

MEMORANDUM

DATE: April 30, 2009

TO: Mr. Geoffrey Engler
Stockard Engler Brigham, LLC
10 Concord Avenue
Cambridge, MA 02138

FROM: Robert J. Michaud, P.E. – Managing Principal
Courtney E. Sudak, E.I.T. – Project Engineer

RE: **Proposed Residential Development**
192 Lexington Street – Newton, Massachusetts

MDM Transportation Consultants, Inc. (MDM) has evaluated traffic and access characteristics for a proposed 10 –unit residential condominium development to be located at 192 Lexington Street in Newton, Massachusetts. This memorandum documents existing roadway characteristics, estimates site trip generation, evaluates driveway sight lines and provides a qualitative assessment of pedestrian activity at the nearby existing signalized crosswalk serving the nearby Burr Elementary School.

In summary, the proposed residential development is a very low traffic generator that is estimated to generate fewer than 5 new vehicle-trips per hour (one new vehicle every 12 minutes on average) relative to the existing residential use of the property. As such, no material impact to area roadways or intersections are anticipated. Ample sight lines will also be provided at the proposed site driveway for vehicles approaching and/or exiting the driveway based on recommended sight line enhancements. The existing pedestrian-activated traffic signal at Lexington Street located approximately 350 feet south of the site driveway was observed to be in proper working order, is staffed by a crossing guard during school arrival/dismissal periods and will not be materially impacted by the proposed residential development project.

PROJECT DESCRIPTION

The project site is an approximate 1.15-acre parcel located at 192 Lexington Street in Newton, Massachusetts. The site is currently occupied by a single-family residential home that is served by a single full-access driveway on Lexington Street. The location of the site relative to adjacent roadways is shown in **Figure 1**.

