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MEMORANDUM
(Draft)

DATE **February 22, 2012**

TO **Michelle Ciccolo, Hudson Community Development Director; Joseph Frawley, Massachusetts Department of Transportation Highway Division District 3**

FROM **Mark Abbott and Chen-Yuan Wang, MPO Staff**

RE **FFY 2011 Safety and Operations Analyses at Selected Boston Region MPO Intersections: Lincoln Street at Cox Street/Packard Street in Hudson**

INTRODUCTION

This memorandum summarizes safety and operations analyses and proposes improvement strategies for the intersection of Lincoln Street (Route 85) at Cox Street/Packard Street in Hudson. It contains the following sections:

- Intersection Layout and Traffic Control
- Issues and Concerns
- Crash Data Analysis
- Intersection Capacity Analysis
- Preliminary Analysis of Traffic Signal Warrants
- Analysis of Traffic Signal Alternative
- Improvement Recommendations and Discussion

The memorandum also includes a collection of technical appendices that contain methods and data applied in the study and detailed reports of the intersection capacity analyses.

INTERSECTION LAYOUT AND TRAFFIC CONTROL

The intersection is located about half a mile north of downtown Hudson. Lincoln Street, the major street of the intersection, is a two-lane roadway running in the north-south direction. It is a part of Route 85 that serves as a minor urban arterial connecting Route 117 in Bolton and Route 16 in Milford and intersecting Route 62 at downtown Hudson. Because Route 85 runs parallel to Interstate 495 (I-495), this section of Route 85 in Hudson is frequently used to access the interstate highway via Route 62 or via Route 117. Cox Street, the intersection's eastern leg, is a two-lane roadway classified as an urban collector. Packard Street, the western leg, is a two-lane urban collector that serves Farley Elementary School, Hudson

Police Department, and the adjacent neighborhoods. The intersection and the approaching roadways are under the Town's jurisdiction.

Figure 1 shows the intersection layout and the area nearby. At the intersection, Lincoln Street operates uncontrolled, while Cox Street and Packard Street are under two-way stop controls. All the approaches are basically one lane shared by all movements. The stop-controlled Cox Street and Packard Street, although they are the minor approaches of the intersection, appear to be somewhat wider than Lincoln Street, especially Packard Street.

Coming from the north, Lincoln Street (Route 85) passes through woods and low-density neighborhoods. Its speed limit is 40 miles per hour (mph). As it approaches the intersection and denser residential areas, its speed limit is gradually reduced to 35 mph (about 1,200 feet north of the intersection), and then to 30 mph (about 150 feet north of the intersection). It appears that the 30-mph speed limit sign is located too close to the intersection, so that drivers do not have sufficient time to slow down. Also, based on observations and discussions with Hudson's police chief, speeds along Lincoln Street are in the 40- to 45-mph range. South of the intersection, traveling northbound from the Hudson downtown area, Lincoln Street has a posted speed limit of 30 mph. Packard Street has a posted speed limit of 30 mph, and Cox Street has a posted speed limit of 25 mph.

The land use in the vicinity of the intersection is mainly residential. Farley Elementary School is located on Packard Street about 1,000 feet west of the intersection. The school has about 500 students. Most of them get a ride to and from school.[1] The four corners of the intersection are occupied by single-family houses with trees situated near the corners (except the southwest corner). The house on the northwest corner has a large slanted front lawn edged by a 4-foot-high stone retaining wall along the corner.

The intersection layout is somewhat irregular, as Lincoln Street and Cox Street/Packard Street do not intersect perpendicularly. The southbound Lincoln Street approach is on a horizontal curve meeting Cox Street/Packard Street at a skewed angle. Drivers usually do not see the intersection as they approach it, and the drivers of cars stopped on Cox Street or on Packard Street cannot see it until they are only about 200 to 250 feet away.[2] The sight distance to Packard Street is particularly limited due to the stone wall on the northwest corner. Packard Street also curves slightly about 300 feet from the intersection.

Meanwhile, the intersection is located in gently rolling terrain. Lincoln Street southbound slopes gently downhill, while Packard Street slopes uphill and then downhill near the intersection. Drivers coming from the west, especially those in passenger cars, usually do not see the intersection and the stop sign until about 300 feet from the intersection. When they come to the stop line, their sight distance to Lincoln Street north of the intersection is limited due to the skewed angle between the two roadways, making it difficult for them to see vehicles approaching from the north.

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[1] On the date of site visit, staff observed about five students (accompanied by their parents) walking across the intersection to school.

[2] This sight distance is considered too short for drivers coming from a street with a 30-mph speed limit.

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FIGURE 1
Existing Conditions
Lincoln Street at Cox Street/Packard Street, Hudson

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Drivers coming from the south on Lincoln Street, and from the east, on Cox Street, usually can see the intersection from an adequate distance. However, overgrown foliage near the corners of the intersection obscures drivers' visibility of the intersection. On the date of the site visit, the stop sign at the Cox Street approach was partly covered by the overgrown foliage from a nearby tree (see Figure 2). The stop sign is 24 inches square, as is the stop sign on Packard Street).

FIGURE 2
Stop Sign on Cox Street

On Packard Street, a "Dangerous intersection" sign is located about 250 feet before the intersection (see Figure 3). The sign is outdated and is now considered ineffective for conveying a clear message to drivers. It is no longer a standard warning sign in the federal guide book, the 2009 edition of *Manual for Uniform Traffic Control Devices* (MUTCD), and MassDOT currently does not recommend using such a sign.[3]

Sidewalks are installed on all approaches near the intersection. Crosswalks are installed on the northbound, southbound, and westbound approaches; there is one on the eastbound approach, across Packard Street. However, the pavement markings of the crosswalk on the northbound approach are completely faded. The crosswalk on the southbound approach is located away from the intersection (about 70 feet north of Cox Street) in order to shorten the crossing distance.[4]

There are no bike lanes or bus routes on any of the approaches of the intersection. MPO staff observed some pedestrians, but no bicyclists, during the turning-movement counts in the AM and

[3] John F. Carr, National Motorists Association, "Proposed changes to Massachusetts MUTCD Supplement," page 3, October 24, 2002

[4] A crosswalk crossing the intersection on the southbound approach would have a fairly long distance due to the irregular shape of the intersection and would expose pedestrians to traffic for a longer time. However, a crosswalk located farther from the intersection would counter drivers' expectations, especially for those making turns from other approaches.

FIGURE 3
"Dangerous Intersection" Sign on Packard Street

PM peak periods performed in April 2011. According to the Town, bicyclists regularly use Route 85 as a bike route even though no bicyclists were observed during the counts.

ISSUES AND CONCERNS

On May 17, 2011, staff met with Hudson town officials, including representatives from of the Police Department, the Public Works Department, and the Community Development Department, to observe the morning traffic conditions and discuss the issues and concerns related to this intersection. The major concern of the Town officials is the high number of crashes over the years at this location. A review of the recent crash data indicates that the intersection has a high number of crashes and a crash rate higher than the average for unsignalized intersections in MassDOT Highway Division District 3 (see the next section for further analyses).

The issues and concerns for this intersection can be summarized as follows:

- High number of crashes and high crash rate
- Traffic congestion on the minor-street approaches during peak hours
- Short sight distance from the southbound and the eastbound approaches
- Insufficient or outdated traffic control devices to alert drivers
- Faded crosswalk pavement markings on the northbound approach
- Outdated and inappropriate signing

Table 1 further summarizes the issues and concerns related to the existing intersection layout and traffic control devices.

TABLE 1
Summary of Issues and Concerns related to the Existing Conditions

Existing Conditions	Issues/Concerns
Traffic operation is under a two-way stop control on Cox Street/ Packard Street. All the approaches are basically one lane shared by all movements. The stop-controlled Cox Street/Packard Street appears to be somewhat wider than Lincoln Street.	• Drivers' confusion increases when traffic increases from different approaches. • During peak periods, traffic tends to back up on the stop-control approaches. • Confused drivers sometimes stop at the intersection even though they are approaching from Lincoln Street. This causes a backup on Lincoln Street from time to time in peak periods.
The Lincoln Street (Route 85) southbound speed limit is gradually reduced to 35 mph (about 1,200 feet from the intersection) and then to 30 mph (about 150 feet from the intersection).	• It appears that the 30-mph speed limit sign is located too close to the intersection, so that drivers do not have sufficient time to slow down.
Lincoln Street southbound approaches the intersection at a skewed angle and does not align smoothly with the northbound approach. The house on the northwest corner is on a hill and has a slanted front lawn edged by a four-foot-high stone wall. There is often overgrown foliage frequently at the intersection corners.	• It is difficult for drivers to observe the traffic conditions and pedestrian movements when they approach the intersection, especially from the southbound and eastbound approaches. • The stop sign on Cox Street is obscured by overgrown foliage.
The intersection is located in rolling terrain. Approaching the intersection, Lincoln Street southbound slopes slightly downhill, while Packard Street slopes uphill and then downhill near the intersection.	• The sight distance for drivers from the Packard Street approach is limited. Drivers do not see the stop sign until the downhill location. • It is difficult for drivers to stop or slow down under wet or icy conditions.
A "Dangerous intersection" sign is located on Packard Street about 250 feet before the intersection.	• This is not a standard MUTCD sign. • It does not convey a clear message to drivers.

CRASH DATA ANALYSIS

Staff collected crash data for the most recent three years from the Massachusetts Department of Transportation (MassDOT) Registry of Motor Vehicles Division and the Hudson Police Department (HPD). The MassDOT data were available from 2007 to 2009, and detailed crash reports from HPD were available from 2008 to 2010. The two sets of data match well for the crashes in 2008 and 2009, which indicates that HPD provided adequate crash data to the Registry of Motor Vehicles.

Table 2 shows that on average six crashes occurred at the intersection each year. In total, about half (50%) of the crashes resulted in personal injuries and the other half caused property damage only. The crash types consist of nearly 70% angle collisions, more than 10% rear-end collisions, and more than 20% of single-vehicle collisions. Nearly 40% of the total crashes occurred during

weekday peak periods. Nearly 30% of the total crashes happened when the roadway pavement was wet or icy. There were no crashes involving pedestrians or cyclists in the three-year period.

The high percentage of personal injury crashes indicates that the severity of crashes at this intersection is above average. The high percentage of angle collisions indicates that the intersection has, as field observation also indicated, a sight distance problem, especially at the eastbound approach. A collision diagram (see Appendix A) indicates that more than half of the crashes involved vehicles from Packard Street. It should be noted that three drivers of the four single-vehicle crashes claimed that they swerved to side of the road (from Lincoln Street) in order to avoid colliding with a vehicle coming from Packard Street without stopping.

