WestCOG

LOCAL ROAD ACCIDENT REDUCTION PROGRAM

Project Proposal Summary – 2017

1. **Project Sponsor:** CITY OF STAMFORD
2. **Project Title:** BROAD STREET CORRIDOR SAFETY IMPROVEMENTS
3. **Project Locations:** BROAD STREET AT ATLANTIC, GAY AND GREYROCK STREETS
4. **Written Description of Proposed Project:**

Introduction

Broad at Atlantic Street is one of the most vibrant and multi-modal intersections in Stamford's downtown area. There is no distinct peak period for this corridor, rather there are consistently high volumes of vehicle and pedestrian traffic throughout the day, see Table 1. This area is in the top 5% of regional safety concerns calibrated in the Traffic Analysis Zones. Also, the Atlantic Street and Broad Street corridors are ranked 2nd and 8th, respectively, in the region for crashes. This proposal highlights systemic and spot safety improvements to the Broad Street corridor between Atlantic Street and Greyrock Place. It also leverages the investment of the 2016 Local Roads Accident Reduction Program project on Summer Street. Safety improvements proposed here are similar to those planned for the Summer Street, such as curb extensions, high-visibility crosswalks, ADA curb ramps, and other FHWA approved countermeasures outlined below.

One of the most important community institutions, the Ferguson Library, is located at this intersection. And in the Broad Street corridor between Atlantic Street and Greyrock Place, the tallest office building in Stamford, Landmark Square, and the Stamford Town Center mall, are both located. In the project area, land uses are truly mixed, including institutional, educational, office, and retail. Other nearby land uses that influence this area are the UCONN-Stamford Campus, CTtransit bus hub at Atlantic Square, as well as two historic districts on Atlantic Street and Bedford Street, which host many of Stamford's downtown restaurants, retail and entertainment. The Broad Street corridor is a major arterial parallel to Tresser Boulevard (Route 1), and thus, significant to our local economy. It is a primary route to access jobs, downtown retail, and entertainment.

The perception of safety in this corridor is critical to cultivating a culture of walking, biking and taking transit, which will ease traffic congestion downtown. By improving safety in this corridor, the City can encourage alternative transportation modes. The highest concentration of zero-car households surrounds the project area, and also, there are many families, elderly, and other vulnerable users in this corridor that depend on safe streets for walking and biking as their primary mode of transportation. Therefore, this corridor is one of the City's priorities for safety for all transportation modes. See Figures 1 and 2 below to view US Census data of spatial distribution of zero car households and vulnerable users in Stamford.

