alternatives 1 and 2
- The opportunities raised by the current MGM Springfield casino development and concomitant increases in vehicular and foot traffic and demand for complementary amenities (e.g., parking, dining, lodging) in the Downtown Springfield core
- Creation of gateway features along major entrances to Downtown Springfield, including along Memorial Bridge and at the southern end of the I-91 Viaduct (in the vicinity of Broad Street)

All three alternatives include an eco-industrial park concept at the northern end of the study area, primarily focused on the currently underutilized lands south of Avocado Street. With the existing cluster of agricultural distribution businesses in this area and an anticipated expansion in demand for local and specialty foods stemming from new entertainment options in Springfield, infill development options such as greenhouses, community gardens, and additional distribution/warehousing facilities are envisioned to capitalize on this existing niche. With the addition of vehicular access under I-91 via Clinton Street, additional development options include a multistory riverfront residential development, commercial units suitable for a restaurant, or a community center. Additional parking and access roads allow an additional route for vehicular access to the riverfront and bikeway. While specific design details vary between alternatives, the eco-industrial park concept is a potential land use present in all three development scenarios. One of the three iterations of this concept is shown in Figure 4-37 (below).

A consistent objective in the depressed alternatives (Alternatives 1 and 2) has been to provide a gateway feature on the Springfield side of Memorial Bridge that creates a sense of arrival into Downtown Springfield and takes advantage of direct access to the at-grade Columbus Avenue corridor. In addition to multistory residential, office, and/or retail commercial development along the riverfront adjacent to Memorial Bridge/Boland Way, both the Alternative 1 and Alternative 2 concepts also depict a green space or terrace above the existing rail lines, providing unobstructed views of the Connecticut River as well as potentially programmable space in a highly prominent location. The addition of this 'green podium' concept also allows for at-grade parking below the podium level for adjacent land uses.

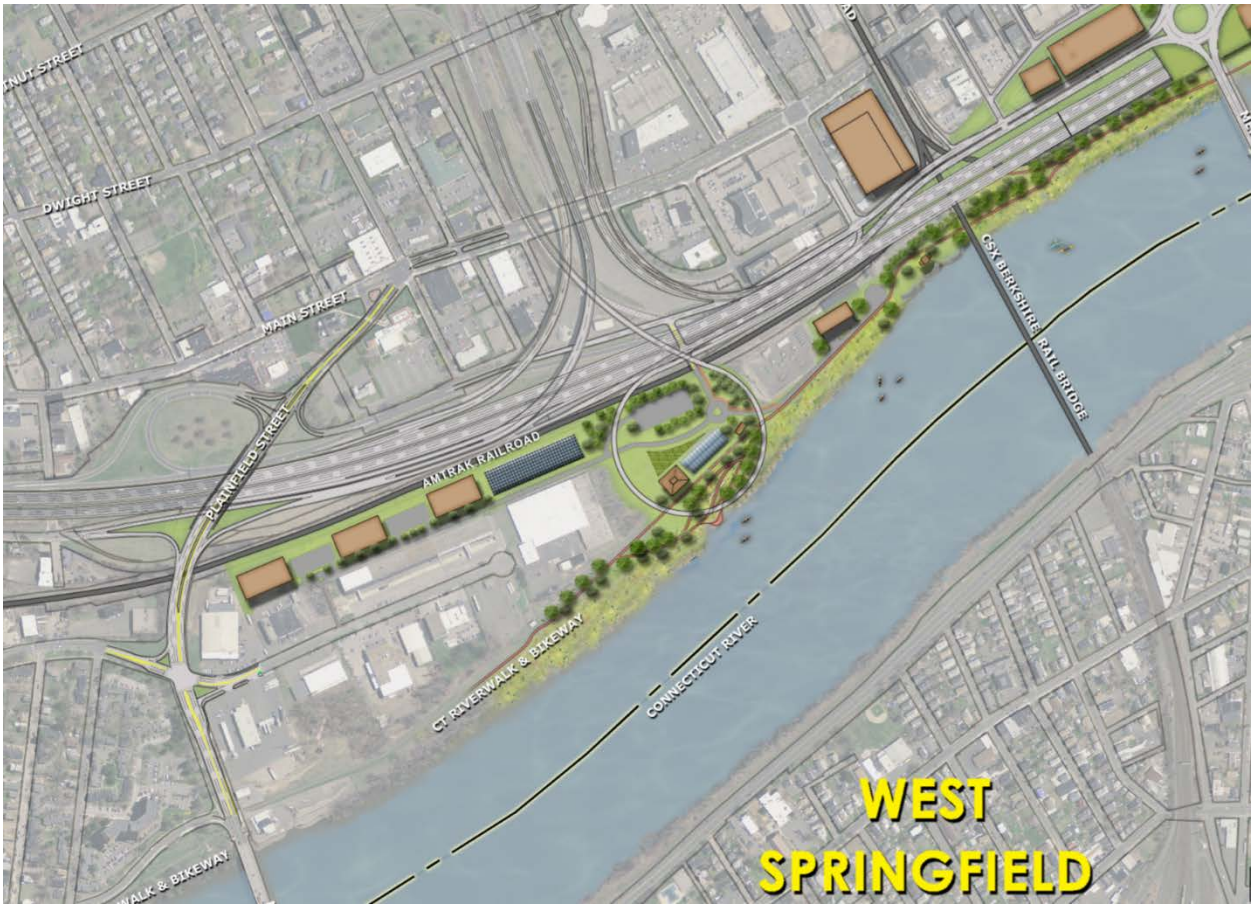


Figure 4-37: Development Concept Example – Avocado Street and Clinton Street

Further south along the I-91 corridor, both the existing and new alignment concepts portrayed in Alternatives 1 and 2 seek to take full advantage of the depressed and capped I-91 to create a high-quality public space bounded by private development. On the eastern side, redevelopment could provide both ground-floor retail units and upper-story residential units. This combination of uses could serve to introduce activity and eyes on the street while taking advantage of potential park and river views. Additional residential, hotel, and commercial development on West Columbus Avenue could provide further definition to the public space and take advantage of both views and development within easy walking distance of key amenities in the area, including the Basketball Hall of Fame and MGM Springfield. The Alternative 2 concept further envisions an elevated pedestrian walkway above the East and West Columbus Greenway to provide a direct connection from the MGM development to complementary amenities on the western side.

The southern end of the Downtown Springfield I-91 corridor also presents an opportunity for a gateway development as the Alternative 1 and Alternative 2 alignments descend into the capped section beginning at Broad Street. The development concepts were oriented around a clustered commercial

tower development on currently vacant/underutilized properties. Commercial real estate in this location will be able to take advantage of easy access at Exit 5 as well as enhanced riverfront amenities in the immediate vicinity.

Following the conceptual design process to create each development scenario, approximate square footages of residential, commercial, and office space were calculated. Following feedback and input from the Working Group on how the proposed development might interact with Springfield's current market conditions, the project team drew upon the expertise of the University of Massachusetts Donahue Institute (UMDI) to market-test and evaluate each concept, allowing the project team to modify the development scenarios where warranted.

After finalizing the total quantity and allocation of development across each alternative, the next step was to translate projected development into population, jobs, and socioeconomic impacts, which is the basis for future modeling. The basis for this work was the existing regional socioeconomic and demographic (SED) projections for 2040 prepared by the Pioneer Valley Planning Commission (PVPC). These projections were updated for each traffic analysis zone (TAZ) based on employment and housing multipliers gathered from state and national datasets and normalized to remain consistent with statewide planning estimates.

The SED modeling provides a key intermediate step in the modeling process, allowing for both primary and secondary effects of each alternative to be captured in traffic models and simulations, air quality and noise impact models, estimates of fiscal impacts, and EJ assessments. Direct impacts of each development scenario are enumerated in the Evaluation Matrix (items 4.1.1 through 4.2.7).

4.3.4 TRAFFIC MODELING AND SIMULATION

Simulations and models of both macroscale travel demand and microscale traffic patterns were central to evaluating the performance of each alternative in terms of design feasibility, mobility, safety, and environmental impacts.

Travel Demand Modeling (TDM) was conducted for each alternative, with the TDM corresponding to the 2040 No-Build scenario (developed in Task 2) serving as the baseline for evaluation. Each model incorporates projected demographic/employment changes and changes to the transportation network. The TDM results were provided at the level of individual roadway segments, allowing for interpolation of traffic volumes for each movement at each intersection. These volumes form the basis of further analysis using *Synchro* and *Highway Capacity Software* (HCS).

The future-year (2040) intersections were analyzed for each of the three alternatives using the *Synchro* software package to project key evaluation metrics, including LOS, delay, and queue length. After running initial models, each network was reviewed to determine any locations that would operate at LOS E or F. Timing adjustments or lane configuration changes were tested to try to improve operations

at these intersections. The resulting LOS, delays, and queue lengths were tabulated and included in this report.

The future-year (2040) freeway, ramp, and weaving segments were evaluated by means of the HCS package. The major inputs for freeway analysis include the freeway traffic volume (as projected by the TDM), number of lanes, ramp density (in ramps per mile), and freeway speed. Levels of Service were determined for each freeway segment, each merge/diverge (on or off ramp) segment, and each weaving segment.

Lastly, the proposed replacement of existing I-91 interchanges at U.S. Route 5, Route 83, and the South End Bridge with two enlarged roundabouts (including the southern peanut-shaped roundabout described previously in this chapter) connected by collector-distributor roads was evaluated using *PTV VISSIM*. 3D models of the highway, roundabouts, and ramps were created based on conceptual drawings, and traffic volumes were modeled based on TDM results. With these inputs, a video-simulation of the 3D model was created to visually see the impacts of the conceptual freeway and new roundabouts.

Figure 4-38: VISSIM Output Example

Results of each of these traffic models and simulations are incorporated into the Evaluation Matrix (sections 1.1 and 1.2).

4.3.5 AIR QUALITY AND NOISE IMPACT EVALUATION

Future-year traffic volumes modeled by TranSystems formed a basis for estimating several traffic-related impacts in greater detail. Air quality impacts and noise impacts were two areas of emphasis in understanding the environmental impacts of each alternative on the area surrounding the I-91 corridor and the people who live, work, and travel in it.

