JANUARY 2020

ROAD SAFETY ASSESSMENT

ATLANTIC AVENUE, ATLANTIC CITY, ATLANTIC COUNTY NJ

JMT Project Number 19-01474-001

ROAD SAFETY ASSESSMENT

Atlantic Avenue from Boston Avenue to Maine Avenue

Submitted to:

City of Atlantic City

MBO Engineering

Transportation Safety Services

Executive Summary

The Atlantic City Road Safety Assessment was initiated in July of 2019 with the purpose of evaluating existing traffic and safety operations along a 2.64-mile corridor of Atlantic Avenue from Boston Avenue to New Hampshire Avenue. The goal of this project was to utilize data-driven engineering analysis to select safety countermeasures and roadway improvements to reduce the frequency of collisions and improve road safety for all users. The objective was to prioritize pedestrian and bicycle improvements.

The corridor was previously studied in December 2014. A Road Safety Audit (RSA) of Atlantic Avenue was performed by the Transportation Safety Resource Center (TSRC) at the Rutgers' Center for Advanced Infrastructure and Transportation (CAIT) in partnership with the South Jersey Transportation Planning Organization (SJTPO) and City of Atlantic City. The findings of the previous study were incorporated into this study.

The project approach consisted of two primary phases: (1) Existing Conditions Review & Analysis; and (2) Countermeasure Selection & Design. The existing conditions review focused on detailed crash analysis and collisions diagrams of all 829 total collisions documented along the 2.64-mile corridor of Atlantic Avenue in Atlantic City from 2013 to 2017. The top 3 crash types were Same Direction – Rear End (210), Same Direction – Sideswipe (162) and Struck Parked Vehicle (148). The findings of the analysis identified Pedestrian crash types were the fifth-most frequent crash type (75 Crashes, 9.1%). The analysis also identified the intersections of most frequent pedestrian collisions.

The selection of countermeasures for this project focused on Pedestrian Safety Countermeasures. Several potential countermeasures were considered when determining the best solution for Atlantic Avenue. The project design team and protect steering committee reviewed alternates for road diets, intersection improvements and performed HSM analyses to identify the most beneficial countermeasures.

The final alternates considered for implementation were Alternate 5 (Road Diet with Median Island & Buffered Bike Lane) and Alternate 6 (Road Diet with Curbside Protected Cycle Track / Bike Lane). The final recommendation for Atlantic City is to implement Alternate 5, Road Diet with Median Island & Buffered Bike. The road diet will include intersection specific countermeasures consisting of Leading Pedestrian Intervals; Targeted Left-Turn Restrictions; Installation of Traffic Signal Heads with Backplates; and, Curb Extensions at select intersections. The data-driven analysis supporting these improvements are summarized within this report. The detailed results are included as **Appendix G** of this report.

References: The following references were referenced in the preparation of this report, as well as the selection and conceptual design of the Atlantic Avenue Road Safety Assessment Countermeasures.

- https://www.fhwa.dot.gov/innovation/everydaycounts/edc_5/step2.cfm
- https://safety.fhwa.dot.gov/provencountermeasures/
- https://safety.fhwa.dot.gov/provencountermeasures/ped_medians/
- https://safety.fhwa.dot.gov/provencountermeasures/lead_ped_int/
- https://nacto.org/publication/urban-bikeway-design-guide/
- https://nacto.org/publication/transit-street-design-guide/

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APPENDIX

I. INTRODUCTION

The purpose of the Road Safety Assessment is to review the existing conditions of Atlantic Avenue and provide recommendations for improving vehicular and pedestrian safety. The Atlantic City Road Safety Assessment performed data-driven analysis to identify the appropriate safety countermeasures to reduce the frequency of vehicular collisions, improve pedestrian safety and maintain efficient traffic flow. A review of the existing conditions traffic conditions along the 2.64-mile corridor of Atlantic Avenue in Atlantic City was conducted as part of this safety assessment.

The following sections of the report summarize the analyses performed along Atlantic Avenue as well as the conceptually designed improvements. The project limits include the following thirty-three (33) Signalized Intersections:

1. Atlantic Avenue and Boston Avenue .... (MP 5.73)
2. Atlantic Avenue and Sovereign Avenue .... (MP 5.78)
3. Atlantic Avenue and Montpelier Avenue .... (MP 5.82)
4. Atlantic Avenue and Chelsea Avenue .... (MP 5.88)
5. Atlantic Avenue and Morris Avenue .... (MP 5.94)
6. Atlantic Avenue and Brighton Avenue .... (MP 6.00)
7. Atlantic Avenue and Iowa Avenue .... (MP 6.08)
8. Atlantic Avenue and California Avenue .... (MP 6.16)
9. Atlantic Avenue and Texas Avenue .... (MP 6.23)
10. Atlantic Avenue and Florida Avenue .... (MP 6.31)
11. Atlantic Avenue and Georgia Avenue .... (MP 6.38)
12. Atlantic Avenue and Mississippi Avenue .... (MP 6.46)
13. Atlantic Avenue and Christopher Columbus Boulevard / Missouri Avenue .... (MP 6.54)
14. Atlantic Avenue and Arkansas Avenue .... (MP 6.61)
15. Atlantic Avenue and Michigan Avenue .... (MP 6.69)
16. Atlantic Avenue and Ohio Avenue .... (MP 6.77)
17. Atlantic Avenue and Indiana Avenue .... (MP 6.84)
18. Atlantic Avenue and Dr Martain Luther King Boulevard .... (MP 6.92)
19. Atlantic Avenue and Kentucky Avenue .... (MP 7.00)
20. Atlantic Avenue and New York Avenue .... (MP 7.07)
21. Atlantic Avenue and Tennessee Avenue .... (MP 7.15)
22. Atlantic Avenue and South Carolina Avenue .... (MP 7.23)
23. Atlantic Avenue and North Carolina Avenue .... (MP 7.30)
24. Atlantic Avenue and Pennsylvania Avenue .... (MP 7.38)
25. Atlantic Avenue and Virginia Avenue .... (MP 7.45)
26. Atlantic Avenue and Maryland Avenue .... (MP 7.53)
27. Atlantic Avenue and Delaware Avenue .... (MP 7.61)
28. Atlantic Avenue and New Jersey Avenue .... (MP 7.68)
29. Atlantic Avenue and Ocean Beach Boulevard / Connecticut Avenue .... (MP 7.76)
30. Atlantic Avenue and Massachusetts Avenue .... (MP 7.83)
31. Atlantic Avenue and Rhode Island Avenue .... (MP 7.91)
32. Atlantic Avenue and Vermont Avenue .... (MP 7.99)
33. Atlantic Avenue and New Hampshire Avenue .... (MP 8.06)

Project Steering Committee

The Project Steering Committee was established at the kick-off meeting and comprised of members of the City of Atlantic City ("City"), South Jersey Transportation Planning Organization ("SJTPO"), New Jersey Department of Transportation ("NJDOT") and other local stakeholders. The project steering committee established the project problem statement, goals, and objectives of this study. The project steering committee was also tasked with overall project oversight to ensure the final recommendations achieved the desired outcomes. The following individuals were included in the project steering committee. Project steering committee correspondence is included in **Appendix A** of this report.

Table 1 – Project Steering Comittee

Name	Organization	Email	Phone
Jim Rutala	Rutala Associates	jmrutala@comcast.net	609.743.0354
Jennifer Marandino	SJTPO	jmarandino@sjtpo.org	856.794.1941
Stephanie A. Wakeley	SJTPO	swakeley@sjtpo.org	856.794.1941
Alan Huff	SJTPO	ahuff@sjtpo.com	856.794.1941
Vijesh Darji	NJDOT Local Aid	Vijesh.darji@dot.nj.gov	856.486.6715
Doug Pierce	Atlantic City – PD Traffic Unit	dpierce@acpolice.org	609.839.3329
Steve Greenwood	Atlantic City – Engineering	sgreenwood@cityofatlanticcity.org	609.347.5360
Steve Lilley	Atlantic City – Engineering	slilley@cityofatlanticcity.org	
Uzoma Ahiarakwe	Atlantic City – Engineering	UAhiarakwe@cityofatlanticcity.org	609.347.5366
Barbara A. Woolley-Dillon	Atlantic City – Planning	Bwoolley-dillon@cityofatlanticcity.org	609.347.5404
Jason Simmons	Cross County Connection TMA	simmons@driveless.com	856.596.8228

Problem Statement

The project "kick-off" meeting was hosted by the City on Tuesday, July 2, 2019. The meeting reviewed the project scope of services, outlined design schedule and established the corridor problem statement, purpose/need and overall goals/objectives. The minutes of this meeting are provided within **Appendix A** of this report.

- **Problem Statement:** The existing roadway conditions and infrastructure along Atlantic Avenue do not properly facilitate safe traffic conditions. Between 2013 and 2017, 829 total crashes were documented along the 2.64-mile corridor of Atlantic Avenue in Atlantic City.

- **Purpose and Need:** The purpose of this project is to provide safety countermeasures to reduce the frequency of collisions, provide pedestrian safety and connectivity improvements, as well as improve traffic flow.

