

Interstate 84 / Route 8
"MIXMASTER" INTERCHANGE

APPENDIX E-2: UNIVERSE OF ALTERNATIVES AND LEVEL 1 SCREENING REPORT

APRIL 2023



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1 Introduction

The Connecticut Department of Transportation (CTDOT) is conducting a Planning and Environmental Linkages (PEL) Study for the Interstate 84 (I-84) / Route 8 Interchange (Mixmaster) Reconstruction Project (the Project) in the City of Waterbury (the City). CTDOT desires to establish a vision, or master plan, for the interchange that addresses and balances the regional importance of the Mixmaster for commuter traffic and motor freight users, while also improving multimodal services, local connections and livability within the city of Waterbury to enhance and support social equity and economic vitality. The overarching goal of the PEL Study is to develop a clear and supported plan of action for addressing transportation deficiencies of the Mixmaster Interchange. The PEL Study Area is illustrated on **Figure 2-1**.

CTDOT is using a PEL approach for the Project to link planning to the National Environmental Policy Act (NEPA) review process. During the PEL Study, the Study Team (CTDOT and its consultants) will work with identified stakeholders (such as the public, City officials, and various agencies) to discern the transportation and community needs, incorporate early stakeholder involvement, and evaluate alternatives relative to transportation needs and key environmental and community resources. The PEL Study will be a resource for future NEPA documentation. It will aim to avoid the duplication of effort, streamline the environmental review process, and reduce delays in project implementation. A detailed outline of study activities can be found in the Project's *PEL Process Framework and Methodology*.

This *Level 1 Conceptual Alternatives and Screening Report* documents the work performed by the Study Team, in cooperation with other PEL Study partners, during “Level 1” of the alternative screening process to develop and screen alternative solutions for the Project. It presents the conceptual alternatives developed, the evaluation performed, and the screening results produced during Level 1.

Previous PEL Study analyses and documents that were relied upon during the development of this report include the following:

- The *Analysis, Needs and Deficiencies Report* which thoroughly documents the PEL Study Area's existing and future transportation needs and deficiencies;

- The draft *Preliminary Purpose and Need Statement* which was developed by the Study Team in cooperation with the PEL Study partners. The statement establishes the purpose of the Project, further summarizes transportation needs, and identifies other transportation related goals and objectives. This document is intended to be refined throughout the PEL process as additional details and input are received. The *Preliminary Purpose and Need Statement* will be utilized for the development of the master plan and forms the basis of the refined NEPA Purpose and Need Statement; and
- The *PEL Process Alternative Screening Methodology*, or ASM, which was produced by the Study Team with input from the Project Advisory Committee (PAC). The PAC includes diverse and inclusive representation from identified stakeholder groups representing the City of Waterbury, other local / regional public agencies, and may include railroad interests, transit agencies and any other public entities with specific interest regarding the project area. The ASM defines the sequential process that will be used during the study as a decision-making tool for evaluating Project alternative solutions and consequently narrowing the “Universe of Alternatives” to a “Range of Reasonable Alternatives / PEL Recommendations”.

2 Alternatives Screening Methodology

The PEL Study alternatives development and evaluation process that is defined by the ASM can be visualized as a funnel which includes three levels of alternatives development, evaluation, and screening (see **Figure 2-2**). This three-level screening process will blend various strategies, corridor needs, and goals to produce a set of refined transportation alternative solutions at the PEL Study's conclusion. The evaluation methodology assesses alternatives based on the Preliminary Purpose and Need, local street and arterial mobility, multimodal travel, constructability, other transportation-related goals and objectives, and costs. Potential impacts and benefits to the community and to the natural and human environments will also be evaluated.

Alternatives that do not satisfy the evaluation criteria of a given level will be eliminated from further study (screened out), while successful alternatives will be refined and moved to the next level of screening. As the study progresses, more data will become available, which will allow for more detailed analyses.

- Level 1 includes development of conceptual alternatives and an initial qualitative evaluation of fatal flaws. Evaluation criteria for this first level of screening derive from the Project's draft Preliminary Purpose and Need. At the time of this report, the evaluation criteria were established from the identified Project's Needs for the structural, geometric, and operational conditions of the I-84 and Route 8 mainlines, as outlined in the draft *Preliminary Purpose and Need Statement*. Not meeting the needs of the Project is considered to be a “fatal flaw”. Additionally, the Level 1 evaluation criteria contained in this report also include other “fatal flaws” related to practicability: cost and feasibility. Not meeting the needs of the Project, including practicability, indicate that a conceptual alternative is fatally flawed and would be dismissed from further evaluation. The alternatives that pass the Level 1 screening will be called **Initial Alternatives** and advance to Level 2.
- Level 2 will include a continued development of the Initial Alternatives. The evaluation criteria at this level will incorporate the other transportation-related goals and objectives identified with input from the public outreach. Criteria related to enhancing mobility and multimodal travel, maximizing ease of construction, and minimizing potential impacts to community, natural, and human environments will be evaluated in this level. The Initial Alternatives that pass the Level 2 screening will be called **Preliminary Alternatives** and proceed to the Level 3 screening.
- Level 3 will include the highest development of detail and an evaluation of the Preliminary Alternatives. The assessments at this level will further evaluate criteria identified as differentiators among the alternatives in Level 2. Additionally, a comprehensive assessment of traffic operations, including traffic simulations, and evaluation of capital and life-cycle costs will occur.

Alternatives that remain after the final level of screening will be recognized as the **PEL Recommended Alternative(s)**, also referred to as a **Range of Reasonable Alternatives** that best address the transportation needs for the PEL Study Area. The Range of Reasonable Alternatives will be provided as the PEL Study's recommendations for further design development and advancement in future NEPA processes.

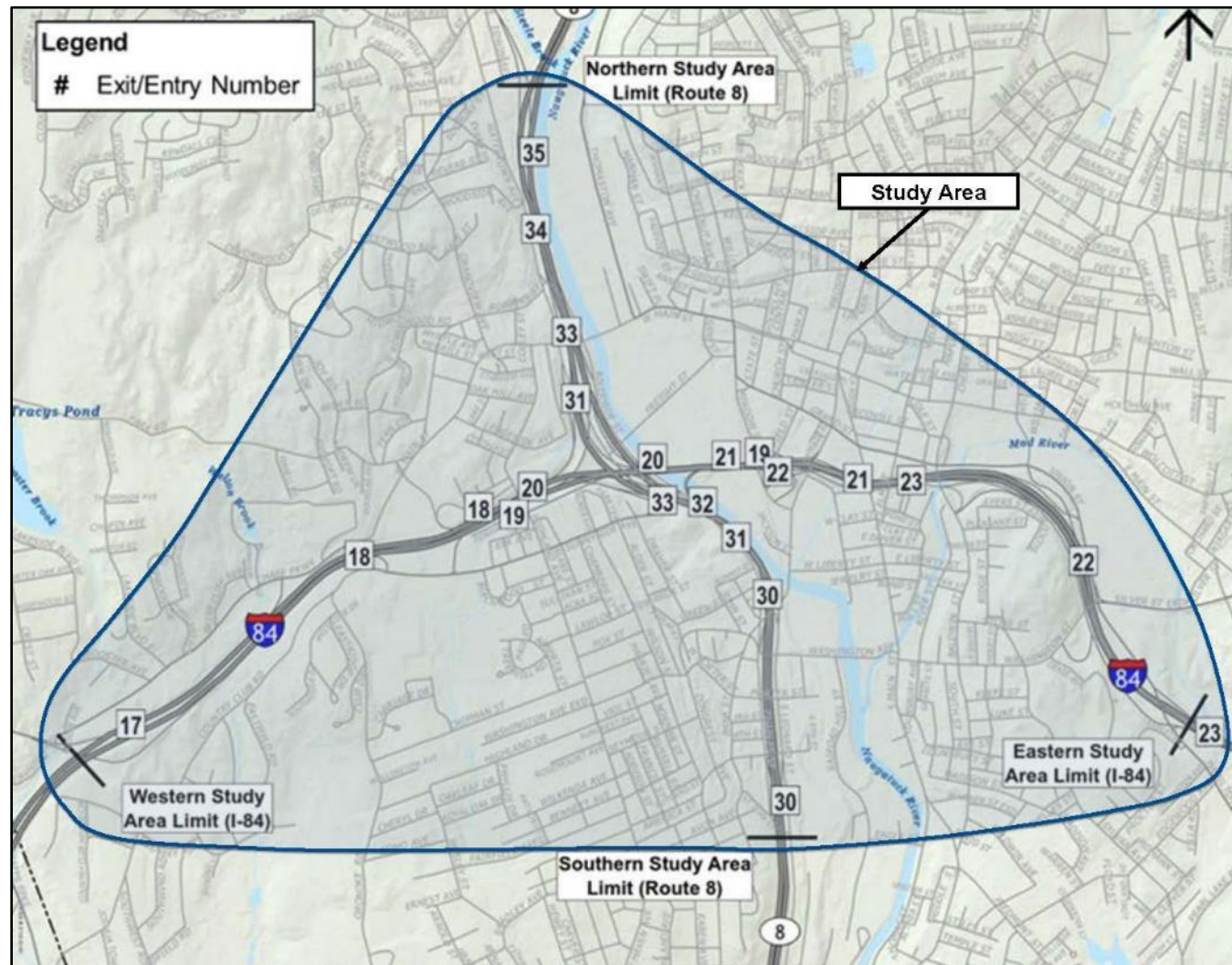


Figure 2-1 PEL Study Area

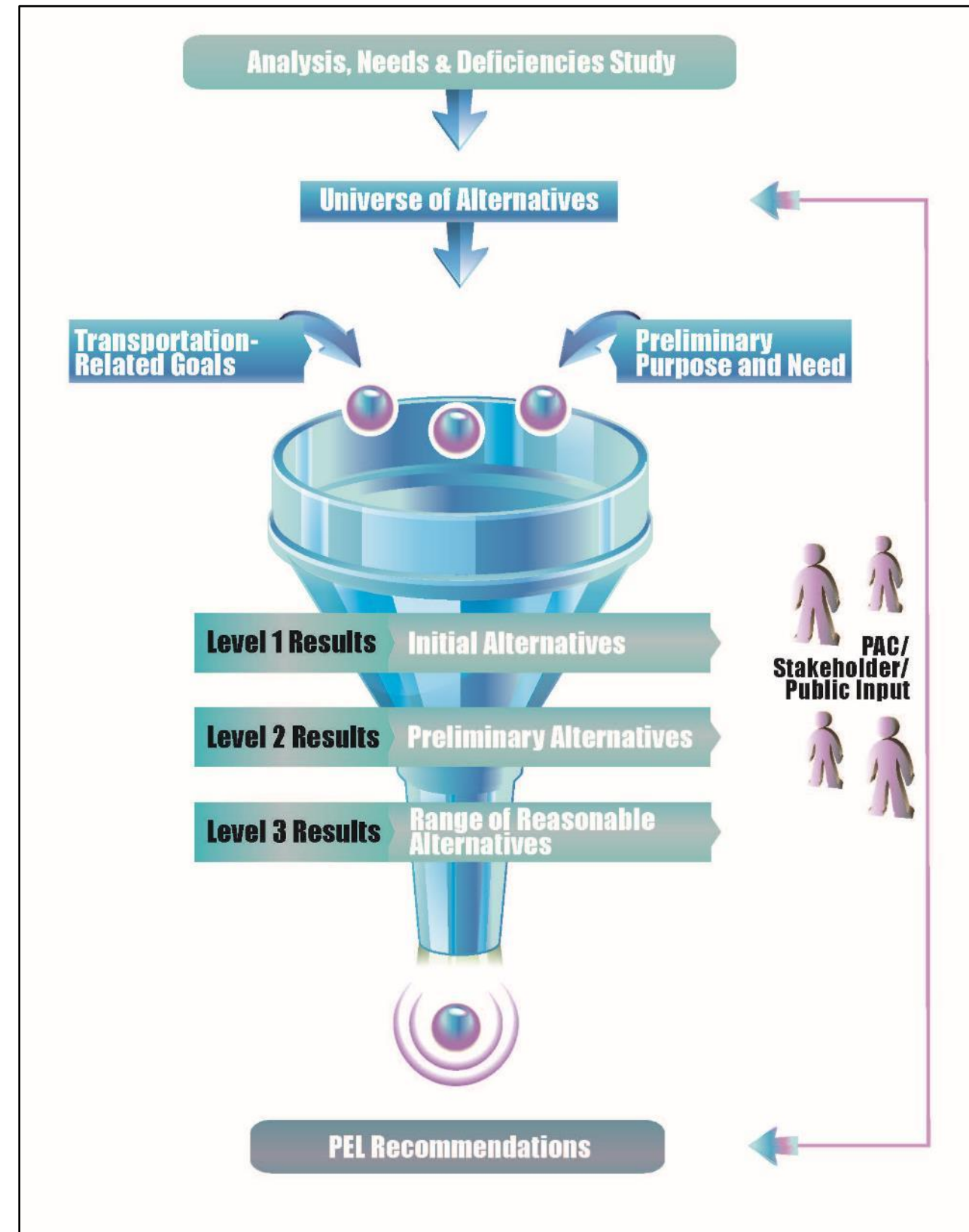


Figure 2-2 Alternatives Development and Evaluation Process

3 Level 1 Conceptual Alternative Development

The initial possible solutions for the PEL Study Area’s transportation deficiencies are referred to as “conceptual alternatives” during Level 1. These conceptual alternatives were developed to varying degrees of detail, as needed, to allow for evaluation by Level 1 criteria. The alternatives are “conceptual” in nature because of the limited engineering analysis that was performed during their development. The distinction is made at this level of screening because additional engineering analysis and design (if it were to be performed) might determine that a conceptual alternative is ultimately not a viable solution. Several conceptual alternatives were very similar, being minor variations of a central idea. Other alternatives were incomplete solutions that investigated only one aspect of the Preliminary Purpose and Need or a discrete region in the Study Area. Additionally, there were very early concepts that, upon further iterations and refinement, were shown to be inferior compared to other conceptual alternatives. The Study Team decided to summarize and consolidate similar conceptual alternatives, thereby reducing report and evaluation redundancy.

A number of studies have been completed that provide background on the study area and were reviewed to assist in the development of alternatives. The most relevant to the PEL Study Area was the *CTDOT Waterbury Interchange Needs Study* (WINS), 2010. Other past relevant studies include:

- *CTDOT Needs and Deficiencies Analysis in the I-84 Corridor Waterbury to Southington*, 1995;
- *Central Naugatuck Valley Regional Plan of Conservation and Development*, 1998;
- *CTDOT I-84 West of Waterbury (WOW) Needs and Deficiencies Study*, 2001;
- *City of Waterbury Downtown Strategic Plan*, 2015; and
- *City of Waterbury Plan of Conservation and Development (POCD)* 2015-2025

Guiding principles of this planning process, detailed in the Project’s *PEL Process Framework and Methodology*, also influence the development of alternatives and affect the overall project. The principles include, and are not limited to, the following (listed in no particular order):

- Accelerated Program Delivery;
- Practical in terms of cost and feasibility;
- Provide Context Sensitive Design/Solutions/aesthetically pleasing facility;
- Minimize the real, perceived, and visual barrier of the freeway;
- In harmony with the community and preserves environmental, scenic, aesthetic, historic, and natural resource values in the area;
- Attentive design and construction provisions to minimize community disruption;
- Supports Local, Regional, and Statewide Transportation Plans; and
- Completed project is seen as an enduring community enhancement;

The conceptual alternatives identified and developed during Level 1 collectively make up the Universe of Alternatives (Universe) that is referred to throughout this report and other PEL Study documents. The Universe contains a broad range of conceptual alternatives that can be grouped into three general categories: rehabilitation alternatives, replacement alternatives, and other travel modes:

1. Rehabilitation alternatives are conceptual alternatives that rely on the major rehabilitation of the existing stacked I-84 structures over the Naugatuck River. The Ongoing Mixmaster Rehabilitation Project has proven that it is feasible for all structures and roadways within the interchange to be rehabilitated, except for the stacked I-84 structures, resulting in the identification of these “major” rehabilitation alternatives for I-84. Rehabilitation alternatives were identified by the Study Team during another workshop. They focus on strategies for replacing the concrete decks of the I-84 mainline structures in the interchange to meet the structural needs of the Project.
2. Replacement alternatives are conceptual alternatives that include the complete replacement of the stacked Route 8 and I-84 structures. The majority of the replacement alternatives in the Universe were identified by the Study Team during a series of technical workshops. These technical workshops were conducted in a charette format involving CTDOT personnel and its consultants. The Study Team collaborated in the development of highway layouts with various interchange configurations, urban planning aspects, and local road network access points. Where appropriate, replacement alternatives incorporated elements from previous CTDOT transportation planning efforts such as

the 2010 *Waterbury Interchange Needs Study* (WINS). The replacement alternatives category has been further organized into five descriptive categories in order to aid in the analysis. These five categories for the replacement alternatives include: in-place reconstruction, full system interchanges, partial system interchanges, ground level options, and bypass alignments.

3. Travel modes are high-level considerations of whether an “other” mode of travel (such as transit, pedestrian, or bicycle) could serve as a standalone solution for the Preliminary Purpose and Need. The Study Team reviewed the recommendations outlined in the Naugatuck Valley Council of Government’s *Waterbury Area Transit Study* (WATS), 2017.

Full System Interchanges vs. Partial System Interchanges

Full system interchanges are “complete” interchanges that use ramps to directly connect intersecting highways (e.g. I-84 Eastbound to Route 8 Northbound), allowing for uninterrupted travel between the highways without leaving the highway system.

Full system interchanges are consistent with the Connecticut Department of Transportation’s goals for maintaining the highest practical level of service, safety, and mobility on the interstate system.

Partial system interchanges are typically “incomplete” interchanges that use one or more roadways that indirectly connect intersecting highways. They usually have undesirable operational characteristics and are not used unless design constraints are extreme.

Direct Connection vs. Indirect Connection

Direct Connections are roadways that connect “limited access” highways to another (e.g. I-84 Eastbound to Route 8 Northbound) without the need to leave the highway system. Direct connections allow for quicker and simpler traffic movements, shortening travel times.

Indirect Connections are traffic movements made outside of the highway environment. Indirect connections that must utilize the local road network, oftentimes by use of a frontage road, require traffic control, and may cause increased travel time and vehicles on the local roadway. This style of connection is not ideal for high volume traffic movements but may help with local network traffic flow.

4 Descriptions of Conceptual Alternatives

This section provides a description and graphical depictions of the Universe of Alternatives under consideration in the Mixmaster Reconstruction Project's PEL Study. Additional graphical depictions illustrating the full aerial view of each conceptual alternative's features and proposed traffic movements are provided in **Section 8 Conceptual Alternative Graphics**. The existing conditions graphic is provided in Figure 4-1 adjacent to the No-Build Alternatives discussion and as **Figure 8-1** in the Graphical appendix.

4.1 NO-BUILD ALTERNATIVE

The No-Build Alternative represents a baseline condition for the PEL Study Area where no additional improvements are implemented other than those that are already programmed in Connecticut's Statewide Transportation Improvement Plan. The No-Build Alternative would include safety and maintenance activities such as pavement resurfacing or reconstruction, signing improvements, and guiderail improvements that would be required to sustain an operational transportation system. As a result, the graphical depiction of the existing conditions is also considered to be the graphical depiction of the No-Build Alternative for the purposes of the PEL Study.

By nature of the No-Build Alternative, it would not address the identified deficiencies within the Study Area, and therefore, would not meet the needs of the Project. The existing structural deficiencies of bridges would remain unaddressed. The substandard roadway geometrics would not be improved. Additionally, the highway would not have the increased capacity needed to accommodate future traffic volumes. Despite not meeting the Project's Needs, the No-Build Alternative is required to be considered and evaluated during PEL and NEPA analyses. Due to the anticipated future structural deficiencies of I-84 mainline bridges over the Naugatuck River, a true "no-build" solution requires major structural rehabilitation or the permanent closure of I-84.

Instead of being dismissed for infeasibility, the No-Build Alternative is to be carried forward to serve as a comparison for other alternatives to be evaluated alongside during the PEL Study evaluation process.



Figure 4-1 Existing Conditions / No-Build Alternative

4.2 REHABILITATION ALTERNATIVES

I-84 and Route 8 True Rehabilitation

See Figure 4-2 and Figure 8-2

Similar to the No-Build Alternative, the True Rehabilitation would maintain all system and service connections as they currently exist today. As a result, the graphical depiction of the existing conditions is also considered to be the graphical depiction of the True Rehabilitation Alternative for the purposes of the PEL Study.

This alternative would be a major rehabilitation project to replace the original concrete bridge decks of the I-84 structures without significantly changing the configuration of the Mixmaster. The construction of temporary crossovers structures would be required to maintain I-84 traffic, and no traffic would be allowed on portions of the interchange where work would be occurring. Drivers would experience significant and nonstop traffic impacts for an estimated five-year period during this alternative's construction. This conceptual alternative required the development of temporary conditions in order to be analyzed for feasibility.

By nature of the True Rehabilitation Alternative, it would not address the geometric and operational deficiencies within the Study Area. In this configuration, I-84 and Route 8 would remain in the current stacked locations. The substandard roadway geometrics would remain unimproved, and the highway would not accommodate future traffic volumes. Additionally, there would be no changes in the left-hand or downtown entrance and exit ramps. New frontage roads are not proposed in this alternative; however, limited local roadway improvements would occur.

System Ramps vs. Service Ramps

System ramps are roadways that connect one highway to another (e.g. I-84 Eastbound to Route 8 Northbound).

Service ramps are roadways that connect the local roadway network to a highway and are commonly referred to as on and off ramps.

Interchange

An **Interchange** is a system of interconnecting roadways that allow for traffic to travel uninterrupted. These roadways use grade separation and commonly involves two or more roadways – or highways on different levels. An interchange is similar to a standard intersection; however, in a standard intersection, roadways cross at the same grade.



Figure 4-2 I-84 and Route 8 True Rehabilitation

I-84 Westbound Bridge Rehabilitation with Construction of New I-84 Eastbound Mainline

See Figure 4-3 and Figure 8-3

This conceptual alternative would involve the construction of a new I-84 Eastbound structure and a deck replacement with major bridge rehabilitation effort for the I-84 Westbound mainline bridge in the Mixmaster Interchange.

Major activities in the rehabilitation would include demolition of the existing I-84 Eastbound upper structure and replacement of the deck on the existing lower I-84 Westbound structure beneath. The new I-84 Eastbound would be constructed to the south of the existing alignment while highway traffic is maintained in its existing location. Highway traffic would be shifted to the new I-84 Eastbound structure, which would be built to temporarily accommodate both westbound and eastbound traffic. The existing I-84 Eastbound upper structure would be demolished, then the deck on I-84 Westbound would be replaced. During the rehabilitation, the new I-84 Eastbound bridge would carry a total of five lanes of both westbound and eastbound traffic. Movable barriers would be used to manage the traffic flow in the AM and PM peak travel hours during this temporary condition to maintain capacity. In the final condition, the I-84 Eastbound bridge would carry three lanes of through-traffic. This conceptual alternative required the development of temporary conditions in order to be analyzed for feasibility.

In this conceptual alternative, access to the downtown area from I-84 Eastbound, west of the Naugatuck River, would move further east to accommodate the new structures. Service ramps would be reconstructed; however, access to the downtown area will remain as it currently exists. System movements would remain unchanged from their existing condition. The conceptual interchange layout maintains left-hand entrances and exits. Frontage roads are not proposed to be constructed; however, limited local roadway improvements would occur for improved traffic flow through the city. Route 8 would remain on the west side of the Naugatuck River in its existing alignment.

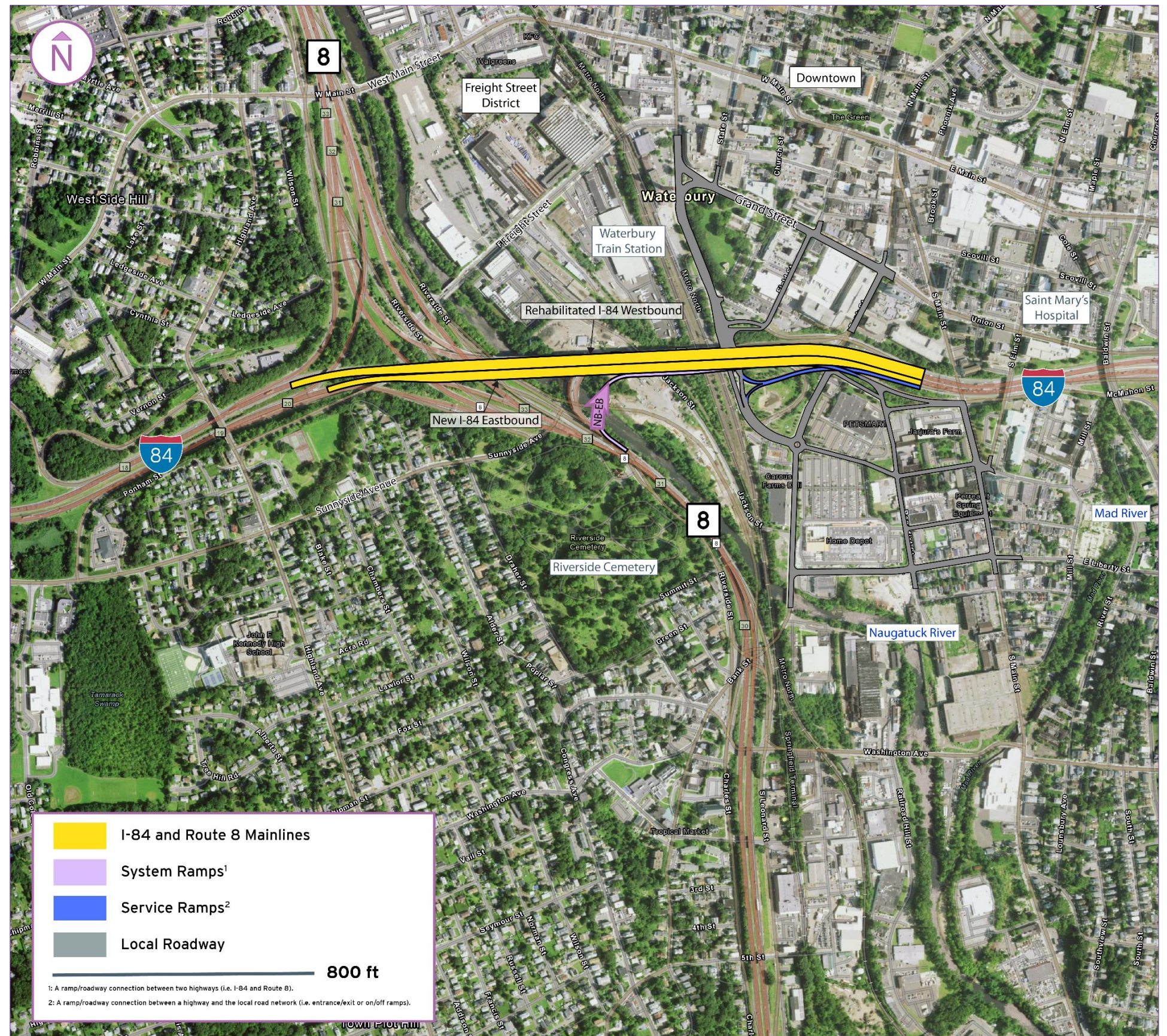


Figure 4-3 I-84 Westbound Bridge Rehabilitation with Construction of New I-84 Eastbound Mainline

I-84 Bridge Rehabilitation with Bypass Repurposed as Frontage Road

See Figure 4-4 and Figure 8-4

This conceptual alternative would involve a major bridge rehabilitation effort that would be focused on improving the condition of the I-84 mainline bridges in the Mixmaster Interchange. Major activities in the rehabilitation would include replacement of the decks on the existing upper and lower structures (I-84 Eastbound and Westbound). Highway traffic would be managed during the rehabilitation by constructing an I-84 bypass structure to the south of the existing alignment. The bypass would be used to carry a total of four lanes of both westbound and eastbound traffic during off-peak hours when construction would be occurring. The I-84 mainlines would generally remain open during peak traffic hours. In the permanent condition the bypass would be converted for use as a new frontage road in the eastbound direction to supplement the local roadway network. This conceptual alternative required the development of temporary conditions in order to be analyzed for feasibility.