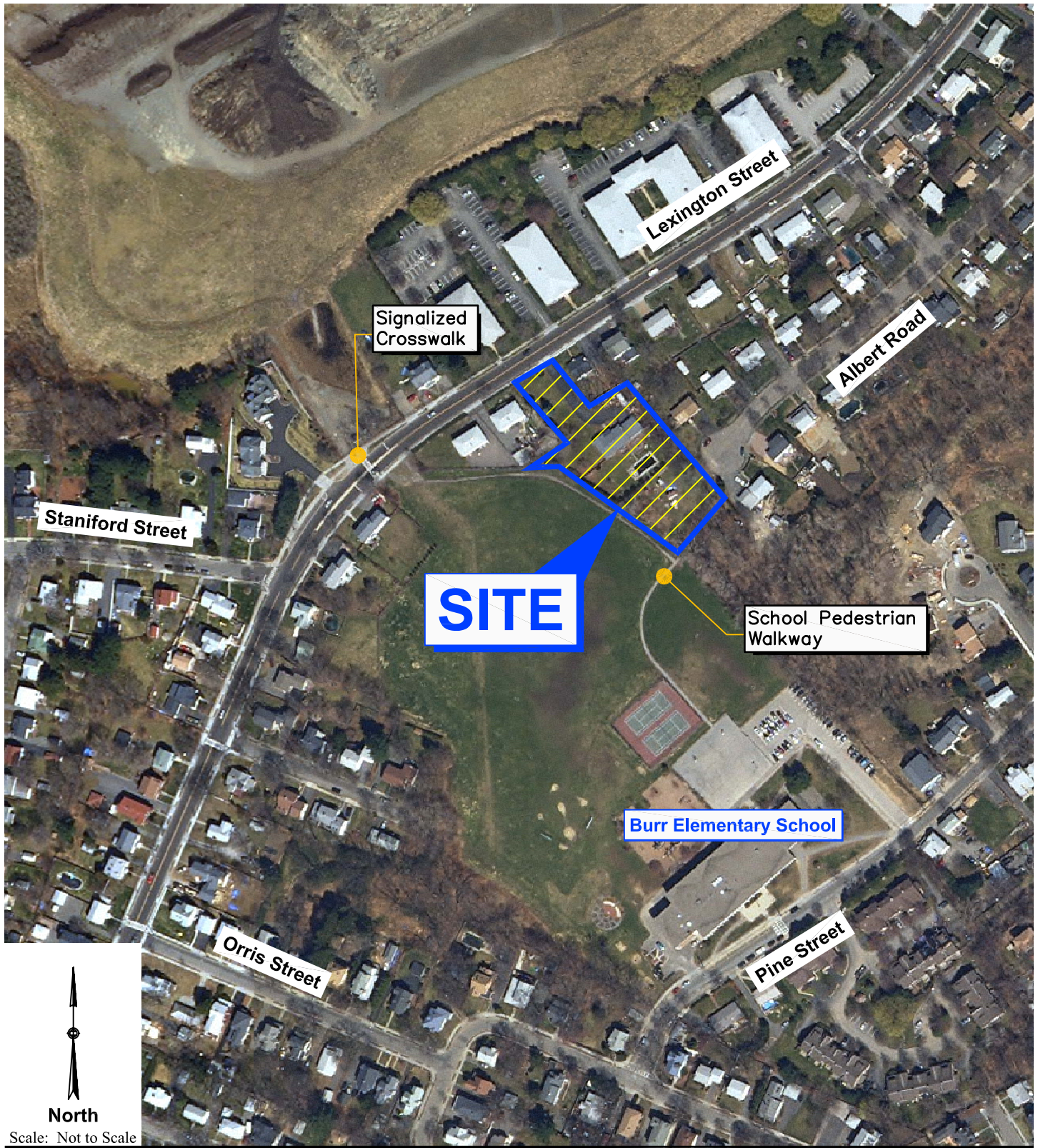


Figure 1

Site Location

Under the proposed development plan, 10 residential condominium units will be constructed. Access to the site will be provided by a single, shared driveway along Lexington Street with an emergency access only gate to be located at the southerly site frontage along Albert Road. The preliminary site layout prepared by Winslow Architects is presented in **Figure 2**.

EXISTING ROADWAY CHARACTERISTICS

Lexington Street is a local (Town) jurisdiction roadway that is classified by the Massachusetts Executive Office of Transportation (EOT) as an Urban Principal Arterial roadway. Roadway width in the site vicinity is approximately 32 feet wide with single 16-foot wide travel lanes separated by a double yellow centerline. Five-foot sidewalks with 3 foot wide grass strips line both sides of Lexington Street in the vicinity of the site.

The posted (regulatory) speed limit in the site vicinity is 30 miles per hour (mph). Land use along Lexington Street in the site vicinity is primarily residential with a pedestrian walkway leading to the Burr Elementary School located approximately 335 feet south of the site. General observations conducted by MDM in April 2009 indicate that the pedestrian-actuated signal is in working order. Average pedestrian activity at the crossing was observed to be approximately 10 crossings over a 30-minute period during a weekday midday, resulting in a total of five (5) pedestrian signal calls (equivalent to 10 pedestrian calls per hour).

Vehicle speeds were obtained for the Lexington Street northbound and southbound travel directions at the proposed site driveway by timing vehicles over a known distance and then converting the travel times to speeds. Collected speed data are provided in the **Attachments**. **Table 1** presents a summary of the travel speed data collected for Lexington Street in the site vicinity.

Table 1
LEXINGTON STREET SPEED STUDY RESULTS

Travel Direction	Posted Speed Limit	Travel Speed	
		Average ¹	85 th Percentile ²
Northbound	30	32	36
Southbound	30	33	38

¹Arithmetic Mean.

²The speed at or below which 85 percent of the vehicles are traveling.



North

Scale: Not to Scale

Source: Winslow Architects, Inc.

Figure 2

MDM TRANSPORTATION CONSULTANTS, INC.
Planners & Engineers

Preliminary Site Layout

As summarized in **Table 1**, the mean (average) travel speed on Lexington Street in the site vicinity traveling northbound is 32 mph and the 85th percentile travel speed is 36 mph. In the southbound direction, the mean travel speed is 33 mph and the 85th percentile travel speed is 38 mph. The observed average travel speeds are slightly higher but consistent with the posted (regulatory) speed limit of 30 mph on Lexington Street in the site vicinity.

