



BOSTON REGION METROPOLITAN PLANNING ORGANIZATION

Stephanie Pollack, MassDOT Secretary and CEO and MPO Chair
Tegin L. Teich, Executive Director, MPO Staff

TECHNICAL MEMORANDUM

DATE: November 7, 2019
TO: Boston Region Metropolitan Planning Organization
FROM: Chen-Yuan Wang
RE: Safety and Operations Analysis at Selected Intersections: FFY 2020

1 BACKGROUND

This memorandum presents the results of Task 1 (Select Study Locations) of the work program for Safety and Operations Analysis at Selected Intersections: Federal Fiscal Year (FFY) 2020.¹

This study builds on recommendations generated by the Boston Region Metropolitan Planning Organization's (MPO) Congestion Management Process (CMP) to address safety and congestion problems at intersections in the MPO area. Several similar studies were completed in previous funding years and received favorable responses from municipalities, which included appreciation of the MPO's assistance with potential low-cost solutions and a head start on conceptual design for the study intersections.

The focus of this work program is on locations with safety and operational concerns and with potential for implementing improvements. The selected locations in previous studies included large, complex intersections, simpler intersections, and locations that include two or more adjacent intersections. Locations that would potentially require major geometry redesigns, such as grade separation or adding travel lanes on an arterial roadway, were considered to be less suitable for this study.

As in the past, the basic requirement for a location to qualify as a study candidate is that it must be located on an arterial roadway in the Boston Region MPO where (1) it has safety and operational concerns and (2) the agencies and/or municipalities with jurisdiction over the roadway are committed to implementing recommended improvements.

¹ The work program is funded through Boston Region MPO FFY 2020 Unified Planning Work Program and was approved by the MPO on September 19, 2019.

2 SELECTION PROCEDURE

The study selection process consisted of the following four steps completed by the MPO:

- 1) Generate a list of potential intersection study locations and then narrow it to 10 locations
- 2) Gather detailed data for each of the 10 locations
- 3) Apply specific criteria to examine potential study locations more closely
- 4) Score and rate the 10 locations, and assign low, medium, or high priority to each intersection location

2.1 Generating List of Potential Locations

MPO staff used the following sources to develop an initial list of potential study locations in the MPO area:

- FFY 2018 safety and operations list of potential candidates
- Suggested locations from Unified Planning Work Program outreach
- Massachusetts Department of Transportation (MassDOT) Top 200 Intersections 2014–16 Crash Clusters

The following exclusion criteria were developed to narrow the list to approximately 30 potential locations:

- Located in a municipality that has been selected for this study within the past three years
- Studied by MPO staff or another agency; included in a Transportation Improvement Program (TIP) project with a status of “advertised” or “programmed,” or included in an active MassDOT or other agency project that is in design (at 25 percent or higher design status), in construction, or recently completed
- Considered part of a larger potential study area, such as a highway interchange or a long traffic corridor with an extensive area of congestion
- Considered not at-grade

2.2 Gathering Detailed Data

Staff gathered data to support the exclusion criteria, to eliminate locations that were not suitable, and to select 10 potential locations for this study. The assembled data are listed below.

- MassDOT’s 2015 Road Inventory File. To collect roadway jurisdiction, National Highway System status, and annual average daily traffic (AADT) for each major arterial segment in each intersection location
- MassDOT’s Transportation Data Management System. To retrieve recently updated AADT counts from MassDOT’s online database
- MassDOT 2014–16 Crash Database. To identify high-crash locations and numbers of crashes
- MPO CMP Data on Arterial Congestion. To determine travel-time index (that is, travel time in the peak period divided by travel time in free-flow conditions) for each major arterial segment intersection location
- MPO Data on Bike Network Gaps and MassDOT Bike Facilities. To identify bicycle needs—including connectivity—and accommodation
- Data on Massachusetts Bay Transportation Authority (MBTA) Bus Service Performance and Passenger Load. To determine the percentage of bus trips that do not adhere to the schedule (late service) or to passenger load standards (crowding)
- Data on MBTA Subway and Commuter Rail Lines. To identify locations serving MBTA stations
- Data from the following sources were also included:
 - Data selected from MassDOT’s project-information and roadway safety audit databases
 - The MPO’s 2020–24 TIP projects
 - MPO planning (and other) studies
 - Municipal websites (to obtain data on projects, studies, and TIP projects planned or programmed for each arterial segment)

