

Appendix A: Comments and Selection Process

Comments

Seth Asante

From: Clark, Michael (DOT)
Sent: Monday, March 13, 2017 11:49 AM
To: Seth Asante
Subject: RE: Safety and Operations Analyses at Andover Street at Esquire Drive and Violet Road in Peabody

Hi Seth,

Thank you for the opportunity to review. I have the following comments:

- Note the absence of pavement markings for bicyclists for Andover Street in section 2.1 on p. 4 (i.e. no sharrow lanes for sharing the roadway)
- “Stripped” instead of “striped” in second paragraph on p. 6
- Given the alternatives and recommendations that are later discussed section 2.2 could use more detail on the U-turn’s occurring on Andover St. and Esquire Dr. Do you have a degree of the volume that these are occurring? The degree to which these illegal movements are disrupting traffic volume and creating safety concerns would then justify an investment like the jug handle later proposed.
- Are service frequencies available for the Route 435 and 465 bus services on p. 7?
- Some of the data shown regarding speed readings in Figure 3 should be brought into the text of section 3.5 E.g. what 85th percentile speeds and 10 mph pace speeds say about traffic flow.
- Section 8.3 could use a comparison table. Any way to use graphics and/or tables to compare and contrast each of the alternatives is helpful.
- The jug handle conversation is throwing me off a bit. The last bullet on p. 21 notes that the distance available for constructing it appears too short. So why is it looked at as an alternative? Perhaps the language just needs to be softened – instead of “appears to” perhaps “may be”? But if your analysis shows that it’s not feasible this should be considered before the alternative is developed further.
- Bulleted list in section 9.1 affirms previous points about the jug handle. The magnitude of the problem should have been further explored in the existing conditions. Space, distance, acquisition are factors you shouldn’t be expected to explore here but impact of U-turns on current operations and potential improvements should be discussed further.

Let me know if you want to talk further.

Thanks,
Michael

From: Seth Asante [mailto:sasante@ctps.org]
Sent: Wednesday, March 08, 2017 10:15 AM
To: Clark, Michael (DOT)
Subject: Safety and Operations Analyses at Andover Street at Esquire Drive and Violet Road in Peabody

Hi Michael,

The preliminary draft technical memorandum for the *Safety and Operations Analyses at Andover Street at Esquire Drive and Violet Road in Peabody* is available for review and comment. The attached documents are the memo and appendices.

I will appreciate it if you can provide me with your comments by Friday, March 17. Feel free to contact me if you have any questions.

Thank you,
Seth

Seth A. Asante | Chief Transportation Planner
CENTRAL TRANSPORTATION PLANNING STAFF
857.702.3644 | sasante@ctps.org
www.ctps.org/bostonmpo

Two Park Plaza, 2d. Fl. 21.80 Boston, MA 02116-1699
Mo's 857.502.5700 Fax 817.878.9488 | TTY 817.878.9488



Seth Asante

From: William Paulitz
Sent: Friday, April 01, 2016 1:46 PM
To: Katrina Crocker; Karen Sawyer
Cc: Seth Asante; Mark Abbott
Subject: RE: Proposed MPO Study at the Intersection of Route 114/Andover Street and Esquire Drive

Hi Katrina,

I am happy to hear that the MPO is moving forward with Safety and Operations Study for Route 114/Andover Road at Esquire Drive and Violet Road.

How far back would you like for the police crash reports to go?

Thanks,

William G. Paulitz, P.E.
City Engineer

City of Peabody
Department of Public Services
50 Farm Avenue
Peabody, MA 01960
Phone: 978-536-7126
Fax: 978-535-3754
william.paulitz@peabody-ma.gov

From: Katrina Crocker [<mailto:kcrocker@ctps.org>]
Sent: Friday, April 01, 2016 1:18 PM
To: Karen Sawyer; William Paulitz
Cc: Seth Asante; Mark Abbott
Subject: Proposed MPO Study at the Intersection of Route 114/Andover Street and Esquire Drive

Good afternoon Karen and William,

I'm pleased to announce that the Boston Region MPO staff has completed its evaluation of 20 location in the MPO region and selected Route 114/Andover Road at Esquire Drive and Violet Road in Peabody for the FFY 2016 Safety and Operations Study. (We also selected Broadway between Fourth Street and Fifth Street in Chelsea.) The selection was emailed to the Boston Region MPO members last week, and as no discussion occurred we are moving ahead with the study. The time frame is now through the end of September 2016.

In order to facilitate the study, we would like to begin our data collection and schedule an initial scoping meeting towards the end of April in Peabody to discuss study limits, tasks, and expectations. We are working with MassDOT Office of Transportation Planning to seek assistance for traffic count data collection. We have submitted an initial list of

count locations, attached. We will discuss this at the scoping meeting, and you are also welcome to provide input on this in the meantime if you like.

Before the scoping meeting, could you please send me police crash reports for crashes occurring at or near Route 114/Andover Road at Esquire Drive and Violet Road?

Thank you,
Katrina

Katrina Crocker | Transportation Planner
CENTRAL TRANSPORTATION PLANNING STAFF
857.702.3703 | kcrocker@ctps.org
www.ctps.org/bostonmpo

Two Park Plaza, Suite 2100 | Boston, MA 02114-1000
Tel: 617.302.5900 | Fax: 617.370.9292 | TTY: 617.370.9295



Selection of Study Locations

TECHNICAL MEMORANDUM

DATE: March 17, 2016
TO: Boston Region MPO
FROM: Seth Asante and Katrina Crocker
RE: Safety and Operations Analyses at Selected Intersections: Federal Fiscal Year 2016

1 BACKGROUND

This memorandum presents the results of Task 1 of the work program for Safety and Operations Analyses at Selected Intersections: Federal Fiscal Year (FFY) 2016.¹ Task 1, Screen and Select Study Locations, includes a presentation of the results to the Boston Region Metropolitan Planning Organization (MPO) for discussion.

This study builds on recommendations generated by the MPO's Congestion Management Process (CMP) to address safety and congestion problems at intersections in the MPO area. Seven similar studies were completed in previous funding years and received favorable responses from municipalities—which appreciated the MPO's assistance with the conceptual design of low-cost improvements, and with the planning and implementation processes.

Previous studies examined large, complex intersections, simpler intersections, and locations that include two or more adjacent intersections. The focus for FFY 2016 is on simpler intersections. 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) many crashes occur, according to the Massachusetts Department of Transportation (MassDOT) crash database; 2) there is congestion during peak periods; and 3) the agencies and/or municipalities with jurisdiction over the roadway are committed to implementing recommended improvements.

A holistic approach to analyzing problems and forming recommendations would consider the needs of all public transportation users equally—whether they are walking, biking, using transit, or driving. Ultimately, this approach would result in

¹ Karl H. Quackenbush, CTPS Executive Director, memorandum of a work program to the Boston Region MPO, "Work Program for: Safety and Operations Analyses at Selected Intersections: FFY 2016," October 15, 2015.

intersections and roadways where it is safe to cross the street, walk or cycle to shops, schools, healthcare services, train stations, or recreational facilities, and where buses could run on time. Typically, the recommended improvements are within a roadway's right-of-way; and take into account the needs of abutters and users, and the interests and support of stakeholders.

2 SELECTION PROCEDURE

The study selection process consisted of four steps, in which MPO staff:

- 1) Generated a list of potential intersection study locations then narrowed it to 20 locations
- 2) Gathered detailed data for each of the 20 locations
- 3) Applied specific criteria to examine potential study locations more closely
- 4) Scored and rated the 20 locations, and assigned low, medium or high priority to each intersection location

2.1 Generating List of Potential Locations

MPO staff developed an initial list of 140 potential study locations in 44 municipalities in the MPO area, and used the following sources:

- FFY 2014 safety and operations list of potential candidates—the 15 intersections that were presented in the selection memorandum but not ultimately selected for study in FFY 2014
- MassDOT list of 2011–13 and 2010–12 statewide top-200 high-crash locations
- Locations suggested through Unified Planning Work Program outreach

Next, staff developed excluding criteria to reduce the list further. The location needed to be:

- In a municipality that has been selected for this study within the past three years
- In a subregion that has been well- or over-represented in past subregional priority corridor projects in terms of the proportion of population or MassDOT top-200 high-crash locations in the region
- 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
- Part of a larger potential study area, such as a highway interchange or a long traffic corridor with an extensive area of congestion

- Not at-grade

2.2 Gathering Detailed Data

Staff gathered data to support the excluding criteria and eliminated locations that were not suitable. Figure 1 was used to help determine which subregions were well- or over-represented by past safety and operations studies; it indicates where studies have occurred and overlays the MassDOT top-200 high-crash locations. Twenty locations passed the excluding criteria and were included in the final list.

The assembled data for 20 intersection locations in 14 municipalities in the MPO region are listed below.

- *MassDOT's 2014 Road Inventory File*. To collect the following information for each major arterial segment in each intersection location: roadway jurisdiction, National Highway System (NHS) status, and annual average daily traffic (AADT)
- *MassDOT's 2009–13 Crash Database*. Identify high-crash locations and numbers of crashes
- *MPO CMP Data on Arterial Congestion*. 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*: Identify bicycle needs—including connectivity—and accommodation
- *Data on Massachusetts Bay Transportation Authority (MBTA) Bus Service Performance and Passenger Load*. 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*. Identify locations serving MBTA stations
- *Data on the Boston Region MPO's Environmental Justice (EJ) Zones*. Identify EJ areas
- *Also Included*:
 - Data selected from MassDOT's project-information and roadway safety audit databases
 - The MPO's 2016–20 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 (at the end of this memorandum) presents the data assembled for each intersection location and cites: the municipality, Metropolitan Area Planning Council (MAPC) subregion, MassDOT district office, jurisdiction, equivalent property damage only 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. It also shows the results of applying the selection criteria, as well as the priority rating, which was performed in the fourth step of this process (described below).

2.3 Applying Criteria

MPO staff further examined the intersection locations by applying the six criteria cited below (each item is worth one point):

- *Safety Conditions, 0–3 Points*
 - Location contains an HSIP-eligible crash cluster
 - Location is on MassDOT's top-200 high-crash locations list
 - Location has a significant number of pedestrian and bicycle crashes per year (more than three) or contains one or more HSIP-eligible bike-pedestrian clusters
- *Congested Conditions, 0–2 Points*
 - Travel time index is at least 1.30, or, in the absence of data, staff-estimated congested conditions
 - Travel time index is at least 1.50
- *Multimodal Significance, 0–3 Points*
 - Location currently supports transit, bicycle, or pedestrian activities
 - Location needs improved transit, bicycle, or pedestrian facilities
 - Location has a high volume of truck traffic serving regional commerce
- *Regional Significance, 0–4 Points*
 - Location is in the NHS
 - Location carries a significant portion of regional traffic (AADT is greater than 20,000 on at least one intersecting road)
 - Location lies within 0.5 miles of an EJ transportation analysis zone
 - Location is essential for the region's economic, cultural, or recreational development
- *Regional equity, 0–2 Points*

- Location is in an MPO subregion that is at least slightly under-represented in previous safety and operations analyses in terms of the proportion of population or number of MassDOT top-200 high-crash locations in the region
- Location is in an MPO subregion that is very under-represented in previous safety and operations analyses in terms of the proportion of population or number of MassDOT top-200 high-crash locations in the region
- *Implementation Potential, 0–3 Points*
 - Location has strong potential for implementation based on the urgent need for safety improvements
 - Location is proposed or endorsed by its roadway administrative agency or agencies
 - Location has strong support for improvements from other stakeholders (e.g., municipalities, MassDOT, and subregions)

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

2.4 Scoring and Rating

Intersection locations with a score of nine or fewer points were rated low priority; those with a score of 10-to-11 points were rated medium priority; and those with a score of 12 or more points were rated high priority. Staff chose these ranges so that roughly one-third of the locations would fall into each rating category. Five 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. The availability of funding resources determined the number of segments selected.

Staff examined the high- and medium-priority segments more closely. Locations within the following parameters were not suitable candidates for this cycle of safety and operations analyses:

- Recently or currently under study
- Complexity of closely spaced intersections suggest that a corridor study is needed
- Selected for the FFY 2016 Subregional Priority Corridors study

3 SELECTED INTERSECTIONS FOR STUDY: BROADWAY AT FOURTH STREET AND FIFTH STREET IN CHELSEA; AND ROUTE 114/ANDOVER STREET AT ESQUIRE DRIVE AND VIOLET ROAD IN PEABODY

Based on the evaluation above, staff selected two intersections for study: 1) Broadway at Fourth Street and Fifth Street in Chelsea, and 2) Route 114/Andover Street at Esquire Drive and Violet Road in Peabody.

- 1) *Broadway at Fourth and Fifth Street in Chelsea:* The City of Chelsea asked MPO staff to study the intersections of Broadway at Fourth Street and Fifth Street because of safety concerns, as well as the potential effect of executing planned changes in its downtown area.

This location is situated within a crash cluster that previously was ranked 141 on MassDOT's list of top-200 crash clusters for 2009–11, and is eligible for HSIP funding. During the five-year period 2009–13, 80 crashes were reported (16 per year), of which 24 resulted in non-fatal injuries. Nineteen crashes involving pedestrians and five crashes involving cyclists were reported.

- 2) *Route 114/Andover Street at Esquire Drive and Violet Road in Peabody:* The City of Peabody is very interested in addressing the large number of crashes at this location.

These two adjacent signalized intersections on Route 114/Andover Street are located within a crash cluster that is ranked 130 on MassDOT's list of top-200 crash clusters for 2011–13. This cluster is eligible for HSIP funding. Fifty-six crashes were reported in the five-year period 2009–2013, 15 of which resulted in non-fatal injuries. Nearly three-quarters of the crashes were rear-ending.

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” intersections would be selected. Staff selected two locations, each of which contains two intersections, for a total of four intersections.

Staff will submit these recommendations to the MPO for discussion. If the MPO endorses the study selections, staff will meet with officials from Chelsea,

Peabody, and MassDOT to discuss specifics of the study, conduct field visits, collect data, and perform analyses.

SA-KC/sa-kc

TABLE 1. FFY 2016 Safety and Operations for Selected Intersections
Selected locations are highlighted in green

Location	Community	MAPC Subregion	Jurisdiction	Street 1	Route 1	Street 2	EPDO Crashes 2011-13	Total Crashes 2011-13	Injury Crashes 2011-13	Bike/Ped Crashes 2011-13	Top-200 Crash Clusters 2011-13	HSIP-eligible Crash Clusters 2011-13	Transit Routes	TIP Status	Safety Conditions	Congested Conditions	Multimodal Significance	Regional Significance	Regional Equity	Implementation Potential	Total Score	Rating	Comments
1	Chelsea	ICC	City	Broadway		Fifth Street and Fourth Street	105	41	16	14	0	1	MBTA 111, 112, 114, 116, and 117	None	2	1	3	3	2	2	13	High	Potential candidate for a safety and operations study. It has a very high number of bicycle and pedestrian crashes. It is also a high-crash location and classified as a Highway Safety Improvement Program (HSIP)-eligible crash cluster. The City of Chelsea has expressed interest.
2	Boston	ICC	DCR	Jamaicaway		Bynner Street	106	46	15	2	1	1	None	None	2	1	2	4	2	2	13	High	Potential candidate for a safety and operations study. The location is in the current list of Top 200 High-Crash Intersections. The City of Boston expressed interest, but the Department of Conservation and Recreation (DCR) did not indicate interest.
3	Peabody	NSTF	MassDOT and City	Andover Street	Route 114	Esquire Drive	108	48	15	0	1	1	MBTA 435 and 465	None	2	2	2	4	1	2	13	High	Potential candidate for a safety and operations study. The location is in the current list of top-200 high-crash intersections. The traffic signal is under City jurisdiction, although Route 114 is under MassDOT jurisdiction. Both the City of Peabody and MassDOT District 4 have indicated interest.
4	Chelsea	ICC	Town	Everett Avenue		Mystic Mall	184	108	19	12	1	1	MBTA 112,114	None	3	1	3	3	2	1	13	High	Although the location has high number of crashes and a very high number of bike and pedestrian crashes, it is not suitable for an intersection study because there are five closely spaced intersections including two signalized intersections and an at-grade railroad crossing that need to be evaluated together.
5	Newton	ICC	MassDOT and City	Washington Street	Route 16	South Entrance to Newton-Wellesley Hospital and Beacon Street	72	40	8	2	0	1	MWRTA Routes 1 and 8	None	2	1	2	3	2	2	12	High	Potential candidate for a safety and operations study. This location contains one HSIP-eligible crash cluster and a second cluster nearby would be included in the analysis.
6	Salem	NSTF	Town	North Street	Route 114	Mason Street	108	51	12	7	1	1	MBTA 465	None	3	0	2	4	1	1	11	Medium	This location was not selected because the crash cluster at this location includes two signalized intersections and four unsignalized intersections in a half-mile distance. An arterial segment study is more suitable for this location. In addition, a Route 1A study involving Swampscott, Salem, and Marblehead has been recommended for the MPO FFY 2016 Subregional Priority Corridors Study, and so, because of geographic equity considerations, this location is not recommended for that reason as well.
7	Watertown	ICC	DCR and Town	Galen Street	Route 16	Watertown Street	98	38	15	6	1	1	MBTA 52, 57, 59, 502, 504	None	3	0	2	3	2	1	11	Medium	Although the intersection has high number of bike and pedestrian crashes, it is too complex for a safety and operations study. It is very close to the Galen Street bridge over the Charles River and Watertown Square, which pose overly difficult challenges as the right-of-way is constrained by buildings, the Charles River, and recreational space.
8	Milton	ICC, TRIC	MassDOT	Randolph Avenue	Route 28	Chickatawbut Road	157	57	25	0	1	1	BAT 12, MBTA 240	Pre-TIP (n.d.) Arterial and Intersection Project 607342	2	0	2	3	2	2	11	Medium	Potential candidate for a safety and operations study. MassDOT District 6 reports that the intersection is congested during commute hours. MassDOT has a project that has not advanced at Route 28/Chickatawbut; an intersection or corridor study would be helpful to address the safety and operations issues because of the high number of injury crashes.
9	Newton	ICC	City	Commonwealth Avenue	Route 30	Washington Street	55	23	8	2	0	1	MBTA 505	None	1	2	2	3	2	1	11	Medium	Potential candidate for a safety and operations analysis.
10	Marlborough	MetroWest	MassDOT	Boston Post Road West	Route 20	Northboro Road East (Shopping Plaza)	124	92	8	5	1	1	MWRTA Route 7	None	3	0	2	3	1	1	10	Medium	A Route 20 study in Marlborough is recommended for the MPO FFY 2016 Subregional Priority Corridors Study. This location was not selected because of the geographic equity consideration applied in the selection study locations.
11	Marlborough	MetroWest	MassDOT	East Main Street	Route 20	Curtis Avenue	220	184	9	2	1	1	MWRTA Route 7	None	2	0	2	4	1	1	10	Medium	This location is included as part of the proposed MPO FFY 2016 Subregional Priority Roadway Study on Route 20 in Marlborough. It has a high number of injury crashes and bike and pedestrian crashes.
12	Peabody	NSTF	MassDOT	Andover Street	Route 114	Northshore Mall	155	107	12	2	1	1	MBTA 435, 436, and 465; CATA Yellow Line	None	2	0	2	4	1	1	10	Medium	It appears that an arterial segment study would be more helpful to address safety and operations problems at four closely-spaced signalized intersections. A recent MassDOT resurfacing project does not appear to have addressed safety issues.
13	Danvers	NSTF	MassDOT	Andover Street	Route 114	Garden Street	98	38	15	1	1	1	None	None	2	0	2	3	1	1	9	Low	This intersection was studied as part of the FFY 2011 Priority Corridors: Route 114 Study in Danvers. That study proposed improvements for addressing safety and operations at the intersection.
14	Cambridge	ICC	DCR and City	Mount Auburn Street and Fresh Pond Parkway	Route 3	Coolidge Hill Road	33	17	4	1	0	0	MBTA 71 and 73	None	0	1	2	4	2	0	9	Low	Comments from MPO outreach indicate pedestrian safety issues and traffic congestion and operations concerns at Mount Auburn Street/Coolidge Hill Road. DCR interest is critical for this study due to the proximity of Route 3/Fresh Pond Parkway at Mount Auburn Street.
15	Boston	ICC	MassDOT	Columbia Road		Buttonwood Street	72	24	12	0	0	1	MBTA 8, 18, and 41	None	1	1	1	3	2	1	9	Low	Potential candidate for a safety and operations study. This unsignalized intersection is located between two busy and closely-spaced signalized intersections.
16	Boston	ICC	City	Dudley Street		Harrison Avenue	58	18	10	0	0	1	MBTA 15, 41, and 45	None	1	0	2	2	2	1	8	Low	This location needs to be analyzed together with several signalized intersections in the vicinity due to traffic circulation and queuing concerns. A subarea study would be more appropriate.
17	Wellesley, Newton	MetroWest, ICC	Town	Washington Street	Route 16	River Street	95	63	8	5	0	1	None	None	2	0	2	2	1	1	8	Low	Potential candidate for safety and operations analysis. A nearby bridge over the Charles River and a signalized intersection about 350 feet east of this intersection in Newton pose difficult challenges. Although the this intersection is in Wellesley, Newton's participation is critical.
18	Natick	MetroWest	Town	Speen Street		Cloverleaf Marketplace Shopping Center	127	79	12	1	1	1	MWRTA Route 9	None	2	0	1	2	1	1	7	Low	This location was studied by a consultant (VHB) for the Town of Natick. VHB proposed several improvements to address pedestrian and bicycle issues, as well as safety and operations problems.
19	Wrentham	SWAP	MassDOT	South Street	Route 1A	Premium Outlet Boulevard	171	99	18	1	1	1	None	None. Nearby Pre-TIP Major Highway Project 603739 does not include location	2	0	1	1	1	1	6	Low	Location is not suitable for an intersection study because it is close to the I-495 and Route 1A ramp-arterial junctions and would probably require signal coordination for four signalized intersections along the stretch. A recent MassDOT resurfacing project does not appear to have addressed safety issues.
20	Sherborn	SWAP	Town	Washington Street	Route 16	S Main Street (Route 27)	49	21	7	0	0	1	None	None	1	1	1	2	1	0	6	Low	Location was studied by CTPS and VHB in 2002 and 2004. Improvements were not implemented. A UPWP comment suggested that this could be a good location for demand response signal.