TABLE 2
Summary of MassDOT and Hudson Police Department Crash Data (2008–10)

					2008-10	
		2008	2009	2010	Total	Average
Total number of crashes		**8**	**5**	**5**	**18**	**6**
Crash severity	Property Damage Only	4	3	2	**9**	3
	Personal Injury	4	2	3	**9**	3
	Fatality	0	0	0	**0**	0
	Not Reported	0	0	0	**0**	0
Collision type	Angle	4	5	3	**12**	4
	Rear-end	2	0	0	**2**	1
	Sideswipe	0	0	0	**0**	0
	Head-on	0	0	0	**0**	0
	Single Vehicle	2	0	2	**4**	1
	Not Reported	0	0	0	**0**	0
Roadway conditions	Wet or icy pavement	3	2	0	**5**	2
	Dark/lighted	0	1	1	**2**	1
Weather conditions	Clear	4	2	4	**10**	3
	Cloudy	2	1	1	**4**	1
	Rain	1	0	0	**1**	0
	Snow	1	2	0	**3**	1
Crashes during weekday peak periods[1]		4	1	2	**7**	2
Crashes involving pedestrian(s)		0	0	0	**0**	0
Crashes involving bicyclist(s)		0	0	0	**0**	0

* Peak periods are defined as 7:00–10:00 AM and 3:30–6:30 PM.

The crash rate is another effective tool for examining the relative safety of a particular location.[5] Based on the 2007–009 crash data and the recently collected traffic volume data, the crash rate for this intersection is calculated as 1.73 crashes per million entering vehicles (see Appendix B, MassDOT's intersection crash rate worksheet). This recent crash rate is more than twice the

[5] Crash rates are estimated based on crash frequency (crashes per year) and vehicle exposure (traffic volumes or miles traveled). Crash rates are expressed as "crashes per million entering vehicles" for intersection locations and as "crashes per million miles traveled" for roadway segments.

average rate for the unsignalized locations in MassDOT Highway Division District 3, which is estimated to be 0.66 crashes per million entering vehicles.[6]

INTERSECTION CAPACITY ANALYSIS

MPO staff collected turning-movement counts at the intersection on April 28, 2011. The data were recorded in 15-minute intervals for the peak traffic periods in the morning, from 7:00 to 9:00 AM, and in the evening, from 4:00 to 6:00 PM. The intersection carried about 820 vehicles in the morning peak hour, from 7:15 to 8:15 AM, and about 920 vehicles in the evening peak hour, from 5:00 to 6:00 PM (see Table 3). Seven pedestrians were observed during the AM peak hour, and two pedestrians during the PM peak hour. No cyclists were observed in either the AM or PM peak hour.

TABLE 3
AM and PM Peak-Hour Traffic Volumes and Pedestrian Crossings

Street name		**Lincoln Street**						**Packard Street**			**Cox Street**			**Total**
Direction		**Northbound**			**Southbound**			**Eastbound**			**Westbound**			
Turning movement		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM peak hour	**Turning volume**	24	118	55	114	157	27	18	96	5	53	87	62	816
	Approach volume	197			298			119			202			
	Ped. crossings	1			4			1			1			7
PM peak hour	**Turning volume**	13	196	44	57	124	34	17	82	8	82	151	115	923
	Approach volume	253			215			107			348			
	Ped. crossings	0			2			0			0			2

Based on the turning-movement counts and the signal timings measured on the site, the intersection capacity was analyzed by using an intersection capacity analysis program, Synchro.[7] The intersection was modeled as an unsignalized intersection with a stop control on Packard Street and Cox Street. As Table 4 shows, the operations on Packard Street were found to operate at level of service (LOS) D with an average delay of about half a minute per approaching vehicle in the AM peak hour, and to operate at LOS C with an average delay of about 20 seconds per vehicle in the PM peak hour. Cox Street was evaluated to operate at level of service (LOS) E in both the AM and PM peak hours with an average delay of about 35 to 45 seconds per vehicle. The criteria for the level of service are based on the *Highway Capacity Manual 2000*.[8] The LOS analysis indicates that generally all the approaches of the intersection except the Cox Street approach operate at an acceptable LOS. Drivers on Cox Street experience somewhat undesirable

[6] The average crash rates estimated by the MassDOT Highway Division (as of July 7, 2011) are based on a database that contains intersection crash rates submitted to MassDOT as part of the review process for an Environmental Impact Report or Functional Design Report. The most recent average crash rates, which are updated on a nearly annual basis, are based on all entries in the database, not just those entries made within the past year.

[7] Synchro Version 7 software is developed and distributed by Trafficware Ltd. It can perform capacity analysis and traffic simulation (when combined with SimTraffic) for an individual intersection or a series of intersections.

[8] Transportation Research Board, National Research Council, *Highway Capacity Manual (HCM) 2000*, Washington, D. C., 2000.

delays in both the AM and PM peak hours. Detailed analysis settings and results for both the AM and PM peak hour are included in Appendix C.

TABLE 4
Intersection Capacity Analysis, Existing Conditions

Street name		**Lincoln Street (Route 85)**						**Packard Street**			**Cox Street**		
Direction		**Northbound**			**Southbound**			**Eastbound**			**Westbound**		
Turning movement		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT
AM Peak hour	**LOS**	**A**			**A**			**D**			**E**		
	Delay (sec/veh)	1.1			3.6			30.2			36.1		
	95% Queue (ft)	2			8			67			117		
PM peak hour	**LOS**	**A**			**A**			**C**			**E**		
	Delay (sec/veh)	0.5			2.4			20.8			43.0		
	95% Queue (ft)	1			4			41			212		

PRELIMINARY ANALYSIS OF TRAFFIC SIGNAL WARRANTS

According to the *Manual for Uniform Traffic Control Devices* (MUTCD),[9] an engineering study of traffic conditions, pedestrian characteristics, and physical characteristics of the location should be performed to determine whether installation of a traffic control signal is justified at a particular location. The investigation should include applicable factors contained in the following traffic signal warrants and other factors related to existing operations and safety at the study location:

1. Eight-Hour Vehicular Volume Warrant
2. Four-Hour Vehicular Volume Warrant
3. Peak-Hour Warrant
4. Pedestrian Volume Warrant
5. School Crossing Warrant
6. Coordinated Signal System Warrant
7. Crash Experience Warrant
8. Roadway Network Warrant
9. Intersection Near a Grade Crossing Warrant

A traffic control signal should not be installed unless one or more of the factors reflected in these warrants are met. Moreover, the satisfaction of a warrant or warrants does not justify signal installation unless an engineering study indicates that the installation will improve the overall safety and/or operation of the intersection.

In this study, we performed a preliminary analysis of the applicable traffic signal warrants based on available traffic data. The applicable factors for this intersection are contained in Warrants 1, 2, and 7. Warrant 3 is intended for unusual cases, such as office complexes, manufacturing plants, industrial complexes, or high-occupancy-vehicle facilities that attract or discharge large numbers

[9] Federal Highway Administration, U.S. Department of Transportation, *Chapter 4C. Traffic Control Signal Needs*, 2009 Edition, December 2009.

of vehicles over a short time. The intersection is regarded as a stand-alone location; it is not close to any schools or near a grade crossing, not a part of a coordinated traffic system, and has low pedestrian volumes. Therefore Warrants 3, 4, 5, 6, 8, and 9 were not tested.

Table 5 shows the examination of Warrants 1, 2, and 7 based on hourly volumes of an average day, which were derived from three midweek days' 24-hour automatic traffic counts. The counts were collected by MassDOT from May 16 to May 20, 2011; the volumes were considered typical for the season (see Appendix D for a detailed summary of hourly volumes from all of the approaches at the intersection). As the speeds along Lincoln Street are observed to be in the 40 to 45 mph range, the necessary volume thresholds for Warrants 1 and 2 were reduced to 70% of the minimum.

TABLE 5
Summary of Hourly Volumes and Warrant Fulfillment

Hourly Period Starting	Lincoln Street (Route 85) (main street)		Packard/Cox Sts. (minor street)		Sum of Main Street	Higher of Minor Street	Volumes above the Minimum Requirement		
	NB	SB	EB	WB			Warrant 1	Warrant 2	Warrant 7
6:00	100	187	79	126	287	126	No	No	No
7:00	180	294	119	246	474	246	Yes	Yes	Yes
8:00	211	265	154	210	476	210	Yes	Yes	Yes
9:00	132	173	63	139	305	139	No	No	Yes
10:00	125	150	88	154	275	154	No	No	No
11:00	153	154	101	153	307	153	No	No	Yes
12:00 noon	142	140	103	168	282	168	No	No	Yes
1:00	161	148	86	147	309	147	No	No	Yes
2:00	192	151	110	211	343	211	No	No	Yes
3:00	211	199	139	246	410	246	Yes	Yes	Yes
4:00	242	201	112	326	443	326	Yes	Yes	Yes
5:00	240	220	119	400	460	400	Yes	Yes	Yes
6:00	172	191	91	241	363	241	No	Yes	Yes

Warrant 1 (Eight-Hour Vehicular Volume Warrant) requires that certain traffic conditions (observed vehicular volumes higher than the specified minimum volumes) exist for each of any eight hours of an average day. In this case, 70% of the volume thresholds were applied based on the observed speeds being greater than 40 mph. The observed traffic conditions were met for only five hours of an average day.

Warrant 2 (Four-Hour Vehicular Volume Warrant) requires that certain traffic condition(similar to Warrant 1, but with minimum volumes specified differently) exist for each of any four hours of an average day. As shown in Table 5, traffic conditions were met in six hours of an average day.

Warrant 7 (Crash Experience Warrant) requires that the traffic conditions exist (vehicular volumes higher than 80 percent of the volumes required by Warrant 1, in addition to the requirement of five or more correctable crashes in the recent 12-month period). Table 5 shows

that traffic conditions over eight hours were met and HPD crash data indicate that there were five crashes in 2010.

The above analysis indicates that the intersection does not meet the traffic conditions required by Warrant 1. However, it meets the conditions required by Warrants 2 and 7.

ANALYSIS OF TRAFFIC SIGNAL ALTERNATIVE

The preliminary traffic signal warrants analysis shows that the intersection is meets the requirements for installing a traffic signal based on Warrants 2 and 7. The following section will examine how a traffic signal control would work at this intersection.

