BEACHAM/WILLIAMS STREET CORRIDOR STUDY

CITY OF CHELSEA,
MASSACHUSETTS




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EXECUTIVE SUMMARY

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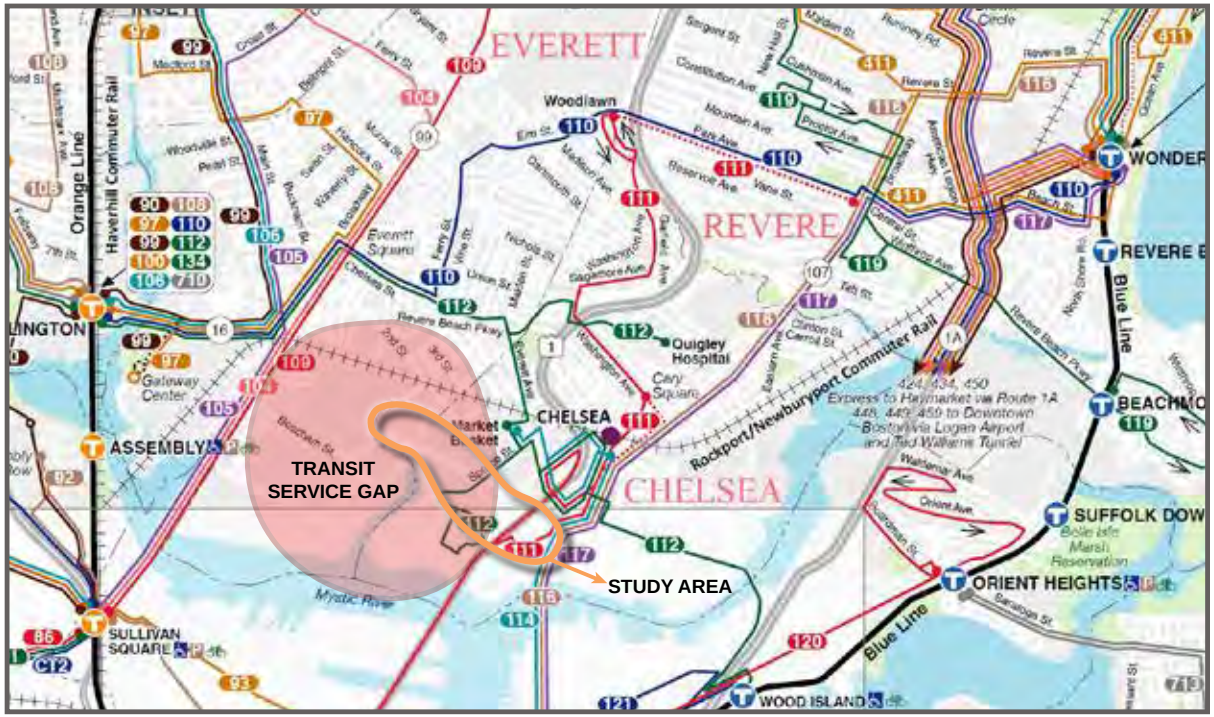
WHY STUDY THE BEACHAM/WILLIAMS STREET CORRIDOR?

The Beacham/Williams Street corridor has long been a primarily industrial roadway, though one that serves critical regional functions. Used by truckers serving the produce markets, hazardous cargo prohibited from bridges and tunnels, and cab drivers and cheap drivers seeking to avoid tolls and traffic, this connection often operates like a local secret. With the Wynn Boston Harbor Casino, growing regional congestion, development pressure and demand for multiple connections – the secret is out – and Chelsea, Everett, and MassDOT must develop an appropriate response for this corridor to serve the future being created around it.

- Truck traffic is 3 to 5 times higher than similar regional facilities
- Approximately 50 to 115 trucks travel the corridor per hour during daytime hours
- Five locations in the top 5% of crash clusters within the Metropolitan Area Planning Council's 101 city and town region
- Traffic volumes are anticipated to increase by 9 to 13% during the morning peak hour and by 17 to 20% during the evening peak hour over the next 5 years
- There is no transit along the corridor despite the fact that one-third of Chelsea residents rely on public transit to get to work
- Most direct route for bicyclists travelling between points east and downtown Boston



MBTA Transit Gap along Corridor

HOW DOES THE CORRIDOR FUNCTION TODAY?

Today, the corridor prioritizes vehicular and freight movement, with few accommodations for people travelling by bike, on foot, or by transit. The physical condition, overall layout, and lack of consistent pavement markings are a detriment to travel and an ongoing safety issue. Therefore, it is not surprising that the corridor experiences a high number of vehicular crashes, including pedestrian/bicycle crashes and injury crashes. While there are clearly overarching condition and safety issues, there are also unique issues associated with the various contextual setting through which the corridor passes. The uniqueness of each contextual setting, or "character area," is defined by the abutting land uses and associated multimodal needs.

Character Area A: Regional Industry (Everett City Line to Mulberry Street) transects an industrial area with a high concentration of produce production and distribution facilities and other industrial uses that support the local and regional economy. Access points to abutting industrial properties are poorly defined, some spanning the entire property frontage. Market Street and Spruce Street are both high crash intersections. There are no sidewalks west of the Spruce Street intersection.

Character Area B: Industrial & Residential Transition Zone (Mulberry Street to Chestnut Street) serves as a transition zone between the industrial section of Area A and commercial area of downtown, and includes a cluster of multi-family residential properties with on-street parking. This area experiences the second highest volume of through truck/freight traffic, as drivers use this section to access the Tobin Bridge southbou.

Character Area C: Downtown Hub (Chestnut Street to Winnisimmet Street) transects a mix of small commercial businesses that function as an extension of the downtown Broadway corridor. This is also where traffic can exit Route 1 northbound from the Tobin Bridge. Within this short section, there are seven intersecting streets, three of which are signalized. Chestnut Street and Broadway are both high crash intersections. There are particularly high pedestrian volumes at the Broadway intersection.

Character Area D: Mixed Use Zone (Winnisimmet Street to Pearl Street) includes a mix of small scale commercial, residential, and industrial land uses on the approach to Pearl Street at the Andrew P. McArdle Bridge. The right turn lane on the westbound approach to Pearl Street makes the roadway feel narrow. Traffic snarls in this area when the drawbridge is raised. Pearl Street is also a high crash intersection.

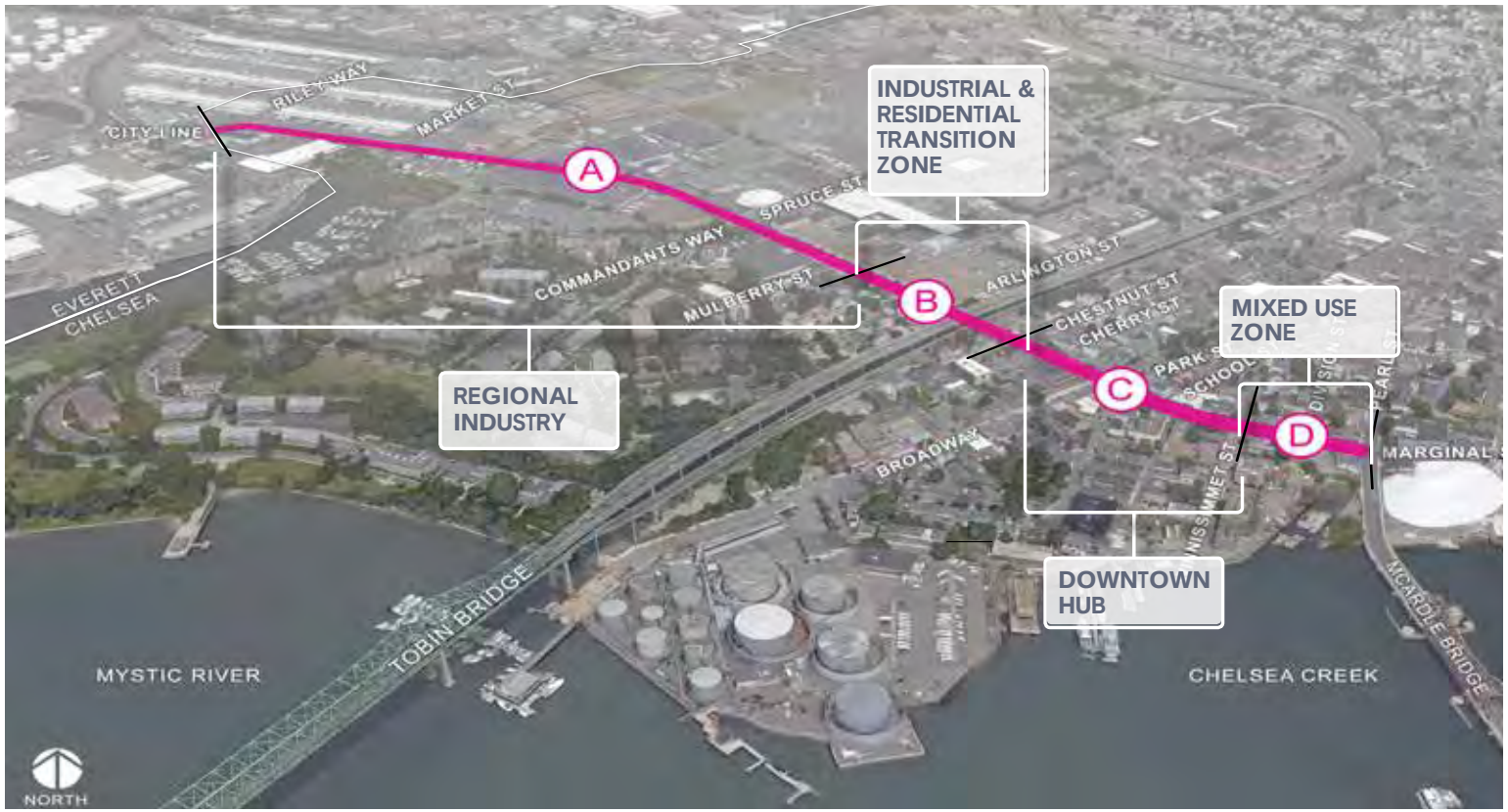
Pedestrians walking through industrial area west of Spruce St

Traffic queue heading into Williams St and Chestnut St

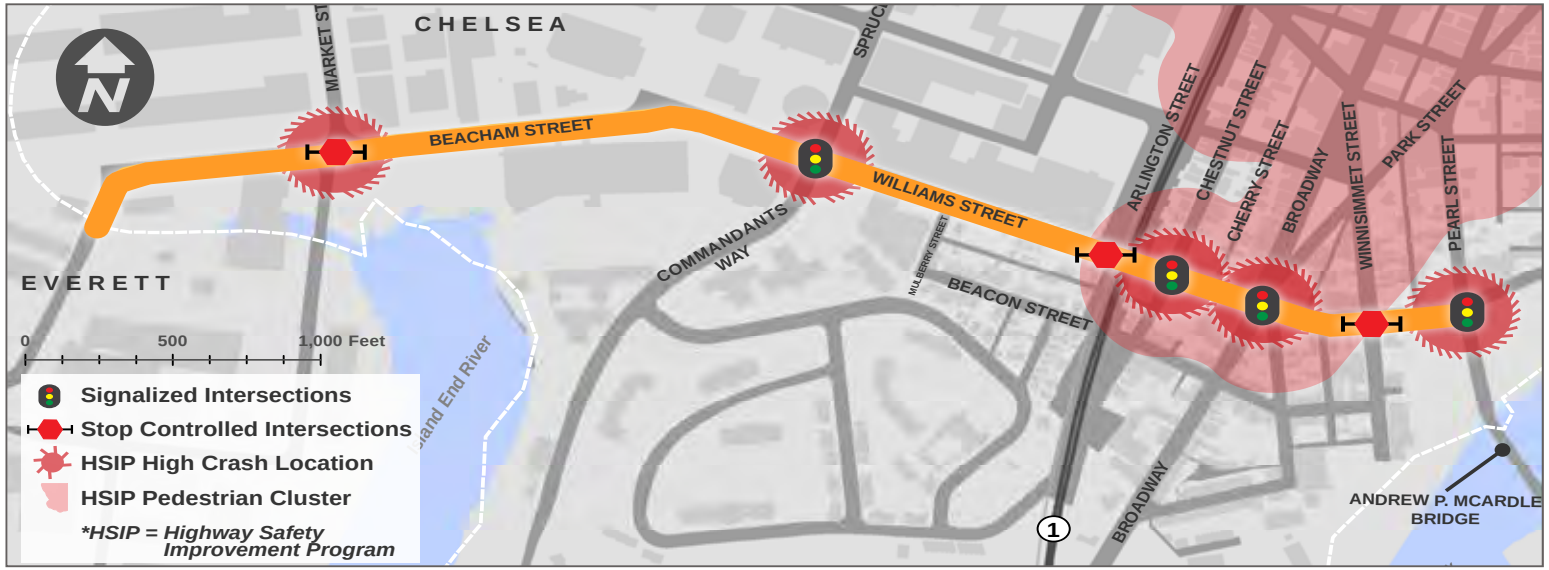
Bicyclists navigating through busy Broadway and Park St intersection

Traffic encroaching onto roadway shoulders at Pearl Street intersections

Character Areas



High Crash Locations



WHAT WE RECOMMEND

The recommendations for the Beacham/ Williams Street corridor are as much about upgrading the corridor, as they are about addressing safety issues, accommodating multiple users, and supporting regional connections while preserving site-specific operations. The good news is that it is possible to accomplish each of these objectives without making the corridor seem incongruous. To do so, concept designs were catered to the challenges and opportunities in each character area while still allowing for a consistent roadway cross section.

Corridor wide improvements consist of full depth roadway reconstruction, 11-foot travel lanes with shoulders, continuous sidewalks, upgraded and coordinated traffic control signal systems, high-visibility pavement markings and signage, and LED street lighting. These improvements will address the common safety issues along the corridor. The primary difference between each character area concept is the type of proposed bicycle facility – shared use path, separated bike lane, or shared lane – and other improvements specific to abutting land uses.

Operationally, the corridor generally operates within capacity today and in the future year 2022. Corridor operations, especially during the morning, are currently dominated by queueing from the Beacham Street/Broadway intersection in Everett. With future development including traffic from the Encore Boston Harbor Casino, queueing will continue at this intersection unless significant changes are made along the Chelsea or Everett sections of Beacham Street.

An analysis of the Chelsea section of corridor shows generally that additional lanes are not needed to improve corridor operations. Rather, it is recommended that signal improvements be made at the Spruce Street, Chestnut Street, and Pearl Street intersections. Coordination among the traffic signals and adaptive traffic control systems should also be deployed to maximize throughput along the corridor and continually monitor and respond to traffic delays and queues. A left turn lane is recommended along Beacham Street west to Spruce Street.

With the recommended changes, operations along the corridor will generally operate at an acceptable level of service.

Level of Service Criteria for Signalized Intersections

LOS	Average Delay (sec/veh)	Motorist Perception
A	< 10	Free flow traffic: "Good" LOS
B	10 - 20	Reasonable free-flow
C	20 - 35	Stable but unreasonable delay begins to occur
D	35 - 55	Borderline "bad" LOS
E	55 - 80	"Bad" LOS: long queues
F	> 80	May be unacceptable: high delay, congestion

Source : Highway Capacity Manual 2000

LOS at Key Corridor Intersections

Intersection	Today		2022 Future Build	
	AM	PM	AM	PM
Beacham St a& Riley Way	C	C	C	C
Beach St & Market St	F	D	F	E
Williams St & Spruce St	C	C	C	C
Williams St & Arlington St	C	C	C	C
Williams St & Chestnut St	C	C	C	C
Williams St & Broadway	B	B	B	C
Williams St & Winnisimmet St	C	D	C	D
Williams St & Pearl St	C	C	C	C

RECOMMENDED IMPROVEMENTS BY CHARACTER AREA

The recommendations were based on the series of technical and qualitative evaluations performed as part of the study, and the input provided by the City, abutters, and the public. The technical evaluations included a Road Safety Audit, traffic analysis of existing and future conditions, environmental screening of soil management strategies, preliminary right-of-way evaluation based on a detailed basemap, and a pavement investigation program. Outreach efforts included meetings with City staff, joint meetings with the City of Everett, two meetings with abutting commercial and industrial businesses in September 2017 along the study corridor, and an October 2017 open house for the public at City Hall.

COMMON SAFETY ISSUES ADDRESSED AS PART OF THE IMPROVEMENTS:

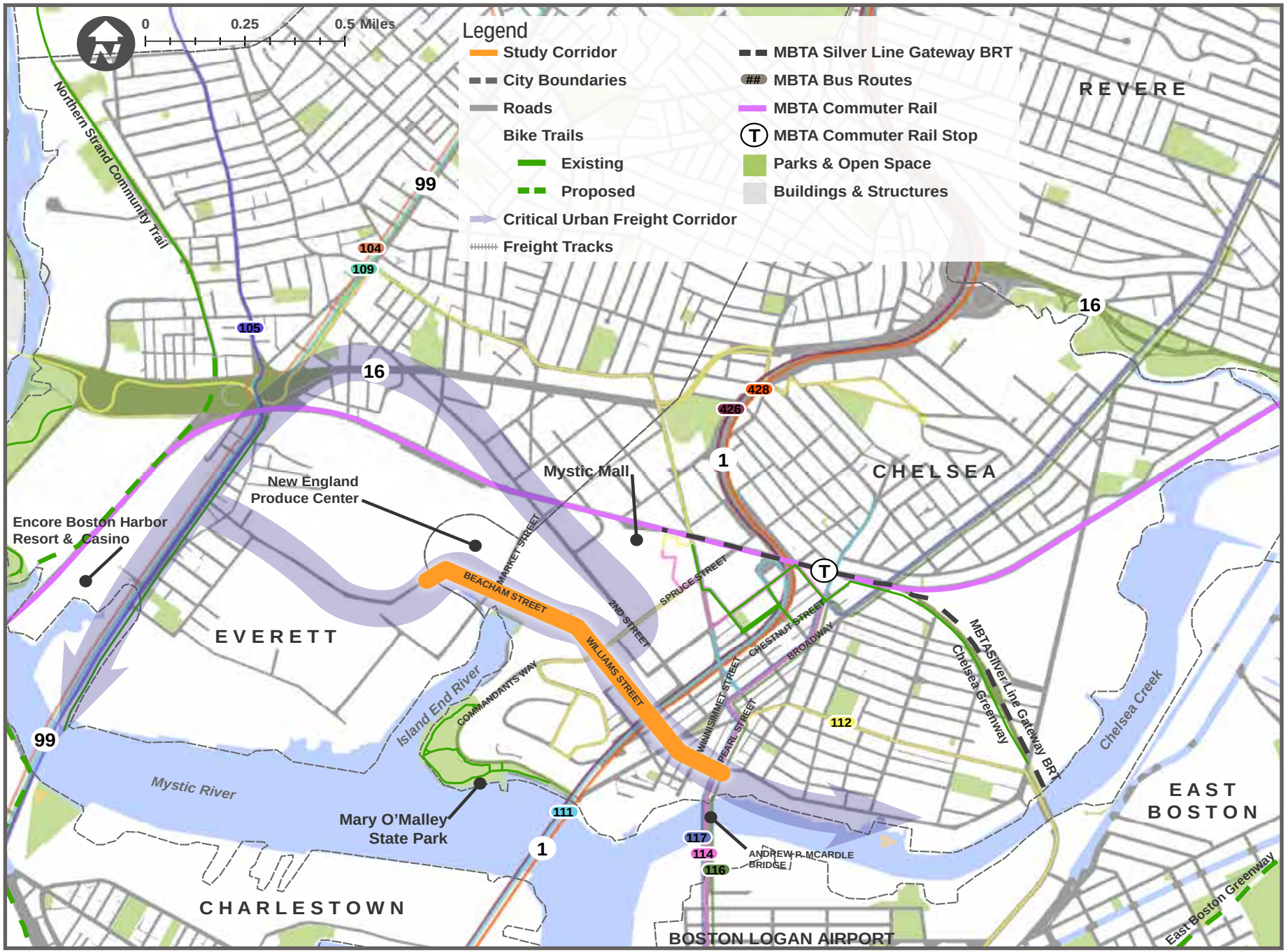
- Lack of dedicated bicycle facilities requires sharing lanes alongside trucks
- Pedestrian confusion due to outdated pedestrian signal buttons and a lack of countdown pedestrian displays
- Non-ADA-compliant sidewalk access ramps
- Vehicles encroaching on curbs when turning

Character Area	Limits	Distance	Construction Cost Estimate*	Improvements at a Glance
A – Regional Industry	Everett City Line to Mulberry Street	3,050 feet	$8,300,000	• 10-foot wide shared use path on south side of street • Furniture zone with street trees • Left turn lane to Spruce Street • Replace Spruce Street traffic signal
B – Industrial & Residential Transition Zone	Mulberry Street to Chestnut Street (including Mulberry Street intersection)	750 feet	$1,900,000	• 10-foot wide separated bike lane on south side of street • Maintain 8-foot wide parking lane for no net loss of on-street parking • Retain existing residential driveways
C – Downtown Hub	Chestnut Street to Winnisimmet Street (including both intersections)	850 feet	$2,800,000	• 5-foot wide separated bike lanes on both sides of street • Replace and coordinate Chestnut Street and Broadway traffic signals • Consider converting Winnissimet Street to one-way towards Broadway
D – Mixed Use Zone	Winnisimmet Street to Pearl Street (including Pearl Street intersection)	360 feet	$1,400,000	• Shared lane with “sharrow” markings in both directions • Realign Pearl Street intersection • Replace Pearl Street traffic signal

*Cost estimates do not include any costs associated with ROW acquisition, utility relocation, force accounts, or design development.


TOW ZONE
NO PARKING
STREET CLEANING
MARCH 1 TO DEC 31
EVEN SIDE
8AM - 1PM
2nd AND 4th
TUESDAYS
EACH MONTH
RESIDENT
PERMIT
PARKING
ONLY
8 AM - 6 PM
12 AM - 5 AM
STORM GUARD

INTRODUCTION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Critical Urban Freight Corridor
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MBTA Bus Routes
MBTA Commuter Rail
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Parks & Open Space
Buildings & Structures
Northern Strand Community Trail
REVERE
CHELSEA
EVERETT
CHARLESTOWN
EAST BOSTON
BOSTON LOGAN AIRPORT
Mystic Mall
New England Produce Center
Encore Boston Harbor Resort & Casino
Mary O'Malley State Park
Mystic River
Island End River
Chelsea Creek
BEACHAM STREET
WILLIAMS STREET
MARKET STREET
2ND STREET
SPRUCE STREET
CHESTNUT STREET
BROADWAY
WINNISIMMET STREET
PEARL STREET
COMMANDANTS WAY
MBTA Silver Line Gateway BRT
Chelsea Greenway
ANDREW P. MCARDLE BRIDGE
East Boston Greenway
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INTRODUCTION

Regional changes, especially in the Lower Mystic area, present a unique opportunity to align Chelsea's growth goals with its evolving, multimodal future. Principal among these changes is the development of the Encore Boston Harbor Resort and Casino in the adjoining City of Everett. The 34-acre resort will be the largest private sector single-phase construction project ever completed in Massachusetts.

Once the Resort is operational, it is anticipated that many local corridors will see changing and increased use from casino patrons, employees, and deliveries. The Beacham/Williams Street corridor, historically a primarily industrial connection, will likely serve as a primary transportation gateway from Chelsea, East Boston (Logan Airport), and points north. While the extent of impact is unclear until the Resort opens in 2019, this route is expected to experience both change and an increase in use, that is incongruent with its current design and function.

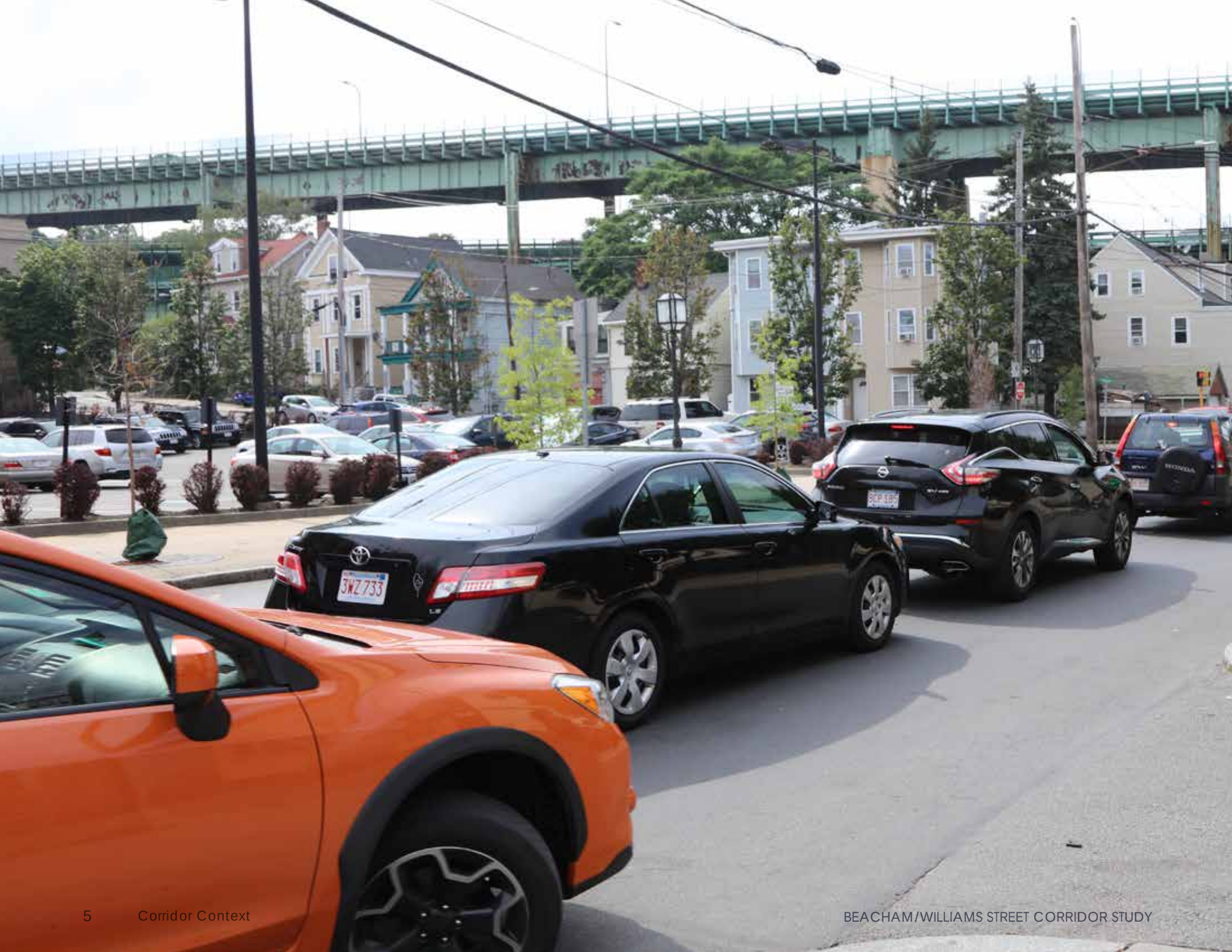
In Chelsea, the Beacham/Williams Street corridor is a critical component of the regional transportation network for freight, commuter, and airport travel. The corridor serves as an east-west urban collector connecting Route 99 to the west, and Route 1 and Boston Logan Airport to the east. Today, vehicle, and especially freight movement is prioritized, with few accommodations for people traveling by bike, on foot, or by transit.

The City has wanted to upgrade the Beacham/Williams Street corridor for quite some time given the degraded roadway conditions. The introduction of the Encore Boston Harbor Resort and Casino, approximately one mile away, gave the City a reason to revisit the corridor and address the multimodal needs of a changing population. Through conversations with the City and other stakeholders, it is clear that improvements to the corridor should seek to:

- Accommodate existing and future truck/freight use to support local and regional economy.
- Encourage alternatives to commuting by car to/from abutting businesses and the Wynn resort
- Increase the appeal of bicycling to/from downtown Boston and Somerville
- Improve safety for all roadway users.

To help convert these goals into implementable concept designs, the City secured a transportation planning grant from the Massachusetts Gaming Commission Community Mitigation Fund for this planning study.

The study corridor begins in the west at the Chelsea/Everett city line and ends in the east at the signalized intersection of Pearl Street/Marginal Street and the Andrew P. McArdle Bridge. Along its approximate 1-mile length, the corridor traverses various contextual settings that are defined by abutting land use and associated multimodal needs. The recommended infrastructure improvements in each character area are based on series of technical evaluations and input provided by the City, abutters, and the public.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1 CORRIDOR CONTEXT

ONGOING PLANNING

CHARACTER AREAS

CORRIDOR CONTEXT

The City of Chelsea is a densely settled urban community of approximately 37,581 residents, in only 2.5 sq miles. Despite being Massachusetts' second densest municipality, most of the Beacham/Williams study area is industrial with few adjacent residences. The City is home to a diverse, largely working class population and a cross-section of regionally critical industries and commercial establishments.

Historically, Chelsea has been, and continues to be, a gateway to America for successive waves of immigrants. Although it contends with socioeconomic and public health challenges, the City has worked hard throughout the past decade to enrich the urban fabric through targeted revitalization efforts, which continue through various ongoing planning efforts.

ONGOING PLANNING

Chelsea is proactive in securing grants and engaging with public and private partners in creative ways to advance revitalization efforts. Currently, the City, with its partners, is working on several infrastructure projects with overlapping footprints. Several of these planning initiatives directly affect the Beacham/Williams Street corridor:

Silver Line Gateway Bus Rapid Transit Project

Just opened in Spring 2018, the **Silver Line Gateway Project** provides new, dedicated bus rapid transit (BRT) service directly connecting Chelsea to East Boston, Logan Airport, the Seaport District and South Station. Four new Chelsea BRT Stations are located at Eastern Avenue, Box District, Bellingham Square, and the Mystic Mall. The BRT service provides new connections and complement existing bus and commuter rail service.

Complete Streets Initiative

The City of Chelsea adopted a **Complete Streets Policy** in December 2017. Following this adoption, Chelsea is developing 5-year Complete Streets Prioritization Plan with recommended infrastructure improvements, associated construction cost estimates, and a timeline to implement those improvements.

City of Everett, MA

The City of Everett is currently **redesigning the Beacham Street corridor within Everett** from Broadway to the Chelsea line. Chelsea has been meeting with their Everett counterparts to ensure cohesiveness in project design and explore potential joint funding opportunities.

Re-Imagining Broadway Study

The City of Chelsea is conducting a **Downtown Circulation and Concept Design Study focused on Broadway from Williams Street to City Hall Avenue**. The Re-Imagining Broadway study is focused on creatively addressing the entire Downtown circulation system to benefit all users, while supporting revitalization efforts and enlivening the main squares. As part of the study, consideration is being given to converting Winissimmet Street to one-way away from Williams Street.

Chelsea Greenway

The City of Chelsea, with assistance from the Commonwealth's Gateway City Parks Program and MassDOT is making the **Chelsea Greenway** project a reality. This bicycle and pedestrian path parallels the Silver Line Gateway from Marginal Street to downtown Chelsea, where it will transition to an on-road bike facility and walking route to the Mystic Mall. In the future, the goal is to connect the Greenway to the Northern Strand Community Trail in Everett and the East Boston Greenway.

Healthy Chelsea Coalition

Massachusetts General Hospital has also taken steps to encourage active living in Chelsea to encourage healthy lifestyles and prevent obesity. The hospital created **Healthy Chelsea**, a community coalition focused on healthy lifestyles and obesity prevention. To accomplish their goal, the coalition has developed a close relationship with the Chelsea Planning and Development Department to support active transportation infrastructure improvements.

Chelsea Creek Municipal Harbor Plan Project with MAPC

The City is in the initial stages of the **Chelsea Creek Municipal Harbor Plan (MHP)** in collaboration with the Metropolitan Area Planning Council (MAPC). Together, they will assess current and future uses along the waterfront and prioritize and incorporate recommendations from the "A Vision for Chelsea Creek" initiative. The goals of the MHP are to maximize economic development opportunities, increase open space and waterfront public access, foster viable maritime uses along the waterfront, buffer residential neighborhoods from maritime industrial uses, and align City zoning with the MHP recommendations.

Chelsea GreenRoots and the Mystic River Watershed Association

The City of Chelsea has been working with Chelsea GreenRoots and the Mystic River Wastershed Association to **address climate resiliency and low-impact industrial operations**. Working together, they have been able to integrate state and municipal hazard mitigation plans with watershed enhancement efforts and interact with community stakeholders to discuss green infrastructure implementation and energy efficiency programs.

In commissioning the Beacham/Williams Street Corridor Study, the City is taking a proactive approach to understanding the multimodal needs of the corridor, and how these needs tie into other local and regional planning efforts. Chelsea intends to create and implement designs for the Beacham/Williams Street corridor that are tailored to adjacent land uses, and provide much needed local and regional connectivity.

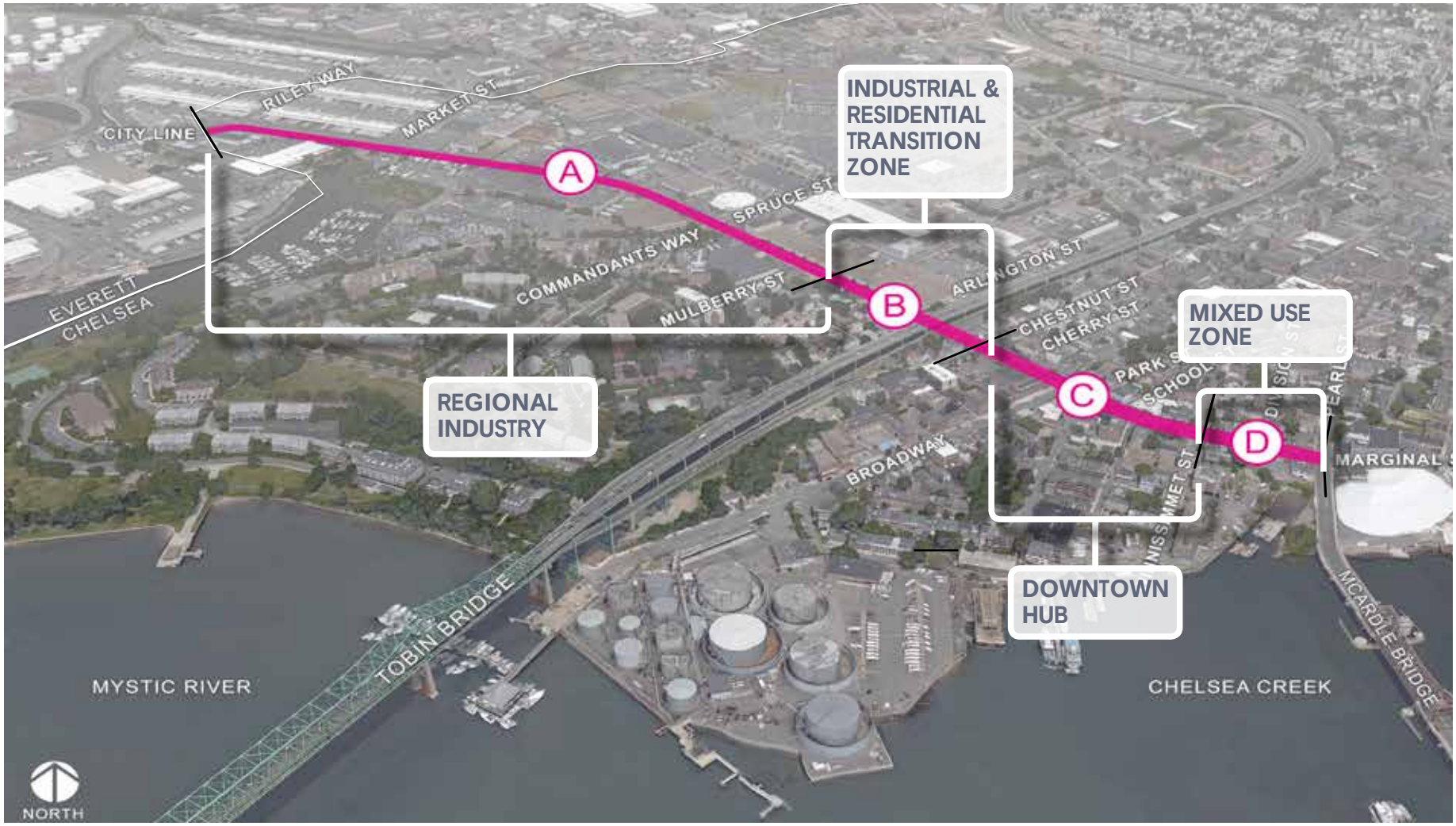
CHARACTER AREAS

Along its approximate 1-mile length, the corridor travels through several different contextual settings, each with their unique and interrelated issues. The uniqueness of each setting is defined by the mix of abutting land uses and their site-specific needs. The interrelationship lies in the City's vision for a cohesive, multimodal corridor. To help frame the study conversation, these contextual settings are referred to as "character areas."

68% *industrial and/or transportation logistics land use*

17% *commercial and/or marina land use*

15% *multi-family residential land use*



CHARACTER AREA A
REGIONAL INDUSTRY

Everett City Line to Mulberry Street (3,050 feet)

Character Area A is characterized by industrial uses with a high concentration of produce production and distribution facilities and specialty food production, and other industrial uses that support the local and regional economy. The New England Produce Center, located between Riley Way and Market Street, is the largest privately-owned terminal market in the country and employs over 1,000 area residents according to terminal management. In addition to the produce cluster, the 260,000 square foot industrial bakery, Signature Bread, has significant frontage on this section of the corridor.

CHARACTERISTICS

- 50 to 60-foot wide right-of-way
- Primarily industrial land use
- Heavy through and turning truck/freight traffic
- Inbound/outbound deliveries during overnight or at dawn
- Overnight shift changes
- Faded centerline delineates one 15 to 22-foot wide lane in each direction
- Drivers operate both approaches to the Spruce Street intersection as two lanes
- No existing sidewalks west of the Spruce Street intersection
- Peak hour traffic between 3:00am and 9:00am

KEY CHALLENGES

- Sharp turn in roadway at Riley Way limits sight distance for all users
- Single entrance/exit to New England Produce Center
- Desire to narrow curb cuts but maintain truck/freight access
- Conflict between people walking/biking and trucks
- Market Street traffic has difficulty finding gaps to turn onto Beacham Street
- High crash intersection at Market Street and Spruce Street
- Poor illumination and a lack of pavement markings, which amplify the safety risks with regular truck traffic

CHARACTER AREA B
INDUSTRIAL & RESIDENTIAL TRANSITION ZONE

Mulberry Street to Chestnut Street (750 feet, including the Mulberry Street intersection)

Character Area B serves as a transition zone between land uses. One large industrial property backs onto Williams Street from Spruce Street to Arlington Street and the Route 1/Tobin Bridge viaduct. This property houses the family owned and operated Steele Canvas Basket company, a wide variety of manufacturing and distribution tenants, and a child development center. The loading docks for these industries are accessible from Spruce Street and Auburn Street, while a simple privately owned and maintained landscape buffer lines Williams Street. Opposite this building, a few small commercial businesses and a cluster of 5 multi-family residential properties front the south side of the street. Front doors, walkways and a handful of driveways connect directly to the existing sidewalk, while other curb cuts provide rear access to properties fronting on Pine Street. On-street parking is located along Williams Street in front of these homes.

CHARACTERISTICS

- 60-foot wide right-of-way
- Mix of residential, commercial and industrial uses
- Second highest volume of through truck/ freight traffic
- On-street parking on south side of street
- Route 1/Tobin overpass
- One 12-foot eastbound and one 20-foot wide westbound travel lane
- Unmarked 8-foot parking lane on south side of street
- Existing sidewalks on both sides of street

KEY CHALLENGES

- Need to retain on-street parking
- Conflict between people walking/biking and abutting residences
- Poor illumination and narrowing of roadway, which impacts bicyclists and pedestrians

CHARACTER AREA C
DOWNTOWN HUB

Chestnut Street to Winnisimmet Street (850 feet, including the Chestnut and Winnisimmet Street intersections)

Land uses in Character Area C primarily consist of small commercial businesses that function as an extension of the downtown Broadway area. Chelsea District Court is also located here. There are 7 intersecting streets within 850 feet, 3 of which are currently signalized. The Beacon Street exit off Route 1 northbound/Tobin Bridge connects directly to Chestnut Street and Williams Street. Given the high volume of turning trucks, the City recently relocated a utility pole on the northwest quadrant of the Broadway intersection after multiple pole strikes caused power outages and lost revenue to local businesses. From Broadway, the corridor makes a slight turn and starts to travel down a hill on the approach to the Chelsea Creek waterfront.

CHARACTERISTICS

- 60-foot wide right-of-way
- Primarily commercial storefronts
- High pedestrian volumes at Broadway intersection
- MBTA bus stop and public plaza (Chelsea Square) at Broadway/Park Street
- Heavy through and turning truck/freight traffic, highest volume along corridor based on counts
- Route 1 northbound/Tobin Bridge off-ramp to Chestnut Street
- No dedicated facilities for people on bikes
- Clearly marked centerline delineating one 15 to 20-foot wide lane in each direction
- Existing sidewalks on both sides of street

KEY CHALLENGES

- Number of closely spaced intersections
- Interaction of heavy truck traffic with active street life
- High crash intersection at Chestnut Street and Broadway
- Poor visibility and lines of sight at intersections, due to current streetscape design
- Lack of bicycle facilities and poorly designed crossings
- Signalized intersections operate inefficiently

CHARACTER AREA D
MIXED USE ZONE

Winnisimmet Street to Pearl Street (360 feet, including the Pearl Street intersection)

Character Area D includes a mix of small scale commercial, residential, and industrial land uses. The introduction of a right turn lane on the approach to the Pearl Street intersection makes the 50-foot wide right-of-way feel narrow. The Andrew P. McArdle Bridge connects Pearl Street in Chelsea with Meridian Street in East Boston. When the drawbridge is raised for Chelsea Creek maritime access, traffic snarls at this intersection. Besides the Chelsea Street Bridge, the Andrew P. McArdle Bridge is the only other toll-free option to drive from East Boston and Logan Airport without heading North, making it a favorite route of taxi and livery services.

CHARACTERISTICS

- 50-foot wide right-of-way
- Mixed land use

KEY CHALLENGES

- Parked vehicles overhanging sidewalks
- Queued vehicles limit access to abutting properties
- Traffic backs up when Andrew P. McArdle Bridge is raised
- High crash intersection at Pearl Street


LANGOSTA REAL.
TODO EL VERANO.
LOBSTER

2 KEY FINDINGS

MODE SHARE

SAFETY EVALUATION

TRAFFIC ANALYSIS

OUTREACH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0.25
0.5 Miles
Legend
Study Corridor
City Boundaries
Roads
Bike Trails
Existing
Proposed
Critical Urban Freight Corridor
Freight Tracks
MBTA Silver Line Gateway BRT
MBTA Bus Routes
MBTA Commuter Rail
MBTA Commuter Rail Stop
Parks & Open Space
Buildings & Structures
Northern Strand Community Trail
REVERE
CHELSEA
EVERETT
CHARLESTOWN
EAST BOSTON
BOSTON LOGAN AIRPORT
Mystic Mall
New England Produce Center
Encore Boston Harbor Resort & Casino
Mary O'Malley State Park
ANDREW P. MCARDLE BRIDGE
MARKET STREET
BEACHAM STREET
WILLIAMS STREET
2ND STREET
SPRUCE STREET
CHESTNUT STREET
BROADWAY
WINNISIMMET STREET
PEARL STREET
COMMANDANTS WAY
Island End River
Mystic River
Chelsea Creek
Chelsea Greenway
MBTA Silver Line Gateway BRT
East Boston Greenway
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KEY FINDINGS

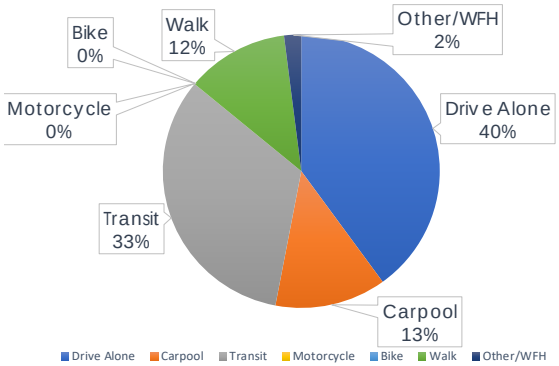
An assessment of current and future conditions was undertaken to better understand corridor issues, needs and opportunities. This assessment included an evaluation of modal share, safety, and traffic, and input from City staff, abutting businesses, residents and commuters. The key findings of this assessment led to the evaluation of various alternatives and ultimately guided the selection of the recommended improvement concepts.

MODE SHARE

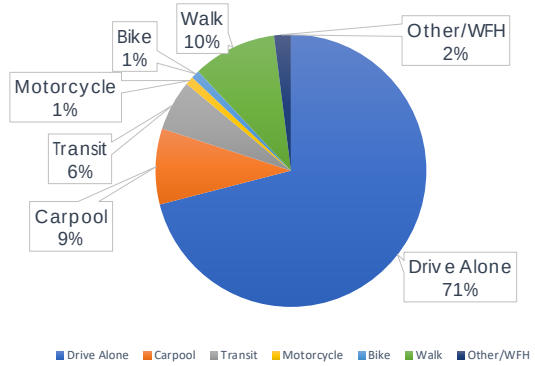
There is a direct relationship between existing conditions and modal share. Today, vehicle, and especially freight movement is prioritized, with few accommodations for people traveling by bike, on foot, or by transit. Clearly the lack of dedicated bicycle facilities, continuous sidewalks, and direct transit access are an impediment to multimodal travel for workers and residents along this corridor, and those traveling to/from surrounding areas.

The Census provides data on how people get to work. The data tells us that just under half of all Chelsea residents do something other than drive to work, with approximately 33% relying on public transit. Interestingly, the majority of workers traveling to the over 100 commercial and industrial businesses located along this corridor opt to drive alone. To support these workers and workers traveling to/from metro Boston via the corridor, improvements should encourage alternatives to commuting by car.

How Do Chelsea Residents Get to Work?



How Do Employees Get to Work Along the Corridor?

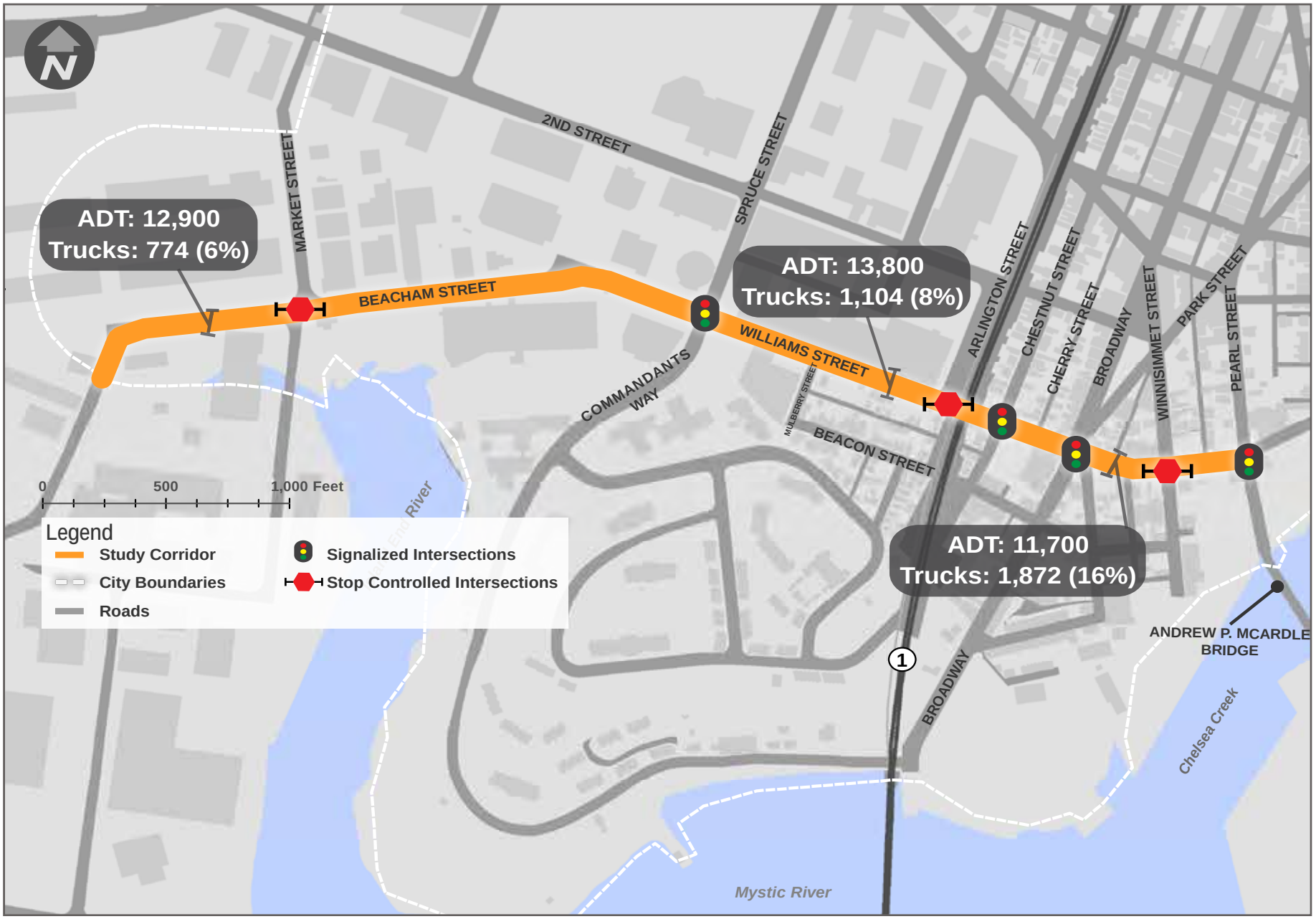


Source : American Community Survey (ACS) 2010 5-year via Census Transportation Planning Products (CTPP)

VEHICLE (AUTO/TRUCK)

Traffic volumes range from 11,700 – 13,800 vehicles per day and are generally consistent throughout the corridor. This volume is typical of an urban minor arterial collector in this region. Truck volumes are particularly high along the corridor, ranging from 6% to 16% of the total volumes. This range is significantly higher than similar roadway facilities in this region, which typically average 2% to 3% trucks.

Of the trucks recorded along the corridor, many are large semi-trailer trucks. These truck percentages are a reflection of the regional significance of this corridor. The corridor connects the Chelsea, East Boston (Logan Airport), and Revere industrial waterfronts with the Everett industrial zone and the Alford Street Bridge (Route 99) across the Mystic River. Given the large volume of truck/freight traffic, vehicles dominate the current roadway.

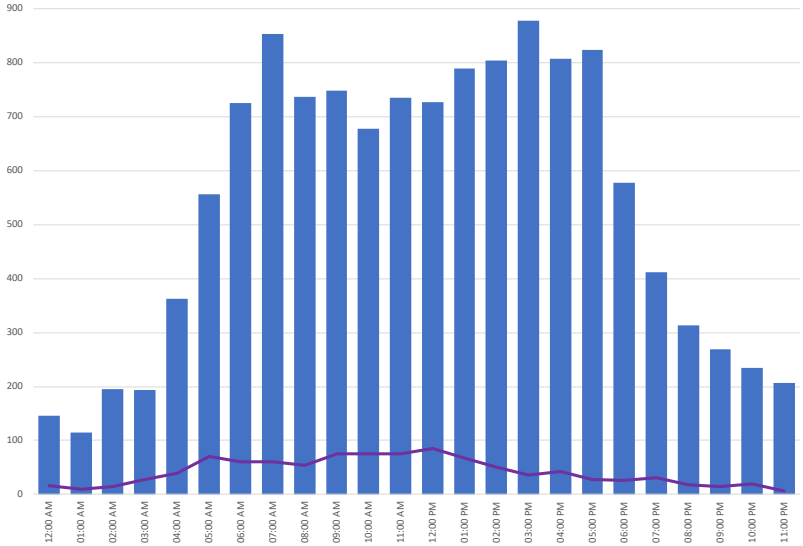


Average Daily Traffic along Corridor

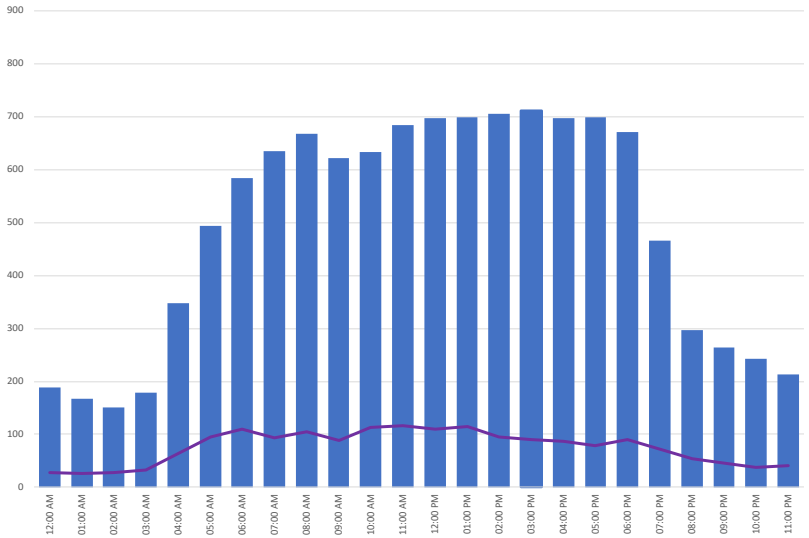
TRAFFIC VOLUMES BY TIME OF DAY

Legend
Total Volume
Large Truck Volumes

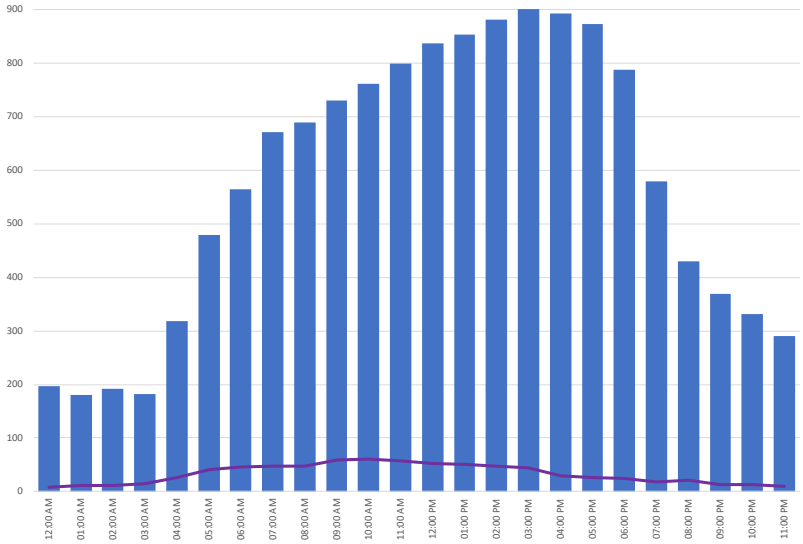
Everett City Line to Spruce Street (Character Area A)



Chestnut Street to Pearl Street (Character Areas C & D)



Spruce Street to Chestnut Street (Character Areas A & B)



ITEMS OF NOTE:

- In morning, the predominant traffic flow is in the westbound direction, while in the afternoon the predominant flow is in the eastbound direction
- Traffic is relatively consistent throughout the day, with very little hourly variation between 6 AM to 6 PM
- The corridor does not experience typical “peak” morning or afternoon hours
- Approximately 50 -115 trucks per hour travel the corridor during daytime hours, with the highest volume of trucks traveling east of Chestnut Street
- Truck traffic is relatively evenly distributed between the hours of 5 AM and 5 PM

BIKE

The corridor currently has very limited bicycle facilities. The western portion of the corridor provides wide lanes which allow for bicycles to use the roadway, but there is no formal indication that cyclists may do so. Given the volume of large vehicles, bicycling can be intimidating. In the eastern portion of the corridor, the paved roadway narrows, and bicyclists are not provided a space. Bicyclists options at intersections are also limited as turning movements can encroach on the very limited space that they have to work with.

