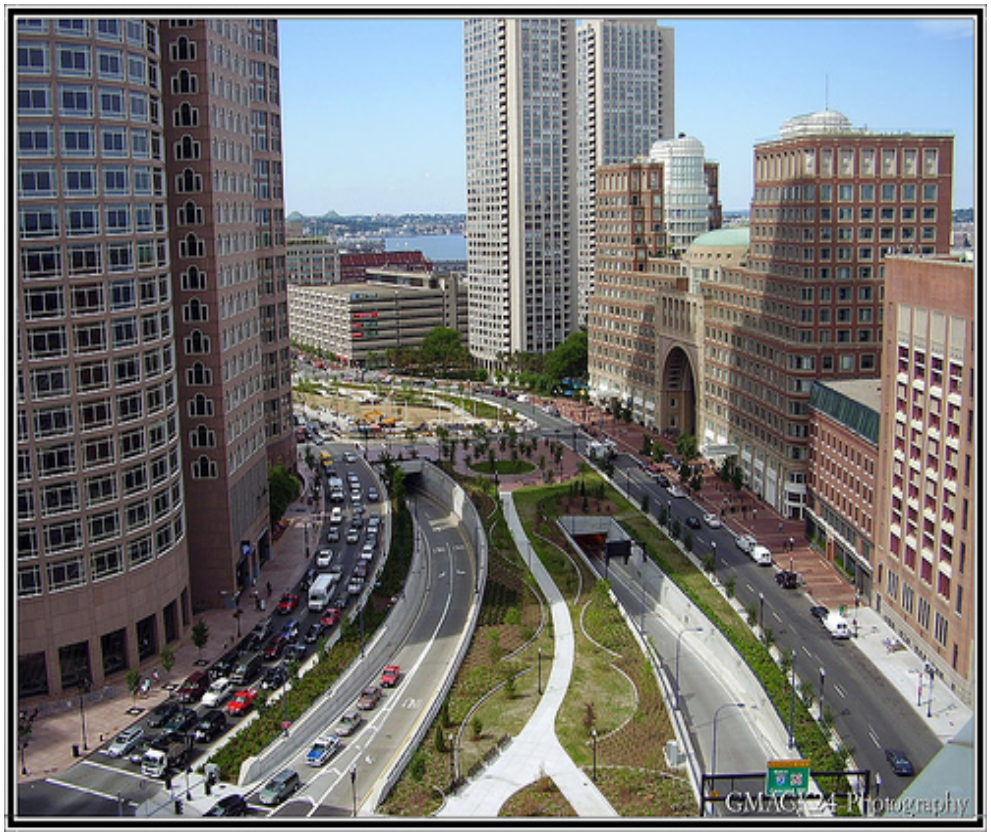
Harbor Ride

Wharf District
Boston, MA



Senior Design Project
Transportation Engineering

Final Report
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1.0 Introduction

Bicycling is a completely sustainable form of travel and has yet to be sufficiently implemented into urban design. Space should be better utilized to accommodate more than just vehicular and pedestrian traffic. The growing concern for sustainability is driving more people to find other means of transportation.

To optimize safety and comfort for all travel modes, bicyclists must have their own separate facilities. In the Wharf District there is an especially high demand for bicycle accommodation for both commuting and recreational purposes. Being adjacent to the central business district and a critical link between the city and the harbor, this area serves as a travel route for many people. Also, because of Boston's rich history and attractions, the Wharf District is an icon for tourism. The street layout of the area creates a corridor for north-south travel and the level terrain is very suitable. The Wharf District is a critical civic space for downtown Boston, and the need for a bicycle route parallel to the shore is unquestionable.

The proposed *Harbor Ride* bicycle trail is a separated two-way cycle track cycle track between the South Station area and the North End (Figure 1). Our design demonstrates the feasibility of utilizing space in the street at South Station and Commercial Street in the North End through traffic capacity analysis. In sections of Atlantic Avenue where in-street accommodations are impractical, the trail is designed through the Rose Kennedy Greenway in locations that do not interfere with other elements of the park. Our proposed *Harbor Ride* bicycle trail makes connections to existing and future bicycle networks. Our design aims to be low cost and implemented in the short term. Changes in street configuration have little to no impact on delay or intersection capacity.

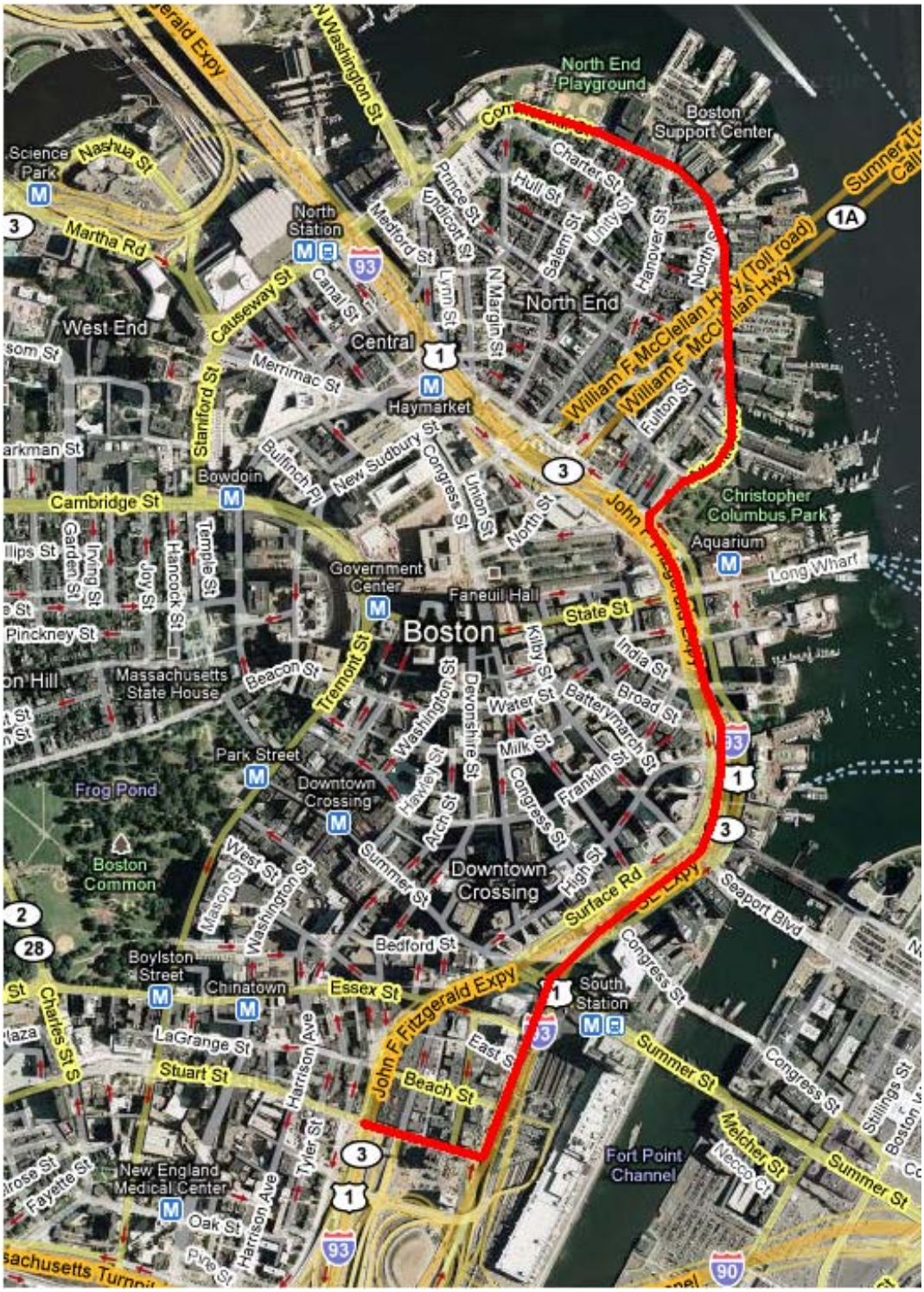


Figure 1 – Site Map

2.0 Need for Trail

In order for Boston to become a leader in bicycle accommodation, routes must be provided for the bicycling public. The existing bicycle network is missing a critical link in the surrounding area and the benefits to public and environmental health are invaluable. Furthermore, the proposed *Harbor Ride* route will promote sustainable travel and increase ridership by creating separation from pedestrians and vehicles.

2.1 *Network Connectivity*

Figure 2 illustrates the existing links that the *Harbor Ride* trail makes connections to. For bicyclists coming into the harbor area from exiting links in South Boston, Charlestown, and the South End area, there is a necessity for continuous service.

Currently, the Harbor Walk Trail shadows the Boston Harbor shoreline in the North End and the Wharf District. The Harbor Walk Trail includes space for bicyclists around North Station and the North End Playground, but it transitions into an exclusive pedestrian path just after the playground (#1 on Figure 2). Bicyclists riding along the Harbor Walk Trail coming from the North Station area are then forced into the street or onto the sidewalks.

Bicyclists using the Northern Ave Bridge to get to and from South Boston also are in need of connections to the surrounding area. Our team has designed the *Harbor Ride* to provide trail access to this critical link (#2 on Figure 2).

Furthermore, future plans are in place to convert Dorchester Avenue along the Fort Point Channel into an esplanade for public space (#3 on Figure 2). Making a connection to here will provide bicyclists with safe and easy access to a valuable civic space.

The South Bay Harbor Trail runs parallel to the Southeast Expressway. The South Bay Harbor Trail terminates at the intersection of Kneeland Street. Bicyclists at this point are forced into the street or onto the sidewalks (#4 on Figure 2). A bike path connecting the South Bay Harbor Trail and Harbor Walk Trail is desperately needed to enhance Boston's bicycle network. The proposed design caters to this need by providing a route connecting these two terminals.

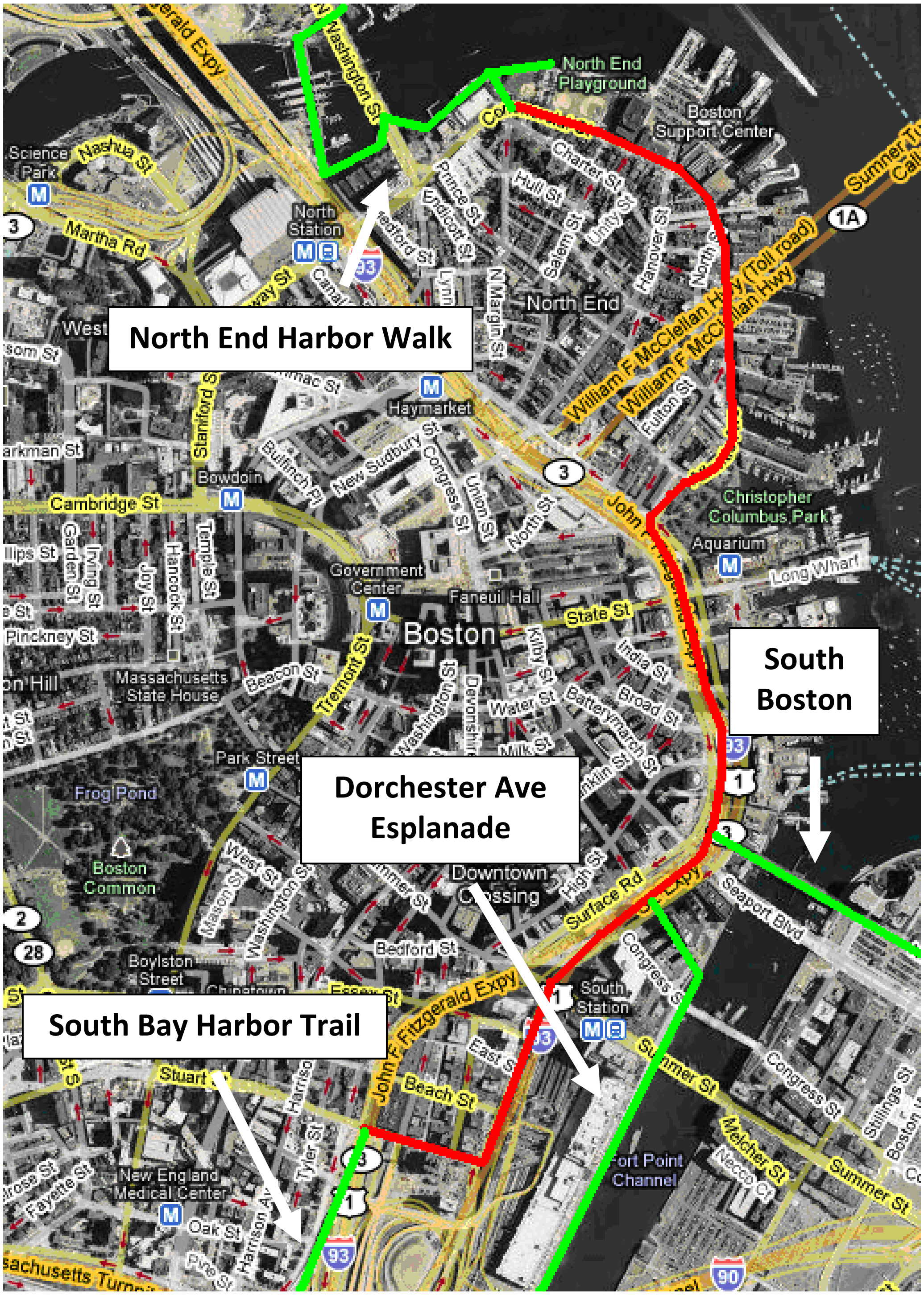


Figure 2 – Network Connections

2.2 *Public Health Benefits*

A well designed bike path would offer many benefits to both bicyclists and the local community. The health of path users would be improved with the added fitness potential. The Massachusetts Bicycle Coalition compiled the following facts showing the health benefits that bicycling offers (Figure 3):

- A 15-minute bike ride to and from work five times a week burns off the equivalent of 11 pounds of fat in a year
- 64% of adults and over 15% of kids are overweight, resulting in 300,000 premature deaths and a cost to society of $117 billion/year
- More than 50% of adults do not get enough physical activity to provide health benefits; 26% are not active in their leisure time at all
- Inactivity is a factor in 10% of total deaths and 25% chronic disease related deaths
- On 350 calories – one apple tart – a cyclist can travel 10 miles, a pedestrian 3.5 miles, and an automobile 100 feet

Figure 3 – Bicycling Public Health Benefits
Source: Massachusetts Bicycle Coalition

A bike path also adds the potential to reduce vehicles on the road. The community would therefore benefit from the decrease in air pollution. Fewer vehicles on the road also have the potential to reduce road congestion. The decrease in traffic volumes, speeds and noise associated with congestion could increase the livability of the community, decrease stress, and possibly decrease bicycle injuries from vehicle collisions.

2.3 *Environmental Benefits*

Along with health and recreation benefits, the environmental benefits bicycling offers are significant. Bicycling is known to be the most efficient form of transportation. Bicycling reduces the dependence on oil, and reduces air and greenhouse gas pollution. Massachusetts Bicycle Coalition compiled the following facts showing the environmental benefits that bicycling offers (Figure 4):

- A short, four-mile round trip by bicycle keeps about 15 pounds of pollutants out of the air we breathe
- If an average person biked to work or shopping once every two weeks instead of driving, it could prevent the pollution of close to one billion gallons of gasoline entering the atmosphere every year
- Since 1982, the time Americans spend in traffic has increased by 236%
- Boston drivers wasted 40 million gallons of gasoline sitting in traffic in 1982; by 2002, the number had increased to 130 million gallons
- Short car trips–which can easily by bicycled–are more polluting on a per mile basis than longer trips
- Motor vehicle exhaust contributes to as much as 95% of carbon monoxide pollution in urban areas
- Air pollution contributes to the deaths of more people nationwide than breast and prostate cancers combined
- Diesel engine emissions are responsible for 125,000 cancers nationwide, including an estimated 2,900 in Boston alone

Figure 4 – Bicycling Environmental Benefits

Source: Massachusetts Bicycle Coalition

2.4 *Pedestrian Separation*

An effective bicycle accommodation plan allows for an effective incorporation of a bike path into an existing transportation network. Boston is an extremely popular tourist destination. Aside from these tourists who often prefer to walk, residents and the high population of business people in the area account for the high pedestrian traffic of the area. Because Boston is considered a walking city, the design of a bike path must consider the needs of pedestrians.

In order to be considered effective, a bicycle route must mitigate hindrances to pedestrians. There are many pedestrian generators along the proposed route which the design must be wary of. Perhaps the greatest pedestrian demand comes from the South Station. South Station is located in the business district of Boston and serves a great number of pedestrians every day. Government Center, The Christopher Columbus Park, The North End Playground and the Harbor Walk trail are all attractions serving pedestrians.