Source: Central Transportation Planning Staff.

Notes

- Locations are in order of their ratings based on scoring from selection criteria.
- EPDO Crash Rating = 10 * Fatal Crashes + 5 * Injury Crashes + 1 * Other Crashes (Property Damage Only or Unknown Severity), based on MassDOT top-200 high-crash locations: 2011-13 crash data.
- 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 the 921 intersections in the top five percent have crash clusters with a minimum EDPO value of 42

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.

Acronyms and Abbreviations

BAT = Brockton Area Transit Authority. CATA = Cape Ann Transit Authority. CTPS = Central Transportation Planning Staff. DCR = Department of Conservation and Recreation. EJ = Environmental justice. 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. MetroWest = MetroWest Regional Collaborative. MPO = Boston Region Metropolitan Planning Organization. MWRTA = MetroWest Regional Transit Authority. NSPC = North Suburban Planning Council. NSTF = North Shore Task Force. SWAP = South West Advisory Planning Committee. TIP = Transportation Improvement Program. TRIC = Three Rivers Interlocal Council. UPWP = Unified Planning Work Program.

Appendix B: Traffic Data Collection

Count Location Maps

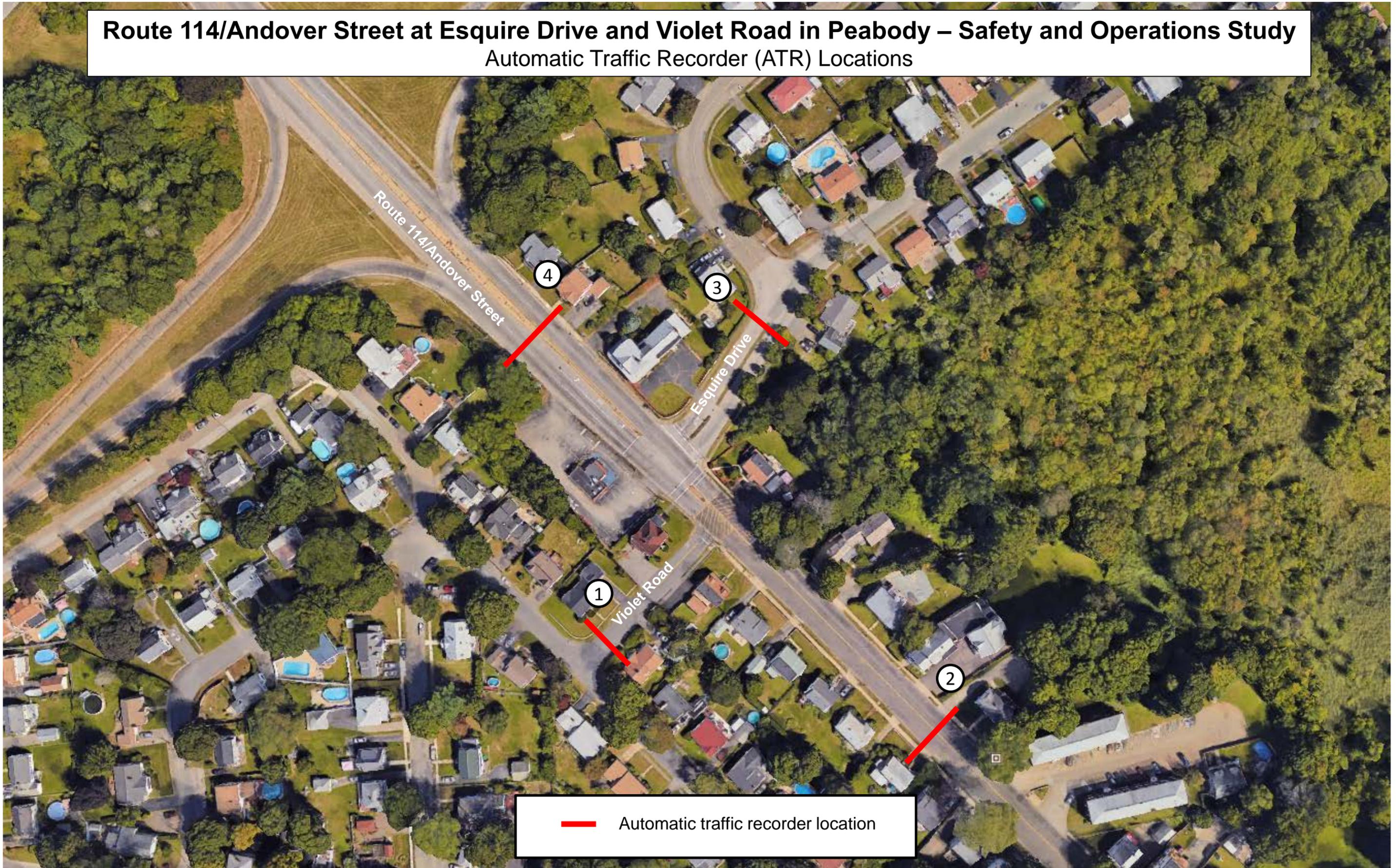
Route 114/Andover Street at Esquire Drive and Violet Road in Peabody – Safety and Operations Study
Turning Movement Count Locations



00 Turning movement count (TMC) location

Route 114/Andover Street at Esquire Drive and Violet Road in Peabody – Safety and Operations Study

Automatic Traffic Recorder (ATR) Locations



— Automatic traffic recorder location

Route 114/Andover Street at Esquire Drive and Violet Road in Peabody – Safety and Operations Study
Spot Speed Study Locations



— Spot speed study location

Turning Movement Counts

Study Name: Pinabody - Route 114 at Esquire Drive and Violet Road I/MC
 Start Date: Thursday, April 14, 2016 7:00 AM
 End Date: Saturday, April 16, 2016 2:00 PM
 Site Code:

Report Summary

Time Period	Class.	Westbound					Northwestbound					Northeastbound					Eastbound					Southeastbound					Crosswalk																	
		BR	T	BL	HL	U	I	O	HR	T	BL	L	U	I	O	R	BR	L	HL	U	I	O	HR	BR	T	HL	U	I	O	HR	R	T	BL	U	I	O	Total	Pedestrians	Total					
Peak 1	Motorcycles	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	E	0	0
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
7:00 AM - 9:00 AM	Cars	51	0	0	17	0	68	29	12	1547	0	0	0	1559	1132	0	0	40	0	0	40	8	0	0	0	0	0	0	0	8	1115	17	0	1140	1638	2807	SE	0	0					
One Hour Peak	%	88%	0%	0%	81%	0%	85%	74%	71%	90%	0%	0%	0%	90%	85%	0%	0%	85%	0%	0%	85%	62%	0%	0%	0%	0%	0%	0%	0%	67%	85%	77%	0%	85%	90%	88%	0%	0%	0%	0%				
7:30 AM - 8:30 AM	Light Goods Vehicles	4	0	0	2	0	6	4	2	116	0	0	0	118	142	0	0	6	0	0	6	2	0	0	0	0	0	0	0	2	140	2	0	144	126	274	SW	0	0					
	%	7%	0%	0%	10%	0%	8%	10%	12%	7%	0%	0%	0%	7%	11%	0%	0%	13%	0%	0%	13%	15%	0%	0%	0%	0%	0%	0%	0%	17%	11%	9%	0%	11%	7%	9%	0%	0%	0%	0%				
	Buses	1	0	1	0	0	2	2	2	14	0	0	0	16	10	0	0	1	0	0	1	3	0	0	0	0	0	0	0	2	10	0	0	12	16	31	W	0	0					
	%	2%	0%	100%	0%	0%	3%	5%	12%	1%	0%	0%	0%	1%	1%	0%	0%	2%	0%	0%	2%	23%	0%	0%	0%	0%	0%	0%	0%	17%	1%	0%	0%	1%	1%	1%	0%	0%	0%	0%				
	Single-Unit Trucks	2	0	0	2	0	4	4	1	33	0	0	0	34	34	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	32	3	0	35	35	73	NW	0	0					
	%	3%	0%	0%	10%	0%	5%	10%	6%	2%	0%	0%	0%	2%	3%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	14%	0%	3%	2%	2%	0%	0%	0%	0%					
	Articulated Trucks	0	0	0	0	0	0	0	0	7	0	0	0	7	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	12	7	19		0	0					
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	0%	1%	0%	0%	0%	0%					
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%		
	Total	58	0	1	21	0	80	39	17	1719	0	0	0	1736	1330	0	0	47	0	0	47	13	0	0	0	0	0	0	0	12	1309	22	0	1343	1824	3206								
	PHF	0.76	0	0.25	0.48	0	0.67	0.7	0.61	0.93	0	0	0	0.94	0.93	0	0	0.9	0	0	0.9	0.65	0	0	0	0	0	0	0	0.75	0.95	0.79	0	0.95	0.94	0.97								
	Approach %						2%	1%					54%	41%						1%	0%					0%	0%						42%	57%										
Peak 2	Motorcycles	0	0	0	0	0	0	0	0	4	0	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	2	4	6	E	3	3						
Specified Period	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%					
4:00 PM - 6:00 PM	Cars	40	0	0	20	0	60	109	27	1277	0	0	0	1304	1224	0	1	25	0	0	26	57	0	1	2	0	0	3	0	0	57	1203	79	0	1339	1342	2732	SE	0	0				
One Hour Peak	%	85%	0%	0%	95%	0%	87%	88%	90%	89%	0%	0%	0%	89%	90%	0%	100%	96%	0%	0%	93%	89%	0%	100%	100%	0%	100%	0%	0%	90%	90%	84%	0%	90%	89%	89%	0%	0%	0%	0%				
5:00 PM - 6:00 PM	Light Goods Vehicles	7	0	1	1	0	9	16	1	136	0	0	0	137	119	1	0	1	0	0	2	7	0	0	0	0	0	0	0	6	117	15	0	138	144	286	SW	1	1					
	%	15%	0%	100%	5%	0%	13%	13%	3%	9%	0%	0%	0%	9%	9%	100%	0%	4%	0%	0%	7%	11%	0%	0%	0%	0%	0%	0%	0%	10%	9%	16%	0%	9%	10%	9%	100%	100%	100%	0%				
	Buses	0	0	0	0	0	0	0	0	3	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	3	4	W	2	2					
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	100%	100%				
	Single-Unit Trucks	0	0	0	0	0	0	2	2	13	0	0	0	15	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	12	13	27	NW	0	0					
	%	0%	0%	0%	0%	0%	0%	2%	7%	1%	0%	0%	0%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	0%	0%	1%	1%	1%	0%	0%	0%	0%					
	Articulated Trucks	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1		0	6					
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%				
	Bicycles on Road	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0			
	%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%			
	Total	47	0	1	21	0	69	127	30	1433	0	0	0	1463	1359	1	1	26	0	0	28	64	0	1	2	0	0	3	0	0	63	1336	94	0	1493	1506	3056							
	PHF	0.84	0	0.25	0.66	0	0.78	0.88	0.62	0.96	0	0	0	0.97	0.93	0.25	0.25	0.72	0	0	0.7	0.84	0	0.25	0.5	0	0	0.38	0	0	0.88	0.93	0.84	0	0.95	0.95	0.96							
	Approach %						2%	4%					48%	44%						1%	2%					0%	0%						49%	49%										

Automatic Traffic Recorder Counts

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE
 Starting: 4/11/2016

STA. 1
 TOTAL

Site Reference: 160100000645
 Site ID: 000000010102
 Location: VIOLET RD., SOUTH OF RTE. 114
 Direction: ROAD TOTAL

File: V10102.prn
 City: PEABODY
 County: VOL N&S

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		1	4	2	8	3			3	15
02:00		4	0	2	4	2			2	10
03:00		0	2	1	4	1			1	7
04:00		2	5	2	2	2			2	11
05:00		11	8	13	12	11			11	44
06:00		19	28	28	25	25			25	100
07:00		35	31	47	36	37			37	149
08:00		56	60	58	70	61			61	244
09:00		70	62	60	64	64			64	256
10:00		65	44	69	45	55			55	223
11:00		69	61	53		61			61	183
12:00	61	54	58	52		56			56	225
13:00	58	47	66	74		61			61	245
14:00	58	57	67	57		59			59	239
15:00	53	60	62	69		61			61	244
16:00	85	62	94	90		82			82	331
17:00	57	82	76	88		75			75	303
18:00	78	101	97	92		92			92	368
19:00	72	70	76	85		75			75	303
20:00	43	48	75	55		55			55	221
21:00	30	41	32	38		35			35	141
22:00	19	23	24	21		21			21	87
23:00	15	12	10	9		11			11	46
24:00	3	5	5	12		6			6	25

TOTALS	632	994	1047	1077	270	1011	0	0	1011	4020

% AVG WKDY	62.5	98.3	103.5	106.5	26.7					
% AVG WEEK	62.5	98.3	103.5	106.5	26.7					

AM Times	12:00	09:00	09:00	10:00	08:00	09:00			09:00	
AM Peaks	61	70	62	69	70	64			64	

PM Times	16:00	18:00	18:00	18:00		18:00			18:00	
PM Peaks	85	101	97	92		92			92	

D%	60	70	60	75	75					
K%	13	10	9	9	26					

UO

COMB AWD 1011

FAC 1.00

COMB ADT 1,000

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/11/2016

STA. 1 N13

Site Reference: 160100000645
 Site ID: 000000010102
 Location: VIOLET RD., SOUTH OF RTE. 114
 Direction: NORTH

File: V10102.prn
 City: PEABODY
 County: VOL N&S

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		1	1	1	2	1			1	5
02:00		1	0	0	1	0			0	2
03:00		0	1	0	2	0			0	3
04:00		1	2	2	2	1			1	7
05:00		10	7	11	10	9			9	38
06:00		19	27	24	23	23			23	93
07:00		28	25	35	26	28			28	114
08:00		43	47	49	52	47			47	191
09:00		45	41	37	44	41			41	167
10:00		40	27	37	23	31			31	127
11:00		34	31	24		29			29	89
12:00	25	28	33	25		27			27	111
13:00	33	21	32	42		32			32	128
14:00	26	21	31	27		26			26	105
15:00	21	24	23	27		23			23	95
16:00	33	26	44	37		35			35	140
17:00	16	28	29	44		29			29	117
18:00	25	32	38	22		29			29	117
19:00	24	26	36	31		29			29	117
20:00	20	22	21	19		20			20	82
21:00	8	13	13	6		10			10	40
22:00	7	10	4	8		7			7	29
23:00	3	1	1	3		2			2	8
24:00	0	1	2	3		1			1	6
TOTALS	241	475	516	514	185	480	0	0	480	1931
% AVG WKDY	50.2	98.9	107.5	107	38.5					
% AVG WEEK	50.2	98.9	107.5	107	38.5					
AM Times	12:00	09:00	08:00	08:00	08:00	08:00			08:00	
AM Peaks	25	45	47	49	52	47			47	
PM Times	13:00	18:00	16:00	17:00		16:00			16:00	
PM Peaks	33	32	44	44		35			35	

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 2
 Starting: 4/11/2016

STA. 1 SB

Site Reference: 160100000645
 Site ID: 000000010102
 Location: VIOLET RD., SOUTH OF RTE. 114
 Direction: SOUTH

File: V10102.prn
 City: PEABODY
 County: VOL N&S

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		0	3	1	6	2			2	10
02:00		3	0	2	3	2			2	8
03:00		0	1	1	2	1			1	4
04:00		1	3	0	0	1			1	4
05:00		1	1	2	2	1			1	6
06:00		0	1	4	2	1			1	7
07:00		7	6	12	10	8			8	35
08:00		13	13	9	18	13			13	53
09:00		25	21	23	20	22			22	89
10:00		25	17	32	22	24			24	96
11:00		35	30	29		31			31	94
12:00	36	26	25	27		28			28	114
13:00	25	26	34	32		29			29	117
14:00	32	36	36	30		33			33	134
15:00	32	36	39	42		37			37	149
16:00	52	36	50	53		47			47	191
17:00	41	54	47	44		46			46	186
18:00	53	69	59	70		62			62	251
19:00	48	44	40	54		46			46	186
20:00	23	26	54	36		34			34	139
21:00	22	28	19	32		25			25	101
22:00	12	13	20	13		14			14	58
23:00	12	11	9	6		9			9	38
24:00	3	4	3	9		4			4	19

TOTALS 391 519 531 563 85 520 0 0 520 2089

% AVG WKDY 75.1 99.8 102.1 108.2 16.3
 % AVG WEEK 75.1 99.8 102.1 108.2 16.3

AM Times 12:00 11:00 11:00 10:00 10:00 11:00 11:00
 AM Peaks 36 35 30 32 22 31 31

PM Times 18:00 18:00 18:00 18:00 18:00 18:00 18:00
 PM Peaks 53 69 59 70 62 62

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/11/2016

STA, 2 EB

Site Reference: 160100000455
 Site ID: 000000000203
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: EAST

File: V2-03.prn
 City: PEABODY
 County: VOL EB

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		144	140	173	177	158			158	634
02:00		81	90	87	90	87			87	348
03:00		51	32	43	38	41			41	164
04:00		36	38	36	40	37			37	150
05:00		55	59	66	68	62			62	248
06:00		292	315	312	313	308			308	1232
07:00		815	851	894	872	858			858	3432
08:00		1425	1496	1429	1337	1421			1421	5687
09:00		1495	1434	1561	1428	1479			1479	5918
10:00		1226	1291	1178	1231	1231			1231	4926
11:00		1226	1227	1267		1240			1240	3720
12:00	1153	1290	1307	1364		1278			1278	5114
13:00	1245	1362	1242	1379		1307			1307	5228
14:00	1304	1339	1335	1391		1342			1342	5369
15:00	1560	1599	1589	1736		1621			1621	6484
16:00	1683	1621	1626	1928		1714			1714	6858
17:00	2050	1944	1536	2051		1895			1895	7581
18:00	2154	1957	1843	2056		2002			2002	8010
19:00	1506	1595	1527	1914		1635			1635	6542
20:00	1127	1256	1312	1301		1249			1249	4996
21:00	1010	1016	1156	1163		1086			1086	4345
22:00	746	821	887	926		845			845	3380
23:00	483	539	555	627		551			551	2204
24:00	327	327	372	345		342			342	1371

TOTALS	16348	23512	23260	25227	5594	23789	0	0	23789	93941
% AVG WKDY	68.7	98.8	97.7	106	23.5					
% AVG WEEK	68.7	98.8	97.7	106	23.5					
AM Times	12:00	09:00	08:00	09:00	09:00	09:00			09:00	
AM Peaks	1153	1495	1496	1561	1428	1479			1479	
PM Times	18:00	18:00	18:00	18:00		18:00			18:00	
PM Peaks	2154	1957	1843	2056		2002			2002	

U2

EB 23789

WB 25471

Comb AWD 49260

FAC .96(.96)

Comb ADT 45,400

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/11/2016

STA. 2 WB

Site Reference: 160100000564
 Site ID: 000000000204
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: WEST

File: V2-04.prn
 City: PEABODY
 County: VOL WB

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		102	85	117	103	101			101	407
02:00		51	78	74	97	75			75	300
03:00		48	58	58	54	54			54	218
04:00		74	73	63	70	70			70	280
05:00		185	172	179	187	180			180	723
06:00		635	625	674	635	642			642	2569
07:00		1525	1497	1488	1406	1479			1479	5916
08:00		2037	1985	1873	1785	1920			1920	7680
09:00		1927	1957	1959	1764	1901			1901	7607
10:00		1613	1475	1493	1433	1503			1503	6014
11:00		1565	1368	1383		1438			1438	4316
12:00	1447	1583	1464	1642		1534			1534	6136
13:00	1533	1609	1500	1536		1544			1544	6178
14:00	1459	1505	1551	1435		1487			1487	5950
15:00	1625	1642	1721	1614		1650			1650	6602
16:00	1906	1959	1853	1813		1882			1882	7531
17:00	1870	1928	1818	1723		1834			1834	7339
18:00	1736	1572	1782	1738		1707			1707	6828
19:00	1377	1264	1313	1378		1333			1333	5332
20:00	1002	1082	1142	1133		1089			1089	4359
21:00	672	773	826	874		786			786	3145
22:00	600	643	663	664		642			642	2570
23:00	354	392	413	417		394			394	1576
24:00	202	243	229	232		226			226	906