Synchro tests of the installation of a traffic signal control indicate that under the existing layout the intersection would operate at an overall level of service (LOS) B in both the AM and PM peak hours, with all individual approaches running at a desirable LOS B or better (see Table 6). The signal was modeled as a three-phase traffic operation, including an exclusive pedestrian phase of 20 seconds. The existing geometry was maintained—single-lane shared approaches and crosswalks provided on all approaches. Detailed analysis and signal timing settings are included in Appendix E.

TABLE 6
Intersection Capacity Analysis
Traffic Signal Option under Existing Traffic Conditions

Street name		**Lincoln Street**						**Packard Street**			**Cox Street**			**Overall**
Direction		**Northbound**			**Southbound**			**Eastbound**			**Westbound**			
Turning movement		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM peak hour	**LOS**	**A**			**B**			**B**			**B**			**B**
	Delay (sec/veh)	9.9			15.1			14.4			16.2			14.0
	95% Queue (ft)	100			220			70			110			NA
PM peak hour	**LOS**	**B**			**B**			**B**			**B**			**B**
	Delay (sec/veh)	16.1			17.0			11.4			18.7			16.7
	95% Queue (ft)	140			128			64			252			NA

In addition, a future-year scenario for 2031 was analyzed for the traffic signal option. The growth assumption is based on a review of MassDOT traffic counts in the Hudson area. They reveal that for the last 10 years, traffic volumes have been level, with no real growth shown. Therefore, a 0.5% per year growth factor was applied over a 20-year period to reflect background traffic growth in the area. This amounts to approximately a 10.5% total growth over the 20-year period. As shown in Table 7, the signalized intersection, without any geometric design modifications, would still operate at a desirable LOS B in both the AM and PM peak hours under the projected traffic conditions (see Appendix F for details of the analysis results).

The above analyses show that a traffic signal would operate at LOS B in the 2031. In addition, the signal is expected to reduce the frequency and severity of certain types of crashes, especially the

angle collisions, which were the predominant crash type at this intersection. Currently the intersection has stop signs located on the Packard Street and Cox Street approaches. The future overhead signal indications would increase the awareness and visibility of the intersection, especially for the eastbound Packard Street approach, which also would have additional advanced "Signal ahead" warning signs. These measures are further discussed in the section on recommendations and discussion.

TABLE 7
Intersection Capacity Analysis
Traffic Signal Option under 2031 Projected Traffic Conditions

Street name		**Lincoln Street**						**Packard Street**			**Cox Street**			**Overall**
Direction		**Northbound**			**Southbound**			**Eastbound**			**Westbound**			
Turning movement		LT	TH	RT	LT	TH	RT	LT	TH	RT	LT	TH	RT	
AM peak hour	LOS	**B**			**B**			**B**			**C**			**B**
	Delay (sec/veh)	10.9			16.6			17.7			20.4			16.2
	95% Queue (ft)	115			240			90			140			NA
PM peak hour	LOS	**B**			**B**			**B**			**B**			**B**
	Delay (sec/veh)	17.4			18.6			11.8			19.6			17.8
	95% Queue (ft)	160			150			70			280			NA

IMPROVEMENT RECOMMENDATIONS AND DISCUSSION

The above safety and operations analyses indicate that the existing two-way stop control is not effective for the roadway and traffic conditions at this intersection. To improve safety and operations at this intersection, a fully actuated traffic signal for the Cox Street and Packard Street approaches should be constructed in place of the two-way STOP control.

The installation of a traffic signal was determined to have met warrant criteria and to be operationally acceptable. Preliminary analysis shows that the required traffic conditions of Warrant 1 are not met, but the conditions of Warrants 2 and 7 are satisfied for this intersection. MassDOT usually prefers that an intersection meet the conditions of Warrant 1 for recommending the installation of a traffic signal. However, the crash data analysis indicates that the intersection has a high number of angle collisions, and a higher-than-average personal injury crash rate (about half of the total crashes in each year). A traffic signal would improve intersection safety by reducing the frequency and severity of the angle collisions. It would also improve the pedestrian safely at this intersection as it could stop all of the traffic at intervals and provide an exclusive pedestrian signal phase for pedestrians crossing the intersection.

Capacity analyses of the signalized intersection under the existing layout indicate that overall traffic operations would be improved. Although Lincoln Street (Route 85) would come under signalized control, resulting in some added delays, both of its approaches would operate at LOS B with acceptable delays, even under the projected future traffic conditions. With the traffic signal, traffic operations on Cox Street and Packard Street would be much improved, with reduced delays. More significantly, a signal would alleviate the problem of sight distance deficiency of

between drivers on the Lincoln Street southbound and on the Packard Street eastbound approach by alternating the green cycles for the two intersecting roadways.

Staff also considered the potential of redesigning this intersection as a modern roundabout. However, a roundabout design was determined to be unfavorable because (1) it would likely require land takings from adjacent properties, and (2) it would not be suitable for safe operations on the downward-sloping approach of Packard Street.

We therefore recommend the installation of a traffic signal at this intersection, with the following major features:

- Install a fully actuated traffic signal system.
- Install overhead signal indications supported by mast arms, which can be clearly viewed from all approaches.
- Install a "Signal ahead" warning sign (MUTCD W3-3) on Packard Street.
- Maintain existing single-lane approaches, as the intersection capacity analyses of the existing and future traffic volumes do not require additional through or turning lanes.
- Modify the intersection layout by extending the curb of the northwest corner about 10 to 15 feet southeastward, farther into the intersection (see Figure 4).[10]
- Relocate the crosswalk on the Lincoln Street southbound approach farther south, closer to the intersection.[11]
- Install crosswalks across all approaches.[12]
- Install pedestrian signal heads and push buttons at all corners of the intersection.
- Install wheelchair ramps that meet ADA (American with Disabilities Act) and AAB (Massachusetts Architectural Access Board) standards at all corners of the intersection.
- Upgrade any substandard sidewalks connected to the intersection.

Figure 4 shows the proposed curb extension and new crosswalks.[13] At this preliminary planning stage, the total cost of the signal installation and the intersection reconstruction can be roughly estimated to be around $1,000,000, assuming that there would not be any land-taking costs. Currently, Lincoln Street (Route 85), Packard Street, and Cox Street are owned by the Town of Hudson. The implementation would require the town to work closely with MassDOT through the project implantation process (see Appendix G). The Town can prepare the Project Need Form (PNF) and Project Initiation Form (PIF) for improvements to be implemented at this location, as

[10] The curb extension would tighten the intersection, allow more defined traffic paths, and slow down the vehicles going through the intersection.

[11] Currently the crosswalk is located about 70 feet north of the intersection because the crossing distance for the approach is too wide at the intersection. The curb extension would provide the opportunity of placing the crosswalk at the intersection for the safety and convenience of pedestrians.

[12] Currently there are crosswalks on the southbound and westbound approaches (and there might have been one on the northbound approach, but if there was one there, the paint has completely faded). With the curb extension, a crosswalk on the eastbound approach could also be installed and connected to the other crosswalks. It would provide pedestrians a safe and convenient crossing environment, with crosswalks on all approaches and an exclusive pedestrian signal phase.

[13] In the design stage, there should also be an investigation of whether or not the turning radii of both corners of Cox Street could be slightly reduced in order to bring the crosswalks closer to the intersection and to slow down intersection traffic.

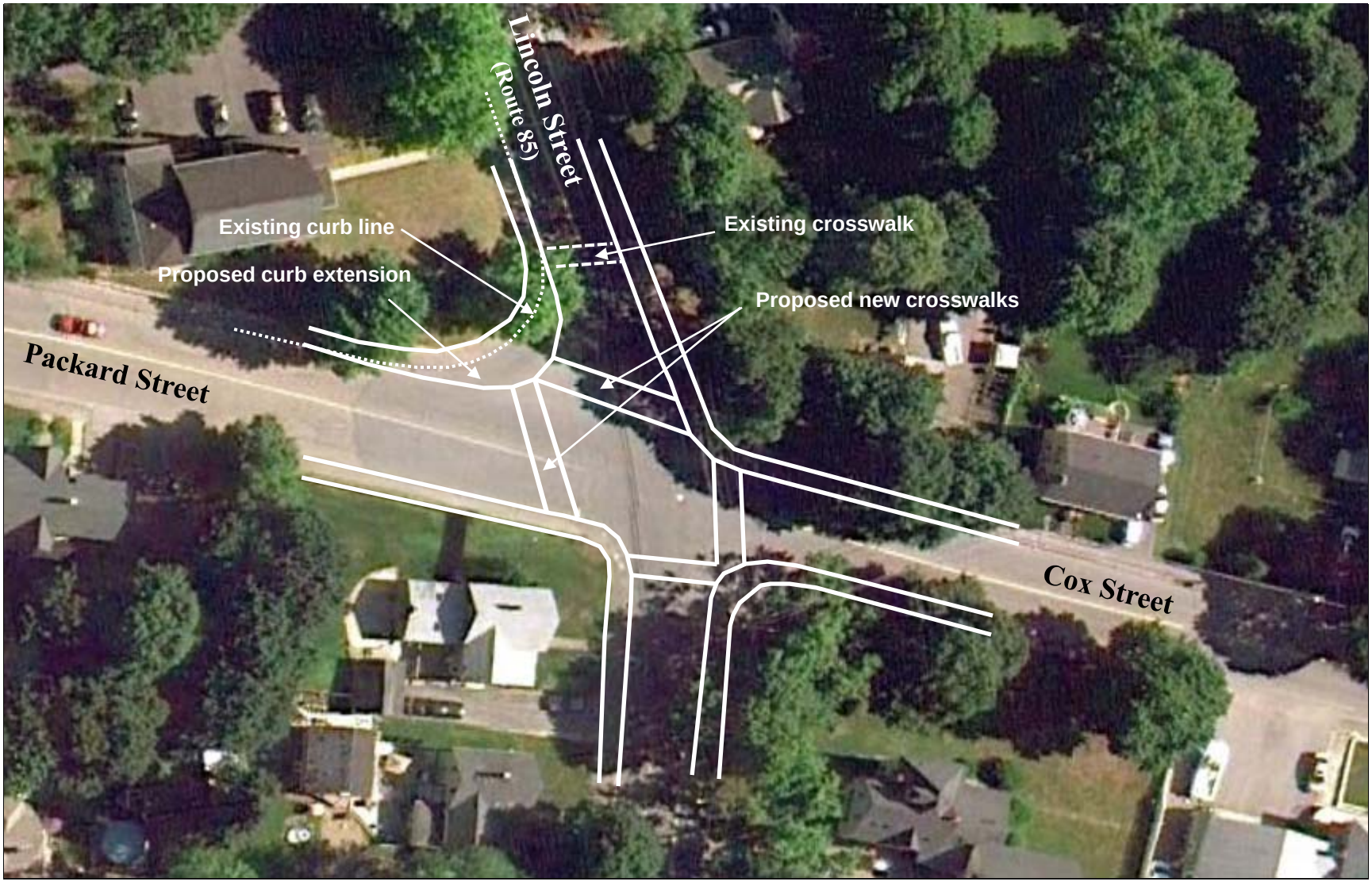

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FIGURE 4
Concept Diagram of Intersection Modifications
Lincoln Street at Cox Street/Packard Street, Hudson

Safety and Operations Analyses at Selected Intersections

an important part of the Needs Identification and Project Initiation process, to attain public consensus for a conceptual design. The MassDOT Highway Division District 3 staff will assist the Town in preparing these forms. In addition, the Town will have to request that the Boston Region MPO place any proposed project for this location in the Transportation Improvement Program.