The proposed design aims to keep potential bike-pedestrian conflicts to a minimum. This is done by favoring a bike path separated from pedestrian sidewalks wherever possible. Any conflict points were identified and appropriate countermeasures were applied.

2.5 *Promote Alternative Transportation*

Providing a bike path would also provide the public with an opportunity to avoid the hassles associated with traffic (parking, congestion etc). The unlicensed public (or public without access to a car) may also benefit from a bike path. Children and the poor would be granted added mobility with the installation of a bike path.

Also, local residents and/or commuters with a trip end along the proposed route would no longer have to spend money (driving, MBTA or taxi) to get to their destination. The proposed design connects many potential trip ends such as South Station, North Station, and any of the wharfs. Any commuter with a trip end along the proposed route would be able to bike to their final destination.

A well designed bike path allows the public to substitute bicycle trips instead of other transportation modes for short to medium distance excursions.

2.6 *Safety Benefits*

Bicycle safety is very important. They must fight with the faster moving vehicular traffic and high pedestrian volumes. These cyclists are subjected to the dangers imposed with a substandard form of bicycle accommodation, commuter bicyclists especially. Bicyclists on the road at the PM peak period (typically commuters) were the subjects of the highest number of crashes by hour between 2001 and 2003 (Figure 5).

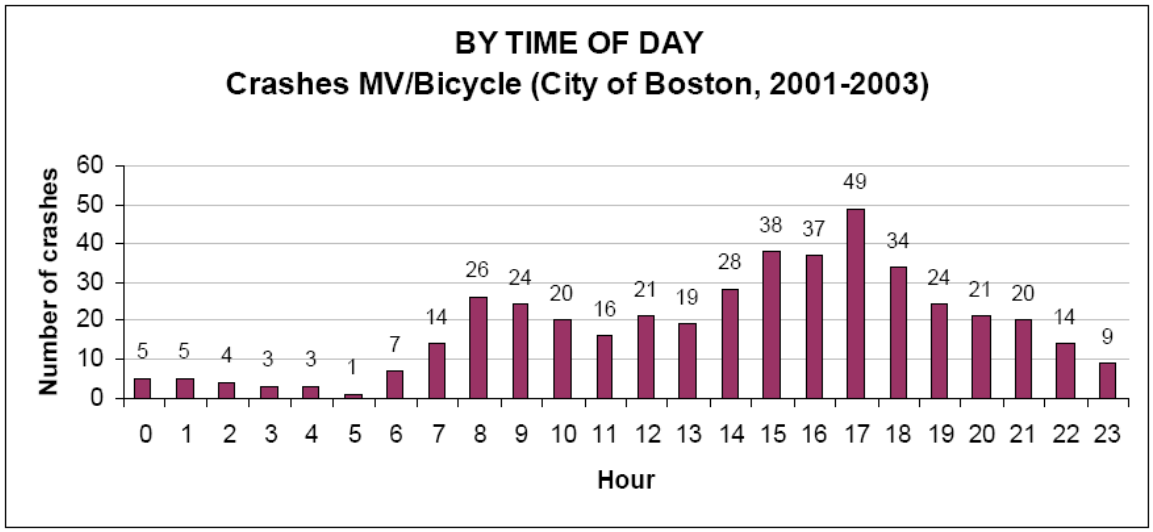


Figure 5 – Bicycle Crashes by Time of Day
Source: Jeff Rosenblum, Livable Streets Alliance

A separated bike path is needed to effectively accommodate the bicycles and separate them from the dangers that they are currently facing in this area.

3.0 Intended Users

The proposed bicycle path of this design aims to serve many forms of the bicycling public. Bicycle paths serve commuter, tourist, recreational and local resident bicyclists. People arriving to Boston by bus or train at North Station are able to bike to their next destination. Also, people arriving by ferry boat at either Rowes of Long Wharf will have the same option. The needs of each of these forms must be incorporated into the design.

3.1 *Tourists- Route to Attractions*

As stated earlier, Boston is a popular tourist destination. Currently, Boston accommodates tourism in many forms of transportation, even going as far as creating a unique form of transportation in the Duck Boat Tours. The many tourist destinations throughout the city should be made bicycle accessible. This proposed design aims to serve the bicycling tourists by providing them a route to access some of the popular attractions along the Boston Harbor. If Boston plans to become a leader in bicycle accommodation, it should anticipate the rise in bicycling tourists and accommodate them accordingly.

3.2 *Recreationalists- Separated and Fun*

This proposed design provides access to the harbor along the Wharf District and the North End. Furthermore, there are several playgrounds along the proposed route where children can play safely. As such, the use of the path by recreationalists is both expected and intended. Bicycling is a popular form of recreation for many people, not just the bicyclists heading to the North End Playground. The proposed path of this design is intended to offer them a safer, easier and more enjoyable way to exercise.

3.3 *Local Residents- Travel Alternative*

As well as commuters, tourists and recreationalists, the proposed path design aims to serve the local residents. Whether the trip is for leisure, errands or travel, the proposed path intends to serve the local residents of Chinatown and The North End. A bike path connecting these areas provides the residents with a new (or perhaps just an improved)

transportation alternative. As discussed earlier, this design hopes to promote the use of alternative transportation which offers many benefits.

4.0 Route Planning

Several locations and designs were in planning our route. Our proposed design is broken up into four different segments that are distinguished by their existing cross sections and design alternatives. Several treatments for each segment are considered and analyzed for safety, feasibility, and consistency. A two-way separated cycle track is preferred throughout the route for consistency, safety and rideability purposes. Traffic analyses were conducted to support the alternatives that involve the reduction of a travel lane.

4.1 *Segment 1 – Kneeland Street*

The proposed bike path starts at the south side of Kneeland Street at Albany Street, continuing the I-93 Bikeway along Albany Street. We first considered the route to begin on Surface Road at Albany Street. We evaluated this street as well as Beach Street, but ultimately chose to use Kneeland Street because we were able to fit the two-way cycle track into existing space without lane reductions or removing parking. Kneeland connects with Atlantic Avenue at its east end.

Figure 6 – Kneeland Street Segment

Existing conditions

Figure 7 – Kneeland St. Existing Conditions Looking East

The starting point of the proposed bike path is located near Chinatown. Kneeland Street is a 5-lane roadway with sidewalks on either side. The south side of the street is industrial, except where there are several basketball courts, and has very little pedestrian traffic. Signalized intersections at Surface Road, Lincoln Street, and Atlantic Ave manage heavy traffic volumes throughout the day.

Alternative Designs

Kneeland A – One-Way Cycle Track on Each Side of Kneeland St:
A proposed one-way cycle track on each side of the street would require a minimum total of 12 ft. By engineering judgment, reducing a lane from Kneeland St. would cause major delays. Reducing lanes to minimum widths gives 7 ft. for the cycle tracks, which is not sufficient for this treatment. Furthermore, bicyclists on the north side of Kneeland are in more conflict with higher volumes of pedestrians and vehicular movements.

Kneeland B – Two-Way Cycle Track on Extended South Sidewalk:

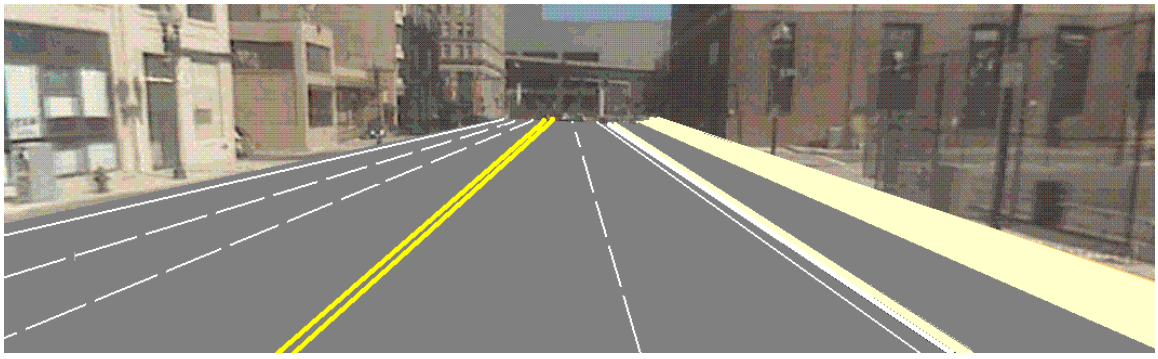


Figure 8 – Kneeland St. Proposed Conditions Looking East

The preferred alternative for this section is a two-way cycle track on the south sidewalk. This design utilizes space in a more efficient manner, while having little to no impact on existing pedestrian or vehicular traffic. A sidewalk extension of 7' provides enough space to accommodate pedestrian and bicycle traffic while maintaining separation. Already 10' wide, this extension will be sufficient for a 2' buffer, 10' two-way cycle track, and 7' pedestrian space. Surfaces for each mode will be different, and bicycle safety is better than Alternative A. The crossing at Atlantic Ave is concurrent with vehicular phasing and reduces delays at the intersection. Additionally, it provides a smooth transition to the Atlantic Ave section of the path.

Intersection of Kneeland Street and Atlantic Avenue:
The issue with this intersection was the location of the cycle track. If it is located on the west side of Kneeland Street, an all pedestrian phase is needed to accommodate the crossing bicycles.

A field measurement was conducted to analyze existing traffic turning movements. The AM peak hour was found to be 7:45AM to 8:45AM. To analyze the traffic conditions during the peak hours, volume-capacity ratios and levels of service can be calculated by Synchro with signal phase timings received from the City of Boston.

Below is a table summarizing the results of incorporating an automatic all-pedestrian phase within the cycle of this intersection (Table 4.1).

TABLE 4.1 Traffic Analysis at Intersection of Kneeland St / Atlantic Ave

Date: 3/27/2009		**Time:**	**7:45 AM**			**To**	**8:45 AM**			
	Existing Condition					**Proposed Condition**				
Route	**Split (s)**	**PHF**	**Vol.**	**v/c**	**LOS**	**Split (s)**	**PHF**	**Vol.**	**v/c**	**LOS**
EBL -Kneeland St	30	0.88	453	0.58	C	21	0.88	453	0.88	D
NBL-Atlantic Ave	70	0.95	197	0.35	C	57	0.95	436	0.81	D
NBT-Atlantic Ave	33	0.88	247	0.46	C	36	0.94	831	0.90	C
NEBL-Atlantic Ave	37	0.95	436	0.89	D	21	0.95	197	0.69	D
NEBT-Atlantic Ave	37	0.94	831	0.76	B	21	0.88	247	0.93	E
Pedestrian	-	-	-	-	-	22	-	-	-	-

The Synchro analysis report shows it is feasible to have an exclusive pedestrian phase for cyclists and pedestrians crossing at this intersection. However, the volume-capacity ratio is increased as much as 0.93 and the 95th percentile volume exceeds capacity. This shows that adding an exclusive pedestrian phase can potentially cause a negative traffic impact during peak hour.

Upon observation, few pedestrians cross at this intersection. Currently, an exclusive pedestrian phase is provided by receiving a signal from pushbutton, and this phase will

be provided after one completed cycle. There will be a large delay for cyclists if they cross Atlantic Ave using this pushbutton.

Cyclist crossings are proposed to be concurrent with eastbound movement in order to accommodate all existing modes (Figure 9). The actuated signals for pedestrians and South Station driveway are to remain the same. The cyclist turning phase will run concurrent with the eastbound signal. A bicycle signal will be added to alert bicycles when it is safe to cross.

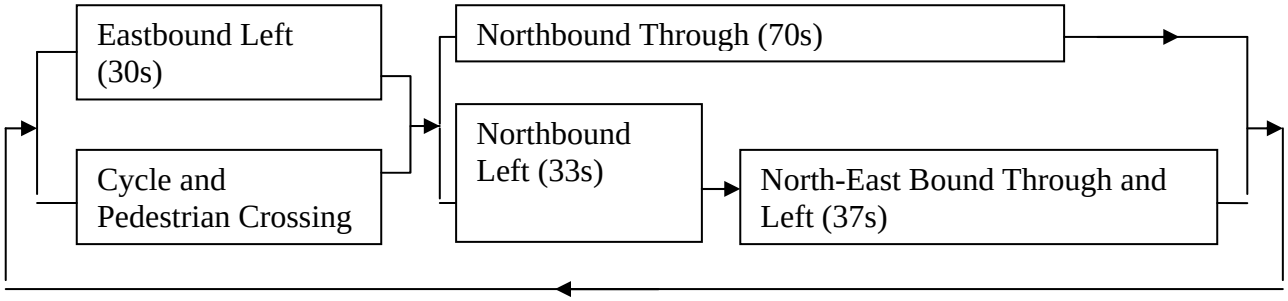


Figure 9 – Kneeland Street Phase Diagram

4.2 *Segment 2 – Atlantic Ave at South Station*

Atlantic Ave, between Kneeland St. and South Station, serves high volumes of pedestrians, bicyclists and vehicles throughout the day. South Station is a hub for bus train, and subway travel in the city. Beach St. and Essex St. serve many vehicles off Atlantic Ave, and Summer St. is also a high volume cross street. Taxis and other vehicles constantly pull in and off the east curb throughout the day. There are high volumes of pedestrians crossing Atlantic Ave. both on the crosswalks and at midblock.

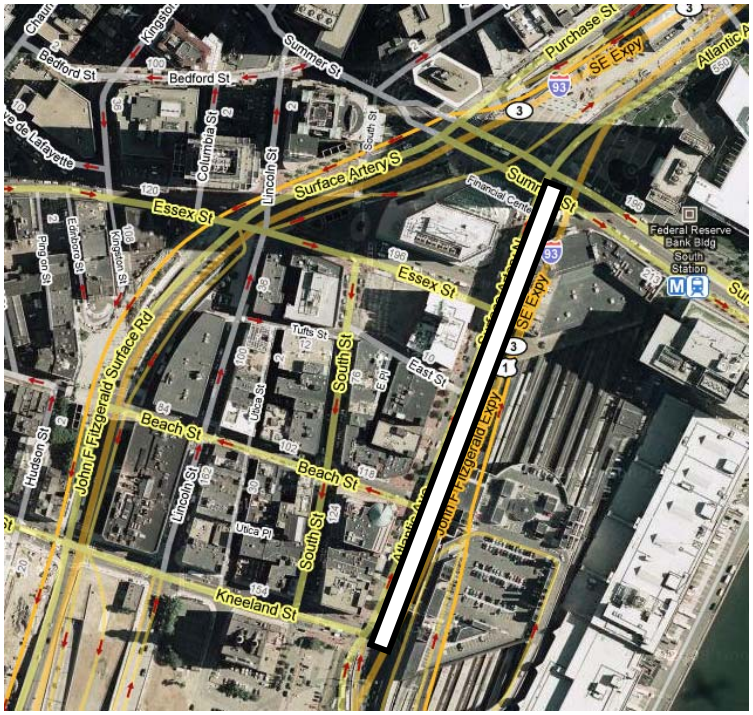


Figure 10 – Atlantic Street at South Station Segment

<u>Existing Conditions</u>

Figure 11 – Atlantic Ave Existing Conditions Looking North

Atlantic Avenue along South Station is 52’ curb-to-curb with 3 northbound lanes and parking on both sides. West side parking is mostly used for commercial vehicles, and there are pairs of bulbouts at the intersections along the section. On the east side there

is a Taxi stand for the majority of the street. There is no pick-up and drop-off area along Atlantic Ave, therefore double parking frequently happens between Essex St and Kneeland St. The double parking destroys the capacity potential of that lane, essentially making Atlantic Avenue 2 travel lanes.

There are high pedestrian volumes around South Station area. They mostly cross Atlantic Ave at Summer St and Beach St. Pedestrians coming from the train station can only get into a taxi at intersection of Essex St because it is the head of the taxi line. Pedestrians leaving the train station have immediate access to the taxi stand.

Alternative Designs

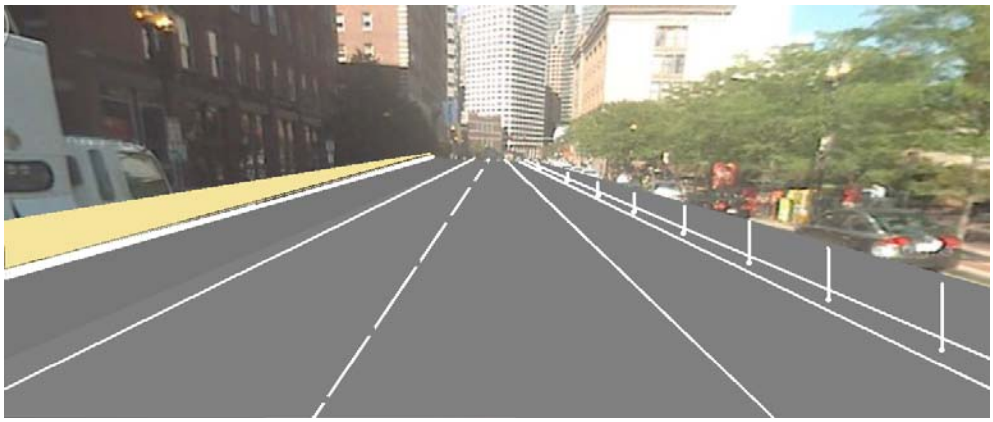


Figure 12 – Atlantic Ave Proposed Conditions Looking North

For this segment, the proposed treatment is a two-way cycle track in the street by reducing Atlantic Avenue to two travel lanes. Intersection capacity analysis shows that two lanes still provide sufficient service to vehicular travel (Appendix B). The alternatives for the cycle track is having it either on the east or west side of the street.