- **Goals & Objectives:** The goal of the project is to select a corridor-wide roadway improvement alternative through a series of data-driven analyses to provide improved safety and expectancy when traveling along the corridor.

II. EXISTING CONDITIONS ASSESSMENT

The following section of the report details the data collection performed along Atlantic Avenue, engineering analysis and on-site review of existing conditions.

Literary Review

In December 2014 a Road Safety Audit (RSA) of Atlantic Avenue was performed by the Transportation Safety Resource Center (TSRC) at the Rutgers' Center for Advanced Infrastructure and Transportation (CAIT) in partnership with the South Jersey Transportation Planning Organization (SJTPO) and City of Atlantic City. This RSA used data driven considerations and analysis of crashes to determine safety improvement solutions and a detailed series of recommendations were provided. The RSA selected four locations along Atlantic Avenue of high pedestrian collisions during the span of 2008 to 2012. The four locations are provided below:

1. Between Michigan Avenue and Ohio Avenue
2. Between Dr. Martin Luther King Boulevard and Kentucky Avenue
3. Between Tennessee Avenue and South Carolina Avenue
4. Between New York Avenue and Tennessee Avenue

The RSA also identified the following issues:

- Bus operations block moving lanes.
- Lane lines and direction are not clearly defined.
- Deficiency in roadway maintenance.
- Roadway does not facilitate cyclist needs.
- Impeded roadway visibility.
- Signal phasing not compliant with traffic needs.
- Inappropriate roadway user behavior.
- Signal equipment is antiquated or poorly placed.
- Roadway does not facilitate pedestrians needs
- Lack of proper signage.

The Project Steering Committee and JMT worked in tandem to address the issues and incorporate the recommendations of the 2019 RSA throughout the Atlantic Avenue Road Safety Assessment.

Crash Data Analysis

The existing roadway corridor is subject to a high-volume of crashes. The existing roadway was sub-divided as part of the previous study to more easily review crash frequency. The previously assigned group designations were maintained by JMT for ease of review. The project team performed detailed tabular and graphical assessment of all crash frequencies and presented them in the previously established groups. The detailed analyses are provided in **Appendix B** of this report. **Table 2** summarizes the group designations.

Table 2 – Roadway Segment Group Designations

Groups	Begin		End		Length	Crash Frequency	
	Nearest Intersection	MP	Nearest Intersection	MP	Mile	No.	%
1	Albany Boulevard	5.51	Boston Avenue	5.73	0.23	29	3.5%
2	Boston Avenue	5.74	Morris Avenue	5.94	0.21	53	6.4%
3	**Morris Avenue**	**5.95**	**California Avenue**	**6.16**	**0.22**	**95**	**11.5%**
4	California Avenue	6.17	Georgia Avenue	6.38	0.22	76	9.2%
5	**Georgia Avenue**	**6.39**	**Missouri Avenue**	**6.54**	**0.16**	**109**	**13.2%**
6	**Missouri Avenue**	**6.55**	**Ohio Avenue**	**6.77**	**0.23**	**97**	**11.7%**
7	Ohio Avenue	6.78	Dr Martin Luther King Blvd	6.91	0.14	56	6.8%
8	**Dr Martin Luther King Blvd**	**6.92**	**New York Avenue**	**7.07**	**0.16**	**84**	**10.1%**
9	**New York Avenue**	**7.08**	**Chalfonte Avenue**	**7.27**	**0.20**	**84**	**10.1%**
10	Chalfonte Avenue	7.28	Virginia Avenue	7.45	0.18	58	6.9%
11	Virginia Avenue	7.46	New Jersey Avenue	7.68	0.23	32	3.8%
12	New Jersey Avenue	7.69	Vermont Avenue	7.99	0.31	51	6.2%
13	Vermont Avenue	8.00	Maine Avenue	8.15	0.16	5	0.6%

Crash Frequency

A total of 829 crashes across the 13 roadway segments as outlined by the client (SJTPO) were received. A cross-reference examination with the Crash Analysis Tool database was conducted. The Crash Analysis Tool is a comprehensive crash analysis analytics tool that contains a replication of the NJDOT Accident Records Database. The crash data was then exported and analyzed to produce nine statistical summaries:

1. Atlantic Avenue Crashes (2013 - 2017) - MP 5.51 - 8.15 which included a summary of the entire corridor, as well as a summary for each identified segment grouping.
2. Atlantic Avenue Bicyclist Crashes (2013 - 2017) - MP 5.51 - 8.15
3. Atlantic Avenue Pedestrian Crashes (2013 - 2017) - MP 5.51 - 8.15
4. Atlantic Avenue Parked Vehicle Crashes (2013 - 2017) - MP 5.51 - 8.15
5. Atlantic Avenue Detailed Intersection Summary including Crash Severity (2013 - 2017) - MP 5.51 - 8.15
6. Atlantic Avenue and Michigan Avenue Intersection Summary (2013 - 2017) - MP 6.69
7. Atlantic Avenue and Missouri Avenue Intersection Summary (2013 - 2017) - MP 6.54
8. Atlantic Avenue and Morris Avenue Intersection Summary (2013 - 2017) - MP 5.94
9. Atlantic Avenue and Tennessee Avenue Intersection Summary (2013 - 2017) - MP 7.15

Overall, 829 total collisions were documented along the 2.64-mile corridor. The following table categorizes crash frequency by collision type. **Figure 1** on the following page details the Atlantic Avenue Crash Frequency distributed spatially across the corridor.

Table 3 – Crash Frequency Summary

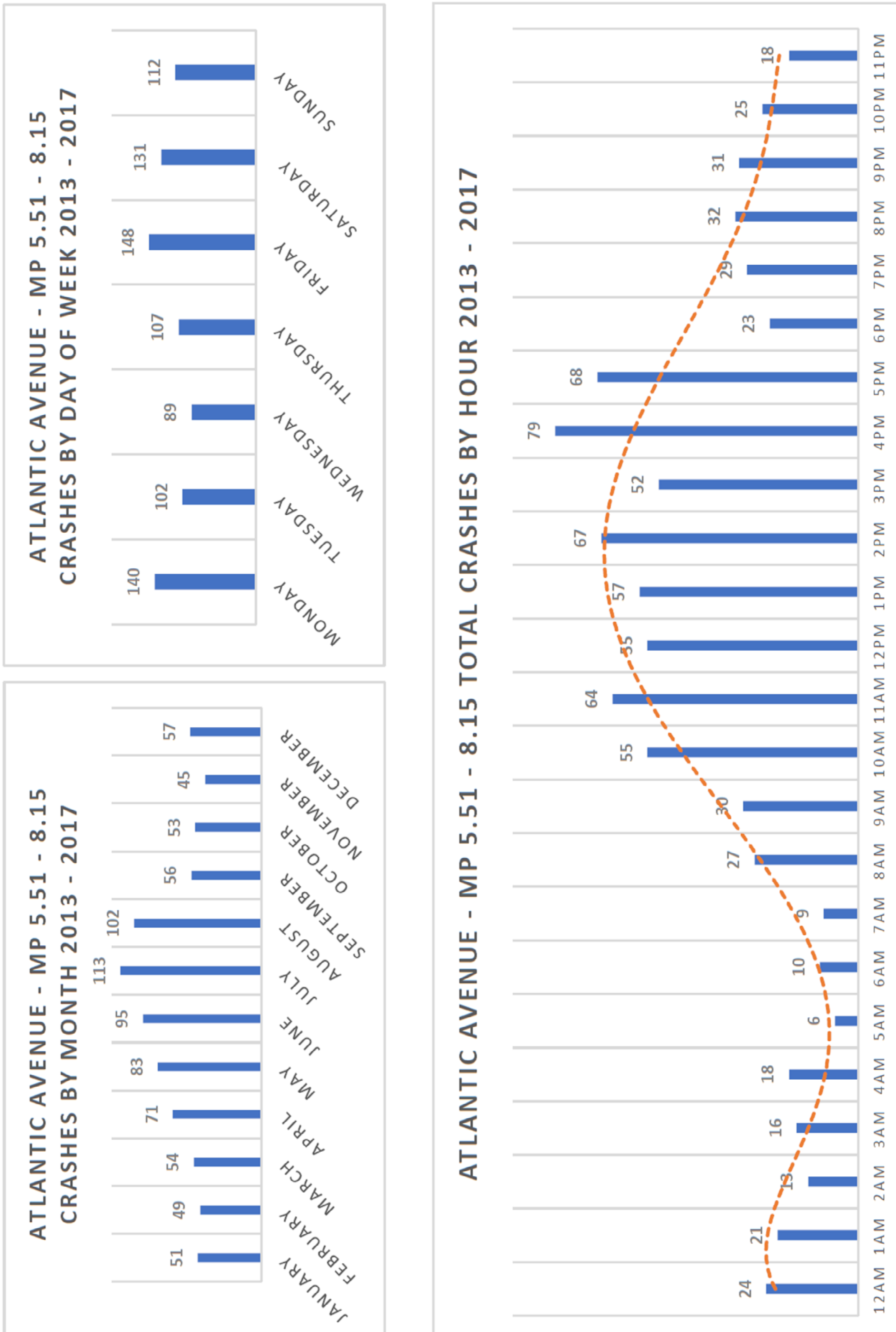
Collision Type	Number of Collisions	Percent of Total
Same Direction – Rear End	210	25.3%
Same Direction - Side Swipe	162	19.6%
Struck Parked Vehicle	148	17.9%
Right Angle	135	16.3%
Pedestrian	75	9.0%
Other*	99	11.9%
Total	**829**	**100%**