Table 1 presents the data assembled for each of the 10 intersections, including located community, Metropolitan Area Planning Council subregion, MassDOT district office, jurisdiction, equivalent property damage only (EPDO) crashes, total crashes, fatal crashes, injury crashes, property damage only and non-reported crashes, bicycle and pedestrian crashes, top-200 crash clusters, crash clusters that are eligible for Highway Safety Improvement Program (HSIP) funding, transit routes, a list of relevant studies or projects, and staff comments.² The table also

² HSIP-eligible crash clusters are defined by MassDOT as crash clusters that rank within the top five percent of crash clusters for each Regional Planning Agency, based on the Equivalent Property Damage Only (EPDO) index. In the EPDO index, property-damage-only and severity unknown crashes are awarded one point each, fatal crashes and crashes involving injuries are given 21 points each. In the Boston Region MPO, 421 intersections are

shows the results of applying the selection criteria and the priority rating, which was performed in step four (see 2.4, Scoring and Rating).

2.3 Applying Criteria

MPO staff further examined the intersection locations by applying the five criteria cited below.

- *Safety Conditions, 0–2 Points (each bullet counts as 1 point)*
 - Location has an estimated crash rate that is higher than the district average or is a HSIP-eligible location
 - Location has a significant number of pedestrian and bicycle crashes (one or more in three years) or has truck traffic safety concerns

- *Multimodal Significance, 0–2 Points (each bullet counts as 1 point)*
 - Location carries a significant number of pedestrians and bicycles (five or more per peak hour) or has a high proportion of truck traffic (five or more percentage of total traffic per peak hour)
 - Location needs improved transit, bicycle, or pedestrian facilities

- *Regional Significance, 0–2 Points (each bullet counts as 1 point)*
 - Location carries a significant portion of regional traffic (AADT is greater than 15,000 on at least one intersecting road)
 - Location is essential for the region’s economic, cultural, or recreational development

- *Implementation Potential, 0–3 Points (each bullet counts as 1 point)*
 - Location has strong potential for implementation based on the urgent need for safety improvements
 - Location is proposed or endorsed by its roadway administrative agency (agencies)
 - Location has strong support from all of its stakeholders

- *Regional equity, 0–1 Points (each bullet counts as 1 point)*
 - Location is in a municipality that has not been selected for this study in the past five years.

identified from MassDOT 2014–16 Crash Data as the top five percent crash clusters with a minimum EPDO value of 115.

In addition, no two locations in the same municipality would be selected.

2.4 Scoring and Rating

Intersection locations with a score of four or fewer points were rated low priority; those with a score of five to seven points were rated medium priority; and those with a score of eight or more points were rated high priority. Three locations were given a high-priority rating and seven a medium-priority rating by MPO staff based on safety, operations, multimodal and regional significance, and support from agencies and municipalities.

3 SELECTED INTERSECTIONS FOR STUDY

Among the high-priority locations, staff selected two intersections for study: (1) Adams Street at Furnace Brook Parkway in Quincy; and (2) Route 27 (North Meadows Road) at West Street in Medfield.

- 1) Adams Street at Furnace Brook Parkway in Quincy: The City of Quincy requested MPO's assistance in addressing the safety and operational concerns at this intersection, especially regarding pedestrian safety issues.

This location, including the adjacent intersection at Common Street, has a high EPDO crash rate and is a HSIP-eligible location. It also has pedestrian safety and other operational concerns. The intersection has a large footprint and is not convenient for pedestrian crossing and bicycle traveling.

The intersection's jurisdiction is currently under the Massachusetts Department of Conservation and Recreation (DCR) and potentially will be transferred to the City. The study of this intersection is supported by both the City and DCR.

- 2) Route 27 (North Meadows Road) at West Street in Medfield: The MPO staff identified this location from the Statewide Top 200 Crash Locations database. The Town also expressed interest and intention to advance this study toward improvement implementation.

Based on MassDOT 2014–16 crash data, this intersection is ranked 115 of the statewide top 200 crash locations with a high EPDO crash rate. It lacks pedestrian and bicycle accommodations while a number of developments are ongoing in the area.

The intersection is under the Town's jurisdiction. This study will be timely to provide a head start for the Town to advance the design project.

Staff also evaluated the pedestrian accommodation and safety improvement needs for the two locations by applying the MPO's Pedestrian Report Card Assessment.³ The two selected locations meet the criteria for pedestrian accommodation or safety improvement requirements. Appendix A contains detailed results of the assessments.