In this conceptual alternative access to the downtown area from I-84 Eastbound, west of the river, would be through the repurposed bypass as a frontage road. Service ramps would be reconstructed; however, access to the downtown area will remain as it currently exists. System movements would remain unchanged from their existing condition. The conceptual interchange layout maintains left-hand entrances and exits. Frontage roads are not proposed to be constructed, apart from the reused bypass; however, limited local roadway improvements would occur for improved traffic flow through the city. Route 8 would remain on the west side of the Naugatuck River in its existing alignment.

Frontage Roads

Frontage roads are urban arterial roadways that often parallel a highway mainline. Frontage roads often improve the traffic operations on local road networks while providing access to commercial properties. Frontage roads allow for more efficient separation of local traffic from the highway mainline.



Figure 4-4 I-84 Bridge Rehabilitation with Bypass Repurposed as Frontage Road

I-84 Bridge Rehabilitation with Widening to Facilitate Staging

See Figure 4-5 and Figure 8-5

This conceptual alternative would involve a structure widening to be able to maintain traffic while the major bridge rehabilitation would be occurring. The major rehabilitation would be focused on improving the condition of the I-84 mainline bridges in the Mixmaster Interchange. Major activities in the rehabilitation would include widening the bridges on the existing upper and lower structures (I-84 Eastbound and Westbound, respectively) to facilitate traffic staging. Substructures would be constructed, strengthened, and extended as needed to support the widened portions of the decks. Once the decks have been widened, existing concrete decks of the stacked structures would be replaced in stages that would allow traffic to be maintained. This conceptual alternative required the development of temporary conditions in order to be analyzed for feasibility.

The conceptual alternative would generally maintain the I-84 stacked structures in their existing locations. Route 8 would remain on the west side of the Naugatuck River in its existing alignment and stacked south of the I-84 river crossing. Service ramps would be reconstructed; however, access to the downtown area will remain as it currently exists. System movements would remain unchanged from their existing condition. The conceptual interchange layout maintains left-hand entrances and exits. Frontage roads are not proposed to be constructed; however, limited local roadway improvements would occur for improved traffic flow through the city.

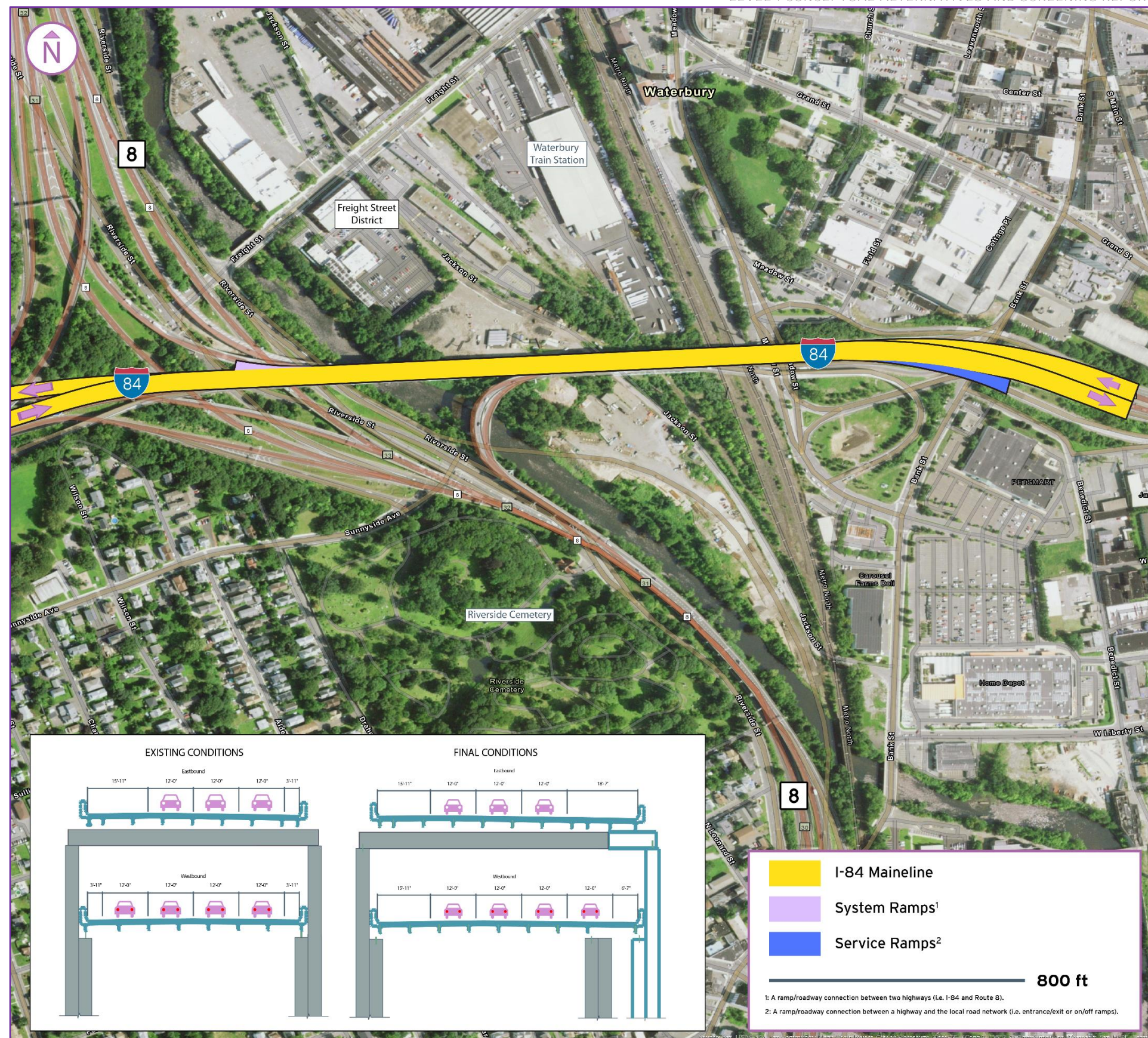


Figure 4-5 I-84 Bridge Rehabilitation with Widening to Facilitate Staging

4.3 REPLACEMENT ALTERNATIVES

4.3.1 IN-PLACE RECONSTRUCTION

I-84 Reconstruction In-Place

See Figure 4-6 and Figure 8-6

This conceptual alternative would replace the Mixmaster with a full system interchange where I-84 generally remains in the same location as existing conditions (i.e., reconstruction “in-place”). The in-place reconstruction was developed to identify an alternative that could minimize rights-of-way impacts and provide opportunities to improve the service ramps at the core of the interchange. The alternative would include a new frontage road system (east / west and north / south) that would improve access to and from I-84 and Route 8 for downtown and local road network.

The alternative would provide all system movements as direct connections. Most system movements would be combined movements. The system ramp locations in the northeast quadrant would encroach on the future Freight Street District. Other system movements would have lower design speeds (speed limits) which would result in a smaller ramp footprint that reduces rights-of-way impacts.

The conceptual interchange layout would avoid most left-hand entrances / exits and eliminates service ramps directly into downtown to improve the interchange spacing. The low volume system movement from I-84 Eastbound to Route 8 Northbound is proposed as a left-hand entrance ramp to avoid a costly “flyover” bridge. Service ramps to Downtown would be on the east side of the Naugatuck River and the eastern study limit along with new or improved frontage roads for traffic flow into, through, and out of the city. Near the interchange core (where the mainlines intersect), Route 8 would be located east of the existing alignment and east of the Naugatuck River both north and south of I-84, resulting in four new river crossings as Route 8 would be in split alignment. The new Route 8 alignment would also encroach on the future Freight Street District.

Split Alignment

When a roadway is in split alignment, instead of a single structure, each bound (eastbound and westbound or northbound and southbound) would use separate structures. Split alignments may reduce the width of a bridge and aid in construction phasing; however, two structures (and associated infrastructure) must be built and maintained. This could result in additional construction and maintenance costs.

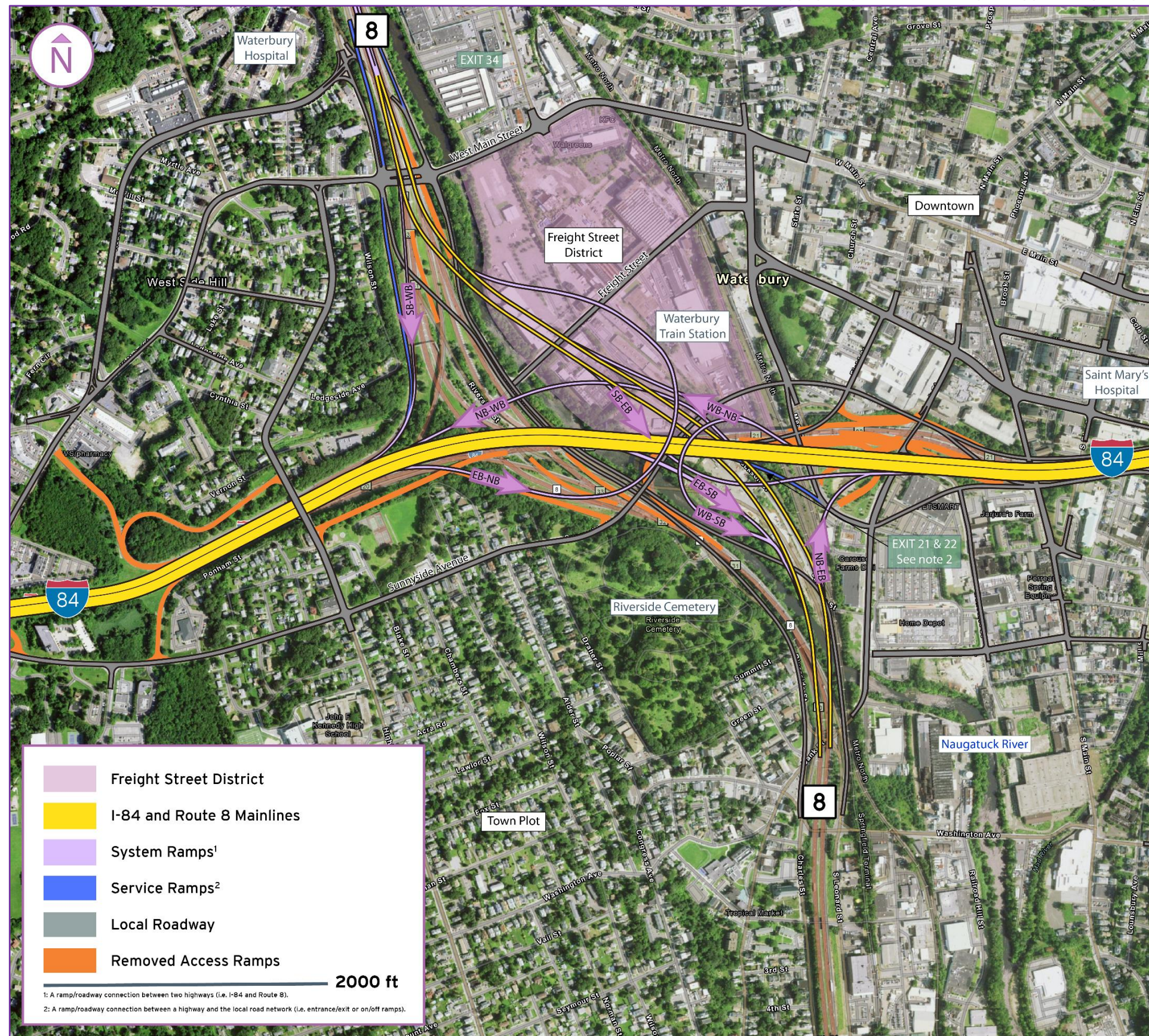


Figure 4-6 I-84 Reconstruction In-Place

4.3.2 FULL SYSTEM INTERCHANGES

Interchange Shifted East

See Figure 4-7 and Figure 8-7

This conceptual alternative would replace the Mixmaster with a full system interchange that would be constructed approximately one half-mile east of the existing interchange. Shifting the interchange and Route 8 alignment to the east would improve system ramp horizontal and vertical alignments. It would also provide numerous opportunities for off-line construction and ample space for a new frontage road system (east / west and north / south). The frontage road system would improve access to and from I-84 and Route 8, as well as, the downtown area and the, local road network. The new Route 8 alignment would run through the future Freight Street District impacting the western portion of the City's proposed redevelopment.

This alternative would provide all system movements as direct connections. All system movements would be combined movements.

The conceptual interchange layout would avoid left-hand ramp entrances and exits. It would also eliminate service ramps directly into downtown, improving the interchange spacing. Service interchanges are proposed on the perimeter of the interchange core along with new or improved frontage roads for traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located south of the existing alignment over the Naugatuck River. Route 8 would be located a half-mile east of the existing alignment, resulting in two new crossings of the Naugatuck River (one located immediately to the south of I-84 and the other near West Main Street).

Improved Interchange Spacing

This refers to the spacing of system and service interchanges. When the ramps of the interchanges are spaced further apart, traffic operations are typically improved. Adequately spaced ramps facilitate safer merging, diverging, and weaving movements between entrance and exit ramps. They also provide room for proper signage in advance of the ramp / decision points.

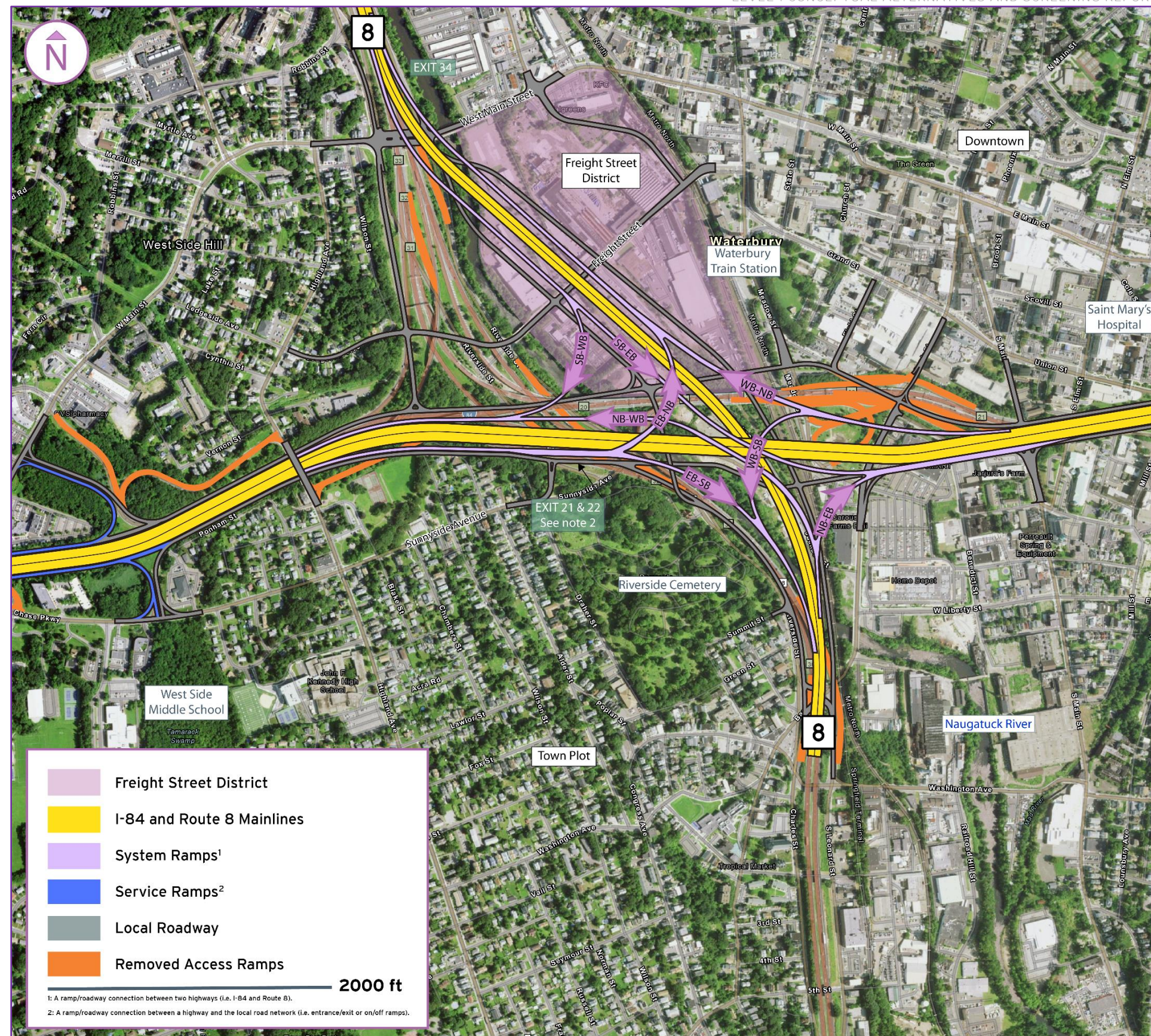


Figure 4-7 Interchange Shifted East

Interchange Shifted East with Inner Loop Ramp

See Figure 4-8 and Figure 8-8

This conceptual alternative would replace the Mixmaster with a full system interchange. The interchange would be shifted east of the Naugatuck River and would include an inner loop system ramp that replaces a low volume flyover bridge (the I-84 Eastbound to Route 8 Northbound ramp). The alternative also features new frontage road systems (east / west and north / south) that would improve access to and from I-84 and Route 8 for the downtown area and local road network.

This alternative would provide all system movements as direct connections. Several system movements would be combined movements. The inner loop ramp to connect I-84 Eastbound to Route 8 Northbound would have a lower speed limit relative to other I-84 and Route 8 connections. The compact ramp would avoid a costly elevated ramp structure resulting in a smaller ramp footprint and reduce rights-of-way impacts.

The preliminary interchange layout would avoid left-hand entrances / exits. Near the interchange core, I-84 would be located south of its existing alignment over the Naugatuck River. Route 8 would be located east of the existing alignment and east of the Naugatuck River both north and south of I-84, resulting in four new river crossings. Route 8 would be in a split alignment on the east bank and encroaches on the future Freight Street District. Consequently, there would be restricted riverfront access along the eastern riverbank within the limits of the Route 8 alignment.



Figure 4-8 Interchange Shifted East with Inner Loop Ramp

Combined System Connections

See Figure 4-9 and Figure 8-9

This conceptual alternative would replace the Mixmaster with a full system interchange that includes several combined system connections. These combined system connections would reduce the number of elevated structures required at the interchange and improve the geometric alignments for several traffic movements between I-84 and Route 8. The location of the combined system connections would also provide space for a new frontage road system (east / west and north / south), improving access to and from I-84 and Route 8 for the downtown area and local road network.

This alternative would provide all system movements as direct connections. The system ramp locations in the northeast quadrant of this alternative would encroach on a portion of the future Freight Street District.

The conceptual interchange layout would avoid left-hand entrances and exits. Additionally, it would eliminate service ramps directly downtown, improving the interchange spacing. Service ramps are proposed immediately east of the Naugatuck River as well as at the eastern study limit. These service ramps would connect with improved frontage roads for more efficient traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located south of the existing alignment over the Naugatuck River. Route 8 would be unstacked and located east of the existing alignment and east of the Naugatuck River both north and south of I-84, resulting in two new river crossings. The new Route 8 alignment would also encroach on the western portion of the future Freight Street District.

Combined System Movement (Connection)

A combined system movement is a traffic movement where vehicles traveling on a mainline together, leave or join a mainline together. This style of connection has increased traffic flow and requires more vehicular movements.

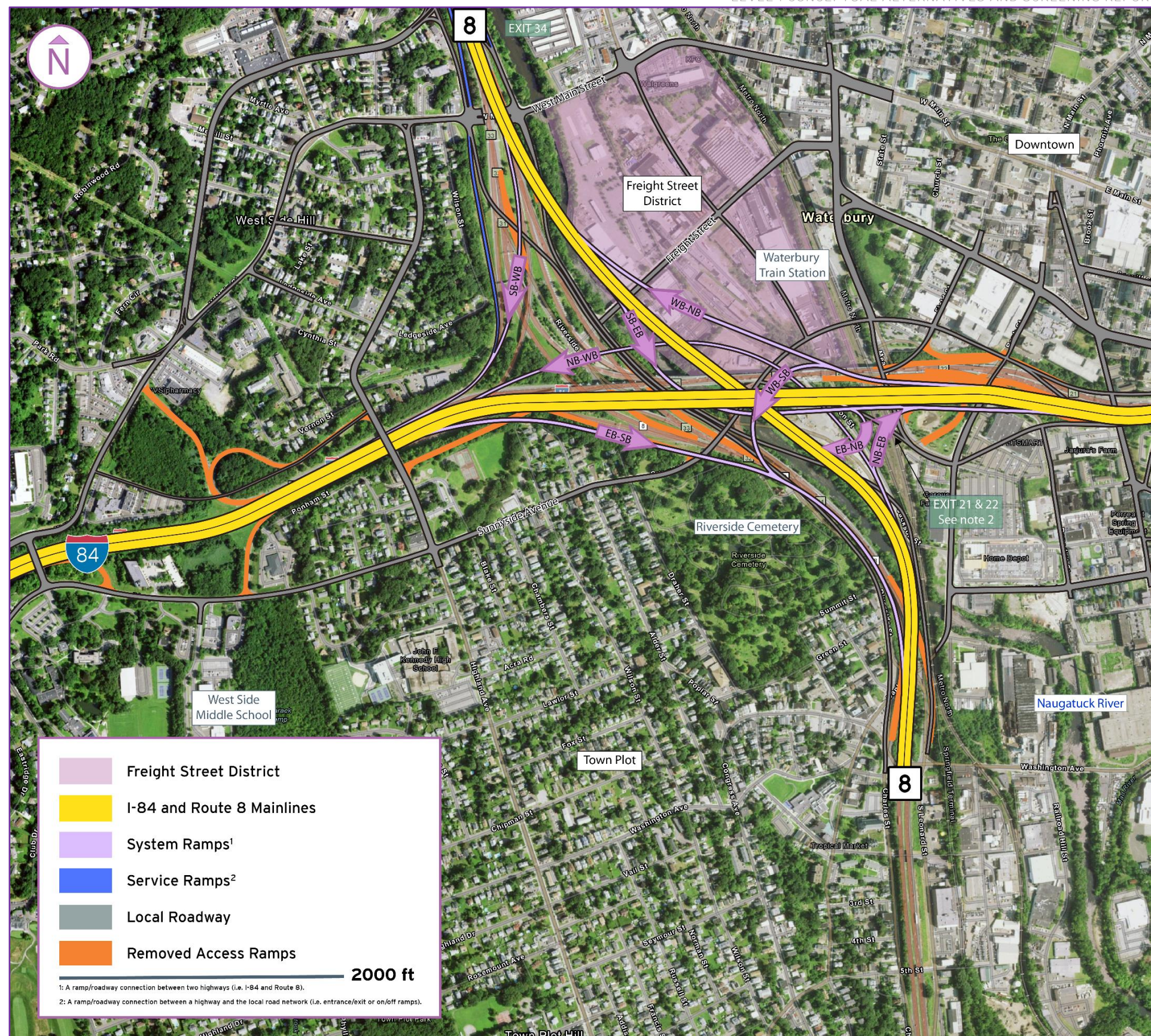


Figure 4-9 Combined System Connections

Modern Crossover Interchange

See Figure 4-10 and Figure 8-10

This conceptual alternative would replace the Mixmaster with a full system “modern” crossover interchange. This alternative would use multiple elevated structures which “cross over” (or under) one another to make connections for the various system movements. The main difference between this conceptual alternative and the existing interchange are the geometric and operational improvements achieved by unstacking the I-84 mainlines and through application of modern highway design criteria. This conceptual alternative would also include a new east / west frontage road system while modifying the existing north / south) frontage road system. This improves access for the downtown area and local road network to and from I-84 and Route 8.

This conceptual alternative would provide all system movements as right-hand direct connections. Some system connections would utilize combined ramps. The preliminary interchange layout indicates that it would be infeasible to eliminate all left-hand service entrances / exits with this conceptual alternative. Service ramps along I-84 are proposed on the perimeter of the downtown area along with new or improved frontage roads for traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located south of the existing alignment over the Naugatuck River. Route 8 would be located east of the existing alignment and east of the Naugatuck River just south of I-84, resulting in new river crossings. North of I-84, Route 8 would remain on the west side of the Naugatuck River near its existing alignment.

