

TRAFFIC IMPACT AND ACCESS STUDY

PROPOSED OFFICE EXPANSION

*15 Pleasant Street Connector
Framingham & Southborough, Massachusetts*

Prepared for:
Avison Young

August 2013

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EXECUTIVE SUMMARY

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed office expansion at 15 Pleasant Street Connector (MetroWest Place) in Framingham & Southborough, Massachusetts. This report documents existing operational and safety-related characteristics of roadways serving the development site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of site-related traffic.

This TIAS has been prepared in accordance with the Town of Framingham Traffic Impact Guidelines as well as standards for the preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

E.1 PROJECT DESCRIPTION

The proposed site is located at MetroWest Place along Pleasant Street Connector in Framingham & Southborough, Massachusetts. The proximity of the site in relation to the regional transportation system is shown in **Figure 1**.

Existing (Current) Conditions

The Site consists of a single 5-story office building totaling approximately 92,700 gross square feet (gsf) which was historically fully occupied by Genzyme until 2012. Parking includes approximately 382 on-site marked parking spaces. Access/egress to the site is provided via a signalized driveway connection to the Pleasant Street Connector opposite Crossing Boulevard and an unsignalized driveway along the Pleasant Street Connector approximately 250 west of Crossing Boulevard. An inter-connection is also provided between the Site and the adjacent office building located at 11 Pleasant Street Connector (Genzyme). Pedestrian infrastructure includes on-site sidewalk connections between the main parking fields and the buildings entranceways and a stairway connecting the Site to the adjacent office building at 11 Pleasant Street Connector.

Proposed Conditions

Under the proposed development program, the existing building will be renovated and expanded resulting in a net building increase of approximately 63,000 sf of general office space and approximately 160 additional marked parking spaces will be constructed. To support the parking needs of the Site, a surface parking lot is planned on a separate lot along Pleasant Street Connector immediately opposite the expanded office building. Following completion of the proposed expansion, Metro West Place will comprise of 155,800± sf which will be supported by approximately 542 marked parking spaces. Access/egress to the main parking fields will remain unchanged. Access to the proposed surface parking area will be provided by a single driveway to be located across from the existing site driveway currently serving the westerly part of the site.

E.2 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the site, and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following intersections:

- Pleasant Street Connector at Crossing Blvd - Framingham
- Crossing Blvd at Route 9 (Boston Turnpike) Ramps – Framingham
- Firmin Avenue at 15 Pleasant Street Connector – Southborough
- Route 30 (Boston Road) at Firmin Ave and Willow Street (“5-Corners”) – Southborough
- Route 30 (Boston Road) at Central Street - Southborough

E.3 TRIP GENERATION

The analyses presented in this TIAS are based on industry-standard trip rates published by the Institute of Transportation Engineers (ITE). As such, the proposed expansion is estimated to generate approximately 93 additional vehicle trips during the weekday morning peak hour (82 entering and 11 exiting) and 71 additional vehicle trips during the weekday evening peak hour (12 entering and 59 exiting). On a daily basis, development is estimated to generate approximately 598 additional vehicle trips on weekdays.

The directional distribution of development-generated trips on the roadway network is a function of a number of variables including existing travel patterns along area roadways, the efficiency of these roadways leading to the site and Journey to work census data.

E.4 SUMMARY OF ANALYSIS AND FINDINGS

Capacity analyses were conducted for each study area intersection to quantify existing and future year traffic operations with and without the development for the weekday morning and weekday evening peak hours. These time periods represent the highest activity periods of the proposed project and the adjacent roadway system.

Under Existing conditions, the signalized intersections operate below capacity at LOS C or better (overall) operations during the weekday morning and weekday evening peak hours. Under future No-Build conditions (independent of the proposed development), the signalized intersections are expected to incur additional delay but will continue to operate below capacity at an overall LOS D or better during the peak hours.

Under future conditions with the office expansion in place the signalized study intersections are expected to continue to operate at an overall LOS D or better during the peak hours. In general, no material change in overall operations relative to No-Build conditions is anticipated. Under Build conditions, capacity analyses indicate that the unsignalized site driveway will operate below capacity at LOS D or better during peak hours and mainline travel along Pleasant Street Connector/ Firmin Avenue will continue to operate with minimal delay. The Proponent proposes traffic signal timing optimization at several study intersections aimed at improving operations and queue management as described in more detail under *Conclusions and Recommendations*.

E.5 RECOMMENDATIONS

MDM recommends access/egress and traffic signal improvements aimed at enhancing traffic operations in the study area. Traffic signal re-timing at several study intersections is recommended to reduce queuing and enhance overall intersection operations. Recommended improvements are described in more detail below, which are based on preliminary consultation with MassDOT and are subject to a MassDOT Access Permit.

- *Firmin Avenue at Unsignalized Site Access.* STOP signs (R1-1) and STOP line pavement markings are recommended on driveway approaches to Firmin Avenue. The signs and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD). Plantings (shrubs, bushes) and structures (walls, fences, etc.) should be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveway to provide unobstructed sight lines.
- *Pedestrian Accommodations.* A sidewalk and associated marked crosswalk is proposed along Firmin Avenue that will connect the new parking area to the expanded office building. A proposed pedestrian crossing on Pleasant Street Connector will be added at the signal at Crossing Boulevard to include ADA-compliant ramps, pedestrian pushbuttons and pedestrian traffic signal indicators that allow for an exclusive pedestrian phase when activated.

- *Route 30 at Firmin Avenue/ Willow Street/ Valley Road (5-Corners).* The Proponent proposes to update malfunctioning equipment and implement an optimized traffic signal timing plan at the intersection. The proposed improvements will enhance traffic operations for both existing and proposed roadway users and will provide ample capacity for projected Build traffic conditions. The signal improvements will be subject to MassDOT review and approval under the Highway Access Permit process.
- *Pleasant Street Connector at Crossing Boulevard/ Site Driveway:* The Proponent proposes to implement an optimized traffic signal timing plan at the intersection. The proposed improvements will enhance traffic operations for both existing and proposed roadway users and will provide ample capacity for projected Build traffic conditions. The signal improvements will be subject to MassDOT review and approval under the Highway Access Permit process.
- *Crossing Boulevard at Route 9 Eastbound Ramps:* This intersection operates under a shared traffic signal controller (cluster design) with the adjacent Pleasant Street Connector at Crossing Boulevard/ Site Driveway intersection. As such, any signal timing changes at one will effect operations at the other. Therefore, the proposed signal timing optimization at the adjacent intersection will also enhance traffic operations for both existing and proposed roadway users and will provide ample capacity for projected Build traffic conditions at the intersection of Crossing Boulevard and the Route 9 Eastbound Ramps.

Analysis results indicate that signal timing modifications result in improved operations at the signalized study intersections that offset impacts of the proposed development with improved operations relative to No-Build conditions. Average and 95th percentile vehicle queues at the study intersections are contained within available storage lanes during peak hours under Build (Mitigated) conditions.

E.6 CONCLUSIONS

In general, traffic associated with the proposed office expansion is not expected to materially change operations at area intersections relative to No-Build conditions. Proponent-sponsored improvements that include signal timing modifications at several of the study intersections will offset project trip impacts and will result in improved signal operations relative to No Build conditions. Likewise, proposed pedestrian crossing on Firmin Avenue at its signalized intersection with Crossing Boulevard/Site Drive intersection will provide a controlled means of pedestrian access that connects the site with its proposed new parking area.

Roadway and signal improvements as identified in this study are based on preliminary discussions and input by MassDOT; proposed site access improvements, signal timing modifications and the proposed pedestrian crossing on Firmin Avenue are subject to review and approval as part of a formal Access Permit process that will be undertaken subsequent to local project review.

1.0 INTRODUCTION

MDM Transportation Consultants, Inc. (MDM) has prepared this Traffic Impact and Access Study (TIAS) for a proposed office expansion at 15 Pleasant Street Connector (MetroWest Place) in Framingham & Southborough, Massachusetts. This report documents existing operational and safety-related characteristics of roadways serving the development site, estimates future year operating characteristics of these roadways independent of the development, estimates development-related trip generation, and identifies incremental impacts of site-related traffic.

This TIAS has been prepared in accordance with the Town of Framingham Traffic Impact Guidelines as well as standards for the preparation of traffic studies as jointly issued by the Commonwealth of Massachusetts Executive Office of Energy & Environmental Affairs/Massachusetts Department of Transportation (EEA/MassDOT).

1.1 PROPOSED DEVELOPMENT

The proposed site is located at MetroWest Place along Pleasant Street Connector in Framingham & Southborough, Massachusetts. The proximity of the site in relation to the regional transportation system is shown in **Figure 1**.

Existing (Current) Conditions

The Site consists of a single 5-story office building totaling approximately 92,700 gross square feet (gsf) which was historically fully occupied by Genzyme until 2012. Parking includes approximately 382 on-site marked parking spaces. Access/egress to the site is provided via a signalized driveway connection to the Pleasant Street Connector opposite Crossing Boulevard and an unsignalized driveway along the Pleasant Street Connector approximately 250 west of Crossing Boulevard. An inter-connection is also provided between the Site and the adjacent office building located at 11 Pleasant Street Connector (Genzyme). Pedestrian infrastructure includes on-site sidewalk connections between the main parking fields and the buildings entranceways and a stairway connecting the Site to the adjacent office building at 11 Pleasant Street Connector.

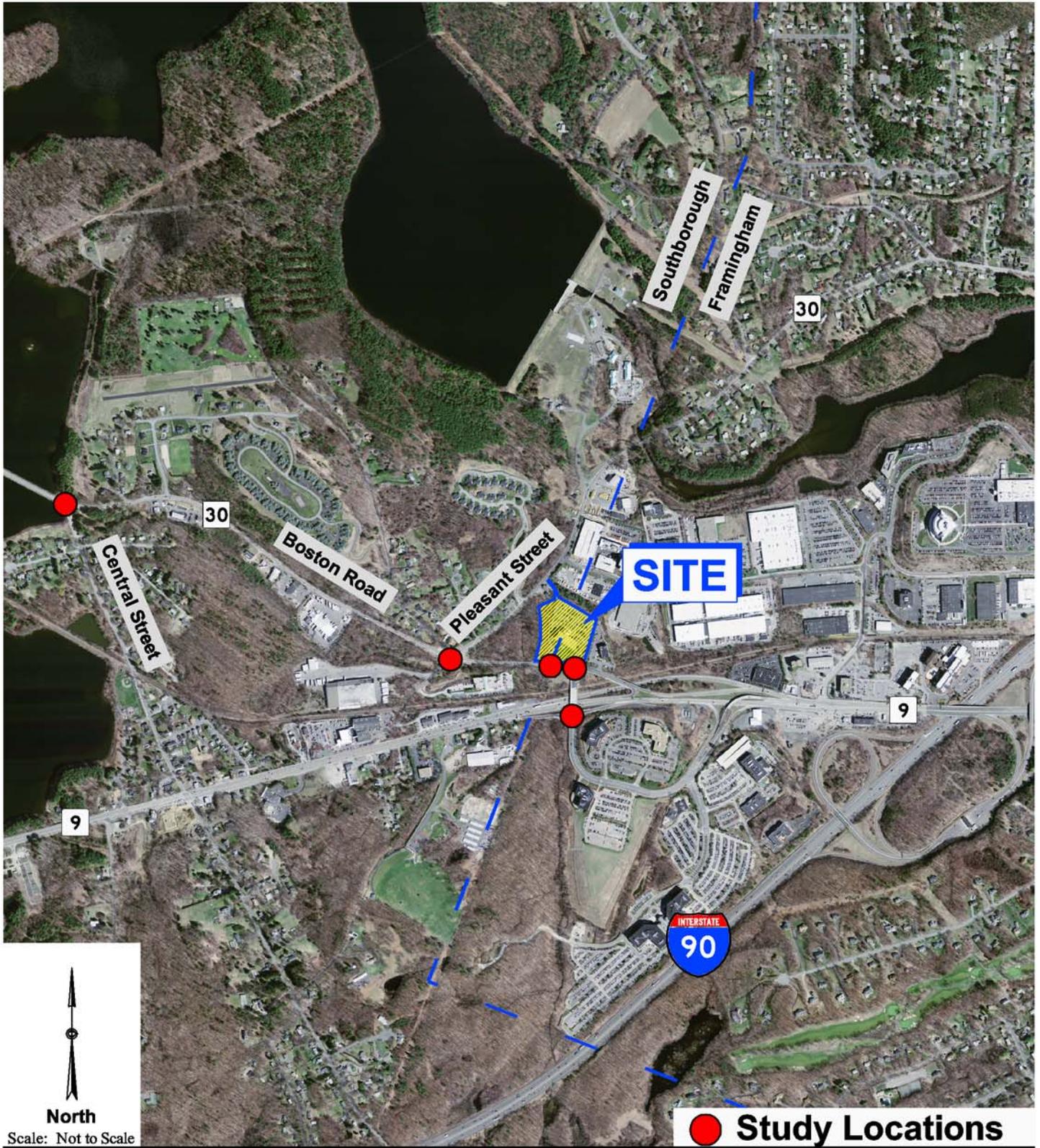


Figure 1

Site Location

Proposed Conditions

Under the proposed development program, the existing building will be renovated and expanded resulting in a net building increase of approximately 63,000 sf of general office space and approximately 160 additional marked parking spaces will be constructed. To support the parking needs of the Site, a surface parking lot is planned on a separate lot along Pleasant Street Connector immediately opposite the expanded office building. Following completion of the proposed expansion, Metro West Place will comprise of 155,800± sf which will be supported by approximately 542 marked parking spaces. Access/egress to the main parking fields will remain unchanged. Access to the proposed surface parking area will be provided by a single driveway to be located across from the existing site driveway currently serving the westerly part of the site. The preliminary site layout prepared by Kelly Engineering Group is presented in **Figure 2**.