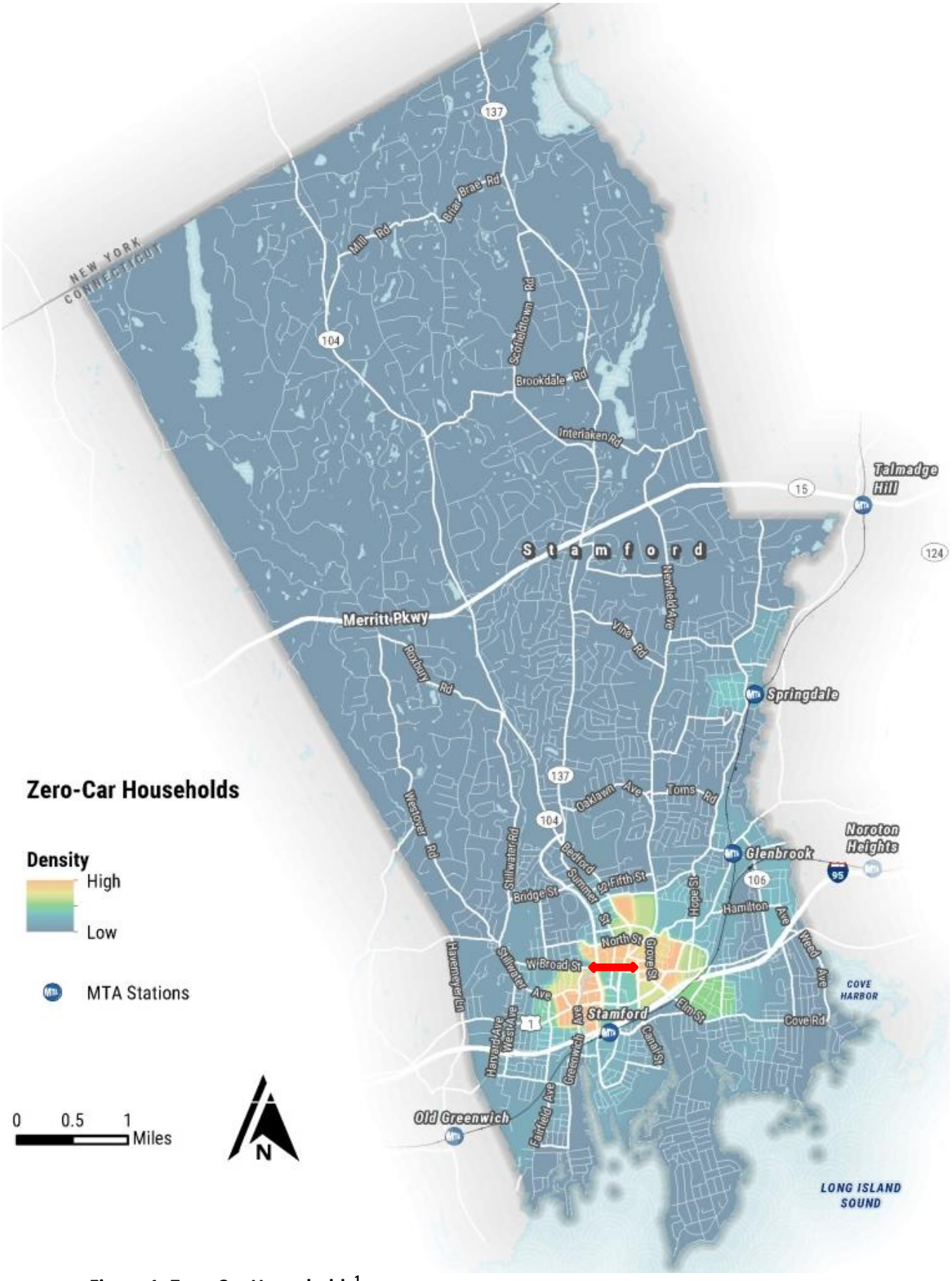


Figure 1: Zero-Car Households[1]

[1] US Census, Zero-Car Household data, 2010.