TOTALS 15783 25957 25648 25560 7534 25471 0 0 25471 100482

% AVG WKDY 61.9 101.9 100.6 100.3 29.5
 % AVG WEEK 61.9 101.9 100.6 100.3 29.5

AM Times 12:00 08:00 08:00 09:00 08:00 08:00 08:00
 AM Peaks 1447 2037 1985 1959 1785 1920 1920

PM Times 16:00 16:00 16:00 16:00 16:00 16:00
 PM Peaks 1906 1959 1853 1813 1882 1882

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE
 Starting: 4/11/2016

STA .3
 TOTAL

Site Reference: 160100000536
 Site ID: 000000030102
 Location: ESQUIRE DR., NORTH OF RTE. 114
 Direction: ROAD TOTAL

File: V30102.prn
 City: PEABODY
 County: VOL N&S

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		16	16	10	13	13			13	55
02:00		12	8	9	9	9			9	38
03:00		10	10	9	10	9			9	39
04:00		10	10	7	9	9			9	36
05:00		19	19	19	26	20			20	83
06:00		61	51	55	62	57			57	229
07:00		132	151	142	126	137			137	551
08:00		158	171	153	160	160			160	642
09:00		170	168	171	182	172			172	691
10:00		127	148	133	136	136			136	544
11:00	118	129	132	138		129			129	517
12:00	166	125	164	143		149			149	598
13:00	171	158	186	151		166			166	666
14:00	160	136	176	136		152			152	608
15:00	201	171	170	215		189			189	757
16:00	211	210	210	190		205			205	821
17:00	205	205	162	199		192			192	771
18:00	196	181	188	241		201			201	806
19:00	149	161	188	217		178			178	715
20:00	141	145	145	156		146			146	587
21:00	87	92	99	96		93			93	374
22:00	63	69	62	79		68			68	273
23:00	41	39	43	53		44			44	176
24:00	19	25	33	23		25			25	100

TOTALS	1928	2561	2710	2745	733	2659	0	0	2659	10677

% AVG WKDY	72.5	96.3	101.9	103.2	27.5					
% AVG WEEK	72.5	96.3	101.9	103.2	27.5					

AM Times	12:00	09:00	08:00	09:00	09:00	09:00			09:00	
AM Peaks	166	170	171	171	182	172			172	

PM Times	16:00	16:00	16:00	18:00		16:00			16:00	
PM Peaks	211	210	210	241		205			205	

D%	55	55	50	55	75					
K%	11	8	8	9	25					

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/11/2016

STA. 3 NB

Site Reference: 160100000536
 Site ID: 000000030102
 Location: ESQUIRE DR., NORTH OF RTE. 114
 Direction: NORTH

File: V30102.prn
 City: PEABODY
 County: VOL N&S

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		12	10	7	7	9			9	36
02:00		4	3	5	3	3			3	15
03:00		2	5	2	4	3			3	13
04:00		2	2	2	4	2			2	10
05:00		4	7	4	9	6			6	24
06:00		6	3	4	7	5			5	20
07:00		19	25	20	20	21			21	84
08:00		30	38	29	32	32			32	129
09:00		51	48	51	50	50			50	200
10:00		41	40	50	47	44			44	178
11:00	39	37	48	48		43			43	172
12:00	58	51	72	57		59			59	238
13:00	84	68	74	59		71			71	285
14:00	66	57	74	65		65			65	262
15:00	95	82	75	88		85			85	340
16:00	91	99	102	83		93			93	375
17:00	110	103	93	105		102			102	411
18:00	98	99	97	135		107			107	429
19:00	77	78	101	86		85			85	342
20:00	71	70	69	81		72			72	291
21:00	53	57	59	60		57			57	229
22:00	34	43	35	40		38			38	152
23:00	30	18	28	34		27			27	110
24:00	13	18	18	14		15			15	63
TOTALS	919	1051	1126	1129	183	1094	0	0	1094	4408
% AVG WKDY	84	96	102.9	103.1	16.7					
% AVG WEEK	84	96	102.9	103.1	16.7					
AM Times	12:00	09:00	12:00	12:00	09:00	12:00			12:00	
AM Peaks	58	51	72	57	50	59			59	
PM Times	17:00	17:00	16:00	18:00		18:00			18:00	
PM Peaks	110	103	102	135		107			107	

40

NB 1094
 SB 1558

 COMB AWD 2652
 FAC 1.00
 COMB ADT 2,700

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 2
 Starting: 4/11/2016

STA. 3 SB

Site Reference: 160100000536
 Site ID: 000000030102
 Location: ESQUIRE DR., NORTH OF RTE. 114
 Direction: SOUTH

File: V30102.prn
 City: PEABODY
 County: VOL N&S

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		4	6	3	6	4			4	19
02:00		8	5	4	6	5			5	23
03:00		8	5	7	6	6			6	26
04:00		8	8	5	5	6			6	26
05:00		15	12	15	17	14			14	59
06:00		55	48	51	55	52			52	209
07:00		113	126	122	106	116			116	467
08:00		128	133	124	128	128			128	513
09:00		119	120	120	132	122			122	491
10:00		86	108	83	89	91			91	366
11:00	79	92	84	90		86			86	345
12:00	108	74	92	86		90			90	360
13:00	87	90	112	92		95			95	381
14:00	94	79	102	71		86			86	346
15:00	106	89	95	127		104			104	417
16:00	120	111	108	107		111			111	446
17:00	95	102	69	94		90			90	360
18:00	98	82	91	106		94			94	377
19:00	72	83	87	131		93			93	373
20:00	70	75	76	75		74			74	296
21:00	34	35	40	36		36			36	145
22:00	29	26	27	39		30			30	121
23:00	11	21	15	19		16			16	66
24:00	6	7	15	9		9			9	37

TOTALS	1009	1510	1584	1616	550	1558	0	0	1558	6269

% AVG WKDY	64.7	96.9	101.6	103.7	35.3					
% AVG WEEK	64.7	96.9	101.6	103.7	35.3					

AM Times	12:00	08:00	08:00	08:00	09:00	08:00			08:00	
AM Peaks	108	128	133	124	132	128			128	

PM Times	16:00	16:00	13:00	19:00		16:00			16:00	
PM Peaks	120	111	112	131		111			111	

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/11/2016

STA 4 EB

Site Reference: 160100000814
 Site ID: 000000000403
 Location: RTE. 114, WEST OF ESQUIRE DR.
 Direction: EAST

File: V4-03.prn
 City: PEABODY
 County: VOL EB

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		164	168	192	200	181			181	724
02:00		94	106	101	101	100			100	402
03:00		54	39	50	50	48			48	193
04:00		43	45	38	41	41			41	167
05:00		65	65	72	69	67			67	271
06:00		309	325	329	318	320			320	1281
07:00		861	873	923	869	881			881	3526
08:00		1406	1405	1359	1259	1357			1357	5429
09:00		1466	1394	1461	1360	1420			1420	5681
10:00		1229	1291	1202	1143	1216			1216	4865
11:00		1213	1232	1256		1233			1233	3701
12:00	1185	1277	1298	1360		1280			1280	5120
13:00	1288	1330	1280	1366		1316			1316	5264
14:00	1340	1366	1388	1458		1388			1388	5552
15:00	1578	1558	1593	1657		1596			1596	6386
16:00	1625	1548	1575	1685		1608			1608	6433
17:00	1697	1630	1606	1722		1663			1663	6655
18:00	1749	1799	1656	1692		1724			1724	6896
19:00	1538	1635	1618	1689		1620			1620	6480
20:00	1220	1301	1465	1366		1338			1338	5352
21:00	1098	1113	1244	1229		1171			1171	4684
22:00	843	870	980	987		920			920	3680
23:00	563	608	614	643		607			607	2428
24:00	364	366	406	369		376			376	1505

TOTALS	16088	23305	23666	24206	5410	23471	0	0	23471	92675

% AVG WKDY	68.5	99.2	100.8	103.1	23					
% AVG WEEK	68.5	99.2	100.8	103.1	23					

AM Times	12:00	09:00	08:00	09:00	09:00	09:00			09:00	
AM Peaks	1185	1466	1405	1461	1360	1420			1420	

PM Times	18:00	18:00	18:00	17:00		18:00			18:00	
PM Peaks	1749	1799	1656	1722		1724			1724	

EB 23471
 WB 22161
 COMB AWD 45632
 FAC .96 (.96)
 COMB ADT 42,100

MassDOT Highway Division
 WEEKLY SUMMARY FOR LANE 1
 Starting: 4/11/2016

STA. 4 WB

Site Reference: 160100000521
 Site ID: 000000000404
 Location: RTE. 114, WEST OF ESQUIRE DR.
 Direction: WEST

File: V4-04.prn
 City: PEABODY
 County: VOL WB

TIME	MON 11	TUE 12	WED 13	THU 14	FRI 15	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		98	83	116	101	99			99	398
02:00		52	78	72	98	75			75	300
03:00		51	56	63	58	57			57	228
04:00		75	75	65	72	71			71	287
05:00		191	175	193	192	187			187	751
06:00		609	628	662	624	630			630	2523
07:00		1349	1330	1338	1258	1318			1318	5275
08:00		1733	1707	1663	1614	1679			1679	6717
09:00		1607	1666	1696	1576	1636			1636	6545
10:00		1373	1311	1323	1339	1336			1336	5346
11:00		1318	1235	1266		1273			1273	3819
12:00	1226	1332	1270	1439		1316			1316	5267
13:00	1263	1311	1293	1374		1310			1310	5241
14:00	1211	1246	1339	1269		1266			1266	5065
15:00	1322	1363	1442	1396		1380			1380	5523
16:00	1554	1486	1542	1565		1536			1536	6147
17:00	1456	1542	1549	1471		1504			1504	6018
18:00	1403	1305	1515	1464		1421			1421	5687
19:00	1166	1106	1179	1242		1173			1173	4693
20:00	891	972	1036	1047		986			986	3946
21:00	614	705	769	793		720			720	2881
22:00	557	579	628	632		599			599	2396
23:00	330	373	380	408		372			372	1491
24:00	191	231	226	222		217			217	870

TOTALS	13184	22007	22512	22779	6932	22161	0	0	22161	87414
% AVG WKDY	59.4	99.3	101.5	102.7	31.2					
% AVG WEEK	59.4	99.3	101.5	102.7	31.2					
AM Times	12:00	08:00	08:00	09:00	08:00	08:00			08:00	
AM Peaks	1226	1733	1707	1696	1614	1679			1679	
PM Times	16:00	17:00	17:00	16:00		16:00			16:00	
PM Peaks	1554	1542	1549	1565		1536			1536	

Spot Speed Survey

MassDOT Highway Division
 SPEED SUMMARY
 Mon 4/11/2016

Site Reference: 160100000884
 Site ID: 110000000203
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: EAST
 Lane: 1

STA. 2 EB

1 - LANE ONLY

File: CLC2-03.prn
 City: PEABODY
 County: CLASS EB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
12:00	27	53	258	250	90	18	5	0	0	0	0	0	0	0	0	701
13:00	16	89	228	305	85	16	0	0	0	0	0	0	0	0	0	739
14:00	30	114	291	263	105	8	1	0	0	0	0	0	0	0	0	812
15:00	74	132	333	229	63	9	1	0	0	0	0	0	0	0	0	841
16:00	189	137	247	197	38	4	0	0	0	0	0	0	0	0	0	812
17:00	573	3	0	0	0	0	0	0	0	0	0	0	0	0	0	576
18:00	514	7	1	0	0	0	0	0	0	0	0	0	0	0	0	522
19:00	99	152	276	179	61	9	0	0	0	0	0	0	0	0	0	776
20:00	4	55	226	262	87	11	7	0	0	1	0	0	0	0	0	653
21:00	1	27	137	294	151	25	6	0	0	0	0	0	0	0	0	641
22:00	2	6	87	226	145	35	4	1	0	0	0	0	0	0	0	506
23:00	1	0	34	124	130	45	14	0	0	0	0	0	0	0	0	348
24:00	1	2	22	91	81	38	7	0	0	0	0	0	0	0	0	242
DAY TOTAL	1531	777	2140	2420	1036	218	45	1	0	1	0	0	0	0	0	8169
PERCENTS	18.8%	9.6%	26.2%	29.7%	12.6%	2.6%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
 15.2 mph

85th Percentile Speed
 34.4 mph

Median Speed
 28.2 mph

Average Speed
 26.1 mph

10 MPH Pace Speed
 24 mph to 34 mph
 4560 vehicles in pace
 Representing 55.8% of the total vehicles

Vehicles > 65 MPH
 0
 0.0%

MassDOT Highway Division
 SPEED SUMMARY
 Tue 4/12/2016

Site Reference: 160100000884
 Site ID: 110000000203
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: EAST
 Lane: 1

File: CLC2-03.prn
 City: PEABODY
 County: CLASS EB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	1	1	2	36	38	19	5	0	1	0	1	0	0	0	0	104
02:00	0	1	0	24	22	7	4	0	0	0	0	0	0	0	0	58
03:00	0	0	3	7	20	3	3	0	0	0	0	0	0	0	0	36
04:00	0	1	3	8	11	3	3	1	0	0	0	0	0	0	0	30
05:00	1	0	4	5	14	7	2	2	0	0	0	0	0	0	0	35
06:00	5	3	21	67	68	19	3	0	0	0	0	0	0	0	0	186
07:00	7	11	103	216	130	46	7	2	0	0	0	0	0	0	0	522
08:00	23	96	295	284	79	12	1	0	0	0	0	0	0	0	0	790
09:00	50	134	317	226	83	17	1	0	0	0	0	0	0	0	0	828
10:00	17	102	260	253	101	13	0	0	0	0	0	0	0	0	0	746
11:00	32	100	266	230	72	9	1	0	0	0	0	0	0	0	0	710
12:00	14	95	314	255	64	9	0	0	0	0	0	0	0	0	0	751
13:00	12	105	298	275	77	5	1	0	0	0	0	0	0	0	0	773
14:00	17	103	310	291	63	12	0	0	0	0	0	0	0	0	0	796
15:00	69	172	327	227	60	6	0	0	0	0	0	0	0	0	0	861
16:00	160	193	276	126	41	3	2	0	0	0	0	0	0	0	0	801
17:00	505	100	43	10	0	0	0	0	0	0	0	0	0	0	0	658
18:00	372	144	116	48	6	2	0	0	0	0	0	0	0	0	0	688
19:00	133	102	227	248	66	11	2	0	0	0	0	0	0	0	0	789
20:00	12	40	265	262	105	21	1	0	0	0	0	0	0	0	0	706
21:00	9	23	153	271	160	24	6	2	1	0	0	0	0	0	0	649
22:00	3	17	88	245	153	26	7	1	1	0	0	0	0	0	0	541
23:00	3	3	31	130	136	28	18	4	0	0	0	0	0	0	0	353
24:00	2	1	14	67	92	40	9	3	0	0	0	0	0	0	0	228

DAY TOTAL	1447	1547	3736	3811	1661	342	76	15	3	0	1	0	0	0	0	12639
PERCENTS	11.5%	12.3%	29.6%	30.1%	13.1%	2.7%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
20.5 mph

85th Percentile Speed
34.6 mph

Median Speed
28.5 mph

Average Speed
27.3 mph

10 MPH Pace Speed
24 mph to 34 mph
7547 vehicles in pace
Representing 59.7% of the total vehicles

Vehicles > 65 MPH
1
0.0%

MassDOT Highway Division
 SPEED SUMMARY
 Wed 4/13/2016

Site Reference: 160100000884
 Site ID: 11000000203
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: EAST
 Lane: 1

File: CLC2-03.prn
 City: PEABODY
 County: CLASS EB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	1	0	6	41	37	9	3	2	0	0	0	0	0	0	0	99
02:00	0	1	4	19	21	8	4	1	0	0	0	0	0	0	0	58
03:00	0	0	1	8	6	3	0	0	0	0	0	0	0	0	0	18
04:00	1	1	1	8	7	4	1	0	0	0	0	0	0	0	0	23
05:00	0	1	3	9	22	8	1	1	0	0	0	0	0	0	0	45
06:00	3	6	19	41	89	31	8	1	0	0	0	0	0	0	0	198
07:00	10	23	70	183	141	45	15	0	0	0	0	0	0	0	0	487
08:00	30	95	270	275	120	16	5	0	0	0	0	0	0	0	0	811
09:00	26	94	283	278	122	23	2	0	0	0	0	0	0	0	0	828
10:00	25	65	283	265	103	26	5	0	0	0	0	0	0	0	0	772
11:00	18	87	254	213	105	22	3	2	0	0	0	0	0	0	0	704
12:00	34	105	255	237	78	8	0	0	0	0	0	0	0	0	0	717
13:00	27	98	285	236	88	12	0	1	0	0	0	0	0	0	0	747
14:00	15	105	337	229	94	14	0	0	0	0	0	0	0	0	0	794
15:00	78	167	341	215	65	9	2	1	0	0	0	0	0	0	0	878
16:00	191	227	250	97	32	0	1	0	0	0	0	0	0	0	0	798
17:00	43	175	338	257	66	8	2	0	0	0	0	0	0	0	0	889
18:00	378	72	146	66	7	0	0	0	0	0	0	0	0	0	0	669
19:00	10	140	362	221	79	13	1	0	0	0	0	0	0	0	0	826
20:00	5	71	253	300	125	20	2	0	0	0	0	0	0	0	0	776
21:00	5	43	215	295	117	18	5	2	0	0	0	0	0	0	0	700
22:00	5	6	118	257	142	33	5	2	0	0	0	0	0	0	0	568
23:00	0	3	35	145	145	39	11	2	0	1	1	0	0	0	0	382
24:00	1	2	14	113	90	23	10	0	0	0	0	0	0	0	0	253

DAY TOTAL	906	1587	4143	4008	1901	392	86	15	0	1	1	0	0	0	0	13040
PERCENTS	7.0%	12.2%	31.8%	30.8%	14.5%	3.0%	0.6%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
22.3 mph

85th Percentile Speed
35.2 mph

Median Speed
28.9 mph

Average Speed
28.3 mph

10 MPH Pace Speed
24 mph to 34 mph
8151 vehicles in pace
Representing 62.5% of the total vehicles

Vehicles > 65 MPH
1
0.0%

MassDOT Highway Division
 SPEED SUMMARY
 Thu 4/14/2016

Site Reference: 160100000884
 Site ID: 110000000203
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: EAST
 Lane: 1

File: CLC2-03.prn
 City: PEABODY
 County: CLASS EB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	0	1	4	45	54	15	10	0	0	0	0	0	0	0	0	129
02:00	0	0	3	9	26	14	4	0	1	0	0	0	0	0	0	57
03:00	0	0	4	10	8	5	1	2	0	0	0	0	0	0	0	30
04:00	0	0	1	5	15	6	1	0	0	0	0	0	0	0	0	28
05:00	0	0	11	11	12	10	2	1	0	0	0	0	0	0	0	47
06:00	0	0	25	66	76	31	1	0	1	0	0	0	0	0	0	200
07:00	10	18	119	202	120	50	11	1	0	0	0	0	0	0	0	531
08:00	29	68	282	285	118	28	4	0	0	0	0	0	0	0	0	814
09:00	40	161	296	256	74	11	1	0	0	0	0	1	0	0	0	840
10:00	10	50	270	276	132	19	3	0	0	0	0	0	0	0	0	760
11:00	35	92	238	242	102	19	0	1	0	0	0	0	0	0	0	729
12:00	38	149	296	219	72	12	0	0	0	0	0	0	0	0	0	786
13:00	25	101	299	279	75	11	2	2	0	0	0	0	0	0	0	794
14:00	16	85	371	267	112	12	3	0	0	0	0	0	0	0	0	866
15:00	222	217	285	100	14	4	0	0	0	0	0	0	0	0	0	842
16:00	471	57	28	10	0	0	0	0	0	0	0	0	0	0	0	566
17:00	515	5	0	0	0	0	0	0	0	0	0	0	0	0	0	520
18:00	565	8	0	0	0	0	0	0	0	0	0	0	0	0	0	573
19:00	406	58	107	68	8	0	0	0	0	0	0	0	0	0	0	647
20:00	23	59	250	297	120	14	1	0	0	0	0	0	0	0	0	764
21:00	5	26	234	310	107	19	7	0	0	0	0	0	0	0	0	708
22:00	1	32	123	249	161	29	8	1	0	0	0	0	0	0	0	604
23:00	2	1	43	162	144	38	6	1	0	0	0	0	0	0	0	397
24:00	3	3	26	83	92	22	9	2	0	0	0	0	0	0	0	240

DAY TOTAL	2416	1191	3315	3451	1642	369	74	11	2	0	0	1	0	0	0	12472
PERCENTS	19.4%	9.6%	26.6%	27.7%	13.2%	3.0%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
 14.7 mph

85th Percentile Speed
 34.7 mph

Median Speed
 28.0 mph

Average Speed
 26.0 mph

10 MPH Pace Speed
 24 mph to 34 mph
 6766 vehicles in pace
 Representing 54.2% of the total vehicles

Vehicles > 65 MPH
 1
 0.0%

MassDOT Highway Division
 SPEED SUMMARY
 Fri 4/15/2016

Site Reference: 160100000884
 Site ID: 110000000203
 Location: RTE. 114, EAST OF VIOLET RD.
 Direction: EAST
 Lane: 1

File: CLC2-03.prn
 City: PEABODY
 County: CLASS EB

TIME	19	24	29	34	39	44	49	54	59	64	69	74	79	85	86+	Tota
01:00	1	0	5	34	53	27	5	3	0	0	0	0	0	0	0	128
02:00	0	1	1	16	32	10	5	0	0	0	0	0	0	0	0	65
03:00	0	0	0	15	8	4	0	0	0	0	0	0	0	0	0	27
04:00	1	0	2	6	8	4	2	1	0	0	0	0	0	0	0	24
05:00	1	0	10	8	19	5	3	0	1	0	0	0	0	0	0	47
06:00	2	1	15	66	71	40	5	1	0	0	0	0	0	0	0	201
07:00	7	15	86	188	158	37	5	0	0	0	0	0	0	0	0	496
08:00	29	59	232	269	121	18	2	0	0	0	0	0	0	0	0	730
09:00	46	76	290	356	102	2	1	0	0	0	0	0	0	0	0	873
10:00	8	85	273	297	87	16	6	1	0	0	0	0	0	0	0	773
DAY TOTAL	95	237	914	1255	659	163	34	6	1	0	0	0	0	0	0	3364
PERCENTS	2.9%	7.1%	27.2%	37.4%	19.5%	4.8%	1.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100%

Statistical Information...

