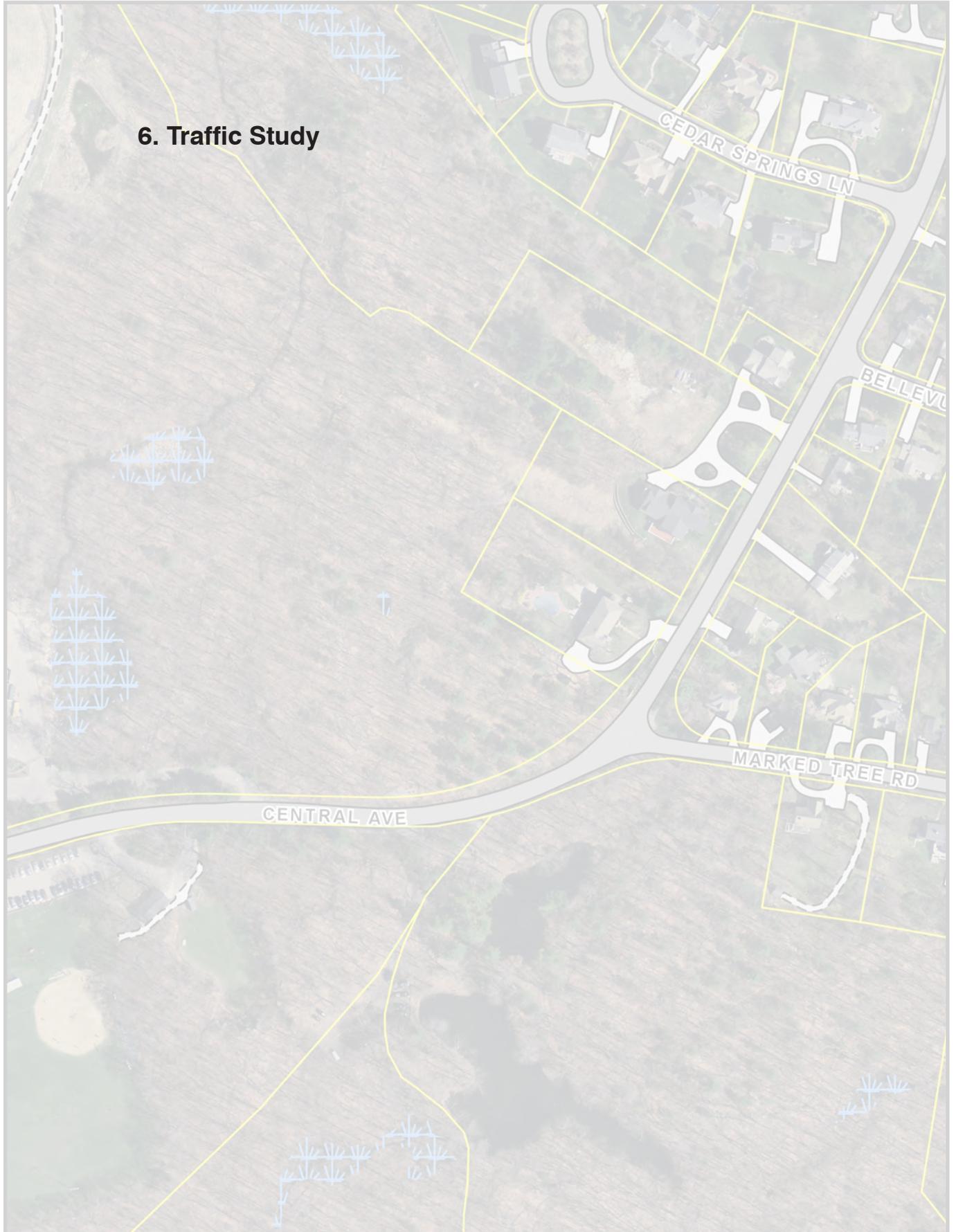


6. Traffic Study





Engineers | Scientists | Planners

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July 31, 2014
Revised December 4, 2014

Mr. William R. Hammer, AIA
HKT Architects Inc.
35 Medford Street
Somerville, MA 02143

Re: **Needham Facilities Master Plan**
Traffic Engineering Services
DPW and Fire/Police Buildings
Needham, Massachusetts
PARE Project No. 14116.01

Dear Mr. Hammer:

Pare Corporation (PARE) has completed the requested traffic study to determine the potential impacts for the construction of a new Department of Public Works (DPW) facility at two locations in Needham, Massachusetts. The two locations under consideration include a shared location with the existing Recycling/Transfer Station (RTS) on Central Avenue and an undeveloped property, known as Parcel 74, on Greendale Avenue (between Cheney Street and Brookline Street). The existing DPW is located at 470 Dedham Avenue. The findings of this investigation are discussed below.

Site Descriptions

Existing DPW Facility

The existing Needham DPW facility is located at 470 Dedham Avenue (Massachusetts Route 135) just west of the Dedham Avenue/South Street signalized intersection. DeFazio Park is located just west of the DPW and the two sites share the western driveway. Dedham Avenue is classified as an Urban Principal Arterial and has a posted speed limit of 40 mile per hour in the vicinity of the site. Dedham Avenue consists of one 11-foot wide travel lane in each direction with 1-foot wide shoulders. Sidewalk is located on the north side of the roadway and is separated from traffic by a grass buffer.