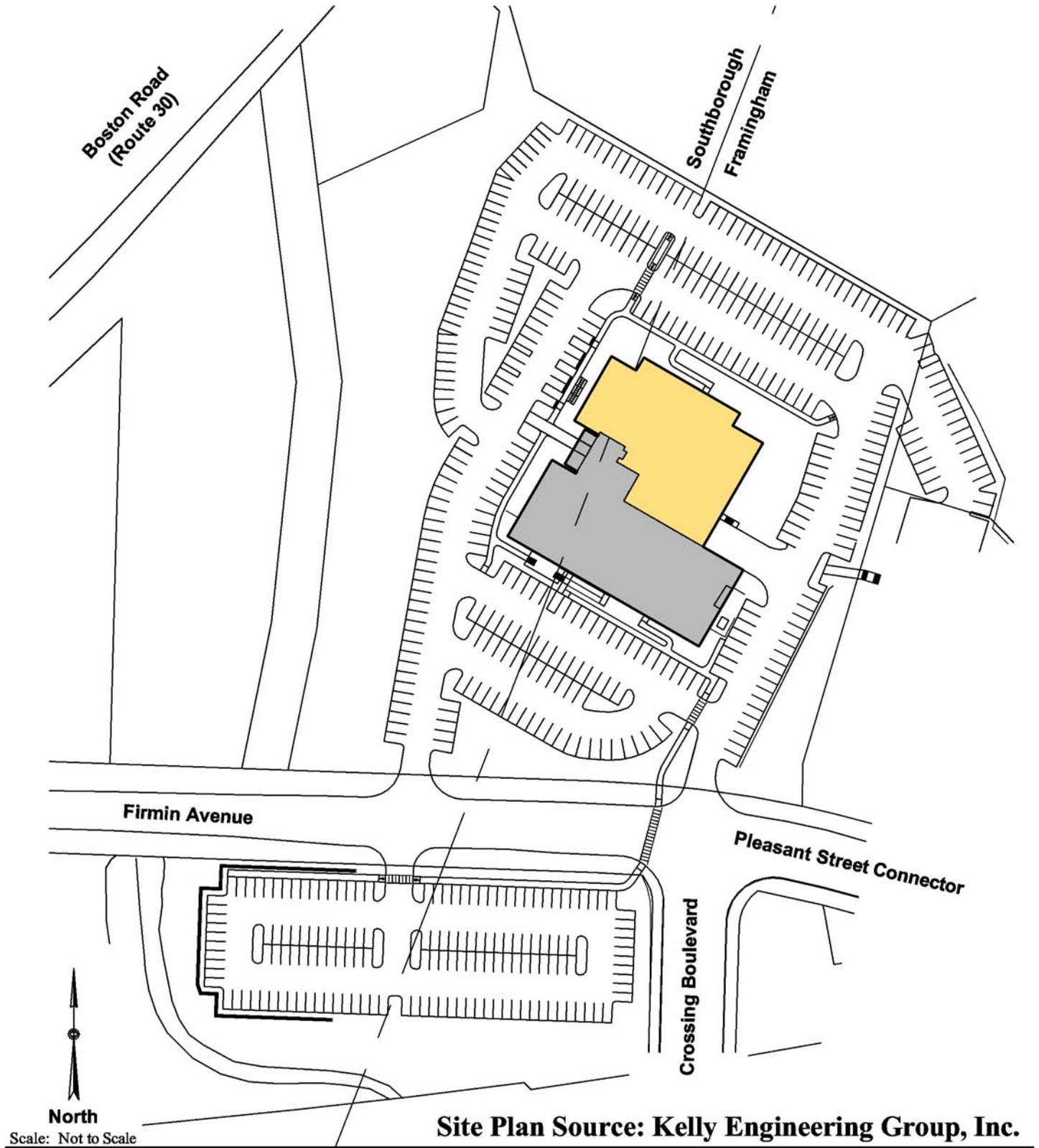
1.2 STUDY METHODOLOGY

This transportation impact and access evaluation is conducted in accordance with local guidelines as well as EEA/MassDOT guidelines, and consists of several steps. The first step documents existing conditions in the transportation study area including an inventory of roadway geometry, observed traffic volumes, and safety characteristics. Next, future year traffic conditions are forecast that account for other planned area developments, normal area growth, and development-related traffic increases. The third step quantifies operating characteristics of the primary study intersections. Specific attention is given to the incremental impacts of the proposed development. Finally, improvements are identified for the development to meet the operational needs of the site and the adjacent roadway network if required.

1.3 STUDY AREA

This TIAS evaluates transportation characteristics of roadways and intersections that provide a primary means of access to the site, and that are likely to sustain a measurable level of traffic impact from the development. The study area includes the following intersections:

- Pleasant Street Connector at Crossing Blvd - Framingham
- Crossing Blvd at Route 9 (Boston Turnpike) Ramps – Framingham
- Firmin Avenue at 15 Pleasant Street Connector – Southborough
- Route 30 (Boston Road) at Firmin Ave and Willow Street (“5-Corners”) – Southborough
- Route 30 (Boston Road) at Central Street - Southborough



Site Plan Source: Kelly Engineering Group, Inc.

Figure 2

2.0 EXISTING CONDITIONS

In order to provide a basis for quantifying the transportation impacts of the development, the existing roadway system and the existing traffic operations of study area roadways were reviewed. This section describes the existing traffic characteristics and operations of roadways and intersections within the study area. Specifically, this section presents an overview of the traffic data collection program, existing traffic volumes and safety data.

2.1 STUDY AREA ROADWAY NETWORK

The study area roadways and intersections are described briefly in this section. A general description of the physical roadway and intersection features is provided. The study area includes roadways under State and local (Town) jurisdiction. The study area and intersections are depicted in **Figure 3**.

2.1.1 Roadways

Pleasant Street Connector/ Firmin Avenue

Pleasant Street Connector/ Firmin Road classified as an Urban Minor Arterial roadway by the Massachusetts Department Transportation (MassDOT), generally runs in an east-west direction and is under MassDOT jurisdiction. Pleasant Street Connector is approximately one-third of a mile in length and provides a connection from Route 9 westbound in Framingham to the Southborough town boundary where it becomes Firmin Avenue which terminates at Boston Road (Route 30). The roadway provides one lane of travel in each direction within an 80 foot right-of-way with additional lanes provided approaching both Boston Road (Route 30) and Crossing Boulevard. There are currently no sidewalks provided along the roadway. Land uses along Pleasant Street Connector/ Firmin Avenue include several office buildings and several undeveloped parcels.

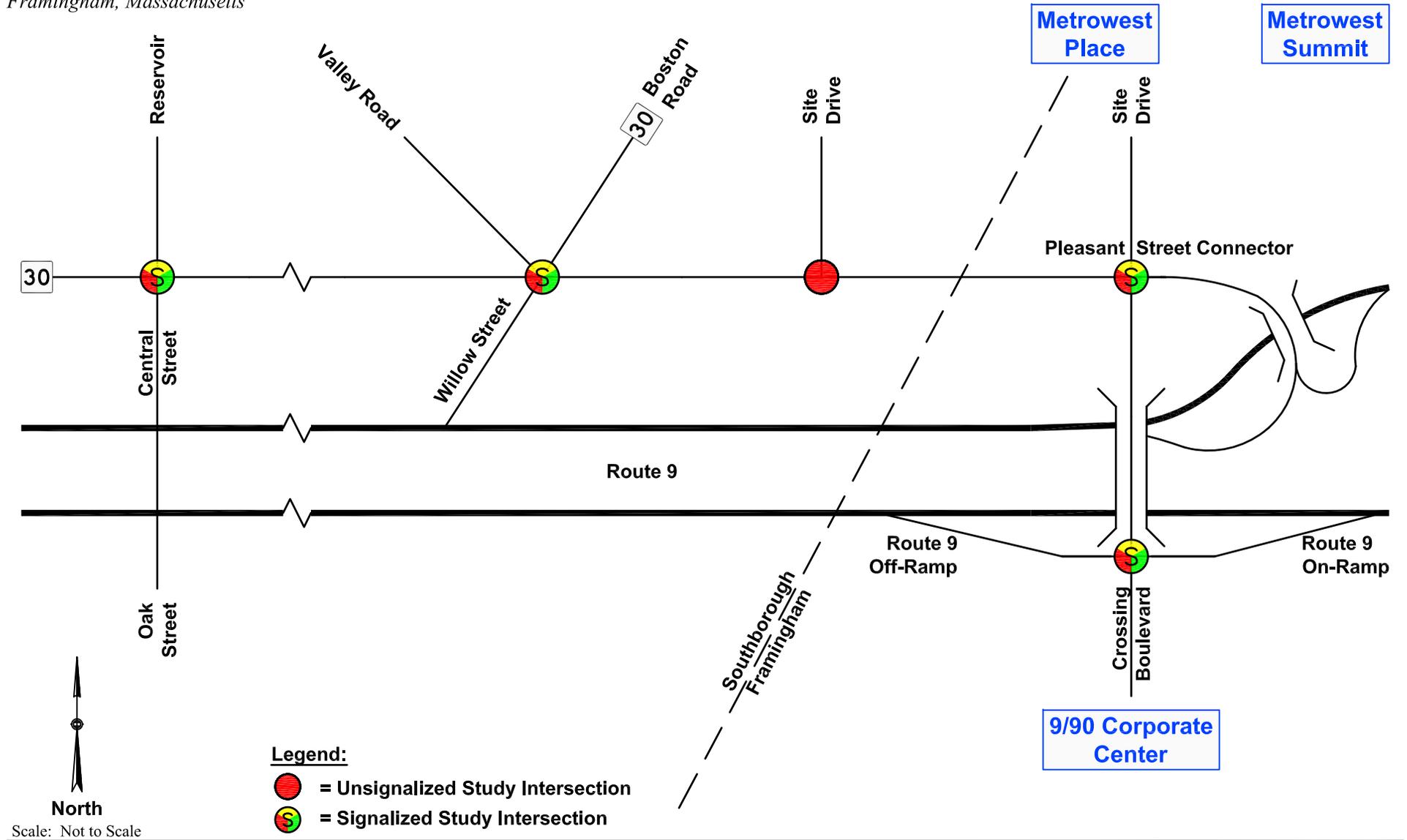


Figure 3

Crossing Boulevard (Bridge over Route 9)

The Crossing Boulevard Bridge over Route 9 is classified as an Urban Local roadway by the MassDOT, generally runs in a north-south direction and is under MassDOT jurisdiction. The bridge connects the Route 9 eastbound on/off ramps to the south with Pleasant Street Connector to the north. The roadway provides two lanes of travel in each direction with a sidewalk provided along its western side. There are no land uses along the bridge; however, Crossing Boulevard provides a connection to the 9/90 Corporate Center to the south of Route 9 which includes office uses and a hotel.

Worcester Road (Route 9)

Route 9 is classified by MassDOT as an Urban Other Principal Arterial roadway and is under the MassDOT jurisdiction. Route 9 is an east-west roadway in the project area which connects Framingham/ Southborough to local communities via connections to major routes I-495, Route 30, and Route 85 to the west and major routes I-90, Route 30, Route 27 and I-95/ I-128 to the east. The roadway in the immediate project area provides three lanes of travel in each direction divided by a cement concrete median with additional lanes provided at its major intersections. The posted speed limit along Route 9 in the study area is 50 miles per hour. Land uses along Route 9 in the immediate project area are primarily commercial and office uses.

Boston Road (Route 30)

Boston Road is classified by MassDOT as an Urban Minor Arterial roadway and is under the MassDOT jurisdiction near its intersection with Firmin Avenue and Local (Town) jurisdiction near its intersection with Central Street. Boston Road is an east-west roadway in the project area which connects Main Street (Route 30) in Southborough to the west with Pleasant Street (Route 30) in Framingham to the east. The roadway generally provides a single travel lane in each direction with additional lanes provided at its major intersections. Land uses along Boston Road within the project area includes a mix-of land uses including a gas station, a fitness center, manufacturing/ warehouse buildings, residential homes, and a reservoir.

Willow Street

Willow Street is classified as an Urban Local roadway under Town jurisdiction. Willow Street provides one travel lane in each direction and connects Route 30/Firmin Avenue to the north with Route 9 westbound to the south. Land uses along Willow Street include cold storage facility, an office building and commercial uses near its intersection with Route 9 eastbound.

Central Street

Central Street is classified as an Urban Local roadway under Town jurisdiction. Central Street is north-south roadway providing one-travel lane in each direction with additional turn lanes provided at its major intersections. Land uses along Central Street include residential homes, a park, commercial buildings, a medical office and a reservoir.

Valley Road

Valley Road is classified as an Urban Local roadway under Town jurisdiction. Valley Road is north-south roadway providing one-travel lane in each direction. Land uses along Valley Road primarily include residential homes but also provide access to a small airport, and Stoneybrook Golf Course.

2.1.2 Intersections

Pleasant Street Connector at Crossing Blvd/15 Pleasant Street Connector (Framingham)

Pleasant Street Connector meets Crossing Boulevard and 15 Pleasant Street Connector to form a four-way signalized intersection. Crossing Boulevard approaches from the south and provides a shared through/left turn lane and a separate right turn lane. Pleasant Street Connector approaches from the east, providing a shared through/right turn lane and a separate left turn lane, and from the west providing a shared through/left turn lane and a separate right turn lane. The driveway for 15 Pleasant Street Connector provides a single general purpose travel lane. The existing traffic signal controller provides five-phase operation and is synchronized with the Crossing Boulevard/Route 9 ramp intersection, given that the same controller controls both intersections.

Crossing Boulevard at Route 9 Ramps (Framingham)

Crossing Boulevard and the Route 9 eastbound off-ramp meet at a four-way signalized intersection. Crossing Boulevard provides two-way travel northbound-southbound and the Route 9 ramps provide one-way travel eastbound. The Crossing Boulevard northbound approach provides a through travel lane and a shared through/right turn lane and is the egress for the 9/90 Corporate Center. The Crossing Boulevard southbound approach provides a through travel lane and a separate left turn lane. The Route 9 off-ramp provides a shared through/left turn travel lane and a channelized right turn lane under *Yield* control. The Route 9 on-ramp departure consists of a single lane. The existing traffic signal controller provides five-phase operation and is synchronized with the Pleasant Street Connector/Crossing Boulevard intersection, given that the same controller controls both intersections.

Firmin Avenue at 15 Pleasant Street Connector (Southborough)

Firmin Avenue and the driveway for 15 Pleasant Street Connector meet at a T-type unsignalized intersection. The Firmin Avenue eastbound and westbound approaches provide a single general purpose travel lane. The 15 Pleasant Street Connector leg provides two-way travel to and from the site.

Boston Road (Route 30) at Firmin Avenue/Willow Street/Valley Road (Southborough)

Boston Road, Firmin Avenue, Willow Street and Valley Road meet and form a five-way signalized intersection. Boston Road approaches from the west and north, as state numbered Route 30. The Boston Road eastbound approach provides two exclusive left turn lanes and a shared through/right turn lane. The Boston Road southbound approach provides an exclusive right turn lane and a shared through/left turn lane. The Firmin Avenue westbound approach provides two general purpose travel turn lanes. The southbound right turn movement from Firmin Avenue is channelized via a raised island and operates under *Yield* control. From the south, Willow Street provides a single general purpose travel lane (shared left/through/right lane). Valley Road, entering from the northwest quadrant of the intersection, provides a single general purpose travel lane and is separated by Boston Road (running east-west) by a raised island. Movements to and from Valley Road and Boston Road (running east-west) are made on the westerly side of the raised island and operate under Stop sign control. The existing traffic signal control provides four-phase operation with lead left turn operation for the Boston Road eastbound approach.