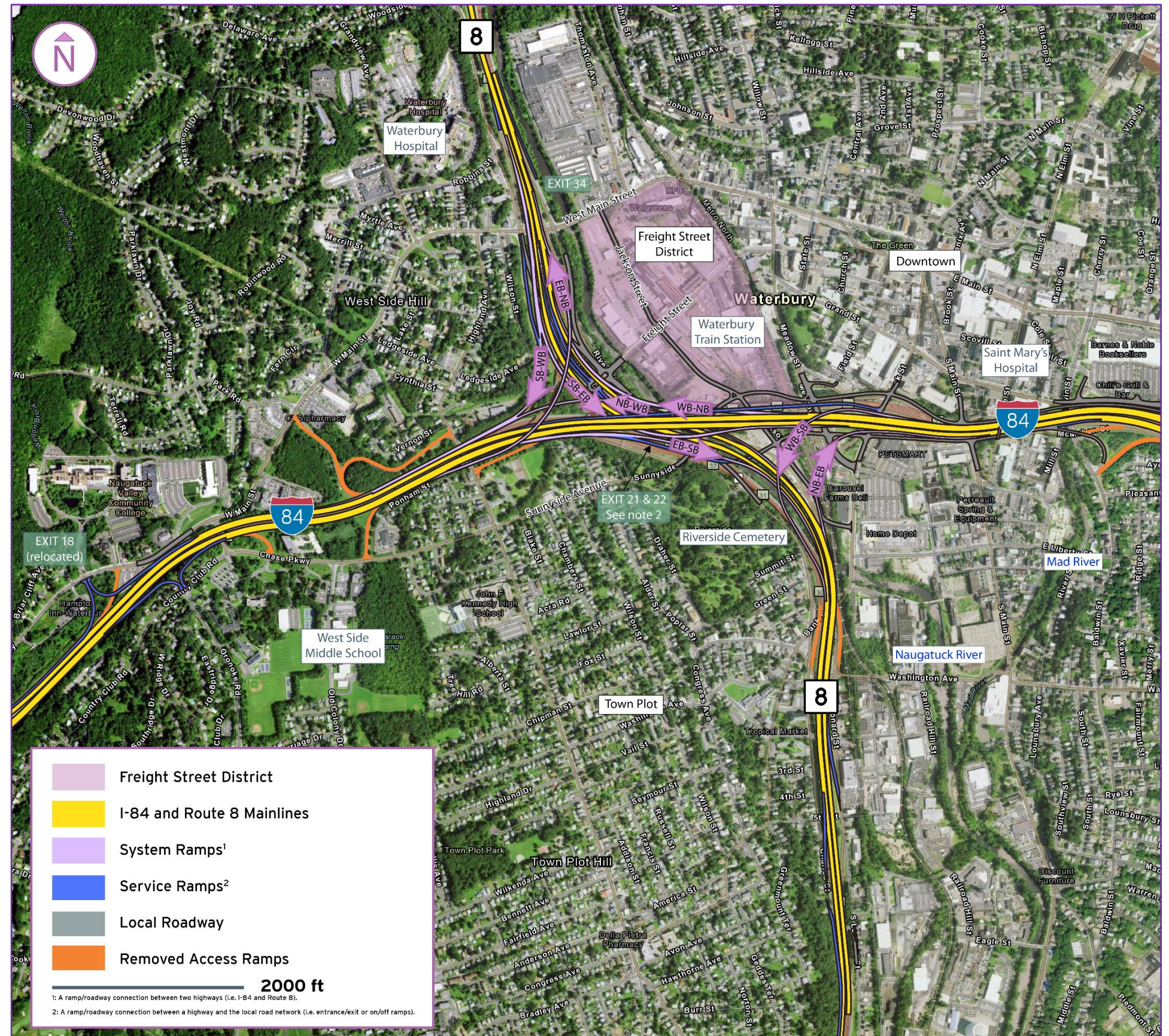


Figure 4-10 Modern Crossover Interchange

Modern Crossover Interchange with Route 8 Split to the South

See Figure 4-11 and Figure 8-11

This conceptual alternative includes a bifurcation (split-alignment) of Route 8 just south of I-84. Route 8 Southbound would remain approximately at its existing alignment, while Route 8 Northbound would cross the Naugatuck River impacting the river's eastern riverbanks. The split alignment would reduce the Route 8 structure width crossing the Naugatuck River and minimizes rights-of-way impacts on the eastern riverbank. As a result, there would be restricted riverfront access within the limits of the split alignment where Route 8 runs along both banks. The alignment would require using Riverside Street and Jackson Street as the north / south frontage road system.

This alternative's conceptual interchange layout indicates that it is infeasible to eliminate all left-hand exits; however, all left-hand entrances are eliminated. Apart from what is described above, this conceptual alternative's preliminary layout and characteristics are similar to **Modern Crossover Interchange** in all other respects.

New service ramps would be constructed and would serve as the primary means for eastbound and westbound traffic to access the downtown area. Traffic would travel via new one-way frontage roads for better traffic flow into, through, and out of the city.

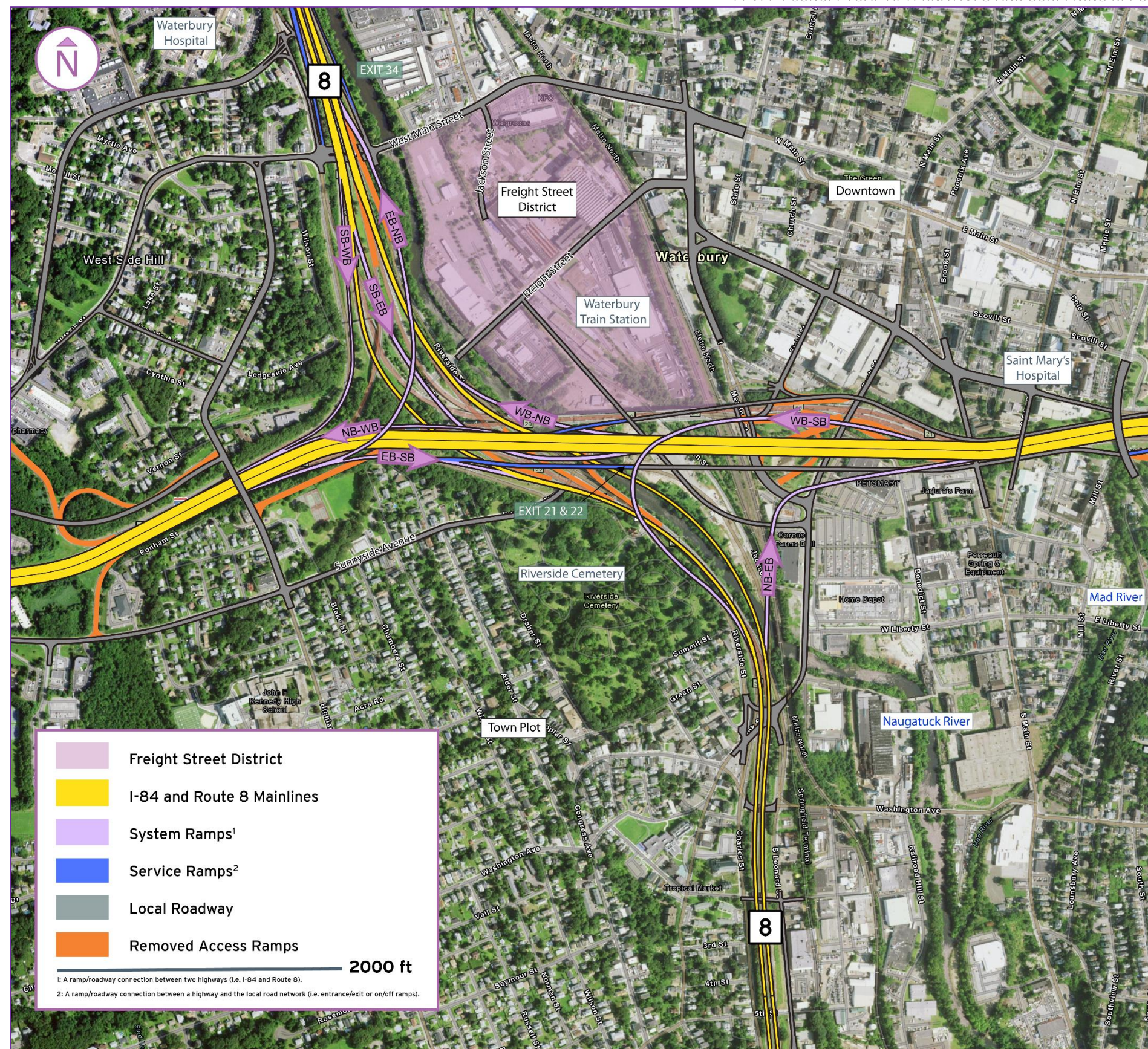


Figure 4-11 Modern Crossover Interchange with Route 8 Split to the South

Keeping Route 8 Stacked

See Figure 4-12 and Figure 8-12

This conceptual alternative would replace the Mixmaster with a full system interchange and highway layout. I-84 mainline structures would be replaced in a new unstacked configuration to the south of the existing alignment. New system ramp structures would also be constructed at this time to establish connections between the new I-84 alignment and the existing Route 8 alignment. The existing Route 8 stacked structures would not be replaced at the time of the I-84 reconstruction and are estimated to remain in service for an additional 20 years. A 2020 rehabilitation of the Route 8 bridge decks, which included replacement of the Route 8 bridge decks, is expected to extend the structure's lifespan. At the end of this 20-year period, the Route 8 structures could be reevaluated for further rehabilitation or replacement in many of the alternate alignments for Route 8 south of I-84.

This conceptual alternative would also include a new east / west frontage road system while modifying the existing north / south frontage road system. This would improve access to and from I-84 and Route 8 for the downtown area and local road network.

This conceptual alternative would provide all system movements as direct connections. All of these system movements would be right hand movements except for the I-84 Westbound to Route 8 Southbound which would continue to be a left hand entrance onto the lower level of the existing stacked structure. The preliminary interchange layout indicates that it would be infeasible to eliminate all left-hand service ramp entrances / exits with this conceptual alternative. This alternative would eliminate service ramps from I-84 directly into downtown improving the interchange spacing. Service ramps are proposed on the perimeter of the downtown area that connect to the frontage roads for traffic flow into, through and out of the city. Near the interchange core, I-84 would be located south of its existing alignment over the Naugatuck River. Route 8 would remain on the west side of the Naugatuck River in its existing alignment.

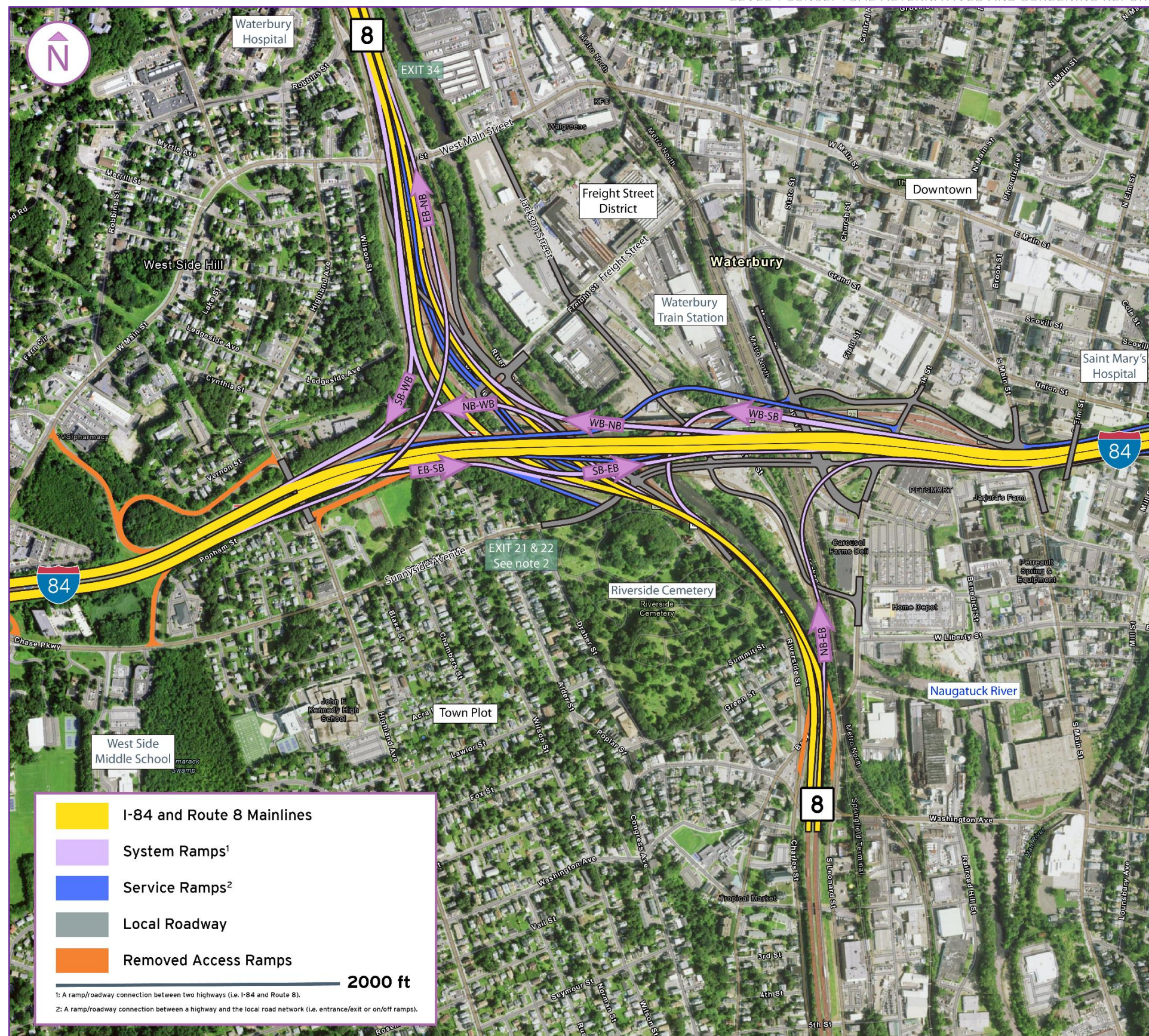


Figure 4-12 Keeping Route 8 Stacked

Naugatuck River Shift

See Figure 4-13 and Figure 8-13

This conceptual alternative would replace the Mixmaster with a full system interchange and highway layout. I-84 mainline structures would be replaced in a new unstacked configuration to the south of the existing alignment. New system ramp structures would also be constructed at this time to establish connections between the new I-84 alignment and Route 8. In this conceptual alternative the Route 8 structures south of I-84 would be reconstructed in an unstacked configuration along the western riverbank of the Naugatuck River. This would allow for riverfront access along the eastern riverbank. This alternative also includes a new east / west frontage road system that would improve access for the downtown and local road network to / from I-84. In order to facilitate Route 8 in an unstacked configuration, a portion of the Naugatuck River would be shifted to a more favorable alignment for the Route 8 roadway, while width, river flow, and capacity would be maintained in its final condition.

This conceptual alternative would provide all system movements as right-hand direct connections. Some system connections would utilize combined ramps. The preliminary interchange layout indicates that it would be infeasible to eliminate all left-hand service entrances / exits with this conceptual alternative. Service ramps along I-84 are proposed on the perimeter of the downtown area along with new or improved frontage roads for traffic flow into, through, and out of the city.

A shift to the Naugatuck River could also be incorporated as a component of other conceptual alternatives, such as Keeping Route 8 Stacked. The system and service connections, as well as the larger preliminary interchange layout depicted in this particular alternative are just one example.

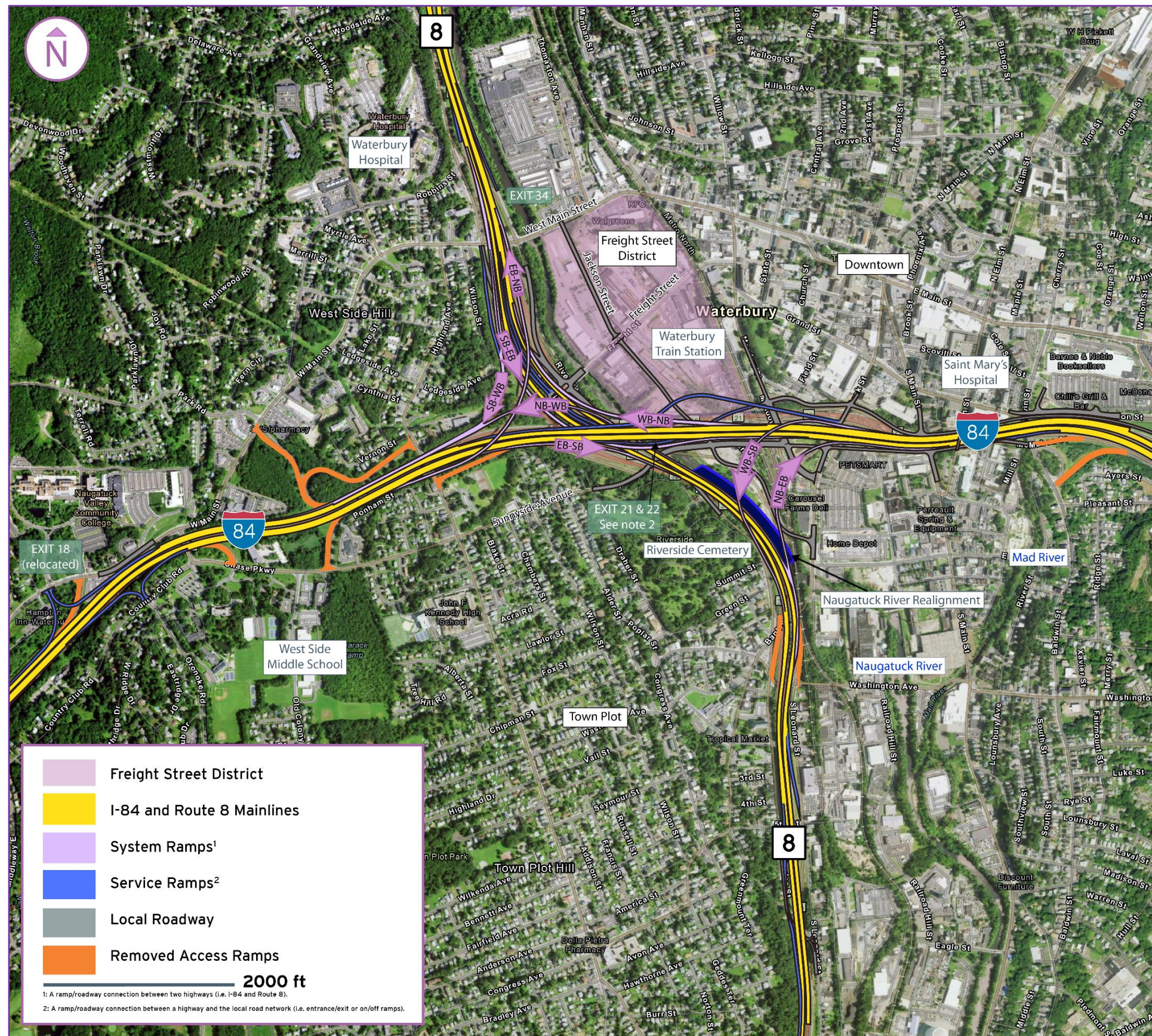


Figure 4-13 Naugatuck River Shift

Stacked I-84

See Figure 4-14 and Figure 8-14

This alternative was developed to evaluate the feasibility of replacing the Mixmaster with a full system interchange that includes the construction of a new stacked I-84 structure over the Naugatuck River. The structure would be built adjacent to the existing stacked I-84 structure potentially minimizing traffic impacts during construction and rights-of-way impacts.

This alternative would provide all system movements as direct connections. The conceptual interchange layout removes several left-hand entrances / exits but two exiting system movements must be left-hand exits due to vertical alignment constraints. The I-84 Eastbound to Route 8 Northbound and I-84 Westbound to Route 8 Southbound system movements would need to become left-hand off ramps, as “flyover” right-hand movements would not be feasible. Near the interchange core, I-84 would be located south of the existing alignment over the Naugatuck River. For constructability reasons, the westbound lanes would be stacked over the eastbound lanes. The stacked structures would be wider than the existing structures, which would facilitate future maintenance needs by providing room for temporary traffic shifts.

Route 8 would be located east of the existing alignment and east of the Naugatuck River just south of I-84, resulting in two new river crossings. North of I-84, Route 8 would remain on the west side of the Naugatuck River near its existing alignment. This conceptual alternative would also include a new east/west frontage road system and would modify the existing north / south frontage road system. This improves access for the downtown area and local road network to and from I-84 and Route 8.

The preliminary interchange layout indicates that it would be infeasible to eliminate all left-hand service entrances / exits. The layout eliminates service ramps from I-84 directly into downtown to improve the interchange spacing. Service ramps are proposed on the perimeter of the downtown area along with new or improved frontage roads for traffic flow into, through, and out of the city.

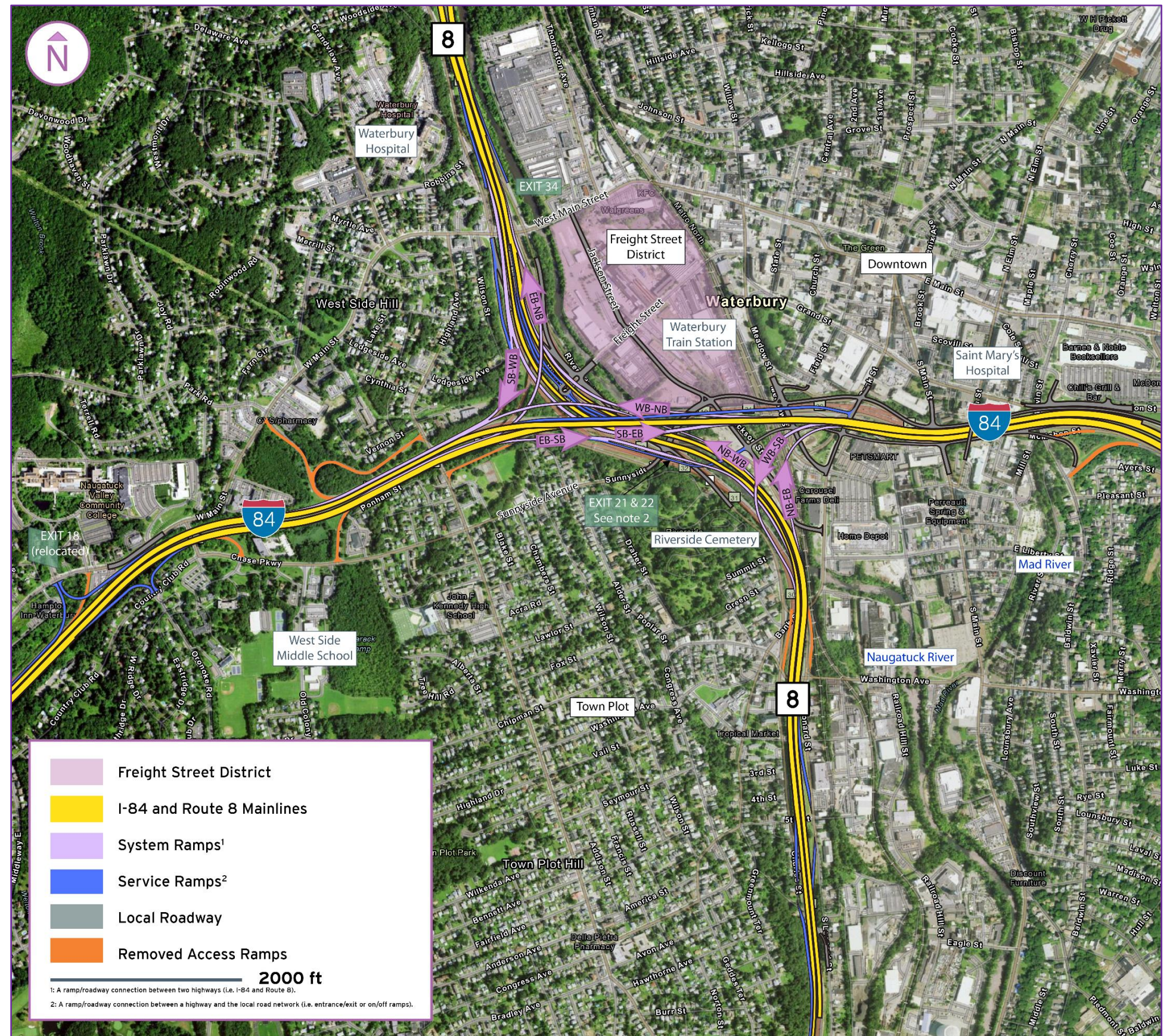


Figure 4-14 Stacked I-84

4.3.3 PARTIAL SYSTEM INTERCHANGES

Partial System Crossover Interchange

See Figure 4-15 and Figure 8-15

This conceptual alternative would replace the Mixmaster with a partial system crossover interchange that optimizes the usage of available rights-of-way. Eliminating direct connections for two low-volume system movements (I-84 Eastbound to Route 8 Northbound and Route 8 Northbound to I-84 Westbound) would reduce the total number of bridges required and the total structure width crossing the Naugatuck River. The realignment of I-84 in this alternative would produce a favorable crossing with Route 8 and would improve the horizontal and vertical alignments of the system ramps. The alternative would include a new east/west and an improved north/south frontage road system, improving access for the downtown area and local road network to and from I-84 and Route 8. The frontage road system would incorporate a new crossing of the Naugatuck River at the end of Sunnyside Avenue.

This conceptual alternative would not provide all system movements as direct connections. I-84 Eastbound to Route 8 Northbound and Route 8 Northbound to I-84 Westbound would be indirect connections which would be made outside of the highway environment using the frontage road system. Making the I-84 Eastbound to Route 8 Northbound movement an indirect connection would eliminate the need for a large “flyover” bridge that would otherwise be required, reducing the total structure width crossing the Naugatuck River.

The conceptual interchange layout indicates that it would be infeasible to eliminate all left-hand entrances / exits with this alternative. The alternative would, however, eliminate service ramps directly into downtown to improve the interchange spacing. Service ramps would be on the perimeter of the downtown area along with new or improved frontage roads for traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located north of its existing alignment over the Naugatuck River. Route 8 would be in a split alignment to the south of existing the I-84 alignment, with Route 8 Northbound east of the Naugatuck River. Route 8 Southbound would remain on the west side of the Naugatuck River, near its existing alignment. As a consequence, there would be restricted riverfront access along the riverbanks within the limits of the Route 8 split alignment.

