Rhode Island's Highway Safety Improvement Program

Pawtucket/Central Falls Station | Pawtucket, RI

Multimodal Transportation Safety and Efficiency Assessment

May 2017

RI DOT Driven to get you there

RIPTA Rhode Island Public Transit Authority

City of Pawtucket

City of Central Falls Incorporated 1895

Federal Transit Administration

HSIP

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Introduction

The Pawtucket/Central Falls Station is a future MBTA Commuter Rail station, which will serve as a transportation hub for various transportation modes including trains, buses, bicyclists, pedestrians, and vehicles. The future station is projected to open in 2019. The station is proposed to be located along the existing commuter rail line between Barton Street and Goff Avenue in Pawtucket, Rhode Island. The future station provides commuters an additional option for travel to Boston, T.F. Green Airport, and South County, RI rather than utilizing the Providence or South Attleboro stations, which are very heavily utilized. The station provides an additional connection for bus service with rail access.

Although the station is currently under design by the Rhode Island Department of Transportation (RIDOT), the RIDOT felt it was necessary to perform a Multimodal Transportation Safety and Efficiency Assessment (MTSEA). A MTSEA reviews how each mode of transportation will join and how they work collectively at the future station. This assessment considered the operations and mobility of the facilities and roadway network under current conditions and under future conditions. The MTSEA documents observed and projected deficiencies as well as the necessary improvements for mitigation. The improvements were prioritized for implementation for either Tier 1, 2 or 3.

The Pawtucket/Central Falls Station MTSEA followed the federal guidelines for a Road Safety Assessment (RSA). A RSA is a formal safety performance with an independent, interdisciplinary team to review existing or future roadways. The Pawtucket/Central Falls Station MTSEA builds upon these approaches by applying

the tools and principles of a roadway safety assessment to a multimodal transportation network and by making projections to anticipate vulnerable user and automobile safety deficiencies. Prior MTSEA efforts have focused on identifying the safety and travel efficiency needs of transportation users across all modes (i.e. automobile, transit, bicycle, pedestrians) at major transportation hubs.

The Pawtucket/Central Falls Station MTSEA is unique in that it focused on the site of a future project. The Pawtucket/Central Falls Station is currently under design for the RIDOT, as previously mentioned. Once the preliminary design stages are completed, the project will be put out for bid as a design-build contract. In 2016, a Transportation Investment Generating Economic Recovery (TIGER) Grant application was submitted to the federal government to provide funding for the design and construction of the Pawtucket/Central Falls Station. The TIGER Grant application was approved by the United States Department of Transportation and $13.1 million in funding was awarded, which filled the funding shortfall. While certain elements of the site have been planned, funded and are under design (i.e. northbound and southbound platforms, cross platform pedestrian access, platform to surface transportation access, and drop-off/pick-up areas also known as a "kiss and ride" area), other elements (i.e. surface transportation access and egress, parking areas, and key multimodal connections) are currently in the planning stages. Those plans will be informed by the findings and recommendations of this assessment.

This approach presents unique challenges and opportunities. Unlike similar assessments at T.F. Green/Interlink and Wickford Junction stations, this assessment was a challenge because the Pawtucket/Central Falls Station has not been constructed yet. Clear and specific deficiencies could not be definitively identified; rather, the team of stakeholders visualize how various users might travel to and from the station, predict their critical needs, anticipate their most efficient routes and the possible safety hazards they may include. Conversely, conducting a RSA at this stage allows for consideration of potential safety concerns during the planning and design phases. This approach will save in design and construction funds spent, improve ease of implementation, and lends itself to improved communication and coordination between stakeholders.

Typical RSAs conducted by RIDOT involve a multidisciplinary team evaluating existing conditions and identifying possible factors contributing to crash history and severity at these locations. An MTSEA expands this scope first to consider the unique needs of each user by mode and second to consider the efficiency or quality of travel for each of the different modes.

The findings of the field visit and follow-up workshop are then prioritized in order of perceived importance and associated with potential opportunities for targeted improvement/corrective mitigation. The potential improvements to be considered are either spot or systemic and are categorized as Tier 1, 2 or 3. Tier 1 are improvements considered critical to assist vehicles, bicyclists, and pedestrians using the station to access it in an efficient and safe manner given a minimal infrastructure budget for improvements. Tier 2 improvements are highly recommended for

opening day but could be delayed due to budgetary restraints, and Tier 3 improvements are recommendations based upon the future needs (assuming future Transit Oriented Developments (TOD)) of the site and the surrounding roadway network.

1.1 Study Area

The study area for the MTSEA consists of the area within a quarter-mile (1/4) radius of the future Pawtucket/Central Falls Station, which is also commonly viewed as the 5-minute walk radius for pedestrians. Key roadways and intersections included within this radius are as follows.

- Roadways:
  - Barton Street
  - Bayley Street
  - Commerce Street
  - Conant Street
  - Dexter Street
  - Goff Avenue
  - Main Street
  - Mineral Spring Avenue
  - Pine Street
  - Weeden Street
- Intersections:
  - Barton Street at Dexter Street
  - Bayley Street at Dexter Street
  - Goff Avenue at Dexter Street
  - Goff Avenue at Pine Street
  - Goff Avenue/Exchange Street at Broad Street
  - Main Street at Dexter Street/Park Place West
  - Main Street at Pine Street
  - Mineral Spring Avenue at Conant Street
  - Mineral Spring Avenue at Main Street/Church Street
  - Weeden Street at Conant Street/Centre Street

Figure 1-1 depicts the entire study area reviewed.

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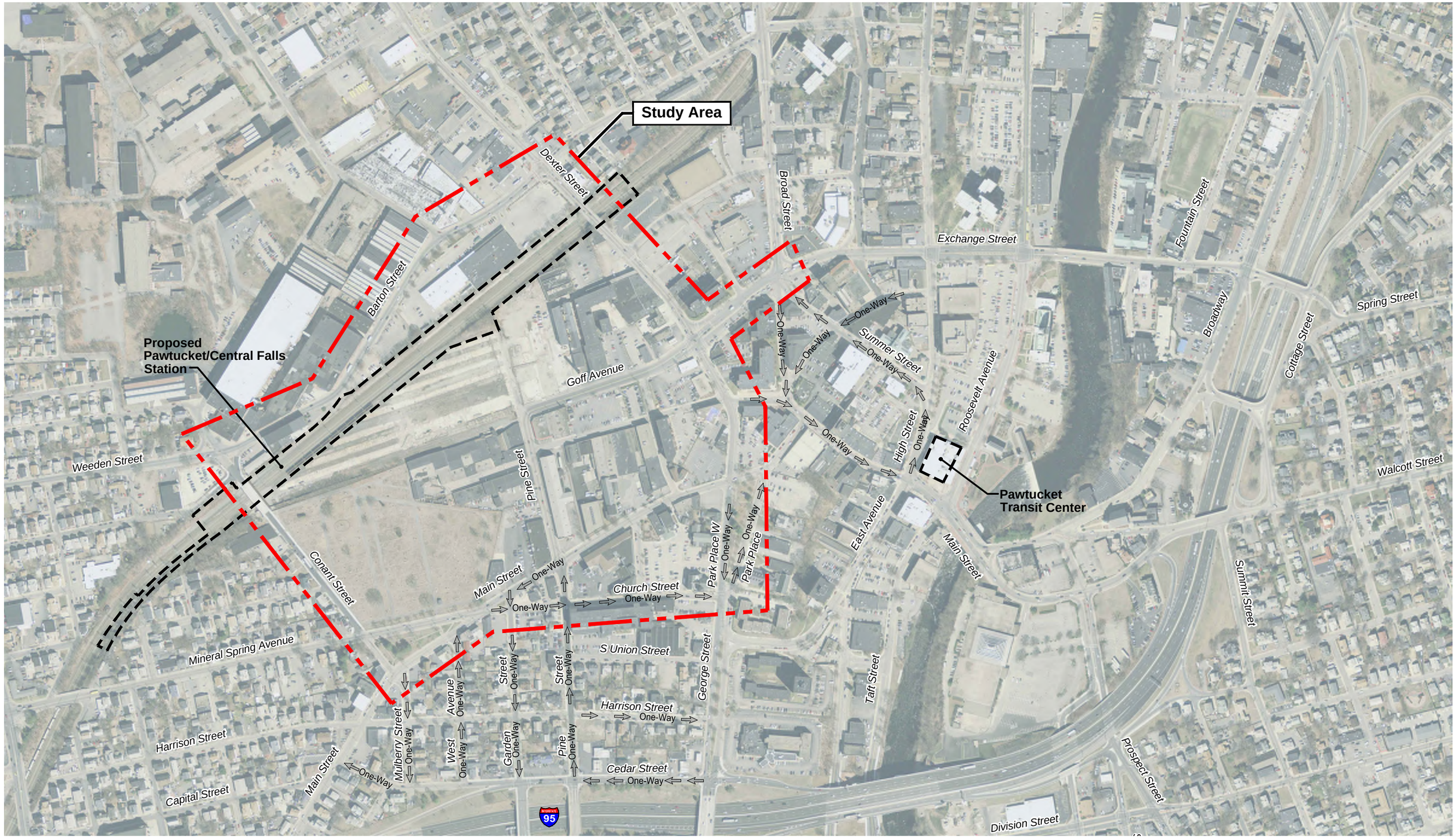

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Project Area
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 1-1

2

Multimodal Transportation Safety and Efficiency Assessment

2.1 Objective of Road Safety Assessments

This MTSEA followed federal guidelines for conducting a Road Safety Assessment (RSA). The Federal Highway Administration (FHWA) defines a RSA as a "formal safety performance evaluation of an existing or future road or intersection by an independent, multidisciplinary team". RSAs are a valuable tool for transportation agencies to evaluate road safety issues contributing to injuries and deaths and to identify opportunities for improvement. The success of RSAs has led to the FHWA including the RSA process as one of its nine "proven safety countermeasures".

Some element of safety is considered in every project; however, sometimes conditions merit a more detailed safety review. RSAs examine these conditions in detail by pulling together an interdisciplinary team that looks at the issues from different perspectives – perspectives that are often not a part of a traditional safety review. RSAs also consider safety from a human factors point of view, which aims to answer the following questions:

- How and why are people reacting to the roadway conditions?
- What do people sense and how do they react to those senses?
- What are the associated risks with those elements?

Interactions between all road users are investigated to determine potential risk and to identify program and measures to help reduce those risks and enhance safety in the roadway environment for all users.

2.2 Multimodal Transportation Safety and Efficiency Assessment (MTSEA) Interdisciplinary Team

An interdisciplinary team approach is a key factor in the success of RSAs. Interactions between all road users (e.g., pedestrians and motor vehicles, commuter traffic and recreational vehicle traffic, bicycles and motor vehicles, etc.) are investigated to determine potential risks and to identify programs and measures to help reduce those risks; creating a safer environment for all road users. By working with an interdisciplinary team of stakeholders, the views of each of the unique users can be captured and integrated into solutions and countermeasures.

The Interdisciplinary RSA Team for the Pawtucket/Central Falls Station MTSEA consisted of engineers and stakeholders from the City of Pawtucket, City of Central Falls, Rhode Island Public Transit Authority (RIPTA), area bicycle advocates, Federal Transit Administration, the local police department, and RIDOT. Representatives from VHB facilitated the RSA. The MTSEA was conducted on October 17th in 2016.

The members of the MTSEA team are as follows:

- Richard Sullivan – Rhode Island Public Transit Authority
- Greg Nordin – Rhode Island Public Transit Authority
- Eric Weiss – Bicycle Advocate and Owner at Cogent
- Julie Oakley – Rhode Island Department of Transportation
- Dave Martone – Rhode Island Department of Transportation
- Andrew Koziol – Rhode Island Department of Transportation
- Thomas Queenan – Rhode Island Department of Transportation
- Sean Raymond – Rhode Island Department of Transportation
- Benjamin Jacobs – Rhode Island Statewide Planning
- Eric Papetti – Federal Transit Administration
- Chris LaMacchia – Federal Transit Administration
- William Sisson – Pawtucket Fire Department
- John Dolan – Pawtucket Fire Department
- Paul King – Pawtucket Police Department
- Paul Catarina – Pawtucket Police Department
- Jan Brodie – Pawtucket Foundation
- Mike Wilcox – Pawtucket Planning
- Jay Rosa – Pawtucket Planning
- Mike Cassidy – Pawtucket Planning

- Susan Mara – Pawtucket Planning
- Thomas Deller – Central Falls Planning
- Mike Burns – Pawtucket Department of Public Works
- Andrew Silvia – Pawtucket Department of Public Works
- Peter Pavao – VHB
- Kristin Caouette – VHB
- Matt Lomas – VHB
- Kayla Cabral – VHB

2.3 Data Review

2.3.1 Crash Analysis

The Rhode Island Strategic Highway Safety Plan (SHSP) outlines seven emphasis areas to support the overall goal of reducing statewide fatalities and serious injuries. The seven emphasis areas are Impaired Driving, Intersection and Run-Off-The-Road Crashes, Occupant Protection, Speeding, Young Drivers, Vulnerable Road Users, and Older Drivers. The Rhode Island Highway Safety Improvement Program (HSIP) aligns with the infrastructure related emphasis areas identified in the SHSP, including Intersection, Run-Off-The-Road, Vulnerable Road Users, and Older Drivers. The HSIP reviews crash data for the statewide emphasis areas on an annual basis in order to prioritize based on safety needs by location.

There are currently no known existing deficiencies in that study area that have been included on the statewide Emphasis Areas top list; however, the MTSEA does include a focus on Vulnerable Road Users and Local Roads. From 2009-2013, there were over 400 fatalities and serious injuries statewide, which involved a pedestrian or bicyclist. This translates to over 20 percent of all fatalities and serious injuries in the state during that time period. Additionally, over this same time period 25 percent of all fatalities and 35 percent of all serious injuries occurred on locally owned roadways, outside of RIDOT jurisdiction.

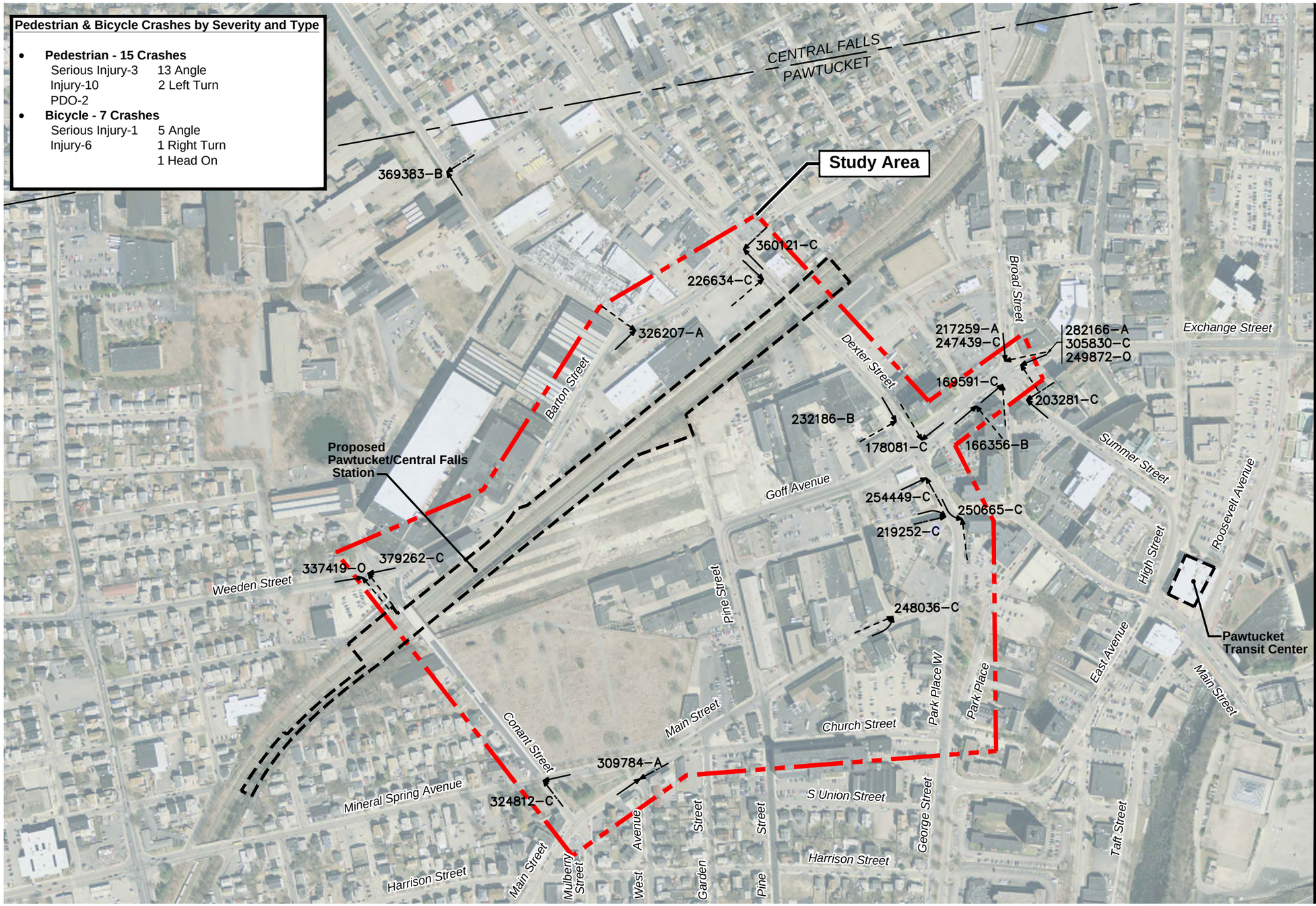
Crash data for the assessment area was provided by the RIDOT for the five-year period between January 1, 2011 and December 31, 2015. RIDOT maintains the statewide database for all crash reports as submitted by local and state police departments. These crashes were reviewed by severity and crash type. Severity is measured using the KABCO method which assigns a severity type to each crash.