Existing bicycle volumes along the corridor are currently low, with less than 5 bicyclists per hour during the peak commuter periods, and 10 times as many trucks as bicyclists. Diagrams of existing bicycle volumes during the peak hour are included in the Technical Appendix. However, the low volumes are likely a reflection of the current condition of the roadway, rather than an indication of demand. Bicyclists from Chelsea, East Boston, Revere, Winthrop, access downtown Boston and Somerville via the Route 99 Bridge over the Mystic River in neighboring Everett. The Route 99 Bridge is accessible by bicycle or on foot via the Beacham/Williams Street corridor, or Route 16. Proposals to create a bicycle-pedestrian bridge over the Mystic River, the reconfiguration of Sullivan Square, and the installation of protected bike lanes along Rutherford Avenue all promise to dramatically increase the appeal of bicycling to and from Metro Boston.

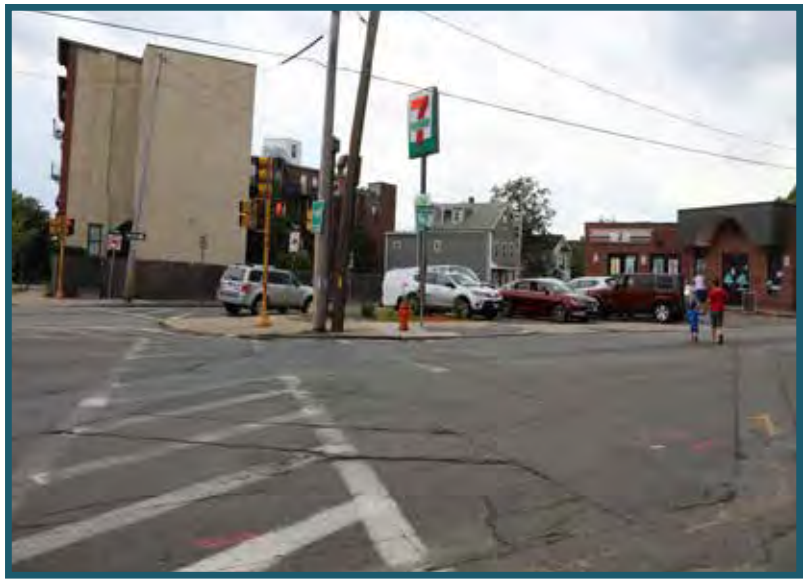
WALKING

For pedestrians, the Beacham/Williams Street corridor can be divided into two sections with entirely different experiences. From the Everett City Line to Spruce Street/ Commandants Way, there are no sidewalks or crosswalks on Beacham Street or any of the side street approaches. From Spruce Street/ Commandants Way to Pearl Street, there are sidewalks along both sides of the street in decent condition with wheelchair ramps at all intersections, though they lack detectable warning panels.

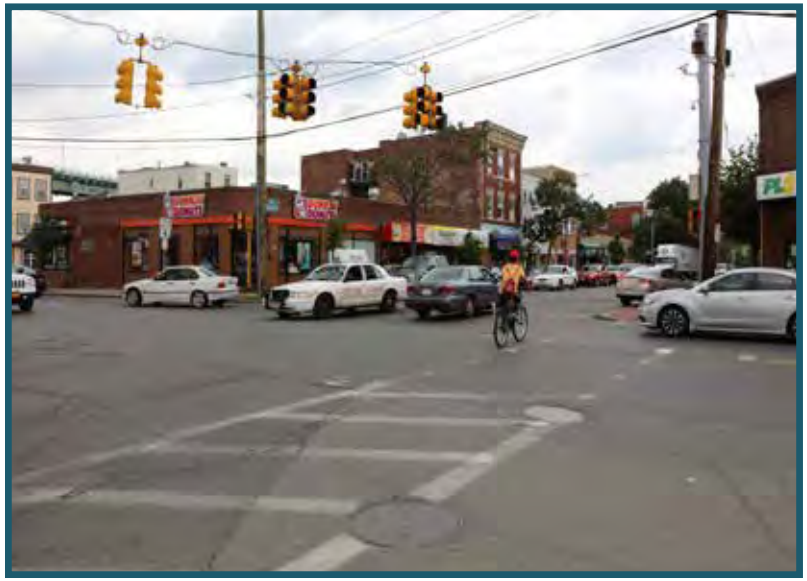
At the signalized intersections along the corridor, there are pedestrian signal heads with push buttons. Not all push buttons are functional, however. Additionally, none of the signalized pedestrian crossings feature accessible pedestrian signals (APS) or have countdown pedestrian signal heads.

Existing pedestrian volumes vary along the corridor. The industrial section of corridor has fewer than 15 pedestrians crossing any roadway leg during the typical peak commuting hours. Diagrams of existing pedestrian volumes during the peak hour are included in the Technical Appendix. This is not surprising given the lack of formal sidewalks and numerous curb cuts and/or places where driveways blend into the sidewalk, creating an environment that prioritizes vehicular movement over people walking. From Chestnut Street east, the pedestrian volumes are the highest, especially at the intersection of Broadway where close to 200 pedestrians per hour were recorded crossing at the intersection during peak hours. This foot traffic is crucial to the commercial storefronts surrounding the Broadway intersection, and may also be the result of the nearby MBTA bus stop at Park Street.

Pedestrians walking through industrial area west of Spruce Street where no sidewalks exist today



Faded pavement markings at Broadway/Tremont Street intersection

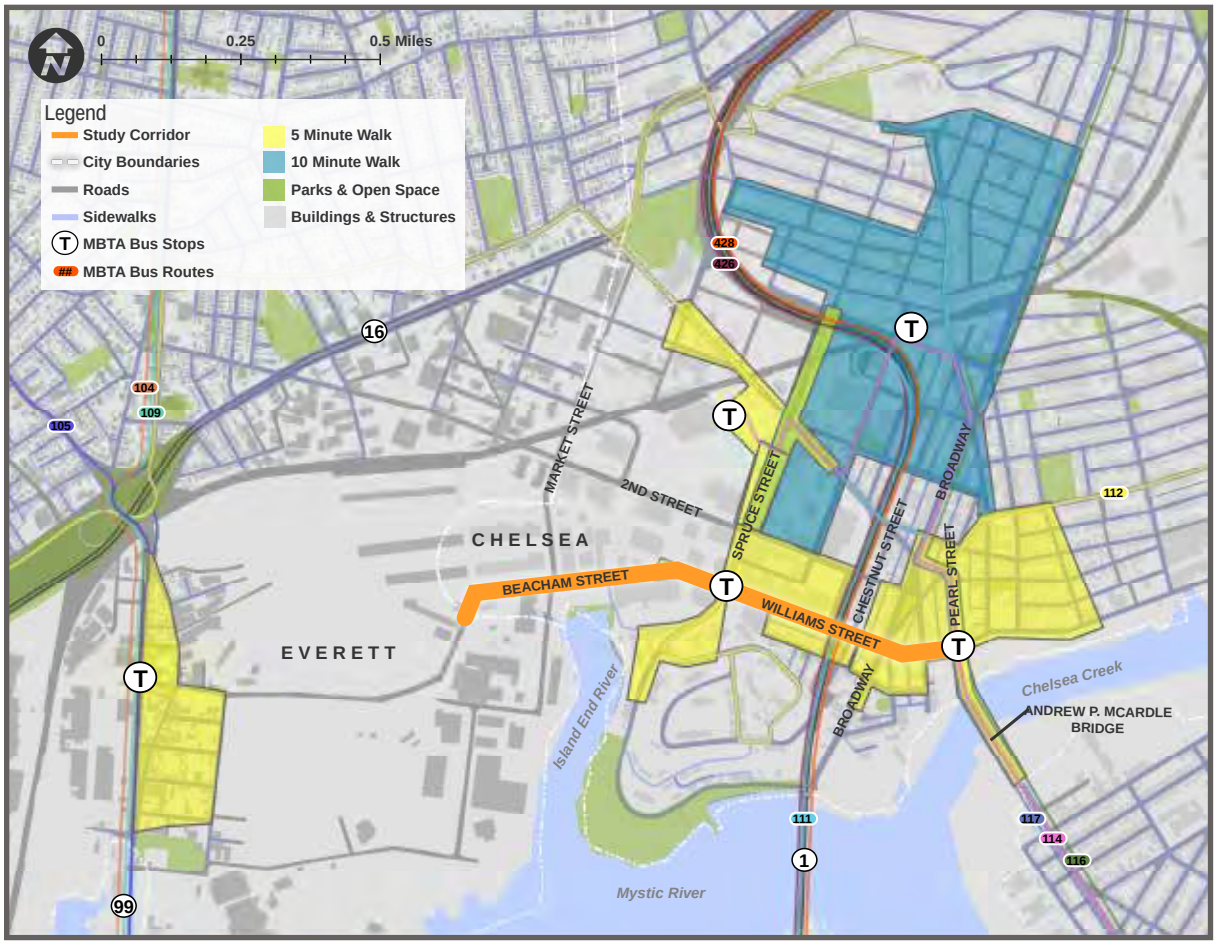


Bicyclist navigating their way through busy Broadway and Park Street intersection

Traffic encroaching onto roadway shoulders at Pearl Street intersection

TRANSIT

There is no direct bus service along the corridor itself. MBTA bus service runs on either end along Spruce Street, Park Street, and Broadway, with frequent connections to Haymarket, Sullivan Square, and Chelsea commuter rail station at typical peak commuting hours. Most of the corridor is within a 5-minute walk of these bus services. The nearest bus stop is located at Broadway and Park Street and serves the Route 111 bus. The new Silver Line Gateway Bus Rapid Transit facility, opening in April 2018, will be approximately a 5 minute walk from the corridor area. The closest connection to Everett via Broadway and bus routes 104, 105, and 109, is approximately a 15 minute walk from the corridor. The Chelsea commuter rail station is outside of a ten minute walk to the corridor, which is approximately how far people are generally willing to go for rail service.



Walking Access to Transit

Bus Service Near the Corridor

Route	Major Destinations	Frequency	Corridor Access
111	Haymarket, Chelsea Station	15 min	Park Street
112	Wood Island, Market Basket	40 min	Spruce Street
104	Malden, Sullivan Square	15-20 min (peak)	Broadway
105	Malden, Sullivan Square	75 min	Broadway
109	Sullivan Station, Linden Square	15-20 min (peak)	Broadway

SAFETY EVALUATION

The physical condition, overall layout, and lack of consistent pavement markings are a detriment to multimodal travel and an ongoing safety issue. For the 3-year period of 2014-2016, there were a total of 102 reported crashes along the roadway corridor, an average of 34 crashes per year. Of these crashes, 36 resulted in injuries and 16 involved pedestrians or bicyclists. The high number of crashes indicates existing safety deficiencies along the corridor. Roadway geometry and pavement markings are ill-defined, making travel confusing for all roadway users. Physically, the pavement is substantially deteriorated from constant, high volumes of truck traffic, and utility patches. Currently, access points to abutting industrial properties are poorly defined, some spanning the entire property frontage.

As the industrial presence in Chelsea has grown, truck access needs have taken preeminence along the corridor. Over time, truck sizes have increased, but the roadway has remained unchanged. A large percentage of the trucks operating along this corridor have 53-foot long trailers (this is a WB-67 design vehicle). Intersection geometry, driveway entrances, and building offsets were established when truck sizes were much smaller. Consequently, truck traffic blocks lanes or overhangs sidewalks when making turns.

West of Spruce Street/Commandants Way, foot-worn dirt paths, paralleling or encroaching on the frontage of abutting properties, have been created by workers needing to reach places of employment. Poor pedestrian accommodations include outdated pushbuttons, short signal timing and worn crosswalk markings, and non-ADA compliant access ramps. There are no dedicated bicycle facilities present along the corridor, requiring people on bicycles to share travel lanes with cars and trucks. Utility poles spaced at varying intervals provide sporadic light levels. Pedestrian scale lighting is only present in front of Chelsea District Court at the corner of Broadway. With industrial shift changes beginning between 8PM and 4AM and inbound/outbound deliveries occurring overnight or at dawn, insufficient lighting contributes to operational and safety concerns, and to public safety concerns.

Operationally, there are a number of high crash locations along the corridor, including five Highway Safety Improvement Program (HSIP) eligible clusters. A detailed review by MassDOT indicated that an RSA was not needed at Market Street. A pedestrian crash cluster also encompasses most of downtown Chelsea including the portion of Williams Street between Arlington Street and Hawthorne Street (east of Pearl Street). HSIP eligible clusters represent the top 5% crash clusters within the Metropolitan Area Planning Council (MAPC) region based on equivalent property damage (EPDO). EPDO is a method of quantified all crashes into a single score, with a higher weight assigned to injury and fatal crashes. The MAPC region includes 101 cities and towns in metropolitan Boston. Given the size and density of the region, having multiple crash clusters along the Beacham/Williams Street corridor in the top 5% is significant. In addition to existing crashes, safety considerations include predicted conflicts and collision rates along the corridor and at intersections.

Additional information can be found in the RSA Final Report in the Technical Appendix.

102 *total reported crashes along the corridor between 2014-2016*

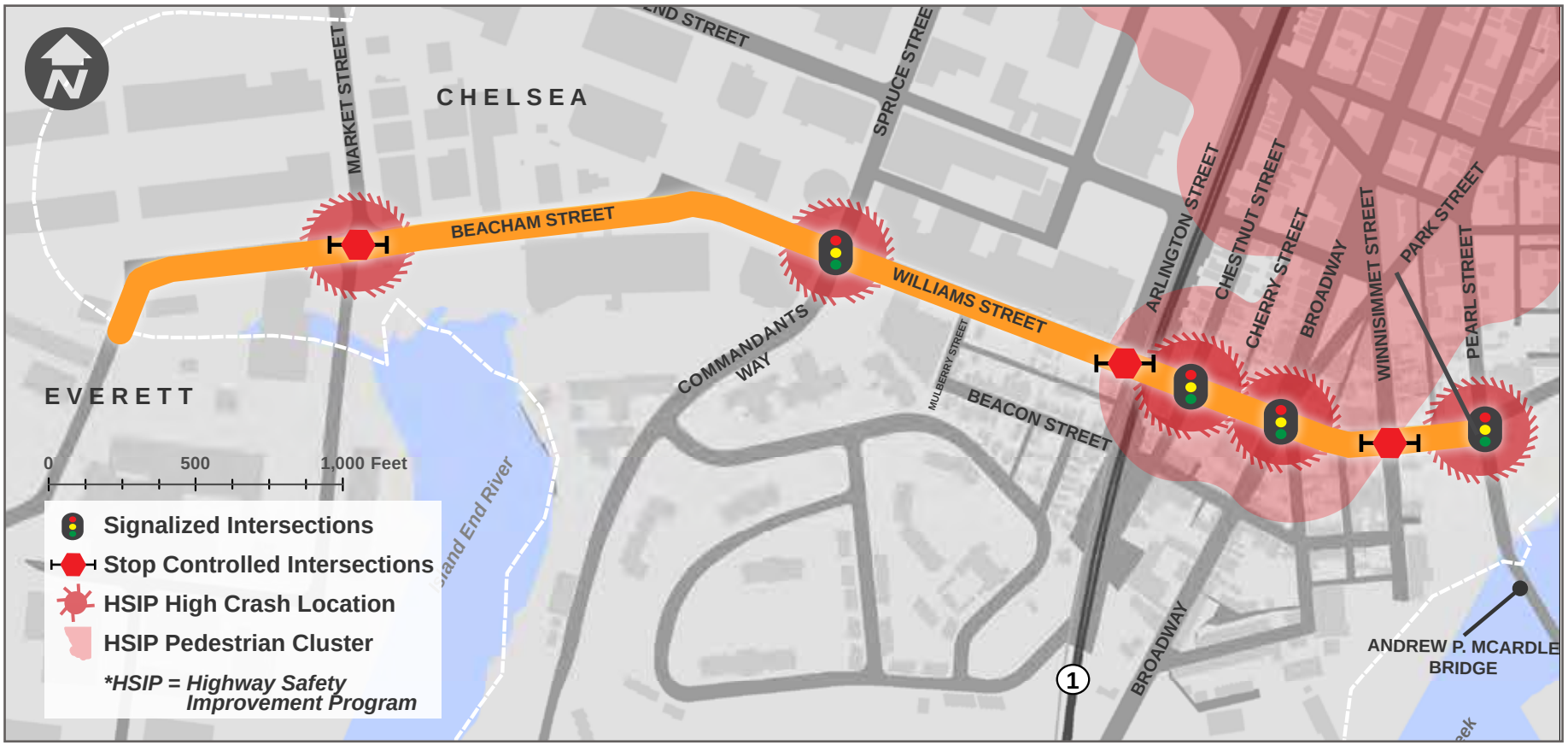
36 *crashes included injuries*

16 *crashes involved bicycles or pedestrians*

34% *crashes during non-daylight hours (nighttime, dawn, dusk) with 3 crashes involving pedestrians.*


MARKET STREET
BEACHAM STREET
2ND STREET
SPRUCE STREET
EVERETT AVENUE
COMMANDANTS WAY
WILLIAMS STREET
ARLINGTON STREET
CHESTNUT STREET
CHERRY STREET
BROADWAY
WINNISIMMET STREET
PEARL STREET
1
1
Legend
Corridor Crashes 2014-2016
Study Corridor
City Boundaries
HSIP Pedestrian Crash Clusters (2012-2014)
0
250
500
1,000 Feet

High Crash Locations



Road Safety Audit

A Road Safety Audit (RSA) was completed for four Highway Safety Improvement Program (HSIP) eligible clusters. The purpose of the RSA was to identify potential safety issues and possible opportunities for safety improvements, considering all roadway users. The RSA is included in the Technical Appendix.

- Williams Street/Spruce Street/Commandants Way
- Williams Street/Chestnut Street
- Williams Street/Broadway
- Williams Street/Pearl Street/Marginal Street

POTENTIAL SAFETY ENHANCEMENT SUMMARY

Based on the Road Safety Audit, the following potential enhancements were identified by the Audit Team.

Williams Street at Spruce Street

Safety Issues	Potential Safety Enhancement
Non-ADA-compliant sidewalk access ramps	Consider replacing all curb ramps with ADA-compliant ramps with detectable warning panels
Outdated pedestrian signals	Consider updating to APS and ADA-compliant pedestrian signal pushbuttons
Lack of bicycle facilities requires sharing lanes	Evaluate the feasibility of providing facilities such as bike lanes or shoulders
Worn crosswalk markings	Replace crosswalk markings on Williams Street and Spruce Street
Vehicles encroaching on curb when turning	Evaluate Location of Stop bars
Vehicles encroaching on curb when turning	Evaluate curb radii for truck turns and relocate any potential obstructions if any changes are made to the curb radii
Undefined Pavement Markings	Consider replacing crosswalk markings and consider signage to better define the lane usage
Trucks encroaching during right turns	Consider a "No turn on Red" restriction.
Vehicles fail to clear intersection	Review clearance intervals and update if necessary
Signal visibility	Consider adding backplates with retro-reflective border to all traffic signal heads

Williams Street at Chestnut Street

Safety Issues	Potential Safety Enhancement
Pedestrian confusion	Update the pedestrian signal buttons and provide countdown pedestrian displays that meet ADA guidelines. Replace defective pedestrian display
Lack of bicycle facilities requires sharing lanes	Evaluate the feasibility of providing bicycle facilities such as bicycle lanes or shoulders
Poor pavement marking visibility	Consider reapplying pavement markings, ensure removal of old pavement markings
Vehicles encroaching on curb when turning	Evaluate existing radii and adjust curb radii and relocate any obstructions including utility poles or signs
Conflict visibility	Consider enhancing roadway lighting by adding additional overhead lighting and pedestrian scale lighting

Williams Street at Broadway/Tremont Street

Safety Issues	Potential Safety Enhancement
Non-ADA-compliant sidewalk access ramps	Consider replacing all curb ramps with ADA-compliant ramps with detectable warning panels
Outdated pedestrian equipment	Update the pedestrian signal buttons and provide countdown pedestrian displays that meet ADA guidelines.
	Evaluate crossing of Williams by Tremont and remove or replace crossing
Long crossing	Consider adding curb bump outs to shorten crossing distances
Lack of bicycle facilities requires sharing lanes	Evaluating the feasibility of providing bike lanes or shoulders
Missing crosswalk south of Tremont Street	Review need for crosswalk and either replace pavement markings or pedestrian light. If crossing maintained, consider installing a bump-out
Vehicles travelling the wrong way down Broadway instead of Park Street	Evaluate the need for additional pavement markings/signage to improve clarity
Vehicles encroaching on curb when turning	Evaluate the existing curb radii and consider adjusting curb radii and relocate any potential obstructions
Excessively wide travel lanes	Evaluate lane widths and geometry to determine if lane widths can be narrowed down
Signal Visibility	Replace broken visors. Consider adding backplates with retro-reflective border to all traffic signal heads
Vehicles fail to clear intersection	Review clearance intervals and update if necessary and consider coordination with signal at Pearl Street
Signal Coordination	Consider integrating emergency preemption
Missing Stop line	Evaluate stop bar location and replace missing stop line on the eastbound Williams Street approach

Williams Street at Pearl Street/Marginal Street/McArdle Bridge

Safety Issues	Potential Safety Enhancement
Non-ADA-compliant sidewalk access ramps	Consider installing separate curb ramps with ADA-compliant ramps with detectable warning panels
Sidewalk obstructions	Consider relocating utility poles, signal poles or signage to allow all sidewalk to be functional and passable.
Sidewalk obstructions	Reduce the size of curb cuts and use enforcement to prevent vehicles parked on the sidewalk.
Sidewalk obstructions	Evaluate feasibility of relocating catch basin to remove hazard
Sidewalk obstructions	Evaluate the feasibility of widening the sidewalk to allow a minimum of 3 feet around obstructions.
Lack of bicycle facilities requires sharing lanes	Evaluate the feasibility of providing bicycle lanes or shoulders.
Outdated pedestrian signal equipment	Updating the pedestrian signal buttons and provide countdown signal displays that meets ADA compliance.
Pedestrian timing	Review Pedestrian clearance timing and update as necessary
Vehicles encroaching on curb when turning	Consider pulling back stop bar on the bridge to allow more space for vehicles to maneuver while executing a turning movement
Lane assignment confusion	Consider applying/re-applying the pavement markings to delineate lane use for vehicle approaching the intersection and provide the correct lane assignment. Review lane usage and provide clarity for lane usage. Install additional lane use signage and "Wide Right" signs.
Intersection Layout	Consider realigning intersection to remove offset for through movements, improve curb radii for turning movements. Consider widening intersection and increasing curb radii.
Reduced sight distance	Consider restricting right turns on red.
Reduced sight distance	Consider relocating utility poles and other obstructions.
Pavement rutting	Resurfacing and/or reconstruct the pavement on Williams Street
Lane visibility	Reapply pavement markings, ensure removal of old pavement markings
Signal visibility	Replace broken visor
	Consider adding additional signal heads in each direction to improve visibility of signals.
	Consider adding backplates with retro-reflective border to all traffic signal heads
Signal Coordination	Consider integrating emergency preemption
	Consider coordinating the signal with the signal on McArdle Bridge
Conflict visibility	Consider conducting a lighting evaluation
Conflict visibility	Consider enhancing roadway lighting by adding additional overhead lighting and pedestrian scale lighting

TRAFFIC ANALYSIS

The traffic analysis focused on intersection operations and vehicular Level of Service (LOS) at intersections (delay time at intersections) today and in the future. In general, lower LOS for vehicles may mean they are traveling more slowly, potentially increasing safety for pedestrians. The corridor includes 14 intersections, 4 signalized and 10 stop controlled (unsignalized). For this study, the 8 most critical intersections were analyzed.

To determine future operations along the corridor, existing peak hour traffic volumes collected in 2016 were projected to the year 2022. The future volumes were calculated using a growth rate from Chelsea's recently designed Upper Broadway Infrastructure Project in addition to individual developments in the region that will impact the corridor. Although in 2013 the Encore Casino FEIR used a 0.5% growth rate compounded annual traffic growth rate for background traffic growth, Chelsea has completed projects more recently with input from the Central Transportation Planning Staff that utilized a higher rate. Therefore, for this study, a 1% per year growth rate was used.

The City identified three proposed developments that may increase traffic volumes along the corridor. Proposed developments identified by the City of Chelsea included the Encore Boston Harbor Resort and Casino, Residences at Chelsea Lofts at Everett Avenue and Carter Street (692 apartments and 8,500 sf of retail at former Chelsea Clock Co. site), and 200 Second Street (139 room hotel). To determine future operations along the corridor, the existing peak hour traffic volumes collected in 2016 were projected to the year 2022 using a 1% per year growth rate and considering the proposed developments.

ITEMS OF NOTE:

- The corridor generally operates within capacity today and in the future.
- Vehicle queues in the morning frequently extend from Everett, backing up westbound traffic on the corridor.
- Most intersections will operate similarly in the future. The evening peak hour will have slightly higher delay for vehicles, reflecting traditional commute peaks.
- The stop-controlled Market Street intersection currently operates poorly. Due to volumes on Beacham Street, side street traffic has difficulty finding gaps. Delays will increase slightly in the future.
- There will be a significant increase in delay at the Chestnut Street (signalized) and Winissimmet Street (stop controlled) intersections.

The traffic analysis memo in the Technical Appendix includes more detailed information on existing and future (2022) traffic conditions along the corridor.

LOS Criteria for Signalized Intersections

LOS	Average Delay (sec/veh)	Motorist Perception
A	< 10	Free flow traffic: "Good" LOS
B	10 - 20	Reasonable free-flow
C	20 - 35	Stable but unreasonable delay begins to occur
D	35 - 55	Borderline "bad" LOS
E	55 - 80	"Bad" LOS: long queues
F	> 80	May be unacceptable: high delay, congestion

Source : Highway Capacity Manual 2000

The future analysis indicates that inefficient operations at the signalized intersection of Williams Street / Chestnut Street leads to excessive delay on the Williams Street eastbound approach during the evening commute. It is recommended that the traffic control signal be retimed to give more time to Williams Street and an interconnect cable be installed to allow for coordination with the Broadway traffic control system.

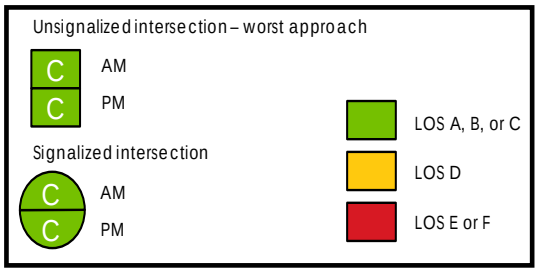
With the recommended improvements at Williams Street/ Chestnut Street and the reconfiguration of Winnisimmet Street implemented, the only study area approaches to an intersection that will operate at LOS F are the Market Street approaches.

With the recommended changes, operations along the corridor will generally operate at an acceptable level of service.

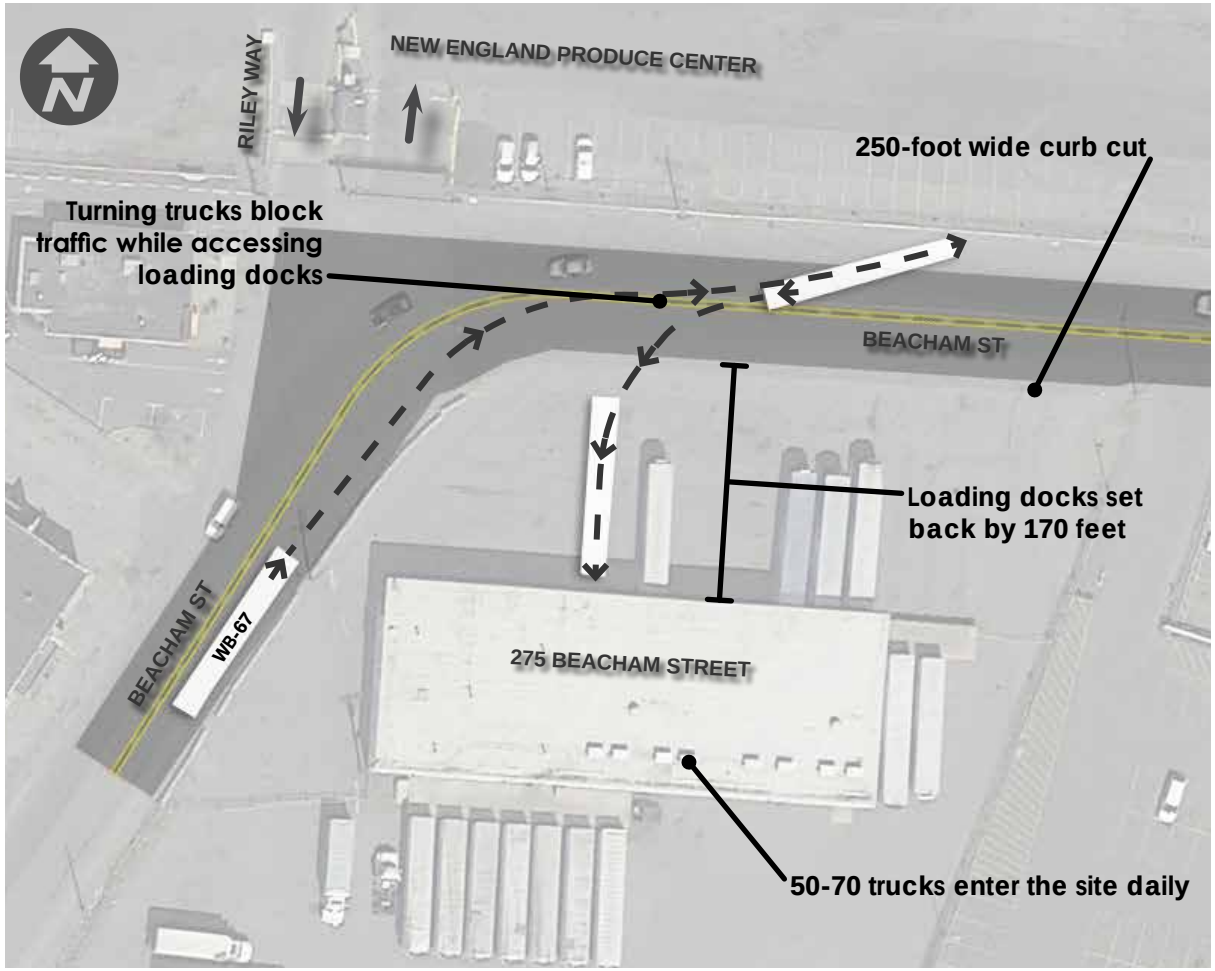
Vehicle Level of Service - Today

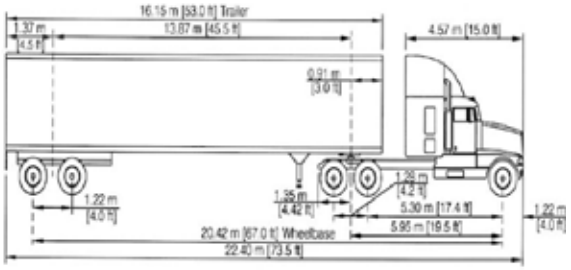
Vehicle Level of Service - 2022 Future No-Build

Vehicle Level of Service - 2022 Future Build



4M FRUIT DISTRIBUTORS CASE STUDY





WB-67 Design Vehicle

4M Fruit Distributors - Loading Docks

275 Beacham Street is a distribution facility for one of the leading fruit wholesalers on the East Coast. While this is the widest curb cut (driveway) along the corridor, other abutting commercial and industrial sites experience similar site circulation and access issues.

Consideration was given to narrowing curb cuts along the entire corridor, but doing so would negatively impact site circulation and access, and in some cases, make loading docks inaccessible. In order to support the economic vitality of these businesses, they need space to function as they do today. Therefore, other physical treatments are needed to better define driveway openings and the path of travel for vehicles, pedestrians, and bicyclists.

These physical treatments could include the installation of:

- **Solid white line (6") shoulder lane markings** to better define the edge of the traveled way
- **Curb corners to distinguish driveway openings from abutting paved areas**
- **A concrete surface across the openings to visibly define the path of travel** for pedestrians and/or bicyclists, and to raise truck drivers' awareness of these other users.

Again, while this case study is about 275 Beacham Street, similar treatments could be used at all commercial and industrial driveways along the corridor.

OUTREACH

In every planning study, it is important to validate findings and seek input from City staff, abutting business, residents, and commuters. The individuals who use the corridor on a daily basis provide insight and perspectives that no amount of data collection could possibly provide.

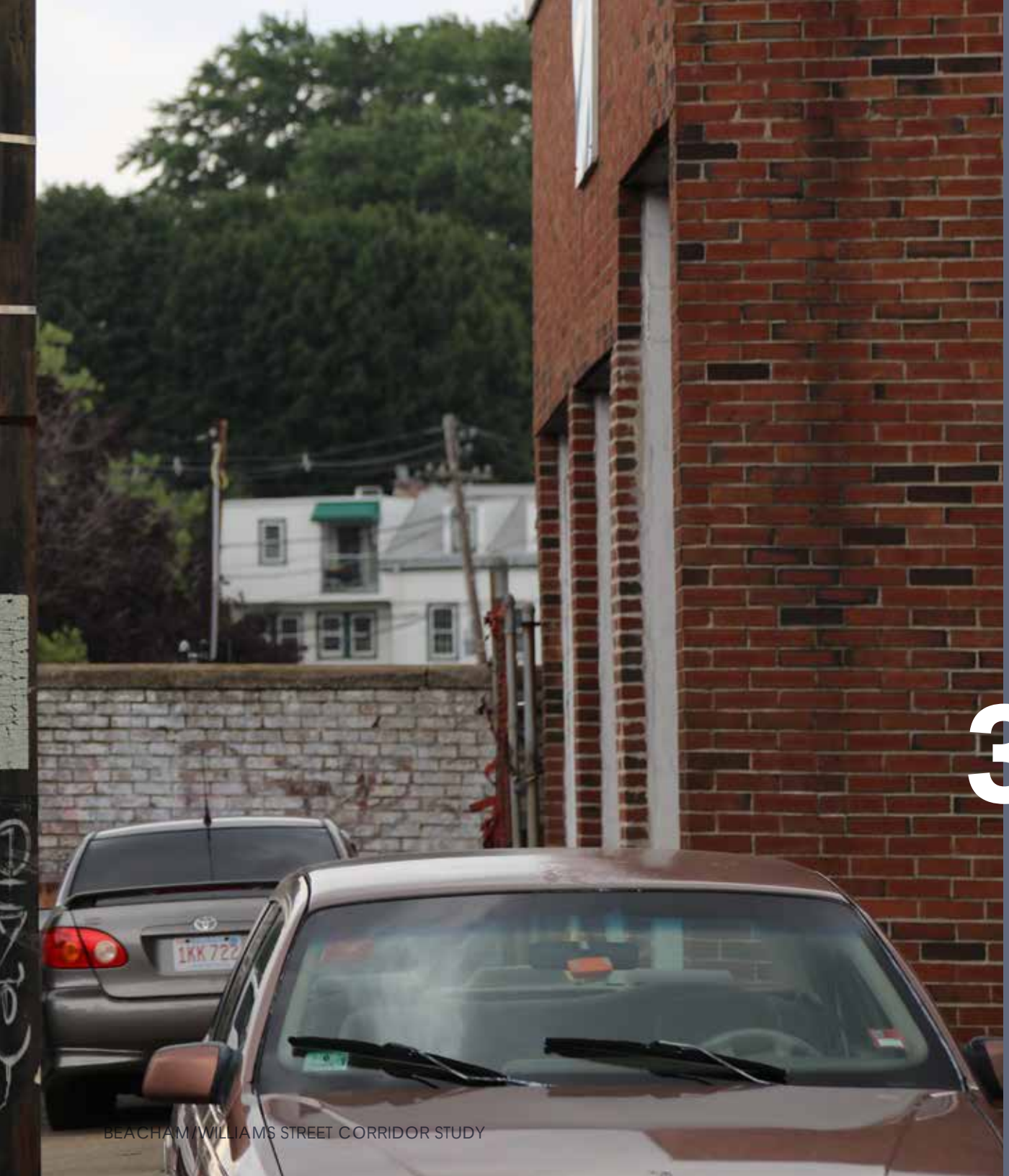
City staff from various departments provided input on the City's economic development goals for this corridor, upcoming public and private projects, existing safety issues, and long-term and seasonal maintenance considerations. Joint meetings with the City of Everett were held to discuss their design goals for the corridor and potential project phasing under a joint process. In addition, WalkBoston and MassDOT had an opportunity to provide input to the study during Roadway Safety Audit (RSA).

Two meetings were held in September 2017 to engage commercial and industrial enterprises to understand their respective transportation needs and infrastructure requirements. A separate open house was held at City Hall in October 2017 for residents and the larger community. At each meeting, roll plans of the corridor were presented along with various multimodal cross section options. Attendees shared their thoughts. Produce companies discussed their operations including when and how their workers get to work and deliveries are made. They stressed the need to maintain full access to their driveways and loading docks, and the hours during which they operate. Truck operators are particularly concerned about seeing bicycles and pedestrians when backing up and turning. Small business owners discussed the importance of downtown foot traffic and nearby on-street parking. A developer noted that streetscape improvements are vital to supporting mixed-use redevelopment. Residents discussed the safety concerns they have crossing the Spruce Street/Commandants Way intersection by foot given vehicles turning on red. Those that commute to Boston by bike find it difficult to avoid the potholes and are concerned for their safety given the number of trucks. They liked the idea of a separate facility where possible. Non-profits discussed the importance of improved bike and pedestrian access for workers and students along the corridor. Snow removal and storage was a concern brought up by both the City and abutters.

WHAT WE HEARD:

- Truck drivers are as concerned about people on bikes, as people on bikes are about trucks
- Existing truck access to abutting properties needs to be maintained
- Improved bicycle access for commuters
- Sidewalks are important for workers, customers, and students
- Streetscape is important for downtown redevelopment sites
- Snow removal and storage requirements should not be overlooked


WEIGHT
LIMIT
20T
25T
40T
BIG T&D
TRUCKING
Apollo



3 CONCEPT DESIGN

CONCEPT DESIGN

The key findings from the site conditions review informed the recommended corridor-wide and character area specific improvements.

Corridor wide improvements call for generally establishing a consistent cross-section. Meanwhile, variations by character area respond to both corridor wide goals and local context. The primary difference is the type of proposed bicycle facility. The selection of the appropriate facility type was driven by available roadway ROW, on-street parking areas, frequency and width of existing curb cuts, and abutting land use.

CORRIDOR-WIDE IMPROVEMENTS

The corridor-wide improvements consist of:

- Roadway repair/reconstruction to improve ride quality and reduce pavement distresses
- New pavement markings to properly delineate vehicle, bicycle and pedestrian zones
- New concrete sidewalks on each side of the street, extending across driveway openings for improved pedestrian visibility
- Full replacement of the drainage system
- Granite curbing to better define walk zones and driveways/curb cuts along the corridor
- New, LED street lighting to improve overall roadway safety
- Street trees, as sidewalk widths allow, to reduce heat islands and provide aesthetic value
- High-visibility ladder pattern crosswalks across roadways and/or at intersections
- 4-foot wide shoulder where feasible to meet design guidance for roadway classification

In addition, the following traffic control signal improvements are recommended at existing signalized intersections:

- Replace existing span wire traffic signals with mast arms
- Deploy coordinated and adaptive traffic control systems (ATCS)

→ Transportation considerations include:

- **Freight movement is important for the corridor and region, and requires specially designed infrastructure and conflict considerations for larger vehicles**
- **The conflict of freight, i.e. large trucks, and other types of trips such as local residents or more regional through traffic requires a focus on safety**
- **Mix of industrial and commercial uses will have different "peak" hours as workers, deliveries, and/or customers arrive and depart**

The existing span wire traffic signals should be replaced with mast arms. This recommendation is based on the outdated signal equipment and the fact that the proposed roadway improvements will also require intersection modifications. The use of mast arms, rather than span wires, allows for proper positioning of overhead traffic signals on each intersection approach. The use of retro-reflective backplates will improve the visibility of the signal faces for all roadway users. The upgraded signal equipment will include new countdown pedestrian signals, Accessible Pedestrian Signal (APS) for the visually impaired, and ADA-compliant pushbuttons. Sufficient yellow and red clearances will be incorporated into the new signal timing.

Coordination among traffic signals and adaptive traffic control systems (ATCS) should be deployed as part of new signal installations along the corridor. Coordinated signals provide the benefit of maximized throughput along the corridor. ATCS's use real-time traffic data to continuously monitor traffic delays and queues.

Due to the close spacing of the Chestnut Street, Broadway and Pearl Street intersections, signal coordination and ATCS technology is more critical at these locations, but can be extended to include Spruce Street. During construction, conduit and an interconnect cable should be installed between Spruce Street and Chestnut Street to facilitate future coordination and ATCS technology. It is also possible to provide communication between an adaptive traffic signal and the Chelsea Street bridge intelligent transportation system (ITS) or a future Andrew P. McArdle bridge system. The ITS system currently encourages drivers to seek alternate routes to avoid delays when the Chelsea Street bridge is up, which is reported to occur up to 5 times per day.

COST ESTIMATES

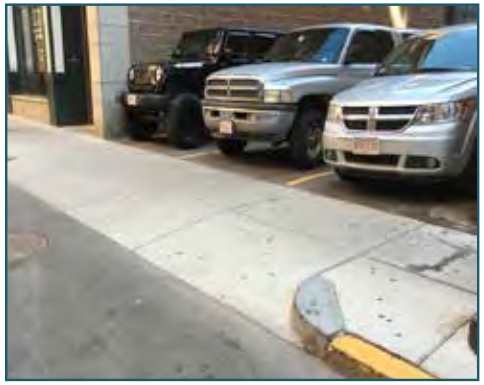
Programming level estimates of probable construction cost were developed based on the concept designs presented for each character area. The estimates include the full build of the corridor-wide improvements, traffic control signal improvements, and any specific recommendations for each character area. For the purposes of this study, the cost estimates do not include any costs associated with ROW acquisition, utility relocation force accounts, or design development.

PROPOSED CORRIDOR-WIDE IMPROVEMENTS

Pedestrian Countdown Signal Head

Retro-reflective Signal Head Backplate

Ladder Pattern Crosswalk



Concrete Sidewalk Across Driveway

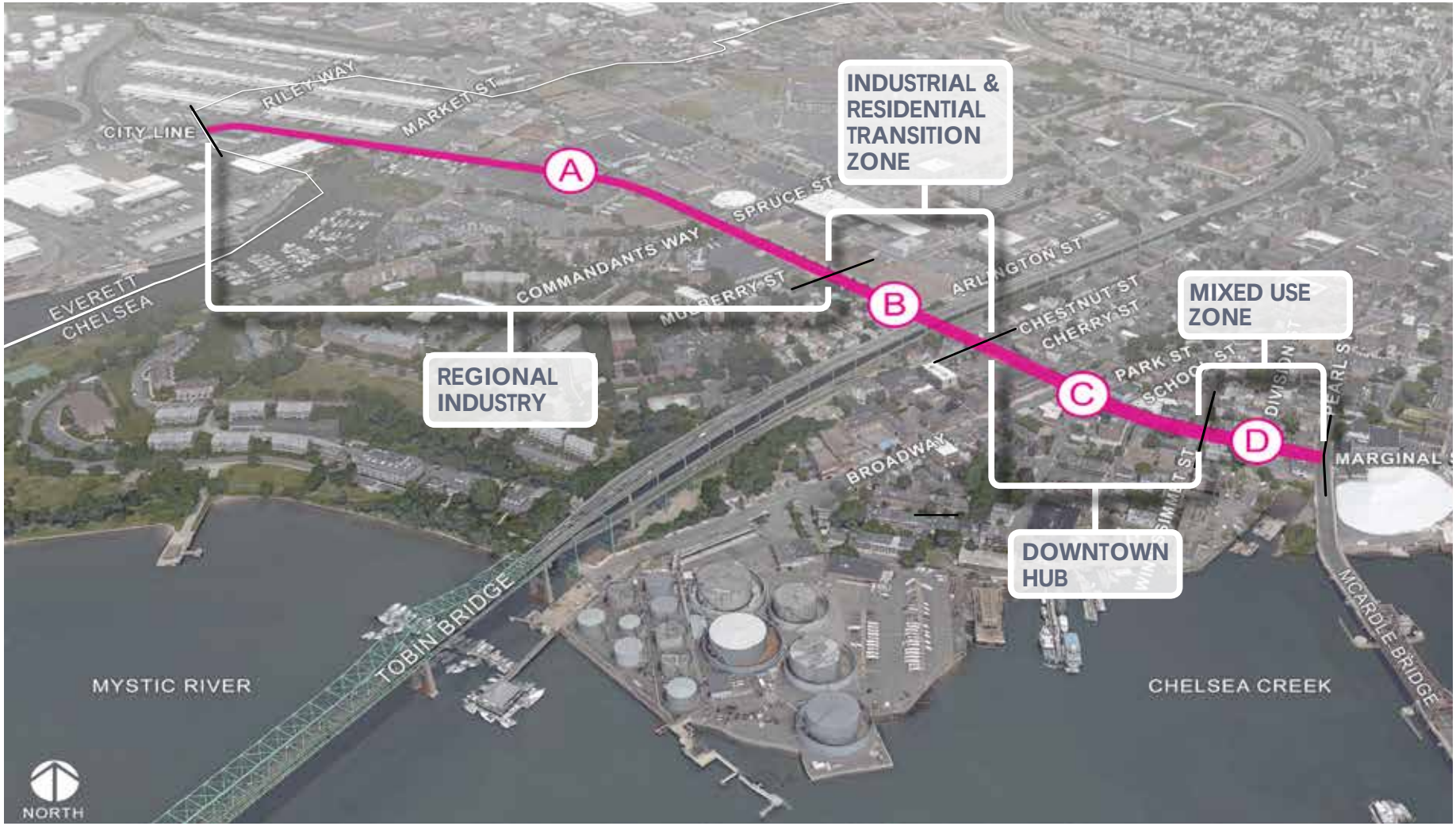
Separated Bike Lane with Median

Concrete Furniture Zone

Shared Lane Markings

Separated Bike Lane

Shared use Path

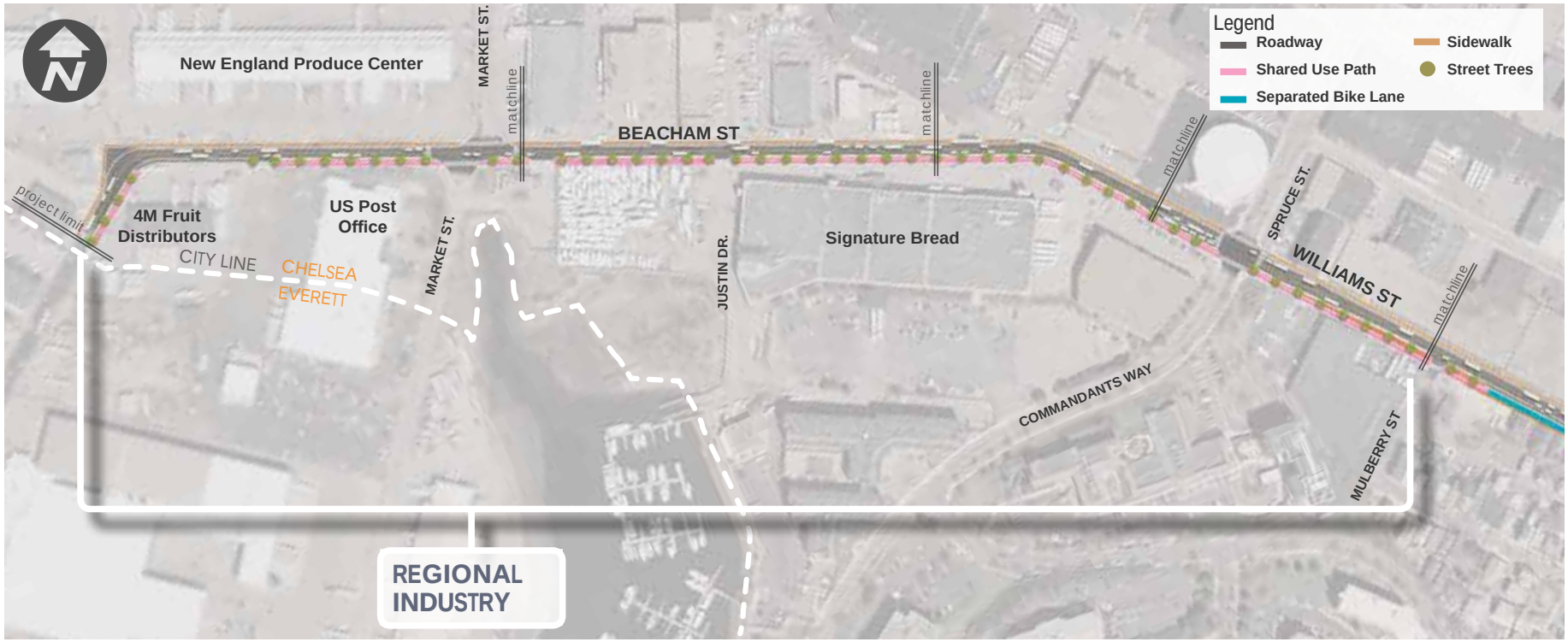


Character Areas

CHARACTER AREA A REGIONAL INDUSTRY

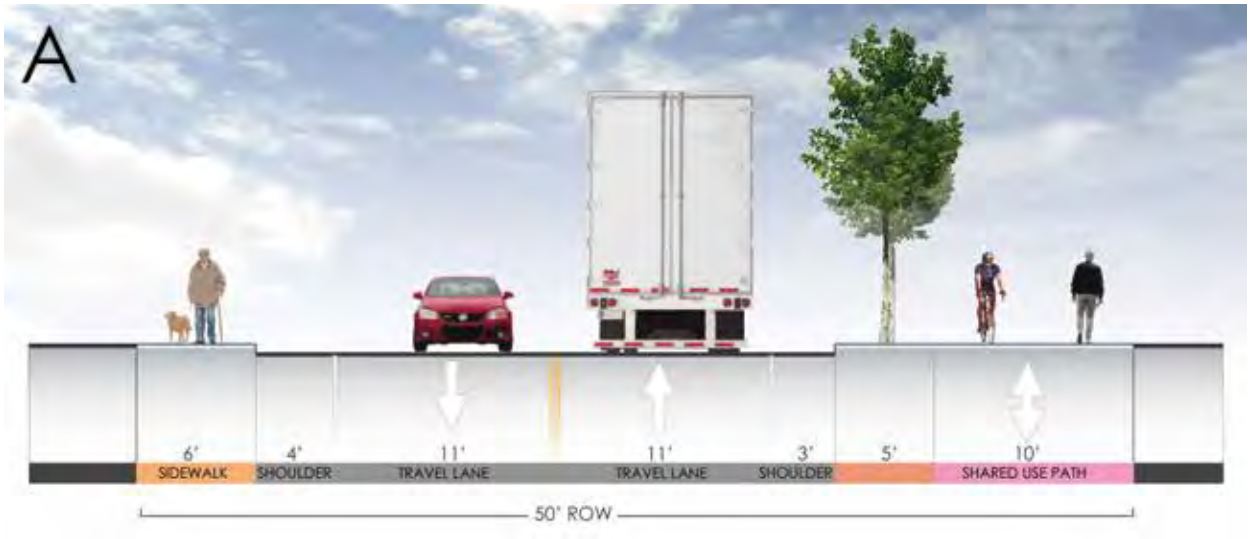
Everett City Line to Mulberry Street (3,050 Feet) | Construction Cost Estimate - $8,300,000

Overall Plan



Character Area A transects an industrial area with a high concentration of produce production and distribution facilities and specialty food, and other industrial uses that support the local and regional economy.