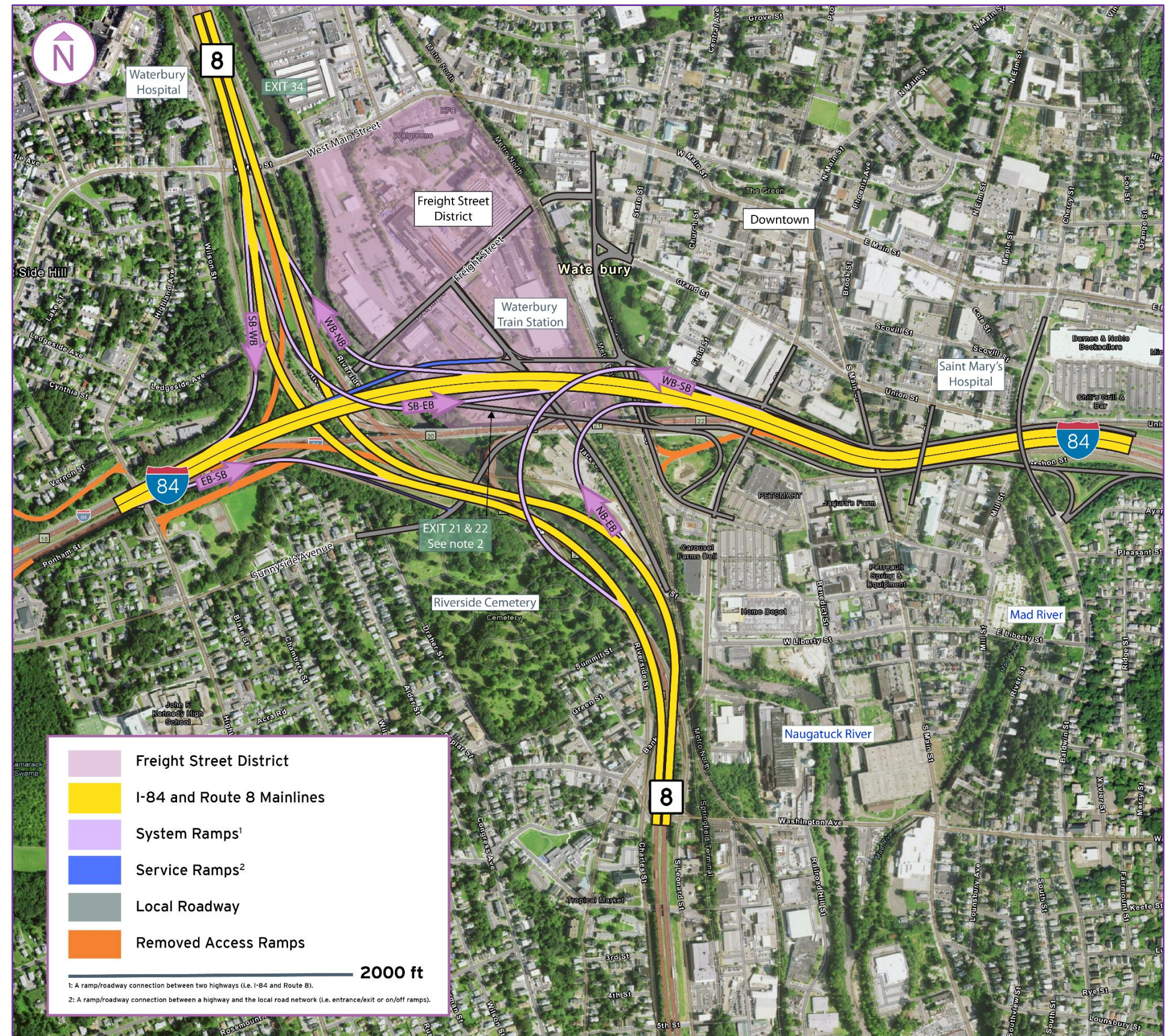


Figure 4-15 Partial System Crossover Interchange

Partial System Interchange with Freight Street Interchange

See Figure 4-16 and Figure 8-16

This conceptual alternative would replace the Mixmaster with a partial system interchange. The alternative's compact layout would require fewer structures and reduce rights-of-way impacts that would allow its construction within the constrained site. This alternative would also include a new frontage road system (east / west and north / south) that would improve access to / from I-84 and Route 8 for the downtown area and local road network.

This conceptual alternative would provide system connections for all interchange movements, however, not all movements would be direct connections. The outer quadrant system movements, Route 8 Southbound to I-84 Eastbound and I-84 Westbound to Route 8 Southbound, would be direct connections. The remaining inner / crossing quadrant system movements would combine with the service ramps. The local roadway network in the vicinity of the core of the interchange would be improved to handle the traffic flow of the two system ramps in combination with the frontage road system. "Texas U-Turns" would be installed to improve the traffic flow with the increased traffic volume. Additional service entrance ramps to the mainlines would be installed or improved to complete these movements.

The conceptual interchange layout would avoid left-hand entrances / exits. Near the interchange core, I-84 would be located south of its existing alignment over the Naugatuck River. Route 8 would be located east of its existing alignment and east of the Naugatuck River just south of I-84, resulting in four new river crossings. North of I-84, Route 8 would remain on the west side of the Naugatuck River near its existing alignment.

Texas U-Turn

A Texas U-Turn is a left-hand traffic movement / travel lane that diverges from a roadway (e.g. a one-way frontage road) to merge with another roadway (e.g. the opposite one-way frontage road) before an at-grade (ground-level) intersection to allow traffic to flow freely. The aim is to reduce the number of traffic signals and

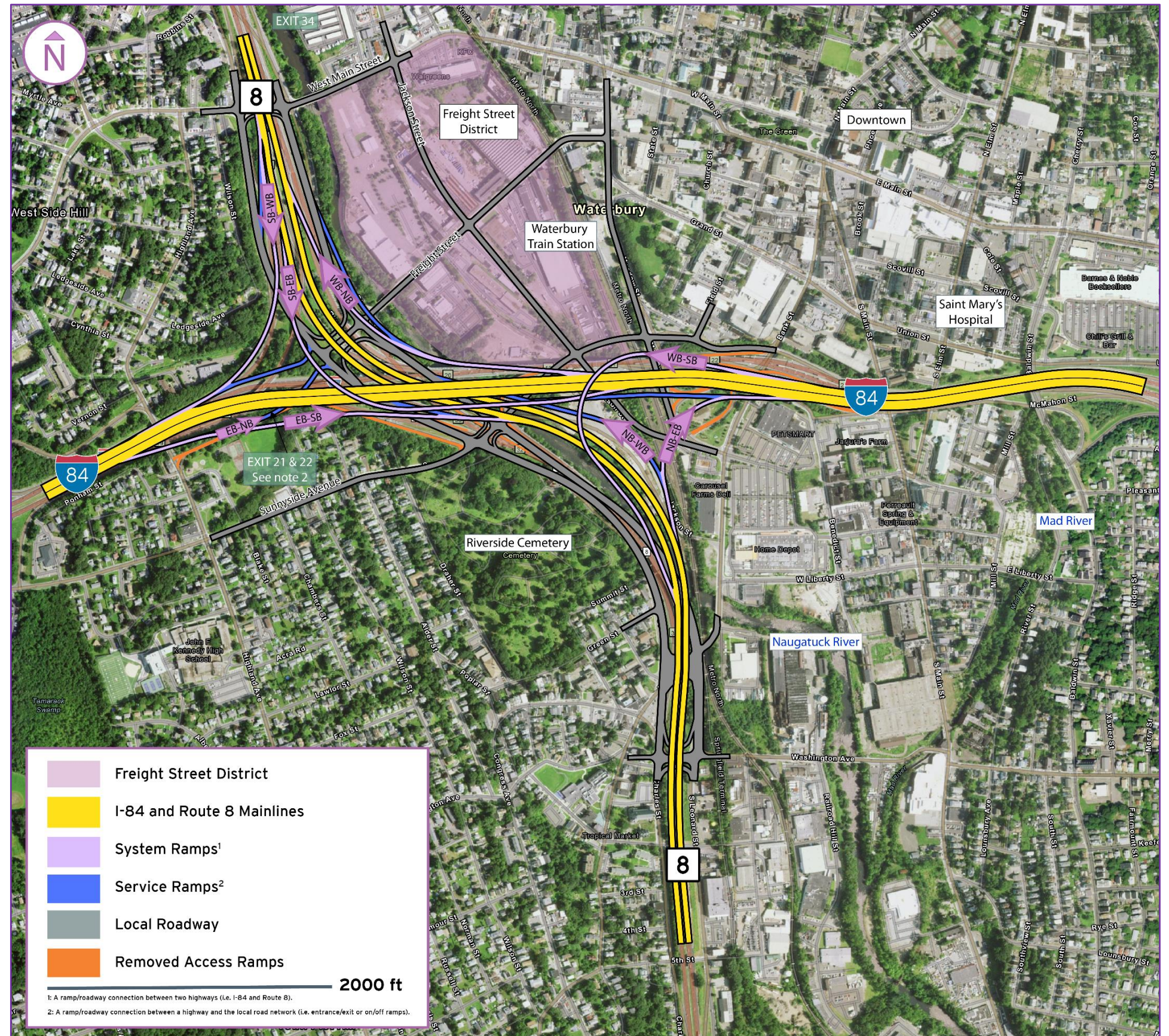


Figure 4-16 Partial System Interchange with Freight Street Interchange

Modified Diverging Diamond

See Figure 4-17 and Figure 8-17

This conceptual alternative would replace the Mixmaster with a full system diverging diamond interchange (DDI). This interchange would consist of modified low-level system ramps for increased compatibility with site constraints. This conceptual alternative's compact layout would minimize rights-of-way impacts and require fewer structures. The alternative would also include a new frontage road system (east / west and north / south) improving access for the downtown area and local road network to / from I-84 and Route 8.

The alternative would provide system connections for all interchange movements, however, not all movements are direct connections. The outer quadrant system movements would be direct connections. These ramps would not cross over or under another mainline or ramp. The remaining system movements would utilize the modified DDI in combination with the local roadway network to complete these movements. These indirect connections would have lower speeds than the elevated ramps, which allow direct and uninterrupted movement between the highways.

The preliminary interchange layout indicates that it would be infeasible to eliminate all left-hand exits with this conceptual alternative; however, all left-hand entrances would be eliminated. The alternative would consolidate the service ramps with the system ramps at the core of the interchange. Service ramps would be on the perimeter of the downtown area. Additionally, new or improved frontage roads are proposed for traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located south of the existing alignment over the Naugatuck River. Route 8 would remain on the west side of the Naugatuck River near its existing alignment.

Diverging Diamond Interchanges (DDIs)

DDIs have been used in France since the 1970s and are a relatively new interchange type in the United States. DDI designs confer many benefits when compared to traditional crossover interchanges, including reduced delays, increased turning movement capacity, and compact layouts.

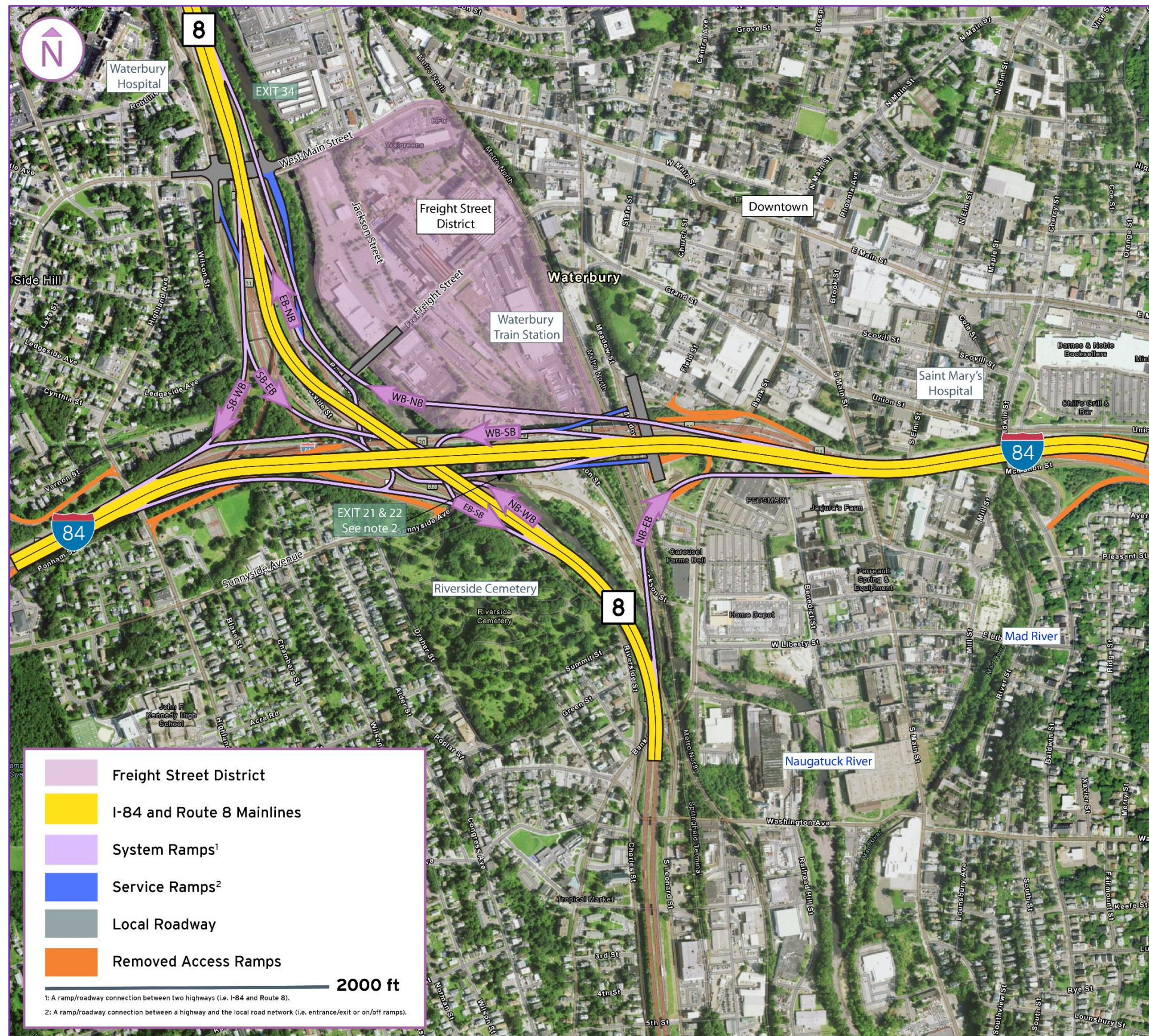


Figure 4-17 Modified Diverging Diamond

Half Diverging Diamond

See Figure 4-18 and Figure 8-18

This conceptual alternative would replace the Mixmaster with a half diverging diamond interchange. Similar to the **Modified Diverging Diamond** conceptual alternative, this alternative would provide a compact layout that would reduce rights-of-way impacts and require fewer structures. The alternative would also include a new frontage road system (east / west and north / south) that improves access to / from I-84 and Route 8 for the downtown area and local road network.

The alternative would provide system connections for all interchange movements; however, not all movements would be direct connections. The outer quadrant system movements along with the Route 8 Southbound to I-84 Eastbound and the I-84 Westbound to Route 8 Southbound movements would be direct connections. The remaining system movements would use a modified half diverging type interchange in combination with the local roadway network to complete these movements. These indirect connections would have lower speeds than the direct ramps, which allow uninterrupted movement between the highways. An additional entrance ramp from Freight Street to I-84 Westbound would be constructed, while the existing entrance ramp along Riverside Street to Route 8 Northbound would be improved.

This alternative would consolidate the service ramps with the system ramps at the core of the interchange that would connect to new or improved frontage roads for traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located south of the existing alignment over the Naugatuck River. Route 8 would remain on the west side of the Naugatuck River near its existing alignment.

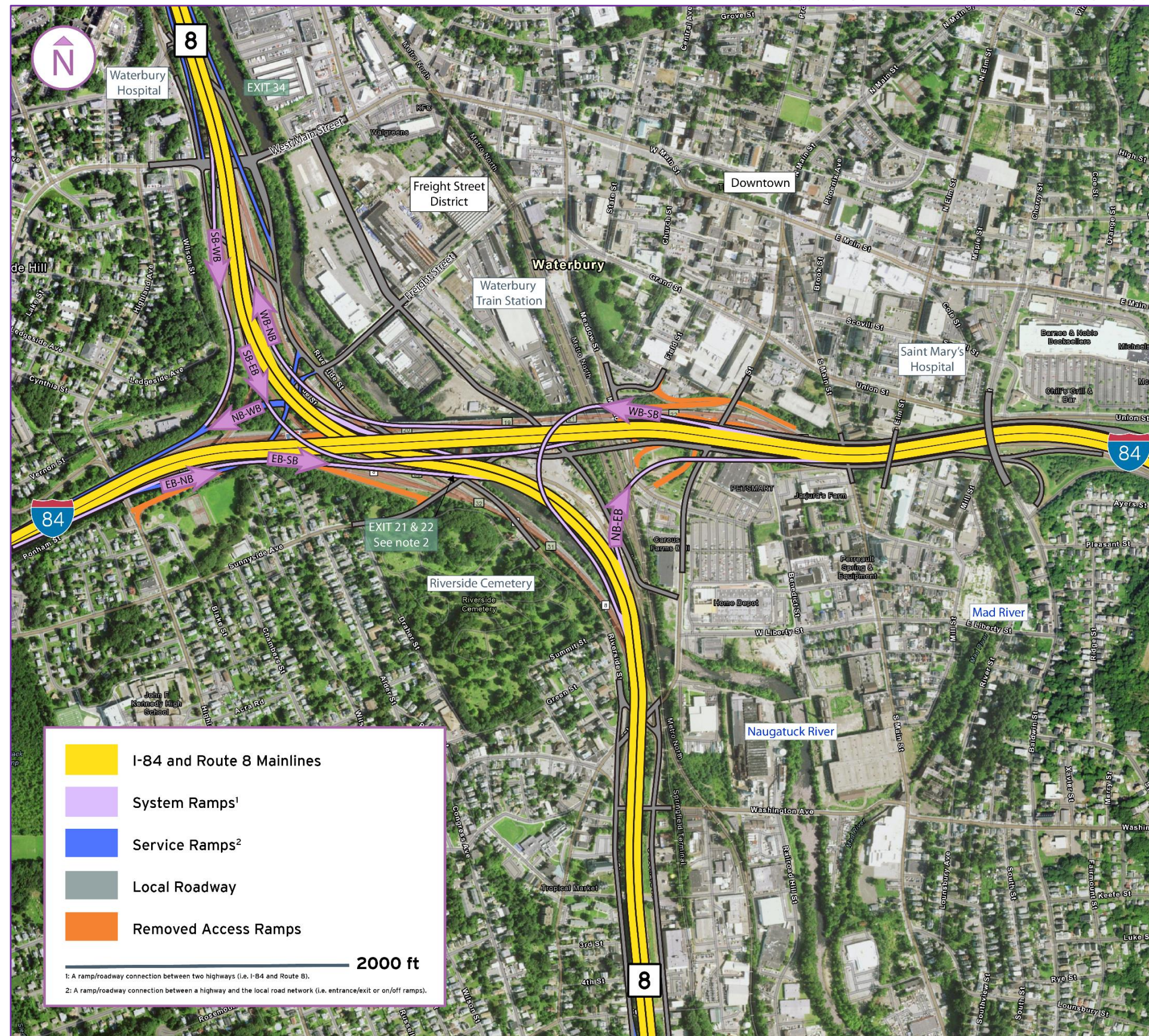


Figure 4-18 Half Diverging Diamond

At Grade System Connections

This conceptual alternative would replace the Mixmaster with a partial system interchange that includes several system ramps as at-grade connections. These at-grade (or ground-level) connections would simplify the bridge geometry between I-84 and Route 8 and allow the system movements to take place within the existing highway rights-of-way. For example, an at grade connection would be used in place of a costly elevated structure for I-84 Eastbound to Route 8 Northbound travel. The at-grade connections would be signalized and would also integrate with a new east/west frontage road system that would improve access to/from I-84 for the downtown area and local road network.

This alternative would provide system connections for all interchange movements. Not all system movements would be provided as direct connections. I-84 Eastbound to Route 8 Northbound and I-84 Eastbound to Route 8 Southbound movements would be indirect connections requiring the use of the frontage road system. Modifying the I-84 Eastbound to Route 8 Northbound movement to an indirect connection eliminates the need for a large “flyover” bridge that would otherwise be required. As previously mentioned, the at grade connections use portions of the local road network for travel between the highways and require signalized intersections. While an indirect connection eliminates the need for a large elevated structure, travel between highways using an indirect connection would be interrupted and requires lower speeds.

The conceptual interchange layout would avoid left-hand ramp entrances and exits, an improvement from existing conditions. Additionally, it would eliminate service ramps directly into downtown to improve the interchange spacing. Service ramps are proposed on the perimeter of the downtown area along with new or improved frontage roads for better traffic flow into, through, and out of the city. Near the interchange core, I-84 would be located south of its existing alignment over the Naugatuck River. Route 8 would be located east of its existing alignment and east of the Naugatuck River, both north and south of I-84, resulting in two new river crossings.

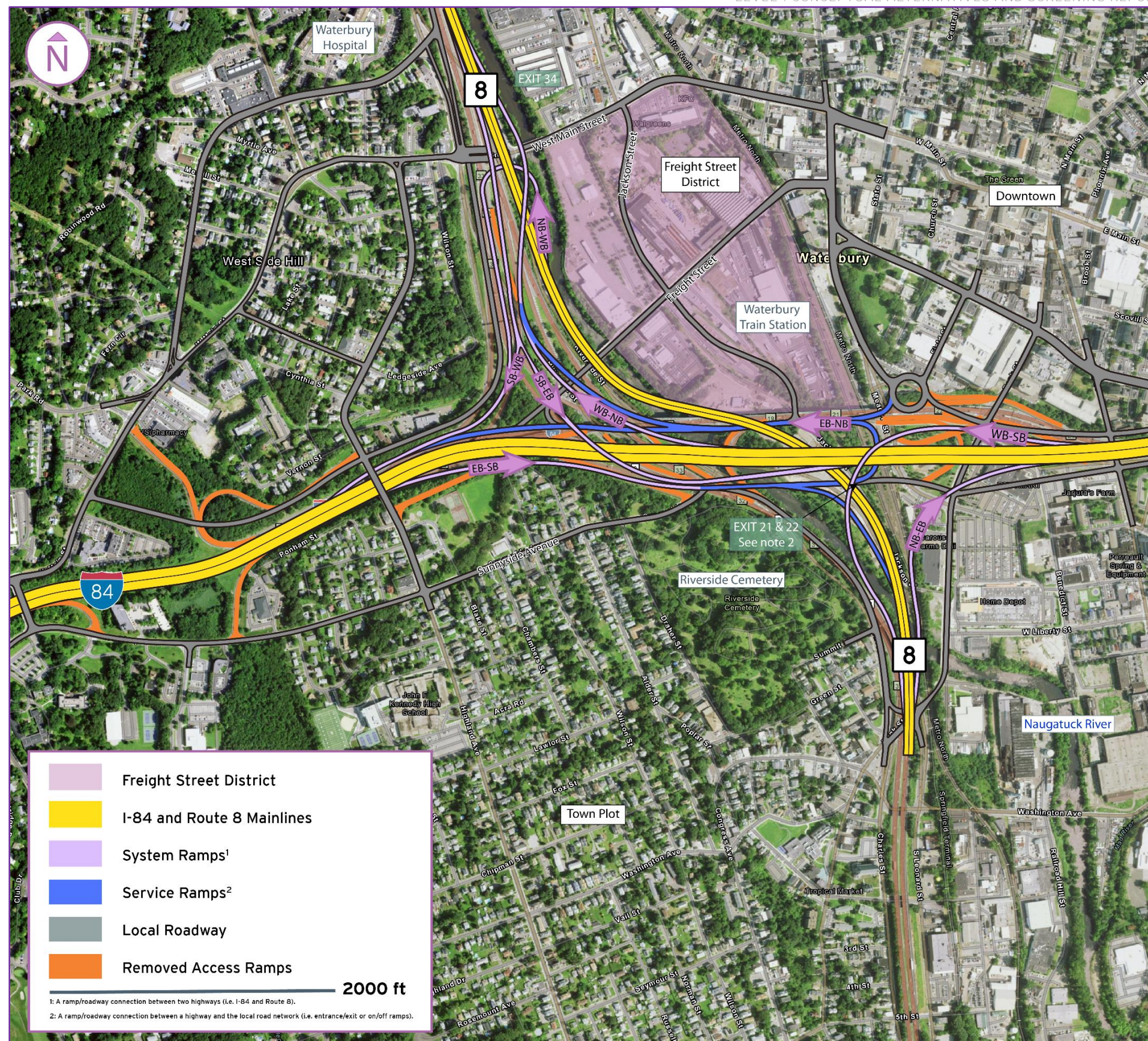


Figure 4-19 At Grade System Connections

Route 8 Boulevard

See Figure 4-20 and Figure 8-20

This conceptual alternative would replace the Mixmaster with an interchange that includes a Route 8 boulevard segment at-grade. The Route 8 boulevard segment would reduce the required number of elevated structures and decreases the overall height and visual barrier of the stacked interchange. The boulevard would also improve downtown access to Route 8; however, it would not allow for east / west or north / south frontage road systems.

The extent of the proposed Route 8 boulevard segment would be between Washington Avenue and West Main Street where the mainline would descend to the local level and combine with Riverside Street. Route 8 would have traffic-controlled at-grade intersections with Washington Avenue, Bank Street, Sunnyside Avenue, Freight Street and West Main Street. These intersections would affect traffic flow on Route 8 as they require lower speeds and reduce through-traffic levels of service. The system connections for all interchange movements would be provided. Two of the system ramp movements would intersect with the boulevard sections of Route 8. Several system ramp movements would be combined on the north side of I-84. An elevated flyover ramp would be utilized to have the system ramp movements from Route 8 avoid intersecting with West Main Street.

A Route 8 boulevard segment could also be incorporated as a component of other conceptual alternatives. The system connections and larger preliminary interchange layout depicted in this particular alternative are just one example.

