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**To**  
Alex Train, City of Chelsea



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**From**  
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**Subject**  
Chelsea Broadway Bus Pilot Analysis

The City of Chelsea implemented a bus pilot on Washington Avenue between Chestnut Street and 5<sup>th</sup> Street and on Broadway between 5<sup>th</sup> Street and 3<sup>rd</sup> Street in November 2020. With this pilot, one of the existing travel lanes on Washington Avenue and Broadway was converted into a dedicated bus/bike lane. In addition, curb extensions were added on Broadway at the intersections with 3<sup>rd</sup> Street and 4<sup>th</sup> Street. The goal of the pilot is to demonstrate the feasibility of integrating bus priority on this critical corridor that serves high volumes of transit riders.

## Road Diet

As a part of the Bus Pilot, a road diet was implemented on Washington Avenue and Broadway. FHWA developed guidelines for selecting candidate Road Diet Locations to ensure that the effect on traffic operations is minimized. A road with an Average Daily Traffic (ADT) of less than 10,000 is considered a great candidate for Road Diets in most instances and capacity will most likely not be affected<sup>1</sup>. The ADT on Broadway and on Washington Avenue are less than 10,000.

## Bus Pilot Analysis

The purpose of this memorandum is to review both qualitative and quantitative data to analyze the success of the Chelsea Bus Pilot to date. Analysis was completed for following five (5) categories:

- Traffic Volumes
- Speeds and Travel Times
- Double Parking Violations
- Safety
- MBTA Ridership & Travel Times

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<sup>1</sup> FHWA, Road Diet Informational Guide. FHWA Report No. FHWA-SA-14-028. Washington, D.C. 2014. Accessible at: [http://safety.fhwa.dot.gov/road\\_diets/info\\_guide/](http://safety.fhwa.dot.gov/road_diets/info_guide/).

## Traffic Volumes

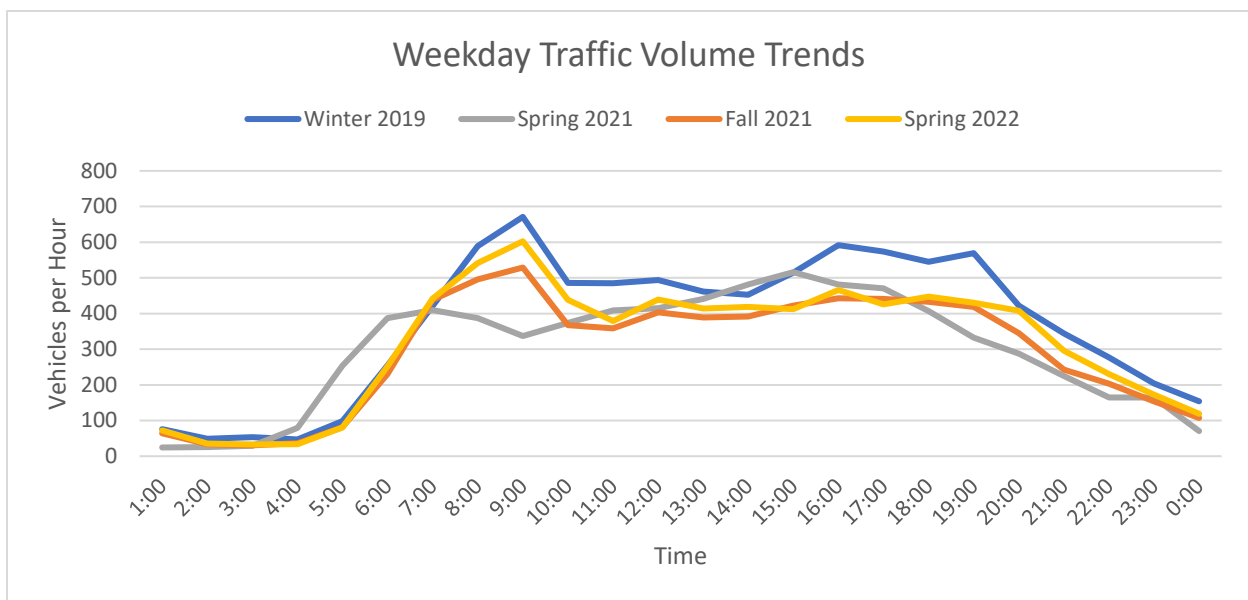
The project team collected traffic counts at the following three (3) stations:

- Station 1: Broadway, between Second St and Everett Ave
- Station 2: Broadway, between Fourth and Fifth St
- Station 3: Washington, between Chestnut St and Fifth St

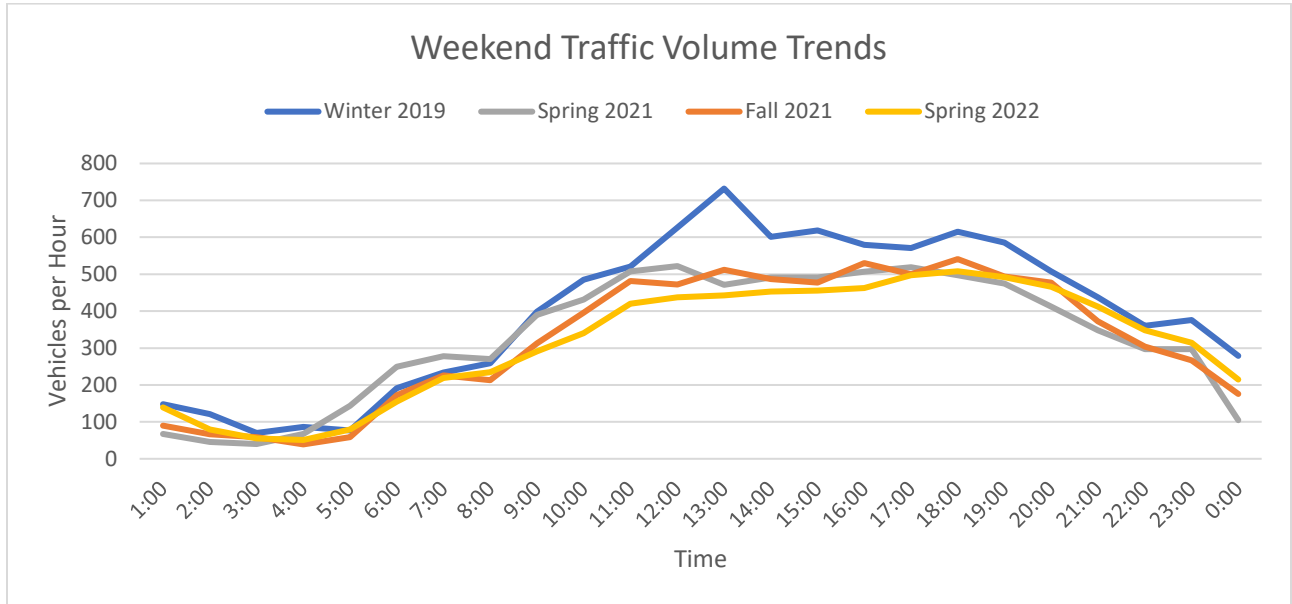
Traffic counts were conducted using Automatic Traffic Recorders (ATRs) during the following time periods:

- December 2019 (pre-pilot)
- April 2021 (bus pilot)
- November 2021 (bus pilot)
- May 2022 (bus pilot)

The project team reviewed the volume trends to determine how different factors such as the road diet and the COVID-19 pandemic impacted the traffic volumes. With the road diet and implementation of a bus lane, it was expected the volumes would either remain similar or decrease slightly. **Figure 1 and Figure 2** shows the weekday and weekend volume trends at Station 2. Station 2 was used for the comparison as there is no bus lane at Station 1 and Station 3 does not have 2019 counts to compare to.



**Figure 1: Weekday Traffic Volume Trends**



**Figure 2: Weekend Traffic Volume Trends**

Based on these volume trends, the project team observed that the COVID-19 pandemic contributed to a decrease in commuter traffic. Spring 2021 and Fall 2021 weekday volumes were lower than Fall 2019 (pre-pandemic). Spring 2022 and later generally represents post-pandemic conditions. Based on this observations, Spring 2022 was used for comparison as it represents a normalized post-pandemic condition. A comparison of the pre-pilot and bus pilot traffic volumes can be found in **Table 1**.