4 SUMMARY

The recommended intersection locations meet the selection criteria of this study because of their potential for safety and operations improvements. The work scope for this study assumed that "as many as three" locations would be selected. Staff selected two locations that contain a total of three intersections.

Staff will submit these recommendations to the MPO for discussion. If the MPO endorses the study selections, staff will meet with officials from Quincy, Medfield, MassDOT, and DCR to discuss study specifics, conduct field visits, collect data, perform analyses, and review short- and long-term improvement alternatives.

³ Pedestrian Level-of-Service Memorandum, Ryan Hicks and Casey-Marie Claude, Boston Region Metropolitan Organization, January 19, 2017.

TABLE 1. FFY 2018 Safety and Operations for Selected Intersections
Selected locations are highlighted in Blue

Location	Community	MAPC Subregion	MassDOT District	Jurisdiction	Street 1	Route 1	Street 2	Study, Project, or TIP Project	Estimated Total Crash Rate	EPDO Crashes 2014-16	Total Crashes 2014-16	Injury Crashes 2014-16	Bike/Ped Crashes 2014-16	Top 200 Crash Clusters 2014-16	HSIP-eligible Crash Clusters 2014-16	Transit Routes	Safety Conditions	Multimodal Significance	Regional Significance	Implementation Potential	Regional Equity	Total Score	Rating	Comments
1	Quincy	ICC	6	DCR	Adams Street		Furnace Brook Parkway	None	3.37	268	48	11	2	0	1	MBTA 245	2	2	2	3	1	10	High	This location, including the adjacent intersection at Common Street, has a high EPDO crash rate and is a HSIP-eligible location. It also has pedestrian safety and other operational concerns. The study of this intersection is supported by all stakeholders.
2	Medfield	TRIC	3	Medfield	North Meadows Road	Route 27	West Street	No current scheduled project. MassDOT Project 600691: Resurfacing and related work on a section of Route 27 (North Meadows Street) in Medfield was conducted many years ago (completed in 2003).	1.66	282	22	13	0	1	1	None	2	1	2	3	1	9	High	This intersection has a high EPDO crash rate and is ranked 115 of the statewide top 200 crash locations. It lacks pedestrian and bicycle accommodations while a number of developments are ongoing in the area. This study is timely to assist the Town to improve the intersection.
3	Randolph	TRIC	6	Randolph	South Main Street	Route 28	Union Street	MassDOT Project 609399: Resurfacing and related work on Route 28 in Randolph. This project is in the preliminary design phase.	1.61	361	41	15	2	1	1	MBTA 238 and 240 BAT 12	2	2	2	1	1	8	High	The intersection is signalized with sufficient sidewalks and crosswalks. It has a large footprint and is located in a built-up area.
4	Salem	NSTF	4	Salem	North Street	Route 114	Mason Street	MassDOT Project 605332: Bridge Replacement on North Street Over North River in Salem, just south of the intersection (TIP project, begins 2021).	0.22	88	8	4	1	0	0	MBTA 465	1	2	2	1	1	7	Medium	An arterial segment study is more suitable for this location.
5	Lynn	ICC	4	Lynn	Washington Street	Route 129	Laighton Street	None	2.60	295	35	13	1	1	1	MBTA 424, 429, 434, 435 and 450	2	2	1	1	1	7	Medium	This is an unsignalized intersection that carries a high proportion of cut-through traffic. The stop-controlled approach is usually congested during peak hours when Washington Street has busy traffic.
6	Milford	SWAP	3	Milford	Medway Road	Route 109	Beaver Street	None	0.97	149	29	6	0	0	1	MWRTA 06 and 14	1	1	2	2	1	7	Medium	This signalized intersection is close to a major highway interchange and may require a much larger study area.
7	Chelsea	ICC	6	Chelsea	Eastern Avenue		Chelsea Street Bridge	MassDOT Project 601199: Reconstruction of Eastern Avenue from Central Avenue to Broadway in Chelsea. This project will provide sidewalks, drainage improvements, and various pedestrian amenities. The project was completed in 2008.	2.52	329	29	15	2	1	1	MBTA Bus 112 and Silver Line 3	2	2	1	1	0	6	Medium	It is a relatively newly reconstructed intersection, with less potential for major improvements.
8	Foxbrough	TRIC	5	MassDOT	Commercial Street	Route 140	Forbes Boulevard	None	0.75	271	31	12	0	1	1	None	1	1	2	1	1	6	Medium	Route 140 is a major regional roadway carrying a high volume of traffic. The intersection has a large footprint and lacks pedestrian and bicycle accommodations.
9	Peabody	NSTF	4	Peabody	Lowell Street		Endicott Street	None	1.05	253	33	11	0	1	1	None	1	2	2	1	0	6	Medium	The intersection is signalized with sufficient sidewalks and crosswalks. It is located in a built-up area with less potential for improvements.
10	Newton	ICC	6	Newton	Commonwealth Avenue	Route 30	Washington Street	None	0.45	53	13	2	0	0	0	MBTA 505	0	2	1	1	1	5	Medium	This location has a lower score of safety conditions than other potential locations.