Boston Road (Route 30) at Central Street (Southborough)

Central Street, located approximately 0.9 mile west of the project site, meets Boston Road (Route 30) and an access to the Sudbury Reservoir to form a four-way signalized intersection. The Boston Road eastbound approach consists of a single general purpose travel lane. The Boston Road westbound approach consists of an exclusive left turn lane and a single through travel lane. The Central Street northbound approach consists of an exclusive left turn lane and an exclusive right turn lane. The southbound approach from the Sudbury Reservoir consists of a single general purpose lane. The existing traffic signal control provides four-phase operation with lead left turn operation for the Boston Road westbound approach and protected phasing for the Sudbury Reservoir access driveway.

2.2 EXISTING TRAFFIC VOLUMES

Traffic-volume data used in this study were obtained by mechanical and manual methods in June 2013. Daily traffic volumes along Firmin Avenue between Boston Road (Route 30) and Crossing Boulevard were collected using a radar recorder. Manual turning movement counts (TMCs) were conducted at the study intersections during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods. These hours represent the combination of busiest activity periods of the proposed site use and commuter traffic periods.

2.2.1 Daily Traffic

Daily traffic volumes along the Firmin Road in the site vicinity were collected in June 2013. The results of the counts are summarized in **Table 1** and included in the **Appendix**.

**TABLE 1
EXISTING TRAFFIC VOLUME SUMMARY
FIRMIN AVENUE WEST OF CROSSING BOULEVARD**

Time Period	Daily Volume (vpd) ¹	Percent Daily Traffic ²	Peak Hour Volume (vph) ³	Peak Flow Direction ⁴	Peak Hour Directional Volume (vph)
Weekday Morning Peak Hour	11,995	9%	1,032	65% EB	666
Weekday Evening Peak Hour	11,995	8%	998	58% WB	577

¹Two-way daily traffic expressed in vehicles per day without seasonal adjustment.

²The percent of daily traffic that occurs during the peak hour.

³Two-way peak-hour volume expressed in vehicles per hour.

⁴EB = Eastbound; WB = Westbound

As summarized in **Table 1**, the weekday daily traffic volume on Firmin Avenue adjacent to the Site is approximately 11,995 vehicles per day (vpd) during a typical weekday. Peak hour traffic flow on Firmin Avenue ranges from approximately 998 vehicles per hour (vph) to 1,032 vph adjacent to the Site which represents 8 to 9 percent of daily traffic flow. The traffic flow on Firmin Avenue is oriented higher in the eastbound direction (towards 9/90 Corporate Center) during the weekday morning peak hour and is slightly higher in the westbound direction (away from 9/90 Corporate Center) during the weekday evening peak hour. The travel patterns are highly consistent with commuter traffic given the location of several large office and technology parks in the area.

2.2.2 Peak-Hour Traffic

Manual turning movement counts (TMCs) were conducted along study area roadways and intersections in June 2013. These traffic data were collected during the weekday morning (7:00 to 9:00 AM) and weekday evening (4:00 to 6:00 PM) peak periods.

Review of MassDOT permanent count station data indicates that June is an above-average traffic month (approximately 5 percent higher than average month conditions). In order to provide a conservative analysis, no seasonal adjustment (reduction) of the data was made to the June traffic volume counts. Permanent count station data is provided in the **Appendix**. The resulting existing weekday morning and weekday evening peak-hour traffic volumes for the study intersections are depicted in **Figure 4** and **Figure 5**.

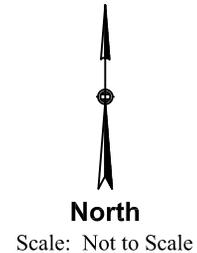
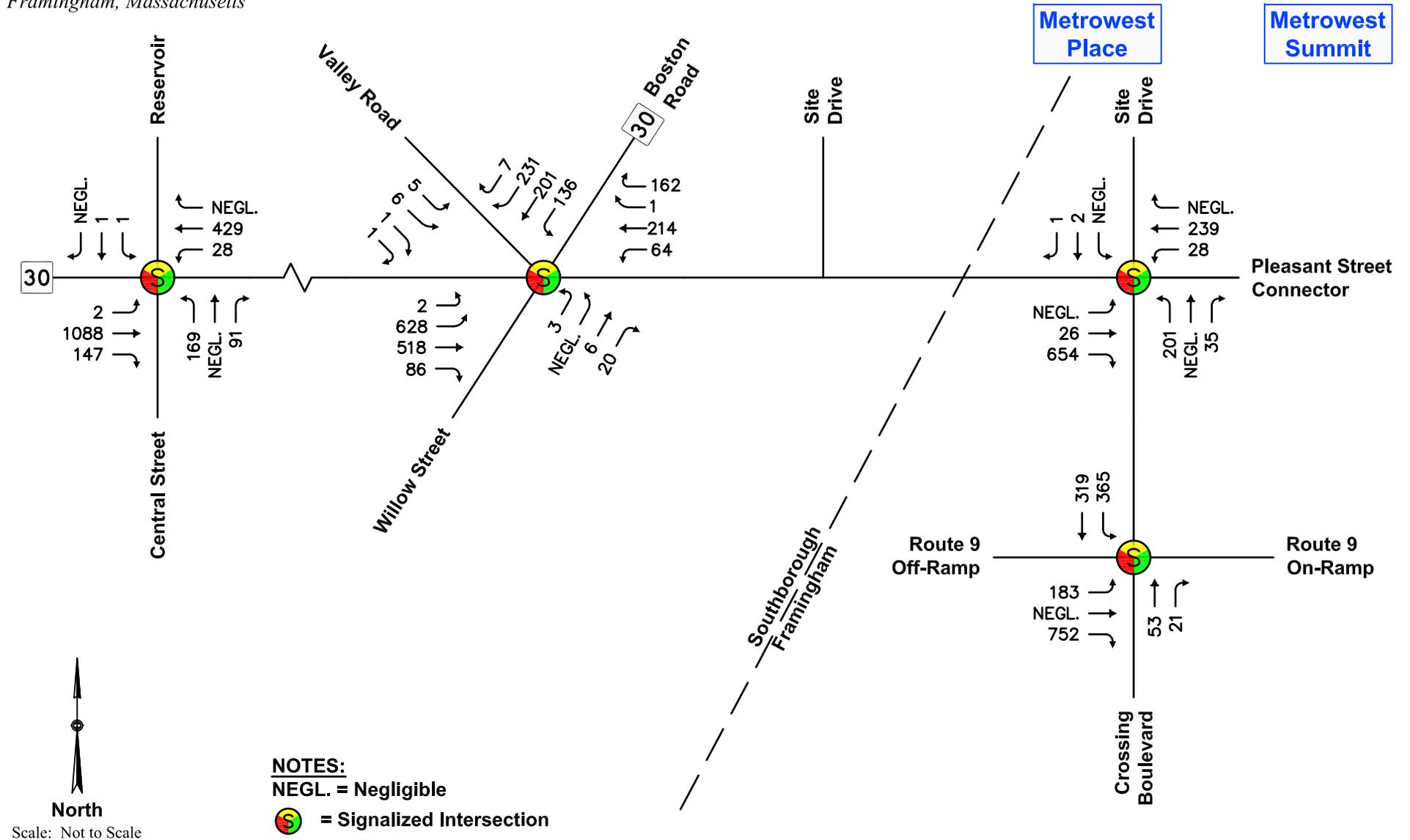


Figure 4

2013 Existing Condition
 Weekday Morning
 Peak Hour Traffic Volumes

2.3 MEASURED TRAVEL SPEEDS

Vehicle speeds were obtained for Firmin Avenue adjacent to the site using a collected using a radar recorder over a 48-hour weekday period in June 2013. **Table 2** summarizes the average and 85th percentile speeds for Firmin Avenue adjacent to the Site. This speed data provides a basis for determining appropriate sight lines for the proposed driveways. Field data are provided in the **Appendix**.

TABLE 2
SPEED STUDY RESULTS – FIRMIN AVENUE

Travel Direction	Travel Speeds		
	Posted¹	Mean²	85th Percentile³
Eastbound	30	35	39
Westbound	30	33	40

¹ Prima Facie Speed (mph)

² Arithmetic mean (mph)

³ The speed at or below which 85 percent of the vehicles are traveling

As summarized in **Table 2**, the mean (average) travel speed on Firmin Avenue traveling eastbound is 35 mph and the 85th percentile travel speed is 39 mph. In the westbound direction, the mean travel speed is 33 mph and the 85th percentile travel speed is 40 mph.

2.4 SAFETY

In order to identify crash trends and safety characteristics for study area intersections, crash data were obtained from MassDOT for the Town's of Framingham and Southborough for the three-year period covering 2008 through 2010 (the most recent data currently available). A summary of the crash data with crash rates for each study area intersection is detailed in **Table 3**. The **Appendix** contains a tabulation of crash data and crash rates calculations.

Crash rates were determined for each study area intersection. These rates quantify the number of accidents per million entering vehicles. MassDOT has determined the accident rates within the District 3 area (which includes the Town's of Framingham and Southborough) to be 0.66 for unsignalized intersections and 0.89 for signalized intersections. These rates represent MassDOT's "average" accident experience for District 3 communities and serve as a basis for comparing reported crash rates for study area intersections located within the districts.

TABLE 3
INTERSECTION CRASH SUMMARY – 2008 THROUGH 2010¹

Data Category	STUDY LOCATIONS			
	Southborough		Framingham	
	Route 30 at Central Street	Route 30 at Valley Rd/ Willow St/ Firmin Ave	Pleasant St Connector at Crossing Blvd	Crossing Blvd at Route 9 EB Ramps
Traffic Control	Signalized	Signalized	Signalized	Signalized
Crash Rate ²	0.10	0.24	0.43	0.54
MHD District 3 Avg ²	0.89	0.89	0.89	0.89
<i>Year:</i>				
2008	1	2	2	1
2009	2	1	2	6
<u>2010</u>	<u>0</u>	<u>4</u>	<u>6</u>	<u>4</u>
Total	3	7	10	11
<i>Type:</i>				
Angle	1	0	2	3
Rear-End	2	5	5	6
Head-On	0	0	0	0
Sideswipe	0	0	2	0
Single Vehicle	0	2	1	1
Unknown/Other	0	0	1	1
<i>Severity:</i>				
P. Damage Only	3	5	7	5
Personal Injury	0	2	3	6
Fatality	0	0	0	0
Unknown	0	0	0	0
<i>Conditions:</i>				
Dry	3	6	4	6
Wet	0	1	5	4
Snow	0	0	1	1
Unknown/Other	0	0	0	0
<i>Time:</i>				
7:00 to 9:00 AM	1	2	4	4
4:00 to 6:00 PM	0	3	1	3
Rest of Day	2	2	5	4

¹Source: MassDOT Crash Database

²Crashes per million entering vehicles (MEV)

³District 3 Average Crash Rate

As summarized in **Table 3**:

- *Route 30 at Central Street.* A total of three (3) crashes were reported for the Route 30 and Central signalized intersection – approximately 1 per year – resulting in a crash rate of 0.10. The majority of reported crashes at the intersection were rear-end type collisions (67%) resulting in property-damage only (100%) and occurring under dry pavement conditions (100%). Thirty three percent (33%) of the reported crashes occurred during the weekday morning peak hours. No fatalities or pedestrian-related incidents were reported.
- *Route 30 at Valley Road/ Willow Street/ Firmin Avenue (5-Corners).* Seven (7) crashes were reported for the 5-Corners signalized intersection – approximately 2 per year – resulting in a crash rate of 0.24. The majority of reported crashes at the intersection were rear-end type collisions (71%) involving eastbound and westbound travel. The remaining two crashes were single vehicle crashes involving fixed objects near the intersection. Seventy-one percent (71%) of the reported crashes occurred during the weekday morning and evening peak commuter hours. No fatalities or pedestrian-related incidents were reported.
- *Pleasant Street Connector at Crossing Boulevard.* Ten (10) crashes were reported for the signalized intersection – approximately 3 per year – resulting in a crash rate of 0.43. The majority of reported crashes at the intersection were rear-end/ sideswipe type collisions (70%) involving two or more westbound vehicles. The remaining crashes included two angle type collisions and a single vehicle crash under snowy conditions. Half (50%) of the reported crashes occurred during the weekday morning and evening peak commuter hours. No fatalities or pedestrian-related incidents were reported.
- *Crossing Boulevard at Route 9 EB Ramps.* Eleven (11) crashes were reported for the signalized intersection – approximately 4 per year – resulting in a crash rate of 0.54. The majority of reported crashes at the intersection were rear-end type collisions (55%) involving two or more eastbound vehicles. The remaining crashes included three angle type collisions and a single vehicle crash under snowy conditions. The majority (64%) of the reported crashes occurred during the weekday morning and evening peak commuter hours. No fatalities or pedestrian-related incidents were reported.
- *Firmin Avenue at Site Driveway (Unsignalized).* No crashes were reported at the unsignalized intersection of Firmin Avenue/ 15 Pleasant Street Connector driveway during the three-year study period.

In summary, the study intersections experienced crash rates well below the District 3 average and no immediate safety countermeasures are warranted based on the crash history at the study intersections.

2.5 PUBLIC TRANSPORTATION FACILITIES

The MetroWest Regional Transit Authority (MWRTA) and MetroWest/ 495 TMA (MW/495 TMA) operate within Framingham and Southborough. Specific route and schedule information is provided in the **Appendix**.

- **MWRTA Route 1:** The bus route runs from the MWRTA central hub in Framingham through the Woodland “T” Station (Green Line) with destinations in Natick, Framingham, and Wellesley. The bus route passes immediately in front of the Site along Pleasant Street Connector (Firmin Avenue) with key stops at the Natick Mall, Logan Express, MW Central Hub, the Woodland T Station, 9/90 Corporate Center, and Framingham Technology Park.
- **MWRTA Route 7:** The bus route runs from the MWRTA central hub in Framingham through Lincoln Street in Marlborough with destinations in Framingham, Southborough and Marlborough. The bus route passes immediately in front of the Site along Pleasant Street Connector with key stops in downtown Southborough, MW Central Hub 9/90 Corporate Center, and Framingham Technology Park.
- **MWRTA Route 9:** The bus route runs from the Natick Mall in Framingham/ Natick through Staples Drive in Framingham with destinations in Framingham, Southborough and Natick. The bus route passes immediately in front of the Site along Pleasant Street Connector (Firmin Avenue) with key stops at the Natick Mall, Logan Express, 9/90 Corporate Center, and Framingham Technology Park.
- **MW/495 TMA Services:** The MW/495 TMA develops and manages commuting solutions for members in Framingham, Hopkinton, Hudson, Marlborough, Natick, Southborough, Sudbury and Westborough.