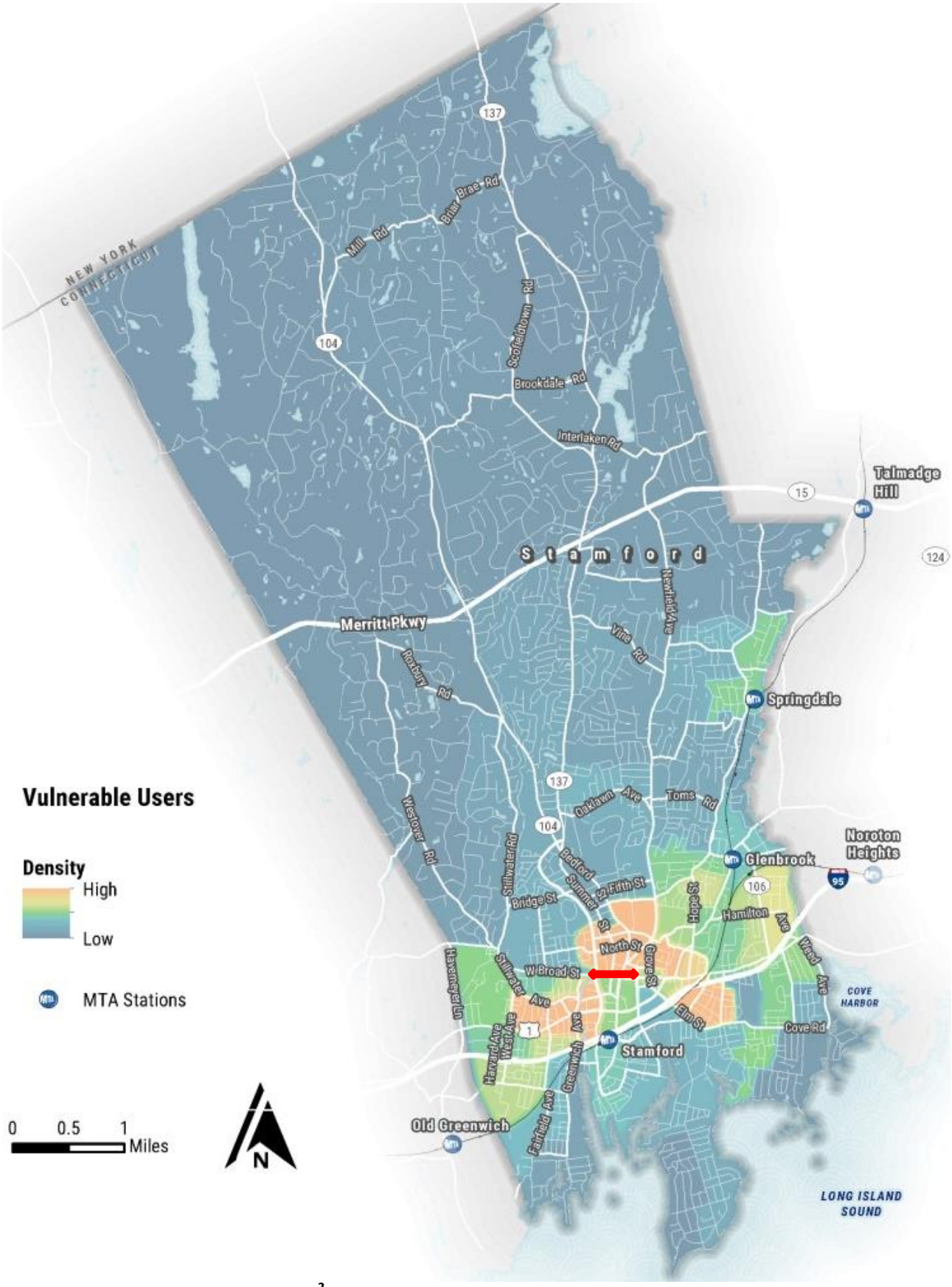


Figure 2: Vulnerable Users [2]

[2] US Census, Vulnerable User data, 2010.

The intersection of Broad and Atlantic Street hosts a high volume of pedestrians, bicycles, CTtransit buses, delivery trucks and motorists. Table 1 below shows peak hour volumes by mode, collected by Urban Engineers, for the Citywide Signal Synchronization Study. This data shows AM, Mid-day and PM periods for all transportation modes, and demonstrates how truly multi-modal this intersection is.[3] The traffic counts demonstrate that there is no off-peak for this corridor because there is consistent activity throughout the day. Table 2 below shows average daily bus ridership data, provided by CTtransit, for the Atlantic Square bus hub, which includes all of the bus routes that use the intersection of Broad and Atlantic Streets. CTDOT traffic data, as shown in Figure 3, which is collected with traffic tubes, shows that average daily traffic is 11,400 on Atlantic Street near this intersection.[4]

Broad Street is a major two-way arterial roadway crossing downtown and connecting the East and West Side neighborhoods. These intersections traffic entering and exiting the Landmark Square offices and parking garage and traffic entering and exiting the Bedford Street parking garage and surface lot. All of the intersections along the corridor are signalized and include crosswalks and pedestrian signal indications as well as motor vehicle signals. In this area, there is only on-street parking on the south side of Broad Street between Atlantic and Gay Streets. There is a 3' wide channelizing median on Broad Street west of Atlantic Street, and a 6' wide pedestrian refuge island and median with landscaping between Atlantic and Gay Streets.

Table 1: Traffic Counts at Broad and Atlantic Street By Mode and Period 2012-2016	AM (6:30-9:30 AM)	MID-DAY (12:00-2:00 PM)	PM (3:30-6:30)
Motorcycles	3	4	9
Cars	2068	1872	2510
Light Goods Vehicles	125	151	127
Buses*	60	31	37
Single-Unit Trucks	40	44	23
Articulated Trucks	3	5	1
Bicycles on road	2	0	7
Bicycles on crosswalk	8	0	2
Pedestrians on crosswalk	362	776	692
Total	2671	2883	3408

[3] Citywide Signal Synchronization Study, Urban Engineers (2017), Traffic Counts for the intersection of Broad and Atlantic Streets.
[4] CTDOT, Average Daily Traffic in Stamford (2014).
http://www.ct.gov/dot/lib/dot/documents/dpolicy/policymaps/adt/2007-2014pdf/135adt.pdf

*FHWA recently issued a final rule on counting the number of *people* using transit rather than number of vehicles. The table above shows total number of buses. See table below for average daily bus ridership. [5]

Table 2: Average Daily Bus Ridership 2012-2016	Boarding (Ons)	Alighting (Offs)
Atlantic Street at Veterans Park (Northbound buses)	2612	632
Atlantic Street at Old Town Hall (Southbound buses)	667	907
Total	3279	1539

Figure 3: CTDOT Average Daily Traffic, 2014

Crash History 2012-2016

Crash Data for this proposal was exported from the UCONN Crash Data Repository to analyze the crash history for the years 2012-2016. The intersection of Broad and Atlantic ranked as the 7th hotspot in the region for injuries and fatalities. The Atlantic/Bedford Street and the Broad Street corridors were ranked 2nd and 8th, respectively, in the region for highest crash corridors based on injuries and fatalities. This area is ranked in the top 5% of traffic analysis zones in expected intersection crashes. This ranking is based on demographic, land use and crash data. The total number of crashes in this area is 168.