TRIP GENERATION ESTIMATES

The proposed residential development consists of 10 condominium units. Trip generation estimates for each alternative have been estimated for the weekday morning and weekday evening peak traffic hours – representative of the highest activity periods (and, therefore, impact) of these uses. Trip estimates were developed by applying trip rates published by the Institute of Transportation Engineers (ITE) *Trip Generation*¹ for land use code (LUC) 230 – Residential Condominium. **Table 2** presents a summary of the site trip generation for the proposed development. Trip generation calculations are provided in the **Attachments**.

Table 2
TRIP-GENERATION SUMMARY

Peak Hour/Direction	Site Trips¹
<i>Weekday Morning Peak Hour:</i>	
Entering	1
<u>Exiting</u>	<u>3</u>
Total	4
<i>Weekday Evening Peak Hour:</i>	
Entering	3
<u>Exiting</u>	<u>2</u>
Total	5
<i>Weekday Daily (24-Hour)</i>	58

Source: ITE *Trip Generation*, Eighth Edition; 2008.

¹Based on ITE LUC 230 trip rates applied to 10 dwelling units.

As summarized in **Table 2**, the proposed development is expected to generate approximately 4 vehicle-trips (1 entering and 3 exiting) during the weekday morning peak hour and 5 vehicle-trips (3 entering and 2 exiting) during the weekday evening peak hour. Therefore, the proposed residential development is expected to generate one additional vehicle every 12 to

¹*Trip Generation*, Eighth Edition; Institute of Transportation Engineers; Washington, DC; 2008.

15 minutes which is well within daily fluctuations of traffic along Lexington Street during weekday morning and evening peak hours. On a daily basis, the proposed residential development is expected to generate approximately 58 vehicle-trips with 50 percent entering and exiting.

DRIVEWAY SIGHT LINE EVALUATION

An evaluation of sight lines at the proposed site driveway location along Lexington Street was conducted following American Association of State Highway and Transportation Officials' (AASHTO) guidelines². The evaluation is based on field measurements of available sight lines and travel speed data collected by MDM on April 1, 2009. In summary, applicable AASHTO sight line standards will be met at the proposed driveway location based on planned driveway layout and modification of existing fence along the northerly property boundary.

The AASHTO standards reference two types of sight distance which are relevant at the proposed site driveway intersection along Lexington Street: stopping sight distance (SSD) and intersection sight distance (ISD). Stopping sight distance pertains to roadway segments (i.e., Lexington Street) and intersection sight distance, as the name implies, relates specifically to intersections. Sight lines for critical vehicle movements at the unsignalized site driveway intersection were compared to minimum safe stopping sight distance (SSD) and intersection sight distance (ISD) requirements for the regulatory speed limit and observed travel speeds along Lexington Street in the site vicinity. Sight line calculations are provided in the **Attachments** and are summarized below in **Table 3**.

² *A policy on Geometric Design of Highways and Streets*, American Association of State Highway and Transportation Officials (AASHTO), 2004.

TABLE 3
Sight Distance

Approach/ Travel Direction	Available Sight Distance	AASHTO Recommended ¹		
		Posted Speed (30 mph)	Average Travel Speed	85 th Percentile Travel Speed
<i>Stopping Sight Distance (SSD)</i>				
<i>Northbound</i>	>300 Feet	195 Feet	215 Feet	250 Feet
<i>Southbound</i>	>300 Feet	205 Feet	235 Feet	290 Feet
<i>Intersection Sight Distance (ISD)⁴</i>				
<i>Looking South</i>	270± Feet	195 Feet	215 Feet	250 Feet
<i>Looking North</i>	>300 Feet ⁵	205 Feet	235 Feet	290 Feet

¹Recommended sight distance based on AASHTO, A Policy on Geometric Design of Highways and Streets. Based on driver height of eye of 3.5 feet to object height of 2.0 feet for SSD or 3.5 feet for ISD and adjustments for roadway grade.