Acronyms and Abbreviations
 BAT = Brockton Area Transit Authority. DCR = Department of Conservation and Recreation. EPDO = Equivalent property damage only. FFY = Federal fiscal year. HSIP = Highway Safety Improvement Program. ICC = Inner Core Committee. MAPC = Metropolitan Area Planning Council. MassDOT = Massachusetts Department of Transportation. MBTA = Massachusetts Bay Transportation Authority. MWRTA = MetroWest Regional Transit Authority. NSTF = North Shore Task Force. SWAP = South West Advisory Planning Committee. TIP = Transportation Improvement Program. TRIC = Three Rivers Interlocal Council.

Selection Criteria
Safety Conditions: Intersection has a HSIP-eligible crash cluster, a top-200 high-crash location, and/or a significant number of or HSIP-eligible clusters of pedestrian or bicycle crashes.
Congested Conditions: Intersection experiences delays during peak periods.
Multimodal Significance: Intersection currently supports transit, bicycle or pedestrian activities, needs improved facilities for these activities, and/or has high truck traffic serving regional commerce.
Regional Significance: Intersection is on the National Highway System, carries a significant proportion of regional traffic, lies within 0.5 miles of Environmental Justice transportation analysis zones, and/or is essential for the region's economic, cultural, or recreational development.
Regional Equity: Intersection is underrepresented in previous safety and operations studies in terms of the proportion of population or number of top-200 high-crash locations.
Implementation Potential: Intersection has strong potential for implementation based on the urgent need for safety improvements, is proposed or endorsed by its roadway administrative agency or agencies, and/or has strong support from other stakeholders.

Notes
 1. Locations are in order of their ratings based on scoring from selection criteria.
 2. EPDO Crash Rating = 21 * (Fatal Crashes + Injury Crashes) + 1 * Other Crashes (Property Damage Only or Unknown Severity), based on MassDOT top-200 high-crash locations: 2014-16 crash data.
 3. HSIP-eligible crash clusters are defined by MassDOT as crash clusters that rank within the top five percent of crash clusters for each Regional Planning Agency, based on the EDPO index. In the Boston region, 421 intersections in the top five percent have crash clusters with a minimum EDPO value of 115.

Source: Central Transportation Planning Staff.

APPENDIX A

Pedestrian Report Card Assessment

Adams Street at Furnace Brook Parkway in Quincy
Route 27 at West Street in Medfield



Central Transportation Planning Staff (CTPS) to the Boston Region MPO:
www.ctps.org | 857.702.3700 | ctps@ctps.org

Ryan Hicks, Congestion Management Process Manager:
www.ctps.org/cmp | 857.702.3661 | rhicks@ctps.org

Casey Claude, Bicycle and Pedestrian Program Manager:
www.ctps.org/bicycle-pedestrian-activities | 857.702.3707 | cclaude@ctps.org

Pedestrian Report Card Assessment (PRCA): Signalized Intersection

Intersection Location		
Furnace Brook Parkway at Adams Street and Common Street, Quincy		

Grading Categories	Score	Rating
Safety	1.2	Poor
System Preservation	2.0	Fair
Capacity Management and Mobility	1.7	Poor
Economic Vitality	3.0	Good

Transportation Equity	
High Priority Area	
Moderate Priority Area	√
Low Priority Area	

Category Ratings

Good: Score 2.3 to 3.0
Fair: 2.3 > Score > 1.7
Poor: Score 1.7 to 0

Transportation Equity Priority

High: Four (4) or Five (5) Factors
Moderate: Two (2) or Three (3) Factors
Low: Zero (0) or One (1) Factor