15th Percentile Speed
 25.0 mph

85th Percentile Speed
 36.7 mph

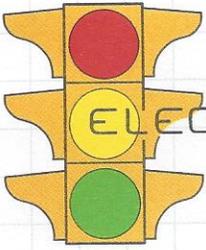
Median Speed
 30.7 mph

Average Speed
 30.5 mph

10 MPH Pace Speed
 24 mph to 34 mph
 2169 vehicles in pace
 Representing 64.4% of the total vehicles

Vehicles > 65 MPH
 0
 0.0%

Signal Timing and Phase Plan



ELECTRIC LIGHT
COMPANY INC.

ANDOVER AND ESQUIRE

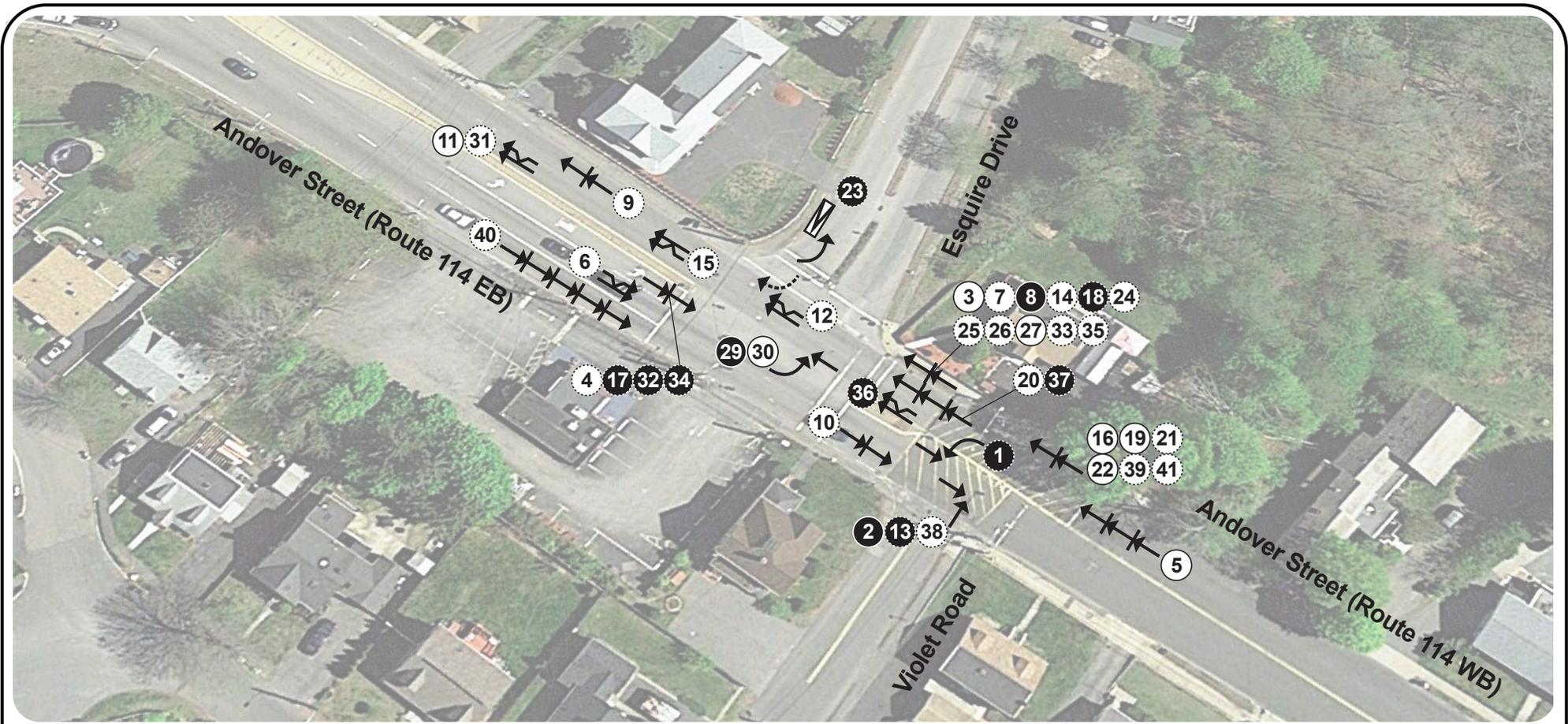
<u>Phase</u>	1	2	3	4	7
MGR	4	12	8	5	
PSG	3	2	3	4	
XEL	4	4	4	4	
RED	2	2	2	2	
MX1	15	30	15	10	
MX2	30	40	30	30	
WLK					8
PCL					12

PHASE

1	EB	LEFT	TURN
2	EB/WB		
3	ESQUIRE		
4	VIOLET		
7	PEOS		

Appendix C: Crash Data and Analysis

Collision Diagram and Crash Statistics



SYMBOLS

- | | |
|-----------------------------------|--|
| → Moving Vehicle | → [rectangle with diagonal lines] Parked Vehicle |
| → [triple arrows] Backing Vehicle | → [square] Fixed Object |
| - - - Non-Involved Vehicle | → [bicycle] Bicycle |
| → [stick figure] Pedestrian | → [animal] Animal |

TYPES OF CRASH

- | | |
|----------------------------|-------------------------------|
| → [triple arrows] Head On | → [V-shape] Sideswipe |
| → [curved arrow] Angle | → [wavy arrow] Out of Control |
| → [triple arrows] Rear End | |

CRASH ID AND SEVERITY

- # Crash Identification Number (Summary Tables in Appendices I and J)
- # Non-Injury Crash
- # Injury Crash
- # Night Time Crash



Figure 4
Collision Diagram: Andover Street (Route 114) at Esquire Drive and Violet Road
Peabody Police Reports: January 2013–December 2015

Crash Data Summary Table

Andover Street (Route 114) at Esquire Street, Peabody, MA
1/1/2013 - 12/31/2015

Crash Diagram Ref #	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages				Comments
	m/d/y								Type	Type	Type	Type	
1	1/11/13	Friday	8:13 PM	Angle	Dark - lighted roadway	Rain	Wet	Failed to yield right of way	22	20			MV1 TRAVELLING STRAIGHT, EB, ON ANDOVER STREET WHEN MV2 MADE LEFT TURN, SB, ONTO VIOLET ROAD. MV2 FAILED TO YIELD RIGHT OF WAY.
2	3/5/13	Tuesday	8:31 PM	Angle	Dark - lighted roadway	Cloudy	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner	23	20			MV1 EB ON ANDOVER AND RAN TWO CONSECUTIVE RED LIGHTS. MV2 WAS NB OUT OF VIOLET WITH GREEN LIGHT. MV1 HITS MV2. MV1 WB ON ANDOVER ST. MV2 STOPPED AT RED LIGHT AT ESQUIRE, MV1 COULDN'T STOP PROPERLY DUE TO SNOW, REAR-ENDED MV2.
3	3/8/13	Friday	11:54 AM	Rear-end	Daylight	Snow	Snow	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	41	25			NO NARRATIVE
4	5/23/13	Thursday	5:46 PM	Rear-end	Daylight	Clear	Dry	Inattention	65	23			MV1 STOPPED AT SIGNAL, MV2 WAS BEHIND MV1 CHANGING INTO LEFT LANE. MV3 REAR-ENDED BOTH MV1 AND MV2. MV3 CLAIMS MV2 CHANGED LANES DIRECTLY IN FRONT OF MV3.
5	8/6/13	Tuesday	10:33 AM	Rear-end	Daylight	Clear	Dry	Unknown	79	25	22		MV1 AND MV2 WB ON ANDOVER ST. UNK MV TURNING LEFT ONTO VIOLET. MV2 ATTEMPTED LANE CHANGE AND COLLIDED WITH MV1. MV1 AND MV2 EB ON ANDOVER ST. SECOND SIGNAL TURNED RED AND MV2 DID NOT REALIZE MV1 STOPPED AT LIGHT, REAR-ENDING MV1.
6	8/9/13	Friday	3:51 PM	Sideswipe, same direction	Daylight	Cloudy	Wet	Distracted	50	59			MV1 AND MV2 WB ON ANDOVER ST. MV1 REAR-ENDED BY MV2 WHEN SIGNAL WAS TURNING RED.
7	9/3/13	Tuesday	8:06 AM	Rear-end	Daylight	Clear	Dry	Followed too closely	54	47			MV1 AND MV2 WB ON ANDOVER ST. MV2 WAS REAR-ENDED BY MV1. BUS CUT OFF MV2 CAUSING SUDDEN HALT.
8	9/9/13	Monday	7:23 PM	Rear-end	Dark - lighted roadway	Cloudy	Dry	Followed too closely	22	49			MV1 STOPPED AT SIGNAL. MV2 REAR-ENDED MV1, CLAIMS DIDN'T SEE MV1 STOPPED.
9	9/27/13	Friday	12:40 PM	Rear-end	Daylight	Cloudy	Dry	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	30	24			MV1 AND MV2 WB ON ANDOVER ST. MV2 ATTEMPTED TO CHANGE LANES BUT DID NOT NOTICE MV1 IN DESIRED LANE.
10	10/4/13	Friday	12:17 PM	Rear-end	Daylight	Rain	Wet	Followed too closely	19	28			MV1 AND MV2 WB ON ANDOVER ST. MV3 PULLED OUT FROM ESQUIRE INTO MV2'S LANE. MV2 SWERVED TO AVOID MV3 BUT HIT MV1.
11	10/19/13	Saturday	12:11 PM	Sideswipe, same direction	Daylight	Clear	Dry	Failure to keep in proper lane or running off road	43	63			MV1 EB ON ANDOVER, FAILED TO STOP FOR RED SIGNAL. MV2 NB FROM VIOLET WITH GREEN, WAS STRUCK BY MV1.
12	11/1/13	Friday	7:37 AM	Sideswipe, same direction	Daylight	Clear	Dry	Other improper action	19	44	60		MV1 AND MV2 WB ON ANDOVER ST. MV1 SPED UP TO MAKE FIRST LIGHT THEN STOP AT SECOND LIGHT. MV2, FOLLOWING MV1, BELIEVED MV1 WAS GOING THROUGH BOTH LIGHTS, REAR-ENDED MV1.
13	11/4/13	Monday	7:15 PM	Angle	Dark - lighted roadway	Cloudy	Dry	Other improper action	56	34			MV1 WB SWERVED TO AVOID A COLLISION, HIT MV2 IN NEXT LANE, THEN COLLIDED WITH MV2 IN REAR. MV1 CLAIMS TRYING TO AVOID UNKNOWN VEHICLE.
14	11/7/13	Thursday	12:37 PM	Rear-end	Daylight	Rain	Wet	Unknown	29	56			MV1 AND MV2 WB ON ANDOVER ST. UNKNOWN MV STOPPED SUDDENLY IN FRONT OF MVS. MV2 COULD NOT REACT IN TIME, REAR-ENDED MV1.
15	11/13/13	Wednesday	7:38 AM	Sideswipe, same direction	Daylight	Clear	Dry	Swerving or avoiding due to wind, slippery surface, vehicle, object, non-motorist in roadway, etc.	36	47			MV1 AND MV2 WB ON ANDOVER ST. MV1 STOPPED AT RED SIGNAL, MV2 REAR-ENDED MV1.
16	11/18/13	Monday	8:47 AM	Rear-end	Daylight	Cloudy	Wet	Followed too closely	42	24			MV1 AND MV2 WB ON ANDOVER ST. MV1 STOPPED AT RED SIGNAL, MV2 WHO WAS STOPPED AT RED SIGNAL.
17	12/28/13	Saturday	10:19 PM	Rear-end	Dark - lighted roadway	Clear	Dry	Followed too closely	50	21			MV1 AND MV2 STOPPED AT SIGNAL IN FRONT OF VIOLET, WB. SIGNAL IN FRONT OF ESQUIRE TURNED GREEN AND MV2 BEGAN TO MOVE BUT MV1 DID NOT CAUSING MV2 TO REAR-END MV1.
18	3/21/14	Friday	9:30 PM	Rear-end	Dark - lighted roadway	Cloudy	Dry	Followed too closely	17	26			MV1, MV2 AND MV3 WB ON ANDOVER BEFORE ESQUIRE. MV1 AND MV2 STOPPED FOR RED SIGNAL. MV3 REAR-ENDED MV2 CAUSING CHAIN REACTION.
19	3/23/14	Sunday	6:54 PM	Rear-end	Dusk	Clear	Sand, mud, dirt, oil, gravel	Inattention	37	26			MV1 AND MV2 WB ON ANDOVER AT VIOLET. MV2 STOPPED DUE TO RED SIGNAL, MV1 COULD NOT STOP IN TIME, REAR-ENDED MV2.
20	3/26/14	Wednesday	1:11 PM	Rear-end	Daylight	Clear	Dry	No Improper Driving	64	30	45		MV1 STOPPED AT FIRST SET OF LIGHTS WHEN MV2 REAR-ENDED MV1. WB ACROSS FROM VIOLET.
21	4/23/14	Wednesday	3:00 PM	Rear-end	Daylight	Clear	Dry	Followed too closely	24	57			MV2 MADE LEFT TURN ONTO ESQUIRE, SIDESWIPING A PARKED MV1.
22	5/16/14	Friday	10:39 PM	Rear-end	Dark - lighted roadway	Rain	Wet	Inattention	32	59			MV1 AND MV2 WB AT ESQUIRE SIGNAL. MV1 STOPPED SHORT, CAUSING MV2 TO REAR-END MV1.
23	5/16/14	Friday	10:53 PM	Angle	Dark - lighted roadway	Clear	Dry	Over-correcting/over-steering	46	24			
24	5/28/14	Wednesday	3:08 PM	Rear-end	Daylight	Rain	Wet	Followed too closely	37	73			

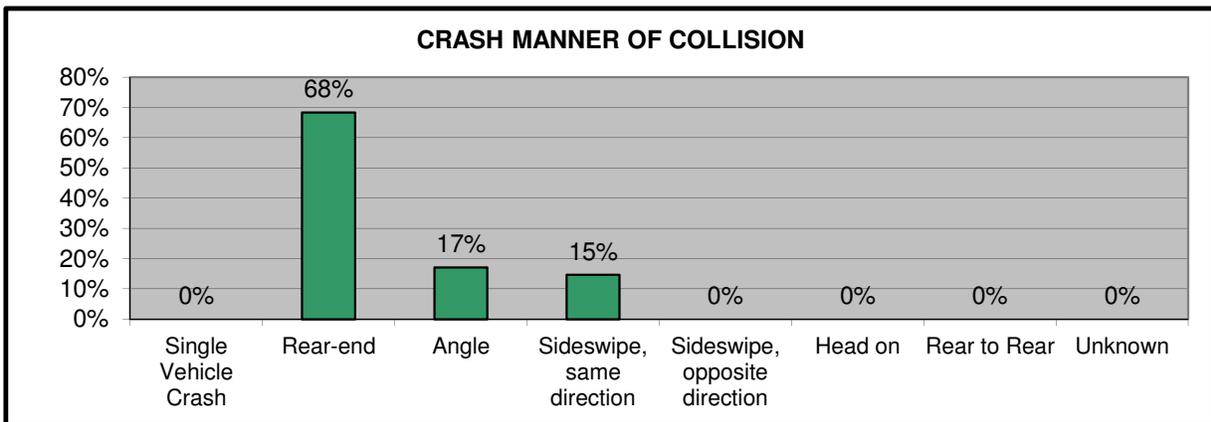
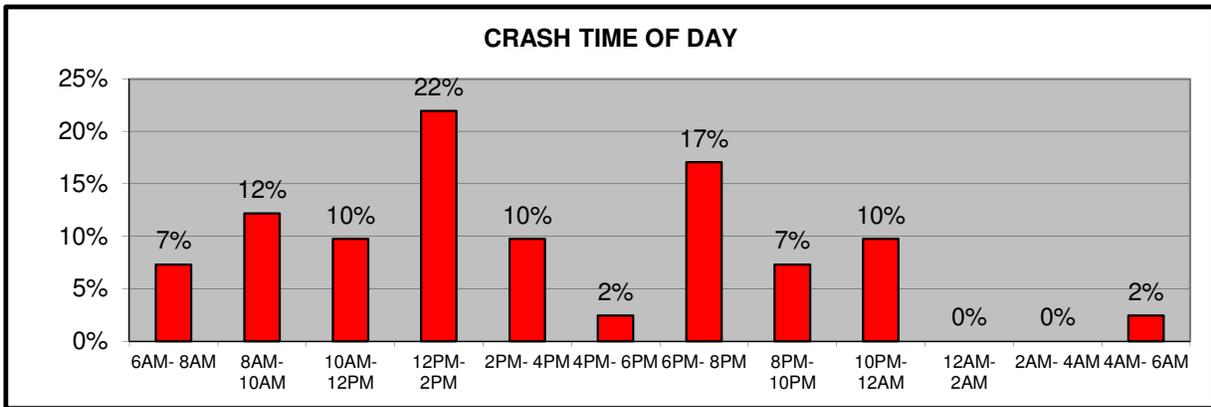
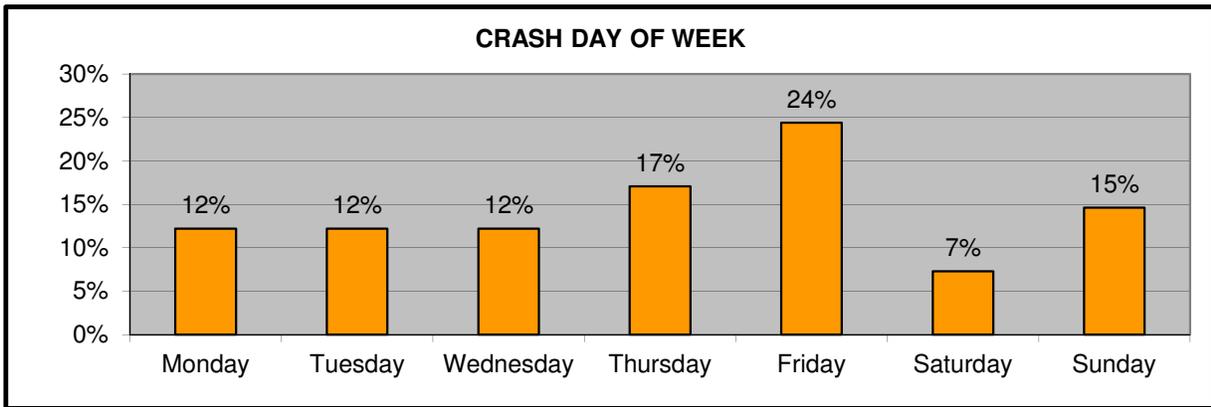
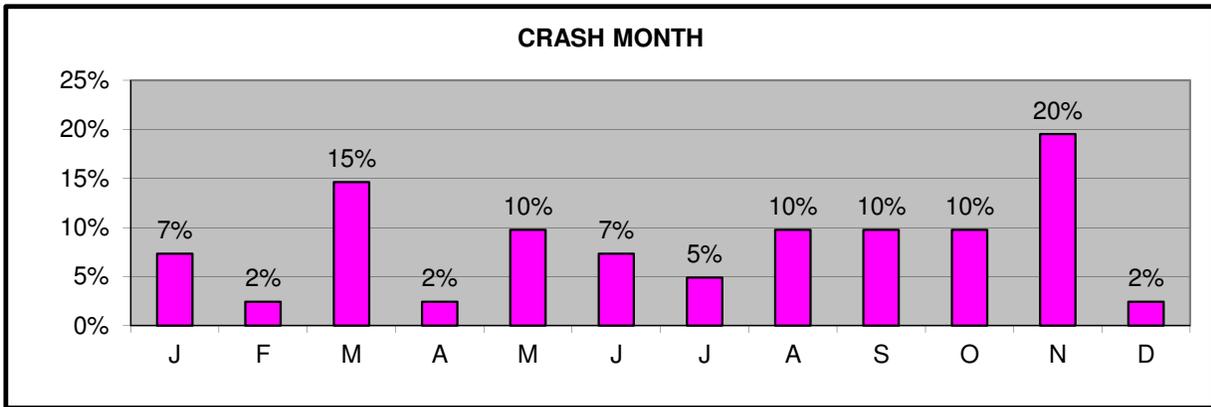
Crash Data Summary Table

