



**M** **MOVE**  
**NEW HAVEN**  
 Transit-Mobility Study

# MOVE NEW HAVEN TRANSIT MOBILITY STUDY FINAL REPORT



City of New Haven  
 CONNECTICUT



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# 1 Study Overview and Process

Through a partnership between the City of New Haven, the Connecticut Department of Transportation (CTDOT), the Greater New Haven Transit District (GNHTD) and the Federal Transit Administration (FTA), the *Move New Haven Transit Mobility Study* (Study) studied and developed potential transit supportive options to strengthen and modernize the CTtransit New Haven bus system. All project stakeholders are committed to providing a robust, multi-modal transportation system within the New Haven Region. It is the intention of the project partners that any community in which public transportation service currently exists, residents will be provided mobility options in the future.

Study goals included:

1. Improve connections to jobs and education;
2. Strengthen quality of service, operating efficiency and productivity;
3. Increase CTtransit New Haven customer service;
4. Provide an integrated multi-modal network; and
5. Develop a fundable project with public support.

Each of the goals had specific objectives as noted below:



## 1. Improve connections to jobs and education:

- **Ensure** transit-dependent residents can reach employment and educational institutions beyond the Downtown New Haven core;
- **Improve** transit access during non-peak/traditional work/school days and hours; and
- **Encourage** choice travelers to use the public transit system for travel to work and school.



## 2. Strengthen quality of service, operating efficiency and productivity:

- **Reduce** service gaps;
- **Improve** service headways;
- **Reduce** bus customer travel times;
- **Improve** bus reliability and on-time performance; and
- **Improve** transit service to high ridership origins and destinations.



### 3. Increase CTtransit New Haven customer service:



- **Provide** user-friendly transit system maps, route renumbering; reliable headways, and real-time information;
- **Reduce** service redundancy with other transit operators; and
- **Improve** branding and customer service relationship.

### 4. Provide an integrated multi-modal network:



- **Better** serve bus connections to commuter and Amtrak rail service;
- **Improve** bus stop comfort and accessibility to bus stops by foot;
- **Provide** multi-modal amenities such as bicycle facilities and bike-share stations at bus stops.

### 5. Develop a fundable project with public support:



- **Minimize** operating increases;
- **Reduce** expenditures that don't result in system performance improvement except where necessary;
- **Ensure** transit improvements can be implemented in phases; and
- **Provide** a recommended transit plan that can secure funding within a highly competitive context.

To achieve these Study goals, the *MOVE New Haven Transit Mobility Study* was organized into two phases: (1) an initial system-wide assessment and project definition phase and (2) development of a toolbox of transit supportive options to strengthen the CTtransit New Haven bus system.

The first phase of the Study examined bus system needs based on a combination of available data, public input, and stakeholder coordination. The results of the analysis were presented in the *MOVE New Haven Transit Mobility Study Phase 1: Existing Conditions Report (Phase 1 Report)*. The goal of Phase 1 was to evaluate the current CTtransit New Haven bus system, to identify how well it serves the community, its performance, and to gather public input.

As indicated in the Phase 1 Report, the four highest ridership routes (core routes) in the CTtransit New Haven system - the Route 212 - Grand Avenue, Route 238 - Dixwell Avenue, Route 243 - Whalley Avenue and Route 265 - Congress Avenue - serve 46% of the system's weekday riders and are listed among the best performing routes of all nineteen CTtransit New Haven routes. As the most heavily used routes in the CTtransit New Haven system, strengthening these four routes would enhance customer service for the greatest number of bus riders.



Following the Phase 1 Report, an Origin-and-Destination (O-D) Survey was conducted in April 2018. Data collected in the Phase 1 Report and the O-D Survey informed Phase 2 of the Study, which developed a toolbox of transit supportive enhancements along the core routes. Implementation of these enhancements would allow Greater New Haven’s goals and vision for the future of its bus system to be met along with setting the foundation for future modernization of the full system.

## 2 Transit Service Today in Greater New Haven

### 2.1 System Overview

The *CTtransit* New Haven Division (*CTtransit* New Haven) operates robust bus service in the Greater New Haven Region serving approximately 10 million annual passenger trips with 15 local fixed-routes, an intercity express bus route, and two shuttle bus routes (Figure 1). The system maintains its historical structure and primarily local-only service radiating from a single hub at the New Haven Green. While investments have been recently made to improve the system, it is differentiated from modern bus systems which include limited-stop routes, multiple hubs, and bus priority measures to move buses faster.

The existing *CTtransit* New Haven hub is in the City of New Haven at the New Haven Green. From this hub, bus routes travel throughout the City of New Haven and to 19 additional municipalities. The core of the regional service area includes New Haven and four additional municipalities: Hamden, West Haven, East Haven, and North Haven. The fixed-routes operate with multiple variations that include different stopping patterns, coverage areas, headways and spans of service. The system’s hub-and-spoke structure requires cross-town travelers to travel through the New Haven Green, even if their destination is not downtown, to continue their journey.

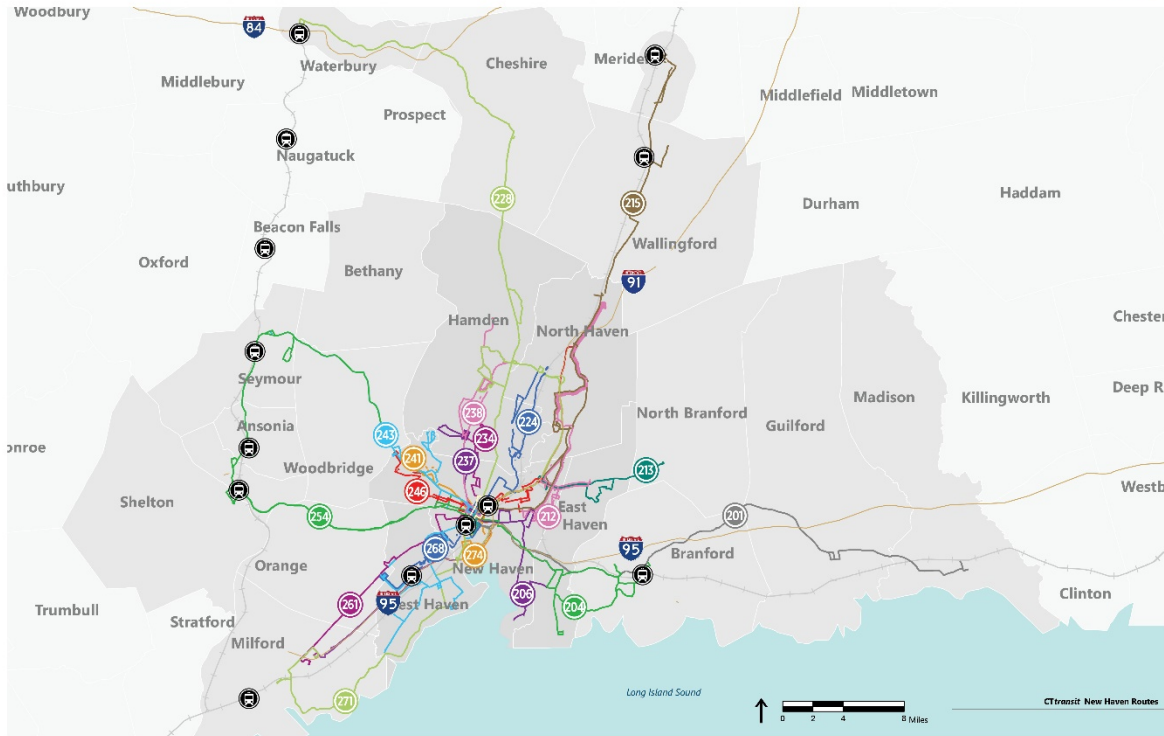
*CTtransit* New Haven provides connections to ten regional train stations. A free shuttle service is operated between Downtown New Haven and New Haven Union Station. At Union Station, connections may be made to intercity and regional rail services including: Amtrak, Metro-North Railroad’s Main Line and Waterbury Branch, and CTDOT Shore Line East and Hartford Lines. A Downtown New Haven commuter shuttle provides service to Union Station in the PM peak.



Figure 1: CTtransit New Haven Bus System



Municipalities served by CTtransit New Haven



- Train Station
- Whalley Ave/Congress Ave
- Grand Ave/Dixwell Ave
- East Haven/West Chapel St.
- Shelton Ave/East Chapel St.
- Whitney Ave/Kimberly Ave
- North Branford
- Washington Ave/State St.
- Boston Post Road/Winchester Ave
- Edgewood Ave
- New Haven/Madison
- Goffe St./Sargent Dr.
- Core Service Area
- Service Area



*CTtransit* New Haven’s routes connect with bus service provided by other *CTtransit* divisions operated by the Meriden Transit District, Greater Waterbury Transit District, Wallingford Transit District, Valley Transit District, and Milford Transit District. GNHTD provides paratransit service within  $\frac{3}{4}$  mile of all *CTtransit* New Haven fixed route service.

A market analysis of the Greater New Haven region examined variables that support transit demand including: population density, employment density, demographics, household income, and the presence of zero car households. An analysis of employment and population forecasts, as well as the location of projected growth, informed transit planning and confirmed that the current transit system provides ample coverage to areas that should be served though frequency, span of service and reliability vary.

The Greater New Haven region is expected to have growth in population and employment by 2025. The region is home to several major employers including institutions, businesses and significant retailers. In the core market area, there are a significant number of households with no vehicles, high population density, and high job density. The results of the market analysis also indicated that the City of New Haven has the highest percentage of transit commuters (12%), followed by the City of West Haven, and the Town of Hamden with more than 5% of residents that commute by transit. Results show that 29% of the City of New Haven households have no vehicle available. Among the City of New Haven’s neighborhoods, West Hills/River has the highest share of transit commuters (38%) while Dwight has the highest share of zero car households (46%).