To provide a conservative analysis, no credit (reduction) in site trips was taken as a result of the available public transportation services.

2.6 SIGHT LINE ANALYSIS

An evaluation of sight lines was conducted at the unsignalized site driveway location to ensure that minimum recommended sight lines are available at its intersection with Pleasant Street Connector/ Firmin Avenue. The evaluation documents existing sight lines for vehicles as they relate to Pleasant Street Connector/ Firmin Avenue with comparison to recommended guidelines.

The American Association of State Highway and Transportation Officials' (AASHTO) standards¹ reference two types of sight distance which are relevant at the site driveway intersection: stopping sight distance (SSD) and intersection sight distance (ISD). Sight lines for critical vehicle movements at the site driveway intersection were compared to minimum SSD and ISD recommendations for the travel speeds in the Site vicinity.

Stopping Sight Distance

Sight distance is the length of roadway visible to the motorist to a fixed object. The minimum sight distance available on a roadway should be sufficiently long enough to enable a below-average operator, traveling at or near a regulatory speed limit, to stop safely before reaching a stationary object in its path, in this case, a vehicle exiting onto Pleasant Street Connector/ Firmin Avenue. The SSD criteria are defined by AASHTO based on design and operating speeds, anticipated driver behavior and vehicle performance, as well as physical roadway conditions. SSD includes the length of roadway traveled during the perception and reaction time of a driver to an object, and the distance traveled during brake application on wet level pavement. Adjustment factors are applied to account for roadway grades when applicable.

SSD was estimated in the field using AASHTO standards for driver's eye (3.5 feet) and object height equivalent to the taillight height of a passenger car (2.0 feet) for the eastbound and westbound Pleasant Street Connector/ Firmin Avenue approaches to the unsignalized site driveway. **Table 4** presents a summary of the available SSD as they relate to Pleasant Street Connector/Firmin Avenue and AASHTO's recommended SSD.

¹A policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials (AASHTO), 2011.

**TABLE 4
STOPPING SIGHT DISTANCE SUMMARY
PLEASANT ST CONNECTOR/ FIRMIN AVE APPROACHES TO SITE DRIVEWAY**

Approach/ Travel Direction	Available Stopping Sight Distance	AASHTO Recommended ¹		
		Posted Speed ²	Average Observed Travel Speed ³	85 th Percentile Observed Travel Speed ⁴
Eastbound	>500 Feet	190 Feet	235 Feet	275 Feet
Westbound	>500 Feet	215 Feet	245 Feet	330 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 with adjustment for grade.

²Prima Facie Speed = 30 mph.

³Average Speed on Pleasant Street Connector/ Firmin Avenue: 35 mph EB, 33 mph WB.

⁴85th Percentile travel speed on Pleasant Street Connector/ Firmin Avenue: 39 mph EB, 40 mph WB.

As summarized in **Table 3**, analysis results indicate that the available sight lines will exceed AASHTO's recommended SSD criteria for both travel directions along Pleasant Street Connector/ Firmin Avenue based on the prima facie speed limit, average observed travel speeds and the observed 85th percentile travel speeds. Stopping sight distance calculations are provided in the **Appendix**.

Intersection Sight Distance

Clear sight lines provide sufficient sight distance for a stopped driver on a minor-road approach to depart from the intersection and enter or cross the major road. As stated under AASHTO's Intersection Sight Distance (ISD) considerations, "...If the available sight distance for an entering ...vehicle is at least equal to the appropriate stopping sight distance for the major road, then drivers have sufficient sight distance to avoid collisions...To enhance traffic operations, intersection sight distances that exceed stopping sight distances are desirable along the major road." AASHTO's ISD criteria are defined into several "cases". For the unsignalized site driveway location which is proposed to be under STOP sign control, the ISD in question relates to the ability to turn left or turn right from the proposed driveway at their intersections with Pleasant Street Connector/ Firmin Avenue.

Available ISD was estimated in the field using AASHTO standards for driver's eye (3.5 feet), object height (3.5 feet) and decision point (14.5 feet from the edge of the travel way) for the eastbound and westbound directions along Pleasant Street Connector/Firmin Avenue. **Table 5** presents a summary of the available ISD for the departure from the unsignalized site driveway and AASHTO's recommended ISD.

TABLE 5
INTERSECTION SIGHT DISTANCE SUMMARY
SITE DRIVE DEPARTURE TO PLEASANT ST CONNECTOR/ FIRMIN AVE

View Direction	Available Intersection Sight Distance	AASHTO Minimum¹		
		Posted Speed²	Average Observed Travel Speed³	85th Percentile Observed Travel Speed⁴
<i>Looking East</i>	>500 Feet	215 Feet	245 Feet	330 Feet
<i>Looking West</i>	>500 Feet	190 Feet	235 Feet	275 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 and an object height of 3.5 feet. Minimum value as noted represents SSD per AASHTO guidance.

²Prima Facie Speed = 30 mph.

³Average Speed on Pleasant Street Connector/ Firmin Avenue: 35 mph EB, 33 mph WB.

⁴85th Percentile travel speed on Pleasant Street Connector/ Firmin Avenue: 39 mph EB, 40 mph WB.

The results of the ISD analysis presented in **Table 4** indicate that the available sight lines looking east and west from the unsignalized site driveway onto Pleasant Street Connector/ Firmin Avenue will exceed the recommended minimum sight line requirements based on the prima facie speed limit, average observed travel speeds and the observed 85th percentile travel speeds. Selective tree and vegetation clearing within the right-of-way will increase sight lines and help to maintain this distance during the growing season. MDM recommends that any new plantings (shrubs, bushes) or physical landscape features (rock wall, etc.) to be located within the driveway sight lines, should also be maintained at a height of 2 feet or less above the adjacent existing roadway grade to ensure unobstructed lines of sight.

3.0 FUTURE CONDITIONS

Evaluation of the proposed development impacts requires the establishment of a future baseline analysis condition. This section estimates future roadway and traffic conditions with and without the proposed development. To be consistent with EEA/MassDOT guidelines, a seven-year planning horizon was selected.

To determine the impact of site-generated traffic volumes on the roadway network under future conditions, baseline traffic volumes in the study area were projected to a future year condition. Traffic volumes on the roadway network at that time, in the absence of the development (that is, the No-Build condition), would include existing traffic, new traffic due to general background traffic growth, and traffic related to specific development by others that is currently under review at the local and/or state level. Consideration of these factors resulted in the development of No-Build traffic volumes. Anticipated site-generated traffic volumes were then superimposed upon these No-Build traffic-flow networks to develop future Build conditions.

The following sections provide an overview of planned roadway improvements in the study area, the future No-Build traffic volumes and projected Build traffic volumes.

3.1 BACKGROUND TRAFFIC GROWTH

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

3.1.1 Historical Area Growth

Background traffic includes demand generated by other planned developments in the area as well as demand increases caused by external factors. External factors are general increases in traffic not attributable to a specific development and are determined using historical data.

Nearby permanent count station data published by MassDOT indicates a declining (-1.1 percent per year) growth rate. For purposes of this evaluation, a 0.5 percent growth rate was used (3.6 percent increase over a 7-year horizon). This growth rate is higher than historic rates, and, as such, is also expected to account for any small fluctuation in hourly traffic as may occur from time to time in the study area and traffic associated with other potential small developments or vacancies in the area. The traffic volumes and growth rate calculations are provided in the **Appendix**.

3.1.2 Development-Related Growth

Development of future No-Build traffic volumes also considers traffic generated from specific area developments. Based on a review of Massachusetts Environmental Policy Act (MEPA) files, several projects have been identified that may result in increased traffic volume through the study area. The projects are as follows:

- MetroWest Place: A 5-story office building totaling 92,700± gross square feet (gsf) which was historically fully occupied by Genzyme until 2012 is currently vacant at 15 Pleasant Street Connector (Site). Parking includes approximately 382 on-site marked parking spaces. Access/egress to the site is provided via a signalized driveway connection to the Pleasant Street Connector opposite Crossing Boulevard and an unsignalized driveway along the Pleasant Street Connector approximately 250 west of Crossing Boulevard. An inter-connection is also provided between the Site and the adjacent office building located at 11 Pleasant Street Connector (Genzyme). Site-generated traffic for the re-occupancy of this building is based on industry-standard trip rates published by ITE in *Trip Generation*² and journey to work data for the Town's of Framingham and Southborough.
- Genzyme Expansion: Genzyme currently has 1,235,500± square feet of building space, primarily R&D and manufacturing space, and approximately 1,820 parking spaces located along New York Avenue and California Avenue in Framingham, MA. The expansion project would include an additional 757,000± sf of building space and an additional 2,280 parking spaces. The Draft Environmental Impact Report (DEIR)³ that was prepared for this development in October 2011 was determined to be inadequate by MEPA in March 2012. To date it is our understanding that no additional information has been submitted and the project build-out remains unknown, therefore, as this project is still undergoing environmental permitting it was excluded as a background project. However, for planning purposes, a "Long Range Build-Out" analysis that includes projected traffic and proposed mitigation actions associated with Phase I of the Genzyme Expansion is provided in *Section 5.0 Long Range Build-Out*.

²*Trip Generation*, Ninth Edition; Institute of Transportation Engineers; Washington, DC; 2012.

³DEIR, Genzyme Framingham Master Plan, *Framingham, MA* prepared by Tetra Tech Rizzo dated October 2011.

- 100 Penn Place: A vacant 77,000± sf office building with 348 surface parking spaces is located along Pennsylvania Avenue in Framingham. Given the location of the building with respect to the study area, site-generated traffic for the re-occupancy of this building will be accounted for in the general growth rate.
- 11 California Avenue: A vacant 14,000± sf office building is located is along California Avenue in Framingham. Given the location of the building with respect to the study area, site-generated traffic for the re-occupancy of this building will be accounted for in the general growth rate.

Traffic associated with the re-occupancy of MetroWest Place was incorporated into the future year 2020 No-Build traffic networks. Site trip tracings and trip generation estimates for this background development is provided in the **Appendix**.

3.2 NO-BUILD TRAFFIC VOLUMES

To account for future traffic growth in the study area, the 0.5 percent annual growth rate was applied to existing traffic volumes over a seven-year period (consistent with MassDOT guidelines), as well as traffic associated with the re-occupancy of MetroWest Place. Future 2020 No-Build traffic volumes are displayed in **Figure 6** and **Figure 7**.

3.3 SITE-GENERATED TRAFFIC

Future Build condition traffic volumes were developed by estimating the number of peak-hour trips expected to be generated by the proposed development, and distributing this additional traffic onto the local roadway network. These future development-related trips were added to future No-Build traffic volumes to allow for examination of future traffic operations with the proposed development built. The methodology utilized to estimate the future trip-generation characteristics of the proposed development is summarized below. In accordance with EEA/MassDOT guidelines, the traffic generated by the proposed development was estimated using trip rates published in ITE's *Trip Generation* for Land Use Code (LUC) 710 – General Office Building.

Table 6 presents the trip-generation estimates for the proposed development based on ITE methodology and EEA/MassDOT guidelines. Trip generation calculations are provided in the **Appendix**.