Recommended Street Section - Looking East



IMPROVEMENTS AT-A-GLANCE:

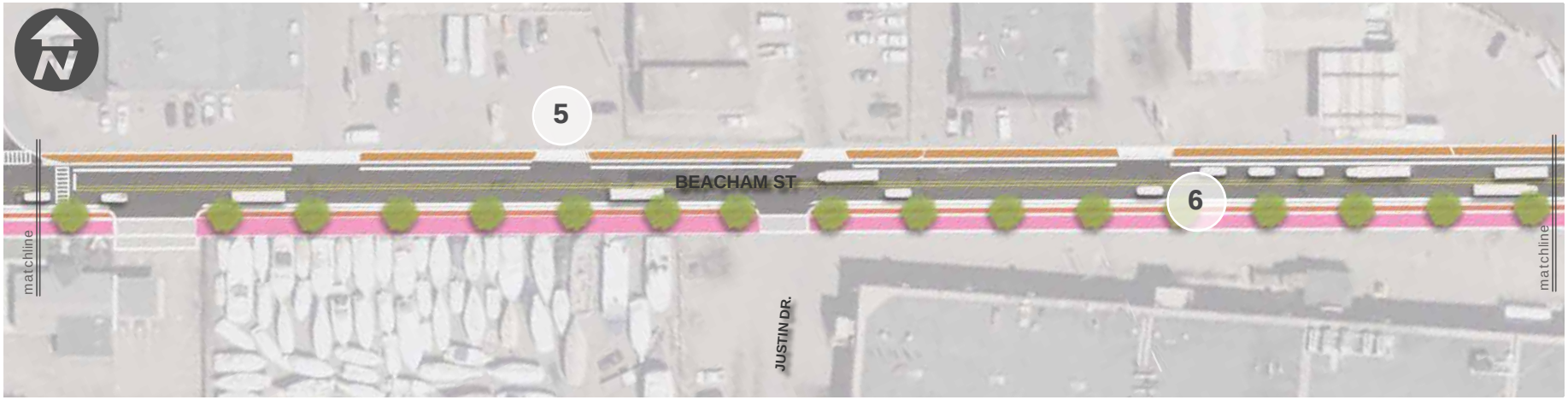
- Better define lanes and shoulders with pavement markings to limit off tracking vehicles
- Extend concrete surface treatment across driveways for improved bicycle/pedestrian visibility
- Construct 10-foot wide shared use path on south side of street
- Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
- Provide 5-foot furniture zone for street trees and utility/light poles
- Provide left turn lane to Spruce Street
- Install signage to prevent right turns on red by trucks from Spruce Street to limit encroachment on Williams Street
- Replace existing traffic signal at Spruce Street/ Commandants Way
- Transition shared use path to separated bike lane

A 10-foot wide shared use path is recommended as a means to separate two-way bicycle traffic from vehicle traffic within this character area. This facility type is consistent with what the City of Everett is proposing along the adjoining corridor section based on early coordination efforts. The decision to place the path on the south side of the street was based on the desire to avoid a potential high bicycle/vehicle conflict point at the New England Produce Center and Dunkin' Donuts entrance, and due to the higher frequency of existing curb cuts on the north side of the street. A sidewalk plow or pickup truck can be used for snow removal. The 5-foot furniture zone separating the path from the traveled way can support healthy street trees and utility/light poles, and be used for snow storage as needed. Pedestrian scale lighting is not recommended in this section given the strike potential for turning trucks.

Signalization was considered at the Market Street intersection but is not recommended. A review of volumes at Market Street show that the majority of turns are right turns, which are not greatly improved by signalization. In addition, if the side street right turns are excluded from the analysis, (which is the typical procedure), the intersection does not meet warrants for signalization.

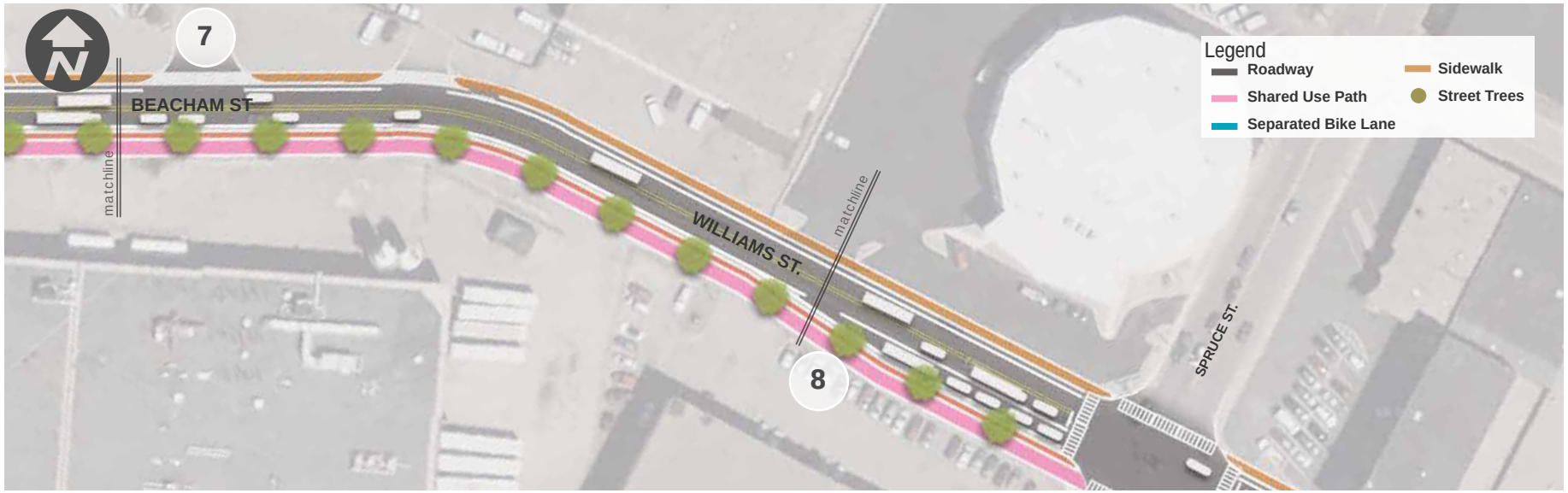
Character Area A - Enlargement Plan 1

Character Area A -Enlargement Plan 2



1. Better define lanes and shoulders with pavement markings to limit off tracking vehicles
2. Extend concrete surface treatment across driveway openings for improved bicycle/ pedestrian visibility
3. Construct 10-foot wide shared use path on south side of street
4. Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
5. Extend 6-foot wide concrete sidewalk across driveway openings
6. Provide 5-foot furniture zone for street trees and utility/light poles

Character Area A - Enlargement Plan 3



Character Area A - Enlargement Plan 4

7 Extend 6-foot wide concrete sidewalk across driveway openings

8 Provide left turn lane to Spruce Street

9 Install signage to prevent right turns on red by trucks from Spruce Street to limit encroachment on Williams Street

10 Replace existing traffic signal at Spruce Street/ Commandants Way

11 Widened furniture zone for street trees and utility/light poles.

12 Transition shared use path to separated bike lane.

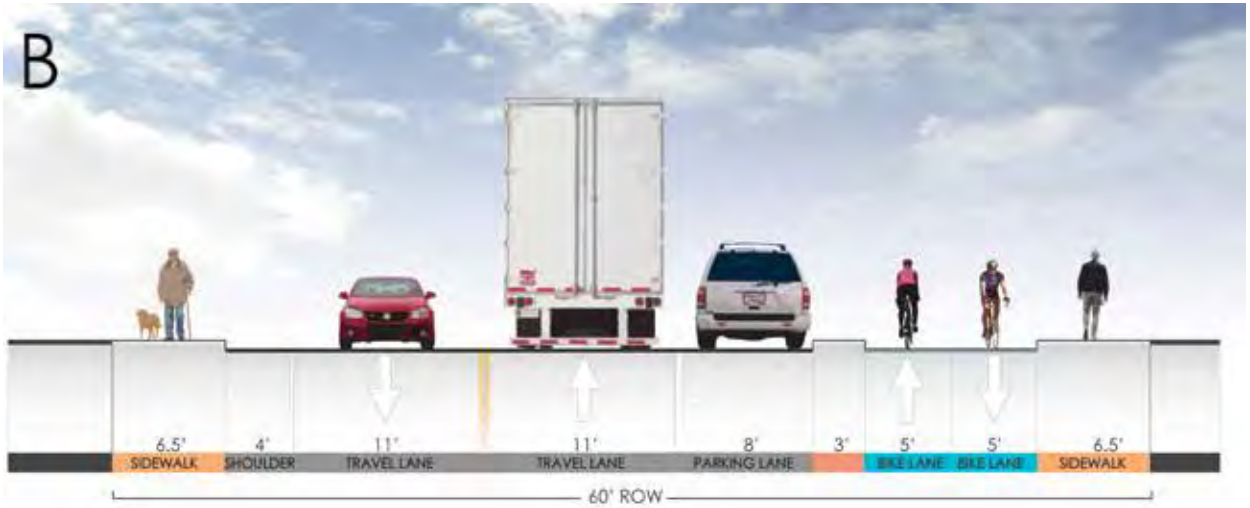
CHARACTER AREA B INDUSTRIAL & RESIDENTIAL TRANSITION ZONE

Mulberry Street to Chestnut Street (750 feet, including the Mulberry Street intersection) | Construction Cost Estimate - $1,900,000

Overall Plan

Character Area B serves as a transition zone between land uses. One large industrial property backs onto Williams Street from Spruce Street to Arlington Street and the Route 1/Tobin Bridge viaduct. Opposite this building, a few small commercial businesses and a cluster of 5 multi-family residential properties front the south side of the street. On-street parking is located along Williams Street in front of these homes.

Recommended Street Section - Looking East

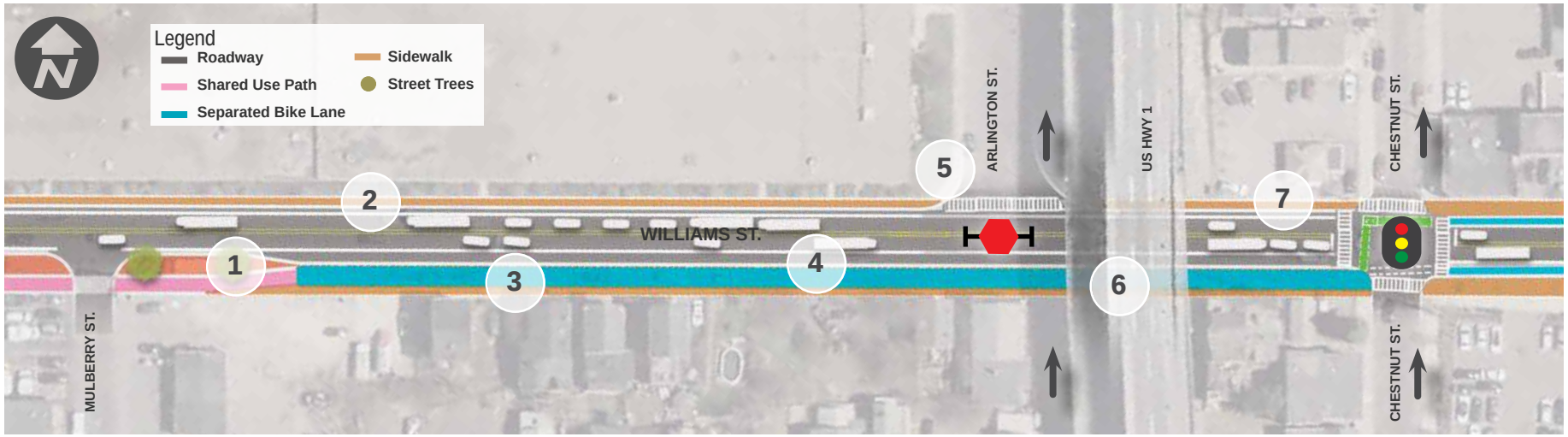


IMPROVEMENTS AT-A-GLANCE:

- Transition shared use path to 10-foot wide separated bike lane on south side of street
- Provide sidewalk along north side of street
- Provide sidewalk along residential frontages and retain driveway openings
- Reconstruct sidewalk located along residential frontages
- Maintain 8-foot wide parking lane
- Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
- Install additional lighting under Route 1/Tobin underpass

The recommended improvements in Character Area B keep both curb lines essentially where they exist today and reallocates the existing curb to curb width to better accommodate use by bicycles. On-street parking will remain on the south side of the street. What is new is the introduction of a 10-foot wide separated bike lane on the south side of the street. A separated bike lane is a two-way separated bicycle facility, with 5-foot lanes in each direction. The separated bike lane is separated from the parking lane by a 3-foot raised median. The 3-foot median serves multiple purposes. First, to prevent vehicles from traveling in or parking in the separated bike lane, second, to prevent parked cars from opening their passenger side doors and dooring bicyclists, and third, to allow for the placement of signs in the median. A sidewalk plow or pickup truck can be used for snow removal of the separated bike lane. Providing a separated bike lane in this location will form a smooth transition from the 10-foot wide shared use path proposed in Character Area A, and bring bicycles to the signalized Chestnut Street intersection. Residents leaving their homes will continue to step onto a sidewalk similar to how they do today. The 6.5-foot wide sidewalk cannot support healthy street trees, but it can support utility poles and pedestrian scale LED lighting. Such lighting would improve the walkability of this section of the corridor.

Character Area B - Enlargement Plan



1. Transition shared use path to 10-foot wide separated bike lane on south side of street
2. Reconstruct a 6.5-foot wide sidewalk along north side of street
3. Reconstruct 6.5-foot wide sidewalk along residential frontages and retain driveway openings
4. Maintain 8-foot wide parking lane
5. Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
6. Install additional lighting under Route 1/Tobin underpass
7. Install a 6.5-foot wide sidewalk on north side of street

CHARACTER AREA C DOWNTOWN HUB

Chestnut Street to Winnisimmet Street (850 feet, including the intersections) | Construction Cost Estimate - $2,800,000

Overall Plan

Character Area C transects a mix of small commercial businesses that function as an extension of the downtown Broadway corridor. There are 7 intersecting streets within 850 feet, 3 of which are currently signalized. The Beacon Street exit off Route 1 northbound/Tobin Bridge connects directly to Chestnut Street and Williams Street. From Broadway, the corridor makes a slight turn and starts to travel down a hill on the approach to the Chelsea Creek waterfront.

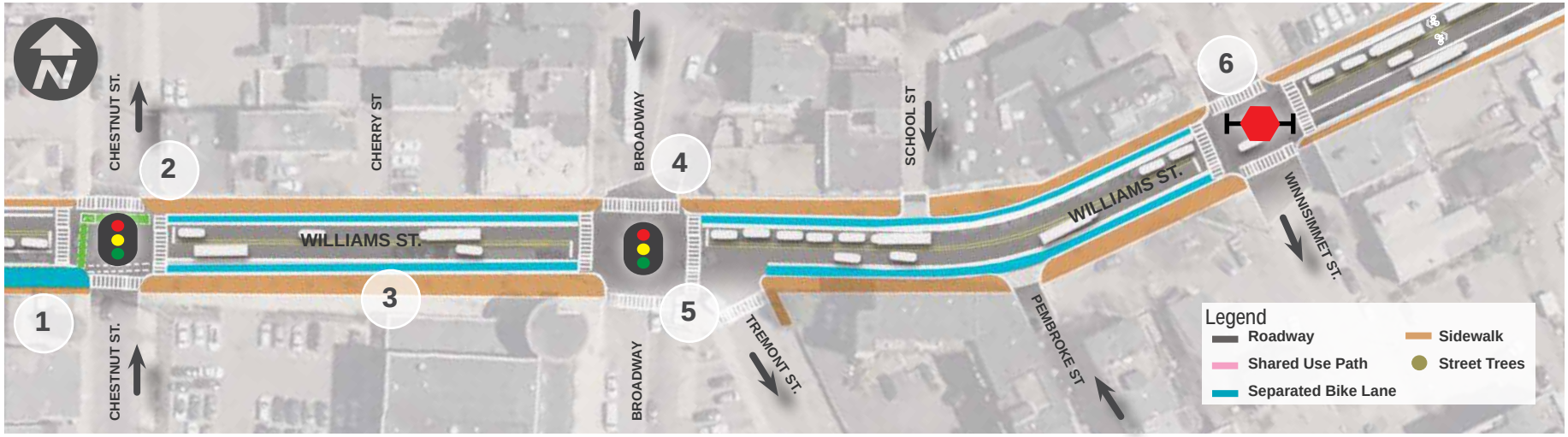
Recommended Street Section - Looking East

IMPROVEMENTS AT-A-GLANCE:

- Transition 10-foot wide separated bike lane to 5-foot wide bike lanes on both sides of the street
- Replace existing traffic signals at Chestnut Street and Broadway
- Reconstruct sidewalk along both sides of the street
- Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
- Consider converting Winissimmet Street to one-way away from Williams Street

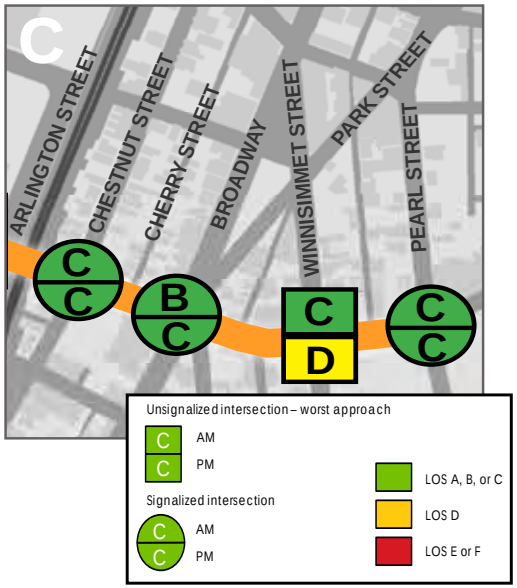
The recommended improvements in Character Area C keep both curb lines essentially where they exist today and reallocates the existing curb to curb width to accommodate a travel lane and 5-foot separated bike lane in each direction. A 2-foot wide flush painted median will separate the bike lane from vehicles. A 6-foot wide sidewalk is proposed on both sides of the street. The addition of a 2-foot wide greenscape/furniture zone on the south side of the street will aid in transitioning the bicycle facility from a two-way separated bike lane in Character Area B to a one-way facility at the Chestnut Street intersection. During the public outreach process, commercial abutters with storefronts expressed an interest in wider sidewalks to accommodate street furniture and outdoor seating areas. Providing wider sidewalks in lieu of improved bike accommodations was considered but is not recommended. A truly multimodal street section should be provided through this congested downtown area. Having a 5-foot wide dedicated bike lane in each direction provides protection for bicyclists on the most heavily traveled part of the corridor with the highest percentage of truck traffic.

Character Area C - Enlargement Plan

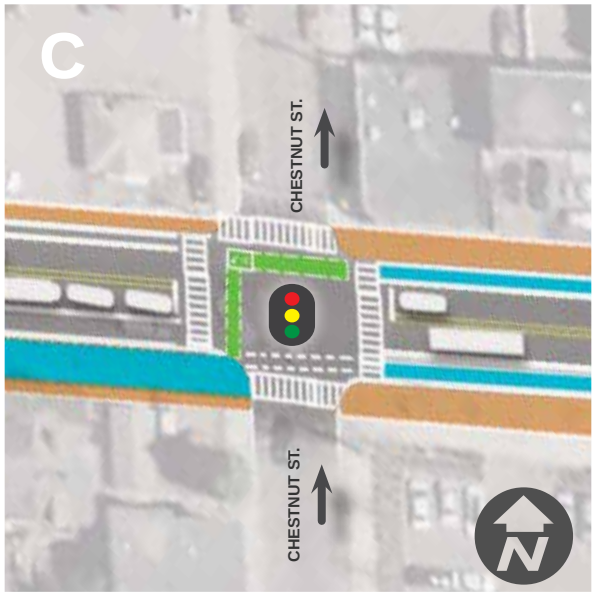


1. Transition 10-foot wide separated bike lane to 5-foot wide bike lanes on both sides of the street
2. Replace existing traffic signal at Chestnut Street
3. Reconstruct a 6-foot wide sidewalk along both sides of the street
4. Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
5. Replace existing traffic signal at Broadway
6. Consider converting Winissimmet Street to one-way away from Williams Street

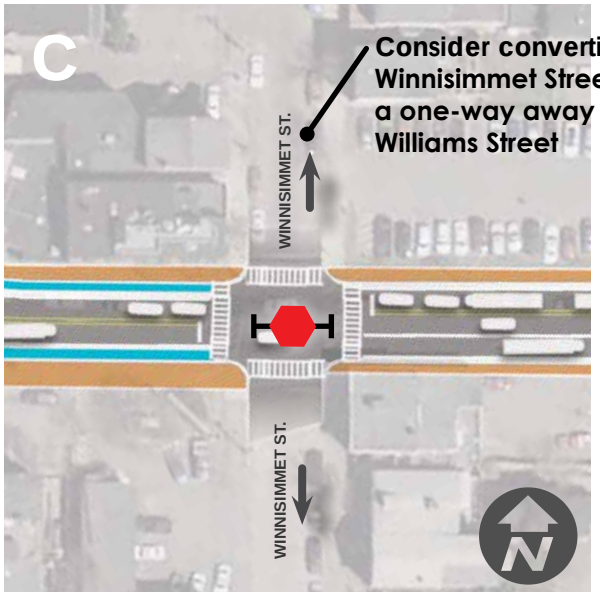
Vehicle Level of Service - 2022 Build Condition



New signals at the Chestnut Street and Broadway intersections will offer significant safety and operational improvements over existing conditions for both vehicles and pedestrians. Re-timing the Chestnut Street traffic control signal and coordinating operations with the Broadway traffic control system will allow the intersection to operate at LOS C during both AM and PM peak hours.



At the Chestnut Street intersection, bicyclists traveling westbound on Williams Street will need to transition to the opposite side of the street. Bicyclists travelling eastbound will remain on the same side of the street. Marked bicycle crossings will delineate a preferred path for people bicycling through the intersection. The crossing may be supplemented with a green colored surface to improve contrast with the surrounding roadway and adjacent pedestrian crosswalks. When crossing Williams Street, either a bike signal will be needed, or the pedestrian phase across Williams Street will need to be called every phase (without pushing the button.) The pedestrian phases across Chestnut Street should be concurrent with the Williams Street thru movement.



At Winissimmet Street, adding a signal so close to Broadway and Pearl Street may not improve corridor operations and may actually encourage more traffic to use Winissimmet Street as a cut through. Therefore, a new signal is not recommended. As part of the Re-Imagining Broadway study, consideration is being given to converting Winissimmet Street to one-way away from Williams Street. In doing so, volumes would be redistributed to Broadway, likely improving operations at the Williams Street/Winissimmet Street intersection.

CHARACTER AREA D MIXED USE ZONE

Winnisimmet Street to Pearl Street (360 feet, including the Pearl Street intersection) | Construction Cost Estimate - $1,400,000

Overall Plan

Character Area D includes a mix of small scale commercial, residential, and industrial land uses. The introduction of a right turn lane on the approach to the Pearl Street intersection makes the 50-foot wide right-of-way feel narrow. At the intersection, the Andrew P. McArdle Bridge connects Pearl Street in Chelsea with Meridian Street in East Boston.

Recommended Street Section - Looking East

IMPROVEMENTS AT-A-GLANCE:

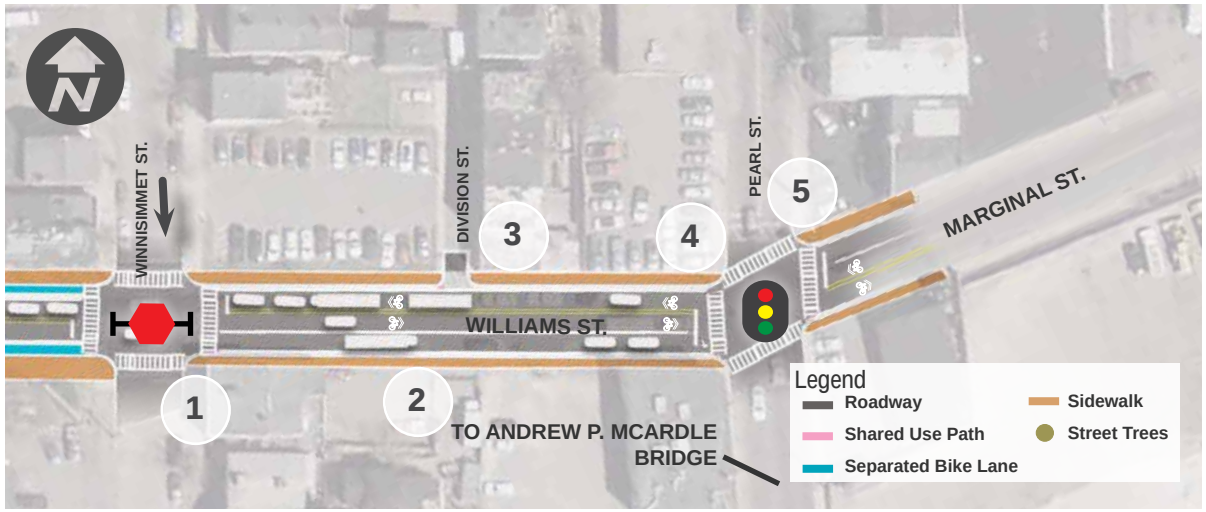
- Transition 5-foot wide bike lanes to shared roadway with "sharrow" markings
- Reconstruct sidewalk along both sides of the street
- Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
- Realign Pearl Street intersection to remove offset for thru travel along Marginal Street westbound
- Replace existing traffic signal at Pearl Street

The recommended improvements in this Character Area D are limited given the need to maintain one travel lane in each direction and a left turn lane on the eastbound approach to Pearl Street. Within the 50-foot ROW, the use of shared lane markings, or sharrows, provide an improvement over existing conditions for bicyclists while maintaining the functionality of the Pearl Street intersection.

A new signal at the Pearl Street intersection will offer significant safety and operational improvements over existing conditions for both vehicles and pedestrians. As part of the intersection redesign, the northwest quadrant of the intersection should be realigned to remove the offset for westbound thru travel along Williams Street. This realignment will require a permanent ROW taking from the abutting property owner, which will impact existing on-site parking. With an existing 40 ton weight limit on the Andrew P. McArdle Bridge, there will continue to be a low volume of turning trucks at this intersection.

Though not included in the construction cost estimate, adaptive signal technology at the Pearl Street intersection could be tied into the Chelsea Street bridge intelligent transportation system (ITS) or a future Andrew P. McArdle bridge system to avoid delays when either bridge is up, which is reported to occur up to 5 times per day.

Character Area D - Enlargement Plan



1. Transition 5-foot wide bike lanes to shared roadway with "sharrow" markings
2. Reconstruct a 5.5-6 foot wide sidewalk along both sides of the street
3. Install high-visibility ladder pattern crosswalks across roadways and/or at intersections
4. Realign Pearl Street intersection to remove offset for thru travel along Marginal Street westbound
5. Replace existing traffic signal at Pearl Street

Shared lane pavement marking or "sharrow"


DUNKIN' DONUTS

4 IMPLEMENTATION PLAN

IMPLEMENTATION PLAN

Physical and operational improvements are needed to address safety issues, accommodate multiple users, and support regional connections while preserving site-specific operations. along and within the Beacham/ Williams Street corridor. Implementing the recommended improvements as a single project is possible, but phasing the project may allow the City to further extend its capital funds by leveraging outside funding sources. A phased approach will serve multimodal users in the near term while helping to advance the corridor project over the long-term.

A schedule of recommended short, mid and long-term improvements are outlined below. These recommendations are based on the technical evaluations performed as part of the study and the input provided by the City, abutters, and the public.

SHORT TERM (< 1 YEAR)

- Continue coordinating with the City of Everett on the adjoining section of corridor
- Replace worn pavement markings in-kind, add "ladder style" crosswalks at intersections, and install shoulder markings in Character Area A to address ill-defined travel lanes (install 45 degree lane markings in the shoulder to prevent travel or parking use)
- If the Eversource Mystic to East Eagle Project includes resurfacing the road from edge to edge, install pavement markings to reflect recommended multi-modal accommodations in Character Areas B, C, and D (from Chestnut Street to Pearl Street)
- Assess feasibility of interim signal upgrades to enhance signal visibility and enable emergency preemption (function of span wire capacity and controller)
- Assess existing light levels along the corridor and replace/install new LED lighting fixtures
- Update the pedestrian signal buttons and provide countdown pedestrian displays that meet ADA guidelines.
- Install signage to prevent right turns on red by trucks from Spruce Street to limit encroachments on Williams Street (Character Area A)
- Re-time signals at Chestnut Street to give more time to Williams Street (Character Area C)
- Incorporate Character Area C recommendations into Re-Imagining Broadway planning and design efforts

MID TERM (1-3 YEARS)

- Apply for state and federal grants to offset capital costs to the City
- Submit a Project Need Form (PNF) to the Boston Region MPO to allow project to be considered for funding on the region's Transportation Improvement Program (TIP)
- Monitor traffic along the corridor following the 2019 Encore Boston Harbor Resort and Casino opening
- Develop design plans for the entire corridor based on the detailed survey base map prepared as part of this study
- Determine ROW requirements and proactively acquire permanent easements or takings from private property owners, including consideration of existing subsurface considerations at each location
- Review existing soil data and/or conduct soil sampling to evaluate soil management and disposal options now rather than later
- Coordinate with utility companies to understand utility relocation costs for budgeting purposes
- Reconstruct Character Area A, as this corridor section lacks bicycle or pedestrian accommodations and requires modern surface and underground infrastructure to efficiently and profitably conduct commerce
- Reconstruct Character Area C as part of the Re-Imagining Broadway project

LONG TERM (> 3 YEARS)

- Complete reconstruction of all character areas based on the concept design recommendations
- Activate interconnect cable between Spruce Street and Pearl Street to facilitate traffic control signal coordination.
- Link corridor traffic control systems to the existing Chelsea Street bridge intelligent transportation system (ITS) or a future Andrew P. McArdle bridge ITS.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TECHNICAL APPENDIX

ROAD SAFETY AUDIT (RSA) FINAL REPORT

TRAFFIC ANALYSIS MEMO

ENVIRONMENTAL SCREENING MEMO

PAVEMENT INVESTIGATION MEMO

PRELIMINARY ROW EVALUATION MEMO

CONSTRUCTION COST ESTIMATE MEMO

ROAD SAFETY AUDIT

Williams Street at Pearl Street
Williams Street at Broadway
Williams Street at Chestnut Street
Williams Street at Spruce Street

City of Chelsea

February 2018

Prepared For:
MassDOT

On Behalf of:
City of Chelsea Department of Planning & Development
Chelsea City Hall, Room #101
500 Broadway
Chelsea, MA 02150

Prepared by:
Stantec
5 Burlington Woods
Burlington, MA 01803

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Background

The Beacham Streets / Williams Street corridor is a key connector route between East Boston, Chelsea, and Everett. The corridor serves an important role for commerce, connecting to commercial and industrial areas in Chelsea and the Lower Broadway District in Everett. Once the Wynn Everett facility is operational, it is anticipated that this corridor will see increased use from casino patrons, employees, and deliveries and effectively function as one of the gateways to the casino. The steady development of the Northern Strand Trail and its connectivity between the North Shore and Boston is anticipated to increase bicycling demand. Proposals to create a bike-pedestrian bridge over the Mystic River, the reconfiguration of Sullivan Square, and the installation of protected bike lanes along Rutherford Avenue all promise to dramatically increase the appeal of bicycling to and from Metro Boston. The current condition of Beacham Street discourages bicyclists from East Boston, Revere, Winthrop and Chelsea from bicycling.

The City of Chelsea is conducting a corridor study for Beacham Street / Williams Street from the Everett City Line to Pearl Street to improve accessibility for all modes of transportation along this vital corridor. Within the project limits, Highway Safety Improvement Program (HSIP) crash clusters based on 2012-2014 crash data have been identified at three intersections along the corridor: Williams Street/Spruce Street/Commandants Way, Williams Street/Broadway, and Williams Street/Pearl Street/Marginal Street/Andrew McArdle Bridge. This indicates that these intersections are among the top 5% within the boundaries of the Metropolitan Area Planning Council (MAPC) based on equivalent property damage. Additionally, based on 2005-2014 crash data, a pedestrian crash cluster encompasses most of downtown Chelsea including Williams Street between Arlington Street and Hawthorne Street. (See MassDOT's online Top Crash Locations map at http://gis.massdot.state.ma.us/maptemplate/topcrashlocations.)

Thus, as part of the project's development, each of these crash clusters warrants a Road Safety Audit (RSA). The Federal Highway Administration defines a Road Safety Audit as the formal safety examination of an existing or future road or intersection by an independent, multidisciplinary team. The purpose of the RSA is to identify potential safety issues and possible opportunities for safety improvements, considering all roadway users.

Project Data

The Road Safety Audit was conducted at the Williams Street intersections with Pearl Street, Broadway, Chestnut Street and Spruce Street on September 18, 2017, with pre- and post-site-visit meetings held at the Chelsea City Hall, located at 500 Broadway, Chelsea, MA. Table 1 lists the Audit team members, a cross-section of State and local engineering, emergency response, and planning professionals, assembled in conjunction with input from MassDOT's Safety Management Unit and the City of Chelsea.

Table 1: Participating Audit Team Members

Audit Team Member	Agency/Affiliation
Alan Cloutier	Stantec
Nathan Gottier	Stantec
Jeff Gooch	MassDOT Traffic Safety
Adi Nochur	WalkBoston
Minh Nguyen	MassDOT D6
Zach Venner	MassDOT D6
Courtney Dwyer	MassDOT D6
Sgt. John Neftle	Chelsea Police
Elsa Chan	MassDOT Traffic Safety
Alex Train	Chelsea Planning & Development
Karl Allen	Chelsea Planning & Development
Rob Ballasty	MassDOT D6 Traffic
Kush Bhagat	MassDOT Traffic Safety

The Audit team members were provided with materials to review prior to the Audit. The materials included a locus map, crash data provided by MassDOT (including pedestrian crashes), and crash diagrams and charts derived from the crash data for each intersection (see Appendix C for the materials). Participants were encouraged to review data prior to the Audit and were urged to consider elements from MassDOT's Safety Review Prompt List (also provided to Audit participants in advance).

On the day of the Audit, a pre-site-visit meeting was held at the Chelsea City Hall to discuss the Audit process, review the distributed materials and to discuss issues that the Audit team members observed from the crash data provided.

After the meeting, the Audit team proceeded to site visits of the Audit intersections. Field observations made by Audit team members during the site visits were documented with handwritten notes and digital photographs.

Following the site visits, a post-site-visit meeting was reconvened at the Chelsea City Hall, in which the Audit team confirmed the observations made in the field, identified deficiencies, and offered solutions to remedy those safety deficiencies noted in the site-visit walks and pre-site-visit meeting. Ideas were categorized into potential short, medium, and long-term solutions.

Project Location and Description

The Audit was conducted at these Williams Street locations:

- Pearl Street/Marginal Street/Andrew McArdle Bridge
- Broadway/Tremont Street
- Chestnut Street
- Spruce Street/Commandants Way

A locus map is provided as Figure 1.

Geometry

Williams Street/ Beacham Street

Williams Street is locally owned by the City of Chelsea. The Williams Street corridor is 2,275 feet, extending from the southern terminus at the intersection of Pearl Street/ Marginal Street/ McArdle Bridge northwest to the intersection of Williams Street/ Spruce Street. From here, the corridor changes the name to Beacham Street and travels an additional 2,225 feet to the Everett City Line. The functional classification of Williams Street is an Urban Minor Arterial.

Along the Williams Street corridor, the roadway geometrics and pavement markings are not well defined and can prove confusing for roadway users.

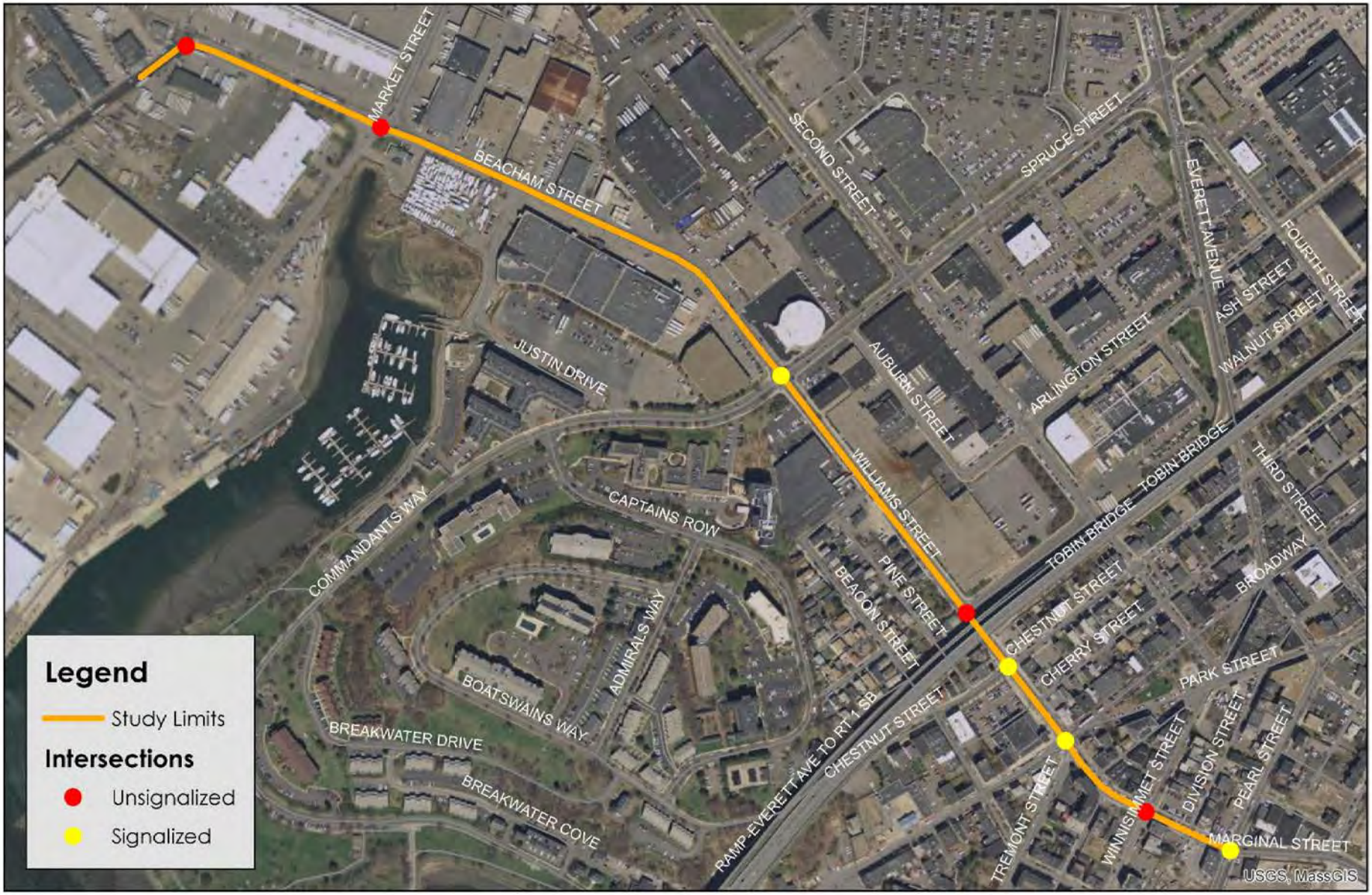
The right-of-way (ROW) along the corridor varies. From the Everett city line to Spruce Street the ROW is approximately 50 feet wide. From Spruce Street to Winnisimmet Street the ROW is 60 feet wide and from Winnisimmet Street to Pearl Street, the ROW is 50 feet wide.

Curbing along the corridor exists continuously along the sidewalk from Spruce Street to Pearl Street. Because of the numerous driveway openings from the Everett city line to Spruce Street, curbing is limited and there are no sidewalks.

Pavement markings along the corridor are mostly faded or nonexistent. From the Everett city line to Spruce Street, a faded double yellow centerline designates one lane in each direction with lane widths that range from 15 feet to 22 feet. From Spruce Street to Chestnut Street, faded double yellow centerline delineates one lane in each direction with lane widths varying from 15 to 22 with street parking permitted on the South side of the street from Mulberry Street to Chestnut Street. From Chestnut Street to Winnisimmet Street, there is a clearly marked double yellow centerline designating one lane with varying widths from 15-20 feet in each direction. From Winnisimmet Street to Pearl Street there are pavement markings for a right-turn-only lane, but there is also a residual double yellow centerline underneath these markings.

Williams Street at Pearl Street / Marginal Street/ McArdle Bridge

Williams Street at Pearl Street/Marginal Street/ McArdle Bridge is a four-way signalized intersection. Williams Street operates as two-lane approach thru-left and right turn lane. The Marginal Street approach operates with left turn and thru-right lanes. Pearl Street operates as a single lane. Although it isn't striped as such, the approach from the McArdle Bridge often operates as two lanes. There are sidewalks on all corners and crosswalks across each approach. The crosswalks are all faded.



Stantec

Project Locus

Beacham Street/Williams Street Concept Design Study
Chelsea, Massachusetts
May 2017

Williams Street at Broadway/ Tremont Street

Williams Street and Broadway/Park Street is a 5-way signalized intersection. Williams Street has a double yellow centerline and operates as one lane in each direction. Broadway northbound has a double yellow center line and operates as a one- or two-lane approach. Broadway/Park Street southbound is designated by pavement markings as a two-lane approach, a right-turn-only lane, and a left-thru lane. Tremont Street is one-way southbound away from the intersection. In addition, there is a truck exclusion on Tremont Street. There are sidewalks on all corners of the intersection and crosswalks across all approaches.

Williams Street at Chestnut Street

Williams Street and Chestnut Street is a 4-way signalized intersection. Williams Street operates as one lane in each direction with a faded double yellow centerline. Chestnut Street is a one-way northbound road that has no pavement markings but operates as two lanes, a left turn lane and a thru-right lane. There are sidewalks on all corners and crosswalks across all approaches. Chestnut Street is an extension of the Route 1 off-ramp to Beacon Street. Chelsea Trial Court parking area is located on the southeast corner, and has driveways that open to Chestnut Street 100 feet south of the intersection and Williams Street 50 feet east of the intersection.

Williams Street at Spruce Street/ Commandant's Way

Williams Street and Spruce Street/Commandants Way is a four-way signalized intersection. Williams Street has only a double yellow centerline, but operates as two-lane approaches in both directions with a thru-left and right turn lane. Spruce Street southbound has pavement markings designated a right-turn lane and a thru-left lane. The Commandant's Way northbound approach also operates as a two-lane approach with thru-left and right turn lanes. There are sidewalks on all corners and crosswalks across each approach. MBTA operates Bus Route 112 along Spruce Street/Commandants Way through the intersection with stops at the southeast and the northwest corners.

Crash Review

The following is a summary of the intersection and corridor crashes. More information, including crash diagram is included in Appendix C

Williams Street at Pearl Street / Marginal Street/ McArdle Bridge

The intersection of Williams Street at Pearl Street / Marginal Street/ McArdle Bridge experienced a total of 45 crashes in the three-year span. Of these crashes, 19 were sideswipe crashes in the same direction and 11 were angle crashes.

It was recorded that 17 crashes occurred in the dark. There was one recorded pedestrian crash and one recorded bicycle crash. Nine crashes involved injuries.

Williams Street at Broadway/ Tremont Street

The intersection of Williams Street at Broadway/ Tremont Street experienced a total of 31 crashes in the three-year span. Of these crashes, 5 were sideswipe crashes in the same direction, 8 were rear end and 6 were angle crashes.

It was recorded that 9 crashes occurred in the dark. There was two recorded pedestrian crashes and no recorded bicycle crashes. Nine crashes involved injuries.

Williams Street at Spruce Street/ Commandant's Way

The intersection of Williams Street at Spruce Street/ Commandant's Way experienced a total of 22 crashes in the three-year span. Of these crashes 5 were sideswipe crashes in the same direction, 8 were rear end and 7 were angle crashes.

It was recorded that 16 crashes occurred during daylight and 5 occurred in the dark. There was one recorded pedestrian crash and one recorded bicycle crash. Six crashes involved injuries.

Corridor Pedestrian Crashes

Along the corridor, from Arlington Street to Pearl Street, 10 pedestrian crashes were recorded. Nine of these crashes were injury crashes. The highest amount was recorded at the intersection where four such crashes occurred.

Audit Observations and Potential Safety Enhancements

Audit team members were solicited for their observations during the meetings before and after the field visit, as well as during the field visit. The team members offered the following observations on roadway and intersection issues as they relate to safety. The team members also discussed potential safety enhancements that could be implemented to mitigate the safety-related observations. Team members were encouraged to consider short-, medium-, and long-term safety enhancements.

Williams Street at Pearl Street/Marginal Street/McArdle Bridge

Pedestrian & Bicycle Facilities

- There was one pedestrian crash and one bicyclist crash, both on Pearl Street.
- The sidewalk access ramps are not ADA-compliant, making it virtually impossible for wheelchair users to access the sidewalk. The crosswalk on Marginal Street arrives at the south curb within a driveway. (The northeast corner had an apex ramp.) The west and south crosswalks had no wheelchair ramps at all. The ramp in the southwest corner had a utility pole in it. Ramps did not have detectable warning panels. Due to the lack of ADA compliant ramps, pedestrians, especially those using wheelchairs are more likely to need to travel within the roadway.

  Potential Enhancement: Consider installing/updating curb ramps to ADA/MAAB compliance. This includes separating the existing Apex ramps. Install detectable warning panels.
- Several locations along the sidewalk were impassable due to obstructions (utility poles, signal poles and signage) and limited sidewalk width. Some curb cuts were also excessively large and were blocked due to parked vehicles. This could leave pedestrians vulnerable to conflict with vehicles and block pedestrians from accessing the facilities. There was also a catch basin located within the east crosswalk which could be a tripping hazard.

  Potential Enhancement: Consider relocating utility poles, signal poles or signage to allow all sidewalk to be functional and passable. Reduce the size of curb cuts and use enforcement to prevent vehicles parked on the sidewalk. Evaluate feasibility of relocating catch basin to remove hazard. Evaluate the feasibility of widening the sidewalk to allow a minimum of 3 feet around obstructions.
- There are no bicycle facilities on any of the roads at the intersection. With effectively no shoulder, bicyclists have to share the vehicle lanes with vehicles. Sharing vehicle lane create more conflicts than separate facilities.

  Potential Enhancement: Evaluate the feasibility of providing facilities such as bicycle lanes or shoulders. This would help separate the bicycle traffic from the vehicles.
- The pedestrian signal pushbuttons, though functional and compliant at the time of installation, were observed to be outdated and inconsistent. There was also only one push button on the northwest and southeast corners. Providing only a single button for two crosswalks can provide confusion, especially for visually impaired pedestrians. Pedestrian phase timing also seemed to be short.

Potential Enhancement: Update the pedestrian signal pushbuttons and provide countdown signal displays. Audible- and tactile-responsive pushbuttons increase the likelihood of their use and compliance by pedestrians. Evaluate pedestrian phase timing to ensure MUTCD compliant duration for each phase.

Intersection Geometry

- Lane definition is deficient through parts of the intersection and the geometry of the intersection also creates confusion to vehicles approaching. Observations, coupled with data from crash reports, highlights some potential issues in the intersection:

    1. Williams Street, Marginal Street and the McArdle bridge operate as two-lane approaches, yet lack clear lane use signage and pavement markings, which create confusion and potential for last minute lane changes and side swipe conflicts through the intersection. This observation is backed by a high number of side swipe incidents recorded in the crash data.

        Additionally, there is an offset between Marginal Street and Williams Street so vehicles crossing through the intersection must adjust to enter the correct lane exiting the opposite side of the intersection.

    2. Corner radii are small in this intersection. It was observed that eastbound trucks turning from Williams onto the bridge encroach into the oncoming lane to execute the movement. There was also evidence of vehicles clipping obstructions as they encroached on the curb while executing turning movements. This included damaged signs and poles. This creates a concern for the safety of pedestrians waiting on the corner.

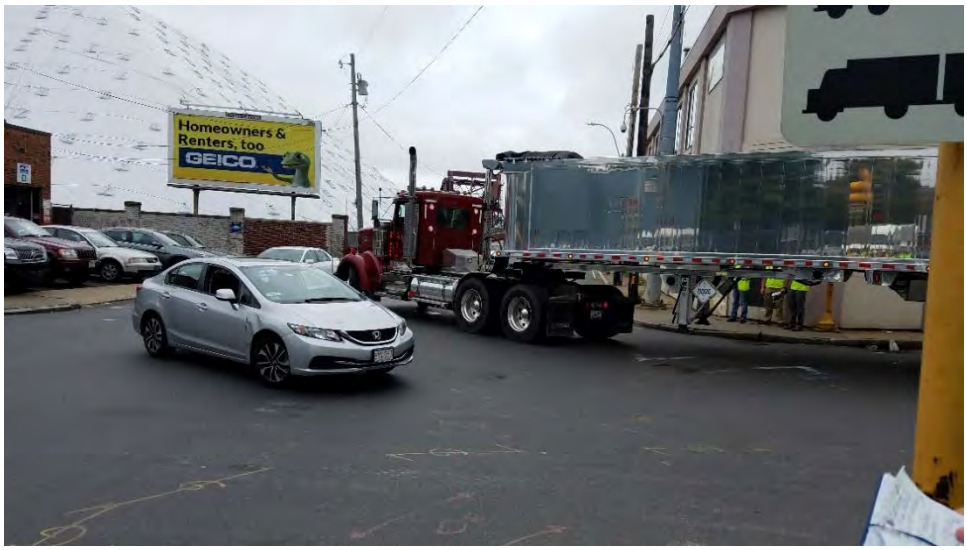


Image 1: Williams Street at Pearl Street – Truck attempting to turn right from Williams onto McArdle Bridge

Potential Enhancement: Consider applying/re-applying the pavement markings to delineate lane use for vehicles approaching the intersection and provide the correct lane assignment. Consider installing lane assignment signage upstream to provide more guidance. “Wide right turn” signage could warn drivers to give room to trucks, thus encouraging trucks to use more width of Williams

Street while preparing to turn right onto McArdle Bridge and decreasing the likelihood of driving onto the sidewalk. Consider pulling back stop bar on the bridge to allow more space for vehicles to maneuver while executing a turning movement. Re-aligning the intersection to create a direct path of travel from Marginal Street to Williams Street would help reduce conflict. Consider widening roadway and increasing curb radii to make turning movements easier. Right of way impacts will need to be considered.

Sightline Obstructions

- Buildings and other obstructions such as signs and utility poles may be restricting sightlines. The building in the southwest corner of the intersection is located at the back of sidewalk. Sightlines for right turning vehicles from Williams Street onto McArdle Bridge are therefore limited. Even though there are no related crashes, with the limited visibility of the crosswalk on McArdle, there is potential for conflicts with pedestrians.

  Potential Enhancement: Consider relocating utility poles and other obstructions where possible. Consider restricting right-turn-on-red for movements with limited visibility.

Pavement Conditions and Markings

- The pavement on Williams Street is worn and has numerous patches. There are also areas of rutting most likely due to the heavy vehicles and braking as vehicles approach the intersection from the West. The rutting can make controlling a vehicle or bicycle difficult.

Image 2: Williams Street at Pearl Street – Williams Street approach showing worn pavement markings and rutted pavement.

Potential Enhancement: Evaluate roadway pavement conditions to determine the need for pavement reconstruction and/or roadway resurfacing. If necessary, develop a pavement design to better handle the heavy vehicles.

- Within the study area, pavement markings are worn, making the double yellow center line and lane lines difficult for vehicle operators to locate. Additionally, some of the old pavement markings are still visible and could create confusion for drivers.

  Potential Enhancement: Reapply the pavement markings to make them more visible to users. Also ensure that older pavement markings are removed fully.

Intersection Control

- A single overhead signal face on span wire is provided facing each direction with an additional post mounted signal. Overhead traffic signals are the most visible. A minimum of two overhead signals is recommended for improved visibility. Some visors were damaged and/or outdated. In addition, there are no backplates on the signal heads at the intersection.

  Potential Enhancement: Replace broken visors. Consider adding additional signal heads facing each direction to improve visibility of the signals. Consider adding backplates with retro-reflective border to all traffic signal heads to enhance the visibility of the signal heads by providing a dark contrasting background to a signal head, along with a visual cue to its location. Consider adding flashing yellow arrow facing Marginal Street for left turning vehicles with a permissive left turn. Existing span wires will need to be evaluated to determine if they can carry the load. New mast arms may be necessary to accommodate the additional heads and backplates. Consider full signal upgrade.

- There is no emergency pre-emption. Emergency preemption would allow emergency vehicles to respond more quickly by allowing emergency vehicle to automatically get the green phase.

  Potential Enhancement: Consider integrating emergency preemption system into intersection.

- There is currently no coordination with the signal on the McArdle Bridge. Queueing can reach the intersection when the bridge is open and traffic is stopped.

  Potential Enhancement: Consider coordinating intersection with the signal on McArdle bridge to control traffic while the bridge is open and traffic cannot pass through.

Lighting

There was only one overhead light at the intersection. Dim lighting makes it more difficult for drivers to discern potential conflicts. Based on the crash data, there were eighteen crashes that took place at nighttime where poor lighting may have contributed.