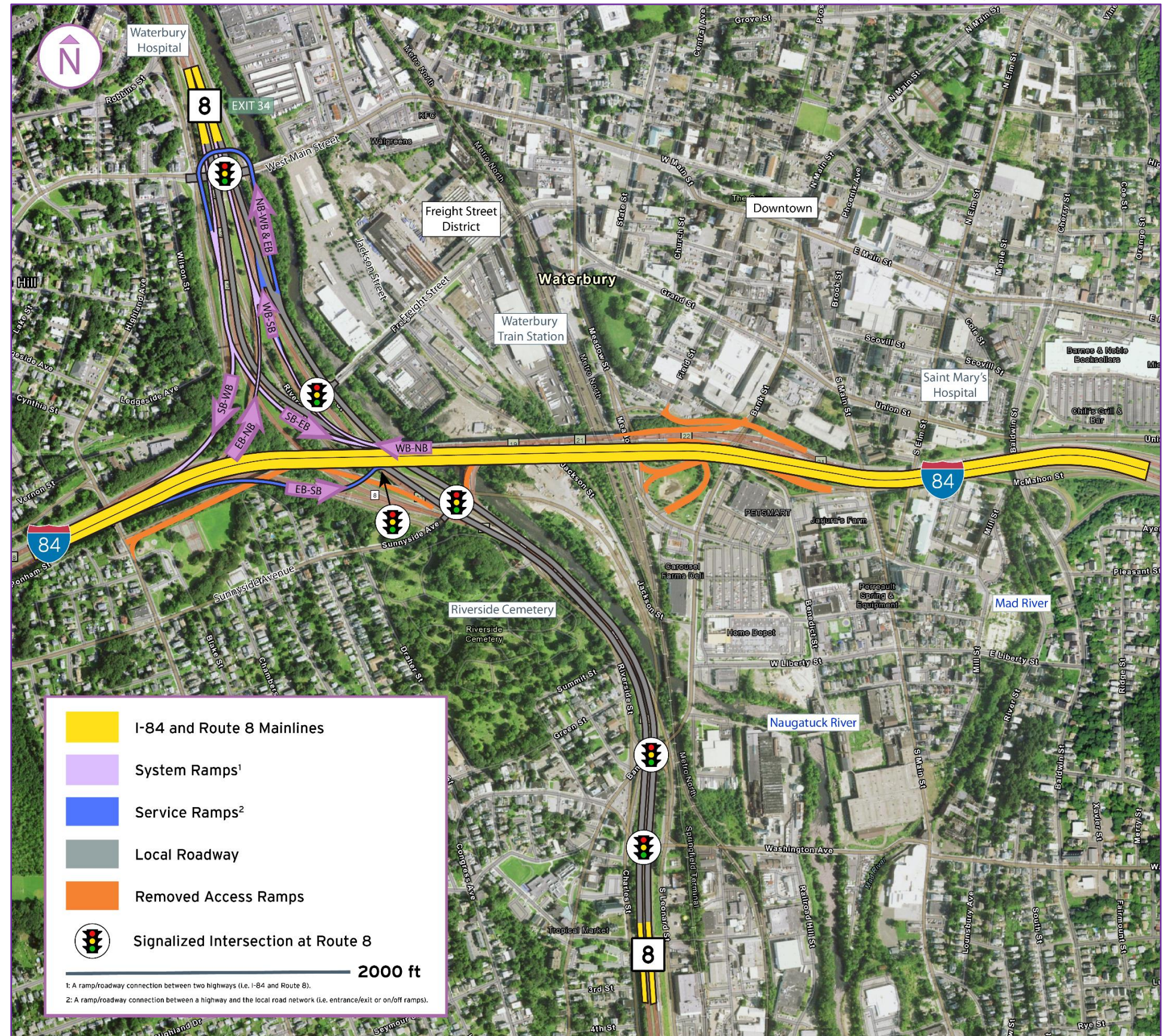


Figure 4-20 Route 8 Boulevard

4.3.5 BYPASS ALIGNMENTS

Washington Street Bypass

See Figure 4-21 and Figure 8-21

This conceptual alternative would replace the Mixmaster with a full system interchange that includes the relocation of the I-84 alignment into the Washington Avenue / Washington Street corridor located on the south side of downtown. The new I-84 alignment would bypass the existing highway segment between the Naugatuck River and Hamilton Avenue. This conceptual alternative would allow for the elimination of the upper deck of the existing stacked I-84 structures over the Naugatuck River. The bypassed segment of I-84 would remain in service as a bi-directional business loop roadway that uses remaining portions of the existing elevated structures. The business loop would connect to the new I-84 alignment and provide access to downtown by using the existing service ramps. This alternative would also provide numerous opportunities for off-line construction. New frontage road systems are not proposed in this alternative.

This alternative would provide all system movements as direct connections. The conceptual interchange layout would avoid left-hand entrances and exits. The bypassed segment of I-84 would provide access to and from downtown. Route 8 would be converted to an approximate ten lane expressway (five lanes in each direction), between existing I-84 and Washington Avenue, becoming the combined I-84 / Route 8 for a relatively short stretch of roadway. The interchange between Route 8 and I-84 would require reconstruction at both ends of this widened section. The alignment of the widened section would generally be located east of the existing Route 8 alignment, resulting in two new crossings of the Naugatuck River.

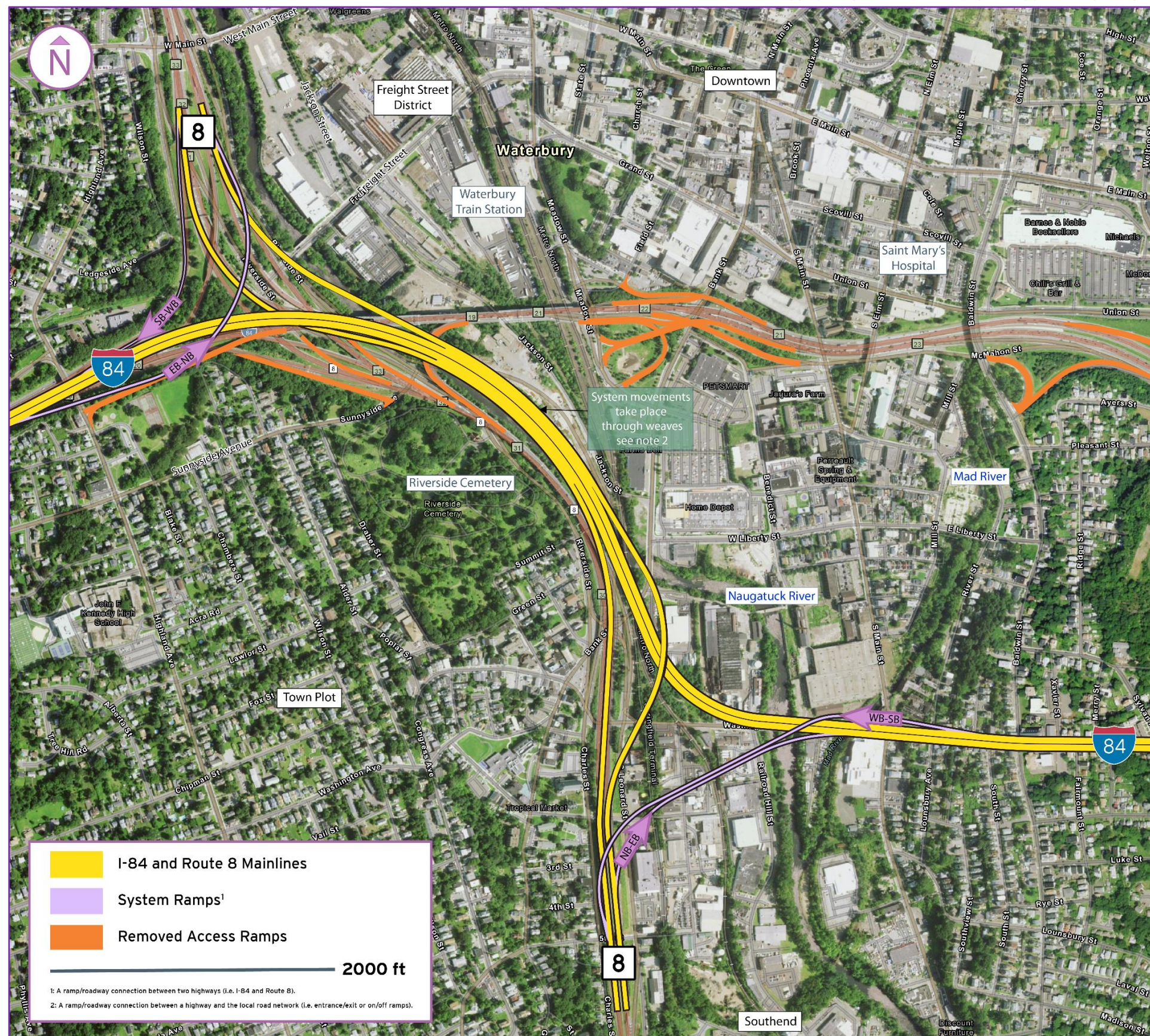


Figure 4-21 Washington Street Bypass

South City Bypass

See Figure 4-22 and Figure 8-22

This conceptual alternative would replace the Mixmaster with a full system interchange that includes relocation of the I-84 alignment into an existing utility corridor about two and a half miles south of the existing interchange. The relocated I-84 alignment would include approximately five miles of newly constructed highway that would bypass the existing I-84 segment between Exits 17 and 25. This conceptual alternative would allow for the elimination of the upper deck of the existing stacked I-84 structures over the Naugatuck River. The bypassed segment of I-84 would remain in service as a bi-directional business loop roadway that uses remaining portions of the existing elevated structures. The business loop would connect to the new I-84 alignment and provide access to the downtown by using the existing service ramps. This alternative would also provide numerous opportunities for off-line construction. New frontage road systems are not proposed in the alternative.

This conceptual alternative would provide all system movements as direct connections. The conceptual interchange layout would avoid left-hand entrances and exits. Additionally, the bypassed segment of I-84 provides access to and from downtown. For this alternative, the Route 8 alignment would stay the same as the existing conditions. The rights-of-way required for this alternative would be extensive.

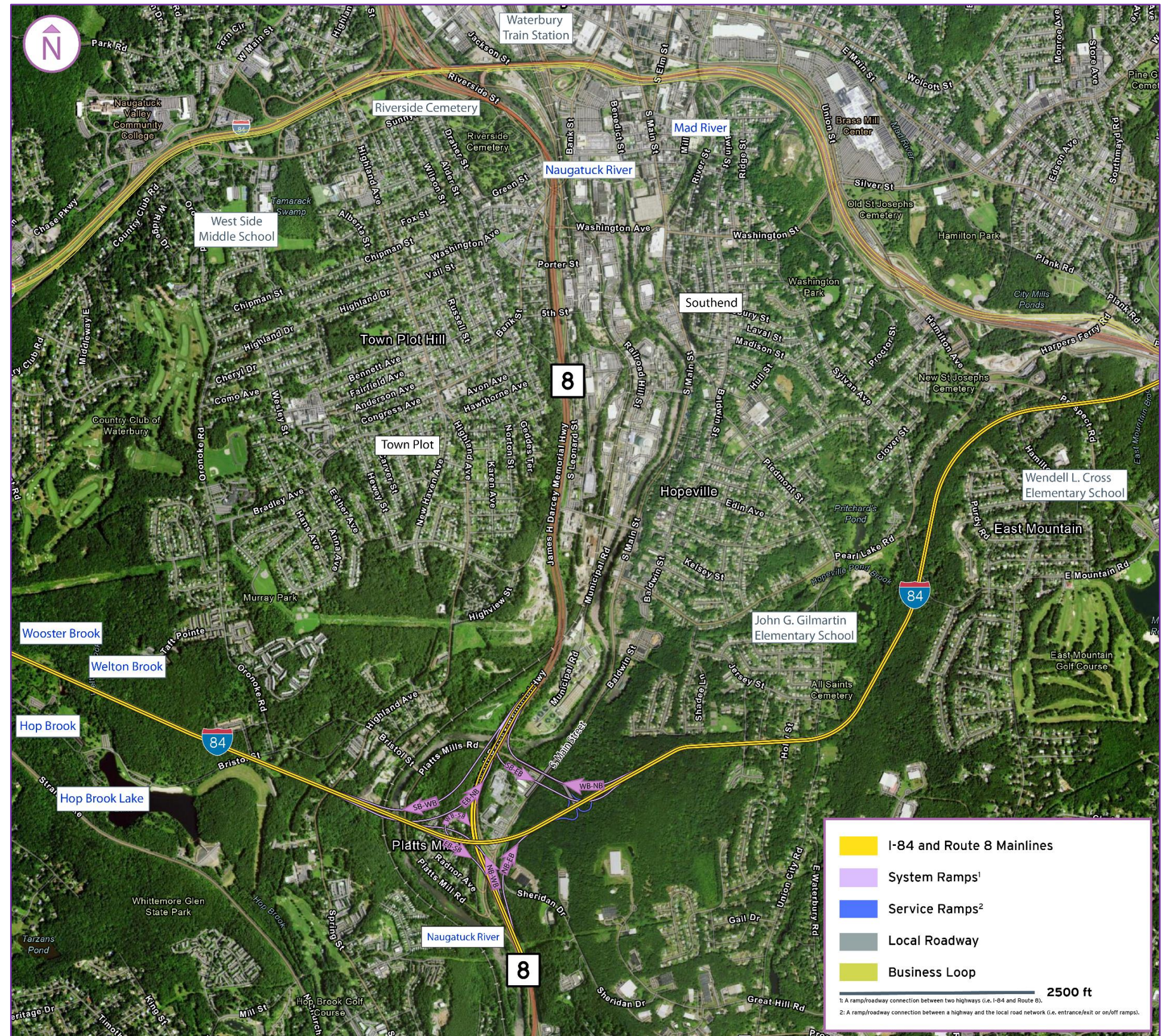


Figure 4-22 South City Bypass

Tunnel

See Figure 4-23 and Figure 8-23

This conceptual alternative would reconstruct the Mixmaster with a full system interchange that would consist of a tunneled (buried below ground) segment for I-84 through-traffic. The tunnel would generally follow the existing I-84 alignment and be approximately 2.25-miles long, extending from approximately 0.5 mile west of the Chase Parkway Overpass to the Baldwin Street Overpass vicinity. Tunneling this segment of the I-84 mainlines could reduce the physical and visual barrier that the existing stacked structure creates.

This alternative would be limited to I-84 mainline through-traffic because of the area's **topographic features**. Below ground, roadway connections between the tunneled portions of I-84 and existing Route 8 or the local road network are infeasible due to the depth that the tunnel must be for constructability. Therefore, above ground roadways (roadways at ground-level or above) would be required to provide system connections and access to downtown. The above ground roadways, also called the “business loop”, would extend from the tunnel entrances / exits to Route 8 and would be located within the existing I-84 footprint. Local road connections between the downtown area and the communities south of the existing I-84 alignment would be improved. While the roadway for the business loop would be smaller in size, the perceived roadway barrier between downtown and surrounding communities would remain. Additional structures and property impacts would also be required near the tunnel entrances/exits where the above ground and below ground roadways would connect. The challenges in regard to developing a feasible tunnel alternative while maintaining/improving connectivity were apparent; therefore, this alternative was developed to a very limited conceptual state. The Study Team determined from their investigation that opportunities for tunneling, or incorporating a depressed highway segment, in the PEL Study Area are extremely limited.

The Study Team has also reviewed areas where depressed (sunken) segments of I-84 could be covered over with a “cap”. This “cap” would allow for land above the capped portion of the mainlines to remain available for potential economic and community development. This capped feature could be incorporated into other alternatives.

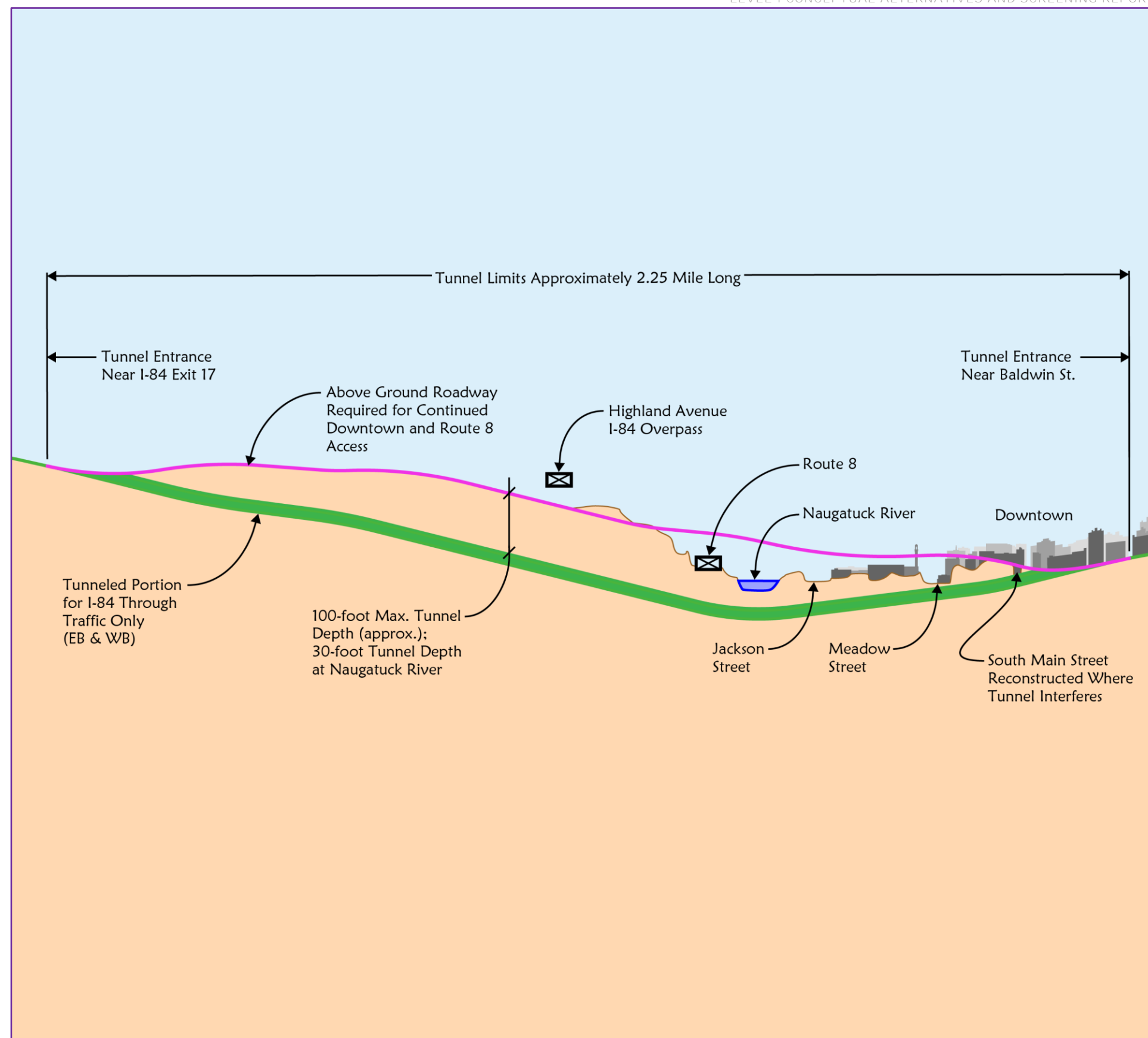


Figure 4-23 Tunnel

4.4 ALTERNATE TRAVEL MODES

Travel Modes

Graphics were not produced for this conceptual alternative.

An initial screening of “travel mode” conceptual alternatives was performed separately (during the development of the *Analysis, Needs and Deficiencies Report*) and prior to the evaluation of other options in the Universe of Alternatives. The alternate travel modes considered included: transit, rail, bicycle, and pedestrian, among others. Within the *Analysis, Needs and Deficiencies Report*, the Study Team determined that no alternative travel mode could serve as a viable standalone solution and meet the needs of the Project as a conceptual alternative. Collectively, the Project Needs include the transportation deficiencies to be addressed, specifically the deficiencies of the highway infrastructure. Inherent in the Project Purpose is to either replace the highways with alternative modes of travel or maintain I-84 and Route 8 as critical system linkages for Connecticut and the northeast. There is no alternative mode of travel that could feasibly replace the movement of people and freight that these two corridors sustain. The Study Team reasonably concluded that any conceptual alternative that was reliant on an alternate mode of travel would be eliminated from further study in Level 1 based on fatal flaw criteria of not satisfying the Project Needs; and on this basis, alternative travel modes were dismissed from further consideration as standalone alternatives.

The Study Team does, however, anticipate that each option in the Range of Reasonable Alternatives will include multimodal aspects. These other travel modes will be complementary measures rather than standalone solutions for the PEL Study Area transportation deficiencies.

5 Level 1 Screening Approach

The purpose of Level 1 screening is to screen the Universe of Alternatives to assess their ability to meet the major highway transportation deficiencies (Project Needs) described within the *Preliminary Purpose and Need Statement* and to meet the practicability evaluation in terms of cost and feasibility. Achieving these two factors indicates that, at this level of screening, a conceptual alternative is not fatally flawed. Specifically, Level 1 is a first-round of screening to determine whether or not a conceptual alternative meets the following:

1. Satisfy the **Project Needs** as contained within the draft Preliminary Purpose and Need in terms of the major highway transportation deficiencies described as **structural**, **geometric**, and **operational** deficiencies; and
2. Meet the following criteria of **practicability** and therefore has no apparent ‘fatal flaws’:
 - a. **Cost:** financial resources can reasonably be made available for the alternative.
 - b. **Feasibility:** the alternative is technically and logistically achievable.

A “pass” rating at Level 1 means that the alternative concept meets the criteria at this conceptual level of design (approximately 5% complete) and this initial screening. A “pass” rating is required in all criteria for an alternative concept to advance to the next level. An alternative that receives a “pass” rating in Level 1 may be eliminated from further study in subsequent evaluations based on advanced study and design. A “fail” rating at Level 1 means that the conceptual alternative clearly does not meet the criteria and therefore will not be advanced for further study.

6 Level 1 Evaluation Criteria

The criteria that each replacement and rehabilitation conceptual alternative was evaluated against is described in detail in the following sections.

6.1 PROJECT NEEDS

Structural (Pass / Fail)

Ability to address the need to improve and / or replace deteriorating bridge structures that have outlived their original intended 50-year service lives.

Geometric (Pass / Fail)

Ability to address and correct geometric deficiencies that do not meet current design standards for the mainlines of I-84 and Route 8, system ramps, and service ramps. System ramps connect one highway to another. Service ramps connect the local roadway network and a highway.

Operational (Pass / Fail)

Ability to provide system ramp connections directly between I-84 and Route 8 for high-volume movements and indirectly for lower volume movements. Additionally, the alternative must demonstrate the ability to provide adequate capacity based on current traffic and future traffic forecasts on the mainlines, system ramps and service ramps.

6.2 PRACTICABILITY

Cost (Pass / Fail)

Order of magnitude construction cost – Ability to be make financial resources available for the alternative. This will include capital construction costs and a contingency factor to account for engineering and mitigation. Right-of-way costs will not be included at Level 1.

Feasibility (Pass / Fail)

Assessment of ability to implement the concept using proven technology, engineering, construction techniques, and general constructability which will allow mainlines and system ramps to continue to operate during construction.

7 Level 1 Screening Results

This section presents the results from the Level 1 screening process and provides the rationale as to why conceptual alternatives were either eliminated or advanced for further study in Level 2.

Figure 7-1 depicts the Level 1 screening results as a matrix which documents the conceptual alternative ratings for each Level 1 criteria and the overall pass / fail rating.



Conceptual Alternative Name	Level 1 Overall Pass / Fail	Structural Criteria Addresses the need to improve and/or replace deteriorating bridge structures that have outlived their original intended 50-year service lives.	Geometric Criteria Demonstrates ability to address and correct geometric deficiencies that do not meet current design standards.	Operational Criteria Provides connections between I-84, Route 8, and the City of Waterbury and provides adequate capacity based on current traffic and future traffic forecasts on mainlines and system and service interchanges.	Practicability - Cost The cost of the alternative demonstrates viability, and can the financial resources reasonably be made available.	Practicability - Feasibility Demonstrates ability to be implemented using proven technology, engineering, construction techniques, and general constructability - allowing mainlines and system ramps to continue to operate.
No-Build Alternative	Fail*	Fail	Fail	Fail	Pass	Fail
I-84/Route 8 True Rehabilitation	Fail	Pass	Fail	Fail	Pass	Fail
I-84 WB Bridge Rehabilitation with Construction of New I-84 EB Mainline	Fail	Pass	Fail	Fail	Pass	Pass
I-84 Bridge Rehabilitation with Bypass Repurposed as Frontage Road	Fail	Pass	Fail	Fail	Pass	Pass
I-84 Bridge Rehabilitation with Widening to Facilitate Staging	Fail	Pass	Fail	Fail	Pass	Pass
I-84 Reconstruction In-Place	Fail	Pass	Pass	Pass	Pass	Fail
Interchange Shifted East	Pass	Pass	Pass	Pass	Pass	Pass
Interchange Shifted East with Inner Loop Ramp	Fail	Pass	Fail	Fail	Pass	Pass
Combined System Connections	Pass	Pass	Pass	Pass	Pass	Pass
Modern Crossover Interchange	Pass	Pass	Pass	Pass	Pass	Pass
Modern Crossover Interchange with Route 8 Split to the South	Pass	Pass	Pass	Pass	Pass	Pass
Keeping Route 8 Stacked	Pass	Pass	Pass	Pass	Pass	Pass
Naugatuck River Shift	Pass	Pass	Pass	Pass	Pass	Pass
Stacked I-84	Fail	Pass	Pass	Fail	Pass	Pass
Partial System Crossover Interchange	Fail	Pass	Pass	Fail	Pass	Fail
Partial System Interchange with Freight Street Interchange	Pass	Pass	Pass	Pass	Pass	Pass
Modified Diverging Diamond	Fail	Pass	Fail	Fail	Pass	Pass
Half Diverging Diamond	Pass	Pass	Pass	Pass	Pass	Pass
At Grade System Connections	Fail	Pass	Fail	Pass	Pass	Fail
Route 8 Boulevard	Fail	Pass	Pass	Fail	Pass	Fail
Washington Street Bypass	Fail	Pass	Fail	Fail	Pass	Fail
South City Bypass	Pass	Pass	Pass	Pass	Pass	Pass
Tunnel	Fail	Pass	Pass	Pass	Fail	Pass
Travel Modes	Fail	Fail	Fail	Fail	N/A	Fail

*The No-Build Alternative does not meet Preliminary Purpose and Need and is impractical, however, it was retained as a comparison that other alternatives will be evaluated against during Level 2 and 3 of the PEL Study screening process. Advancement of a No-Build Alternative for this purpose is a requirement for PEL and NEPA analyses.