Andover Street (Route 114) at Esquire Street, Peabody, MA
1/1/2013 - 12/31/2015

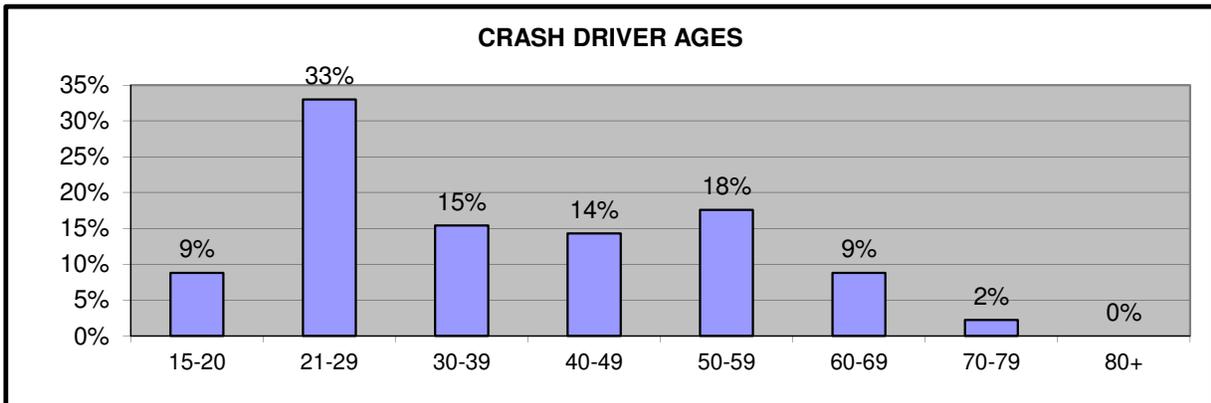
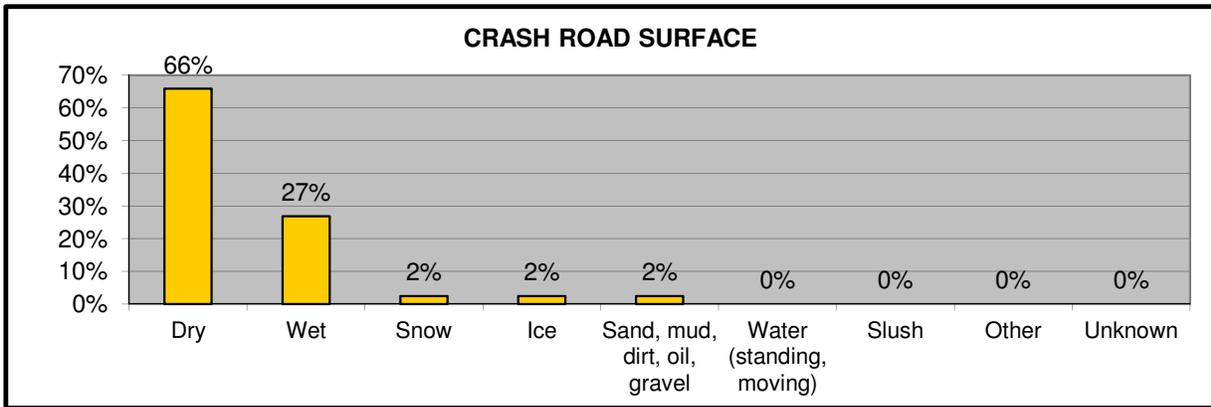
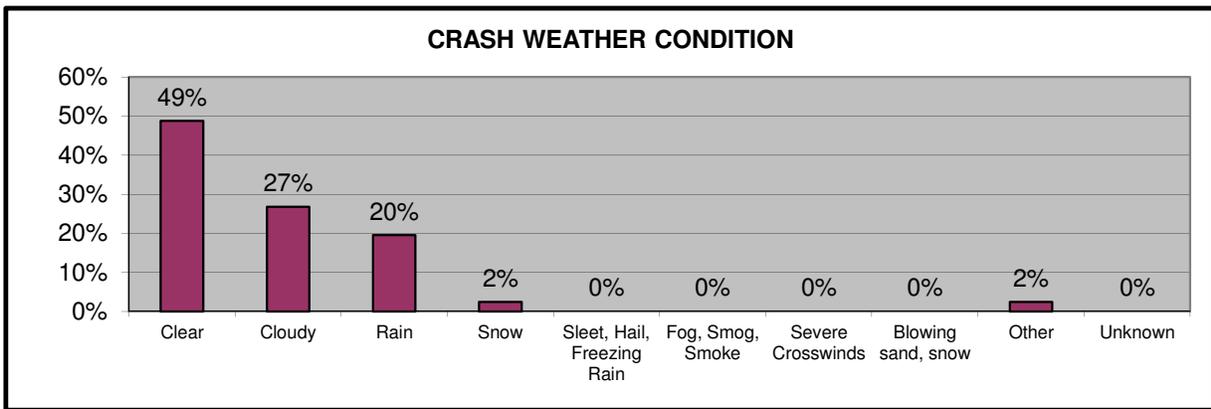
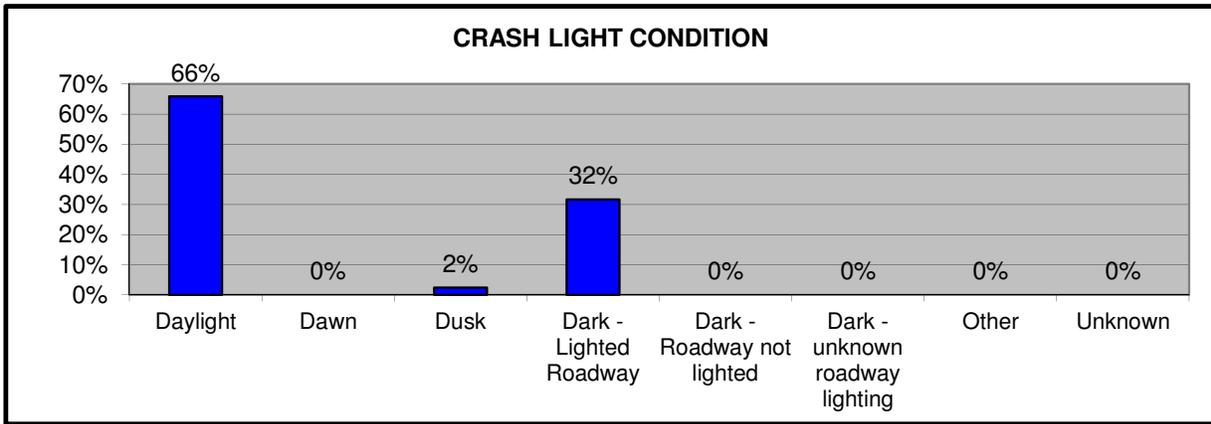
Crash Diagram Ref #	Crash Date	Crash Day	Time of Day	Manner of Collision	Light Condition	Weather Condition	Road Surface	Driver Contributing Code	Ages				Comments	
	m/d/y								Type	Type	Type	Type		D1
25	7/27/14	Sunday	10:55 AM	Rear-end	Daylight	Clear	Dry	No Improper Driving		21	56			MV1 AND MV2 WB AT ESQUIRE SIGNAL. MV1 STOPPED AT RED LIGHT WHEN MV2 REAR-ENDED MV1.
26	7/28/14	Monday	8:07 AM	Rear-end	Daylight	Rain	Wet	No Improper Driving		32	66			MV1 WB, STOPPED AT SECOND LIGHT AFTER FIRST LIGHT TURNED YELLOW. MV2 REAR-ENDED MV1 AT RED LIGHT AFTER PROCEEDING THROUGH FIRST YELLOW LIGHT.
27	8/19/14	Tuesday	1:22 PM	Rear-end	Daylight	Clear	Dry	Inattention		53	21			MV2 WB, STOPPED AT ESQUIRE RED SIGNAL. MV1 REAR-ENDED MV2
28	8/19/14	Tuesday	6:17 PM	Rear-end	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		30	28			MV1 STOPPED AT RED SIGNAL, WB ON ANDOVER ST, REAR-ENDED BY MV2. MV2 WAS UNCONSCIOUS.
29	9/27/14	Saturday	11:02 PM	Angle	Dark - lighted roadway	Cloudy	Dry	Unknown		34	24			MV1 EB ON ANDOVER MAKING LEFT TURN ONTO ESQUIRE. MV2 WB WITH GREEN LIGHT. WITNESS STATES LEFT TURN WAS RED.
30	10/9/14	Thursday	8:08 AM	Angle	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		23	68			MV1 ATTEMPTING LEFT TURN ONTO ESQUIRE WITH GREEN TURN SIGNAL. MV2 WB RAN RED SIGNAL, COLLISION IN INTERSECTION.
31	11/13/14	Thursday	10:27 AM	Sideswipe, same direction	Daylight	Clear	Dry	Inattention		60	23			MV1 AND MV2 WB ON ANDOVER ST. MV2 ATTEMPTED TO CHANGE LANES BUT DID NOT NOTICE MV1 IN DESIRED LANE.
32	11/23/14	Sunday	6:32 PM	Rear-end	Dark - lighted roadway	Clear	Dry	No Improper Driving		56	19			MV1 EB STOPPED AT RED LIGHT. MV2 REAR-ENDED MV1, TRIED SWERVING BUT COULD NOT AVOID MV1.
33	11/28/14	Friday	12:34 PM	Rear-end	Daylight	Cloudy	Wet	No Improper Driving		23	55			MV1 STOPPING AT RED SIGNAL, REAR-ENDED BY MV2. MV2 HAD TROUBLES STOPPING DUE TO ROAD CONDITIONS.
34	1/4/15	Sunday	6:22 PM	Rear-end	Dark - lighted roadway	Cloudy	Wet	No Improper Driving		32	20			MV1 STOPPED AT RED LIGHT WHEN REAR-ENDED BY MV2. SLICK ROAD CONDITIONS.
35	1/21/15	Wednesday	9:48 AM	Rear-end	Daylight	Cloudy	Dry	Inattention		53	48			MV1 AND MV2 WB. MV1 STOPPED DUE TO TRAFFIC, MV2 DIDN'T NOTICE MV1 STOPPING AND REAR-ENDED MV1.
36	2/22/15	Sunday	4:14 AM	Sideswipe, same direction	Dark - lighted roadway	Clear	Ice	No Improper Driving		32	29			WB, MV2 SWERVED INTO SIDE OF MV1.
37	3/5/15	Thursday	7:15 PM	Rear-end	Dark - lighted roadway	Clear	Dry	Physical Impairment		33	18	44		MV3 REAR-ENDED MV2, WHICH REAR-ENDED MV1. WB ON ANDOVER BEFORE ESQUIRE SIGNAL.
38	6/18/15	Thursday	1:48 PM	Angle	Daylight	Other	Dry	Physical Impairment		58	57			MV1 EB ON ANDOVER. MV2 EXITING VIOLET WITHOUT YIELDING TO TRAFFIC. MV2 STRUCK MV1 WHICH COLLIDED WITH AN ADDITIONAL MV ON OPPOSITE SIDE OF STREET.
39	6/28/15	Sunday	1:52 PM	Rear-end	Daylight	Rain	Dry	Unknown		47	26			MV1 AND MV2 WB. MV1 CLAIMED TO STOP SHORT DUE TO UNK MV IN FRONT. MV2 COULD NOT STOP IN TIME AND REAR-ENDED MV1.
40	6/29/15	Monday	3:17 PM	Rear-end	Daylight	Clear	Dry	Operating Vehicle in erratic, reckless, careless, negligent, or aggressive manner		54	38	42	27	5 MV CRASH. MV5 REAR-ENDED MV4 CAUSING A CHAIN COLLISION. ALL 4 MVS STOPPED OR STOPPING AT SIGNAL. EB. MV5-OUI, AGE 45
41	10/29/15	Thursday	7:02 AM	Rear-end	Daylight	Rain	Wet	Unknown		68	22			MV1 WB STOPPING AT RED SIGNAL. MV2 REAR-ENDED MV1.

Summary based on Crash Reports obtained from the Local Police

Crash Data Summary Tables and Charts
 Andover Street (Route 114) at Esquire Street, Peabody, MA



Crash Data Summary Tables and Charts
 Andover Street (Route 114) at Esquire Street, Peabody, MA



Intersection Crash Rate

Appendix D: Intersection Levels of Service

2016 Existing Conditions Analysis

Andover Street at Esquire Drive and Violet Road - Peabody
 AM Existing Conditions

Queues
 11/28/2016 7:30 am

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	22	1321	0	0	1754	17	0	0	0	22	0	58
Future Volume (vph)	22	1321	0	0	1754	17	0	0	0	22	0	58
Satd. Flow (prot)	1678	3002	0	0	2999	0	0	0	0	0	1571	0
Flt Permitted	0.950										0.986	
Satd. Flow (perm)	1678	3002	0	0	2999	0	0	0	0	0	1571	0
Satd. Flow (RTOR)					1							
Lane Group Flow (vph)	23	1362	0	0	1826	0	0	0	0	0	83	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	15.0	45.0			30.0					15.0	15.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	6.5	43.9			38.7						8.6	
Actuated g/C Ratio	0.10	0.67			0.59						0.13	
v/c Ratio	0.14	0.68			1.03						0.40	
Control Delay	30.4	12.6			37.8						34.2	
Queue Delay	0.0	0.0			1.7						0.6	
Total Delay	30.4	12.6			39.5						34.8	
LOS	C	B			D						C	
Approach Delay		12.9			39.5						34.8	
Approach LOS		B			D						C	
Queue Length 50th (ft)	9	228			-460						34	
Queue Length 95th (ft)	29	320			m#613						73	
Internal Link Dist (ft)		867			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	230	2000			1766						215	
Starvation Cap Reductn	0	0			8						0	
Spillback Cap Reductn	0	2			0						26	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.10	0.68			1.04						0.44	

Intersection Summary

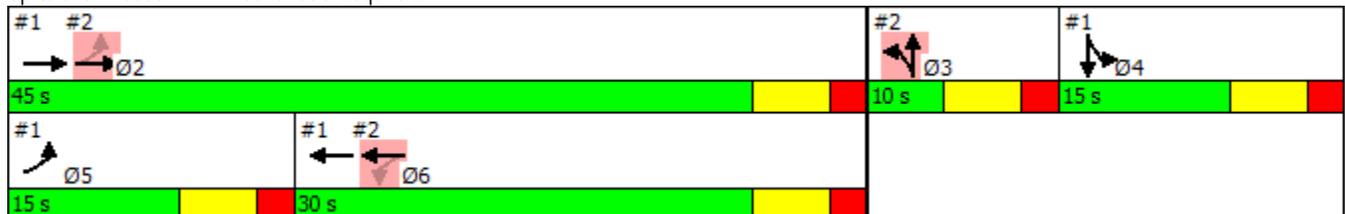
Cycle Length: 70
 Actuated Cycle Length: 65.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.03
 Intersection Signal Delay: 28.2
 Intersection Capacity Utilization 71.5%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service C

~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 AM Existing Conditions

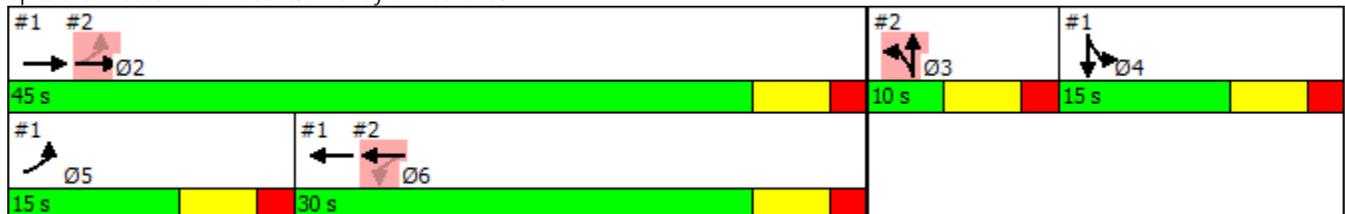
Queues
 11/28/2016 7:30 am

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1331	12	1	1736	0	47	0	1	0	0	0
Future Volume (vph)	1	1331	12	1	1736	0	47	0	1	0	0	0
Satd. Flow (prot)	0	3352	0	0	3355	0	0	1678	0	0	0	0
Flt Permitted		0.903			0.954			0.953				
Satd. Flow (perm)	0	3027	0	0	3201	0	0	1678	0	0	0	0
Satd. Flow (RTOR)		2						*100				
Lane Group Flow (vph)	0	1385	0	0	1791	0	0	49	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	45.0	45.0		30.0	30.0		10.0	10.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		43.9			38.7			4.0				
Actuated g/C Ratio		0.67			0.59			0.06				
v/c Ratio		0.69			0.95			0.25				
Control Delay		3.1			34.3			4.6				
Queue Delay		0.0			1.6			35.8				
Total Delay		3.1			35.9			40.4				
LOS		A			D			D				
Approach Delay		3.1			35.9			40.4				
Approach LOS		A			D			D				
Queue Length 50th (ft)		18			-375			0				
Queue Length 95th (ft)		25			#720			8				
Internal Link Dist (ft)		34			769			120			9	
Turn Bay Length (ft)												
Base Capacity (vph)		2018			1884			196				
Starvation Cap Reductn		23			0			0				
Spillback Cap Reductn		0			33			139				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.69			0.97			0.86				

Intersection Summary

Cycle Length: 70
 Actuated Cycle Length: 65.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.03
 Intersection Signal Delay: 21.9
 Intersection LOS: C
 Intersection Capacity Utilization 62.0%
 ICU Level of Service B
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3195
Total Delay / Veh (s/v)	28

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3128
Total Delay / Veh (s/v)	22

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	25
Performance Index	50.1

Andover Street at Esquire Drive and Violet Road - Peabody
 PM Existing Conditions

Queues
 12/09/2016

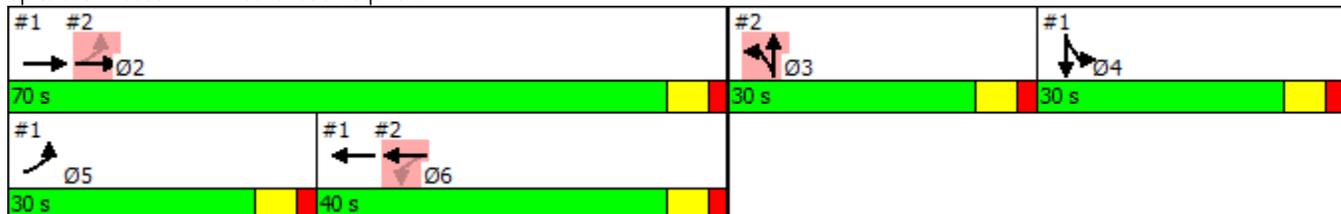
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	94	1399	0	0	1459	30	0	0	0	22	0	47
Future Volume (vph)	94	1399	0	0	1459	30	0	0	0	22	0	47
Satd. Flow (prot)	1678	2826	0	0	2817	0	0	0	0	0	1578	0
Flt Permitted	0.950										0.984	
Satd. Flow (perm)	1678	2826	0	0	2817	0	0	0	0	0	1578	0
Satd. Flow (RTOR)					1							
Lane Group Flow (vph)	98	1457	0	0	1551	0	0	0	0	0	72	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	30.0	70.0			40.0					30.0	30.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	10.8	67.1			53.5						10.2	
Actuated g/C Ratio	0.12	0.73			0.58						0.11	
v/c Ratio	0.50	0.71			0.95						0.41	
Control Delay	49.6	13.9			14.1						49.0	
Queue Delay	0.0	0.1			3.0						0.1	
Total Delay	49.6	14.0			17.1						49.0	
LOS	D	B			B						D	
Approach Delay		16.2			17.1						49.0	
Approach LOS		B			B						D	
Queue Length 50th (ft)	59	314			-586						43	
Queue Length 95th (ft)	113	505			m#677						90	
Internal Link Dist (ft)		804			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	448	2064			1641						422	
Starvation Cap Reductn	0	0			49						0	
Spillback Cap Reductn	0	50			0						46	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.22	0.72			0.97						0.19	

Intersection Summary

Cycle Length: 130
 Actuated Cycle Length: 91.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.97
 Intersection Signal Delay: 17.4
 Intersection LOS: B
 Intersection Capacity Utilization 75.9%
 ICU Level of Service D
 Analysis Period (min) 15

- ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 PM Existing Conditions

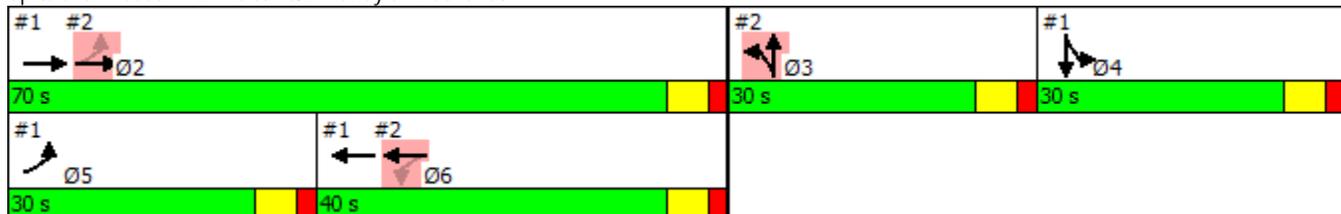
Queues
 12/09/2016

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1358	63	1	1463	0	26	0	2	0	0	0
Future Volume (vph)	1	1358	63	1	1463	0	26	0	2	0	0	0
Satd. Flow (prot)	0	2806	0	0	2826	0	0	1409	0	0	0	0
Flt Permitted		0.954			0.954			0.956				
Satd. Flow (perm)	0	2677	0	0	2696	0	0	1409	0	0	0	0
Satd. Flow (RTOR)		5						*25				
Lane Group Flow (vph)	0	1482	0	0	1525	0	0	29	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	70.0	70.0		40.0	40.0		30.0	30.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		67.1			53.5			7.4				
Actuated g/C Ratio		0.73			0.58			0.08				
v/c Ratio		0.76			0.97			0.21				
Control Delay		4.6			44.2			23.5				
Queue Delay		0.0			1.4			5.7				
Total Delay		4.6			45.6			29.1				
LOS		A			D			C				
Approach Delay		4.6			45.6			29.1				
Approach LOS		A			D			C				
Queue Length 50th (ft)		21			-609			2				
Queue Length 95th (ft)		#48			#863			31				
Internal Link Dist (ft)		34			769			120			6	
Turn Bay Length (ft)												
Base Capacity (vph)		1956			1570			395				
Starvation Cap Reductn		0			0			0				
Spillback Cap Reductn		0			15			327				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.76			0.98			0.43				

Intersection Summary

Cycle Length: 130
 Actuated Cycle Length: 91.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.97
 Intersection Signal Delay: 25.4
 Intersection LOS: C
 Intersection Capacity Utilization 62.2%
 ICU Level of Service B
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3051
Total Delay / Veh (s/v)	17

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	2915
Total Delay / Veh (s/v)	25

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	21
Performance Index	41.1

Andover Street at Esquire Drive and Violet Road - Peabody
 Saturday PM Existing Conditions

Queues
 11/28/2016 1:00 pm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	61	1385	0	0	1592	23	0	0	0	12	0	64
Future Volume (vph)	61	1385	0	0	1592	23	0	0	0	12	0	64
Satd. Flow (prot)	1678	3002	0	0	2996	0	0	0	0	0	1552	0
Flt Permitted	0.950										0.992	
Satd. Flow (perm)	1678	3002	0	0	2996	0	0	0	0	0	1552	0
Satd. Flow (RTOR)					1							
Lane Group Flow (vph)	63	1428	0	0	1665	0	0	0	0	0	78	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	30.0	70.0			40.0					30.0	30.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	9.0	69.2			56.9						10.5	
Actuated g/C Ratio	0.09	0.73			0.60						0.11	
v/c Ratio	0.40	0.65			0.93						0.46	
Control Delay	49.6	12.2			13.7						49.9	
Queue Delay	0.0	0.2			8.1						0.0	
Total Delay	49.6	12.3			21.8						49.9	
LOS	D	B			C						D	
Approach Delay		13.9			21.8						49.9	
Approach LOS		B			C						D	
Queue Length 50th (ft)	38	286			-619						47	
Queue Length 95th (ft)	81	446			m#701						95	
Internal Link Dist (ft)		842			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	428	2192			1797						396	
Starvation Cap Reductn	0	0			128						0	
Spillback Cap Reductn	0	155			0						0	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.15	0.70			1.00						0.20	

Intersection Summary

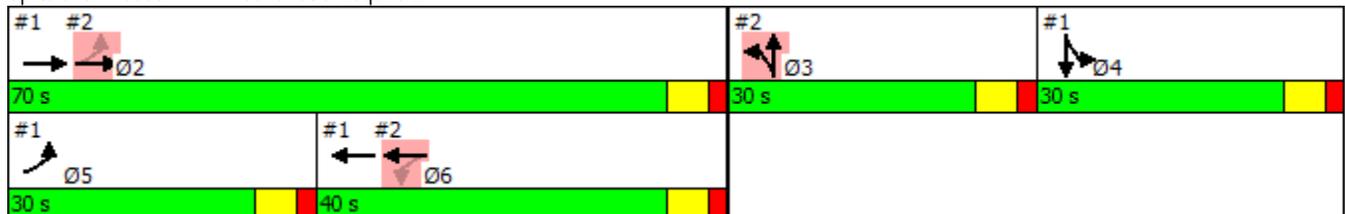
Cycle Length: 130
 Actuated Cycle Length: 94.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 18.9
 Intersection Capacity Utilization 67.4%
 Analysis Period (min) 15
 Intersection LOS: B
 ICU Level of Service C

~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 Saturday PM Existing Conditions

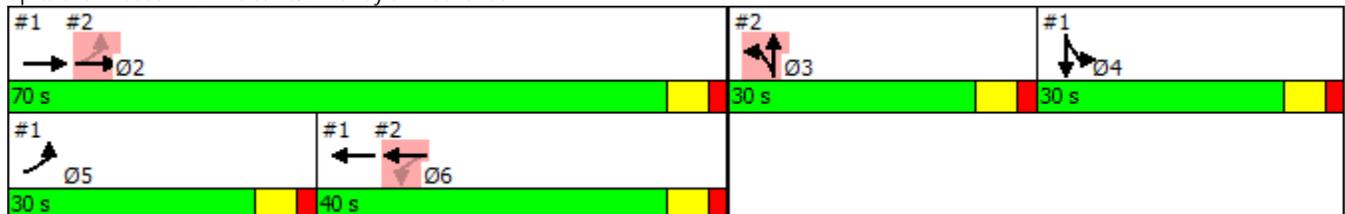
Queues
 11/28/2016 1:00 pm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1359	38	1	1569	0	35	0	4	0	0	0
Future Volume (vph)	1	1359	38	1	1569	0	35	0	4	0	0	0
Satd. Flow (prot)	0	2814	0	0	2826	0	0	1666	0	0	0	0
Flt Permitted		0.954			0.954			0.957				
Satd. Flow (perm)	0	2685	0	0	2696	0	0	1666	0	0	0	0
Satd. Flow (RTOR)		3						*50				
Lane Group Flow (vph)	0	1441	0	0	1619	0	0	40	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	70.0	70.0		40.0	40.0		30.0	30.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		69.2			56.9			7.0				
Actuated g/C Ratio		0.73			0.60			0.07				
v/c Ratio		0.73			1.00			0.24				
Control Delay		4.7			49.3			13.6				
Queue Delay		0.0			2.4			16.1				
Total Delay		4.7			51.7			29.7				
LOS		A			D			C				
Approach Delay		4.7			51.7			29.7				
Approach LOS		A			D			C				
Queue Length 50th (ft)		35			-660			0				
Queue Length 95th (ft)		29			#903			26				
Internal Link Dist (ft)		34			769			120			1	
Turn Bay Length (ft)												
Base Capacity (vph)		1961			1617			462				
Starvation Cap Reductn		0			0			0				
Spillback Cap Reductn		0			15			402				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.73			1.01			0.67				

Intersection Summary

Cycle Length: 130
 Actuated Cycle Length: 94.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 29.6
 Intersection LOS: C
 Intersection Capacity Utilization 65.7%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3137
Total Delay / Veh (s/v)	19

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3007
Total Delay / Veh (s/v)	30

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	24
Performance Index	47.0

2040 No Build Alternative

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 AM No Build Conditions

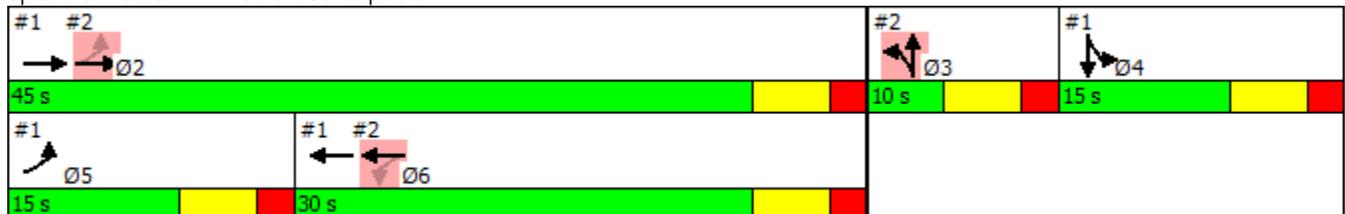
Queues
 11/28/2016 7:30 am

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1387	0	0	1842	18	0	0	0	23	0	61
Future Volume (vph)	23	1387	0	0	1842	18	0	0	0	23	0	61
Satd. Flow (prot)	1678	3002	0	0	2999	0	0	0	0	0	1571	0
Flt Permitted	0.950										0.986	
Satd. Flow (perm)	1678	3002	0	0	2999	0	0	0	0	0	1571	0
Satd. Flow (RTOR)					1							
Lane Group Flow (vph)	25	1501	0	0	2013	0	0	0	0	0	91	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	15.0	45.0			30.0					15.0	15.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	6.6	43.9			38.7						8.6	
Actuated g/C Ratio	0.10	0.67			0.59						0.13	
v/c Ratio	0.15	0.75			1.14						0.44	
Control Delay	30.5	14.8			80.7						35.3	
Queue Delay	0.0	0.0			0.0						3.7	
Total Delay	30.5	14.8			80.8						39.0	
LOS	C	B			F						D	
Approach Delay		15.1			80.8						39.0	
Approach LOS		B			F						D	
Queue Length 50th (ft)	10	275			-551						37	
Queue Length 95th (ft)	31	#446			m#616						80	
Internal Link Dist (ft)		831			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	230	2000			1763						215	
Starvation Cap Reductn	0	0			8						0	
Spillback Cap Reductn	0	5			0						66	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.11	0.75			1.15						0.61	

Intersection Summary

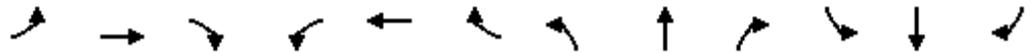
Cycle Length: 70
 Actuated Cycle Length: 65.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.14
 Intersection Signal Delay: 52.1
 Intersection LOS: D
 Intersection Capacity Utilization 77.1%
 ICU Level of Service D
 Analysis Period (min) 15
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 AM No Build Conditions

Queues
 11/28/2016 7:30 am

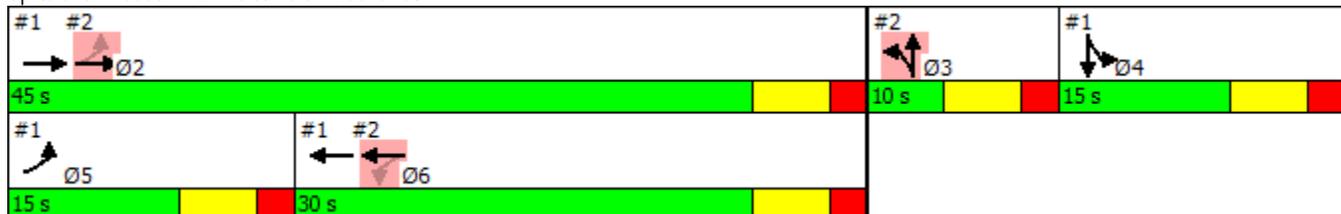


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕				
Traffic Volume (vph)	1	1398	13	1	1823	0	49	0	1	0	0	0
Future Volume (vph)	1	1398	13	1	1823	0	49	0	1	0	0	0
Satd. Flow (prot)	0	3352	0	0	3355	0	0	1678	0	0	0	0
Flt Permitted		0.864			0.954			0.953				
Satd. Flow (perm)	0	2896	0	0	3201	0	0	1678	0	0	0	0
Satd. Flow (RTOR)		2						*100				
Lane Group Flow (vph)	0	1528	0	0	1974	0	0	54	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	45.0	45.0		30.0	30.0		10.0	10.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		43.9			38.7			4.0				
Actuated g/C Ratio		0.67			0.59			0.06				
v/c Ratio		0.79			1.05			0.28				
Control Delay		6.3			58.1			5.9				
Queue Delay		0.0			9.2			51.8				
Total Delay		6.3			67.2			57.7				
LOS		A			E			E				
Approach Delay		6.3			67.2			57.7				
Approach LOS		A			E			E				
Queue Length 50th (ft)		20			-522			0				
Queue Length 95th (ft)		#456			#812			11				
Internal Link Dist (ft)		34			769			120			1	
Turn Bay Length (ft)												
Base Capacity (vph)		1930			1881			196				
Starvation Cap Reductn		4			0			0				
Spillback Cap Reductn		0			40			139				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.79			1.07			0.95				

Intersection Summary

Cycle Length: 70
 Actuated Cycle Length: 65.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.14
 Intersection Signal Delay: 40.9
 Intersection LOS: D
 Intersection Capacity Utilization 67.0%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3521
Total Delay / Veh (s/v)	52

2: Violet Rd & Andover St

Direction	All
Future Volume (vph)	3449
Total Delay / Veh (s/v)	41

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	47
Performance Index	97.0

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 PM No Build Conditions

Queues
 11/28/2016 5:00 pm

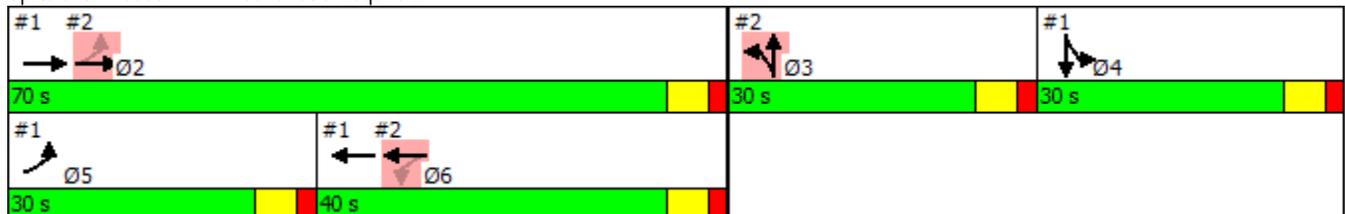
Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	1469	0	0	1532	32	0	0	0	23	0	49
Future Volume (vph)	99	1469	0	0	1532	32	0	0	0	23	0	49
Satd. Flow (prot)	1678	2826	0	0	2817	0	0	0	0	0	1578	0
Flt Permitted	0.950										0.984	
Satd. Flow (perm)	1678	2826	0	0	2817	0	0	0	0	0	1578	0
Satd. Flow (RTOR)					2							
Lane Group Flow (vph)	108	1607	0	0	1711	0	0	0	0	0	79	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	30.0	70.0			40.0					30.0	30.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	11.3	67.1			53.1						10.5	
Actuated g/C Ratio	0.12	0.73			0.57						0.11	
v/c Ratio	0.53	0.78			1.06						0.44	
Control Delay	50.2	17.0			42.1						49.6	
Queue Delay	0.0	0.4			12.6						0.1	
Total Delay	50.2	17.4			54.7						49.7	
LOS	D	B			D						D	
Approach Delay		19.5			54.7						49.7	
Approach LOS		B			D						D	
Queue Length 50th (ft)	65	397			~710						48	
Queue Length 95th (ft)	122	#705			m#682						97	
Internal Link Dist (ft)		790			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	446	2053			1619						419	
Starvation Cap Reductn	0	0			46						0	
Spillback Cap Reductn	0	121			0						51	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.24	0.83			1.09						0.21	

Intersection Summary

Cycle Length: 130
 Actuated Cycle Length: 92.4
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.09
 Intersection Signal Delay: 37.4
 Intersection LOS: D
 Intersection Capacity Utilization 81.5%
 ICU Level of Service D
 Analysis Period (min) 15

- ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 PM No Build Conditions

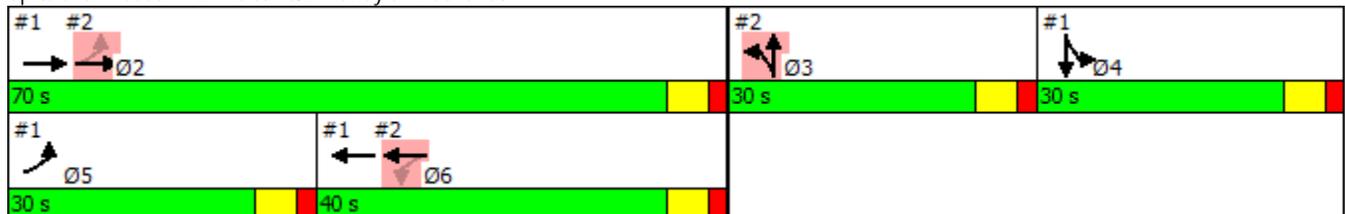
Queues
 11/28/2016 5:00 pm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1426	66	1	1536	0	27	0	2	0	0	0
Future Volume (vph)	1	1426	66	1	1536	0	27	0	2	0	0	0
Satd. Flow (prot)	0	2806	0	0	2826	0	0	1409	0	0	0	0
Flt Permitted		0.954			0.954			0.955				
Satd. Flow (perm)	0	2677	0	0	2696	0	0	1409	0	0	0	0
Satd. Flow (RTOR)		5						*25				
Lane Group Flow (vph)	0	1633	0	0	1681	0	0	32	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	70.0	70.0		40.0	40.0		30.0	30.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		67.1			53.1			7.6				
Actuated g/C Ratio		0.73			0.57			0.08				
v/c Ratio		0.84			1.09			0.23				
Control Delay		7.1			77.1			25.4				
Queue Delay		0.0			6.0			4.2				
Total Delay		7.1			83.1			29.5				
LOS		A			F			C				
Approach Delay		7.1			83.1			29.5				
Approach LOS		A			F			C				
Queue Length 50th (ft)		23			-731			4				
Queue Length 95th (ft)		#744			#1002			34				
Internal Link Dist (ft)		34			769			120			5	
Turn Bay Length (ft)												
Base Capacity (vph)		1946			1549			393				
Starvation Cap Reductn		1			0			0				
Spillback Cap Reductn		0			20			312				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.84			1.10			0.40				

Intersection Summary

Cycle Length: 130
 Actuated Cycle Length: 92.4
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.09
 Intersection Signal Delay: 45.5
 Intersection LOS: D
 Intersection Capacity Utilization 67.1%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3366
Total Delay / Veh (s/v)	37

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3213
Total Delay / Veh (s/v)	46

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	41
Performance Index	82.0

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 Sat Middday No BuildConditions

Lanes, Volumes, Timings
 12/09/2016

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	64	1454	0	0	1672	24	0	0	0	13	0	67
Future Volume (vph)	64	1454	0	0	1672	24	0	0	0	13	0	67
Satd. Flow (prot)	1678	3002	0	0	2996	0	0	0	0	0	1554	0
Flt Permitted	0.950										0.992	
Satd. Flow (perm)	1678	3002	0	0	2996	0	0	0	0	0	1554	0
Satd. Flow (RTOR)												
Lane Group Flow (vph)	69	1574	0	0	1836	0	0	0	0	0	87	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	30.0	70.0			40.0					30.0	30.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	9.4	67.6			55.1						11.2	
Actuated g/C Ratio	0.10	0.72			0.59						0.12	
v/c Ratio	0.41	0.73			1.04						0.47	
Control Delay	50.0	15.1			34.7						50.2	
Queue Delay	0.0	0.2			24.1						0.0	
Total Delay	50.0	15.3			58.8						50.2	
LOS	D	B			E						D	
Approach Delay		16.7			58.8						50.2	
Approach LOS		B			E						D	
Queue Length 50th (ft)	42	362			-757						53	
Queue Length 95th (ft)	89	581			m#692						105	
Internal Link Dist (ft)		817			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	439	2167			1764						406	
Starvation Cap Reductn	0	0			125						0	
Spillback Cap Reductn	0	99			0						0	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.16	0.76			1.12						0.21	