Potential Enhancement: Conduct a lighting evaluation. Consider enhancing roadway lighting by adding additional overhead lighting or pedestrian scale lighting. This would result in increased visibility of pedestrians, bicyclists, and drivers, which could potentially help to reduce the number of crashes where darkness is an issue.

Williams Street at Broadway/Tremont Street

Pedestrian & Bicycle Facilities

- There were two recorded pedestrian crashes and no bicycle crashes at this intersection.
- The sidewalk access ramps were observed to be non-compliant, making it difficult for wheelchair users to maintain control. The southwest corner has an apex ramp, which creates difficulties for wheelchair users and visually impaired pedestrians. There were crosswalks that had no wheelchair ramps at all.

  Potential Enhancement: Consider installing/updating curb ramps to ADA/MAAB compliance including warning panels.

- There are no bicycle facilities on any of the roads at the intersection. With effectively no shoulder, bicyclists have to share the road with vehicles.

  Potential Enhancement: Evaluate the feasibility of providing facilities such as bicycle lanes or shoulders. This would help separate the bicycle traffic from the vehicles. If bike lanes are not feasible, sharrows would increase awareness for drivers that they are to share the road with cyclists.

- The pedestrian signal pushbuttons, though functional and compliant at the time of installation, were observed to be outdated and inconsistent. Some push buttons apperared to be located too far from the corresponding crosswalk. Pedestrian phase timing also appeared to be insuffient for the crossing.

  Potential Enhancement: Update the pedestrian signal to meet existing ADA compliance including countdown displays and audible /vibrotactile pushbuttons. Audible- and tactile-responsive pushbuttons increase the likelihood of their use and compliance by pedestrians. Review the existing pedestrian clearance times based on MUTCD standards and update as necessary. Consider placing pedestrian phase on automatic recall. This would limit pedestrian wait time and therefore increase pedestrian compliance.

- There is currently a pedestrian signal and crossing across Williams Street, south of Tremont Street. There are no crosswalk markings and the post-mounted signal is hard to see since the post is located against the building. In addition, there is a sign that says, “Stop here on Red”. This combined with the proximity to the Broadway signal creates confusion as to where vehicles should stop when waiting at a red light. There was a pedestrian crash that occurred at this location. Another pedestrian crash occurred while a pedestrian was crossing the western crosswalk.

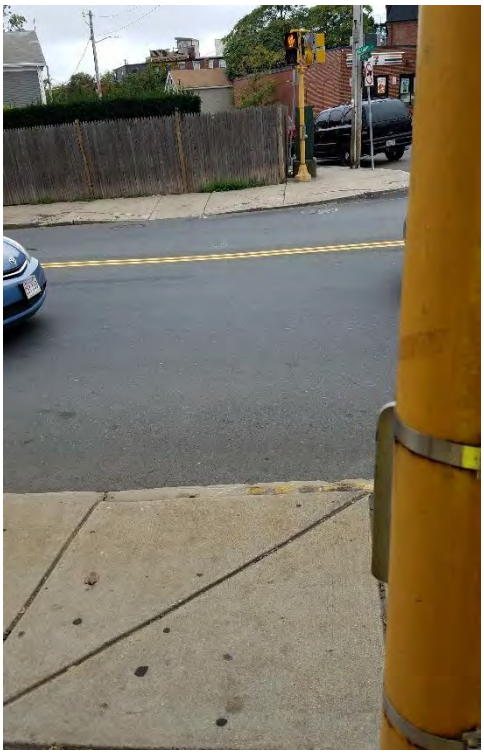


Image 3: Crossing at Williams Street at Tremont Street. No crosswalk but pedestrian signals present.

Potential Enhancement: Either replace the crosswalk markings and clarify the stop location for vehicles at this location or remove the crossing altogether and have pedestrians cross at the intersection of Williams and Broadway. If the crossing is maintained, consider creating bump out at Tremont Street to reduce crossing distances.

- There is a long crossing at Tremont Street. This leaves pedestrians exposed for a longer period of time while crossing the roadway.

  Potential Enhancement: Evaluate the feasibility of curb bump outs. These would reduce the crossing distance.

Intersection Geometry

- Traffic heading northbound must continue onto Park Street as Broadway is one-way into the intersection. According to Audit participants, there have been cases where vehicles begin travelling down Broadway the wrong way due to lack of guidance and the confusion of a two-way road changing to one-way roads.

  Potential Enhancement: Evaluate the need for additional pavement markings/signage to improve clarity at this location and make the intersection easier to navigate.

- Curb radii were inconsistent and may not be sufficient for large trucks to make some turning movements. There was visible evidence of vehicles hitting poles (damage to utility poles) that were placed in the corners of the intersection. A crash on 10/20/2016 hit a utility pole and knocked out power.

  Potential Enhancement: Evaluate existing curb radii and consider adjusting curb radii and relocate any potential obstructions to ensure that vehicles can execute movements without encroaching on curb.

- Lane approaches are wide which provides excess area for vehicles to bypass other and greater pedestrian crossing distances. This provides confusion where drivers should position themselves and can increase sideswipe crashes. There were three sideswipe crashes.

  Potential Enhancement: Evaluate lane widths and geometry to determine if the lane widths can be narrowed down. This may consist of striping shoulders or bike lanes on Williams Street.

Intersection Control

- There are no backplates on the signal heads at the intersection. In addition, the visor facing on West Broadway approach is damaged. There were 9 rear-end crashes that could be attributed to the lack of signal visibility.

  Potential Enhancement: Consider adding backplates with retro-reflective border to all traffic signal heads to enhance the visibility of the signal heads by providing a dark contrasting background to a signal head, along with a visual cue to its location. Consider replacing damaged signal visors. Existing span wires will need to be evaluated to determine if they can carry the load.

- There is no emergency or transit pre-emption. Emergency preemption would allow emergency vehicles to respond more quickly.

  Potential Enhancement: Consider integrating emergency and/or transit preemption system into intersection.

- The stop line pavement markings are missing on the eastbound approach on Williams Street.

  Potential Enhancement: Evaluate stop bar location and replace stop line pavement markings.

- There were cases observed in the field where vehicles were stranded in the center of the intersection when the signal changed and blocked the intersection. This can cause delays and increases the potential for angle crashes. Three angle crashes took place at this intersection.

  Potential Enhancement: Review clearance intervals to allow traffic to clear based on Institute of Transportation Engineers guidelines and update if necessary. This includes evaluating yellow/red clearance intervals. Coordinating timing with the intersection at Pearl Street could potentially help alleviate congestion.

Image 4: Williams Street at Broadway.

Williams Street at Chestnut Street

Pedestrian & Bicycle Facilities

- The pedestrian signal pushbuttons, though functional and compliant at the time of installation, were observed to be outdated and inconsistent. There was only one pedestrian button located on the northwest and southwest corners. The was no pedestrian signal on the southeast corner. Four pedestrian crashes occurred at this intersection, all involving pedestrians crossing from the south to the north and resulting in injuries. Three of these were vehicles turning left from Chestnut onto Williams. The pedestrian signal for the corresponding pedestrian movement has a defective display.

  Potential Enhancement: Update the pedestrian signal pushbuttons to meet existing ADA compliance and provide countdown pedestrian heads on all crossings. Audible- and tactile-responsive pushbuttons increase the likelihood of their use and compliance by pedestrians. Provide countdown pedestrian signal faces on all crossings. Replace the defective pedestrian display.

- There are no bicycle facilities on any of the roads at the intersection. With effectively no shoulder, bicyclists have to share the road with vehicles. There were no recorded bicycle crashes at this intersection.

  Potential Enhancement: Evaluate the feasibility of providing facilities such as bicycle lanes or shoulders. This would help separate the bicycle traffic from the vehicles. If bike lanes are not feasible, sharrows would increase awareness for drivers that they are to share the road with cyclists.

Pavement Markings

- Within the study area, pavement markings are worn, making the double yellow center line and lane lines difficult for vehicle operators to locate. This can create confusion for all users.

  Potential Enhancement: Consider reapplying the pavement markings to make them more visible to users. Also ensure that older pavement markings are removed fully.

Intersection Geometry

- Curb radii were inconsistent and may not be sufficient for vehicles to make turning movements. Breaks in the sidewalk surface indicates that turning trucks have driven over the curbing.

  Potential Enhancement: Evaluate existing and adjust curb radii and relocate any potential obstructions, including utility poles or signs, to ensure that vehicles can execute movements without encroaching on curb.

Lighting

- Team members mentioned that there was limited overhead light at the intersection. Dim lighting makes it more difficult for drivers to see pedestrians and bicyclists. Two of the pedestrian crashes occurred when it was dark where poor lighting may have contributed.

  Potential Enhancement: Consider enhancing roadway lighting by adding additional overhead lighting or pedestrian scale lighting. This would result in increased visibility of pedestrians,

bicyclists, and drivers, which would be expected to result in fewer crashes where darkness is an issue.

Williams Street at Spruce Street

Pedestrian & Bicycle Facilities

- There are no bicycle facilities on any of the roads at the intersection. With effectively no shoulder, bicyclists have to share the road with vehicles. There was a cyclist crash that occurred at this location.

  Potential Enhancement: Evaluate the feasibility of providing facilities such as bicycle lanes or shoulders. This would help separate the bicycle traffic from the vehicles which reduces the risk of multi-modal crashes. If bike lanes are not feasible, sharrows would increase awareness for drivers that they are to share the road with cyclists.

- The pedestrian signal pushbuttons, though functional and compliant at the time of installation, were observed to be outdated and inconsistent. They included a variety of different countdowns and displays. There is a lack of push buttons on the northwest and southwest corners.

  Potential Enhancement: Update the pedestrian signal pushbuttons and pedestrian displays to APS signals with countdowns displays that meet existing ADA and MUTCD compliance. Audible- and tactile-responsive pushbuttons increase the likelihood of their use and compliance by pedestrians.

- The sidewalk access ramps were observed to be non-compliant, making it difficult for wheelchair users to maintain control. There is an apex ramp located at the southeast corner which is difficult for wheelchair users and visually impaired pedestrians to use.

  Potential Enhancement: Consider installing/updating curb ramps to ADA/MAAB compliance including warning panels.

- Crosswalk pavement markings are worn or missing on Williams Street and Spruce Street.

  Potential Enhancement: Replace pavement markings to delineate pedestrian crossings.

Intersection Geometry

- Curb radii were inconsistent and may not be sufficient for vehicles to make turning movements. There was evidence of vehicles hitting poles that were placed in the corners of the intersection. The right turn movement from Spruce Street right onto Williams Street requires trucks to encroach into the oncoming lane to avoid driving onto the curb. Due to this, the stop bar on Williams Street is pulled back from the intersection to provide more turning space. During the audit, the Audit Team it was witnessed that vehicles ignored the stop bar and as a result they were in the way of truck turns. This area has a high volume of truck traffic, as this is a truck route. There are high number of heavy vehicles travelling on both Williams Street and Spruce Street through the intersection and making right turns from Spruce Street onto Williams Street.

Potential Enhancement: Evaluate curb radii for truck turns and consider relocating any potential obstructions (utility poles, signs, etc.) to ensure that vehicles can execute movements without encroaching on curb. Evaluate location of stop bars and ensure that pavement markings/signage clearly convey stop location to vehicles.

Image 5: Williams Street at Spruce Street – Truck turning right from Spruce onto Williams. Encroaching into oncoming lane on Williams Street.

- The pavement markings in the intersection are worn and not well defined. There is a lack of signage to define the lane usage. These could be contributing factors to the four side-swipe crashes. Williams Street is one lane, but was observed functioning as two-lane. There is one receiving lane on Commandants Way to the south, but it was observed functioning as two-lane. The lane assignment sign for the southbound Spruce Street approach is placed behind a utility pole.

  Potential Enhancement: Consider replacing pavement markings and consider signage to better define the lane usage.

- There is rutting due to the high volume of heavy vehicles.

  Potential Enhancement: Evaluate roadway pavement conditions to determine the need for pavement reconstruction and/or roadway resurfacing. If necessary, develop a pavement design to better handle the heavy vehicles.

- It was observed that trucks were turning right on red from Spruce Street onto Williams Street. This maneuver requires them to enter the oncoming lane during the movement. This means that traffic enters the oncoming lane where there could potentially be traffic that is being shown a green light.

Potential Enhancement: Consider a no turn on red sign facing Spruce Street to eliminate the potential for conflict when a truck makes the wide turn.

Intersection Control

- There were observed cases where vehicles were stranded in the center of the intersection when the signal changed and resulted in blocking the intersection. There were eight rear-end crashes and 7 angle crashes at this intersection that could be attributed to the failure to clear the intersection.

  Potential Enhancement: Review clearance intervals to allow traffic to clear based on Institute of Transportation Engineers guidelines and update if necessary. This includes evaluating yellow/red clearance intervals. Factor in the longer time that it may take for a truck to clear the intersection.

- There are no backplates on the signal heads at the intersection.

  Potential Enhancement: Consider adding backplates with retro-reflective border to all traffic signal heads to enhance the visibility of the signal heads by providing a dark contrasting background to a signal head, along with a visual cue to its location. Existing span wires will need to be evaluated to determine if they can carry the load.

Summary of Road Safety Audit

For each safety enhancement noted in the previous section, the following table summarizes the proposed enhancement, its potential safety payoff, the estimated timeframe for its completion, its estimated construction cost, and the responsible agency.

Safety payoff estimates are based on engineering judgment and are categorized as follows: low, medium, and high. The estimated timeframe and the range of costs for completing enhancements are categorized in Table 3:

Table 2: Estimated Timeframe and Costs Breakdown

Timeframe	
Short-Term	<1 Year
Mid-Term	1-3 Years
Long-Term	>3 Years

Costs	
Low	<$10,000
Medium	$10,001-$50,000
High	>$50,000

Table 3: Potential Safety Enhancement Summary

Safety Issue	Potential Safety Enhancement	Safety Payoff	Timeframe	Cost	Jurisdiction
Williams Street at Pearl Street/Marginal Street/McArdle Bridge					
Pedestrian & Bicycle Facilities					
Non-ADA-compliant sidewalk access ramps	Consider installing separate curb ramps with ADA-compliant ramps with detectable warning panels	Medium	Long	High	City
Sidewalk obstructions	Consider relocating utility poles, signal poles or signage to allow all sidewalk to be functional and passable.	Medium	Medium	High	City
Sidewalk obstructions	Reduce the size of curb cuts and use enforcement to prevent vehicles parked on the sidewalk.	Medium	Medium	Medium	City
Sidewalk obstructions	Evaluate feasibility of relocating catch basin to remove hazard	Medium	Medium	Medium	City
Sidewalk obstructions	Evaluate the feasibility of widening the sidewalk to allow a minimum of 3 feet around obstructions.	Medium	Medium	Medium	City
Lack of bicycle facilities requires sharing lanes	Evaluate the feasibility of providing bicycle lanes or shoulders.	Medium	Long	High	City
Outdated pedestrian signal equipment	Updating the pedestrian signal buttons and provide countdown signal displays that meets ADA compliance.	Low	Short	Medium	City
Pedestrian timing	Review Pedestrian clearance timing and update as necessary	Low	Short	Low	City
Intersection Geometry					
Vehicles encroaching on curb when turning	Consider pulling back stop bar on the bridge to allow more space for vehicles to maneuver while executing a turning movement	Low	Short	Low	City

Safety Issue	Potential Safety Enhancement	Safety Payoff	Timeframe	Cost	Jurisdiction
Lane assignment confusion	Consider applying/re-applying the pavement markings to delineate lane use for vehicle approaching the intersection and provide the correct lane assignment. Review lane usage and provide clarity for lane usage. Install additional lane use signage and “Wide Right” signs.	Medium	Short	Low	City
Intersection Layout	Consider realigning intersection to remove offset for through movements, improve curb radii for turning movements. Consider widening intersection and increasing curb radii.	Medium	Long	High	City
Sightline Obstructions					
Reduced sight distance	Consider restricting right turns on red.	Medium	Medium	Low	City
Reduced sight distance	Consider relocating utility poles and other obstructions.	Medium	Long	High	City
Pavement Conditions and Markings					
Pavement rutting	Resurfacing and/or reconstruct the pavement on Williams Street	Low	Long	High	City
Lane visibility	Reapply pavement markings, ensure removal of old pavement markings	Medium	Short	Low	City
Intersection Control					
Signal visibility	Replace broken visor	Medium	Short	Low	City
	Consider adding additional signal heads in each direction to improve visibility of signals.	Medium	Medium	High	City
	Consider adding backplates with retro-reflective border to all traffic signal heads	Medium	Short	Low	City
Signal Coordination	Consider integrating emergency preemption	Medium	Medium	Medium	City
	Consider coordinating the signal with the signal on McArdle Bridge	Medium	Medium	Medium	City

Safety Issue	Potential Safety Enhancement	Safety Payoff	Timeframe	Cost	Jurisdiction
Lighting					
Conflict visibility	Consider conducting a lighting evaluation	Medium	Short	Low	City
Conflict visibility	Consider enhancing roadway lighting by adding additional overhead lighting and pedestrian scale lighting	Medium	Long	Medium	City
Williams Street at Broadway/Tremont Street					
Pedestrian & Bicycle Facilities					
Non-ADA-compliant sidewalk access ramps	Consider replacing all curb ramps with ADA-compliant ramps with detectable warning panels	Medium	Medium	High	City
Outdated pedestrian equipment	Update the pedestrian signal buttons and provide countdown pedestrian displays that meet ADA guidelines.	Low	Medium	Medium	City
	Evaluate crossing of Williams by Tremont and remove or replace crossing	Medium	Medium	Medium	City
Long crossing	Consider adding curb bump outs to shorten crossing distances	Medium	Medium	Medium	City
Lack of bicycle facilities requires sharing lanes	Evaluating the feasibility of providing bike lanes or shoulders	Medium	Long	High	City
Crosswalk Layout					
Missing crosswalk south of Tremont Street	Review need for crosswalk and either replace pavement markings or pedestrian light. If crossing maintained, consider installing a bump-out	Medium	Medium	Medium	City
Intersection Geometry					
Vehicles travelling the wrong way down Broadway instead of Park Street	Evaluate the need for additional pavement markings/signage to improve clarity	Medium	Short	Low	City

Safety Issue	Potential Safety Enhancement	Safety Payoff	Timeframe	Cost	Jurisdiction
Vehicles encroaching on curb when turning	Evaluate the existing curb radii and consider adjusting curb radii and relocate any potential obstructions	Medium	Long	High	City
Excessively wide travel lanes	Evaluate lane widths and geometry to determine if lane widths can be narrowed down	Medium	Short	Low	City
Intersection Control					
Signal Visibility	Replace broken visors. Consider adding backplates with retro-reflective border to all traffic signal heads	Medium	Short	Low	City
Vehicles fail to clear intersection	Review clearance intervals and update if necessary and consider coordination with signal at Pearl Street	High	Short	Low	City
Signal Coordination	Consider integrating emergency preemption	Medium	Medium	Medium	City
Missing Stop line	Evaluate stop bar location and replace missing stop line on the eastbound Williams Street approach	Low	Short	Low	City
Williams Street at Chestnut Street					
Pedestrian & Bicycle Facilities					
Pedestrian confusion	Update the pedestrian signal buttons and provide countdown pedestrian displays that meet ADA guidelines. Replace defective pedestrian display	Low	Medium	Medium	City
Lack of bicycle facilities requires sharing lanes	Evaluate the feasibility of providing bicycle facilities such as bicycle lanes or shoulders	Medium	Long	High	City
Pavement Markings					
Poor pavement marking visibility	Consider reapplying pavement markings, ensure removal of old pavement markings	Medium	Short	Low	City

Safety Issue	Potential Safety Enhancement	Safety Payoff	Timeframe	Cost	Jurisdiction
Intersection Geometry					
Vehicles encroaching on curb when turning	Evaluate existing radii and adjust curb radii and relocate any obstructions including utility poles or signs	Medium	Long	High	City
Lighting					
Conflict visibility	Consider enhancing roadway lighting by adding additional overhead lighting and pedestrian scale lighting	Medium	Long	Medium	City
Williams Street at Spruce Street					
Pedestrian & Bicycle Facilities					
Non-ADA-compliant sidewalk access ramps	Consider replacing all curb ramps with ADA-compliant ramps with detectable warning panels	Medium	Long	High	City
Outdated pedestrian signals	Consider updating to APS and ADA-compliant pedestrian signal pushbuttons	Low	Medium	Medium	City
Lack of bicycle facilities requires sharing lanes	Evaluate the feasibility of providing facilities such as bike lanes or shoulders	Medium	Long	High	City
Worn crosswalk markings	Replace crosswalk markings on Williams Street and Spruce Street	Low	Short	Low	City
Intersection Geometry					
Vehicles encroaching on curb when turning	Evaluate Location of Stop bars	Medium	Short	Low	City
Vehicles encroaching on curb when turning	Evaluate curb radii for truck turns and relocate any potential obstructions if any changes are made to the curb radii	Medium	Long	High	City
Undefined Pavement Markings	Consider replacing crosswalk markings and consider signage to better define the lane usage	Low	Short	Low	City
Trucks encroaching during right turns	Consider a “No turn on Red” restriction.	Medium	Short	Low	City

Safety Issue	Potential Safety Enhancement	Safety Payoff	Timeframe	Cost	Jurisdiction
Intersection Control					
Vehicles fail to clear intersection	Review clearance intervals and update if necessary	High	Short	Low	City
Signal visibility	Consider adding backplates with retro-reflective border to all traffic signal heads	Medium	Short	Low	City

Appendix A. RSA Meeting Agenda

Agenda

Road Safety Audit

Beacham and Williams St Corridor

Intersections at Broadway, Commandants Way/Spruce St., & Pearl St.

Monday, September 18, 2017, 9:00 a.m. – 12:00 noon Meeting
Location: Chelsea City Hall, 500 Broadway, Chelsea, MA 02150

Type of meeting:	**Road Safety Audit**
Attendees:	**Invited Participants to Comprise a Multidisciplinary Team**
Please bring:	**Thoughts and Enthusiasm!!**

9:00 a.m.	**Welcome and Introductions**
9:15 a.m.	**Review of Site-Specific Material** • Crash, Speed & Volume Summaries– provided in advance • Existing Geometries and Conditions
10:00 a.m.	**Visit the Sites** • Walk to intersections • As a group, identify areas for improvement
11:00 a.m.	**Post Visit Discussion / Completion of RSA** • Discuss observations and finalize findings • Discuss potential improvements and finalize recommendations
12:00 noon	**Adjourn for the Day – but the RSA has not ended (see below)**

Instructions for Participants:

- **Before attending the RSA, participants are encouraged to drive through the intersections and complete/consider elements on the RSA Prompt List with a focus on safety.**
- **All participants will be actively involved in the process throughout. Participants are encouraged to come with thoughts and ideas, but are reminded that the synergy that develops and the respect for others' opinions are key elements to the success of the overall RSA process.**
- **After the RSA meeting, participants will be asked to comment and respond to a draft report on the RSA to assure it is reflective of the RSA completed by the multidisciplinary team.**

Safety Review Prompt List

The Safety Review Prompt List provides basic safety-related questions to use when evaluating a given roadway location. The prompt list should be considered when evaluating a roadway to design improvements or conduct a Road Safety Audit. The primary purpose of the prompt list is to identify potential road safety hazards. The list is meant to be general and should be used to prompt an evaluator as to specific matters identified in the field that may have an adverse effect on road safety. The Safety Review Prompt List is not a check of compliance with design standards.

This Prompt List represents the minimum that should be considered when exploring safety opportunities and is not intended to address all aspects of safety.

A summary of the responses should be prepared to highlight potential safety improvement opportunities.

Speed

- Are posted speed limits consistent with speed regulations; are they adequate?
- Are design features consistent with the posted speed (passing opportunities, sight distance, warning signs for horizontal and vertical curves, clearance intervals, sign placement, etc.)
- Are adequate controls in place for driver compliance with speed limits?

Multi-modal

- Have accommodations been provided for safe movement of pedestrians, bicycles, emergency vehicles, public transportation, and commercial vehicles?
- What design features could be improved, added, or removed to enhance the safe mobility of the various modes?

Pavement Markings

- Are there highly visible and retro reflective edge lines, center lines, and other pavement markings?
- Do the pavement markings provide sufficient guidance to the road users? Can the placement of the pavement markings be modified to improve guidance to road users?

Signs

- Are all signs retro reflective and visible for all roadway conditions, including placed free from obstructions?
- Are signs located to maximize perception and reaction while minimizing intrusion in clear zones?

- Does the signage provide adequate guidance to road users for given road conditions?
- Are pavement markings and signs consistent in effectively guiding road users?

Intersection Control

- Do all signs (stop signs, lane assignments, street names, etc.) provide visible, clear, non-conflicting messages?
- Is there clear, non-conflicting visibility of traffic control (signal heads, signs, and markings) from all approach lanes?
- Has the potential of misrepresentation of intersection control been considered (at closely spaced intersections or through control that is against expectation)?
- For signalized intersections, have the implications on safety been considered for the signal phasing?
- Is there a safe means by which all modes can travel through the intersection?

Lighting

- Is lighting (from headlights and/or streetlights) adequate for specific roadway conditions and/or use?
- If glare exists from sunlight or opposing headlights, are there countermeasures that can be implemented to minimize potentially detrimental effects?

Obstructions

- Are there obstructions to sight lines or roadway guidance (signs, markings, etc.) that can be removed, relocated, or minimized as part of this project?
- If obstructions or fixed objects exist but cannot be moved, can they be shielded (with guardrails, etc.) or delineated (with reflectors) to improve road user safety? If so, what can be done?

Pavement

- Could the condition of the pavement impact mobility and safety (potholes, edge drop-offs, skid resistance, etc)?
- What improvements can be made to minimize safety impacts?

Access Points and Traffic Generators

- Is the access control sufficient for the road's function?
- Are site access points located to maximize safety while still providing adequate access?

- Have impacts of site developments been adequately accommodated for safe mobility of all road users?

Parking

- Is parking clearly delineated and in conformance with signs, markings, and regulations?
- Might parking obstruct mobility/safety of pedestrians and other roadway users?

Weather Conditions

- Have accommodations been made for impacts from adverse weather condition (storage of snow, removal of ponding, adequate drainage, signage of low salt areas, maintenance program for snow removal, and catch basin clearing, etc.)?

Auxiliary Lanes

- Could taper locations and/or alignments contribute to safety challenges?
- Could lack of climbing lanes or passing zones cause driver frustration?
- Do acceleration/deceleration lane lengths necessitate additional signage and/or markings?

Animals

- Do animal migrations impact safety?
- Can measures be taken to reduce animal-vehicle conflicts?

Appendix B. RSA Audit Team Contact List

Participating Audit Team Members

September 18, 2017 Location: Chelsea City Hall

First	Last	Agency	Department	E-mail	Comments
Jeff	Gooch	MassDOT	Highway Safety	jeffery.gooch@state.ma.us	
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Minh	Nguyen	MassDOT	District 6	minh.nguyen@dot.state.ma.us	
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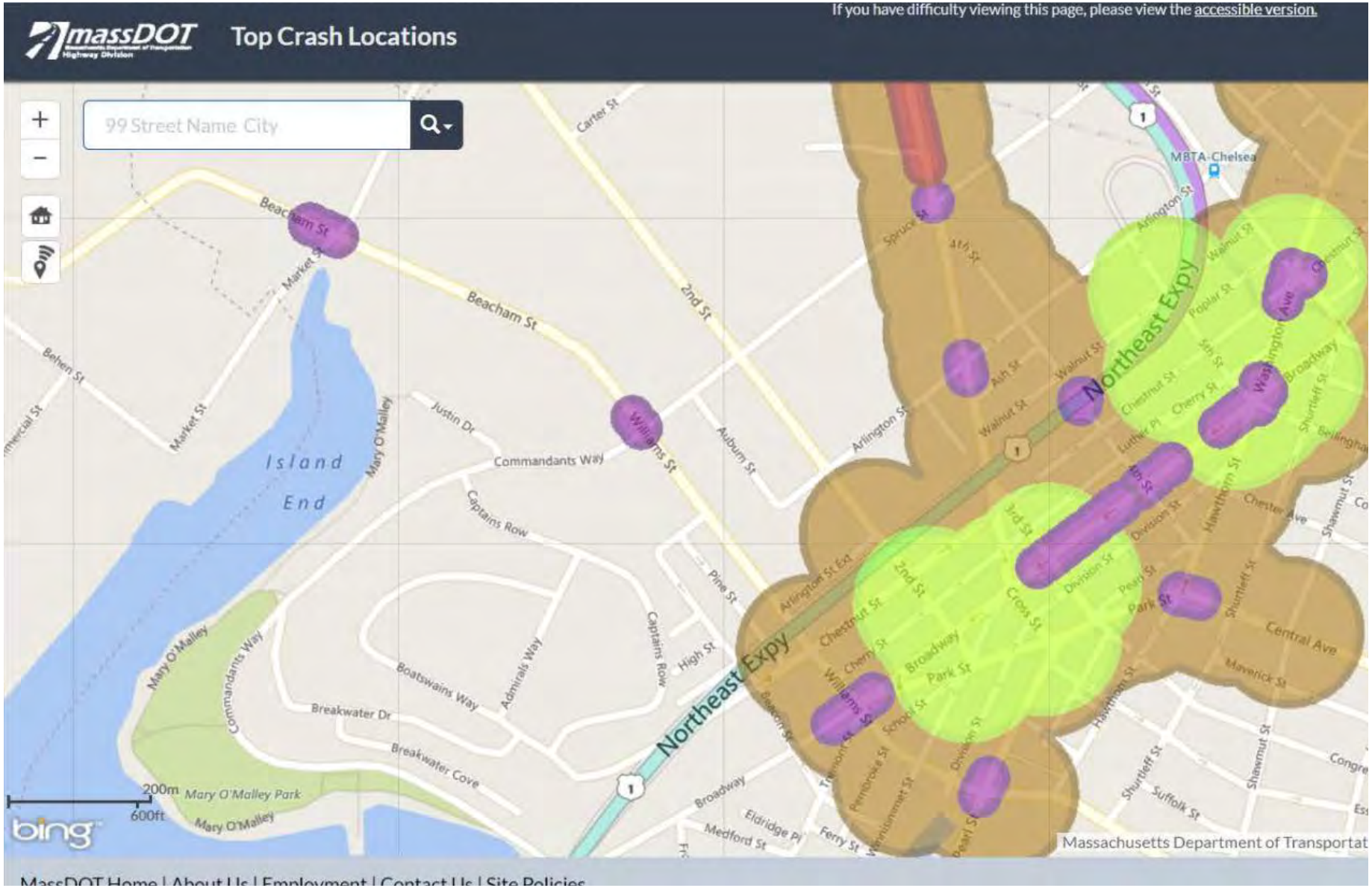
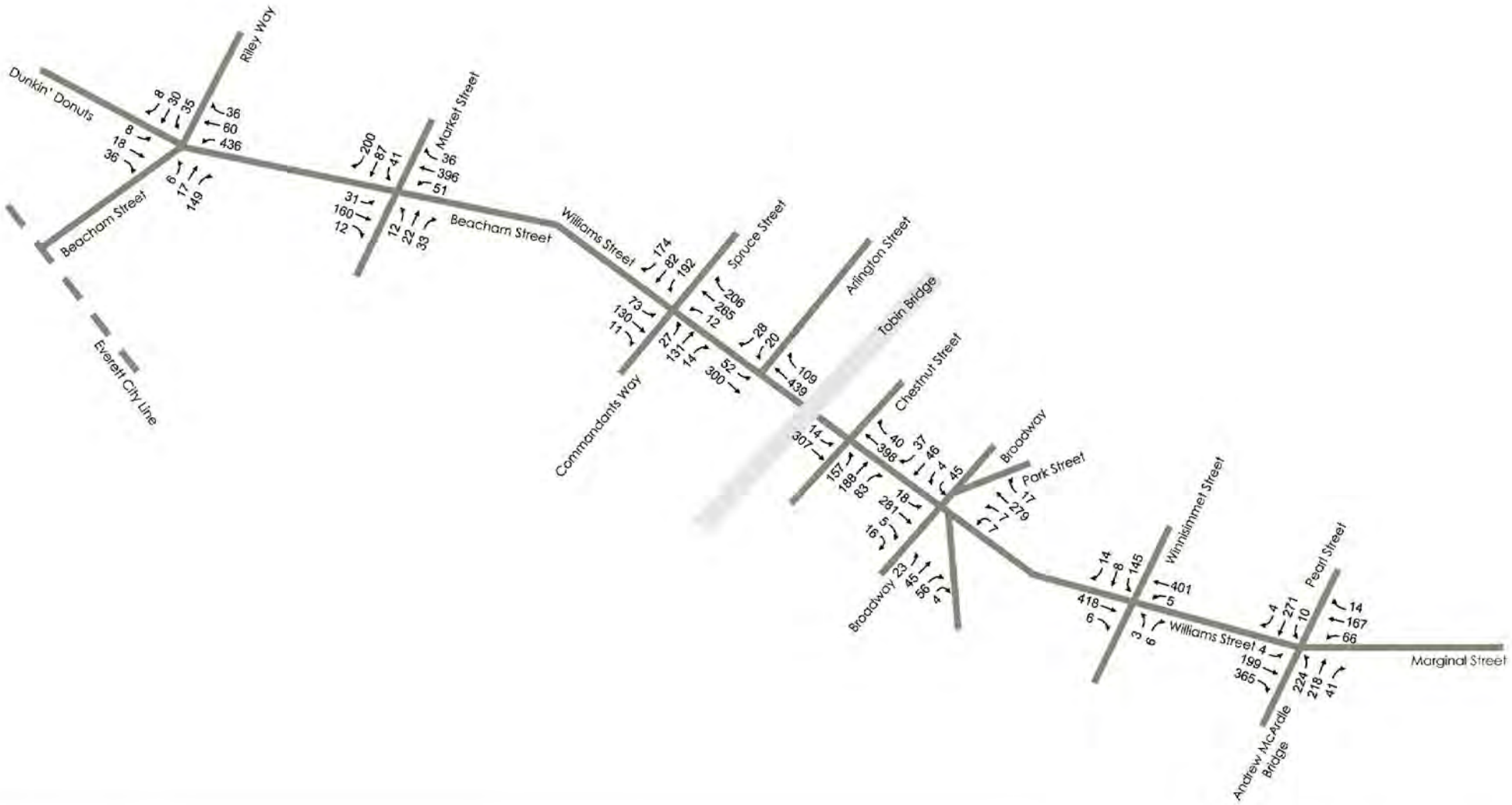
Sgt. John	Noftle	Chelsea	Police Department	jnoftle@chelseama.gov	
Alex	Train	Chelsea	Planning Department	atrain@chelseama.gov	
Karl	Allen	Chelsea	Planning Department	kallen@chelseama.gov	
Nathan	Gottier	Stantec	Transportation	nate.gottier@stantec.com	
Rob	Ballasty	MassDOT	District 6 - Traffic	robert.ballasty@dot.state.ma.us	
Kush	Bhagat	MassDOT	Traffic Safety	kush.bhagat@dot.state.ma.us	

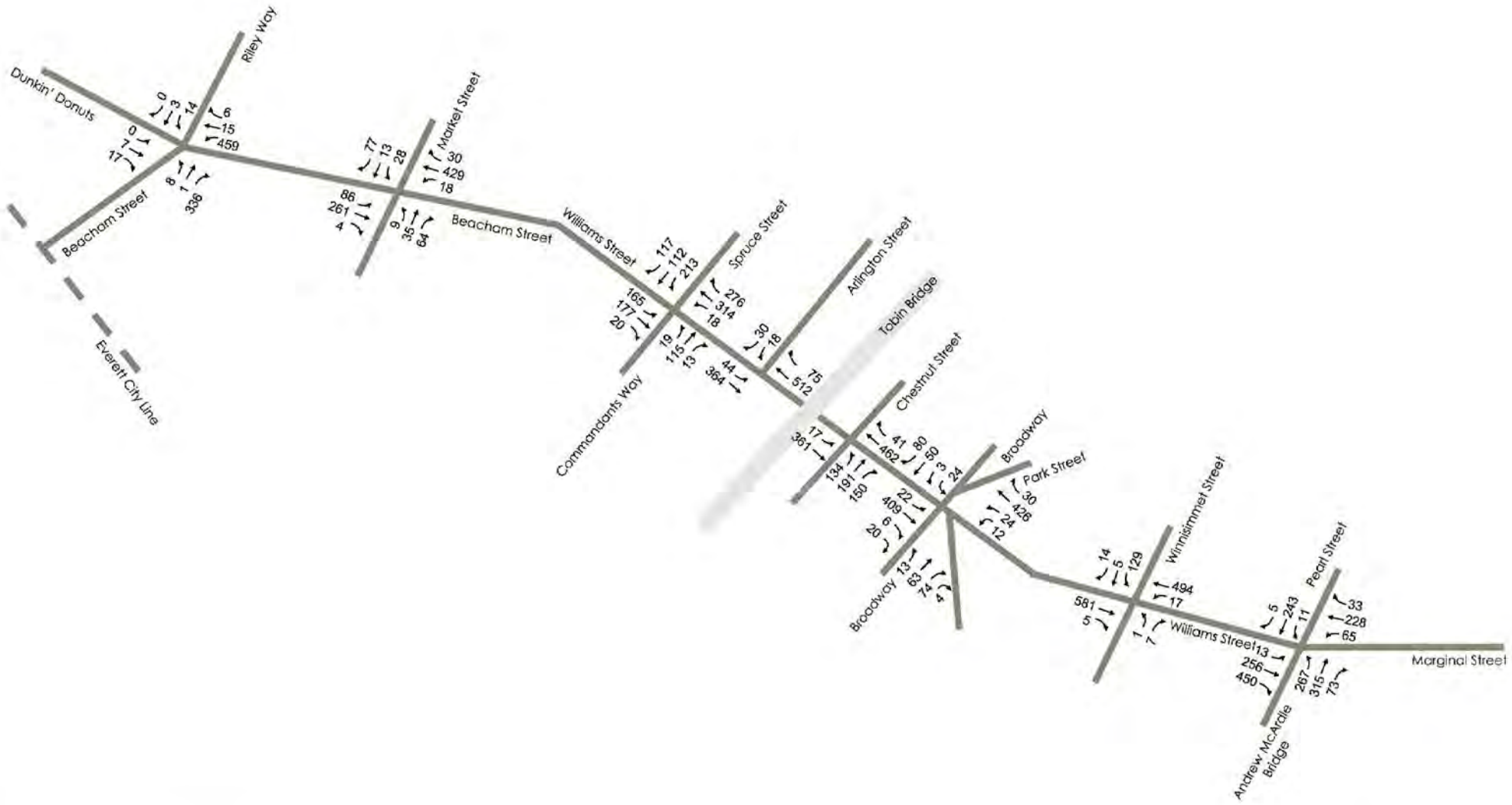
Appendix C. Detailed Crash Data


massDOT
Highway Division
Top Crash Locations
If you have difficulty viewing this page, please view the accessible version.
99 Street Name City
Beacham St
Market St
Behen St
Mary O'Malley
Island End
Justin Dr
Commandants Way
Captains Row
Williams St
Auburn St
Arlington St
2nd St
Carter St
Spruce St
4th St
Ash St
Walnut St
Northeast Expy
Poplar St
Chestnut St
Cherry St
Luther Pl
5th St
Washington Ave
Broadway
Shurtleff St
MBTA-Chelsea
Arlington St Ext
3rd St
Division St
Hawthorn St
Chester Ave
Shawmut St
Pearl St
Park St
Cross St
Central Ave
Maverick St
Pine St
High St
Boatswains Way
Admirals Way
Breakwater Dr
Breakwater Cove
Mary O'Malley Park
200m
600ft
bing
Eldridge Pl
Medford St
Ferry St
Pembroke St
School St
Suffolk St
Massachusetts Department of Transportat



Schematic Diagram
Not to Scale

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
2017 Existing AM Peak Hour

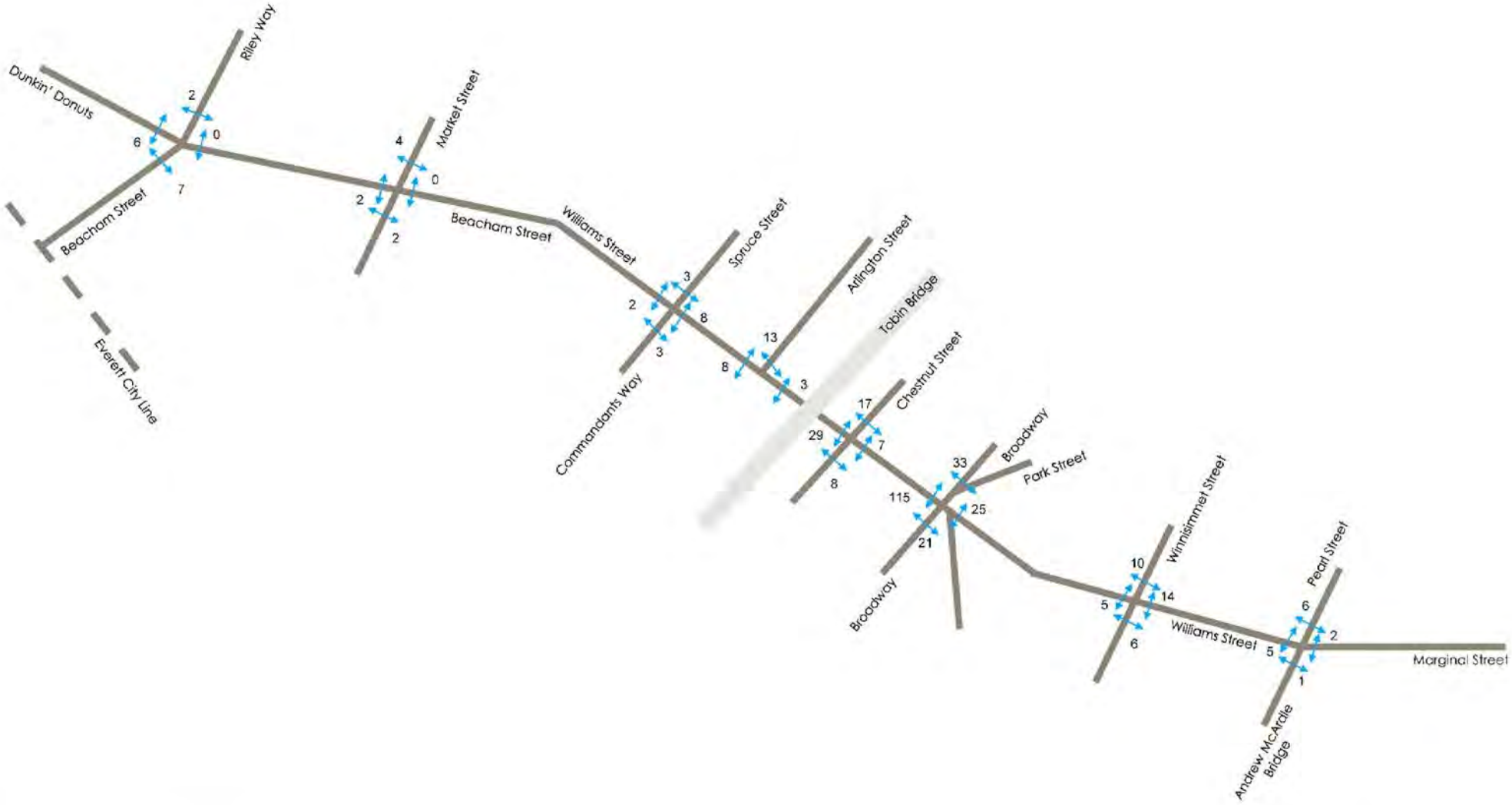


Schematic Diagram:
Not to Scale

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
2017 Existing PM Peak Hour

Stantec Consulting Services Inc.

Stantec

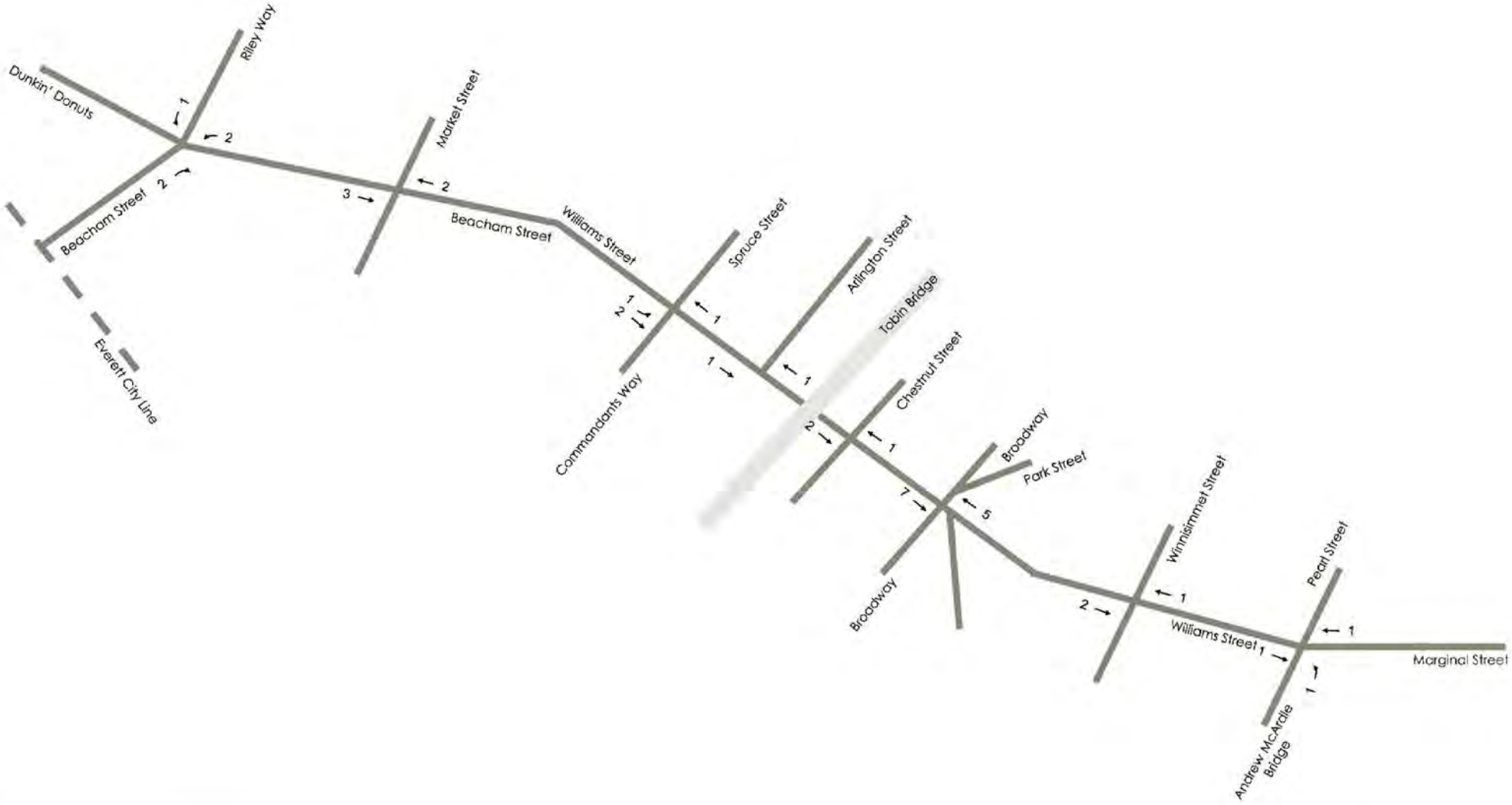


Schematic Diagram:
Not to Scale

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
2017 Existing Ped Peak Hour

Stantec Consulting Services Inc.

Stantec



Schematic Diagram:
Not to Scale

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
2017 Existing Bike Peak Hour

Stantec Consulting Services Inc.