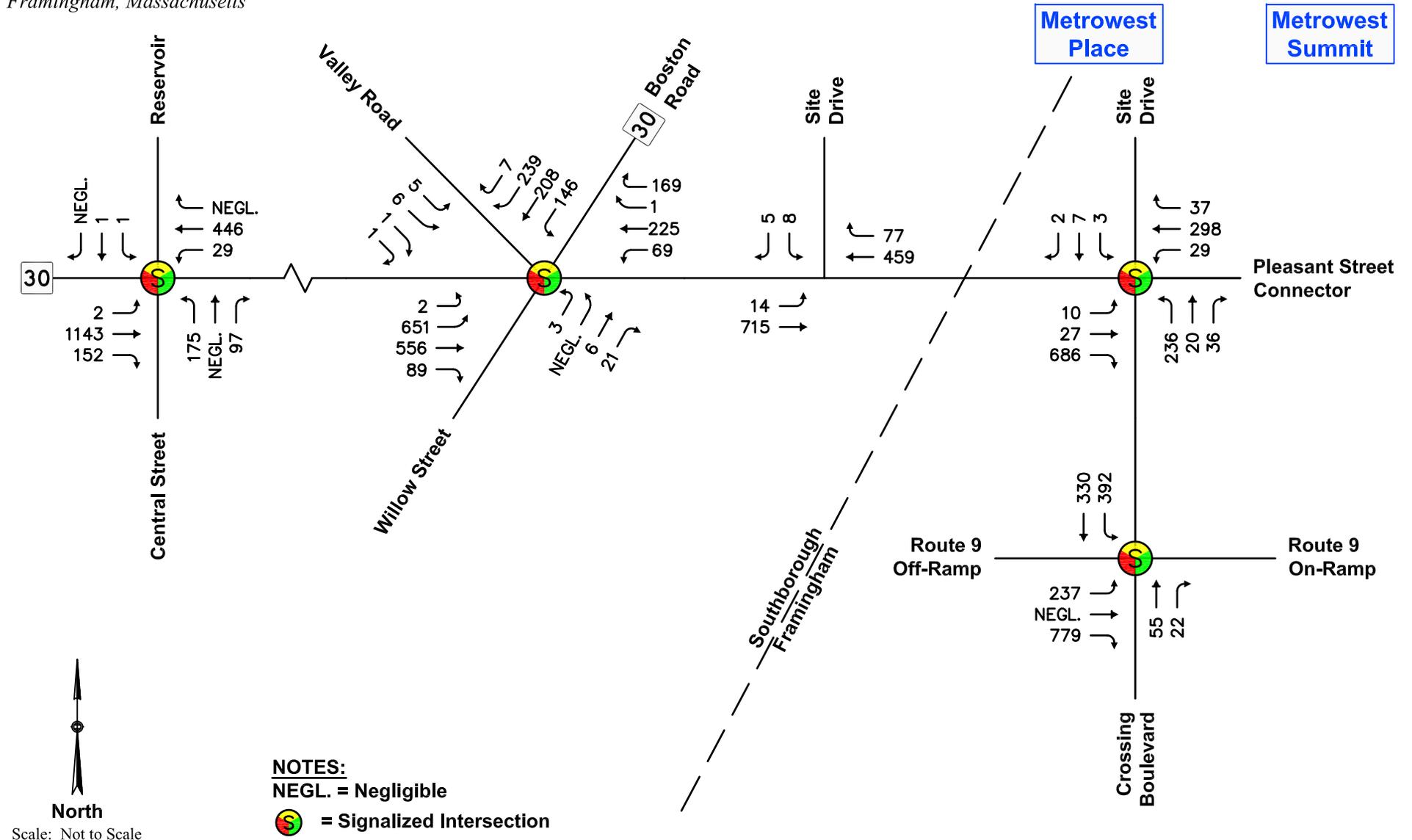


Figure 6

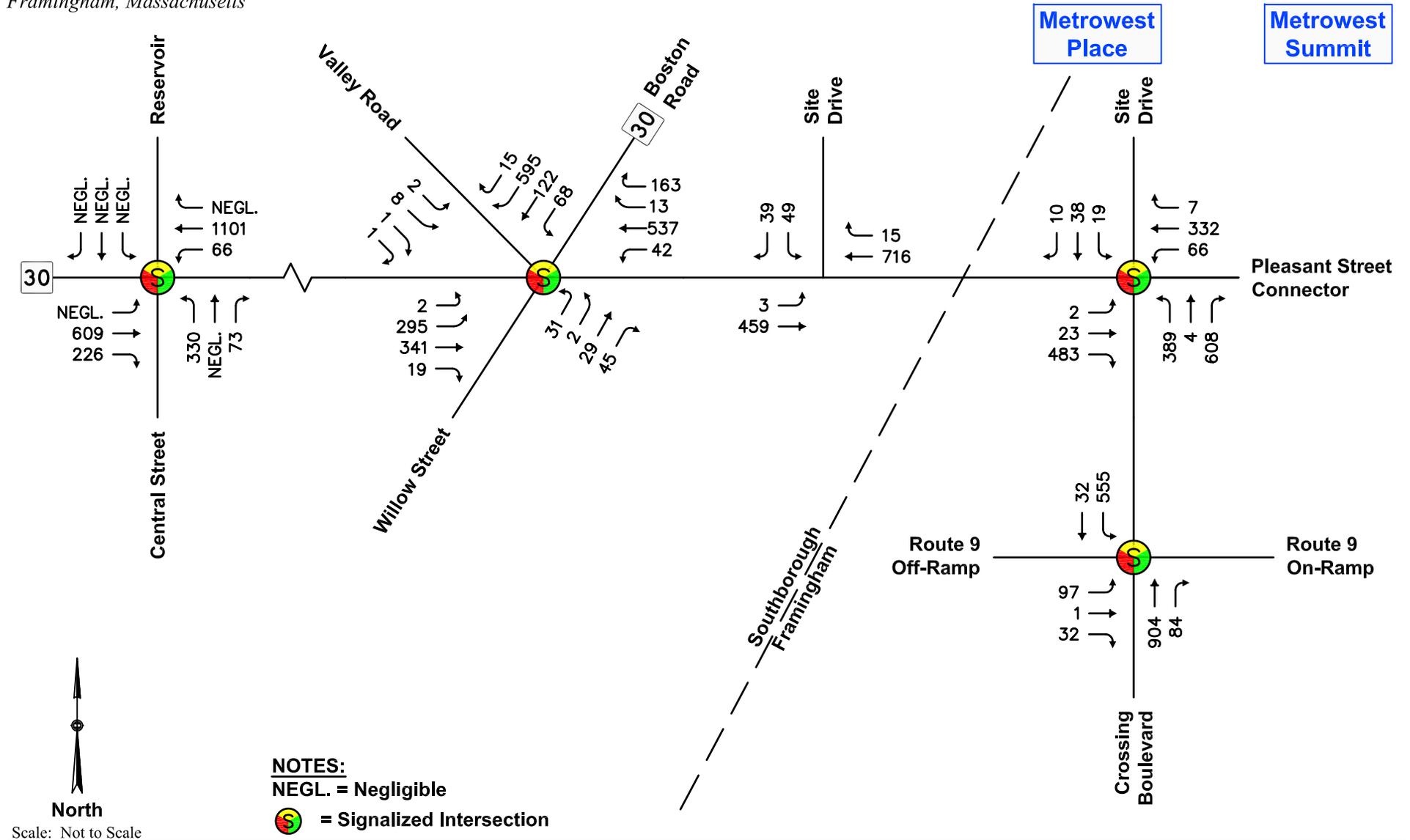


Figure 7

**TABLE 6
PROJECTED TRIP GENERATION**

Period/Direction	SITE TRIPS		
	Existing Office Building ¹	Proposed Expansion ²	Total ³
<i>Weekday Morning Peak Hour</i>			
Entering	158	82	240
Exiting	<u>22</u>	<u>11</u>	<u>33</u>
Total	180	93	273
<i>Weekday Evening Peak Hour</i>			
Entering	31	12	43
Exiting	<u>151</u>	<u>59</u>	<u>210</u>
Total	182	71	253
<i>Weekday Daily</i>	1,240	598	1,838

Source: ITE *Trip Generation*, Ninth Edition; 2012.

¹Based on ITE LUC 710 regression trip rates applied to 92,729 sf.

²Proposed Expansion = Total – Existing Conditions

³Based on ITE LUC 710 regression trip rates applied to 155,812 sf.

Based on industry-standard trip rates, the proposed expansion project is estimated to generate approximately 93 additional vehicle trips during the weekday morning peak hour (82 entering and 11 exiting) and 71 additional vehicle trips during the weekday evening peak hour (12 entering and 59 exiting). On a daily basis, the development is estimated to generate approximately 598 additional vehicle trips on a weekday.

3.4 TRIP DISTRIBUTION AND ASSIGNMENT

The directional distribution of development-generated trips on the roadway network is a function of a number of variables including existing travel patterns along area roadways, the efficiency of these roadways leading to the site and Journey to work census data. Supporting trip distribution calculations are provided in the **Appendix**. Based on these factors, a trip distribution for the development has been estimated and is displayed in **Figure 8**. Development-related trips were assigned to the roadway network using the ITE trip-generation estimates for the expansion as outlined in **Table 6** and the above distribution patterns and are quantified in **Figure 9** and **Figure 10**.

3.5 BUILD TRAFFIC VOLUMES

Future Build condition traffic volumes were arrived at by adding development-specific traffic volumes to the 2020 No-Build conditions. **Figure 11** and **Figure 12** presents the 2020 Build condition traffic-volume networks for the weekday morning and weekday evening peak hours.