**Table 1: Volume Comparison on Washington and Broadway**

<b>Weekday Average</b>				
	<b>Pre-Pilot</b>	<b>Bus pilot</b>	<b>Difference</b>	<b>%</b>
<b>Station 1</b>	2,933	3,828	895	30%
<b>Station 2</b>	8,833	7,588	-1,245	-14%
<b>Station 3</b>	-	10,315	-	-
<b>Weekday AM Peak Hour (7-9 AM)</b>				
	<b>Pre-Pilot</b>	<b>Bus pilot</b>	<b>Difference</b>	<b>%</b>
<b>Station 1</b>	250	371	121	48%
<b>Station 2</b>	1,010	984	-27	-3%
<b>Station 3</b>	-	1,264	-	-
<b>Weekday PM Peak Hour (4-6 PM)</b>				
	<b>Pre-Pilot</b>	<b>Bus pilot</b>	<b>Difference</b>	<b>%</b>
<b>Station 1</b>	459	530	71	15%
<b>Station 2</b>	1166	892	-274	-23%
<b>Station 3</b>	-	1,280	-	-
<b>Weekend Average</b>				
	<b>Pre-Pilot</b>	<b>Bus pilot</b>	<b>Difference</b>	<b>%</b>
<b>Station 1</b>	3,795	4,235	440	12%
<b>Station 2</b>	9,480	7,567	-1,913	-20%
<b>Station 3</b>	-	9,844	-	-

Based on these volumes, the project team has made the following observations:

1. Traffic volumes from 2019 could be abnormally high due to adjacent construction. In fall of 2019, the 5<sup>th</sup> Street on-ramp was closed to traffic as a part of the Chelsea Viaduct project. The detour associated with the ramp closure directed vehicles down Broadway to the Everett Street ramp. This may have resulted in a temporary increase in vehicles in the area and a change in circulation in Winter 2019. The ramp reopened in June of 2021.
2. Vehicles could be choosing a different route due to the road diet. Spring 2022 had similar hourly trends as Fall 2019, but the total volumes were lower. A reduction in traffic volumes is common on corridors after implementation of a road diet. A similar pilot, the Somerville Central Broadway Dedicated Bus/Bike lane, saw a 20-30% decrease in traffic volumes compared to before the dedicated lane was implemented.
3. The post-pandemic conditions in Spring 2022 could have lower volumes than the pre-pandemic Winter 2019 volumes as a result of the COVID-19 pandemic.

The project team also reviewed bicycle volumes on Washington and Broadway. With the implementation of a dedicated bus/bike lane, it was anticipated that bicycle volumes would increase. During the weekday, the number of cyclists riding on the roadway after the implementation of the Bus Pilot was significantly higher

than before the Bus Pilot was implemented. However, it should be noted that the pre-pilot data was taken in December 2019, which may have accounted for lower volumes of cyclists during that time.

However, the trends show that the number of cyclists riding on the roadway during the bus pilot has increased from Spring 2021 to Spring 2022. This may indicate that cyclists are more comfortable riding in the shared bus/bike lane. Bicycle volumes can be found in **Table 2**.

**Table 2: Bicycle Volumes on Washington and Broadway**

Weekday				
	Pre-Pilot	Spring 2021	Fall 2021	Spring 2022
<b>Station 1</b>	1	13	25	30
<b>Station 2</b>	16	12	34	41
<b>Station 3</b>	2	7	31	30
Weekend				
	Pre-Pilot	Spring 2021	Fall 2021	Spring 2022
<b>Station 1</b>	-	17	9	11
<b>Station 2</b>	-	24	16	40
<b>Station 3</b>	-	13	10	17

### *Speeds and Passenger Vehicle Travel Times*

The project team compared vehicle speeds and travel times from before the Bus Pilot was implemented and after implementation. The team looked at Weekday AM, Weekday PM, and Weekend speeds and travel times for two date ranges:

- November 2018- October 2020 (pre-pilot)
- November 2020 – May 2022 (bus pilot)

Speeds and travel times can be found in **Table 3**.

Overall, speeds stayed relatively consistent on the corridor. While road diets can provide traffic calming and reduced speeds on roadways, the introduction of the bus lane did not affect speeds as there was little congestion on the corridor before the pilot. Travel times also stayed relatively consistent with pre-pilot travel times trending slightly higher. This could be a result of the higher volumes on Broadway from the nearby construction.