In Table 3, the data shows that the majority of crashes in this area are front-to-rear crashes and sideswipe crashes, which often occur when cars are driving too fast and/or not paying attention. Front-to-rear crashes, which are also known as rear-end crashes, are also frequently caused by following too closely. A sideswipe crash happens when two motor vehicles are moving next to each other in the same direction and their sides contact one another. To reduce sideswipes, the lane line markers could be painted to guide cars throughout the intersection, advanced notice of lane types could be posted, and lane types could be posted overhead. Other countermeasures that reduce speeds are travel lane narrowing with curb extension, tightening corners with curb extensions to slow down turns, and speed radar signs. In Table 5, the data shows that 35% of crashes happen after dark. To reduce these crashes, the City proposes high visibility crosswalks, retroreflective tape on signs and signals, and increased overhead lighting at the intersection. Tables 6 and 7 show that most crashes occur in clear and dry weather. Table 8 shows that the majority of crashes occur between 4-6 PM.

[5] Federal Highway Administration, Federal Register. National Performance Management Measures; Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program. (2017) https://www.federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system

Table 3: Manner of Crash Impact 2012-2016		
	Count	Percent
Sideswipe, same direction	52	36%
Front-to-rear	74	51%
Angle	11	8%
Not Applicable	6	4%
Other	2	1%
Manner of crash not reported	23	
	168	

Table 4: Crash Severity 2012-2016		
	Count	Percent
Injury of any type (Serious, Minor, Possible)	32	19%
Property Damage Only	136	81%
	168	

Table 5: Light Condition 2012-2016		
	Count	Percent
Dark-Lighted	56	33%
Dark-Not Lighted	1	1%
Daylight	108	64%
Dusk	2	1%
	168	

Table 6: Weather Condition 2012-2016		
	Count	Percent
Clear	142	85%
Rain	18	11%

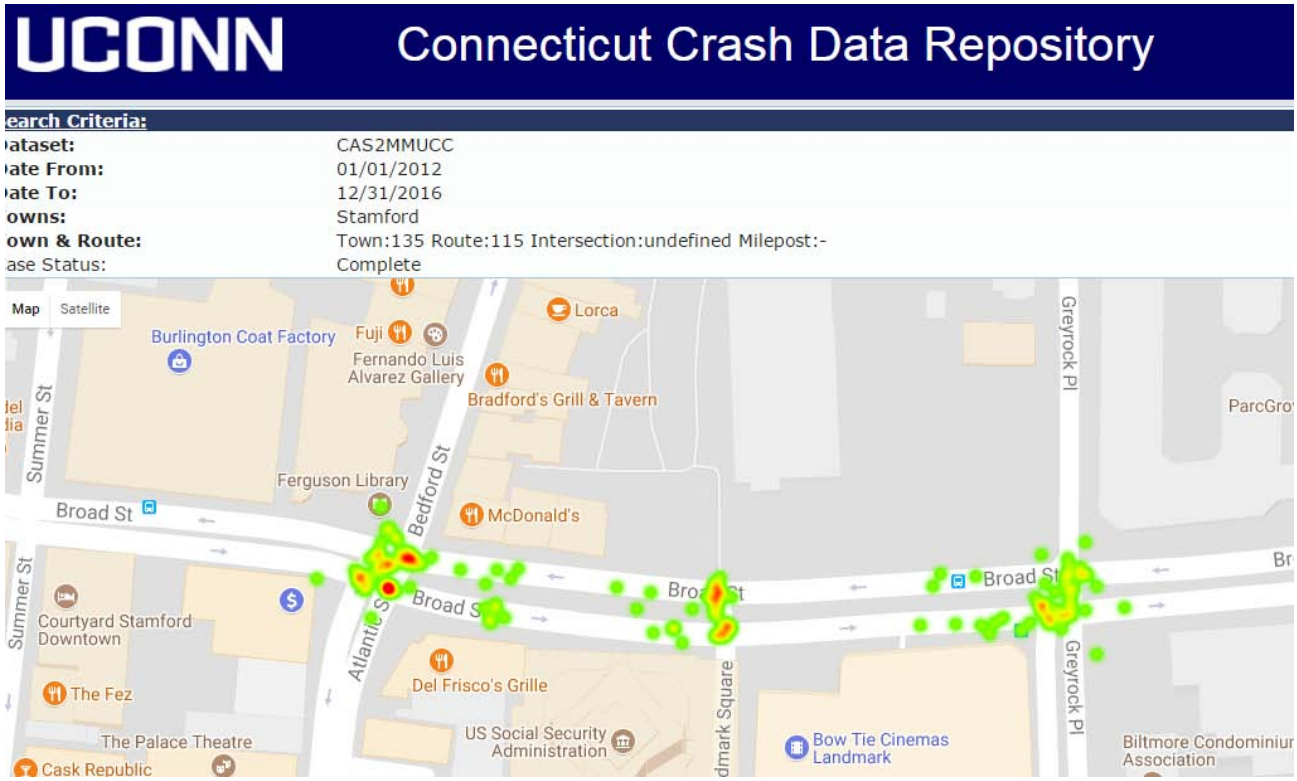
Cloudy	4	2%
Snow	3	2%
Unknown	1	1%
	168	

Table 7: Road Surface Condition 2012-2016		
	Count	Percent
Dry	137	82%
Slush	1	1%
Snow	2	1%
Standing Water	1	1%
Wet	26	15%
	168	