K-type crashes result in a fatality, A-type crashes result in an incapacitating injury, B-type crashes result in an evident injury, C-type crashes result in complaints of pain, and O-type crashes result in property damage only. **Figure 2-1** provides a collision diagram illustrating the pedestrian and bicycle crashes and summarizing the vehicular crashes throughout the study area resulting in an injury. No crashes were found to result in a fatality.

Throughout the study area, twenty-three (23) pedestrian and bicycle crashes and 107 vehicular crashes resulting in injury, occurred between 2011 to 2015. Eight (8) crashes resulted in an incapacitating injury (A-type crash), fourteen (14) crashes were B-type, and the remaining were C-type injury crashes. Forty (40) rear-end crashes and twenty-eight (28) angle crashes occurred at intersections within the study area. More than half of the total number of crashes occurred during daylight conditions. Twenty-four percent (24%) of the total crashes occurred during the evening commuter peak period when congestion is typically highest.

Pedestrian & Bicycle Crashes by Severity and Type

- **Pedestrian - 15 Crashes**
  - Serious Injury-3: 13 Angle
  - Injury-10: 2 Left Turn
  - PDO-2
- **Bicycle - 7 Crashes**
  - Serious Injury-1: 5 Angle
  - Injury-6: 1 Right Turn
  - 1 Head On



Vehicular Injury Crashes by Severity and Type

- **Barton St./Weeden St. Corridor - 7 Crashes**
  - Serious Injury-1: 4 Single Vehicle
  - Injury-6: 2 Head On
  - 1 Rear End
- **Broad St. at Goff Ave. - 13 Crashes**
  - Serious Injury-2: 7 Rear End
  - Injury-9: 5 Angle
  - 1 Sideswipe
- **Dexter St. at Clay St. - 2 Crashes**
  - Injury-2: 2 Rear End
- **Dexter St. at Barton St. - 10 Crashes**
  - Injury-10: 8 Rear End
  - 1 Angle
  - 1 Single Vehicle
- **Dexter St. at Goff Ave. - 14 Crashes**
  - Injury-14: 10 Rear End
  - 3 Angle
  - 1 Head On
- **Dexter St. at Bayley St. - 3 Crashes**
  - Injury-3: 2 Angle
  - 1 Rear End
- **Main St. at Park Pl. W. - 2 Crashes**
  - Injury-2: 1 Rear End
  - 1 Single Vehicle
- **Pine St. at Cross St. - 1 Crash**
  - Injury-1: 1 Angle
- **Pine St. at Congress St. - 1 Crash**
  - Injury-1: 1 Angle
- **Pine St. at Conant St. - 4 Crashes**
  - Serious Injury-1: 3 Single Vehicle
  - Injury-3: 1 Rear End
- **Pine St. at Barton St. - 3 Crashes**
  - Injury-3: 2 Single Vehicle
  - 1 Head On
- **Pine St. at Goff Ave. - 7 Crashes**
  - Injury-7: 3 Angle
  - 3 Single Vehicle
  - 1 Rear End
- **Pine St. at Bayley St. - 2 Crashes**
  - Injury-2: 2 Rear End
- **Pine St. at Main St. - 7 Crashes**
  - Injury-7: 4 Angle
  - 2 Rear End
  - 1 Head On
- **Pine St. at Church St. - 1 Crash**
  - Injury-1: 1 Single Vehicle
- **Conant St. at Weeden St. - 5 Crashes**
  - Injury-5: 4 Rear End
  - 1 Angle
- **Conant St. at Mineral Spring Ave. - 12 Crashes**
  - Injury-12: 5 Angle
  - 5 Rear End
  - 1 Head On
  - 1 Single Vehicle
- **Conant St. at Main St. - 2 Crashes**
  - Injury-2: 2 Angle
- **Main St. at West Ave. - 4 Crashes**
  - Injury-4: 2 Single Vehicle
  - 2 Rear End

SOURCE:
CRASH DATA PROVIDED BY RIDOT TRAFFIC RESEARCH UNIT.
CRASH DATA PROVIDED DATES FROM 2011 THROUGH 2015.

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SYMBOLS

- MOVING VEHICLE
- BACKING VEHICLE
- PEDESTRIAN
- BICYCLE
- PARKED VEHICLE
- FIXED OBJECT

TYPES OF COLLISION

- REAR END
- HEAD ON
- SIDE SWIPE
- OUT OF CONTROL
- LEFT TURN
- ANGLE

SEVERITY

K	FATAL INJURY CRASH
A	INCAPACITATING INJURY CRASH
B	NON–INCAPACITATING INJURY CRASH
C	COMPLAINT INJURY CRASH
O	NO INJURY/PROPERTY DAMAGE ONLY CRASH

CRASH CASE INFORMATION

XXXXXX CRASH CASE NUMBER

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Collision Diagram
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 2-1

2.3.2 Background Projects

The City of Pawtucket Planning Department provided the completed and programmed housing projects throughout the City. **Table 2-1** shows developments that are located within a one-quarter mile radius and a one-half mile radius of the future site of the Pawtucket/Central Falls Station.

Table 2-1 Pawtucket Housing Developments

Distance from Station	Development	# of Units	Status	Total
Within ¼ Mile 5-minute walk	The Lofts 125	140	Completed	229
	Gately Building	13	Completed	
	Bayley Street Lofts #505	25	Completed	
	Dexter Street Lofts	51	Programmed	
Within ½ Mile 5-10 minute walk	Slater Cotton Mill Apartments	125	Completed	299
	Riverfront Lofts	55	Completed	
	Fuller Mill Lofts	15	Programmed	
	Nulco Lofts	104	Programmed	

This information emphasizes the value that a transportation hub may have in this area and the potential for multimodal users in the immediate vicinity of the future station.

2.3.3 Transit Inventory

In August 2015, a Traffic Impact and Access Study (TIAS) by Gordon R. Archibald, Inc. (GRA) was completed for the RIDOT to identify the impacts of the future Pawtucket/Central Falls Station to the surrounding roadway network. From the existing conditions inventory, GRA documented the Rhode Island Public Transit Authority (RIPTA) bus routes that currently travel through the study area. Three of the listed bus routes (Route 71, Route 73, and the R-line) currently operate along Goff Avenue past the site without stopping, while the other three routes listed (Route 1, Route 72, and Route 75) currently operate along nearby Exchange Street. The Pawtucket Transit Center in Downtown Pawtucket is primarily the origin or destination for these routes. **Table 2-2** below summarizes the bus routes within the quarter-mile radius.

Table 2-2 RIPTA Bus Routes

Route Number	Description	Origin/ Destination	Weekday Frequency	Saturday Frequency	Sunday/ Holiday Frequency
R-Line	Broad St./ N. Main St.	Pawtucket Transit Center/ Cranston City Line	3-6/hr daytime	3/hr daytime	3/hr daytime
1	Hope St./ Eddy St.	TF Green Airport/ S. Attleboro MBTA Station	Varies per stop	1-2/hr daytime	1-2/hr daytime
71	Broad St.	Stop & Shop (Mendon Rd.)/ Job Lot (Ann Mary St.)	1-2/hr daytime	1-2/hr daytime	1-2/hr daytime
72	Weeden St./ Central Falls	Pawtucket Transit Center/ Kennedy Plaza	2/hr daytime	1-2/hr daytime	1-2/hr daytime
73	Mineral Spring/ Twin River/ CCRI	CCRI Lincoln/ Pawtucket Transit Center or Slater Mill Stop	1/hr daytime	No Service	No Service
75	Dexter Street	North central Industrial Park (Powder Hill Rd.)/ Pawtucket Transit Center.	1/hr daytime	1/hr daytime	1/hr daytime

2.3.4 Vehicular Trip Generation

The TIAS by GRA also assessed trip generation. Ridership projections, an anticipated train schedule, the proposed number of parking spaces available, and the "MBTA Commuter Rail Passenger Count Results" memo dated December 21, 2012 were used to determine the anticipated vehicular traffic generated by the future Pawtucket/Central Falls Station. It should be noted that 208 parking spaces proposed at the site that was used to determine the trip generation was based upon a previous layout of the site. As previously mentioned in this report, the parking at the site is unknown and this MTSEA will be used to assist in determining the best locations for parking. The following assumptions were made in the 2015 GRA study in order to determine the site generated trips:

- 55% of the total peak period ridership occurs during the weekday morning peak hour.
- 50% of the total peak period ridership occurs during the weekday evening peak hour.
- 80% of the total vehicle trips generated were estimated to be park and ride users. The remaining 20% of the transit riders are users that will be dropped off and picked up at the station.
- 50% of riders that will be dropped off and picked up will use the area designated on Barton Street.

The projected site-generated trips based on the GRA assumptions mentioned above, from the 2015 GRA TIAS, are below in **Table 2-3**.

Table 2-3 Trip Generation

Peak Period	Enter	Exit
AM Peak Hour	135	21
PM Peak Hour	21	135

The 2015 study by GRA provides the assumed trip distribution for the site generated trips for the future Pawtucket/Central Falls Station. This trip distribution is established based upon the ridership information, expected travel routes to and from the future station, and balanced to completely distribute all of the new trips throughout the roadway network.

2.3.5 Regional Access

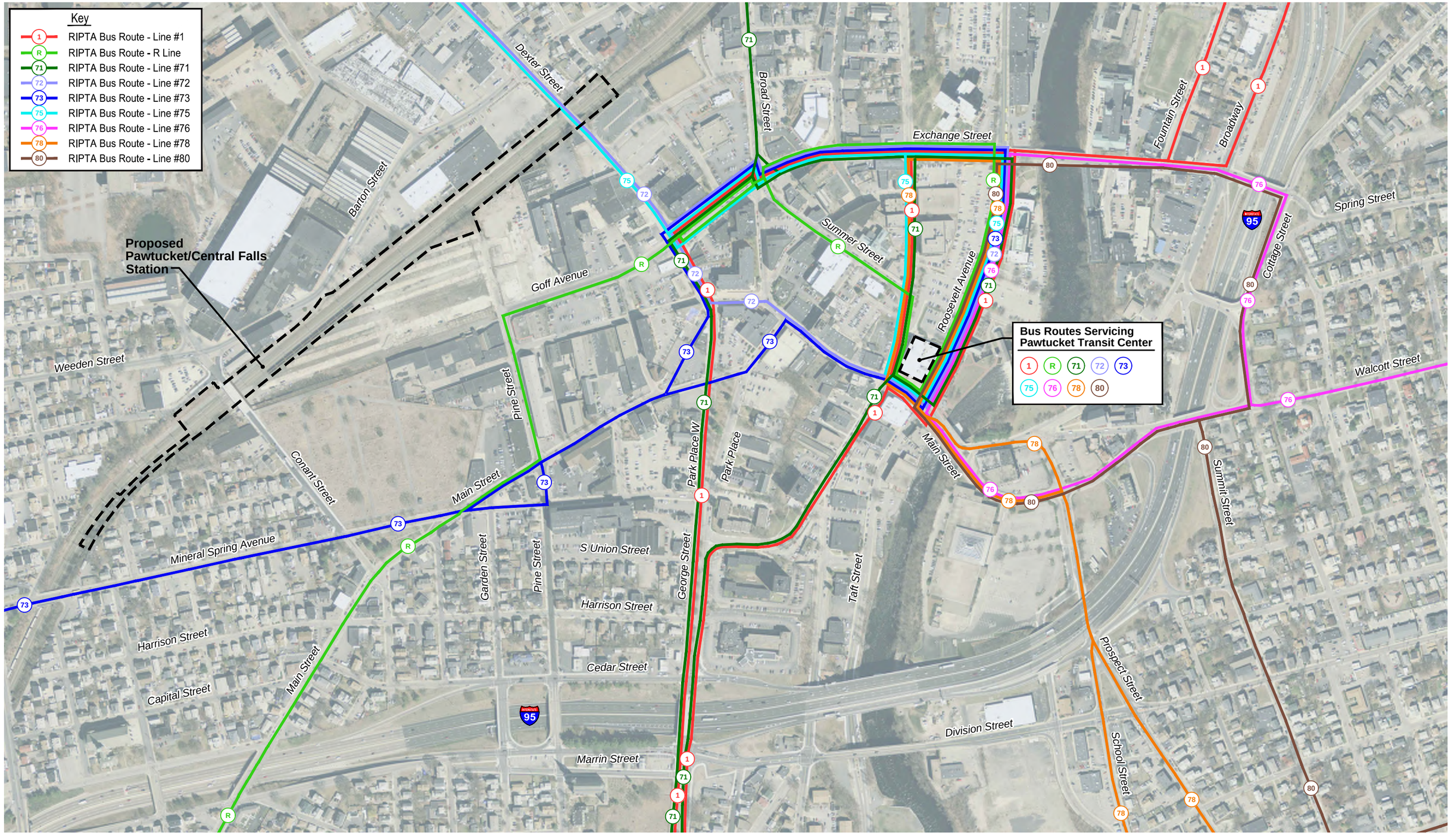
Regional access to and from the future station was discussed during the RSA. Regional access refers to access to and from the proposed Pawtucket/Central Falls Station beyond the quarter mile radius, specified in the general assessment **Figure 1-1**. Likely travel routes were documented for all modes of transportation including transit, pedestrian, bicycle, and vehicle access to and from the station based upon two entrance points to the station located on Barton Street and at the intersection of Pine Street and Goff Street. The use of the existing regional access by modes allows prioritization of particular modes on those specific roadways.

Transit buses from RIPTA currently utilize the roadway network in the vicinity of the station for various routes, but there are no transit stops at the current location. When entering from the south, RIPTA uses Main Street then travels along Pine Street and Goff Street, passing by the southern entrance of the future station. Providing regional access via RIPTA transit buses is crucial in order to gain ridership from outside of the walkable and bike-able vicinity of the future station. **Figure 2-2** shows the existing regional access transit map and **Figure 2-3** proposed transit bus route changes that will access the Pawtucket/Central Falls Station when completely built.

Vehicle access is more wide spread throughout the vicinity of the station. From the south, vehicles will likely utilize I-95 then split to either George Street or Pine Street depending on if they are parking at the site or being dropped off or picked up. From the north, vehicles will utilize Dexter Street and Barton Street to access the northern entrance to the future station.

Bicycle access was reviewed in order to determine the existing access to the future station. The East Coast Greenway provides nearby regional bicycle access to downtown Pawtucket. The East Coast Greenway runs along Roosevelt Avenue and Taft Avenue east of the site. Segments of Exchange Street and Dexter Street provide dedicated bicycle lanes in the vicinity of the site. Otherwise, bicycle facilities are shared with vehicular travel lanes.

Figure 2-2 thru **Figure 2-5** show the Regional Access Maps to the site for transit, vehicle, and bicycle access.



Note:
The proposed Pawtucket/Central Falls Station currently has no transit stops serving the Site but transit access near the Site is depicted above.

