APPENDIX 1: Traffic Study

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Traffic Study
Lexington Technology Park
Lexington, Massachusetts

Submitted to:
Patriot Partners
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Executive Summary

This study analyzes the traffic impact resulting from proposed additional density at the Lexington Technology Park in Lexington, Massachusetts.

The buildings currently permitted at the Lexington Technology Park will provide a floor area of approximately 696,000 gross square feet (gsf)[1]. The proposed additional density will add approximately 380,000 gsf, for a total building area of approximately 1,076,600 gsf.

The study area addresses eight intersections along Spring Street, Hayden Avenue, and Concord Avenue, including Route 2 interchanges 53 (Concord Ave/Hayden Ave near Spring Street) and 54 (Waltham Street at Hayden Ave). All intersections studied are currently unsignalized. At present, at least one turning movement experiences LOS E or F during peak conditions at five of the eight intersections.

In the interest of simplifying the public review process, data and assumptions regarding existing traffic volumes, crashes, future traffic volumes without the project, and the distribution of additional project trips were taken directly from December 2008 Ledgemont Corporate Center traffic impact study. This study is a public document and addresses a proposed development directly across Spring Street from the Lexington Technology Park.

A future No-Bulid scenario was generated for the year 2014 assuming 1.0% annual growth, in addition to growth from other active development proposals in the vicinity. The 2014 Build scenario was created by adding trips generated by the proposed additional density to the No-Build scenario. Trip generation due to the proposed additional density was calculated assuming that all of the proposed space will be used as office. Under the Build scenario, one turning movement at each of two locations which experience levels of service no worse than LOS D under No-Build conditions will experience level of service E during the morning peak hour.

In excess of existing commitments from prior applications, the proponent is proposing to include an escrow deposit of $120,000 to be spent at the discretion of the Town to improve the roadway system in the project vicinity; update trip generation targets for the site; and contribute an additional $12,000 annually to LEXPRESS.

[1] The Zoning Board of Appeals on January 24, 2008 by Special Permit increase the original 631,600 gross floor area by 65,000 s.f. while maintaining the net square footage at 505,800 s.f.

1.0 Introduction

Tetra Tech Rizzo has evaluated the potential traffic impacts associated with the additional laboratory and office space proposed at Lexington Technology Park in Lexington, Massachusetts. The study evaluates traffic operating conditions in the project site vicinity under existing and future conditions with and without the additional development. The evaluation assesses the traffic impacts of two possible occupancy scenarios of the proposed new buildings. Potential mitigation measures that would address local impacts to traffic operations are also evaluated in the study.

1.1 Project Description

The Lexington Technology Park site is bounded on the south by Route 2 and on the west by Interstate 95 (Route 128). The site is located near the intersection of Spring Street/Hayden Avenue, which has interchange connections at Route 2.

In 2007, the Town of Lexington granted permits for the development and occupancy of up to 696,600 sf (gross) of office and laboratory complex at the site, which is under construction and partially occupied. The current proposal would add 380,000 sf of office and laboratory space to the permitted development, for a total of 1,076,600 sf.

The new buildings would be located in the main part of the campus along Patriot Way, a private way which meets Spring Street directly opposite Hayden Avenue. The existing building at 125 Spring Street, which has separate direct access to Spring Street, will not be affected by this proposal.

1.2 Project Study Area

The study area includes Spring Street, Hayden Avenue, Concord Avenue, Waltham Street, Marrett Road and the Route 2 interchanges at Hayden Avenue and Concord Avenue (Exit 53) and at Waltham Street (Exit 54). Eight intersections are considered in the study. These are depicted in Figure 1 and are as follows:

- Spring Street, Hayden Avenue and Patriot Way (site driveway)
- Hayden Avenue and Route 2 westbound on-ramp (Interchange 53)
- Concord Avenue and Route 2 eastbound on-off ramps (Interchange 53)
- Hayden Avenue and Route 2 westbound off-ramp (Interchange 54)
- Spring Street and Concord Avenue
- Spring Street and Shade Street
- Waltham Street and Hayden Avenue; and
- Marrett Road (Route 2A), Spring Street and Bridge Street

All of these intersections are currently unsignalized.

2.0 Existing Conditions

2.1 Roadway Segments

As noted above, the Lexington Technology Park is located proximate to Route 2 and Route 128 (Interstate 95), highways of regional significance, however there is no direct access to the site from either highway. The nearest access to the regional highway system is at Route 2 Exit 53 which includes ramps to/from Hayden Avenue and Concord Avenue. Local roadways providing site access are described below.

Spring Street

Spring Street passes through the town of Lexington in an approximate north-south direction. Spring Street south of Route 2 is designated as Old Spring Street. Spring Street provides one travel lane in each direction with additional turn lanes at intersections. Street lights are provided on the west side of the road. The posted speed limit is 30 miles per hour (mph). Office and residential land uses are located along the roadway. The roadway has a slight upgrade proceeding northbound north of the site driveway. Pavement markings on Spring Street at Hayden Avenue and Concord Avenue consist of double yellow centerline and solid white edge lines. There are no pavement markings on Spring Street at Marrett Road or at the site driveway at 125 Spring Street. The pavement surface is in good condition.

Hayden Avenue

Hayden Avenue runs between Spring and Waltham Streets in an east-west direction for approximately one mile. It provides one travel lane in each direction. There are no sidewalks. Pavement markings in this section of roadway consist of solid white edge lines and a double yellow centerline. Street lighting is provided on the north side of the road. The pavement is in good condition. Land uses along this roadway are mostly commercial. Ramps to Route 2 westbound are provided off of this roadway approximately 1,200 feet east of Spring Street.

Concord Avenue

Concord Avenue runs in an east-west direction parallel and south of Route 2. Between Spring Street and the Route 2 eastbound on-off ramps Concord Avenue has one travel lane in each direction. The posted speed limit is 35 mph. Land uses along this section of the roadway are mostly residential. The pavement surface is in good condition and pavement marking in this section of roadway consists of double yellow centerline. The Route 2 eastbound on-off ramps are located off of this roadway approximately 650 feet east of Spring Street.