Air quality modeling work was conducted by the Central Transportation Planning Staff (CTPS) based on AM/PM peak-period traffic volumes for base year 2014, 2040 No-Build, and Alternatives 1 through 3, as well as land use data. The geography under consideration for this model is identical to that used for development of the traffic demand model discussed in section 4.3.4. The modeling process used by CTPS incorporates emissions associated both with VMT (by speed and vehicle type) and with cold starts across four pollutant categories: CO, CO_2, NO_X, and (VOCs).

The modeling procedure also incorporates anticipated changes in technology that may affect vehicle emissions. Comparing the 2014 base year and 2040 No-Build scenarios, this change is apparent in the greatly reduced levels of emissions across all modeled pollutants. Due to the conceptual level of the designs under consideration, this analysis did not include dispersion modeling of pollutants and, therefore, does not provide a basis for determining the geographic distribution of pollutant exposure.

TABLE 7: SUMMARY OF I-91 VIADUCT STUDY AIR QUALITY RESULTS

Scen.	AM/ PM	VMT	VHT (Hrs.)	Ave. Speeds	CO2 (kg)	VOC (kg)	CO (kg)	NOx (kg)
2014	AM	697,549	17,497	39.87	299,913	396	4,689	520
	PM	1,003,910	26,803	37.46	449,137	331	5,854	728
2040 NB	AM	753,940	19,085	39.50	188,445	110.73	1,573	75.55
	PM	1,091,945	29,665	36.81	280,386	75.40	1,753	96.56
2040 Alt1	AM	757,748	19,251	39.36	189,426	110.91	1,576	75.76
	PM	1,101,185	29,908	36.82	282,847	75.64	1,765	97.21
2040 Alt2	AM	760,559	19,450	39.10	190,270	111.05	1,577	75.84
	PM	1,111,613	30,551	36.39	286,364	75.94	1,773	97.70
2040 Alt3	AM	753,908	19,146	39.38	188,511	110.77	1,572	75.51
	PM	1,092,900	29,648	36.86	280,779	75.44	1,756	96.71

Figure 4-39: CTPS Summary of Air Quality Metrics by Scenario

The results of the air quality assessment indicate that reductions in pollutants anticipated from technological changes exceed the differences between alternatives by two to three orders of magnitude. Comparing each alternative to the 2040 No-Build scenario, slight increases in CO_2, VOC, CO, and NO_X are projected for Alternatives 1 and 2. Projected emissions under Alternative 3 increase for AM CO_2 and VOC but decrease for AM CO and NO_X while PM emissions increase by a very small margin. Overall emissions increase along with VMT under all three alternatives albeit by small margins relative to the secular decrease in emissions over time. Additional details on this analysis are available in Appendix H (CTPS Technical Memorandum) and are presented in the Evaluation Matrix (items 3.2.1 and 3.2.2).

An analysis of potential noise impacts under each alternative was conducted by VHB based on the same travel demand model results as discussed in section 4.3.4. This analysis was conducted using the Federal Highway Administration's (FHWA) *Traffic Noise Model v2.5*, a standard method for evaluating noise impacts of transportation projects. Each alternative was assessed relative to 2040 No-Build conditions in terms of the geographical areas affected at threshold noise levels, as well as the number of commercial and residential locations (or 'receptors') that would be impacted. Threshold noise levels were established based on FHWA Noise Abatement Criteria (NAC), which specify that residential uses are classified as impacted at noise levels above 66dB(A) and commercial uses at levels above 71dB(A).

The results of the noise impact model indicated that all three alternatives performed better than the No-Build scenario, impacting fewer residential and commercial receptors and creating sound levels above NAC thresholds for smaller distances. Alternative 2 performed best in terms of both commercial and residential impacts, with Alternative 1 performing better than Alternative 3 in terms of impacted distances and impacted residential receptors but also impacting slightly more commercial receptors. The results of these impacts are included in the Evaluation Matrix (items 3.3.1 and 3.3.2).

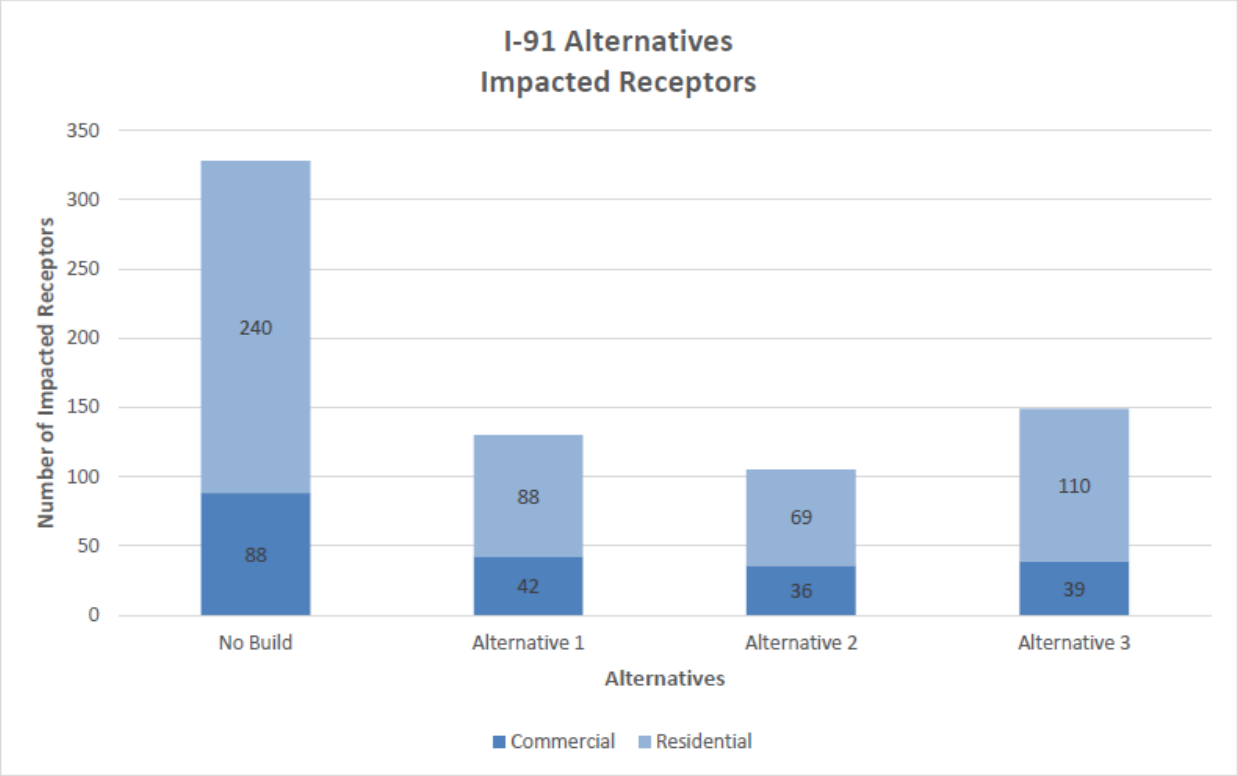


Figure 4-40: VHB Summary of Noise Impacts by Scenario (Draft Result)

4.3.6 ENVIRONMENTAL JUSTICE

In accordance with Title VI of the Civil Rights Act of 1964 and the *Environmental Justice Policy* of the Commonwealth of Massachusetts' Executive Office of Energy and Environmental Affairs, all transportation studies carried out on behalf of MassDOT's Office of Transportation Planning must include an EJ evaluation of proposed alternatives. The purpose of this policy is to ensure that federally funded projects do not discriminate based on race, color, or national origin and require that project proponents demonstrate that proposed projects will not disproportionately impact specific populations vulnerable to discrimination. Accordingly, the evaluation criteria (items 5.2.1 through 5.2.7) examine several dimensions along which potentially disproportionate impacts might occur.

The PVPC has developed a regionally accepted method for identifying geographies with concentrations of EJ population groups. The PVPC currently considers Census block groups with minority populations exceeding the Pioneer Valley regional average of 23.48 percent to be EJ, with minority persons classified as "the population that is not identified by the Census as 'White Non-Hispanic.'" Similar criteria exist for median income levels and limited English proficiency levels.

Per the PVPC's definitions, the entirety of the populated Primary Study Area geography meets at least one of the EJ criteria. Because of this, evaluations of most dimensions of EJ in the evaluation criteria are aligned with aggregate measures, including statistics reported for other evaluation criteria items. Many of the benefits of potential reconstruction alternatives for the I-91 Viaduct would accrue to the disproportionately lower-income, minority, or limited-English-proficiency populations.

Many of the effects that would be concentrated within the Primary Study Area are positive for residents and workers. The development scenarios posited for each of the alternatives yield increases in jobs across retail, office, and industrial sectors, with the magnitude of job gains ranging from 136 to 2,330. The development scenarios posited under Alternatives 1 and 2, which open significant areas of newly connected riverfront land for commercial uses, have much higher estimated job gains. Moreover, these new employment opportunities would be within reasonable walking or bicycling distances of Downtown Springfield residents and would be served by an expanded network of bicycle and pedestrian routes and amenities through the existing downtown and toward the Connecticut River. A parallel benefit of these development scenarios is expanded access to goods and services for residents within the study area, including enhanced bicycle and pedestrian access to businesses as well as existing community amenities, including libraries, a farmer's market, and the South End Middle School.

Environmental impacts within the EJ geography are projected to be mixed in their impacts on the EJ populations identified within the Primary Study Area. Compared to 2014 conditions, both the 2040 No-Build and Alternatives 1 through 3 result in significantly lower concentrations of criteria pollutants due largely to expected changes in technology. The three alternatives score slightly lower than the No-Build scenario due to small net increases in emissions associated with greater VMT through the I-91 corridor. However, the noise impacts associated with Alternatives 1 through 3 compare favorably with the No-Build scenario. In each alternative, the number of businesses and residences impacted by noise levels exceeding FHWA Noise Abatement Criteria declines relative to the No-Build scenario, and the distances at which those noise levels are experienced decline. Alternatives 1 and 2, with a depressed and covered Downtown Springfield alignment, show greater declines in noise levels, but Alternative 3's elevated viaduct also reduces noise impacts. (For further details on the methodology behind these assessments, see section 4.3.5.)