**Table 3: Weekday & Weekend Speeds and Travel Times**

Weekday AM		
	Speed (mph)	Travel Time (min)
Nov 2018 – Oct 2020 (pre-pilot)	11.50	1.81
Nov 2020 – May 2022 (bus pilot)	11.63	1.72
Weekday PM		
	Speed (mph)	Travel Time (min)
Nov 2018 – Oct 2020 (pre-pilot)	10.88	2.10
Nov 2020 – May 2022 (bus pilot)	10.41	1.98
Weekend		
	Speed (mph)	Travel Time (min)
Nov 2018 – Oct 2020 (pre-pilot)	11.24	2.08
Nov 2020 – May 2022 (bus pilot)	11.35	1.69

### *MBTA Bus Routes and Ridership*

The project team compared pre-pilot vs bus pilot MBTA ridership at three bus stops within the project limits including:

- Stop ID #5605: Washington Ave @ Broadway
- Stop ID #5606: Broadway @ Fourth Street
- Stop ID #5653: Broadway Opp Cross Street

Based on the impacts COVID-19 had on commuting patterns, April 2022 – June 2022 was used for the bus pilot date range in order to capture a more normalized data set. Ridership data can be found in **Table 4**.

**Table 4: MBTA Average Daily Ridership**

Weekday On + Off				
	Pre-Pilot Jan 2018 – Dec 2018	Bus Pilot April 2022 – June 2022	Difference	%
Washington Ave @ Broadway	2235	2149	-86	-4%
Broadway @ Fourth Street	984	856	-127	-13%
Broadway @ Cross Street	432	358	-74	-17%
Saturday On + Off				
	Pre-Pilot Jan 2018 – Dec 2018	Bus Pilot April 2022 – June 2022	Difference	%
Washington Ave @ Broadway	1586	1469	-117	-7%
Broadway @ Fourth Street	792	617	-175	-22%
Broadway @ Cross Street	251	246	-5	-2%

Ridership remained high along the corridor, similar to before the Bus Pilot was implemented; however, there was a slight drop in ridership in 2022. This could be due to the change in commuting patterns where riders may have either opted to use an alternate mode of transportation instead of a bus or worked remotely.

The project team also analyzed travel times for the following portion of the five bus routes within the project limits:

- 111 Bus Inbound: Washington @ Chestnut – Third & Chestnut
- 112 Bus Outbound: Broadway @ Shurtleff to Third @ Chestnut
- 112/114 Bus Inbound: Sixth @ Walnut to Opp Cross St
- 114 Bus Outbound: City Hall to Third @ Chestnut
- 116/117 Bus Inbound: City Hall Ave to Opp Cross St

Overall, peak hour travel times stayed the same after the Bus Pilot was implemented for the 111 IB, 112/114 IB, and 116/117 IB. The 112 OB bus saw a slight increase in travel times. MBTA Travel Times can be found in **Table 5**.

**Table 4: MBTA Travel Times**

<b>Weekday AM Peak Hour (7-9 AM)</b>			
	<b>Pre-Pilot Oct 2019 – Nov 2019 (min)</b>	<b>Bus Pilot Jan 2021 – Dec 2021 (min)</b>	<b>Bus Pilot Jan 2022 – May 2022 (min)</b>
111 Bus Inbound	3.35	2.87	3.46
112 Bus Outbound	3.33	3.70	4.53
112/114 Bus Inbound	1.57	1.55	1.71
116/117 Bus Inbound	3.49	3.66	3.52
<b>Weekday PM Peak Hour (4-6 PM)</b>			
	<b>Pre-Pilot Oct 2019 – Nov 2019 (min)</b>	<b>Bus Pilot Jan 2021 – Dec 2021 (min)</b>	<b>Bus Pilot Jan 2022 – May 2022 (min)</b>
111 Bus Inbound	3.43	3.42	3.48
112 Bus Outbound	3.85	3.97	4.20
112/114 Bus Inbound	1.91	1.99	2.03
116/117 Bus Inbound	3.59	3.42	3.37

### *Double Parking Violations*

The project team reviewed the ticketed parking violations for the following date ranges:

- January 2019 – October 2020, before the bus pilot was implemented
- November 2020 – October 2021, after the bus pilot was implemented

The number of double parking tickets issued each month decreased. Before the Bus Pilot an average of 30 double parking tickets were issued each month. After the Bus Pilot was implemented, an average of 22 double parking tickets were issued each month. This could mean that less vehicles are double parking in the

bus lane. However, because this data is based on the number of tickets issued, this data may not be representative of the success of the Bus Pilot. Additionally, with more enforcement it can be expected that double parking would decrease and travel times would go down for buses as there are less obstacles within the bus lane.

### Crash Data

In April 2019 a Road Safety Audit (RSA) was performed along the corridor. Crash data was obtained from the Chelsea Police Department for the period between January 2014 and December 2016 and used during the RSA for the corridor. This analysis utilizes the same data to represent the crashes before the bus pilot. Additional crash data was also obtained from the Chelsea Police Department for the period after the Bus Pilot between November 2020 and May 2022.