A cycle track on the west side would need to cross three intersecting streets along this segment, creating conflict with turning vehicles. These conflict points increase delay and decrease rider safety. On the east side of Atlantic Avenue, bicyclists would be in conflict with pedestrians getting picked up or dropped off at South Station. Because the cycle track is between the curb and parking, pedestrians need to cross it to get to and from their vehicles. This poses the threat of collision between pedestrians and bicyclists that is a substantial safety concern.

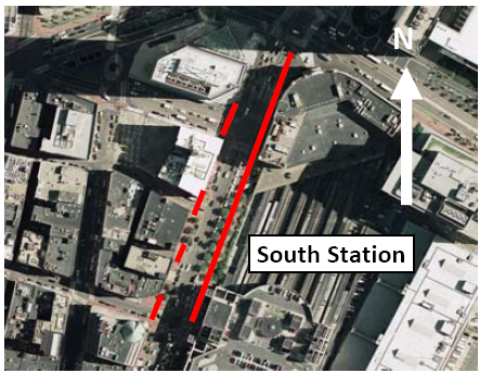
Turning movement counts were done to determine the number on conflicts there would be for a cycle track on the east or west side (see Section 5 for details). Turning movements on both Beach St and Essex St are much larger than the volume of pedestrians getting into or out of taxis, proving the east side to be a safer and more efficient location for bicycle travel (Figure 24).

Figure 24 - Vehicular Turning Movements and Pedestrian Counts
Atlantic Ave at South Station
3/27/2009 7:45 AM - 8:45 AM

West Side

Vehicular Turning Movement		
Beach St.	East St.	Essex St.
150	40	267

Total = 457 (88%)



East Side

Cab	
Ped (in)	Ped (out)
30	32

Total = 62 (12%)

Field measurements during the AM and PM peak hours have done to analyze existing traffic turning movements at the intersection with Summer Street. The AM peak hour is between 7:45AM and 8:45AM and the PM peak hour is between 4:00PM and 5:00PM. The volume-capacity ratio and level of service has been calculated by Synchro with signal phase timings provided by the City of Boston.

4.3 *Segment 3 – Atlantic Ave along the Rose Kennedy Greenway*

The next section to be examined runs from South Station along Atlantic Ave and continues north until reaching the Christopher Columbus Park in the North End. The newly constructed Rose Kennedy Greenway runs along this segment, and is a practical but controversial landscape for bicycle facilities.

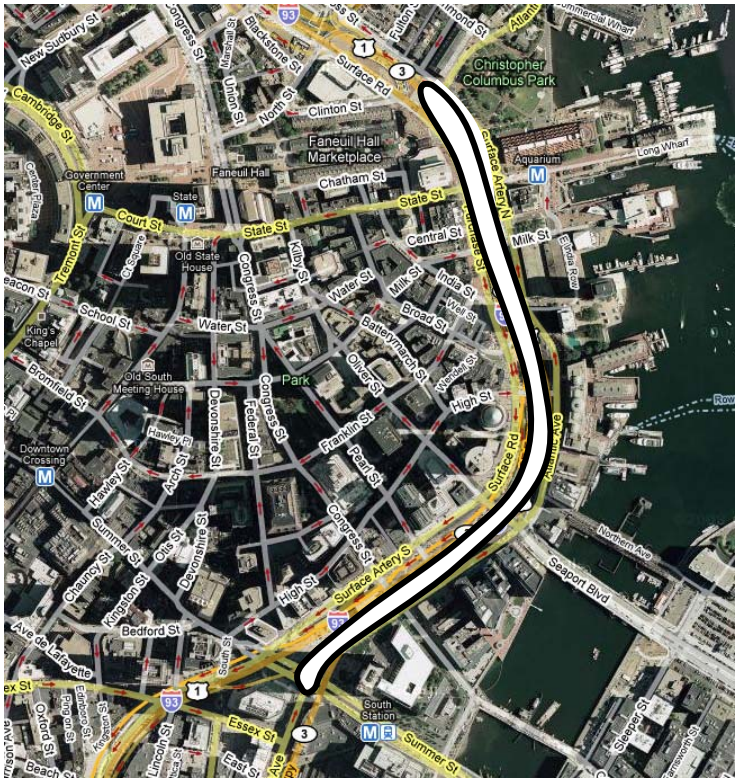


Figure 13 – Atlantic Ave Along Rose Kennedy Greenway Segment

Existing Conditions

Figure 14 – Atlantic Ave Northbound Existing Conditions

Figure 15 – Surface Road Southbound Existing Conditions

Atlantic Avenue runs northbound with either three travel lanes or two travel lanes and a parking lane. Surface Road has three southbound travel lanes and runs parallel with Atlantic Ave. In many locations, sidewalk widths on both streets are more than adequate in accommodating pedestrian traffic and sidewalk furniture. However there are several locations where widths are constraining. The Harbor Hotel has valet parking on the sidewalk and takes up a good portion of pedestrian travel way. Much of the sidewalk along the segment is brick and in great condition. Businesses and the neighboring *Harbor Walk* along the harbor side of Atlantic Ave attract a significant amount of tourism and commerce. The newly constructed Rose Kennedy Greenway runs along this segment and contains pedestrian paths and amenities, green space, and fountains. Bicycling on the Greenway is currently prohibited even though there is more than enough space to accommodate it.

Alternative Designs

We have devised three design alternatives for this segment. Each alternative was analyzed according to space limitations, traffic analysis, safety, and comfort for both bicyclists and drivers. Space provided by Atlantic Avenue, Surface Road and the Rose Kennedy Greenway were analyzed. Spatial requirements or traffic capacity proved to be the constraining issues for each alternative. Parking is prohibited on the section of Surface Road that is being considered, while Atlantic Avenue accommodates it in several locations.

Each alternative was considered with the potential for removing parking on Atlantic Avenue. However, the existing parking sections of the street are critical to nearby destinations and removing them would cause traffic congestion due to illegal parking. The elimination of vehicular access, especially for commercial or delivery vehicles, would also be detrimental to the local businesses of the area. Furthermore, a lane reduction was analyzed for Atlantic Avenue. Traffic analysis at the intersection with

Oliver Street shows that the reduction of a lane would result in an unacceptable level of service (Appendix B).

Alternative 3A – Two-Way Cycle Track on Sidewalk:
In order to fit a cycle track into the existing sidewalk space with adequate buffers, a minimum of 22 feet is desired. At the intersection of High Street and Surface Road, the sidewalk along Surface Road is constricted to 14 feet. At the intersection of State Street and Surface Road, the sidewalk along Surface Road is constricted to 17 feet. Finally, at the intersection of Oliver Street and Surface Road, the sidewalk along Surface Road is constricted to 14 feet as well. These dimensions demonstrate that space for a bike path cannot be found on the sidewalks of Surface road. Furthermore, southbound bicyclists on Surface Road would not be able to easily make the *Harbor Walk* and other bicycle path link connections off of Atlantic Ave.

The sidewalk along Atlantic Ave on the harbor side is wide enough to accommodate a two-way cycle track in some locations, however many areas along the segment are constraining and are wide enough only for pedestrian traffic. The constraining sidewalk width of 13 feet is at Christopher Columbus Park. At Northern Avenue Bridge, the sidewalk along Atlantic Avenue is constrained to 14 feet. At the intersection of Atlantic Avenue near East India Row, the sidewalk along Atlantic Avenue is again constrained to 14 feet. Also, the sidewalk between East India Row and State Street is never wider than 21 feet, which is less than the minimum required dimension. These constraining sections inhibit the placement of a bike path on the sidewalks along Atlantic Avenue. Upon analyzing sidewalk widths along the proposed route, it was clear that the bike route must find space elsewhere.

Alternative 3B – Two-Way Cycle Track using Atlantic Ave for Space:
A minimum of 10’ would be needed for the cycle track and a buffer. Adjusting lane widths cannot produce the needed space. The added space can only be achieved by eliminating a parking lane or travel lane.

Atlantic Avenue has a parking lane between Seaport Boulevard and Milk Street. Eliminating the parking lane in this area is an option. Along with parked cars, buses, limos, trolleys and delivery vehicles would be affected if the parking lane were eliminated.

From Summer Street to Seaport Boulevard and from Atlantic Avenue, has three travel lanes. Traffic analysis shows that eliminating a travel lane is possible at the intersection of Atlantic Avenue and Mercantile Street (Appendix B). However, traffic Synchro software analysis shows that eliminating a lane from Atlantic Avenue is impossible at the intersection of Seaport Boulevard without introducing excessive delay (Appendix B). The three travel lanes for Atlantic Avenue are required for this intersection as well as each upstream intersection back to Summer Street.

Overall the use of Atlantic Avenue is infeasible because it cannot be done throughout the entire segment. Our intersection analyses show that the three travel lanes between Summer Street and Seaport Boulevard are needed to maintain the capacity of the street. Unless another long term solution to parking and capacity needs can be met, it is not practical to use street space for the two-way cycle track.

These alternatives were considered for Surface Road as well. However, all the lanes along the entire stretch of Surface Road were deemed essential and could not be eliminated. Furthermore, placing a cycle track along Surface Road would further remove bicyclists from the attractions and bikeable connections along the Harbor. Therefore, the alternatives utilizing Surface Road were not actively pursued.

Alternative 3C – Two-Way Cycle Track in Rose Kennedy Greenway:
Space for a cycle track was determined to be unavailable both in the street and on the sidewalk, the next alternative for this segment is a two-way cycle track that runs along the Rose Kennedy Greenway.

There is sufficient room along the segment to add a two-way cycle track. Cyclists would have a safer and more relaxed means of travel and have limited interference with vehicular and pedestrian travel. The Greenway is designed for recreation and aesthetics anyway. Pedestrian walkways, planters and grassy areas are currently located within the Greenway. Still, there is plenty of space available for the incorporation of a separated cycle track. The Greenway is roughly 150 feet along the entire segment, which offers more than sufficient space for pedestrians, bicycles and landscaping.

The proposed alignment of the cycle-track is separate from pedestrian paths and other Greenway amenities. Bicyclists currently use the space even though it is prohibited, so providing them their own path is a more than rational solution.

This design does not simply take space from the greenway, but rather incorporates another sustainable and recreational feature into it. Much of the route along the Greenway has little to no major impact on the aesthetics and/or functionality of the Greenway.

Figure 16 – Atlantic St Along Rose Kennedy Greenway Proposed Conditions

4.4 Segment 4 – Commercial Street

This segment funs from the intersection of Atlantic Avenue, Mercantile Street, and Cross Street and heads north along Atlantic Avenue. Atlantic Avenue becomes Commercial Avenue around Lewis Wharf. The path follows Commercial Street and connects to the bikeable section of the *Harbor Walk* trail at the North End Playground.

Figure 17 – Commercial Street Segment

Existing Conditions

The starting point is located at the Western corner of Christopher Columbus Park. Atlantic Avenue and Commercial Street are 4-lane streets with two lanes in each direction. There is on-street parking available on the Southern Approach of Atlantic Avenue at the intersection of Mercantile Street.

The intersections of Atlantic Avenue at Mercantile Street, Atlantic Avenue at Richmond Street, Atlantic Avenue at Commercial Wharf W, Commercial Street at Battery Street, Commercial Street at Hanover Street, and Commercial Street at Foster Street are all signalized intersections. The sidewalks on the harbor side of both streets vary in width but are generally too small to incorporate a separated bike path and keep a comfortable pedestrian walkway.

However, the curb to curb width along Commercial street is very wide (minimum of 60 feet). A freight rail line used to be located on the land that is now Commercial Street. Compared to other streets in the North End, Commercial Street is much wider than is needed to carry the volumes of traffic in the area.

Alternative Designs

Traffic volumes were counted for the intersections of Atlantic Ave/Mercantile St and Commercial St/Hanover St. Synchro software was used to analyze intersection capacity and show the feasibility of eliminating a lane and utilizing that space for an in-street bike path (Appendix B).

All three alternatives consisted of an in-street bike path on the harbor side of Commercial Street. A separated bike path on the harbor side provides an easy transition to the Harbor Walk Trail at the North End Playground (terminal) and has little conflict with vehicles at intersections.

The first alternative consists of one travel lane in each direction with a dual left-turn lane in between. This alternative was discarded because a dual left-turn lane would likely invite illegal parking. Also, dual left-turn lanes are rare in Boston.

For a three-lane cross-section, then, the question was which direction should have 2 lanes and which direction should have only 1. The preferred alternative for this section incorporates two harbor-side travel lanes and with one travel lane in the other direction because volumes are greater in the northbound and because the northbound movement has more left turning traffic. Attached Synchro analysis at the Commercial Street – Hanover Street intersection shows the optimal alternative for this lane reduction (Appendix B).

5.0 Proposed Design

After careful consideration of all alternatives, our team has designed an efficient and feasible trail that ensures safety for bicyclists by maintaining separation from other travel modes in the area. This chapter discusses the proposed treatments for all four major segments of the Harbor Ride trail.

Section 5.1 details the proposed treatments for Kneeland Street. Section 5.2 details the proposed treatments for Atlantic Avenue along South Station. Section 5.3 details the proposed treatments for the Rose Kennedy Greenway and section 5.4 details the proposed treatments for Commercial Street. The design of each treatment in our proposal is based on critical analysis of existing traffic conditions, pedestrian volumes, and space.

5.1 *Kneeland Street*

Kneeland St currently is 60 ft curb-to-curb with 3 westbound lanes and 2 eastbound lanes, without street-parking (Figure 18). There are sidewalks on both sides, but

pedestrians mostly prefer using the north sidewalk because the south side of Kneeland St is industrial.

Figure 18 – Kneeland Street Existing Cross Section

Kneeland St at Atlantic Ave is a 3-phase T-shape intersection (Figure 19). One phase is eastbound from Kneeland St only moves left to Atlantic Ave. The other two phases are two northbound from both I-93N and I-90W. Additionally, there is a 30' wide sloped driveway from a South Station employee parking lot cutting the east sidewalk of Atlantic Ave. Vehicles exiting from this driveway have exclusive actuated signals which are concurrent with the south-leg crossing signal.

Figure 19 – Intersection of Kneeland and Atlantic Ave

<u>Proposed Design for Kneeland Street</u>
(Refer to analyses in chapter 4)

Due to the substantial volumes of turning movements at intersections along Kneeland St, the 5 existing lanes are necessary to be retained. The selected design (P1, P2) will reduce the width of each lane to 10 feet. The 1 foot fog lines and gutter area on either side bring the new curb-to-curb width to 52 feet. The seven feet gained from lane reductions allows the south sidewalk area of Kneeland St to be extended to a total of 17 feet.

The sidewalk will be divided into a 7 foot footpath, an eight foot cycle track, and a 2 foot buffer zone next to the curb (Figure 20). The buffer zone provides separation between cyclists and travelling vehicles and space for snow storage and street furniture. The curb line will gradually decrease to merge to the cycle track at crossings.

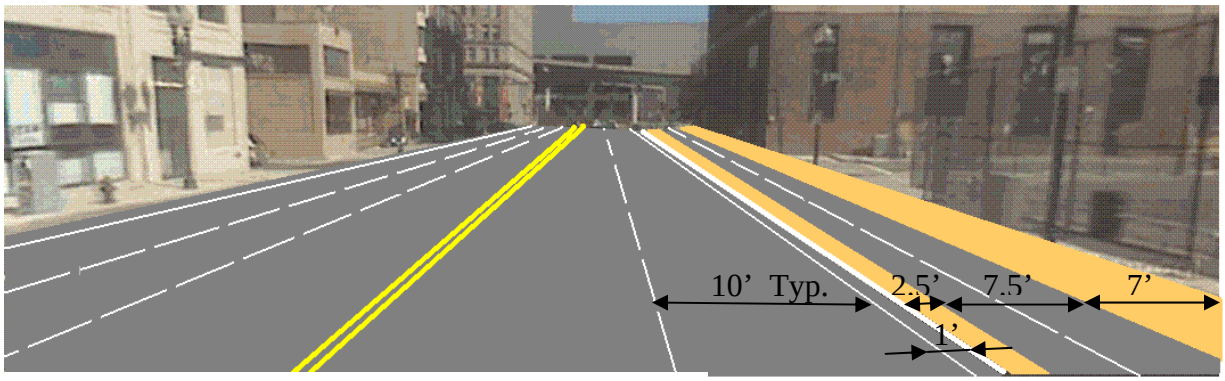


Figure 20 – Kneeland Street Proposed Design

Proposed Design for Utica Street Driveway

At Utica Street, there is a parking lot entry that introduces a blind spot for westbound cyclists on Kneeland St. Cyclists cannot see vehicles or other bicycles approaching from Utica St (Figure 21). In order to provide safety to cyclists at this location, we propose marking Utica St as an entrance-only driveway.