Stantec

ROAD	POSTED SPEED (MPH)	ADT (VPD)
WILLIAMS STREET	25	12,000
BEACHAM STREET	30	12,000

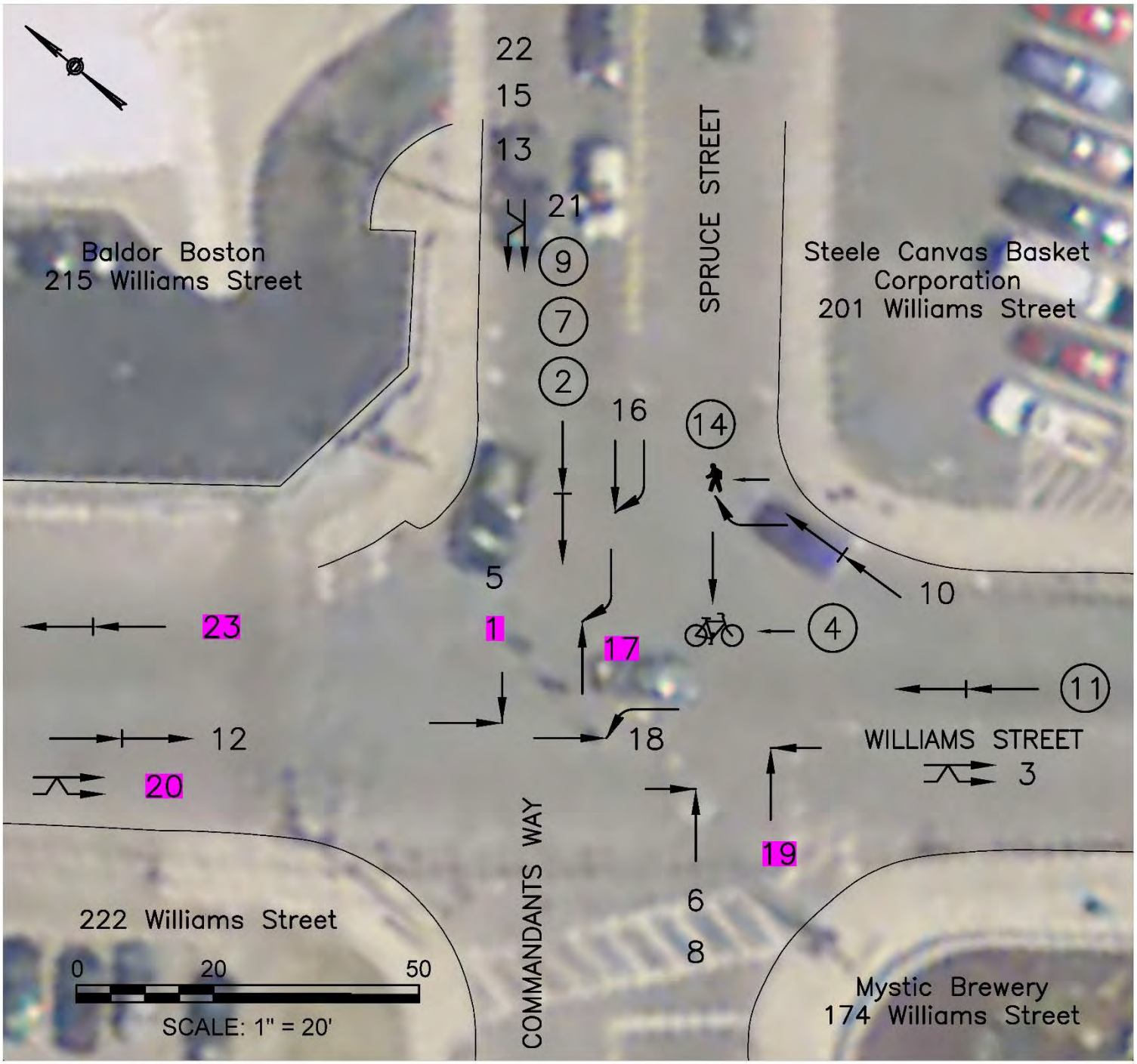
Stantec

Crash Diagram
Locus Map

Client/Project
City of Chelsea
Beacham Street/ Williams Street, Chelsea
Road Safety Audit

Figure No.
1

Title
Locus Map



CRASH DIAGRAM

PROJECT:	CHELSEA - BEACHAM STREET/ WILLIAMS STREET ROAD SAFETY AUDIT
INTERSECTION:	COMMANDANTS WAY/ SPRUCE STREET
FIGURE NO.:	2
PERIOD:	JANUARY 2014 TO DECEMBER 2016
SOURCE:	CHELSEA POLICE DEPARTMENT
PREPARATION:	STANTEC - JULY 2017

SEVERITY

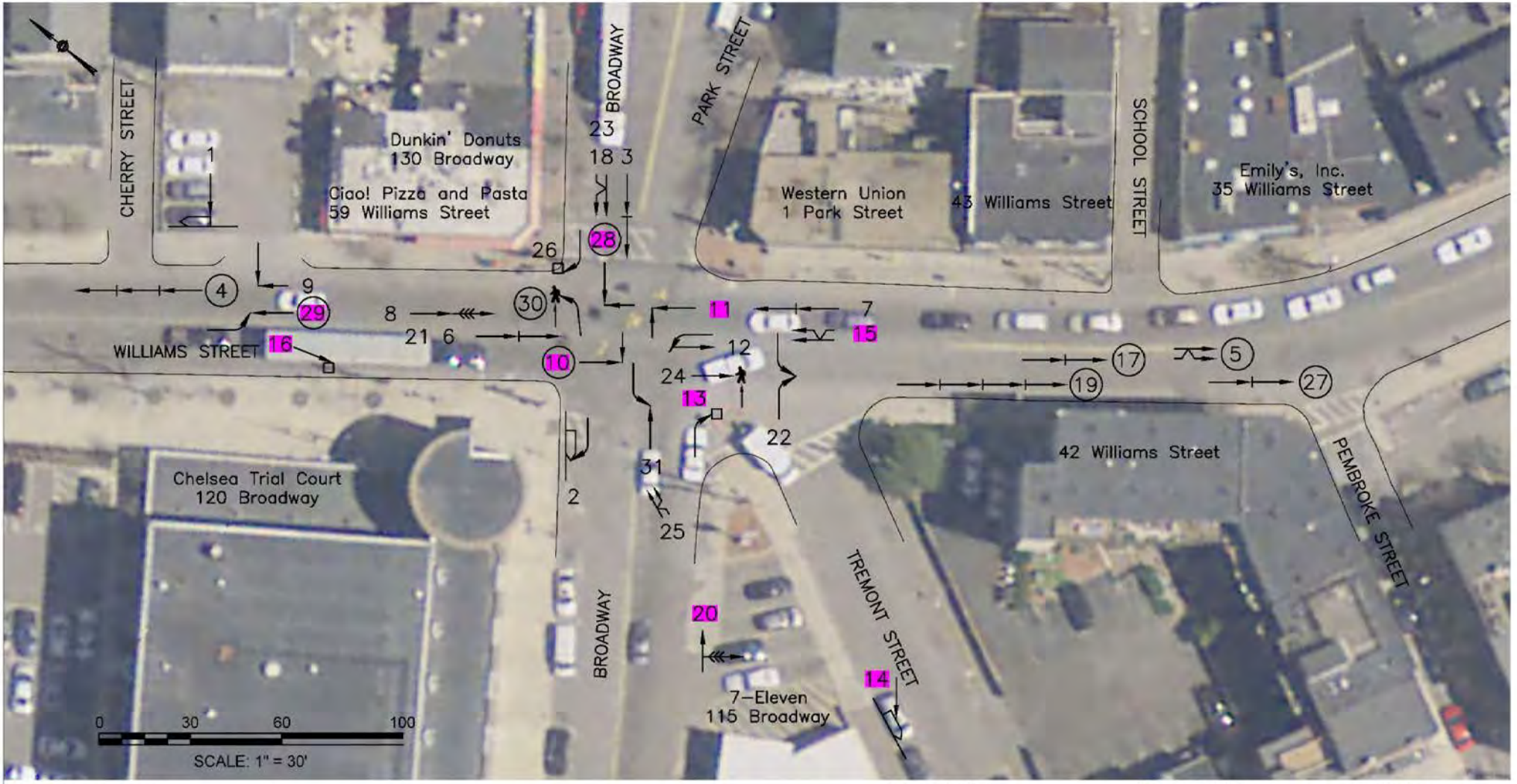
- (#) FATALITY
- # INJURY

CRASH TYPE

- REAR-END
- HEAD-ON
- SIDE-SWIPE
- # NIGHTTIME CRASH
- OUT-OF-CONTROL
- TURN
- ANGLE

INVOLVEMENT

- MOVING VEHICLE
- BACKING VEHICLE
- NON MOTORIST DIRECTION
- MOTORCYCLE
- BICYCLE
- PEDESTRIAN
- ANIMAL
- PARKED VEHICLE
- FIXED OBJECT



CRASH DIAGRAM

PROJECT:	CHELSEA - BEACHAM STREET/ WILLIAMS STREET ROAD SAFETY AUDIT
INTERSECTION:	CHERRY STREET TO PEMBROKE STREET
FIGURE NO.:	3
PERIOD:	JANUARY 2014 TO DECEMBER 2016
SOURCE:	CHELSEA POLICE DEPARTMENT
PREPARATION:	STANTEC - JULY 2017

CRASH TYPE
- REAR-END
- HEAD-ON
- SIDE-SWIPE
- OUT-OF-CONTROL
- TURN
- ANGLE
- # NIGHTTIME CRASH

INVOLVEMENT
- MOVING VEHICLE
- BACKING VEHICLE
- NON MOTORIST DIRECTION
- MOTORCYCLE
- BICYCLE
- PEDESTRIAN
- ANIMAL
- PARKED VEHICLE
- FIXED OBJECT

SEVERITY
- (#) FATALITY
- # INJURY

CRASH DIAGRAM

PROJECT:	CHELSEA - BEACHAM STREET/ WILLIAMS STREET ROAD SAFETY AUDIT
INTERSECTION:	PEARL STREET/ ANDREW MCARDLE BRIDGE
FIGURE NO.:	4
PERIOD:	JANUARY 2014 TO DECEMBER 2016
SOURCE:	CHELSEA POLICE DEPARTMENT
PREPARATION:	STANTEC - JULY 2017

SEVERITY

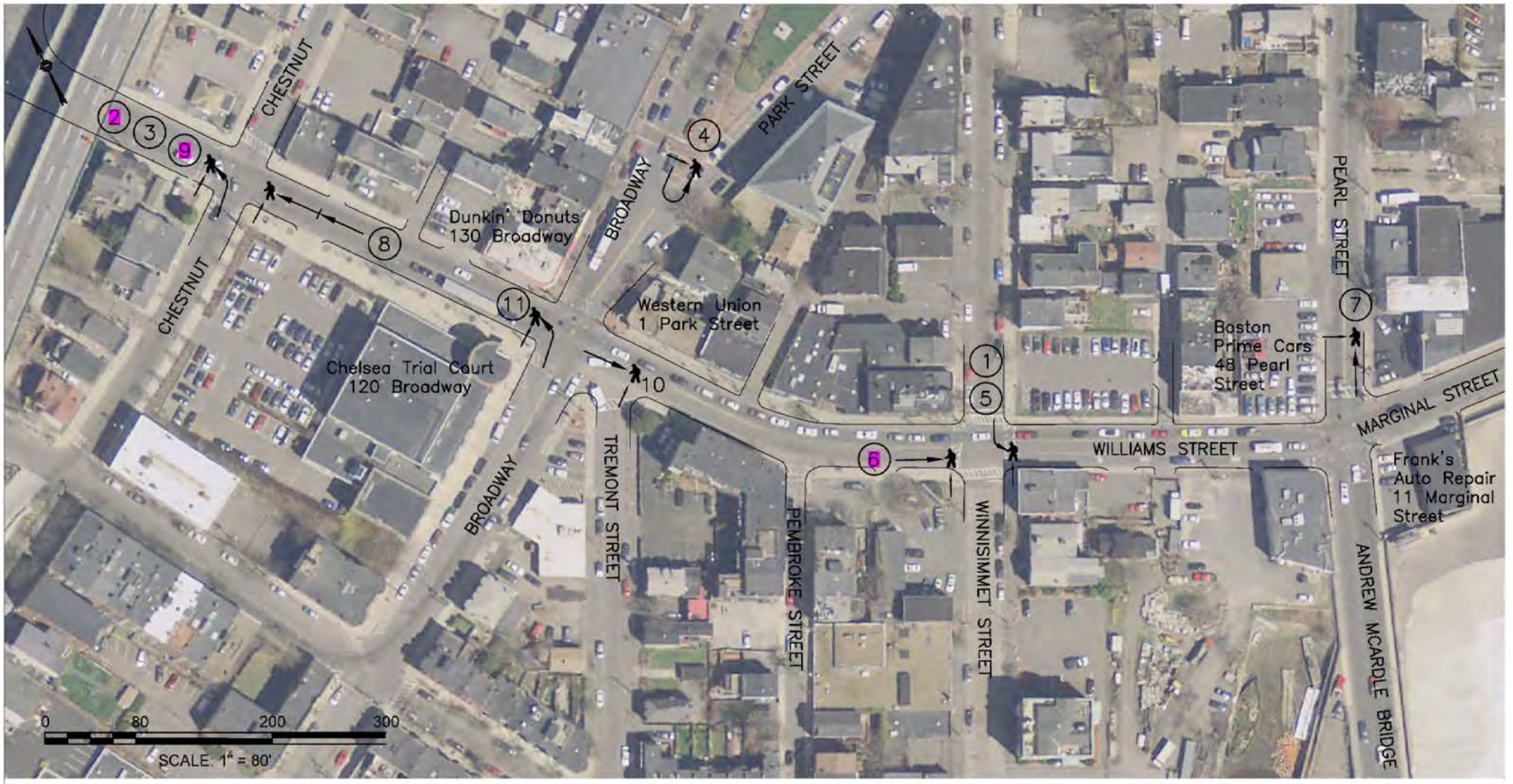
- (#) FATALITY
- (#) INJURY

CRASH TYPE

- REAR-END
- HEAD-ON
- SIDE-SWIPE
- # NIGHTTIME CRASH
- OUT-OF-CONTROL
- TURN
- ANGLE

INVOLVEMENT

- MOVING VEHICLE
- BACKING VEHICLE
- NON MOTORIST DIRECTION
- MOTORCYCLE
- BICYCLE
- PEDESTRIAN
- ANIMAL
- PARKED VEHICLE
- FIXED OBJECT



CRASH DIAGRAM

PROJECT:	CHELSEA - BEACHAM STREET/ WILLIAMS STREET ROAD SAFETY AUDIT
INTERSECTION:	CHESTNUT TO PEARL STREET - PEDESTRIAN AND BICYCLE CRASHES
FIGURE NO.:	5
PERIOD:	JANUARY 2012 TO DECEMBER 2016
SOURCE:	CHELSEA POLICE DEPARTMENT
PREPARATION:	STANTEC - JULY 2017

CRASH TYPE
- REAR-END
- HEAD-ON
- SIDE-SWIPE
- OUT-OF-CONTROL
- TURN
- ANGLE
- # NIGHTTIME CRASH

INVOLVEMENT
- MOVING VEHICLE
- BACKING VEHICLE
- NON MOTORIST DIRECTION
- MOTORCYCLE
- BICYCLE
- PEDESTRIAN
- ANIMAL
- PARKED VEHICLE
- FIXED OBJECT

SEVERITY
- (#) FATALITY
- # INJURY

2014-2016 Crashes at Williams Street and Spruce/Commandants Way - As Seen on Figure 2

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
1	1/15/2014	Wednesday	8:30 PM	Angle	Dry	Dark - lighted roadway	Cloudy	No injury	D1:(Swerving or avoiding),(Over-correcting/over-steering) D2:(No improper driving)	V1 traveling SB on Spruce Street swerved to avoid a collision with a vehicle and struck the rear of V2 who was traveling WB on Williams Street stopped at the red light
2	1/26/2014	Sunday	1:03 PM	Rear-end	Dry	Daylight	Clear/Other	Non-fatal injury - Possible	D1:(No improper driving) D2:(No improper driving)	V1 traveling SB on Spruce Street stopped in traffic was struck from behind by V2
3	4/21/2014	Monday	3:01 PM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling EB on Williams Street switched lanes and struck V2 who was also traveling EB
4	11/1/2014	Saturday	2:24 PM	Angle	Wet	Daylight	Rain/Cloudy	Non-fatal injury - Non-incapacitating	D1:(Unknown)	V1 traveling SB on Spruce Street struck a cyclist traveling WB on Williams Street. Both V1 and the cyclist claimed they had a green light
5	11/13/2014	Thursday	11:23 AM	Angle	Dry	Daylight	Clear/Other	No injury	D1:(No improper driving) D2:(Unknown)	V1 traveling EB on Williams Street ran a red light and struck V2 who was traveling SB on Spruce Street
6	12/10/2014	Wednesday	6:20 AM	Angle	Wet	Daylight	Cloudy/Rain	No injury	D1:(Unknown) D2:(No improper driving)	V1 traveling EB on Williams Street continued straight through a flashing yellow light and struck V2 who was traveling SB on Spruce Street continuing through a flashing red light
7	3/16/2015	Monday	3:32 PM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Non-incapacitating	D1:(Unknown) D2:(Unknown)	V1 traveling SB on Spruce Street was struck from behind by V2
8	4/25/2015	Saturday	9:43 AM	Angle	Dry	Daylight	Cloudy	No injury	D1:(Disregarded traffic signs, signals, road markings), (No improper driving) D2:(No improper driving)	V1 traveling WB on Williams Street ran a red light and struck V2 who was traveling NB on Commandants Way
9	5/17/2015	Sunday	2:52 PM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(No improper driving) D2:(Distracted)	V1 traveling SB on Spruce Street was stopped at a red light and struck from behind by V2
10	5/29/2015	Friday	1:42 PM	Rear-end	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(No improper driving)	V2 traveling WB on Williams Street turned right and pulled over to allow an emergency vehicle to pass. V1 turned right behind V2 and struck V2 from behind
11	5/31/2015	Sunday	10:17 AM	Rear-end	Dry	Daylight	Cloudy	Non-fatal injury - Non-incapacitating	D1:(No improper driving)	V1 traveling WB on Williams Street was stopped at a red light and struck from behind by V2
12	9/13/2015	Sunday	2:19 PM	Rear-end	Dry	Daylight	Clear	No injury	D1:(No improper driving)	V1 traveling EB on Williams Street was stopped at in traffic and struck from behind by V2
13	10/28/2015	Wednesday	7:08 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Failed to yield right of way), (Failure to keep in proper lane or running off road) D2:(No improper driving)	V1 traveling SB on Spruce Street in the left-hand lane made an abrupt lane change and was struck by V2 traveling SB in the righthand lane
14	11/23/2014	Sunday	11:43 AM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(Unknown) D2:(No improper driving)	V2 traveling WB on Williams Street slowing at a red light was struck from behind by V1. This pushed V2 into pedestrian crossing the road.
15	12/22/2015	Tuesday	11:14 AM	Angle	Wet	Daylight	Cloudy/Rain	No injury	D1:(No improper driving) D2:(Unknown)	V1 traveling SB on Spruce Street in the right lane was stuck by V2 traveling NB in the left lane who was making a wide right turn

2014-2016 Crashes at Williams Street and Spruce/Commandants Way - As Seen on Figure 2

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
16	4/7/2016	Thursday	1:13 PM	Sideswipe, same direction	Wet	Dawn	Cloudy/Rain	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling SB on Spruce Street was struck on the driver's side by V2 who was in the left lane making a wide right turn onto Williams Street
17	7/8/2016	Friday	11:30 PM	Sideswipe, opposite direction	Dry	Dark - lighted roadway	Clear	No injury	D1:(Disregarded traffic signs, signals, road markings) D2:(Disregarded traffic signs, signals, road markings)	V1 traveling NB on Commandants Way and V2 traveling SB on Spruce Street and turning right both accelerated through a yellow light and collided
18	7/13/2016	Wednesday	4:03 PM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Disregarded traffic signs, signals, road markings)	V1 traveling EB on Williams Street was sideswiped by V2 who was also traveling EB trying to pass vehicles across a double yellow centerline
19	7/14/2016	Thursday	11:06 PM	Angle	Dry	Dark - lighted roadway	Cloudy	No injury	D1:(No improper driving) D2:(No improper driving) D3:(No improper driving)	V1 traveling NB on Commandants Way ran a red light was struck by V2 who was traveling WB on Williams Street. Due to the impact, V2 then struck V3 and V4 who were waiting on Spruce Street SB at the red light
20	8/2/2016	Tuesday	9:50 PM	Head-on	Dry	Dark - lighted roadway	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling EB on Williams Street struck V2 who was traveling WB and turning left
21	8/20/2016	Saturday	7:05 PM	Rear-end	Dry	Daylight	Clear	No injury	D1:(Followed too closely), (Unknown) D2:(No improper driving)	V2 traveling SB on Spruce Street was stopped at the red light and struck from behind by V1
22	10/14/2016	Friday	11:57 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling SB on Spruce Street in the left-hand lane made an abrupt right turn and struck V2 traveling SB in the righthand lane
23	11/17/2016	Thursday	5:57 PM	Rear-end	Dry	Dark - lighted roadway	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling WB stopped for a pedestrian crossing the street and was struck by V2 from behind

2014-2016 Crashes at Williams Street and Broadway - As Seen on Figure 3

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
1	2/1/2014	Saturday	4:33 PM	Angle	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 was exiting driveway to travel WB on Williams Street and struck V2 parked along Williams Street
2	3/11/2014	Tuesday	9:45 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Inattention) D2:(Unknown)	V1 traveling WB on Williams Street turning left struck V2 who was parked illegally on the corner and blocking V1 from clearing the turn
3	4/17/2014	Thursday	12:41 PM	Rear-end	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling EB on Williams Street turning left was waved to turn by opposing approach vehicle, but stopped suddenly and was struck from behind by V2
4	7/7/2014	Monday	10:59 AM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(No improper driving) D2:(Inattention) D3:(Inattention)	V1 traveling WB on Williams Street stopped at a red light was struck from behind by V2
5	8/1/2014	Friday	6:01 PM	Angle	Dry	Daylight	Clear	Non-fatal injury - Non-incapacitating	D1:(Unknown) D2:(Followed too closely)	V1 traveling EB on Williams Street started to turn right and then changed direction back to the left and struck V2 who had tried to go around V1. V2 was a scooter/moped
6	8/9/2014	Saturday	2:20 PM	Single vehicle crash	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling EB on Williams Street stopped suddenly in traffic and was struck from behind by V2
7	8/25/2014	Monday	2:28 PM	Rear-end	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling WB on Williams Street was stopped at a red light and struck from behind by V2
8	9/8/2014	Monday	8:32 AM	Rear-end	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(No improper driving)	V1 traveling EB on Williams Street stopped at a red light, backed up to allow a truck traveling SB to turn right from Broadway and struck the front of V2
9	10/1/2014	Wednesday	7:08 AM	Angle	Wet	Dawn	Rain/Cloudy	No injury	D1:(Over-correcting/over-steering) D2:(No improper driving)	V1 turning left exiting a driveway to travel EB on Williams Street overcorrected and struck V2 who stopped traveling WB
10	10/1/2014	Wednesday	7:47 PM	Angle	Wet	Dark - lighted roadway	Cloudy/Rain	Non-fatal injury - Possible	D1:(Disregarded traffic signs, signals, road markings) D2:(Disregarded traffic signs, signals, road markings)	V1 traveling SB on Broadway and V2 traveling EB on Williams Street both claimed to have the green light and collided in the intersection
11	1/27/2015	Tuesday	8:48 PM	Sideswipe, same direction	Snow	Dark - lighted roadway	Blowing sand, snow	No injury	D1:(Inattention) D2:(No improper driving)	V1 traveling WB on Williams Street ran a red light and struck V2 who was traveling NB on Broadway
12	6/10/2015	Wednesday	1:20 PM	Sideswipe, opposite direction	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling EB on Williams Street was stopped in traffic and struck by V2 who traveling WB on Williams Street and turning left
13	12/13/2015	Sunday	10:48 PM	Single vehicle crash	Dry	Dark - lighted roadway	Clear	No injury	D1:(Operating vehicle in erratic, reckless, careless, negligent or aggressive manner)	V1 traveling NB on Broadway turned right onto Williams Street and struck a utility pole
14	1/17/2016	Sunday	11:31 PM	Sideswipe, same direction	Wet	Dark - lighted roadway	Snow	No injury	D1:(Disregarded traffic signs, signals, road markings), (Inattention)	V1 traveling WB turned right and struck V2 who was parked along Tremont Street
15	2/2/2016	Tuesday	5:59 PM	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling WB on Williams Street struck V2 who was traveling SB and tried to change lanes in the intersection in front of V1
16	3/21/2016	Monday	11:23 PM	Rear-end	Dry	Dark - lighted roadway	Clear	No injury	D1:(Inattention)	V1 traveling EB on Williams Street lost control of the vehicle and struck a utility pole
17	5/20/2016	Friday	12:47 PM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(No improper driving) D2:(Inattention)	V1 traveling EB on Williams Street stopped in traffic was struck from behind by V2

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
18	5/26/2016	Thursday	11:40 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling SB on Broadway attempted to pass between a truck stopped at the red light and a parked vehicle, but struck both vehicles
19	6/1/2016	Wednesday	12:59 PM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Non-incapacitating	D1:(No improper driving) D2:(No improper driving) D3:(No improper driving) D4:(Inattention), (Followed too closely)	V1, V2, V3, and V4 were traveling EB on Williams Street and slowing in traffic. V4 was following too closely behind V3 and struck V3 from behind, who in turn struck V2 who in turn struck V1
20	6/18/2016	Saturday	10:21 PM	Single vehicle crash	Dry	Dark - lighted roadway	Clear	No injury	D1:(Inattention) D2:(No improper driving)	V2 traveling NB on Broadway was stopped at the red light and struck by V1 who was backing out of the 7-Eleven parking lot
21	7/19/2016	Tuesday	7:47 AM	Rear-end	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Unknown)	V1 traveling EB on Williams Street was slowing at a red light and struck from behind by V2
22	8/3/2016	Wednesday	9:34 AM	Angle	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling NB on Broadway turning right onto Williams Street struck V2 who was traveling SB on Broadway turning left onto Williams Street
23	8/12/2016	Friday	2:03 PM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling SB on Broadway was sideswiped by V2 who was also traveling SB
24	10/7/2016	Friday	2:58 PM	Single vehicle crash	Dry	Daylight	Clear	No injury	D1:(No improper driving)	V1 traveling EB on Williams Street struck a pedestrian who was crossing Williams Street. V1 had a green light and was traveling straight
25	10/8/2016	Saturday	7:22 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling NB on Broadway was struck on the passengers side door by V2 while both vehicles were turning left
26	10/20/2016	Thursday	7:46 AM	Single vehicle crash	Dry	Daylight	Clear	No injury	D1:(No improper driving)	V1 traveling SB on Broadway turning right attempted to avoid a collision with V2 who was traveling NB on Broadway turning left and as a result V1 struck a utility pole
27	11/8/2016	Tuesday	12:14 PM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(Unknown) D2:(Other improper action)	V1 traveling EB on Williams Street was stopped in traffic and struck from behind by V2
28	11/11/2016	Friday	7:12 PM	Angle	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Non-incapacitating	D1:(No improper driving) D2:(Disregarded traffic signs, signals, road markings)	V1 traveling WB on Williams Street through a green light was struck by V2 traveling SB on Broadway who ran a red light
29	11/12/2016	Saturday	8:44 PM	Sideswipe, opposite direction	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Non-incapacitating	D1:(No improper driving) D2:(No improper driving)	V1 traveling EB on Williams Street turned left and struck V2 who was traveling WB slowing in traffic
30	12/20/2016	Tuesday	11:46 AM	Head-on	Dry	Daylight	Clear	Non-fatal injury - Incapacitating	D1:(Unknown)	V2 traveling NB on Broadway turned left onto Williams Street and struck a pedestrian in the crosswalk
31	12/24/2016	Saturday	2:40 PM	Angle	Wet	Daylight	Cloudy	Unknown	D1:(Operating vehicle in erratic, reckless, careless, negligent or aggressive manner), (Failed to yield right of way) D2:(No improper driving)	V2 traveling NB on Broadway was struck by V1 who was traveling SB on Broadway turning left onto Williams Street

2014-2016 Crashes at Williams Street and Pearl Street/Andrew McArdle Bridge - As Seen on Figure 4

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
1	1/10/2014	Friday	5:38 PM	Angle	Wet	Daylight	Cloudy	No injury	D1:(Unknown) D2:(No improper driving)	V1 traveling EB on Williams Street turned right on red and struck V1 who was stopped at a red light in the left-hand EB lane
2	1/20/2014	Monday	1:34 AM	Angle	Dry	Dark - lighted roadway	Clear	No injury	D1:(No improper driving),(No improper driving) D2:(Disregarded traffic signs, signals, road markings)	V2 traveling NB on the Andrew McArdle Bridge ran a red light and struck V1 who was traveling WB on Marginal Street
3	1/22/2014	Wednesday	2:15 AM	Sideswipe, opposite direction	Wet	Dark - lighted roadway	Snow/Blowing sand, snow	No injury	D1:(No improper driving)	V1 traveling EB on Williams Street turning right, struck V2 traveling NB on Andrew McArdle Bridge turning left onto Williams Street
4	2/2/2014	Sunday	9:24 PM	Rear-end	Wet	Dark - lighted roadway	Cloudy	No injury	D1:(No improper driving)	V1 traveling SB on Pearl Street was struck from behind by V2 who was also traveling SB
5	3/5/2014	Wednesday	2:18 PM	Single vehicle crash	Snow	Daylight	Snow	Non-fatal injury - Non-incapacitating	D1:(Unknown)	V1 traveling NB on Pearl Street struck a pedestrian waiting at a bus stop
6	3/30/2014	Sunday	12:09 AM	Rear-end	Wet	Dark - lighted roadway	Rain/Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling WB on Williams Street was stopped for a pedestrian crossing and was struck from behind by V2
7	3/31/2014	Monday	12:44 AM	Sideswipe, same direction	Wet	Dark - lighted roadway	Sleet, hail (freezing rain or drizzle)	No injury	D1:(No improper driving) D2:(Operating vehicle in erratic, reckless, careless, negligent or aggressive manner)	V1 traveling EB on Williams Street was sideswiped by V2 also traveling EB
8	5/12/2014	Monday	1:55 AM	Single vehicle crash	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Possible	D1:(Failure to keep in proper lane or running off road),(Unknown)	V1 traveling NB on the Andrew McArdle Bridge crossed the double yellow centerline and collided with a concrete light pole on the sidewalk.
9	5/12/2014	Monday	9:32 AM	Rear-end	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Inattention)	V1 traveling SB on Pearl Street was struck from behind by V2 who was also traveling SB
10	8/13/2014	Wednesday	5:42 PM	Single vehicle crash	Wet	Daylight	Rain/Cloudy	Non-fatal injury - Non-incapacitating	D1:(No improper driving)	V1 traveling SB on Pearl Street started driving as the light turned green and struck a cyclist from behind who was weaving through traffic
11	9/17/2014	Wednesday	12:17 PM	Angle	Dry	Daylight	Clear/Other	Non-fatal injury - Possible	D1:(Unknown) D2:(No improper driving) D3:(No improper driving)	V1 traveling EB on Williams Street ran a red light and struck V2 who was traveling NB on the Andrew McArdle Bridge and turning right
12	12/16/2014	Tuesday	6:34 PM	Angle	Wet	Dusk	Clear	No injury	D1:(Operating vehicle in erratic, reckless, careless, negligent or aggressive manner) D2:(No improper driving)	V2 traveling NB on the Andrew McArdle Bridge turned left onto Williams Street and was struck by V1 who was traveling SB on Pearl Street
13	12/21/2014	Sunday	12:08 AM	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Incapacitating	D1:(Inattention), (Operating vehicle in erratic, reckless, careless, negligent or aggressive manner) D2:() D3:()	V1 traveling NB on Pearl Street struck parked V2 on the driver's side which in turn was pushed into V3
14	4/1/2015	Wednesday	6:41 PM	Angle	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling WB on Marginal Street struck V2 who was traveling NB on the Andrew McArdle Bridge and turning left

2014-2016 Crashes at Williams Street and Pearl Street/Andrew McArdle Bridge - As Seen on Figure 4

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
15	4/4/2015	Saturday	10:30 AM	Angle	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Wrong side or wrong way), (Failure to keep in proper lane or running off road)	V2 traveling SB on the Andrew McArdle Bridge attempted to pass V1 slowing in traffic due to the raised drawbridge also traveling SB. When V2 merged back into the right lane, it struck the side of V1
16	4/16/2015	Thursday	7:46 AM	Sideswipe, same direction	Dry	Daylight	Clear/Unknown	No injury	D1:(No improper driving) D2:(Unknown)	V1 traveling WB on Marginal Street was sideswiped by V2 who was also traveling WB
17	5/10/2015	Sunday	8:44 PM	Rear-end	Dry	Dark - lighted roadway	Clear	No injury	D1:(No improper driving) D2:(Inattention)	V1 traveling WB on Marginal Street stopped at a red light was struck from behind by V2
18	7/22/2015	Wednesday	6:32 AM	Angle	Dry	Daylight	Clear	No injury	D1:(Made an improper turn) D2:(Failure to keep in proper lane or running off road) D3:(No improper driving)	V1 traveling NB on the Andrew McArdle Bridge made a sudden illegal U-turn and was struck by V2 who was traveling NB
19	9/10/2015	Thursday	3:44 PM	Rear-end	Wet	Daylight	Cloudy/Rain	No injury	D1:(Inattention) D2:(Other improper action) D3:(No improper driving)	V1 traveling NB on the Andrew McArdle Bridge slowing in traffic was struck from behind by V2
20	11/18/2015	Wednesday	5:23 PM	Sideswipe, same direction	Dry	Daylight	Cloudy	No injury	D1:(Failure to keep in proper lane or running off road) D2:(No improper driving)	V1 traveling WB on Marginal Street in the right lane struck the rear of V2 who was traveling WB in the left lane
21	12/3/2015	Thursday	5:00 PM	Rear-end	Dry	Dusk	Clear	Non-fatal injury - Possible	D1:(Unknown) D2:(No improper driving)	V3 traveling NB on Pearl Street struck V2 from behind who was then pushed into V1
22	12/15/2015	Tuesday	7:39 AM	Sideswipe, same direction	Wet	Daylight	Cloudy/Rain	No injury	D1:(No improper driving) D2:(Made an improper turn)	V1 traveling NB on the Andrew McArdle Bridge in the left lane turning left was struck by V2 who was turning left from the improper lane
23	1/10/2016	Sunday	10:49 AM	Single vehicle crash	Wet	Daylight	Cloudy/Rain	Non-fatal injury - Non-incapacitating	D1:(Driving too fast for conditions) D2:(Failed to yield right of way)	V2 traveling EB on Williams Street turned right and struck the side of V1 who was traveling SB on Pearl Street through a green light
24	1/12/2016	Tuesday	9:35 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Inattention)	V2 traveling WB on Marginal Street moved to the left lane make a wide right turn onto Pearl Street and was struck by V1 who was traveling WB through from the right lane
25	1/26/2016	Tuesday	5:31 PM	Rear-end	Dry	Dark - lighted roadway	Cloudy	Non-fatal injury - Non-incapacitating	D1:(Followed too closely), (Other improper action) D2:(No improper driving)	V2 traveling NB on the Andrew McArdle Bridge was slowing in traffic and struck from behind by V1.
26	2/15/2016	Monday	2:40 PM	Head-on	Dry	Daylight	Clear	No injury	D1:(Unknown)	V1 traveling EB on Williams Street hit a snow bank and lost control of the vehicle and struck a building and two parked cars.
27	2/19/2016	Friday	7:35 PM	Sideswipe, same direction	Dry	Dark - lighted roadway	Cloudy	No injury	D1:(No improper driving) D2:(Unknown)	V1 traveling WB on Williams Street turning wide right struck V2 who was stopped in the right lane
28	2/19/2016	Friday	8:38 PM	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	No injury	D1:(Unknown) D2:(No improper driving)	V1 traveling NB on the Andrew McArdle Bridge attempted to turn left onto Williams Street, but Williams Street was closed. V1 then attempted to reenter the lane to continue straight onto Pearl Street and struck V2 who was also traveling NB onto Pearl Street
29	3/29/2016	Tuesday	6:15 PM	Rear-to-rear	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(No improper driving)	V1 traveling WB on Williams Street was struck by V2 who was traveling SB through the intersection

2014-2016 Crashes at Williams Street and Pearl Street/Andrew McArdle Bridge - As Seen on Figure 4

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
30	4/1/2016	Friday	4:23 PM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling NB on the Andrew McArdle Bridge merged from the left lane to the right lane and struck V2 who was stopped in traffic in the right lane
31	4/21/2016	Thursday	8:52 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Failure to keep in proper lane or running off road), (Other improper action)	V1 traveling NB on the Andrew McArdle Bridge made a wide right turn onto Marginal Street and was struck by V2 who attempted to pass V1 on the right
32	5/9/2016	Monday	3:18 AM	Single vehicle crash	Dry	Dark - lighted roadway	Clear	No injury	D1:(Swerving or avoiding due to wind, slippery surface, vehicle object, non-motorist in roadway, etc.)	V1 traveling WB on Marginal Street turned right and had to cut the turn harder than intended to avoid a collision with a vehicle that failed to yield. As a result, V1 struck the curb, a traffic sign, and a utility pole
33	5/13/2016	Friday	8:13 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(Unknown)	V1 traveling NB on the Andrew McArdle Bridge was struck on the driver's side by V2 who was attempting to pass her on the left
34	7/2/2016	Saturday	7:27 PM	Sideswipe, same direction	Dry	Dusk	Clear	No injury	D1:13, (Disregarded traffic signs, signals, road markings) D2:13, (Disregarded traffic signs, signals, road markings)	V2 traveling WB on Marginal Street continued straight through the intersection from the left turn only lane and struck V1 who was traveling WB from the right hand through lane
35	7/20/2016	Wednesday	1:51 PM	Angle	Dry	Daylight	Clear	No injury	D1:(Unknown) D2:(No improper driving)	V1 traveling NB on the Andrew McArdle Bridge was struck from behind by V2 who was traveling NB turning left
36	8/15/2016	Monday	10:26 PM	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	No injury	D1:(No improper driving)	V1 traveling WB on Marginal Street sideswiped V2 who was illegally passing V1
37	8/22/2016	Monday	11:40 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(Failed to yield right of way) D2:(No improper driving) D3:(No improper driving)	V1 traveling SB on Pearl Street attempted to continue straight through the intersection between V2 who was turning left and V1 who was traveling straight, but struck both vehicles
38	8/28/2016	Sunday	11:03 PM	Angle	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Incapacitating	D1:(Unknown) D2:(Unknown)	V1 traveling WB on Marginal Street was struck by V2 who was traveling SB on Pearl Street. Both vehicles claimed to have a green light
39	9/6/2016	Tuesday	11:23 AM	Sideswipe, opposite direction	Dry	Daylight	Clear/Unknown	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling WB on Marginal Street turned left, misjudged the turn and struck V2 who was stopped at the light traveling NB on the Andrew McArdle Bridge
40	10/17/2016	Monday	3:26 PM	Angle	Dry	Daylight	Clear	No injury	D1:(Followed too closely) D2:(No improper driving)	V2 traveling WB on Marginal Street made a wide right turn onto Pearl Street and was struck on the side by V1 who attempted to pass V2 on the right hand side
41	11/24/2016	Thursday	1:41 AM	Angle	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Possible	D1:(No improper driving) D2:(Disregarded traffic signs, signals, road markings)	V1 traveling NB on the Andrew McArdle Bridge struck V2 who was traveling EB on Williams Street and ran a red light
42	11/25/2016	Friday	10:30 PM	Head-on	Dry	Dark - lighted roadway	Clear	No injury	D1:(No improper driving) D2:(No improper driving)	V1 traveling WB struck V2 who was traveling SB and turning left through a red light
43	12/3/2016	Saturday	6:14 PM	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	No injury	D1:(Unknown)	V1 traveling EB on Williams Street was waiting at a red light and struck from behind by V2 who attempted to go around V1

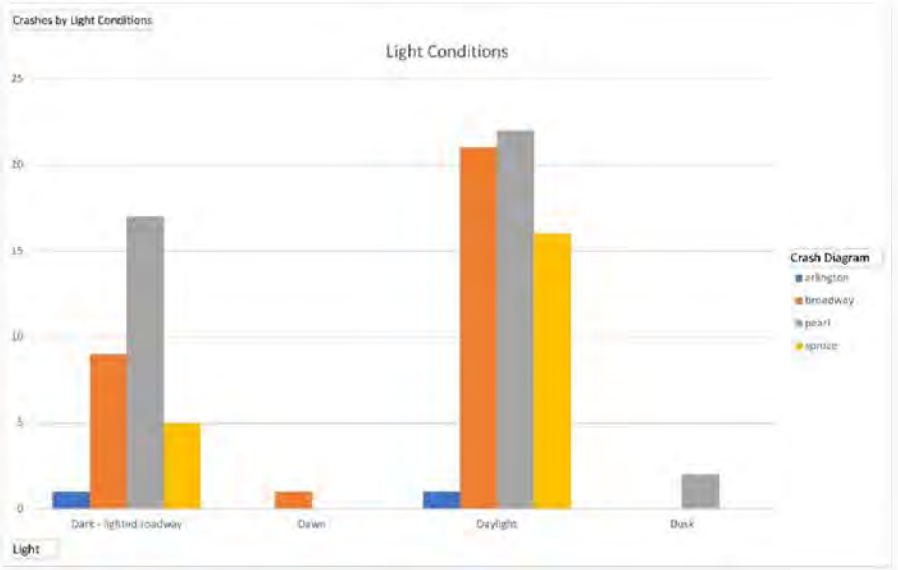
2014-2016 Crashes at Williams Street and Pearl Street/Andrew McArdle Bridge - As Seen on Figure 4

Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
44	12/6/2016	Tuesday	11:53 AM	Sideswipe, same direction	Dry	Daylight	Clear	No injury	D1:(No improper driving) D2:(Failure to keep in proper lane or running off road)	V1 traveling EB on Williams Street was struck by V2 who was traveling EB straight from a right turn only lane
45	12/20/2016	Tuesday	5:55 PM	Sideswipe, same direction	Dry	Dark - lighted roadway	Clear	No injury	D1:(Unknown) D2:(No improper driving)	V1 traveling NB on Pearl Street in the left-turn only lane proceeded straight and struck V2 who was traveling straight in the thru lane

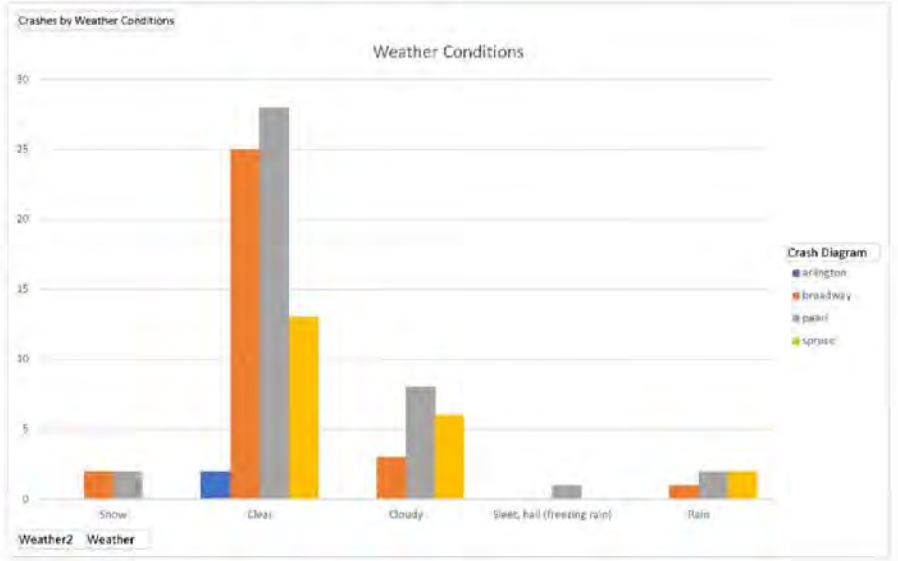
2014-2016 Pedestrian Crashes at Williams Street from Chestnut Street to Pearl Street - As Seen on Figure 5

Pedestrian Diagram Number	Date	Day of Week	Crash Time	Manner	Surface	Light	Weather	Severity	Driver Contributing Code	Narrative
1	2/15/2009	Sunday	11:50 AM	Single vehicle crash	Dry	Daylight	Clear	Non-fatal injury - Incapacitating	D1:(No improper driving)	V1 traveling SB on Winnisimmet turned left onto Williams Street and struck a pedestrian crossing Williams Street
2	1/27/2010	Wednesday	6:02 AM	Angle	Dry	Dark - lighted roadway	Clear	Non-fatal injury - Non-incapacitating	D1:(Unknown)	V1 traveling NB on Chestnut Street turned left onto Williams Street and struck a pedestrian in the crosswalk crossing Williams Street
3	6/8/2010	Tuesday	3:27 PM	Head-on	Dry	Daylight	Clear	Non-fatal injury - Incapacitating	D1:(Distracted)	V1 traveling NB on Chestnut Street turned left onto Williams Street and struck a pedestrian in the crosswalk crossing Williams Street
4	10/5/2010	Tuesday	2:08 PM	Single vehicle crash	Wet	Daylight	Cloudy	Non-fatal injury - Non-incapacitating	D1:(No improper driving)	V1 traveling SB on Broadway made a U-turn onto Park Street and struck a pedestrian who was crossing Park Street
5	7/30/2012	Monday	5:34 PM	Single vehicle crash	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(Glare)	V1 traveling SB on Winnisimmet Street turned left onto Williams Street and struck pedestrian who was crossing Williams Street
6	10/31/2013	Thursday	7:14 PM	Single vehicle crash	Wet	Dark - lighted roadway	Rain	Non-fatal injury - Incapacitating	D1:(Inattention),(Driving too fast for conditions)	V1 traveling EB on Williams Street struck a pedestrian who was crossing Williams Street near the corner of Winnisimmet Street. The street lighting was poor and made it difficult to see
7	3/5/2014	Wednesday	2:18 PM	Single vehicle crash	Snow	Daylight	Snow	Non-fatal injury - Non-incapacitating	D1:(Unknown)	V1 traveling NB on Pearl Street struck a pedestrian waiting at a bus stop
8	11/23/2014	Sunday	11:43 AM	Rear-end	Dry	Daylight	Clear	Non-fatal injury - Possible	D1:(Unknown) D2:(No improper driving)	V2 traveling WB on Williams Street slowing at a red light was struck from behind by V1. This pushed V2 into pedestrian crossing the road.
9	11/13/2015	Friday	1:07 AM	Single vehicle crash	Wet	Dark - lighted roadway	Clear/Rain	Non-fatal injury - Possible	D1:(Unknown)	V1 traveling NB on Chestnut Street turning left struck pedestrian crossing Williams
10	10/7/2016	Friday	2:58 PM	Single vehicle crash	Dry	Daylight	Clear	No injury	D1:(No improper driving)	V1 traveling EB on Williams Street struck a pedestrian who was crossing Williams Street. V1 had a green light and was traveling straight
11	12/20/2016	Tuesday	11:46 AM	Head-on	Dry	Daylight	Clear	Non-fatal injury - Incapacitating	D1:(Unknown)	V2 traveling NB on Broadway turned left onto Williams Street and struck a pedestrian in the crosswalk

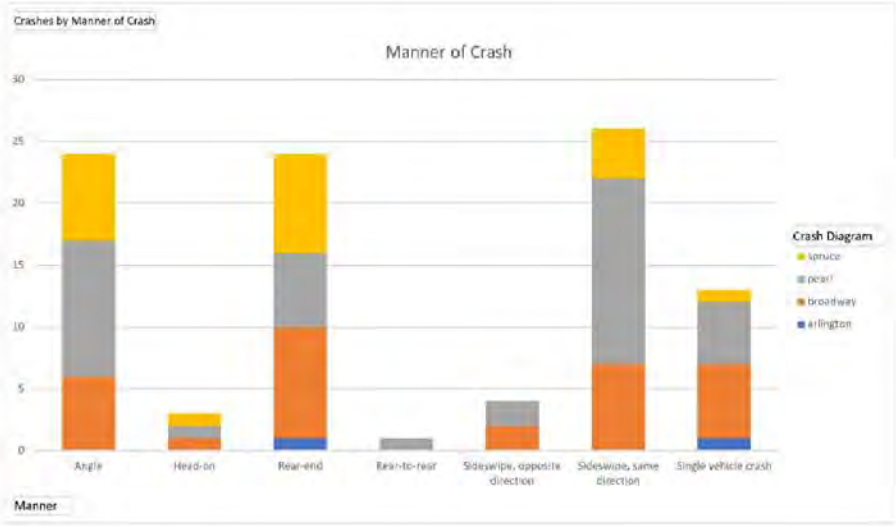
Crashes by Light Conditions	arlington	broadway	pearl	spruce	Grand Total
Dark - lighted roadway	1	9	17	5	32
Dawn		1			1
Daylight	1	21	22	16	60
Dusk			2		2
Grand Total	**2**	**31**	**41**	**21**	**95**



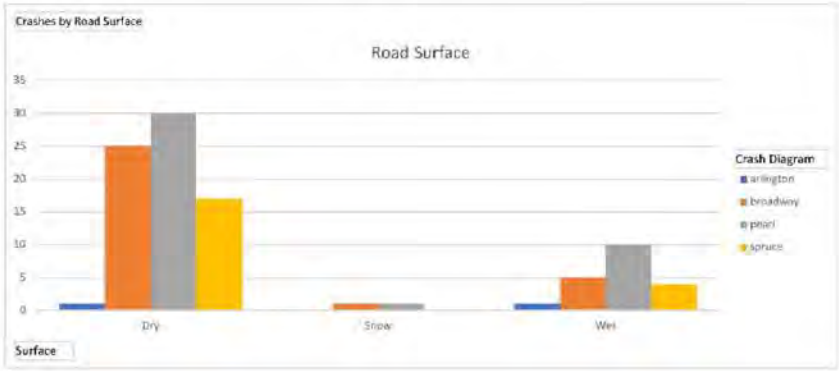
Crashes by Weather Conditions	arlington	broadway	pearl	spruce	Grand Total
Snow		**2**	**2**		**4**
Clear	**2**	**25**	**28**	**13**	**68**
Cloudy		**3**	**8**	**6**	**17**
Sleet, hail (freezing rain)			**1**		**1**
Rain		**1**	**2**	**2**	**5**
Grand Total	**2**	**31**	**41**	**21**	**95**



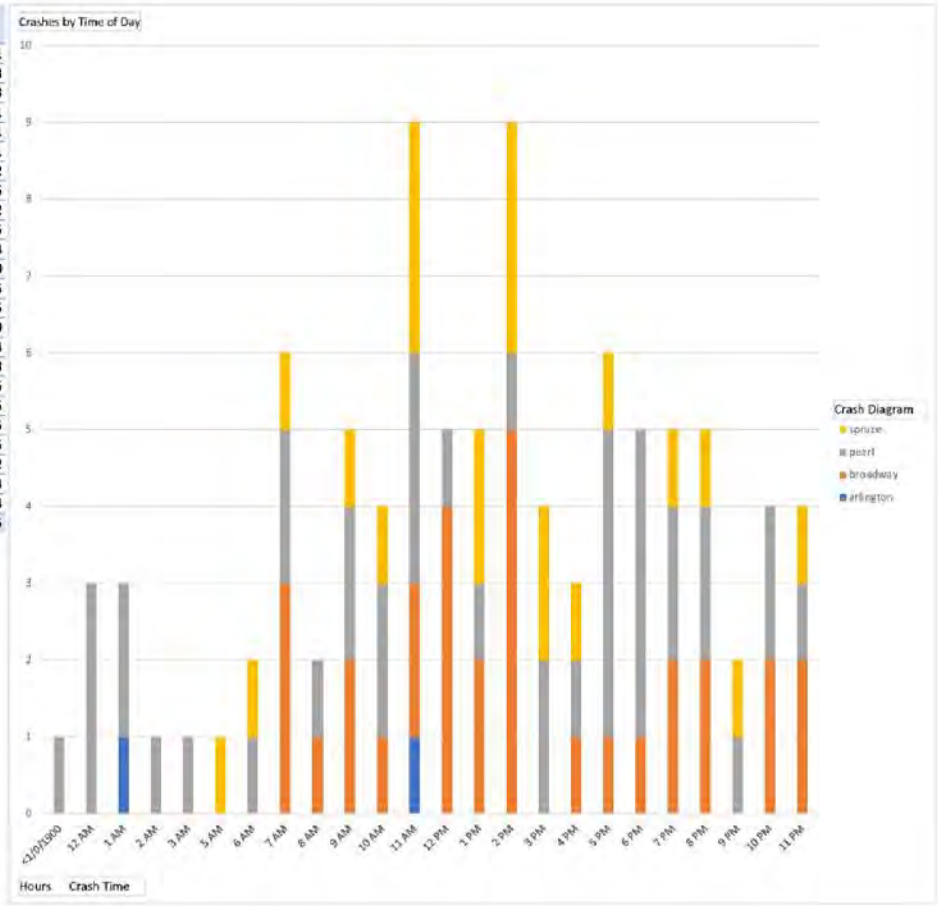
Crashes by Manner of Crash	arlington	broadway	pearl	spruce	Grand Total
Angle		6	11	7	24
Head-on		1	1	1	3
Rear-end	1	9	6	8	24
Rear-to-rear			1		1
Sideswipe, opposite direction		2	2		4
Sideswipe, same direction		7	15	4	26
Single vehicle crash	1	6	5	1	13
Grand Total	**2**	**31**	**41**	**21**	**95**



Crashes by Road Surface	arlington	broadway	pearl	spruce	Grand Total
Dry	1	25	30	17	73
Snow		1	1		2
Wet	1	5	10	4	20
Grand Total	**2**	**31**	**41**	**21**	**95**



Crashes by Time of Day	arlington	broadway	pearl	spruce	Grand Total
<1/0/1900			1		1
12 AM			3		3
1 AM		1	2		3
2 AM			1		1
3 AM			1		1
5 AM				1	1
6 AM			1	1	2
7 AM		3	2	1	6
8 AM		1	1		2
9 AM		2	2	1	5
10 AM		1	2	1	4
11 AM		1	2	3	3	9
12 PM		4	1		5
1 PM		2	1	2	5
2 PM		5	1	3	9
3 PM			2	2	4
4 PM		1	1	1	3
5 PM		1	4	1	6
6 PM		1	4		5
7 PM		2	2	1	5
8 PM		2	2	1	5
9 PM			1	1	2
10 PM		2	2		4
11 PM		2	1	1	4
Grand Total	2	31	41	21	95



Appendix D. Road Safety Audit References

Road Safety Audit References

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Stantec

Memo

To:	Jennifer Ducey, PE Boston, MA	From:	Alan Cloutier, PE, PTOE Burlington, MA
File:	179410441	Date:	March 15, 2018

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

As part of the Beacham/Williams Street Corridor Study, Stantec assessed existing and future (2022) traffic conditions at seven key intersections along the corridor. Most of these intersections were not analyzed as part of the Traffic Impact and Access Study (TIAS) for the Wynn Boston Harbor Resort and Casino Supplemental FEIR. The only intersection included in the TIAS was at Williams Street/Broadway. The traffic analysis focused on intersection operations and vehicular Level of Service (LOS) at each of the seven intersections (delay time at intersections) shown on Figure 1.

Key traffic analysis findings included:

- The corridor generally operates within capacity today and in the future.
- Vehicle queues in the morning frequently extend from Everett, backing up westbound traffic on the corridor.
- Most intersections will operate similarly in the future. Morning (AM) intersection operations will be the same at most intersections. The evening (PM) peak hour will have slightly higher delay for vehicles, reflecting traditional commute peaks.
- The stop-controlled Market Street intersection currently operates poorly. Due to volumes on Beacham Street, side street traffic has difficulty finding gaps. Delays will increase slightly in the future.
- There will be a significant increase in delay at the Chestnut Street (signalized) and Winissimmet Street (stop controlled) intersections.

Key recommendations include:

- **Signalization was considered at the Market Street and Winissimmet Street intersections but is not recommended.** A review of volumes at Market Street show that the majority of turns are right turns, which are not greatly improved by signalization. In addition, if the side street right turns are excluded from signal warrant analysis, which is the typical procedure, the intersection does not meet MUTCD warrants for signalization. At Winissimmet Street, adding a signal so close to Broadway and Pearl Street may not improve corridor operations and may actually encourage more traffic to use Winissimmet Street as a cut through. Therefore, a new signal is not recommended. As part of the Re-Imagining Broadway study, consideration is being given to converting Winissimmet Street to one-way away from Williams

Street. In doing so, volumes would be redistributed to Broadway, improving operations at the Williams Street/Winissimmet Street intersection.

- **At the existing signalized intersections, the existing span wire traffic signals should be replaced by new mast arms.** This recommendation is based on the outdated signal equipment and the fact that the proposed roadway improvements will also require intersection modifications. The use of mast arms, rather than span wires, allows for proper positioning of overhead traffic signals on each intersection approach. The use of retroreflective backplates will improve the visibility of the signal faces for all roadway users. The upgraded signal equipment will include new countdown pedestrian signals, Accessible Pedestrian Signal (APS) for the visually impaired, and ADA-compliant pushbuttons. Sufficient yellow and red clearances will be incorporated into the new signal timing. At Spruce Street, it is recommended that signage be installed to prevent right turns on red by trucks from Spruce Street to limit encroachment on Williams Street.
- **Consideration could also be given to signal coordination and adaptive signal technology at Spruce Street and Pearl Street.** During construction, conduit and an interconnect cable should be installed between Spruce Street and Pearl Street to facilitate future signal coordination and adaptive signal technology. Under usual conditions, individual intersections tend to operate more efficient as a standalone signal. Coordinated signals provide the benefit of maximized throughput along the corridor. An adaptive traffic signal system continuously monitors traffic delays and queues and can quickly adjust to changes in traffic. For example, if there were excessive delays on a particular intersection approach, the signal would adjust to provide additional time to the impacted approach to reduce delay time or secondary queueing between one intersection and another. It is also possible to provide communication between an adaptive traffic signal and the Chelsea Street bridge ITS system or a future Andrew P. McArdle bridge system. The ITS system encourages drivers to seek alternate routes to avoid delays when the Chelsea Street bridge is up, which is reported to occur up to 5 times per day.

Each of the following topics is discussed in more detail to follow:

- Traffic Count Program
- Traffic Speeds
- Existing Traffic Operations
- Future Traffic Operations
- Capacity Analysis with Recommended Improvements

Traffic Count Program

A traffic count program was conducted in April 2017. This traffic count program consisted of capturing turning movement counts (TMCs) only. TMCs included vehicular, pedestrian, and bike volumes. Automatic traffic recorder (ATR) counts, including truck classification counts, were collected by Eversource and their consultants along the corridor in January 2016.

TMCs were conducted manually at the intersections listed below on a weekday during the 7:00 - 9:00 AM and 4:00 - 6:00 PM peak traffic periods.