4.3.7 COST AND FINANCIAL IMPACT ESTIMATES

To develop order-of-magnitude estimates of costs for comparison purposes, the project team used a hybrid approach of compiling comparable project costs and actual project quantification and development of unit prices. Each alternative was broken into major sub-items for which costs were quantified in detail. Substantial contingencies and adjustments for inflation were included in all cost estimates. It should be noted that any changes in design or existing conditions prior to project development may have significant impacts on conceptual cost estimates.

Estimated costs were broken down by major project sections to facilitate comparison between alternatives. The No-Build alternative is estimated to cost approximately $1.57 billion. Alternatives 1 and 2 are roughly comparable in terms of overall costs ($3.78 billion and $3.74 billion, respectively) while Alternative 3 is somewhat less costly ($3.18 billion) due to the estimated cost of the elevated viaduct structure in comparison to that of a depressed alignment. All cost estimates are expressed in 2015 dollars. Estimated costs are incorporated into the Evaluation Matrix (item 6.1.1).

Estimated Project Costs by Scenario

Section	No-Build	Alternative 1	Alternative 2	Alternative 3
Longmeadow Curve	$ 212,750,000	$ 212,750,000	$ 212,750,000	$ 212,750,000
Bikeway	$ 19,750,000	$ 19,750,000	$ 19,750,000	$ 19,750,000
South End Bridge	$ 206,250,000	$ 206,250,000	$ 206,250,000	$ 206,250,000
Route 5 / 57 Interchange & Route 5 Bridge	$ 156,600,000	$ 156,600,000	$ 156,600,000	$ 156,600,000
Plainfield Street Improvements	$ 76,000,000	$ 76,000,000	$ 76,000,000	$ 76,000,000
I-91 / I-291 Interchange	$ 152,000,000	$ 413,250,000	$ 407,500,000	$ 424,350,000
Frontage Road Improvements	N/A	$ 159,675,000	$ 155,550,000	$ 158,450,000
I-91 Northern Touchdown	N/A	$ 33,350,000	$ 33,350,000	$ 33,350,000
Viaduct Rehabilitation	$ 750,000,000	N/A	N/A	N/A
I-91 Downtown Core	N/A	$2,500,000,000	$2,475,000,000	$1,850,000,000
TOTAL	$1,573,350,000	$ 3,777,625,000	$ 3,742,750,000	$ 3,137,500,000

Figure 4-41: Project Cost Estimates

The development scenarios described in section 4.3.3, to the extent that they are implemented, will generate a flow of property tax revenue to the City of Springfield. In order to provide a complete picture of financial impacts of each alternative, estimates of tax revenue generated were developed based on the development scenarios associated with each alternative.

Estimated Tax Revenues by Scenario

	Alternative 1	Alternative 2	Alternative 3
Units	285	460	54
Est. Unit Value		135,000	
Mill Rate		$19.66	
Est. Tax/Unit		$2,654.10	
Total Est. Tax	$756,419	$1,220,886	$143,321
Office SF	263,000	425,000	0
Retail SF	127,139	205,453	20,000
Office/Retail: $85/SF Est.	$33,161,803	$53,588,466	$1,700,000
Industrial Sq.Ft.	60,000	90,000	60,000
Industrial: $45/SF Est.	$2,700,000	$4,050,000	$2,700,000
Mill Rate		$39.07	
Total Est. Tax	$1,401,121	$2,251,935	$171,908
Grand Total Est. Tax	$2,157,539	$3,472,821	$315,229

Figure 4-42: Tax Revenue Estimates

The number of residential units (apartment/condominium) and office, retail, and industrial square feet of development under each scenario were the starting point of the financial analysis. Estimated per-unit and per-square-foot valuations were drawn of a representative sample of existing properties from the City of Springfield's publicly available assessor's data, with adjustments for property condition. These estimated valuations were multiplied by the quantity of property depicted under each scenario and local mill rates to yield an estimate of annual tax revenue. All tax revenue estimates are based on 2017 mill rates and are expressed in 2017 dollars. These estimates are incorporated into the Evaluation Matrix (item 4.1.5). As with the development scenarios on which these estimates are based, results should be interpreted cautiously as actual realized development may vary significantly from the development scenarios presented should any Alternative move forward in the future.

4.4 EVALUATION MATRIX

The full evaluation matrix is included at the end of this chapter. A summary of the rankings across each of the six areas that were evaluated is provided below to facilitate comparison of the areas in which each alternative outperforms or underperforms the other scenarios.

	Scenario			
TOPIC AREA	**No-Build**	**Alt. 1**	**Alt. 2**	**Alt. 3**
MOBILITY AND ACCESSIBILITY	0	14	10	13
SAFETY	1	13	13	14
ENVIRONMENTAL EFFECTS	0	7	7	3
LAND USE AND ECONOMIC DEVELOPMENT	0	19	18	9
COMMUNITY EFFECTS	0	5	5	6
COST	1	-1	-1	-1
TOTAL	**2**	**57**	**52**	**44**

4.5 ALTERNATIVE SUMMARIES AND COMPARISON

4.5.1 ALTERNATIVE 1: DEPRESSED, SAME ALIGNMENT

Differentiating Factors

In terms of local and regional mobility, Alternative 1 performs well in comparison to the No-Build scenario (as well as Alternatives 2 and 3) across several metrics. At the level of Downtown Springfield's local street grid, AM/PM delay times and intersection LOS are both used as indicators of how the design impacts traffic performance. Alternative 1 shows a marked decline in delay during the AM peak hour (from 9.32 minutes to 2.58 minutes) and similar performance during the PM peak (from 13.99 minutes to 14.16 minutes); likewise, the AM peak hour shows a reduction in the number of intersections operating at LOS E/F from five to two. The reduction in AM delay time for Alternative 1 may be attributed to a slightly more efficient roadway alignment, favorable on and off ramp locations, and the proposed realigned and signalized intersection at Boland Way and East/West Columbus Boulevard.

A related metric of travel time between a representative pair of destinations (East Columbus Avenue at Union Station to Springfield Street and Chestnut Street) also indicates net reductions in travel time. Travel times indicated by the regional travel demand model are faster by 18 to 25 seconds in the AM peak for both northbound and southbound directions; in the PM peak, northbound travel times are estimated to be 15 seconds slower while southbound travel times decline by 53 seconds.

Traffic flow on the I-91 corridor itself also improves relative to projected No-Build conditions under Alternative 1. Average travel times as estimated by the regional travel demand model drop for both northbound and southbound trips in the AM and PM, with reduced travel times between 11 and 56 seconds.

Alternative 1's depressed and covered I-91 alignment transforms the conditions experienced along the western edge of Downtown Springfield. Compared to the No-Build conditions, the Alternative 1 design allows for the development of new green space above the covered tunnel, yielding approximately 468,000 square feet (10.7 acres) of additional space for recreation and community use. The addition of a large quantity of pervious surface in the place of the existing viaduct footprint also facilitates natural stormwater drainage.

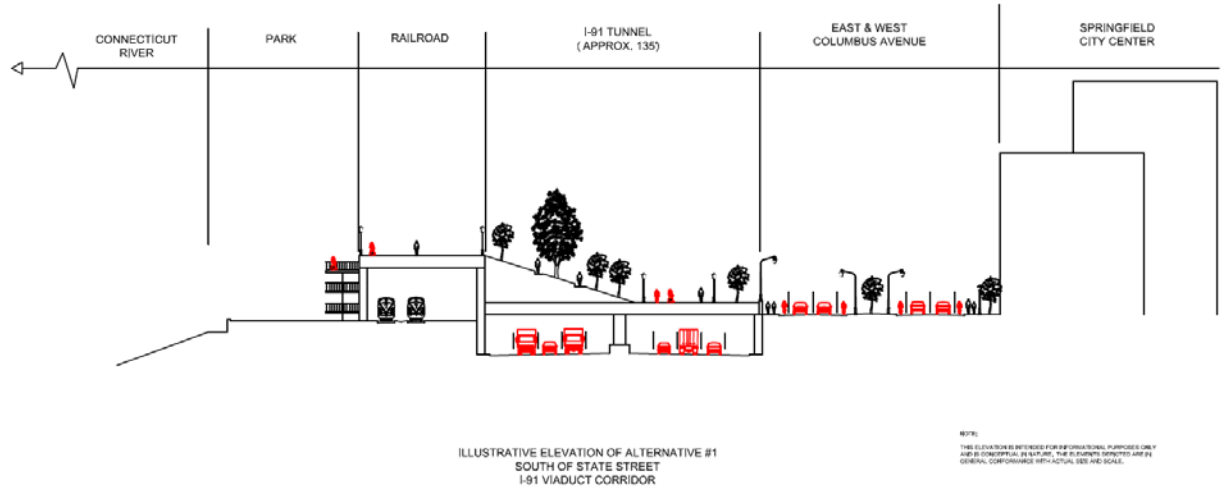


Figure 4-43: Illustrative Elevation - Alternative 1

Compared to the Depressed – New Alignment alternative, Alternative 1 yields a somewhat smaller quantity of green space as depressing I-91 below the existing alignment yields a smaller total quantity of land useable for open space between the Riverfront and Downtown Springfield areas than the revised alignment in Alternative 2.

With a large portion of the Downtown Springfield alignment operating below grade, the noise impacts of Alternative 1 diminish substantially in comparison to No-Build and Alternative 3 conditions. Compared to No-Build conditions, commercial premises affected by noise levels above NAC standards are reduced from 88 to 42, and residences affected are reduced from 240 to 88. A more qualitative consideration in which Alternative 1 provides added value for the surrounding urban neighborhood is the removal of a substantial visual obstruction between the Downtown Springfield core and the Connecticut Riverfront. The removal of this obstruction could increase property values, the aesthetic experience of travelers, and perceptions of safety in this area.

In addition to improving the ambient conditions that pedestrians and cyclists experience in the vicinity of the I-91 corridor, Alternative 1 includes an expansion of sidewalks (over 54,000 linear feet) and bike lanes (over 26,000 linear feet). The largest part of the sidewalk expansion and a substantial portion of new bike lanes in Alternative 1 are driven by the redesign of East and West Columbus Avenues into a combined boulevard that provides new and separated connections throughout the newly created green space corridor.