Utica St connects to the parking lot for this building. On the opposite side of this building, there is another driveway located at the intersection of South St. This driveway will be converted to exit-only. At the exit-only driveway, cyclists will have more distance to see cars existing from the parking lot. Drivers will notice coming cyclists easily unlike at Utica St (P2).

Figure 21 Blind Spot at Utica Street

Proposed Design for Kneeland/Atlantic Ave Crossing

The cycle track will be designed to cross Atlantic Ave using the bicycle crossing treatment. The sidewalk area of Atlantic Ave near the South Station employee parking lot will be expanded so that the cycle track will be on the sidewalk with a perpendicular position to the eastbound traffic flow. The new curb line will be adjusted in order to prevent northbound vehicles getting onto the sidewalk. The sloped driveway of the South Station parking lot will be set forward to line up with the new curb. The entrance of driveway will now require sharp angle turns, effectively reducing the speed of exiting

vehicles. The actuated signal for the driveway will be eliminated due to the safety problem of cycle track (Figure 22, P2).

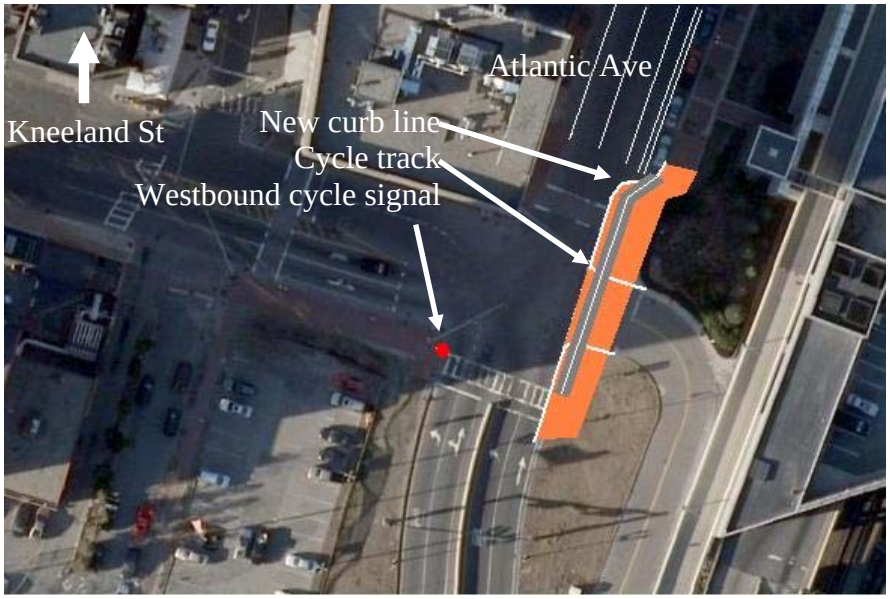


Figure 22 Kneeland/Atlantic Ave Crossing

5.2 *Atlantic Avenue along South Station*

(Refer to analyses in chapter 4)

Proposed Design

Our proposed design will retain the west side parking while reducing the width of the travel lanes 11 feet (Figure 26). The 8' parking lane next to the travelling lanes on the east side will remain. The 8' two-way cycle track will be along the east sidewalk between the existing curb and parking. A 5' buffer with stanchions separates the cycle track and the parking. This area provides extra space for pedestrians to enter or exit taxis. The stanchions will be placed 1.5 feet from the edge of the parking lane to ensure that vehicles do not encroach on the buffer area or cycle track. A bump out will be installed at Beach Street to prohibit double parking in the crossing area and shorten the crossing distance for pedestrians. There also will be bollards here to separate the cycle track and pedestrian area (Figure 26, P3, P4).

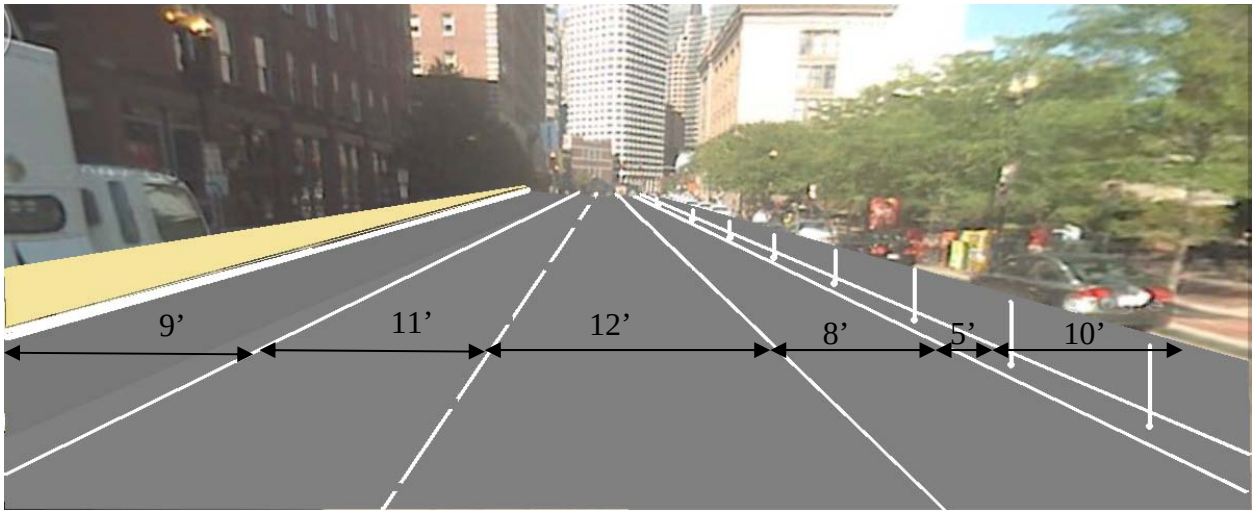


Figure 26 – Proposed Atlantic Ave Cross Section

As discussed in chapter 4, pedestrians often cut through taxi line to reach the double-parking vehicles, essentially reducing the travel capacity of the street. In order to reduce the potential for double parking, new parking strategies must be implemented along this section of Atlantic Avenue. We proposed the introduction of loading/drop-off specific areas, parking lanes with small standing times (5 minutes maximum for example) or metered areas.

<u>Proposed Design for Atlantic Avenue/Summer Street Crossing</u>

Summer St at Atlantic Ave is a busy intersection during AM and PM peak hours (see Appendix A for volume counts). Atlantic Ave at the intersection has 4 discharging lanes by eliminating the eastside parking. Summer Street has 2 eastbound lanes and 3 westbound lanes. Westbound vehicles turning right are permitted throughout most of the northbound phase. An exclusive pedestrian phase is provided for large number of pedestrians crossing between South Station and downtown business district (Figure 24).

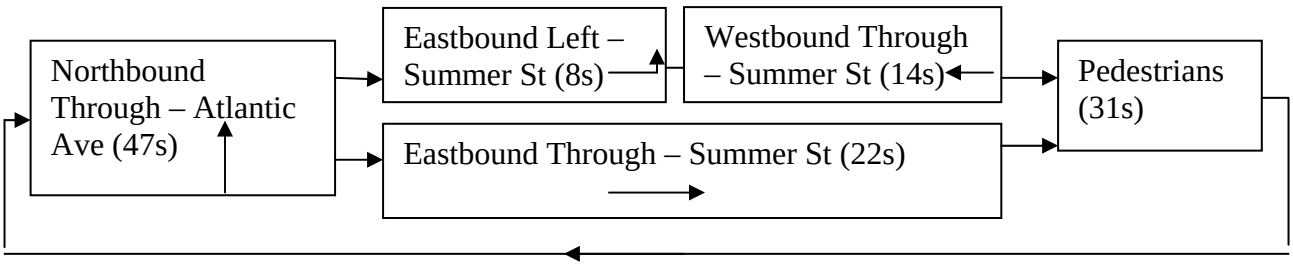


Figure 24 – Existing Summer Street / Atlantic Ave Intersection Timing

The Synchro analysis report indicates it is feasible to eliminate 1 northbound discharging lane at the Summer St intersection (Appendix B). The maximum volume-capacity ratio increases from 0.77 to 0.91. However, the level of service at this intersection remains at D (Table 5.2).

Atlantic Avenue will have three lanes between the Essex and Summer Street intersections. Analysis of this added lane shows a capacity of 0.91 (Appendix A).

The cycle track at this intersection will cross diagonally from the corner of the South Station to the beginning of the Rose Kennedy Greenway (Figure 25, P4). Cyclists can cross during the exclusive pedestrian phase and continue on the proposed trail in the Greenway.

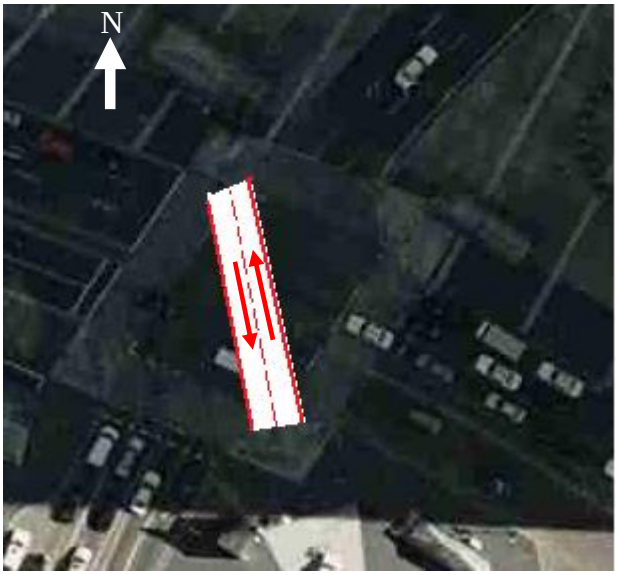


Figure 25 – Proposed Summer St. Crossing

Table 5.2 – Traffic Analysis at Intersection of Summer St / Atlantic Ave

Date: 3/27/2009		Time:	7:45 AM-8:45 AM							
	Existing (4 Lanes)					Proposed (Three lanes)				
Route	Duration (s)	PHF	Vol.	v/c	LOS	Duration (s)	PHF	Vol.	v/c	LOS
NB - Atlantic Ave	47	0.85	1288	0.52	C	45	0.85	1288	0.91	C
WB - Summer St	22	0.90	423	0.62	D	21	0.90	423	0.89	D
EBL - Summer St	8	0.72	322	0.77	D	8	0.72	322	0.87	D
EB - Summer St	14	0.83	26	0.77	D	13	0.83	26	0.87	D
Pedestrian	31	-	-	-	-	34	-	-	-	-

5.3 *Atlantic Ave along the Rose Kennedy Greenway*

Atlantic Ave between Summer Street to Columbus Park has 3 northbound lanes with 37' curb-to-curb (Figure 27). The third lane on several blocks is used for parking. The west side of Atlantic Ave is the newly constructed Rose Kennedy Greenway. Pedestrian paths are included in the park, however cycling is currently prohibited throughout.

Figure 27 –Avenue Existing Cross Section

Proposed Design

A 12’ two-way cycle track along east side of the Rose Kennedy Greenway is proposed for this section (Figure 28, P5-11). A 3’ minimum buffer will be added as a separation between cycle track and roadway. Where the trail is next to pedestrian space, a 4’ buffer is designed At all the street crossing along Atlantic Ave, there will be separated paths for cyclists next to the existing crosswalks are proposed only for pedestrians.

Figure 28 – Proposed Typical Cross Section

The sidewalk and Greenway are split by the ramp of I-93N at intersection of Seaport Boulevard, and the cycle track is designed to cut through the ramp entrance and cross

diagonally to the sidewalk (Figure 29). The existing exclusive pedestrian phase at the intersection will ensure that cyclists can cross safely. The staging area between the on-ramp and Atlantic Avenue will be expanded to 9 feet so bicyclists have adequate space to wait for a crossing. The bulbout at the northeast side of the intersection will be reduced in order compensate for the space used for the staging area. The two receiving lanes on Atlantic Ave will be orientated properly along the new curb line. A bicycle crossing is also designed just north of this intersection to offer an additional crossing at the Northern Ave Bridge (Figure 29).

Figure 29 – Seaport Boulevard Intersection Staging Area

The Walk to the Sea connecting the Christopher Columbus Park and Faneuil Hall, has high pedestrian volumes. Collisions between pedestrians and cyclists are of high concern since bicyclists don't have to stop there for moving traffic. Both sides of the cycle track crossing will feature sharp s-curves in order to slow approaching bicyclists (Figure 30). Landscape will be added where the trail is curved to prevent the cyclists from continuing straight through.

Figure 30 – Walk to the Sea Crossing

5.4 *Commercial Street*

Atlantic Ave turns eastbound at the intersection with Mercantile Street, and then becomes Commercial Street two blocks later. Commercial Street is a 4-lane roadway with 2 eastbound lanes and 2 westbound lanes (Figures 31, 32). The street width varies from 53’ to 60’. Parking is in high demanded by the North End residents. Vehicles prefer using the center lanes to avoid the frequent parking maneuvers.

Figure 31 – Existing Cross Section at Christopher Columbus Park

Figure 32 – Existing Cross Section at Commercial Wharf

Planning and Analysis
(Refer to analyses in chapter 4)

Traffic analysis reports at intersections of Atlantic Ave/Mercantile Street and Commercial Street/Hannover Street show higher traffic volumes on the harbor side of Commercial Street (Synchro). Therefore, only 1 land side lane is needed for. There are many access points on the harbor side of the street, such as the *Harbor Walk*, that serve recreational purposes.

Proposed Design

Our proposed design reduces harbor side travel to 1 lane (Figures 33, 34, P11-17). The centerline of Commercial Street will be shifted to account for the roadway reconfiguration. Our designed two-way cycle track will be between the existing curb and parking or harbor side travel where there is no parking. A 2.5' buffer with stanchions will provide separation. In locations where there is a driveway or parking lot, there will be bicycle crossings to alert vehicles of the path.

Figure 33 – Proposed Cross Section at Christopher Columbus Park

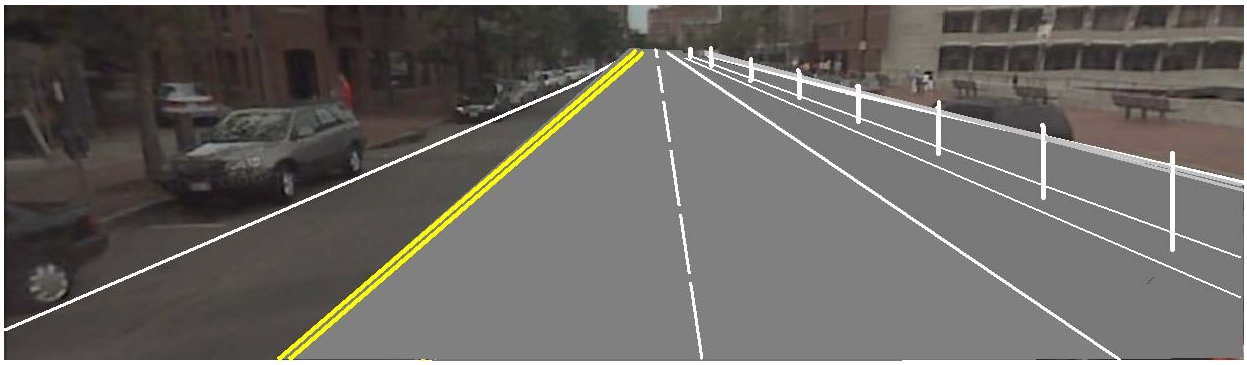


Figure 34 – Proposed Cross Section at Commercial Wharf

The path will end at the North End Playground and provide access to the bikeable portion of the Harbor Walk Trail (P17).

6.0 Conclusion

Our team's proposal for bicycle accommodations through the Wharf District that provides riders with safe and easy access to the surrounding area. The separate two-way cycle track is a consistent and sufficient means of travel for commuting and recreational purposes. Several alternatives for each critical segment were analyzed, and our *Harbor Ride* trail design is based on the feasibility of each alternative.