Table 8: Hour of Crash 2012-2016		
	Count	Percent
0:00	4	2%
1:00	4	2%
2:00	1	1%
3:00	1	1%
4:00	0	0%
5:00	0	0%
6:00	0	0%
7:00	3	2%
8:00	12	7%
9:00	14	8%
10:00	7	4%

11:00	8	5%
12:00	11	7%
13:00	9	5%
14:00	12	7%
15:00	6	4%
16:00	12	7%
17:00	17	10%
18:00	14	8%
19:00	7	4%
20:00	5	3%
21:00	13	8%
22:00	1	1%
23:00	7	4%
	168	

Figure 4: Crash Heat Map 2012-2016, Total Crashes



Summary of Pedestrian Crashes

From 2012-2016, 11 pedestrians were involved in crashes in the area of Broad Street at Atlantic, Gay and Greyrock Streets, which is 42% of all injuries sustained in the area during that time. Only 1% of crashes involving pedestrians resulted in no injury, and of the other 99%, 63% resulted in minor injuries and 27% resulted in serious injury. There is a positive correlation between travel speed and the severity of crashes. This proposal includes strategies to increase visibility of pedestrians and slow traffic, with countermeasures such as high-visibility crosswalks and curb extensions. 64% of pedestrian-involved crashes occurred when the pedestrian was crossing the roadway. Curb extensions and pedestrian refuge islands could help prevent these crashes and increase safety for those that are slower to cross the roadway 18% of pedestrian-involved crashes included failure to yield to pedestrian in the crosswalk on the part of the driver as a contributing factor. To prevent these crashes, the City proposes warning signs for turning drivers to yield to pedestrian in crosswalk. The weather conditions were clear and dry during 100% of these pedestrian crashes. It was daylight during 55% of crashes and after dark during 45% of crashes. To address crashes that took place after dark, the City proposes brighter light and increased lighting in this corridor. 10% of crashes took place during the AM peak hour and mid-day, 50% during the PM peak hour, and 40% at between midnight and 2:00 AM.

Figure 5: Direction of Travel for Pedestrian Crashes

Seven out of the eleven crashes occurred when cars were turning, three of which were turning right and four turning left. Three out the eleven crashes occurred when cars were driving straight. To address all pedestrian crashes in the corridor, the City proposes FHWA approved countermeasures such as high visibility crosswalks and curb extensions where feasible to increase visibility of the pedestrians and shorten crosswalk distance. To address turning crashes in particular, the City proposes illuminated warning signs that are programmed in synch with the vehicle turning signals.

Two of the left-turning pedestrian crashes were by vehicles turning onto westbound Broad Street from Atlantic. This is a spot in which the pedestrian desire line is wide, with pedestrians crossing near the corner to the Ferguson Library's front door. In addition, the west side of Broad Street has a 3' median rather than the 6' pedestrian refuge island that exists on the east side. The proposed design may consider highlighting or narrowing the pedestrian desire line and accommodating an ADA-compliant pedestrian refuge island on the west side if possible.