- Beacham Street/ Riley Way
- Beacham Street/ Market Street
- Williams Street/ Spruce Street/ Commandants Way (signalized)
- Williams Street/ Walnut Street
- Williams Street/ Chestnut Street (signalized)
- Williams Street/ Winnisimmet Street
- Williams Street / Pearl Street/ Marginal Street/ Andrew McCardle Bridge (signalized)

Additionally, a TMC was conducted at the intersection of Williams Street, Park Street, and Broadway by another consultant for the City of Chelsea completing the study of the Broadway corridor. The TMC was conducted manually on a weekday in March 2017 during the 7:00 - 9:00 AM and 4:00 - 6:00 PM peak traffic periods. Figures 2 and 3 show the existing peak hour vehicular volumes. Figures 4 and 5 show the existing peak hour pedestrian and bike volumes, respectively.

ATRs conducted by Eversource were recorded over a 7-day period at the locations listed below.

- Williams Street west of Market Street
- Williams Street north of Spruce Street
- Williams Street south of Spruce Street
- Spruce Street east of Williams Street
- Williams Street south of Chestnut Street
- Chestnut Street east of Williams Street
- Chestnut Street west of Williams Street
- Broadway east of Williams Street
- Broadway west of Williams Street
- Pearl Street north of Williams Street
- Marginal Street east of Pearl Street

As shown on Figure 1, traffic volumes along the Beacham/Williams Street corridor range from 11,700 – 13,800 vehicles per day. This is typical of an urban minor arterial collector in this region. Truck volumes are particularly high along the corridor, ranging from 6% to 16% of the total volumes. This range is significantly higher than similar facilities, which typically average 2% to 3% trucks. Between Pearl Street and Chestnut Street, traffic volumes average 11,700 vehicles per day, with 16 % trucks. Between Chestnut Street and Spruce Street, traffic volumes average 13,800 vehicles per day, with 8 % trucks. Between Street and the Everett Line, traffic volumes average 12,900 vehicles per day, with 6 % trucks.

As shown on Figure 4, existing pedestrian volumes vary. West of Arlington Street, volumes are sparse, with generally less than 15 pedestrians crossing any roadway leg during the morning or evening peak hours. East of Arlington Street, the volumes are highest, especially at the intersection of Broadway where close to 200 pedestrians per hour were recorded crossing at the intersection. As shown on Figure 5, existing bicycle volumes along the corridor are currently low, with less than 5 bicyclists per hour during the peak commuter periods. The variation and lack of pedestrians and bicycles is more likely a reflection of the current condition of the roadway, rather than an indication of the demand.

Traffic Speeds

From the Eversource ATR data, traffic speeds were analyzed. The speed limit along Beacham Street and Williams Street is 30 mph from the Everett city line to Spruce Street and 25 mph from Spruce Street to Pearl Street. The 85th percentile speed ranges collected from the ATR data at three locations are listed in Table 1 below. Based on this data, the 85th percentile speeds are approximately within the speed limit.

Table 1: 85th Percentile Speeds on Williams Street from Eversource ATR Data

Location	Eastbound 85th Percentile Speed Range	Westbound 85th Percentile Speed Range	Speed Limit
Williams St. west of Spruce St.	20-24 mph	25-29 mph	30 mph
Williams St. east of Spruce St.	25-29 mph	25-29 mph	25 mph
Williams St. between Chestnut St. and Cherry St.	20-24 mph	20-24 mph	25 mph

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Existing Traffic Operations

From the 2017 TMC data, existing volume networks were created for the weekday AM and PM peak hours as seen in Tables 2 and 3. ATR data was not included in these networks as the counts were taken during different time periods and would not balance across the network.

Table 2: 2017 Existing Weekday Peak Hour Intersection Level of Service – Unsignalized

		AM Peak				PM Peak			
Intersection	Movement	Delay[1]	LOS[2]	v/c[3]	Queue[4] 95%	Delay[1]	LOS[2]	v/c[3]	Queue[4] 95%
Beacham Street/Riley Way/Dunkin Donuts Driveway									
Beacham Street	EB L/T	1.5	A	0.03	2	0.3	A	0.01	1
Beacham Street	WB T/R	0		0.34	0	0		0.31	0
Riley Way/Dunkin Donuts Driveway	SB L	18.1	C	0.17	16	17.7	C	0.08	6
Riley Way/Dunkin Donuts Driveway	SB R	13.5	B	0.15	13	11.7	B	0.04	3
Beacham Street/Market Street									
Beacham Street	EB L/T/R	1.7	A	0.04	3	2.9	A	0.09	7
Beacham Street	WB L/T/R	1.2	A	0.04	3	0.5	A	0.02	1
Market Street	NB L/T/R	27.7	D	0.32	33	20.7	C	0.34	37
Market Street	SB L/T/R	61.9	F	0.92	247	26.3	D	0.44	52
Williams Street/Arlington Street									
Williams Street	EB L/T	2.0	A	0.06	5	1.6	A	0.05	4
Williams Street	WB T/R	0		0.35	0	0		0.38	0
Arlington Street	SB L/R	16.5	C	0.14	12	17.3	C	0.15	13
Williams Street/Winnisimmet Street									
Williams Street	EB T/R								
Williams Street	WB L/T	0.1	A	0	0	0.6	A	0.02	2
Winnisimmet Street	NB L/R	12.0	B	0.02	1	12.7	B	0.02	1
Winnisimmet Street	SB L/T/R	21.4	C	0.46	58	26.1	D	0.49	64

[1] Average delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue in feet per lane (25 feet per vehicle)

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Table 3: Existing Weekday Peak Hour Intersection Level of Service - Signalized

Approach	Direction/ turning movement	AM Peak					PM Peak				
		Delay[1]	LOS[2]	v/c[3]	Queue[4] 50th	Queue[4] 95th	Delay[1]	LOS[2]	v/c[3]	Queue[4] 50th	Queue[4] 95th
Williams Street/Spruce Street/Commandants Way											
Williams Street	EB L	8.7	A	0.14	15	51	12.6	B	0.29	76	136
Williams Street	EB T/R	9.1	A	0.15	32	92	12.0	B	0.18	95	164
Williams Street	WB L/T	14.5	B	0.30	93	225	20.8	C	0.36	222	367
Williams Street	WB R	12.8	B	0.13	0	46	19.1	B	0.24	64	158
Commandants Way	NB L/T/R	37.4	D	0.55	92	198	46.9	D	0.41	131	202
Spruce Street	SB L/T/R	50.8	D	0.84	109	238	65.8	E	0.91	225	295
OVERALL		**28.7**	**C**	**0.40**			**33.8**	**C**	**0.45**		
Williams Street/Chestnut Street											
Williams Street	EB L/T	21.4	C	0.57	86	242	25.9	C	0.70	107	339
Williams Street	WB T/R	26.5	C	0.73	125	389	31.8	C	0.83	151	470
Chestnut Street	NB L	15.7	B	0.25	36	113	15.3	B	0.21	30	97
Chestnut Street	NB T/R	17.6	B	0.40	58	177	19.2	B	0.50	73	221
OVERALL		**21.7**	**C**	**0.51**			**25.4**	**C**	**0.59**		
Williams Street/Park Street/Broadway/Tremont Street											
Williams Street	EB L/T/R	12.7	B	0.59	53	200	14.1	B	0.65	95	285
Williams Street	WB L/T/R	11.8	B	0.54	50	188	16.2	B	0.72	106	323
Broadway	NB L/T/R	15.1	B	0.42	23	114	21.3	C	0.52	38	192
Park Street	SB L/T	14.6	B	0.32	17	88	19.5	B	0.26	18	88
Park Street	SB R	13.4	B	0.03	0	14	18.6	B	0.06	0	41
OVERALL		**12.9**	**B**	**0.49**			**16.4**	**B**	**0.59**		
Williams Street/Marginal Street/Pearl Street											
Williams Street	EB L/T	37.2	D	0.60	103	212	28.3	C	0.60	107	233
Williams Street	EB R	32.1	C	0.26	0	78	24.4	C	0.31	0	72
Marginal Street	WB L	35.8	D	0.46	33	89	25.9	C	0.37	24	74
Marginal Street	WB T/R	36.1	D	0.56	90	190	28.9	C	0.61	102	227
Andrew McArdle Bridge	NB L	9.9	A	0.38	37	152	13.7	B	0.49	52	205
Andrew McArdle Bridge	NB T/R	9.4	A	0.26	49	182	14.5	B	0.45	91	319
Pearl Street	SB L/T/R	19.1	B	0.39	91	296	27.9	C	0.53	97	318
OVERALL		**24.2**	**C**	**0.42**			**22.6**	**C**	**0.52**		

[1] Average delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue in feet per lane (25 feet per vehicle)

The intersections Level of Service (LOS) were analyzed. LOS, an expression of traffic flow, is a commonly used and accepted measure of effectiveness of peak-hour traffic operating conditions. It considers such factors as auto and truck volumes, roadway width, speed, grades, parking restrictions, pedestrian activity, and traffic control devices.

LOS is designated in a range from Level "A", which is the optimal condition where roadway operating conditions are at their best, to Level "F", which indicates traffic jam conditions. Levels "A" through "D" are typically associated with acceptable levels of peak-hour traffic operation within urban areas, with LOS "D" marking the boundary between acceptable and unacceptable traffic conditions. At Level "E", the ratio of the approach volume to capacity, or v/c ratio, of an

intersection is between 90 and 100 percent of its theoretical capacity. Traffic congestion is considered unacceptable at LOS "E" or "F".

All capacity analysis for this study was performed in accordance with the methodologies set forth in the Highway Capacity Manual. As defined in the Highway Capacity Manual, LOS for unsignalized and signalized intersections is defined in terms of the average control delay in seconds per vehicle approaching the intersection for the peak 15-minute analysis period of a peak hour. The delay criteria and their associated LOS rankings are given in Tables 4 and 5.

Table 4: LOS Criteria for Unsignalized Intersections

Level of Service (LOS)	Total Delay (sec/veh)
A	≤10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	> 50.0

Table 5: LOS Criteria for Signalized Intersections

Level of Service LOS	Total Delay (sec/veh)
A	≤10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	> 80.0

Source: Highway Capacity Manual, Transportation Research Board, 2000

The existing (2017) peak hour traffic volumes were used in the capacity analysis conducted on the study area intersections. The analysis was conducted based on assumptions that side streets currently without stop control operate as stop controlled intersections. The results of this analysis, are summarized in Table 6 and Table 7 below. The results indicate that currently, the only intersection operating below an acceptable LOS is the Market Street southbound approach during the AM peak hour. Additionally, the intersections at Market Street and at Winnisimmet Street both operate at a LOS D during the PM peak hour.

It should be noted that during the morning peak hour excessive queueing on Williams Street extends from Everett into Chelsea. This queue sometimes extends through the Spruce Street intersection. This condition is not accounted for in the capacity analysis since the capacity issue is at driveways and intersections in Everett. Adjusting the capacity analysis at Spruce Street would give the false indication that additional lanes are needed at Spruce Street.

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Table 6: 2017 Existing Weekday Peak Hour Intersection Level of Service – Unsignalized

		AM Peak				PM Peak			
Intersection	Movement	Delay[1]	LOS[2]	v/c[3]	Queue[4] 95%	Delay[1]	LOS[2]	v/c[3]	Queue[4] 95%
Beacham Street/Riley Way/Dunkin Donuts Driveway									
Beacham Street	EB L/T	1.5	A	0.03	2	0.3	A	0.01	1
Beacham Street	WB T/R	0		0.34	0	0		0.31	0
Riley Way/Dunkin Donuts Driveway	SB L	18.1	C	0.17	16	17.7	C	0.08	6
Riley Way/Dunkin Donuts Driveway	SB R	13.5	B	0.15	13	11.7	B	0.04	3
Beacham Street/Market Street									
Beacham Street	EB L/T/R	1.7	A	0.04	3	2.9	A	0.09	7
Beacham Street	WB L/T/R	1.2	A	0.04	3	0.5	A	0.02	1
Market Street	NB L/T/R	27.7	D	0.32	33	20.7	C	0.34	37
Market Street	SB L/T/R	61.9	F	0.92	247	26.3	D	0.44	52
Williams Street/Arlington Street									
Williams Street	EB L/T	2.0	A	0.06	5	1.6	A	0.05	4
Williams Street	WB T/R	0		0.35	0	0		0.38	0
Arlington Street	SB L/R	16.5	C	0.14	12	17.3	C	0.15	13
Williams Street/Winnisimmet Street									
Williams Street	EB T/R								
Williams Street	WB L/T	0.1	A	0	0	0.6	A	0.02	2
Winnisimmet Street	NB L/R	12.0	B	0.02	1	12.7	B	0.02	1
Winnisimmet Street	SB L/T/R	21.4	C	0.46	58	26.1	D	0.49	64

[1] Average delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue in feet per lane (25 feet per vehicle)

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Table 7: Existing Weekday Peak Hour Intersection Level of Service - Signalized

Approach	Direction/ turning movement	AM Peak					PM Peak				
		Delay[1]	LOS[2]	v/c[3]	Queue[4] 50th	Queue[4] 95th	Delay[1]	LOS[2]	v/c[3]	Queue[4] 50th	Queue[4] 95th
Williams Street/Spruce Street/Commandants Way											
Williams Street	EB L	8.7	A	0.14	15	51	12.6	B	0.29	76	136
Williams Street	EB T/R	9.1	A	0.15	32	92	12.0	B	0.18	95	164
Williams Street	WB L/T	14.5	B	0.30	93	225	20.8	C	0.36	222	367
Williams Street	WB R	12.8	B	0.13	0	46	19.1	B	0.24	64	158
Commandants Way	NB L/T/R	37.4	D	0.55	92	198	46.9	D	0.41	131	202
Spruce Street	SB L/T/R	50.8	D	0.84	109	238	65.8	E	0.91	225	295
OVERALL		**28.7**	**C**	**0.40**			**33.8**	**C**	**0.45**		
Williams Street/Chestnut Street											
Williams Street	EB L/T	21.4	C	0.57	86	242	25.9	C	0.70	107	339
Williams Street	WB T/R	26.5	C	0.73	125	389	31.8	C	0.83	151	470
Chestnut Street	NB L	15.7	B	0.25	36	113	15.3	B	0.21	30	97
Chestnut Street	NB T/R	17.6	B	0.40	58	177	19.2	B	0.50	73	221
OVERALL		**21.7**	**C**	**0.51**			**25.4**	**C**	**0.59**		
Williams Street/Park Street/Broadway/Tremont Street											
Williams Street	EB L/T/R	12.7	B	0.59	53	200	14.1	B	0.65	95	285
Williams Street	WB L/T/R	11.8	B	0.54	50	188	16.2	B	0.72	106	323
Broadway	NB L/T/R	15.1	B	0.42	23	114	21.3	C	0.52	38	192
Park Street	SB L/T	14.6	B	0.32	17	88	19.5	B	0.26	18	88
Park Street	SB R	13.4	B	0.03	0	14	18.6	B	0.06	0	41
OVERALL		**12.9**	**B**	**0.49**			**16.4**	**B**	**0.59**		
Williams Street/Marginal Street/Pearl Street											
Williams Street	EB L/T	37.2	D	0.60	103	212	28.3	C	0.60	107	233
Williams Street	EB R	32.1	C	0.26	0	78	24.4	C	0.31	0	72
Marginal Street	WB L	35.8	D	0.46	33	89	25.9	C	0.37	24	74
Marginal Street	WB T/R	36.1	D	0.56	90	190	28.9	C	0.61	102	227
Andrew McArdle Bridge	NB L	9.9	A	0.38	37	152	13.7	B	0.49	52	205
Andrew McArdle Bridge	NB T/R	9.4	A	0.26	49	182	14.5	B	0.45	91	319
Pearl Street	SB L/T/R	19.1	B	0.39	91	296	27.9	C	0.53	97	318
OVERALL		**24.2**	**C**	**0.42**			**22.6**	**C**	**0.52**		

[1] Average delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue in feet per lane (25 feet per vehicle)

Future Traffic Operations

The existing peak hour traffic volumes collected in 2016 were projected to the year 2022 to determine future traffic operations along the corridor. The future volumes were calculated using a growth rate from Chelsea's recently designed Upper Broadway Infrastructure Project in addition to individual developments in the region that will impact the corridor. Although in 2013 the Wynn Casino FEIR used a 0.5% growth rate compounded annual traffic growth rate for background traffic growth, the City of Chelsea has completed projects more recently with input from the Central Transportation Planning Staff (CTPS) that utilized a higher rate. For this study, a 1% per year growth rate was used.

The City of Chelsea identified three proposed developments located near the study area that may increase traffic volumes along the corridor. Proposed developments identified by the City of Chelsea included the Wynn Boston Harbor Resort and Casino, Residences at Chelsea Lofts at Everett Avenue and Carter Street (692 apartments and 8,500 sf of retail at former Chelsea Clock Co. site), and 200 Second Street (139 room hotel). The trip distribution and AM/PM peak hour trips for each proposed development is illustrated in the attached figures. The composite of these trips is shown on Figures 6 and 7. To determine future operations along the corridor, the existing peak hour traffic volumes collected in 2016 were projected to the year 2022 using a 1% growth rate including the proposed developments identified by the City.

The future (2022) peak hour traffic volumes, shown in Figure 8 and 9, were used in the future capacity analysis conducted on the study-area intersections. The results of this analysis are summarized in Tables 7 and 8. The results indicate that the only study area approaches to an intersection that will operate at LOS F are the Market Street southbound approach during the AM peak hour and the Williams Street eastbound approach at Chestnut Street (signalized) during the PM peak hour. The future volumes push other approaches (Market Street, Spruce Street, Winnisimmet Street) to LOS E during one or more of the time periods.

As previously discussed, no adjustments were made for the morning peak hour queue on Beacham Street that extends from Everett into Chelsea. Adjusting the capacity analysis at Spruce Street would give the false indication that additional lanes are needed at Spruce Street.

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Table 8: 2022 Future No-build Weekday Peak Hour Intersection Level of Service – Unsignalized

		AM Peak				PM Peak			
Intersection	Movement	Delay[1]	LOS[2]	v/c[3]	Queue[4] 95%	Delay[1]	LOS[2]	v/c[3]	Queue[4] 95%
Beacham Street/Riley Way/Dunkin Donuts Driveway									
Beacham Street	EB L/T	1.5	A	0.03	2	0.4	A	0.01	1
Beacham Street	WB T/R								
Riley Way/Dunkin Donuts Driveway	SB L	19.9	C	0.20	19	21.1	C	0.10	8
Riley Way/Dunkin Donuts Driveway	SB R	14.2	B	0.16	14	12.4	B	0.05	4
Beacham Street/Market Street									
Beacham Street	EB L/T/R	1.6	A	0.04	3	2.9	A	0.10	8
Beacham Street	WB L/T/R	1.3	A	0.04	4	0.5	A	0.02	1
Market Street	NB L/T/R	37.1	E	0.41	47	27.8	D	0.45	54
Market Street	SB L/T/R	103.2	F	1.07	339	42.0	E	0.60	86
Williams Street/Arlington Street									
Williams Street	EB L/T	2.1	A	0.07	6	1.8	A	0.07	5
Williams Street	WB T/R								
Arlington Street	SB L/R	19.8	C	0.19	17	21.9	C	0.21	19
Williams Street/Winnisimmet Street									
Williams Street	EB T/R								
Williams Street	WB L/T	0.2	A	0.01	1	0.7	A	0.03	2
Winnisimmet Street	NB L/R	12.7	B	0.03	2	14.6	B	0.03	2
Winnisimmet Street	SB L/T/R	29.5	D	0.62	98	49.0	E	0.74	133

[1] Delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue in feet per lane (25 feet per vehicle)

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Table 9: 2022 Future No-build Weekday Peak Hour Intersection Level of Service - Signalized

Approach	Direction/ turning movement	AM Peak Delay[1]	AM Peak LOS[2]	AM Peak v/c[3]	AM Peak Queue[4] 50th	AM Peak Queue[4] 95th	PM Peak Delay[1]	PM Peak LOS[2]	PM Peak v/c[3]	PM Peak Queue[4] 50th	PM Peak Queue[4] 95th
Williams Street/Spruce Street/Commandants Way											
Williams Street	EB L	10.1	B	0.16	16	53	14.8	B	0.35	86	153
Williams Street	EB T/R	10.5	B	0.15	38	105	13.9	B	0.24	138	229
Williams Street	WB L/T	16.6	B	0.32	105	247	24.3	C	0.44	293	477
Williams Street	WB R	14.5	B	0.16	3	54	22.1	C	0.31	108	230
Commandants Way	NB L/T/R	36.3	D	0.55	99	211	46.1	D	0.41	140	212
Spruce Street	SB L/T/R	53.0	D	0.86	131	290	66.0	E	0.95	251	325
OVERALL		**30.0**	**C**	**0.43**			**34.5**	**C**	**0.52**		
Williams Street/Chestnut Street											
Williams Street	EB L/T	25.1	C	0.68	104	325	122.9	F	1.17	174	516
Williams Street	WB T/R	30.9	C	0.81	144	452	54.6	D	0.99	198	597
Chestnut Street	NB L	16.0	B	0.28	40	125	15.6	B	0.24	34	108
Chestnut Street	NB T/R	18.3	B	0.45	66	197	21.6	C	0.61	97	282
OVERALL		**24.5**	**C**	**0.55**			**62.0**	**E**	**0.80**		
Williams Street/Park Street/Broadway/Tremont Street											
Williams Street	EB L/T/R	14.2	B	0.64	68	222	15.9	B	0.71	126	347
Williams Street	WB L/T/R	13.0	B	0.59	65	208	18.7	B	0.78	140	390
Broadway	NB L/T/R	15.7	B	0.47	30	162	24.8	C	0.58	51	254
Park Street	SB L/T	15.1	B	0.36	21	106	22.1	C	0.35	30	127
Park Street	SB R	13.6	B	0.03	0	15	20.5	C	0.06	0	44
OVERALL		**14.1**	**B**	**0.53**			**18.8**	**B**	**0.65**		
Williams Street/Marginal Street/Pearl Street											
Williams Street	EB L/T	36.7	D	0.60	112	228	27.7	C	0.60	122	260
Williams Street	EB R	32.1	C	0.31	0	86	24.3	C	0.38	0	74
Marginal Street	WB L	35.6	D	0.47	35	94	25.2	C	0.38	26	78
Marginal Street	WB T/R	35.7	D	0.56	99	206	28.5	C	0.62	120	259
Andrew McArdle Bridge	NB L	11.2	B	0.44	47	181	18.3	B	0.64	78	281
Andrew McArdle Bridge	NB T/R	10.5	B	0.29	59	208	17.5	B	0.53	122	404
Pearl Street	SB L/T/R	21.6	C	0.44	105	332	38.1	D	0.69	119	375
OVERALL		**24.9**	**C**	**0.46**			**24.8**	**C**	**0.62**		

[1] Average Delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue Length in feet (25 feet per vehicle)

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Capacity Analysis with Recommended Improvements

The recommend concept designs will alter the roadway alignment, but will not impact the corridor capacity as the lane configurations will be similar to existing conditions. In addition, the operations at most of the intersections are adequate, when not impacted by the bridge closures or queueing from Everett.

Based on the projected future volumes, capacity improvements are recommended at two intersections.

Williams Street / Chestnut Street: Inefficient operations at the signalized intersection of Williams Street / Chestnut Street leads to excessive delay on the Williams Street eastbound approach during the evening commute. It is recommended that the traffic control signal be retimed to give more time to Williams Street and an interconnect cable be installed to allow for coordination with the Broadway traffic control system. As shown in Table 10, these two capacity improvements will allow the intersection to operate at LOS C during both AM and PM peak hours.

Williams Street / Winnisimmet Street: The unsignalized intersection of Williams Street/ Winnisimmett Street operates poorly as it is used as a cut through from Broadway to Williams Street eastbound. At Winissimmet Street, adding a signal so close to Broadway and Pearl Street may not improve corridor operations and may actually encourage more traffic to use Winissimmet Street as a cut through. Therefore, a new signal is not recommended. As part of the Re-Imagining Broadway study, consideration is being given to converting Winissimmet Street to one-way away from Williams Street. In doing so, approximately 100 vehicles per hour during the peak hour would be redistributed to Broadway, likely improving operations at the Williams Street/Winissimmet Street intersection, and resulting in a minor increase in delay at the Williams Street/ Broadway intersection. Table 11 shows the analysis at Williams Street/ Winnisimmett Street while operations at Williams Street is shown in Table 10.

Reference: Traffic Analysis, Beacham/Williams Street Corridor Study, Chelsea, MA

Table 10: 2022 Build Future Weekday Peak Hour Intersection Level of Service – Signalized

Approach	Direction/ turning movement	AM Peak Delay[1]	AM Peak LOS[2]	AM Peak v/c[3]	AM Peak Queue[4] 50th	AM Peak Queue[4] 95th	PM Peak Delay[1]	PM Peak LOS[2]	PM Peak v/c[3]	PM Peak Queue[4] 50th	PM Peak Queue[4] 95th
Williams Street/Chestnut Street											
Williams Street	EB L/T	27	C	0.66	104	325	26.5	C	0.80	146	415
Williams Street	WB T/R	42.6	C	0.96	144	452	29.9	C	0.86	198	562
Chestnut Street	NB L	17.9	B	0.27	40	125	18.0	C	0.26	41	139
Chestnut Street	NB T/R	18.4	A	0.45	66	197	23.8	B	0.66	121	416
OVERALL		**22.1**	**C**	**0.57**			**26.3**	**C**	**0.71**		
Williams Street/Park Street/Broadway/Tremont Street											
Williams Street	EB L/T/R	15.7	B	0.67	72	222	16.6	B	0.72	126	347
Williams Street	WB L/T/R	14.4	B	0.61	68	208	19.6	B	0.78	140	390
Broadway	NB L/T/R	15.1	B	0.43	30	164	24.3	C	0.57	51	255
Park Street	SB L/T	15.1	B	0.36	45	261	34.6	C	0.77	64	326
Park Street	SB R	13.6	B	0.03	0	15	20.4	C	0.06	0	44
OVERALL		**16.1**	**B**	**0.63**			**21.1**	**C**	**0.71**		

[1] Average Delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue Length in feet

Table 11: 2022 Future Build Weekday Peak Hour Intersection Level of Service – Unsignalized

Intersection	Movement	AM Peak Delay[1]	AM Peak LOS[2]	AM Peak v/c3	AM Peak Queue[4] 95%	PM Peak Delay[1]	PM Peak LOS[2]	PM Peak v/c[3]	PM Peak Queue[4] 95%
Williams Street/Winnisimmet Street									
Williams Street	EB T/R								
Williams Street	WB L/T	0.2	A	0.01	1	0.7	A	0.03	2
Winnisimmet Street	NB L/R	14.5	B	0.03	2	14.6	C	0.04	3
Winnisimmet Street	SB L/T/R	24.0	C	0.38	43	49.0	D	0.42	48

[1]Delay in seconds per vehicle
[2] Level of Service
[3] Volume to capacity ratio
[4] Queue in feet per lane (25 feet per vehicle)

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Attachment: Figures 1 - 9

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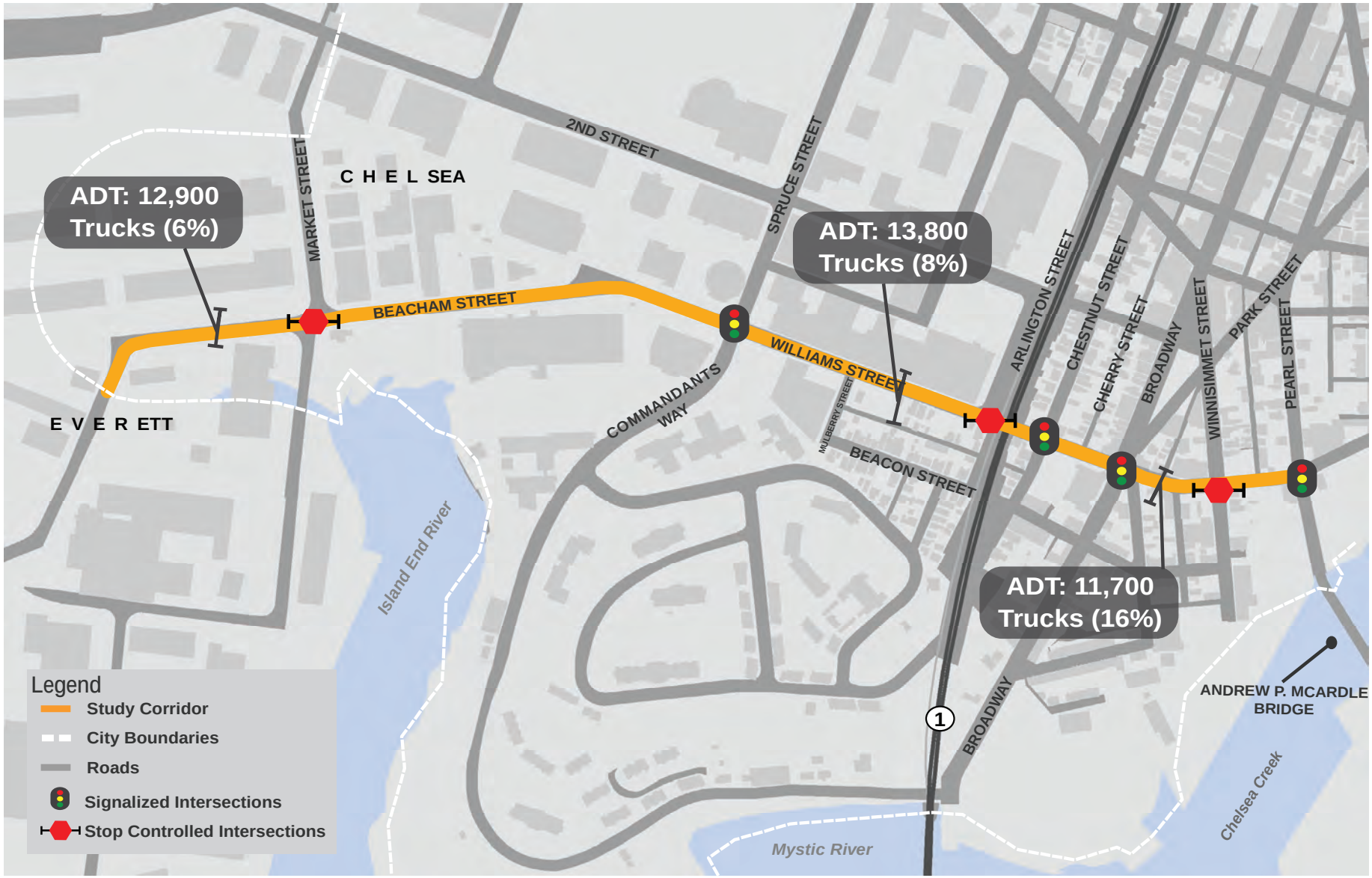
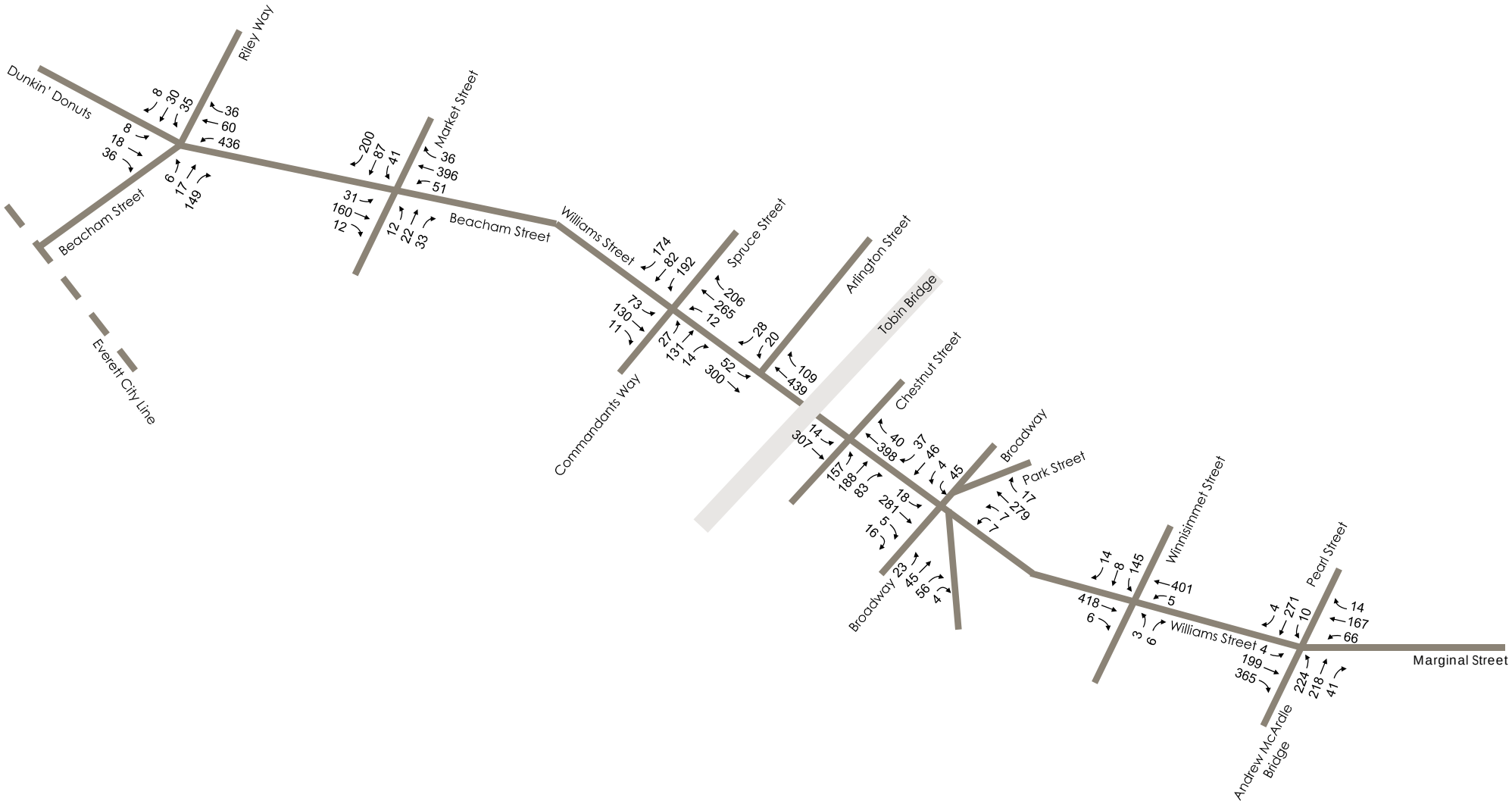


Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

Stantec

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 1
Locus Map



Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

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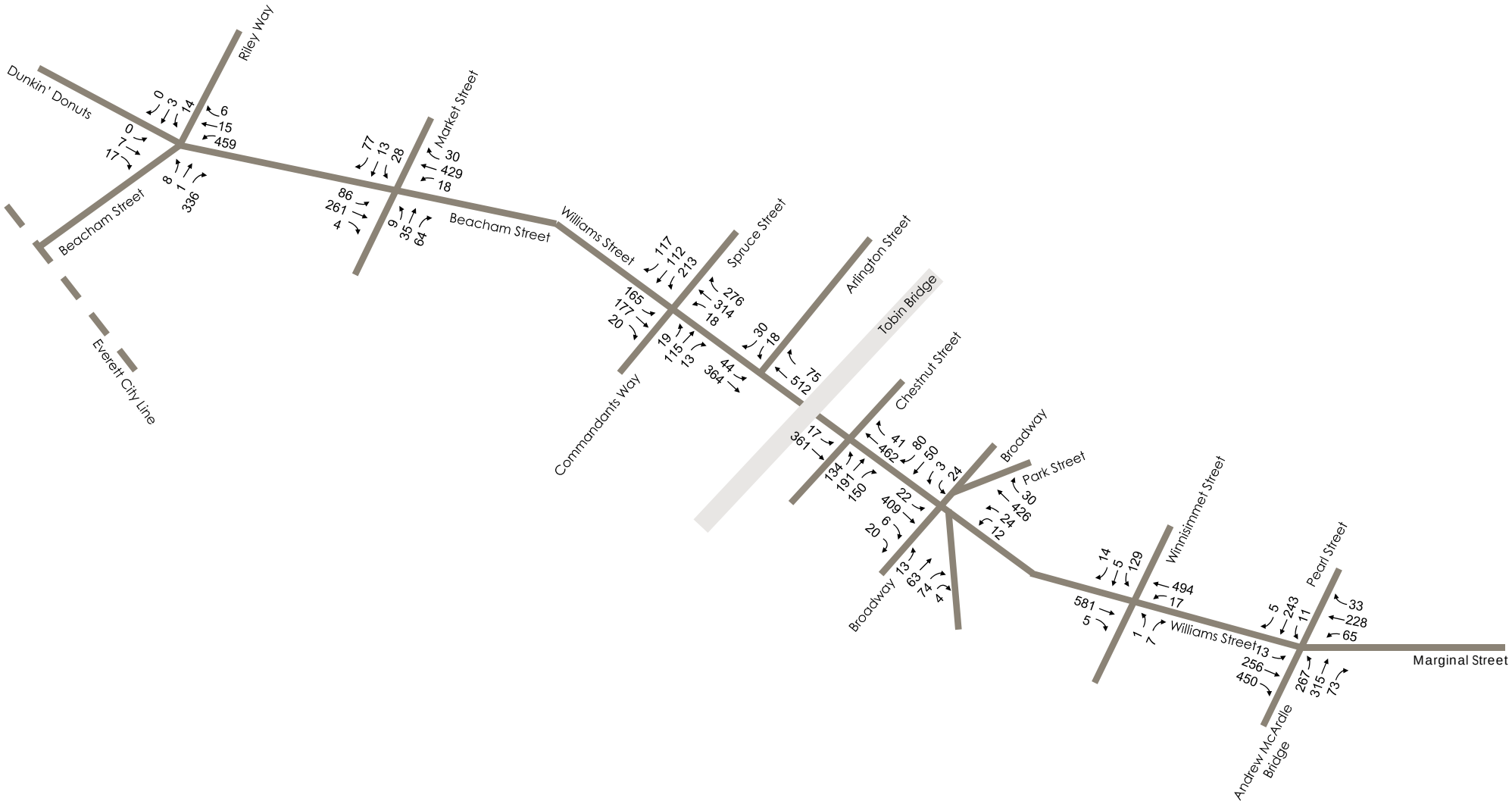
Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 2
2017 Existing AM Peak Hour



Schematic Diagram:
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Stantec Consulting Services Inc.

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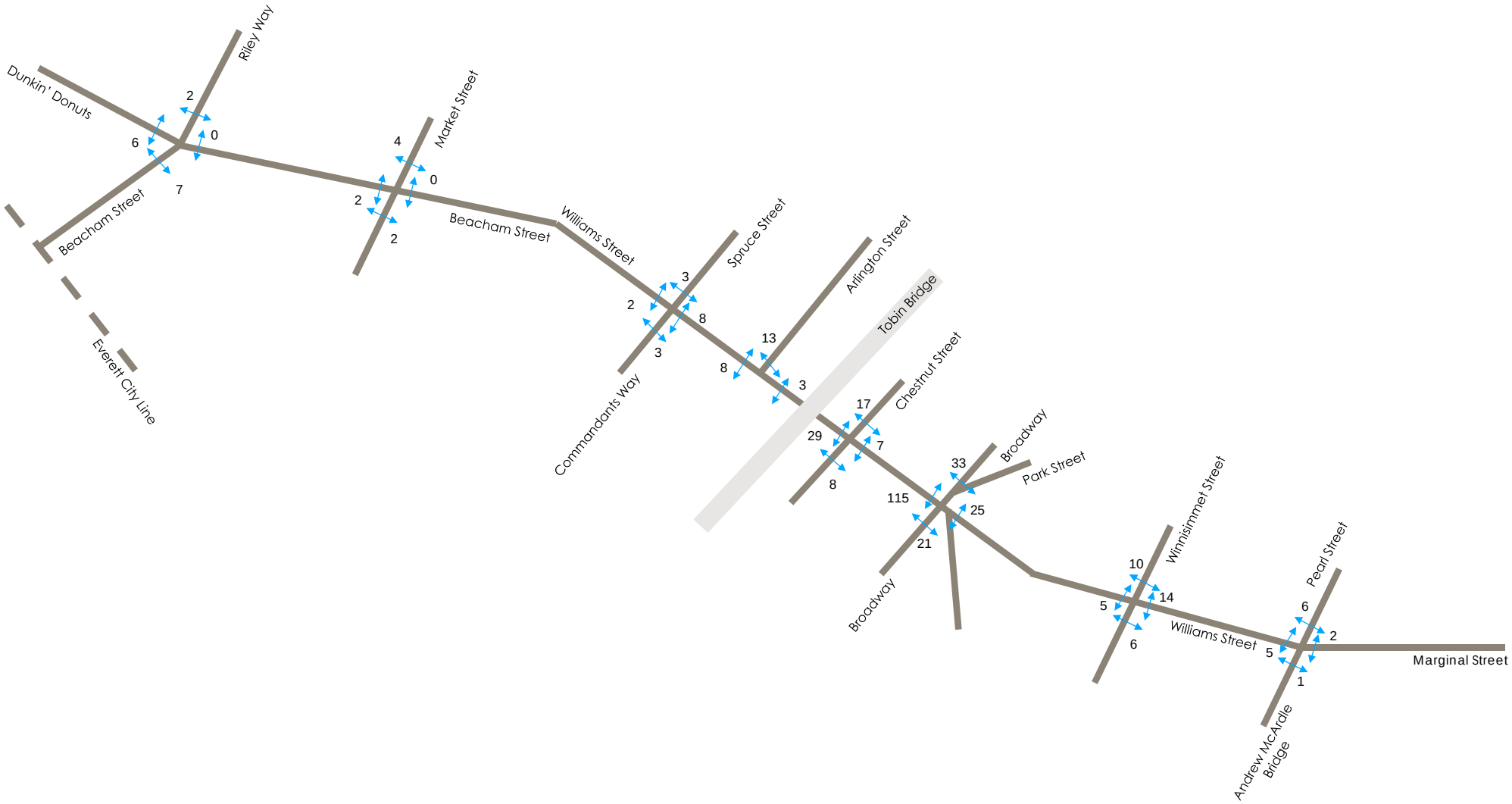
Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 3
2017 Existing PM Peak Hour

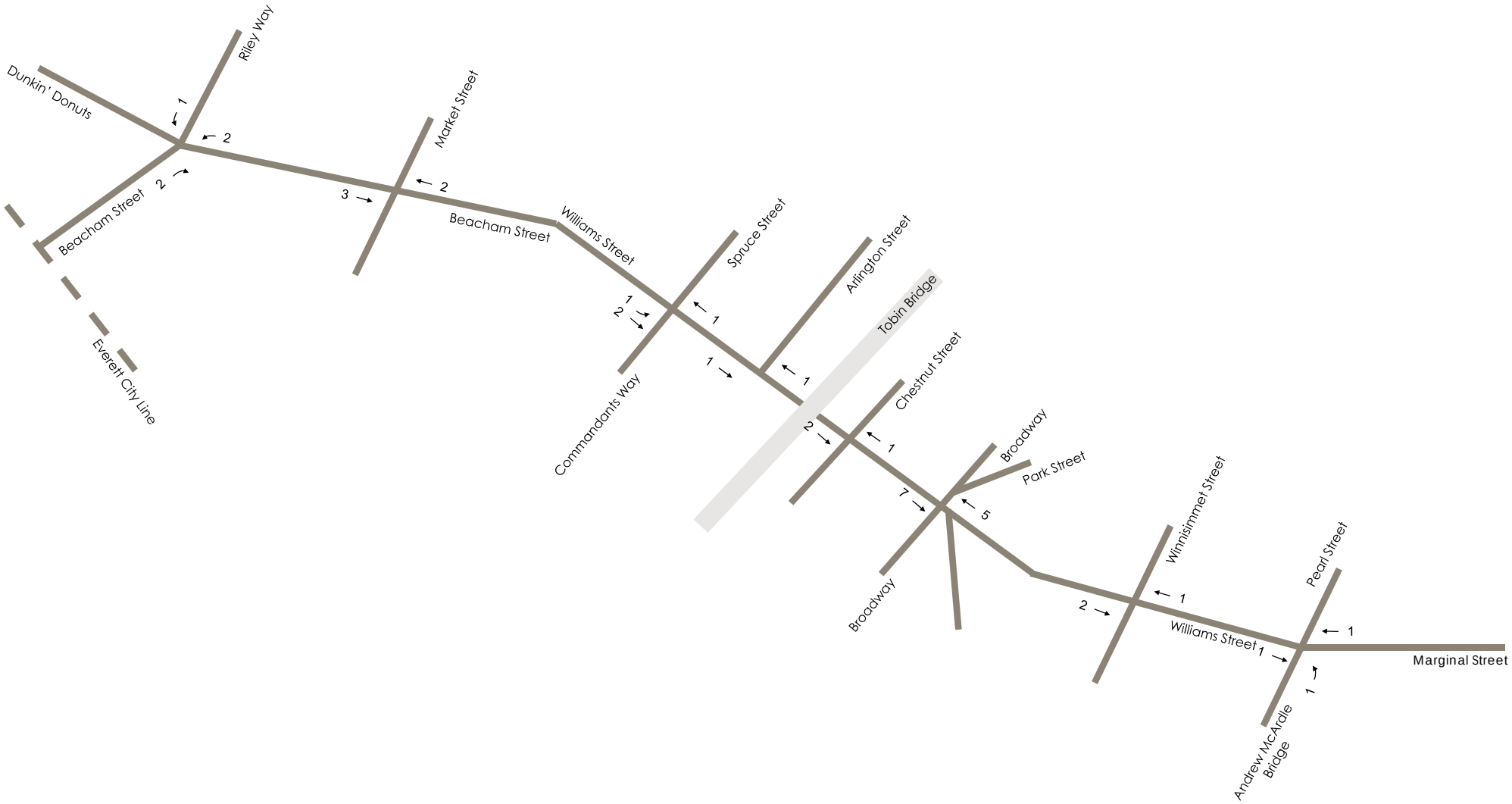


Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

Stantec

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 4
2017 Existing Ped Peak Hour

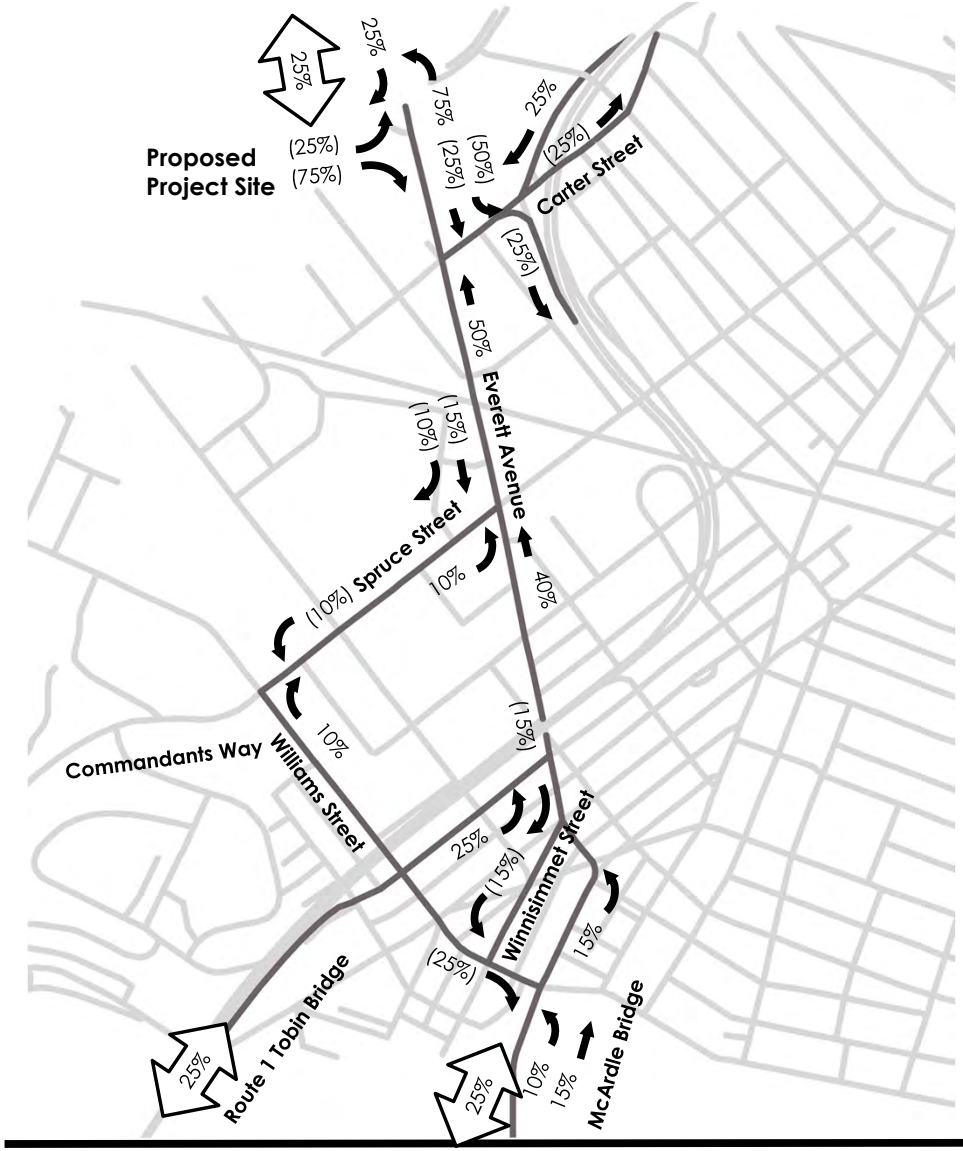


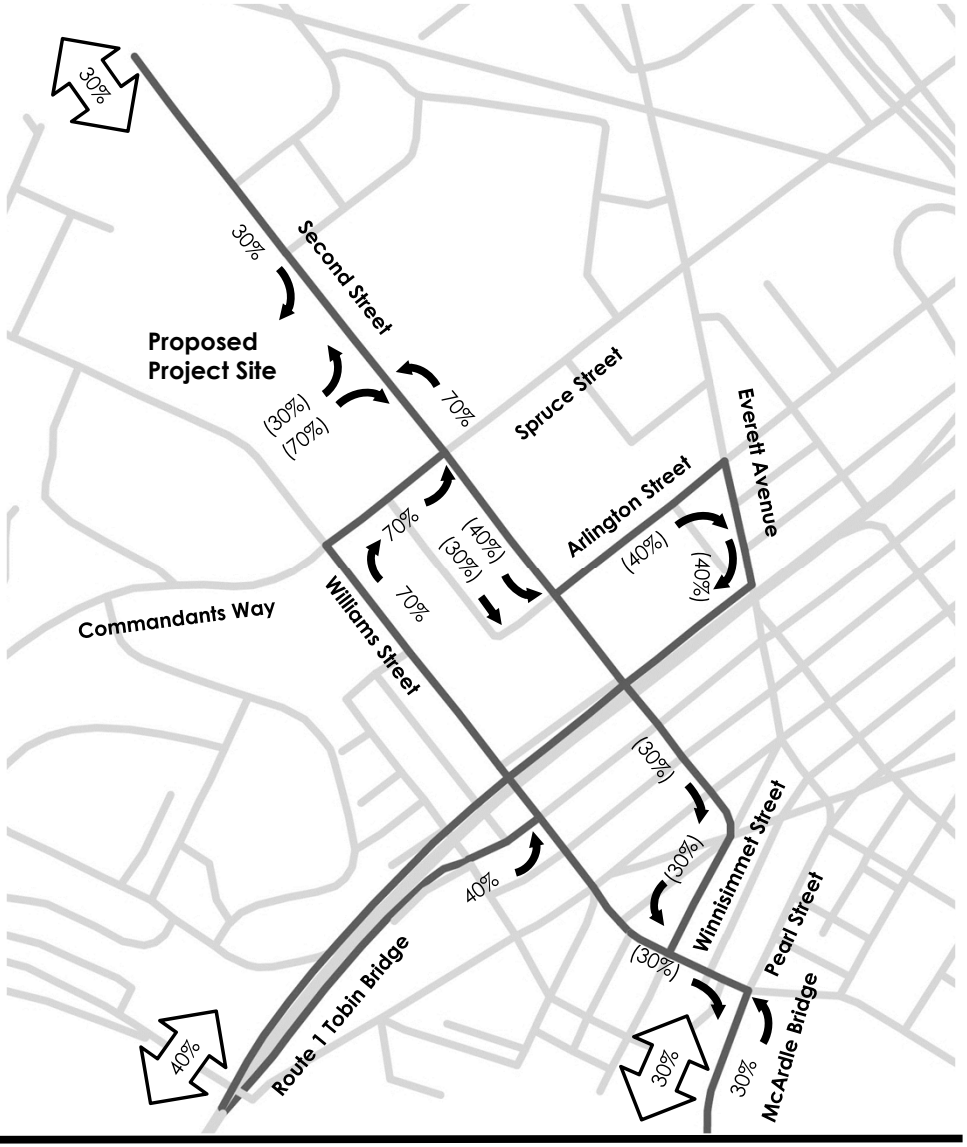
Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

Stantec

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 5
2017 Existing Bike Peak Hour