In the short term, the following measures can help to improve the existing traffic operations and the intersection safety:

- Replace existing 24 –inch-square stop signs (MUTCD type R-1) with oversized 36-inch square stop signs. To increase attention to the signs, a red reflective stripe should be installed on the sign post.
- Provide advance warning signs on the Packard Street and Cox Street approaches. A "Stop ahead" graphic sign (W3-1, oversized, 36 by 36 inches) should be placed a minimum of 125 feet from the existing stop sign (at the crest of the hill on the Packard Street approach). An additional "Cross road" (W2-1) sign should be placed before the W3-1 sign.
- Provide "Stop ahead" pavement markings on both the Packard Street and Cox Street approaches.
- Increase the size of the existing Lincoln Street southbound 30-mph speed limit sign (R2-1) to 30 by 36 inches.
- Install pedestrian crossing warning signs (W 11-2 and W 16-7P) at both sides of the existing crosswalk on Lincoln Street just north of the intersection.
- Consider relocating the existing Lincoln Street southbound 35-mph and 30-mph speed limit signs from the current location to farther north. Alternatively, a "Reduced Speed Limit Ahead" (W 3-5) warning sign could be installed approaching the existing 30-mph speed limit sign.
- Install "Cross road" (W2-1) signs on both the northbound and southbound Lincoln Street approaches.
- Ensure that pavements markings such as stop lines, yellow center lines, and white shoulder lines are clearly visible to delineate the travel path of vehicles at the intersection.
- Ensure that low-hanging tree limbs located on the Cox Street approach are trimmed to allow clear sight lines for drivers.
- Ensure that the two existing street lights at the intersection are on from dusk to dawn and consider adding lighting on Packard Street.

These short-term measures would increase drivers' awareness and attention to the traffic conditions and regulations at the intersection. As a consequence, the frequency and severity of the crashes at the intersection would potentially be reduced.

MassDOT Highway Division District 3 reviewed this study and provided comments on the short- and long-term improvements (see Appendix H). In addition, the Town's comments on this study and responses to MassDOT District 3's comments are provided in Appendix I.

MA/CW/EP/ma/cw

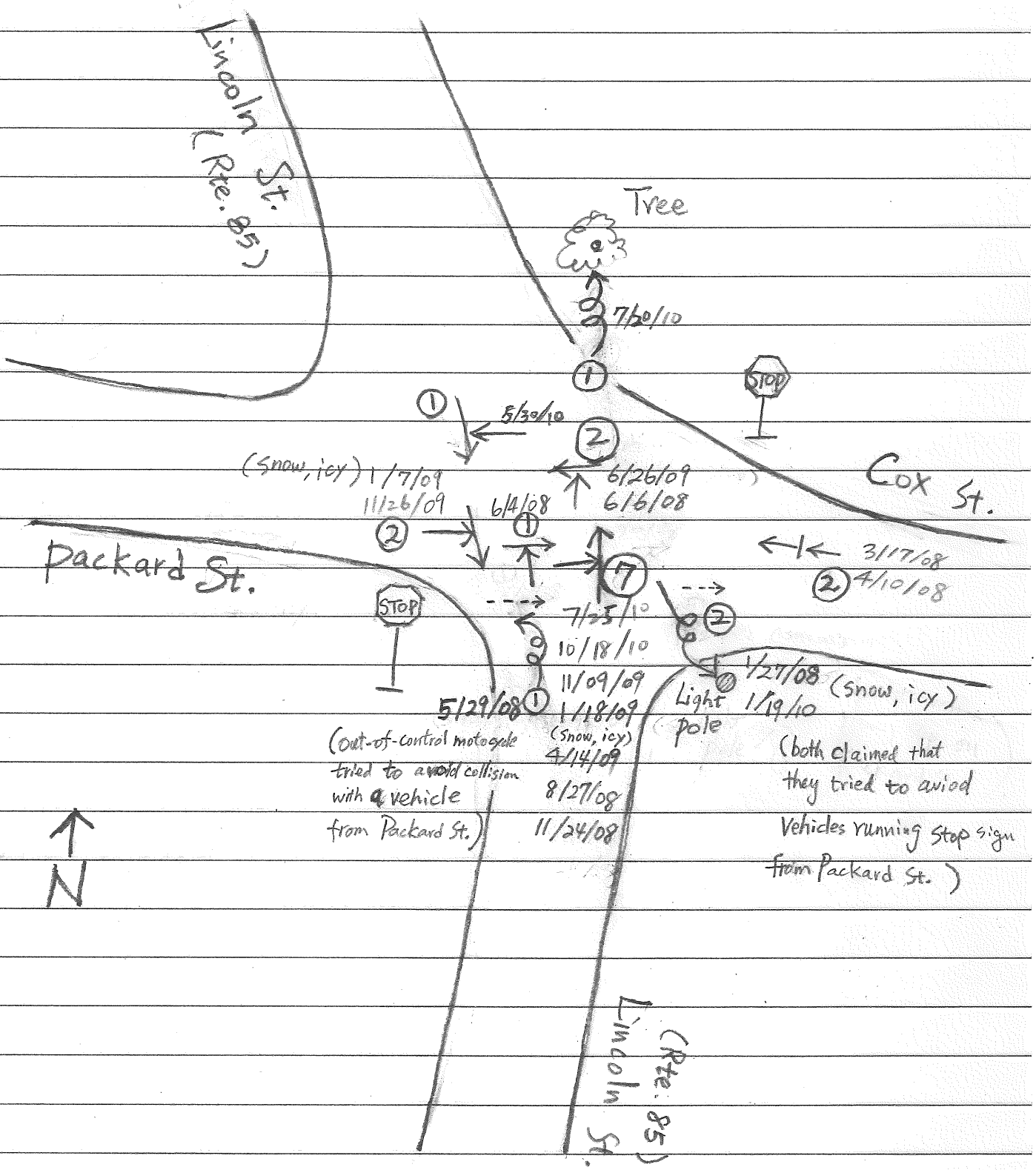
APPENDIX A

Draft Intersection Crash Diagram:
Lincoln Street at Cox Street/Packard Street, Hudson

Draft Collision Diagram

Lincoln St. @ Cox / Parcard St., Hudson

2008 - 2010 Hudson Police Department Crash Reports



APPENDIX B

Intersection Crash Rate Calculation:
Lincoln Street at Cox Street/Packard Street, Hudson

INTERSECTION CRASH RATE WORKSHEET

CITY/TOWN : Hudson | COUNT DATE : 4/28/2011

DISTRICT : 3 | UNSIGNALIZED : X | SIGNALIZED :

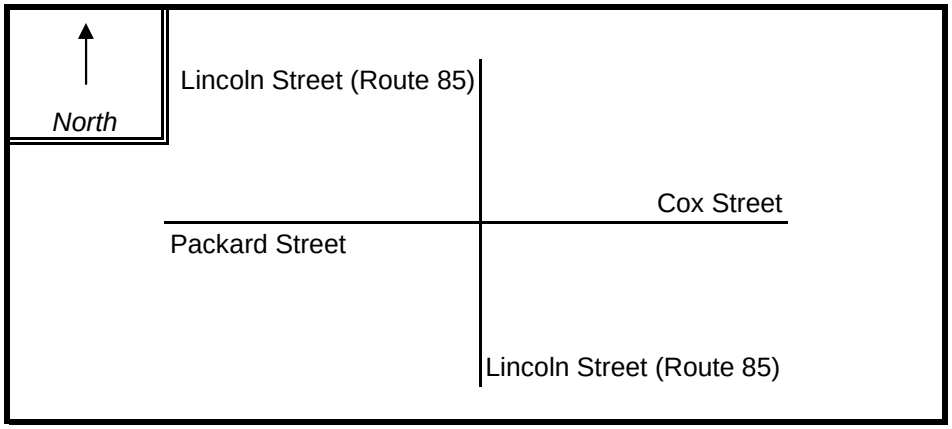
~ INTERSECTION DATA ~

MAJOR STREET : Lincoln Street (Route 85)

MINOR STREET(S) : Packard Street

Cox Street

INTERSECTION DIAGRAM (Label Approaches)



PEAK HOUR VOLUMES

APPROACH :	1	2	3	4	5	Total Peak Hourly Approach Volume
DIRECTION :	NB	SB	EB	WB		
PEAK HOURLY VOLUMES (AM/**PM**) :	253	215	107	348		**923**

" K " FACTOR : **0.097**

INTERSECTION ADT (**V**) = TOTAL DAILY APPROACH VOLUME : **9,515**

TOTAL # OF CRASHES : 18

OF YEARS : 3

AVERAGE # OF CRASHES PER YEAR (**A**) : **6.00**

CRASH RATE CALCULATION : **1.728**

RATE = $\frac{(A * 1{,}000{,}000)}{(V * 365)}$

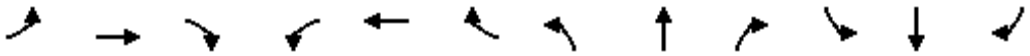
Comments : MassDOT District 3 Average Rate = 0.66 (July 7, 2011)

Project Title & Date: Safety and Operations Analyses at Selected Intersections

APPENDIX C

AM/PM Peak-Hour Intersection Capacity Analysis:
Existing Conditions
Lincoln Street at Cox Street/Packard Street, Hudson