Figure 7-1 Level 1 Screening Matrix

7.1 CONCEPTUAL ALTERNATIVES ELIMINATED

The following section describes the conceptual alternatives eliminated from further study as a result of this Level 1 screening. These alternatives were eliminated because they contain at least one fatal flaw of either not generally **supporting the Project's Needs** or being deemed impractical in terms of the practicability criteria (cost and feasibility).

The conceptual alternatives that were eliminated as well as the rationale for their elimination are provided in the following list:

- I-84 and Route 8 True Rehabilitation: This conceptual alternative does not address the **Project's Needs** and was eliminated during the Level 1 screening. This alternative is unable to meet current design standards such as CTDOT and the American Association of State Highway and Transportation Officials (AASHTO) standards. The geometric and operational deficiencies of the existing interchange would not be improved through the rehabilitation. This was considered to be a failure of the “Geometric” and “Operational” criteria. The “Practicability – Feasibility” criterion for rehabilitating the I-84 structures also received a “Fail” rating. While the stacked Route 8 Structures could continue to be rehabilitated without significant traffic disruptions due to construction, the same could not be stated for the I-84 mainlines and considered to be a fatal flaw. Major traffic disruptions would be necessary in order to rehabilitate the stacked I-84 mainline structures while maintaining traffic and access.
- I-84 Westbound Bridge Rehabilitation with Construction of New I-84 Eastbound: This conceptual alternative does not address the **Project's Needs** and was eliminated by failing the “Geometric” and “Operational” criteria. The geometric conditions of the existing interchange would not be improved or corrected through the rehabilitation and would therefore be unable to meet current CTDOT and AASHTO design standards. Additionally, analyses have shown that the existing interchange configuration would result in unacceptable levels of service in the future – a rehabilitation would not address or minimize these future deficiencies, and are considered to be a failure of the “Operational” screening criterion.
- I-84 Bridge Rehabilitation with Bypass Repurposed as Frontage Road: This conceptual alternative does not address the **Project's Needs** and was eliminated by failing “Geometric” and “Operational” criteria. The geometric conditions of the existing interchange would not be improved

through the rehabilitation; therefore, the geometric deficiencies remain unaddressed and would be unable to meet current CTDOT and AASHTO design standards. Also, analyses have shown that the existing interchange configuration would result in unacceptable levels of service in the future – a rehabilitation would not be able to address these future deficiencies, and therefore considered to be a failure of the “Operational” screening criterion.

- I-84 Bridge Rehabilitation with Widening to Facilitate Staging: This conceptual alternative does not address the **Project's Needs** and was eliminated during the Level 1 screening. The geometrics of the existing interchange would not be improved through the rehabilitation and therefore is unable to meet current CTDOT and AASHTO design standards. This was considered to be a failure of the “Geometric” criterion. Also, analyses have shown that the existing interchange configuration would result in unacceptable levels of service in the future; a rehabilitation would not address these future deficiencies, and this was considered to be a failure of the “Operational” screening criterion.
- I-84 Reconstruction In-Place: This conceptual alternative does not address the **Project's Needs** as it received a “Fail” in the “Practicability - Feasibility” criterion and was therefore eliminated during the Level 1 screening. The reconstruction of I-84 in-place was deemed infeasible and eliminated because of the major constructability issues associated with maintaining traffic during reconstruction of I-84. This was considered to be a failure of the “Feasibility” screening criterion as alternatives must minimize construction impacts to the city and traveling public while maintaining traffic flow during construction. The foreseen construction impacts were evaluated and considered to be a fatal flaw.
- Interchange Shifted East with Inner Loop Ramp: This alternative does not address the **Project's Needs** as it received a “Fail” for “Geometric” and “Operational” screening criteria and was therefore eliminated during the Level 1 screening. The geometry of the inner loop ramp fails current design standards such as CTDOT and AASHTO standards. Additionally, at this level of design, it can be stated that the conceptual layout of the loop ramp would not perform adequately with future increased traffic volumes likely to worsen congestion along I-84 which was considered to be a failure of the “Operational” screening criterion.
- Stacked I-84: This conceptual alternative was eliminated during the Level 1 screening because it does not demonstrate the ability to meet the **Project's Needs** and is fatally flawed. Stacked I-84 failed to meet the “Operational” criterion because it would require the use of poor

functioning left-hand system ramps to provide connections between I-84 and Route 8. These left-hand ramps result in operational deficiencies that would adversely affect traffic operations. In order to be constructed, the left-hand system movements would need to be shifted in a way that would decrease the interchange spacing. The reduced distance between the ramps would result in operational deficiencies and substandard weave distances. The use of right-hand ramps at these locations was investigated; however, the flyover ramps that would be needed to make the connections would need to be moved away from the core of the interchange to meet AASHTO and CTDOT design standards. This would decrease the interchange spacing and would result in operational deficiencies and substandard weave distances. The site's topographic constraints and the barrier presented by the stacked I-84 structure restrict increased spacing between the interchanges.

- Partial System Crossover Interchange: This conceptual alternative does not demonstrate the ability to meet the **Project's Needs** and also contains a fatal flaw and therefore was eliminated during the Level 1 screening. The Partial System Crossover Interchange would require indirect connections outside of the highway environment, requiring use of the frontage road system, causing an increase of traffic on the local road system at levels it cannot currently handle. With vehicular travel anticipated to increase, this conceptual alternative does not demonstrate the ability to provide adequate capacity based on current and future traffic forecasts. Therefore, this alternative receives a “Fail” for the “Operational” screening criterion. Additionally, due to the topographic constraints the system movement Route 8 NB to I-84 WB would be unable to meet current CTDOT and AASHTO design standards. This conceptual alternative would also have significant constructability issues associated with the I-84 construction to the north of its existing alignment. These issues were considered to be a failure of the “Practicability - Feasibility” screening criterion.
- Modified Diverging Diamond: This conceptual alternative does not demonstrate the ability to satisfy the **Project's Needs** and was therefore eliminated during the Level 1 screening. The Modified Diverging Diamond conceptual alternative received a “Fail” for the “Geometric” and “Operational” criteria. This is a result of the heavy traffic volume on two of the system movements that would utilize the DDI. These system movements would not function adequately due to poor geometry and high traffic volumes, rendering it unable to provide adequate capacity based on current traffic and future traffic forecasts and the inability to correct geometric deficiencies not meeting current CTDOT and



AASHTO design standards. Additionally, due to the topographic constraints the system movement Route 8 NB to I-84 WB would be unable to meet current CTDOT and AASHTO design standards.

- At Grade System Connections: This conceptual alternative does not address the Project Needs and was eliminated during the Level 1 screening due to engineering challenges associated with two indirect system movement connections. The alternative received a Fail for the “Geometric” Criterion as it would be unable to meet current CTDOT and AASHTO design standards. In order to make the required system connections for the mainline of I-84 and Route 8, a significant deviation from design guidelines would be required. The alternative was also failed the “Practicability – Feasibility” screening criterion for similar reasons as the alternative it is not technologically and logistically achievable as a result of the existing topography through the city of Waterbury and the close proximity of the I-84 Eastbound system ramp to the existing railroad line. These constraints result in construction challenges that would be infeasible to overcome for this alternative.
- Route 8 Boulevard: This conceptual alternative does not demonstrate the ability to address the Project’s Needs and also contains a fatal flaw. Therefore, it was eliminated during the Level 1 screening. It received a “Fail” for the “Operational,” and “Practicability – Feasibility” criteria. A boulevard requires at-grade signalized intersections that would severely impact the traffic operations, reducing the levels of service for the traveling public. This conceptual alternative would markedly reduce travel speed and increase travel time and interruptions, becoming an unacceptable source of congestion for through-traffic and system movements. Additionally, creating an at-grade roadway for a portion of Route 8 is also infeasible when examining general constructability options, engineering, and construction techniques. Construction for an at-grade Route 8 boulevard would require significant disruption to Route 8 traffic.
- Washington Street Bypass: This conceptual alternative does not demonstrate the ability to meet the Project’s Needs and also contains a fatal flaw. It received a “Fail” for the “Geometric,” “Operational,” and “Practicability – Feasibility” criteria and was therefore eliminated as a result of the Level 1 analysis. While this alternative provides all system movements as direct connections, by relocating the Mixmaster interchange south of its existing alignment there are significant challenges that were considered to be infeasible to overcome in order to implement this alternative. There are highway geometric constraints within the limits of the alternative, particularly at the existing Metro-

North Waterbury Branch Railroad crossing of Washington Avenue. In order to complete this connection, over a very short distance, the highway would need to be significantly elevated to cross the railroad then immediately and sharply decline to meet with the Route 8 roadway. These geometric challenges would not meet current CTDOT and AASHTO design standards triggering significant negative impacts within the project area to the traveling public and city of Waterbury. Additionally, in order to implement this alternative, the weave distances of the five-lane highway do not meet the operational criterion for adequate level of service. This alternative received a “Fail” for the “Practicability – Feasibility” screening criterion due to the significant construction challenges at locations of steep vertical variances and the existing infrastructure.

- Tunnel: This conceptual alternative was eliminated because it failed the “Practicability – Cost” evaluation criterion of the Level 1 analysis. The projected construction and maintenance costs were considered unreasonable and impractical due to the length of tunnel needed to construct a functioning interchange costing a minimum of \$10 billion, more than two times higher than the next most expensive alternative. Due to the exorbitant projected cost, this alternative was eliminated.
- Travel Modes: This group of conceptual alternatives does not address the Project’s Needs and was therefore eliminated. During this Level 1 screening, the alternatives failed the “Structural,” “Geometric,” and “Operational” screening criteria; structural deficiencies of existing bridges were found to remain unaddressed, substandard roadway geometrics would not be improved, and the highway would not have the increased capacity needed to accommodate future traffic volumes. These conceptual alternatives were also considered to be impractical through failure of the “Feasibility” screening criterion because no alternative mode of travel could feasibly replace the movement of people and freight that the I-84 and Route 8 corridors currently carry and is projected to sustain. The Study Team does, however, anticipate that each option in the Range of Reasonable Alternatives will include multimodal aspects as complementary measures.

7.2 CONCEPTUAL ALTERNATIVES ADVANCED

Nine conceptual alternatives and the No-Build Alternative were retained for further study as a result of the Level 1 screening. Apart from the No-Build Alternative, these alternatives were retained because they were practical, in

terms of cost and feasibility, and generally supported the Project’s Needs. They will be advanced to Level 2 of the PEL Study Alternatives Screening Methodology process for further development and evaluation:

- No-Build Alternative: The No-Build Alternative was retained as a comparison that other alternatives will be evaluated against during Level 2 of the PEL Study screening process. Advancement of a No-Build Alternative for this purpose is a requirement for PEL and NEPA analyses.
- Modern Crossover Interchange with Route 8 Split to the South: This conceptual alternative minimizes right-of-way impacts. Despite impacts to both banks of the Naugatuck River, this alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project’s Needs and Practicability Criteria at this level of screening.
- Interchange Shifted East: This conceptual alternative is a full system interchange that provides access to downtown Waterbury and is constructible with both mainlines built offline. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project’s Needs and Practicability Criteria at this level of screening.
- Combined System Connections: This conceptual alternative provides access to downtown Waterbury and provides all system movements as direct connections. Note, this conceptual alternative provided no added benefits when compared with Interchange Shifted East. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project’s Needs and Practicability criteria at this level of screening.
- Half Diverging Diamond: This conceptual alternative appears to have reduced right of way impacts and is perceived to have reduced costs relative to other alternatives. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project’s Needs and Practicability Criteria at this level of screening.
- Partial System Interchange with Freight Street Interchange: This conceptual alternative appears to have reduced right of way impacts and is perceived to have reduced costs relative to other alternatives. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project’s Needs and Practicability Criteria at this level of screening.



- Modern Crossover Interchange: This conceptual alternative appears to be the most technically feasible replacement alternative that would provide a full system interchange. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project's Needs and Practicability Criteria at this level of screening.
- South City Bypass: This conceptual alternative is a full system interchange with the relocation of the mainlines of I-84. This alternative appears to provide CTDOT with the most flexibility for off-line construction and all system movements as direct connections while maintaining traffic during construction. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project's Needs and Practicability Criteria at this level of screening.
- Keeping Route 8 Stacked: This conceptual alternative is a full system interchange that appears to provide the CTDOT with the most funding flexibility among replacement alternatives. The long duration of phasing in this replacement alternative would increase the feasibility for funding its construction. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project's Needs and Practicability Criteria at this level of screening.
- Naugatuck River Shift: This conceptual alternative appears to be a feasible replacement alternative that would provide a full system interchange. This alternative will be advanced for further study in the Level 2 analyses as no fatal flaws were identified with regard to satisfying the Project's Needs and Practicability Criteria at this level of screening.

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FIGURE 8-1 EXISTING CONDITIONS / NO-BUILD