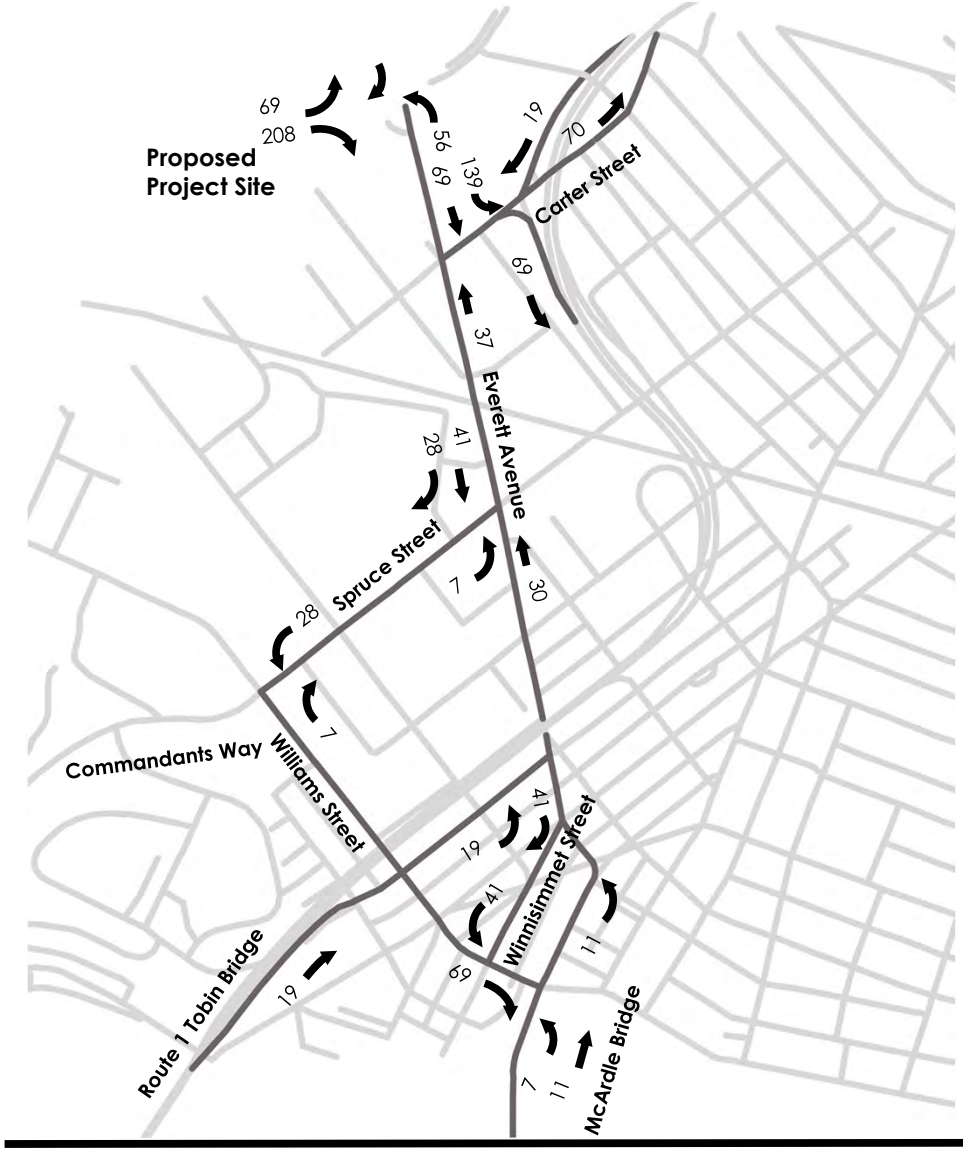


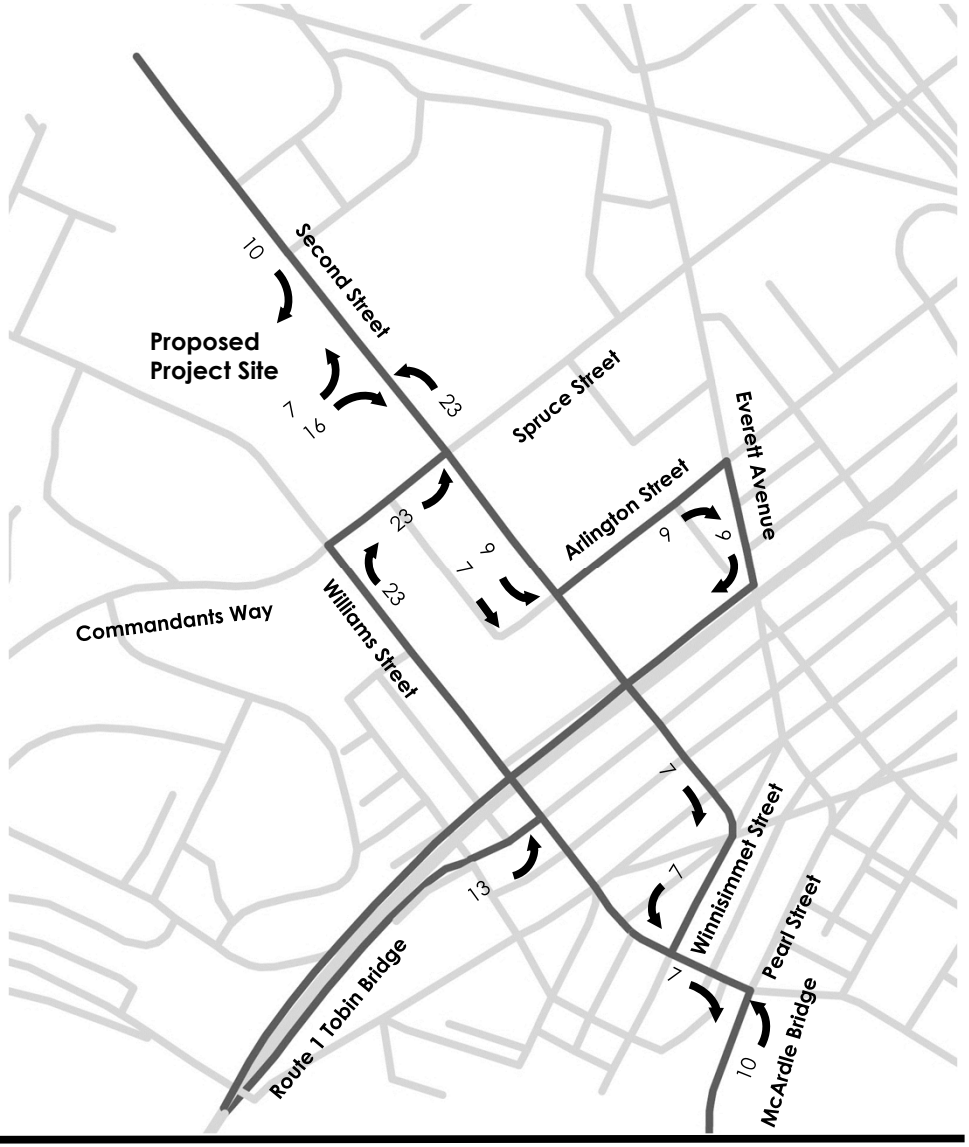


Schematic Diagram:
Not to Scale

Trip Distribution – Residences at Chelsea Loft
Everett Avenue and Carter Street

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Trip Distribution – Baywood Hotel
200 Second Street

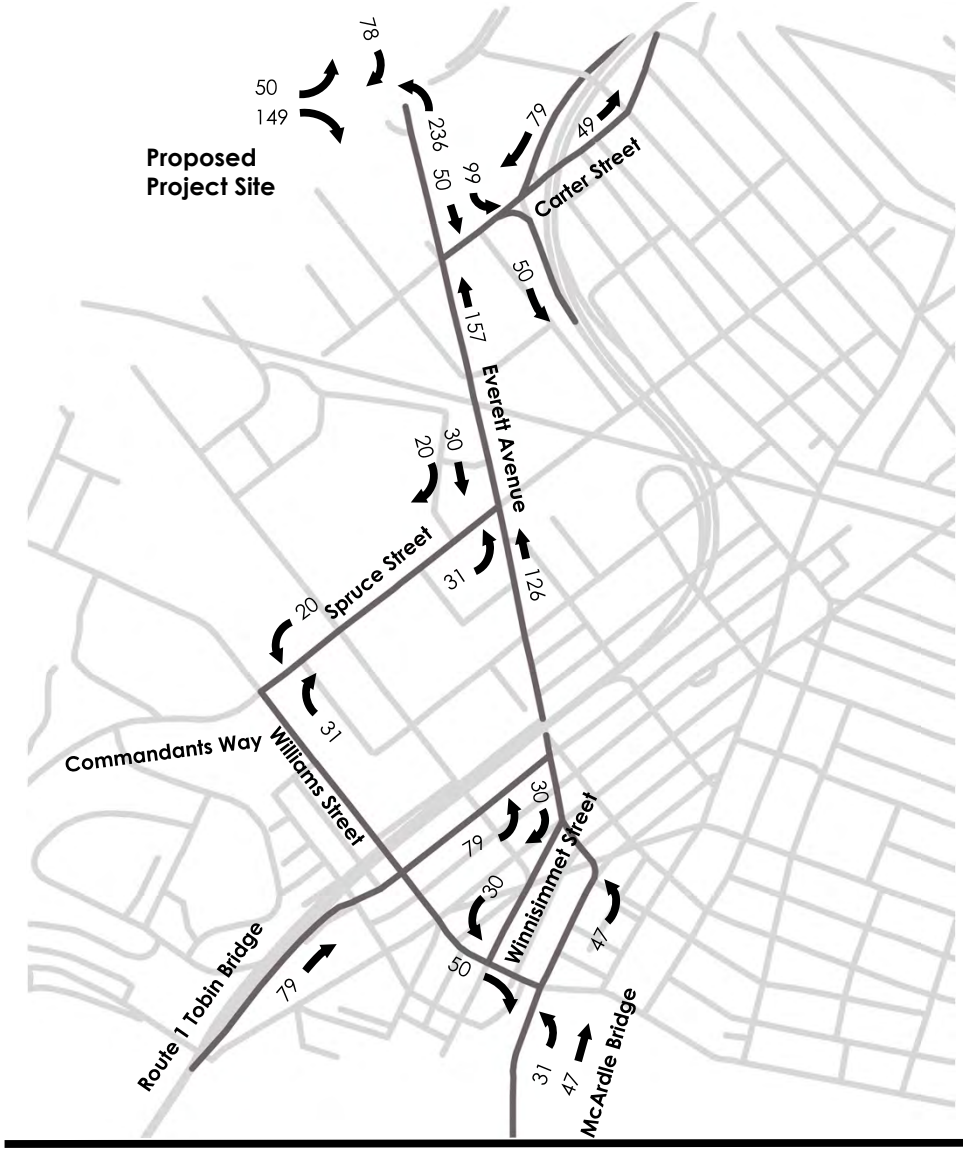




Schematic Diagram:
Not to Scale

AM Peak Hour Hotel Trips – Residences at Chelsea Loft
Everett Avenue and Carter Street

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
AM Peak Hour Hotel Trips – Baywood Hotel
200 Second Street



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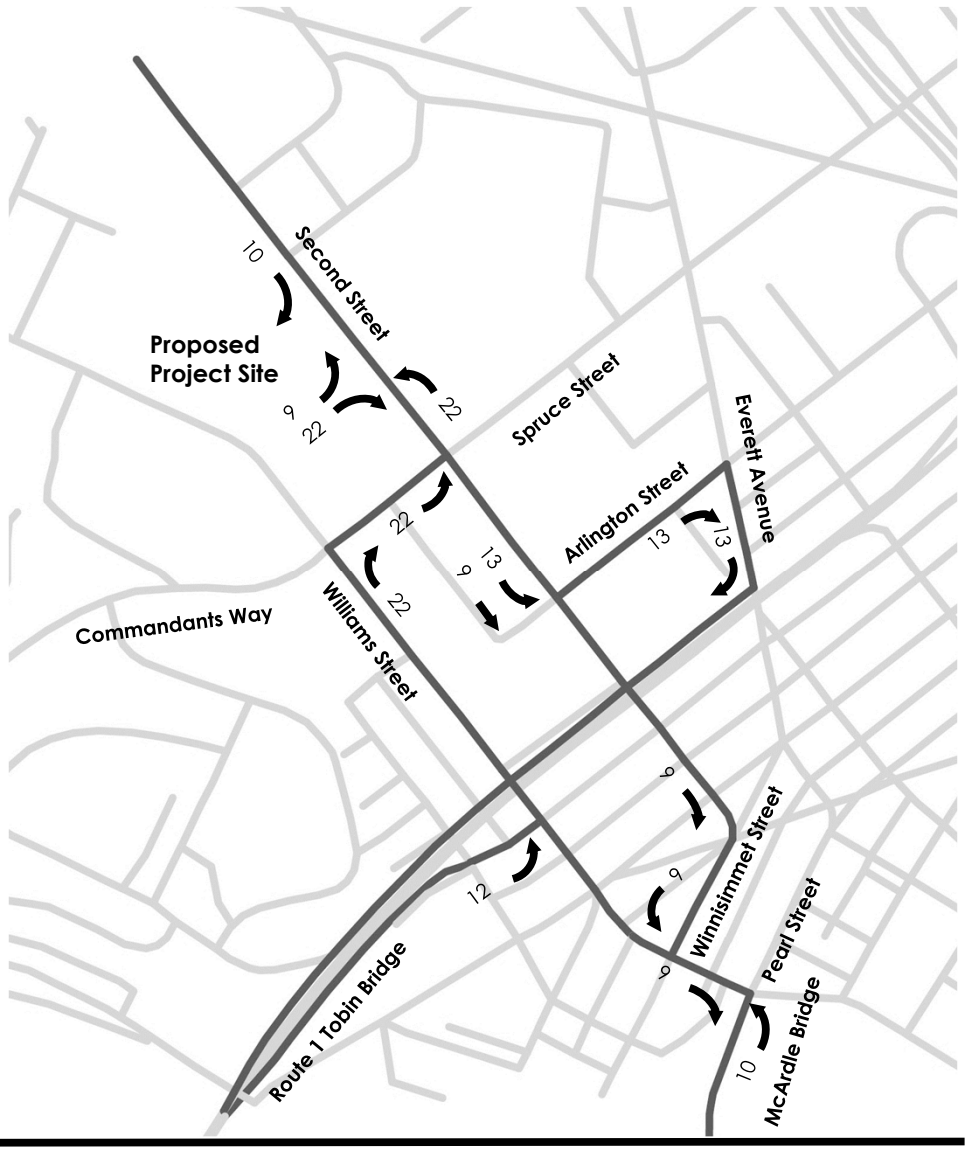
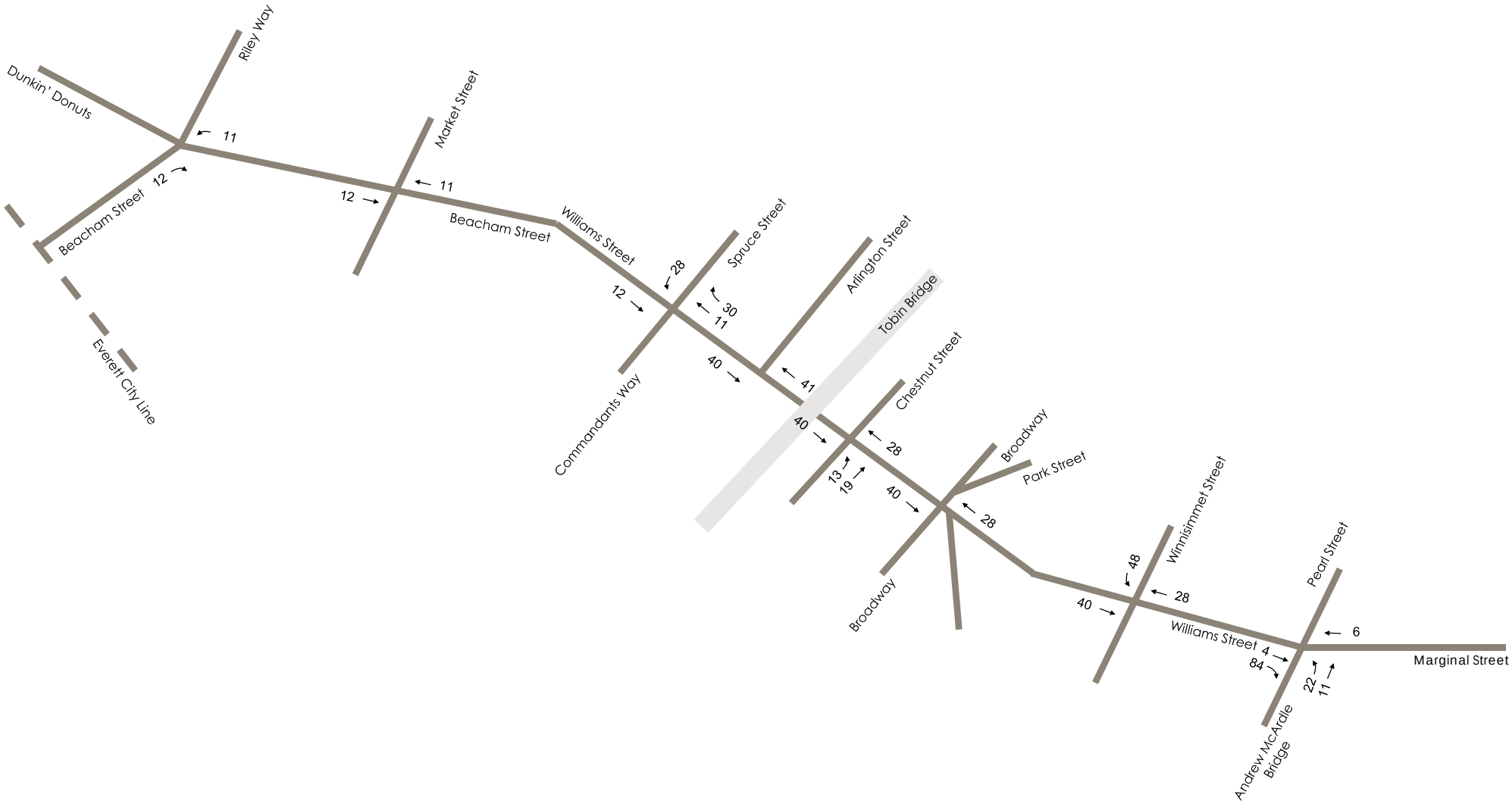
PM Peak Hour Hotel Trips – Residences at Chelsea Loft
Everett Avenue and Carter Street



Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
PM Peak Hour Hotel Trips – Baywood Hotel
200 Second Street



Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

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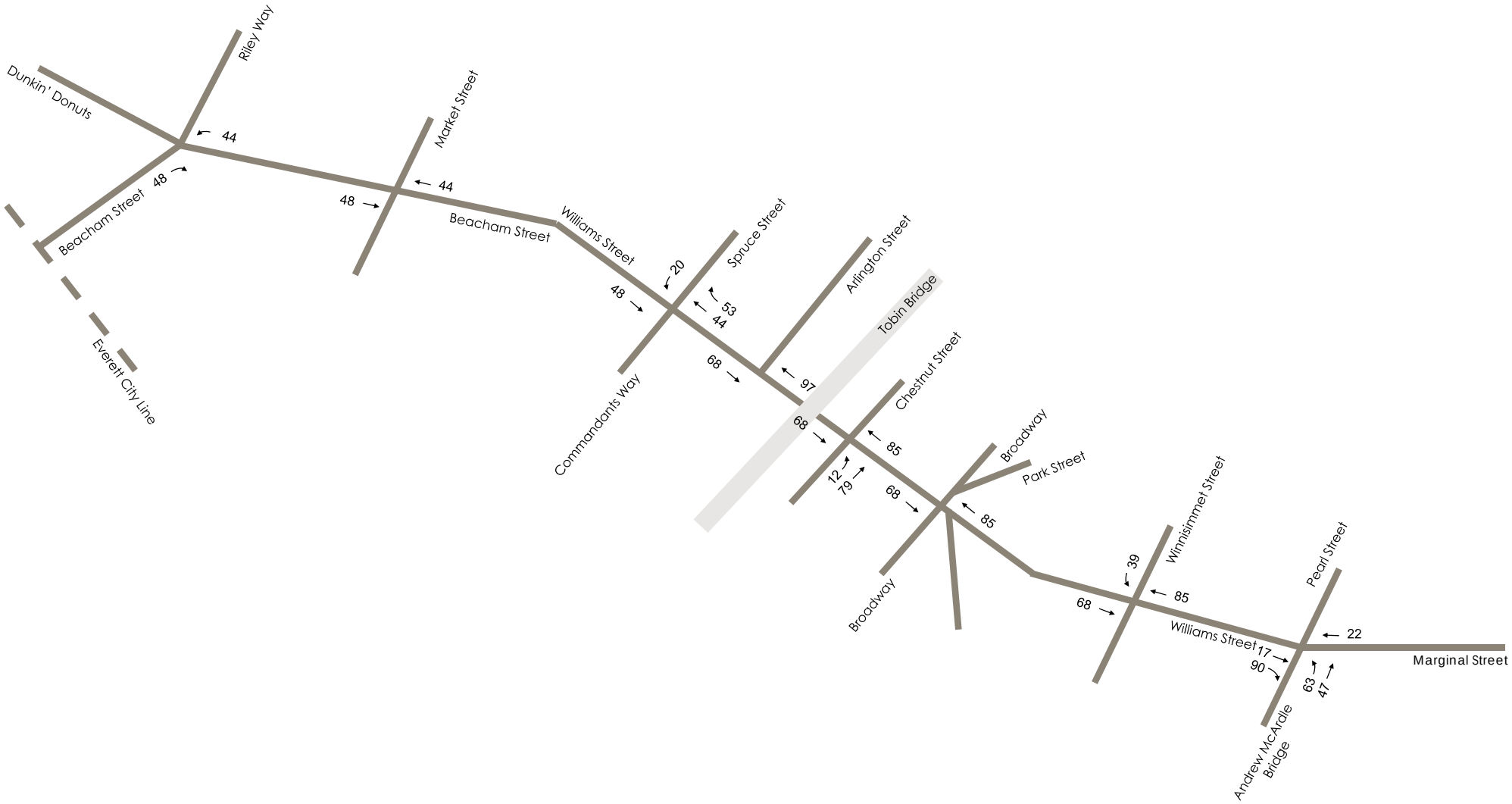
Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 6
AM Peak Hour Composite Trips



Schematic Diagram:
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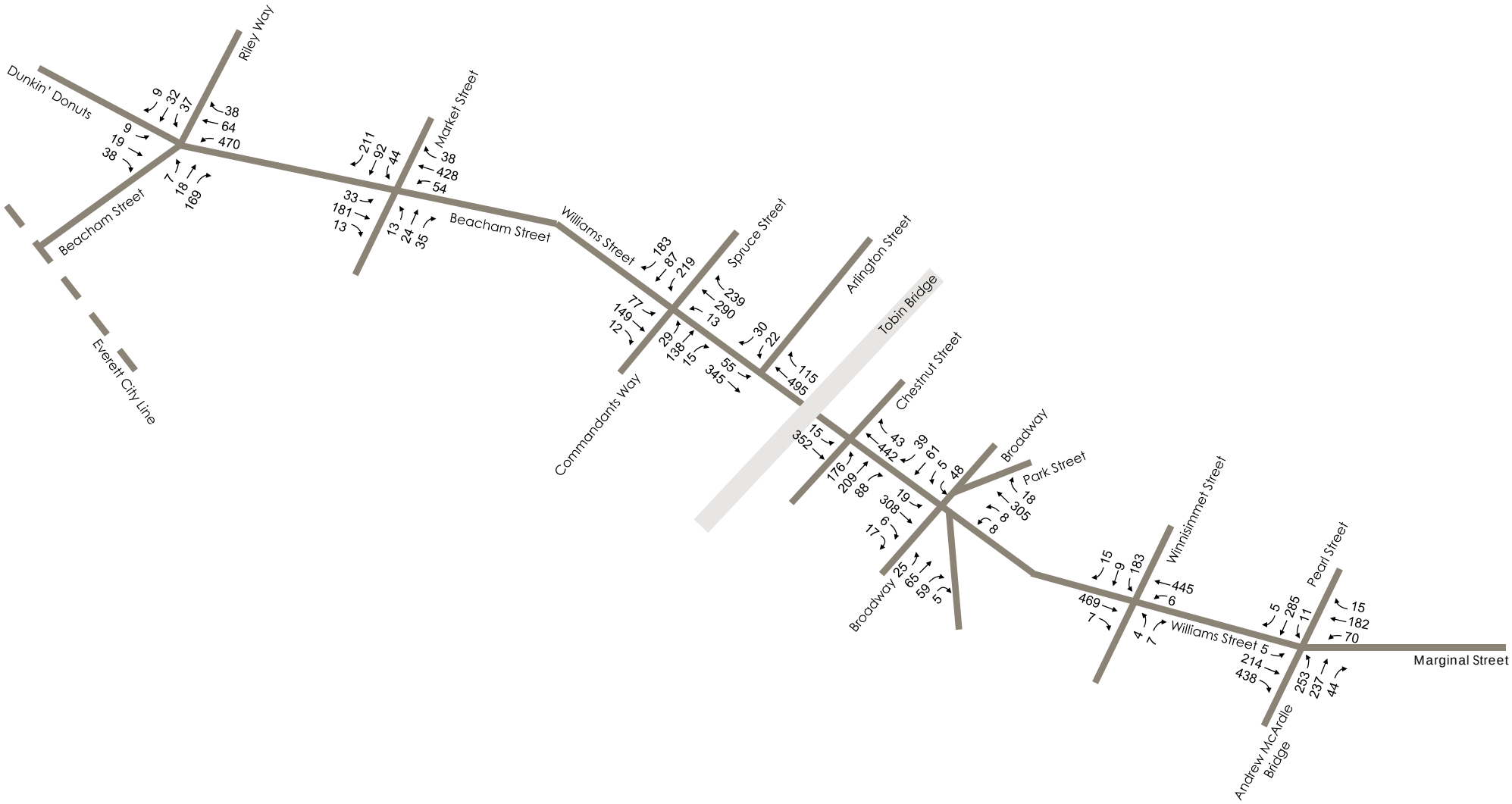
Stantec Consulting Services Inc.

Stantec

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 7
PM Peak Hour Composite Trips

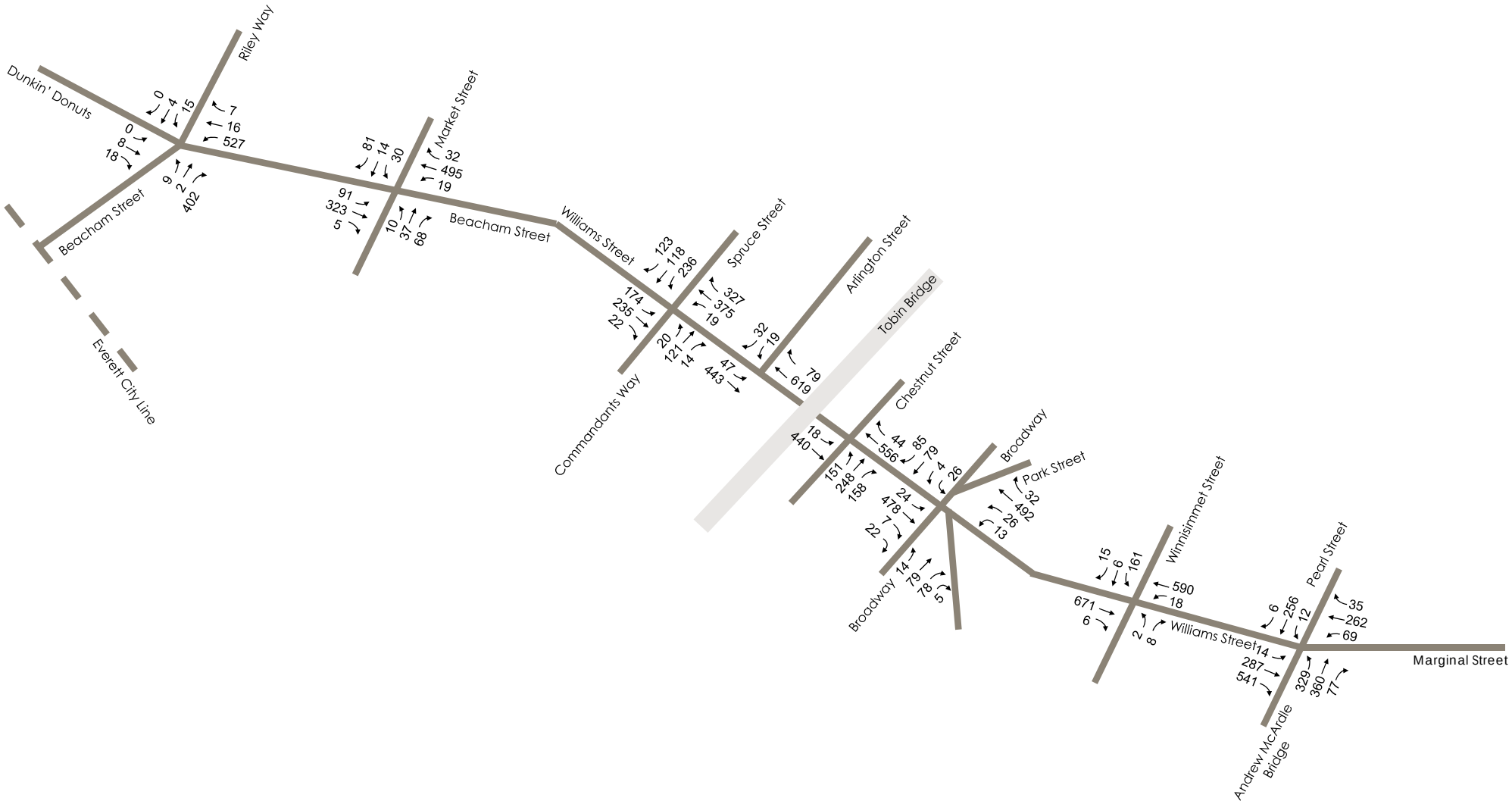


Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

Stantec

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 8
2022 Future AM Peak Hour



Schematic Diagram:
Not to Scale

Stantec Consulting Services Inc.

Stantec

Beacham Street/Williams Street Corridor Study
Chelsea, Massachusetts
Figure 9
2022 Future PM Peak Hour

Stantec

Memo

To:	Jennifer Ducey, PE Boston, MA	From:	Richard Learned, LSP Hyannis, MA
File:	179410441	Date:	March 15, 2018

Reference: Environmental Screening, Beacham/Williams Street Corridor Study, Chelsea, MA

Stantec conducted a review of available information concerning the quality of environmental media that may be encountered along the Beacham Street / Williams Street corridor in Chelsea, Massachusetts. The purpose of the review was to evaluate the potential for roadway reconstruction to encounter contaminated soils and/or groundwater based on a review of publicly available information. The environmental screening did not include any soil or groundwater sampling.

An Executive Summary and a complete Environmental Screening Report of the potential environmental concerns for the work corridor follows. Reading the full body of the report is recommended. The supporting environmental database report will be provided to the City under separate cover.

The corridor was analyzed in the same 4 character areas as the planning study:

- **Area A** – Everett City Line to Mulberry Street (3,050 Feet)
- **Area B** – Mulberry Street to Chestnut Street (750 feet, including Mulberry Street)
- **Area C** – Chestnut Street to Winnisimmet Street (850 feet, including the Chestnut and Winnisimmet Street intersections)
- **Area D** – Winnisimmet Street to Pearl Street (360 feet, including the Pearl Street intersection)

EXECUTIVE SUMMARY

Summary of the History of the Work Corridor

The work corridor is located in an area that has an extensive history of commercial and industrial activities. The environmental history of the northern portion of the work corridor is closely related to the filling of the former oxbow section of the Island End River. The oxbow and associated tidal marshes encompassed most of the area that is currently Beacham Street within Area A, and the western side of Williams Street from Beacham Street to Commandants Way. Historical information indicates the oxbow and marshes were filled between the late 1800's and into the 1960s. The origin of the fill material is reportedly byproducts of the historical coal tar processing operations that were conducted along the western bank of the Island End River, debris from demolition of the former processing facilities, material dredged from the Island End and Mystic Rivers, and possibly material from various construction sites in Boston. Fill materials encountered at the state-listed hazardous waste sites (SHWS) in the vicinity are reported to include slag, clinkers, ash, brick, oil/tar, and scrap

metal. Other activities that have the potential to impact large sections of the work corridor include the former Williams Street Dump, the Chelsea Gas Light Company and later the Boston Consolidated Gas Company located along William Street, and possibly maintenance of the Tobin Bridge.

Summary of Oil or Hazardous Material Releases

There are 32 SHWS sites within 300 feet of the work corridor in corridor Areas A, B and C (see Figure 1, Hazardous Waste Sites Locus Map). No records of SHWS sites were encountered for Area D. Most of the releases pertain to petroleum (including coal tar, transformer oil, diesel fuel, and waste oil), polynuclear aromatic hydrocarbons (PAHs), and metals. Many of the SHWS sites in Area A are related to the materials used to fill the oxbow. There is an area in Area C where elevated lead was found in surface soils. This may also be true for other areas proximal to the Tobin Bridge if lead paint used on the bridge is the source of the lead. For disposal options, these soils would likely be considered hazardous (discussed below). As many as 11 Activity and Use Limitations (AULs) have been implemented for SHWS sites along the work corridor all of which are located within Area A. An AUL indicates that residual soil contamination still exists and restricts human exposure by maintaining surface barriers such as pavement, buildings, or clean fill cover. Typically, AULs require a soil management plan for excavated materials and a health and safety plan for workers and the public. In general, it appears the AULs are limited to the parcel boundaries and do not extend into the right-of-way of the work corridor. If the proposed work extends into an AUL area, a Licensed Site Professional (LSP) should be consulted and the City may need to interact with the property owner and their LSP. The City should evaluate the ramifications of *taking* property or interests in property that may be contaminated. This is especially true where AULs exist since it would then be incumbent upon the City to maintain the property in conformance with the AUL.

Recommendations

Given the potential to encounter historic fill material and residual impacts due to releases at SHWS sites, a review of any existing soil data from the work corridor, where available, and / or soil sampling is recommended so that appropriate soil management and disposal options can be evaluated prior to excavation of the soil. A sampling and analysis plan (SAP) should include evaluating soil quality beneath the pavement box for disposal options which include in-state landfill (least expensive), asphalt batching of petroleum-impacted soils, or disposal as hazardous material at an out of state facility (most expensive). Based upon our current understanding of the quality of soil along the work corridor, it is likely that a large percentage of the surplus soil will require disposal as hazardous material. This is particularly true for Area A, where as much as 50% to 75% can be considered hazardous for budgeting purposes. Surplus soil in Areas B through D may be of higher quality. However, the landfill and asphalt batch contaminant limits are relatively stringent. The objective

should be to reuse as much of the excavate as possible and thereby minimize soil that must be disposed. For surplus soil, soil pre-characterization and a soil management plan can identify the lease costly disposal option, and these should be a primary component of estimating soil management and disposal costs.

Groundwater is expected to be relatively shallow in the northern portion of the work corridor along Area A and at the easternmost end near Pearl Street (Area D). Groundwater sampling is recommended prior to excavation if dewatering is anticipated.

ENVIRONMENTAL SCREENING REPORT

The work performed as part of the environmental screening included the following:

- Review an environmental database search, Sanborn Insurance Maps and historical aerial photographs from EDR. The database search covers multiple State and federal environmental databases for potential contamination issues per ASTM standards. The supporting EDR report will be provided to the City under separate cover.
- Review historical USGS maps and aerial photographs, Sanborn Fire Insurance Maps, and city directories for additional historical context.
- Review select files available on MassDEP's website for sites proximate to the corridor.
- Conduct a site walk to observe possible indications of contamination.

The environmental screening did not include any soil or groundwater sampling.

A general description of corridor geology and hydrogeology, and a summary of the potential environmental concerns and recommendations for each of the four character areas follows.

General Description of Geology

According to the 1932 USGS map titled Map Showing Surficial Geology of the Boston and Boston Bay Quadrangles (Map B-839 Plate 2), surficial geology in the Beacham Street area is described as marine silt, muck and peat. Note that the map was prepared prior to reclamation of the area and depicts the former oxbow of the Island End River.

The Williams Street area north of Spruce Street is described as made land indicating the area was filled. Surficial geology south of Spruce Street is described as ground moraine and drumlins.

The 1932 USGS map titled Map and Sections Showing Arial Geology of the Boston and Boston Bay Quadrangles (Map B-839 Plate 1), indicates bedrock in the Chelsea area is mapped as Cambridge Slate.

Reference: Environmental Screening, Beacham/Williams Street Corridor Study, Chelsea, MA

General Hydrogeology

According to the 1980 USGS map titled Hydrology and Water Resources of the Coastal Drainage Basins of Northeasrn Massachusetts from Castle Neck River, Ipswich to Mystic River Boston (Map HA-589 Plate 2), aquifer materials in the work area are mapped within the Mystic River Basin which is described as underlain by extensive clay deposits yielding little or no water to wells. Some areas also include till deposits described as poorly sorted glacial material with low transmissivities. Depth to groundwater is expected to be shallowest along Area A and at the eastern extent of Area D where the topographic elevations are 10 feet±. Perched groundwater may exist above low permeable silts and clay.

Summary of the History of the Work Corridor

The environmental history of the northern portion of the work corridor is closely related to the filling of the former oxbow section of the Island End River. The Island End River is a tributary of the Mystic River. The oxbow and associated marshlands encompassed most of the area that is currently Beacham Street within Area A, and the western side of Williams Street from Beacham Street to Commandants Way (see Figure 1, Hazardous Waste Sites Locus Map).

Historical information indicates the tidal marsh along the western shore of the Island End River waterfront was filled in the late 1890s. By 1900 the New England Coal and Coke Company was operating a coal tar processing plant on the western shore. Crude coal tar, a byproduct of coal gasification, is a black, viscous liquid or semi-solid substance derived from the distillation of bituminous coal. Records indicate this and associated industries continued until 1960.

Fill permits from the late 1800's into the 1960s were issued for various sections of the former oxbow and associated tidal marshes as part of pier and bulkhead construction, dredging disposal, and general solid fill purposes. A 1938 aerial photograph depicts the northern end of Williams Street terminating at the marsh near what is current-day Carter Street. The marsh extended along the west side of Williams Street to approximately Commandants Way. This marsh was also eventually filled. Therefore, most of the work corridor within Area A except for the east side of Williams Street was developed on filled lands.

Subsurface conditions encountered in test pits and borings conducted at the coal tar processing property describe a surficial layer of miscellaneous fill that varies in thickness from approximately 5 feet to 15 feet overlying peat and low permeability organic silt. The origin of the fill material is not well documented. However, it is reported that slag and ash from the coal tar processing operations, debris from demolition of the former processing facilities, material dredged from the Island End and Mystic Rivers, and possibly material from various construction sites in Boston was used. Filling was completed by the mid-1960s and the reclaimed area was subsequently developed. Fill materials

encountered at the state-listed hazardous waste sites (SHWS) in the vicinity are reported to include slag, clinkers, ash, brick, oil/tar, and small amounts of scrap metal.

A fill permit dated 1945 depicts a *20" gas main and embankment* in the approximate footprint of the current Beacham Street layout within Area A. Some time after the mid-1960s the entire section of Beacham Street from the Everett / Chelsea line south to its current intersection with Williams Street was constructed through the former oxbow and marsh areas. The road appears to have been constructed along the gas main embankment.

The work corridor is located in an area that has an extensive history of commercial and industrial activities. Some areas along Beacham Street and Williams Street are referred to as the former Williams Street Dump which was reported to have been a municipal landfill. There are also reports that the area was historically use as a clay pit in the late 1800s, early 1900s. Clay excavations were likely filled similar to the oxbow and associated tidal marshes.

Other activities that have the potential to impact large sections of the work corridor include the Chelsea Gas Light Company and later the Boston Consolidated Gas Company formerly located along Williams Street, and maintenance of the Tobin Bridge. The United States Marine and Naval Hospital has existed west of Williams Street since the 1800s.

Character Area A

There are 22 SHWS within 300 feet of the work corridor in Area A. Most of the releases pertain to petroleum (including coal tar, transformer oil, diesel fuel, and waste oil), polynuclear aromatic hydrocarbons (PAHs) and metals. Many of the SHWS sites in Area A are related to the materials used to fill the oxbow. As many as 11 Activity and Use Limitations (AULs) have been implemented for SHWS sites along the work corridor. These include 276 Beacham Street due to coal tar, 307 Beacham Street also due to coal tar, 357 Beacham Street due to PAHs, 380 Beaham Street due to oil, 390 Beacham Street due to PAHs and lead, 410 Beacham Street due to petroleum, and 215 Williams Street due to waste oil, PAHs and lead. An AUL indicates that residual soil contamination still exists and restricts human exposure by maintaining surface barriers such as pavement, buildings, or clean fill cover. Typically, AULs require a soil management plan for excavated materials and a health and safety plan for workers and the public. In general, it appears the AULs are limited to the parcel boundaries and do not extend into the right-of-way of the work corridor. If the proposed work extends into an AUL area, a Licensed Site Professional (LSP) should be consulted and the City may need to interact with the property owner and their LSP. The City should evaluate the ramifications of *taking* property or interests in property that may be contaminated. This is especially true where AULs exist since it would then be incumbent upon the City to maintain the property in conformance with the AUL. Soil and/or groundwater sampling along the frontages of these properties (discussed below) should be assessed for the contaminants specified in the AULs.

Recommendations for Character Area A

Based upon the extensive historic filling of most of Area A, and the known use of contaminated materials from the former coal tar processing operations, the Williams Street Dump, or from other unknown sources, it should be assumed that material excavated from this section will contain contaminants which will require special handling and disposal. Stantec recommends that comprehensive soil sampling be conducted along the work corridor in Area A prior to initiation of intrusive construction activities. The soil should be evaluated to the maximum depth of the proposed subsurface installations presently estimated as six feet below ground surface. It is likely that most or all of the surplus excavated material will have to be disposed at an appropriate receiving facility. Therefore, for pre-characterization purposes, soil samples should be analyzed for at least the landfill criteria (see COMM-97). Some soils may not meet landfill criteria and may need to be disposed at an out-of-state landfill or as a hazardous material depending on contaminant concentrations.

Topography across Area A appears to be approximately 10 feet±. Groundwater has been reported to be within 5 or 6 feet of surface grade according to surrounding SHWS reports. Therefore, groundwater may be encountered during some of the work especially in the area of Market Street during periods of high tides. Perched groundwater may also exist above low permeable silts and clay. Monitoring wells are recommended along this section of the work corridor to pre-characterize groundwater for potential dewatering permits.

Character Area B

There are four SHWSs within 300 feet of the work corridor in Area B. The releases included gasoline, No. 2 fuel oil, total petroleum hydrocarbons (TPH), and diesel fuel. All of the SHWSs achieved regulatory closure with site conditions returned to background or near background levels. No AULs exist for these SHWSs. In Stantec's opinion, these SHWS sites will not affect the proposed work. It is unlikely that significant exposure to oil or hazardous materials (OHM) will be encountered or that special handling for soil will be necessary due to these historic releases in Area B. Topography continues to increase along Area B. Therefore, it is less likely that impacted groundwater will be encountered.

Recommendations for Character Area B

Given the potential to encounter historic fill materials in the work corridor, some soil sampling is recommended within Area B so that appropriate soil management and disposal options can be evaluated prior to excavation of soil. If construction activities involve excavation into the water table, dewatering of groundwater may be necessary. If groundwater is

encountered in soil borings within or near the depth limits of the work, monitoring wells are recommended to pre-characterize groundwater for potential dewatering permits.

Character Area C

There are six SHWSs within 300 feet of the work corridor in Area C. The releases included lead, gasoline, petroleum, No. 2 fuel oil, and diesel fuel. All of the SHWSs achieved regulatory closure. Only one of the SHWS sites has the potential to affect the proposed work. Lead was encountered at elevated levels in surficial soils at 122 Broadway. This property has frontage along Broadway and also along Williams Street between Broadway and Chestnut Street. The lead was attributed to engine emissions, urban fill, cinder and ash in the fill, and possibly the use of lead-based paint on historic buildings and on the nearby Tobin Bridge. The removal of some of the lead-impacted soil was conducted during the construction of the District Court House in the late 1990s. In Stantec's opinion, the lead in surfical urban fill soil may extend into the work corridor. It is possible exposure to lead soils will be encountered and that special handling for re-use and / or disposal of soil will be necessary. Soil sampling along the frontage of this property should be assessed for lead.

None of the remaining SHWS sites in Area C are expected affect the proposed work. No AULs exist for any of the SHWS sites. Topography decreases along Area C. However, it is greater than 15 feet at the lowest point. Therefore, it is less likely that impacted groundwater will be encountered.

Recommendations for Character Area C

Given the potential to encounter historic fill materials in the work corridor, some soil sampling is recommended within Area C so that appropriate soil management and disposal options can be evaluated prior to excavation of soil. If construction activities involve excavation into the water table, dewatering of groundwater may be necessary. If groundwater is encountered in soil borings within or near the depth limits of the work, monitoring wells are recommended to pre-characterize groundwater for potential dewatering permits.

Character Area D

No SHWS sites exist within 300 feet of the work corridor in Section D. Topography continues to decrease along Area D to a low of approximately 10 feet± near Pearl Street. Therefore, groundwater may be encountered during some of the work especially in the area of Pearl Street during periods of high tides.

Recommendations for Character Area D

Given the potential to encounter historic fill materials in the work corridor, some soil sampling is recommended within Area D so that appropriate soil management and disposal options

can be evaluated prior to excavation of soil. Monitoring wells are recommended along this section of the work corridor to pre-characterize groundwater for potential dewatering permits.

Conclusions

Given the potential to encounter historic fill material and residual impacts due to releases at SHWS sites, a review of any existing soil data from the work corridor, where available, and / or soil sampling is recommended so that appropriate soil management and disposal options can be evaluated prior to excavation of the soil. A sampling and analysis plan (SAP) should include evaluating soil quality beneath the pavement box for disposal options which include in-state landfill (least expensive), asphalt batching of petroleum-impacted soils, or disposal as hazardous material at an out of state facility (most expensive). Based upon our current understanding of the quality of soil along the work corridor, it is likely that a large percentage of the surplus soil will require disposal as hazardous material. This is particularly true for Area A, where as much as 50% to 75% can be considered hazardous for budgeting purposes. Surplus soil in Areas B through D may be of higher quality. However, the landfill and asphalt batch contaminant limits are relatively stringent. The objective should be to reuse as much of the excavate as possible and thereby minimize soil that must be disposed. For surplus soil, soil pre-characterization and a soil management plan can identify the lease costly disposal option, and these should be a primary component of estimating soil management and disposal costs.

Groundwater has been found to be relatively shallow especially in the northern portion of the work corridor along Area A and at the eastern end of Area D. Groundwater sampling is recommended prior to excavation if dewatering is anticipated based upon soil boring observations.

STANTEC CONSULTING SERVICES INC.

Richard Learned, LSP
Senior Environmental Project Manager
Phone: (508) 591-4351
Fax: (508) 790-8998
Richard.Learned@stantec.com

Attachment: Figure 1 - Hazardous Waste Sites Locus Map

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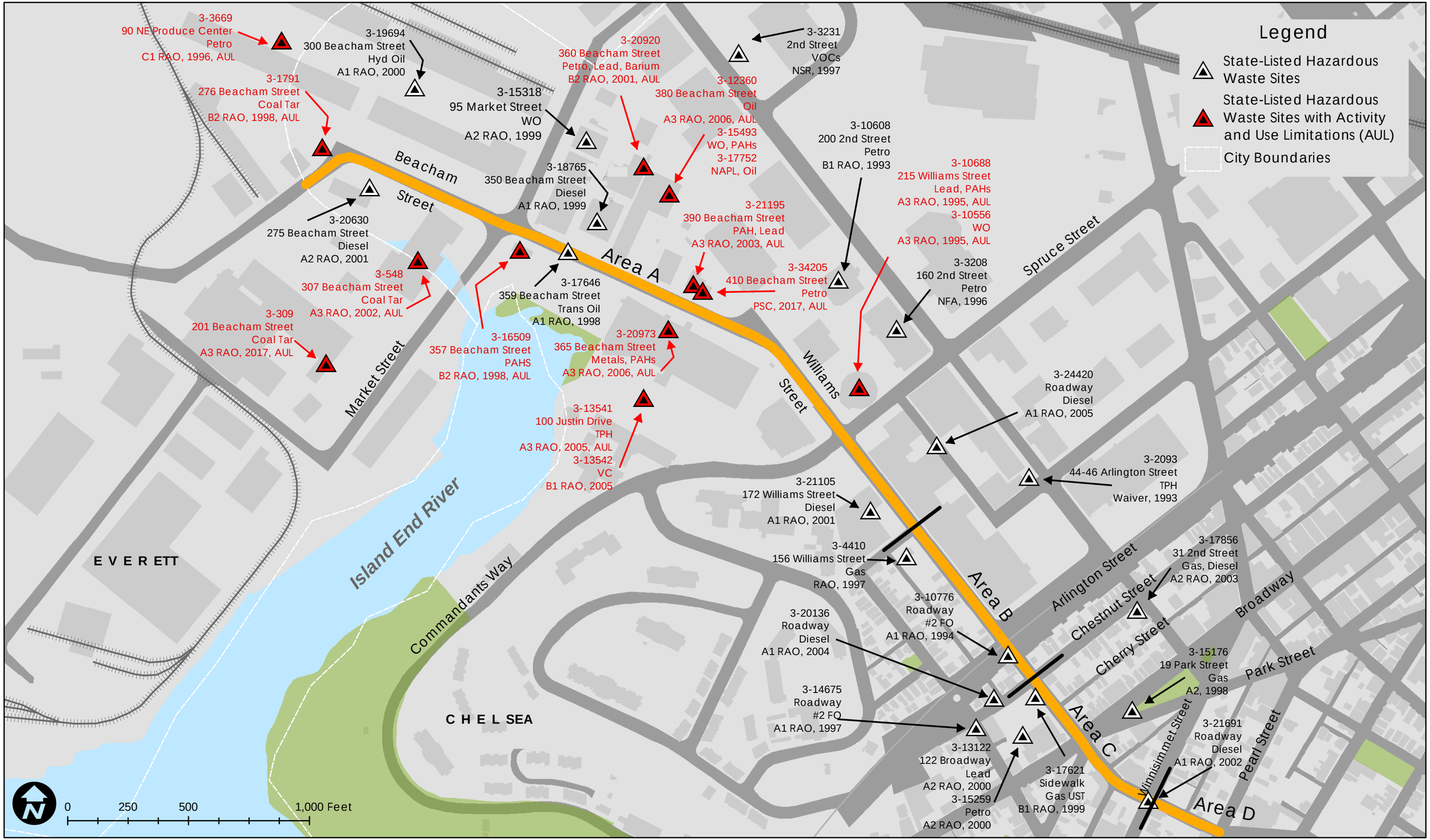

Figure 1: Hazardous Waste Sites Locus Map

Beacham / Williams Street Corridor Study
City of Chelsea, Massachusetts
March 15, 2018

Stantec

Stantec

Memo

To:	Jennifer Ducey, PE Boston, MA	From:	John Hayden, PE Burlington, MA
File:	179410441	Date:	March 15, 2018

Reference: Preliminary ROW Evaluation, Beacham/Williams Street Corridor Study, Chelsea, MA

Stantec performed a preliminary Right-of-Way (ROW) evaluation to determine where the City may need to acquire takings or temporary and permanent easements from abutting property owners to allow for construction of the recommended concept designs. The ROW impacts described herein are general in nature and will need to be confirmed and refined as part of the design development process.

General ROW comments are as follows:

- *Private Features in Public Way:* There are private features in the public way (trees, fences and granite blocks). These features should be removed as part of the project. Should the adjacent land owner wish to keep these features, they can be removed by the owners at their own expense. Otherwise they should be removed and disposed of by the City as part of the construction contract.
- *Public Features on Private Property:* There are public facilities on private property (sidewalks, hydrants, light and signal poles). These features should be relocated or the City-owned ROW adjusted to include them.
- *Temporary Easements:* Along the entire corridor, a 10-foot wide Temporary Easement should be taken on both sides of the street. This easement will allow for construction access and tie-ins to existing conditions at the back of sidewalks and driveways, for example. This access can be granted through temporary easements or rights-of-entry, which we understand are preferred by the City.
- *Takings/Permanent Easements*: For costing purposes, up to 15 takings or permanent easements may be required along the entire corridor.

ROW comments for each character area are as follows:

Area A – Everett City Line to Mulberry Street (3,050 Feet)

- *United States Postal Service – 307 Beacham Street*: It appears that the existing Beacham Street curb line is located on private property. The recommended concept design will likely pull the curb line out into the existing ROW (street layout) thereby eliminating this impact.

Reference: Preliminary ROW Evaluation, Beacham/Williams Street Corridor Study, Chelsea, MA

- *Burke, Dennis K – 410 Beacham Street:* There is an existing catch basin on the edge of this property, beyond the ROW line. This structure should be moved into the street layout or a permanent easement taken to allow for future access to the drainage structure.
- *Manchester Group I Condominium – 365 Beacham Street:* There are two existing hydrants adjacent to each other at this location. One hydrant is within the street layout the other is not. The hydrant outside of the street layout should either be relocated into the layout or a permanent easement taken to allow for future access to the hydrant.
- *Stanett, Jeffery – 222 Williams Street:* There is an existing hydrant on private property at this location. The hydrant should be relocated within the layout or a permanent easement taken to allow for future access to the hydrant.
- *Simboli, Anthony J & Patricia – 215 Williams Street:* The existing sidewalk along Spruce Street at the Williams Street intersection is partially on private property. A permanent easement or alteration to the Spruce Street layout should be taken to encompass the limits of the sidewalk at this location.

Area B – Mulberry Street to Chestnut Street (750 feet, including Mulberry Street)

- No specific ROW concerns.

Area C – Chestnut Street to Winnisimmet Street (850 feet, including the Chestnut and Winnisimmet Street Intersections)

- No Specific ROW concerns.

Area D – Winnisimmet Street to Pearl Street (360 feet, including the Pearl Street intersection)

- *Nickerson, Raymond P – 42 Pearl Street:* On the northwest quadrant of the intersection, the recommended intersection realignment would require a permanent taking. This taking would impact the existing parking lot on this property.