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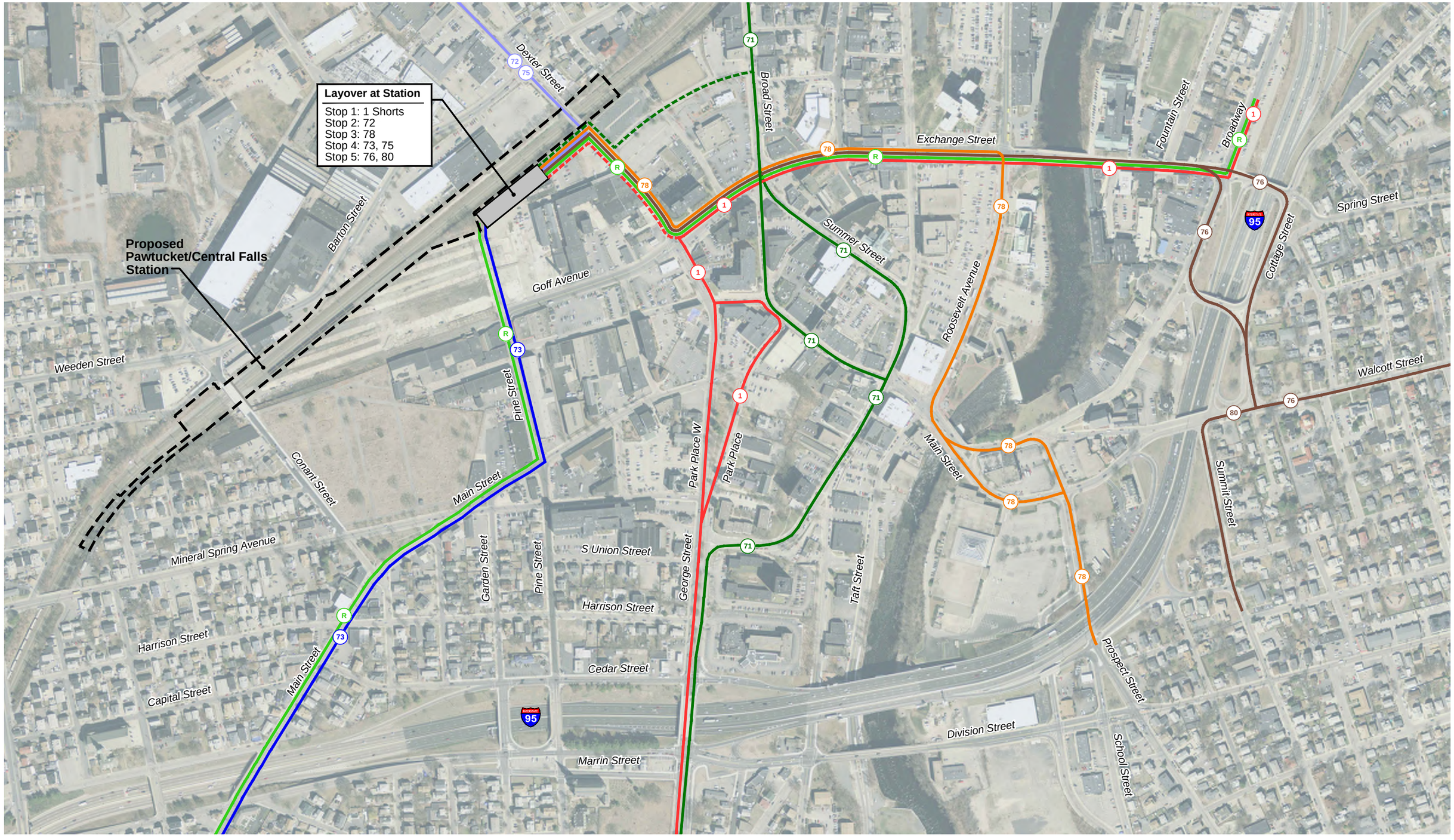
Existing Regional Access Map - Transit Figure 2-2
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island



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Note:
The proposed Pawtucket/Central Falls Station currently has no transit stops serving the Site but transit access near the Site is depicted above.

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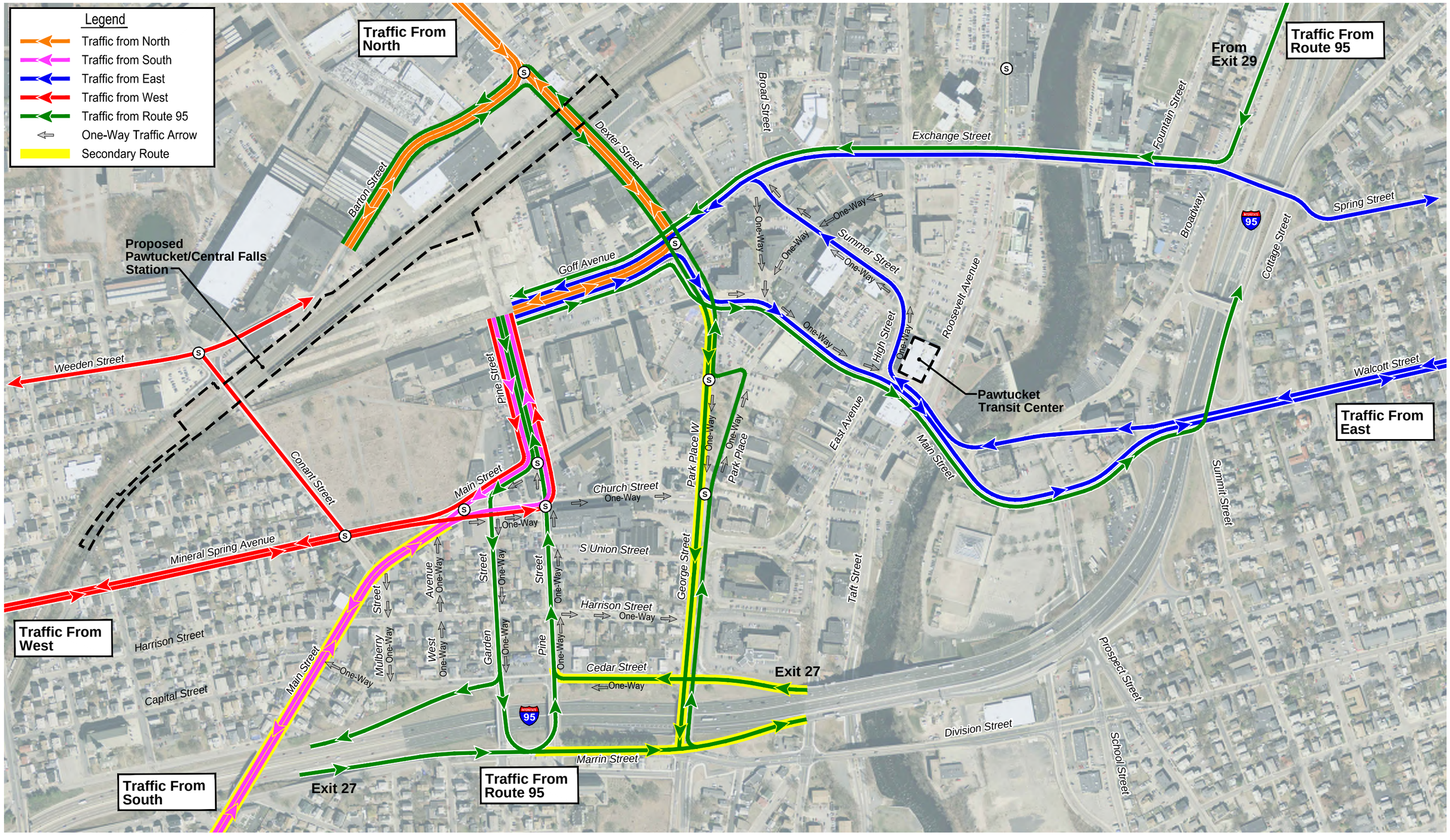
Proposed Regional Access Map - Transit Changes
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 2-3



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Regional Access Map - Vehicular
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 2-4

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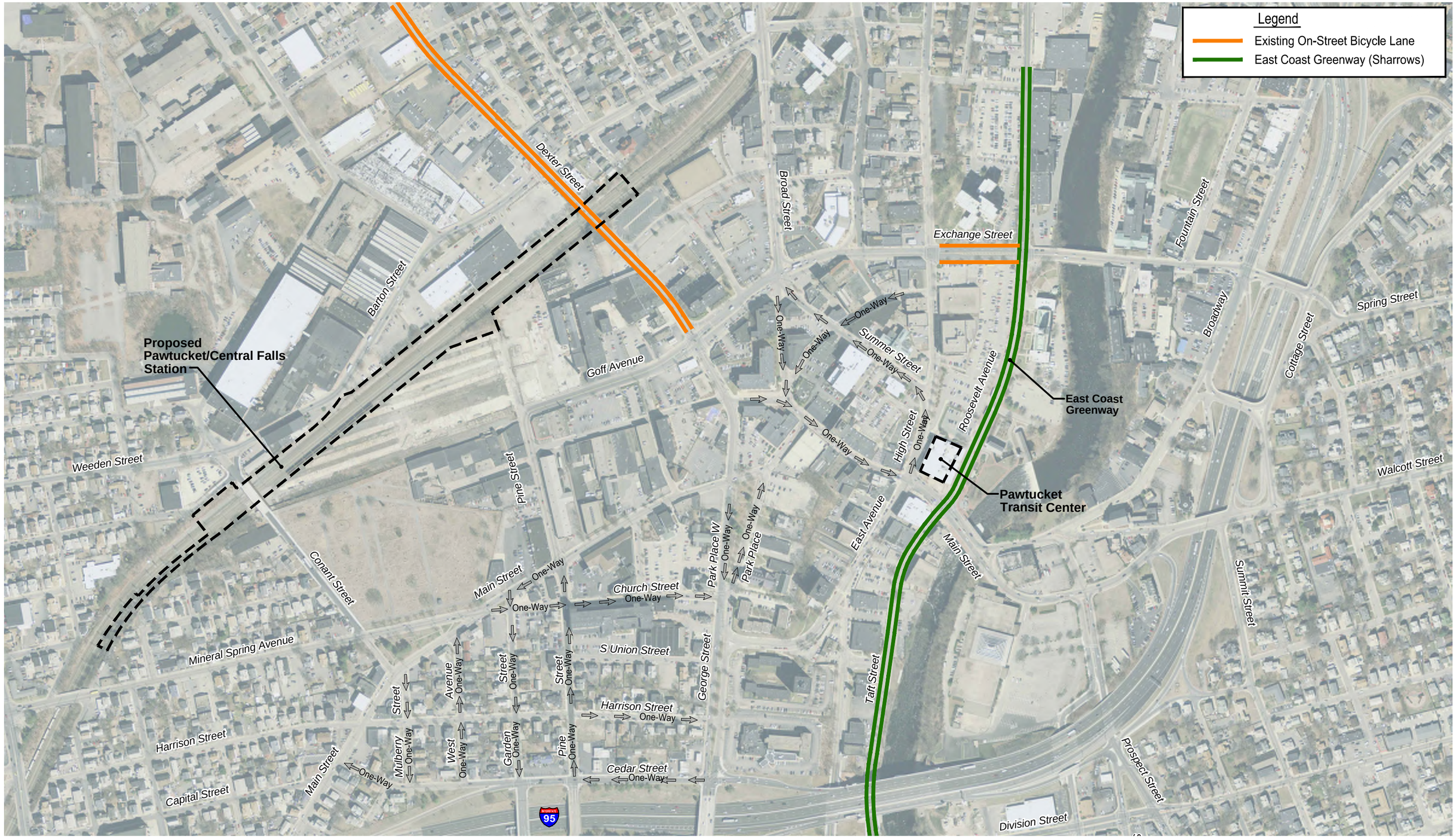

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Regional Access Map - Bicyclists
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 2-5

2.4 MTSEA Findings and Suggestions for Improvement

Based on a review of the provided crash data, available background and project information, and existing field conditions, the MTSEA participants identified several key safety-related findings within the assessment area. These findings were prioritized in order of perceived importance and associated with potential opportunities for targeted improvement/corrective mitigation.

Table 2-4 summarizes the findings and suggestions for each location included in this assessment.

Table 2-4 Summary of Findings and Suggestions for the Pawtucket/Central Falls Station MTSEA

OBSERVATION	TIER 1 AND 2 IMPROVEMENTS	TIER 3 IMPROVEMENTS	COMMENTS
1.0 Area-wide			
Inadequate Pedestrian Facilities – The current pedestrian facilities observed could prevent pedestrians from having appropriate access to desired destinations and facilities. This includes lack of marked crossings, unsignalized crossings at key locations, ADA compliance, and lack of sidewalks or deteriorated sidewalks. 	**ENGINEERING:** **1.1** Install or replace sidewalks where missing or insufficient along pedestrian routes to the station. Specifically, along: • Both sides of Pine Street north of Main Street, • Southeast corner of Main Street/Pine Street, • North side of Main Street between Pine Street and Park Place W, • Intersection of Weeden Street at Conant Street, and • Both sides of Barton Street east of Conant Street. **1.2** Restripe all crosswalks with continental style pavement markings for enhanced visibility.	**ENGINEERING:** **1.3** Consider reviewing future developments throughout the City to determine additional pedestrian routes to and from the station.	**As new developments are programmed and constructed, review the need for additional signage to accommodate the new travel demands in the community.**
Inadequate Bicycle Facilities – Lack of bike routes, signage, pavement markings, and facilities in the vicinity of the station.	**ENGINEERING:** **1.4** Install bicycle pavement markings (e.g. dedicated bicycle lane markings, sharrows, etc.) and signage for enhanced visibility of bicyclists along: • Exchange Street, • Goff Avenue, • Pine Street, and • Barton Street. **1.5** Consider prioritizing different modes of transportation by street to establish routes for each mode and set expectations for all users.	**ENGINEERING:** **1.6** Consider reviewing future developments throughout the City to determine additional bicycle routes to and from the station.	**As new developments are programmed and constructed, review the need for additional signage to accommodate the new travel demands in the community.**

OBSERVATION	TIER 1 AND 2 IMPROVEMENTS	TIER 3 IMPROVEMENTS	COMMENTS
High Vehicle Speeds– Wide pavement and minimal striping leads vehicles to speed, specifically in areas north of the rail road tracks. 	**ENGINEERING:** **1.7** Restripe area-wide due to lack of pavement marking visibility. **1.8** Utilizing striping to implement a road diet or modify roadway cross sections to provide multimodal accommodations.		
Insufficient vehicle sight lines – Narrow streets with buildings located close to property lines and small turning radii, obstruct sight lines for vehicles to other vehicles and to other roadway users, specifically in areas south of the rail road tracks. 	**ENGINEERING:** **1.9** Install No Parking signs 20 feet from crosswalks and 25 feet from curb cuts to reinforce State Law. **1.10** Utilize hatch pavement markings to restrict parking 20 feet from crosswalks and 30 feet from traffic control to reinforce State Law. **1.11** Remove or relocate objects that limit sight lines of vehicles and pedestrians, where feasible. **ENFORCEMENT:** **1.12** Continue enforcement of State Law prohibiting parking within 20 feet from crosswalks and 30 feet from traffic control to reinforce State Law.	**ENGINEERING:** **1.13** Consider signalizing the intersection of Dexter Street at Bayley Street due to limited sight visibility.	
Driver Confusion at one-way roads – Many one-way roads in the vicinity of the future station lack appropriate One-Way, Do Not Enter, and Wrong Way signage.	**ENGINEERING:** **1.14** Enhance signage for one-way roads at intersections to include DO NOT ENTER, ONE-WAY, and WRONG WAY signs where appropriate.		**Item 1.14 was also recommended in the 2015 Traffic Impact and Access Study by GRA.**
2.0 Wayfinding			
Signage – Appropriate wayfinding signage at the time of the station opening will be critical to successful multimodal access.	**ENGINEERING:** **2.1** Install signage to and from the station and regional access points for vehicular traffic. **2.2** Install signage to and from the station for bicycle and pedestrian users.	**ENGINEERING:** **2.3** Consider reviewing future developments throughout the City to determine additional wayfinding signage needed.	**As new developments are programmed and constructed, review the need for additional signage to accommodate the new travel demands in the community.**

OBSERVATION	TIER 1 AND 2 IMPROVEMENTS	TIER 3 IMPROVEMENTS	COMMENTS
3.0 Signalized Intersections			
Signal timing and equipment deficiencies – Through observations during the field visit, it was noted that many existing signal timings and equipment are deficient and impacting traffic operations.	**ENGINEERING:** **3.1** Revise vehicular clearance times (minimum green, yellow, all red, and passage/extension time) to reflect speed and geometric conditions. **3.2** Revise the location and placement of signal heads due to poor cone of vision poor at: • Weeden Street at Conant Street, • Main Street at Park Place W, • Goff Avenue at Dexter Street, and • Goff Avenue at Exchange Street and Broad Street. **3.3** Revise traffic signal timings to provide more efficient operations at the intersections of: • Dexter Street at Barton Street, • Dexter Street at Goff Avenue, and • Goff Avenue ay Exchange Street and Broad Street. **3.4** Upgrade signal equipment to fix existing deficiencies.	**ENGINEERING:** **3.5** Consider revising signal phasing, traffic signal corridor coordinated and a pedestrian scramble phase, based on increased volumes to and from the future site, if warranted. Including additional turn phases and/or lanes where warranted. **3.6** Consider revising signal phasing to improve operations and safety with the increased traffic volumes from the opening of the station at the intersection of Dexter Street at Goff Avenue.	**Signal inventory and traffic analysis shall be conduct based on existing and future conditions to ensure efficient operations.** **Item 3.3 was also recommended in the 2015 Traffic Impact and Access Study by GRA.**
Pedestrian Accommodation Deficiencies– Pedestrian accommodation deficiencies were observed during the field visit, including deficient pedestrian signal equipment, poor visibility, and lack of awareness.  	**ENGINEERING:** **3.7** Review pedestrian signal equipment to identify and resolve any issues. **3.8** Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently. **3.9** Restripe signalized crosswalks with continental style pavement markings for enhanced visibility. **3.10** Construct curb extensions to provide improved visibility of pedestrians and shorten the pedestrian crossing distance. **3.11** Consider a lead pedestrian interval (LPI) to enhance pedestrian visibility. **3.12** Review pedestrian clearance times to ensure sufficient walk and flashing don't walk intervals.	**ENGINEERING:** **3.13** Upgrade pedestrian signal equipment to provide countdown timers, Accessible Pedestrian Signal (APS) push buttons, and detectable warning panels.	