The development scenario prepared for Alternative 1 drives several sets of economic and land use outcomes that vary across alternatives based on the availability, locations, and connectivity of land adjacent to the Downtown Springfield core. Alternative 1 yields a middle-ground level of new development in the Primary Study Area. An estimated 555 new residents living in 271 households would increase the area's residential density and drive additional demand for services in Downtown

Springfield while 1,325 new jobs across retail, office, and industrial developments would represent substantial new job opportunities for workers of differing skill and educational levels. The opportunities presented by this development scenario would allow the City of Springfield to realize approximately $2.2 million in annual property tax revenue at full buildout.

In terms of costs, Alternative 1 would require the most significant levels of temporary detouring, excavation, dewatering, and significant wall and deck construction in order to build the desired depressed highway corridor.

4.5.2 ALTERNATIVE 2: DEPRESSED, NEW ALIGNMENT

Differentiating Factors

Alternative 2 yields mixed results in terms of metrics of enhanced vehicular mobility through the Primary Study Area. During the AM peak period, levels of service and delay across intersections in Downtown Springfield improve modestly, with declines in total delay of about 2 minutes on average (from 9.32 minutes to 7.29 minutes) and one fewer intersection operating at LOS E/F. However, these gains are negated by a substantial increase in delays during the PM peak (from 13.99 minutes to 23.08 minutes) and an additional intersection operating at a substandard LOS (up to 10 minutes from 9 minutes). A related measure, the volume-to-capacity ratio, rises relative to No-Build conditions from approximately 0.35 to 0.41 in the AM peak and from 0.47 to 0.52 in the PM peak. The decline in PM performance relative to No-Build conditions as well as for Alternatives 1 and 3 may be attributable to a number of different roadway alignments and knock-on effects of the highway realignment. An additional consideration in evaluating the results of Alternative 2 is that this scenario posits the largest increase in both residential population and employment in the Downtown Springfield core among the scenarios under consideration. Accordingly, the greater volume of commuters entering and (especially) exiting the core during peak commuting hours places additional demands on the network.

However, the realigned I-91 mainline under this alternative performs better in terms of the LOS experienced at merge, diverge, and weave locations. While the No-Build scenario and Alternatives 1 and 3 each experience five to six locations with LOS E/F during the AM or PM peaks, the new alignment's configuration reduces this number to just two locations (I-291 eastbound from I-91 to Liberty Street, and I-291 westbound from the Dwight Street on ramp to I-91 northbound), which indicates potential safety benefits from Alternative 2.

Measures of travel time for Alternative 2 on both the I-91 corridor and on local streets indicate that while the southbound traffic experiences improved outcomes relative to the baseline No-Build conditions northbound traffic may experience greater delays. In terms of vehicular travel time on I-91, model results of traffic speeds indicate northbound trips that are 14 seconds slower than the baseline in the AM peak and 12 seconds slower during the PM peak. On local roads, travel times between a representative pair of destinations (East Columbus Avenue at Union Station to Springfield Street and

Chestnut Street) are 29 to 43 seconds faster on southbound trips in the AM and PM, respectively, but 45 seconds slower for AM southbound trips and one minute and 18 seconds slower for PM southbound trips. These results from the TDM are built on a broad set of conditions experienced on local roads, including increased volumes generated by extensive redevelopment activity under this alternative; however, these results indicate potentially worse travel time performance for Alternative 2 than the other scenarios under consideration.

The combination of sinking the I-91 mainline below grade and realigning it closer to the riverfront yields the largest gains in terms of community green space across all three alternatives under consideration. With the additional open space in the Columbus Avenue corridor included, a total of 553,800 square feet (or about 12.7 acres) of green space would be available under this proposed design. This translates into new public amenities for Downtown Springfield, especially toward the southern end of the Columbus Avenue corridor, where a combination of retail and mixed-use development could complement and enclose programmable public space.

Figure 4-44: Plan View of Green Space above Viaduct Footprint (Alternative 2)

With a large portion of the Downtown Springfield alignment operating below grade, Alternative 2's noise impacts are the lowest of the four scenarios. Because the realigned freeway is shifted farther from existing uses as well as being capped, its noise impacts are further reduced relative to Alternative

1. Noise above NAC decibel levels that indicate residential and commercial impacts occurs over a smaller area (65 to 275 feet for commercial and 70 to 615 feet for residential uses) and affects a smaller number of receptors (36 commercial properties and 69 residences). Reduced noise levels would increase the quality of life of those who live, work, and visit Downtown Springfield and would synergize with enhanced public realm amenities in the Downtown Springfield core. In addition, the removal of the visual barrier that the current viaduct imposes on Downtown Springfield could increase perceived safety in the area and may increase property values as well as the aesthetic value of the existing public realm.

The design for Alternative 2 provides extensive coverage of new sidewalk (53,100 linear feet) and bike lane (27,000 linear feet) infrastructure in the study area. Like Alternative 1, the largest part of this sidewalk expansion and a substantial portion of new bike lanes are driven by the redesign of East and West Columbus Avenues into a combined boulevard with substantial new and separated connections throughout the newly created green space corridor. In contrast, the design for Alternative 3 precludes taking advantage of this opportunity, resulting in fewer new routes for active travelers.

The realignment of I-91 in Alternative 2 provided the most useable, viable land in the core area and therefore the most potential for beneficial redevelopment in the Downtown Springfield area. The contemplated development scenario for this alternative yields condominium and apartment housing for an estimated 888 persons in 347 households as well as various types of commercial and industrial space that could employ some 2,330 workers. To a greater extent than the other scenarios, this level of redevelopment would represent a large increase in new job opportunities for workers of differing skill and educational levels in a revitalized Downtown Springfield center. The increase in Springfield's tax base associated with this development would yield annual revenues of approximately $3.5 million for the city, which exceeds Alternative 1's next-highest revenue estimate by about $1.3 million.

In terms of costs, Alternative 2, like Alternative 1, would require the most significant levels of temporary detouring, excavation, dewatering, and significant wall and deck construction in order to build the desired depressed highway corridor. One area of difference between Alternatives 1 and 2 is that the latter would allow for several portions of the new alignment to be constructed offline as the new alignment of the highway will not follow the existing alignment for the northern half of the viaduct corridor. This may result in less cost associated with temporary roadway and highway construction and allow for better overall project phasing.

4.5.3 ALTERNATIVE 3: ELEVATED VIADUCT

Alternative 3 performs similarly to the No-Build scenario in terms of its performance on local road intersections in the study area. During the AM peak, the average intersection would have an estimated 11.19 minutes of delay compared to 9.32 minutes under No-Build conditions. In the PM peak, it would perform slightly better, with 12.18 minutes of delay vs. 13.99 minutes. No change in the number of intersections performing at LOS E/F conditions is projected to occur. Accordingly, Alternative 3 is rated

as approximately on par with the No-Build and Alternative 2 scenarios compared to the potential operational improvements expected under Alternative 1. Alternative 3 ranks similarly to the other scenarios with respect to volume-to-capacity ratios (worse than Alternative 1 and comparable to the other scenarios).

Travel times along the I-91 corridor would improve under Alternative 3 in both travel directions and across both the AM and PM peaks by 10 to 56 seconds. It also outperforms the No-Build scenario and Alternative 2 with respect to average travel times through the Downtown Springfield core. During the AM peak, travel times decrease in both the northbound and southbound directions by 42 and 25 seconds, respectively. During the PM peak, the northbound trip is marginally slowed (by four seconds) while the southbound trip is 55 seconds faster than baseline conditions. These improvements in travel times are attributable to this alternative's design details as well as the reduced quantity of new development generating new traffic under this alternative compared to the development scenarios posited for the other alternatives.

The elevated viaduct concept yields a much smaller quantity of potential green space than the two depressed alternatives as the viaduct superstructure would remain in place. However, conditions under the viaduct would be enhanced with additional pedestrian crossings and amenities, reduction or elimination of existing barriers to movement and sight lines, and improved illumination and surveillance. All of these factors would improve the perceived safety of land underneath the reconstructed viaduct (see Figure 4-45).

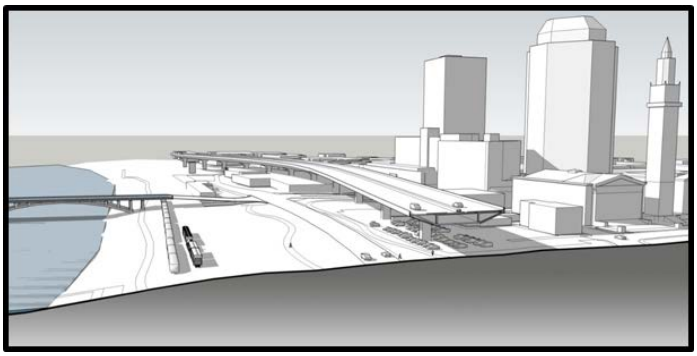


Figure 4-45: Elevated Viaduct Visualization (Conceptual I-91 Viaduct)

The greater heights (approximately 10’ higher than the current maximum) of the elevated viaduct concept would have beneficial impacts on the noise levels experienced in the study area albeit not to the extent projected under Alternatives 1 and 2. Compared to No-Build conditions, Alternative 3 results in a reduction from 88 to 39 impacted commercial properties and from 240 to 110 impacted residences. Compared to Alternatives 1 and 2, the 110 residences likely to remain affected by noise levels exceeding NAC standards is a smaller improvement.

Compared to Alternatives 1 and 2, potential pedestrian and bicycle accommodations in the Primary Study Area are more limited, with only 16,000 linear feet of proposed sidewalk improvements and 19,900 linear feet of bike lanes. As mentioned in the alternative descriptions above, this difference is attributable to the lack of a large green space development and the combined East and West Columbus corridor, which allow for more extensive bike and pedestrian infrastructure.

Another area in which Alternative 3 proposes less extensive changes to the study area than the other alternatives is in the extent of real estate development made feasible. Without the improved access to lands west of the existing alignment, new opportunities for redevelopment, including the creation of 'gateway' features or mixed-use developments that could complement the MGM Springfield casino development, are limited. The Alternative 3 development scenario is primarily concentrated along the northern end of the Primary Study Area and would yield an increase of an estimated 104 persons in 51 households as well as 136 jobs. Likewise, the smaller magnitude of redevelopment expected under this alternative would yield substantially less tax revenue for the City of Springfield, with annual revenues estimated at $300,000.