Marrett Road (Route 2A)

Marrett Road passes east-west through the town of Lexington with one travel lane in each direction. Pavement markings in this section of roadway consist of solid white edge lines and double yellow centerline. The pavement is in good condition. Street lights and sidewalks are provided on the north side of the road. The posted speed limit is 30 mph. Land uses located along the roadway are mostly residential.

Waltham Street

Waltham Street runs north-south and is wide enough to provide two travel lanes in each direction. Pavement marking in the vicinity of Hayden Avenue consists of solid white edge lines. A raised concrete median at the center of the roadway separates the northbound and southbound traffic. The pavement is in good condition. Curbing is provided on both sides of the roadway. Street lighting is provided on the east side of the road. The speed limit on this street varies between 35 and 40 mph. Land uses along this roadway are commercial and residential.

Shade Street

Shade Street meets Spring Street just north of the project site and extends westward from Spring Street. It primarily provides local access to a residential neighborhood and does not function as a significant access route to the project site. In the vicinity of the project site, the roadway has no pavement markings, is approximately 20 feet wide and functions with one lane in each direction.

2.2 Intersections

Spring Street, Hayden Avenue and Patriot Way (site driveway)

Spring Street, Hayden Avenue and Patriot Way meet at a four-way unsignalized intersection. The Hayden Avenue and the Patriot Way approaches are STOP controlled while traffic on Spring Street is free. All approaches to this intersection provide exclusive left turn lanes and a through/right turn lane with the exception of the Hayden Avenue approach, which has a channelized right turn lane under YIELD-sign control, an exclusive left turn lane and a through lane. No crosswalks are provided at this intersection. There is curbing on both sides of all approaches. There is a guardrail on Spring Street for both the southbound and northbound approaches.

Hayden Avenue at Route 2 westbound on-ramp (Exit 53)

The Route 2 westbound on-ramp is accessed from Hayden Avenue approximately 1,200 feet east of Spring Street at an unsignalized three-way intersection. Guardrails are provided on both sides on Hayden Avenue at this intersection. The eastbound and westbound approaches on Hayden Avenue are wide enough to accommodate turning and through traffic in separate lanes.

Concord Avenue at Route 2 eastbound on-off ramps (Exit 53)

The Route 2 eastbound on and off ramps intersects Concord Avenue approximately 650 feet east of Spring Street to form an unsignalized three-way intersection. The Route 2 eastbound off-ramp provides access to Concord Avenue westbound only; no left turn is allowed. The approach has no STOP or YIELD control and drivers must merge with westbound traffic on Concord Avenue which also has no STOP or YIELD control. The Concord Avenue eastbound approach at this intersection is wide enough to function as a left turn lane and a through lane. Similarly, the westbound approach functions as a through lane and a right turn lane.

Hayden Avenue at Route 2 westbound off-ramp (Exit 54)

The Route 2 westbound off-ramp intersects Hayden Avenue approximately 500 feet west of Waltham Street to form an unsignalized three-way intersection. The left turn from the off-ramp to Hayden Avenue is under STOP control and the right turn from the ramp is channelized and is under YIELD control. Hayden Avenue eastbound and westbound approaches this intersection with one travel lane in each direction.

Spring Street and Concord Avenue

Spring Street at Concord Avenue is an unsignalized three-way intersection. The Concord Avenue approach is STOP controlled. The Spring Street southbound approach and Concord Avenue approach each have exclusive left turn lanes. The northbound Spring Street approach has one shared through/right lane. No crosswalks are provided at this intersection. Residential driveways just north of this intersection on the west side of Spring Street are close enough to affect operations at the intersection when turning movements are made.

Spring Street and Shade Street

Spring Street at Shade Street is an unsignalized three-way intersection. Shade Street is under STOP-control. All approachs to the intersection have one shared lane.

Waltham Street and Hayden Avenue

Hayden Avenue intersects Waltham Street to form an unsignalized T-intersection. The Hayden Avenue approach consists of a left turn lane under STOP control and an exclusive channelized right turn lane under YIELD control. The Waltham Street northbound approach consists of an exclusive left turn lane and a through lane. The Waltham Street southbound approach operates with one through lane and a shared through/right turn lane. The intersection includes a raised island which separates the northbound and southbound traffic.

Marrett Road (Route 2A), Spring Street and Bridge Street

Marrett Road at Spring Street and Bridge Street is an unsignalized four-way intersection. Spring Street and Bridge Street approach the intersection from the south and southeast, respectively, and are under STOP control. All approaches to this intersection provide one travel lane in each direction, with the exception of Bridge Street which is one-way departing the intersection. No crosswalks are provided at this intersection.

2.3 Traffic Volumes

Existing traffic volume conditions in the traffic study were taken directly from the December 2008 Ledgemont Corporate Center traffic impact study. As noted above, the Ledgemont study is a public document and use of consistent data between the two studies simplifies the public review process for the two projects. Automatic Traffic Recorder (ATR) and Turning Movement Count (TMC) data collected for the Ledgemont Study in June 2008 are summarized below.

2.3.1 Daily Traffic Volumes

Daily traffic on Spring Street just north of Patriot Way is 8,200 vehicles per day with 12 percent of that traffic occurring during the morning peak hour and another 12 percent occurring during the afternoon peak hour. The hours of heaviest traffic on Spring Street are from 7:45 to 8:45 in the morning and at from 5:00 to 6:00 in the afternoon. Traffic is heavily directional with 82 percent of the volume southbound in the morning and 67 percent northbound in the afternoon. Hayden Avenue volumes are slightly lower, only 6,000 vehicles per day east of the Ledgemont Driveway. This information is summarized in Table 1.