Figure 6: Crash Heat Map 2012-2016, Pedestrian Crashes Only

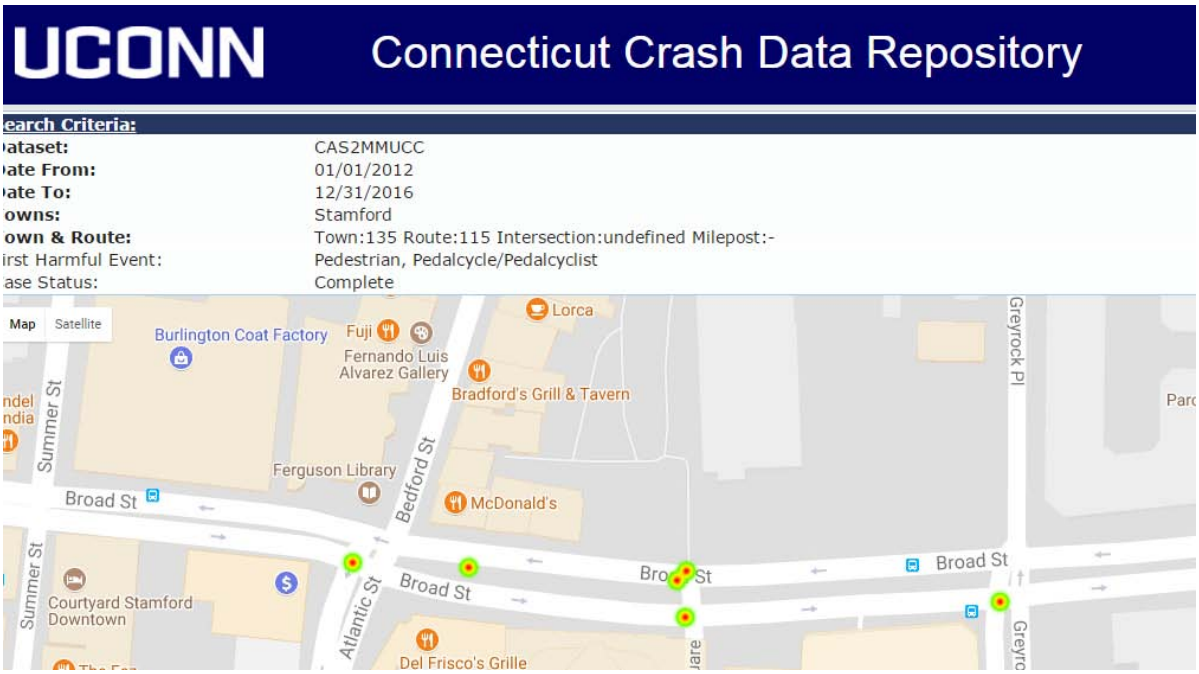
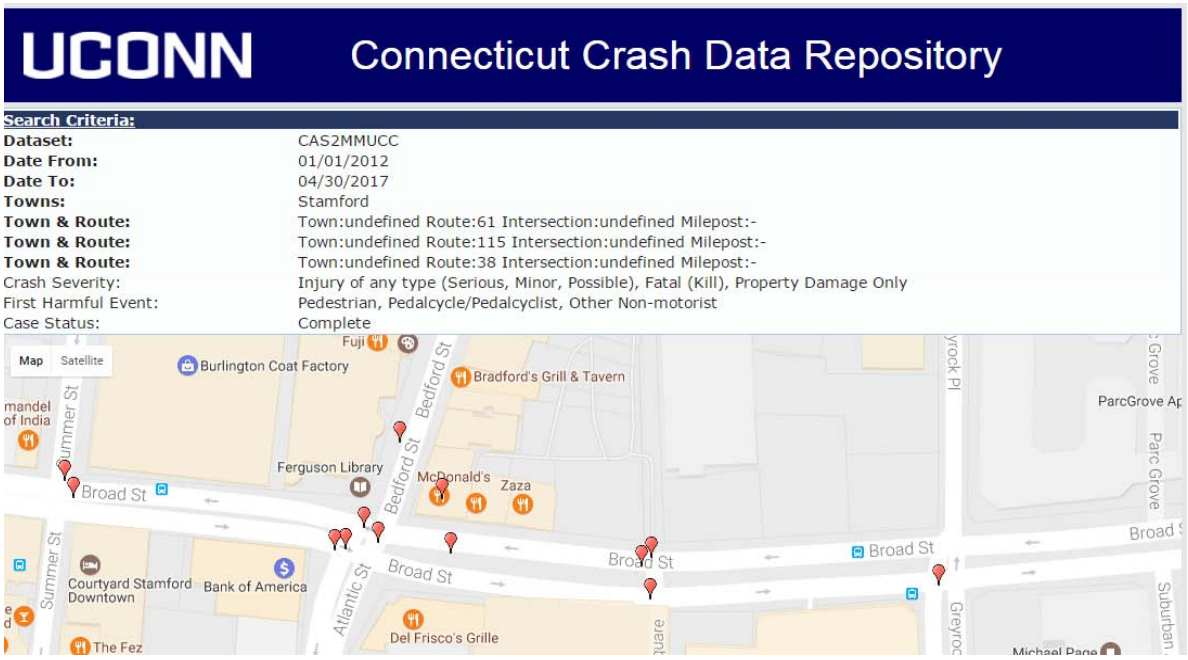


Figure 7: Pedestrian Crashes in the Project Area



All data was collected from the UCONN Connecticut Crash Data Repository.
Dataset: MMUCC Format (2003-)
Please note, this is the newest dataset available through the Repository and contains an extract of crash data from 2003 to present day that has been converted to fit the MMUCC crash variables.
Data Period: 5 year from 2012 to 2016.