Lane reduction and curb extensions were used to provide a cycle track on the sidewalk for Kneeland Street. Atlantic Avenue along South Station was subjected to a potential conflict study. Based on the findings, a separated cycle track was placed on the East side to avoid the large number of potential vehicular conflicts.

The next section, spanning along Atlantic Avenue posed several main concerns. The sidewalks were determined to be too narrow and a consistent in-street bike lane was determined infeasible. From our analysis, the use of the Rose Kennedy Greenway was the most viable option for that section. Future plans may consider curb extensions on either side of the park to accommodate a cycle track and fully preserve the Greenway layout. Landscape sections in the Greenway should be designed by a landscape architect.

The Commercial Street section of our design utilizes in-street separation through a lane reduction. Separation was achieved through the implementation of bollards placed in a painted buffer zone. The parked cars on the west side of the cycle track provide an additional buffer against moving vehicles for bicyclists.

Our trail incorporates professional analysis as well as practical judgment. Bicyclists, pedestrians, and vehicles have all been considered in every aspect of the design. We have demonstrated that adding a bicycle trail through the Wharf District is feasible without disrupting other forms of travel. The *Harbor Ride* trail is a vital addition to the transportation network of the area, and it encourages sustainable travel for other cities to model.

Appendix A

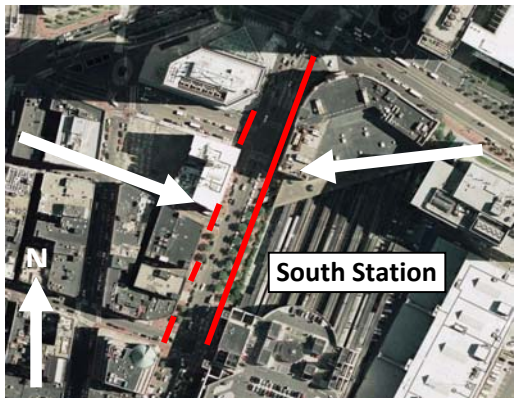
Volume Counts

Atlantic Ave at South Station
Vehicular Turning Movements and Pedestrian Counts
3/27/2009 7:45 AM - 8:45 AM

West Side

Vehicular Turning Movement		
Beach St.	East St.	Essex St.
150	40	267

Total = 457 (88%)



East Side

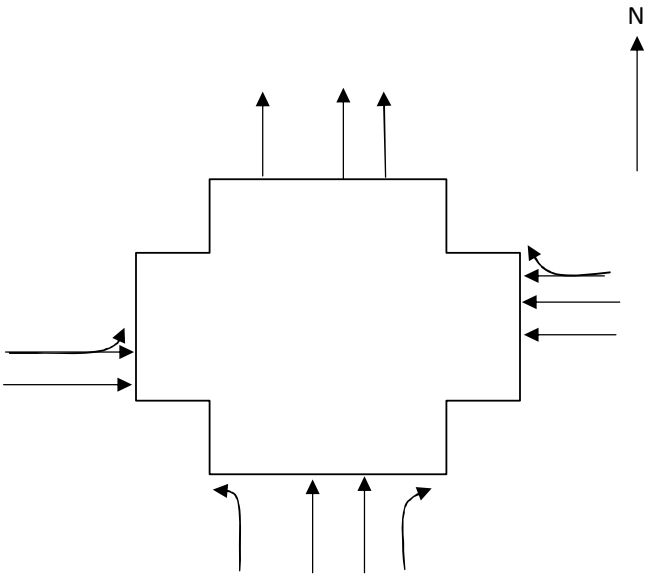
Cab	
Ped (in)	Ped (out)
30	32

Total = 62 (12%)

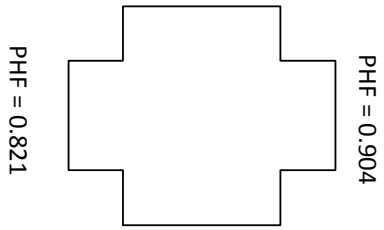
Atlantic Ave- Summer St Vehicle Movement Survey Summary

PROJECT:	**Wharf District Harbor Ride**	SURVEY DATE:	3/12/2009	DATE:	**FRIDAY**
N Approach:	**Atlantic Ave**	SURVEY TIME:	**7:00 AM**	TO	**9:00 AM**
E-W Approach:	**Summer Street**	CITY:	**BOSTON**	BY:	**GRACE**

PEAK HOUR: 7:45AM **TO** 8:45AM



PEAK HOUR FACTOR



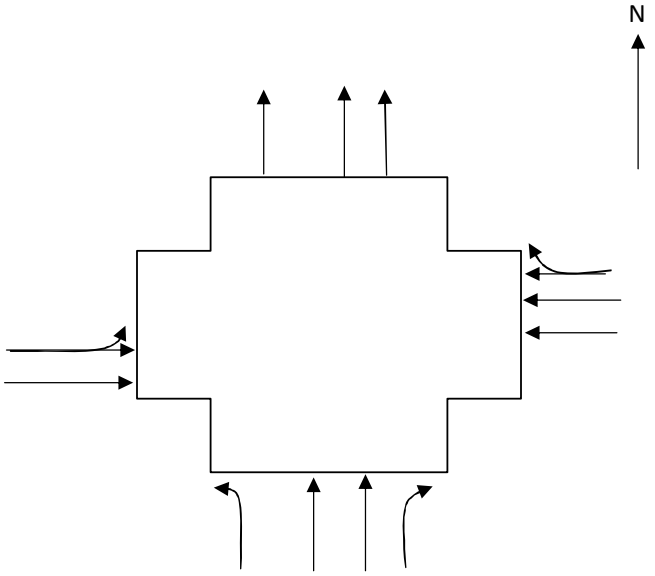
PHF = 0.850

3/13/2009		Atlantic Ave						Summer Street						
Time Period		Northbound			Southbound			Eastbound			Westbound			
From	To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
7:00 AM ---	7:15 AM	82	137	96	---	---	---	6	102	---	---	71	23	517
7:15 AM ---	7:30 AM	58	149	90	---	---	---	17	61	---	---	71	12	458
7:30 AM ---	7:45 AM	94	141	94	---	---	---	18	68	---	---	89	32	536
7:45 AM ---	8:00 AM	**89**	**115**	**89**	**---**	**---**	**---**	**9**	**80**	**---**	**---**	**87**	**27**	**496**
8:00 AM ---	8:15 AM	**93**	**141**	**68**	**---**	**---**	**---**	**6**	**83**	**---**	**---**	**75**	**23**	**489**
8:15 AM ---	8:30 AM	**84**	**146**	**84**	**---**	**---**	**---**	**2**	**62**	**---**	**---**	**81**	**13**	**472**
8:30 AM ---	8:45 AM	**92**	**195**	**92**	**---**	**---**	**---**	**9**	**97**	**---**	**---**	**93**	**24**	**602**
8:45 AM ---	9:00 AM	73	126	90	---	---	---	6	62	---	---	92	29	478
	PHF	0.850						0.821			0.904			
	PHV	358	597	333				26	322			336	87	

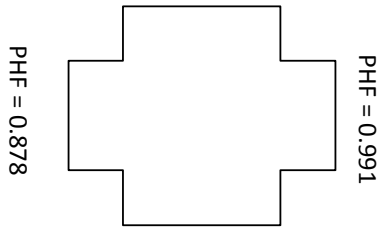
Atlantic Ave- Summer St Vehicle Movement Survey Summary

PROJECT:	**Wharf District Harbor Ride**	SURVEY DATE:	3/24/2009	DATE:	TUESDAY
N Approach:	**Atlantic Ave**	SURVEY TIME:	**4:00 PM**	TO	**6:00 PM**
E-W Approach:	**Summer Street**	CITY:	**BOSTON**	BY:	**GRACE**

PEAK HOUR: 4:00 PM **TO** 6:00 PM



PEAK HOUR FACTOR



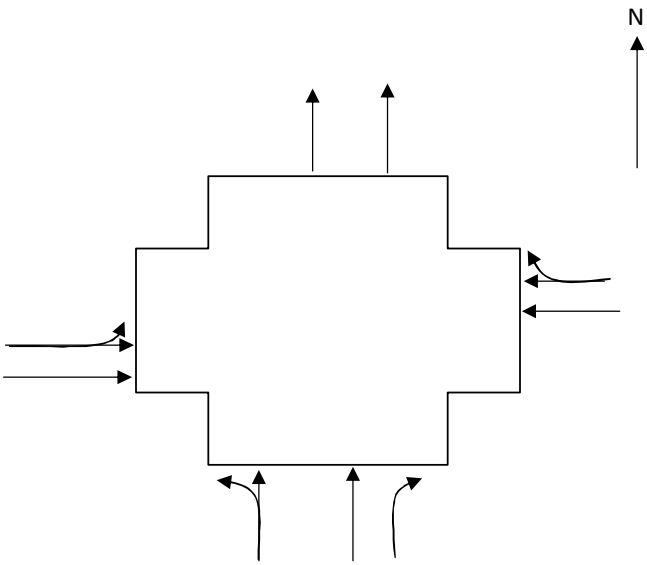
PHF = 0.910

3/24/2009		Atlantic Ave						Summer Street						
Time Period		Northbound			Southbound			Eastbound			Westbound			
From	To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
4:00 PM ---	4:15 PM	**56**	**96**	**74**	**---**	**---**	**---**	**17**	**65**	**---**	**---**	**95**	**50**	**453**
4:15 PM ---	4:30 PM	**50**	**86**	**56**	**---**	**---**	**---**	**10**	**61**	**---**	**---**	**106**	**52**	**421**
4:30 PM ---	4:45 PM	**60**	**87**	**64**	**---**	**---**	**---**	**9**	**50**	**---**	**---**	**112**	**30**	**412**
4:45 PM ---	5:00 PM	**41**	**105**	**48**	**---**	**---**	**---**	**8**	**68**	**---**	**---**	**96**	**34**	**400**
5:00 PM ---	5:15 PM	35	78	68	---	---	---	20	48	---	---	110	43	402
5:15 PM ---	5:30 PM	48	102	68	---	---	---	11	55	---	---	122	56	462
5:30 PM ---	5:45 PM	43	90	52	---	---	---	7	50	---	---	129	43	414
5:45 PM ---	6:00 PM	36	68	44	---	---	---	6	38	---	---	100	28	320
	PHF	0.91						0.878			0.991			
	PHV	207	374	242				44	244			409	166	

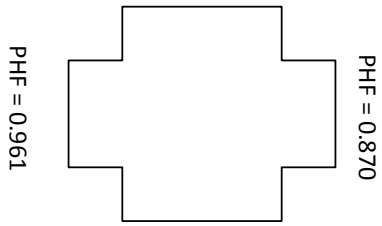
Atlantic - Mercantile Vehicle Movement Survey Summary

PROJECT:	**Wharf District Harbor Ride**	SURVEY DATE:	3/24/2009	DAY:	**TU**
N Approach:	**Atlantic Ave**	SURVEY TIME:	**7:00 AM**	TO	**9:00 AM**
E-W Approach:	**Atlantic Ave**	CITY:	**BOSTON**	BY:	**HGM**

PEAK HOUR: 8:00 AM **TO** 9:00 AM



PEAK HOUR FACTOR



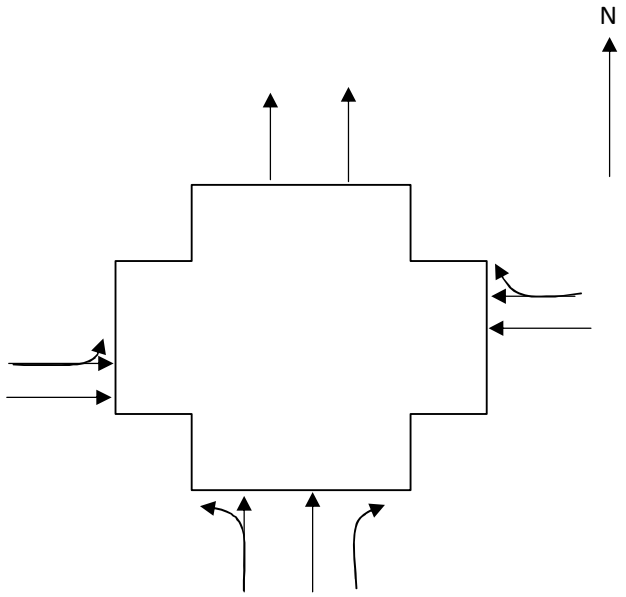
PHF = 0.826

3/24/2009			Atlantic Ave						Summer Street						
Time Period			Northbound			Southbound			Eastbound			Westbound			
From		To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
7:00 AM	---	7:15 AM	1	43	33	---	---	---	9	28	---	---	21	12	147
7:15 AM	---	7:30 AM	3	39	35	---	---	---	1	17	---	---	42	3	140
7:30 AM	---	7:45 AM	1	46	41	---	---	---	2	19	---	---	45	6	160
7:45 AM	---	8:00 AM	0	54	62	---	---	---	6	31	---	---	61	8	222
8:00 AM	**---**	**8:15 AM**	**1**	**45**	**49**	**---**	**---**	**---**	**7**	**27**	**---**	**---**	**54**	**13**	**196**
8:15 AM	**---**	**8:30 AM**	**2**	**59**	**48**	**---**	**---**	**---**	**9**	**33**	**---**	**---**	**47**	**11**	**209**
8:30 AM	**---**	**8:45 AM**	**2**	**60**	**52**	**---**	**---**	**---**	**11**	**27**	**---**	**---**	**54**	**7**	**213**
8:45 AM	**---**	**9:00 AM**	**6**	**84**	**48**	**---**	**---**	**---**	**6**	**26**	**---**	**---**	**68**	**7**	**245**
	PHF		0.826						0.961				0.870		
	PHV		11	248	197				33	113			223	38	

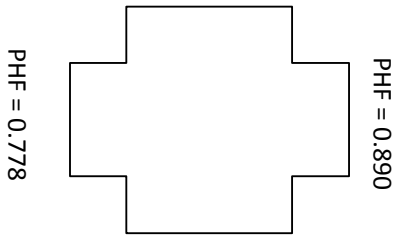
Atlantic - Mercantile Vehicle Movement Survey Summary

PROJECT:	**Wharf District Harbor Ride**	SURVEY DATE:	3/24/2009	DAY:	**TU**
N Approach:	**Atlantic Ave**	SURVEY TIME:	**4:00 PM**	TO	**6:00 PM**
E-W Approach:	**Atlantic Ave**	CITY:	**BOSTON**	BY:	**HGM**

PEAK HOUR: 5:00 PM **TO** 6:00 PM



PEAK HOUR FACTOR



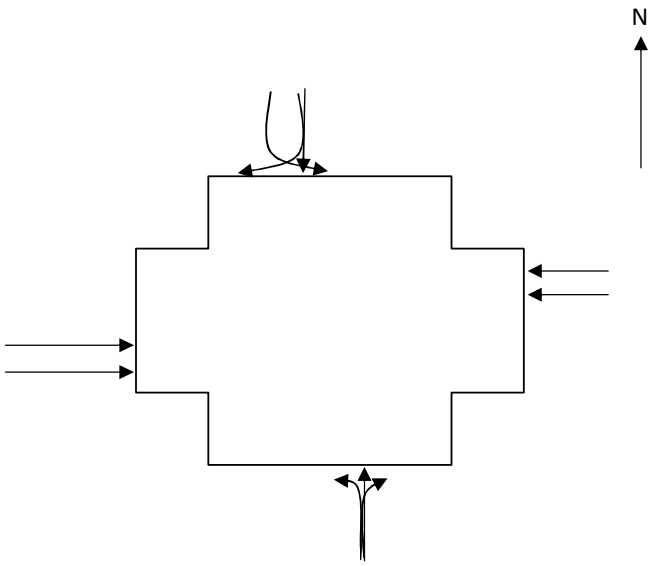
PHF = 0.940

3/24/2009			Atlantic Ave						Summer Street						
Time Period			**Northbound**			**Southbound**			**Eastbound**			**Westbound**			
From		**To**	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
4:00 PM	---	4:15 PM	2	79	60	---	---	---	11	26	---	---	55	8	241
4:15 PM	---	4:30 PM	4	99	56	---	---	---	7	29	---	---	31	5	231
4:30 PM	---	4:45 PM	3	98	52	---	---	---	12	35	---	---	57	6	263
4:45 PM	---	5:00 PM	1	81	63	---	---	---	7	27	---	---	43	5	227
5:00 PM	---	5:15 PM	**1**	**126**	**81**	**---**	**---**	**---**	**5**	**29**	**---**	**---**	**58**	**9**	**309**
5:15 PM	---	5:30 PM	**6**	**116**	**98**	**---**	**---**	**---**	**9**	**38**	**---**	**---**	**46**	**12**	**325**
5:30 PM	---	5:45 PM	**1**	**150**	**89**	**---**	**---**	**---**	**9**	**41**	**---**	**---**	**54**	**8**	**352**
5:45 PM	---	6:00 PM	**4**	**136**	**94**	**---**	**---**	**---**	**17**	**45**	**---**	**---**	**65**	**8**	**369**
		PHF	0.940						0.778				0.890		
		PHV	12	528	362				40	153			223	37	