The main entrance to the DPW is located approximately 450 feet north of South Street and operates as a two-way driveway. The second access point to the DPW is shared with DeFazio Park and is located approximately 1,000 feet to the west. Two-way access to the rear of the DPW facility is provided through the DeFazio Park parking lot and is frequently used by the DPW. Figure 1 shows the location of the existing DPW facility and surrounding area.

o

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Scale: 1" = 800'



PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
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LINCOLN, RI 02865
401-334-4100

Project No. 14116.01

Date: August 2014

Figure 1
Existing DPW Site
Needham Department of Public Works
Needham, Massachusetts



William R. Hammer

(3)

July 31, 2014
Revised December 4, 2014

Alternative 1 – Needham Recycling / Transfer Station – Central Avenue

Under Alternative 1, the new DPW facility is planned to be co-located with the existing Needham Recycling/Transfer Station site on Central Avenue. Central Avenue consists of one 12-foot wide travel lane in each direction with 1-foot wide shoulders. Central Avenue is classified as an Urban Minor Arterial and has a posted speed limit of 30 miles per hour in the vicinity of the project area. Claxton Field is located across Central Avenue from the RTS. A map of the RTS site is shown in Figure 2.

The existing RTS has three driveways. The northern driveway is enter only and serves all vehicles accessing the site. The center driveway is exit only and provides one right turn lane and one left turn lane. The center driveway serves as the primary exit point for vehicles leaving the site. The southern driveway is exit only and consists of one exiting lane. Each of these driveways is planned to be preserved under the proposed addition of the DPW. The conceptual design for the proposed DPW site includes the addition of an employee parking lot on the east side of the site. The new driveway to the parking lot would be placed just south of the intersection of Central Avenue and Marked Tree Road. The conceptual site plan for Alternative 1 is shown in Figure 4.

The RTS currently has operating hours of 7:30 a.m. to 4:00 p.m. Tuesday-Saturday. Based on correspondence with the Town, the heaviest traffic periods at the RTS can be observed in the early morning just after the RTS opens and in the afternoon, just prior to closing. Tuesdays and Friday are typically busy days while Saturday is the busiest. Additionally, the Newman School is located approximately one-half mile north of the proposed site on Central Avenue. The Newman School is heavy traffic generator in the hour surrounding the a.m. drop-off period and p.m. dismissal period.

Alternative 2 – Parcel 74 – Greendale Avenue

Under Alternative 2, the new DPW facility is planned to be placed on currently undeveloped Parcel 74, currently under the control of the Parks and Recreation Department, on Greendale Avenue. In the area of Parcel 74, Greendale Avenue consists of two 14-foot wide travel lanes separated by a double-yellow centerline with 6 to 7-foot wide shoulders, resulting in a total roadway width of approximately 40 to 42 feet. Parcel 74 is located between Cheney Street and Brookline Street on the east side of Greendale Avenue. Greendale Avenue is classified as an Urban Minor Arterial and has a posted speed limit of 40 mile per hour in the vicinity of the site. Land use surrounding this site primarily consists of single family homes. Greendale Avenue generally runs in a north/south direction and is parallel to I-95. The majority of land between Greendale Avenue and I-95 is heavily wooded and undeveloped. A map of the site area is shown in Figure 3.

The proposed DPW site would be located on the east side of Greendale Avenue, between Greendale Avenue and I-95. The site would stretch from Cheney Street to Brookline Street with one driveway accessing Cheney Street and one driveway accessing Greendale Avenue at Brookline Street. A small visitor parking lot would also have access to Greendale Avenue between Paul Revere Road and Oak Hill Road. The width of Greendale Avenue and public right-of-way would allow for the installation of a turning lane on Greendale Avenue to serve the DPW site. The conceptual site plan for Alternative 2 is shown in Figure 5.



Scale: 1" = 800'



Project No. 14116.01

Date: August 2014



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Figure 2
Needham Recycling Transfer Site - Central Avenue
Needham Department of Public Works
Needham, Massachusetts



Scale: 1" = 800'



Project No. 14116.01

Date: August 2014



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Figure 3
Parcel 74 - Greendale Avenue
Needham Department of Public Works
Needham, Massachusetts