Table 1 Existing Traffic Volume Summary

Location	Spring St., north of Hayden Ave.	Hayden Ave., east of Ledgemont
Average Weekday Volume	8,200 vpd	6,000 vpd
AM Peak		
Volume	1,020 vph	720 vph
Peak Direction and %	82% SB	50% WB
K factor	0.12	0.12
PM Peak		
Volume	1,020	590
Peak Direction and %	67% NB	65% EB
K factor	0.12	0.10

Source: Traffic Impact Study, Three Ledgemont Office Building. BSC Group, December, 2008
Vpd – Vehicles Per Day Vph – Vehicles Per Hour
K factor: proportion of daily traffic
EB - eastbound, WB - westbound, NB - northbound, SB - southbound

2.3.2 Peak Hour Traffic Volumes

Peak hour turning movement counts conducted in June 2008 for the Ledgemont project were used to develop the peak hour traffic flow networks shown in Figures 2 and 3 for the AM and PM peak hours, respectively. As shown, consistent with the above ATR data, the primary flows along Spring Street at the project site are southbound (toward Route 2) during the morning peak hour and northbound (toward Marrett Road) during the afternoon peak hour. Observed peak hour traffic volumes using Patriots Way, summarized Table 2, reflect approximately 130,000 square feet of building space occupied at the time, plus construction traffic.

Table 2 Existing Site Traffic Summary

Location	Morning Peak Hour	Afternoon Peak Hour
Entering Site		
Trips	72	12
Percent	75%	25%
Exiting Site		
Trips	24	55
Percent	82%	18%
Total	96	67

Source: Traffic Impact Study, Three Ledgemont Office Building. BSC Group,

Observed traffic volume levels in 2008 are generally similar to or lower than traffic volume levels observed in 2003 throughout the study area. This comparison suggests that the recent area-wide peak hour traffic growth rate is zero or negative.

2.4 Traffic Safety

The most recent available traffic crash data were inventoried as part of the Ledgemont study from the records of the Massachusetts Highway Department (MassHighway) for the latest available three-year period, 2004 through 2006. A summary of the information from that study is presented below.

The accident rates at study area intersections were calculated in terms of accidents per million entering vehicles (MEV) at each intersection. The calculated rate was compared to the average accident rates for unsignalized intersections Statewide and for the MassHighway District, which are calculated by MassHighway.

Three of the seven intersections in the Ledgemont report study area – Spring Street/Hayden Avenue/Patriot Way, Waltham Street/Hayden Avenue and Waltham Street/Route 2 westbound – were found to have crash rates in excess of the Statewide and District averages.[2] The most common accident type was "rear-end" which is common for STOP-controlled intersections.

3.0 Future Conditions

Traffic volumes and roadway conditions in the study area were reviewed for the year 2014 which represents a five-year planning horizon consistent with state requirements for traffic impact studies. Independent of the proposed development, traffic volumes on the roadway network in 2014 will include existing traffic, new traffic resulting from general growth and traffic growth related to other known development projects in the area, including space on the project site which is permitted but is not yet built and occupied. This represents "No-Build" traffic conditions. "Build" traffic conditions include No-Build conditions plus traffic associated with new development which could occur with approval of the requested zoning change. The 2014 roadway system is assumed to include currently planned roadway improvement projects.

3.1 2014 No-Build Traffic Volumes

The 2014 Build condition traffic flow networks from the Ledgemont traffic study incorporates all of the above elements and represent the 2014 No-Build condition for this (Lexington Technology Park) study. Specifically, the Ledgemont Future Build condition networks considered an overall traffic growth rate of one percent per year applied to the observed traffic volumes. (This is a conservative figure given that there has been little or no growth since 2003 in

[2] The Concord Avenue/Route 2 intersection was not included in the Ledgemont Study. From 2005 through 2007 there were two crashes at this location, resulting in a crash rate well below Statewide and District averages.

study area volumes.) Additionally, it includes background development traffic. Background traffic includes all traffic anticipated from the Lexington Park project under "by-right" conditions, that is, associated with 631,000 square feet of building floor area as described in the 2003 traffic study, and traffic from full build out of the proposed AvalonBay residential development at the former Metropolitan State Hospital site on Concord Avenue. Finally, it includes all traffic from the currently proposed expansion of Ledgemont by 162,000 square feet. This represents a "worst case" scenario for the Lexington Park project as the Town has not yet granted approvals to the Ledgemont project. The 2014 No-Build traffic volumes for the AM and PM commuter peak hours are shown in Figures 4 and 5, respectively.

3.2 Future Roadway Improvements

In addition to traffic volume changes, roadway improvements planned in the study area are considered in the 2014 No-Build and Build traffic analyses. Roadway improvements are proposed by the Town of Lexington along Spring Street and at the Marrett Road / Spring Street / Bridge Street intersection.

3.2.1 Spring Street Corridor Improvements

The Town of Lexington is in the final stages of planning to add sidewalk and crosswalks along Spring Street. The project extends from the bridge carrying Spring Street over Route 2 northward to the intersection of Spring St, Marrett Road (Route 2A), and Bridge Street. Sidewalk is planned for one side of Spring Street. Beginning at the south (Route 2) end, the sidewalk will be on the western side of Spring Street and extend past Patriot Way and 125 Spring Street to approximately Hudson Road. Just to the south of Hudson Road, a new crosswalk will be established and the sidewalk will cross to the east side of Spring Street. The sidewalk will continue on the east side of Spring Street northward to Marrett Road.

3.2.2 Marrett Road/Spring Street/Bridge Street Improvements

The Town of Lexington is in the final stages of planning for improvements to the intersection of Marrett Road (Route 2A), Spring Street, and Bridge Street. As of early February 2009 there were three alternative designs under consideration for this location. Under all alternatives, Bridge Street would be closed at this intersection (the northwest end of Bridge St.) and become a cul-de-sac with access and egress only via the southeast. Additionally, a westbound left-turn lane would be added to Marrett Road. All alternatives also anticipate the future full signalization of the Marrett Road/Spring Street intersection. A signal operating in flash mode only and/or with a button-actuated pedestrian phase may be used on an interim basis.