Summary of Countermeasures

The City will implement the following safety countermeasures in the Broad Street Corridor:

- Replace all existing crosswalks with high visibility retroreflective thermoplastic
- ADA Curb Ramps
- Improved Lighting
- Build out existing painted curb extensions where appropriate and feasible
- Install illuminated 'turning vehicles yield to pedestrians in crosswalk' signs
- Install illuminated 'no turn on red' signs
- Retroreflective signal backplates
- Speed Radar Signs showing posted speed and actual speed on Broad Street
- Pedestrian Refuge Island with pedestrian signal buttons
- Lane Line Markers

High Visibility Retroreflective Thermoplastic Crosswalks

Thermoplastic crosswalks are proven to raise the visibility of pedestrians and reduce pedestrian-Related crashes at intersections. They are also more durable and longer lasting than traditional paint.[6]

ADA Curb Ramps

At the intersections of Broad at Atlantic, Gay and Greyrock, ADA curb ramps will be installed where they are currently not ADA-compliant. This improves the safety for pedestrians that are disabled, blind, or otherwise mobility challenged.

Lighting

The City will analyze lighting in the project area, and install brighter lighting or additional fixtures where feasible.

Concrete/Brick Curb Extensions

We are proposing to build out the existing painted curb extensions at Broad at Atlantic and Greyrock, where there are existing painted curb extensions. These will prevent high speed turning, reduce crashes at intersections and also reduce the severity of crashes as a result of traffic calming.[7] Curb extensions reduce the crossing distance, improve visibility, slow turning vehicles, reduces motorist speed by visually narrowing the street.[8] Pedestrians often wait to cross where they can see on-coming cars, which is often in front of parked cars. Thus, curb extensions safely allow pedestrians to stand where they can see and be seen by traffic. In this high density residential and mixed-use area, there is a high volume of pedestrian traffic, and there have been many complaints about speeding traffic. Also, crash data supports the problems on this corridor.

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[6] Federal Highway Administration. Safety of Thermoplastic Crosswalks. http://safety.fhwa.dot.gov/saferjourney1/library/countermeasures/04.htm

[7] Johnson, R. S. *Pedestrian Safety Impacts of Curb Extensions: A Case Study*. Publication FHWA-OR-DF-06-01, Oregon Department of Transportation, Salem, OR, 2005.

[8] King, M.R. Calming New York City Intersections. Transportation Research Board Circular E-CO19: Urban Street Symposium, Issue Number 501, Dallas, Texas, 1999.

Illuminated Safety Signage

'Turning cars yield to pedestrian' signs and 'no turn on red' signs will prevent crashes from turning vehicles.

Retroreflective Signal Backplates

Failing to see traffic signals is often cited as a contributing factor by drivers who are involved in collisions at intersections. Increasing the visibility of traffic signals can lead to improved safety performance. [9] [10] We are proposing to add strips of yellow micro-prismatic retroreflective sheeting along the outer edge in an attempt to frame the signal heads and make them more visible to motorists.

Speed Radar Signs

Speed enforcement is one of the most common countermeasures to reduce crashes. Studies show that automated speed radar signs are effective at reducing speeds and reducing severe collisions.[11]

Pedestrian Refuge Islands

A pedestrian safety island reduces the exposure time experienced by a pedestrian in the intersection. Pedestrians frequently use the 3' wide channelizing median on the west side of Broad at Atlantic Street as a refuge, however it is not wide enough or ADA-compliant. Pedestrian refuge island should be at least 6' wide and should have a "nose" that separates the refuge area from the intersection. Establishing a pedestrian refuge island here, similar to the one on the east side of the intersection will greatly improve pedestrian safety. Pedestrian signal buttons should also be included in the islands. In addition, there is a painted curb extension on the west side of Broad and Greyrock that this project proposes to build out as a pedestrian refuge island.

Lane Line Markers

Lane line markers help to guide drivers to stay in their lane while driving through an intersection. There are a numerous sideswipe crashes in the project area, and these pavement markings will reduce those crashes.

Conclusion

This LRARP proposal seeks to build upon the crash reduction strategies proposed for the adjacent intersection of Summer Street and Broad Street, and the Summer Street corridor improvements from Stamford's 2016 LRARP proposal. The City seeks to extend these strategies to Broad Street at Atlantic, Gay and Greyrock Streets. This 2017 LRARP proposal leverages safety investments made in adjacent high crash areas. These strategies give pedestrians, shorter crossings (sidewalk extensions), enhance the

[9] Federal Highway Administration. "Proven Safety Countermeasure: Backplates with Retroreflective Borders". http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_007.pdf

[10] Sayed, T., Leur, P., and Pump, J., "Safety Impact of Increased Traffic Signal Backboards Conspicuity." 2005 TRB 84th Annual Meeting: Compendium of Papers CD-ROM, Vol. TRB#05-16, Washington, D.C., http://www.cmfclearinghouse.org/study_detail.cfm?stid=85

[11] Li, R., K. El-Basyouny, and A. Kim. "A Before-and-After Empirical Bayes Evaluation of Automated Mobile Speed Enforcement on Urban Arterial Roads". Presented at the 94th Annual Meeting of the Transportation Research Board, Paper No. 15-1563, Washington, D.C., (2015).

visibility of pedestrians and crosswalks (retroreflective crosswalks) and call attention to the requirement to yield (illuminated 'turning vehicle yield to pedestrian in crosswalk' signs) and restrict right turns on red (illuminated 'no turn on red' signs). These are FHWA proven countermeasures as well as strategies that CTDOT has approved from Stamford's 2016 LRARP proposal.