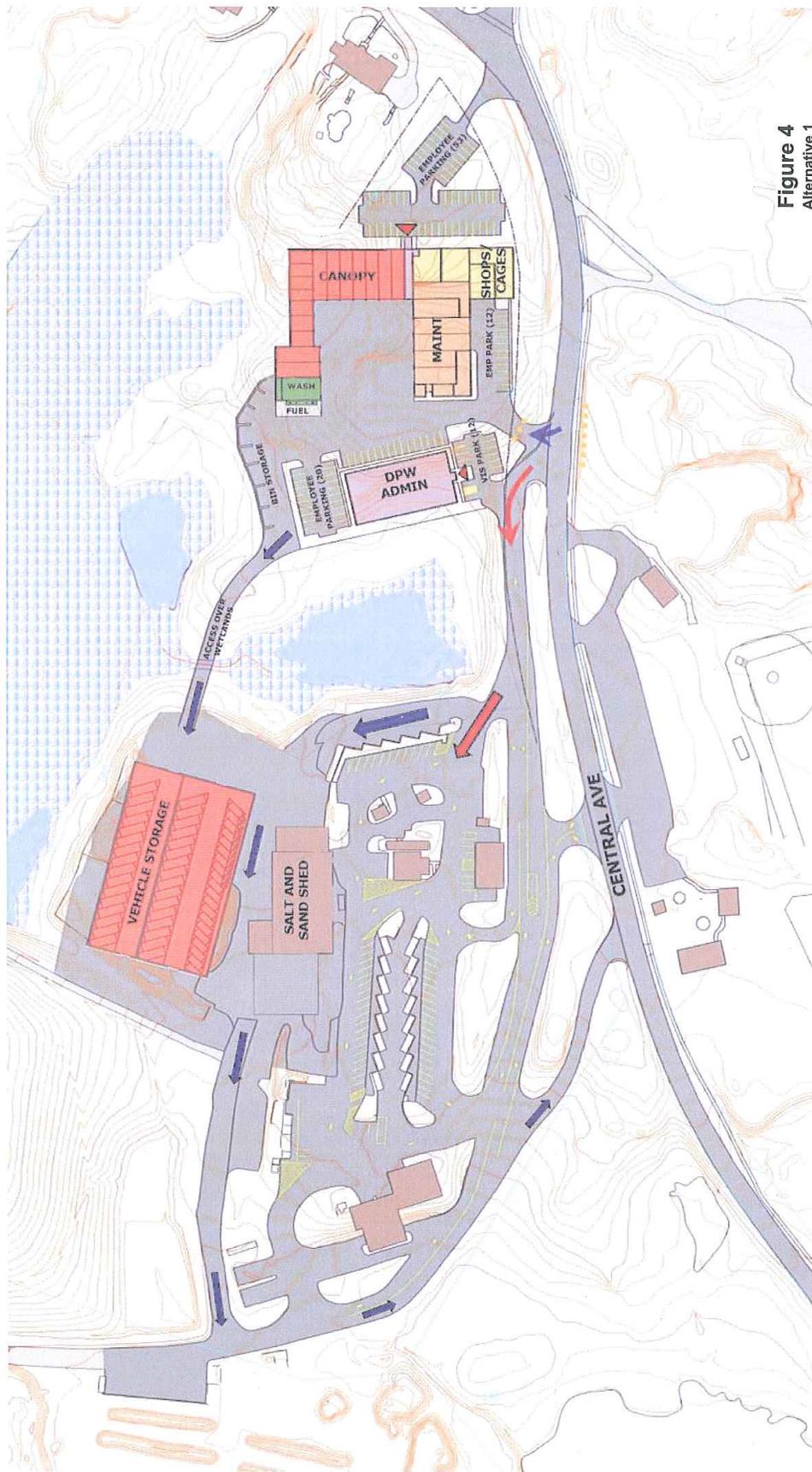


Figure 4
 Alternative 1
 Recycling/Transfer Station -
 Central Avenue

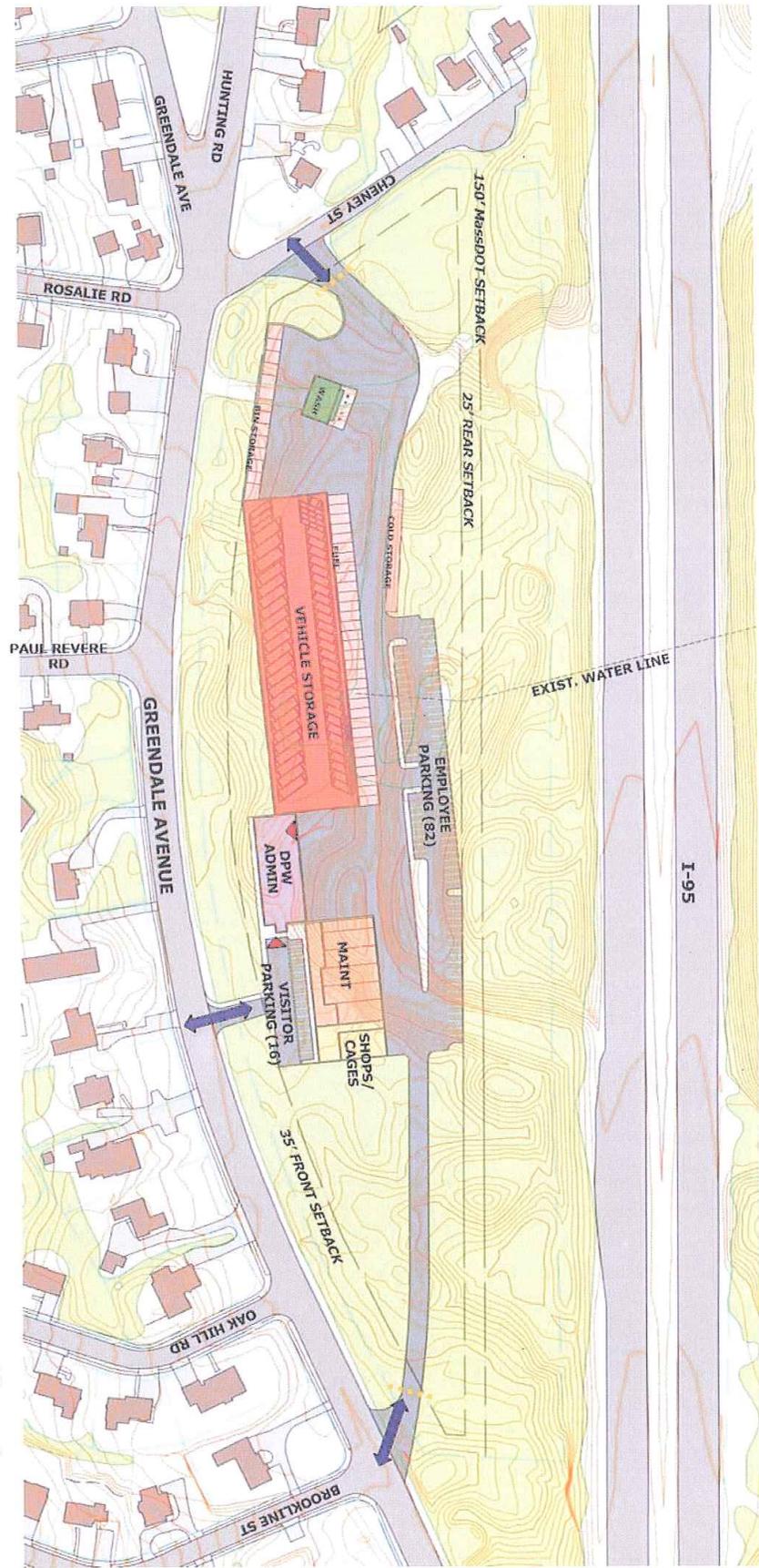


Figure 5
 Alternative 2
 Parcel 74 - Greendale Avenue



Traffic Safety Analysis

Crash History

Crash data for the study areas for the years of 2010 to 2012, was gathered from the MassDOT Crash Portal. The study area included the driveway and intersections immediately surrounding the existing and proposed DPW sites. The crash data is summarized in Table 1.