Compared to Alternatives 1 and 2, the total cost of constructing the elevated viaduct and associated improvements outlined in the Alternative 3 design would be modestly lower. The order-of-magnitude cost estimate for this alternative is $3.14 billion (2017 dollars) compared to approximately $3.7 to $3.8 billion for Alternatives 1 and 2. Maintenance costs are also estimated to be somewhat lower by a margin of roughly $500,000 per year extended out to the year 2075.

Figure 4-46 - Evaluation Criteria

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
			○ WORSE ◔ ◑ SAME ◕ ● BETTER		Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
1	MOBILITY AND ACCESSIBILITY To maintain or improve the conveyance of regional traffic through the corridor, while enhancing the connectivity of all modes of transportation into and around the City and its waterfront.												
1.1	Roadway Operational Functionality												
1.1.1		Provide acceptable intersection level of service	Delay or LOS change in total number of intersections	Change in delay (in minutes) and LOS for intersections with E and F. See Map Nos. 1, 2 and 3.	Synchro (Microsimulation Software), Mapping of intersections	◑	Total AM delay: 9.32 veh-min. Total PM delay: 13.99 veh-min. Intersections LOS E/F: 5in AM, 9 in PM	◕	Total AM delay: 2.58 veh-min. Total PM delay: 14.16 veh-min. Intersections LOS E/F: 2 in AM, 9 in PM	◑	Total AM delay: 7.29 veh-min. Total PM delay: 23.08 veh-min. Intersections LOS E/F: 4 in AM, 10 in PM	◑	Total AM delay: 11.19 veh-min. Total PM delay: 12.18 veh-min. Intersections LOS E/F: 5 in AM, 9 in PM
1.1.2		Provide acceptable intersection level of service	V/C change by total number of intersections	Max. V/C (Volume to Capacity Ratio) at each signalized Intersection	Synchro (Microsimulation Software)	◑	Average App. V/C AM: 0.3571 Average App. V/C PM: 0.4747	◑	Average App. V/C AM: 0.381 Average App. V/C PM: 0.473	◔	Average App. V/C AM: 0.4150 Average App. V/C PM: 0.5220	◑	Average App. V/C AM: 0.376 Average App. V/C PM: 0.475
1.1.3		Provide acceptable intersection levels of service	Queue length changes in total number of intersections - Calculated 50th and 95th percentile queues	Queue length by lane and approach	Synchro (Microsimulation Software)	◑	Total 50th Queue AM: 16,618 LF Total 50th Queue PM: 25,939 LF Total 95th Queue AM: 27,916 LF Total 95th Queue PM: 40,325 LF	◔	Total 50th Queue AM: 22,731 LF Total 50th Queue PM: 32,292 LF Total 95th Queue AM: 36,400 LF Total 95th Queue PM: 49,900 LF	◔	Total 50th Queue AM: 22,860 LF Total 50th Queue PM: 30,928 LF Total 95th Queue AM: 36,029 LF Total 95th Queue PM: 47,217 LF	◔	Total 50th Queue AM: 22,172LF Total 50th Queue PM: 34,011 LF Total 95th Queue AM: 35,620 LF Total 95th Queue PM: 50,846 LF
1.1.4		Provide or maintain acceptable merge, diverge, and weave level of service on I-91 mainline	Change in LOS at merge, diverge and weave locations on limited access roadways	LOS by location	Highway Capacity Software/Manual 2010	◑	LOCATIONS: Interstate 91 NB between Route 5 On-Ramp and Exit 2 - Longmeadow, MA: AM E, PM E Interstate 91 Exit 3 Off-ramp, between Route 5 SB off-ramp to East Columbus Avenue from South End Bridge, on-ramp to I-91 NB, off-ramp to East Columbus Avenue: AM E West Columbus Avenue SB between I-91 SB Off-ramp, I-91 SB On-Ramp and On-ramp to South End Bridge WB: PM F Interstate 291 EB Ramp from I-91SB between the Route 20 On-ramp and the Exit 2 Off-ramp: AM E, PM E Interstate 91 NB between East Columbus Avenue On-ramp and Exit 8 On-ramp I291 EB: AM E, PM E Interstate 91 SB between On-ramp from East Columbus Avenue and Exit Off-ramp Route 5 SB in Longmeadow, MA: AM E, PM F	◑	LOCATIONS: Interstate 91 NB from South End Bridge to Broad Street: AM F, PM, F Interstate 91 SB from Union Street to South End Bridge: AM E, PM E Interstate 291 WB from Liberty Street to Exits 1 and 2: AM F Interstate 291 EB from Interstate 91 to Liberty Street: AM F, PM F Interstate 91 NB from Union Street to Interstate 291: AM F, PM F	◕	LOCATIONS: Interstate 291 EB from Interstate 91 to Liberty Street: PM F Interstate 291 WB from Dwight Street on-ramp Interstate 91 NB: AM F, PM F	◑	LOCATIONS: Interstate 91 NB from South End Bridge to Broad Street: AM F, PM F Interstate 91 SB from Union Street to South End Bridge: AM E, PM E Interstate 291 WB from Liberty Street to Exits 1 and 2: AM F Interstate 291 EB from Interstate 91 to Liberty Street: AM F, PM F Interstate 91 NB from Union Street to Interstate 291: AM F, PM F
1.1.5		Provide acceptable I-91 mainline and on and off-ramp levels of service	Change in LOS on limited access ramps and highway segments	LOS by location	Highway Capacity Software/Manual 2010	◑	RAMPS I-91 Exit 1 and 2 Interchange US Route 5 NB On-ramp to I-91 NB: PM E I-91 Exit 3 Interchange I-91 SB On-ramp from West Columbus Avenue: PM F I-91 / I-291 Interchange - I-291 SB Ramp to I-91 NB: AM F, PM F MAINLINE All D or better	◕	RAMPS All LOS D or better MAINLINE All D or better	◕	RAMPS All LOS D or better MAINLINE All D or better	◕	RAMPS All LOS D or better MAINLINE All D or better
1.2	Travel Time												
1.2.1		Average vehicular travel time along I-91 corridor	Change in travel time along I-91 between two points	Travel time in minutes for a given distance during AM and PM peak hours. See Map Nos. 4 and 5.	TransCAD (Macro Travel Demand Model)	◑	NB From CT State Line to Plainfield Street AM = 7 min 43 sec PM = 8 min 42 sec SB From Plainfield Street to CT State Line AM = 7 min 37 sec PM = 7 min 55 sec	●	NB From CT State Line to Plainfield Street AM = 18 seconds faster than No Build PM = 56 seconds faster than No Build SB From Plainfield Street to CT State Line AM = 11 seconds faster than No Build PM = 26 seconds faster than No Build	◑	NB From CT State Line to Plainfield Street AM = 14 seconds slower than No Build PM = 12 seconds slower than No Build SB From Plainfield Street to CT State Line AM = 11 seconds faster than No Build PM = 25 seconds faster than No Build	●	NB From CT State Line to Plainfield Street AM = 18 seconds faster than No Build PM = 56 seconds faster than No Build SB From Plainfield Street to CT State Line AM = 10 seconds faster than No Build PM = 26 seconds faster than No Build

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						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
1.2.2		Average vehicular travel times throughout primary study area	Change in travel time between A to B travel pairs	Travel time in minutes for a given distances for A to B points (through delay reduction). See Map Nos. 6 and 7.	TransCAD (Macro Travel Demand Model)/VISSIM	◑	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM = 3 min 43 sec PM = 4 min 20 sec SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 4 min 11 sec PM = 4 min 17 sec	◕	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM = 18 seconds faster than No Build PM = 15 second slower than No Build SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 25 seconds faster than No Build PM = 53 seconds faster than No Build	◔	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM = 45 seconds slower than No Build PM = 1 min 18 seconds slower than No Build SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 29 seconds faster than No Build PM = 43 seconds faster than No Build	◕	NB from E. Columbus @ Union St. to Springfield St. @ Chestnut St. AM =42 seconds faster than No Build PM = 4 seconds slower than No Build SB from Springfield St. @ Chestnut St. to E. Columbus @ Union St. AM = 25 seconds faster than No Build PM = 55 seconds faster than No Build
1.3	Pedestrian and Bicycle Functionality and Connectivity												
1.3.1		Improve access from the downtown urban core to the riverfront (i.e. Connecticut Riverwalk, open space, environmental resources, and activity centers along)	Change in number of connections between downtown urban core and riverfront	Number of connections from downtown urban core, across I-91 and rail line, to the riverfront. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	Conceptual Plans	◑	Limited Connections - No change	◕	Reconfiguration of Clinton Street & West Columbus Ave to Create Greenspace Development Along Riverfront. Additional 600 LF of Sidewalk Along W. York Street. Improve Bike & Ped Access to Riverfront with Approximately 6000 LF of Shared-Use Paths Along South End Bridge, West Columbus Ave & Broad Street	●	Reconfiguration of Clinton Street & West Columbus Ave to Create Greenspace Development Along Riverfront. Improve Bike & Ped Access to Riverfront with Approximately 6000 LF of Shared-Use Paths Along South End Bridge, West Columbus Ave & Broad Street	●	Reconfiguration of Clinton Street Create Greenspace Development Along Riverfront. Improve Bike & Ped Access to Riverfront with Approximately 6000 LF of Shared-Use Paths Along South End Bridge &West Columbus Ave
1.3.2		Improve access to community resources and social services	Change in number of connections to schools, health care, social services, etc.	Number of connections to schools, health care, social services, etc. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans/GIS data layers for environmental, open space, and activity centers	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See map "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)" See Map No. 8	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See map "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)" See Map No. 8	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See map "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternative 3)" See Map No. 9
1.3.3		Improve access to retail, goods, commercial activity centers	Change in number of connections to goods and employment centers	Number of connections to goods and employment centers. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans GIS data layers for environmental, open space, and activity centers	◑	No change	●	Improvements to bike/ped access (such as enhanced sidewalks, Bike Accomodations, longer walk times, countdown heads, lead pedestrian intervals, and/or exclusive pedestrian phases) within 0.25mi of 313 commercial, industrial, or public/institutional properties within Primary Study Area. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No. 10	●	Improvements to bike/ped access (such as enhanced sidewalks, Bike Accomodations, longer walk times, countdown heads, lead pedestrian intervals, and/or exclusive pedestrian phases) within 0.25mi of 313 commercial, industrial, or public/institutional properties within Primary Study Area. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No.10	●	Improvements to bike/ped access (such as enhanced sidewalks, Bike Accomodations, longer walk times, countdown heads, lead pedestrian intervals, and/or exclusive pedestrian phases) within 0.25mi of 321 commercial, industrial, or public/institutional properties within Primary Study Area. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)" See Map No. 11
1.3.4		Improve connections to Union Station	Change in vehicular, bicycle, pedestrian and transit network to promote connectivity to Union Station	Additional sidewalk, bike path, bicycle facilities, bus stops and amenities. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	●	2,370 LF of Bike Accomodations added within 1/4 mile of Union Station	●	1,690 LF of Bike Accomodations added within 1/4 mile of Union Station	◕	760 LF of Bike Accomodations added within 1/4 mile of Union Station
1.3.5		Provide regional bicycle and pedestrian connectivity	Promote longer distance commuting and recreational trips through improved access to regional bicycle and pedestrian facilities	Change in number of connections (population reached)	ARCGIS Conceptual Plans	◑	No change	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See map "Bicycle, Pedestrian, and Transit Connectivity and Employment (Alternative 1)" See Map No. 12	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See map "Bicycle, Pedestrian, and Transit Connectivity and Employment (Alternative 2)" See Map No. 13	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront; additional north/south connector along waterfront. See map "Bicycle, Pedestrian, and Transit Connectivity and Employment (Alternative 3)" See Map No. 14
1.4	Mode Shift												
1.4.1		Increase transit mode share	Improve access to public transportation or increase in transit services	Change in access to or amount of transit services	ARCGIS Conceptual Plans	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 21 transit stops, providing enhanced first/last mile access to existing transit service. No proposed route/ service changes.	◕	Improved bike/ped access (within 0.25mi) to 21 transit stops, providing enhanced first/last mile access to existing transit service. No proposed route/ service changes.	◕	Improved bike/ped access (within 0.25mi) to 21 transit stops, providing enhanced first/last mile access to existing transit service. No proposed route/ service changes.