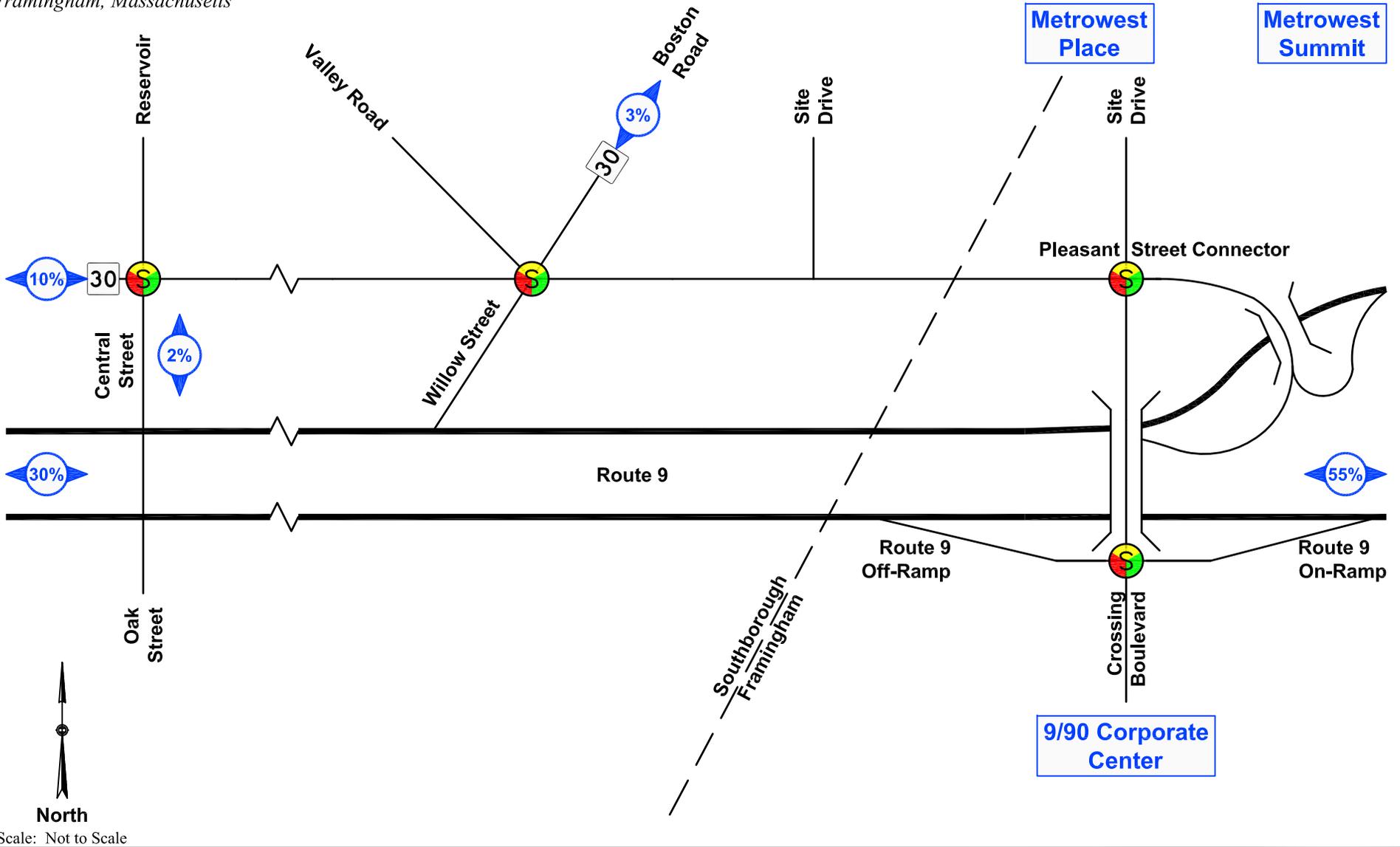


Figure 8

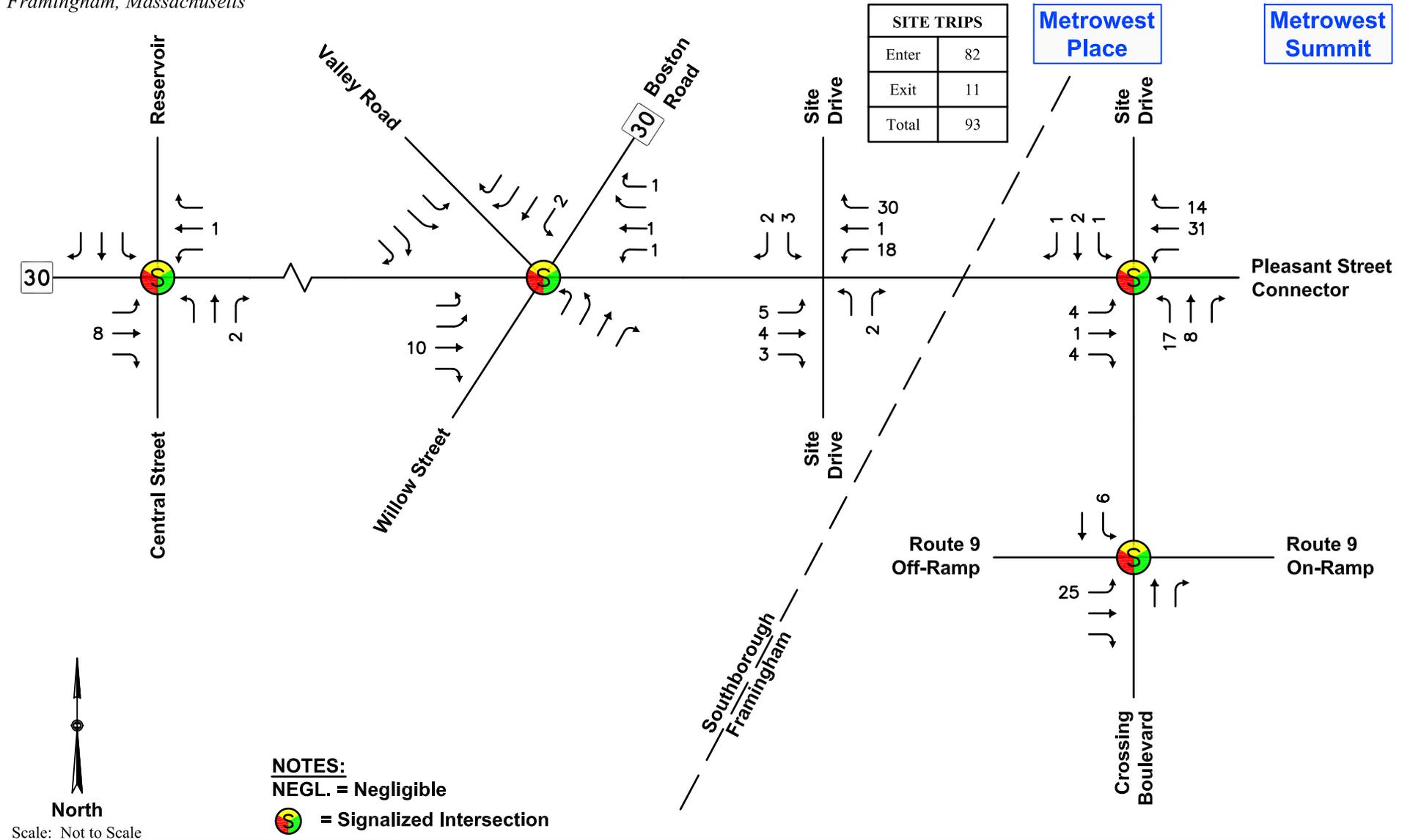


Figure 9

**Site-Generated Trips
 Weekday Morning
 Peak Hour Traffic Volumes**

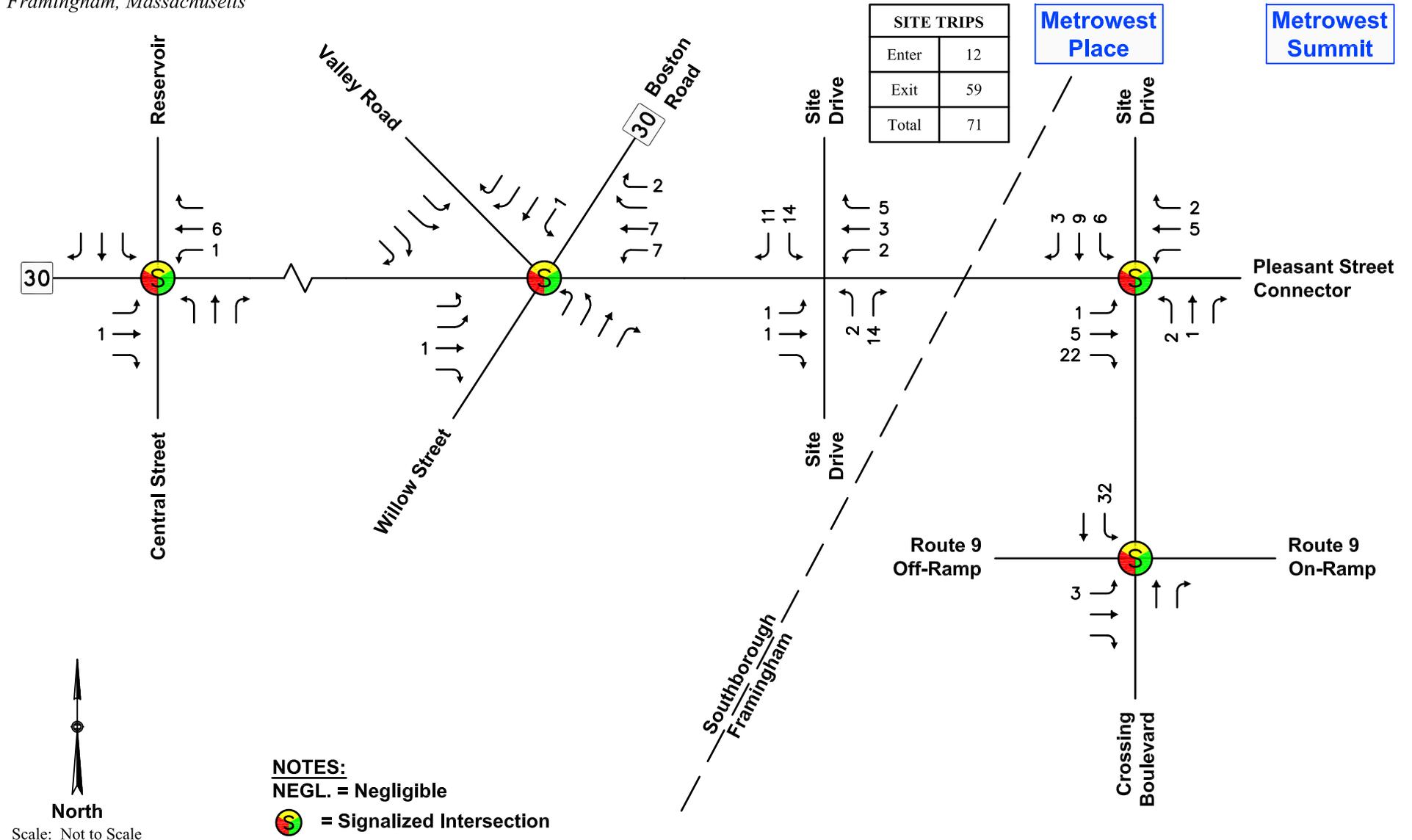


Figure 10

**Site-Generated Trips
 Weekday Evening
 Peak Hour Traffic Volumes**

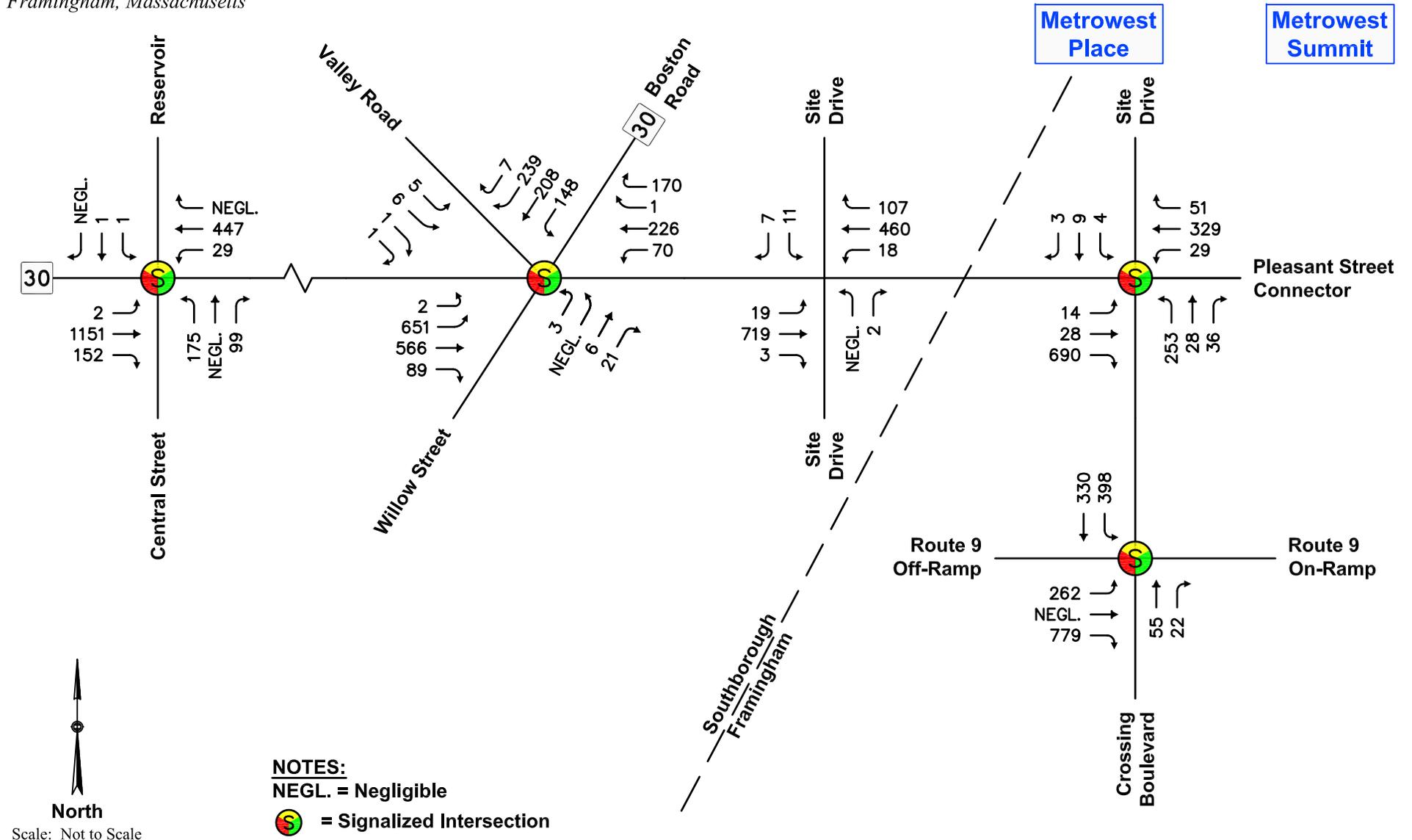


Figure 11

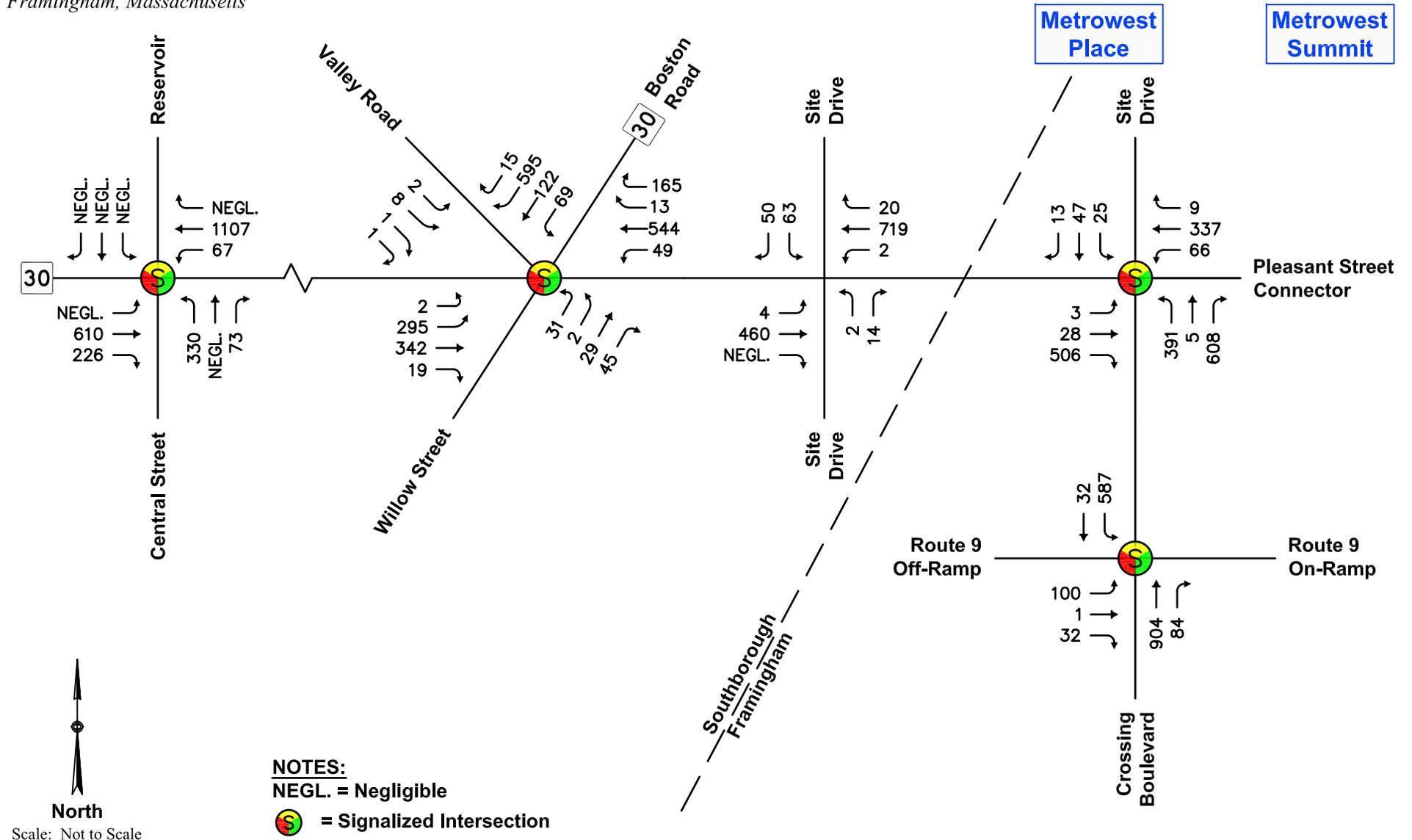


Figure 12

4.0 TRAFFIC OPERATIONS ANALYSIS

Intersection capacity analyses are presented in this section for the Existing, No-Build, and Build traffic-volume conditions. Capacity analyses, conducted in accordance with EEA/MassDOT guidelines, provide an index of how well the roadway facilities serve the traffic demands placed upon them. The operational results provide the basis for recommended access and roadway improvements in the following section.

4.1 CAPACITY ANALYSIS PROCEDURES

Capacity analysis of intersections is developed using the Synchro[®] computer software, which implements the methods of the Highway Capacity Manual (HCM). The resulting analysis presents a level-of-service (LOS) designation for individual intersection movements and (for signalized intersections) for the entire intersection. The LOS is a letter designation that provides a qualitative measure of operating conditions based on several factors including roadway geometry, speeds, ambient traffic volumes, traffic controls, and driver characteristics. Since the LOS of a traffic facility is a function of the traffic flows placed upon it, such a facility may operate at a wide range of LOS, depending on the time of day, day of week, or period of year. A range of six levels of service are defined on the basis of average delay, ranging from LOS A (the least delay) to LOS F (delays greater than 50 seconds for unsignalized movements, and greater than 80 seconds for signalized movements). The specific control delays and associated LOS designations are presented in the **Appendix**.

4.2 INTERSECTION CAPACITY ANALYSIS RESULTS

LOS analyses were conducted for Existing, No-Build, and Build conditions for the intersections within the study area. The results of the intersection capacity analyses are summarized below.

4.2.1 Level of Service

Capacity analysis results for the weekday morning and weekday evening peak hour capacity analysis results for the unsignalized and signalized study intersections are presented in **Table 7** and **Table 8** and are described below, with detailed analysis results presented in the **Appendix**.

**TABLE 7
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR**

Intersection	Approach	Existing			2020 No-Build			2020 Build		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c ^a	Delay	LOS
<i>Crossing Boulevard at Route 9 Eastbound Ramps</i>	Eastbound	0.50	7	A	0.59	8	A	0.64	9	A
	Northbound	0.10	20	B	0.11	21	C	0.12	22	C
	Southbound	<u>0.36</u>	<u>6</u>	<u>A</u>	<u>0.39</u>	<u>7</u>	<u>A</u>	<u>0.39</u>	<u>7</u>	<u>A</u>
	OVERALL	0.50	7	A	0.59	8	A	0.64	9	A
<i>Pleasant St Connector at Crossing Boulevard/ Site Drive</i>	Eastbound	0.49	<5	A	0.50	<5	A	0.50	<5	A
	Westbound	0.60	31	C	0.75	39	D	0.81	43	D
	Northbound	0.20	<5	A	0.26	<5	A	0.28	<5	A
	Southbound	<u>0.01</u>	<u>29</u>	<u>C</u>	<u>0.07</u>	<u>33</u>	<u>C</u>	<u>0.09</u>	<u>33</u>	<u>C</u>
OVERALL	0.60	9	A	0.75	12	B	0.81	14	B	
<i>Boston Road (Route 30) at Firmin Avenue/ Willow Street/ Valley Road</i>	Eastbound	0.74	32	C	0.76	34	C	0.77	35	C
	Westbound	0.75	43	D	0.78	47	D	0.79	48	D
	Northbound	0.07	17	B	0.07	17	B	0.07	17	B
	Southbound	0.75	17	C	0.77	32	C	0.77	32	C
	S-Eastbound	<u>0.09</u>	<u>30</u>	<u>D</u>	<u>0.09</u>	<u>52</u>	<u>D</u>	<u>0.09</u>	<u>52</u>	<u>D</u>
OVERALL	0.75	51	C	0.76	36	D	0.79	37	D	
<i>Boston Road (Route 30) at Central Street</i>	Eastbound	0.87	23	C	0.92	27	C	0.92	28	C
	Westbound	0.29	5	A	0.31	5	A	0.31	5	A
	Northbound	0.69	38	D	0.70	38	D	0.70	37	D
	Southbound	<u>0.02</u>	<u>46</u>	<u>D</u>	<u>0.02</u>	<u>46</u>	<u>D</u>	<u>0.02</u>	<u>46</u>	<u>D</u>
	OVERALL	0.87	20	C	0.92	23	C	0.92	24	C
<i>Firmin Avenue/Pleasant Street Connector at Site Driveway</i>	Eastbound	-	-	-	0.01	9	A	0.02	9	A
	Westbound	-	-	-	-	-	-	0.02	9	A
	NB Exit	-	-	-	n/a	n/a	n/a	0.03	11	B
	SB Exit	n/a ⁴	n/a	n/a	0.04	16	C	0.07	19	C