The summarized crash data for the years 2014 to 2016 (pre-bus pilot) and the years 2020 to 2022 (bus pilot) is shown in **Table 4**.

**Table 4 - Crash Summary**

	Average Crashes per Year											
	Broadway at Second St		Broadway at Everett St/ Cross St		Broadway at Third St/ Congress Ave		Broadway at Fourth St		Bellingham Square		Broadway/ Washington Corridor	
	Pre-Pilot	Bus Pilot	Pre-Pilot	Bus Pilot	Pre-Pilot	Bus Pilot	Pre-Pilot	Bus Pilot	Pre-Pilot	Bus Pilot	Pre-Pilot	Bus Pilot
<b>Total</b>	2.3	0.7	7.7	1.3	14	4.0	8.3	2.7	16.7	2.7	3	1.3
<b>Pedestrian</b>	0	0	1.3	0.7	0.7	0	2	0	2.3	0	0	0
<b>Cyclist</b>	0	0	0	0	0	1.3	0	0.7	0.7	0	0.7	0.7
<b>Angle</b>	0.7	1.3	1.0	0.7	10	2.7	1.3	0.7	5.0	0	0	0

The data shows a reduction in total crashes. Before the Bus Pilot, there were 52 crashes on average per year within the project area. After the bus pilot, there were 19 crashes on average per year within the project area. The data also shows a reduction in angled collisions. Before the Bus Pilot, there was an average of 18 angled collisions per year. After the bus pilot, there was an average of 5.4 angled collisions per year. At the Broadway/Third/Congress intersection, there was a 60% decrease in angled crashes which could be a result of the improvements made during the Bus Pilot.

### Pedestrian Safety

Pedestrian improvements were implemented on Broadway and Washington including installing curb extensions, refreshing pavement markings, and installing Rapid Rectangular Flashing Beacons (RRFB's).

Curb extensions create intersection safety measures including:

- Improved walkability
- ADA accessibility to bus stops and crossings
- Reduction of crosswalk distances leading to improved visibility and reduced exposure to vehicular conflicts
- Tightened intersection curb radii to encourage slower turning speeds



Additionally, the road diet also improves visibility of pedestrians and decreases the likelihood of “courtesy” type crashes.

Overall, there was a decrease in pedestrian crashes within the study area after the bus pilot was implemented. Before the bus pilot, there were 6.3 pedestrian crashes on average per year. After the bus pilot, there was 1 pedestrian crash per year. The decrease in pedestrian crashes can be attributed to the pedestrian improvements made on Broadway and Washington Avenue.

### **Cyclist Safety**

Cyclist improvements were implemented on Broadway and Washington including a shared bus-bike lane and a buffered bike lane. These improvements create safety and accessibility measures including:

- Providing bicycle access on transit streets when no space is available for dedicated bikeways
- Increased space and visibility for bikers

Shared bus-bike lanes are generally limited to bus lanes with operating speeds of 20 mph or less, and transit headways of 4 minutes or longer, according to NACTO guidance. On the Roslindale Bus-Bike Lane, 89% of bicyclists surveyed reported feeling safer in the shared lane. However, despite the cyclist improvements, there was an increase in cyclist crashes after the bus pilot implementation. Before the bus pilot there was approximately 1 cyclist crash on average per year with a cyclist crash rate of 5.5%. After the bus pilot, there were 3 cyclist crashes per year with a reduced cyclist crash rate of 3%. Additionally, of the three crashes that occurred after the Bus Pilot was implemented, only one cyclist crash was related to the Bus Lane.

### **Conclusion**

The success of the bus pilot can be measured by any one of or combination of the following:

- Reduction in crashes, especially for vulnerable users
- Reduction in travel times for MBTA buses
- Minimal increase to delay on Washington and Broadway
- Increase in MBTA bus ridership
- Increase in number of cyclists

While there has been an increase in bicycle-related crashes, the number of crashes involving pedestrians decreased significantly as well as the total number of crashes along the corridor. Vehicle speeds and travel times remained consistent, MBTA travel times remained similar, and MBTA ridership decreased slightly. Overall, it can be concluded that the Bus Pilot had no detrimental impacts on the Washington and Broadway corridors. With the decrease in crashes and the increase in the number of cyclists on the corridor, the bus pilot can be considered a success. It is anticipated that the formalization of the dedicated bus/bike lane will further improve safety along the corridor and increase comfort and safety of pedestrians and cyclists.