²Average Speed is 32 mph NB and 33 mph SB.

³85th Percentile travel speed is 36 mph NB and 38 mph SB.

⁴Recommended ISD is minimum sight distance recommended by AASHTO which is equal to SSD recommendation.

⁵Available ISD assumes removal of existing on-site fencing for a minimum of 20 feet back from the curblane.

As summarized in **Table 3**:

- *Stopping Sight Distance Criteria Are Met.* Existing available SSD in both travel directions along Lexington Street is greater than 300 feet, which exceed AASHTO's recommended SSD criteria for the posted and observed travel speeds (250 feet or less northbound and 290 feet or less southbound).
- *Intersection Sight Distance Criteria Are Met.* Available ISD in both travel directions along Lexington Street is 270 feet looking south and greater than 300 feet looking north (assuming partial fence removal as cited under Recommendations), which exceed AASHTO's recommended ISD criteria for the posted and observed travel speeds (250 feet or less looking south and 290 feet or less looking north).

RECOMMENDATIONS

Specific design elements of the proposed driveway at Lexington Street are to be developed by the Applicant to ensure compliance with Town requirements. Recommended elements include curb radii and driveway width sufficient to accommodate emergency and service vehicle access/egress and traffic signs and pavement markings that comply with the current Manual on Traffic Control Devices (MUTCD).

Review of applicable SSD and ISD criteria and ambient travel speeds indicates that ample stopping sight distance will be provided at the site drive on Lexington Street that meet or exceed AASHTO sight line criteria based on implementation of the following recommendations:

- Remove existing fencing along the northerly property line for a minimum setback distance of 20 feet from the Lexington Street curblin.
- Any new plantings along Lexington Street along the site frontage should be limited to species that will not exceed twenty four (24") in height when fully mature.

CONCLUSIONS

The proposed residential development is a very low traffic generator that is estimated to generate fewer than 5 new vehicle-trips per hour (one new vehicle every 12 minutes on average) relative to the existing residential use of the property. As such, no material impact to area roadways or intersections are anticipated. Ample sight lines will also be provided at the proposed site driveway for vehicles approaching and/or exiting the driveway based on recommended sight line enhancements. The existing pedestrian-activated traffic signal at Lexington Street located approximately 350 feet south of the site driveway was observed to be in proper working order, is staffed by a crossing guard during school arrival/dismissal periods and will not be materially impacted by the proposed residential development project.

ATTACHMENTS

- Travel Speed Data
- Trip Generation Calculations
- Stopping Sight Distance Calculations

□ **Travel Speed Data**

MDM Transportation Consultants, Inc.

28 Lord Road, Suite 280
Marlborough, MA 01752

Spot Speed Study
192 Lexington Street
Newton, MA

File Name : 492 Spot Speed #2
Site Code : 00492002
Start Date : 4/1/2009
Page No : 1

#	Northbound	Southbound
1	29	34
2	36	32
3	30	36
4	34	31
5	32	33
6	34	31
7	31	31
8	30	29
9	29	31
10	29	40
11	32	28
12	33	29
13	29	38
14	26	37
15	32	35
16	35	34
17	36	33
18	38	25
19	31	34
20	25	34
21	33	37
22	36	40
23	30	32
24	30	34
25	32	28
26	32	28
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28	33	35
29	28	39
30	25	37
31	30	32
32	33	32
33	34	30
34	35	34
35	27	34
36	43	31
37	30	38
38	27	29
39	33	34
40	36	41
41	34	33
42	29	42
43	36	33
44	33	40
45	30	34
46	29	29
47	39	31
48	38	30
49	27	27
50	31	29
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Class	Vehicle Count	Average Speed	True Median (50th Percentile)	85 Percentile	10 MPH Pace Speed	Number in Pace	Percent in Pace	Number of Vehicles Over 30 MPH	Percent of Vehicles Over 30 MPH
Northbound	54	32	32	36	29 - 38	45	83	34	63
Southbound	56	33	34	38	28 - 37	44	79	42	75
Summary	110	33	33	37	29 - 38	88	80	76	69