¹Volume-to-capacity ratio

²Average control delay per vehicle (in seconds)

³Level of service

⁴Not applicable

**TABLE 8
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR**

Intersection	Approach	Existing			2020 No-Build			2020 Build		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c ^a	Delay	LOS
<i>Crossing Boulevard at Route 9 Eastbound Ramps</i>	Eastbound	0.29	26	C	0.31	27	C	0.31	27	C
	Northbound	0.86	38	D	0.89	41	D	0.89	41	D
	Southbound	<u>0.65</u>	<u>21</u>	<u>C</u>	<u>0.81</u>	<u>27</u>	<u>C</u>	<u>0.86</u>	<u>31</u>	<u>C</u>
	OVERALL	0.86	31	C	0.89	35	C	0.89	36	D
<i>Pleasant St Connector at Crossing Boulevard/ Site Drive</i>	Eastbound	0.34	<5	A	0.38	<5	A	0.40	<5	A
	Westbound	0.89	59	E	1.00	78	E	>1.0	>80	F
	Northbound	0.46	5	A	0.47	5	A	0.47	7	A
	Southbound	<u>0.02</u>	<u>36</u>	<u>D</u>	<u>0.42</u>	<u>45</u>	<u>D</u>	<u>0.54</u>	<u>52</u>	<u>D</u>
OVERALL	0.89	16	B	1.00	21	C	>1.0	23	C	
<i>Boston Road (Route 30) at Firmin Avenue/ Willow Street/ Valley Road</i>	Eastbound	0.41	22	C	0.41	23	C	0.41	23	C
	Westbound	0.81	34	C	0.88	42	D	0.90	44	D
	Northbound	0.48	37	D	0.49	37	D	0.48	37	D
	Southbound	0.86	42	D	0.87	42	D	0.87	42	D
	S-Eastbound	<u>0.08</u>	<u>51</u>	<u>D</u>	<u>0.09</u>	<u>52</u>	<u>D</u>	<u>0.09</u>	<u>52</u>	<u>D</u>
OVERALL	0.86	33	C	0.88	36	D	0.90	37	D	
<i>Boston Road (Route 30) at Central Street</i>	Eastbound	0.77	19	B	0.74	17	B	0.73	17	B
	Westbound	0.87	18	B	0.86	17	B	0.86	17	B
	Northbound	0.72	33	C	0.83	43	D	0.84	45	D
	Southbound	<u>0.00</u>	<u><5</u>	<u>A</u>	<u>0.00</u>	<u><5</u>	<u>A</u>	<u>0.00</u>	<u><5</u>	<u>A</u>
OVERALL	0.87	21	C	0.87	22	C	0.86	22	C	
<i>Firmin Avenue/Pleasant Street Connector at Site Driveway</i>	Eastbound	-	-	-	0.01	9	A	0.01	9	A
	Westbound	-	-	-	-	-	-	0.01	8	A
	NB Exit	-	-	-	n/a	n/a	n/a	0.04	14	B
	SB Exit	n/a ⁴	n/a	n/a	0.34	24	C	0.52	34	D

¹Volume-to-capacity ratio

²Average control delay per vehicle (in seconds)

³Level of service

⁴Not applicable

As summarized in **Table 7** and **Table 8**:

- *Crossing Boulevard at Route 9 Eastbound Ramps*: Under existing conditions, capacity analyses indicate that the signalized study intersection generally operates below capacity at LOS A (overall) during the weekday morning peak hour and below capacity at LOS C (overall) during the weekday evening peak hour. Under future No-Build and Build conditions, capacity analyses indicate that the signalized intersection will continue to operate below capacity with nominal increases in delay due to the proposed office expansion.
- *Pleasant Street Connector at Crossing Boulevard/ Site Driveway*: Under existing conditions, capacity analyses indicate that the signalized study intersection generally operates at LOS A (overall) during the weekday morning peak hour and at LOS B (overall) during the weekday evening peak hour. The westbound approach currently operates with long delay at LOS E during the weekday evening peak hour. Under future No-Build and Build conditions, capacity analyses indicate that the westbound approach (Pleasant Street Connector) to the signalized intersection will continue to operate with long delays as LOS E/F operations during the weekday evening peak hour. The Proponent proposes to implement an alternative (i.e. improved) traffic signal timing plan at the intersection aimed at improving operations and queue management as described in more detail under *Conclusions and Recommendations*.
- *Route 30 at Firmin Avenue/ Willow Street/ Valley Road (5-Corners)*: Under existing conditions, capacity analyses indicate at the signalized study intersection operates at LOS C (overall) during the weekday morning and weekday evening peak hours. Field review of the traffic signal controller cabinet indicates that some of the existing signal equipment may be malfunctioning. Under future (No-Build and Build) conditions, capacity analyses indicate that the signalized intersection will operate at LOS D (overall) during the weekday morning and weekday evening peak hours. The Proponent proposes to implement off-site mitigation at the intersection aimed at updating malfunctioning equipment as required to improve operations and enhance queue management as described in more detail under *Conclusions and Recommendations*.
- *Route 30 at Central Street*: Under existing conditions, capacity analyses indicate at the signalized study intersection generally operates at LOS C (overall) or better during the weekday morning and evening peak hours. Under future No-Build and Build conditions, capacity analyses indicate that the signalized intersection will continue to operate at LOS C (overall) or better during peak hours with nominal increases in delay due to the proposed office expansion.
- *Pleasant Street Connector/ Firmin Avenue at Site Driveway*: Under Build conditions, capacity analyses indicate that the unsignalized site driveway will operate below capacity at LOS D or better during peak hours. Mainline travel along Pleasant Street Connector/ Firmin Avenue will continue to operate with minimal delay.

In summary, incremental traffic increases at the study intersections due to the proposed development generally do not result in any significant change in overall intersection operations compared to No-Build conditions. Off-site recommendations are described under *Conclusions and Recommendations* to address several existing deficiencies at the signalized intersections within the study area.

4.2.2 Vehicle Queue Analysis

Vehicle queue results are presented for the signalized study intersections. These vehicle queues are compared to available storage lengths, which are defined as lengths of exclusive turn lanes or the distance to the nearest major intersection for through lanes. Vehicle queue results from the capacity analysis are summarized in **Tables 9 – 12**. Detailed worksheets of the queuing analysis are provided in the **Appendix**.

**TABLE 9
VEHICLE QUEUE ANALYSIS SUMMARY
CROSSING BOULEVARD AT ROUTE 9 EASTBOUND RAMPS**

Approach	Storage Length (feet)	Existing		2020 No-Build		2020 Build	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT/TH	750±	68	153	104	200	117	221
Eastbound RT	750±	<25	<25	<25	<25	<25	<25
Northbound TH/RT	1500±	<25	31	<25	33	<25	33
Southbound LT	400±	50	116	66	138	71	138
Southbound TH/RT	400±	42	98	53	111	55	109
<i>Weekday Evening Peak Hour</i>							
Eastbound LT/TH	750±	50	94	58	104	59	106
Eastbound RT	750±	<25	<25	<25	<25	<25	<25
Northbound TH/RT	1500±	302	454	326	482	326	482
Southbound LT	400±	146	255	199	475	232	529
Southbound TH/RT	400±	<25	<25	<25	<25	<25	<25

¹ Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 10
VEHICLE QUEUE ANALYSIS SUMMARY
PLEASANT STREET CONNECTOR AT CROSSING BOULEVARD/ SITE DRIVE

Approach	Storage Length (feet)	Existing		2020 No-Build		2020 Build	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT/TH	1,000±	<25	33	<25	45	<25	49
Eastbound RT	350±	<25	<25	<25	<25	<25	<25
Westbound LT	225±	<25	35	<25	38	<25	38
Westbound TH/RT	2,000±	86	196	138	338	167	405
Northbound LT/TH	400±	<25	<25	<25	<25	<25	<25
Northbound TH/RT	400±	<25	<25	<25	<25	<25	<25
Southbound LT/TH/RT	450±	<25	<25	<25	<25	<25	26
<i>Weekday Evening Peak Hour</i>							
Eastbound LT/TH	1,000±	<25	35	<25	39	<25	47
Eastbound RT	350±	<25	<25	<25	<25	<25	<25
Westbound LT	225±	35	80	37	82	37	82
Westbound TH/RT	2,000±	197	392	224	445	235	455
Northbound LT/TH	400±	<25	<25	<25	<25	<25	207
Northbound TH/RT	400±	109	160	122	151	122	150
Southbound LT/TH/RT	450±	<25	<25	38	87	49	112

¹ Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 11
VEHICLE QUEUE ANALYSIS SUMMARY
BOSTON ROAD (ROUTE 30) AT FIRMIN AVENUE/WILLOW STREET/VALLEY ROAD

Approach	Storage Length (feet)	Existing		2020 No-Build		2020 Build	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT	375±	183	371	198	406	198	413
Eastbound TH/RT	>2,000	280	505	318	558	326	570
Westbound LT	150±	40	138	45	154	46	158
Westbound TH/RT	1,000±	203	359	220	379	221	380
Northbound LT/TH/RT	1,000±	<25	31	<25	32	<25	32
Southbound LT/TH	>2,000	185	441	202	489	204	503
Southbound RT	300±	43	144	48	156	48	159
Southeast LT/TH/RT	>2,000	<25	30	<25	31	<25	30
<i>Weekday Evening Peak Hour</i>							
Eastbound LT	375±	79	149	84	156	84	156
Eastbound TH/RT	>2,000	56	223	96	240	96	241
Westbound LT	150±	<25	37	27	90	32	106
Westbound TH/RT	1,000±	338	815	408	914	418	931
Northbound LT/TH/RT	1,000±	45	111	48	115	48	115
Southbound LT/TH	>2,000	112	218	120	225	121	227
Southbound RT	300±	296	537	316	570	316	568
Southeast LT/TH/RT	>2,000	<25	29	<25	28	<25	28

¹ Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 12
VEHICLE QUEUE ANALYSIS SUMMARY
BOSTON ROAD (ROUTE 30) AT CENTRAL STREET

Approach	Storage Length (feet)	Existing		2020 No-Build		2020 Build	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT/TH/RT	1,700	528	1186	610	1275	621	1287
Westbound LT	150±	<25	<25	<25	<25	<25	<25
Westbound TH/RT	>2,000	59	163	65	172	64	172
Northbound LT/TH	250±	94	178	98	186	98	186
Northbound RT	>2,000	<25	44	<25	46	<25	46
Southbound LT/TH/RT	100±	<25	<25	<25	<25	<25	<25
<i>Weekday Evening Peak Hour</i>							
Eastbound LT/TH/RT	1,700	278	418	299	448	299	449
Westbound LT	150±	<25	20	<25	<25	<25	21
Westbound TH/RT	>2,000	333	503	372	557	378	566
Northbound LT/TH	250±	131	352	166	402	169	402
Northbound RT	>2,000	<25	29	<25	33	<25	33
Southbound LT/TH/RT	100±	<25	<25	<25	<25	<25	<25

¹ Average and 95th percentile queue lengths are reported in feet per lane.

As presented in **Tables 9 – 12**, average and 95th percentile vehicle queues at the signalized study intersections are generally contained within available storage lanes during weekday morning and weekday evening peak hours under existing and No-Build conditions. The exceptions being the eastbound left turn lanes onto Route 30 at the 5-Corners intersection during the weekday morning peak hour, the southbound Crossing Boulevard approach to the Route 9 EB on/off ramps during the weekday evening peak hour, the southbound right turn lane approach to the 5-Corners intersection during the weekday evening peak hour and the northbound left-turn/through lane during the weekday evening peak hour. The 63,000± sf office expansion generally results in similar vehicle queues compared to No-Build conditions. The Proponent proposes to implement traffic signal timing optimization as described in more detail under *Conclusions and Recommendations* aimed at improving operations and queue management.

5.0 LONG RANGE BUILD-OUT

An analysis has been conducted that includes traffic associated with Phase I of the Genzyme Expansion project. The Draft Environmental Impact Report (DEIR) that was prepared for this development in October 2011 was determined to be inadequate by MEPA in March 2012. However, for planning purposes, MDM has conducted a “Long Range Build-Out” analysis that includes projected traffic and proposed mitigation actions associated Phase I as described in more detail below:

- Genzyme Expansion (Phase I): Genzyme currently has 1,235,500± square feet of building space, primarily R&D and manufacturing space, and approximately 1,820 parking spaces located along New York Avenue and California Avenue in Framingham, MA. Phase I of the expansion project would include an additional 277,000 sf of research and development space, 50,000 sf of manufacturing space, and 180,000 sf of office space. The project would also remove an existing 101,616 sf warehouse. The trip generation associated with Phase I, which may or may not be build-out within the next 5 years, was estimated based on the DEIR prepared for this development. Peak hour trip tracings for Phase I for the weekday morning and weekday evening peak hours are provided in the **Appendix**.

Based on the traffic study prepared for this project, Genzyme identify the following improvements within the study area as Phase I mitigation which are assumed to be implemented under the 2020 Build (Long Range Build-Out) condition:

- Widen Route 30 eastbound to accommodate the extension of the existing double left turn lanes.
- Convert the Firmin Avenue protected left turn lane into a shared left/through travel lane. Accordingly, provide a second westbound departure lane and adequate lane drop taper along Route 30.
- Modify the existing traffic signal to accommodate the new lane arrangement and provide an emergency vehicle pre-emption system.

To account for traffic associated with the Phase 1 of the Genzyme Expansion under the Long Range Build-Out analysis, the trips associated with the Phase I were added to the 2020 Build condition traffic volume networks presented in **Figure 11** and **Figure 12**. Future Long Range Build-Out traffic volume networks are presented in **Figure 13** and **Figure 14** for the weekday morning and weekday evening peak hours.

5.1 LEVEL OF SERVICE (LONG RANGE BUILD-OUT)

Capacity analysis results for the Long Range Build-Out analysis for the weekday morning and weekday evening peak hour capacity analysis for the study intersections are presented in **Table 13** and **Table 14** and are described below. Detailed analysis results presented in the **Appendix**.