**Other category includes the following crash types: Backing, Fixed Object, Left-Turn/U-Turn, Pedalcyclist, Opposite Direction-Side Swipe, Opposite Direction-Head On/Angular, Encroachment.*

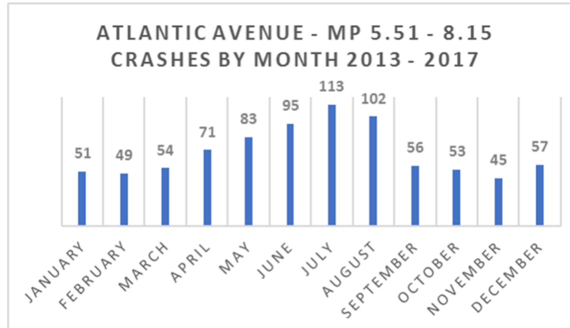
Collision Diagram

The detailed police crash reports from 2013 to 2017 were utilized to plot crashes along the corridor. The collision diagrams were prepared to support field visits, which were performed in the next stage of the road safety assessment. The collision diagram for Atlantic Avenue is provided in **Appendix C** of this report.

Figure 1 – Atlantic Avenue Crash Frequency



Seasonal Crash Data Review



JMT reviewed the seasonal crash conditions to determine the associated impacts increased tourist activity may have on the corridor. Reviewing data from 2013 – 2017, Atlantic Avenue experiences an increase in collisions during the three-month span of June, July and August. A standard 12-month distribution would anticipate approximately one-quarter (25%) of crashes be reported during any three-month time period. Along Atlantic Avenue, a total of 310 (37.4%) crashed were reported during the summer.

High-Priority Locations

The two groups with increased collisions are Groups 3 and 6. The roadway segment of Group 3 spans 0.23 miles (MP 5.93 – 6.16) and contains 116 collisions (14% of all collisions). This group contains five signalized intersections (Morris Avenue, Brighton Avenue, Stenton Avenue, Iowa Avenue and California Avenue). The following table summarizes the crash frequency within this group:

Table 4 – Group 3 Crash Frequency Summary

Collision Type	Number of Collisions	Percent of Total
Same Direction – Rear End	35	30.2%
Struck Parked Vehicle	22	19.0%
Same Direction - Side Swipe	21	18.1%
Right Angle	12	10.3%
Other*	26	22.4%
Total	**116**	**100%**

**Other category includes the following crash types: Pedestrian, Backing, Pedalcyclist, Fixed Object, Left-Turn/U-Turn.*

Group 6 spans 0.26 miles (MP 6.51 – 6.77) and contains 151 collisions (18% of all collisions). This group contains four signalized intersections (Missouri Avenue, Arkansas Avenue, Michigan Avenue and Ohio Avenue) and the intersections within this group are subject to slightly more exposure and higher peak traffic conditions due to the influence of the Atlantic City Expressway. The Tanger Outlet Mall between Mississippi Avenue and Ohio Avenue contributes a larger number of pedestrians to these intersections. Crashes are more likely within this roadway segment due to higher traffic volumes, longer crosswalks and increased pedestrian volumes. The following table summarizes the crash frequency within this group:

Table 5 – Group 6 Crash Frequency Summary

Collision Type	Number of Collisions	Percent of Total
Right Angle	51	33.8%
Same Direction – Rear End	36	23.8%
Pedestrian	28	18.5%
Same Direction – Side Swipe	25	16.6%
Other*	11	7.3%
Total	**151**	**100%**

**Other category includes the following crash types: Backing, Struck Parked Vehicle, Fixed Object, Left-Turn/U-Turn, Opposite Direction-Head On/Angular.*

Pedestrian Crash Frequency

A total of 75 pedestrian collisions were documented along the 2.64-mile corridor. **Figure 2** on the following page details the crash frequency for Atlantic Avenue. The locations with the four highest pedestrian collisions are as follows:

1. Michigan Avenue (MP 6.69)...15 Crashes (20.0%)
2. Morris Avenue (MP 5.94)..9 Crashes (12.0%)
3. Missouri Avenue (MP 6.54)...5 Crashes (6.6%)
4. Tennessee Avenue (MP 7.15)..5 Crashes (6.6%)

The following details the findings of JMT in reviewing the pedestrian crash data:

- 35% of pedestrian collisions occur outside of intersection boundaries.
- 28% of pedestrian collisions occur during inclement weather.
- Most pedestrian collisions occur during the weekend/weekday change; Monday and Friday
- Most pedestrian collisions occur from 4pm to 9pm during twilight conditions;

Bicycle Crash Frequency

A total of 19 bicycle crashes were documented along the 2.64-mile corridor. The locations with the four highest bicycle collisions are as follows:

1. Iowa Avenue (MP 6.07) – 2 Collisions (10%)
2. Mississippi Avenue (MP 6.47) – 2 Collisions (10%)
3. Missouri Avenue (MP 6.55) – 2 Collisions (10%)
4. Virginia Avenue (MP 7.45) – 2 Collisions (10%)

The following details the findings of JMT in reviewing the bicycle crash data:

- Bicyclist collisions have decreased in the past 2 years
- A high-volume of bicyclist crashes were reported on the weekend
- A high-volume of bicyclist crashes were reported around 4pm

Parked Vehicle Crash Frequency

A total of 148 parked vehicle crashes were documented along the 2.64-mile corridor. The locations with the five highest parked vehicle collisions are as follows:

1. Between Iowa Ave and California Ave (MP 6.08-6.16) – 11 Collisions (7.4%)
2. Between Florida Ave and Georgia Ave (MP 6.31-6.38) – 18 Collisions (12.2%)
3. Between Indiana Ave and Dr Martin Luther King Jr (MP 6.84-6.92) – 15 Collisions (10.1%)
4. Between Tennessee Ave and South Carolina Avenue (MP 7.15-7.23) – 19 Collisions (12.8%)