OBSERVATION	TIER 1 AND 2 IMPROVEMENTS	TIER 3 IMPROVEMENTS	COMMENTS
Multimodal Access – Consider multimodal access for pedestrians and bicyclists along Andrew Ferland Way to access the station and any related sites, such as overflow parking.		**ENGINEERING:** **3.14** Construct a separated path/facility for pedestrian and bicycles between the station and overflow parking areas that are not immediately adjacent to the station site.	**Due to limited parking areas adjacent to the platforms, overflow parking may be located on Andrew Ferland Way. There is additional space between existing buildings to provide a separated area designated for pedestrian and bicycles to access the future station.**
4.0 Site Access and Development			
Parking – Station parking, handicap parking, and drop-off/pick-up areas for the opening day of operations must be identified to ensure smooth operations.	**ENGINEERING:** **4.1** Locate parking facilities for station users for daily and longer term use. **4.2** Locate ADA-accessible parking areas adjacent to the station. **4.3** Determine the queue/staking needed for the drop-off/pick-up parking area on Barton Street or Pine Street. **4.4** Provide bicycle parking on both the north and south side of the station to accommodate users. **ENFORCEMENT:** **4.5** Continue enforcement of State Law prohibiting parking within 20 feet from crosswalks and 30 feet from traffic control to reinforce State Law.		

OBSERVATION	TIER 1 AND 2 IMPROVEMENTS	TIER 3 IMPROVEMENTS	COMMENTS
Site Access – The southern access point to the site at the intersection of Pine Street and Goff Street does not have any traffic control. Inadequate bicycle and pedestrian facilities were observed in the vicinity of the station from both southern and northern points. 	**ENGINEERING:** **4.6** Enhance traffic control at the intersection of Pine Street and Goff Avenue due to increased volume with an all-way stop controlled intersection. **4.7** Coordinate uses of Goff Avenue to meet the needs for all roadway users including emergency vehicles, loading/unloading, pedestrians, bicyclists, vehicles, RIPTA buses. Consider using Pine Street to accommodate some of the needs of the roadway users listed. **4.8** Consider a HAWK or RRFB crossing at major crosswalks that provide access to the station. **4.9** Consider utilizing Goff Avenue as a primary bike route by revising the cross section to include a bike lane and multimodal accommodations. **4.10** Consider utilizing Pine Street (south) as the primary northbound bike route to the station by revising the cross section to include a bike lane and multimodal accommodations. Use Garden Street as the primary southbound bike route from the station.	**ENGINEERING:** **4.11** Develop a pedestrian and bicycle path at Andrew Ferland Way to accommodate multimodal traffic (particularly if overflow parking is located here). Consider HAWK or RRFB if Andrew Ferland Way is designated a key crossing. **4.12** Install a roundabout at the intersection of Pine Street and Goff Avenue due to increased volume.	**Item 4.6 was also recommended in the 2015 Traffic Impact and Access Study by GRA.** **Due to limited parking areas adjacent to the platforms, overflow parking may be located off Andrew Ferland Way. There is additional space between existing buildings to provide a separated area designated for pedestrian and bicycles to access the future station without walking/operating along Dexter Street.** **A HAWK is a High Intensity Activated Crosswalk, which is a signal that is used at major pedestrian crossing if it meets warrants provided in the MUTCD are met.** **A RRFB is a Rectangular Rapid Flashing Beacon, which is a flashing beacon used to supplement warning signage to provide enhanced awareness.**
5.0 Barton Street			
Wide pavement and horizontal curves – The wide pavement width and lack of pavement markings encourages high speeds and leads to drivers crossing the double yellow line on horizontal curves. 	**ENGINEERING:** **5.1** Consider installing speed tables to reduce speeds along the corridor due to the increased number of pedestrian and vehicular activity. **5.2** Revise roadway cross section to accommodate bike lanes in each direction with a buffer where possible. **5.3** Install additional signage to enhance the horizontal curves along the corridor. **5.4** Create a gateway to the site that is welcoming for all users.		**As part of the 2013 Statewide Horizontal Curve delineation project, additional curve warning signs were previously installed.**

OBSERVATION	TIER 1 AND 2 IMPROVEMENTS	TIER 3 IMPROVEMENTS	COMMENTS
Inadequate Pedestrian Facilities – The proposed northern entrance to the station will be on Barton Street and a midblock crossing will likely be installed. Pedestrian facilities are not adequate to accommodate an increased number of pedestrians due to the lack of visibility along Barton Street caused by limiting sight lines. 	**ENGINEERING:** **5.5** Construct curb extensions to provide improved visibility of pedestrians and shorten the pedestrian crossing distance. **5.6** Consider a HAWK or RRFB crossing at the major crossings adjacent to the entrance to the station. **5.7** Reconfigure Barton Street at Pine Street intersection to improve sight lines for vehicles, pedestrians, and bicyclists.	**ENGINEERING:** **5.8** Reconstruct sidewalks where they are deteriorated or inadequate along pedestrian routes to the station. (Outside what is listed in Item 1.1) **5.9** Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently.	**A HAWK is a High Intensity Activated Crosswalk, which is a signal that is used at major pedestrian crossing if it meets warrants provided in the MUTCD are met.** **A RRFB is a Rectangular Rapid Flashing Beacon, which is a flashing beacon used to supplement warning signage to provide enhanced awareness.**
6.0 Exchange Street			
Inadequate Pedestrian Facilities – High pedestrian volumes were observed along this corridor and will likely increase with the opening of the station. The existing pedestrian facilities do not meet ADA compliance and sidewalks are deteriorated.	**ENGINEERING:** **6.1** Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently. **6.2** Construct pedestrian refuge areas in the roadway to provide two stage crossings and limit pedestrian exposure.	**ENGINEERING:** **6.3** Reconstruct sidewalks where they are deteriorated or inadequate along pedestrian routes to the station. (Outside what is listed in Item 1.1)	
Inadequate Bicycle Facilities – Lack of bike routes, signage, and pavement markings in the vicinity of the station.	**ENGINEERING:** **6.4** Consider utilizing Exchange Street as a primary bike route by revising the cross section to include a bike lane and multimodal accommodations.		
7.0 Park Place W.			
Wide roadway cross section – Wide pavement width and cross section encourages high speeds and increases driver confusion.		**ENGINEERING:** **7.1** Consider one-way vs. two-way operations on Park Place W. between Main Street and Cedar Street.	

3

Countermeasure Implementation

All recommendations from this MTSEA have been reviewed and vetted by the assessment team. This chapter provides a high-level evaluation of the proposed mitigation measures for implementation feasibility and appropriateness.

3.1 Implementation Plan

Table 3-1 presents the implementation plan for the MTSEA recommendations, including the timeframe in which each recommendation could reasonably be implemented. In addition, the table lists the preliminary costs (where applicable) and the status of the recommendation. Implementation costs are order-of-magnitude estimates based on recent contracts and other sources.

As stated previously, the potential mitigation measures are categorized as Tier 1, 2 or 3.

- Tier 1 are improvements considered critical to assist vehicles, bicyclists, and pedestrians using the station to access it in an efficient and safe manner given a minimal infrastructure budget for improvements.
- Tier 2 improvements are highly recommended for opening day, but could be delayed due to budgetary restraints, and
- Tier 3 improvements are recommendations based upon the future needs (assuming future TOD) of the site and the surrounding roadway network.

Tier 2 and 3 are contingent upon additional traffic studies, traffic movement counts, design etc.

Table 3-1 Recommendations Matrix – Pawtucket/Central Falls Station MTSEA

Mitigation Measures	Timeframe			Preliminary Costs	Status
	Tier 1	Tier 2	Tier 3		
1.0 Area Wide					
1.1 Install or replace sidewalks where missing or insufficient along pedestrian route to the station. Specifically, along: • Both sides of Pine Street north of Main Street, • Southeast corner of Main Street at Pine Street, • North side of Main Street between Pine Street and Park Place W, • Intersection of Weeden Street at Conant Street, and • Both sides of Barton Street east of Conant Street.	**X**			$350,000	
1.2 Restripe all crosswalks with continental style pavement markings	**X**			$50,000	
1.3 Consider reviewing future developments throughout the City to determine additional pedestrian routes to and from the station			**X**	n/a	
1.4 Install bicycle pavement markings (e.g. dedicated bicycle lane markings, sharrows, etc.) and signage for enhanced visibility of bicyclists along: • Exchange Street, • Goff Avenue, • Pine Street and/or Garden Street, and • Barton Street		**X**		$10,000	
1.5 Consider prioritizing different modes of transportation by street to establish routes for each mode and set expectations for all users.	**X**			n/a	

Mitigation Measures	Timeframe			Preliminary Costs	Status
	Tier 1	Tier 2	Tier 3		
1.6 Consider reviewing future developments throughout the City to determine additional bicycle routes to and from the station			X	n/a	
1.7 Restripe area-wide due to lack of pavement marking visibility.	X			$50,000	
1.8 Utilizing striping to implement a road diet or modify roadway cross sections to provide multimodal accommodations.		X		$25,000/corridor	
1.9 Install No Parking signs 20 feet from crosswalks and 25 feet from curb cuts to reinforce State Law.	X			$10,000	
1.10 Utilizing hatch pavement markings to restrict parking 20 feet from crosswalks and 30 feet from traffic control to reinforce State Law.	X			$10,000	
1.11 Remove and relocate objects that limit sight lines of vehicles and pedestrians, where feasible.		X		Cost Dependent on Object	
1.12 Continue enforcement of State Law prohibiting parking within 20 feet from crosswalks and 30 feet from traffic control to reinforce State Law.	X			n/a	
1.13 Consider signalizing the intersection of Dexter Street at Bayley Street due to limited sight visibility.			X	$150,000	
1.14 Enhance signage for one-way roads at intersections to include DO NOT ENTER, ONE-WAY, and WRONG WAY signs where appropriate.	X			$10,000	
2.0 Wayfinding					
2.1 Install signage to and from the station and regional access points for vehicular traffic.	X			$100,000	
2.2 Install signage to and from the station for bicycle and pedestrian users.	X			$100,000	

Mitigation Measures	Timeframe			Preliminary Costs	Status
	Tier 1	Tier 2	Tier 3		
2.3 Consider reviewing future developments throughout the City to determine additional wayfinding signage needed.			X	n/a	
3.0 Signalized Intersections					
3.1 Revise vehicular clearance times (minimum green, yellow, all red, and passage/extension times) to reflect speed and geometric conditions	X			$10,000	
3.2 Revise the location and placement of signal heads due to poor cone of vision at: • Weeden Street at Conant Street, • Main Street at Park Place W, • Goff Avenue at Dexter Street, and • Goff Avenue at Exchange Street and Broad Street.	X			$25,000	
3.3 Revise traffic signal timings to provide more efficient operations at the intersections of: • Dexter Street at Barton Street, • Dexter Street at Goff Avenue, and • Goff Avenue at Exchange Street and Broad Street.	X			$10,000	
3.4 Upgrade signal equipment to fix existing deficiencies.	X			$25,000	
3.5 Consider revising signal phasing, traffic signal corridor coordination and a pedestrian scramble phase, based on increased volumes to and from the future site, if warranted. Including additional turn phases and/or lanes where warranted.			X	$25,000	
3.6 Consider revising signal phasing to improve operations and safety with the increased traffic volumes from the opening of the station at the intersection of Dexter Street at Goff Avenue.			X	$25,000	

Mitigation Measures		Timeframe			Preliminary Costs	Status
		Tier 1	Tier 2	Tier 3		
3.7	Review pedestrian signal equipment to identify and resolve any issues.	X			$10,000	
3.8	Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently.	X			$20,000	
3.9	Restripe signalized crosswalks with continental style pavement markings for enhanced visibility.	X			$50,000 (covered under Item 1.2)	
3.10	Construct curb extensions to provide improved visibility of pedestrians and shorten the pedestrian crossing distance.		X		$10,000/location	
3.11	Consider a leading pedestrian interval (LPI) to enhance pedestrian visibility.		X		$2,500/location	
3.12	Review pedestrian clearance times to ensure sufficient walk and flashing don't walk intervals.	X			$10,000 (covered under Item 3.1)	
3.13	Upgrade pedestrian signal equipment to provide countdown timers, Accessible Pedestrian Signal (APS) push buttons, and detectable warning panels.			X	$10,000/location	
3.14	Construct a separated path/facility for pedestrians and bicycles between the station and overflow parking areas that are not immediately adjacent to the station site.			X	Dependent on location of path	
4.0	**Site Access and Development**					
4.1	Locate parking facilities for station users for daily and longer term use.	X			n/a	
4.2	Locate ADA-accessible parking areas adjacent to the station.	X			n/a	
4.3	Determine queue/stacking needed for the drop-off/ pick-up parking area on Barton Street or Pine Street.	X			n/a	

Mitigation Measures		Timeframe			Preliminary Costs	Status
		Tier 1	Tier 2	Tier 3		
4.4	Provide bicycle parking on both the north and south side of the station to accommodate users.	**X**			$20,000	
4.5	Continue enforcement of State Law prohibiting parking within 20 feet of crosswalks and 30 feet from traffic control to reinforce State Law.	**X**			n/a	
4.6	Enhance traffic control at the intersection of Pine Street and Goff Avenue due to increased traffic volumes with an all-way stop controlled intersection.	**X**			$5,000	
4.7	Coordinate uses of Goff Avenue to meet the needs for all roadway users including emergency vehicles, loading/unloading, pedestrians, bicyclists, vehicles, and RIPTA buses. Consider using Pine Street to accommodate some of the needs of the roadway users listed.		**X**		n/a	
4.8	Consider a HAWK or RRFB crossing at major crosswalks that provide access to the station.	**X**			RRFB - $10,000/each HAWK - $75,000/each	
4.9	Consider utilizing Goff Avenue as a primary bike route by revising the cross section to include a bike lane and multimodal accommodations.		**X**		$10,000 (striping only)	
4.10	Consider utilizing Pine Street (south) as the primary northbound bike route to the station by revising the cross section to include a bike lane. Use Garden Street as the primary southbound bike route from the station.		**X**		$10,000 (striping only)	
4.11	Develop a pedestrian and bicycle path at Andrew Ferland Way to accommodate multimodal traffic (particularly if overflow parking is located here). Consider HAWK or RRFB, if Andrew Ferland Way is designated a key crossing.			**X**	Dependent on location of path	

Mitigation Measures	Timeframe			Preliminary Costs	Status
	Tier 1	Tier 2	Tier 3		
4.12 Install a roundabout at the intersection of Pine Street and Goff Avenue due to increased traffic volumes.			**X**	$1,000,000	
5.0 Barton Street					
5.1 Consider installing speed tables to reduce speeds along the corridor due to the increased number of pedestrians and vehicular activity.	**X**			$10,000	
5.2 Revise roadway cross section to accommodate bike lanes in each direction with a buffer where possible.		**X**		$10,000 (striping only)	
5.3 Install additional signage to enhance the horizontal curves along the corridor.	**X**			$5,000	
5.4 Create a gateway to the site that is welcoming for all users.		**X**		n/a	
5.5 Construct curb extensions to provide improved visibility of pedestrians and shorten crossing distances.		**X**		$10,000/location	
5.6 Consider a HAWK or RRFB crossing at major crossings adjacent to the entrance to the station.		**X**		RRFB - $10,000/each HAWK - $75,000/each	
5.7 Reconfigure Barton Street at Pine Street intersection to improve sight lines for vehicles, pedestrians, and bicyclists.	**X**			$20,000	
5.8 Reconstruct sidewalks where they are deteriorated or inadequate along pedestrian routes to the station. (Outside what is listed in Item 1.1)			**X**	$40/foot	