These factors combine to indicate that the core area and areas around most existing routes have a high propensity to support transit which will continue; thus, any investments made in the system would be effective today and in the future.



## 2.2 Bus Supportive Infrastructure and Fleet

The CT*transit* New Haven system buses operate in mixed traffic on the regional and local roadway network. The bus routes also operate without transit priority measures, which can result in queuing at signalized intersections in Downtown New Haven, longer bus trip times, and reliability issues as reported anecdotally by some bus riders.

At the New Haven Green transit hub, bus riders may transfer to other bus routes to complete cross-town trips. The hub is a “pulse point” meaning bus routes converge at this location at scheduled times to allow passengers to transfer between routes before resuming their trips. Bus routes are pulsed from the New Haven Green (multiple routes arrive and depart at the same time) only during the weekday off-peak hours, Saturday after 6:15PM and all day on Sunday to ensure passengers make connections when buses run less frequently.



There is a total of 11 bus stops at or near the New Haven Green. The reason behind the large number of bus stops in such a compact geographic area is due to the one-way street pattern in Downtown New Haven. Buses traveling inbound must stop at a bus stop along one street, and conversely travel outbound from another bus stop on a parallel street. While the hub is effective in providing for connections, the concentration of

bus routes and bus stops at the New Haven Green and pedestrians accessing those bus stops makes it difficult for buses and pedestrians to navigate.

## 2.3 Recent CTtransit New Haven System Improvements

CTDOT recently delivered new buses to the CTtransit New Haven system which have improved the fleet’s reliability and reduced delays. In addition,



new technologies such as more advanced fareboxes and fare media (Go CT cards and smart-phone options) are reducing boarding time and speeding up trips. Also, all routes were renumbered to improve customer understanding of the system. In addition, CTtransit’s Upass fare program has been expanded, providing convenient and cost-effective fares for students at participating colleges and universities.

CTtransit New Haven and the City of New Haven have advanced initiatives to support implementation of transit priority measures, such as Transit Signal Priority (TSP). TSP gives buses priority over cars at enabled intersections, thereby making bus travel faster and more reliable.

CTtransit New Haven has also equipped buses with a Trapeze Transit Master<sup>1</sup> (TTM) for its Automatic Vehicle Locator (AVL) system capabilities. The TTM supports the provision of real-time information for customers and can support TSP in the future. Real-time information is provided in GTFS format which allow third-party applications to use the data for passenger information. Customers can track real-time bus information using the “transit” application that can be used on iOS and Android devices. CTtransit New Haven has also implemented Automated Passenger Counters (APC) on CTtransit New Haven buses to better monitor ridership and crowding.

## 2.4 Greater New Haven Origin-and-Destination Survey

As part of the *Move New Haven Transit Mobility Study*, a comprehensive, system-wide, Origin and Destination (O-D) survey of bus riders within the CTtransit New Haven system was conducted to better understand how transit travel is made within Greater New Haven. The information gathered from the O-D survey served several objectives, including:

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<sup>1</sup> Route 1 Bus Rapid Transit Feasibility Study, 2017, Prepared for CTDOT

- To gain a better understanding of today's transit riders and their travel behavior at a region-wide level, and
- To support transit planning and operations of the CT*transit* New Haven system based on ridership patterns, including the development of a tool box of transit supportive options for Greater New Haven.

## 2.5 Community and Stakeholder Participation



The Study implemented a community and stakeholder outreach plan to inform and seek community input from residents, business owners, educational institutions, community groups, and public officials. Public engagement meetings and Stakeholder and Community Engagement Committee meetings were held at key points in the Study.

In addition, an in-person and on-line outreach survey was conducted resulting in more than 800 survey responses (not a statistical sample). The survey provided bus customer and non-bus customer feedback on the CT*transit* New Haven system and bus service needs. A website and social media outreach were also used in the survey effort.

This comprehensive approach ensured that the public and stakeholders had multiple opportunities to learn about and understand the Study process and scope, to provide input.

## 2.6 Peer Review

A benchmark analysis of three peer transit provider agencies that were modernizing their systems was conducted. The peer review provided context for the CT*transit* New Haven system and insight to potential strategies employed in those cities for their applicability to CT*transit* New Haven.

- Ann Arbor Area Transportation Authority (TheRide) – Ann Arbor, Michigan
- Metropolitan Transit Authority (METRO) – Houston, Texas

➤ Rhode Island Public Transit Authority (RIPTA) – Providence, Rhode Island

In addition to a high-level review of each system, phone interviews were conducted with transit agency staff. The information obtained in these phone interviews provided invaluable information regarding new or innovative approaches used to improve service delivery, promote transit usage, and to better link to communities, large institutions, and key employers. Key strategies that enabled these systems to increase ridership included:

- Implementing service improvements to expand transit linkages to new locations.
- Conducting extensive public outreach and obtaining elected official buy-in to implement improvements.
- Employing faster bus service, including bus rapid transit features.
- Improvements to time-table information and new maps were implemented to make the system more “user-friendly”.



Peer City: Rhode Island Public Transit Authority (RIPTA) in Providence, RI

### 3 The Need for Enhancing Service in Greater New Haven



Arriving CTtransit New Haven bus along Temple Street at the New Haven Green

The CTtransit New Haven system is typical of a mature, urban transit system that has organically expanded over time. Overall, the existing transit system is providing adequate coverage where it is needed today and, in the future (as evidenced by the proximity of bus routes to planned development) but not necessarily good service (headways and span of service). In addition, it traverses some areas with low population and employment densities which result in low ridership for the service miles operated in those areas (low productivity). Additionally, all CTtransit New Haven fixed route service is local, which means that the bus picks up passengers at every occupied stop, resulting in longer travel times for passengers, especially those with destinations towards the end of the line.

Building on existing changes to rolling stock and payment systems now being implemented, there is a need to make additional and more robust improvements to the CTtransit New Haven route and bus stop system through a phased approach that will ultimately modernize the system like its peers.

However, additional modern system features are needed, including bus priority measures, multiple transfer hubs or direct routings, diversified service offerings such as local, limited and express routes, and better multi-modal connectivity to improve usage of all systems, including bicycle and pedestrian networks and private shuttles. BRT service and infrastructure features should also be considered.



Example of a Bus-Only Lane

The following BRT service and infrastructure features reflect a modern transit system with reliable and frequent service to high demand locations within a transit network that does not require passengers to consult a schedule on major corridors for enhanced bus customer experience:

**BRT Service Features:**

- Frequent and reliable service of 10-15 minutes or less on designated lines
- Early morning to after midnight service
- Faster service with fewer stops
- Direct service with effective connections to local service and other modes

**BRT Infrastructure Features:**

- Dedicated lanes or portions of lanes
- Bus priority at intersections
- Real-time information and user-friendly maps
- Faster fare payment to reduce dwell times at bus stops
- Improved, distinct level-boarding bus-stops/stations with amenities
- Unique bus branding to increase visibility
- Smart technology buses

An incremental transition of the CT*transit* New Haven system to incorporate these modern transit system features is important because the system provides a lifeline for seniors, youth, and other transit dependent populations. The Greater New Haven economy is also dependent on the provision of travel choices to jobs and educational opportunity, which enables growth. There are over 320,000 jobs and 250,000 households



within a ½ mile of existing bus service within Greater New Haven. Every \$1 invested in public transportation generates \$4 in economic returns.<sup>2</sup>

Overall, the Greater New Haven region’s bus system needs to be modernized so the region can stay economically vibrant and competitive with peer cities that have already embraced modern transit features.

### 3.1 Bus Performance Evaluation

The Study conducted a bus performance evaluation to identify areas where the system could be enhanced. Through the identification and application of a wide range of metrics, each bus route was assessed for performance. While the evaluation highlighted issues that should be addressed on most routes it also identified four bus routes as the most effective in the system: **CTtransit Routes 212 (Grand Avenue) and 238 (Dixwell Avenue), 243 (Whalley Avenue) and 265 (Congress Avenue)**. These four routes attract 46% of the system’s weekday ridership, with the remaining ridership (54%) distributed across the remaining 11 bus routes.

These routes were rated the best in the system for all performance metrics (including costs per rider) except for two metrics (bus stop spacing and peak/off-peak loading). For bus stop spacing these routes exceed the metric of 4 bus stops per mile, with some route segments exceeding nine stops per mile. Numerous closely-spaced bus stops on high ridership routes result in longer bus travel times and only nominally expand accessibility. Additionally, these routes have periods during the day where passenger crowding is an issue, with as many as 1.71 riders per seat in the peak and 1.11 riders per seat in the off-peak.<sup>3</sup> This exceeds the recommended number of 1.0 passengers per bus seat during off-peak times and 1.3 passengers per bus seat during peak times.<sup>4</sup>

This evaluation suggested there is crowding on these routes, which leads to long dwell times at stops, customer discomfort and dissatisfaction. Crowding indicates a need to examine bus scheduling, fleet assignment, and to consider new types of service such as Bus Rapid Transit (BRT).

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<sup>2</sup> American Public Transportation Association (APTA) *Public Transportation Facts, 2019*.

<sup>3</sup> 2017 Phase 1: *Existing Conditions and Evaluation of the Greater New Haven Bus System, Page 54*.

<sup>4</sup> The *Transit Capacity and Quality of Service Manual* (TCRP Report 100) recommends specific load factors for overall passenger comfort. To efficiently allocate service and maintain passenger comfort, the TCQSM recommends scheduling service to meet 1.0 passengers per seat during off-peak times and 1.3 passengers per seat during peak times.