Table 1: Crash Data Summary

Location	Intersection	Total	Type of Damage		Type of Collision								
			Injury	PDO ¹	Rear-End	Angle	Head-on	Sideswipe Opposite Direction	Bike	Object	Loss of Control	Unknown	
Existing DPW – Dedham Avenue	Dedham Avenue & Existing DPW Driveway	4	-	4	3	-	-	-	-	-	-	-	1
	Dedham Avenue & South Street	9	1	8	2	5	1	-	1	-	-	-	-
Recycling/ Transfer Station – Central Avenue	Central Avenue & Recycling/ Transfer Center	1	-	1	-	-	-	-	-	1	-	-	-
	Central Street & Marked Tree Road	9	4	5	1	2	-	1	1	1	1	1	2
Parcel 74 – Greendale Avenue	Greendale Avenue, Hunting Road, Cheney Street, & Rosalie Road	2	-	2	1	-	-	-	-	1	-	-	-
	Greendale Avenue & Brookline Street	2	-	2	-	1	-	-	-	-	1	-	-

1. Property Damage Only.

Four crashes were observed in the three-year analysis period at the intersection of Dedham Avenue and the existing DPW facility. Three of the crashes were rear-end collisions and none resulted in injury.

Nine crashes were observed at the intersection of Dedham Avenue and South Street. Angle collisions were the most common type crash at this intersection with a total of five. In general, the crashes appear to be of low severity as only one of the nine resulted in injury.

Nine crashes were also observed at the intersection of Central Avenue and Marked Tree Street. Crashes at this intersection appear to be of higher severity than the other location as four of the nine crashes resulted in injury. This location also included a vehicle-bicycle crash.

*Vehicle Speed Studies*

Vehicle speed studies were taken on Dedham Avenue, Greendale Avenue, and Central Avenue. The results of the speed studies are summarized in Table 2.

Table 2: Speed Study Results

Location	Posted Speed Limit	Average Speed	Median Speed	85 Percentile Speed	10 m.p.h. Pace Speed	Percent of Vehicle over Speed Limit
<i>Dedham Avenue</i>	40	35	35	38	29-38	10
<i>Central Avenue</i>	30	36	36	39	31-40	95
<i>Greendale Avenue</i>	40	39	40	43	34-43	38

1. All speed data reported in miles per hour.

Sight Distance Analysis

Sight distance measurements were taken at the driveways of the existing DPW and each of the potential sites. Stopping site distance (SSD) is the distance required by a vehicle traveling at the design speed of a roadway to stop prior to striking an object in its path of travel. Intersection sight distance (ISD) is the sight distance required by a driver entering or crossing an intersecting roadway to perceive an on-coming vehicle and safely complete an entering or crossing maneuver with on-coming traffic. The design speeds used to determine the minimum safe SSD and ISD for each location were based on the 85th percentile speeds of the approaching roadway as determined by the speed studies. SSD and ISD measurements were compared to minimum requirements presented in the American Association of State Highway and Transportation Officials (AASHTO) publication *A Policy on the Geometric Design of Highways and Streets, Sixth Edition 2011*. AASHTO does state that if the measured ISD is at least equal to the required SSD for the specified design speed, the intersection can operate safely. Tables 3, 4, and 5 summarize the results of the sight distances measured at each location.

**Table 3: Sight Distance Summary - Dedham Avenue**

Intersection/Sight Distance Measurement	Feet		
	Required Minimum ¹	Intersection Sight Distance ²	Measured
<i>Dedham Avenue & Existing DPW Driveway (East Entrance)</i>			
<i>Stopping Sight Distance:</i>			
Dedham Avenue approaching from the north	305	--	>500
Dedham Avenue approaching from the south	305	--	>500
<i>Intersection Sight Distance:</i>			
Looking north from Existing DPW Driveway(East Entrance)	305	385/445	>500
Looking south from Existing DPW Driveway(East Entrance)	305	385/445	>500
<i>Dedham Avenue & DPW/DeFazio Park Driveway</i>			
<i>Stopping Sight Distance:</i>			
Dedham Avenue approaching from the north	305	--	>500
Dedham Avenue approaching from the south	305	--	>500
<i>Intersection Sight Distance:</i>			
Looking north from DPW/DeFazio Park Driveway	305	385/445	>500
Looking south from DPW/DeFazio Park Driveway	305	385/445	>500

1. Based on 40 mile per hour design speed.
2. ISD values shown are for right turn/left turn movements.

Stopping sight distance and intersection sight distance requirement were exceeded at both of the existing DPW driveways on Dedham Avenue.