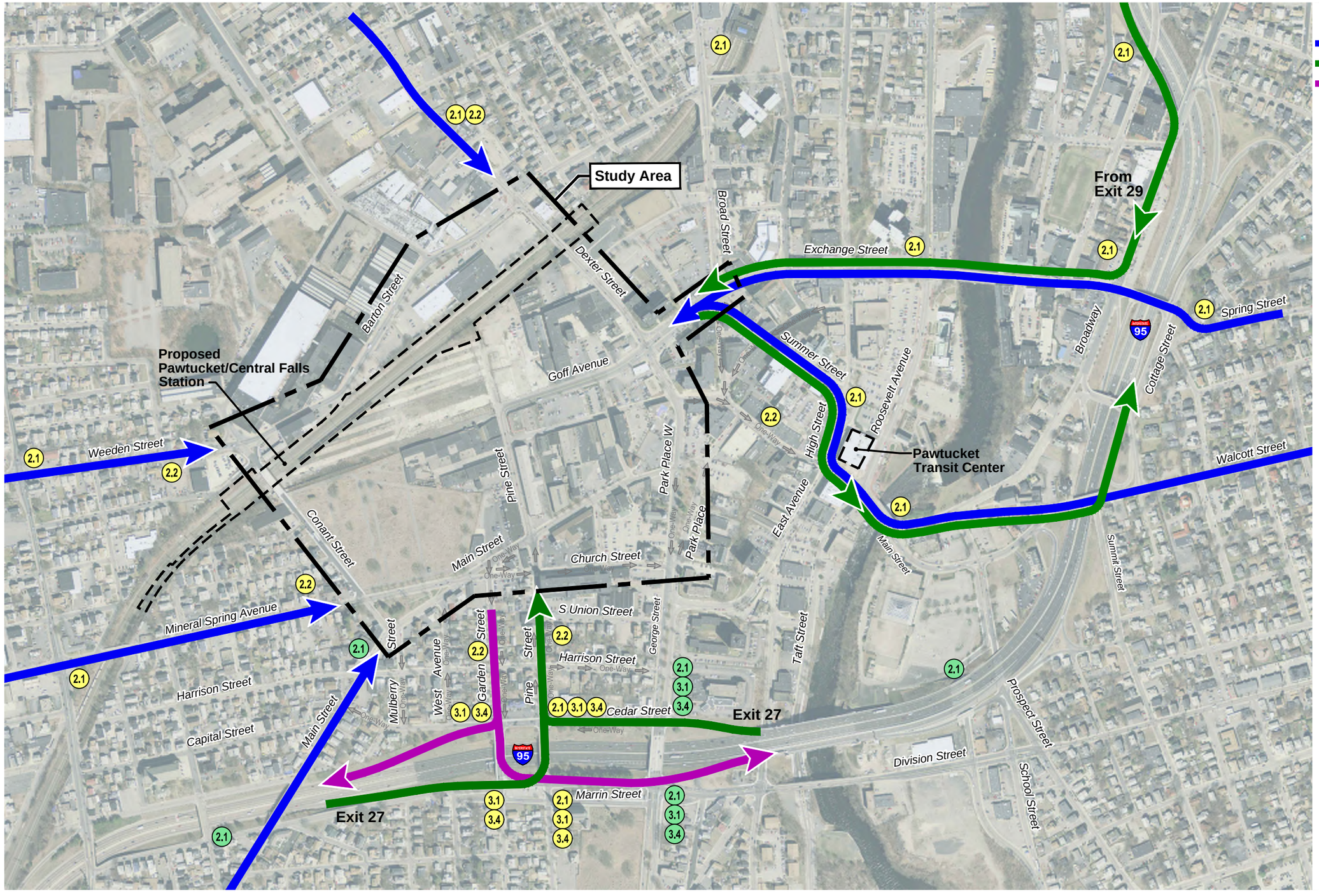
Mitigation Measures		Timeframe			Preliminary Costs	Status
		Tier 1	Tier 2	Tier 3		
5.9	Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently.			X	$20,000	
6.0	**Exchange Street**					
6.1	Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently.	X			$20,000	
6.2	Construct pedestrian refuge areas in the roadway to provide two stage crossings and limit pedestrian exposure.		X		$5,000	
6.3	Reconstruct sidewalks where they are deteriorated or inadequate along pedestrian routes to the station. (Outside what is listed in Item 1.1)			X	$40/foot	
6.4	Consider utilizing Exchange Street as a primary bike route by revising the cross section to include a bike lane and multimodal accommodations.		X		$10,000 (striping only)	
7.0	**Park Place W.**					
7.1	Consider one-way vs. two-way operations on Park Place W between Main Street and Cedar Street.			X	$25,000 (striping & traffic signal changes only)	

Table 3-2 summarizes the preliminary costs for each tier but does not include the cost of contingent work.

Table 3-2 Preliminary Costs Summary – Pawtucket/Central Falls Station MTSEA

Improvement Tier	Preliminary Costs	Contingent Work Costs
Tier 1	$500,000 ±	No
Tier 2	$150,000 ±	Yes
Tier 3	$1,500,000 ±	Yes

Figure 3-1 shows the proposed Regional Access Map for the Tier 1 mitigation measures and **Figure 3-2** depicts the Tier 1 Enhancements for the Study Area. Additionally, the Tier 1 mitigation measures were further broken down into primary and secondary key findings based on the origin-destination data obtained from the MBTA license Plate Survey at South Attleboro and Attleboro Stations on July 18, 2016. This helps further prioritize the Tier 1 improvements for opening day.



Legend

- Inbound Local Traffic
- Inbound Regional Traffic
- Outbound Regional Traffic
- (x.x) Primary Tier 1 Key Findings
- (x.x) Secondary Tier 1 Key Findings
- (S) Existing Traffic Signal

Key

- (2.1) Install signage to and from the station and regional access points for vehicular traffic
- (2.2) Install signage to and from the station for bicycle and pedestrian users
- (3.1) Revise vehicular clearance times (minimum green, yellow, all red and passage/extension times) to reflect speed and geometric conditions.
- (3.4) Upgrade signal equipment to fix existing deficiencies.

Area Wide

- (1.5) Consider prioritizing different modes of transportation by street to establish routes for each mode and set expectations for all users
- (1.7) Restripe area-wide due to lack of pavement marking visibility
- (1.9) Install No Parking signs 20 feet from crosswalks and 25 feet from curb cuts to reinforce State Law
- (1.10) Utilizing hatch pavement markings to restrict parking 20 feet from crosswalks and 30 feet from traffic control to reinforce State Law
- (1.12) Continue enforcement of State Law prohibiting parking within 20 feet from crosswalks and 25 feet from curb cuts to reinforce State Law
- (3.9) Restripe signalized crosswalks with continental style pavement markings for enhanced visibility
- (4.5) Continue enforcement of State Law prohibiting parking within 20 feet of crosswalks and 30 feet from traffic control to reinforce State Law

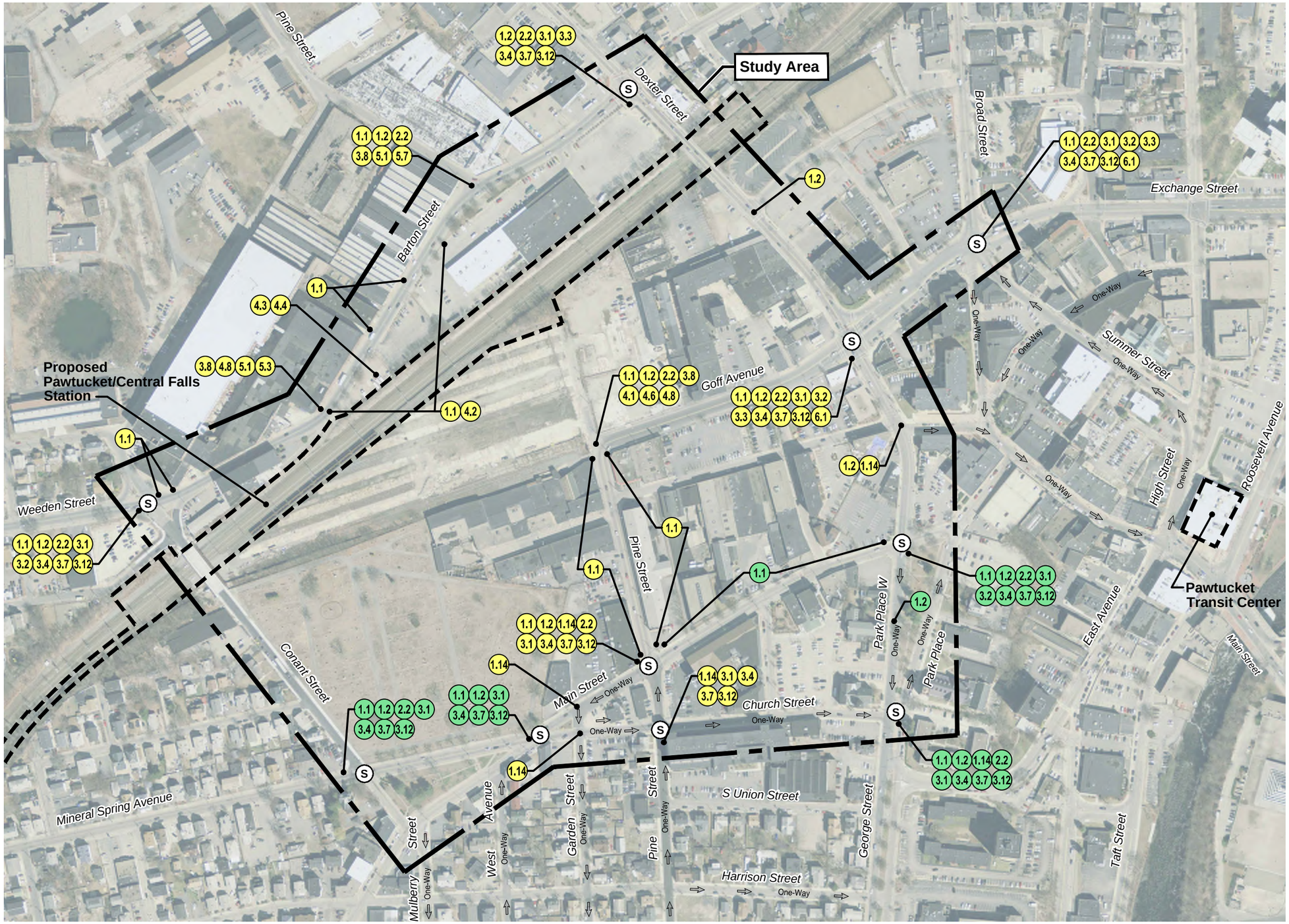
0 250 500 Feet

Note:
All mitigation measures depicted on this figure are Tier 1 only.
Tier 2 and 3 are described in Table 2-4 and 3-1.

vhb

Regional Access Map
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 3-1



Legend

- x.x — Primary Tier 1 Key Findings
- x.x — Secondary Tier 1 Key Findings
- S — Existing Traffic Signal

Key

- 1.1 Install or Replace Sidewalks or Insufficient Along Pedestrian Route to Station
- 1.2 Restripe All Crosswalks with Continental Style Pavement Markings
- 1.14 Enhance signage for one-way roads at intersectioins to include DO NOT ENTER, ONE-WAY, and WRONG WAY signs where appropriate
- 2.2 Install signage to and from the station for bicycle and pedestrian users
- 3.1 Revise vehicular clearance times (minimum green, yellow, all red and passage/extension times) to reflect speed and geometric conditions.
- 3.2 Revise the location and placement of signal heads due to poor cone of vision at:
  - Weeden Street at Conant Street
  - Main Street at Park Place W
  - Goff Avenue at Dexter Street
  - Goff Avenue at Exchange Street and Broad Street
- 3.3 Revise traffic signal timings to provide more efficient operations at the intersections of:
  - Dexter Street at Barton Street
  - Dexter Street at Goff Avenue
  - Goff Avenue at Exchange Street and Broad Street
- 3.4 Upgrade signal equipment to fix existing deficiencies.
- 3.7 Review pedestrian signal equipment to identify and resolve any issues
- 3.8 Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently
- 3.12 Review pedestrian clearance times to ensure sufficient walk and flashing don't walk intervals
- 4.1 Locate parking facilities for station users for daily and longer term use
- 4.2 Locate ADA-accessible parking areas adjacent to the station
- 4.3 Determine queue/stacking needed for the drop-off/pick-up parking area on Barton Street or Pine Street
- 4.4 Provide bicycle parking on both the north and south side of the station to accomodate users
- 4.6 Enhance traffic control at the intersection of Pine and Goff Avenue due to increased traffic volumes with an all-way stop controlled intersection
- 4.8 Consider a HAWK or RRFB crossing at major crosswalks that provide access to the station
- 5.1 Consider installing speed tables to reduce speeds along the corridor due to the increased number of pedestrians and vehicular activity
- 5.3 Installing additional signage to enhance the horizontal curves along the corridor
- 5.7 Reconfigure Barton Street at Pine Street intersection to improve sight lines for vehicles, pedestrians, and bicyclists
- 6.1 Exchange Street: Install ADA compliant wheelchair ramps with detectable warning panels and install pedestrian signal equipment for crosswalks with high pedestrian volume that are unsignalized currently

0 150 300 Feet

Note:
All mitigation measures depicted on this figure are Tier 1 only.
Tier 2 and 3 are described in Table 2-4 and 3-1.

Study Area Enhancements
Bicyclists/Pedestrians
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Figure 3-2

3.2 Countermeasure Effectiveness

Determined from the crash review, there are no known existing deficiencies throughout the study area that have been included in the statewide Emphasis Areas top lists. However, with the increase in pedestrian and vehicular volume projected to utilize this area with the construction of the station it is imperative to take preventative measures in order to mitigate potential conflicts before the opening of the station.

The Highway Safety Manual[1] and the Crash Modification Factor Clearinghouse[2] provide a database of crash modification factors to evaluate countermeasure effectiveness. These two resources provide an organized and peer-reviewed database of transportation crash countermeasures and are the basis of this review, where data is available.

3.2.1 High Intensity Activated Crosswalk (HAWK) and Rectangular Rapid Flashing Beacon (RRFB)

Lack of pedestrian visibility was observed during the MTSEA field walk within the vicinity of the future station. High Intensity Activated Crosswalks (HAWKs) or Rectangular Rapid Flashing Beacons (RRFBs) at key pedestrian crossings within the study area are the recommended countermeasure.

High-intensity Activated Crosswalks (HAWKs), as depicted below, consist of a signal face made up of three sections. Two red lights are mounted side by side above one centered yellow light. When activated by a pedestrian this combination of lights is used to slow vehicles to a stop, protect the pedestrian movement while crossing, and transition back to the vehicle movement when the pedestrian walk phase has ended. The system can be activated manually by a push button or by a passive system, which means that the presence of a pedestrian is enough to activate the signal, no push button is needed. This system should be installed at least a 100 feet from side streets or driveways that are controlled by stop of yield signs.

Figure 3-3 High-Intensity Activated Crosswalk (HAWKs)[3]

1 Highway Safety Manual. American Associate of State Highway and Transportation Officials. 1st Edition. 2010.

2 Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/.

3 Safety Effectiveness of the HAWK Pedestrian Crossing Treatment. U.S. Department of Transportation, Federal Highway Administration. https://www.fhwa.dot.gov/publications/research/safety/10045/index.cfm.

The Crash Modification Factor (CMF) Clearinghouse provides a modification factor for "Installation of a HAWK pedestrian-activated beacon at an intersection"[4]. This modification factor is based on a minor-road stop-controlled type facility on a roadway with speeds of between 30-40 mph. The HAWK pedestrian signal is also a Federal Highway Administration (FHWA) Proven Safety Countermeasure.

The CMF Clearinghouse concluded that:

- Approximately 29 percent of total crashes including all types and all severities had been reduced. Collisions between vehicles and pedestrians specifically could be reduced by 69 percent for all severity crashes.
- Provides warning to motorists if their view of the pedestrian is obstructed.

Rectangular Rapid Flashing Beacons (RRFBs), as depicted below, are user activated LEDs that supplement MUTCD compliant warning signs at unsignalized intersections or mid-block crosswalks. The system can be activated manually by a push button or by a passive system.

Figure 3-4 Rectangular Rapid Flashing Beacons (RRFBs)[5]

The CMF Clearinghouse provides limited information on the impact RRFBs have on crashes. As a surrogate for reduction in crashes, studies have reviewed their impact to quantify benefits of the installation of RRFBs. Specifically, FHWA and the State of Florida studied the benefits of the installation[6].

FHWA concluded that:

4 "Installation of a HAWK pedestrian-activated beacon at an intersection" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=2911. Accessed: November 29, 2016.

5 Rectangular Rapid Flashing Beacon (RRFB). U.S. Department of Transportation, Federal Highway Administration. https://safety.fhwa.dot.gov/intersection/conventional/unsignalized/tech_sum/fhwasa09009/

6 "Rectangular Rapid Flash Beacon (RRFB)" Frederick, Michael and Rice, Ed, FHWA-SA-09-009. May 2009.

- RRFBs are a low cost alternative to traffic signals and HAWK signals that are proven to increase driver yielding behavior at crosswalks.
- The stutter flash of the RRFB may have a greater response from drivers than traditional methods.
- From the study completed in Florida, yielding behavior was increased from 18 percent to 81 percent from converting a no-beacon arrangement to a beacon system mounted on the supplementary warning sign on the right side of the crossing.

Given these findings, HAWKs or RRFBs are proposed at key crossings throughout the study area to enhance pedestrian visibility with the increased number of pedestrian to utilize existing crossings in the vicinity of the station. A HAWK system generally costs $70,000 which includes mast arms, a controller cabinet, signal heads, conduit and cabling. The cost of a pair of RRFBs for one crossing would be approximately $10,000.

3.2.2 Pedestrian Crossing Enhancements

During the MTSEA insufficient pedestrian crossings were observed throughout the study area. Curb extensions, also known as bump-outs, and speed humps are the recommended countermeasures.