HCM Unsignalized Intersection Capacity Analysis
1: Packard Street EB & Lincoln Street SB

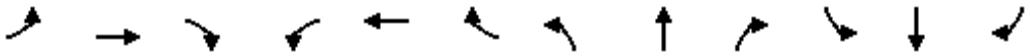


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	18	96	5	53	87	62	24	118	55	114	157	27
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.83	0.83	0.83	0.90	0.90	0.90	0.82	0.82	0.82	0.86	0.86	0.86
Hourly flow rate (vph)	22	116	6	59	97	69	29	144	67	133	183	31
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	817	733	198	763	715	177	214			211		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	817	733	198	763	715	177	214			211		
tC, single (s)	7.2	6.6	6.3	7.1	6.5	6.2	4.2			4.1		
tC, 2 stage (s)												
tF (s)	3.6	4.1	3.4	3.5	4.0	3.3	2.3			2.2		
p0 queue free %	88	62	99	71	69	92	98			90		
cM capacity (veh/h)	185	302	830	203	312	860	1327			1366		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	143	224	240	347
Volume Left	22	59	29	133
Volume Right	6	69	67	31
cSH	283	331	1327	1366
Volume to Capacity	0.51	0.68	0.02	0.10
Queue Length 95th (ft)	67	117	2	8
Control Delay (s)	30.2	36.1	1.1	3.6
Lane LOS	D	E	A	A
Approach Delay (s)	30.2	36.1	1.1	3.6
Approach LOS	D	E		

Intersection Summary				
Average Delay	14.6			
Intersection Capacity Utilization	55.1%	ICU Level of Service	B	
Analysis Period (min)	15			

HCM Unsignalized Intersection Capacity Analysis
1: Packard Street EB & Lincoln Street SB



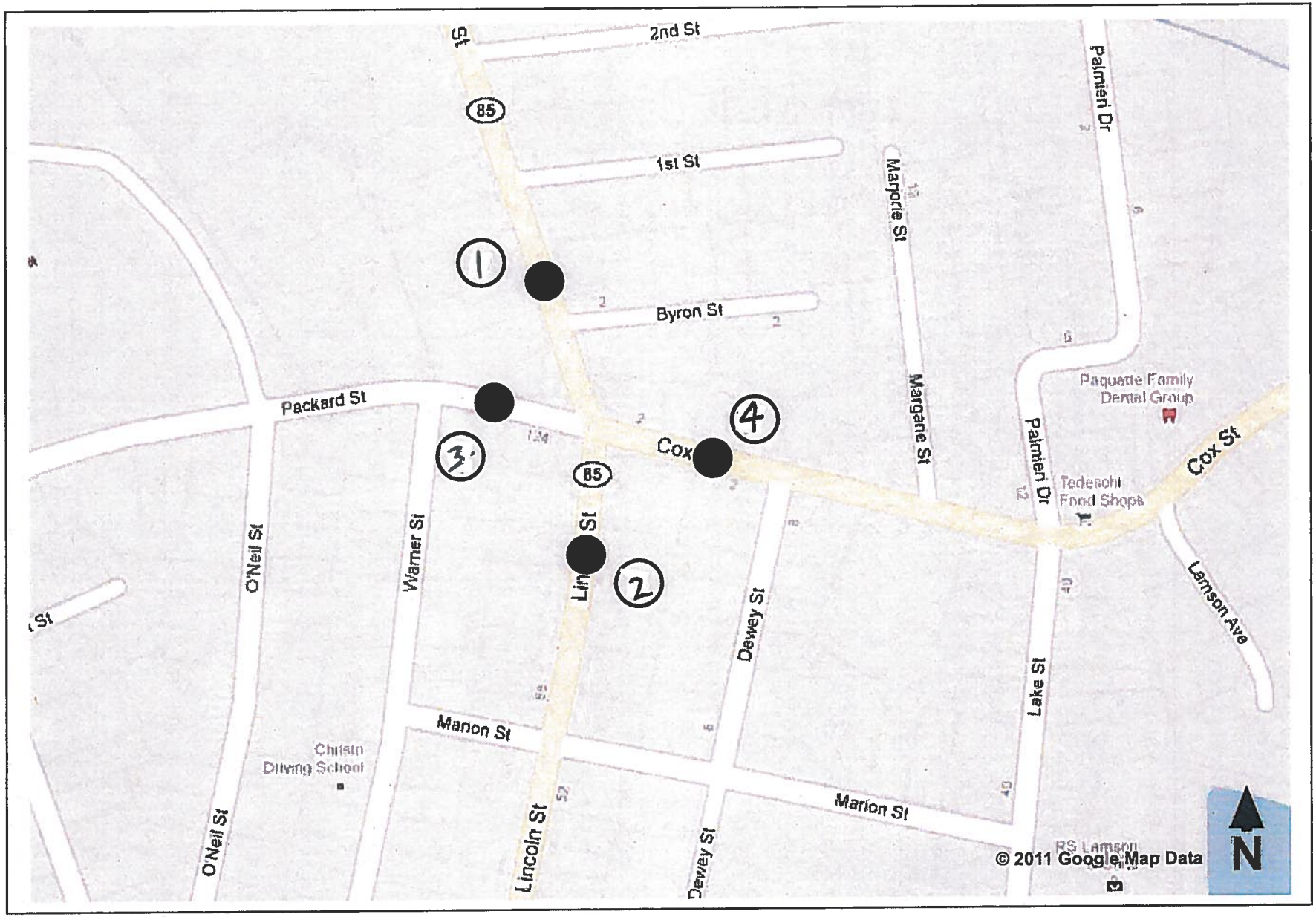
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	17	82	8	82	151	115	13	196	44	57	124	34
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.81	0.81	0.81	0.89	0.89	0.89	0.96	0.96	0.96	0.93	0.93	0.93
Hourly flow rate (vph)	21	101	10	92	170	129	14	204	46	61	133	37
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	742	551	152	589	547	227	170			250		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	742	551	152	589	547	227	170			250		
tC, single (s)	7.1	6.5	6.2	7.1	6.5	6.2	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	89	76	99	72	60	84	99			95		
cM capacity (veh/h)	183	417	895	324	420	812	1414			1304		

Direction, Lane #	EB 1	WB 1	NB 1	SB 1
Volume Total	132	391	264	231
Volume Left	21	92	14	61
Volume Right	10	129	46	37
cSH	359	461	1414	1304
Volume to Capacity	0.37	0.85	0.01	0.05
Queue Length 95th (ft)	41	212	1	4
Control Delay (s)	20.8	43.0	0.5	2.4
Lane LOS	C	E	A	A
Approach Delay (s)	20.8	43.0	0.5	2.4
Approach LOS	C	E		

Intersection Summary			
Average Delay	19.9		
Intersection Capacity Utilization	61.6%	ICU Level of Service	B
Analysis Period (min)	15		

APPENDIX D

Summary of Weekday Traffic Volumes:
5/16 to 5/19, 2011
Lincoln Street at Cox Street/Packard Street, Hudson



Locations 1 – 4 in Hudson

Mass Highway Department
WEEKLY SUMMARY FOR LANE 1
Starting: 5/16/2011

STA. 1 NB

Site Reference: 110260000512
Site ID: 000000010102
Location: RTE. 85/LINCOLN ST. NORTH OF COX ST.
Direction: NORTH

File: 1-0102.prn
City: HUDSON
County: DIR VOL N&S

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		19	16	19		18			18	54
02:00		9	3	4		5			5	16
03:00		3	6	3		4			4	12
04:00		2	6	4		4			4	12
05:00		10	17	12		13			13	39
06:00		40	39	41		40			40	120
07:00		117	119	128		121			121	364
08:00		199	186	174		186			186	559
09:00		173	189	170		177			177	532
10:00		144	119	129		130			130	392
11:00		131	128			129			129	259
12:00		140	157			148			148	297
13:00	126	146	160			144			144	432
14:00	152	157	171			160			160	480
15:00	183	201	215			199			199	599
16:00	278	257	248			261			261	783
17:00	308	292	290			296			296	890
18:00	312	338	318			322			322	968
19:00	187	215	213			205			205	615
20:00	156	176	153			161			161	485
21:00	111	115	97			107			107	323
22:00	86	94	105			95			95	285
23:00	44	46	60			50			50	150
24:00	28	44	31			34			34	103
TOTALS	1971	3068	3046	684	0	3009	0	0	3009	8769
% AVG WKDY	65.5	101.9	101.2	22.7						
% AVG WEEK	65.5	101.9	101.2	22.7						
AM Times		08:00	09:00	08:00		08:00			08:00	
AM Peaks		199	189	174		186			186	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	312	338	318			322			322	

495

NB 3009
SB 2855
COMB AWD 5864
FAC .91 (.98)
COMB ADT 5,200

STA. 1SB

Site Reference: 110260000512
Site ID: 000000010102
Location: RTE. 85/LINCOLN ST. NORTH OF COX ST.
Direction: SOUTH

File: 1-0102.prn
City: HUDSON
County: DIR VOL N&S

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		9	10	19		12			12	38
02:00		4	4	1		3			3	9
03:00		3	1	0		1			1	4
04:00		3	6	3		4			4	12
05:00		7	10	6		7			7	23
06:00		52	50	63		55			55	165
07:00		178	184	199		187			187	561
08:00		300	284	298		294			294	882
09:00		275	255	267		265			265	797
10:00		162	185	172		173			173	519
11:00		142	159			150			150	301
12:00		156	153			154			154	309
13:00	128	131	163			140			140	422
14:00	153	141	150			148			148	444
15:00	130	145	180			151			151	455
16:00	202	199	197			199			199	598
17:00	202	196	207			201			201	605
18:00	203	228	230			220			220	661
19:00	195	195	183			191			191	573
20:00	99	153	100			117			117	352
21:00	66	78	78			74			74	222
22:00	53	65	52			56			56	170
23:00	31	38	37			35			35	106
24:00	14	23	19			18			18	56
TOTALS	1476	2883	2897	1028	0	2855	0	0	2855	8284
% AVG WKDY	51.6	100.9	101.4	36						
% AVG WEEK	51.6	100.9	101.4	36						
AM Times		08:00	08:00	08:00		08:00			08:00	
AM Peaks		300	284	298		294			294	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	203	228	230			220			220	

Mass Highway Department
WEEKLY SUMMARY FOR LANE 1
Starting: 5/16/2011

STA. 2 NB

Site Reference: 110260000654
Site ID: 000000020102
Location: RTE. 85/LINCOLN ST. SOUTH OF COX ST.
Direction: NORTH