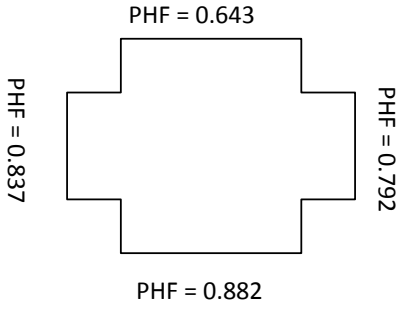
Commercial St- Hanover St Vehicle Movement Survey Summary

PROJECT:	**Wharf District Harbor Ride**	SURVEY DATE:	3/24/2009	DATE:	**TUESDAY**
N-S Approach:	**Hanover Street**	SURVEY TIME:	**7:00 AM**	TO	**9:00 AM**
E-W Approach:	**Commercial Street**	CITY:	**BOSTON**	BY:	**BL**

PEAK HOUR: 7:30AM **TO** 8:30AM



PEAK HOUR FACTOR

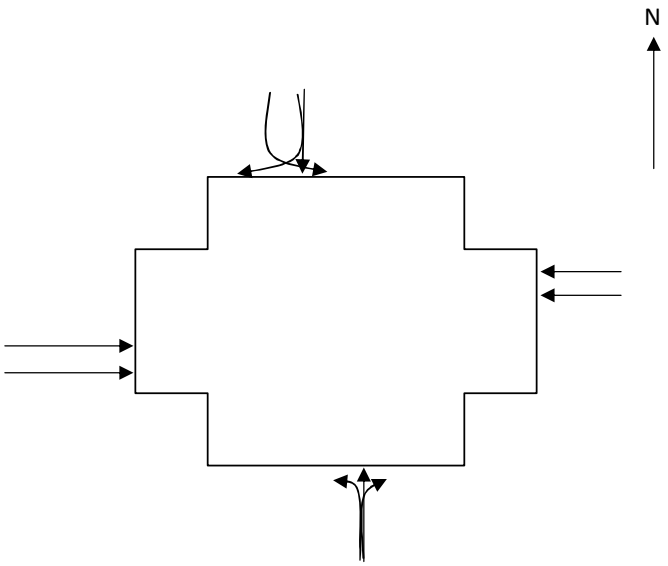


3/13/2009		Hanover Street						Commercial Street						
Time Period		Northbound			Southbound			Eastbound			Westbound			
From	To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
7:00 AM ---	7:15 AM	10	1	3	1	1	2	6	35	18	2	49	3	131
7:15 AM ---	7:30 AM	5	3	6	0	2	3	1	42	14	4	55	5	140
7:30 AM ---	7:45 AM	**11**	**2**	**4**	**1**	**4**	**2**	**7**	**61**	**21**	**5**	**72**	**1**	**191**
7:45 AM ---	8:00 AM	**12**	**2**	**2**	**1**	**0**	**1**	**3**	**63**	**18**	**1**	**88**	**1**	**192**
8:00 AM ---	8:15 AM	**13**	**0**	**2**	**0**	**1**	**3**	**3**	**64**	**23**	**10**	**100**	**4**	**223**
8:15 AM ---	8:30 AM	**15**	**0**	**4**	**1**	**0**	**4**	**4**	**87**	**21**	**6**	**73**	**0**	**215**
8:30 AM ---	8:45 AM	12	0	3	2	1	5	3	54	16	6	58	4	164
8:45 AM ---	9:00 AM	19	5	6	3	2	5	5	74	18	3	61	6	207
	PHF	0.882			0.643			0.837			0.792			
	PHV	51	4	12	3	5	10	17	275	83	22	333	6	

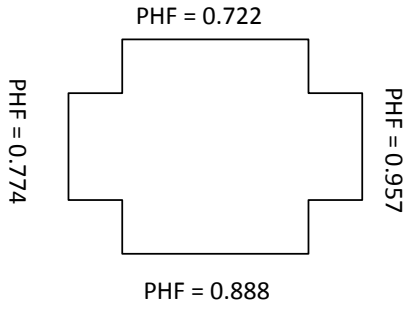
Commercial St- Hanover St Vehicle Movement Survey Summary

PROJECT:	**Wharf District Harbor Ride**	SURVEY DATE:	3/24/2009	DATE:	**TUESDAY**
N-S Approach:	**Hanover Street**	SURVEY TIME:	**4:00 PM**	TO	**6:00 PM**
E-W Approach:	**Commercial Street**	CITY:	**BOSTON**	BY:	**BL**

PEAK HOUR: 7:30AM **TO** 8:30AM



PEAK HOUR FACTOR



3/13/2009		Hanover Street						Commercial Street						
Time Period		Northbound			Southbound			Eastbound			Westbound			
From	To	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Left	Thru	Right	Total
4:00 PM ---	4:15 PM	9	0	2	3	1	12	2	43	16	10	82	1	181
4:15 PM ---	4:30 PM	11	0	9	5	1	13	1	39	16	6	81	0	182
4:30 PM ---	4:45 PM	7	0	7	2	7	12	1	48	12	11	88	2	197
4:45 PM ---	5:00 PM	15	0	6	0	2	6	0	51	17	12	86	1	196
5:00 PM ---	5:15 PM	**15**	**1**	**3**	**1**	**0**	**8**	**0**	**50**	**19**	**6**	**116**	**1**	**220**
5:15 PM ---	5:30 PM	**7**	**0**	**6**	**1**	**1**	**4**	**2**	**47**	**13**	**4**	**121**	**2**	**208**
5:30 PM ---	5:45 PM	**11**	**2**	**6**	**1**	**0**	**4**	**2**	**70**	**20**	**6**	**106**	**0**	**228**
5:45 PM ---	6:00 PM	**13**	**1**	**6**	**1**	**0**	**5**	**1**	**48**	**13**	**8**	**119**	**1**	**216**
	PHF	0.888			0.722			0.774			0.957			
	PHV	46	4	21	4	1	21	5	215	65	24	462	4	

Appendix B

Synchro Reports

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	NEL2	NEL	NER
Lane Configurations									
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15	9	15			9	15	15	9
Lane Util. Factor	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Frt									
Flt Protected	0.950		0.950				0.950	0.950	
Satd. Flow (prot)	3433	0	1770	1863	0	0	1770	1770	0
Flt Permitted	0.950		0.950				0.950	0.950	
Satd. Flow (perm)	3433	0	1770	1863	0	0	1770	1770	0
Right Turn on Red									Yes
Satd. Flow (RTOR)									
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)	30			30	30			30	
Link Distance (ft)	6436			3177	4640			3188	
Travel Time (s)	146.3			72.2	105.5			72.5	
Volume (vph)	453	0	436	831	0	0	197	247	0
Peak Hour Factor	0.88	0.92	0.95	0.94	0.92	0.92	0.95	0.88	0.92
Adj. Flow (vph)	515	0	459	884	0	0	207	281	0
Lane Group Flow (vph)	515	0	459	884	0	0	207	281	0
Turn Type			Prot				Split		
Protected Phases	2		7	3!			8	8!	
Permitted Phases									
Minimum Split (s)	20.0		20.0	20.0			20.0	20.0	
Total Split (s)	30.0	0.0	33.0	70.0	0.0	0.0	37.0	37.0	0.0
Total Split (%)	30%	0%	33%	70%	0%	0%	37%	37%	0%
Maximum Green (s)	26.0		29.0	66.0			33.0	33.0	
Yellow Time (s)	3.5		3.5	3.5			3.5	3.5	
All-Red Time (s)	0.5		0.5	0.5			0.5	0.5	
Lead/Lag			Lead				Lag	Lag	
Lead-Lag Optimize?			Yes				Yes	Yes	
Walk Time (s)	5.0		5.0	5.0			5.0	5.0	
Flash Dont Walk (s)	11.0		11.0	11.0			11.0	11.0	
Pedestrian Calls (#/hr)	0		0	0			0	0	
Act Effct Green (s)	26.0		29.0	66.0			33.0	33.0	
Actuated g/C Ratio	0.26		0.29	0.66			0.33	0.33	
v/c Ratio	0.58		0.89	0.72			0.35	0.48	
Uniform Delay, d1	32.2		34.0	11.0			25.4	26.7	
Delay	32.6		45.9	11.6			25.9	27.3	
LOS	C		D	B			C	C	
Approach Delay	32.6			23.3				26.7	
Approach LOS	C			C				C	
Queue Length 50th (ft)	147		280	328			99	142	
Queue Length 95th (ft)	195		#462	478			162	213	
Internal Link Dist (ft)	6356			3097	4560			3108	
50th Up Block Time (%)									
95th Up Block Time (%)									
Turn Bay Length (ft)									
50th Bay Block Time %									

Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	NEL2	NEL	NER
95th Bay Block Time %									
Queuing Penalty (veh)									

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green			
Natural Cycle: 60			
Control Type: Pretimed			
Maximum v/c Ratio: 0.89			
Intersection Signal Delay: 26.1		Intersection LOS: C	
Intersection Capacity Utilization 86.8%		ICU Level of Service D	
# 95th percentile volume exceeds capacity, queue may be longer.			
Queue shown is maximum after two cycles.			
! Phase conflict between lane groups.			

Splits and Phases: 3: Kneeland Street & Atlantic Ave

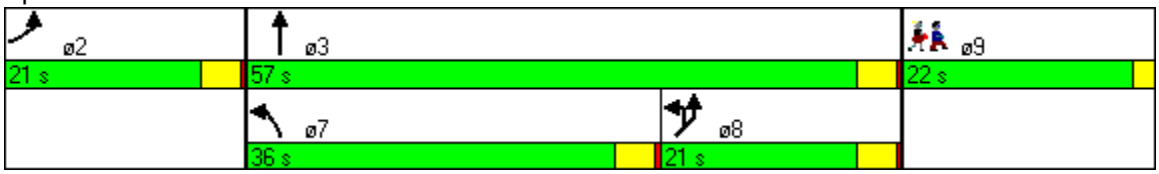
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	NEL2	NEL	NER	ø9
Lane Configurations										
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Turning Speed (mph)	15	9	15			9	15	15	9	
Lane Util. Factor	*1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Frt										
Flt Protected	0.950		0.950				0.950	0.950		
Satd. Flow (prot)	3539	0	1770	1863	0	0	1770	1770	0	
Flt Permitted	0.950		0.950				0.950	0.950		
Satd. Flow (perm)	3539	0	1770	1863	0	0	1770	1770	0	
Right Turn on Red									Yes	
Satd. Flow (RTOR)										
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Link Speed (mph)	30			30	30			30		
Link Distance (ft)	6436			3177	4640			3188		
Travel Time (s)	146.3			72.2	105.5			72.5		
Volume (vph)	453	0	436	831	0	0	197	247	0	
Peak Hour Factor	0.88	0.92	0.95	0.94	0.92	0.92	0.95	0.88	0.92	
Adj. Flow (vph)	515	0	459	884	0	0	207	281	0	
Lane Group Flow (vph)	515	0	459	884	0	0	207	281	0	
Turn Type			Prot				Split			
Protected Phases	2		7	3!			8	8!		9
Permitted Phases										
Minimum Split (s)	20.0		22.0	20.0			21.0	21.0		22.0
Total Split (s)	21.0	0.0	36.0	57.0	0.0	0.0	21.0	21.0	0.0	22.0
Total Split (%)	21%	0%	36%	57%	0%	0%	21%	21%	0%	22%
Maximum Green (s)	17.0		32.0	53.0			17.0	17.0		20.0
Yellow Time (s)	3.5		3.5	3.5			3.5	3.5		2.0
All-Red Time (s)	0.5		0.5	0.5			0.5	0.5		0.0
Lead/Lag			Lead				Lag	Lag		
Lead-Lag Optimize?			Yes				Yes	Yes		
Walk Time (s)										7.0
Flash Dont Walk (s)										15.0
Pedestrian Calls (#/hr)										0
Act Effct Green (s)	17.0		32.0	53.0			17.0	17.0		
Actuated g/C Ratio	0.17		0.32	0.53			0.17	0.17		
v/c Ratio	0.86		0.81	0.90			0.69	0.93		
Uniform Delay, d1	40.3		31.2	21.0			39.0	40.9		
Delay	46.4		35.7	27.0			41.9	67.8		
LOS	D		D	C			D	E		
Approach Delay	46.4			30.0				56.8		
Approach LOS	D			C				E		
Queue Length 50th (ft)	161		267	479			125	179		
Queue Length 95th (ft)	#233		#427	#754			#218	#322		
Internal Link Dist (ft)	6356			3097	4560			3108		
50th Up Block Time (%)										
95th Up Block Time (%)										
Turn Bay Length (ft)										
50th Bay Block Time %										

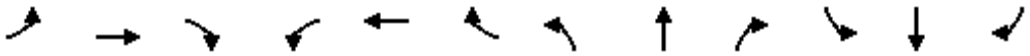
Lane Group	EBL	EBR	NBL	NBT	SBT	SBR	NEL2	NEL	NER	ø9
95th Bay Block Time %										
Queuing Penalty (veh)										

Intersection Summary			
Area Type:	Other		
Cycle Length: 100			
Actuated Cycle Length: 100			
Offset: 0 (0%), Referenced to phase 2:EBL and 6:, Start of Green			
Natural Cycle: 85			
Control Type: Pretimed			
Maximum v/c Ratio: 0.93			
Intersection Signal Delay: 39.2		Intersection LOS: D	
Intersection Capacity Utilization 86.8%		ICU Level of Service D	

* User Entered Value
\# 95th percentile volume exceeds capacity, queue may be longer.
Queue shown is maximum after two cycles.
! Phase conflict between lane groups.

Splits and Phases: 3: Kneeland Street & Atlantic Ave





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	1.00	0.91	0.91	1.00	1.00	1.00	1.00
Frt						0.850			0.850			
Flt Protected		0.996						0.982				
Satd. Flow (prot)	0	3525	0	0	3539	1583	0	4994	1583	0	0	0
Flt Permitted		0.833						0.982				
Satd. Flow (perm)	0	2948	0	0	3539	1583	0	4994	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)						102			392			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		4192			4752			4064			4192	
Travel Time (s)		95.3			108.0			92.4			95.3	
Volume (vph)	26	322	0	0	336	87	358	597	333	0	0	0
Peak Hour Factor	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Adj. Flow (vph)	31	379	0	0	395	102	421	702	392	0	0	0
Lane Group Flow (vph)	0	410	0	0	395	102	0	1123	392	0	0	0
Turn Type	Perm					Perm	Perm		Perm			
Protected Phases		4			8			2				
Permitted Phases	4					8	2		2			
Minimum Split (s)	20.0	20.0			20.0	20.0	20.0	20.0	20.0			
Total Split (s)	22.0	22.0	0.0	0.0	22.0	22.0	47.0	47.0	47.0	0.0	0.0	0.0
Total Split (%)	22%	22%	0%	0%	22%	22%	47%	47%	47%	0%	0%	0%
Maximum Green (s)	18.0	18.0			18.0	18.0	43.0	43.0	43.0			
Yellow Time (s)	3.5	3.5			3.5	3.5	3.5	3.5	3.5			
All-Red Time (s)	0.5	0.5			0.5	0.5	0.5	0.5	0.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0			5.0	5.0	5.0	5.0	5.0			
Flash Dont Walk (s)	11.0	11.0			11.0	11.0	11.0	11.0	11.0			
Pedestrian Calls (#/hr)	0	0			0	0	0	0	0			
Act Effct Green (s)		18.0			18.0	18.0		43.0	43.0			
Actuated g/C Ratio		0.18			0.18	0.18		0.43	0.43			
v/c Ratio		0.77			0.62	0.28		0.52	0.43			
Uniform Delay, d1		39.0			37.8	0.0		20.9	0.0			
Delay		41.8			38.2	7.6		21.1	2.0			
LOS		D			D	A		C	A			
Approach Delay		41.8			31.9			16.2				
Approach LOS		D			C			B				