Curb extensions or bump-outs extend the curb to visually and physically narrow the roadway, reduce pedestrian crossing distances and exposure, improve sight lines between pedestrians and drivers, and increase the available space for pedestrian amenities such as benches, plantings, etc. The CMF Clearinghouse provides limited information concerning the impact of bump-outs on observed crashes. As a surrogate for reduction in crashes, studies have reviewed to quantify benefits of the installation of bump-outs. Specifically, the National Association of City Transportation Officials (NACTO) Urban Street Design Guide[7] studied the benefits of the installation.

The guide concluded that:

- Bump-outs increase the overall visibility of pedestrians by aligning them with the parking lane and reducing pedestrian exposure.
- Bump-outs can serve as a visual cue to drivers that they are entering an area with greater vehicular and pedestrian activity and can contribute to reduced speeds.
- Pedestrian crossing with bump-outs experienced a 20 percent increase in the number of vehicles stopping to allow the pedestrian to cross.

Speed tables are a method of traffic calming typically used to reduce operating speeds and/or cut-through volumes to minimize conflicts, provide easier crossings for pedestrians, and decrease traffic noise. The NACTO defined speed tables as

7 Urban Street Design Guide. The National Association of City Transportation Officials. 2013.

midblock traffic calming devices that raise the entire wheelbase of a vehicle to reduce its traffic speed. Speed tables are longer than speed humps and flat-topped with a height of 3 to 3.5 inches and a length of 22 feet.[8] The CMF Clearinghouse provides information regarding the safety impacts that speed humps have on crashes occurring on two-lane roadways in urban and suburban areas.

The CMF Clearinghouse concluded that:

- Streets that have a higher than desired operating speed are good candidates for speed humps, especially where there is an upcoming device which requires lower speeds such as a major pedestrian crossing, unsignalized intersection, or horizontal curve.
- The installation of speed humps has the potential to mitigate 40 percent of all crashes types and all crash severities[9].

Given these findings, bump-outs are proposed at all pedestrian crossings within a quarter-mile radius from the station. Speed humps are proposed along corridors that have higher than desired operating speeds, specifically Barton Street due to the increase in activity with the opening of the station. The typical cost of a pair of bump outs at a crosswalk would be $20,000, but may vary based upon the size of the bump-out. Speed humps typically cost $500.

3.2.3 Pedestrian Scramble

A pedestrian scramble, also known as Barnes Dance, is an exclusive pedestrian phase, which stops vehicle traffic in all directions and allows pedestrians to cross in any fashion, including diagonally.

The CMF Clearinghouse provides limited information concerning the impact on crashes that the pedestrian scramble has in urban areas. A study associated with the CMF[10] compared the effectiveness of reducing pedestrian crashes compared to motorist safety. From this study a CMF was created for Implementing Barnes Dance which states that vehicle/pedestrian crashes will be reduced, however angle, head-on, left-turn, rear-end, right-turn and sideswipe vehicular crashes will all increase with this countermeasure.

3.2.4 Lane Width Reduction

Wide roadway cross sections and travel lanes, as well as limited pavement markings were observed throughout the study area roadways. Lane width reductions through

8 Urban Street Design Guide, Speed Table. National Association of City Transportation Officials (NACTO). http://nacto.org/publication/urban-street-design-guide/street-design-elements/vertical-speed-control-elements/speed-table/

9 "Install Speed Humps" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=134. Accessed: November 29, 2016.

10 Chen, L., C. Chen, and R. Ewing. "The Relative Effectiveness of Pedestrian Safety Countermeasures at Urban Intersections - Lessons from a New York City Experience." Presented at the 91st Annual Meeting of the Transportation Research Board, January 22-26, Washington, DC, 2012.

striping was chosen as the countermeasure to alleviate the potential for crash problems.

The CMF Clearinghouse provides limited information concerning the impact on crashes that the reduction of lane widths has in urban areas. As a surrogate for reduction in crashes, studies have reviewed the direct benefits to speed reduction from reduced lane widths. Reductions in speed should translate into reductions in crash severity and ultimately a reduction in total crashes.

National Cooperative Highway Research Program (NCHRP) 613 "Guidelines for Selection of Speed Reduction Treatments at High-Speed Intersections" provides a summary of outcomes and best practices for several treatment options including reduced lane widths.

The report concluded that reducing lane widths:

- Reduces mid-block speeds,
- Reduces driver comfort,
- Provides space for other roadway features (i.e. bicycle lanes, bus berths, curbside parking),
- May decrease capacity due to reduced saturation flow rates.

As capacity was not an observed issue throughout the study area, the potential for decreased capacity should not prohibit reducing lane widths.

The NACTO Urban Street Design Guide also studied the relationship between the width of a travel lane and the speed of the roadway. The guide also provides design options for reallocating the roadway width.

The guide concluded that:

- Narrower streets help promote slower driving speeds and reduce crossing distances and shorten signal cycles.
- Lanes greater than 11 feet should not be used in urban areas as they may cause unintended speeding and assume valuable right-of-way at the expense of other modes.
- Revising the roadway cross section to narrow travel lanes allows for repurposing the additional space to provide multimodal accommodations for buses and bicycles.

Reducing lane widths would have the additional advantage of being a low-cost application. Given the findings of this review, it is recommended that lane widths are reduced to a minimum of 10 feet along key roadways such as Barton Street, Goff Avenue, Exchange Street, Pine Street, and Garden Street in order to encourage drivers to reduce speeds and delineate vehicle parking, bus berths, and/or buffered bike lanes. The lane width varies on the selected roadway segments, depending on the needs of the roadway. The reduction is speeds will mitigate the potential for crashes with the increase of activity throughout the study area with the construction of the station. The cost of lane width reduction would vary depending on the length

of the segment and the number of lanes. A detailed cost estimate would need to be completed for the specific locations chosen to be implemented.

3.2.5 Leading Pedestrian Interval

Instances of pedestrian signal heads or buttons not functioning properly were observed during the field inventory. The proposed station will draw additional pedestrian volume to these intersections where pedestrian equipment is lacking. With the proper equipment, there is still the potential for vehicle-pedestrian related crashes near a significant pedestrian generator like the commuter rail station. The implementation of leading pedestrian interval (LPI) is considered as a countermeasure to reduce the opportunity for vehicle-pedestrian crashes as signalized intersections. LPI typically give pedestrians a 3 to 7 second head start when entering an intersection with a corresponding green signal in the same direction of travel, as described by National Association of City Transportation Officials (NACTO).[11]

The CMF Clearinghouse provides information concerning the impact on crashes that implementing a LPI has in urban areas. The clearinghouse provides a CMF for "Modifying signal phasing (implement a leading pedestrian interval)"[12] to project the number of crashes that may be reduced through the implementation of LPI.

The CMF Clearinghouse concluded that:

- LPI allows pedestrians to establish themselves within the crosswalk before the concurrent vehicular phase has a green signal.
- Intersections with the potential for high rates of collisions between left-turning motorists and pedestrians are good candidates for LPI, especially where pedestrian crossings average 60 or more per hour.
- With the installation of LPI, conflicts are nearly eliminated for pedestrians departing during the beginning of the walk interval.
- The implementation of LPI has the potential to reduce the number of vehicle-pedestrian and vehicle-bicycle crashes by 37 percent.

The implementation of LPI would have the additional advantage of being a low-cost application. Given the findings of this review, it is recommended to consider LPI as critical signalized pedestrian crossing locations within the vicinity of the future station. With the increased number of pedestrians projected to access these signalized intersections, it is crucial to take preventative action to reduce the potential for vehicle-pedestrian crashes. The cost of implementing a leading

11 Urban Street Design Guide, Leading Pedestrian Interval. National Association of City Transportation Officials (NACTO). http://nacto.org/publication/urban-street-design-guide/intersection-design-elements/traffic-signals/leading-pedestrian-interval/

12 "Modifying signal phasing (implement a leading pedestrian interval)" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=1993. Accessed: November 29, 2016.

pedestrian interval is approximately $2,000 per intersection if the signal equipment is otherwise in proper working condition.

3.2.6 Signalized Intersection Improvements

During the field assessment of the study area, it was observed that there were deficiencies at various signalized intersections, which include insufficient vehicular clearance intervals, lack of protected left-turn phases, poor traffic operations, and lack of pedestrian countdown timers. Signal improvements such as appropriate vehicular clearance intervals, protected left-turn phasing, revised signal timings, and installing pedestrian countdown timers are countermeasures selected to increase both vehicular and pedestrian safety at signalized intersections.

3.2.6.1 Vehicular Clearance Intervals

Calculating appropriate timing durations for the yellow change interval and the red clearance interval has been cited as one of the FHWA nine Proven Safety Countermeasures in 2008. The *Institute of Transportation Engineers Proposed Recommended Practice* (1985) continues to be the cited reference for determining appropriate change and clearance intervals for a given signalized intersection. The recommended intervals are based on site specific intersection widths and vehicle speeds.

The CMF Clearinghouse provides a crash modification factors for modifying the change plus clearance interval to the ITE 1985 Proposed Recommended Practice. The outcomes are consistent with what is presented by the FHWA guidance. Total crashes have a CMF of 0.92, which results in an eight percent reduction in crashes[13]. Injury crashes specifically could be reduced by 12 percent[14]. One consideration with this improvement is that research shows there is the possibility of increasing the number of rear end crashes, likely due to vehicles given the time and making an effort to stop for the red light. The potential increase in rear end crashes does not offset potential benefits to angle crashes.

3.2.6.2 Protected Left-turn Phasing

Protected left-turn phasing allows for vehicles in a designated left-turn lane to make the movement with no potential conflicts. Revising the signal phasing to make a left-turn movement protected from permissive or protected/permissive, mitigates nearly all of the potential crashes.

12 "*Modify change plus clearance interval to ITE 1985 Proposed Recommended Practice*" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=380. Accessed: August 31, 2016.

13 "*Modify change plus clearance interval to ITE 1985 Proposed Recommended Practice*" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=384. Accessed: August 31, 2016.

The CMF Clearinghouse provides a crash modification factors for modifying the signal phasing from permitted or permitted-protected to protected phasing. Total crashes have a CMF of 0.01, which results in a 99 percent reduction in crashes[15]. The significant crash reduction with this improvement is due to eliminating the conflict between the left-turning vehicles and opposing through vehicles.

3.2.6.3 Pedestrian Countdown Signals

Pedestrian countdown signals provide a visual queue to pedestrians crossing showing the remaining seconds available before the pedestrian phase ends. The signal systems can operate with pedestrian activation, using push buttons, or passive detection.

The CMF Clearinghouse does not provide information concerning the impact that pedestrian countdown signals have on crashes. However, FHWA studied the potential benefits through a pilot program of the deployment of the systems[16].

The FHWA determined the following:

- The pedestrian countdown signals have been associated with a 52 percent reduction in pedestrian related crashes.
- Observations after installation show that fewer pedestrians are left with insufficient crossing time once in the crosswalk due to the understanding of how much time is remaining to cross during the phase.

3.2.6.4 Signal Timings

Inefficient signal timings have the potential to cause driver frustration due to long cycle lengths, faulting detection, or deficient equipment. Signal timings and operation have a significant impact on the overall intersection performance. The development of signal timings should address the needs of all users at one particular location.

The CMF Clearinghouse provides limited information of the impact that the optimization of signal timings has on the reduction of crashes and the overall safety of a signalized intersection. Depending on the magnitude of existing deficiencies the results of signal timing optimization could vary greatly from one application to the next.

Texas A&M University studied the benefits signal retiming has on the safety at signalized intersections[17].

15 "*Change from Permitted or permitted-protected to protected*" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=333. Accessed: September 27, 2016.

16 "Pedestrian Safety – Report to Congress. US Department of Transportation, Federal Highway Administration. http://safety.fhwa.dot.gov/ped_bike/legis_guide/rpts_cngs/pedrpt_0808/chap_3.cfm. August 2008. Accessed: November 29, 2016

17 "The Benefits of Retiming Traffic Signals". Sunkari, Srinivasa, PE. Institute of Transportation Engineers Journal. April 2014.

The following was concluded that:

- Optimization of signal timings is considered a low-cost, high benefit approach to mitigating congestion and reduce delays, which improves safety.
- Efficient signal timings minimize diversion of traffic to local and residential roadways improving safety and conditions in those areas.
- This practice allows operating agencies to conduct quality checks on their equipment to prevent malfunctions before they occur.

Signalizing intersection improvements have been demonstrated to be critical in the improvement of safety for all users in order to decrease driver frustration. With the increase in vehicular and pedestrian volumes in the vicinity of the station, it is imperative to revise the yellow and red clearance intervals at all signalized intersections, provide protected left-turn phasing where warranted with the future traffic volumes, install pedestrian countdown timers at all signalized crossings, and optimize signal timings based on the projected increase in traffic volumes with the presence of the station. The cost of signalized intersection improvements would vary depending on the specific needs. A detailed cost estimate would need to be completed for the specific locations for improvements chosen to be implemented.

3.2.7 Installation of Buffered Bike Lanes

During the MTSEA it was observed that within the vicinity of the future station, there is a lack of bicycle facilities. In order to accommodate those that will be commuting by bicycle rather than walk or opt for transit, buffered bike lanes are recommended as the countermeasure to reduce the potential for vehicle-bicycle related crashes.

A buffered bike lane is a conventional bike lane paired with a designed buffered space separating it from the vehicle travel lanes or parking lane. The CMF Clearinghouse provides information concerning the impact on crashes that the installation of buffered bicycle lane has within urban areas. The Clearinghouse provides a CMF for "Install cycle tracks, bike lanes, or on-street cycling"[18]. Although the bike lanes are not exactly the same as the recommended countermeasure due to the fact they are not buffered. The buffered bike lanes would likely enhance safety further.

The CMF Clearinghouse concluded that:

- The installation of a unidirectional bicycle lane has the potential to reduce vehicle-bicycle related injury crashes up to 59 percent.
- By providing a separate facility rather than a shared facility for bicycles, it allows the roadway to be delineated for each mode of transportation.

18 "Install cycle tracks, bike lanes, or on-street cycling" Crash Modification Factor Clearinghouse. US Department of Transportation, Federal Highway Administration. http://www.cmfclearinghouse.org/detail.cfm?facid=4102. Accessed: November 29, 2016.

The National Association of City Transportation Officials (NACTO) Urban Street Design Guide studied the installation of buffered bike lanes.

The guide determined that buffered bike lanes:

- Encourage bicycling by contributing to the perception of safety among users.
- Provide a space for bicycles to ride that is outside of the automobile door zone and allow bicycles to maneuver without encroaching into adjacent travel lanes.

The implementation of buffered bicycle lanes along critical roadways in the vicinity of the station would provide accommodations for those that do not live within walking distance or along a transit route. The buffered bicycle lane would reduce the opportunity for vehicle-bicycle related crashes. The cost of buffered bike lanes would vary depending on the length of the segment and the width of the buffer. A detailed cost estimate would need to be completed for the specific locations chosen to be implemented.

3.2.8 Installation of All-Way Stop Control

During the field assessment of the study area, it was observed that there were deficiencies at Goff Avenue and Pine Street to accommodate the new Pawtucket/Central Falls Station. There is currently no traffic control at this intersection and it is proposed that an all-way stop be installed A recent review by FHWA concluded that conversion from a two-way stop to an all-way stop control could reduce total intersection crashes by 53%. Another study determined that converting to an all-way stop from a two-way stop may reduce overall crashes at urban locations by up to 71%. Similarly, reductions were seen for left-turn crashes (20%), right-angle crashes (72%), rear-end crashes (13%), and pedestrian crashes (39%).[19] Although the current intersection does not have any stop control, these studies prove that opening day Goff Avenue and Pine Street need stop control to safely accommodate vehicular traffic.

3.2.9 Installation of a Roundabout

The FHWA Office of Safety identified roundabouts as a Proven Safety Countermeasure because of their ability to substantially reduce types of crashes where people are seriously hurt or killed by 78-82%, when compared to conventional intersection types, per the AASHTO Highway Safety Manual.[20]

Roundabouts are significantly safer intersections due to the reduced number and severity of conflict points and because of the lower vehicular speeds. Roundabouts are also designed to improve safety for all users, including pedestrians and bicycles.

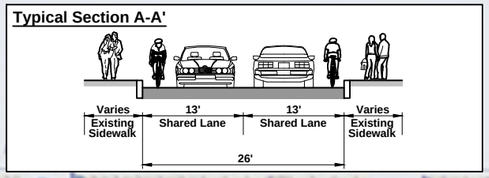
19 Strategy F2. Provide All-Way Stop Control at Appropriate Intersections. NCHRP Report 500 / Volume 5: A Guide for Addressing Unsignalized Intersection Collisions. U.S. Department of Transportation, Federal Highway Administration. https://safety.fhwa.dot.gov/intersection/other_topics/fhwasa08008/uf2.cfm

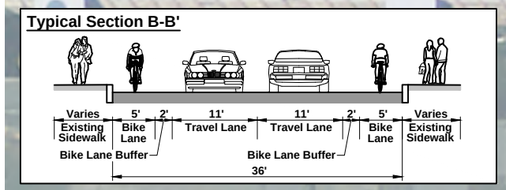
20 Roundabouts and Mini Roundabouts. U.S. Department of Transportation, Federal Highway Administration. https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/

3.3 Next Steps

Using this report to help inform site needs and guide decision-making, it is now stakeholders' responsibility to identify a resolution plan. The purpose of a resolution plan is to identify which proposed countermeasures would be of the greatest benefit to the Pawtucket/Central Falls Station site and the host communities, prioritize those needs, identify funding opportunities and ultimately assign a stakeholder as the champion who can commit to having that need addressed on an agreed upon timeline. **Concepts 1-7,** located at the end of this section, summarize the proposed countermeasures as a result of this review.