3.3 2014 Build Condition

Future Build traffic conditions represent the No-Build condition with traffic added associated with the potential new development allowed by the requested zoning change.

3.3.1 Project Trip Generation

The amount of travel associated with the requested zoning change is dependent upon the expected land use conditions with the zoning in place. For this analysis, trip generation for the potential development conditions was compared to the trip generation for the 2003/2004 program (631,000 square feet of development) included in the No-Build traffic network. The applicable trip rates were selected from the publication *Trip Generation* (Institute of Transportation Engineers, Eighth Edition, 2008). The appropriate categories for the potential development are Research and Development Center (ITE Land Use Code 760) for the proposed biotech laboratory space; General Office Building (ITE Land Use Code 710) for the potential office space; and, Light Manufacturing (ITE Land Use Code 140) for the potential manufacturing space.

The potential development program includes approximately 1,076,600 square feet of building area. Based on current commitments for the use of space and the assumption that all new space at 100 and 600 Patriot Way will be used as office space (as a worst case scenario), future land use conditions are defined in Table 3.

Table 3 Lexington Technology Park Proposed Land Use Program

Building	Status	Floor Area (Gsf)			
		Office	Lab	Manufacturing	Total
125 Spring Street	Existing	25,517	25,517		51,034
300 Patriot Way	Existing	71,900	71,899		143,799
500 Patriot Way	Existing	69,615	29,835		99,450
Subtotal Existing		***166,032***	***127,251***		***294,283***
200 Patriot Way	Under Construction	94,669	94,668		189,337
400 Patriot Way	Under Construction			212,980	212,980
Subtotal Under Construction		***94,669***	***94,668***	***212,980***	***402,317***
100 & 600 Patriot Way	Proposed	380,000			380,000
Subtotal Proposed		***380,000***			***380,000***
TOTAL		**641,701**	**221,919**	**212,980**	**1,076,600**

[1] Office use assumed for worst-case trip generation. Building may include Laboratory space when constructed.

Anticipated trip generation from this land use program based on ITE rates is shown in Table 4. As noted the program will generate approximately 8300 daily vehicle trips with 1255 and 1200 trips occurring during that AM and PM peak hours, respectively. In Table 5, these trip estimates are compared to the trip estimates for the 2003/2004 land use program included in the No-Build networks. As shown, the net peak hour traffic increases associated with the proposed zoning change are 405 trips during the AM peak hour and 395 trips during the PM peak hour.

Table 4 Trip Generation Estimates, Lexington Technology Park

		AM Peak Hour		PM Peak Hour		Weekday	
Land Use	**Area (Gsf)**	Avg Trip Rate[1, 3]	Trips	Avg Trip Rate[1, 3]	Trips	Avg Trip Rate[2, 3]	Trips
Office	641,700	1.29	830	1.24	800	8.70	5,580
Laboratory	221,920	1.19	265	1.12	250	8.74	1,940
Manufacturing	213,000	0.69	150	0.72	150	3.78	805
TOTAL	**1,076,600**	**1.17**	**1,245**	**1.12**	**1,200**	**7.74**	**8,325**

Based on *Trip Generation* (Institute of Transportation Engineers, Eighth Edition, 2008) for Land Use Code 710 (General Office), Land Use Code 760 (Research and Development) and Land Use Code 140 (Manufacturing)

[1] Vehicles per thousand square feet per hour

[2] Vehicles per thousand square feet per day

[3] Most calculations based on non-linear functional estimates. Values shown are trips per total Gsf.

Table 5 Project Traffic

	No-Build (Permitted) Scenario	Potential Full Development	
		Net New	**Total**
AM Peak Trips	850	395	1,245
Entering	745	320	1,065
Exiting	105	75	180
PM Peak Trips	805	395	1,200
Entering	135	95	230
Exiting	670	300	970
Weekday Daily Trips	5,840	2,485	8,325

Based on *Trip Generation* (Institute of Transportation Engineers, Eighth Edition, 2008) for Land Use Code 140 (Manufacturing), Land Use Code 710 (General Office) and Land Use Code 760 (Research and Development)

3.3.2 Project Trip Distribution

The net new project generated vehicle trips were assigned to the roadway network consistent with the trip distribution assumptions used in the Ledgemont Corporate Center report. The Ledgemont study travel patterns are based on existing traffic volume patterns as well as data regarding the geographical distribution of employee residences at the Ledgemont Corporate Center. The proposed development at the Lexington Technology Park is expected to draw employees from a similar geographic distribution. The project trip distribution is depicted in Figure 6. Based on the trip distribution percentages, new project traffic (from Table 5) was assigned to the study area roadway network. The resulting peak hour traffic assignments are shown in Figure 7 (AM) and Figure 8 (PM).

3.3.3 2014 Build Condition Traffic Volumes

The combined new site traffic and No-Build traffic volumes represent the 2014 Build Condition traffic flow networks. These networks are shown in Figures 9 and 10 for the AM and PM peak hours, respectively.

3.4 Traffic Operations Analysis

Intersection operating levels of service were determined for Existing, 2014 No-Build and 2014 Build conditions in order to define the impacts of the requested zoning change on roadway operations. The level of service evaluation criteria and analysis results are presented below.

3.4.1 Level of Service Criteria

Level of service (LOS) is a term used to describe the quality of the traffic flow on a roadway facility at a particular point in time. It is an aggregate measure of travel delay, travel speed, congestion, driver discomfort, convenience, and safety based on a comparison of roadway system capacity to roadway system travel demand. Operating levels of service are reported on a scale of A to F, with A representing the best operating conditions and F representing the worst. Depending upon the type of facility being analyzed, level of service A represents free-flow or uncongested conditions with little or no delay to motorists, while level of service F represents long delays with traffic demands sometimes exceeding roadway capacity.