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						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
1.4.2		Increase bicycle and pedestrian mode share	Improve access or quality of bicycle and pedestrian facilities. Increase pedestrian and bicyclist perception of safety	Change in linear feet of sidewalk, linear feet of designated bicycle facilities	ARCGIS Conceptual Plans	◑	No change	●	54,100 LF of Sidewalk, 26,150 LF of Bike Accomodations, 13,180 LF of Shared-Use Paths. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No. 10	●	54,100 LF of Sidewalk, 26,150 LF of Bike Accomodations, 13,180 LF of Shared-Use Paths. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)" See Map No. 10	●	54,100 LF of Sidewalk, 26,150 LF of Bike Accomodations, 13,180 LF of Shared-Use Paths. See map "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)" See Map No. 11
2	SAFETY	To create a safer and more user friendly pedestrian and bicycle system through and across the transportation corridor											
2.1	Pedestrian and Bicycle Safety												
2.1.1		Improve bicycle and pedestrian safety	Minimize conflicts (between Bike/Peds & Vehicles)	Change in number of conflict points between vehicles and bicycles or pedestrians, mapping of conflict points .	Intersection Plans, Conceptual Plans	◑	11 Conflict Points Exist	◕	Conflict Points Reduced to 10 locations	◕	Conflict Points Reduced to 10 locations	◕	Conflict Points Reduced to 10 locations
2.1.2		Improve bicycle and pedestrian safety	ADA compliance	ADA Compliant Ramps at Primary Study Area Intersections, Improvements to ramps and Crossings, Pedestrian Clearance Times at numerous locations	Field observations, measurements	◑	No change	●	RRFBs & Detectable Warning Strips @ Highway Ramps Where Crosswalks Exist. See Map No.1	●	RRFBs & Detectable Warning Strips @ Highway Ramps Where Crosswalks Exist. See Map No.2	●	RRFBs & Detectable Warning Strips @ Highway Ramps Where Crosswalks Exist. See Map No.3
2.1.3		Improve bicycle and pedestrian safety	Provide safe crossing accommodations at I-91 on and off-ramps	Pedestrian and bicyclist crossing provisions at intersections with highway off-ramps	Conceptual Plans	◑	I-91 NB: 6 On-Ramps, 6 Off-Ramps I-91 SB: 6 On-Ramps, 5 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On-Ramps	●	All ramps to be improved with safe crossing accommodations: I-91 NB: 4 On-Ramps, 4 Off-Ramps I-91 SB: 3 On-Ramps, 4 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On Ramps	●	I-91 NB: 2 On-Ramps, 3 Off-Ramps I-91 SB: 3 On-Ramps, 3 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On Ramps	●	I-91 NB: 4 On-Ramps, 4 Off-Ramps I-91 SB: 3 On-Ramps, 4 Off-Ramps I-291 EB: 3 Off-Ramps, 2 On-Ramps I-291 WB: 2 Off-Ramps, 3 On Ramps
2.1.4		Improve bicycle and pedestrian safety	Improve intersection crossing times for bicycles and pedestrians	Improved intersection design and adequate crossing timing	Intersection Plans, Conceptual Plans/Synchro	◑	No change in crossing times	◕	Likely increases in crossing times at 6 intersections	◕	Likely increases in crossing times at 6 intersections	●	Likely increases in crossing times at 7 intersections
2.1.5		Improve bicycle and pedestrian safety	Provision of separated facilities	Additional pedestrian corridors and/or bicycle facilities created and separated from typical on-street situation	Conceptual Plans	◑	No change	●	Addition of 13, 180 LF of Shared-Use Paths	●	Addition of 13, 180 LF of Shared-Use Paths	●	Addition of 13, 180 LF of Shared-Use Paths
2.2	Vehicular Safety												
2.2.1		Improve interaction and roadway safety	Reduction of conflict points - based on the reduction of intersections and weaving segments	Change in number of conflict points between vehicles	Conceptual Plans	◑	16 Weaving Segments, 24 intersections	◕	9 Weaving Segments, 24 Intersections	◕	10 Weaving Segments, 19 intersections	◕	10 Weaving Segments, 24 Intersections
2.2.2		Improve interaction and roadway safety	Mitigate High Crash locations	Existing conditions crash data inventory, new alternatives maps	Conceptual Plans	◑	27 crash clusters identified on/ adjacent to I-91 or I-291	●	15 crash clusters redesigned	●	15 crash clusters redesigned	●	15 crash clusters redesigned
2.3	Public Safety												
2.3.1		Improve public safety	Minimize factors that would contribute to increased crime and fear of crime	Change in lighting, land uses, network isolation (natural surveillance, other environmental factors)	Qualitative review of improvements (i.e. lighting, open spaces, line of sight) to safety/crime of Conceptual Alternative Plans	◕	Improved lighting under viaduct, installation of video surveillance, promote under viaduct recreational or slightly better	●	Remove section overhead viaduct, create green space over depressed viaduct, natural light, redevelopment, connection to river over railroad	●	Remove section overhead viaduct, create green space over depressed viaduct, natural light, redevelopment, connection to, river over railroad	●	New, modern elevated viaduct, improved lighting under viaduct, land-use/redevelopment under less visual obstruction/better visual surveillance
3	ENVIRONMENTAL EFFECTS	Improve the overall environmental quality of the transportation corridor											
3.1	Sustainability												
3.1.1		Impacts on environmental resources (i.e. wetlands, floodplains, aquifers)	Specific environmental resources impacted critical resources in study area	Square footage of specific resource impacted or created	ARCGIS Conceptual Plans/GIS data layers for environmental, open space etc.	◑	No change	◔	20,200 SF of 100' FEMA Floodway; 57,100 SF of 500' FEMA Floodway; 1,155,000 SF NHESP Priority Habitat; 26,900 SF of DEP Wetlands. See Maps 015 and 018.	◔	33,900 SF of 100' FEMA Floodway; 57,000 SF of 500' FEMA Floodway; 1,155,000 SF NHESP Priority Habitat; 26,900 SF of DEP Wetlands. See Maps 016 and 018.	◔	20,200 SF of 100' FEMA Floodway; 57,000 SF of 500' FEMA Floodway; 1,155,000 SF NHESP Priority Habitat; 26,900 SF of DEP Wetlands. See Maps 017 and 018.