Developing a resolution plan is an important step in the success of an MTSEA. Without this resolution plan there is no clear path to addressing the safety and mobility findings from this report. A resolution plan will take this report from a document on paper to design and application in the field with measurable benefits.





A

Typical Section

A'

Install speed table

Narrow vehicle travel lanes by providing bicycle lanes

Barton Street

Typical Section

B

B'

Pine Street

Narrow intersection width while accomodating heavy vehicle movements

Install a raised pedestrian crossing to provide access to the Barton Street platform

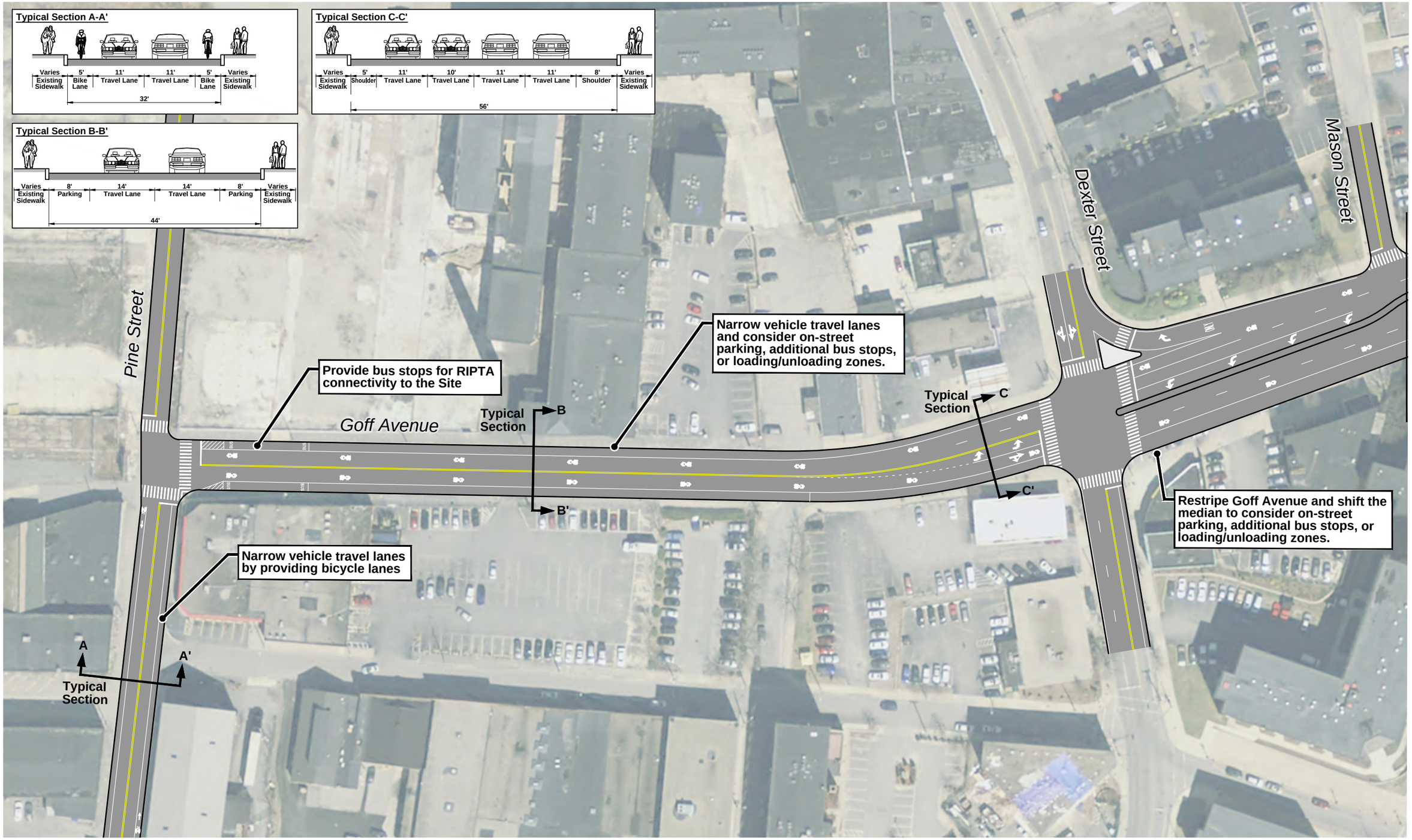
Install speed table

0 40 80 Feet

vhb

Roadway Improvements
Barton Street
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 1



0 40 80 Feet

Roadway Improvements
Goff Avenue and Pine Street
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 2

MATCH TO CONCEPT 2

Broad Street

Montgomery Street

High Street

Exchange Street

Roosevelt Avenue

Broad Street

Summer Street

A

A'

B

B'

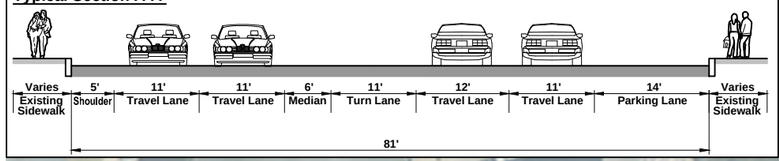
C

C'

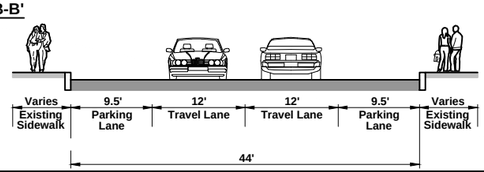
Restripe Exchange Street and shift the median to consider on-street parking, additional bus stops, or loading/unloading zones.

Restripe Exchange Street and shift the median to consider on-street parking, additional bus stops, or loading/unloading zones.

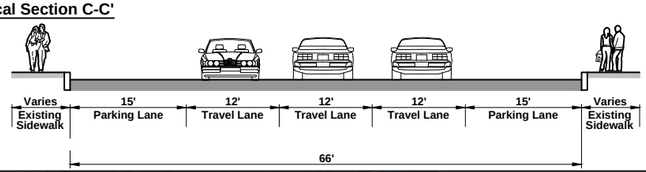
Typical Section A-A'



Typical Section B-B'



Typical Section C-C'



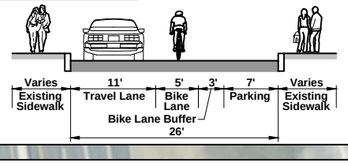
0 40 80 Feet

vhb

Roadway Improvements
Goff Avenue and Exchange Street
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 3

Typical Section A-A'



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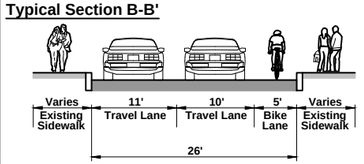
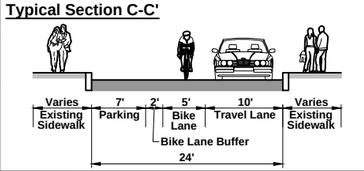


Typical Section C-C'



Typical Section C

C'

Garden Street

One Way

Restripe Garden Street to incorporate a bicycle lane

Main Street

Cedar Street

Harrison Street

Church Street

INTERSTATE 95

Typical Section A

A'

Pine Street

One Way

Typical Section B

B'

Restripe Pine Street to incorporate a bicycle lane

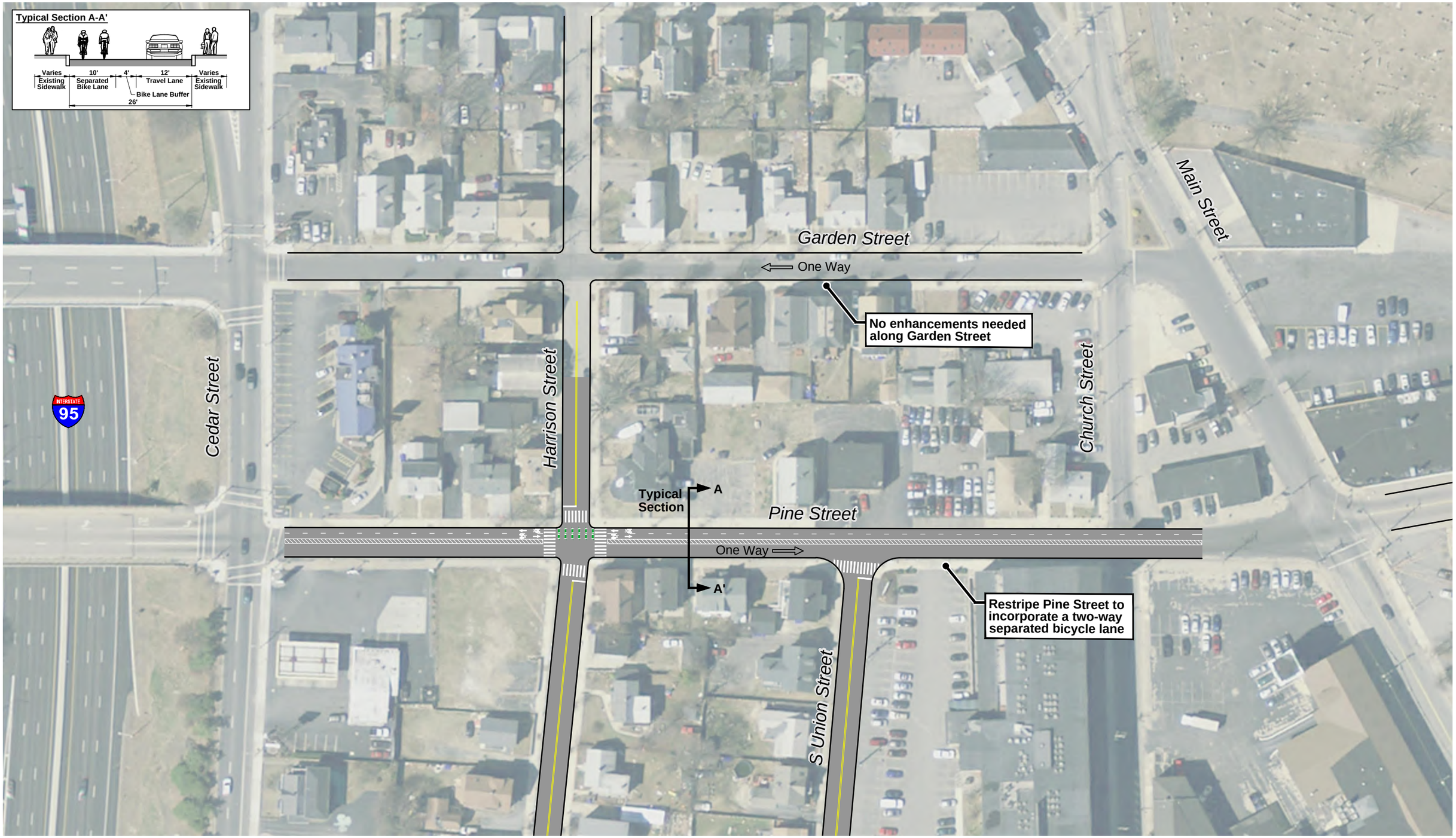
S Union Street

0 40 80 Feet

vhb

Roadway Improvements
Garden Street and Pine Street (Option 1)
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 4



0 40 80 Feet

vhb

Roadway Improvements
Pine Street (Option 2)
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 5

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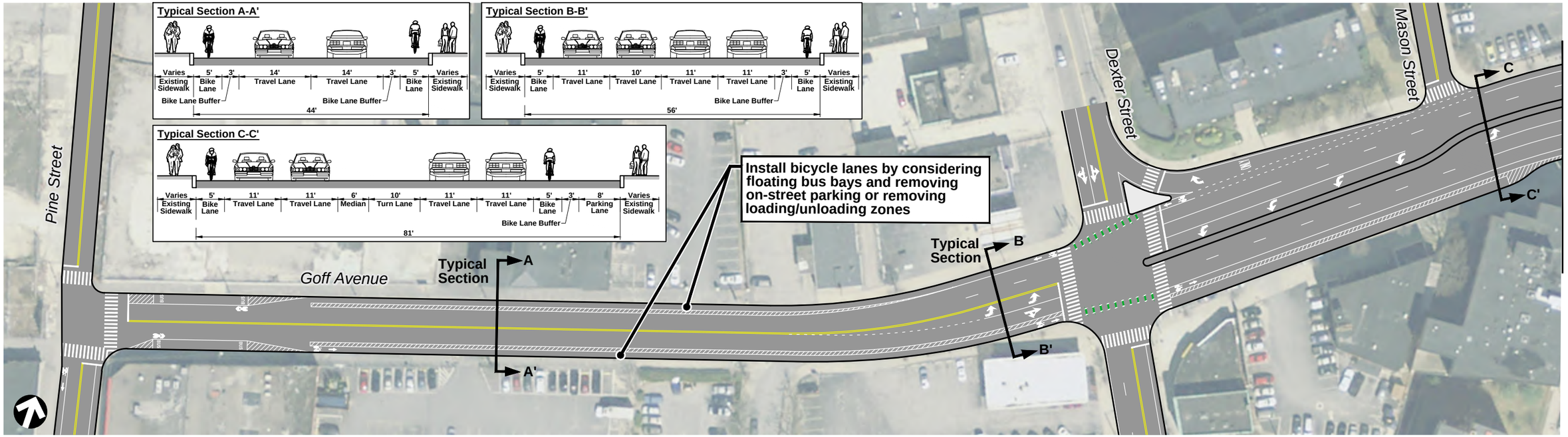
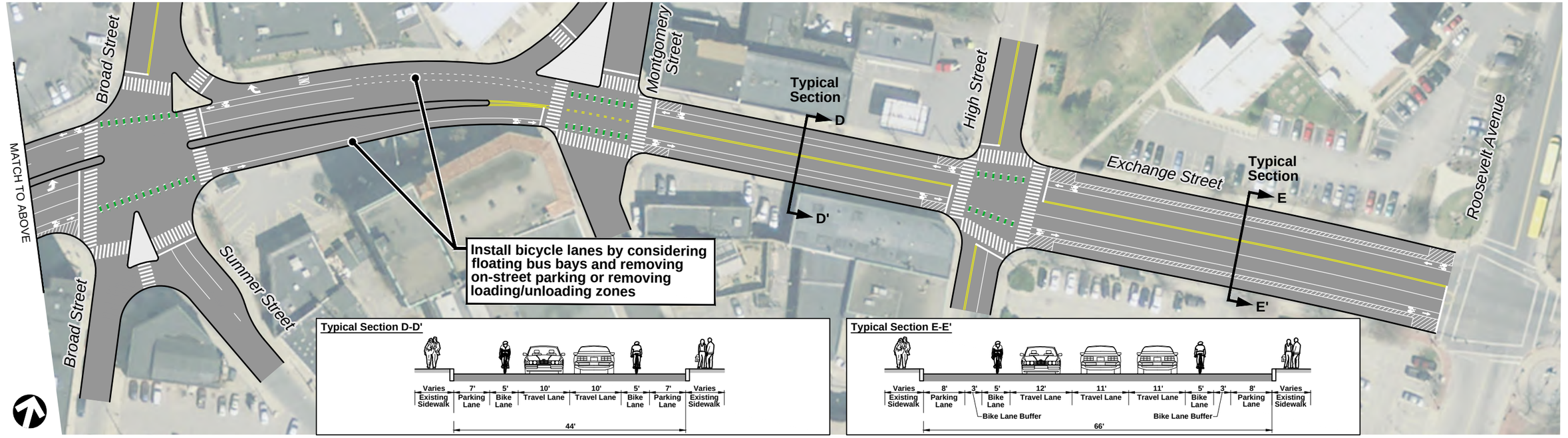