**Based on the results of the bus performance evaluation, the core routes (CTtransit Routes 212, 238, 243, and 265), became the primary focus for the Study’s identification and assessment of transit improvements.**

## 4 Enhancing Service in Greater New Haven

The Study identifies three primary enhancements to modernize CTtransit New Haven operations and bus infrastructure. The first enhancement captures BRT service and infrastructure features as an overlay of four local high-ridership routes within the CTtransit New Haven system. The second enhancement would provide an opportunity for more direct cross-town service without having to travel to the hub of the system (New Haven Green). Lastly, the third enhancement discusses management at the New Haven Green to enhance the bus customer experience and pedestrian circulation at high boarding and alighting bus stops, the proposed “one-way” to “two-way” Downtown New Haven street conversions, as well as multi-modal connectivity. These three enhancements complement each other and could be implemented individually or in combination. A bulleted list of the three enhancements are provided below.

- **Enhancement 1:** Introducing an added limited-stop BRT service overlaid along core local bus routes; CTtransit Routes 212 and 238 and Routes 243 and 265.
- **Enhancement 2:** Expanding service by developing cross-town routes to provide more direct service outside of Downtown New Haven.
- **Enhancement 3:** Improving the traffic and bus stops along the New Haven Green transit hub to better accommodate buses, passengers and the general public.

### 4.1 Enhancement 1: Improving the CTtransit New Haven Customer Experience with BRT Overlay Routes

Two limited-stop BRT overlay routes were studied that would operate on Grand and Dixwell Avenues (currently served by Routes 212 and 238) and on Whalley and Congress Avenues (currently served by Routes 243 and 265). All existing local bus routes and their service patterns would continue to operate as they currently do with two new overlay BRT routes along the Grand Avenue - Dixwell Avenue corridor and the Whalley Avenue - Congress Avenue corridor.





The goal of the BRT overlay routes is to make service faster, more reliable and more attractive. These features represent an improvement over those provided for existing local service in these corridors. Suggested BRT service and infrastructure features for these two overlays include:

**Overlay BRT Service Features:**

- Consistent and frequent headways of every 10 minutes during the peak periods and every 20 minutes in the off-peak periods-on weekdays and every 30 minutes on weekends and holidays; span of service from early morning to after midnight service, seven days per week;
- A limited number of BRT stops; and
- Direct service with effective connections to local service and other modes.

**Overlay BRT Infrastructure Features:**

- Prominent stations and mini-hubs
- Dedicated “Bus Only” Lanes
- Transit Signal Priority (TSP)
- Queue jump lanes
- Real time information at BRT stations and mini-hubs
- Branded fleet with all door boarding
- Off-board fare collection or smart card payment systems

With these features the BRT overlay routes could provide an attractive limited-stop option for riders traveling to key destinations in the core corridors. This could help alleviate crowding on the parallel local bus routes. **On average, the BRT overlay service could save between approximately 11 and 18 minutes (31-43%) of travel time** compared to the local services on the Grand Avenue - Dixwell Avenue corridor and on the Whalley Avenue - Congress Avenue corridor, end to end. (see Table 1)

**Table 1: Comparison of BRT Overlay Service in the Core to Existing Local Service**

Route	Travel Time Savings (Average Travel Time in Minutes and Seconds)*	
	Hamden – New Haven	West Haven – New Haven
<b>Existing Service (Local)</b>	36:00	42:48
<b>BRT Overlay Service</b>	24:45	24:33
<b>Travel Time Savings (%):</b>	<b>11:15 (31%)</b>	<b>18:15 (43%)</b>

\*Assumes 4-minute layover at New Haven Green

### Proposed Route Alignment and BRT Stations

One BRT overlay route would potentially operate between Dixwell Avenue and Putnam Avenue in the Town of Hamden and Grand Avenue and Ferry Street in the City of New Haven with mini-hubs located at each end of the route. The BRT overlay route would be 4.7-miles in length and would potentially feature nine BRT stations with an average spacing of a half-mile (See Figure 2).

A second BRT overlay route would potentially operate between Whalley Avenue and Blake Street in the City of New Haven and Campbell Avenue and Main Street in the City of West Haven. Mini-hubs could be established at the ends of the route. The BRT overlay route would be 6.3-miles in length and would potentially feature 13 BRT stations with an average spacing of a half-mile (see Figure 3).

BRT stations provide branding and a physical presence for a BRT service. Bus customers would be able to easily identify the buses and bus stops that serve the BRT route. BRT stations provide customers with improved amenities as noted below:

- Enhanced stations with distinctive branding, station markers, level boarding platforms, specially designed shelters or canopies; seating/leaning rails,



Example of distinctive BRT station



- passenger information (maps, schedules, etc.);
- Real-time passenger information (i.e., Variable Message Signs);
- Station lighting;
- Ticket vending machines for off-board fare collection or smart card payment systems;
- Trash/recycling receptacles; and
- Bicycle racks/lockers



Figure 2: Town of Hamden – City of New Haven Potential BRT Overlay Route

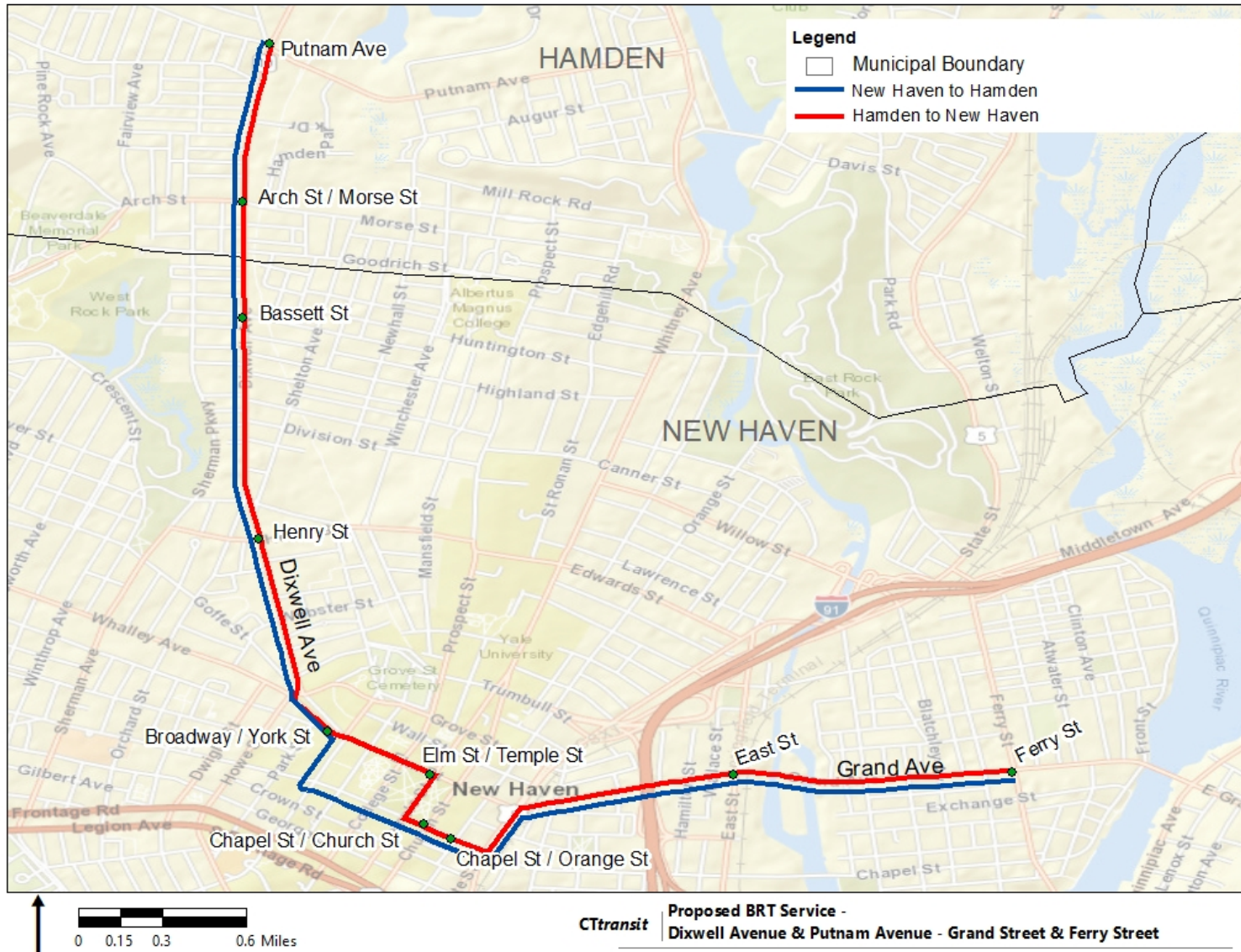
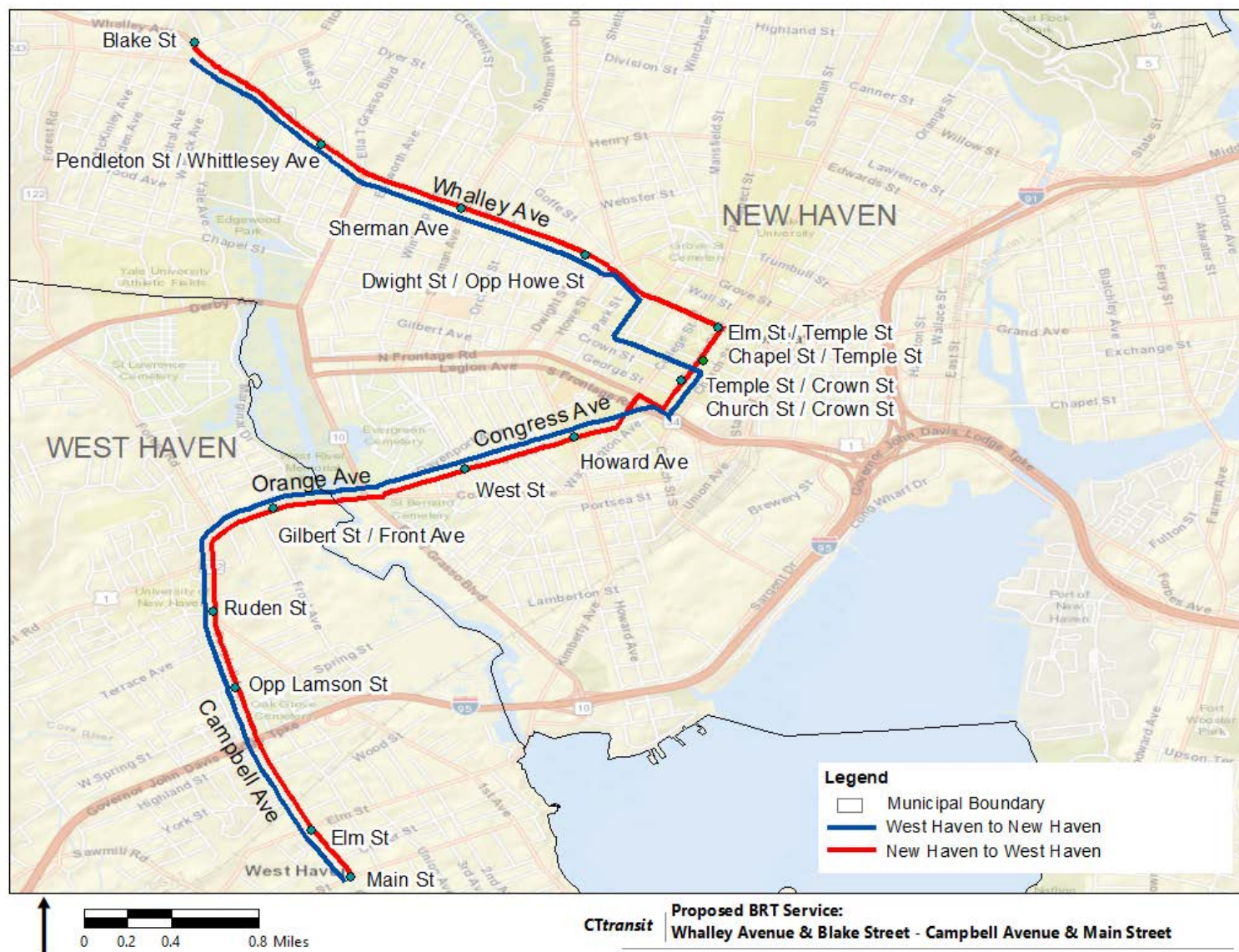