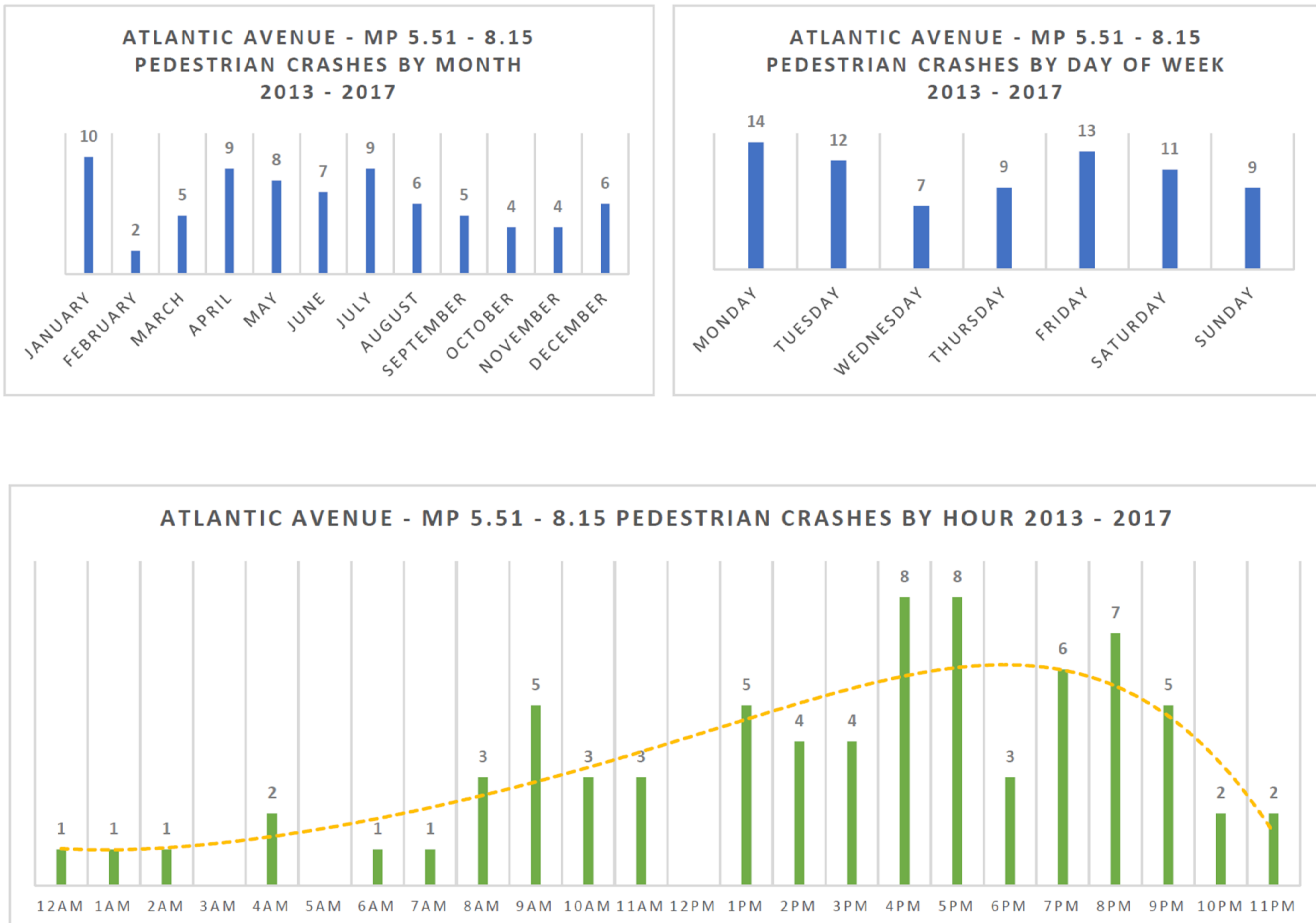


Figure 2 - Atlantic Avenue Pedestrian Crash Frequency

Travel Time Runs

The current signal timings for all thirty-three (33) traffic signals within the project limits are included in **Appendix D** of this report. The signal timing schedule for the corridor is detailed within **Table 6**. JMT performed travel time runs during each of the corridors signal timing schedule.

Table 6 – Atlantic Avenue Signal Timing Schedule

Timing Plan	Off Peak Timing	Weekend 1 Timing	Weekend 2 Timing
Time Periods	5AM Monday - 4PM Friday	4PM Friday – 9PM Friday	9PM Friday – 5PM Saturday
	-	5PM Saturday – 10 PM Saturday	10PM Saturday – 5AM Monday

Off Peak runs were performed on July 25, 2019. Weekend 1 and Weekend 2 runs were performed on August 23 and 24, 2019 respectively. Travel time studies were performed by traveling the corridor with an OSTARZ Travel Recorder XT GPS device. JMT completed three complete runs, both eastbound and westbound, along the corridor during each established signal timing directive plan to establish the existing signal progression. The travel time data is provided as **Appendix D** of this report. A summary of the data is provided in **Table 7**.

Table 7 – Atlantic Avenue Travel Time Summary

Peak	Eastbound				Westbound			
	TT (min)	**Avg Speed (mph)**	**Stops (#)**	**Stop Delay (sec)**	**TT (min)**	**Avg Speed (mph)**	**Stops (#)**	**Stop Delay (sec)**
Off – Peak	12.6	11.3	13.0	379.0	11.8	11.9	8.0	332.0
Weekend 1	12.9	11.0	11.5	400.0	12.1	11.7	9.5	339.0
Weekend 2	13.4	10.6	12.3	442.0	11.1	12.6	8.5	310.0
Average	**12.9**	**11.0**	**12.3**	**407.0**	**11.7**	**12.1**	**8.7**	**327.0**

JMT identified the signals and corridor exhibit progression along the corridor during Weekend Time Periods, but not during off-peak periods. these time periods. The Weekend 1 and Weekend 2 progression is designed to service traffic entering/exiting the City in the east/west directions from the AC Expressway (Intersection of Christopher Columbus Boulevard).

The Weekend 1 timings exhibit progression from the intersection of Christopher Columbus Boulevard traveling west to the end of the corridor to facilitate vehicles entering Atlantic City from the Atlantic City Expressway. Weekend 2 timings exhibit the opposing progression, serving traffic traveling east along the corridor to Arkansas Avenue towards the Atlantic City Expressway. **Table 8** on the following page tabulates the travel time progression.

Table 8 – Atlantic Avenue Weekend Progression Travel Time Summary

Direction of Travel	Peak	Corridor Location							
		West of AC Expressway				East of AC Expressway			
		TT (min)	Avg Speed (mph)	Stops (#)	Stop Delay (sec)	TT (min)	Avg Speed (mph)	Stops (#)	Stop Delay (sec)
Eastbound	Weekend 1	4.5	12.1	3.5	133.0	**8.6**	**10.7**	**8.7**	**263.0**
	Weekend 2	**4.5**	**12.1**	**3.7**	**131.0**	9.2	10.1	8.7	311.0
Westbound	Weekend 1	**3.8**	**14.1**	**3.5**	**88.0**	9.3	10.1	6.7	306.0
	Weekend 2	3.8	14.0	3.0	98.0	**7.5**	**12.2**	**5.5**	**212.0**

Spot Speed Study

JMT conducted a spot speed study along Atlantic Avenue in accordance with the methods outlined by the Institute of Transportation Engineers (ITE) Traffic Engineering Manual, 7th Edition and FHWAs proven safety countermeasure speed tool, US Limits 2. The following details the methodology and results.

Data Collection

The study was conducted on Sunday, September 29, 2019 from 10:00am to 12:00pm. The time-period for the study was selected based on the travel-time runs conducted to ensure speed data was captured during free-flow traffic conditions. Spot-speed locations were identified using the travel time data. The locations where vehicle platoons existed and several vehicles could consistently traverse three to four signalized intersections without a red light were selected. Speeds were gathered at several locations both eastbound and westbound. Table 9 details the locations the Eastbound and Westbound vehicle speeds were reported.

Table 9 – Spot Speed Study Data Collection Locations

EASTBOUND TRAFFIC		WESTBOUND TRAFFIC	
MP	**Description**	**MP**	**Description**
7.03	Kentucky Avenue and New York Avenue	**7.57**	Delaware Avenue and Maryland Avenue
7.26	South Carolina Avenue and North Carolina Avenue	**7.11**	Tennessee Avenue and New York Avenue
5.85	Montpelier Avenue and Chelsea Avenue	**6.42**	Mississippi Avenue and Georgia Avenue
6.19	California Avenue and Texas Avenue	**6.11**	California Avenue and Iowa Avenue
-	-	**5.85**	Chelsea Avenue and Montpelier Avenue

Speeds were gathered using a POCKET RADAR device, Model PR1000, in an unmarked vehicle parked along Atlantic Avenue with no vehicle parked in front as to limit reaction from drivers.

Sample Size

The minimum sample size for the study was established using the formula as noted on page 120 of the ITE Traffic Engineering Manual, 7th Edition. Using the below referenced formula, a minimum sample size of 160 was calculated. JMT recorded 100 measurements in each direction to satisfy the needs of this required sample size. The raw speed data can be found in **Appendix E** of the report.

$$N = \left(S * \frac{K}{E}\right)^2 \text{ whereas;}$$

N = minimum number of measured speeds
S = estimated sample standard deviation, mph
K = Constant from the standard normal distribution corresponding to confidence level (1.96 for 95%, 2.58 for 99%)
E = permitted error or tolerance in the average speed estimate, mph (typical: ±1 to ±5)

JMT calculated a minimum of 120 measurements would be required to have a statistically accurate sample size (99% confidence and ±1 error tolerance) using the calculated standard deviation of 4.23 from the gathered measurements. The study sample size of 200 measurements exceeds this data. The results of the speed study are summarized in **Table 10** below; the raw data is provided in **Appendix E**.

Findings & Conclusions

JMT utilized the Federal Highway Administration (FHWA) USLIMITS2 web-based tool to review the speed data to further assess crash history and review speed limit compliance. USLIMITS2 is designed to help set reasonable, safe and consistent speed limits for specific segments of roads. The spot speed study results are summarized in **Table 10**. The detailed results from USLIMITS2 are included in **Appendix E**.

Table 10 – Speed Study & FHWA USLIMITS2 Results

Direction	Eastbound	Westbound	Combined
Existing Speed Limit	25 mph	25 mph	25 mph
Median Speed	31 mph	30 mph	30 mph
85th Percentile Speed	35 mph	34 mph	35 mph

III. SUMMARY OF FINDINGS

The following section of the report details the findings of the Road Safety Assessment. The summary of findings includes the pertinent information from the crash data assessment, travel time/speed studies and on-site field observations of the design team.

Data Findings

- The 50th percentile travel (30 mph) and 85th percentile travel speed (35 mph) exceed the speed limit of 25 mph.
- There is no time-based progression along the corridor during off-peak hours; with directional progression observed during weekend peaks.
- The most frequent crash types along Atlantic Avenue were Same Direction – Rear End, Same Direction – Side Swipe, Struck Parked Vehicle, Right Angle and Pedestrian
- The locations with the four highest reported pedestrian crash types are as follows: Morris Avenue (MP 5.94) – 9 Collisions (12%); Missouri Avenue (MP 6.54) – 5 Collisions (6.6%); Michigan Avenue (MP 6.69) – 15 Collisions (20%); and Tennessee Avenue (MP 7.15) – 5 Collisions (6.6%)

Field Observations

The design team conducted field visits along Atlantic Avenue to complete a Road Safety Assessment. Field assessments were conducted on Friday August 16, 2019, Saturday August 17, 2019 and Sunday August 18, 2019. The on-site observations were focused on identifying two major areas of concern: (1) existing casual factors, both roadway and driver-related, which contribute to crash frequency; and (2) existing condition of roadway infrastructure, specifically signing, striping/markings and traffic control devices. The Collision diagrams prepared at the outset of the project were utilized to support the on-site assessments to identify possible causes of elevated crash frequency at select locations. The corridor was driven at night to determine visibility of signs and signals.