Roadway operating levels of service are calculated following procedures defined in the *2000 Highway Capacity Manual*, published by the Transportation Research Board. The specific criteria applied per the *2000 Highway Capacity Manual* are summarized in Table 6. For unsignalized intersections, the operating level of service is based on travel delays. Delays are generally calculated as a function of traffic volume, peaking characteristics of traffic flow, percentage of heavy vehicles in the traffic stream, type of traffic control, number of travel lanes and lane use, intersection approach grades, pedestrian activity, and signal timing, phasing, and progression where applicable.

The calculated average delay per vehicle for signalized intersections applies to all vehicles entering the intersection and under control of the traffic signal. For unsignalized intersections, it is assumed that through movements on the main street have the right of way and are not delayed by side street traffic. Consequently, for unsignalized intersections, average delay values apply only to the minor street intersection approaches or to left turns from the major street into the minor street, which must yield to oncoming traffic.

Table 6 shows the range of delay represented by each LOS letter grade for unsignalized intersections.

Table 6 Level of Service Criteria

Level of Service	Average Delay per Vehicle (seconds)
A	0 – 10.0
B	10.1 – 15
C	15.1 – 25.0
D	25.1 – 35.0
E	35.1- 50.0
F	>50

Source: *Highway Capacity Manual* (Transportation Research Board [TRB], 2000)

3.4.2 Capacity Analysis

The procedures described above were used to determine existing peak hour levels of service at the study area intersections using Synchro version 7.0 software.

The capacity analyses are given in Appendix B and the results are summarized in

Table 7. All turning movements currently operate at LOS "D" or better, with the exception of the following:

- Spring Street / Concord Avenue: During the morning and afternoon peak hours, westbound left turns at this intersection operate at LOS F.

- Spring Street / Hayden Avenue / Patriot Way: Eastbound left turns operate at LOS E during both the morning and afternoon peak hours. Westbound left turns operate at LOS F during both the morning and afternoon peak hours. The westbound thru movement experiences LOS E during the morning peak hour and LOS C during the afternoon peak hour.

- Marrett Road / Spring Street / Bridge Street: The shared northbound lane on Spring Street, which accommodates both left and right turns, operates at LOS F during the morning and afternoon peak hours.

- Hayden Avenue / Route 2 Westbound Off Ramp: The northbound left turn (exiting Route 2) experiences LOS F during the morning peak hour.

- Hayden Avenue / Waltham Street: Eastbound left and right turns operate at LOS F during the morning peak hour. During the afternoon peak hour the eastbound left turn also operates at LOS F, while the eastbound right turn experiences LOS D.

Under 2014 No-Build conditions, the following additional movements experience levels of service below LOS D:

- Spring Street / Concord Avenue: Westbound right turns from Concord Ave to Spring St are projected to operate at LOS E during the morning and afternoon peak hours.

- Spring Street / Hayden Avenue / Patriot Way: The eastbound left turn and through movements are projected to experience LOS F during both the morning and afternoon peak hours. Westbound left turns also operate at LOS F during both the morning and afternoon peak hours. Westbound through movements operate at LOS F during the morning peak hour and LOS E during the afternoon peak hour.

- Hayden Avenue / Waltham Street: Eastbound right turns operate at LOS F during the afternoon peak hour.

In addition, the LOS F conditions that occur under Existing conditions are exacerbated under 2014 No-Build conditions. All intersections whose turning movements operate at or below LOS D under existing conditions will maintain this status under No-Build conditions.

Under 2014 Build conditions, two the following additional turning movements experience level of service E:

- Concord Avenue / Route 2 Eastbound Ramps: The southbound right turn, merging with westbound Concord Ave, is projected to experience LOS E during the morning peak hour.

- Spring Street / Shade Street: The eastbound approach, which accommodates both left and right turns from Shade Street onto Spring Street, is projected to experience LOS E during the morning peak hour.

In addition, the following turning movements which experience LOS E under 2014 No-Build conditions are projected to experience LOS F under build conditions:

- Spring Street and Concord Avenue: Westbound right turn from Concord Ave onto Spring Street, morning and afternoon peak hours

- Spring Street / Hayden Avenue / Patriot Way: Westbound through movement during the PM peak hour

In addition, the LOS F conditions that occur under 2014 No-Build conditions are exacerbated under 2014 Build conditions.

All study area intersections are unsignalized. Where main streets are free and side streets are stopped, it is typical for side street vehicles to experience longer delays and lower levels of service. The results presented are based on a capacity model in which drivers require relatively long gaps in the through street traffic in order to exit a minor street. In actual operation, particularly in large metropolitan areas like Boston, motorists often accept much shorter gaps, resulting in shorter delays and better levels of service.