Figure 3: City of New Haven – City of West Haven Potential BRT Overlay Route





### **BRT Overlay Mini-Hubs**

As part of the BRT overlay, the establishment of mini-hubs would provide additional connections between bus routes to provide opportunities for transfers between bus routes at locations outside of the New Haven Green (thereby, reducing the dependence upon a single hub in Downtown New Haven). Each of the following four proposed mini-hubs (two at each end of the BRT overlay routes) would feature shelters, seating and real-time passenger information. For locations where multiple buses (local and BRT buses) would arrive together, changes to existing bus stop lengths were identified entailing either extending the length of the bus stop or by creating a second, new stop adjacent to the first bus stop. In some cases, a limited number of curbside parking spaces may need to be taken.

➤ **Dixwell Avenue and Putnam Avenue Mini-Hub**

Transfers could be made to the BRT route, *CTtransit* Routes 238 Dixwell Avenue at this location, and to Routes 234 Winchester Avenue and 237 Shelton Avenue at the Putnam Place Mall (300 feet east).

➤ **Grand Avenue and Ferry Street Mini-Hub**

Transfers to the BRT route, *CTtransit* Routes 212 Grand Avenue and 215 New Haven/Wallingford/Meriden could be available at this location.

➤ **Whalley Avenue and Blake Street**

Transfers to the BRT route and *CTtransit* Route 243 Whalley Avenue could be available at this location. In addition, transfers to *CTtransit* Route 241 Goffe Street could be made at the Blake Street/Valley Street bus stop, located 300 feet east of the mini-hub, and to *CTtransit* Route 246 Edgewood Avenue at the Alden Avenue/Fountain Street stop located 800 feet south of the mini-hub.

➤ **Campbell Avenue and Main Street in West Haven**

Transfers could be made at this location to the BRT route, *CTtransit* Route 265 Congress Avenue and Route 271 Kimberly Avenue.



### Dedicated Bus-Only Lanes

The BRT overlay routes would potentially include bus-only lanes identified using pavement markings (i.e., no physical barrier between buses and general traffic). The locations of bus-only lanes were selected based on the following criteria:

- High existing ridership segment (+1,400 daily boardings and alightings)
- Sufficient roadway width to accommodate a bus-only lane (greater than 40 feet for one-way street and greater than 49 feet for bi-directional roadways)
- Includes intersections with vehicular congestion

The locations of the proposed bus-only lanes include:

- **Elm Street from York Street to Temple Street.** A bus-only lane is proposed in this segment along the south side of Elm Street (a one-way length of 1,268 feet).
- **State Street from Grand Avenue to Chapel Street.** A bus-only lane on each side of the road is proposed in this segment (a one-way length of 780 feet).
- **Dixwell Avenue from Morse Street to Putnam Avenue.** A bus-only lane on each side of the road in the curb lanes is proposed in this segment (a one-way length of 2,574 feet). Sections where curbside parking is allowed would be converted into Bus-only lanes.
- **Church Street from Chapel Street to MLK Boulevard.** Bus-only lanes are proposed in this segment along the east side of Church Street from MLK Boulevard to Center Street. This would require converting the dedicated turn lane to shared right-turn/bus lanes between MLK Boulevard and George Street, taking the parking lane between George Street and Crown Street, and restriping the curb lane between Crown and Center Streets. On the west side of Church Street, between Center Street and Chapel Street, the left turn only lane would be converted into a shared left-turn/Bus-only lane. The one-way length of bus-only lanes in this segment is 1,092 feet.
- **Whalley Avenue from West Rock Avenue to Howe Street.** A bus-only lane on each side of the road in the curb lanes are proposed in this



segment (a one-way length of 8,095 feet). A road diet (i.e., roadway configuration) in which number of travel lanes and/or the effective width of the road is reduced in order to create bus-only lanes. Sections where curbside parking is allowed would be converted into Bus-only lanes.

Travel time savings for the BRT lanes was assumed to be the equivalent of early AM bus run time in existing segment (to represent no congestion; also validated with Google travel times).

Detailed traffic and parking impact analyses would be required to further verify the feasibility of the bus only lanes.

### Transit Signal Priority (TSP)

TSP would provide priority for transit vehicles at signalized intersections to improve bus travel times within a corridor. The implementation of TSP would require installation of bus detection equipment at traffic signals and on-board buses in addition to the existing AVL system. It was assumed at each potential signalized intersection equipped with TSP that six seconds in travel time would be saved. On average, in the Hamden to New Haven corridor, TSP implementation could result in between 1.5 to 2 minutes in travel time savings. In the West Haven to New Haven corridor, travel time savings could be 4 minutes.

Below are potential roadway segments considered for an “active” priority strategy TSP. These segments were selected because they experience higher than average levels of traffic congestion and/or are used by more than 500 daily *CTtransit* New Haven riders. Far side bus stops are should be considered at TSP intersections, where feasible. TSP could be installed for the 57 traffic signals on the following roadway segments:

#### Town of Hamden – City of New Haven

- Chapel Street from State Street to York Street
- Elm Street/Broadway from Howe Street to Temple Street
- Grand Avenue from Olive Street to Ferry Street
- Dixwell Avenue from Goffe Street to Putnam Avenue

#### City of New Haven – City of West Haven

- Elm Street/Broadway from Howe Street to Temple Street
- Chapel Street from Temple Street to York Street
- Whalley Avenue from Blake Street to Dwight Street
- Campbell Avenue from Main Street to Boston Post Road (Route 1)





### Queue Jump Lanes

A queue jump lane is a short bus lane located at the approach of a signalized intersection. When a queue jump lane is combined with TSP, the bus bypasses waiting traffic and is given an early green signal allowing it to quickly cross the intersection before other traffic and to merge into the nearest travel lane. Queue jump lanes with TSP are typically installed at near-side bus stops. At near-side pull-out bus stops, the bus completes loading before rolling forward onto a loop detector that gives it signal priority. As with bus-only lanes and TSP, only BRT buses could take advantage of queue jump lanes in this alternative.

Potential queue jump locations were identified at locations that experience higher than average levels of congestion and/or are used by more than 500 daily *CTtransit* New Haven riders.

An inbound and outbound queue jump lane could be installed in the right-lane of the intersection of Ella T. Grasso Boulevard and Route 1/Boston Post Road in the City of New Haven.

An inbound and outbound queue jump lane could be installed in the right-lane of the intersection of Dixwell Avenue and Putnam Avenue in the Town of Hamden. The queue jump would be a shared transit/right-turn lane long enough to allow storage of right-turning vehicles and allow buses to reach the queue jump during each signal cycle.

Additional evaluation and consultation with CTDOT and the Town of Hamden would be needed to confirm the design feasibility of a queue jump at these locations.