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						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
3.1.2		Inclusion of Low Impact Development (LID) standards	Net change in pervious surface area to facilitate natural stormwater drainage and runoff	Square footage of pervious surface area created or removed	ARCGIS Conceptual Plans/GIS data layers for environmental, open space etc.	◑	No change	●	Up to 468,800 SF of Greenspace Development Over Existing Viaduct Footprint	●	Up to 553,800 SF of Greenspace Development Over Existing Viaduct Footprint	◕	Up to 13,800 SF of Greenspace Development Under Existing Viaduct Footprint
3.1.3		Reduction of pavement footprint	Net change in impervious surface area within the I-91 Corridor between East and West Columbus Avenue under existing conditions (within the Primary Study Area)	Square footage of impervious surface area created or removed	ARCGIS Conceptual Plans/GIS data layers for environmental, open space etc.	◑	Total Impervious = 136.1 Acres / Total Pervious = 16.9 Acres	●	Total Impervious = 118 Acres / Total Pervious = 34.9 Acres	●	Total Impervious = 124.7 Acres / Total Pervious = 28.3 Acres	◕	Total Impervious = 130.9 Acres / Total Pervious = 22 Acres
3.2	Air Quality												
3.2.1		Improve air quality	Health impact to vehicle occupants, bicyclists, and pedestrians	Change in regional NOx, VOC, CO	CTPS emissions modeling	◑	Model VMT = 753,940 miles AM/ 1,091,945 miles PM Model VOC emissions: 110.73 kg AM/ 75.4 kg PM Model CO emissions: 1,573 kg AM/ 1,753 kg PM Model NOx emissions: 75.55kg AM / 96.56 kg PM	◑	Model change in VMT = +3,808 miles AM/ +9,240 miles PM Model change in VOC emissions: +0.17 kg AM/ + 0.24 kg PM Model change in CO emissions: +2.66 kg AM/ +12.26 kg PM Model change in NOx emissions: +0.21 kg AM / +0.65 kg PM	◑	Model change in VMT = +6,619 miles AM/ +19,668 miles PM Model change in VOC emissions: +0.31 kg AM/ +0.54 kg PM Model change in CO emissions: +3.74 kg AM/ 19.99 kg PM Model change in NOx emissions: +0.30 kg AM / +1.13 kg PM	◑	Model change in VMT = -32 miles AM/ +955 miles PM Model change in VOC emissions: +0.04 kg AM/ +0.05 kg PM Model change in CO emissions: -1.65 kg AM/ +2.84 kg PM Model change in NOx emissions: -0.04 kg AM / +0.15 kg PM
3.2.2		Improve air quality	Reduction of greenhouse gas emissions	Change in CO2 emissions	CTPS emissions modeling	◑	Model VMT = 753,940 miles AM/ 1,091,945 miles PM Model CO2 emissions: 188,445 kg AM/ 280,386 kg PM	◑	Model change in VMT = +3,808 miles AM/ +9,240 miles PM Model change in CO2 emissions: +981 kg AM/ +2,462 kg PM	◑	Model change in VMT = +6,619 miles AM/ +19,668 miles PM Model change in CO2 emissions: +1,825 kg AM/ +5,978 kg PM	◑	Model change in VMT = -32 miles AM/ +955 miles PM Model change in CO2 emissions: +66 kg AM/ +393 kg PM
3.3	Noise												
3.3.1		Noise impacts	Impacts to abutting residences and businesses (Expected change in decibel levels or number of vehicles at corridor intersections)	Expected change in distance from roadway experiencing decibel levels above Noise Abatement Criteria	Conceptual Alternative Plans, VHB Conceptual Level Noise Assessment	◑	Impact distances of 350 - 575 feet (commercial use, **>71dB) and 625 - 800 feet (residential use, >66db).** See Map 019	●	Impact distances of 65 - 300 feet (commercial **use, >71dB) and 70 -730 feet (residential use, >66db) See Map 020**	●	Impact distances of 65 - 275 feet (commercial **use, >71dB) and 70 - 615 feet (residential use, >66db). See Map 021**	◕	Impact distances of 65 - 465 feet (commercial **use, >71dB) and 70 - 800 feet (residential use, >66db). See Map 022**
3.3.2		Noise impacts		Expected change in number and type (commercial/residential) of impacted receptors.	Conceptual Alternative Plans, VHB Conceptual Level Noise Assessment	◑	88 impacted commercial receptors and 240 impacted residential receptors. See Map 019	●	42 impacted commercial receptors and 88 impacted residential receptors. See Map 020	●	36 impacted commercial receptors and 69 impacted residential receptors. See Map 021	◕	39 impacted commercial receptors and 110 impacted residential receptors. See Map 022
4	LAND USE AND ECONOMIC DEVELOPMENT To design transportation based improvements that create beneficial land use opportunities for the City and the region that promote both access to open space and new opportunities for economic development												
4.1	Economic Development Potential												
4.1.1		Parcel growth - increase in available land suitable for private, institutional, or public development	Land area created for development or open space	Change in square feet/acreage by land use type - residential, commercial, recreational, open space. Population reached within a 1/4 mile for walking, (biking for 10 miles where feasible).	ARCGIS Conceptual Plans	◑	No change	●	1,120,800 SF / 25.73 Acres of Accessible Greenspace/Development Land Created	●	1,111,400 SF / 25.51 Acres of Accessible Greenspace/Development Land Created	◕	54,100 SF / 1.24 Acres of Accessible Greenspace/Development Land Created

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						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
4.1.2		Improve accessibility to potential and existing development parcels	Vehicular, bicycle and pedestrian connections to potential development parcels (Studies show that commercial corridors may benefit from bike and ped infrastructure)	Connections to existing and parcels provided	ARCGIS Conceptual Plans	◑	No change	◕	6 additional high-quality bike/ped connections to waterfront area	◕	6 additional high-quality bike/ped connections to waterfront area	●	6 additional high-quality bike/ped connections to waterfront area w/ additional connector along waterfront
4.1.3		Improved bicycle and pedestrian infrastructure	Studies show that commercial corridors may benefit from bike and ped infrastructure	Connections to existing and proposed development parcels provided	ARCGIS Conceptual Plans	◑	No change	●	54,100 LF of Sidewalk & 26,150 LF of Bike Accomodations	●	53,100 LF of Sidewalk & 27,000 LF of Bike Accomodations	◕	16,000 LF of Sidewalk & 19,900 LF of Bike Accomodations
4.1.4		Increase density with more intensified development	More compact, mixed, connected land use development patterns tend to improve overall accessibility, increase agglomeration efficiencies, reduce public service costs	Increases in households, jobs, and businesses within study area	ARCGIS Conceptual Plans	◑	No change	●	Increase of 550 persons, 271 households, and 1325 jobs within study area (vs. no-build)	●	Increase of 888 persons, 347 households, and 2330 jobs within study area (vs. no-build)	◕	Increase of 104 persons, 51 households, and 136 jobs within study area (vs. no-build)
4.1.5		Incur new tax generation	Value of land and buildings, or changes in those values	Increase in property values and property taxes generated within study area (accruing to Springfield)	ARCGIS Conceptual Plans, Municipal records	◑	No change	●	Development scenario yields est. $2.2M in annual tax revenue for City of Springfield at full buildout	●	Development scenario yields est. $3.5M in annual tax revenue for City of Springfield at full buildout	◕	Development scenario yields est. $0.3M in annual tax revenue for City of Springfield at full buildout
4.2	Socio-Economic Impacts												
4.2.1		Increase employment	Change in jobs in area	Net changes in jobs post project	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	●	Increase of 1325 jobs (vs. no-build) within PSA	●	Increase of 2330 jobs (vs. no-build) within PSA	◕	Increase of 136 jobs (vs. no-build) within PSA
4.2.2		Increase population	Change in number of people living in area	Net changes in population post project	Census, Municipal Sources	◑	No change	●	Increase of 550 persons (vs. no-build) within PSA	●	Increase of 888 persons (vs. no-build) within PSA	◕	Increase of 136 persons (vs. no-build) within PSA
4.2.3		Increase housing	Number of new housing units	New housing starts	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Plans	◑	No change	●	Increase of 285 housing units (vs. no-build) within PSA	●	Increase of 460 housing units (vs. no-build) within PSA	◕	Increase of 54 housing units (vs. no-build) within PSA
4.2.4		Improve affordability - housing in proximity to transit	New housing to be developed within close proximity of major transit facilities	Euclidian distance from Union Station (Transportation Hub) to housing units reached within a 1/4 mile for walking	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	◑	No direct change in housing units within 0.25mi walk radius.	◕	160,000 SF development within 0.25mi walk radius could include approx. 100 housing units with bicycle/pedestrian connectivity to Union Station.	◑	No direct change in housing units within 0.25mi walk radius.

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						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
4.2.5		Improved public service provision	New tax generation	Change in municipal tax revenue	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	●	Development scenario yields est. $2.2M in annual tax revenue at full buildout	●	Development scenario yields est. $3.5M in annual tax revenue at full buildout	◕	Development scenario yields est. $0.3M in annual tax revenue at full buildout
4.2.6		Promote reduced travel costs	Reduced costs for bicycle and pedestrians, and potentially transit users - frees up spending for other purposes like housing, necessities, disposable, etc.	Change in transit mode	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	◕	Significantly improved walkability/ bike-ability, greater extent and continuity of pedestrian environments, greater critical mass of bike/ ped/ and potential transit use	◕	Significantly improved walkability/ bike-ability, greater extent and continuity of pedestrian environments, greater critical mass of bike/ ped/ and potential transit use	◕	Significantly improved walkability/ bike-ability, greater extent and continuity of pedestrian environments, greater critical mass of bike/ ped/ and potential transit use
4.2.7		Improve social cohesion	Potential improved connections (Acre/linear feet Complete Streets or pedestrian corridor) from North End neighborhoods and the Urban Core and Riverfront; Creation of connected/linked open space.	Measurement of connected or linked open spaces (Square Footage/Acreage) from population centers to activity centers.	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	No change	●	2 additional bike/ped connections to North End; 6 additional high-quality bicycle and pedestrian connections to waterfront; additional 468,800 SF of greenspace over existing viaduct footprint	●	2 additional bike/ped connections to North End; 6 additional high-quality bicycle and pedestrian connections to waterfront; additional 553,800 SF of greenspace over existing viaduct footprint	◕	2 additional bike/ped connections to North End; 6 additional high-quality bicycle and pedestrian connections to waterfront; additional 13,800 SF of greenspace over existing viaduct footprint
4.3	Freight Rail Impacts												
4.3.1		Operational impacts	Construction related impacts to freight operations	Displacement or delay on freight movement	ARCGIS Conceptual Plans	◑	Limited impacts to freight operations which may require minor to moderate mitigation measures.	◔	Potential impacts to freight operations which will require mitigation measures (e.g. temporary tracks, flagmen).	○	Greater potential impacts to freight operations based on closer proximity of alignment to railroad ROW which will require more extensive mitigation measures (e.g. temporary tracks, flagmen)	◑	Limited impacts to freight operations which may require minor to moderate mitigation measures.
4.3.2		Implementation costs	Capital or relocation costs	Displacement or delay on freight movement	ARCGIS Conceptual Plans	◑	Limited impacts to freight operations	◔	Moderate impacts based on East/West Columbus Ave. underpass widening and covering of railroad in vicinity of public esplanade	○	Significant impacts based on East/West Columbus Ave underpass widening, alignment change of I-91, covering of railroad in the vicinity of public esplanade	◑	Limited impacts to freight operations
4.4	Parking Impacts												
4.4.1		Impacts to parking under I-91	Reduction/addition of parking spaces	Change in parking spaces	ARCGIS Conceptual Plans (map showing locations of parking spaces)	◑	1,768 existing spaces beneath I-91	◔	Remove highway North & South Garages with new parking location; net reduction of 700 spaces	◔	Remove highway North & South Garages with new parking location; net reduction of 700 spaces	○	Remove highway South Garage, maintain North Garage; net reduction of 1,100 spaces
5	COMMUNITY EFFECTS		Minimize temporary impacts to all stakeholders, while understanding and maximizing the future benefits of a completed project										
5.1	Visual Impacts												
5.1.1		Visual perception of I-91 Viaduct	Vertical location of Viaduct (Visual perception of I-91 Viaduct)	Change in vertical or horizontal alignment in number of feet relative to activity center proxies.	ARCGIS Conceptual Plans	◑	No change - Remains Visual/Physical Barrier	●	25' Below Ground for 1600LF Covered	●	25' Below Ground for 1600LF Covered	◕	Vertical change (TBD), higher than existing, reduced number of vertical piers/columns
5.2	Construction Impacts												
5.2.1		Construction duration	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures	ARCGIS Conceptual Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	10-15 years minimum	○	10-15 years minimum	◔	8-12 years minimum
5.2.2		Lane closures and detours	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures	ARCGIS Conceptual Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	12-15 years minimum	○	12-15 years minimum	◔	10-12 years minimum