File: 2-0102.prn
City: HUDSON
County: DIR VOL N&S

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		15	13	14		14			14	42
02:00		10	4	5		6			6	19
03:00		2	3	4		3			3	9
04:00		0	3	3		2			2	6
05:00		5	10	5		6			6	20
06:00		28	31	32		30			30	91
07:00		95	99	108		100			100	302
08:00		182	179	179		180			180	540
09:00		217	223	193		211			211	633
10:00		142	134	120		132			132	396
11:00		118	132			125			125	250
12:00		134	172			153			153	306
13:00	126	138	162			142			142	426
14:00	148	179	157			161			161	484
15:00	190	201	186			192			192	577
16:00	225	205	204			211			211	634
17:00	245	238	245			242			242	728
18:00	247	246	229			240			240	722
19:00	179	176	163			172			172	518
20:00	136	166	144			148			148	446
21:00	99	119	100			106			106	318
22:00	79	93	105			92			92	277
23:00	46	42	59			49			49	147
24:00	28	38	33			33			33	99
TOTALS	1748	2789	2790	663	0	2750	0	0	2750	7990
% AVG WKDY	63.5	101.4	101.4	24.1						
% AVG WEEK	63.5	101.4	101.4	24.1						
AM Times		09:00	09:00	09:00		09:00			09:00	
AM Peaks		217	223	193		211			211	
PM Times	18:00	18:00	17:00			17:00			17:00	
PM Peaks	247	246	245			242			242	

US

NB 2750
SB 2678
COMB AWD 5428
FAC .91 (.98)
COMB ADT 4,800

Mass Highway Department
WEEKLY SUMMARY FOR LANE 2
Starting: 5/16/2011

STA. 2 SB

Site Reference: 110260000654
Site ID: 000000020102
Location: RTE. 85/LINCOLN ST. SOUTH OF COX ST.
Direction: SOUTH

File: 2-0102.prn
City: HUDSON
County: DIR VOL N&S

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		8	11	13		10			10	32
02:00		4	6	4		4			4	14
03:00		2	3	1		2			2	6
04:00		2	4	3		3			3	9
05:00		8	9	5		7			7	22
06:00		44	46	53		47			47	143
07:00		126	138	148		137			137	412
08:00		210	197	214		207			207	621
09:00		206	201	197		201			201	604
10:00		148	154	154		152			152	456
11:00		176	173			174			174	349
12:00		148	193			170			170	341
13:00	137	149	183			156			156	469
14:00	143	143	145			143			143	431
15:00	163	160	188			170			170	511
16:00	201	195	200			198			198	596
17:00	182	176	188			182			182	546
18:00	194	212	217			207			207	623
19:00	186	208	191			195			195	585
20:00	104	132	120			118			118	356
21:00	67	75	90			77			77	232
22:00	57	70	70			65			65	197
23:00	34	33	30			32			32	97
24:00	21	23	21			21			21	65
TOTALS	1489	2658	2778	792	0	2678	0	0	2678	7717
% AVG WKDY	55.6	99.2	103.7	29.5						
% AVG WEEK	55.6	99.2	103.7	29.5						
AM Times		08:00	09:00	08:00		08:00			08:00	
AM Peaks		210	201	214		207			207	
PM Times	16:00	18:00	18:00			18:00			18:00	
PM Peaks	201	212	217			207			207	

Mass Highway Department
WEEKLY SUMMARY FOR LANE 1
Starting: 5/16/2011

STA. 3 EB

Site Reference: 110260000770
Site ID: 000000030304
Location: PACKARD ST. WEST OF RTE. 85/LINCOLN ST.
Direction: EAST

File: 3-0304.prn
City: HUDSON
County: DIR VOL E&W

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		4	8	1		4			4	13
02:00		0	3	2		1			1	5
03:00		1	2	2		1			1	5
04:00		4	1	6		3			3	11
05:00		5	7	3		5			5	15
06:00		23	27	18		22			22	68
07:00		81	86	71		79			79	238
08:00		123	113	122		119			119	358
09:00		136	174	154		154			154	464
10:00		56	72	63		63			63	191
11:00		69	107			88			88	176
12:00		69	134			101			101	203
13:00	80	104	125			103			103	309
14:00	94	78	87			86			86	259
15:00	124	105	102			110			110	331
16:00	138	133	146			139			139	417
17:00	109	116	111			112			112	336
18:00	137	122	98			119			119	357
19:00	89	100	85			91			91	274
20:00	43	64	72			59			59	179
21:00	56	49	33			46			46	138
22:00	50	38	28			38			38	116
23:00	18	26	14			19			19	58
24:00	12	18	12			14			14	42
TOTALS	950	1524	1647	442	0	1576	0	0	1576	4563
% AVG WKDY	60.2	96.7	104.5	28						
% AVG WEEK	60.2	96.7	104.5	28						
AM Times		09:00	09:00	09:00		09:00			09:00	
AM Peaks		136	174	154		154			154	
PM Times	16:00	16:00	16:00			16:00			16:00	
PM Peaks	138	133	146			139			139	

U6

EB 1576
WB 1800
COMB AWD 3376
FAC .91(.99)
COMB ADT 3,000

Mass Highway Department
WEEKLY SUMMARY FOR LANE 2 Page: 2
Starting: 5/16/2011

STA. 3 WB

Site Reference: 110260000770 File: 3-0304.prn
Site ID: 000000030304 City: HUDSON
Location: PACKARD ST. WEST OF RTE. 85/LINCOLN ST. County: DIR VOL E&W
Direction: WEST

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		8	8	12		9			9	28
02:00		3	2	1		2			2	6
03:00		0	4	2		2			2	6
04:00		2	1	3		2			2	6
05:00		0	2	5		2			2	7
06:00		20	19	22		20			20	61
07:00		30	42	41		37			37	113
08:00		115	117	106		112			112	338
09:00		191	180	174		181			181	545
10:00		76	72	86		78			78	234
11:00		82	101			91			91	183
12:00		83	135			109			109	218
13:00	119	100	110			109			109	329
14:00	98	86	98			94			94	282
15:00	142	155	93			130			130	390
16:00	144	152	130			142			142	426
17:00	152	167	149			156			156	468
18:00	185	188	191			188			188	564
19:00	140	119	123			127			127	382
20:00	76	92	80			82			82	248
21:00	55	66	56			59			59	177
22:00	29	38	31			32			32	98
23:00	26	29	25			26			26	80
24:00	10	12	8			10			10	30
TOTALS	1176	1814	1777	452	0	1800	0	0	1800	5219
% AVG WKDY	65.3	100.7	98.7	25.1						
% AVG WEEK	65.3	100.7	98.7	25.1						
AM Times		09:00	09:00	09:00		09:00			09:00	
AM Peaks		191	180	174		181			181	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	185	188	191			188			188	

Mass Highway Department
WEEKLY SUMMARY FOR LANE 1
Starting: 5/16/2011

STA. 4EB

Site Reference: 110260000805
Site ID: 000000040304
Location: COX ST. EAST OF RTE. 85/LINCOLN ST.
Direction: EAST

File: 4-0304.prn
City: HUDSON
County: DIR VOL E&W

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		9	8	22		13			13	39
02:00		1	4	3		2			2	8
03:00		2	2	2		2			2	6
04:00		2	3	3		2			2	8
05:00		7	10	11		9			9	28
06:00		28	34	47		36			36	109
07:00		150	147	28		108			108	325
08:00		280	257	233		256			256	770
09:00		240	237	322		266			266	799
10:00		110	154	175		146			146	439
11:00		102	139			120			120	241
12:00	62	110	130			100			100	302
13:00	130	131	143			134			134	404
14:00	148	123	125			132			132	396
15:00	170	147	139			152			152	456
16:00	184	188	189			187			187	561
17:00	213	174	65			150			150	452
18:00	237	195	129			187			187	561
19:00	157	136	214			169			169	507
20:00	91	106	192			129			129	389
21:00	69	84	133			95			95	286
22:00	56	73	81			70			70	210
23:00	21	25	47			31			31	93
24:00	14	15	10			13			13	39
TOTALS	1552	2438	2592	846	0	2509	0	0	2509	7428
% AVG WKDY	61.8	97.1	103.3	33.7						
% AVG WEEK	61.8	97.1	103.3	33.7						
AM Times	12:00	08:00	08:00	09:00		09:00			09:00	
AM Peaks	62	280	257	322		266			266	
PM Times	18:00	18:00	19:00			16:00			16:00	
PM Peaks	237	195	214			187			187	

46

EB 2509
WB 3189
COMB AWD 5698
FAC .91 (.99)
COMB ADT 5,100

Mass Highway Department
WEEKLY SUMMARY FOR LANE 2
Starting: 5/16/2011

STA. 4 WB

Site Reference: 110260000805
Site ID: 000000040304
Location: COX ST. EAST OF RTE. 85/LINCOLN ST.
Direction: WEST

File: 4-0304.prn
City: HUDSON
County: DIR VOL E&W

TIME	MON 16	TUE 17	WED 18	THU 19	FRI	WKDAY AVG	SAT	SUN	WEEK AVG	TOTAL
01:00		16	11	20		15			15	47
02:00		0	4	6		3			3	10
03:00		2	6	3		3			3	11
04:00		1	4	7		4			4	12
05:00		9	11	10		10			10	30
06:00		30	31	61		40			40	122
07:00		72	79	228		126			126	379
08:00		192	169	379		246			246	740
09:00		170	171	290		210			210	631
10:00		128	108	182		139			139	418
11:00		161	148			154			154	309
12:00	80	134	171			128			128	385
13:00	167	163	174			168			168	504
14:00	154	125	164			147			147	443
15:00	235	229	170			211			211	634
16:00	251	246	241			246			246	738
17:00	286	274	420			326			326	980
18:00	316	345	540			400			400	1201
19:00	207	209	309			241			241	725
20:00	139	125	174			146			146	438
21:00	79	87	131			99			99	297
22:00	51	69	90			70			70	210
23:00	35	34	53			40			40	122
24:00	18	19	15			17			17	52
TOTALS	2018	2840	3394	1186	0	3189	0	0	3189	9438
% AVG WKDY	63.2	89	106.4	37.1						
% AVG WEEK	63.2	89	106.4	37.1						
AM Times	12:00	08:00	09:00	08:00		08:00			08:00	
AM Peaks	80	192	171	379		246			246	
PM Times	18:00	18:00	18:00			18:00			18:00	
PM Peaks	316	345	540			400			400	