### Ridership Potential & Cost

A ridership demand forecasting model based on the FTA's Simplified Trips-On-Project Software (STOPS) model was developed. Survey results from the 2018 O-D survey formed the basis for a New Haven transit forecasting model that was used to understand current trip-making characteristics and expected changes in ridership that would result from alternative bus service concepts. Areas within the modeling area of the South-Central Regional Council of Governments (SCRCOG) used zones from the SCRCOG modeling system. Outside of the SCRCOG area, zones were based on 2006-2010 CTPP Traffic Analysis Zones. The model included highway travel times provided by SCROG and existing *CTtransit*



services from its General Transit Feed Specification (GTFS)<sup>5</sup> schedules to represent existing transit services. The resulting model presented a snapshot of transit ridership patterns as it existed at the time of the 2018 on-board survey. These characteristics provided insights into how improvements to the network could be made to enhance the quality of service offered to travelers.

Two types of ridership statistics are useful for understanding ridership potential: **linked transit trips** and **boardings** (also known as unlinked trips). Linked transit trips represent the number of trips from an origin (e.g., home) to a destination (e.g., work or shopping) regardless of the number of transfers are made to complete the trip. Boardings represent the number of passengers boarding a bus, for each bus route, or each bus stop.

Across the full CT*transit* New Haven bus system, the implementation of the BRT overlay routes in the core corridors are forecasted to potentially increase the number of weekday linked trips by 3% compared to the existing bus service, from 26,737 to 27,428 trips. The number of daily boardings are forecasted to potentially increase by 8%, from 28,835 to 31,029 for the overall CT*transit* New Haven system with a higher increase in the number of boardings among the CT*transit* New Haven routes with the proposed BRT overlay. Boardings along the BRT corridor for local Routes 212, 238, 243, and 265 plus the BRT service overlay are forecasted to **increase by 25%**, from 13,227 to 16,494 boardings daily.

Order-of-magnitude cost estimates were developed for the BRT overlay routes including costs associated with the proposed BRT facilities (i.e., TSP infrastructure, queue jumps and Bus-only lanes) and operational needs (vehicles required for the BRT overlay service plan). As shown in Table 2, the capital costs associated with the BRT overlay routes are estimated at approximately \$15.6 million (2019\$). The incremental estimated annual operating and maintenance (O&M) costs to operate the BRT overlay routes are approximately \$7.8 million (see Table 3).

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<sup>5</sup> The General Transit Feed Specification (GTFS) is a common format for public transportation schedules and associated geographic information.

**Table 2: BRT Overlay Routes Capital Costs<sup>6</sup>**

Item	Quantity	Unit Price	Cost
<b>Mini-Hubs</b>			
Grand Avenue and Ferry Street	1	\$192,741	\$193,000
Dixwell Avenue and Putnam Avenue	1	\$187,074	\$188,000
Whalley Avenue and Blake Street	1	\$328,894	\$329,000
Campbell Avenue and Main Street	1	\$95,139	\$96,000
<b>Subtotal</b>			<b>\$806,000</b>
<b>Vehicles</b>			
Local Bus Service - Additional 40' Buses required for Maximum Service (including spares)	0	\$440,000	\$0
BRT Overlay Service - Additional 60' Buses required for Maximum Service (including spares)	18	\$700,000	\$12,600,000
TSP Detection Equipment	18	\$4,400	\$79,200
<b>Subtotal</b>			<b>\$12,679,200</b>
<b>Queue Jumps</b>			
Dixwell Avenue/Putnam Avenue	1	\$12,000	\$12,000
Whalley Avenue/Ella T. Grasso Boulevard	1	\$2,500	\$2,500
<b>Subtotal</b>			<b>\$14,500</b>
<b>TSP</b>			
Hamden - New Haven Corridor			\$78,000
West Haven - New Haven Corridor			\$278,000
<b>Subtotal</b>			<b>\$356,000</b>
<b>BRT Stations</b>			
Hamden - New Haven Corridor			\$593,000
West Haven - New Haven Corridor			\$973,000
<b>Subtotal</b>			<b>\$1,566,000</b>
<b>Bus-Only Lanes</b>			
Bus-Only Lanes			\$141,000
<b>Grand Total</b>			<b>\$15,563,000</b>

<sup>6</sup> Unit costs were developed using local source data including CTDOT pricing data from other recently bid projects in the State (for vehicle costs and TSP costs) and the recently completed *Route 1 BRT Feasibility Study Final Report*, which is similar in terms of scope and materials to the *MOVE New Haven Transit Mobility Study* (for mini-hub and BRT station costs).

**Table 3: BRT Overlay Routes O&M Costs<sup>7</sup>**

Alternative	Annual Weekday O&M Cost	Annual Saturday O&M Cost	Annual Sunday/Holiday O&M Cost	Annual Fare Inspection-O&M Cost	Annual Mini-Hubs O&M Costs	Annual BRT Stations O&M Costs	Total Annual O&M Cost
<b>BRT Overlay Routes</b>	\$6,655,835	\$376,876	\$413,114	\$542,382	\$84,201	\$241,245	<b>\$7,771,271</b>

## 4.2 Enhancement 2: Cross-Town Services, East and West of Downtown New Haven

Under the existing *CTtransit* New Haven bus system, cross-town travel is made by passengers riding a bus downtown to the New Haven Green and either staying on the bus through the dwell at the New Haven Green or transferring to a connecting bus route. In some instances, passengers can remain on the same physical bus both inbound and outbound, even though the route number designation changes at the New Haven Green. For example, the inbound Route 212 Grand Avenue travels from the eastern neighborhoods of the City of New Haven to the New Haven Green and then continues as the outbound Route 238 Dixwell Avenue to the western neighborhoods of the City of New Haven and the Town of Hamden.

Today, there are no bus routes that provide cross-town travel in a north-south or east-west direction outside Downtown New Haven; all cross-town trips must go through the New Haven Green. Two potential cross-town route options were identified to potentially meet this need as part of this study. While data from the origin-destination study supports further investigation of these routes, the suggested next steps are a more detailed analysis of the routes identified with proposed headways and span of service, potential stop locations, inter-connection with the proposed mini-hubs and estimated costs.

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<sup>7</sup> The estimation of operating costs was developed using a three-unit cost factor model, incorporating revenue hour, revenue mile and overhead data provided by *CTtransit* from its 2018 National Transit Database's (NTD) profile, and *CTtransit's* New Haven Division *Line Summary Report*. All unit costs were escalated to 2019 dollars. O&M costs associated with the BRT Overlay including fare inspection, Mini-Hubs and BRT stations were based on data provided by the Connecticut Department of Transportation.



### Cross-Town Route Option 1: CTtransit New Haven’s City of New Haven/Town of Hamden Crosstown

Cross-Town Route Option 1 was developed by CTtransit New Haven, and would be a potential City of New Haven/Town of Hamden Crosstown Service from the eastern and western neighborhoods of the City of New Haven to the Town of Hamden (Figure 4). The service would operate between Union Station in the City of New Haven and Hamden Plaza in the Town of Hamden. No stop would be provided at the New Haven Green. The Cross-Town Route Option 1 would provide more service along one of the highest ridership CTtransit New Haven routes in the system (Route 238).

This route would be approximately 8 miles long and would connect Union Station, Sherman Avenue, Whalley Avenue, Goffe Street, West Hills, SCSU and Dixwell Avenue in the City of New Haven and Town of Hamden. The Cross-Town Route Option 1 would have 16 bus stops in both directions traveling along Spring Street, Howard Avenue, Sylvan Avenue, Winthrop Avenue, Sherman Avenue, Munson Street, Crescent Street, Fitch Street, Arch Street, and Dixwell Avenue. The total estimated travel time from end-to-end for the Cross-Town Route Option 1 is approximately 51 minutes.

The Cross-Town Route Option 1 bus stops are served by other routes. At the south end of the Cross-Town Route Option 1, connections to CTtransit New Haven Routes 271, 272 and the Union Station Shuttle (USS) would be provided at Union Station. At the north end, at Hamden Plaza, connections would be provided to CTtransit New Haven Routes 228 and 238 and Routes 234, 237, 238 and the potential BRT overlay route at the potential mini-hub located at the intersection of Putnam Avenue and Dixwell Avenue. Additional connections along the route could be made to CTtransit New Haven Routes 265, 261, 254, 255, 246, 243, 241, and the Routes 265 and 243 BRT overlays.

The proposed service hours would be 6:00am to 11:00pm on weekdays, 7:00am to 11:00pm on Saturdays, and 7:00am to 7:00pm on Sundays and holidays. Headways would be every 30 minutes on weekdays and Saturdays and every hour on Sundays and holidays. Table 4 provides estimated order-of-magnitude costs for this cross-town route. Capital costs are for fleet (3 buses) needed to accommodate the route.<sup>8</sup>

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<sup>8</sup> O&M costs were provided by CTtransit and escalated to 2019 dollars using US Department of Labor, Consumer Price Index Calculator. Capital costs are based on the purchase of three buses needed for service, with unit costs provided by CTDOT.