The overall findings of the design team field observations are the Atlantic Avenue corridor lacks consistency, which results in unpredictable driving conditions. The variation in lane assignments, signal head positioning and lack of consistent signing are all contributing factors. The presence of transit vehicles, bicycles and parked cars interacting in shared space creates conflicts which are often unavoidable; and pedestrian traffic is generally high and often do not utilize marked crosswalks when crossing the street.

The comprehensive findings of this assessment are provided in **Appendix A.** A brief summary of the primary observations is provided herein:

- Conflicting movements from side streets lead to higher risk of collisions. When side streets are not uniform in layout it leads to more decisions that drivers need to make. These delays in decisions can lead to decreased reaction time and increased risk of collision.
- Bus stops at intersections cause delays and increased risk of collision. There are some near side intersection bus stops along the corridor. These near side bus stops interrupt the flow of traffic. Bus stops do not have enough shoulder space due to narrow side street parking and require busses to take up portions of the travel way. Vehicles traveling behind the bus attempting to make it through the traffic light have increased risk of rear end collisions and same direction side swipe collisions. The sudden change of expectation of drivers and quick reactions required are the leading causes of these collisions.

- Pedestrians and bicyclists crossing outside of the designated crosswalks are unexpected and decrease traffic flow and increase risk for both pedestrian and driver. When an unexpected event occurs on the roadway It requires the driver to react slower than when an expected event. Drivers that attempt to predict where unexpected events will occur drive slower and reduce progression.

- Traffic progression along the corridor is lacking. The signal timing design does not match the sequencing observed in the field. These discrepancies cause frustration and unpredictability on the drivers of the roadway. Setting corridor progression should control platoons of vehicles to proceed down the corridor in an organized and timely fashion. When vehicles believe that they should be progressing faster or perceive that the signals are changing when there is no cross traffic it instills a desire to beat the next light creates an expectation that there will be no traffic at the next signal. This blinds the driver to potential dangers and causes them to speed to attempt to make the traffic signal green light. Pedestrian cross timing is not standard and may give pedestrians too much or too little time to cross the lanes of traffic. This can create safety concerns for pedestrians or excess delay to the vehicles on the road.

- The traffic signal equipment in the field is not uniform and is not in keeping with the MUTCD standard layout. The traffic signal heads along the corridor sometimes change layout between horizontal and vertical. The placement of signal heads is not over the top of the center of travel lanes and do not have near left and far right alignment. Especially for a corridor with short distances between signalized intersections having different traffic signal layouts creates a scenario for drivers where they do not know where the next signal is to look for and may read the further signal head that may create a dangerous scenario for all road users. Use of nonstandard signing or placement creates a similar scenario where a regulatory sign may not be observed, and the driver is not warned properly of a change in condition of the travel way. Atlantic city at night is decoratively lighted along the corridor, since businesses are close to the roadway and lights and electronic billboards are prominent it can create a confusing scenario for drivers looking for a traffic signal head which are camouflaged with casino advertisements and building colors.

- Stop bars and crosswalks are faded or not placed properly which creates confusion for drivers. This causes vehicles to sometimes stop on top of the crosswalk which not only can be dangerous for pedestrians attempting to cross the road but causes them to walk around the vehicle, increasing the crossing time, possibly more than they safely have left on the pedestrian signal head.

- Yellow paint is used on the right side of the roadway to mark out parking and bike lanes. This is confusing to drivers who expect yellow paint to only be used in the center or left of a roadway to delineate the separation of different direction travel ways.

- Nighttime visibility is lacking along the corridor. Street name signs are difficult to perceive.

IV. ALTERNATIVES ASSESSMENT

The established goal of this project is to select roadway and intersection countermeasures using a data-driven approach. The results of the field observations determined the countermeasures should be implemented systematically to create a more consistent roadway corridor. The selected improvements will enhance safety through increased driver expectancy and improved pedestrian compliance within marked crosswalks. The following section of the report details the selection of intersection and road segment countermeasures.

Intersection Countermeasure Selection

Systemic application of cost-effective countermeasures with known safety benefits can help reduce pedestrian fatalities at both uncontrolled and signalized crossing locations. The following countermeasures were identified by the project team and steering committee for assessment and potential implementation along Atlantic Avenue to meet the project goals.

1. **Leading pedestrian intervals.** A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left. The LPI increases visibility, reduces conflicts, and improves compliance of drivers yielding to pedestrians.

2. **Turning Restrictions (Prohibit Left/U Turns with Signs).** Prohibiting turns can improve transit performance, general traffic performance, and walking and bicycling safety at the same time. Left-turn restrictions may reduce the frequency of pedestrian injuries, pending location and application. Turning restrictions should always be considered in context with traffic volume demands, network connectivity and transit service. Protected left-turn have been maintained at select intersections. Signal progression analysis will be required to properly design these improvements.

3. **Retroreflective Borders on Traffic Signal Backplates.** An FHWA proven safety countermeasure, Backplates added to a traffic signal indication improve visibility by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a retroreflective border. FHWA estimates a 15% reduction in total crash may be achieved with this countermeasure.

4. **Curb Extensions / Bulb-Outs.** The use of curb extensions improves safety for pedestrians and motorists at intersections by increasing visibility of pedestrian entering crosswalks and reducing the speed of right-turning vehicles. Curb extensions encourage pedestrians to cross at designated locations and prevents motor vehicles from parking at corners. There are no available CMFs for Curb Extensions currently issued, therefore, this report is unable to statistically quantify the safety impact for Curb Extensions in the data driven analysis.

5. **Road Diet (Four lanes to two lanes):** Sideswipes, Rear End and Striking Parked Vehicles Crashes account for 62% of the total crashes within the project limits. The road diet and lane reduction from two thru lanes to one thru lane reduces driver decision making and limits aggressive lane changes. This results in less opportunity for the above-referenced crash types.

Corridor Countermeasure Selection

The project design team approached establishing safety along Atlantic Avenue by evaluating individual intersection improvements and corridor-wide roadway improvements separately. This approach was designed to isolate improvements at individual intersections which could be integrated as part of a corridor wide roadway improvement project. The roadway improvements described in this section were considered as part of the Alternatives Analysis.

1. **Road Diets.** Road diets are an FHWA proven safety countermeasure designed to reallocate the traveled way to create space to add new pedestrian, bicycle and transit facilities. The road diet alternates along Atlantic Avenue will be designed to reduce the opportunity for pedestrian conflicts, narrow travel lanes and designate space for bike/transit road users. The road diet may include a raised-curb median designed to delineate direction of travel and reduce the distance in which pedestrians cross by adding pedestrian crossing/refuge islands at intersections.

2. **Shared Transit/Bike Facilities.** The shared bus-bike lane is not a high-comfort bike facility; however, buses and bicycles often compete for the same space in the roadway. Along Atlantic Avenue, this space is both in the roadway adjacent to parked vehicles, and at intersection corners along the curbside. In locations where dedicated bicycle infrastructure is not considered desirable, a curbside shared bus-bike lane can accommodate both modes at low speeds and moderate bus headways. Shared bus-bike lanes provide increased space/visibility for active street users and may also improve transit service reliability. In appropriate conditions, bus-bike lanes are an option on streets where dedicated bus and separate high-comfort bicycle facilities cannot be provided.

3. **Buffered Bike Lanes & Cycle Tracks.** The existing cartway of Atlantic Avenue is wide-enough to accommodate dedicated bike lanes if implemented in conjunction with a road diet. The road diet would entail reducing traffic flow from two-lanes to one-lane in each direction. Road Diet Alternates and roadway improvements for Atlantic Avenue investigated both buffered and protected bike lanes. The definitions of both treatments are provided as follows:

    - **Buffered bike lanes** are conventional bicycle lanes paired with a designated buffer space separating the bicycle lane from the adjacent travel lane and/or parking lane. A buffered bike lane shall be marked with 2 solid white lines on both edges of the buffer space. Typical buffers shall include interior diagonal cross hatching or chevron markings if 3 feet in width or wider to delineate the bike lane from the travel lane.

    - **Cycle tracks** are exclusive bike facilities which combine the user experience of a separated path with the on-street infrastructure of a conventional bike lane. These facilities may be one-way or two-way, and may be at street level, sidewalk level, or raised. A one-way protected cycle track at street level may be applied in various methods for physical protection of bicycles from adjacent traffic lanes.