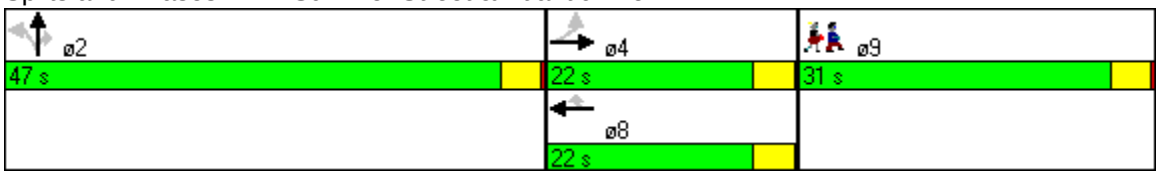
Intersection Summary	
Area Type:	Other
Cycle Length: 100	
Actuated Cycle Length: 100	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green	
Natural Cycle: 50	

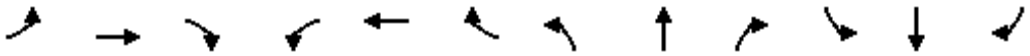
Lane Group	ø9
Lane Configurations	
Ideal Flow (vphpl)	
Total Lost Time (s)	
Turning Speed (mph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Headway Factor	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Volume (vph)	
Peak Hour Factor	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Split (s)	8.0
Total Split (s)	31.0
Total Split (%)	31%
Maximum Green (s)	27.0
Yellow Time (s)	3.5
All-Red Time (s)	0.5
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Uniform Delay, d1	
Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Control Type: Pretimed
Maximum v/c Ratio: 0.77
Intersection Signal Delay: 23.7 Intersection LOS: C
Intersection Capacity Utilization 51.0% ICU Level of Service A

Splits and Phases: 1: Summer Street & Atlantic Ave





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	*1.00	1.00	1.00	*1.00	0.91	0.95	*0.84	1.00	1.00	1.00	1.00
Frt					0.967				0.850			
Flt Protected		0.996						0.984				
Satd. Flow (prot)	0	3711	0	0	5404	0	0	3079	1583	0	0	0
Flt Permitted		0.698						0.984				
Satd. Flow (perm)	0	2600	0	0	5404	0	0	3079	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					57				364			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		4192			4752			4064			4192	
Travel Time (s)		95.3			108.0			92.4			95.3	
Volume (vph)	26	322	0	0	336	87	358	597	333	0	0	0
Peak Hour Factor	0.72	0.83	0.85	0.85	0.90	0.81	0.96	0.77	0.90	0.85	0.85	0.85
Adj. Flow (vph)	36	388	0	0	373	107	373	775	370	0	0	0
Lane Group Flow (vph)	0	424	0	0	480	0	0	1148	370	0	0	0
Turn Type	pm+pt						Perm		Perm			
Protected Phases	3	7			4			2				
Permitted Phases	7						2		2			
Minimum Split (s)	8.0	20.0			13.0		20.0	20.0	20.0			
Total Split (s)	8.0	21.0	0.0	0.0	13.0	0.0	45.0	45.0	45.0	0.0	0.0	0.0
Total Split (%)	8%	21%	0%	0%	13%	0%	45%	45%	45%	0%	0%	0%
Maximum Green (s)	4.0	17.0			9.0		41.0	41.0	41.0			
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5	3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5	0.5			
Lead/Lag	Lead				Lag							
Lead-Lag Optimize?	Yes				Yes							
Walk Time (s)		5.0			5.0		5.0	5.0	5.0			
Flash Dont Walk (s)		11.0			11.0		11.0	11.0	11.0			
Pedestrian Calls (#/hr)		0			0		0	0	0			
Act Effct Green (s)		17.0			9.0			41.0	41.0			
Actuated g/C Ratio		0.17			0.09			0.41	0.41			
v/c Ratio		0.87			0.89			0.91	0.43			
Uniform Delay, d1		39.8			39.6			27.7	0.3			
Delay		49.3			50.1			32.9	2.4			
LOS		D			D			C	A			
Approach Delay		49.3			50.1			25.5				
Approach LOS		D			D			C				

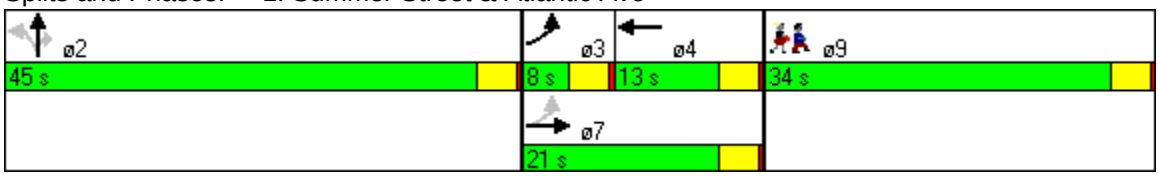
Intersection Summary	
Area Type:	Other
Cycle Length: 100	
Actuated Cycle Length: 100	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green	
Natural Cycle: 60	

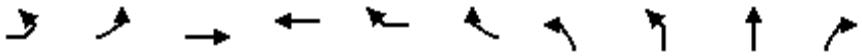
Lane Group	ø9
Lane Configurations	
Ideal Flow (vphpl)	
Total Lost Time (s)	
Turning Speed (mph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Headway Factor	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Volume (vph)	
Peak Hour Factor	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	9
Permitted Phases	
Minimum Split (s)	8.0
Total Split (s)	34.0
Total Split (%)	34%
Maximum Green (s)	30.0
Yellow Time (s)	3.5
All-Red Time (s)	0.5
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	
Flash Dont Walk (s)	
Pedestrian Calls (#/hr)	
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Uniform Delay, d1	
Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Control Type: Pretimed
Maximum v/c Ratio: 0.91
Intersection Signal Delay: 34.5 Intersection LOS: C
Intersection Capacity Utilization 54.3% ICU Level of Service A
* User Entered Value

Splits and Phases: 1: Summer Street & Atlantic Ave



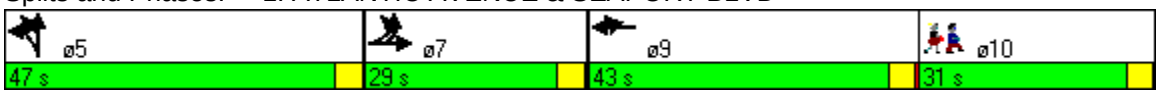


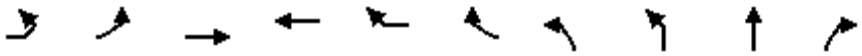
Lane Group	EBL2	EBL	EBT	WBT	WBR	WBR2	NBL2	NBL	NBT	NBR	ø10
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Leading Detector (ft)	50	50	50	50	50		50	50	50		
Trailing Detector (ft)	0	0	0	0	0		0	0	0		
Turning Speed (mph)	15	15			9	9	15	15		9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	*0.91	*0.91	1.00	
Frt					0.850				0.930		
Flt Protected		0.950						0.950	0.995		
Satd. Flow (prot)	0	1770	1863	1863	1583	0	0	1610	1569	0	
Flt Permitted		0.950						0.950	0.995		
Satd. Flow (perm)	0	1770	1863	1863	1583	0	0	1610	1569	0	
Right Turn on Red						No				No	
Satd. Flow (RTOR)											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Link Speed (mph)			30	30					30		
Link Distance (ft)			4176	4360					4504		
Travel Time (s)			94.9	99.1					102.4		
Volume (vph)	108	45	438	334	442	185	45	537	225	242	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	117	49	476	363	480	201	49	584	245	263	
Lane Group Flow (vph)	0	166	476	363	681	0	0	579	562	0	
Turn Type	Split	Split			Prot		Split	Split			
Protected Phases	7	7	7	9	9		5	5	5		10
Permitted Phases											
Detector Phases	7	7	7	9	9		5	5	5		
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0		1.0
Minimum Split (s)	8.0	8.0	8.0	20.0	20.0		8.0	8.0	8.0		31.0
Total Split (s)	29.0	29.0	29.0	43.0	43.0	0.0	47.0	47.0	47.0	0.0	31.0
Total Split (%)	19%	19%	19%	29%	29%	0%	31%	31%	31%	0%	21%
Maximum Green (s)	25.0	25.0	25.0	39.0	39.0		43.0	43.0	43.0		27.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5		0.5
Lead/Lag				Lead	Lead						Lag
Lead-Lag Optimize?				Yes	Yes						Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0
Recall Mode	None	None	None	None	None		None	None	None		None
Walk Time (s)											7.0
Flash Dont Walk (s)											20.0
Pedestrian Calls (#/hr)											6
Act Effct Green (s)		25.2	25.2	39.4	39.4			43.3	43.3		
Actuated g/C Ratio		0.20	0.20	0.31	0.31			0.35	0.35		
v/c Ratio		0.46	1.27	0.62	1.37			1.04	1.03		
Uniform Delay, d1		45.7	51.6	38.4	44.6			42.5	42.5		
Delay		46.7	160.3	39.0	182.2			83.6	83.2		
LOS		D	F	D	F			F	F		
Approach Delay			130.9	132.4					83.4		
Approach LOS			F	F					F		

Intersection Summary

Area Type:	Other
Cycle Length: 150	
Actuated Cycle Length: 125.2	
Natural Cycle: 150	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.37	
Intersection Signal Delay: 112.3	Intersection LOS: F
Intersection Capacity Utilization 93.4%	ICU Level of Service E
* User Entered Value	

Splits and Phases: 1: ATLANTIC AVENUE & SEAPORT BLVD



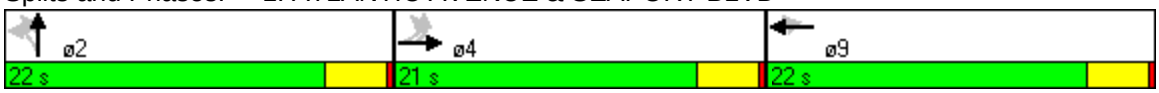


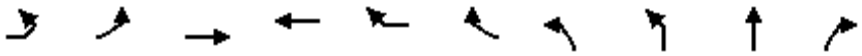
Lane Group	EBL2	EBL	EBT	WBT	WBR	WBR2	NBL2	NBL	NBT	NBR
Lane Configurations										
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Leading Detector (ft)	50	50	50	50	50		50	50	50	
Trailing Detector (ft)	0	0	0	0	0		0	0	0	
Turning Speed (mph)	15	15			9	9	15	15		9
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	*0.91	*0.91	1.00
Frt					0.850				0.930	
Flt Protected		0.950						0.950	0.995	
Satd. Flow (prot)	0	1770	1863	1863	1583	0	0	1610	1569	0
Flt Permitted		0.235						0.950	0.995	
Satd. Flow (perm)	0	438	1863	1863	1583	0	0	1610	1569	0
Right Turn on Red						No				No
Satd. Flow (RTOR)										
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)			30	30					30	
Link Distance (ft)			4176	4360					4504	
Travel Time (s)			94.9	99.1					102.4	
Volume (vph)	108	45	438	334	442	185	45	537	225	242
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	117	49	476	363	480	201	49	584	245	263
Lane Group Flow (vph)	0	166	476	363	681	0	0	579	562	0
Turn Type	Perm	Perm			Perm		Perm	Perm		
Protected Phases			4	9					2	
Permitted Phases	4	4			9		2	2		
Detector Phases	4	4	4	9	9		2	2	2	
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0	
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0		20.0	20.0	20.0	
Total Split (s)	21.0	21.0	21.0	22.0	22.0	0.0	22.0	22.0	22.0	0.0
Total Split (%)	32%	32%	32%	34%	34%	0%	34%	34%	34%	0%
Maximum Green (s)	17.0	17.0	17.0	18.0	18.0		18.0	18.0	18.0	
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5	
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5	
Lead/Lag										
Lead-Lag Optimize?										
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0	
Recall Mode	None	None	None	None	None		None	None	None	
Act Effct Green (s)		17.0	17.0	18.0	18.0			18.0	18.0	
Actuated g/C Ratio		0.26	0.26	0.28	0.28			0.28	0.28	
v/c Ratio		1.44	0.98	0.70	1.55			1.30	1.29	
Uniform Delay, d1		24.0	23.8	21.1	23.5			23.5	23.5	
Delay		173.7	52.2	23.6	189.7			133.2	132.4	
LOS		F	D	C	F			F	F	
Approach Delay			83.6	131.9					132.8	
Approach LOS			F	F					F	

Intersection Summary	
Area Type:	Other
Cycle Length: 65	

Actuated Cycle Length: 65
Natural Cycle: 65
Control Type: Actuated-Uncoordinated
Maximum v/c Ratio: 1.55
Intersection Signal Delay: 121.3 Intersection LOS: F
Intersection Capacity Utilization 93.4% ICU Level of Service E
* User Entered Value

Splits and Phases: 1: ATLANTIC AVENUE & SEAPORT BLVD



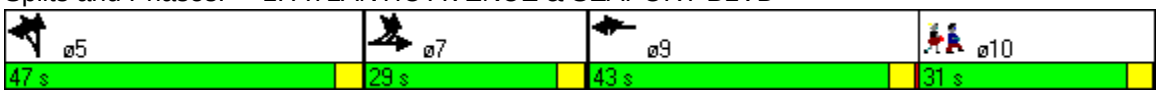


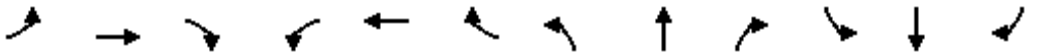
Lane Group	EBL2	EBL	EBT	WBT	WBR	WBR2	NBL2	NBL	NBT	NBR	ø10
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Leading Detector (ft)	50	50	50	50	50		50	50	50		
Trailing Detector (ft)	0	0	0	0	0		0	0	0		
Turning Speed (mph)	15	15			9	9	15	15		9	
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	*0.91	*0.91	1.00	
Frt					0.850				0.922		
Flt Protected		0.950						0.950			
Satd. Flow (prot)	0	1770	1863	1863	1583	0	0	1610	1563	0	
Flt Permitted		0.950						0.950			
Satd. Flow (perm)	0	1770	1863	1863	1583	0	0	1610	1563	0	
Right Turn on Red						No				No	
Satd. Flow (RTOR)											
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
Link Speed (mph)			30	30					30		
Link Distance (ft)			4176	4360					4504		
Travel Time (s)			94.9	99.1					102.4		
Volume (vph)	108	45	438	334	442	185	45	537	225	242	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	
Adj. Flow (vph)	117	49	476	363	480	201	49	584	245	263	
Lane Group Flow (vph)	0	166	476	363	681	0	0	633	508	0	
Turn Type	Split	Split			Prot		Split	Split			
Protected Phases	7	7	7	9	9		5	5	5		10
Permitted Phases											
Detector Phases	7	7	7	9	9		5	5	5		
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0		1.0
Minimum Split (s)	8.0	8.0	8.0	20.0	20.0		8.0	8.0	8.0		31.0
Total Split (s)	29.0	29.0	29.0	43.0	43.0	0.0	47.0	47.0	47.0	0.0	31.0
Total Split (%)	19%	19%	19%	29%	29%	0%	31%	31%	31%	0%	21%
Maximum Green (s)	25.0	25.0	25.0	39.0	39.0		43.0	43.0	43.0		27.0
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5		3.5	3.5	3.5		3.5
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5		0.5	0.5	0.5		0.5
Lead/Lag				Lead	Lead						Lag
Lead-Lag Optimize?				Yes	Yes						Yes
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0		3.0
Recall Mode	None	None	None	None	None		None	None	None		None
Walk Time (s)											7.0
Flash Dont Walk (s)											20.0
Pedestrian Calls (#/hr)											6
Act Effct Green (s)		25.2	25.2	39.4	39.4			43.3	43.3		
Actuated g/C Ratio		0.20	0.20	0.31	0.31			0.35	0.35		
v/c Ratio		0.46	1.27	0.62	1.37			1.13	0.94		
Uniform Delay, d1		45.7	51.6	38.4	44.6			42.5	41.7		
Delay		46.7	160.3	39.0	182.2			111.1	63.3		
LOS		D	F	D	F			F	E		
Approach Delay			130.9	132.4					89.8		
Approach LOS			F	F					F		

Intersection Summary

Area Type:	Other
Cycle Length: 150	
Actuated Cycle Length: 125.2	
Natural Cycle: 150	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 1.37	
Intersection Signal Delay: 114.9	Intersection LOS: F
Intersection Capacity Utilization 96.5%	ICU Level of Service E
* User Entered Value	