**Table 4: Cross-Town Route Option 1 O&M and Capital Costs**

Cross-Town Route Option 1	Total Capital Cost (\$2019)	Total Annual O&M Cost (\$2019)
	\$1.3 million	\$1.2 million

**Cross-Town Route Option 2: Eastern City of New Haven to North of City of New Haven**

Cross-Town Route Option 2 was developed for this Study to provide a more direct route between the Annex, East Shore, Fair Haven, Fair Haven Heights, and Quinnipiac neighborhoods of the City of New Haven and the Town of Hamden with more direct connections to the Town of North Haven (see Figure 4). The proposed Cross-Town Route Option 2 would provide a transfer opportunity for passengers on CTtransit New Haven Routes 212, 215 and 223, who wish to connect to Routes 228, 229, 237 and 238. Currently, bus riders seeking to make this connection must take a circuitous route through the New Haven Green. The potential Cross-Town Route Option 2 would provide a more direct route outside of the New Haven Green. According to a April 2018 O-D survey for the CTtransit New Haven system, There are approximately 226 daily bus riders traveling from the Annex, East Shore, Fair Haven, Fair Haven Heights, and Quinnipiac neighborhoods of the City of New Haven to the Town of Hamden and approximately 217 daily bus riders traveling from the Town of Hamden to the Annex, East Shore, Fair Haven, Fair Haven Heights, and Quinnipiac neighborhoods of the City of New Haven. This Cross-Town Route Option 2 may potentially attract this demand if implemented.

The Cross-Town Route Option 2 would be approximately 4 miles long and would begin at Dixwell Avenue and Putnam Avenue in the Town of Hamden (where connections to CTtransit New Haven Routes 234, 237 and 238 and the proposed BRT overlay route could be made), travel east along Putnam Avenue, south on Whitney Avenue, east on Davis Street (crossing Lake Whitney), south on Ridge Road (offering a connection to CTtransit New Haven Route 224), south on State Street and south on Ferry Street (offering a connection to CTtransit New Haven Route 223 at Lombard Street) before terminating at the potential mini-hub location at the intersection of Grand Avenue and Ferry Street in the City of New Haven (offering a connection to CTtransit New Haven Routes 212 and 215 and the Route 212 BRT overlay). The total estimated travel time from end-to-



end of the Cross-Town Route Option 2 would be approximately 28 minutes.

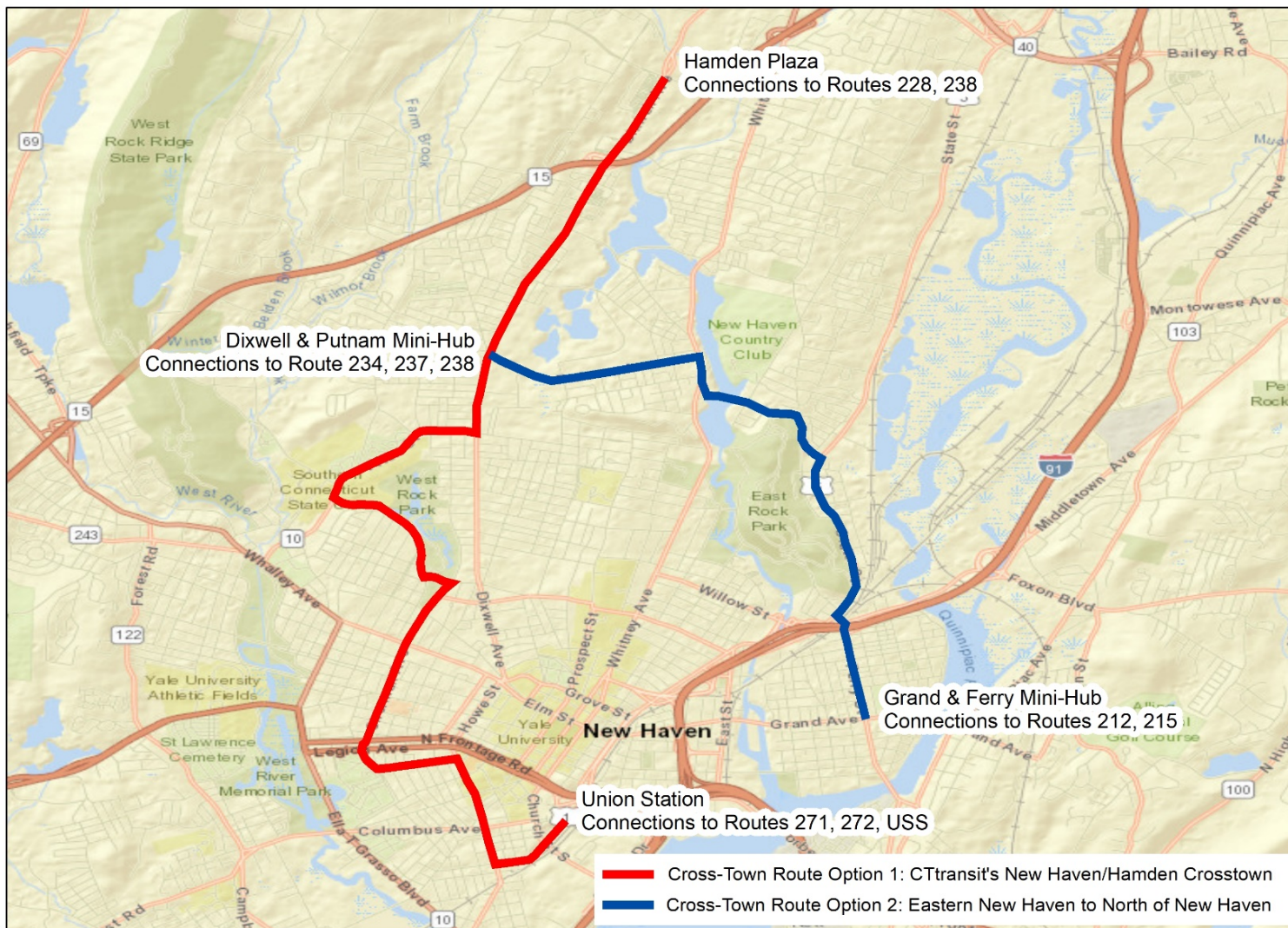
As with Cross-Town Route Option 1, the proposed service hours would be 6:00am to 11:00pm on weekdays, 7:00am to 11:00pm on Saturdays, and 7:00am to 7:00pm on Sundays and holidays. Headways would be every 30 minutes on weekdays and Saturdays and every hour on Sundays and holidays. Table 5 provides estimated order-of-magnitude costs for this cross-town route. Capital costs are for additional vehicles (3 buses) needed to accommodate the route.

**Table 5: Cross-Town Route Option 2 O&M and Capital Costs**

<b>Cross-Town Route Option 1</b>	<b>Total Capital Cost (\$2019)</b>	<b>Total Annual O&amp;M Cost (\$2019)</b>
	\$1.4 million	\$1.3 million



Figure 4: Potential Cross-Town Route Options







## 4.3 Enhancement 3: Management Improvements at New Haven Green

### Elm Street / Two Way Street Improvements

Proposed signal upgrades in Downtown New Haven coincide with the proposed conversion of existing “one-way” to “two-way” traffic movement within Downtown New Haven and the New Haven Green, including Elm Street. One-way streets dominate much of Downtown New Haven. This “one-way” street network makes circulation difficult and navigation confusing for automobiles and buses.<sup>9</sup> It requires bus stops for the same route to be located on two different streets and can cause pedestrians to walk further to make transfers between routes. It also makes the overall transit system less intuitive for bus riders, especially for visitors and infrequent transit users. Bus circulation can be negatively impacted with additional turning movements, recirculation, and increased vehicle miles traveled that can add fuel and operating costs. As a result of recirculation in a “one-way” street network, timetables and schedules may have longer end-to-end route travel times.

In 2015, the South-Central Regional Council of Governments (SCRCOG) and the City of New Haven finalized a *City of New Haven Two-Way Conversion Final Report*. The report recommended the conversion of 18 Downtown New Haven streets from one-way to two-way. These recommended conversions are proximate to bus stops that are within the top 10 highest boardings and alightings of the CTtransit New Haven system. The recommended street conversions could simplify existing bus routes with shorter end-to-end route running times among the highest ridership routes within the CTtransit New Haven system, which equates to more efficient operations and potentially reduced fuel costs.

It could also reduce the number of bus stops at the New Haven Green. For example, it could eliminate the need to route buses through the center of the New Haven Green along Temple Street between Elm Street and Chapel Street and relocate bus stops at the center of the New Haven Green to outside of the New Haven Green. The high-ridership south-bound CTtransit Route 265 from the western neighborhoods of the City of New Haven to the City of West Haven could remain on Elm Street east-bound, rather than making a right-turn at the intersection of Temple and Elm Streets to travel south, and instead take a right turn on Church Street<sup>10</sup> to ultimately travel south-west towards the City of West Haven. CTtransit

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<sup>9</sup> City of New Haven Two-Way Conversion Final Report, 2015, Prepared for City of New Haven

<sup>10</sup> The City of New Haven is proposing a conversion of Church Street between Elm Street and Chapel Street from “one-way” to “two-way”.



Route 265's north-bound route (CT*transit* Route 243) could utilize the same routing due to the conversion of "one-way" to "two-way" streets at the New Haven Green. Thus, making these two routes more intuitive for bus riders with reduced bus turning movements and end-to end running times. It would also reduce bus congestion and bus stop crowding on Chapel Street at the New Haven Green with the relocation of bus stop demand to Church Street between Chapel Street and Elm Street.

To ensure a successful transition from "one-way" to "two-way" street conversions at the New Haven Green and Downtown New Haven, additional analysis of auto, bus, and pedestrian flows, bus customer transfers, as well as sidewalk space for bus stops along the westbound side of Elm and Church Streets would be needed to assess feasibility and impacts. A traffic analysis is recommended, as well as consideration of impacts to bus operations such as bus dwell times, schedules, and time-tables.

A close partnership between the City of New Haven and CT*transit* New Haven should be ensured at all stages of the "one-way" to "two-way" street conversion process to enhance the bus customer experience and overall traffic flow within Downtown New Haven. Auto and bus congestion and the ability of bus customers to make seamless bus transfers to access destinations are important considerations.