Table 7 **Capacity Analysis**

	Peak Hour	Existing (2009)			Future (2014) No-Build			Future (2014) Build		
		LOS[3]	Delay[2]	V/C[1]	LOS	Delay	V/C	LOS	Delay	V/C
Concord Ave/Rte 2 EB Ramp										
Concord Ave EB L	AM	A	8.0	0.14	A	8.2	0.17	A	8.3	0.17
	PM	A	8.2	0.23	A	8.5	0.30	A	8.9	0.35
Concord Ave EB T	AM	A	0.0	0.10	A	0.0	0.13	A	0.0	0.13
	PM	A	0.0	0.10	A	0.0	0.13	A	0.0	0.13
Concord Ave WB T	AM	A	0.0	0.07	A	0.0	0.13	A	0.0	0.13
	PM	A	0.0	0.07	A	0.0	0.08	A	0.0	0.08
Route 2 EB Ramp SB R	AM	B	11.3	0.39	C	21.8	0.76	E	37.3	0.92
	PM	B	10.3	0.25	B	10.8	0.32	B	11.2	0.36
Concord Ave/Spring St										
Concord Ave WB L	AM	F	*	1.41	F	*	>1.5	F	*	>1.5
	PM	F	147.8	1.01	F	*	>1.5	F	*	>1.5
Concord Ave WB R	AM	B	12.3	0.39	E	39.5	0.91	F	93.7	1.12
	PM	D	30.7	0.64	E	38.8	0.76	F	51.4	0.86
Spring St NB T/R	AM	A	0.0	0.18	A	0.0	0.23	A	0.0	0.24
	PM	A	0.0	0.60	A	0.0	0.60	A	0.0	0.60
Spring St SB L	AM	A	8.7	0.22	A	9.2	0.27	A	9.4	0.29
	PM	B	11.8	0.19	B	13.5	0.38	C	15.8	0.51
Spring St SB T	AM	A	0.0	0.42	A	0.0	0.44	A	0.0	0.45
	PM	A	0.0	0.17	A	0.0	0.21	A	0.0	0.22
Spring St/Hayden Ave/Patriot Way										
Patriot Way EB L	AM	E	36.8	0.13	F	*	>1.5	F	*	>1.5
	PM	E	47.3	0.20	F	*	>1.5	F	*	>1.5
Patriot Way EB T/R	AM	D	25.9	0.12	F	*	>1.5	F	*	>1.5
	PM	C	20.9	0.24	F	*	>1.5	F	*	>1.5
Hayden Ave WB L	AM	F	*	>1.5	F	*	>1.5	F	*	>1.5
	PM	F	108.0	0.85	F	*	>1.5	F	*	>1.5
Hayden Ave WB T	AM	E	36.4	0.12	F	*	>1.5	F	*	>1.5
	PM	C	24.9	0.03	E	39.7	0.18	F	85.1	0.62
Hayden Ave WB R	AM	B	10.4	0.09	B	11.3	0.11	B	11.3	0.11
	PM	C	16.9	0.31	C	19.4	0.39	C	19.4	0.39
Spring St NB L	AM	A	9.9	0.07	C	15.6	0.49	D	27.4	0.77
	PM	A	7.9	0.02	A	8.1	0.05	A	8.3	0.09
Spring St NB T/R	AM	A	0.0	0.25	A	0.0	0.35	A	0.0	0.35
	PM	A	0.0	0.46	A	0.0	0.52	A	0.0	0.52
Spring St SB L	AM	A	8.6	0.10	A	9.3	0.14	A	9.3	0.14
	PM	A	9.7	0.07	B	10.1	0.09	B	10.1	0.09
Spring St SB T/R	AM	A	0.0	0.49	A	0.0	0.61	A	0.0	0.65
	PM	A	0.0	0.17	A	0.0	0.21	A	0.0	0.23

	Peak Hour	Existing (2009)			Future (2014) No-Build			Future (2014) Build		
		LOS[3]	Delay[2]	V/C[1]	LOS	Delay	V/C	LOS	Delay	V/C
125 Spring St/Spring St										
125 Spring St EB L/R	AM	C	15.0	0.03	C	18.2	0.04	C	19.5	0.05
	PM	B	11.5	0.05	B	12.7	0.06	B	13.1	0.08
Spring St NB L/T	AM	A	1.3	0.03	A	1.3	0.03	A	1.3	0.04
	PM	A	0.0	0.01	A	0.0	0.01	A	0.0	0.01
Spring St SB T/R	AM	A	0.0	0.49	A	0.0	0.60	A	0.0	0.64
	PM	A	0.0	0.17	A	0.0	0.20	A	0.0	0.22
Marrett Rd (Re 2A)/Spring St/Bridge St.										
Marrett Rd EB T/R	AM	A	0.0	0.47	A	0.0	0.56	A	0.0	0.58
	PM	A	0.0	0.43	A	0.0	0.46	A	0.0	0.50
Marrett Rd WB L/T	AM	B	11.5	0.51	C	23.5	0.75	D	31.0	0.83
	PM	A	0.0	0.20	A	0.0	0.21	A	0.0	0.22
Spring St NB L/R	AM	F	*	>1.5	F	*	>1.5	F	*	>1.5
	PM	F	*	>1.5	F	*	>1.5	F	*	>1.5
Bridge St NB L/R	AM	C	18.8	0.16	C	20.2	0.19	C	21.3	0.20
	PM	C	16.4	0.02	C	17.7	0.03	C	18.9	0.03
Hayden Ave/Re 2 WB On-Ramp										
Hayden Ave EB T	AM	A	0.0	0.14	A	0.0	0.15	A	0.0	0.16
	PM	A	0.0	0.14	A	0.0	0.24	A	0.0	0.28
Hayden Ave EB R	AM	A	0.0	0.04	A	0.0	0.08	A	0.0	0.09
	PM	A	0.0	0.10	A	0.0	0.31	A	0.0	0.38
Hayden Ave WB L	AM	A	8.4	0.15	A	8.7	0.17	A	8.9	0.18
	PM	A	9.0	0.21	B	12.5	0.35	B	15.0	0.42
Hayden Ave WB T	AM	A	0.0	0.21	A	0.0	0.35	A	0.0	0.44
	PM	A	0.0	0.14	A	0.0	0.17	A	0.0	0.19
Hayden Ave/Re 2 WB Off-Ramp										
Hayden Ave EB T	AM	A	0.0	0.08	A	0.0	0.09	A	0.0	0.10
	PM	A	0.0	0.22	A	0.0	0.30	A	0.0	0.34
Hayden Ave WB T	AM	A	0.0	0.29	A	0.0	0.35	A	0.0	0.38
	PM	A	0.0	0.14	A	0.0	0.15	A	0.0	0.16
Re 2 WB Off Ramp NB L	AM	F	65.8	0.94	F	223.2	1.40	F	*	>1.5
	PM	C	15.1	0.23	C	20.5	0.37	D	26.5	0.50
Re 2 WB Off Ramp NB R	AM	B	14.7	0.61	C	16.3	0.65	C	17.0	0.67
	PM	B	13.7	0.39	C	17.7	0.50	C	20.2	0.55
Hayden Ave/Waltham St										
Hayden Ave EB L	AM	F	76.2	0.47	F	*	>1.5	F	*	>1.5
	PM	F	115.7	0.87	F	*	>1.5	F	*	>1.5
Hayden Ave EB R	AM	F	232.3	1.43	F	*	>1.5	F	*	>1.5