STANTEC CONSULTING SERVICES INC.

John Hayden, PE
Senior Transportation Engineer
Phone: (781) 221-1198
John.Hayden2@stantec.com

Attachment: Figure 1 – Preliminary ROW Evaluation Based on Recommended Concept Design

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Figure 1: Preliminary ROW Evaluation Based on Reccommended Concept

Beacham / Williams Street Corridor Study
City of Chelsea, Massachusetts
March 15, 2018

Stantec

Memo

To:	Jennifer Ducey, PE Boston, MA	From:	Mike Mancuso Burlington, MA
File:	179410441	Date:	June 13, 2018

Reference: Pavement Investigation, Beacham/Williams Street Corridor Study, Chelsea, MA

Stantec performed a pavement investigation of the subject roadway between the Everett City Line and Pearl Street. This included a visual pavement evaluation to determine of Pavement Condition Index (PCI). PCI is a measure of pavement surface condition based on type, severity, and extent of 9 major pavement distresses such as different types of cracking, distortions, potholes, etc. A roadway's PCI is measured on a 0-100 scale with 100 representing a pavement in excellent condition and zero representing a road in complete failure. Each type of distress is assigned deduct values and a weighted calculation of existing distresses generates a roadway segment's PCI.

The pavement investigation consisted of test pits and pavement cores to determine existing roadway structure and subsurface material. These locations were selected by Stantec and the soil beneath the pavement was sampled to a depth of three feet at each test pit. In addition to current PCI; existing pavement thickness, structural number of subsurface material, functional classification and most importantly traffic loading also factored into the pavement design calculations. The traffic loading calculations included an evaluation of truck type based on the number of axles and the impact each type of truck has on the pavement. The equivalent single axle load (ESAL) calculation was used for the pavement design calculations whereas the percentage of trucks used in the traffic analysis represented the total of all larger trucks, generally those having six wheels or more.

The investigation revealed a flexible pavement for the majority of the corridor between the Everett City Line and Chestnut Street with granular base and inconsistent pavement thickness. South of Chestnut Street, cores revealed thin pavement above a cobblestone base. Due to overall insufficient pavement thickness, inconsistent road structure cross section, unsuitable granular base material, high truck traffic volumes, and isolated cobblestone base, Stantec recommends full depth reconstruction for the project corridor.

The portion of Williams Street between Broadway and Pearl Street was excluded from the investigation as this area was resurfaced recently by the City and the testing would have required an MWRA 8(m) permit. For this reason, additional cores may be necessary during a future design development phase to determine existing road structure cross section in this area and extent of cobblestone base.

Stantec Consulting Services Inc.

Michael Mancuso
Transportation Designer

Phone: (781) 221-1204
Michael.Mancuso@stantec.com

Attachment: Pavement Design Report

PAVEMENT EVALUATION AND RECOMMENDATIONS

SECTION: **n/a**
LOCATION: **Beacham St** FROM: **Everett City Line** TO: **Spruce St.**

EXISTING CONDITIONS

PAVEMENT TYPE: Bituminous Concrete
STRUCTURE TYPE: Flexible
FUNCTIONAL CLASSIFICATION: Urban Minor Arterial
ZONE: Industrial

RIDING COMFORT: Fair
DRAINAGE CONDITION INDEX: Fair
CURB REVEAL: 0
CURB TYPE: -

LENGTH (FT): 2521
WIDTH (FT): 46
AREA (SY): 12885

RATER: MJM
EVALUATION DATE: November, 2017
VISUAL PCI: 85

SURFACE DISTRESS EVALUATION

Distress Identification	Severity Low	Medium	High	Extent (%)
1 Potholes/Non-Utility Patching				
2 Alligator Cracking				
3 Rutting	X			10
4 Distortion/Utility Patching	X			0.3
5 Block Cracking				
6 Longitudinal & Transverse Cracking	X			15
7 Bleeding				
8 Weathering & Raveling	X			5
9 Corrugations/Shoving		X		0.2

PAVEMENT CONDITION INDEX (PCI)

85.0

NOTES

Stantec conducted both, a network-level, and project-level evaluation of the subject pavement in Chelsea, MA to evaluate roadway surface distresses and pavement thickness for the purpose of recommending pavement treatment(s).

Stantec determined Pavement Condition Index (PCI) for this roadway to be a 85, or in good condition. PCI is in accordance to ASTM D6344-09 standard (0 –100 scale) and based on measuring the severity, extent, and type of distress.

Stantec subcontractors extracted six (6) pavement structure cores and three (3) test pits. The investigation revealed a flexible pavement (see attached core log). Soil beneath the HMA was also sampled to a depth of 3'.

Based on pavement structure sampling, granular sub-base classification, and traffic loading, a full depth reconstruction is recommended for this segment of Beacham St. Binder Grade PG 64E-28 (surface course only) is recommended.

Based on our evaluation and AASHTO pavement design calculations, Stantec recommends removing 20" of existing HMA and granular base, grade and compact existing subgrade to proposed lines and grades, place 8" gravel borrow, 4" Dense Graded Crushed Stone base, followed by 4" Superpave Base Course 37.5mm, 2.25" Superpave Intermediate Course 19.0mm and 1.75" Superpave Surface Course 12.5mm.

PAVEMENT INVESTIGATION AND DESIGN

MASSACHUSETTS DESIGN METHODS

LOCATION:	Beacham St	LENGTH (FT):	2521	PROJECT #:	179410441
FROM:	Everett City Line	WIDTH (FT):	46.0	CITY/TOWN:	Chelsea, MA
TO:	Spruce St.	AREA (SY):	12885	INVESTIGATION DATE:	5/14/2018
SECTION ID:	n/a			PAVEMENT CONDITION INDEX (PCI):	85
DESIGNER:	WPS/MJM				

CLASSIFICATION:	Urban Minor Arterial	ESTIMATED TRUCK TRAFFIC %:	6.0%
ZONE:	Commercial	TRAVEL DIRECTIONS:	2
CURRENT ADT (2017):	12,900	TRAFFIC DATA SOURCE:	AC

STRUCTURAL DESIGN DATA

Future ADT (20 year @ 1%/year):	15740
Mean ADT = (ADT + Future ADT)/2:	14320
Directional ADT= Mean ADT/Travel Directions:	7160
Directional Truck ADT:	430

Daily Equivalent 18 single kip axle loads (T_{18}):		Total Equivalent 18 single kip axle loads (T_{18}):
(Freeway 1100):	473	
(Urban Major & Minor Art. 880):	378	4,941,630
(Rural Minor Art./Coll. 660):	284	

DETERMINATION OF STRUCTURAL NUMBER (SN)

					MATERIAL
Subbase:	DBR =	45	SSV =	8.0	Dense Graded
Subbase:	DBR =	40	SSV =	7.8	Gravel Borrow
Subgrade	DBR =	30	SSV =	7.1	A-1-a

Design Structural Number (SN) from Design Nomograph

Above Subbase =	2.68	+15%	=	3.08
Above Subbase =	2.77	+15%	=	3.19
Above Subgrade =	3.01	+15%	=	3.46

NEW PAVEMENT STRUCTURAL NUMBER (SN)

HMA Thickness *Remove existing material to 20" depth, place 8.0" Gravel borrow, 4.0" Dense Graded, 4.0" SBC 37.5mm, 2.25" SIC 19.0mm, 1.75" SSC 12.5mm*

Surface Course:	1.75	SN =	0.44	Layer Value =		0.77
Intermediate Course:	2.25	SN =	0.44	Layer Value =		0.99
Base Course:	4.00	SN =	0.34	Layer Value =		1.36
				Total SN above granular materials =	3.12	ok
Subbase Course						
Dense Graded Thickness:	4.00	SN =	0.14	Layer Value =		0.56
Processed Gravel Thickness:	8.00	SN =	0.11	Layer Value =		0.88
				Total SN above subbase =	4.56	ok
Subbase (Gravel):						
Thickness:	2.41	SN =	0.10	Layer Value =		0.24
				Total SN above subgrade =	4.80	ok

TOTAL: 22.41

EXISTING PAVEMENT STRUCTURAL NUMBER (SN)

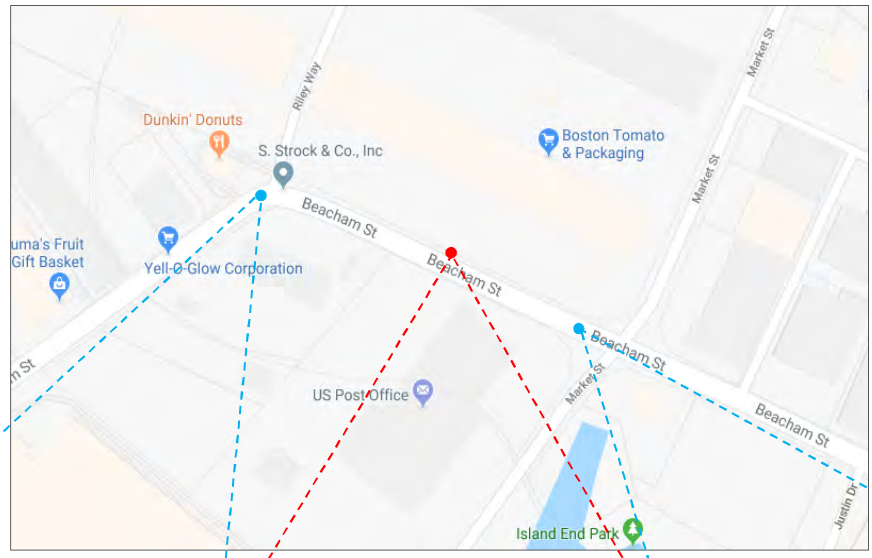
	Thickness		Value	(RF)	SN
Bit. Conc.....	7.75	in.	0.44	50	1.71
Sand Asphalt.....	0.00	in.	0.40	50	0.00
Premix Base.....	0.00	in.	0.34	50	0.00
Penetrated Stone.....	0.00	in.	0.24	-	0.00
PCC.....	0.00	in.	0.20	-	0.00
Silty Gravel Borrow.....	0.00	in.	0.10	-	0.00
Gravel.....	14.58	in.	0.06	-	0.87
Silty Gravel.....	17.00	in.	0.08	-	1.36
Silty Sand.....	0.00	in.	0.04	-	0.00

TOTAL INFLUENCE = 39.33 TOTAL SN = 3.94

SITE LOCATION AND TEST PIT PROFILE

LOCATION: Beacham St
FROM: Everett City Line
TO: Spruce St.

LENGTH (FT): 2521
WIDTH (FT): 46
AREA (SY): 12885.1



CORE **1**
150' S of Everett City Line; 5' off W curb

TEST PIT **2**
350' N of Market St.; 12' off E curb

CORE **3**
100' N of Market St.; 10' off W curb

CORE **1**

	DEPTH	CLASSIFICATION
Bit Conc	5.75"	Bituminous Concrete
Base	N/A	Granular Base

TEST PIT **2**

	DEPTH	CLASSIFICATION
Bit Conc	11.75"	Bituminous Concrete
Base	24.25	A-1-a

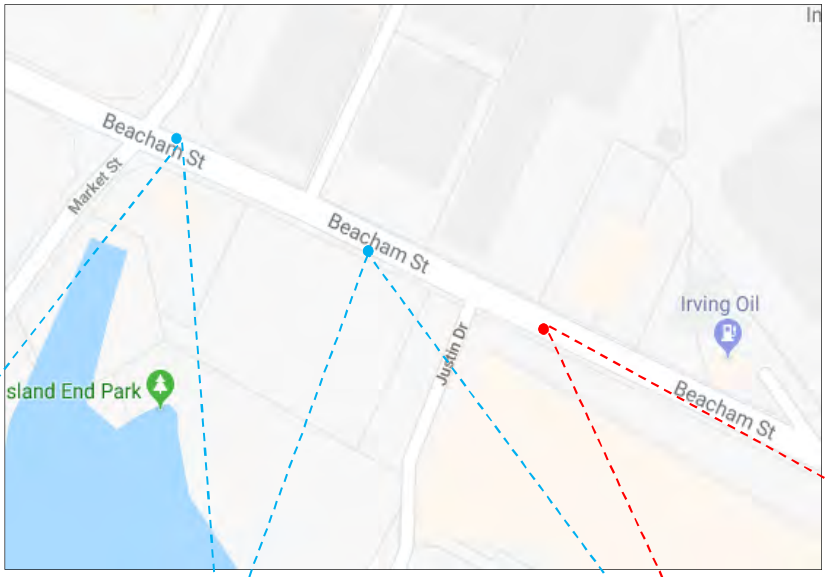
CORE **3**

	DEPTH	CLASSIFICATION
Bit Conc	6.75"	Bituminous Concrete
Base	N/A	Granular Base

SITE LOCATION AND TEST PIT PROFILE

LOCATION: Beacham St
FROM: Everett City Line
TO: Spruce St.

LENGTH (FT): 2521
WIDTH (FT): 46
AREA (SY): 12885.1



CORE **4**
75' S of Market St.; 7' off E curb

CORE **5**
200' N of Justin Dr.; 4' off E curb

TEST PIT **6**
100' N of Market St.; 7' off E curb

CORE **4**

	DEPTH	CLASSIFICATION
Bit Conc	6.75"	Bituminous Concrete
Base	N/A	Granular Base

CORE **5**

	DEPTH	CLASSIFICATION
Bit Conc	11.5"	Bituminous Concrete
Base	N/A	Granular Base

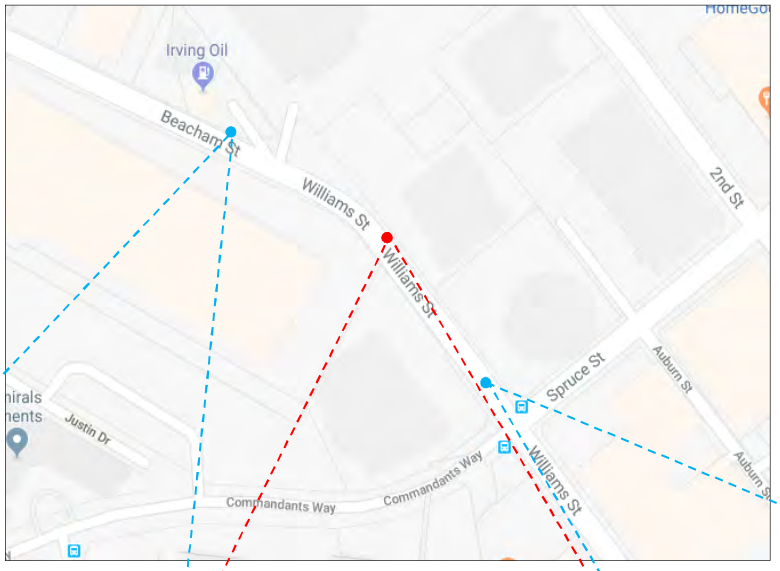
TEST PIT **6**

	DEPTH	CLASSIFICATION
Bit Conc	7.75"	Bituminous Concrete
Base	9.25"	A-1-a
Sub Base	18"	A-1-a

SITE LOCATION AND TEST PIT PROFILE

LOCATION: Beacham St
FROM: Everett City Line
TO: Spruce St.

LENGTH (FT): 2521
WIDTH (FT): 46
AREA (SY): 12885.1



CORE **7**
370' s of Justin Dr.; 4' off E curb

TEST PIT **8**
450' N of Spruce St.; 6' off E curb

CORE **9**
150' N of Spruce St.; 3' off W curb

CORE **7**	DEPTH	CLASSIFICATION
Bit Conc	4.75"	Bituminous Concrete
Base	N/A	Granular Base

TEST PIT **8**	DEPTH	CLASSIFICATION
Bit Conc	8.75"	Bituminous Concrete
Base	10.25"	A-1-b
Sub Base	16"	A-1-b

CORE **9**	DEPTH	CLASSIFICATION
Bit Conc	6.75"	Bituminous Concrete
Base	N/A	Granular Base

PAVEMENT EVALUATION AND RECOMMENDATIONS

SECTION: **n/a**
LOCATION: **Williams St** FROM: **Spruce St.** TO: **Chestnut St.**

EXISTING CONDITIONS

PAVEMENT TYPE: Bituminous Concrete
STRUCTURE TYPE: Flexible
FUNCTIONAL CLASSIFICATION: Urban Minor Arterial
ZONE: Industrial

RIDING COMFORT: Fair
DRAINAGE CONDITION INDEX: Fair
CURB REVEAL: Varies
CURB TYPE: Varies

LENGTH (FT): 1270
WIDTH (FT): 38
AREA (SY): 5362

RATER: MJM
EVALUATION DATE: November, 2017
VISUAL PCI: 49

SURFACE DISTRESS EVALUATION

Distress Identification	Severity Low	Medium	High	Extent (%)
1 Potholes/Non-Utility Patching				
2 Alligator Cracking		X		5
3 Rutting	X			3
4 Distortion/Utility Patching		X		0.4
5 Block Cracking		X		15
6 Longitudinal & Transverse Cracking		X		40
7 Bleeding				
8 Weathering & Raveling	X			7
9 Corrugations/Shoving		X		0.2

PAVEMENT CONDITION INDEX (PCI)
49.0

NOTES

Stantec conducted both, a network-level, and project-level evaluation of the subject pavement in Chelsea, MA to evaluate roadway surface distresses and pavement thickness for the purpose of recommending pavement treatment(s).

Stantec determined Pavement Condition Index (PCI) for this roadway to be a 49, or in fair condition. PCI is in accordance to ASTM D6344-09 standard (0 –100 scale) and based on measuring the severity, extent, and type of distress.

Stantec subcontractors extracted three (3) pavement structure cores and two (2) test pits. The investigation revealed a flexible pavement (see attached core log). Soil beneath the HMA was also sampled to a depth of 3'.

Based on pavement structure sampling, granular sub-base classification, and traffic loading, a full depth reconstruction is recommended for this segment of Beacham St. and Williams St. Binder Grade PG 64E-28 (surface course only) is recommended.

Based on our evaluation and AASHTO pavement design calculations, Stantec recommends removing 20" of existing HMA and granular base, grade and compact existing subgrade to proposed lines and grades, place 8" gravel borrow, 4" Dense Graded Crushed Stone base, followed by 4" Superpave Base Course 37.5mm, 2.25" Superpave Intermediate Course 19.0mm and 1.75" Superpave Surface Course 12.5mm.

PAVEMENT INVESTIGATION AND DESIGN

MASSACHUSETTS DESIGN METHODS

LOCATION:	Williams St	LENGTH (FT):	1270	PROJECT #:	179410441
FROM:	Spruce St.	WIDTH (FT):	38.0	CITY/TOWN:	Chelsea, MA
TO:	Chestnut St.	AREA (SY):	5362	INVESTIGATION DATE:	5/14/2018
SECTION ID:	n/a			PAVEMENT CONDITION INDEX (PCI):	65
DESIGNER:	WPS/MJM				

CLASSIFICATION:	Urban Minor Arterial	ESTIMATED TRUCK TRAFFIC %:	8.0%
ZONE:	Commercial	TRAVEL DIRECTIONS:	2
CURRENT ADT (2017):	13,800	TRAFFIC DATA SOURCE:	AC

STRUCTURAL DESIGN DATA

Future ADT (20 year @ 1%/year):	16839
Mean ADT = (ADT + Future ADT)/2:	15319
Directional ADT= Mean ADT/Travel Directions:	7660
Directional Truck ADT:	613

		Total Equivalent 18 single kip axle loads (T_{18}):
Daily Equivalent 18 single kip axle loads (T_{18}):		
(Freeway 1100):	674	
(Urban Major & Minor Art. 880):	539	3,904,022
(Rural Minor Art./Coll. 660):	404	

DETERMINATION OF STRUCTURAL NUMBER (SN)

					MATERIAL
Subbase:	DBR =	45	SSV =	8.0	Dense Graded
Subbase:	DBR =	40	SSV =	7.8	Gravel Borrow
Subgrade	DBR =	20	SSV =	6.2	A-1-b

Design Structural Number (SN) from Design Nomograph

Above Subbase =	2.60	+15% =	2.99
Above Subbase =	2.69	+15% =	3.09
Above Subgrade =	3.29	+15% =	3.78

NEW PAVEMENT STRUCTURAL NUMBER (SN)

HMA Thickness *Remove existing material to 20.0" depth, place 8.0" Gravel borrow, 4.0" Dense Graded, 4.0" SBC 37.5mm, 2.25" SIC 19.0mm, 1.75" SSC 12.5mm*

Surface Course:	1.75	SN =	0.44	Layer Value =		0.77
Intermediate Course:	2.25	SN =	0.44	Layer Value =		0.99
Base Course:	4.00	SN =	0.34	Layer Value =		1.36
				Total SN above granular materials =	3.12	ok
Subbase Course						
Dense Graded Thickness:	4.00	SN =	0.14	Layer Value =		0.56
Processed Gravel Thickness:	8.00	SN =	0.11	Layer Value =		0.88
				Total SN above subbase =	4.56	ok
Subbase (Gravel):						
Thickness:	9.56	SN =	0.06	Layer Value =		0.57
				Total SN above subgrade =	5.13	ok

TOTAL: 29.56

EXISTING PAVEMENT STRUCTURAL NUMBER (SN)

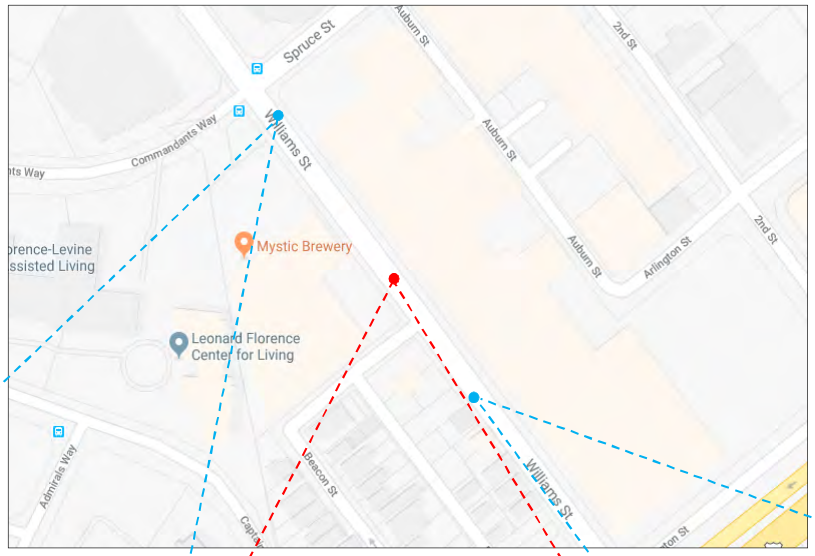
	Thickness		Value	(RF)	SN
Bit. Conc.....	6.75	in.	0.44	50	1.49
Sand Asphalt.....	0.00	in.	0.40	50	0.00
Premix Base.....	0.00	in.	0.34	50	0.00
Penetrated Stone.....	0.00	in.	0.24	-	0.00
PCC.....	0.00	in.	0.20	-	0.00
Silty Gravel Borrow.....	0.00	in.	0.10	-	0.00
Gravel.....	0.00	in.	0.06	-	0.00
Silty Gravel.....	28.50	in.	0.06	-	1.71
Silty Sand.....	0.00	in.	0.06	-	0.00

TOTAL INFLUENCE = 35.25 TOTAL SN = 3.20

SITE LOCATION AND TEST PIT PROFILE

LOCATION: Williams St
FROM: Spruce St.
TO: Chestnut St.

LENGTH (FT): 1270
WIDTH (FT): 38
AREA (SY): 5362.22



CORE **10**
125' S of Spruce St.; 5' off E curb

TEST PIT **11**
50' N of Mulberry St.; 4' off W curb

CORE **12**
150' S of Mulberry St.; 4' off W curb

CORE **10**	DEPTH	CLASSIFICATION
Bit Conc	6.25"	Bituminous Concrete
Base	N/A	Granular Base

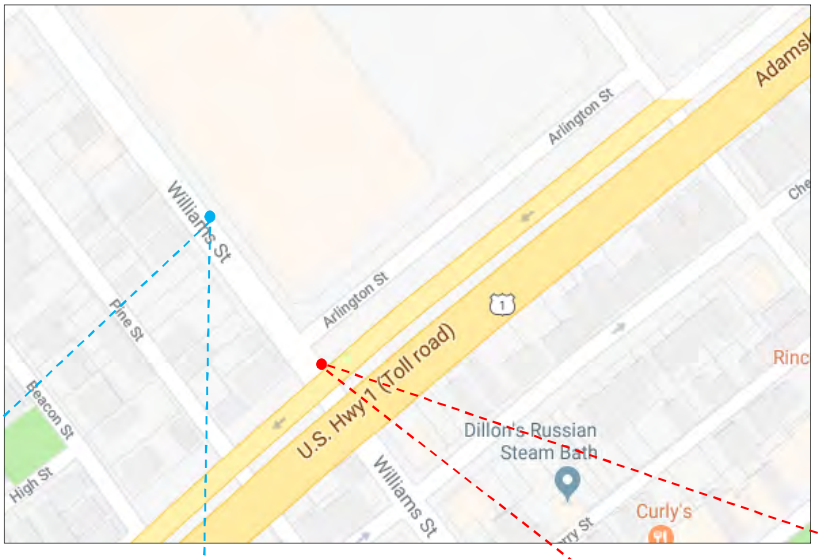
TEST PIT **11**	DEPTH	CLASSIFICATION
Bit Conc	7.5"	Bituminous Concrete
Base	28"	A-1-b

CORE **12**	DEPTH	CLASSIFICATION
Bit Conc	7.75"	Bituminous Concrete
Base	N/A	Granular Base

SITE LOCATION AND TEST PIT PROFILE

LOCATION: Williams St
FROM: Spruce St.
TO: Chestnut St.

LENGTH (FT): 1270
WIDTH (FT): 38
AREA (SY): 5362.22



CORE **13**

115' N of Arlington St.; 5' off E curb

TEST PIT **14**

50' S of Arlington St.; 5' off E curb

CORE **13**	**DEPTH**	**CLASSIFICATION**
Bit Conc	6.0"	Bituminous Concrete
Base	N/A	Granular Base

TEST PIT **14**	**DEPTH**	**CLASSIFICATION**
Bit Conc	7.5"	Bituminous Concrete
Base	29"	A-1-b

PAVEMENT EVALUATION AND RECOMMENDATIONS

SECTION: **n/a**
LOCATION: **Williams St** FROM: **Chestnut St.** TO: **Pearl St.**

EXISTING CONDITIONS

PAVEMENT TYPE:	Bituminous Concrete	RIDING COMFORT:	Fair
STRUCTURE TYPE:	Flexible	DRAINAGE CONDITION INDEX:	Fair
FUNCTIONAL CLASSIFICATION:	Urban Minor Arterial	CURB REVEAL:	6
ZONE:	Residential	CURB TYPE:	GV
LENGTH (FT):	1017	RATER:	MJM
WIDTH (FT):	37	EVALUATION DATE:	November, 2017
AREA (SY):	4181	VISUAL PCI:	89

SURFACE DISTRESS EVALUATION

Distress Identification	Severity Low	Medium	High	Extent (%)
1 Potholes/Non-Utility Patching				
2 Alligator Cracking				
3 Rutting	X			4
4 Distortion/Utility Patching				
5 Block Cracking				
6 Longitudinal & Transverse Cracking				
7 Bleeding	X			5
8 Weathering & Raveling				
9 Corrugations/Shoving			X	0.5

PAVEMENT CONDITION INDEX (PCI)
89.0

NOTES

Stantec conducted both, a network-level, and project-level evaluation of the subject pavement in Chelsea, MA to evaluate roadway surface distresses and pavement thickness for the purpose of recommending pavement treatment(s).

Stantec determined Pavement Condition Index (PCI) for this roadway to be a 89, or in good condition. PCI is in accordance to ASTM D6344-09 standard (0 –100 scale) and based on measuring the severity, extent, and type of distress.

Stantec subcontractors extracted one (1) pavement structure cores. The investigation revealed a composite pavement with cobblestone base (see attached core log).

Based on pavement structure sampling, existing cobblestone base, and traffic loading, a full depth reconstruction is recommended for this segment of Williams St. Binder Grade PG 64E-28 (surface course only) is recommended.

Based on our evaluation and AASHTO pavement design calculations, Stantec recommends removing 21" of existing HMA and granular base, grade and compact existing subgrade to proposed lines and grades, place 8" gravel borrow, 4" Dense Graded Crushed Stone base, followed by 5" Superpave Base Course 37.5mm, 2.25" Superpave Intermediate Course 19.0mm and 1.75" Superpave Surface Course 12.5mm.

PAVEMENT INVESTIGATION AND DESIGN

MASSACHUSETTS DESIGN METHODS

LOCATION:	Williams St	LENGTH (FT):	1017	PROJECT #:	179410441
FROM:	Chestnut St.	WIDTH (FT):	37.0	CITY/TOWN:	Chelsea, MA
TO:	Pearl St.	AREA (SY):	4181	INVESTIGATION DATE:	N/A
SECTION ID:	n/a			PAVEMENT CONDITION INDEX (PCI):	65
DESIGNER:	WPS/MJM				

CLASSIFICATION:	Urban Minor Arterial	ESTIMATED TRUCK TRAFFIC %:	16.0%
ZONE:	Commercial	TRAVEL DIRECTIONS:	2
CURRENT ADT (2017):	11,700	TRAFFIC DATA SOURCE:	AC

STRUCTURAL DESIGN DATA

Future ADT (20 year @ 1%/year):	14276
Mean ADT = (ADT + Future ADT)/2:	12988
Directional ADT= Mean ADT/Travel Directions:	6494
Directional Truck ADT:	1039

Daily Equivalent 18 single kip axle loads (T_{18}):		Total Equivalent 18 single kip axle loads (T_{18}):
(Freeway 1100):	1143	
(Urban Major & Minor Art. 880):	914	9,439,900
(Rural Minor Art./Coll. 660):	686	

DETERMINATION OF STRUCTURAL NUMBER (SN)

					MATERIAL
Subbase:	DBR =	45	SSV =	8.0	Dense Graded
Subbase:	DBR =	40	SSV =	7.8	Gravel Borrow
Subgrade	DBR =	30	SSV =	7.1	A-1-a

Design Structural Number (SN) from Design Nomograph

Above Subbase =	3.01	+15% =	3.46
Above Subbase =	3.12	+15% =	3.59
Above Subgrade =	3.40	+15% =	3.91

NEW PAVEMENT STRUCTURAL NUMBER (SN)

HMA Thickness *Remove existing material to 21" depth, place 8.0" Gravel borrow, 4.0" Dense Graded, 5.0" SBC 37.5mm, 2.25" SIC 19.0mm, 1.75" SSC 12.5mm*

Surface Course:	1.75	SN =	0.44	Layer Value =		0.77
Intermediate Course:	2.25	SN =	0.44	Layer Value =		0.99
Base Course:	5.00	SN =	0.34	Layer Value =		1.70
				Total SN above granular materials =	3.46	ok
Subbase Course						
Dense Graded Thickness:	4.00	SN =	0.14	Layer Value =		0.56
Processed Gravel Thickness:	8.00	SN =	0.11	Layer Value =		0.88
				Total SN above subbase =	4.90	ok
Subbase (Gravel):						
Thickness:	3.16	SN =	0.10	Layer Value =		0.32
				Total SN above subgrade =	5.22	ok

TOTAL: 24.16

EXISTING PAVEMENT STRUCTURAL NUMBER (SN)

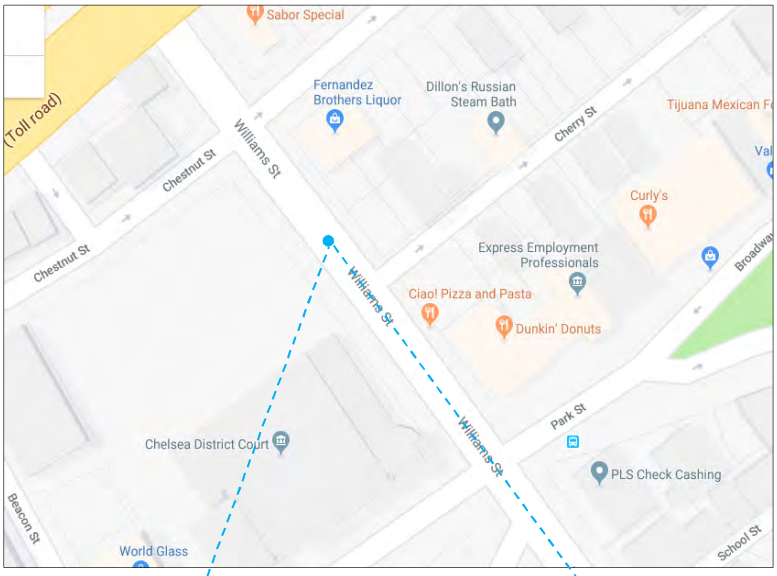
	Thickness		Value	(RF)	SN
Bit. Conc.....	3.75	in.	0.44	60	0.66
Sand Asphalt.....	0.00	in.	0.40	60	0.00
Premix Base.....	0.00	in.	0.34	60	0.00
Penetrated Stone.....	0.00	in.	0.24	-	0.00
Cobblestone.....	5.00	in.	0.21	-	1.05
Silty Gravel Borrow.....	0.00	in.	0.10	-	0.00
Gravel.....	0.00	in.	0.06	-	0.00
Silty Gravel.....	0.00	in.	0.08	-	0.00
Silty Sand.....	0.00	in.	0.04	-	0.00

TOTAL INFLUENCE = 8.75 TOTAL SN = 1.71

SITE LOCATION AND TEST PIT PROFILE

LOCATION: Williams St
FROM: Chestnut St.
TO: Pearl St.

LENGTH (FT): 1017
WIDTH (FT): 37
AREA (SY): 4181



CORE **15**

140' S of Chestnut St.; 5' off E curb

CORE **15**	**DEPTH**	**CLASSIFICATION**
Bit Conc	3.75	Bituminous Concrete
Cobble	5"	Cobblestone

Memo

To:	Jennifer Ducey, PE Boston, MA	From:	John Hayden, PE Burlington, MA
File:	179410441	Date:	June 13, 2018

Reference: Construction Cost Estimate, Beacham/Williams Street Corridor Study, Chelsea, MA

Stantec developed programming level estimates of probable construction cost for the full build of the concept designs presented for each character area. The estimates include the corridor-wide improvements and any specific improvements recommended for each character area. The estimates will need to be refined depending on the selected construction phasing strategy to address any overlaps in construction items, and therefore costs.

All estimates are based on current MassDOT District 6 unit bid prices as of January 18, 2018. The estimates also include a 30% contingency for design details yet to be determined, allowances for contract administration and traffic police, and a flat inflation rate of 3% per year compounded annually for 4 years to 2022 to account for expected increases in the cost of construction.

The cost estimates do not include any costs associated with ROW acquisition, utility relocation force accounts, or design development.

The full build construction cost estimates for each character area are as follows:

- **Area A** – Everett City Line to Mulberry Street (3,050 Feet) = $8,300,000
- **Area B** – Mulberry Street to Chestnut Street (750 feet, including the Mulberry Street intersection) = $1,900,000
- **Area C** – Chestnut Street to Winnisimmet Street (850 feet, including the Chestnut and Winnisimmet Street intersections) = $2,800,000
- **Area D** – Winnisimmet Street to Pearl Street (360 feet, including the Pearl Street intersection) = $1,400,000

STANTEC CONSULTING SERVICES INC.

John Hayden, PE
Senior Transportation Engineer
Phone: (781) 221-1198
John.Hayden2@stantec.com

Attachment: Conceptual Engineers Estimates (4 sheets), dated June 13, 2018

s:\1794\active\179410441\design\conceptual estimate\2018_recommended_concept\chelsea_bw_cost estimate_memo_20180613.docx

BEACHAM/WILLIAMS STREET CORRIDOR
CHELSEA, MASSACHUSETTS

Stantec Consulting Services Inc.
226 Causeway Street, Boston, Massachusetts 02114

ESTIMATE OF QUANTITIES - CONCEPTUAL ENGINEERS ESTIMATE
PREPARED BY: STANTEC CONSULTING SERVICES INC.
DATE June 13, 2018

SECTION A - CITY LINE TO MULBERRY STREET (3,050 Feet)

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
120.	EARTH EXCAVATION	CY	12,100	$ 32.00	$ 387,200.00
151.	GRAVEL BORROW	CY	5,300	$ 40.00	$ 212,000.00
170.	FINE GRADING AND COMPACTING	SY	17,800	$ 3.50	$ 62,300.00
1XX	DISPOSAL OF REGULATED SOIL - IN-STATE	TON	2,500	$ 85.00	$ 212,500.00
1XX	DISPOSAL OF HAZAROUS MATERIALS	TON	2,500	$ 350.00	$ 875,000.00
201.	CATCH BASIN	EA	27	$ 3,700.00	$ 99,900.00
202.	MANHOLE	EA	14	$ 4,700.00	$ 65,800.00
220.7	SANITARY STRUCTURE ADJUSTED	EA	14	$ 400.00	$ 5,600.00
221.	FRAME AND COVER	EA	14	$ 800.00	$ 11,200.00
222.	FRAME AND GRATE	EA	27	$ 865.00	$ 23,355.00
241.12	12 INCH REINFORCED CONCRETE PIPE	FT	650	$ 105.00	$ 68,250.00
241.18	18 INCH REINFORCED CONCRETE PIPE	FT	3,210	$ 110.00	$ 353,100.00
376.	HYDRANT	EA	10	$ 5,100.00	$ 51,000.00
402.	DENSE GRADED CRUSHED STONE FOR SUB-BASE	CY	1,370	$ 65.00	$ 89,050.00
450.90	CONTRACTOR QUALITY CONTROL	TON	4,420	$ 2.70	$ 11,934.00
452.	ASPHALT EMULSION FOR TACK COAT	GAL	1,040	$ 8.75	$ 9,100.00
453.	HMA JOINT SEALANT	FT	3,300	$ 1.00	$ 3,300.00
455.23	SUPERPAVE SURFACE COURSE 12.5 (SSC-12.5)	TON	970	$ 125.00	$ 121,250.00
455.32	SUPERPAVE INTERMEDIATE COURSE 19.0 (SIC-19.0)	TON	1,240	$ 140.00	$ 173,600.00
455.42	SUPERPAVE BASE COURSE 37.5 (SBC-37.5)	TON	2,210	$ 100.00	$ 221,000.00
506.	GRANITE CURB TYPE VB - STRAIGHT	FT	6,500	$ 32.00	$ 208,000.00
701.	CEMENT CONCRETE SIDEWALK	SY	4,000	$ 47.00	$ 188,000.00
702.	HOT MIX ASPHALT WALK SURFACE	TON	500	$ 185.00	$ 92,500.00
748.	MOBILIZATION	LS	1	$ 106,500.00	$ 106,500.00
756.	NPDES STORMWATER POLLUTION PREVENTION PLAN	LS	1	$ 4,000.00	$ 4,000.00
7XX	TREE	EA	40	$ 600.00	$ 24,000.00
815.11	TRAFFIC CONTROL SIGNAL - LOCATION NO. 1 - SPRUCE STREET	LS	1	$ 250,000.00	$ 250,000.00
815.925	ADAPTIVE CONTROL TECHNOLOGY	LS	1	$ 30,000.00	$ 30,000.00
8XX	ROADWAY LIGHTING (INDEPENDENT SYSTEM)	LS	1	$ 915,000.00	$ 915,000.00
866.106	6 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	FT	6,500	$ 1.00	$ 6,500.00
867.106	6 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	FT	6,500	$ 1.00	$ 6,500.00
			SUBTOTAL		**$ 4,887,439.00**
			30% CONTINGENCY		$ 1,466,231.70
			CONTRACT ADMINISTRATION (10%)		$ 488,743.90
			TRAFFIC POLICE (10%)		$ 488,743.90
			UTILITY FORCE ACCOUNT		TO BE DETERMINED BY CITY
			TOTAL		$ 7,331,158.50
			ESCALLATION ALLOWANCE (3% PER YEAR, 4 YEARS TO 2022)		$ 920,124.98
			TOTAL		**$ 8,251,283.48**
			SAY		**$ 8,300,000**

NOTE: UNIT PRICES BASED ON MASSDOT WEBSITE FOR DISTRICT 6 (CHART PRICES) ON 18 JANUARY 2018

BEACHAM / WILLIAMS STREET CORRIDOR
CHELSEA, MASSACHUSETTS

Stantec Consulting Services Inc.
226 Causeway Street, Boston, Massachusetts 02114

ESTIMATE OF QUANTITIES - CONCEPTUAL ENGINEERS ESTIMATE
PREPARED BY: STANTEC CONSULTING SERVICES INC.
DATE June 13, 2018

SECTION B - MULBERRY STREET TO CHESTNUT STREET (750 Feet)

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
120.	EARTH EXCAVATION	CY	3,600	$ 32.00	$ 115,200.00
151.	GRAVEL BORROW	CY	1,600	$ 40.00	$ 64,000.00
170.	FINE GRADING AND COMPACTING	SY	5,300	$ 3.50	$ 18,550.00
1XX	DISPOSAL OF REGULATED SOIL - IN-STATE	TON	685	$ 85.00	$ 58,225.00
1XX	DISPOSAL OF HAZARDOUS MATERIALS	TON	685	$ 350.00	$ 239,750.00
201.	CATCH BASIN	EA	7	$ 3,700.00	$ 25,900.00
202.	MANHOLE	EA	4	$ 4,700.00	$ 18,800.00
220.7	SANITARY STRUCTURE ADJUSTED	EA	4	$ 400.00	$ 1,600.00
221.	FRAME AND COVER	EA	4	$ 800.00	$ 3,200.00
222.	FRAME AND GRATE	EA	7	$ 865.00	$ 6,055.00
241.12	12 INCH REINFORCED CONCRETE PIPE	FT	160	$ 105.00	$ 16,800.00
241.18	18 INCH REINFORCED CONCRETE PIPE	FT	790	$ 110.00	$ 86,900.00
376.	HYDRANT	EA	2	$ 5,100.00	$ 10,200.00
402.	DENSE GRADED CRUSHED STONE FOR SUB-BASE	CY	700	$ 65.00	$ 45,500.00
450.90	CONTRACTOR QUALITY CONTROL	TON	1,280	$ 2.70	$ 3,456.00
452.	ASPHALT EMULSION FOR TACK COAT	GAL	300	$ 8.75	$ 2,625.00
453.	HMA JOINT SEALANT	FT	1,600	$ 1.00	$ 1,600.00
455.23	SUPERPAVE SURFACE COURSE 12.5 (SSC-12.5)	TON	280	$ 125.00	$ 35,000.00
455.32	SUPERPAVE INTERMEDIATE COURSE 19.0 (SIC-19.0)	TON	360	$ 140.00	$ 50,400.00
455.42	SUPERPAVE BASE COURSE 37.5 (SBC-37.5)	TON	640	$ 100.00	$ 64,000.00
506.	GRANITE CURB TYPE VB - STRAIGHT	FT	3,200	$ 32.00	$ 102,400.00
701.	CEMENT CONCRETE SIDEWALK	SY	1,400	$ 47.00	$ 65,800.00
702.	HOT MIX ASPHALT WALK SURFACE	TON	200	$ 185.00	$ 37,000.00
748.	MOBILIZATION	LS	1	$ 32,400.00	$ 32,400.00
756.	NPDES STORMWATER POLLUTION PREVENTION PLAN	LS	1	$ 4,000.00	$ 4,000.00
7XX	TREE	EA	10	$ 600.00	$ 6,000.00
8XX	LIGHTING	LS	2,500	$ -	$ -
8XY	PEDESTRIAN LIGHTING	LS	2,500	$ -	$ -
866.106	6 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	FT	1,600	$ 1.00	$ 1,600.00
867.106	6 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	FT	1,600	$ 1.00	$ 1,600.00
			SUBTOTAL		**$ 1,118,561.00**
			30% CONTINGENCY		$ 335,568.30
			CONTRACT ADMINISTRATION (10%)		$ 111,856.10
			TRAFFIC POLICE (10%)		$ 111,856.10
			UTILITY FORCE ACCOUNT		
			TOTAL		$ 1,677,841.50
			ESCALLATION ALLOWANCE (3% PER YEAR, 4 YEARS TO 2022)		$ 210,583.89
			TOTAL		**$ 1,888,425.39**
			SAY		**$ 1,900,000**

NOTE: UNIT PRICES BASED ON MASSDOT WEBSITE FOR DISTRICT 6 (CHART PRICES) ON 18 JANUARY 2018

BEACHAM / WILLIAMS STREET CORRIDOR
CHELSEA, MASSACHUSETTS

Stantec Consulting Services Inc.
226 Causeway Street, Boston, Massachusetts 02114

ESTIMATE OF QUANTITIES - CONCEPTUAL ENGINEERS ESTIMATE
PREPARED BY: STANTEC CONSULTING SERVICES INC.
DATE June 13, 2018

SECTION C - CHESTNUT STREET TO WINNISIMMET STREET (850 Feet)

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
120.	EARTH EXCAVATION	CY	3,400	$ 32.00	$ 108,800.00
151.	GRAVEL BORROW	CY	1,500	$ 40.00	$ 60,000.00
170.	FINE GRADING AND COMPACTING	SY	5,000	$ 3.50	$ 17,500.00
1XX	DISPOSAL OF REGULATED SOIL - IN-STATE	TON	695	$ 85.00	$ 59,075.00
1XX	DISPOSAL OF HAZARDOUS MATERIALS	TON	695	$ 350.00	$ 243,250.00
201.	CATCH BASIN	EA	8	$ 3,700.00	$ 29,600.00
202.	MANHOLE	EA	5	$ 4,700.00	$ 23,500.00
220.7	SANITARY STRUCTURE ADJUSTED	EA	5	$ 400.00	$ 2,000.00
221.	FRAME AND COVER	EA	5	$ 800.00	$ 4,000.00
222.	FRAME AND GRATE	EA	8	$ 865.00	$ 6,920.00
241.12	12 INCH REINFORCED CONCRETE PIPE	FT	180	$ 105.00	$ 18,900.00
241.18	18 INCH REINFORCED CONCRETE PIPE	FT	900	$ 110.00	$ 99,000.00
376.	HYDRANT	EA	2	$ 5,100.00	$ 10,200.00
402.	DENSE GRADED CRUSHED STONE FOR SUB-BASE	CY	660	$ 65.00	$ 42,900.00
450.90	CONTRACTOR QUALITY CONTROL	TON	1,480	$ 2.70	$ 3,996.00
452.	ASPHALT EMULSION FOR TACK COAT	GAL	310	$ 8.75	$ 2,712.50
453.	HMA JOINT SEALANT	FT	1,800	$ 1.00	$ 1,800.00
455.23	SUPERPAVE SURFACE COURSE 12.5 (SSC-12.5)	TON	290	$ 125.00	$ 36,250.00
455.32	SUPERPAVE INTERMEDIATE COURSE 19.0 (SIC-19.0)	TON	370	$ 140.00	$ 51,800.00
455.42	SUPERPAVE BASE COURSE 37.5 (SBC-37.5)	TON	820	$ 100.00	$ 82,000.00
506.	GRANITE CURB TYPE VB - STRAIGHT	FT	1,800	$ 32.00	$ 57,600.00
701.	CEMENT CONCRETE SIDEWALK	SY	1,400	$ 47.00	$ 65,800.00
702.	HOT MIX ASPHALT WALK SURFACE	TON	-	$ 185.00	$ -
748.	MOBILIZATION	LS	1	$ 31,000.00	$ 31,000.00
756.	NPDES STORMWATER POLLUTION PREVENTION PLAN	LS	1	$ 4,000.00	$ 4,000.00
7XX	TREE	EA	10	$ 600.00	$ 6,000.00
815.12	TRAFFIC CONTROL SIGNAL - LOCATION NO. 2 - CHESTNUT ST	LS	1	$ 250,000.00	$ 250,000.00
815.13	TRAFFIC CONTROL SIGNAL - LOCATION NO. 3 - BROADWAY	LS	1	$ 250,000.00	$ 250,000.00
815.925	ADAPTIVE CONTROL TECHNOLOGY	LS	1	$ 60,000.00	$ 60,000.00
8XX	LIGHTING	LS	2,500	$ -	$ -
8XY	PEDESTRIAN LIGHTING	LS	2,500	$ -	$ -
866.106	6 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	FT	3,600	$ 1.00	$ 3,600.00
867.106	6 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	FT	1,800	$ 1.00	$ 1,800.00
			SUBTOTAL		**$ 1,634,003.50**
			30% CONTINGENCY		$ 490,201.05
			CONTRACT ADMINISTRATION (10%)		$ 163,400.35
			TRAFFIC POLICE (10%)		$ 163,400.35
			UTILITY FORCE ACCOUNT		
			TOTAL		$ 2,451,005.25
			ESCALLATION ALLOWANCE (3% PER YEAR, 4 YEARS TO 2022)		$ 307,622.75
			TOTAL		**$ 2,758,628.00**
			SAY		**$ 2,800,000**

NOTE: UNIT PRICES BASED ON MASSDOT WEBSITE FOR DISTRICT 6 (CHART PRICES) ON 18 JANUARY 2018

BEACHAM / WILLIAMS STREET CORRIDOR
CHELSEA, MASSACHUSETTS

Stantec Consulting Services Inc.
226 Causeway Street, Boston, Massachusetts 02114

ESTIMATE OF QUANTITIES - CONCEPTUAL ENGINEERS ESTIMATE
PREPARED BY: STANTEC CONSULTING SERVICES INC.
DATE June 13, 2018

SECTION D - WINNISIMMET STREET TO PEARL STREET (360 Feet)

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT PRICE	AMOUNT
120.	EARTH EXCAVATION	CY	1,500	$ 32.00	$ 48,000.00
151.	GRAVEL BORROW	CY	700	$ 40.00	$ 28,000.00
170.	FINE GRADING AND COMPACTING	SY	2,100	$ 3.50	$ 7,350.00
1XX	DISPOSAL OF REGULATED SOIL - IN-STATE	TON	300	$ 85.00	$ 25,500.00
1XX	DISPOSAL OF HAZARDOUS MATERIALS	TON	300	$ 350.00	$ 105,000.00
201.	CATCH BASIN	EA	4	$ 3,700.00	$ 14,800.00
202.	MANHOLE	EA	3	$ 4,700.00	$ 14,100.00
220.7	SANITARY STRUCTURE ADJUSTED	EA	3	$ 400.00	$ 1,200.00
221.	FRAME AND COVER	EA	3	$ 800.00	$ 2,400.00
222.	FRAME AND GRATE	EA	4	$ 865.00	$ 3,460.00
241.12	12 INCH REINFORCED CONCRETE PIPE	FT	90	$ 105.00	$ 9,450.00
241.18	18 INCH REINFORCED CONCRETE PIPE	FT	380	$ 110.00	$ 41,800.00
376.	HYDRANT	EA	10	$ 5,100.00	$ 51,000.00
402.	DENSE GRADED CRUSHED STONE FOR SUB-BASE	CY	280	$ 65.00	$ 18,200.00
450.90	CONTRACTOR QUALITY CONTROL	TON	760	$ 2.70	$ 2,052.00
452.	ASPHALT EMULSION FOR TACK COAT	GAL	160	$ 8.75	$ 1,400.00
453.	HMA JOINT SEALANT	FT	800	$ 1.00	$ 800.00
455.23	SUPERPAVE SURFACE COURSE 12.5 (SSC-12.5)	TON	150	$ 125.00	$ 18,750.00
455.32	SUPERPAVE INTERMEDIATE COURSE 19.0 (SIC-19.0)	TON	190	$ 140.00	$ 26,600.00
455.42	SUPERPAVE BASE COURSE 37.5 (SBC-37.5)	TON	420	$ 100.00	$ 42,000.00
506.	GRANITE CURB TYPE VB - STRAIGHT	FT	800	$ 32.00	$ 25,600.00
701.	CEMENT CONCRETE SIDEWALK	SY	600	$ 47.00	$ 28,200.00
702.	HOT MIX ASPHALT WALK SURFACE	TON	-	$ 185.00	$ -
748.	MOBILIZATION	LS	1	$ 15,600.00	$ 15,600.00
756.	NPDES STORMWATER POLLUTION PREVENTION PLAN	LS	1	$ 4,000.00	$ 4,000.00
7XX	TREE	EA	5	$ 600.00	$ 3,000.00
815.14	TRAFFIC CONTROL SIGNAL - LOCATION NO. 4 - PEARL	LS	1	$ 250,000.00	$ 250,000.00
815.925	ADAPTIVE CONTROL TECHNOLOGY	LS	1	$ 30,000.00	$ 30,000.00
8XX	LIGHTING	LS	2,500	$ -	$ -
8XY	PEDESTRIAN LIGHTING	LS	2,500	$ -	$ -
866.106	6 INCH REFLECTORIZED WHITE LINE (THERMOPLASTIC)	FT	800	$ 1.00	$ 800.00
867.106	6 INCH REFLECTORIZED YELLOW LINE (THERMOPLASTIC)	FT	800	$ 1.00	$ 800.00
			SUBTOTAL		**$ 819,862.00**
			30% CONTINGENCY		$ 245,958.60
			CONTRACT ADMINISTRATION (10%)		$ 81,986.20
			TRAFFIC POLICE (10%)		$ 81,986.20
			UTILITY FORCE ACCOUNT		
			TOTAL		$ 1,229,793.00
			ESCALLATION ALLOWANCE (3% PER YEAR, 4 YEARS TO 2022)		$ 154,349.86
			TOTAL		**$ 1,384,142.86**
			SAY		**$ 1,400,000**

NOTE: UNIT PRICES BASED ON MASSDOT WEBSITE FOR DISTRICT 6 (CHART PRICES) ON 18 JANUARY 2018