Table 4: Sight Distance Summary - Central Avenue

Intersection/Sight Distance Measurement	Feet		
	Required Minimum ¹	Intersection Sight Distance ²	Measured
Central Avenue & RTS Southern Driveway			
<i>Stopping Sight Distance:</i>			
Central Avenue approaching from the north	305	--	>500
Central Avenue approaching from the south	305	--	475
<i>Intersection Sight Distance:</i>			
Looking north from RTS Southern Driveway	305	385/445	>500
Looking south from RTS Southern Driveway	305	385/445	475
Central Avenue & RTS Center Driveway			
<i>Stopping Sight Distance:</i>			
Central Avenue approaching from the north	305	--	>500
Central Avenue approaching from the south	305	--	310
<i>Intersection Sight Distance:</i>			
Looking north from RTS Center Driveway	305	385/445	>500
Looking south from RTS Center Driveway	305	385/445	310
Central Avenue & RTS Entrance Driveway			
<i>Stopping Sight Distance:</i>			
Central Avenue approaching from the north	305	--	335
Central Avenue approaching from the south	305	--	>500
<i>Intersection Sight Distance:</i>			
Looking north from RTS Entrance Park Driveway	305	385/445	335
Looking south from RTS Entrance Park Driveway	305	385/445	>500
Central Avenue & Employee Parking Lot			
<i>Stopping Sight Distance:</i>			
Central Avenue approaching from the north	305	--	125
Central Avenue approaching from the south	305	--	165
<i>Intersection Sight Distance:</i>			
Looking north from Employee Parking Lot	305	385/445	115
Looking south from Employee Parking Lot	305	385/445	145

1. Based on 40 mile per hour design speed.
2. ISD values shown are for right turn/left turn movements.

Several sight distance measurements taken at the RTS site fell short of those required by AASHTO. The ISD measurement at the Center Driveway did not meet AASHTO requirements from the driveway looking to the south. There is a vertical crest curve just south of the driveway that limits visibility from the driveway to the south. The ISD does however, exceed the required SSD.

Sight distance measurements were taken at the existing RTS entrance driveway. This driveway currently operates as one-way, entry only. However, under Alternative 1, this driveway is planned to operate as a two-way driveway to serve the new DPW facility. ISD measurements from the existing driveway to the north were not met as the sight distance is restricted by the horizontal curvature of Central Avenue, and from vegetation and exposed bedrock along the west side of Central Avenue. The ISD does however, exceed the required SSD.



Both SSD and ISD measurements at the proposed new employee parking lot fell short of those required by AASHTO. Sight distance to the north of the proposed driveway is restricted by a horizontal curve in Central Avenue, existing trees and shrubs, and a white roadside fence of the adjacent property owner. Even with the removal of the trees and shrubs, the position of the horizontal curve and the fence limits sight distance to less than the required distance.

To the south, sight distance is restricted by the horizontal curvature of Central Street, vegetation, and exposed bedrock. To achieve the required sight distance at this location, the existing vegetation would have to be removed in addition to removal of a portion of the exposed bedrock.

Table 5: Sight Distance Summary - Greendale Avenue

Intersection/Sight Distance Measurement	Feet		
	Required Minimum ¹	Intersection Sight Distance ²	Measured
Greendale Avenue & Cheney Street			
<i>Stopping Sight Distance:</i>			
Greendale Avenue approaching from the north	360	--	>500
Greendale Avenue approaching from the south	360	--	420
<i>Intersection Sight Distance:</i>			
Looking north from Cheney Street	360	430/500	>500
Looking south from Cheney Street	360	430/500	205
Greendale Avenue & Site Driveway (at Brookline Street)			
<i>Stopping Sight Distance:</i>			
Greendale Avenue approaching from the north	305	--	595
Greendale Avenue approaching from the south	305	--	570
<i>Intersection Sight Distance:</i>			
Looking north from Site Driveway (at Brookline Street)	305	430/500	595
Looking south from Site Driveway (at Brookline Street)	305	430/500	570

1. Based on 45 mile per hour design speed.
2. ISD values shown are for right turn/left turn movements.

Sight distance measurements taken for the Parcel 74 site all met those required by AASHTO with the exception of the ISD measurement taken from Cheney Street looking south on Greendale Avenue. Sight distance at this location is restricted by the roadside slope and vegetation on the southeast corner of the intersection. To achieve the AASHTO recommended ISD, vegetation would have to be removed from the corner and a portion of the slope may have to be removed. The ISD does however, exceed the required SSD.



Traffic Volumes

Traffic volumes within the study area were supplied by the Town of Needham and collected by PARE. Traffic data for the study area surrounding the Greendale Avenue site was also obtained from the *Traffic Impact and Access Study for the proposed Needham Mews Residential Community* prepared by Vanasse and Associates, Inc., 2013. The traffic count information is described below.

Traffic counts were taken at the driveway of the existing DPW Driveway from 6:30 – 9:00 a.m. on Tuesday, July 22 and Wednesday, July 23, 2014 to determine traffic generated by the existing DPW facility. The existing facility is co-located with the Public Service Administration Building which houses additional Town Departments. The counts shown below do not differentiate between DPW traffic and traffic associated with the other Town Departments. These traffic volumes are therefore slightly higher than the volumes that can be expected at the new DPW facility. The peak hour of traffic at the existing DPW site was from 7:00 – 8:00 a.m. and is summarized in Table 7.

Table 6: DPW Generated Traffic

Time interval	Entering	Exiting
7:00 – 8:00 a.m.	40	42

Turning movement counts were also taken at the two proposed site locations. Traffic counts at the intersection of Greendale Avenue and Brookline Street were taken on Wednesday, October 1, 2014 while traffic counts at Central Avenue and the RTS Driveway were taken on Thursday, October 2, 2014. Turning movement count locations and times are summarized below.

- Greendale Avenue & Brookline Street – 7:00 a.m. to 9:00 a.m.
- Central Avenue & RTS Driveways – 7:00 a.m. to 9:00 a.m.
- Central Avenue & RTS Driveways – 3:00 p.m. to 6:00 p.m.

Morning and afternoon peak period counts were performed at the RTS site to capture fluctuations in traffic associated with the nearby Newman Elementary School. The Newman School hours are from 8:45 a.m. to 3:10 p.m. Traffic counts at the intersection of Greendale Avenue and Brookline Street were taken during the a.m. peak periods, as this time period coincides with the peak traffic period of the DPW.