	Peak Hour	Existing (2009)			Future (2014) No-Build			Future (2014) Build		
		LOS[3]	Delay[2]	V/C[1]	LOS	Delay	V/C	LOS	Delay	V/C
	PM	D	25.6	0.76	F	51.9	0.96	F	59.9	0.99
Waltham St NB L	AM	C	17.1	0.49	C	21.5	0.60	C	24.3	0.66
	PM	A	9.7	0.17	B	10.3	0.19	B	10.4	0.20
Waltham St NB T	AM	A	0.0	0.13	A	0.0	0.14	A	0.0	0.14
	PM	A	0.0	0.21	A	0.0	0.22	A	0.0	0.22
Waltham St SB T	AM	A	0.0	0.41	A	0.0	0.43	A	0.0	0.43
	PM	A	0.0	0.24	A	0.0	0.27	A	0.0	0.27
Waltham St SB R	AM	A	0.0	0.29	A	0.0	0.33	A	0.0	0.35
	PM	A	0.0	0.15	A	0.0	0.17	A	0.0	0.18
Spring St/Shade St										
Shade St. EB LR	AM	C	23.3	0.26	D	32.6	0.41	E	37.8	0.45
	PM	B	12.1	0.07	B	13.9	0.11	B	14.6	0.12
Spring St NB LT	AM	A	2.0	0.05	A	2.3	0.06	A	2.3	0.07
	PM	A	2.5	0.10	A	2.7	0.10	A	2.9	0.10
Spring St SB TR	AM	A	0.0	0.61	A	0.0	0.69	A	0.0	0.74
	PM	A	0.0	0.18	A	0.0	0.19	A	0.0	0.21

[1] LOS= Level of Service [2] Delay = Average delay expressed in seconds per vehicle
[3] v/c = volume-to-capacity ratio L = Left Turn, T = Trough, R = Right Turn

3.5 Signal Warrants Analysis

Tetra Tech Rizzo has performed a traffic signal warrant analysis for the Spring Street/Hayden Avenue/Patriot Way intersection. The analysis was conducted in accordance with the guidelines of the *Manual on Uniform Traffic Control Devices* (U.S. Department of Transportation, 2000). Detailed calculations are contained in Appendix C.

Under existing conditions at this intersection, the peak-hour traffic warrant is met but the four-hour warrant is not. Under 2014 No-Build conditions, the intersection is projected to be at the cusp of meeting the four-hour signal warrant. Additional information is needed to complete the four-hour warrant for the 2014 Build condition. However it is safe to assume that the four-hour warrant would be met under 2014 Build condition assumptions.

A traffic signal is generally recommended when an intersection meets peak, four-hour, and eight-hour signal warrants. Additional information is needed in order to complete eight-hour warrants for future (2014) conditions. Typically an intersection on the cusp of meeting the four-hour warrant will not meet the eight-hour warrant.

4.0 Traffic Mitigation

A Traffic Mitigation Plan is proposed in consideration of the requested zoning change that is consistent with the mitigation agreement approved during the 2003/2004 rezoning process for the subject site and summarized in Table 10. At the time, a Traffic Mitigation Plan was agreed upon which included two components. First, the plan provided Transportation Demand Management measures (TDM) and funding aimed at reducing single occupant vehicle trips to/from the project site and on Lexington roadways in general. Second, the plan allowed for mitigation funds to be spent on physical improvements to area roadways at the discretion of the Town. The current mitigation commitment extends the TDM program to the potential additional building floor area at the project site and offers additional funding for Lexington's transit operations and/or physical roadway improvements. The level of additional funding offered is in proportion to the additional trip generation associated with the proposed new development.

Table 8 2003/2004 Traffic Mitigation Plan

- Patriot Partners shall appoint a staff person to act as ongoing site transportation coordinator.
- Patriot Partners shall participate in ride sharing, guaranteed ride home and other transportation demand management programs.
- Patriot Partners shall make an annual $10,000 contribution to Lexington's transit provider, LEXPRESS, increasing to $20,000 upon reaching occupancy of 180,000 square feet (50 percent of the existing floor area) at the Park.
- Patriot Partners shall make an additional $10,000 contribution to LEXPRESS in any given year after reaching occupancy of 180,000 square feet that trip generation targets are not met.
- The above contributions shall be adjusted annually for inflation based upon a change in the Consumer Price Index for the Boston, Massachusetts, metropolitan area.
- Patriot Partners shall ensure that design of on-site traffic circulation can accommodate a LEXPRESS bus and will provide an on-site bus shelter.
- Patriot Partners shall ask that LEXPRESS modify its Route #2 to allow buses to enter the project site.
- Patriot Partners shall deposit in escrow with the Town a sum of $100,000 to be discussed by the Planning Board after consultation with appropriate Town Boards and Departments to fund traffic mitigation improvements and/or services which benefit the Project such as, but not limited to:
    - Operating subsidy for LEXPRESS
    - Financial
    - Operating subsidy for LEXPRESS
    - Financial support in hiring a Transportation Coordinator by the Town.
    - Design and/or reconstruction of the Marrett Road/Spring St. intersection
    - Design and/or reconstruction of sidewalks along Spring St. and/or Shade St
    - Design and/or reconstruction of traffic calming devices along Shade St.
- Beginning in year one, Patriot Partners shall maintain commuter shuttle bus service between the project site and the Alewife MBTA station either through membership in the 128 Business Council or by operating a private shuttle with direct "door to door" service. The private shuttle would operate with a single vehicle on a continuous loop to/from the Alewife Station during commuter peak hours. The vehicle will be available for on-demand service and transportation to Lexington Center during other hours of the workday.
- Upon traffic volumes at the site driveway meeting peak hour traffic signal warrants as defined in the Federal Highway Administration's (FHWA) Manual of Uniform Traffic Control Devices (MUTCD),

Patriot Partners shall provide peak period police officer control at the main site driveway/Spring Street intersection.