Splits and Phases: 1: ATLANTIC AVENUE & SEAPORT BLVD



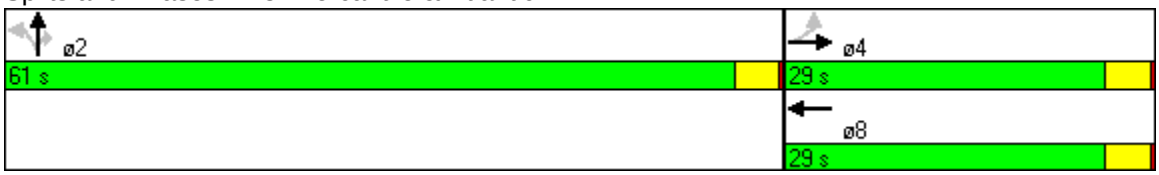


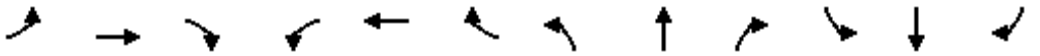
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00
Frt					0.978				0.850			
Flt Protected		0.989						0.998				
Satd. Flow (prot)	0	3500	0	0	3461	0	0	3532	1583	0	0	0
Flt Permitted		0.846						0.998				
Satd. Flow (perm)	0	2994	0	0	3461	0	0	3532	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					21				214			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5272			5416			4712			4424	
Travel Time (s)		119.8			123.1			107.1			100.5	
Volume (vph)	33	113	0	0	223	38	11	248	197	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	36	123	0	0	242	41	12	270	214	0	0	0
Lane Group Flow (vph)	0	159	0	0	283	0	0	282	214	0	0	0
Turn Type	Perm						Perm		Perm			
Protected Phases		4			8			2				
Permitted Phases	4						2		2			
Minimum Split (s)	20.0	20.0			20.0		20.0	20.0	20.0			
Total Split (s)	29.0	29.0	0.0	0.0	29.0	0.0	61.0	61.0	61.0	0.0	0.0	0.0
Total Split (%)	32%	32%	0%	0%	32%	0%	68%	68%	68%	0%	0%	0%
Maximum Green (s)	25.0	25.0			25.0		57.0	57.0	57.0			
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5	3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5	0.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0			5.0		5.0	5.0	5.0			
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0	11.0			
Pedestrian Calls (#/hr)	0	0			0		0	0	0			
Act Effct Green (s)		25.0			25.0			57.0	57.0			
Actuated g/C Ratio		0.28			0.28			0.63	0.63			
v/c Ratio		0.19			0.29			0.13	0.20			
Uniform Delay, d1		24.8			23.5			6.6	0.0			
Delay		25.1			23.8			6.6	1.0			
LOS		C			C			A	A			
Approach Delay		25.1			23.8			4.2				
Approach LOS		C			C			A				

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green	
Natural Cycle: 40	

Control Type: Pretimed
Maximum v/c Ratio: 0.29
Intersection Signal Delay: 13.6 Intersection LOS: B
Intersection Capacity Utilization 24.4% ICU Level of Service A

Splits and Phases: 3: Mercantile & Atlantic



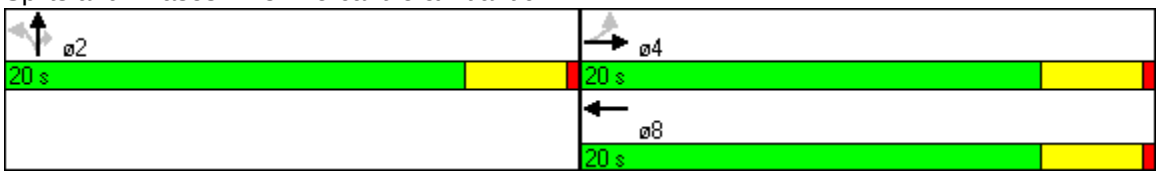


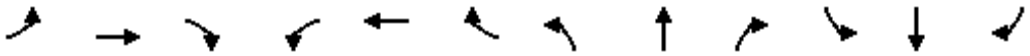
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.95	0.95	1.00	1.00	1.00	1.00
Frt					0.980				0.850			
Flt Protected		0.989						0.998				
Satd. Flow (prot)	0	3500	0	0	1825	0	0	3532	1583	0	0	0
Flt Permitted		0.869						0.998				
Satd. Flow (perm)	0	3076	0	0	1825	0	0	3532	1583	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					25				214			
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5272			5416			4712			4424	
Travel Time (s)		119.8			123.1			107.1			100.5	
Volume (vph)	33	113	0	0	223	38	11	248	197	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	36	123	0	0	242	41	12	270	214	0	0	0
Lane Group Flow (vph)	0	159	0	0	283	0	0	282	214	0	0	0
Turn Type	Perm						Perm		Perm			
Protected Phases		4			8			2				
Permitted Phases	4						2		2			
Minimum Split (s)	20.0	20.0			20.0		20.0	20.0	20.0			
Total Split (s)	20.0	20.0	0.0	0.0	20.0	0.0	20.0	20.0	20.0	0.0	0.0	0.0
Total Split (%)	50%	50%	0%	0%	50%	0%	50%	50%	50%	0%	0%	0%
Maximum Green (s)	16.0	16.0			16.0		16.0	16.0	16.0			
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5	3.5			
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5	0.5			
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0			5.0		5.0	5.0	5.0			
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0	11.0			
Pedestrian Calls (#/hr)	0	0			0		0	0	0			
Act Effct Green (s)		16.0			16.0			16.0	16.0			
Actuated g/C Ratio		0.40			0.40			0.40	0.40			
v/c Ratio		0.13			0.38			0.20	0.28			
Uniform Delay, d1		7.6			7.7			7.8	0.0			
Delay		7.8			8.1			8.0	1.9			
LOS		A			A			A	A			
Approach Delay		7.8			8.1			5.4				
Approach LOS		A			A			A				

Intersection Summary	
Area Type:	Other
Cycle Length: 40	
Actuated Cycle Length: 40	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green	
Natural Cycle: 40	

Control Type: Pretimed
Maximum v/c Ratio: 0.38
Intersection Signal Delay: 6.6 Intersection LOS: A
Intersection Capacity Utilization 29.7% ICU Level of Service A

Splits and Phases: 3: Mercantile & Atlantic



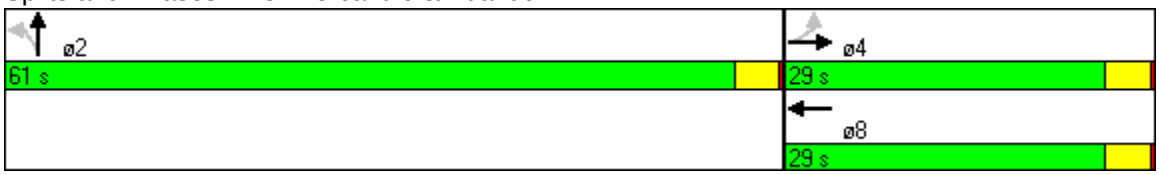


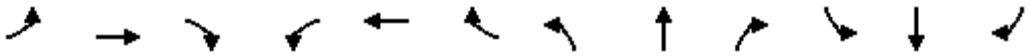
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	1.00	1.00	1.00	1.00	0.95	0.95	0.95	1.00	1.00	1.00
Frt					0.980			0.935				
Flt Protected		0.989						0.999				
Satd. Flow (prot)	0	3500	0	0	1825	0	0	3306	0	0	0	0
Flt Permitted		0.832						0.999				
Satd. Flow (perm)	0	2945	0	0	1825	0	0	3306	0	0	0	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)					9			214				
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		5272			5416			4712			4424	
Travel Time (s)		119.8			123.1			107.1			100.5	
Volume (vph)	33	113	0	0	223	38	11	248	197	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	36	123	0	0	242	41	12	270	214	0	0	0
Lane Group Flow (vph)	0	159	0	0	283	0	0	496	0	0	0	0
Turn Type	Perm						Perm					
Protected Phases		4			8			2				
Permitted Phases	4						2					
Minimum Split (s)	20.0	20.0			20.0		20.0	20.0				
Total Split (s)	29.0	29.0	0.0	0.0	29.0	0.0	61.0	61.0	0.0	0.0	0.0	0.0
Total Split (%)	32%	32%	0%	0%	32%	0%	68%	68%	0%	0%	0%	0%
Maximum Green (s)	25.0	25.0			25.0		57.0	57.0				
Yellow Time (s)	3.5	3.5			3.5		3.5	3.5				
All-Red Time (s)	0.5	0.5			0.5		0.5	0.5				
Lead/Lag												
Lead-Lag Optimize?												
Walk Time (s)	5.0	5.0			5.0		5.0	5.0				
Flash Dont Walk (s)	11.0	11.0			11.0		11.0	11.0				
Pedestrian Calls (#/hr)	0	0			0		0	0				
Act Effct Green (s)		25.0			25.0			57.0				
Actuated g/C Ratio		0.28			0.28			0.63				
v/c Ratio		0.19			0.55			0.23				
Uniform Delay, d1		24.8			26.7			3.8				
Delay		25.1			27.4			3.9				
LOS		C			C			A				
Approach Delay		25.1			27.4			3.9				
Approach LOS		C			C			A				

Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:NBTL and 6:, Start of Green	
Natural Cycle: 40	

Control Type: Pretimed
Maximum v/c Ratio: 0.55
Intersection Signal Delay: 14.6 Intersection LOS: B
Intersection Capacity Utilization 36.6% ICU Level of Service A

Splits and Phases: 3: Mercantile & Atlantic





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	0.95	0.95	0.95	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.966			0.999			0.960			0.891	
Flt Protected		0.999			0.998			0.969			0.992	
Satd. Flow (prot)	0	3415	0	0	3529	0	0	1733	0	0	1646	0
Flt Permitted		0.949			0.927			0.782			0.955	
Satd. Flow (perm)	0	3245	0	0	3278	0	0	1398	0	0	1585	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		72			1			20			29	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3939			5357			4847			5569	
Travel Time (s)		89.5			121.8			110.2			126.6	
Volume (vph)	5	215	65	24	462	4	46	4	21	4	1	21
Peak Hour Factor	0.77	0.77	0.77	0.96	0.96	0.96	0.89	0.89	0.89	0.72	0.72	0.72
Adj. Flow (vph)	6	279	84	25	481	4	52	4	24	6	1	29
Lane Group Flow (vph)	0	369	0	0	510	0	0	80	0	0	36	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1			1			2			2		
Minimum Split (s)	20.0	20.0		20.0	20.0		15.0	15.0		15.0	15.0	
Total Split (s)	56.0	56.0	0.0	56.0	56.0	0.0	15.0	15.0	0.0	15.0	15.0	0.0
Total Split (%)	62%	62%	0%	62%	62%	0%	17%	17%	0%	17%	17%	0%
Maximum Green (s)	52.0	52.0		52.0	52.0		11.0	11.0		11.0	11.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lead	Lead		Lag	Lag		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Walk Time (s)												
Flash Dont Walk (s)												
Pedestrian Calls (#/hr)												
Act Effct Green (s)		52.0			52.0			11.0			11.0	
Actuated g/C Ratio		0.58			0.58			0.12			0.12	
v/c Ratio		0.19			0.27			0.43			0.16	
Uniform Delay, d1		7.1			9.5			27.1			6.8	
Delay		7.2			9.6			29.2			16.6	
LOS		A			A			C			B	
Approach Delay		7.2			9.6			29.2			16.6	
Approach LOS		A			A			C			B	

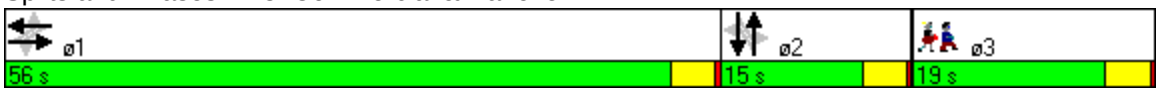
Intersection Summary	
Area Type:	Other
Cycle Length: 90	
Actuated Cycle Length: 90	
Offset: 0 (0%), Referenced to phase 2:NBSB, Start of Green	
Natural Cycle: 55	

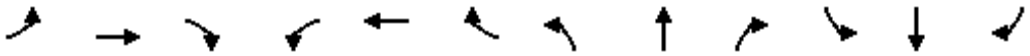
Lane Group	ø3
Lane Configurations	
Ideal Flow (vphpl)	
Total Lost Time (s)	
Turning Speed (mph)	
Lane Util. Factor	
Frt	
Flt Protected	
Satd. Flow (prot)	
Flt Permitted	
Satd. Flow (perm)	
Right Turn on Red	
Satd. Flow (RTOR)	
Headway Factor	
Link Speed (mph)	
Link Distance (ft)	
Travel Time (s)	
Volume (vph)	
Peak Hour Factor	
Adj. Flow (vph)	
Lane Group Flow (vph)	
Turn Type	
Protected Phases	3
Permitted Phases	
Minimum Split (s)	19.0
Total Split (s)	19.0
Total Split (%)	21%
Maximum Green (s)	15.0
Yellow Time (s)	3.5
All-Red Time (s)	0.5
Lead/Lag	
Lead-Lag Optimize?	
Walk Time (s)	7.0
Flash Dont Walk (s)	12.0
Pedestrian Calls (#/hr)	0
Act Effct Green (s)	
Actuated g/C Ratio	
v/c Ratio	
Uniform Delay, d1	
Delay	
LOS	
Approach Delay	
Approach LOS	

Intersection Summary

Control Type: Pretimed
Maximum v/c Ratio: 0.43
Intersection Signal Delay: 10.5 Intersection LOS: B
Intersection Capacity Utilization 34.8% ICU Level of Service A

Splits and Phases: 3: Commercial & Hanover





Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Turning Speed (mph)	15		9	15		9	15		9	15		9
Lane Util. Factor	1.00	1.00	1.00	0.95	0.95	0.95	1.00	1.00	1.00	1.00	1.00	1.00
Frt		0.969			0.999			0.960			0.891	
Flt Protected		0.999			0.998			0.969			0.992	
Satd. Flow (prot)	0	1803	0	0	3529	0	0	1733	0	0	1646	0
Flt Permitted		0.994			0.933			0.786			0.950	
Satd. Flow (perm)	0	1794	0	0	3299	0	0	1406	0	0	1577	0
Right Turn on Red			Yes			Yes			Yes			Yes
Satd. Flow (RTOR)		66			3			24			29	
Headway Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Link Speed (mph)		30			30			30			30	
Link Distance (ft)		3939			5357			4847			5569	
Travel Time (s)		89.5			121.8			110.2			126.6	
Volume (vph)	5	215	65	24	462	4	46	4	21	4	1	21
Peak Hour Factor	0.77	0.77	0.77	0.96	0.96	0.96	0.89	0.89	0.89	0.72	0.72	0.72
Adj. Flow (vph)	6	279	84	25	481	4	52	4	24	6	1	29
Lane Group Flow (vph)	0	369	0	0	510	0	0	80	0	0	36	0
Turn Type	Perm			Perm			Perm			Perm		
Protected Phases		1			1			2			2	
Permitted Phases	1			1			2			2		
Minimum Split (s)	22.0	22.0		22.0	22.0		17.0	17.0		17.0	17.0	
Total Split (s)	33.0	33.0	0.0	33.0	33.0	0.0	12.0	12.0	0.0	12.0	12.0	0.0
Total Split (%)	73%	73%	0%	73%	73%	0%	27%	27%	0%	27%	27%	0%
Maximum Green (s)	29.0	29.0		29.0	29.0		8.0	8.0		8.0	8.0	
Yellow Time (s)	3.5	3.5		3.5	3.5		3.5	3.5		3.5	3.5	
All-Red Time (s)	0.5	0.5		0.5	0.5		0.5	0.5		0.5	0.5	
Lead/Lag	Lead	Lead		Lead	Lead		Lag	Lag		Lag	Lag	
Lead-Lag Optimize?	Yes	Yes		Yes	Yes		Yes	Yes		Yes	Yes	
Walk Time (s)	7.0	7.0		7.0	7.0		7.0	7.0		7.0	7.0	
Flash Dont Walk (s)	11.0	11.0		11.0	11.0		11.0	11.0		11.0	11.0	
Pedestrian Calls (#/hr)	0	0		0	0		0	0		0	0	
Act Effct Green (s)		29.0			29.0			8.0			8.0	
Actuated g/C Ratio		0.64			0.64			0.18			0.18	
v/c Ratio		0.31			0.24			0.30			0.12	
Uniform Delay, d1		2.8			3.3			11.1			3.0	
Delay		3.0			3.4			12.8			8.8	
LOS		A			A			B			A	
Approach Delay		3.0			3.4			12.8			8.8	
Approach LOS		A			A			B			A	

Intersection Summary	
Area Type:	Other
Cycle Length: 45	
Actuated Cycle Length: 45	
Offset: 0 (0%), Referenced to phase 2:NBSB, Start of Green	
Natural Cycle: 40	

Control Type: Pretimed
Maximum v/c Ratio: 0.31
Intersection Signal Delay: 4.2 Intersection LOS: A
Intersection Capacity Utilization 40.1% ICU Level of Service A

Splits and Phases: 3: Commercial & Hanover