FIGURE 8-2 I-84 AND ROUTE 8 TRUE REHABILITATION



FIGURE 8-3 I-84 WB BRIDGE REHABILITATION WITH CONSTRUCTION OF NEW I-84 EB MAINLINE

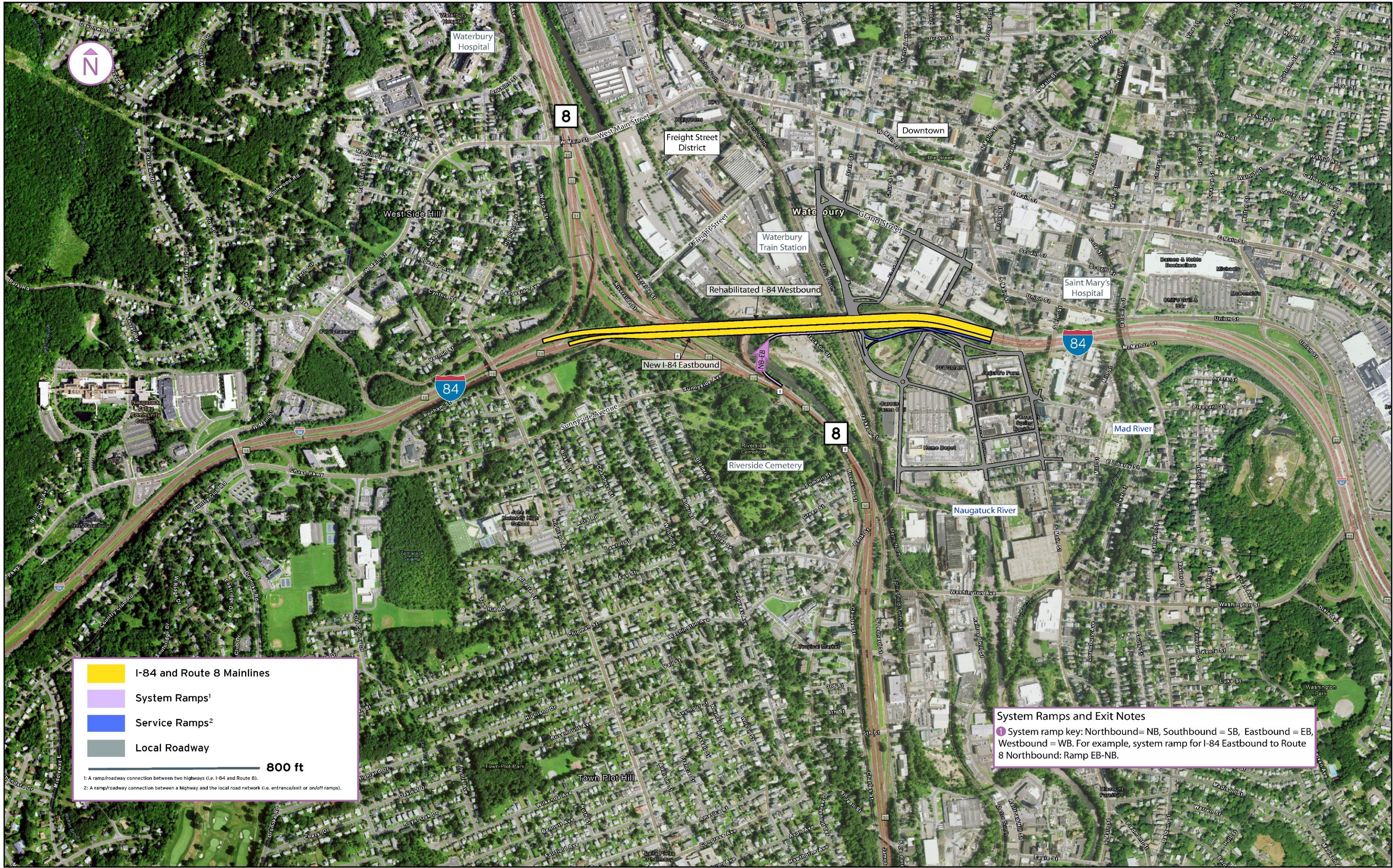


FIGURE 8-4 I-84 BRIDGE REHABILITATION WITH BYPASS REPURPOSED AS FRONTAGE ROAD

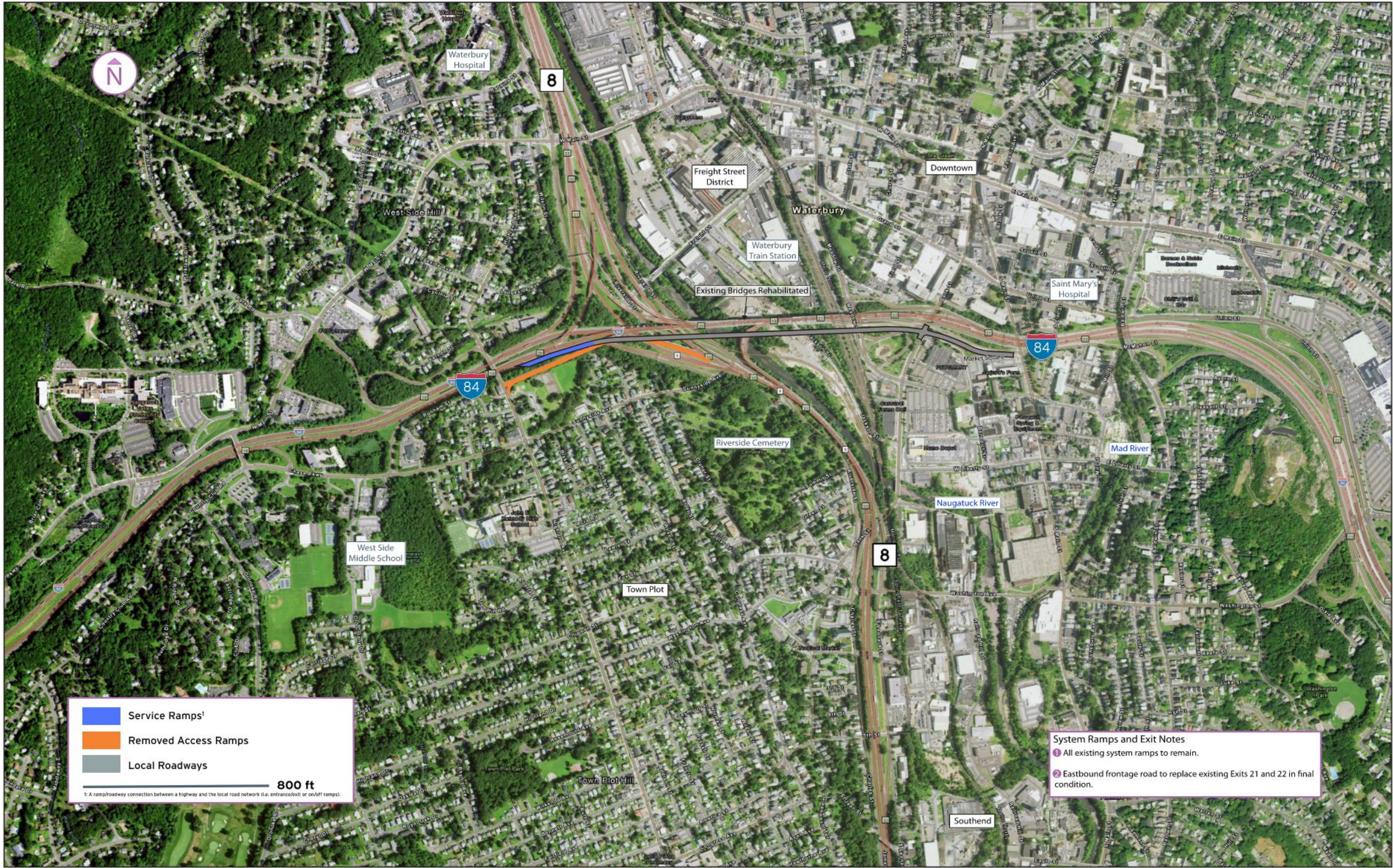


FIGURE 8-5 I-84 BRIDGE REHABILITATION WITH WIDENING TO FACILITATE STAGING

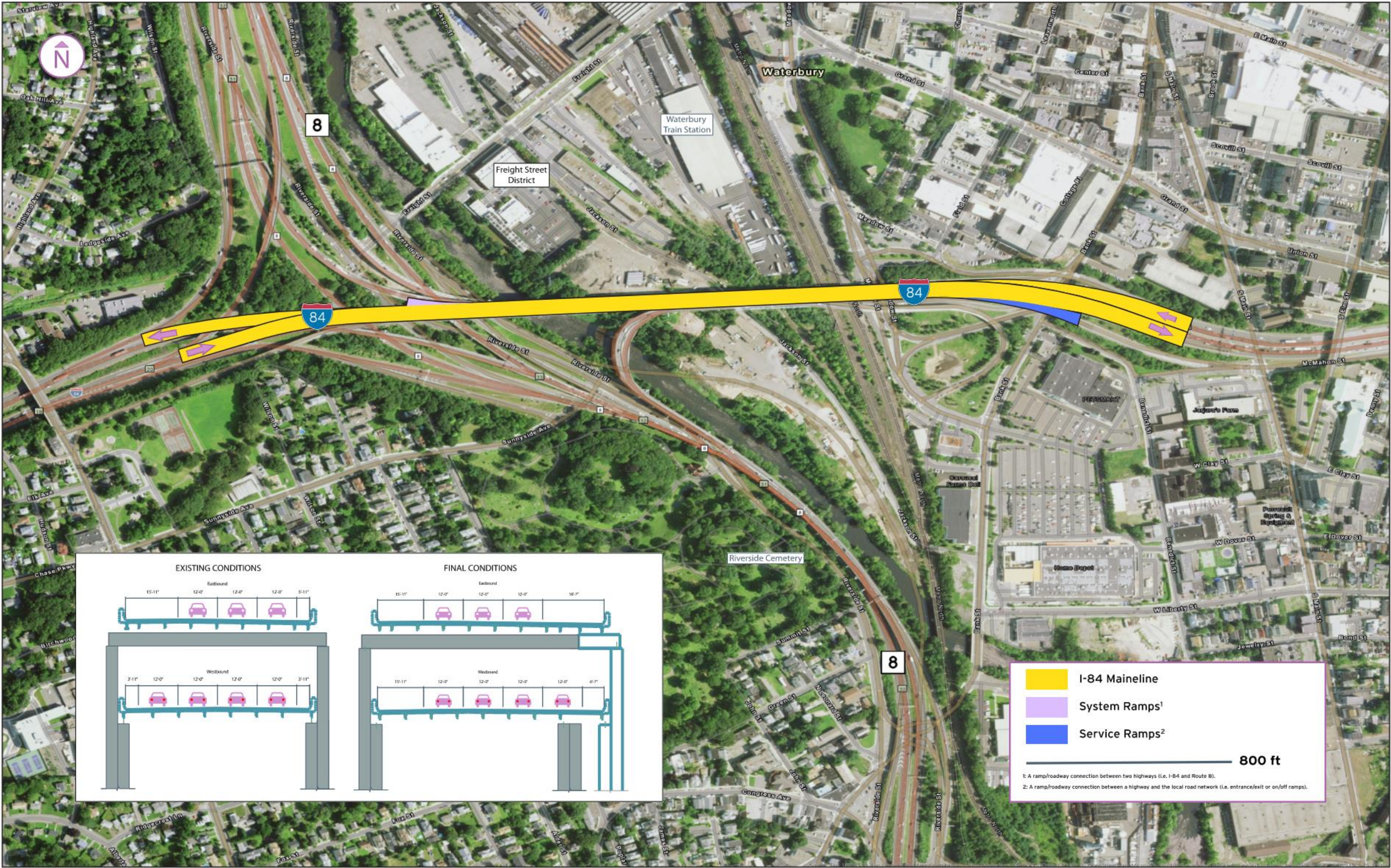


FIGURE 8-6 I-84 RECONSTRUCTION IN PLACE

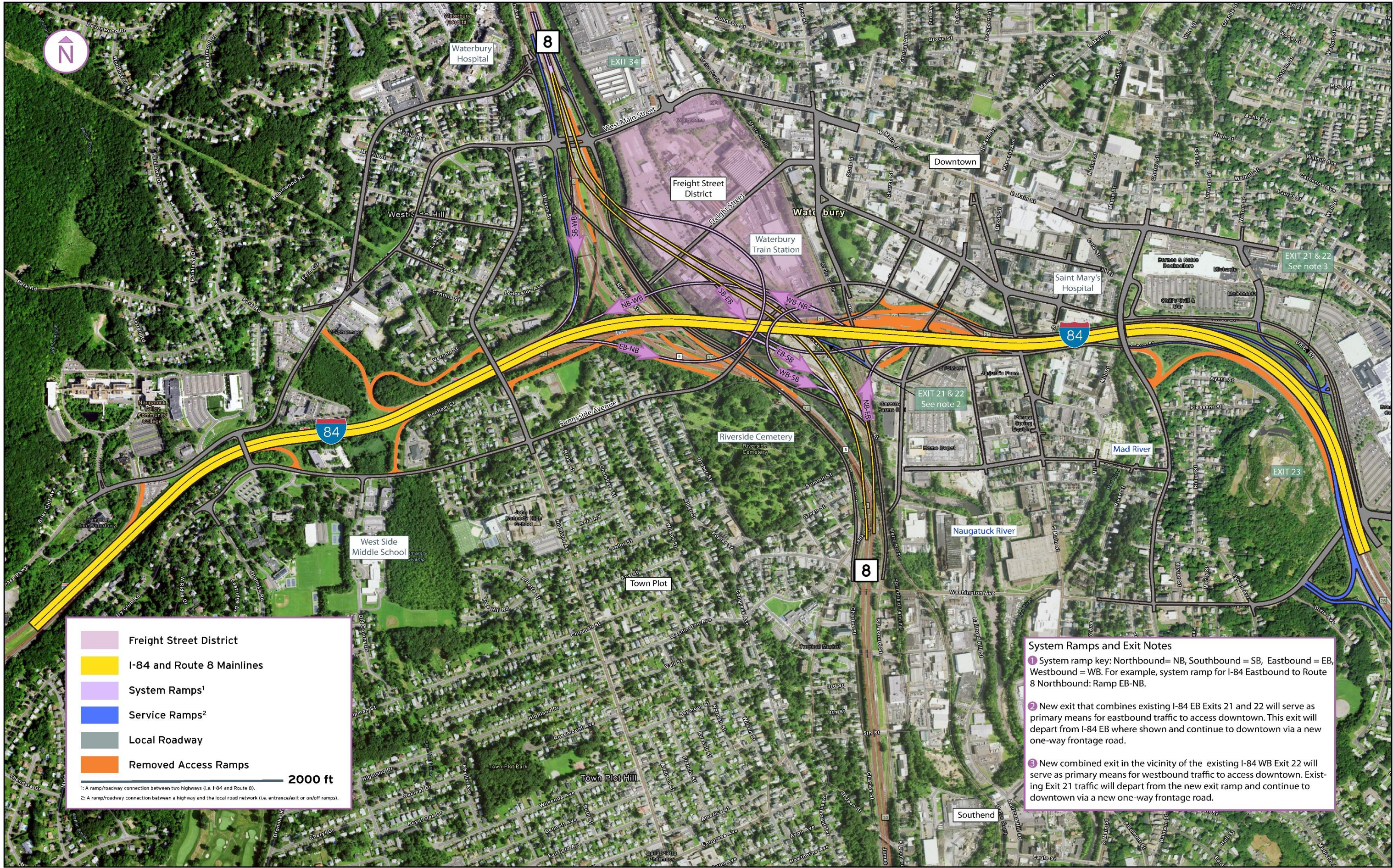


FIGURE 8-7 INTERCHANGE SHIFTED EAST

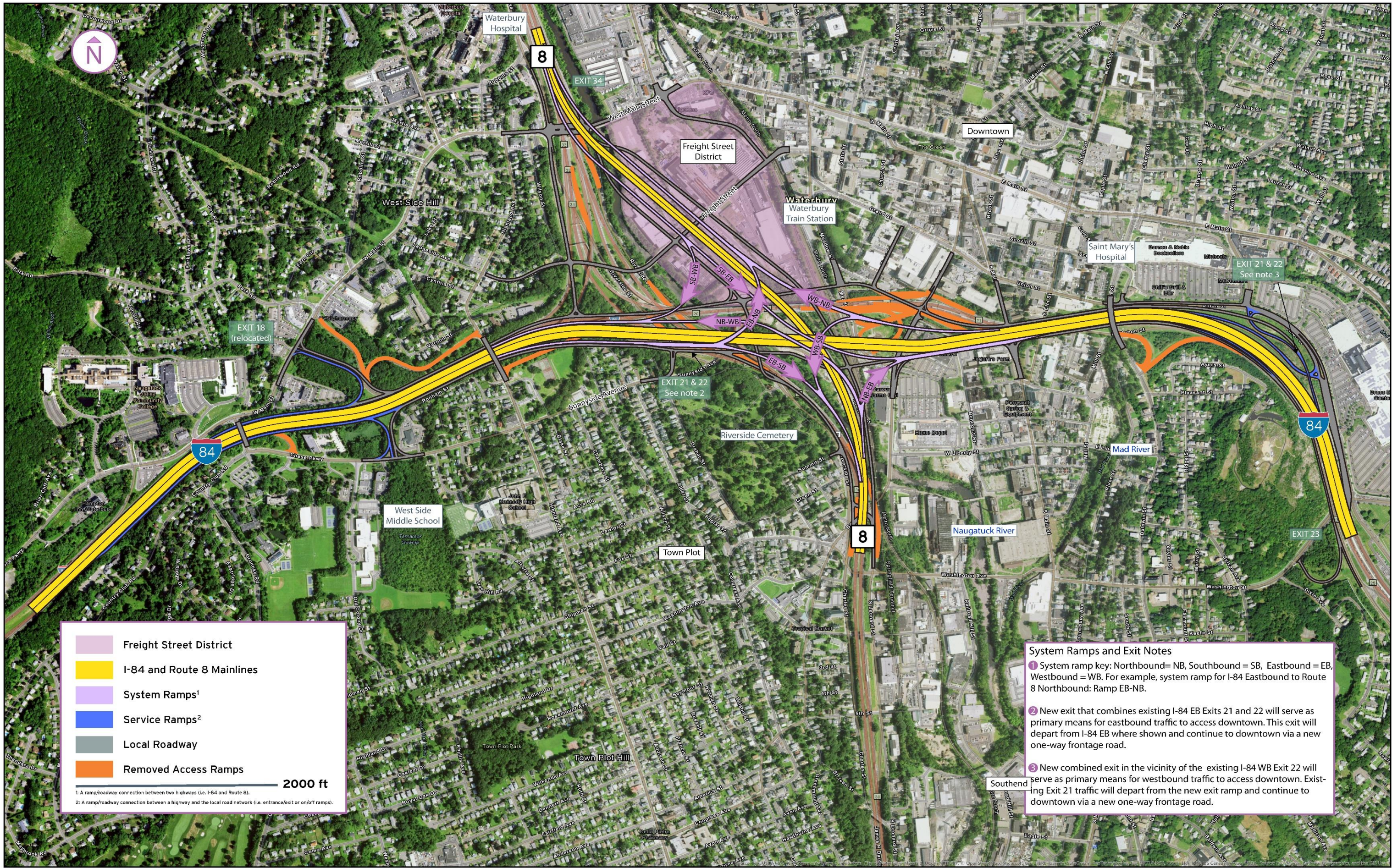


FIGURE 8-8 INTERCHANGE SHIFTED EAST WITH INNER LOOP RAMP



FIGURE 8-9 COMBINED SYSTEM CONNECTIONS

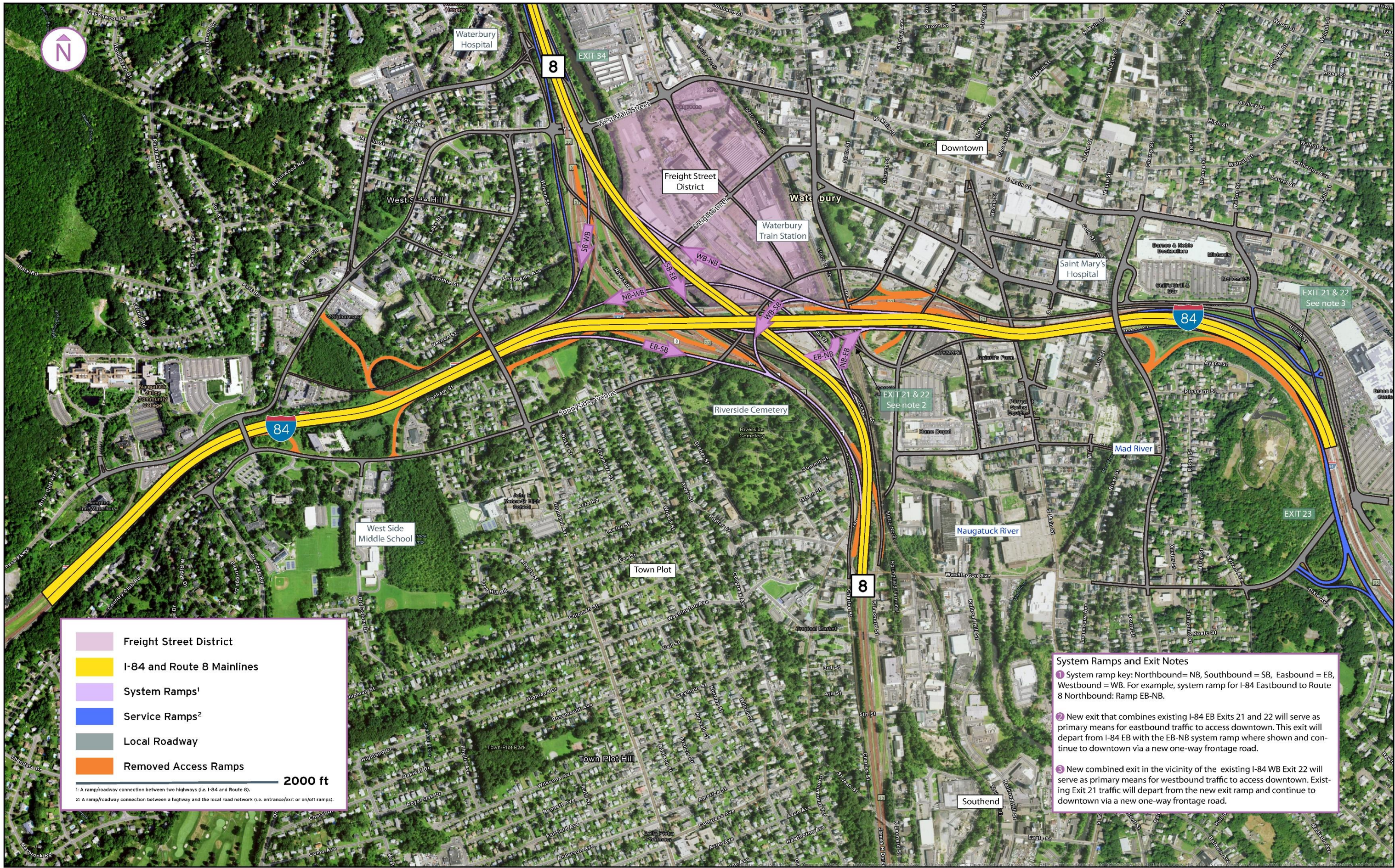


FIGURE 8-10 MODERN CROSSOVER INTERCHANGE

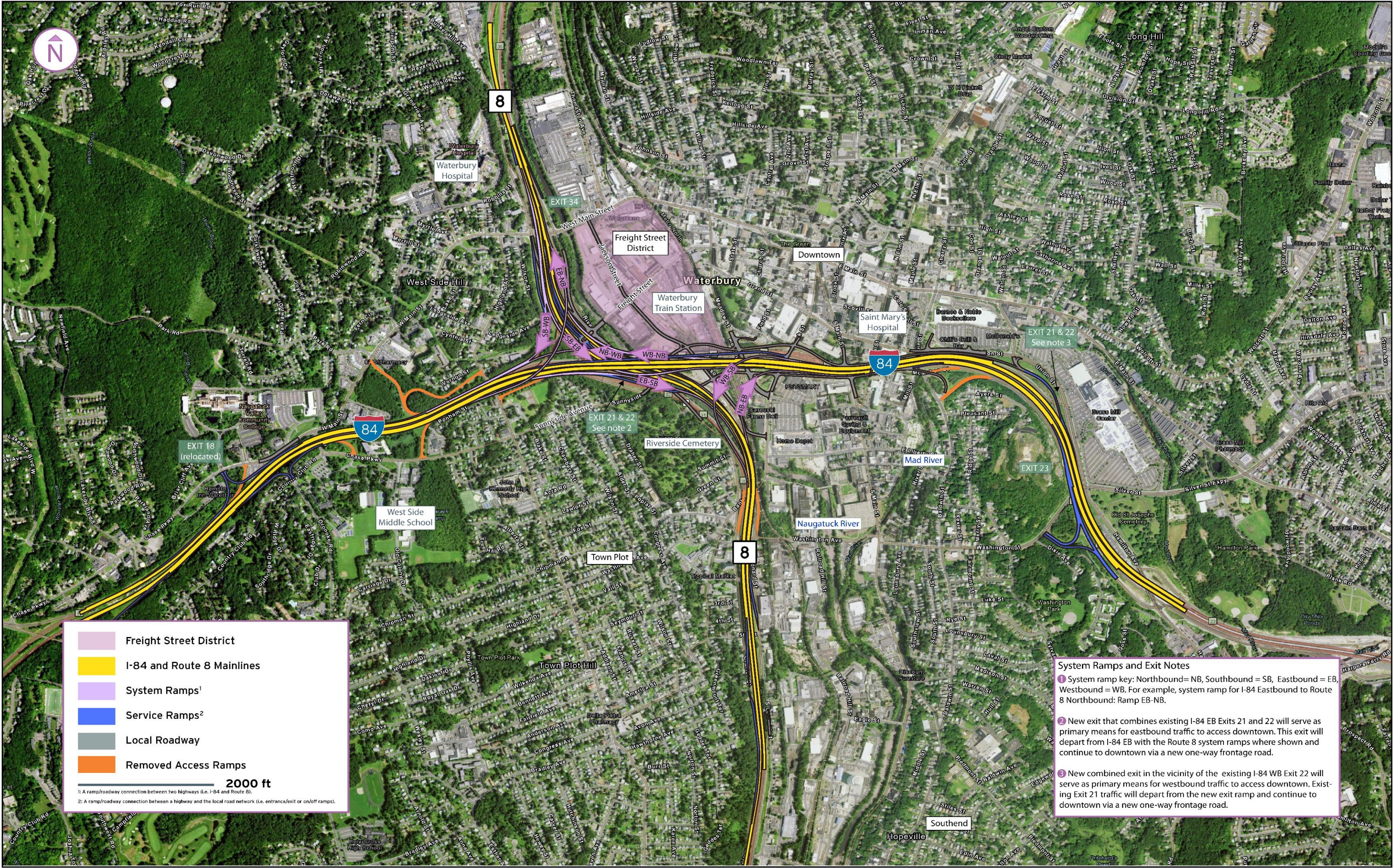


FIGURE 8-11 MODERN CROSSOVER INTERCHANGE WITH ROUTE 8 SPLIT TO THE SOUTH