### Reduced Dwell Time at the New Haven Green

CT*transit* New Haven's bus routes operate from the New Haven Green, the primary hub for the system, as a result the area is often congested. A strategy to help relieve this congestion is to reduce the amount of time buses dwell at the New Haven Green. While dwell time allows for passengers to make transfers between routes and for operator layover, an improved system with greater headways (frequency of service) means that buses do not have to dwell to ensure seamless transfer activity.

This Study analyzed reducing the average dwell time for the four core local routes (CT*transit* Route 212 - Grand Avenue, Route 238 - Dixwell Avenue, Route 243 - Whalley Avenue and Route 265 - Congress Avenue) and the two proposed limited-stop BRT service. By reducing the average dwell time for these four routes from its **current four minutes to one minute** (and assuming a one-minute dwell for the BRT routes), the overall dwell time at the New Haven Green during a weekday is decreased significantly even while the number of overall transit trips is increased. In



other words, a one-minute dwell time effectively saves about one minute per bus trip, resulting in an **overall decrease in the collective time these buses spend at the New Haven Green by an estimated 625 daily minutes**. This reduction in dwell time could provide for some congestion relief at the Green.

Any changes to dwell times and headways at the New Haven Green would need to be further studied by *CTtransit* New Haven to ensure that the system has sufficient buses, could provide adequate connections between routes, allow for operator breaks at other locations in the system, and not conflict with any existing union contract obligations to their staff. This matter would be taken up at the Implementation Team planning level and logistical issues would be discussed at that juncture. If it is possible to lessen dwell time at the Green, all system-wide schedules would need to be adjusted and alternate dwell locations would need to be identified, as the Green remains the primary dwell location at this time.

### **Public Amenities**

Provision of public amenities are an important consideration for enhancing the customer experience on the New Haven Green, which serves as an active, vibrant, safe and attractive city center for both the bus traveler and many other users. To enhance the *CTtransit* customer experience, priority public amenities improvements include upgrading the existing bus shelters. Although some bus shelters were recently replaced, some shelters are simple three-sided shelters which shield waiting passengers from inclement weather but provide little else in terms of customer amenities or comfort. The bus shelter upgrade program should maintain installing 3-sided bus shelters and include other passenger amenities such as real-time information, well-lit pedestrian scale lighting, easy-to-read branded transit route signage and maps, and adequate space for bus passengers and passing pedestrians alike within the vicinity of *CTtransit* New Haven bus stops.

Provision of public amenities that support multi-modal connections are encouraged. These amenities include bicycle facilities and bike-share stations near high ridership bus stops, as well as traffic-calming measures at nearby intersections, pedestrian signal upgrades, protected bike lanes, signalized pedestrian crosswalks, and facilities that provide for the mobility of disabled travelers.



### **On-site Management / Governance**

Even though the New Haven Green has the largest single concentration of *CTtransit* activity, on-site management is limited. *CTtransit* provides personnel to assist customers at staffed ticket office opposite 900 Chapel Street as well as bus supervisors who are available to assist and monitor bus system performance. One of many challenges of the current system is that the *CTtransit* bus stops are used by both transit riders and others who are not customers of the system. Another challenge is the lack of back-of-house space for *CTtransit* bus drivers and customer service personnel. Consideration should be given to enhanced *CTtransit* management responsibilities at the high-ridership bus stop locations. This would primarily entail a re-design of the Chapel Street bus stop(s) which runs along the entire south side of the New Haven Green between Church Street and Temple Street. Recommended improvements include a larger overhead shelter for passengers, bathroom facilities for *CTtransit* staff and an enhanced ticket office with brand identity for the system. It is recommended that *CTtransit* engage with the proprietors of the New Green and the City of New Haven to memorialize existing and new management responsibilities.

## **5 Additional Considerations**

To fully achieve the goals set forth in this Study, there are additional transit supportive measures that should be considered and potentially be employed. These tools, along with policy strategies, can augment the proposed BRT overlay service and cross-town service to truly make the *CTtransit* New Haven bus network and transit system a world-class operation.

### **5.1 Enhancing Existing Service in Key Corridors**

As discussed earlier, the four core routes (*CTtransit* Route 212 - Grand Avenue, Route 238 - Dixwell Avenue, Route 243 - Whalley Avenue and Route 265 - Congress Avenue) are proposed to remain unchanged when the potential BRT overlay routes and other strategies developed in this Study are implemented. This Study has identified discrete strategies to also potentially improve service along those local routes as follows:

**Local Route Simplification and Restructuring.** This strategy would modify existing route structures by consolidating variations in local service and realigning indirect service. Reduced costs could then be redirected to more frequent and more user-friendly service and longer spans of local



service. The resulting more frequent and fewer routes, with coordinated transfer opportunities, would result in a faster overall trip.

**Local Bus Stop Consolidation.** This strategy would be one of the least costly and most effective ways to provide faster, more reliable, and comfortable service. The placement and spacing of bus stops along a route have an impact on route reliability and travel time. With more bus stops, bus riders don't have to walk as far to access transit service; however, they may spend more time on the bus and waiting at the bus stop because service reliability is reduced, and travel time is increased. Bus stop consolidation focuses on balancing travel time and effective customer access.

## 5.2 Microtransit

Across the country, transit agencies, such as Norwalk Transit District, Alameda-Contra Costa Transit District and Los Angeles Department of JTransportation have been implementing microtransit, or on-demand transit, to fill coverage gaps in areas that have low fixed route transit ridership or areas that do not currently have transit but are not dense enough to support a fixed route. Changing patterns of transit use, in part due to the prevalence of Transportation Network Companies (TNCs) such as Uber, Lift, Via, etc., have prompted traditional transit agencies to borrow aspects of rideshare technology to investigate extending shared on-demand car (with or without TNC partnerships) or shuttle bus alternatives to their passengers. This microtransit alternative generally allows passengers to access shared rides (whether in cars or on shuttle buses) where the pick-up time and or location is scheduled by the user, and the routes, origins and/or destinations may contain some element of flexibility.

The new flexibility of on-demand service potentially allows transit providers to reach people in a more widely drawn and thinly populated area more economically than fixed route bus service.

## 5.3 Title VI Compliance

Title VI of the Civil Rights Act of 1964 protects people from discrimination based on race, color, and national origin in programs and activities receiving federal financial assistance. As a public transportation provider, *CTtransit* is required to assess if the changes would represent a major service change and if so, conduct an analysis to verify that the change



complies with Title VI of the Civil Rights Act. The analysis considers if there are adverse effects or impacts on minority riders as a result of a service change. Prior to implementation of any major service change, including those identified in this study, CT*transit* would need to conduct such an analysis. The following is CTDOT’s Major Service Change Policy:

“All changes in service meeting the definition of a “Major Service Change” are subject to a Title VI Service Equity Analysis and a public hearing prior to presentation to the Commissioner of Transportation for approval and implementation actions. The following are considered “major service changes” that would require a public hearing and a service equity analysis prior to approval by CTDOT:

1. A proposal to abandon all service on an entire bus route or rail line, or elimination of a route or a branch that reduces the span of service by more than five percent (5%);
2. A proposal to eliminate service on a portion of a bus route or rail line that represents more than twenty percent (20%) of the route miles of the particular route or line. (No major service change will be considered if alternative transit service is available on existing duplicative service provided by another transit provider or by transfer to another route, and if the elimination does not trigger any other threshold for a major service change);
3. A proposal to substantially reduce service on a bus route or rail line, specifically where reduction of service increases the headway of the peak period service by more than fifty percent (50%) or more than doubles the off-peak headway.
4. The addition of, or reduction in, more than ten percent (10%) of the rail or bus system’s overall riders or vehicle revenue hours through one or more route changes.

The BRT Overlay Service would meet the definition of a Major Service Change under Criteria 4 as it would result in a 36% increase in total daily revenue hours compared to existing service. A Title VI analysis would be performed prior to implementation.



## 6 Moving the Plan Forward

The Greater New Haven region is served by a robust CT*transit* New Haven bus system that provides transit mobility for the region’s population to access jobs and educational opportunities. As evidenced by the existing and future market analysis, the region relies (and will continue to rely) on the bus system. **Regional demographics support a continued investment in transit.** *The Move New Haven Transit Mobility Study* supports this continued investment with the consideration of transit enhancements that strengthen the system with BRT features along key corridors, cross-town service, mini-hubs, the impacts of downtown one-way to two-way street conversions, micro-transit, and new approaches to the management of the New Haven Green transit hub in order to continue to improve customer service and service productivity, which are the hallmarks of a modern transit system.

With continued public and stakeholder participation, the CT*transit* New Haven bus rider experience can be improved through thoughtful re-programming of the system’s service and the funds used to sustain it, as well as the implementation of infrastructure improvements that can be delivered in a phased fashion as funding becomes available. Strengthening a well-established transit system is no small task and requires leadership and dedication at every level. The CT*transit* New Haven system currently provides an important transit link for residents, visitors, and workers of the Greater New Haven region.

**This Study can be used as a resource for enhancing the transit system to get passengers where they need to go quickly, efficiently and safely.** In order to move this Study forward, the following next steps should be undertaken. The suggested implementation timeframe is provided in Section 8 of this report.

- In coordination with CT*transit*, evolve the sketch operating schedules developed in this Study to implementable schedules for the proposed BRT routes.
- Consider one-way to two-way conversions of key roadways in Downtown New Haven and dwell management strategies at the New Haven Green in the production of the implementable schedules
- Incorporate public and stakeholder feedback to refine improvements.