    - **NJDOT Bikeway Selection Guidance**
        - The NJDOT design guidance for Atlantic Avenue (ADT of 15,000 and 85th Percentile Speed of 35MPH) states a Buffered Bicycle Lane, Separated Bicycle Lane or Shared-Use Path are the preferred treatments given the roadway conditions. Please refer to Table A on page 106 of the New Jersey Complete Streets Design Guide for more details.
        - http://njbikeped.org/wp-content/uploads/2017/05/Complete-Streets-Design-Guide.pdf

Road Diet Alternatives

The assessment of intersection and systemic corridor-wide countermeasures was performed concurrently with the development of a Conceptually Design Preliminary Preferred Alternative (PPA) for an Atlantic Avenue Road Diet. The process for developing road diet alternates began with understanding the corridor operations as noted during the project kick-off meeting (see meeting minutes in Appendix A) and advanced to a bicycle/pedestrian focused road diet. The Road Diet Alternates developed as part of this project are detailed herein.

Alternatives #1 – #4

Four alternates (Alternatives No. 1 – No. 4) were developed to support pedestrian safety at intersections and improve transit/bike operations along the corridor. Alternatives 1 – 4 were developed in "sample segments" along the corridor to serve as a template for potential corridor-wide implementation. These four alternates were presented to the project steering committee. A meeting was held on October 21, 2019 with the project steering committee. It was agreed by the project team and project steering committee to revise the alternates for proposed improvements. SJTPO provided direction on the need for dedicated bike lanes along Atlantic Avenue. This correspondence is included in Appendix A. Accordingly, Alternates No. 1 through No. 4 were not advanced for detailed analysis because they did not adequately prioritize bicycle and pedestrian safety improvements for the corridor.

Alternatives #5 & #6

The design team revised previous alternatives and presented two new options identified as Alternatives #5 & #6. The alternatives were developed with a focus on implementing a road diet with dedicated bike facilities. Both Alternatives #5 & #6 propose to delineate travel lanes via a curbed/striped median and to prohibit left turns at select intersections to improve pedestrian safety. Alternate 5 provides in-street buffered bike lanes; while Alternate 6 proposes a protected cycle track in each direction. The concepts are provided in **Appendix F** of this report. The improvements proposed for each alternate are detailed below.

Alternative 5: Road Diet with Median Island & Buffered Bike Lane

Alternative 5 proposes to construct a curbed median center island to delineate east/west approaches with a reallocation of a travel lane to support a buffered bicycle lane. The road diet will reduce travel lanes to one-lane in each direction, with the option of a striped or physical center island, a buffered bike lane and on-street parking. This alternate provides comparable improvements to Alternative 1 with a more focused consideration for bicycle traffic. This alternate also includes the option to phase implementation with striping a gore median to perform pilot testing prior to fully constructing center islands. The advantages of Alternate 5 are listed as follows:

- Provides greater shy distance between motor vehicles and bicyclists.
- Provides space for bicyclists to pass without encroaching into the adjacent motor vehicle travel lane.
- Provides a greater space for bicycling without making the bike lane be mistaken for a travel lane or a parking lane.
- Appeals to a wider cross-section of bicycle users.
- Encourages bicycling by contributing to a perception of safety among users of the bicycle network

Alternative 6: Road Diet with Curbside Protected Cycle Track / Bike Lane

Alternate 6 will construct a curbed median center island to delineate east/west approaches, reduce travel lanes to one-lane in each direction and reposition parking adjacent to travel lane. The redesign of parking will reallocate curbside space to accommodate a protected cycle track / bike lane. The curbside protected buffer would be physical, preferably curb with sidewalk to support passengers entering parked cars while also providing space for passenger vehicle doors to swing open without impacting bike traffic.

The protected lane may also be raised so bike traffic is vertically separated from adjacent parking. The advantages of Alternate 6 are listed as follows:

- Dedicates and protects space for bicyclists in order to improve perceived comfort and safety.
- Eliminates risk and fear of collisions with over-taking vehicles and reduces risk of ‘dooring’
- Prevents double-parking, unlike a bike lane.
- Supports installation of curb extensions at intersection to reduce pedestrian crossing time.
- More attractive for bicyclists of all levels and ages

Data-Driven Analysis

The selection of countermeasures, improvements and safety recommendations appropriate for implementation along Atlantic Avenue must consider roadway context, project goals/objectives and existing traffic conditions. A data-driven analysis of the identified countermeasures and alternatives was performed to weigh the benefits and provide guidance on application.

Traffic Volume Data

A combination of available/historic traffic data and site-specific traffic data collection was utilized to support the performance of data-driven analysis. The scope of work did not include traffic data collection along the corridor; however, as noted in the meeting agenda from October 11, 2019, intersection ADTs are necessary to properly perform data-driven analysis. Accordingly, the SJTPO and City agreed to undertake the following scope of work and methodology to obtain and establish reasonable estimates of traffic data within the corridor in the 2019 Existing Conditions.

- **High Priority Intersection Evaluations:** Detailed HSM and data-driven analysis was performed at specific intersections classified as "high-priority" (HP). The HP locations were identified through crash data analysis, on-site findings and those intersections ranked highly as part of the previous RSD and RFP. In total, 16 intersections were selected for site-specific assessment (**bold** historical traffic volume data available, *italics* indicates supplemental traffic volume data was collected).

Group 3	Group 6	Pedestrian Intersections	Other
Morris Avenue *Brighton Avenue* *Stenton Place* **Iowa Avenue**	**Georgia Avenue** **Mississippi Avenue** **Missouri Avenue** **Arkansas Avenue** *Michigan Avenue* **Ohio Avenue**	*Morris Avenue (part of Group 3)* **Missouri Avenue (part of Group 6)** *Michigan Avenue (part of Group 6)* *Tennessee Avenue*	**Indiana Avenue** *Dr. Martin Luther King* *Pennsylvania Avenue* **South Carolina Avenue** *Connecticut Avenue (MP 7.76)*

- **Existing/Historic Traffic Volume Data**

Historical traffic data was gathered ADT from counts provided by the NJDOT Roadway Information and Traffic Monitoring System Program and SJTPO. The historical traffic data was grown using the NJDOT Annual Background Growth Rate Table 2019. Atlantic Avenue is an Urban Principal Arterial and an Urban Minor Arterial roadway; both with a 1.00% Growth Rate. All Avenues which intersect Atlantic Avenue were classified as Collector Roadways and have a Growth Rate of 1.75%. The following Formula found in the NJDOT Annual Background Growth Rate Table was used to Grow the existing Volumes to 2019 volumes.

$$Future\ Volume = Present\ Volume\ x\ (1 + Growth\ Rate)^{\#\ of\ Years}$$

- **Supplemental Traffic Volume Data**

On-site 7-day Automatic Traffic Recorder Counts were initiated the week of October 14, 2019 to establish the 2019 Existing Conditions at the following intersections. All counts were performed between Monday, October 14, 2019 and Monday, October 21, 2019. The traffic volume counts were conducted using JAMAR and MetroCount ATR Tube Counters along the following side-streets.

  - Morris Avenue
  - Brighton Avenue
  - Stenton Place
  - Michigan Avenue
  - Dr Martin Luther King Boulevard
  - Tennessee Avenue
  - Pennsylvania Avenue
  - Connecticut Avenue

Please Note: The supplemental traffic data collection initiated for this project was performed on side-streets in one-direction only. Thus, for side-streets which are two-way, ATR counts include traffic traveling in both directions, as well as turning movements from Atlantic Avenue onto side-streets. Typically, traffic counts would only identify approaching traffic volumes at intersections. However, due to the constraints of this project, the traffic volume methods and estimates herein were considered acceptable for a conceptual planning approach and selection of the PPA. More detailed HSM Analysis, data-driven assessment and intersection specific traffic operational analyses are anticipated to be necessary in the following phases of design for advancement of the PPA.

- **2019 Pedestrian Traffic Volumes**

As pedestrian crossing data at sections of the corridor was not available, JMT utilized the American Association of State Highway and Transportation Officials (AASHTO) Highway Safety Manual (HSM) to estimate the pedestrian volume at signalized intersections on Atlantic Avenue. For Atlantic Avenue all permitted pedestrian crossings occur at 4-leg signalized intersections so the 4SG category is used in Table 12-14 and 12-15 of the HSM. Table 11 and 12 detail the selected criteria.

Table 11 – SPFs for Vehicle-Pedestrian Collisions at Signalized Intersections

Intersection Type	Coefficients used in Equation 12-29					Overdispersion Parameter (k)
	Intercept (a)	AADT Total (b)	$AADT_{min}/AADT_{maj}$ (c)	PedVol (d)	N_{lanesx} (e)	
3SG	-6.60	0.05	0.24	0.41	0.09	0.52
4SG	**-9.53**	**0.40**	**0.26**	**0.45**	**0.04**	**0.24**

Table 12 – Estimates of Pedestrian Crossing Volumes Based on general Level of Pedestrian Activity

	Estimate of PedVol (pedestrian/day) for Use in Equation 12-29	
General Level of Pedestrian Activity	3SG Intersections	4SG Intersections
High	1,700	3,200
Medium-High	**750**	**1,500**
Medium	400	700
Medium-Low	120	240
Low	20	50

HSM Analysis

JMT subconsultant, SAFE Highway Engineering LLC (SAFE), prepared a quantitative safety analysis for Atlantic Avenue using the HSM. SAFE applied methodologies specified in the 2010 Edition of HSM. SAFE completed the analyses within this report primarily using the following tools:

1. HSM Analysis Tool A and HSM Analysis Tool B developed by the Pennsylvania Department of Transportation (PennDOT) and similar to those of other State DOTs
   - Tool A was used to determine the safety performance of the corridor;
   - Tool B was used to determine the effectiveness of selected countermeasures and provide economic analyses.
2. Crash Modification Factors Clearinghouse (http://www.cmfclearinghouse.org/), maintained by the Federal Highway Administration (FHWA) to estimate the change in crashes expected after implementation of potential countermeasures.