Intersection Summary

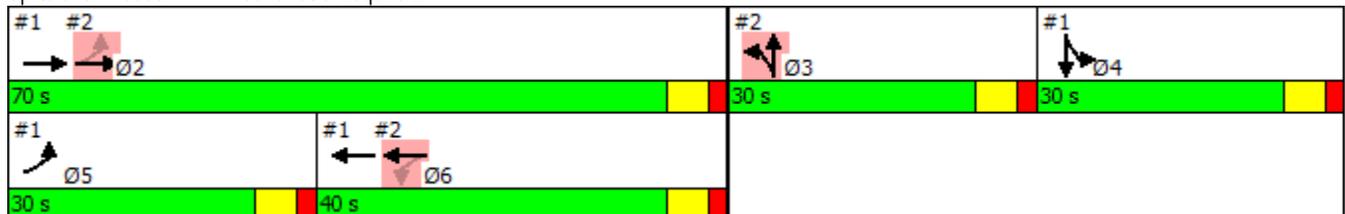
Cycle Length: 130
 Actuated Cycle Length: 93.6
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.12
 Intersection Signal Delay: 39.2
 Intersection LOS: D
 Intersection Capacity Utilization 72.5%
 ICU Level of Service C
 Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 Sat Middday No BuildConditions

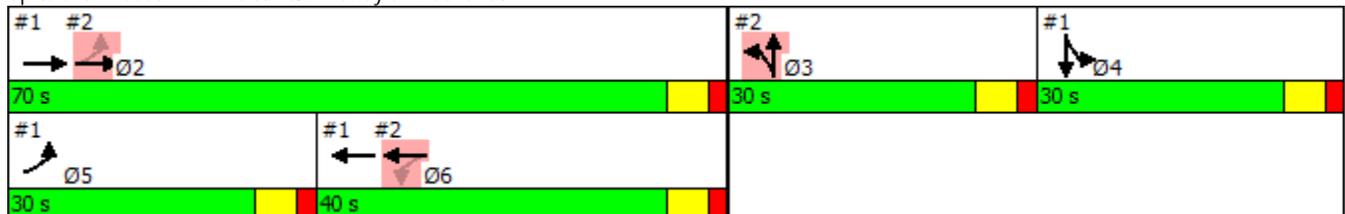
Lanes, Volumes, Timings
 12/09/2016

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1427	40	1	1647	0	37	0	4	0	0	0
Future Volume (vph)	1	1427	40	1	1647	0	37	0	4	0	0	0
Satd. Flow (prot)	0	2814	0	0	2826	0	0	1670	0	0	0	0
Flt Permitted		0.951			0.954			0.957				
Satd. Flow (perm)	0	2676	0	0	2696	0	0	1670	0	0	0	0
Satd. Flow (RTOR)		3						*35				
Lane Group Flow (vph)	0	1589	0	0	1784	0	0	44	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	70.0	70.0		40.0	40.0		30.0	30.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		67.6			55.1			7.6				
Actuated g/C Ratio		0.72			0.59			0.08				
v/c Ratio		0.82			1.12			0.26				
Control Delay		7.4			91.2			23.5				
Queue Delay		0.0			0.0			19.7				
Total Delay		7.4			91.2			43.1				
LOS		A			F			D				
Approach Delay		7.4			91.2			43.1				
Approach LOS		A			F			D				
Queue Length 50th (ft)		48			-792			5				
Queue Length 95th (ft)		#722			#1064			40				
Internal Link Dist (ft)		34			769			120			1	
Turn Bay Length (ft)												
Base Capacity (vph)		1932			1587			462				
Starvation Cap Reductn		0			0			0				
Spillback Cap Reductn		0			22			401				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.82			1.14			0.72				

Intersection Summary

Cycle Length: 130
 Actuated Cycle Length: 93.6
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.12
 Intersection Signal Delay: 51.6
 Intersection LOS: D
 Intersection Capacity Utilization 71.0%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3459
Total Delay / Veh (s/v)	39

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3314
Total Delay / Veh (s/v)	52

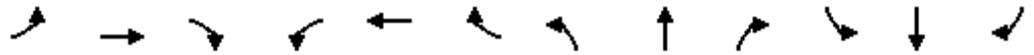
Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	45
Performance Index	92.0

2040 Build Alternative 1

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 AM Build Alt 1 Conditions

Queues
 11/28/2016 7:30 am



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	23	1387	0	0	1842	18	0	0	0	23	0	61
Future Volume (vph)	23	1387	0	0	1842	18	0	0	0	23	0	61
Satd. Flow (prot)	1678	3002	0	0	2999	0	0	0	0	0	1571	0
Flt Permitted	0.950										0.986	
Satd. Flow (perm)	1678	3002	0	0	2999	0	0	0	0	0	1571	0
Satd. Flow (RTOR)					1							
Lane Group Flow (vph)	25	1501	0	0	2013	0	0	0	0	0	91	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	15.0	79.0			64.0					20.0	20.0	
Total Lost Time (s)	6.0	6.0			6.0						6.0	
Act Effct Green (s)	7.1	77.9			69.8						11.2	
Actuated g/C Ratio	0.07	0.74			0.66						0.11	
v/c Ratio	0.22	0.68			1.01						0.54	
Control Delay	52.5	12.1			26.8						57.9	
Queue Delay	0.0	0.0			0.9						0.8	
Total Delay	52.5	12.1			27.7						58.7	
LOS	D	B			C						E	
Approach Delay		12.8			27.7						58.7	
Approach LOS		B			C						E	
Queue Length 50th (ft)	17	313			-873						60	
Queue Length 95th (ft)	45	432			m#1022						114	
Internal Link Dist (ft)		831			34			27			61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	143	2222			1989						209	
Starvation Cap Reductn	0	0			6						0	
Spillback Cap Reductn	0	0			0						23	
Storage Cap Reductn	0	0			0						0	
Reduced v/c Ratio	0.17	0.68			1.02						0.49	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 105.3
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.01
 Intersection Signal Delay: 22.2
 Intersection LOS: C
 Intersection Capacity Utilization 77.1%
 ICU Level of Service D
 Analysis Period (min) 15

- ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
- # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
- m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 AM Build Alt 1 Conditions

Queues
 11/28/2016 7:30 am

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1398	13	1	1823	0	49	0	1	0	0	0
Future Volume (vph)	1	1398	13	1	1823	0	49	0	1	0	0	0
Satd. Flow (prot)	0	3352	0	0	3355	0	0	1678	0	0	0	0
Flt Permitted		0.954			0.955			0.953				
Satd. Flow (perm)	0	3198	0	0	3204	0	0	1678	0	0	0	0
Satd. Flow (RTOR)		2						*100				
Lane Group Flow (vph)	0	1528	0	0	1974	0	0	54	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	79.0	79.0		64.0	64.0		11.0	11.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		77.9			69.8			5.0				
Actuated g/C Ratio		0.74			0.66			0.05				
v/c Ratio		0.65			0.93			0.31				
Control Delay		1.9			31.3			6.1				
Queue Delay		0.1			0.4			43.8				
Total Delay		2.0			31.8			49.9				
LOS		A			C			D				
Approach Delay		2.0			31.8			49.9				
Approach LOS		A			C			D				
Queue Length 50th (ft)		24			-817			0				
Queue Length 95th (ft)		27			#1014			8				
Internal Link Dist (ft)		34			769			120			1	
Turn Bay Length (ft)												
Base Capacity (vph)		2367			2124			174				
Starvation Cap Reductn		136			0			0				
Spillback Cap Reductn		0			21			115				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.68			0.94			0.92				

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 105.3
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.01
 Intersection Signal Delay: 19.2
 Intersection LOS: B
 Intersection Capacity Utilization 67.0%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3521
Total Delay / Veh (s/v)	22

2: Violet Rd & Andover St

Direction	All
Future Volume (vph)	3449
Total Delay / Veh (s/v)	19

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	21
Performance Index	46.6

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 PM Build Alt 1 Conditions

Queues
 11/28/2016 5:00 pm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	99	1469	0	0	1532	32	0	0	0	23	0	49
Future Volume (vph)	99	1469	0	0	1532	32	0	0	0	23	0	49
Satd. Flow (prot)	1678	2826	0	0	2817	0	0	0	0	0	1578	0
Flt Permitted	0.950										0.984	
Satd. Flow (perm)	1678	2826	0	0	2817	0	0	0	0	0	1578	0
Satd. Flow (RTOR)					3							
Lane Group Flow (vph)	108	1607	0	0	1711	0	0	0	0	0	79	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	20.0	80.0			60.0					20.0	20.0	
Total Lost Time (s)	6.0	6.0			6.0					6.0	6.0	
Act Effct Green (s)	11.1	76.6			62.6					10.6	10.6	
Actuated g/C Ratio	0.11	0.77			0.63					0.11	0.11	
v/c Ratio	0.58	0.74			0.97					0.47	0.47	
Control Delay	56.9	12.9			13.3					54.3	54.3	
Queue Delay	0.0	0.1			4.3					0.5	0.5	
Total Delay	56.9	13.0			17.6					54.8	54.8	
LOS	E	B			B					D	D	
Approach Delay		15.7			17.6					54.8	54.8	
Approach LOS		B			B					D	D	
Queue Length 50th (ft)	71	362			~710					52	52	
Queue Length 95th (ft)	130	532			m#732					101	101	
Internal Link Dist (ft)		790			34			27		61	61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	238	2165			1765					224	224	
Starvation Cap Reductn	0	0			46					0	0	
Spillback Cap Reductn	0	56			0					27	27	
Storage Cap Reductn	0	0			0					0	0	
Reduced v/c Ratio	0.45	0.76			1.00					0.40	0.40	

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 99.9
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 17.5
 Intersection LOS: B
 Intersection Capacity Utilization 81.5%
 ICU Level of Service D
 Analysis Period (min) 15

~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 PM Build Alt 1 Conditions

Queues
 11/28/2016 5:00 pm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1426	66	1	1536	0	27	0	2	0	0	0
Future Volume (vph)	1	1426	66	1	1536	0	27	0	2	0	0	0
Satd. Flow (prot)	0	2806	0	0	2826	0	0	1409	0	0	0	0
Flt Permitted		0.954			0.954			0.955				
Satd. Flow (perm)	0	2677	0	0	2696	0	0	1409	0	0	0	0
Satd. Flow (RTOR)		9						*60				
Lane Group Flow (vph)	0	1633	0	0	1681	0	0	32	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	80.0	80.0		60.0	60.0		10.0	10.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		76.6			62.6			4.1				
Actuated g/C Ratio		0.77			0.63			0.04				
v/c Ratio		0.80			1.00			0.28				
Control Delay		4.6			47.1			10.0				
Queue Delay		0.0			1.8			29.9				
Total Delay		4.6			48.9			39.9				
LOS		A			D			D				
Approach Delay		4.6			48.9			39.9				
Approach LOS		A			D			D				
Queue Length 50th (ft)		24			~731			0				
Queue Length 95th (ft)		#38			#928			12				
Internal Link Dist (ft)		34			769			120			5	
Turn Bay Length (ft)												
Base Capacity (vph)		2053			1688			114				
Starvation Cap Reductn		2			0			0				
Spillback Cap Reductn		0			13			72				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.80			1.00			0.76				

Intersection Summary

Cycle Length: 110
 Actuated Cycle Length: 99.9
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.00
 Intersection Signal Delay: 27.2
 Intersection LOS: C
 Intersection Capacity Utilization 67.1%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3366
Total Delay / Veh (s/v)	18

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3213
Total Delay / Veh (s/v)	27

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	22
Performance Index	47.1

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 Sat Middday Build Alt 1 Conditions

Queues
 12/09/2016

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	64	1454	0	0	1672	24	0	0	0	13	0	67
Future Volume (vph)	64	1454	0	0	1672	24	0	0	0	13	0	67
Satd. Flow (prot)	1678	3002	0	0	2996	0	0	0	0	0	1554	0
Flt Permitted	0.950										0.992	
Satd. Flow (perm)	1678	3002	0	0	2996	0	0	0	0	0	1554	0
Satd. Flow (RTOR)												
Lane Group Flow (vph)	69	1574	0	0	1836	0	0	0	0	0	87	0
Turn Type	Prot	NA			NA					Split	NA	
Protected Phases	5	2			6					4	4	
Permitted Phases												
Total Split (s)	25.0	80.0			55.0					25.0	25.0	
Total Lost Time (s)	6.0	6.0			6.0					6.0	6.0	
Act Effct Green (s)	9.8	77.0			64.3					11.6	11.6	
Actuated g/C Ratio	0.09	0.73			0.61					0.11	0.11	
v/c Ratio	0.45	0.72			1.00					0.51	0.51	
Control Delay	56.7	14.2			18.8					56.9	56.9	
Queue Delay	0.0	0.3			26.9					0.0	0.0	
Total Delay	56.7	14.5			45.7					56.9	56.9	
LOS	E	B			D					E	E	
Approach Delay		16.2			45.7					56.9	56.9	
Approach LOS		B			D					E	E	
Queue Length 50th (ft)	47	362			~789					59	59	
Queue Length 95th (ft)	94	531			m#738					111	111	
Internal Link Dist (ft)		817			34			27		61	61	
Turn Bay Length (ft)	200											
Base Capacity (vph)	308	2199			1831					285	285	
Starvation Cap Reductn	0	0			128					0	0	
Spillback Cap Reductn	0	168			0					0	0	
Storage Cap Reductn	0	0			0					0	0	
Reduced v/c Ratio	0.22	0.77			1.08					0.31	0.31	

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 105.1
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.08
 Intersection Signal Delay: 32.4
 Intersection Capacity Utilization 72.5%
 Analysis Period (min) 15
 Intersection LOS: C
 ICU Level of Service C

~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.

95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Andover St & Esquire Dr



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 Sat Middday Build Alt 1 Conditions

Queues
 12/09/2016



Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕				
Traffic Volume (vph)	1	1427	40	1	1647	0	37	0	4	0	0	0
Future Volume (vph)	1	1427	40	1	1647	0	37	0	4	0	0	0
Satd. Flow (prot)	0	2814	0	0	2826	0	0	1670	0	0	0	0
Flt Permitted		0.954			0.954			0.957				
Satd. Flow (perm)	0	2685	0	0	2696	0	0	1670	0	0	0	0
Satd. Flow (RTOR)		4						*100				
Lane Group Flow (vph)	0	1589	0	0	1784	0	0	44	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		3	3				
Permitted Phases	2			6								
Total Split (s)	80.0	80.0		55.0	55.0		15.0	15.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		77.0			64.3			6.6				
Actuated g/C Ratio		0.73			0.61			0.06				
v/c Ratio		0.81			1.08			0.22				
Control Delay		6.0			75.5			2.6				
Queue Delay		0.0			4.2			19.3				
Total Delay		6.0			79.7			21.8				
LOS		A			E			C				
Approach Delay		6.0			79.7			21.8				
Approach LOS		A			E			C				
Queue Length 50th (ft)		46			-830			0				
Queue Length 95th (ft)		#726			#1071			0				
Internal Link Dist (ft)		34			769			120			1	
Turn Bay Length (ft)												
Base Capacity (vph)		1968			1648			236				
Starvation Cap Reductn		0			0			0				
Spillback Cap Reductn		0			15			175				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.81			1.09			0.72				

Intersection Summary

Cycle Length: 120
 Actuated Cycle Length: 105.1
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 1.08
 Intersection Signal Delay: 44.7
 Intersection LOS: D
 Intersection Capacity Utilization 71.0%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Andover St & Esquire Dr

Direction	All
Future Volume (vph)	3459
Total Delay / Veh (s/v)	32

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3314
Total Delay / Veh (s/v)	45

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	38
Performance Index	79.0

2040 Build Alternative 2

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 AM Build Alt 2 Conditions

Queues
 11/28/2016 7:30 am

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	0	1387	0	0	1842	18	5	18	0	23	0	61
Future Volume (vph)	0	1387	0	0	1842	18	5	18	0	23	0	61
Satd. Flow (prot)	0	3002	0	0	2999	0	0	1748	0	0	1571	0
Flt Permitted								0.918			0.899	
Satd. Flow (perm)	0	3002	0	0	2999	0	0	1621	0	0	1432	0
Satd. Flow (RTOR)					2						*50	
Lane Group Flow (vph)	0	1501	0	0	2013	0	0	24	0	0	91	0
Turn Type		NA			NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases							8			4		
Total Split (s)		65.0			65.0		20.0	20.0		20.0	20.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Act Effct Green (s)		64.0			64.0			9.4			9.4	
Actuated g/C Ratio		0.70			0.70			0.10			0.10	
v/c Ratio		0.71			0.95			0.14			0.47	
Control Delay		13.9			13.2			39.9			29.0	
Queue Delay		0.0			0.2			0.0			0.7	
Total Delay		13.9			13.4			39.9			29.7	
LOS		B			B			D			C	
Approach Delay		13.9			13.4			39.9			29.7	
Approach LOS		B			B			D			C	
Queue Length 50th (ft)		292			-672			13			23	
Queue Length 95th (ft)		463			#877			37			69	
Internal Link Dist (ft)		831			34			65			61	
Turn Bay Length (ft)												
Base Capacity (vph)		2116			2115			251			263	
Starvation Cap Reductn		0			6			0			0	
Spillback Cap Reductn		0			0			0			47	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.71			0.95			0.10			0.42	

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 90.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 14.2
 Intersection LOS: B
 Intersection Capacity Utilization 78.1%
 ICU Level of Service D
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 1: Jug Handle/Esquire Dr & Andover St



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 AM Build Alt 2 Conditions

Queues
 11/28/2016 7:30 am

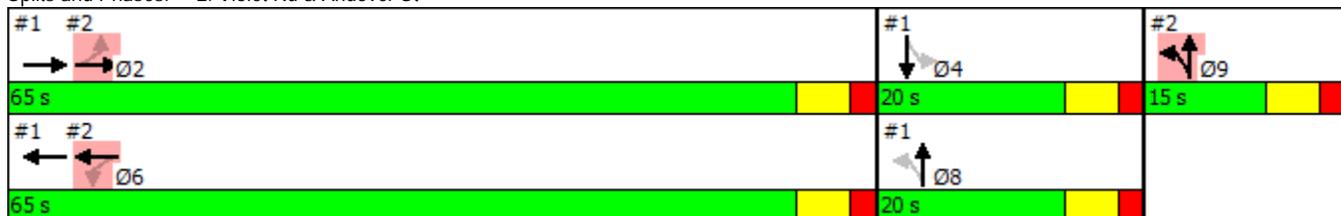


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕				
Traffic Volume (vph)	1	1398	13	1	1823	0	49	0	1	0	0	0
Future Volume (vph)	1	1398	13	1	1823	0	49	0	1	0	0	0
Satd. Flow (prot)	0	3352	0	0	3355	0	0	1678	0	0	0	0
Flt Permitted		0.954			0.955			0.953				
Satd. Flow (perm)	0	3198	0	0	3204	0	0	1678	0	0	0	0
Satd. Flow (RTOR)		2						*100				
Lane Group Flow (vph)	0	1528	0	0	1974	0	0	54	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		9	9				
Permitted Phases	2			6								
Total Split (s)	65.0	65.0		65.0	65.0		15.0	15.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		64.0			64.0			6.6				
Actuated g/C Ratio		0.70			0.70			0.07				
v/c Ratio		0.68			0.87			0.25				
Control Delay		2.2			20.8			4.5				
Queue Delay		0.1			0.9			10.8				
Total Delay		2.4			21.8			15.2				
LOS		A			C			B				
Approach Delay		2.4			21.8			15.2				
Approach LOS		A			C			B				
Queue Length 50th (ft)		19			501			0				
Queue Length 95th (ft)		28			#822			9				
Internal Link Dist (ft)		34			769			120				1
Turn Bay Length (ft)												
Base Capacity (vph)		2255			2259			257				
Starvation Cap Reductn		121			0			0				
Spillback Cap Reductn		0			101			174				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.72			0.91			0.65				

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 90.8
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.95
 Intersection Signal Delay: 13.3
 Intersection LOS: B
 Intersection Capacity Utilization 67.0%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd & Andover St



1: Jug Handle/Esquire Dr & Andover St

Direction	All
Future Volume (vph)	3520
Total Delay / Veh (s/v)	14

2: Violet Rd & Andover St

Direction	All
Future Volume (vph)	3449
Total Delay / Veh (s/v)	13

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	14
Performance Index	33.6

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 PM Build Alt 2 Conditions

Queues
 11/28/2016 5:00 pm

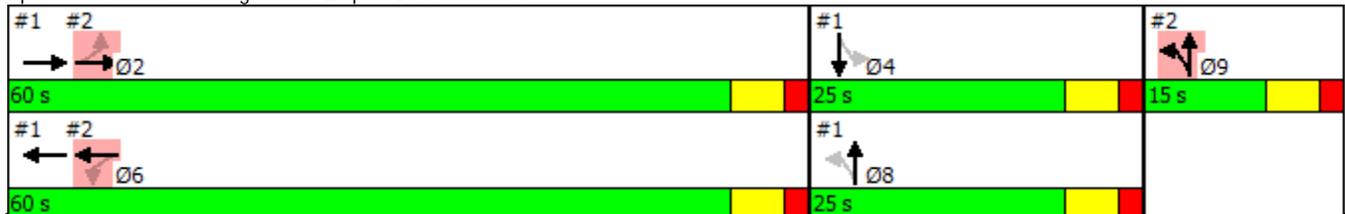


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑			↑			↑↓	
Traffic Volume (vph)	0	1469	0	0	1532	32	25	65	0	23	0	49
Future Volume (vph)	0	1469	0	0	1532	32	25	65	0	23	0	49
Satd. Flow (prot)	0	2826	0	0	2817	0	0	1741	0	0	1578	0
Flt Permitted								0.910			0.877	
Satd. Flow (perm)	0	2826	0	0	2817	0	0	1607	0	0	1406	0
Satd. Flow (RTOR)					3						*50	
Lane Group Flow (vph)	0	1607	0	0	1711	0	0	98	0	0	79	0
Turn Type		NA			NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases							8			4		
Total Split (s)		60.0			60.0		25.0	25.0		25.0	25.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Act Effct Green (s)		59.3			59.3			10.9			10.9	
Actuated g/C Ratio		0.70			0.70			0.13			0.13	
v/c Ratio		0.81			0.87			0.48			0.35	
Control Delay		19.0			8.2			43.6			21.6	
Queue Delay		0.6			0.6			0.0			3.8	
Total Delay		19.6			8.7			43.6			25.4	
LOS		B			A			D			C	
Approach Delay		19.6			8.7			43.6			25.4	
Approach LOS		B			A			D			C	
Queue Length 50th (ft)		398			-31			53			15	
Queue Length 95th (ft)		#671			m#702			102			56	
Internal Link Dist (ft)		790			34			45			61	
Turn Bay Length (ft)												
Base Capacity (vph)		1973			1967			363			356	
Starvation Cap Reductn		0			59			0			0	
Spillback Cap Reductn		109			0			0			209	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.86			0.90			0.27			0.54	