Future Conditions

Traffic volumes in the study areas were projected to the year 2019 to present a five-year future build scenario. MassDOT traffic count data within the Town of Needham was reviewed and indicated that traffic volumes have fallen slightly over the last several years. However, in order to provide a conservative analysis, a 1% annual growth rate was applied to the existing traffic volumes as general background growth.

Three additional developments proposed within the Greendale Avenue study area are expected to have an impact on the traffic conditions within the five-year study period. The information from these studies was collected from the *Traffic Impact and Access Study for the proposed Needham Mews Residential Community* prepared by Vanasse and Associates, Inc. 2013. Information for these studies is provided in Table 7.

**Table 7: Future Developments within the Study Area¹**

PROJECT NAME	DESCRIPTION
Greendale Village 40B Residential Development	20 single family homes
Center 128 Commercial Development	740,000 square feet of office and 128-room hotel
Mews Residential Community	300-unit residential apartment community

¹Information on the future developments within the project area were obtained from the *Traffic Impact and Access Study for the proposed Needham Mews Residential Community* prepared by Vanasse and Associates, Inc, 2013.

The MassDOT I-95/Route 128 Add-A-Lane Project is currently under construction and is expected to have a significant impact on the traffic volumes on Greendale Avenue. The project consists of widening I-95/Route 128 from Randolph to Wellesley, providing four travel lanes in each direction. The project also includes construction of a new interchange at Kendrick Street and new collector and distributor roads between Highland Avenue and Kendrick Street.

The addition of the Kendrick Street interchange as part of the I-95/Route 128 Add-A-Lane project is expected to reduce commuter traffic on Greendale Avenue as north/south traffic will have access to I-95/Route 128 via the Kendrick Street interchange. The reduction in Greendale Avenue traffic volumes was also provided in *Traffic Impact and Access Study for the proposed Needham Mews Residential Community* prepared by Vanasse and Associates, Inc. 2013 and included in the analysis of the future scenario.

Trip Generation

It is expected that the traffic counts taken at the existing DPW facility site during the morning peak period will be the same as those at the proposed facility. The traffic counts that were taken at the existing facility also included traffic associated with the Public Service Administration Building which shares a driveway. Based on information provided by the Town, the peak morning traffic period for the DPW facility will include employees entering the site, about 8 to 10 trucks exiting the DPW facility, as well as other Town vehicles using the site for fueling. Based on this information, the traffic counts taken at the existing DPW represent a reasonable, conservative, estimate of the traffic the DPW facility is expected to generate during the a.m. peak period.

During the p.m. peak period, the peak traffic generated by the facility will generally consist of employees leaving the site. Based on information provided by the Town, the traffic volumes will consist of approximately 50 employees leaving the site around 3:00 p.m. At the RTS site, this period is expected to overlap with RTS operations and the dismissal of the Newman Elementary School.

Trip Distribution

Recycling/Transfer Station – Central Avenue

During the a.m. peak hour, trips to and from the proposed DPW facility at the RTS site were distributed amongst the three DPW driveways. Trips entering the site were evenly divided between the proposed employee parking lot adjacent to Marked Tree Road and the existing northern driveway. Trips exiting the site were distributed between the Southern RTS Driveway, DPW Maintenance and Administration Driveway and the Employee Parking Lot. No DPW traffic was assumed to use the Central Driveway as it is expected this would be used for RTS operations only. It was assumed that 50% of traffic would exit via the Southern Driveway, 30% via the DPW Maintenance and Administration Driveway, and 20% via the Employee Parking Lot. Due to the location of the RTS with respect to the Town of Needham, 80% of traffic was assumed to enter and exit the site to/from the north and 20% was expected to enter/exit the site to/from the south.



During the p.m. peak hour, exiting traffic was evenly split between the DPW Maintenance and Administration Driveway and the Employee Parking Lot. The same distribution of traffic from the site used for the a.m. peak period was used for the p.m. peak period as 80% of traffic is assumed to exit to the north and 20% is assumed to exit to the south. The trip distribution to and from the RTS Site is summarized in Figure 6.