APPENDIX E

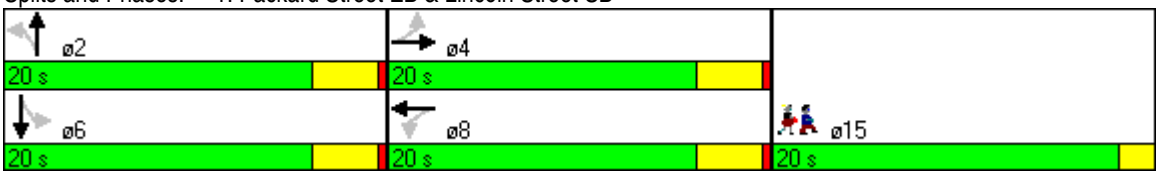
AM/PM Peak-Hour Intersection Capacity Analysis:
Traffic Signal Alternative with the Existing Intersection Layout
Lincoln Street at Cox Street/Packard Street, Hudson

Timings
1: Packard Street EB & Lincoln Street SB

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	ø15
Lane Configurations									
Volume (vph)	18	96	53	87	24	118	114	157	
Turn Type	Perm		Perm		Perm		Perm		
Protected Phases		4		8		2		6	15
Permitted Phases	4		8		2		6		
Detector Phase	4	4	8	8	2	2	6	6	
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	1.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (%)	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33%
Yellow Time (s)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	2.0
All-Red Time (s)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	None
Act Effct Green (s)		10.2		10.2		19.6		19.6	
Actuated g/C Ratio		0.25		0.25		0.48		0.48	
v/c Ratio		0.34		0.54		0.30		0.48	
Control Delay		14.4		16.2		9.9		15.1	
Queue Delay		0.0		0.0		0.0		0.0	
Total Delay		14.4		16.2		9.9		15.1	
LOS		B		B		A		B	
Approach Delay		14.4		16.2		9.9		15.1	
Approach LOS		B		B		A		B	

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 40.6	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.54	
Intersection Signal Delay: 14.0	Intersection LOS: B
Intersection Capacity Utilization 55.3%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Packard Street EB & Lincoln Street SB

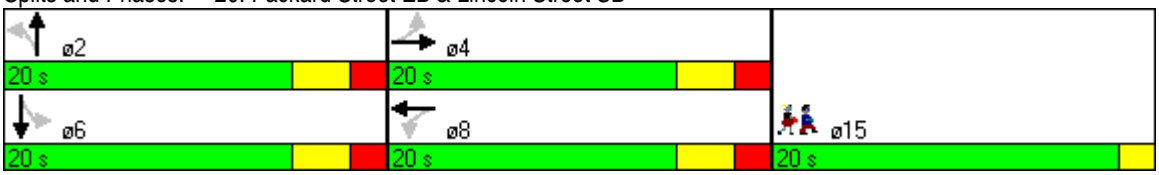


Timings
20: Packard Street EB & Lincoln Street SB

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	ø15
Lane Configurations									
Volume (vph)	17	82	82	151	13	196	57	124	
Turn Type	Perm		Perm		Perm		Perm		
Protected Phases		4		8		2		6	15
Permitted Phases	4		8		2		6		
Detector Phase	4	4	8	8	2	2	6	6	
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	1.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (%)	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33.3%	33%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	None
Act Effct Green (s)		14.8		14.8		11.1		11.1	
Actuated g/C Ratio		0.38		0.38		0.29		0.29	
v/c Ratio		0.20		0.63		0.51		0.51	
Control Delay		11.4		18.7		16.1		17.0	
Queue Delay		0.0		0.0		0.0		0.0	
Total Delay		11.4		18.7		16.1		17.0	
LOS		B		B		B		B	
Approach Delay		11.4		18.7		16.1		17.0	
Approach LOS		B		B		B		B	

Intersection Summary	
Cycle Length: 60	
Actuated Cycle Length: 38.7	
Natural Cycle: 60	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.63	
Intersection Signal Delay: 16.7	Intersection LOS: B
Intersection Capacity Utilization 64.5%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 20: Packard Street EB & Lincoln Street SB



APPENDIX F

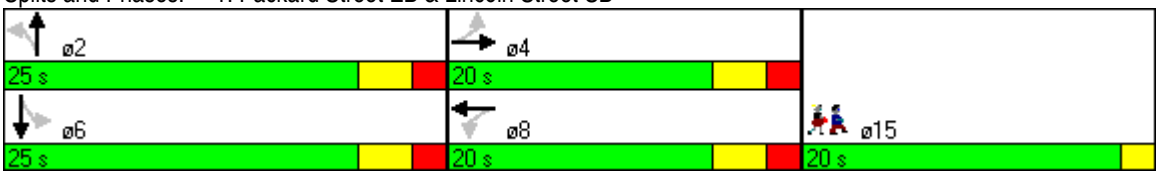
AM/PM Peak-Hour Intersection Capacity Analysis:
Traffic Signal Alternative under the Projected Future Traffic conditions
Lincoln Street at Cox Street/Packard Street, Hudson

Timings
1: Packard Street EB & Lincoln Street SB

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	ø15
Lane Configurations									
Volume (vph)	18	96	53	87	24	118	114	157	
Turn Type	Perm		Perm		Perm		Perm		
Protected Phases		4		8		2		6	15
Permitted Phases	4		8		2		6		
Detector Phase	4	4	8	8	2	2	6	6	
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	1.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	20.0	20.0	20.0	20.0	25.0	25.0	25.0	25.0	20.0
Total Split (%)	30.8%	30.8%	30.8%	30.8%	38.5%	38.5%	38.5%	38.5%	31%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	None
Act Effct Green (s)		11.2		11.2		20.5		20.5	
Actuated g/C Ratio		0.25		0.25		0.46		0.46	
v/c Ratio		0.38		0.60		0.35		0.56	
Control Delay		17.7		20.4		10.9		16.6	
Queue Delay		0.0		0.0		0.0		0.0	
Total Delay		17.7		20.4		10.9		16.6	
LOS		B		C		B		B	
Approach Delay		17.7		20.4		10.9		16.6	
Approach LOS		B		C		B		B	

Intersection Summary	
Cycle Length: 65	
Actuated Cycle Length: 44.4	
Natural Cycle: 65	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.60	
Intersection Signal Delay: 16.2	Intersection LOS: B
Intersection Capacity Utilization 61.4%	ICU Level of Service B
Analysis Period (min) 15	

Splits and Phases: 1: Packard Street EB & Lincoln Street SB

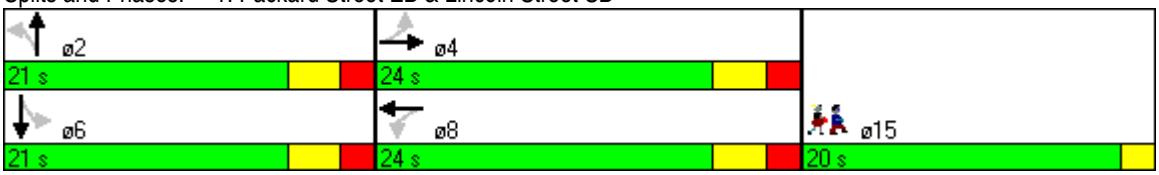


Timings
1: Packard Street EB & Lincoln Street SB

Lane Group	EBL	EBT	WBL	WBT	NBL	NBT	SBL	SBT	ø15
Lane Configurations									
Volume (vph)	17	82	82	151	13	196	57	124	
Turn Type	Perm		Perm		Perm		Perm		
Protected Phases		4		8		2		6	15
Permitted Phases	4		8		2		6		
Detector Phase	4	4	8	8	2	2	6	6	
Switch Phase									
Minimum Initial (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	1.0
Minimum Split (s)	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0	20.0
Total Split (s)	24.0	24.0	24.0	24.0	21.0	21.0	21.0	21.0	20.0
Total Split (%)	36.9%	36.9%	36.9%	36.9%	32.3%	32.3%	32.3%	32.3%	31%
Yellow Time (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.0
All-Red Time (s)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	0.0
Lost Time Adjust (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
Total Lost Time (s)	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	
Lead/Lag									
Lead-Lag Optimize?									
Recall Mode	None	None	None	None	Min	Min	Min	Min	None
Act Effct Green (s)		16.7		16.7		13.1		13.1	
Actuated g/C Ratio		0.39		0.39		0.31		0.31	
v/c Ratio		0.22		0.67		0.52		0.53	
Control Delay		11.8		19.6		17.4		18.6	
Queue Delay		0.0		0.0		0.0		0.0	
Total Delay		11.8		19.6		17.4		18.6	
LOS		B		B		B		B	
Approach Delay		11.8		19.6		17.4		18.6	
Approach LOS		B		B		B		B	

Intersection Summary	
Cycle Length: 65	
Actuated Cycle Length: 42.8	
Natural Cycle: 65	
Control Type: Actuated-Uncoordinated	
Maximum v/c Ratio: 0.67	
Intersection Signal Delay: 17.8	Intersection LOS: B
Intersection Capacity Utilization 68.6%	ICU Level of Service C
Analysis Period (min) 15	

Splits and Phases: 1: Packard Street EB & Lincoln Street SB



APPENDIX G

MassDOT Project Implementation Process

The following description of the implementation process is based on Chapter 2 of the *MassDOT Highway Division's Project Development and Design Guide (2005).* The text below borrows heavily from that document.

1 NEEDS IDENTIFICATION

For each of the locations at which an improvement is to be implemented, MassDOT Highway Division 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 Highway Division meets with potential participants, such as the Boston Region 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 Highway Division 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, for each improvement, a Project Initiation Form (PIF), 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 Capital Expenditure Program Office (CEPO). 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 Executive Office of Transportation and Public Works'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, 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.

5 PROGRAMMING

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, where the MPO receives preliminary information on the proposed project, the proponent requests that the MPO place the project in the region's TIP. The MPO considers the project in terms of 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, 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.

APPENDIX H

Comments from MassDOT Highway Division District 3

Chen-Yuan Wang

From: Frawley, Joseph (DOT) <joseph.frawley@state.ma.us>
Sent: Friday, January 20, 2012 2:35 PM
To: 'Chen-Yuan Wang'
Cc: 'Mark Abbott'; Efi Pagitsas; Nelson, Paul (DOT); 'Michelle Ciccolo'; 'kshea@townofhudson.org'
Subject: [unclassified] RE: Hudson Intersection Study

Chen-Yuan,

I have reviewed the draft report for the intersection of Lincoln Street at Cox Street / Packard Street in the Town of Hudson. I have provided some comments below for your consideration before the report is submitted to the Boston Region MPO for approval.