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 85
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 15.1
 Intersection LOS: B
 Intersection Capacity Utilization 70.7%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Jug Handle/Esquire Dr & Andover St



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 PM Build Alt 2 Conditions

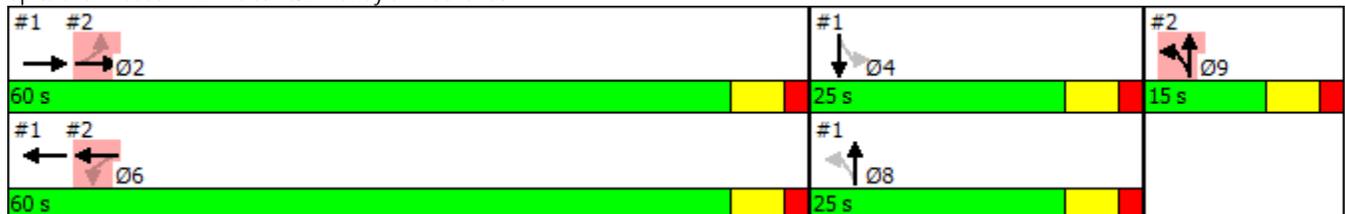
Queues
 11/28/2016 5:00 pm

Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Traffic Volume (vph)	1	1426	66	1	1536	0	27	0	2	0	0	0
Future Volume (vph)	1	1426	66	1	1536	0	27	0	2	0	0	0
Satd. Flow (prot)	0	2806	0	0	2826	0	0	1409	0	0	0	0
Flt Permitted		0.954			0.954			0.955				
Satd. Flow (perm)	0	2677	0	0	2696	0	0	1409	0	0	0	0
Satd. Flow (RTOR)		7						*60				
Lane Group Flow (vph)	0	1633	0	0	1681	0	0	32	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		9	9				
Permitted Phases	2			6								
Total Split (s)	60.0	60.0		60.0	60.0		15.0	15.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		59.3			59.3			6.7				
Actuated g/C Ratio		0.70			0.70			0.08				
v/c Ratio		0.87			0.89			0.19				
Control Delay		9.6			24.3			6.6				
Queue Delay		0.0			0.1			8.9				
Total Delay		9.6			24.3			15.5				
LOS		A			C			B				
Approach Delay		9.6			24.3			15.5				
Approach LOS		A			C			B				
Queue Length 50th (ft)		-33			-540			0				
Queue Length 95th (ft)		#700			#745			12				
Internal Link Dist (ft)		34			769			120			5	
Turn Bay Length (ft)												
Base Capacity (vph)		1871			1882			204				
Starvation Cap Reductn		0			0			0				
Spillback Cap Reductn		0			5			143				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.87			0.90			0.52				

Intersection Summary

Cycle Length: 100
 Actuated Cycle Length: 85
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.89
 Intersection Signal Delay: 17.1
 Intersection LOS: B
 Intersection Capacity Utilization 67.1%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Jug Handle/Esquire Dr & Andover St

Direction	All
Future Volume (vph)	3356
Total Delay / Veh (s/v)	15

2: Violet Rd/Driveway & Andover St

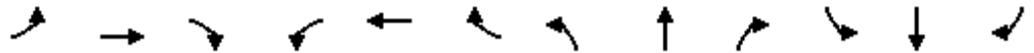
Direction	All
Future Volume (vph)	3213
Total Delay / Veh (s/v)	17

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	16
Performance Index	36.0

Andover Street at Esquire Drive and Violet Road - Peabody
 2040 Sat Middday Build Alt 2 Conditions

Queues
 01/03/2017

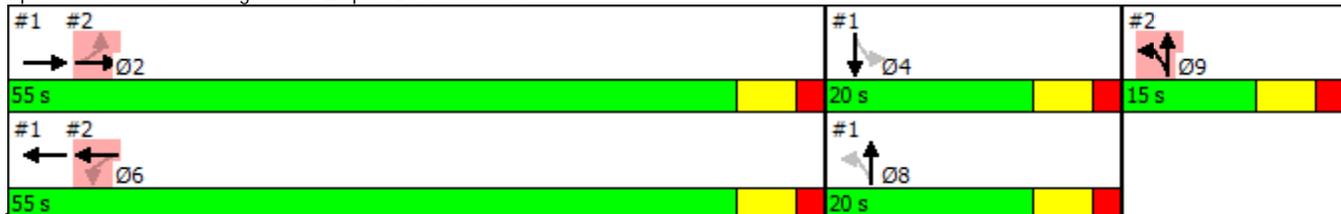


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑			↑↑			↑			↑↓	
Traffic Volume (vph)	0	1454	0	0	1672	24	25	40	0	13	0	67
Future Volume (vph)	0	1454	0	0	1672	24	25	40	0	13	0	67
Satd. Flow (prot)	0	3002	0	0	2996	0	0	1732	0	0	1554	0
Flt Permitted								0.886			0.938	
Satd. Flow (perm)	0	3002	0	0	2996	0	0	1565	0	0	1469	0
Satd. Flow (RTOR)					2						*50	
Lane Group Flow (vph)	0	1574	0	0	1836	0	0	70	0	0	87	0
Turn Type		NA			NA		Perm	NA		Perm	NA	
Protected Phases		2			6			8			4	
Permitted Phases							8			4		
Total Split (s)		55.0			55.0		20.0	20.0		20.0	20.0	
Total Lost Time (s)		6.0			6.0			6.0			6.0	
Act Effct Green (s)		54.2			54.2			9.7			9.7	
Actuated g/C Ratio		0.69			0.69			0.12			0.12	
v/c Ratio		0.76			0.89			0.36			0.39	
Control Delay		15.9			8.8			38.7			22.7	
Queue Delay		0.3			3.0			0.0			0.0	
Total Delay		16.2			11.8			38.7			22.7	
LOS		B			B			D			C	
Approach Delay		16.2			11.8			38.7			22.7	
Approach LOS		B			B			D			C	
Queue Length 50th (ft)		334			-52			34			18	
Queue Length 95th (ft)		#570			m#608			74			60	
Internal Link Dist (ft)		817			34			43			61	
Turn Bay Length (ft)												
Base Capacity (vph)		2072			2069			282			305	
Starvation Cap Reductn		0			150			0			0	
Spillback Cap Reductn		113			0			0			0	
Storage Cap Reductn		0			0			0			0	
Reduced v/c Ratio		0.80			0.96			0.25			0.29	

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 78.5
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay: 14.5
 Intersection LOS: B
 Intersection Capacity Utilization 72.5%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.
 m Volume for 95th percentile queue is metered by upstream signal.

Splits and Phases: 1: Jug Handle/Esquire Dr & Andover St



Andover Street at Esquire Drive and Violet Road - Peabody
 2040 Sat Middday Build Alt 2 Conditions

Queues
 01/03/2017

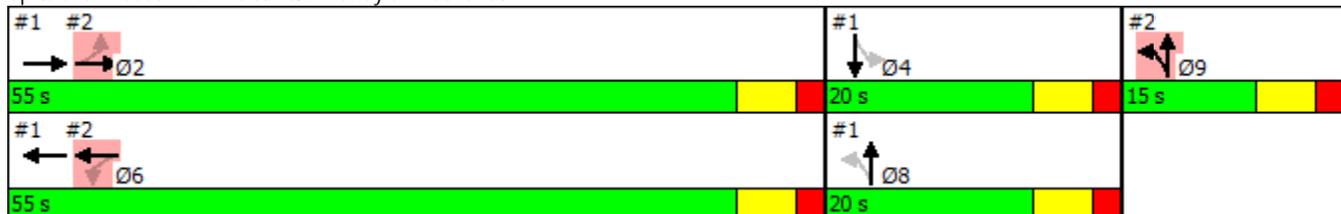


Lane Group	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↕↕			↕↕			↕↕				
Traffic Volume (vph)	1	1427	40	1	1647	0	37	0	4	0	0	0
Future Volume (vph)	1	1427	40	1	1647	0	37	0	4	0	0	0
Satd. Flow (prot)	0	2814	0	0	2826	0	0	1670	0	0	0	0
Flt Permitted		0.954			0.954			0.957				
Satd. Flow (perm)	0	2685	0	0	2696	0	0	1670	0	0	0	0
Satd. Flow (RTOR)		5						*100				
Lane Group Flow (vph)	0	1589	0	0	1784	0	0	44	0	0	0	0
Turn Type	Perm	NA		Perm	NA		Split	NA				
Protected Phases		2			6		9	9				
Permitted Phases	2			6								
Total Split (s)	55.0	55.0		55.0	55.0		15.0	15.0				
Total Lost Time (s)		6.0			6.0			6.0				
Act Effct Green (s)		54.2			54.2			6.6				
Actuated g/C Ratio		0.69			0.69			0.08				
v/c Ratio		0.86			0.96			0.19				
Control Delay		9.6			31.6			1.8				
Queue Delay		0.0			0.6			7.9				
Total Delay		9.6			32.2			9.7				
LOS		A			C			A				
Approach Delay		9.6			32.2			9.7				
Approach LOS		A			C			A				
Queue Length 50th (ft)		43			-565			0				
Queue Length 95th (ft)		#617			#751			2				
Internal Link Dist (ft)		34			769			120			1	
Turn Bay Length (ft)												
Base Capacity (vph)		1855			1861			281				
Starvation Cap Reductn		0			0			0				
Spillback Cap Reductn		0			11			202				
Storage Cap Reductn		0			0			0				
Reduced v/c Ratio		0.86			0.96			0.56				

Intersection Summary

Cycle Length: 90
 Actuated Cycle Length: 78.5
 Control Type: Actuated-Uncoordinated
 Maximum v/c Ratio: 0.96
 Intersection Signal Delay: 21.4
 Intersection LOS: C
 Intersection Capacity Utilization 71.0%
 ICU Level of Service C
 Analysis Period (min) 15
 * User Entered Value
 ~ Volume exceeds capacity, queue is theoretically infinite.
 Queue shown is maximum after two cycles.
 # 95th percentile volume exceeds capacity, queue may be longer.
 Queue shown is maximum after two cycles.

Splits and Phases: 2: Violet Rd/Driveway & Andover St



1: Jug Handle/Esquire Dr & Andover St

Direction	All
Future Volume (vph)	3460
Total Delay / Veh (s/v)	15

2: Violet Rd/Driveway & Andover St

Direction	All
Future Volume (vph)	3314
Total Delay / Veh (s/v)	21

Network Totals

Number of Intersections	2
Total Delay / Veh (s/v)	18
Performance Index	40.4

Appendix E: MassDOT Highway Division's Project Development Process

Overview of the Project Development Process

Transportation decision-making is complex and can be influenced by legislative mandates, environmental regulations, financial limitations, agency programmatic commitments, and partnering opportunities. Decision-makers and reviewing agencies, when consulted early and often throughout the project development process, can ensure that all participants understand the potential impact these factors can have on project implementation. Project development is the process that takes a transportation improvement from concept through construction.

The MassDOT Highway Division has developed a comprehensive project development process which is contained in Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide*. The eight-step process covers a range of activities extending from identification of a project need, through completion of a set of finished contract plans, to construction of the project. The sequence of decisions made through the project development process progressively narrows the project focus and, ultimately, leads to a project that addresses the identified needs. The descriptions provided below are focused on the process for a highway project, but the same basic process will need to be followed for non-highway projects as well.

1. Needs Identification

For each of the locations at which an improvement is to be implemented, MassDOT leads an effort to define the problem, establishes project goals and objectives, and defines the scope of the planning needed for implementation. To that end, it has to complete a Project Need Form (PNF), which states in general terms the deficiencies or needs related to the transportation facility or location. The PNF documents the problems and explains why corrective action is needed. For this study, the information defining the need for the project will be drawn primarily, perhaps exclusively, from the present report. Also, at this point in the process, MassDOT meets with potential participants, such as the Metropolitan Planning Organization (MPO) and community members, to allow for an informal review of the project.

The PNF is reviewed by the MassDOT Highway Division district office whose jurisdiction includes the location of the proposed project. MassDOT also sends the PNF to the MPO, for informational purposes. The outcome of this step determines whether the project requires further planning, whether it is already well supported by prior planning studies, and, therefore, whether it is ready to move forward into the design phase, or whether it should be dismissed from further consideration.

2. Planning

This phase will likely not be required for the implementation of the improvements proposed in this planning study, as this planning report should constitute the outcome of this step. However, in general, the purpose of this implementation step is for the project proponent to identify issues, impacts, and approvals that may need to be obtained, so that the subsequent design and permitting processes are understood.

The level of planning needed will vary widely, based on the complexity of the project. Typical tasks include: define the existing context, confirm project need, establish goals and objectives, initiate public outreach, define the project, collect data, develop and analyze alternatives, make recommendations, and provide documentation. Likely outcomes include consensus on the project definition to enable it to move forward into environmental documentation (if needed) and design, or a recommendation to delay the project or dismiss it from further consideration.

3. Project Initiation

At this point in the process, the proponent, MassDOT Highway Division, fills out a Project Initiation Form (PIF) for each improvement, which is reviewed by its Project Review Committee (PRC) and the MPO. The PRC is composed of the Chief Engineer, each District Highway Director, and representatives of the Project Management, Environmental, Planning, Right-of-Way, Traffic, and Bridge departments, and the MassDOT Federal Aid Program Office (FAPO). The PIF documents the project type and description, summarizes the project planning process, identifies likely funding and project management responsibility, and defines a plan for interagency and public participation. First the PRC reviews and evaluates the proposed project based on the MassDOT's statewide priorities and criteria. If the result is positive, MassDOT Highway Division moves the project forward to the design phase, and to programming review by the MPO. The PRC may provide a Project Management Plan to define roles and responsibilities for subsequent steps. The MPO review includes project evaluation based on the MPO's regional priorities and criteria. The MPO may assign project evaluation criteria score, a Transportation Improvement Program (TIP) year, a tentative project category, and a tentative funding category.

4. Environmental Permitting, Design, and Right-of-Way Process

This step has four distinct but closely integrated elements: public outreach, environmental documentation and permitting (if required), design, and right-of-way acquisition (if required). The outcome of this step is a fully designed and permitted project ready for construction. However, a project does not have to be fully designed in order for the MPO to program it in the TIP. The sections below provide more detailed information on the four elements of this step of the project development process.

Public Outreach

Continued public outreach in the design and environmental process is essential to maintain public support for the project and to seek meaningful input on the design elements. The public outreach is often in the form of required public hearings, but can also include less formal dialogues with those interested in and affected by a proposed project.

Environmental Documentation and Permitting

The project proponent, in coordination with the Environmental Services section of the MassDOT Highway Division, will be responsible for identifying and complying with all applicable federal, state, and local environmental laws and requirements. This includes determining the appropriate project category for both the Massachusetts Environmental Protection Act (MEPA) and the National Environmental Protection Act (NEPA). Environmental documentation and permitting is often completed in conjunction with the **Preliminary Design** phase described below.

Design

There are three major phases of design. The first is **Preliminary Design**, which is also referred to as the 25-percent submission. The major components of this phase include full survey of the project area, preparation of base plans, development of basic geometric layout, development of preliminary cost estimates, and submission of a functional design report. Preliminary Design, although not required to, is often completed in conjunction with the Environmental Documentation and Permitting. The next phase is **Final Design**, which is also referred to as the 75-percent and 100-percent submission. The major components of this phase include preparation of a subsurface exploratory plan (if required), coordination of utility relocations, development of traffic management plans through construction zones, development of final cost estimates, and refinement and finalization of the construction plans. Once Final Design is complete, a full set of **Plans, Specifications, and Estimates (PS&E)** is developed for the project.

Right-of-Way Acquisition

A separate set of Right-of-Way plans are required for any project that requires land acquisition or easements. The plans must identify the existing and proposed layout lines, easements, property lines, names of property owners, and the dimensions and areas of estimated takings and easements.

5. Programming (Identification of Funding)

Programming, which typically begins during the design phase, can actually occur at any time during the process, from planning to design. In this step, which is distinct from project initiation, the proponent requests that the MPO place the project in the region's Transportation Improvement Program (TIP). The proponent requesting the project's listing on the TIP can be the community or it can be one of the MPO member agencies (the Regional Planning Agency, MassDOT, and the Regional Transit Authority). The MPO then considers the project in terms of state and regional needs, evaluation criteria, and compliance with the regional Transportation Plan and decides whether to place it in the draft TIP for public review and then in the final TIP.

6. Procurement

Following project design and programming of a highway project, the MassDOT Highway Division publishes a request for proposals. It then reviews the bids and awards the contract to the qualified bidder with the lowest bid.

7. Construction

After a construction contract is awarded, MassDOT Highway Division and the contractor develop a public participation plan and a management plan for the construction process.

8. Project Assessment

The purpose of this step is to receive constituents' comments on the project development process and the project's design elements. MassDOT Highway Division can apply what is learned in this process to future projects.

Project Development Schematic Timetable

Description	Schedule Influence	Typical Duration
<p>Step I: Problem/Need/Opportunity Identification The proponent completes a Project Need Form (PNF). This form is then reviewed by the MassDOT District office which provides guidance to the proponent on the subsequent steps of the process.</p>	<p>The Project Need Form has been developed so that it can be prepared quickly by the proponent, including any supporting data that is readily available. The District office shall return comments to the proponent within one month of PNF submission.</p>	<p>1 to 3 months</p>
<p>Step II: Planning Project planning can range from agreement that the problem should be addressed through a clear solution to a detailed analysis of alternatives and their impacts.</p>	<p>For some projects, no planning beyond preparation of the Project Need Form is required. Some projects require a planning study centered on specific project issues associated with the proposed solution or a narrow family of alternatives. More complex projects will likely require a detailed alternatives analysis.</p>	<p>Project Planning Report: 3 to 24+ months</p>
<p>Step III: Project Initiation The proponent prepares and submits a Project Initiation Form (PIF) and a Transportation Evaluation Criteria (TEC) form in this step. The PIF and TEC are informally reviewed by the Metropolitan Planning Organization (MPO) and MassDOT District office, and formally reviewed by the PRC.</p>	<p>The PIF includes refinement of the preliminary information contained in the PNF. Additional information summarizing the results of the planning process, such as the Project Planning Report, are included with the PIF and TEC. The schedule is determined by PRC staff review (dependent on project complexity) and meeting schedule.</p>	<p>1 to 4 months</p>
<p>Step IV: Design, Environmental, and Right of Way The proponent completes the project design. Concurrently, the proponent completes necessary environmental permitting analyses and files applications for permits. Any right of way needed for the project is identified and the acquisition process begins.</p>	<p>The schedule for this step is dependent upon the size of the project and the complexity of the design, permitting, and right-of-way issues. Design review by the MassDOT district and appropriate sections is completed in this step.</p>	<p>3 to 48+ months</p>
<p>Step V: Programming The MPO considers the project in terms of its regional priorities and determines whether or not to include the project in the draft Regional Transportation Improvement Program (TIP) which is then made available for public comment. The TIP includes a project description and funding source.</p>	<p>The schedule for this step is subject to each MPO's programming cycle and meeting schedule. It is also possible that the MPO will not include a project in its Draft TIP based on its review and approval procedures.</p>	<p>3 to 12+ months</p>
<p>Step VI: Procurement The project is advertised for construction and a contract awarded.</p>	<p>Administration of competing projects can influence the advertising schedule.</p>	<p>1 to 12 months</p>
<p>Step VII: Construction The construction process is initiated including public notification and any anticipated public involvement. Construction continues to project completion.</p>	<p>The duration for this step is entirely dependent upon project complexity and phasing.</p>	<p>3 to 60+ months</p>
<p>Step VIII: Project Assessment The construction period is complete and project elements and processes are evaluated on a voluntary basis.</p>	<p>The duration for this step is dependent upon the proponent's approach to this step and any follow-up required.</p>	<p>1 month</p>

Source: MassDOT Highway Division Project Development and Design Guide