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
				○ WORSE ◔ ◑ SAME ◕ ● BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
5.2.3		Maintenance of access to abutters	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures	ARCGIS Conceptual Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	12-15 years minimum	○	12-15 years minimum	◔	10-12 years minimum
5.2.4		Disruption of local businesses	Impacts to residents, businesses, and visitors	(Assumed) Length of anticipated temporary and permanent closures(At minimum, the number and location of businesses and number of employees impacted by closure.	Census, Municipal Sources, Economic Data, ARCGIS Conceptual Alternative Plans	◑	Ongoing maintenance and future rehab projects antiicpated to be in the 0-5 year range.	○	8-10 years	○	8-10 years	◔	5-8 years
5.3	Compatibility												
5.3.1		Compatibility with local and regional transportation plans, strategic plans and plans of conservation and development	Compatibility with local and regional transportation plans, strategic plans and plans of conservation and development	General Compliance with Local and Regional Plans Qualitative - Yes or no	ARCGIS Conceptual Plans	◑	No change	●	Strongly supports Rebuild Springfield Plan; aligned with Longmeadow, West Springfield, Agawam, and regional plans	●	Strongly supports Rebuild Springfield Plan; aligned with Longmeadow, West Springfield, Agawam, and regional plans	●	Strongly supports Rebuild Springfield Plan; aligned with Longmeadow, West Springfield, Agawam, and regional plans
5.3.2		Consistency with MassDOT goals, policies, and directives	Consistency with MassDOT goals, policies, and directives	General Compliance with MassDOT Qualitative (Yes or No)	ARCGIS Conceptual Plans	◑	No change	◑	Conceptual plans meet the latest goals, policies and directives	◑	Conceptual plans meet the bids & goals, policies and directives	◑	Conceptual plans meet the bids & goals, policies and directives
5.4	Environmental Justice Impacts												
5.4.1		Availability of jobs in EJ areas	Access to jobs	Reduction in travel time from residential area to downtown business center	ARCGIS Conceptual Alternative Plans	◑	No change	●	Increase of 1325 jobs (vs. no-build); See Map No. 010"Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	●	Increase of 2330 jobs (vs. no-build); See Map No. 010 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	◕	Increase of 136 jobs (vs. no-build); See Map No. 011"Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)"
5.4.2		Availability of education and health services in EJ areas	Access to community services	Qualitative assessment - spatial examination of the community assets	ARCGIS Conceptual Alternative Plans	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No.008 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No.8 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No.009 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternative 3)"
5.4.3		Mobility impacts in EJ areas	Access to transportation modes	Qualitative assessment - spatial examination of the transportation modes	ARCGIS Conceptual Alternative Plans	◑	No change	●	54,100 LF of Sidewalk & 26,150 LF of Bike Accomodations	●	53,100 LF of Sidewalk & 27,000 LF of Bike Accomodations	●	16,000 LF of Sidewalk & 19,900 LF of Bike Accomodations

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
				○ WORSE ◔ ◑ SAME ◕ ● BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
5.4.4		Improve local access from the downtown urban core to the riverfront (i.e. Connecticut Riverwalk), open space, environmental resources, and activity centers (i.e. Basketball Hall of Fame) in EJ areas	Change in number of connections between downtown and riverfront, to open space, environmental resources, retail, goods and social services, and activity centers in EJ areas	Number of connections across I-91 and rail line, to open space, environmental resources, and activity centers in EJ areas. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	◕	6 additional high-quality bike/ped connections to waterfront area	◕	6 additional high-quality bike/ped connections to waterfront area	●	6 additional high-quality bike/ped connections to waterfront area w/ additional connector along waterfront
5.4.5		Improve access to community resources and social services in EJ areas	Change in number of connections to schools, health care, social services, etc. in EJ areas	Number of connections to schools, health care, social services, etc. in EJ areas. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No. 008 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No. 008 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternatives 1 and 2)"	◕	Improved bike/ped access (within 0.25mi) to 4 libraries, 1 farmers market, 1 middle school within Primary Study Area. No improved access to healthcare facilities. See Map No. 009 "Bicycle, Pedestrian, and Transit Access to Public Facilities (Alternative 3)"
5.4.6		Improve access to retail, goods, commercial activity centers in EJ areas	Change in number of connections to goods and employment centers in EJ areas	Number of connections to goods and employment centers in EJ areas. This will include euclidian distance to population reached within a 1/4 mile for walking, (biking for 10 miles where feasible) from connection points.	ARCGIS Conceptual Plans	◑	No change	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See Map No.010 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront. See Map No.010 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternatives 1 and 2)"	◕	2 additional bike/ped connections from downtown to North End; 6 additional bike/ped connections from downtown to waterfront; additional north/south connector along waterfront. See Map No. 011 "Bicycle, Pedestrian, and Transit Access to Goods and Services (Alternative 3)"
5.4.7		Environmental Impacts in EJ areas	Environmental Impacts (Improvement of air quality and noise impacts in EJ areas)	Quantitative assessment (Expected change in decibel levels or number of vehicles at corridor intersections in EJ areas. Feet of buffer between vehicular travel and bicycle/pedestrians in EJ areas)	ARCGIS Conceptual Alternative Plans	◑	Model VMT = 753,940 miles AM/ 1,091,945 miles PM Model VOC emissions: 110.73 kg AM/ 75.4 kg PM Model CO emissions: 1,573 kg AM/ 1,753 kg PM Model NOx emissions: 75.55kg AM / 96.56 kg PM Impact distances of 350 - 575 feet (commercial use, **>71dB) and 625 - 800 feet (residential use, >66db)**	◑	Model change in VMT = +3,808 miles (+0.5%) AM/ +9,240 miles (+0.8%) PM Model change in VOC emissions: +0.17 kg AM/ + 0.24 kg PM Model change in CO emissions: +2.66 kg AM/ +12.26 kg PM Model change in NOx emissions: +0.21 kg AM / +0.65 kg PM Impact distances of 65 - 300 feet (commercial **use, >71dB) and 70 -730 feet (residential use, >66db)**	◑	Model change in VMT = +6,619 miles (+0.8%) AM/ +19,668 miles (+1.8%) PM Model change in VOC emissions: +0.31 kg AM/ +0.54 kg PM Model change in CO emissions: +3.74 kg AM/ 19.99 kg PM Model change in NOx emissions: +0.30 kg AM / +1.13 kg PM Impact distances of 65 - 275 feet (commercial **use, >71dB) and 70 - 615 feet (residential use, >66db)**	◑	Model change in VMT = -32 miles (<-0.1%) AM/ +955 miles (<+0.1%) PM Model change in VOC emissions: +0.04 kg AM/ +0.05 kg PM Model change in CO emissions: -1.65 kg AM/ +2.84 kg PM Model change in NOx emissions: -0.04 kg AM / +0.15 kg PM Impact distances of 65 - 465 feet (commercial **use, >71dB) and 70 - 800 feet (residential use, >66db)**
6	COST	Development of Alternative Designs will combine the approach of Feasibility, Creativity, and Long Term Sustainability											
6.1	Construction Costs												
6.1.1		Order of magnitude implementation cost	Estimated capital costs of construction	Value in 2015 dollars	ARCGIS Conceptual Plans	◑	$750 million (assumes structural & piers replacement/repair)	○	$3.78 Billion	○	$3.74 Billion	○	$3.14 Billion
6.1.2		Right-of-way impact	Impact to abutting right-of-way	Square footage/Acres Impacted	ARCGIS Conceptual Plans	◑	No Impact	◕	Approximately 34 AC Affected, See Map No. 023	◕	Approximately 39 AC Affected, See Map No. 024	◕	Approximately 31.4 AC Affected, See Map No. 025
6.2	Maintenance Costs												
6.2.1		Anticipated annual maintenance costs	Estimated cost of maintenance for infrastructure	Value in 2015 dollars	ARCGIS Conceptual Plans	◕	$500,000/year	◔	$1.75 million/year (est.)	◔	$1.75 million/year (est.)	◑	$1.25 million/year (est.)

Criteria		Measure	Description	Data	Source/Tool	Alternatives							
				○ ◔ ◑ ◕ ● WORSE SAME BETTER	Compared to 2040 No Build	Future No-Build		Depressed / Same Alignment		Depressed / New Alignment		Elevated Viaduct	
						Ranking	Discussion	Ranking	Discussion	Ranking	Discussion	Ranking	Discussion
6.2.2		Life-cycle Cost-Benefit Analysis	Cost-Benefit Analysis: Including Construction Cost, Longevity of structure, Environmental, Annual Maintenance, Safety, Redevelopment Potential, Social/EJ	Cumulative Approach to Analysis considering Quantitative and Qualitative assessment of life-cycle elements based upon a value of 1-10, with 10 being extremely positive, 5 being no change and 1 being an extremely negative score when considering all described elements.	ARCGIS Conceptual Plans/Cost opinions Evaluation Criteria	◑	Cost (5) Longevity (3) Environmental (3) Annual Maintenance (5) Safety (2) Redevelopment (2) Social (5) = Total of 25 Approximate Life Cycle Cost (2075): $1.62 Billion	◕	Cost (1) Longevity (7) Environmental (7) Annual Maintenance (4) Safety (7) Redevelopment (8) Social (8) = Total of 42 Approximate Life Cycle Cost (2075): $3.88 Billion	◕	Cost (1) Longevity (7) Environmental (7) Annual Maintenance (4) Safety (6) Redevelopment (8) Social (8) = Total of 41 Approximate Life Cycle Cost (2075): $3.84 Billion	◑	Cost (2) Longevity (4) Environmental (3) Annual Maintenance (6) Safety (5) Redevelopment (4) Social (6) = Total of 30 Approximate Life Cycle Cost (2075): $3.24 Billion