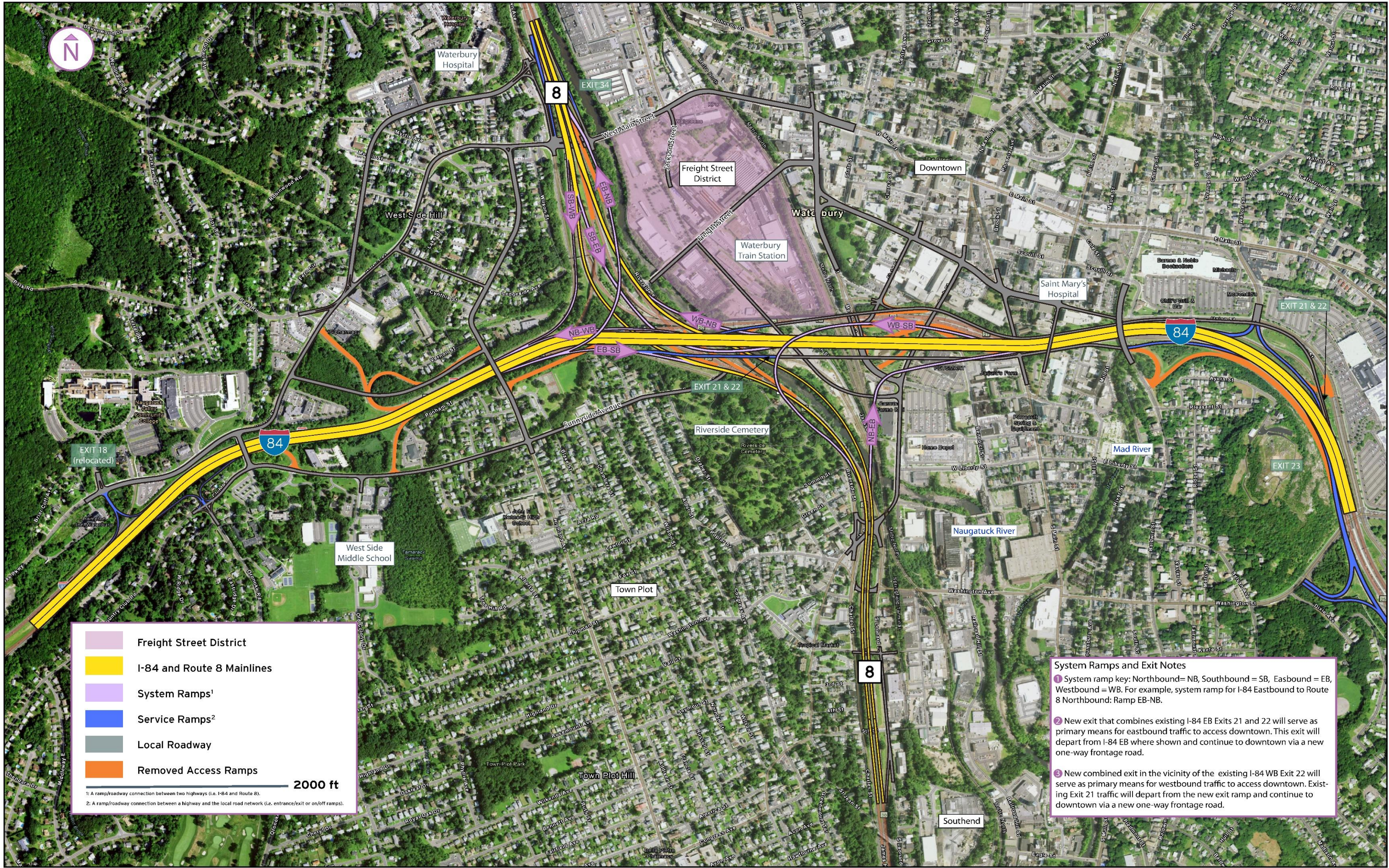


FIGURE 8-12 KEEPING ROUTE 8 STACKED

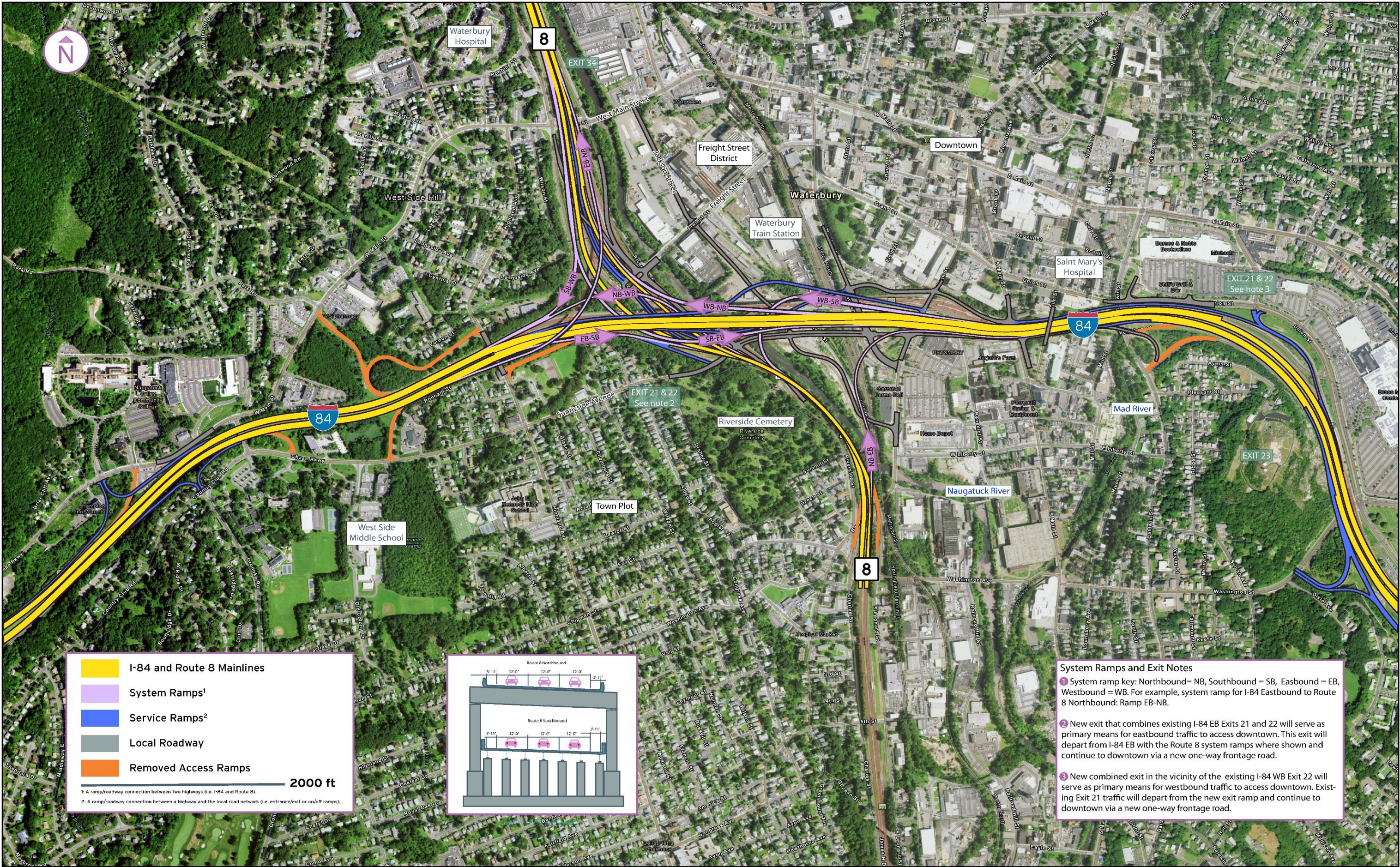


FIGURE 8-13 NAUGATUCK RIVER SHIFT

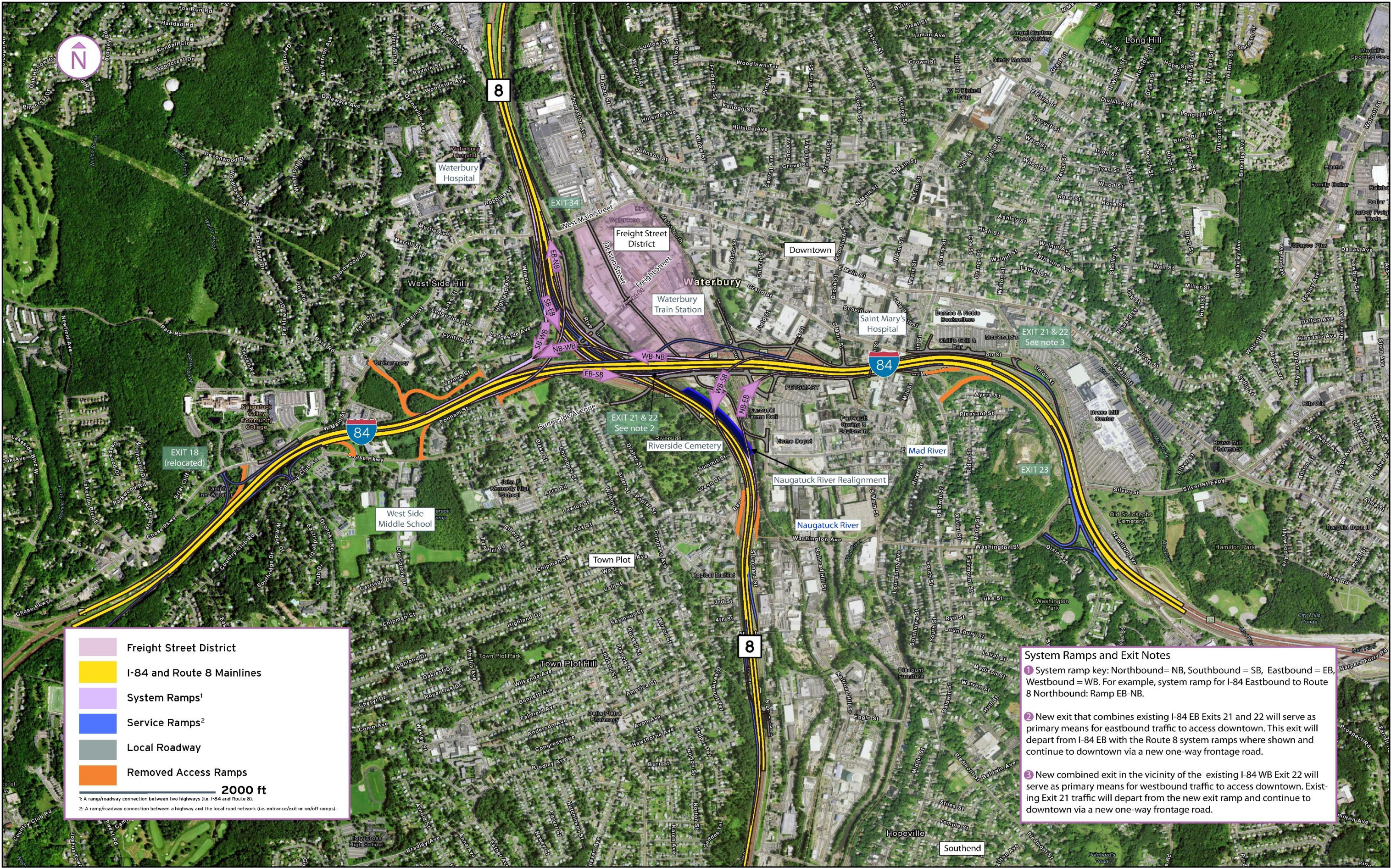


FIGURE 8-14 STACKED I-84

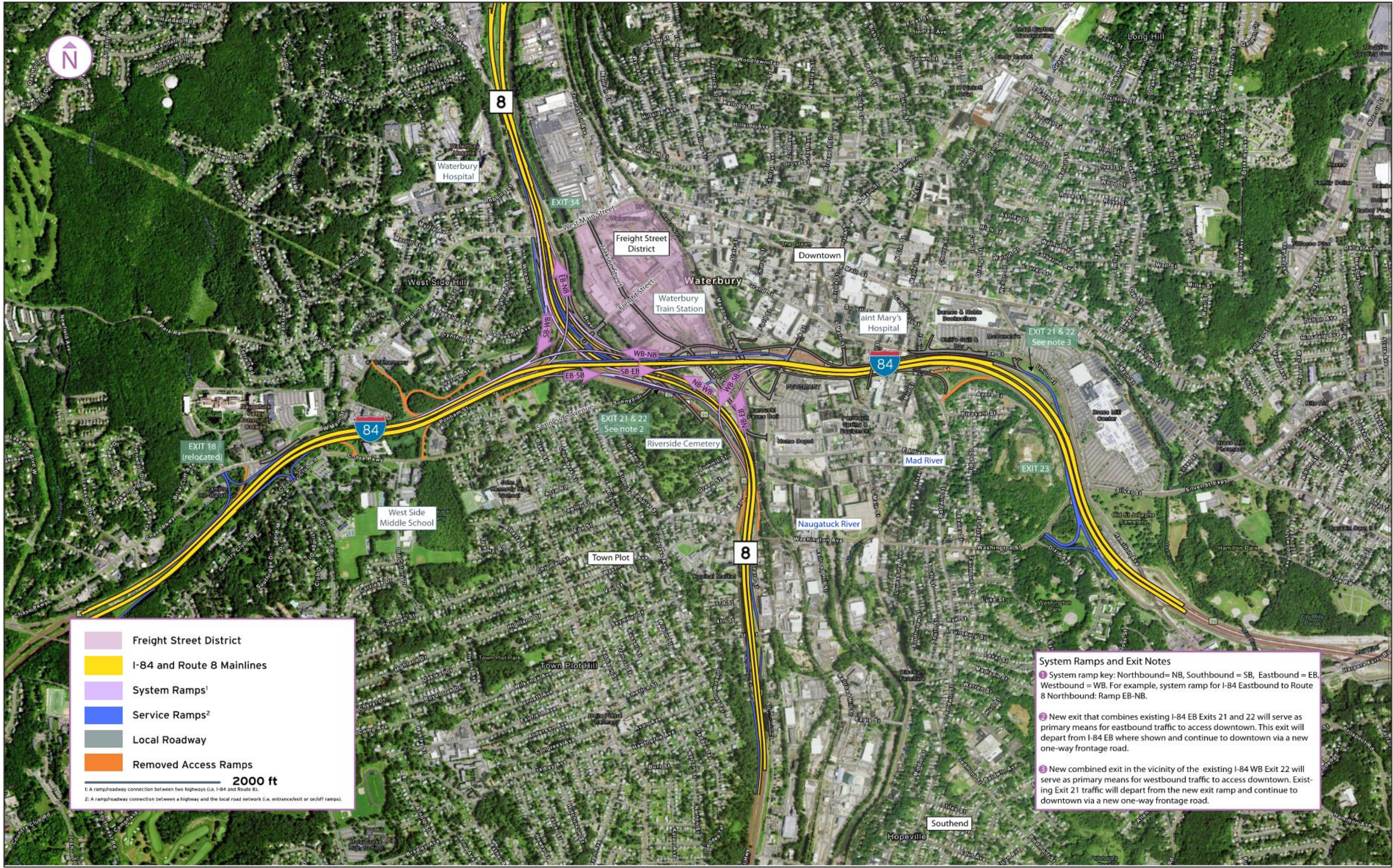


FIGURE 8-15 PARTIAL SYSTEM CROSSOVER INTERCHANGE



FIGURE 8-16 PARTIAL SYSTEM INTERCHANGE WITH FREIGHT STREET INTERCHANGE

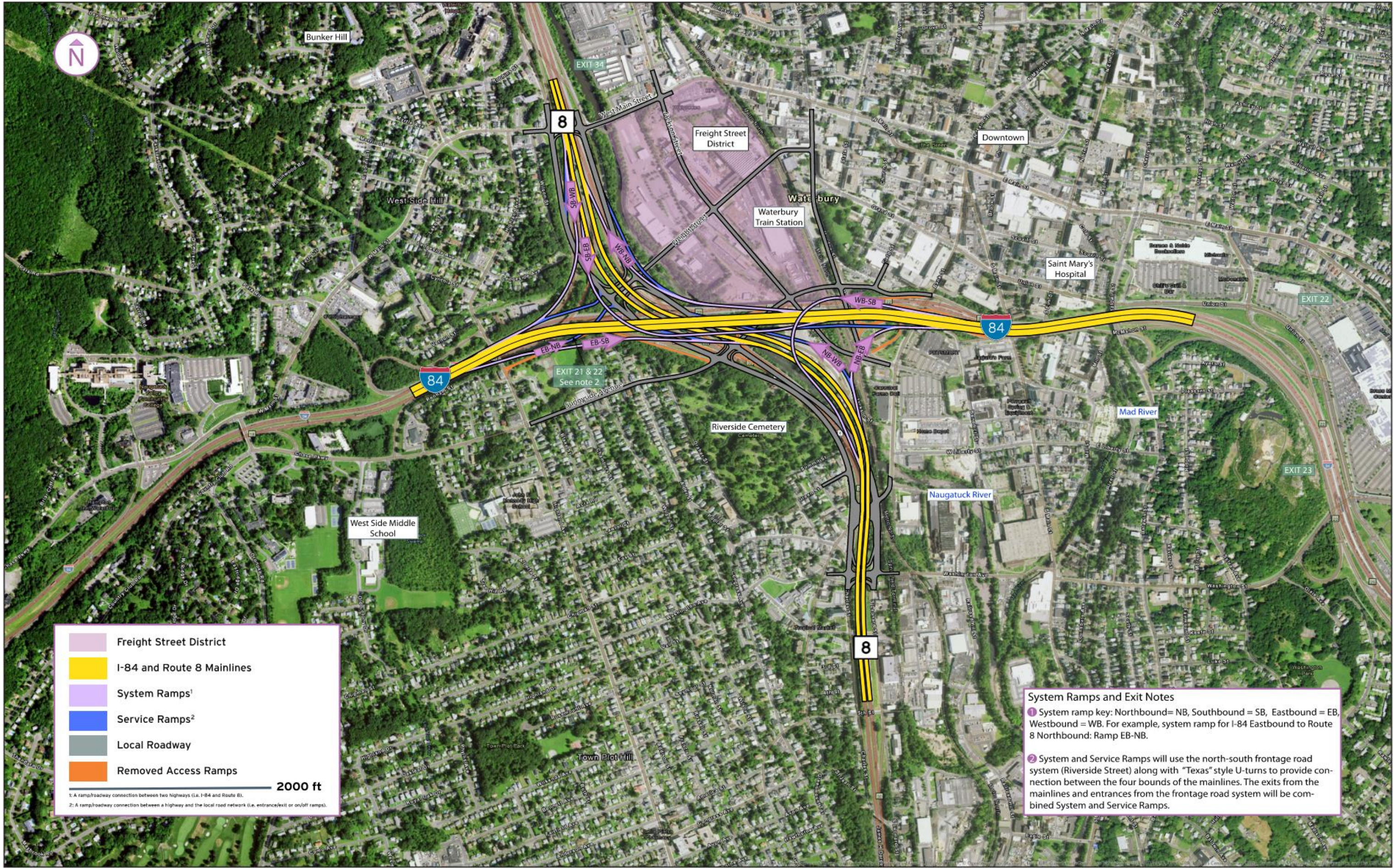


FIGURE 8-17 MODIFIED DIVERGING DIAMOND

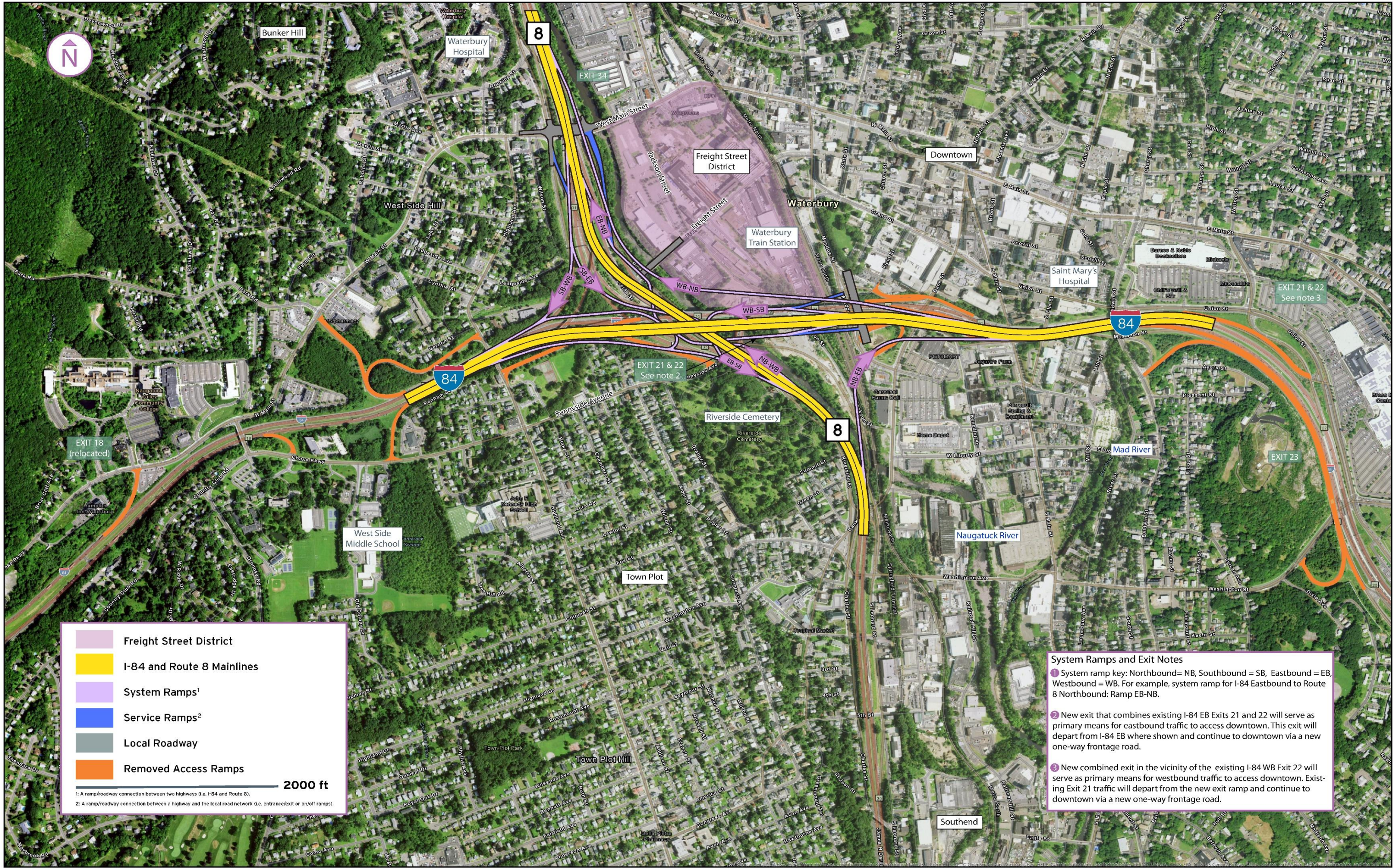


FIGURE 8-18 HALF DIVERGING DIAMOND

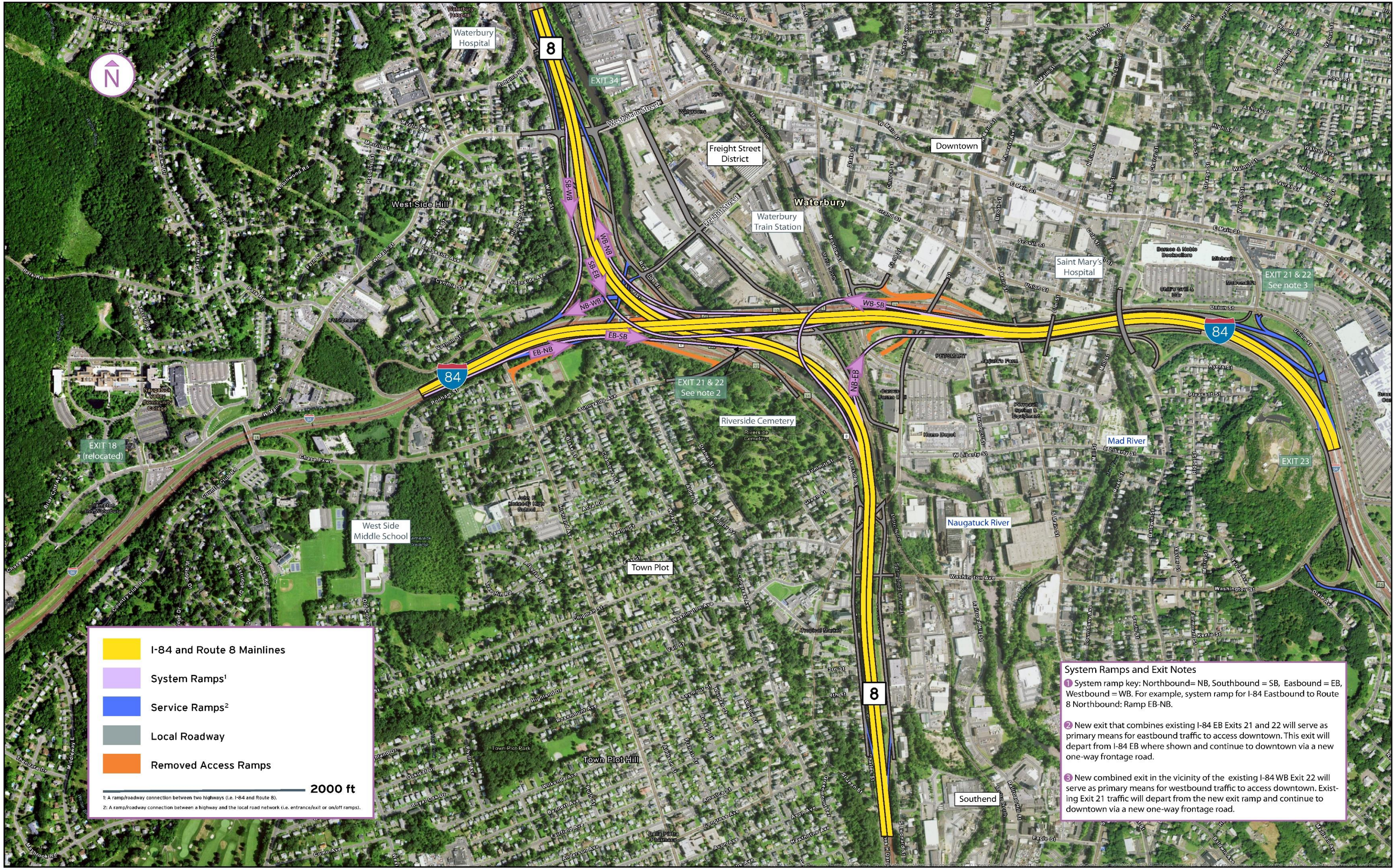


FIGURE 8-19 AT GRADE SYSTEM CONNECTIONS

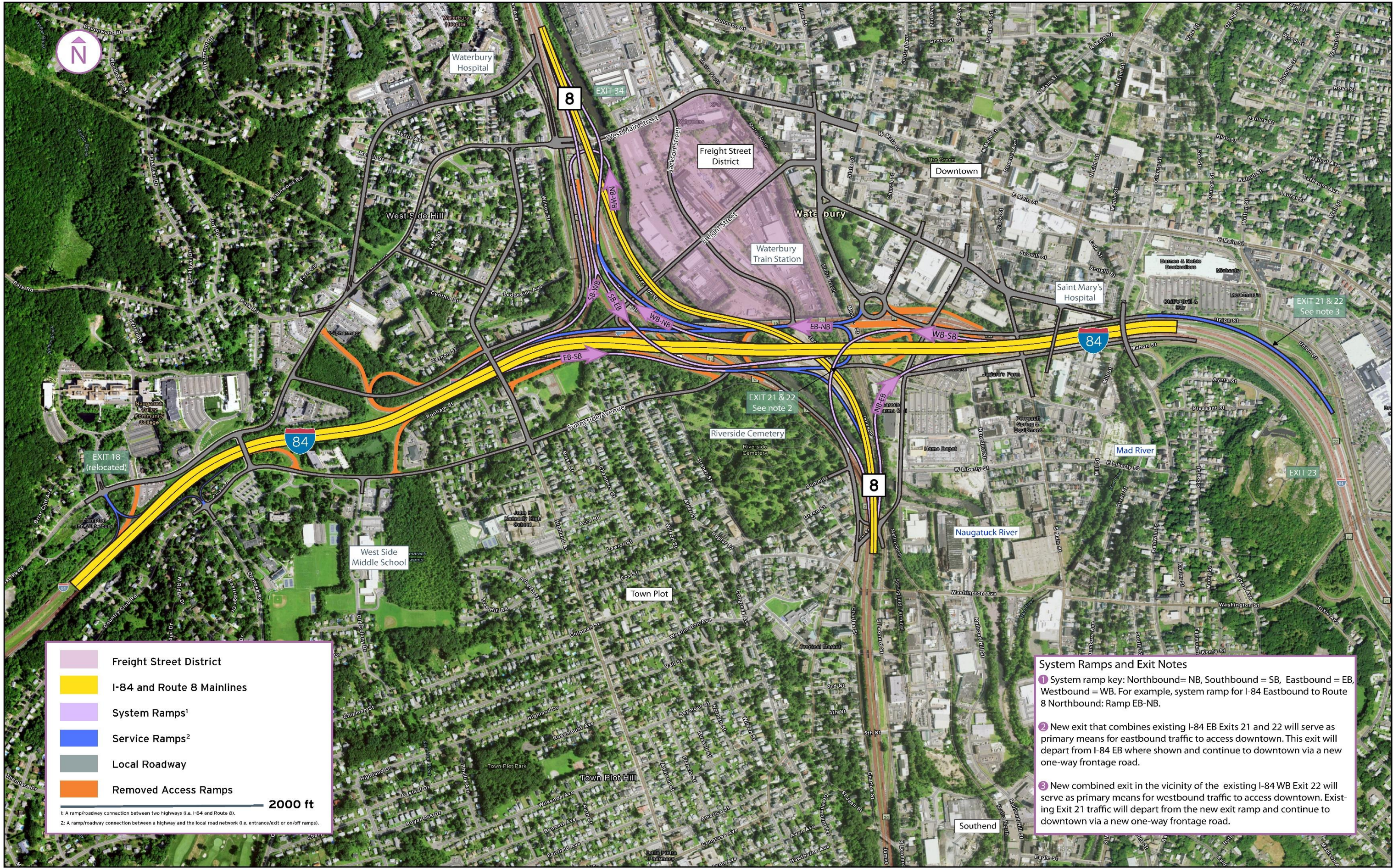


FIGURE 8-20 ROUTE 8 BOULEVARD

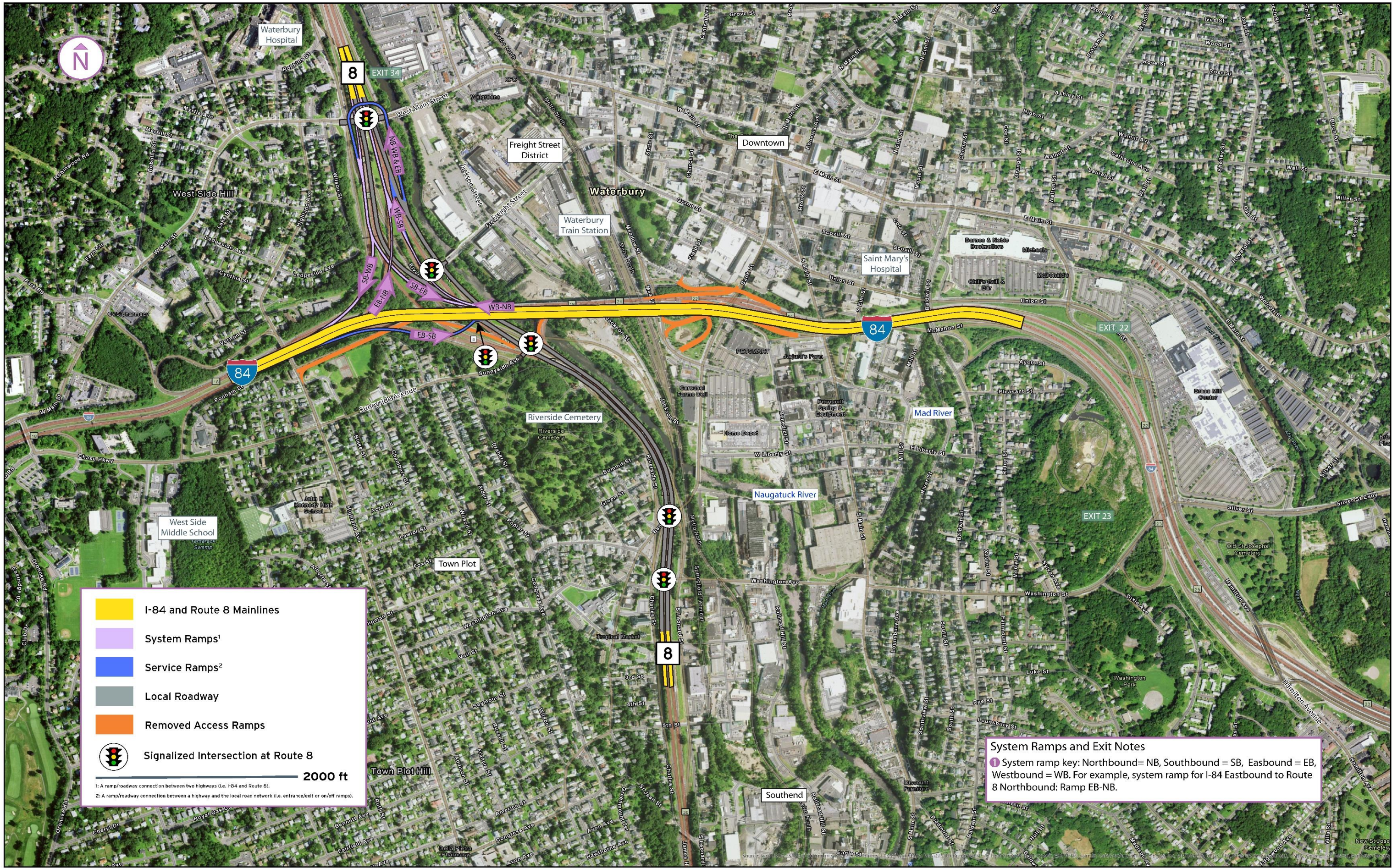


FIGURE 8-21 WASHINGTON STREET BYPASS



FIGURE 8-22 SOUTH CITY BYPASS

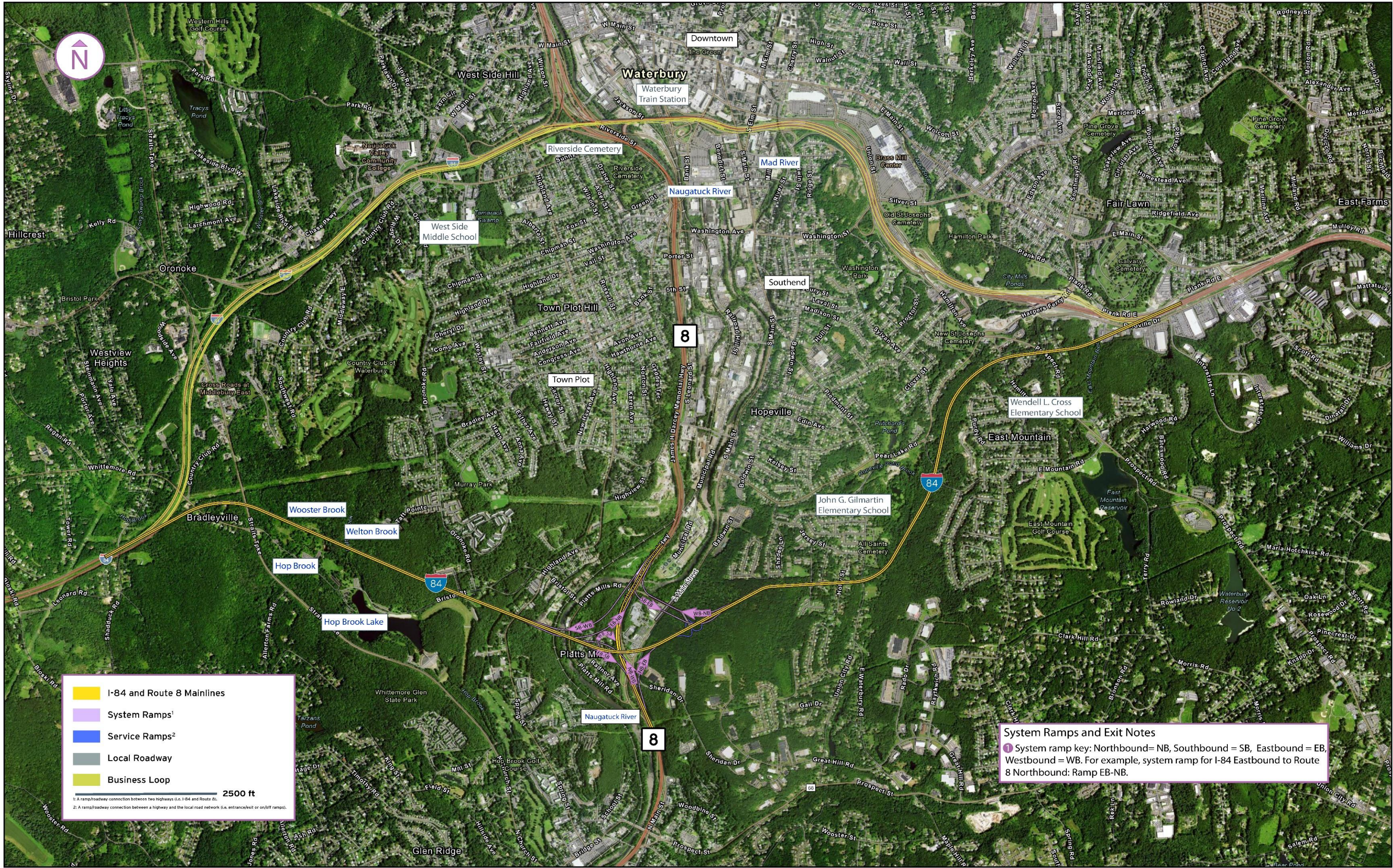


FIGURE 8-23 I-84 TUNNEL