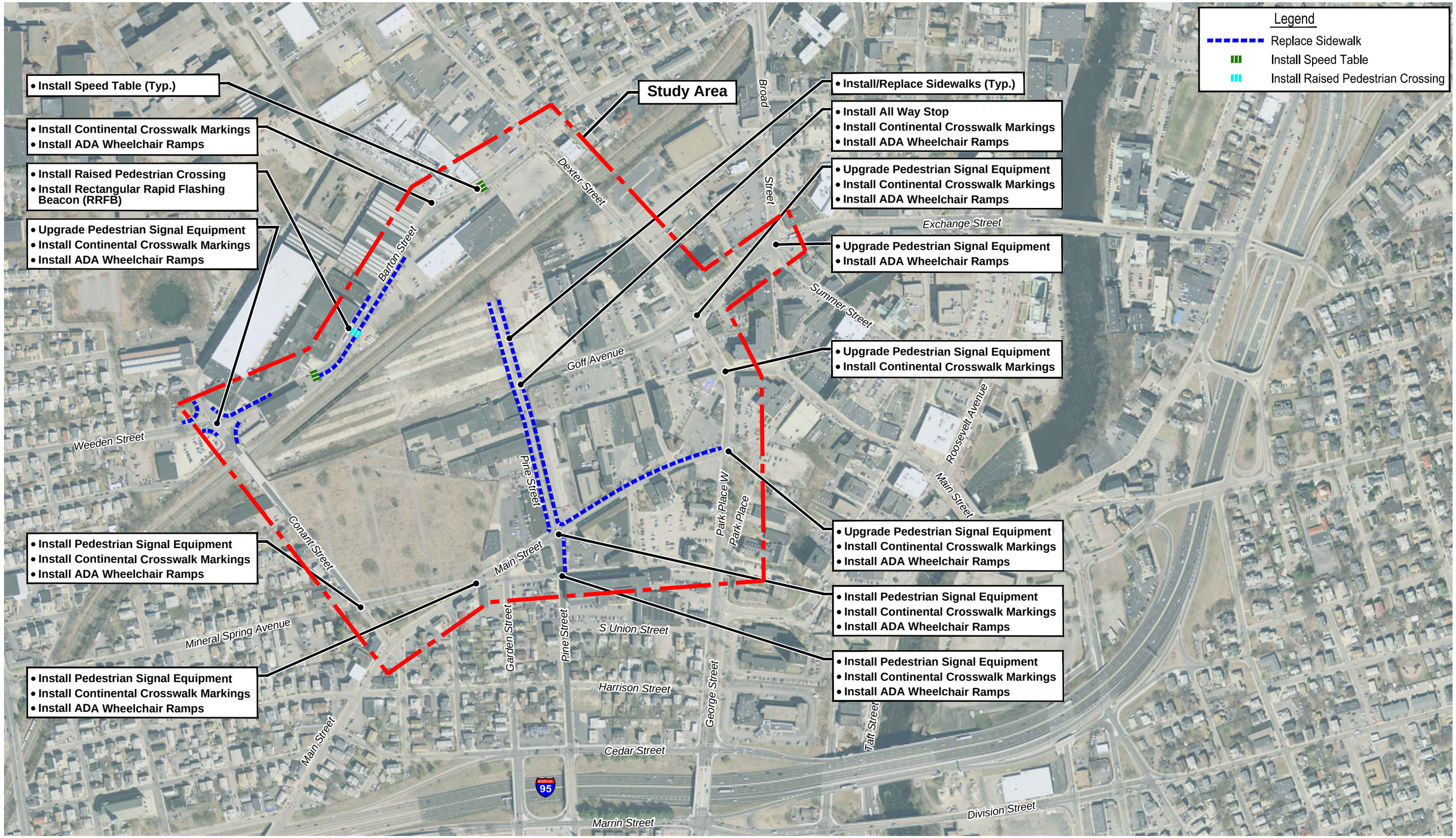
0 40 80 Feet

Note:
Additional roadways, such as Main Street and Bayley Street were assessed for potential bicycle lanes, however removal of parking through these roadway corridors need further analysis and approval from the surrounding businesses and City of Pawtucket.

vhb

Bicycle Improvements (Optional)
Goff Avenue and Exchange Street
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 6



vhb

Proposed Enhancements
Pawtucket/Central Falls Station MTSEA
Pawtucket, Rhode Island

Concept 7

Appendix A – Crash Data

Pawtucket Station MTSEA 1/1/2011 - 12/31/2015														
Case #	Date	Day of the Week	Time	On Street	At Street	Direction	Location	Distance from Ref. Intersection (ft)	Lighting	Weather	Crash Type	Collision with	Severity	Emphasis Area
161190	1/25/2011	Tuesday	7:25 PM	Goff	Dexter	WB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
166310	2/28/2011	Monday	7:58 PM	Main	Pine	WB	Intersection	0	Dark - Lighted	Clear	Angle	Vehicle-Vehicle	C	Intersection
169106	3/25/2011	Friday	4:22 PM	Dexter	Barton	NB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
169592	3/30/2011	Wednesday	7:16 PM	Dexter	Goff	SB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
175380	5/21/2011	Saturday	11:52 PM	Barton	Pine	EB	Intersection	200	Dark - Lighted	Rain	Collision with Roadside Object	Vehicle-Fixed Object	B	Roadway Departure
176946	6/3/2011	Friday	9:26 AM	Mineral Spring	Conant	EB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
177019	6/4/2011	Saturday	1:56 AM	Main	West	SB	Intersection	0	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure
177636	6/8/2011	Wednesday	4:49 PM	Main	Conant	SB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
178081	6/11/2011	Saturday	9:38 AM	Goff	Dexter	WB	Intersection	0	Daylight	Cloudy	Collision with Vulnerable User	Vehicle-Pedestrian	C	Vulnerable Road Users
181625	7/11/2011	Monday	7:54 AM	Main	West	EB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
185737	8/13/2011	Saturday	10:24 AM	Main	Park Place	SB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
193297	10/14/2011	Friday	2:50 PM	Mineral Spring	Conant	EB	Intersection	0	Daylight	Rain	Rear end	Vehicle-Vehicle	C	Intersection
195061	10/28/2011	Friday	4:01 PM	Dexter	Barton	SB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
195832	11/2/2011	Wednesday	12:42 PM	Dexter	Clay	NB	Intersection	50	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
196956	11/10/2011	Thursday	7:39 PM	Goff	Dexter	WB	Intersection	0	Dark - Lighted	Rain	Rear end	Vehicle-Vehicle	C	Intersection
198875	11/27/2011	Sunday	3:06 AM	Dexter	Barton	SB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
202445	12/22/2011	Thursday	12:21 PM	Main	Pine	WB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
206181	1/25/2012	Wednesday	8:13 AM	Dexter	Goff	NB	Intersection	50	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
211322	3/13/2012	Tuesday	10:48 AM	Pine	Main	NB	Intersection	0	Daylight	Cloudy	Rear end	Vehicle-Vehicle	C	Intersection
211365	3/14/2012	Wednesday	3:22 AM	Pine	Goff	NB	Intersection	0	Dark - Lighted	Fog, Smog, Smoke	Angle	Vehicle-Vehicle	C	Intersection
213973	4/8/2012	Sunday	5:44 PM	Goff	Dexter	WB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
216933	5/5/2012	Saturday	6:30 AM	Pine	Goff	NB	Intersection	0	Daylight	Rain	Collision with Roadside Object	Motorcycle-Fixed Object	C	Roadway Departure
219252	5/24/2012	Thursday	12:08 PM	Bayley	Dexter	EB	Intersection	0	Daylight	Clear	Collision with Vulnerable User	Vehicle-Bicycle	C	Vulnerable Road Users
219742	5/26/2012	Saturday	5:09 PM	Goff	Dexter	EB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
226079	7/18/2012	Wednesday	4:18 PM	Pine	Goff	NB	Intersection	0	Daylight	Rain	Angle	Vehicle-Vehicle	C	Intersection
226634	7/21/2012	Saturday	10:58 PM	Dexter	Barton	SB	Intersection	75	Dark - Lighted	Clear	Collision with Vulnerable User	Vehicle-Pedestrian	C	Vulnerable Road Users
232186	9/8/2012	Saturday	12:50 PM	Dexter	Goff	SB	Intersection	0	Daylight	Clear	Collision with Vulnerable User	Vehicle-Pedestrian	B	Vulnerable Road Users
233255	9/15/2012	Saturday	5:36 PM	West	Main	SB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
236157	10/10/2012	Wednesday	6:07 PM	Pine	Main	SB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
236480	10/13/2012	Saturday	12:37 PM	Goff	Pine	WB	Intersection	100	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
239503	11/7/2012	Wednesday	7:13 PM	Mineral Spring	Conant	WB	Intersection	200	Dark - Lighted	Snow	Rear end	Vehicle-Vehicle	C	Intersection
240057	11/9/2012	Friday	5:25 PM	Dexter	Barton	NB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
241286	11/23/2012	Friday	10:01 AM	Main	Pine	WB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
243084	12/8/2012	Saturday	2:13 PM	Pine	Cross	SB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
246649	1/4/2013	Friday	12:15 AM	Pine	Conant	SB	Intersection	0	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure
248036	1/16/2013	Wednesday	6:11 PM	Main	Commerce	EB	Intersection	0	Dark - Lighted	Rain	Collision with Vulnerable User	Vehicle-Pedestrian	C	Vulnerable Road Users
250665	2/8/2013	Friday	3:30 PM	Bayley	Dexter	SB	Intersection	0	Daylight	Snow	Collision with Vulnerable User	Vehicle-Pedestrian	C	Vulnerable Road Users
254449	3/11/2013	Monday	11:36 AM	Main	Bayley	EB	Intersection	100	Daylight	Clear	Collision with Vulnerable User	Vehicle-Bicycle	C	Vulnerable Road Users
258746	4/18/2013	Thursday	12:59 AM	Main	West	EB	Intersection	0	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure
260751	5/6/2013	Monday	9:05 PM	Pine	Conant	SB	Intersection	0	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	A	Roadway Departure
260751	5/6/2013	Monday	9:05 PM	Pine	Conant	SB	Intersection	0	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure
264687	6/6/2013	Thursday	10:56 PM	Pine	Main	NB	Intersection	0	Dark - Lighted	Rain	Head on	Vehicle-Vehicle	B	Distracted Driving
265316	6/11/2013	Tuesday	3:46 PM	Pine	Congress	NB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
271547	7/31/2013	Wednesday	5:46 PM	Weeden	Conant	EB	Intersection	50	Daylight	clear	Rear end	Vehicle-Vehicle	C	Intersection
273367	8/16/2013	Friday	9:35 PM	Dexter	Goff	SB	Intersection	0	Dark - Lighted	Clear	Head on	Vehicle-Vehicle	C	Roadway Departure
277780	9/21/2013	Saturday	11:34 AM	Goff	Dexter	EB	Intersection	75	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
278414	9/28/2013	Saturday	5:06 PM	Dexter	Bayley	SB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
285347	11/22/2013	Friday	8:04 AM	Barton	Dexter	WB	Intersection	0	Daylight	Rain	Rear end	Vehicle-Vehicle	C	Intersection
285936	11/26/2013	Tuesday	9:48 PM	Mineral Spring	Conant	WB	Intersection	200	Dark - Lighted	Rain	Head on	Vehicle-Vehicle	C	Intersection
290315	1/1/2014	Wednesday	8:05 AM	Goff	Pine	WB	Intersection	0	Daylight	Clear	Collision with Roadside Object	Vehicle-Fixed Object	B	Roadway Departure
290791	1/3/2014	Friday	10:27 PM	Goff	Pine	WB	Intersection	0	Dark - Lighted	Snow	Angle	Vehicle-Vehicle	C	Intersection
296005	2/11/2014	Tuesday	12:57 PM	Barton	Pine	EB	Intersection	0	Daylight	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure
296249	2/12/2014	Wednesday	4:55 PM	Weeden	Conant	WB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
298554	2/26/2014	Wednesday	11:41 AM	Goff	Dexter	WB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
300231	3/11/2014	Tuesday	2:07 PM	Mineral Spring	Conant	WB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
300754	3/17/2014	Monday	3:11 PM	Dexter	Clay	SB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
301005	3/19/2014	Wednesday	8:21 PM	Park Place	Main	SB	Intersection	200	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Vehicle	C	Roadway Departure
308610	5/28/2014	Wednesday	10:27 AM	Dexter	Bayley	SB	Intersection	0	Daylight	Cloudy	Angle	Vehicle-Vehicle	C	Intersection
309784	6/6/2014	Friday	4:00 PM	Main	West	NB	Intersection	0	Daylight	Clear	Collision with Vulnerable User	Vehicle-Bicycle	A	Vulnerable Road Users
310722	6/15/2014	Sunday	1:16 AM	Barton	Dexter	EB	Intersection	200	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	None
312397	6/24/2014	Tuesday	3:14 AM	Barton	Dexter	EB	Intersection	100	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	B	Intersection
319160	8/26/2014	Tuesday	7:24 AM	Main	Conant	NB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
319299	8/26/2014	Tuesday	9:14 AM	Mineral Spring	Conant	EB	Intersection	100	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure
319644	8/30/2014	Saturday	11:57 AM	Dexter	Goff	NB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
320240	9/5/2014	Friday	1:47 AM	Dexter	Barton	SB	Intersection	100	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	C	Roadway Departure

Pawtucket Station MTSEA 1/1/2011 - 12/31/2015														
Case #	Date	Day of the Week	Time	On Street	At Street	Direction	Location	Distance from Ref. Intersection (ft)	Lighting	Weather	Crash Type	Collision with	Severity	Emphasis Area
320312	9/5/2014	Friday	9:16 AM	Barton	Dexter	WB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
323400	9/30/2014	Tuesday	11:50 AM	Dexter	Goff	WB	Intersection	0	Daylight	Rain	Angle	Vehicle-Vehicle	C	Intersection
324812	10/11/2014	Saturday	7:02 PM	Mineral Spring	Mulberry	WB	Intersection	0	Dark - Lighted	Clear	Collision with Vulnerable User	Vehicle-Bicycle	C	Vulnerable Road Users
326029	10/21/2014	Tuesday	10:03 AM	Barton	Pine	EB	Intersection	0	Daylight	Clear	Head on	Vehicle-Vehicle	C	Intersection
326207	10/22/2014	Wednesday	6:45 PM	Barton	Pine	EB	Intersection	0	Dark - Lighted	Rain	Collision with Vulnerable User	Vehicle-Pedestrian	A	Vulnerable Road Users
333981	12/21/2014	Sunday	4:29 PM	Goff	Pine	WB	Intersection	0	Dark - Lighted	Clear	Collision with Roadside Object	Vehicle-Fixed Object	B	Roadway Departure
335708	1/5/2015	Monday	11:24 AM	Conant	Mineral Spring	NB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
336291	1/9/2015	Friday	9:17 AM	Mineral Spring	Conant	EB	Intersection	0	Daylight	Snow	Rear end	Vehicle-Vehicle	C	Intersection
337223	1/16/2015	Friday	7:39 PM	Goff	Dexter	EB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
391236	1/18/2015	Sunday	1:15 AM	Mineral Spring	Mulberry	EB	Intersection	200	Dark - Lighted	Clear	Angle	Vehicle-Vehicle	B	None
337419	1/19/2015	Monday	6:08 AM	Weeden	Conant	EB	Intersection	0	Dawn	Clear	Collision with Vulnerable User	Vehicle-Pedestrian	O	Vulnerable Road Users
338028	1/23/2015	Friday	10:33 AM	Mineral Spring	Conant	EB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
391274	2/27/2015	Friday	5:27 PM	Dexter	Bayley	NB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
344185	2/27/2015	Friday	9:07 AM	Conant	Pine	WB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
347072	3/15/2015	Sunday	12:44 PM	Dexter	Goff	SB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
350697	4/16/2015	Thursday	5:56 PM	Main	Pine	EB	Intersection	0	Daylight	Clear	Angle	Vehicle-Vehicle	C	Intersection
350827	4/18/2015	Saturday	1:01 PM	Conant	Mineral Spring	NB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
352836	5/2/2015	Saturday	10:21 PM	Dexter	Barton	SB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
354595	5/18/2015	Monday	12:56 PM	Pine	Bayley	NB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
360121	6/24/2015	Wednesday	9:19 PM	Dexter	Barton	NB	Intersection	0	Dark - Lighted	Clear	Collision with Vulnerable User	Vehicle-Bicycle	C	Vulnerable Road Users
365058	8/2/2015	Sunday	11:32 PM	Weeden	Conant	EB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
369383	9/4/2015	Friday	3:50 PM	Pine	Congress	NB	Intersection	0	Daylight	Clear	Collision with Vulnerable User	Vehicle-Bicycle	B	Vulnerable Road Users
375842	10/26/2015	Monday	6:35 PM	Dexter	Goff	NB	Intersection	0	Dark - Lighted	Clear	Angle	Vehicle-Motorcycle	B	Intersection
378392	11/13/2015	Friday	5:19 PM	Weeden	Conant	NB	Intersection	0	Dark - Lighted	Clear	Angle	Vehicle-Vehicle	C	Intersection
379262	11/21/2015	Saturday	3:30 PM	Weeden	Conant	WB	Intersection	0	Daylight	Clear	Collision with Vulnerable User	Vehicle-Pedestrian	C	Vulnerable Road Users
380022	11/27/2015	Friday	8:34 AM	Weeden	Conant	WB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
385654	12/11/2015	Friday	11:14 AM	Pine	Bayley	SB	Intersection	0	Daylight	Clear	Rear end	Vehicle-Vehicle	C	Intersection
385664	12/12/2015	Saturday	5:29 PM	Mineral Spring	Conant	WB	Intersection	0	Dark - Lighted	Clear	Rear end	Vehicle-Vehicle	C	Intersection
385702	12/17/2015	Thursday	11:43 AM	Pine	Church	SB	Intersection	0	Daylight	Rain	Collision with Roadside Object	Vehicle-Fixed Object	C	Intersection


vhb