- Advance the BRT-related infrastructure improvements (queue jumps, bus-only lanes, stations and mini-hubs to further study and design
- Refine BRT operating cost estimates
- Refine BRT capital cost estimates
- Explore federal funding opportunities such as the FTA’s Corridor-Based grants to make a substantial capital investment within a specific corridor(s). This FTA grant could potentially apply to the implementation of mini-hub infrastructure and for infrastructure to support the BRT overlay services along *CTtransit* New Haven Routes 212, 238, 243, and 265) including BRT stations, queue jumps, bus-only lanes and TSP implementation. Additional federal grant programs can be explored to acquire the fleet necessary to support improved service headways and spans
- Conduct a public outreach effort to communicate the benefits of the proposed service improvements
- Conduct Title VI analysis
- Implement BRT Overlay routes with mini-hubs, queue jumps, bus only lanes and fleet procurement
- Further study proposed Cross-town routes including development of implementable schedules, ridership estimates and refined costs
- Develop a branding and marketing plan for the BRT service
- Continuation of regional campaigns that are promoting the benefits of a strong transit system for all users
- Advance implementation of suggested transit enhancements to local service within the core corridors and consider studying additional improvements to the remainder of the system including implementation of Microtransit.

## 7 Opportunities for Systemwide Improvements (Building on Core Corridors)

This Study focused on improvements in the four core corridors. If and when improved, these core corridors could serve as the foundation upon which improvements across the entire *CTtransit* New Haven bus network can be progressed. The opportunities include:

- Developing a rating system tied to route productivity to manage requests for route expansions and additional bus stops





- Expanding public amenities at stops across the full system, including developing and implementing standards based upon bus stop usage
- Expanding public amenities at the New Haven Green, as the system's primary destination, while focusing on implementation of the studied management improvements
- Evolving routes to form a grid structure centered on key hubs and rail stations, rather than the existing hub and spoke system
- Exploring additional limited-stop BRT service, including on Route 1 between the CT Post Mall and Downtown New Haven<sup>11</sup> or other routes in the *CTtransit* New Haven bus system
- Improving headways and spans on remaining routes so that the entire system operates with primary routes on consistent headways and spans of service, seven days per week
- Investigating additional intersections to include TSP and queue jumps as additional limited-stop service is implemented and traffic controllers are upgraded region-wide

The suggested phasing and implementation timeframe of these improvements is provided in Section 8 of this report.

## 8 Improvements and Implementation Timeframe

The *Move New Transit Mobility Study* studied and developed potential transit supportive options to strengthen and modernize the *CTtransit* New Haven bus system. The following is a summary of these actions and the timeframes required to implement them. Timeframes for implementation are dependent upon the availability of funding and procurement requirements. **Table 6** presents the actions, the area of focus for these actions, and the suggested implementation timeframe.

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<sup>11</sup> BRT service on Route 1 has been previously studied in CTDOT's *Route 1 Bus Rapid Transit Feasibility Study* completed in February 2017.



**Table 6: Improvements and Implementation Timeframe**

Actions	Focus	2019	2020				2021				2022				2023			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Develop rating system to measure route productivity, and manage route expansions & new bus stops requests	Systemwide	■																
Expand public amenities at bus stops across entire bus system	Systemwide	■																
Refine Move New Haven Study's sketch operating schedules into implementable schedules for proposed BRT routes	Core Corridors	■																
Expand public amenities at New Haven Green; focus on implementation of on-site management/governance improvements for New Haven Green	Systemwide		■															
Incorporate public & stakeholder feedback to refine improvements	Core Corridors		■															
Advance BRT-related infrastructure improvements (queue jumps, bus-only lanes, BRT stations and mini-hubs) for further study and design	Core Corridors		■	■	■													
Refine BRT operating cost estimates	Core Corridors				■													
Refine BRT capital cost estimates	Core Corridors					■												
Explore federal funding opportunities including FTA Corridor-Based grants for a substantial capital investment within a specific corridor(s)	Core Corridors				■	■	■											
Conduct a public outreach effort communicating benefits of proposed service improvements	Core Corridors						■											
Conduct Title VI analysis	Core Corridors							■										
Implement BRT overlay routes in core corridors with mini-hubs, stations, queue jumps, bus lanes and fleet procurement	Core Corridors								■	■	■							
Continue study of proposed cross-town routes (refine ridership estimates and costs), and develop implementable schedules	Core Corridors				■	■												
Develop a branding and marketing plan for the BRT service	Core Corridors									■	■							
Continue regional campaigns promoting the benefits of a strong transit system for all users	Core Corridors/Systemwide										■	■						
Advance implementation of suggested transit enhancements to local service within the core corridors; Consider studying additional improvements for remainder of bus system including implementation of Microtransit	Core Corridors/Systemwide												■					
Evolve routes to form a grid structure centered on additional key hubs and rail stations instead of existing hub and spoke system	Systemwide													■	■			
Explore additional limited-stop BRT services, including Route 1 between CT Post Mall and Downtown New Haven	Systemwide													■	■	■		
Improve headways and spans on remaining routes outside of core corridors	Systemwide													■				
Investigate additional intersections for TSP & queue jumps as additional limited-stop service is implemented & traffic signals are upgraded region wide	Systemwide														■			



## 9 Benefits for CTtransit Riders & the New Haven Region

Consistent with the collaboratively developed vision for the CTtransit New Haven system, the proposed BRT overlay service and its related features, the potential cross-town service and the potential New Haven Green management strategies, the goals and objectives of the Study will have been addressed while providing the following potential significant benefits to CTtransit riders and the New Haven region:

### Improved connections to jobs and education

- The BRT overlay routes in the core corridors would serve key employment and education centers such as Southern Connecticut State University, Veterans Affairs Connecticut Healthcare System, Temple Medical Center and Gateway Community College.
- The new routes would further serve the following residential and commercial developments in the City of New Haven:
  - ✓ Hill-to-Downtown (City of West Haven – City of New Haven BRT Overlay Route)
  - ✓ Live, Work, Learn, Play (Town of Hamden – City of New Haven BRT Overlay Route)
  - ✓ Downtown Crossing (City of West Haven – Town of New Haven BRT Overlay Route)
  - ✓ 900 Chapel St (City of West Haven – Town of New Haven BRT Overlay Route)
  - ✓ Mill River (Town of Hamden – City of New Haven BRT Overlay Route)

### Upgraded quality, reliability and speed of service

- The initiatives could drastically upgrade service including frequency, span of service, and faster travel time in the core corridors through:
  - ✓ Introduction of bus priority treatments such as TSP, queue jump lanes and dedicated bus lanes. The Hamden – New Haven BRT overlay route could provide an estimated 33% decrease in travel time compared the existing CTtransit 212 and 238 routes. The West Haven – New Haven BRT overlay route could result in an estimated 43% decrease in travel time compared to the existing CTtransit 243 and 265 routes
  - ✓ Diversification of routes from local-only to local and limited; microtransit introduced as a service type to be investigated



- ✓ Cross-town routes to potentially provide improved connections for passengers travelling across Downtown New Haven

#### User-friendly service

- The proposed BRT overlay service would offer existing features like real-time information, potential off-board fare collection and branded vehicles to enhance the passenger experience
- Proposed mini-hubs could potentially optimize transfers between routes outside of the New Haven Green and provide an opportunity to further communicate with customers and improve system visibility

#### Retain existing riders and attract new transit riders

- The initiatives result in a net increase in transit riders

#### Reduced private automobile congestion and greenhouse gas production

- The BRT overlay service would reduce vehicle miles travelled by 3,185 per weekday as compared to existing service today

#### Provided cost-efficiency

- While the operating cost of the proposed initiatives are not net \$0, the improvements are discernible and can be customized and phased based upon the investments that can be sustainably funded. Significantly more service would be provided, especially on the weekends, which would result in increased costs. Implementation of other strategies could also moderate cost increases.

The benefits afforded to CT*transit* New Haven riders could increase substantially with the additional strategies outlined in this Study:

- ✓ Route simplification and restructuring could provide riders with **improved service headways** and **improved bus reliability and on-time performance**.
- ✓ Microtransit would fill in service gaps and **provide reliable and cost-effective service** for areas with lower demand.
- ✓ Bus stop consolidation would **reduce bus customer travel times**.



- ✓ Expanding improvements to other routes in the system would result in a **cohesive, easy to use, modern bus system** for the Greater New Haven Region.

## Who Benefits from a Successful Transit System?

### Transit is a benefit to the community even if you're not a rider:

- Promotes the **economy** by providing more travel choices to jobs and educational opportunity and enables growth.
  - *Every \$1 invested in public transit yields approximately \$4 in economic benefits.*<sup>12</sup>
  - *Over 320,000 jobs and 250,000 households are within a ½ mile of existing bus service within Greater New Haven.*<sup>13</sup>
- Provides a **lifeline** for seniors, youth, people on low incomes, people without automobiles (including one-car households) and people with disabilities, perhaps a friend, neighbor, or relative.
  - *More than 30,000 households without a car are within a ½ mile of existing bus service within Greater New Haven.*<sup>14</sup>
- Reduces **parking demand, roadway congestion and carbon emissions**. A reduced parking footprint which provides more land for new homes and employment opportunity in the downtown.
- Provides **travel choice** if your first travel method falls through.
- **Welcomes visitors** to the area who do not want to rent a car or pay for taxi service.
- **Saves money** on gasoline and the cost of auto-ownership.
- Provides you with **personal time** to listen to music, work, nap and other mobile activities.

<sup>12</sup> American Public Transit Association

<sup>13</sup> 2014 U.S. Census Bureau

<sup>14</sup> 2014 U.S. Census Bureau