Grading Categories: Scoring Breakdown Signalized Intersection

Capacity Management and Mobility			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Pedestrian Delay	43%	1.0	Poor
Sidewalk Presence	29%	2.0	Fair
Curb Ramp Presence	14%	2.0	Fair
Crosswalk Presence	14%	2.0	Fair
Total <small>(Pedestrian Delay Score * 0.43) + (Sidewalk Presence Score * 0.29) + (Curb Ramp Presence Score * 0.14) + (Crosswalk Presence Score * 0.14)</small>	100%	1.7	Poor

Economic Vitality			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Pedestrian Volumes	100%	3.0	Good

Meaning of Ratings

Good: 3.0

Fair: 2.0

Poor: 1.0

Transportation Equity Priority

High: Four (4) or Five (5) Factors

Moderate: Two (2) or Three (3) Factors

Low: Zero (0) or One (1) Factor

Safety			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Sufficient Crossing Time (Index)	38%	1.0	Poor
Pedestrian Crashes	38%	1.0	Poor
Pedestrian Signal Phase	13%	2.0	Fair
Vehicle Travel Speed	13%	1.0	Poor
Total <small>(Sufficient Crossing Time (Index) Score * 0.38) + (Pedestrian Crashes Score * 0.38) + (Pedestrian Signal Presence Score * 0.13) + (Vehicle Travel Speed Score * 0.13)</small>	100%	1.2	Poor

System Preservation			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Sidewalk Condition	100%	2.0	Fair

Transportation Equity Priority	
Area Condition	Yes/No
Low Income Population \geq 32.32%	No
Minority Population \geq 28.19%	No
6.69%+ of Population > 75 Years of Age	Yes
16.15%+ of Households w/o Vehicle	No
Within ¼ Mile of School/College	Yes



Central Transportation Planning Staff (CTPS) to the Boston Region MPO:
www.ctps.org | 857.702.3700 | ctps@ctps.org

Ryan Hicks, Congestion Management Process Manager:
www.ctps.org/cmp | 857.702.3661 | rhicks@ctps.org

Casey Claude, Bicycle and Pedestrian Program Manager:
www.ctps.org/bicycle-pedestrian-activities | 857.702.3707 | cclaude@ctps.org

Pedestrian Report Card Assessment (PRCA): Signalized Intersection

Intersection Location		
Route 27 at West Street, Medfield		

Grading Categories	Score	Rating
Safety	1.3	Poor
System Preservation	0	Poor
Capacity Management and Mobility	0	Poor
Economic Vitality	1.0	Poor

Transportation Equity	
High Priority Area	
Moderate Priority Area	√
Low Priority Area	

Category Ratings

Good: Score 2.3 to 3.0
Fair: 2.3 > Score > 1.7
Poor: Score 1.7 to 0

Transportation Equity Priority

High: Four (4) or Five (5) Factors
Moderate: Two (2) or Three (3) Factors
Low: Zero (0) or One (1) Factor

Grading Categories: Scoring Breakdown Signalized Intersection

Capacity Management and Mobility			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Pedestrian Delay	43%	0	Poor
Sidewalk Presence	29%	0	Poor
Curb Ramp Presence	14%	0	Poor
Crosswalk Presence	14%	0	Poor
Total <small>(Pedestrian Delay Score * 0.43) + (Sidewalk Presence Score * 0.29) + (Curb Ramp Presence Score * 0.14) + (Crosswalk Presence Score * 0.14)</small>	100%	0	Poor

Economic Vitality			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Pedestrian Volumes	100%	1	Poor

Meaning of Ratings

Good: 3.0

Fair: 2.0

Poor: 1.0

Transportation Equity Priority

High: Four (4) or Five (5) Factors

Moderate: Two (2) or Three (3) Factors

Low: Zero (0) or One (1) Factor

Safety			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Sufficient Crossing Time (Index)	38%	3	Poor
Pedestrian Crashes	38%	0	Poor
Pedestrian Signal Phase	13%	0	Poor
Vehicle Travel Speed	13%	1	Poor
Total <small>(Sufficient Crossing Time (Index) Score * 0.38) + (Pedestrian Crashes Score * 0.38) + (Pedestrian Signal Presence Score * 0.13) + (Vehicle Travel Speed Score * 0.13)</small>	100%	1.3	Poor

System Preservation			
Performance Measure	Percentage	Score (out of 3.0)	Rating
Sidewalk Condition	100%	0	Poor

Transportation Equity Priority	
Area Condition	Yes/No
Low Income Population \geq 32.32%	No
Minority Population \geq 28.19%	No
6.69%+ of Population > 75 Years of Age	Yes
16.15%+ of Households w/o Vehicle	No
Within ¼ Mile of School/College	Yes