- Patriot Partners shall monitor site traffic generation on an annual basis to determine if trip generation goals are met and if a police detail is warranted at the site driveway. Patriot Partners shall also report results to the Planning Board, Town Planner and/or Town Transportation Coordinator.
- Should LEXPRESS cease operations, committed contributions will be deposited by Patriot Partners into a fund to be used by the Town to implement transportation system improvements in the project vicinity. Specific uses may include but not be limited to: design and construction of a traffic signal and related improvements for the Marrett Road/Spring Street intersection; design and construction of sidewalks along Spring Street; and, design and construction of traffic calming measures for Shade Street.
- Patriot Partners will join the South Lexington Transportation Organization and participate in its ongoing activities.

The 2003/2004 mitigation plan supports up to 631,000 square feet of building floor area. Prior to the 2003/2004 zoning change there was 361,000 square feet of building floor space on the site.

Traffic Mitigation in Place

As required by the 2003/2004 agreement, certain mitigation measures have been implemented by the applicant, Patriot Partners and/or the site's principal tenant, Shire. Specifically,

- Jim Palmer has been appointed as a site transportation coordinator.
- Patriot Partners and Shire have joined the 128 Business Council and now have access to the ride sharing, guaranteed ride home and other transportation demand management programs offered by the 128 Business Council.
- Patriot Partners made $10,000 contributions to Lexington's transit provider, LEXPRESS, from 2004 through 2007 and $20,000 contributions in 2008 after reaching occupancy of 180,000 square feet at the Park.
- Patriot Partners has developed internal site plans that can accommodate the turning movements of a LEXPRESS bus and has designated a site for a bus shelter near Building #300.
- Patriot Partners has asked that LEXPRESS modify bus Route #4 to allow buses to enter the project site. (LEXPRESS has not yet agreed to make this route change.)
- Patriot Partners deposited in escrow with the Town a sum of $100,000. The Town has used these funds to:
    - Provide an additional operating subsidy for LEXPRESS
    - Support hiring a Transportation Coordinator for the Town.
    - Pursuit of a state (MORE) grant for the design and reconstruction of the Marrett Road/Spring Street intersection and for the design and construction of a sidewalk along Spring Street
- Patriot Partners has maintained commuter shuttle bus service between the project site and the Alewife MBTA station through membership in the 128 Business Council.
- Patriot Partners has been a member of the South Lexington Transportation Organization and has supported its ongoing activities to improve transportation in the area.

Future Traffic Mitigation Commitments

Pursuant to the 2003/2004 agreement Patriot Partners has future obligations independent of the current zoning change application. Specifically,

- Patriot Partners shall continue making annual $20,000 (inflation adjusted) contributions to LEXPRESS (This payment would be reduced to $10,000 if site occupancy drops below 180,000 square feet).
- Patriot Partners shall annually monitor site traffic generation and make an additional $10,000 (inflation adjusted) contribution to LEXPRESS in any given year that trip generation targets are not met. Monitoring results shall be reported to the Planning Board, Town Planner and/or Town Transportation Coordinator. (Since the existing site trip generation includes a high percentage of construction related trips, the start of the monitoring program has been delayed. The start of the program will be negotiated with the Town based on anticipated future construction activity.)
- Upon traffic volumes at the site driveway meeting peak hour traffic signal warrants as defined in the Manual of Uniform Traffic Control Devices, Patriot Partners shall provide peak period police officer control at the main site driveway/Spring Street intersection.

Proposed Additional Traffic Mitigation

In consideration of the requested zoning change Patriot Partners will provide additional traffic mitigation to the Town. Prior to the start of construction of any new building space that will increase the project floor area to more than 696,600 square feet, Patriot Partners will:

- Deposit in escrow with the Town a sum of $120,000 to be spent at the discretion of the Town on travel demand strategies and/or roadway improvements which benefit the roadway system in the project vicinity such as, but not limited to:
    - Design and/or reconstruction of the Marrett Road/Spring Street intersection
    - Design and/or reconstruction of traffic calming devices along Shade Street
    - Design and/or installation of a traffic signal at the Spring Street/Hayden Street intersection
    - Design and/or installation of a traffic signal at the Spring Street/Concord Avenue intersection
- Work with the Town to update the trip generation targets for the site based on the expanded development program and traffic forecasts provided in this report.

- When site occupancy first exceeds 696,600 square feet Patriot Partners shall make an additional annual $12,000 contribution to LEXPRESS. Should LEXPRESS operations cease the Town will still be entitled to this annual contribution as described in the 2003/2004 agreement.

The values of the financial contributions offered in the additional traffic mitigation package are reflective of the contributions included in the 2003/2004 agreement. The site development changes approved in 2003/2004 will generate an estimated 330 PM peak hour vehicle trips. The $100,000 escrow payment offered at that time amounts to approximately $300 per trip. The currently requested changes will add up to 395 PM peak hour trips at the site. Consequently, at a rate of $300 per trip, the additional escrow payment offer is $120,000. Similarly, the annual LEXPRESS payment reflects a 20 percent increase over the 2003/2004 value. All figures are subject to adjustments for inflation as specified in the 2003/2004 agreement.

Implementation of the proposed traffic mitigation program will ensure significant opportunities to minimize single occupant vehicle trips to/from the project site and on the area roadway. Limiting vehicle trip generation may also serve to delay if not eliminate the need to make physical roadway system changes that could impact community character.

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