5. Preliminary Project Plans:

Existing Condition

Sketch of proposal

Key

- High visibility crosswalks, realigned to tighten crosswalks toward the corners to improve visibility of pedestrians while crossing
- Existing painted curb extensions filled in
- Lane line markers for all travel lanes not shown, but will be conceptualized during design process

 Locations where new ADA curb ramps are needed

 Locations where street lighting needs to be analyzed

 Potential Location for speed radar signs

 Potential for safety warning signs for turning vehicles at all three intersections

6. Cost Estimates and Proposed Schedule:

See attached Cost Summary and Estimate spreadsheets.

7. Supporting Information:

See Figures and Tables in Section 4.

8. Priority of Project for Sponsor: 1

9. Local/Regional Priority:

10. Project Sponsor:

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Broad Street Corridor Safety Improvements Project
Estimated Cost

Town: Stamford

1	Construction Items		**$**	**315,785**
2	M & P Traffic (not incl. Trafficperson)	4%	$	12,631.40
3	Construction Staking	1%	$	3,157.85
4	Total Contract Items (sum of lines 1 thru 3)		**$**	**331,574.25**
5	Contingencies	10%	$	33,157.43
6	Contract Items & Contingencies		**$**	**364,731.68**
7	Inflation (4% per year)		$	14,589.27
8	Contract Items w/ Contingencies and Inflation		**$**	**379,320.94**
9	Incidentals (City)	15%	$	56,898.14
10	Incidentals (State)	10%	$	37,932.09
11	Trafficperson		$	25,000.00
12	**TOTAL PROJECT COST (sum of 8, 9, 10 & 11)**		**$**	**499,151.18**

Broad/Atlantic

Item Description	Units	Quant.	Unit Cost	Total Cost
Milling	SY	800.00	$2.15	$1,720.00
Paving	Tonnage	150.00	$100.00	$15,000.00
Permanent Trench Repair	SY	20.00	$50.00	$1,000.00
Thermoplastic Crosswalk	SF	1800.00	$20.00	$36,000.00
Concrete Curb	LF	200.00	$35.00	$7,000.00
Concrete/Brick Bumpout Fill	SF	400.00	$45.00	$18,000.00
ADA Tacile Strip	EA	2.00	$60.00	$120.00
ADA Curb Ramp	SF	50.00	$50.00	$2,500.00
Pedestrian Refuge Island	Total	1.00	$18,000.00	$18,000.00
Left-Turning Cars Yield to Pedestrians	EA	2	$2,000.00	$4,000.00
Speed Radar Signs	EA	3	$4,000	$12,000
Additional Lighting	EA	4	$2,500	$10,000
TOTAL				$125,340.00

Broad/Gay

Item Description	Units	Quant.	Unit Cost	Total Cost
Milling	SY	300.00	$2.15	$645.00
Paving	Tonnage	80.00	$100.00	$8,000.00
Permanent Trench Repair	SY	15.00	$50.00	$750.00
Thermoplastic Crosswalk	SF	1500.00	$20.00	$30,000.00
Concrete Curb	LF	70.00	$35.00	$2,450.00
ADA Tacile Strip	EA	2.00	$60.00	$120.00
ADA Curb Ramp	SF	50.00	$50.00	$2,500.00
Left-Turning Cars Yield to Pedestrians	EA	4	$2,000.00	$8,000.00
TOTAL				$52,465.00

Broad/Greyrock

Item Description	Units	Quant.	Unit Cost	Total Cost
Milling	SY	800.00	$2.15	$1,720.00
Paving	Tonnage	150.00	$100.00	$15,000.00
Permanent Trench Repair	SY	20.00	$50.00	$1,000.00
Thermoplastic Crosswalk	SF	1900.00	$20.00	$38,000.00
Concrete Curb	LF	140.00	$35.00	$4,900.00
Concrete/Brick Bumpout Fill	SF	400.00	$45.00	$18,000.00
ADA Tacile Strip	EA	6.00	$60.00	$360.00
ADA Curb Ramp	SF	300.00	$50.00	$15,000.00
Pedestrian Refuge Island	Total	1.00	$18,000.00	$18,000.00
Catch Basin	Total	2.00	$3,000.00	$6,000.00
Left-Turning Cars Yield to Pedestrians	EA	4	$2,000.00	$8,000.00
Speed Radar Signs	EA	3	$4,000	$12,000
TOTAL				$137,980.00