Trip Generation Calculations

Institute of Transportation Engineers (ITE) 8th Edition
Land Use Code (LUC) 230 - Residential Condominium/Townhouse

Average Vehicle Trips Ends vs: Dwelling Units
Independent Variable (X): 10

AVERAGE WEEKDAY DAILY

$T = 5.81 * (X)$
 $T = 5.81 * 10$
 $T = 58.10$
 $T = 58$ vehicle trips
with 50% (29 vpd) entering and 50% (29 vpd) exiting.

WEEKDAY MORNING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.44 * (X)$
 $T = 0.44 * 10$
 $T = 4.40$
 $T = 4$ vehicle trips
with 17% (1 vpd) entering and 83% (3 vpd) exiting.

WEEKDAY EVENING PEAK HOUR OF ADJACENT STREET TRAFFIC

$T = 0.52 * (X)$
 $T = 0.52 * 10$
 $T = 5.20$
 $T = 5$ vehicle trips
with 67% (3 vpd) entering and 33% (2 vpd) exiting.

SATURDAY DAILY

$T = 5.67 * (X)$
 $T = 5.67 * 10$
 $T = 56.70$
 $T = 56$ vehicle trips
with 50% (28 vpd) entering and 50% (28 vpd) exiting.

SATURDAY MIDDAY PEAK HOUR OF GENERATOR

$T = 0.47 * (X)$
 $T = 0.47 * 10$
 $T = 4.70$
 $T = 5$ vehicle trips
with 54% (3 vpd) entering and 46% (2 vpd) exiting.

□ **Stopping Sight Distance Calculations**

Stopping Sight Distance

Posted

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	SB	30	110.25	91.5	201.8
Direction 2	NB	30	110.25	81.6	191.8

INPUTS

Direction 1

Direction 2

Travel Direction	SB	NB
Speed	30	30
Grade	-0.02	0.02
t	2.5	2.5
a	11.2	11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = $1.47 \times t \times V$

Brake Distance = $V^2 / (30 \times ((a/32.2)+G))$

Where:

t = reaction time (sec)

V = travel speed (mph)

G= roadway grade

a - deceleration rate (ft/sec²)

Stopping Sight Distance

Observed Average Travel Speeds

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	SB	33	121.275	110.7	232.0
Direction 2	NB	32	117.6	92.8	210.4

INPUTS

Direction 1

Direction 2

Travel Direction

SB

NB

Speed

33

32

Grade

-0.02

0.02

t

2.5

2.5

a

11.2

11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = $1.47 \times t \times V$

Brake Distance = $V^2 / (30 \times ((a/32.2)+G))$

Where:

t = reaction time (sec)

V = travel speed (mph)

G= roadway grade

a - deceleration rate (ft/sec²)

Stopping Sight Distance

Observed 85th Percentile Travel Speeds

		SPEED (MPH)	BRAKE REACTION DISTANCE (FT)	BRAKING DISTANCE (FT)	CALCULATED STOPPING SIGHT DISTANCE (FT)
Direction 1	SB	38	139.65	146.8	286.5
Direction 2	NB	36	132.3	117.4	249.7

INPUTS

Direction 1

Direction 2

Travel Direction
Speed
Grade
t
a

SB
38
-0.02
2.5
11.2

NB
36
0.02
2.5
11.2

Stopping Sight Distance (SSD) - Source: AASHTO

SSD = Reaction Distance + Brake Distance

Reaction Distance = $1.47 \times t \times V$

Brake Distance = $V^2 / (30 \times ((a/32.2)+G))$

Where:

t = reaction time (sec)

V = travel speed (mph)

G= roadway grade

a - deceleration rate (ft/sec²)