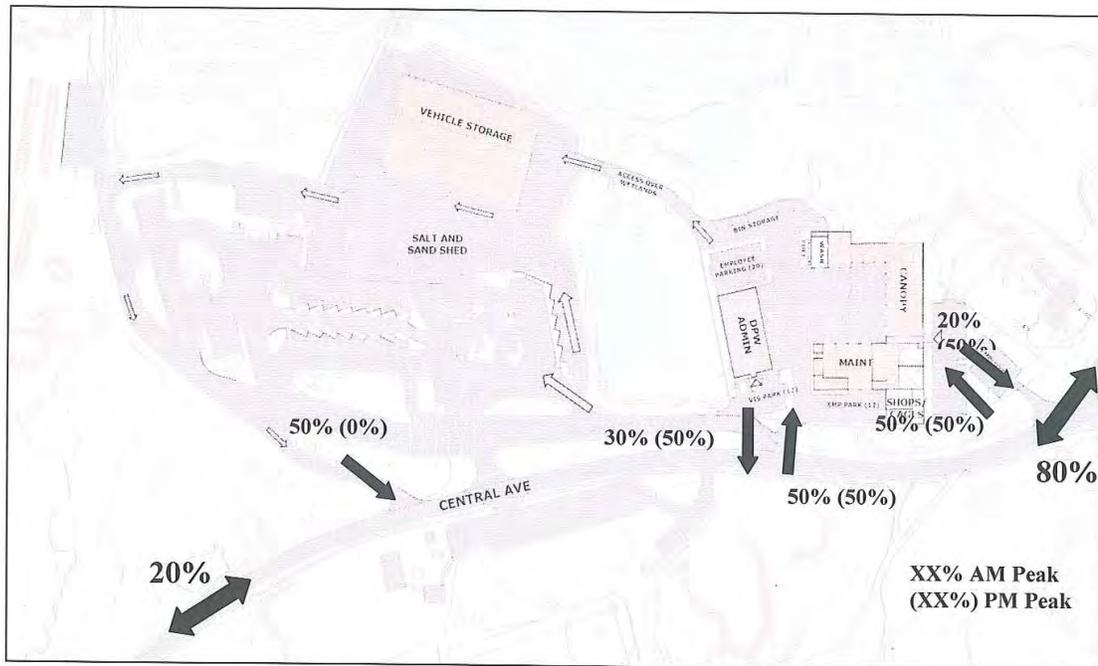


Figure 6: Trip Distribution at RTS Site

*Parcel 74 – Greendale Avenue*

Trips to and from the proposed DPW facility at Parcel 74 were evenly distributed between the northern and southern driveways. Due to the positioning of the site with regards to the Town of Needham, traffic to/from north, south, and west of the site was evenly split.

Capacity Analysis

Capacity analysis characterizes intersections based on their level of service (LOS). At unsignalized intersections, LOS is a quality measure describing operational conditions based on the amount of seconds of delay per vehicle. Delay at an unsignalized intersection is the amount of time a vehicle spends from the point at which it reaches the rear of the vehicle queue at the approach to the intersection, to the time it performs its maneuver at the intersection and enters the main roadway. If no vehicle queue is present as the vehicle approaches the intersection, the delay is the amount of time it takes the driver to find an acceptable gap in the traffic stream on the main street, and perform the turning maneuver. Level of Service is determined by the average amount of delay per vehicle. Six LOS are defined for each type of facility, from A to F, with A representing the best operating conditions and F representing the worst operating conditions. The LOS criteria for unsignalized intersections are provided in Table 8 below.

Table 8: LOS Criteria for Unsignalized Intersection

LOS	Unsignalized Intersection Delay Time (sec/veh)
A	0-10
B	> 10-15
C	> 15-25
D	> 25-35
E	> 35-50
F	> 50

Also included in the capacity analysis is the 95th percentile queue length at the approaches to each intersection. This figure represents the maximum queue length that can be expected during each peak period analyzed.

Recycling/Transfer Station – Central Avenue

At the RTS site, capacity analyses were performed during the a.m. peak hour (7:00 – 8:00 a.m.) and the anticipated DPW p.m. peak hour (3:00 – 4:00) to coincide with the two time periods the DPW is expected to generate the most traffic. Based on discussion with the Town, these time periods are also the peak traffic periods associated with the RTS. The results of the capacity analyses are shown in Table 9 below.



Table 9: Recycling/Transfer Station – Central Avenue - Capacity Analysis Results

Intersection	Movement	Weekday A.M. Peak Hour			Weekday P.M. Peak Hour		
		LOS	Delay ¹	Queue Length ²	LOS	Delay ¹	Queue Length ²
Central Avenue & Southern RTS Driveway	EB LR	D	34.9	0.6	A ³	-	-
	NB LT	A	N/C	-	A	N/C	-
	SB TR	A	N/C	-	A	N/C	-
Central Avenue & DPW Maintenance & Administration Driveway	EB LR	D	27.2	0.3	E	37.4	1.1
	NB LT	A	0.0	0	A	0.0	0
	SB TR	A	N/C	-	A	N/C	-
Central Avenue & Employee Parking Lot	EB LR	D	27.3	0.2	E	39.9	1.1
	NB LT	A	0.0	0	A	0.0	0
	SB TR	A	N/C	-	A	N/C	-

1. Delay is measured in seconds/vehicle.
2. Queue Length shown represents the 95th percentile queue length in number of vehicles.
3. N/C – No Conflict
4. This driveway is expected to serve DPW trucks exiting the facility. Minimal traffic is expected to utilize this driveway during the p.m. peak hour.

The results of the capacity analysis indicate that the turning movements into the site all operate at an acceptable level of service (LOS A). Movements exiting the site resulted in LOS D during the a.m. peak period and LOS E during the p.m. peak period. LOS D and E are considered acceptable levels of service for an unsignalized intersection and intersection capacity for the driveways at this potential location do not appear to present a significant concern.

Parcel 74 – Greendale Avenue

At the Parcel 74 site, capacity analyses were performed only during the a.m. peak hour (7:15 – 8:15 a.m.). The morning peak hour was the only period analyzed as it was indicated by the Town as the period experiencing the greatest traffic volumes. The p.m. peak hour is less of a concern at this location as the p.m. peak of the DPW is not expected to overlap with the commuter peak.

Two scenarios were analyzed at the Greendale Avenue site location. Under each scenario, traffic volumes on Greendale Avenue have been adjusted based on the expected reduction from the I-95/Route 128 Add-A-Lane project and increased based on anticipated increases in traffic from the Greendale Village and Center 128 developments. Based on a discussion with the Town, the Mews 40B residential development has yet to be approved. The first analysis includes the additional traffic volumes from the Mew 40B residential development while the second analysis does not.

The results of the capacity analyses are shown in Table 10.