The main improvement recommendation is to install a fully-actuated traffic signal at the intersection. However, the District feels that the report has not adequately demonstrated that a traffic signal is warranted and desirable, or that the signal is the best alternative to address the safety issues found in the study and noted by the Town.

The cost of this improvement is estimated in the report to be between $600,000 and $750,000 (not including potential right-of-way costs). Given our experience with past signalization projects, the cost will likely be in $1,000,000+ range for MassDOT to construct. The report recommends that the Town work with the MassDOT District 3 office to initiate a project to install the traffic signal, with the improvements being funded using the MPO's Transportation Improvement Program (TIP). The District is willing to work closely with the Town. However, if the Town decides to pursue a project to install the traffic signal, they may want to consider other funding sources, including using Town funds or funds from private development mitigation.

I recommend that additional improvement alternatives be considered, with a focus on alternatives that could be implemented at lower cost and in the shorter term. One alternative that should be evaluated is to change the traffic control at the intersection from two-way stop control to all-way stop control. If warranted and desirable, all-way stop control could be installed using only signs and pavement markings.

My specific comments on the report are as follows:

1) The volume thresholds for Traffic Signal Warrants 1 and 2 were reduced to 70% of the minimum because of observed speeds on Lincoln Street (Route 85) in the 40 to 45 mph range. However, the roadway is posted at 35 mph (north of the intersection) and 30 mph (at and south of the intersection). Generally, MassDOT does not reduce the volume thresholds on roadways with posted speeds of less than 45 miles per hour. If the warrant analysis was submitted to MassDOT, we would want the analysis run with the standard volume thresholds, and would want speed data provided to confirm the observations noted in the report.

2) The report states that Warrant 7 is met because the crash data from the Hudson Police indicate that there were five crashes in 2010. However, the MUTCD states that these crashes must be "of types susceptible to correction by a traffic control signal". According to the draft collision diagram, two of the five crashes in 2010 were single-vehicle crashes (run-off-road), which are not typically corrected by a traffic signal. Please review the crash data from 2008-2010 and determine if Warrant 7 is met for this intersection.

3) The proposed traffic signal will have similar or longer queuing on the side street approaches (Cox Street and Packard Street) under existing traffic volumes when compared to the existing two-way stop control. Queuing was noted as an issue / concern, and appears to not be addressed by installing a traffic signal.

4) The fourth short-term measure is to increase the size of the 30 mph speed limit sign (R2-1) on Lincoln Street southbound to 36"x48", and to relocate the sign further from the intersection. I feel that the proposed speed limit sign is too large (the 2009 MUTCD provides the dimension for "oversized" speed limit signs as 30"x36"). Also, the speed limit sign locations cannot be moved significantly, as they must stay consistent with the approved Special Speed Regulation. If advance warning of the 30 mph speed zone is needed on Lincoln Street southbound, we recommend using Reduced Speed Ahead (W3-5) warning signs.

5) As an additional short-term measure, a red reflective stripe can installed on the sign post with the "Stop" signs facing Cox Street and Packard Street. These red reflective stripes may increase attention to the sign, particularly at night.

6) As an additional short-term measure, pedestrian crossing warning signs (W11-2 and W16-7P) could be installed at the existing pedestrian crosswalk across Lincoln Street just north of the intersection.

Thank you for providing us with the opportunity to review the draft report and provide comments. If you have any questions please feel free to give me a call.

Joe

Joseph Frawley, P.E.
District 3 Traffic Engineer
Massachusetts Department of Transportation, Highway Division
T: 508.929.3916
F: 508.799.9763
www.mass.gov/massdot

From: Chen-Yuan Wang [mailto:cwang@ctps.org]
Sent: Friday, December 16, 2011 12:36 PM
To: 'Michelle Ciccolo'
Cc: 'Mark Abbott'; Efi Pagitsas; Frawley, Joseph (DOT); Nelson, Paul (DOT)
Subject: Hudson Intersection Study

Dear Michelle,

Boston Region MPO staff recently completed the analyses and improvement recommendations for the intersection of Lincoln Street at Cox Street/Packard Street in Hudson. Attached please find a draft memo of the study for your review. The report is a preliminary draft and your comments within 3-4 weeks are much appreciated. After receiving your comments, we will include them and modify the report if necessary. We plan to submit it to Boston Region MPO for approval soon after your view and then we can release the final report. I'll be on vacation for a few weeks, if you have any questions about the study, please contact my colleague Mark Abbott or my group manager Efi Pagitsas. Thank you.

Chen-Yuan Wang | Chief Transportation Planner
CENTRAL TRANSPORTATION PLANNING STAFF
617.973.8009 | cwang@ctps.org
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CTPS MPO

APPENDIX I

Letters from the Town of Hudson

Town of Hudson

Department of Community Development

78 Main Street, Hudson, MA 01749
Tel: (978) 562-2989 Fax: (978) 568-9641
mciccolo@townofhudson.org

February 14, 2012

Chen-Yuan Wang
Boston MPO
10 Park Plaza
Boston, Ma 02116

Re: MPO Intersection Study on Lincoln/Cox/Packard St.

Dear Mr. Wang,

Thank you and your team for its excellent work on the above noted intersection study. Studies such as these are invaluable to us in evaluating safety challenges which require complex solutions. Without the data and expertise you provided, we would not have had the opportunity to bring staff together to discuss the problem and examine ways to improve safety at that location. Hudson is small enough not to have a full time traffic engineer on its staff, so again, the outside help was quite useful to us.

I apologize for the delay in getting comments to you. At the time the study came in, we needed to wait until our regular monthly traffic meeting with staff to discuss the recommendations in the study and consolidate our comments. Attached to this letter is a copy of the report with a few comments inserted as notes within the text. All of our comments were quite minor.

When our traffic committee discussed the report, it did agree it wanted to go forward with seeking funding for a traffic signal by submitting the project to the Boston MPO. We understand the queue for TIP funding is great and that it might be some time before this item would be eligible for funding. Nonetheless, with this study in hand, it will also be easier for us to seek developer mitigation funds, other grants, or municipal appropriations to advance this work. Without the study, such advancement would not have been likely.

We understand that District 3 has some concerns with the notion of signalizing this intersection. Attached you will find our comment letter to Mr. Frawley of District 3. We disagree with his assessment that some of the crash data is not relevant to the metrics utilized when justifying the signal warrants. We know first hand that many of the accidents which only involved one car were instances where the vehicle swerved to avoid the oncoming traffic and a light would dramatically remediate this situation.

We have applied, through our Public Works Department for the “Low Cost Safety Improvements” program offered by MassDOT and hope our intersections are chosen. In addition, we will recommend to our Board of Selectmen that a 4-way stop control be pursued in the interim until such time as we can upgrade with a full traffic light or another solution is developed.

Again, my appreciation for your hard work and we hope to have the opportunity to work with CTPS again in the future.

Sincerely,

Michelle Ciccolo
Director of Community Development

C: Hudson Board of Selectmen
Internal Traffic Committee
Joe Frawley, District 3

Town of Hudson

Department of Community Development

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Tel: (978) 562-2989 Fax: (978) 568-9641
mciccolo@townofhudson.org

February 14, 2012

Mr. Joseph Frawley, Traffic Engineer
MassDOT District 3
403 Belmont Street
Worcester, MA 01604

Re: Hudson Intersection Study (Cox St., Lincoln St., Packard St.)

Dear Mr. Frawley,

Thank you for your email of 1/20/12 wherein you cite concerns with some of the analysis from the Boston MPO Intersection Study which ultimately recommended a traffic signal be installed at the above noted intersection. You note that "the District feels that the report has not adequately demonstrated that a traffic signal is warranted and desirable, or that the signal is the best alternative to address the safety issues found in the study." In your subsequent comments, you indicated a willingness to work with the Town, while also suggesting the Town seek municipal or private funds for the installation of a traffic light. From our phone conversations, I gather this latter suggestion stems in part from the long waiting list of projects seeking funding on the TIP, along with the relatively low priority that the District would place on a traffic light at this location, given that you don't yet agree with its merits.

The Town of Hudson understands that in the near-term, the likelihood of receiving TIP funding for this project is remote. Nonetheless, we have gone ahead and asked that the project be including in the "Universe of Projects" on the TIP, while we pursue additional analysis of this intersection. Given the number of high injury accidents, we want to advance any viable options for safety upgrades.

We have also reviewed the MPO study and discussed it at the January meeting of the Town's Internal Traffic Committee, a committee comprised of the Director of Public Works, Police Chief, Fire Chief, Building Commissioner, and Planning Director. The ITC agreed with your recommendation in pursuing a 4-way stop controlled intersection in the interim until further safety improvements can be implemented. The Internal Traffic Committee will recommend that the Board of Selectmen consider initiating a 4-way stop control at this intersection should it be found to be warranted per the MUTCD guidelines. That item will likely be taken up by the Hudson BOS at its February 29th, 2012 meeting. We will keep you informed as to the decision of that Board.

The Public Works Director also submitted a request to participate in the MassDOT solicitation for projects to be included in the "Low Cost Safety Improvements at Stop-Sign Controlled Intersections." We hope Lincoln/Cox/Packard will be included in this program to receive signage and striping upgrades.

Finally, we wanted to comment on one concern you raised relative to the report's data where our observations differ from your conclusions. In your email, you object to the inclusion of certain crash data because "according to the draft collision diagram, two of the five crashes in 2010 were single-vehicle crashes (run-off-road), which are not typically corrected by a traffic signal." However, on page 7 of the MPO report, "it should be noted that three drives of the four single-vehicle crashes claimed that they swerved to side of the road (from Lincoln Street) in order to avoid colliding with a vehicle coming from Packard Street without stopping." Our local knowledge of this roadway is consistent with this finding. People at this intersection run the stop sign or are overly aggressive in pulling out. If a traffic light were to be installed, with the approaches upgraded to accommodate better sight distances, it is hard to imagine that this situation would not be dramatically reduced or completely corrected.

Thank you for the analysis you put into reviewing the draft report. We look forward to working closely with you should this project proceed to any subsequent phases.

Sincerely,

Michelle Ciccolo
Director of Community Development

C: Hudson Internal Traffic Committee
Arthur Frost
Efi Pagitsas