SAFE used the Crash Estimation Method in Part C of the HSM, commonly referred to as the “Predictive Method”, to estimate the Expected Average Crash Frequency under existing conditions. The complete report, CMFs and other supplemental analysis submitted by SAFE is appended to this report as **Appendix G** and **Appendix H**. The following summarizes the results.

- **Atlantic Avenue Intersection Analysis**

The Intersection Analyses conducted by SAFE consisted of a detailed review of the 16 “high-priority” intersections identified previously in this report. The goal was to establish the expected safety benefits for the typical intersections within the corridor based upon the HSM predicted crash frequency. The following table summarizes the results of the Safety Performance Summary included in Appendix G of this report.

Table 13 – Intersection Safety Benefit Analysis

Countermeasure	Reduction in Crashes			Safety Benefit Ratio
	Total Crashes	Fatal/Injury	PDO	
Leading Pedestrian Interval	5.61	2.23	3.38	13.71
Prohibit Left-Turns	32.39	12.84	19.55	130.01
Retroreflective Backplates	6.47	2.57	3.90	35.46
Curb Extensions	4.95	1.96	2.99	9.26
LPIs + Curb Extensions	10.56	4.19	6.37	17.13
LPIs + LTs + CEs	41.62	16.53	25.08	58.28

- **Atlantic Avenue Segment Analysis**

The Segment Analyses conducted by SAFE consisted of a detailed review of the 13 roadway segments identified previously in this report. The goal was to establish the expected safety benefits for the typical corridor-wide systemic improvements proposed as part of Alternates 5 and 6. The following table summarizes the results of the Safety Performance Summary included in Appendix G of this report.

Table 14 – Roadway Segment Safety Benefit Analysis

Countermeasure	Reduction in Crashes			Safety Benefit Ratio
	Total Crashes	Fatal/Injury	PDO	
Road Diet (4 Lanes to 2 Lanes)	3.74	1.27	2.47	2.03
Road Diet + Bike Lanes	4.19	1.43	2.76	1.17
Road Diet + Bike Lanes + Raised Median	10.47	3.57	6.90	112.25
Curb Extensions	10.47	3.57	6.90	83.46
CEs + Road Diet	14.21	4.84	9.37	4.90
CEs + Road Diet + Bike Lanes	18.40	6.27	12.13	4.81
Raised Median + Fencing	20.94	7.13	13.81	7.20
RM + Fencing + RD	24.68	8.41	16.27	8.08

- **Comments & Conclusions**

The analyses presented in this report were developed using CMFS from the Crash Modification Clearinghouse. The construction costs, maintenance costs, and salvage values developed as part of the economic portions of the analyses (Safety Benefit Ratios) used are conceptual design estimates and represent present day costs. These costs may increase over time. Overall, the following general conclusions can be reached when reviewing the analyses provided:

1. The safety performance of the 16 intersections included in the study show high potential for safety benefit (16.28 fewer crashes per year).
2. The safety performance of the 13 segments included in the study show a slightly lower overall potential for safety benefit (9.93 fewer crashes per year), but a rather high potential for property damage only crashes, most likely due to the high occurrence of sideswipe crashes with parked vehicles.
3. The following "Crash Reduction Factors" (CRFs) provide a relative percentage of the expected reduction of all crashes for the countermeasures evaluated in this report.
    - Prohibit Left Turns and U-Turns with Signs: CRF = 72%
    - Add 3" yellow retroreflective backplates on traffic signals: CRF = 15%

- Install a raised median: CRF = 14%, Install median fencing on a raised median: CRF = 14%
- Implement a leading pedestrian interval in traffic signal phasing: CRF = 13%
- Install Curb Extensions at intersections: CRF = 11% at intersections, 14% in segments
- Install bicycle lanes: CRF = 5.6%
- Convert 4 lanes to 2 lanes (with turning lanes): CRF = 5%

V. FINAL RECOMMENDATIONS

The following section of the report details the final recommendations for Atlantic Avenue. This includes the conceptually designed roadway improvements, educational/public outreach efforts and implementation/phasing recommendations.

Preliminary Preferred Alternative (PPA)

The following details the proposed improvements and anticipated benefits of the PPA, Road Diet with a Center Raised-Curbed Median and Buffered Bike Lane (Alternate 5). Alternative 5 proposes to construct a curbed median center island to delineate east/west approaches with a reallocation of a travel lane to support a buffered bicycle lane. The road diet will reduce travel lanes to one-lane in each direction, with the option of a striped or physical center island, a buffered bike lane and on-street parking.

Curb Extensions at Intersections

- Curb Extensions at intersection reduces the crossing distance (14 feet) and time to cross (4 Seconds) and therefore reduces exposure of pedestrians in the crosswalk, as well as improving the line of sight of drivers and pedestrians of each other at these crosswalks.

Lane Reductions via a Road Diet. The anticipated benefits of the Atlantic Avenue road diet are detailed herein:

- Reduces conflicts drivers and pedestrians experience traversing the corridor.
- The raised-curb median between opposing lanes of traffic in an urban area can help improve safety by lowering vehicle speeds, reducing the number of travel lanes and minimizing the opportunity for conflicts.
- Curb medians may be extended into the crosswalk to serve as pedestrian crossing islands/refuge areas at select intersections, specifically multi-lane intersections or other pedestrian-focused sites.
- Raised medians with landscaping and/or fencing discourages jaywalking and thus reducing the conflict between motorists and pedestrians.
- Median Islands provide aesthetic opportunity for corridor to include potential green stormwater infrastructure; incorporate in-street decorative lighting; and/or afford the ability for phased implementation with pilot programs using gore striping as an interim treatment.
- An Alternative to Median center Islands with Curbs is a Flush Median using a Street Print Surface. It is less costly to install and allows vehicles to pass double parked or broken-down vehicles. It also allows Emergency vehicles greater flexibility to reaching destinations.

Atlantic Avenue Ohio Ave to Mississippi Ave.

- If a road Diet is done on Atlantic Avenue this stretch still requires multiple lanes for access to the Expressway. There is also an Outlet Mall which is a large pedestrian generator.
- Parking is restricted from Mississippi Ave. to Michigan Ave. EB and from Michigan Ave. to Columbus Blvd. WB. This can be maintained.
- Installing dotted extensions through intersections to assist in lane shifts.
- Lane configurations are detailed in Alternative 5 & 6 in **Appendix F.**

Turning Restrictions (No Left Turn/No U-Turn Signs)

- Protected Left turns or turning restrictions at intersections is an option to reduce conflicts with Pedestrians and Bicycles.

- Based on the chosen Signal Progression Pattern Protected Left Turn signals can be fit into the progression at selected intersections so that do not reduce the Green Band of the corridor.
- The reduction of a left turn conflict at one intersection must be compared to the addition of other conflicts created to complete the movement. Developing a pattern of allowed left turn movements will allow drivers the flexibility to reach their destination while improving pedestrian safety.
- JMT recommends the City conduct supplemental traffic counts along the corridor during the retiming analysis for concurrence. After conducting field observations and determining land use patterns, JMT recommends the following intersections maintain left turn improvements: Sovereign Avenue (MP 5.78); Montpelier Avenue (MP 5.82); Brighton Avenue (MP 6.00); Stenton Place (MP 6.04); Mississippi Avenue (MP 6.46); Christopher Columbus Boulevard (MP 6.54); Arkansas Avenue (MP 6.61); Ohio Avenue (MP 6.77); South Carolina Avenue (MP 7.23); North Carolina Avenue (MP 7.30); Virginia Avenue (MP 7.45); Delaware Avenue (MP 7.61); Connecticut Avenue (MP 7.76); New Hampshire Avenue (MP 8.06).

PPA Implementation

The PPA is anticipated to be implemented systematically throughout the corridor, from Boston Avenue (MP 5.73) to Mississippi Avenue (MP 6.46) and from Michigan Avenue (MP 6.69) to New Hampshire Avenue (MP 8.06). These two segments of Atlantic Avenue typically have the same existing cross-section and can be converted to support the PPA.

The City can examine individual intersections and the necessity to maintain existing left-turns at select intersections as deemed appropriate. The PPA has conceptually identified left-turn movements to remain. It is recommended Manual Turning Movement Counts (MTCs) and signalized operational analysis should be performed to support the maintenance of any left-turn movements.

The existing roadway and signalized intersections at the center of the corridor which service traffic entering/exiting the City via the Atlantic City Expressway (Intersections of Mississippi, Columbus, Arkansas and Michigan) will be subject to comparable roadway and intersection improvements identified herein. However, it is recommended this section of Atlantic Avenue be examined for more specific roadway improvement alternates due to the volume of traffic, density of turning movements and overall cartway width.