Table 10: Parcel 74 – Greendale Avenue - Capacity Analysis Results

Intersection	Movement	Weekday A.M. Peak Hour with Mews Development			Weekday A.M. Peak Hour without Mews Development		
		LOS	Delay ¹	Queue Length ²	LOS	Delay ¹	Queue Length ²
Greendale Avenue & Cheney Street	WB LR	E	35.1	0.6	D	29.1	0.4
	NB TR	A	N/C	-	A	N/C	-
	SB LT	A	0.4	0.1	A	0.4	0.1
Greendale Avenue, Brookline Street & Southern Site Driveway	EB LTR	F	>150	20.0	F	>150	17.3
	WB LTR	E	48.0	0.8	D	33.0	0.6
	NB LTR	A	0.4	0.2	A	0.5	0.2
	SB LTR	A	0.2	0.0	A	0.2	0.0

1. Delay is measured in seconds/vehicle.
2. Queue Length shown represents the 95th percentile queue length in number of vehicles.
3. N/C – No Conflict

The results of the capacity analysis indicate that the turning movements out of the site from Cheney Street operate at LOS E with the Mews development and LOS D without the Mews development. Both LOS D and LOS E are acceptable levels of service at this location.

At the intersection of Greendale Avenue, Brookline Street and the Southern DPW Driveway, the westbound approach from the DPW driveway experiences LOS E with the Mews development and LOS D without the Mews development. Both LOS E and LOS D from this driveway are acceptable levels of service. However, the eastbound approach from Brookline Street experiences significant delays during the a.m. peak hour. The existing conditions of this intersection were analyzed and are shown in Table 11 below. Under existing conditions, the Brookline Street approach experiences significant delays, operating at LOS F. Under the two future scenarios analyzed, with the addition of the DPW Driveway at this location, conditions to the Brookline Street approach are expected to worsen as vehicle delay and queue length increase.

Table 11: Greendale Avenue & Brookline Street – Existing Conditions - Capacity Analysis Results

Intersection	Movement	Existing Weekday A.M. Peak Hour		
		LOS	Delay ¹	Queue Length ²
Greendale Avenue, Brookline Street & Southern Site Driveway	EB LR	F	>150	11.5
	SB LT	A	0.5	0.2
	NB TR	A	N/C	0.0

1. Delay is measured in seconds/vehicle.
2. Queue Length shown represents the 95th percentile queue length in number of vehicles.
3. N/C – No Conflict

A peak hour volume signal warrant analysis was performed at the intersection of Greendale Avenue and Brookline Street for the a.m. peak hour of 7:15 to 8:15 a.m. The signal warrant analysis, attached to this letter report, shows that the existing volumes at the intersection meet the peak hour volume requirements to warrant a traffic signal.

**Conclusion**

Upon completion of the preliminary traffic study of the areas surrounding the potential locations of the Needham DPW, several conclusions can be made.

- The proposed location of the Employee Parking Lot Driveway at the proposed RTS site presents sight distance concerns. The placement of the driveway with relation to the horizontal curvature of Central Avenue limits the available sight distance at the intersection to less than that recommended by AASHTO. North of the intersection, increasing the available sight distance would require removal of existing vegetation and the white fence of the adjacent property owner. South of the intersection, improving the sight distance would require removal of existing vegetation and exposed bedrock from the southwest corner of the intersection.
- The placement of the DPW Administration/Maintenance Driveway with the RTS Entrance Driveway may also present some traffic circulation and safety concerns. The Driveway currently operates as a one-way, entry only driveway. Allowing two-way traffic to/from the DPW Administration/Maintenance Driveway presents a conflict point with vehicles entering the RTS driveway and vehicles exiting the DPW Administration/Maintenance Driveway. This concern is heightened by the relatively high and continuous volume of traffic that enters the RTS driveway.
- In general, no significant capacity concerns are anticipated at the proposed DPW driveways at the RTS site. The capacity analysis performed indicated that all driveways are expected to operate at an acceptable LOS during the a.m. and p.m. peak hours with minimal impact to the main roadways.
- No capacity concerns are anticipated at the northern DPW driveway (Cheney Street) at Parcel 74. However, there is a capacity concerns at the intersection of Greendale Avenue and Brookline Street. This intersection operates poorly during the a.m. peak period under existing conditions and is expected to worsen with the introduction of DPW traffic. While vehicles exiting the DPW driveway may not experience excessive delays, the additional traffic at the intersection would worsen the performance of the movement from Brookline Street to Greendale Avenue.
- The existing peak hour volumes at the intersection of Greendale Avenue and Brookline Street were analyzed to determine if they exceed the volumes required to warrant signalization of the intersection. The existing a.m. peak hour volumes just meet the minimum warrant for signalization. Other volume related signal warrants, including an eight-hour warrant and four-hour warrant, were not able to be analyzed as only morning peak data was collected. It is likely that these warrants would not be met as it appears that congestion at this intersection is isolated to the a.m. peak. Additionally, meeting one signal warrant should not, in itself, be justification for installation of traffic signal. Additional factors, such as crash history, intersection geometry, vehicle delay, etc. should also be considered prior to signalizing an intersection.
- There is potential for the a.m. peak hour volumes at the intersection of Greendale Avenue and Brookline Street to fall below those warranting signalization of the intersection under future conditions. The I-95/Route 128 Add-A-Lane project is expected to decrease traffic along Greendale Avenue. However, the majority of this traffic is expected to be replaced with traffic associated with new developments including the Mews Residential Community, Center 128 Commercial Development, and Greendale Village Residential Development. Should these developments fail to be



William R. Hammer

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constructed or the I-95/Route 128 Add-A-Lane project reduces traffic more than projected, the intersection would likely no longer meet the signal warrant.

- Consideration could also be given to relocating the Southern DPW Driveway on Greendale Avenue towards Oak Hill Road, away from Brookline Street. This would reduce the impact to the intersection of Greendale Avenue and Brookline Street and also alleviate some of the concerns connecting the DPW driveway to the intersection presents.

We are available to discuss this report with you at your convenience. Please feel free to contact us if you have any questions or need additional information.

Sincerely,

A handwritten signature in black ink, appearing to read 'John Shevlin', is written over the typed name and title.

John Shevlin
Senior Vice President

JPS/TT
Enclosures

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