Gore Striping / Flush Median /Raised Curb Median

a. **Phased Implementation:** The City has the option of installing Gore Striping along the corridor to allow the public to acclimate to the road diet before investing in more permanent median installations. The downside to this option is that it does not discourage jaywalking or provide protection to pedestrians crossing the roadway.

b. **Aesthetic Treatments in Median:** The City should include aesthetic landscaping treatments and fencing within the median to prevent/minimize mid-block crossing and jaywalking within the corridor. Other elements to consider within the median may include decorative lighting, supplement roadway signing and green stormwater infrastructure. The Final Design of any improvements within the curbed median should include a review of NCHRP Report 612 (Safe and Aesthetic Design of Urban Roadside Treatments) and the AASHTO Roadside Design Guide.

c. **Pedestrian Refuge in Median Islands:** There is an option to have curb refuge median islands at critical intersections (Group six area). The crossing distance for the Avenue with curb extension is 54 feet which would be two travel lanes two bike lanes and buffer or a mixing zone for the right turn and either a median or left turn lane. When the crossing distance is greater than this a curb median should be installed.

Intersection Specific Countermeasures

- Leading pedestrian intervals.
- Turning Restrictions (Prohibit Left/U Turns with Signs) or Protected Left Turn movements

- Retroreflective Backplates to Signals.

Additional Systemic Safety Improvements.

The following details other systemic improvements recommended for implementation as part of this analysis; as well as recommendations included from the previous study, the 2014 Road Safety Audit.

1. **Pedestrian Safety Improvements**
    - Initiate enforcement/education for cyclists and pedestrians.
    - Consider an enforcement/education campaign in partnership with NJ Transit.
    - Consider installation of center island fencing.
    - Widen Crosswalks
    - Install uniform high visibility crosswalks along entire corridor.
    - Consider installing an exclusive pedestrian phase at high-volume times.
2. **Bus Stops**
    - All existing bus stops are maintained but shall be relocated to the far-side of the intersections to improve loading, unloading and signal operations.
    - Paint a bus loading zone to accommodate length and width of bus.
    - Consolidate bus stops to reduce number of stops. Will increase parking and reduce conflicts with bikes.
3. **Radar Speed Sign, Posting Speed Limit Signs**
    - JMT recommends more frequent posting of speed limit signs. This may be ground mounted within the curbed median; or mast-arm mounted on traffic signal mast arms.
    - The City may also consider the use of Solar Powered Radar Speed (“Your Speed”) Signs. These improvements are recommended to support the conformance to the posted speed limit and slow traffic when they are driving at speeds above the posted limits.
4. **Signing, Striping & Pavement Markings**
    - Crosswalk visibility enhancements, such as high-visibility crosswalks, intersection lighting and enhanced signing/markings help drivers detect pedestrians, particularly at night.
5. **Signals and Phasing**
    - Retime signals and design signal Progression to a managed speed. A managed speed of progression that can be seen and is reliably provided will reduce speeding in the platoon and if the grouping of signals is not to long speeding up to catch the platoon reduces. A reliable signal progression that moves traffic at a reasonable and managed speed. This reduces stops and red light running.
    - The road diet reduces the ability of drivers to be aggressive and if the coordination of the system moves a whole platoon thru the corridor with drivers not having to stop for a whole cycle reduces the desire to be aggressive.
    - Design Yellow Clearance intervals to current standards. Revise pedestrian walk timing, install countdown pedestrian heads at all locations, install 12” LED signal heads, install near side signal heads.

Public Involvement Summary

The public involvement conducted by JMT was 3-phase. Two Public Information Centers were conducted on Thursday December 5, 2019 and Thursday January 9, 2020. Civic association stakeholders and the general public was invited to give their input and concerns for the Alternatives proposed for the project with the Project Steering committee. The project was also presented to the City Council of Atlantic City for approval on Wednesday January 22, 2020 which was live streamed on the Atlantic City Website.

Stakeholder Lists

Table 15 – Civic Association Stakeholders

Civic Association	Name	Role	Phone No.	Email
First Ward Civic Association	Libbie Wills	President	609-344-5648	wlibbiew@aol.com
Bungalow Park Civic Association	Shiela-Hull Freeman		267-738-6132	shefree@verizon.net
Westside Neighborhood Protective Association	Sylvester Showell	President	609-233-8405	Slyone720@yahoo.com
Venice Park Civic Association	Augusta Garrett	President	609-328-1484	abaudy@hotmail.com
Chelsea Neighborhood Association	Carol Ruffu	President	609-457-7397	cruffu@comcast.net
NAACP	Kaleem Shabazz	President	609-442-7284	

Table 16 – Project Steering Committee

Name	Organization	Phone	Email
Jim Rutala	Rutala Associates	609.743.0354	jmrutala@comcast.net
Jennifer Marandino	SJTPO	856.794.1941	jmarandino@sjtpo.org
Stephanie A. Wakeley	SJTPO	856.794.1941	swakeley@sjtpo.org
Alan Huff	SJTPO	856.794.1941	ahuff@sjtpo.com
Vijesh Darji	NJDOT Local Aid	856.486.6715	Vijesh.darji@dot.nj.gov
Doug Pierce	Atlantic City – PD Traffic Unit	609.839.3329	dpierce@acpolice.org
Steve Greenwood	Atlantic City – Engineering	609.347.5360	sgreenwood@cityofatlanticcity.org
Steve Lilley	Atlantic City – Engineering		slilley@cityofatlanticcity.org
Uzoma Ahiarakwe	Atlantic City – Engineering	609.347.5366	UAhiarakwe@cityofatlanticcity.org
Barbara A. Woolley-Dillon	Atlantic City – Planning	609.347.5404	Bwoolley-dillon@cityofatlanticcity.org
Jason Simmons	Cross County Connection TMA	856.596.8228	simmons@driveless.com

Public Information Center Attendees

JMT and the City of Atlantic City hosted two public information centers for this project. The PICs were hosted at the City of Atlantic City Council Hall Chambers, Room 208, located at 1301 Bacharach Blvd. The PICs were hosted on Thursday December 5, 2019 from 5:00pm to 7:00pm and Thursday January 9, 2020 from 5:00pm to 7:00pm. The individuals in attendance should be prioritized during the next phase of the project and public outreach process.

City Council Meeting

The City of Atlantic City hosted a public council meeting where this project was on the agenda. The meeting was hosted at the City of Atlantic City Council Hall Chambers, Room 208, located at 1301 Bacharach Blvd. The meeting was hosted on Wednesday January 22, 2019 from 5:20pm to 7:55pm. The meeting was streamed live, recorded and saved on the City of Atlantic City's website under the Government tab labeled Atlantic City Council Meeting Stream.

Next Steps: Public Outreach / Education

The following detail the next steps in the Public Outreach and Education Process Recommended as part of the Atlantic Avenue Road Safety Assessment:

1. **Outreach:** Throughout the remaining phases of project delivery, JMT recommends more active public outreach be undertaken to engage the public. The techniques to accomplish this should include, but are not limited to, pop-up events and bi-lingual communications. Attendance at local events, or "Pop-Up" Events, is an outreach strategy in which outreach is performed in local areas of interest and/or during events to solicit feedback from those residents who typically do not attend. These events are usually attended by a more diverse and wide-ranging representation of the local community. Bi-Lingual Targeted Outreach is recommended to foster a relationship with the residents and stakeholders by understanding of how to best communicate with them. These strategies of outreach will be effective in increasing public knowledge, input and support for the project.

2. **Education:** Develop Educational Program for cyclists and pedestrians, such as NJ Street Smart Initiative. The Street-Smart NJ pedestrian safety campaign is coordinated by the North Jersey Transportation Planning Authority (NJTPA). The SJTPO has initiated contact with the NJTPA and will coordinate with Will Yarzab, Street Smart NJ Project Manager (wyarzab@njtpa.org), to properly incorporate these elements into the project public outreach process in the next phase of design.

   - https://bestreetsmartnj.org/
   - https://bestreetsmartnj.org/wp-content/uploads/2019/03/SSNJ_Campaign_Checklist.pdf
   - https://www.nj.gov/oag/hts/grants/index.html

3. **Enforcement:** High-Visibility Enforcement (HVE) is a National Highway Traffic Safety Administration safety initiative. HVE combines enforcement with traffic engineering strategies to promote voluntary compliance with the law. HVE incorporates strategies, such as visibility elements (i.e. VMS, road signs) to make enforcement obvious.

   - https://www.nhtsa.gov/enforcement-justice-services/high-visibility-enforcement-hve-toolkit

Appendix A

Correspondence

Appendix B

Crash Data Summary

Appendix C

Collision Diagrams

Appendix D

Travel Time Runs

Appendix E

Spot Speed Study (US LIMITS 2)

Appendix F

Alternatives

Appendix G

HSM Data Driven Analysis

Appendix H

Crash Modification Factors

Appendix I

Economic Valuations