TABLE 13
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR
(LONG RANGE BUILD-OUT)

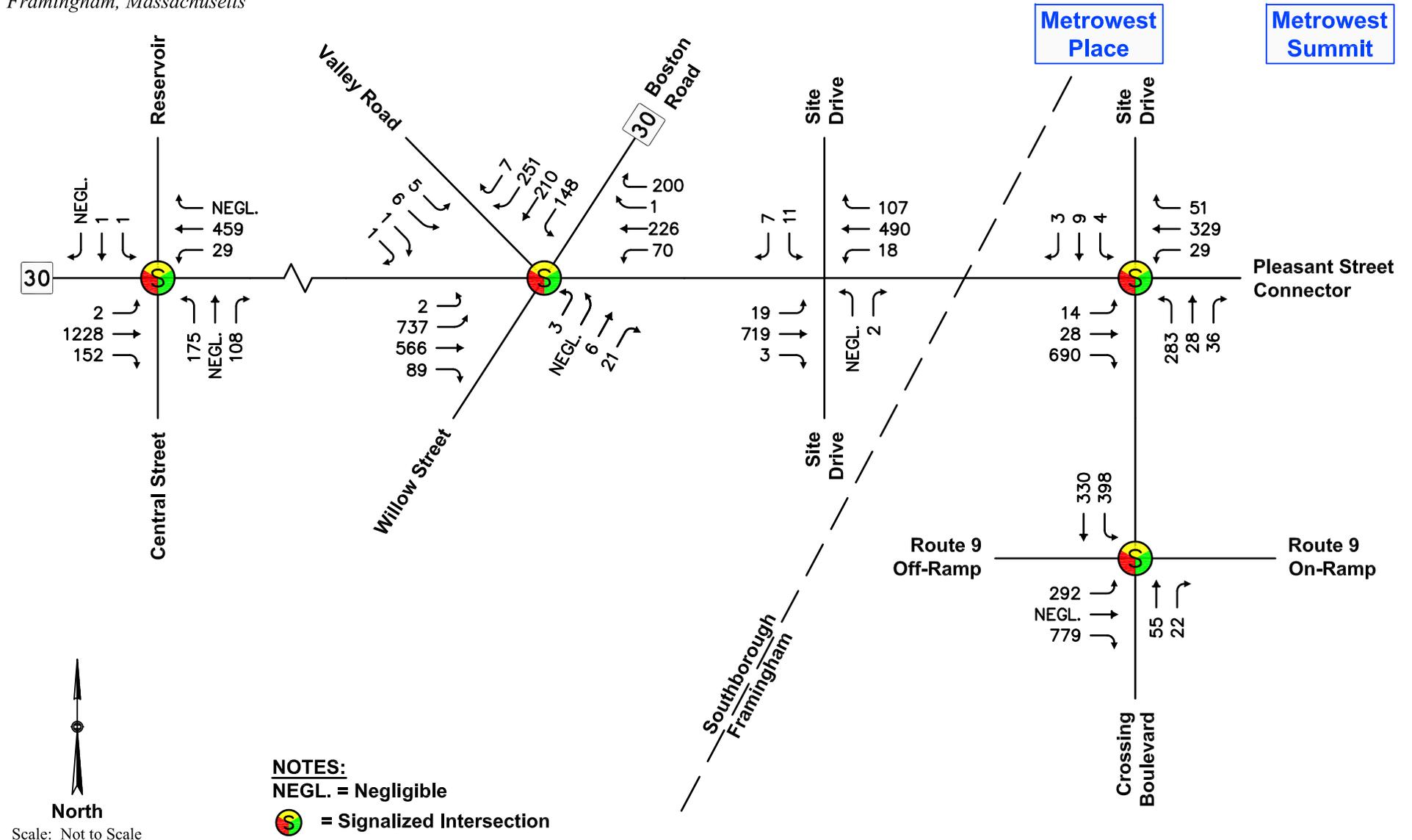
Intersection	Approach	2020 Build (Long Range Build-out) ¹		
		v/c ²	Delay ³	LOS ⁴
<i>Crossing Boulevard at Route 9 Eastbound Ramps</i>	Eastbound	0.68	10	A
	Northbound	0.13	22	C
	Southbound	<u>0.40</u>	<u>7</u>	<u>A</u>
	OVERALL	0.69	9	A
<i>Pleasant Street Connector at Crossing Boulevard/ Site Drive</i>	Eastbound	0.50	<5	A
	Westbound	0.78	35	C
	Northbound	0.32	<5	A
	Southbound	<u>0.10</u>	<u>32</u>	<u>C</u>
	OVERALL	0.77	11	B
<i>Boston Road (Route 30) at Firmin Avenue/ Willow Street/ Valley Road</i>	Eastbound	0.81	24	C
	Westbound	0.74	23	C
	Northbound	0.07	12	B
	Southbound	0.81	26	C
	S-Eastbound	<u>0.06</u>	<u>32</u>	<u>C</u>
	OVERALL	0.81	24	C
<i>Boston Road (Route 30) at Central Street</i>	Eastbound	0.98	37	D
	Westbound	0.31	6	A
	Northbound	0.70	36	D
	Southbound	<u>0.02</u>	<u>46</u>	<u>D</u>
	OVERALL	0.98	30	C
<i>Firmin Avenue/Pleasant Street Connector at Site Drive</i>	Eastbound	0.02	9	A
	Westbound	0.02	9	A
	NB Exit	0.01	11	B
	SB Exit	0.07	19	C

¹Assumes mitigation measures and additional volume proposed by Genzyme Phase I

²Volume-to-capacity ratio

³Average control delay per vehicle (in seconds)

⁴Level of service



Metrowest Place
 Metrowest Summit

North
 Scale: Not to Scale

Figure 13
 2020 Build Condition
 Weekday Morning
 Peak Hour Traffic Volumes
 (Long Range Build-Out)

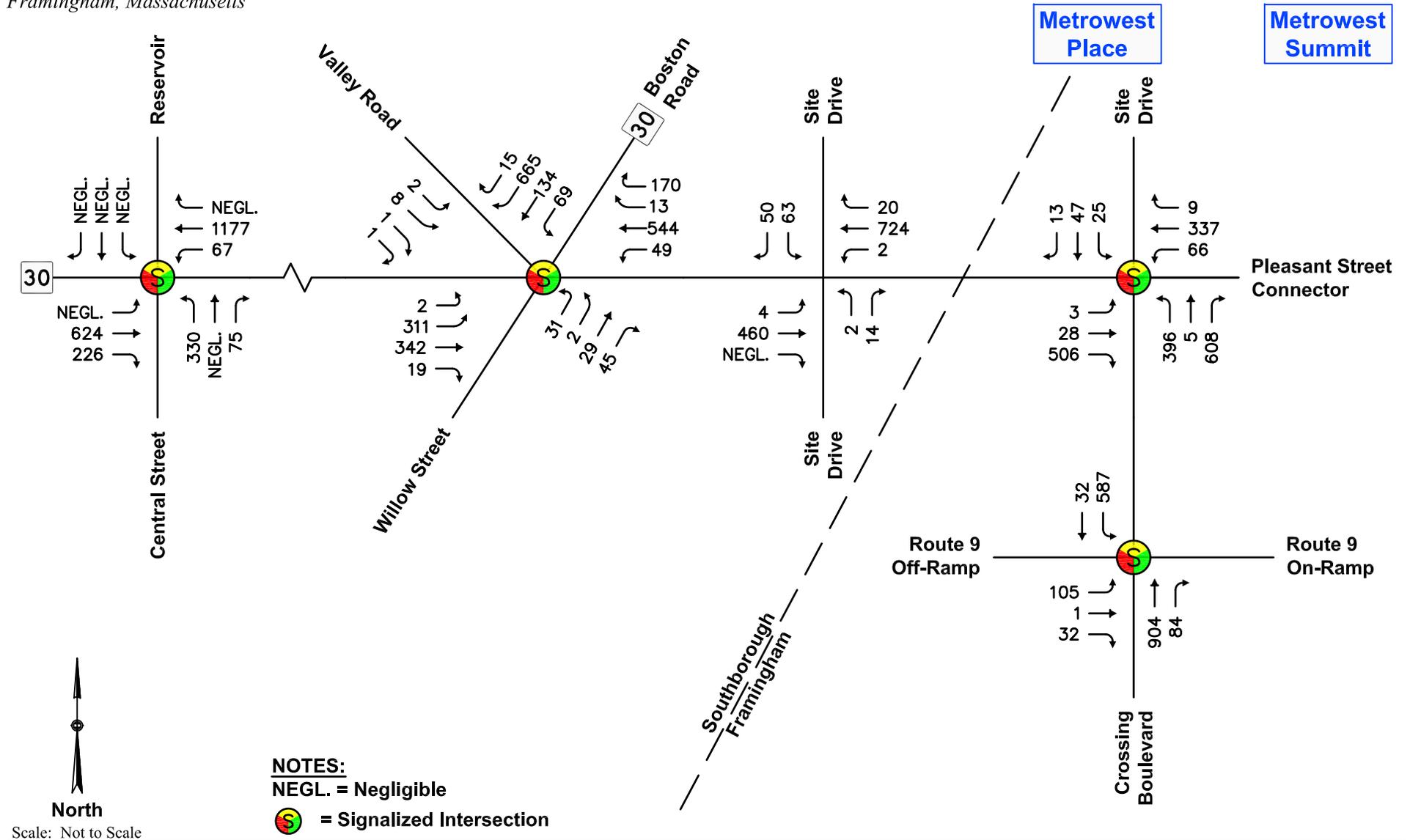


Figure 14

**2020 Build Condition
 Weekday Evening
 Peak Hour Traffic Volumes
 (Long Range Build-Out)**

TABLE 14
INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR
(LONG RANGE BUILD-OUT)

Intersection	Approach	2020 Build (Long Range Build-out) ¹		
		v/c ²	Delay ³	LOS ⁴
<i>Crossing Boulevard at Route 9 Eastbound Ramps</i>	Eastbound	0.47	32	C
	Northbound	0.93	44	D
	Southbound	<u>0.74</u>	<u>18</u>	<u>B</u>
	OVERALL	0.93	34	C
<i>Pleasant Street Connector at Crossing Boulevard/ Site Drive</i>	Eastbound	0.41	<5	A
	Westbound	0.86	47	D
	Northbound	0.49	5	A
	Southbound	<u>0.47</u>	<u>40</u>	<u>D</u>
OVERALL	0.86	14	B	
<i>Boston Road (Route 30) at Firmin Avenue/ Willow Street/ Valley Road</i>	Eastbound	0.35	13	B
	Westbound	0.78	27	C
	Northbound	0.41	24	C
	Southbound	0.81	27	C
	S-Eastbound	<u>0.06</u>	<u>32</u>	<u>C</u>
OVERALL	0.81	23	C	
<i>Boston Road (Route 30) at Central Street</i>	Eastbound	0.67	14	B
	Westbound	0.85	16	B
	Northbound	1.00	75	E
	Southbound	<u>0.00</u>	<u><5</u>	<u>A</u>
OVERALL	1.00	25	C	
<i>Firmin Avenue/Pleasant Street Connector at Site Drive</i>	Eastbound	0.01	9	A
	Westbound	0.01	8	A
	NB Exit	0.04	14	B
	SB Exit	0.51	36	E

¹Assumes mitigation measures and additional volume proposed by Genzyme Phase I

²Volume-to-capacity ratio

³Average control delay per vehicle (in seconds)

⁴Level of service

As summarized in **Table 13** and **Table 14**, the signalized study intersections are estimated to operate at overall LOS C or better operations under Long Range Build-Out conditions. Furthermore, the unsignalized site driveway intersection along Firming Avenue is expected to operate well below capacity at LOS D or better operations. As shown, the office expansion project will have minimal impact on the long range viability of the build-out of Genzyme's Phase I expansion project.

5.2 VEHICLE QUEUE ANALYSIS (LONG RANGE BUILD-OUT)

Under Long Range Build-Out conditions, average and 95th percentile vehicle queues at the signalized study intersection are generally contained within available storage lanes during the weekday morning and weekday evening peak hours. Detailed worksheets of the queuing analysis are provided in the **Appendix**.

6.0 CONCLUSIONS AND RECOMMENDATIONS

Trip generation for the development is estimated at approximately 93 additional vehicle trips during the weekday morning peak hour and 71 additional vehicle trips during the weekday evening peak hour. On a daily basis, the development is estimated to generate approximately 598 additional vehicle trips on a weekday. In general, MDM finds that incremental traffic associated with the proposed development will not materially impact traffic conditions in the study area relative to No-Build conditions. Roadway improvements will support projected traffic increases associated with the proposed development and minimize/offset project-related traffic impacts and facilitate vehicular and pedestrian access/egress for the Site. The mitigation commitments by the Proponent will be further refined as part of the MassDOT Access Permit process.

6.1 PROPOSED IMPROVEMENTS

MDM recommends access/egress and traffic signal improvements aimed at enhancing traffic operations in the study area. Traffic signal re-timing at several study intersections is recommended to reduce queuing and enhance overall intersection operations. Recommended improvements are described in more detail below, which are based on preliminary consultation with MassDOT and are subject to a MassDOT Access Permit.

- *Firmin Avenue at Unsignalized Site Access.* STOP signs (R1-1) and STOP line pavement markings are recommended on driveway approaches to Firmin Avenue. The signs and pavement markings shall be compliant with the Manual on Uniform Traffic Control Devices (MUTCD). Plantings (shrubs, bushes) and structures (walls, fences, etc.) should be maintained at a height of 2 feet or less within the sight lines in vicinity of the Site driveway to provide unobstructed sight lines.

- *Pedestrian Accommodations.* A sidewalk and associated marked crosswalk is proposed along Firmin Avenue that will connect the new parking area to the expanded office building. A proposed pedestrian crossing on Pleasant Street Connector will be added at the signal at Crossing Boulevard to include ADA-compliant ramps, pedestrian pushbuttons and pedestrian traffic signal indicators that allow for an exclusive pedestrian phase when activated.
- *Route 30 at Firmin Avenue/ Willow Street/ Valley Road (5-Corners).* The Proponent proposes to update malfunctioning equipment and implement an optimized traffic signal timing plan at the intersection. The proposed improvements will enhance traffic operations for both existing and proposed roadway users and will provide ample capacity for projected Build traffic conditions. The signal improvements will be subject to MassDOT review and approval under the Highway Access Permit process.
- *Pleasant Street Connector at Crossing Boulevard/ Site Driveway:* The Proponent proposes to implement an optimized traffic signal timing plan at the intersection. The proposed improvements will enhance traffic operations for both existing and proposed roadway users and will provide ample capacity for projected Build traffic conditions. The signal improvements will be subject to MassDOT review and approval under the Highway Access Permit process.
- *Crossing Boulevard at Route 9 Eastbound Ramps:* This intersection operates under a shared traffic signal controller (cluster design) with the adjacent Pleasant Street Connector at Crossing Boulevard/ Site Driveway intersection. As such, any signal timing changes at one will effect operations at the other. Therefore, the proposed signal timing optimization at the adjacent intersection will also enhance traffic operations for both existing and proposed roadway users and will provide ample capacity for projected Build traffic conditions at the intersection of Crossing Boulevard and the Route 9 Eastbound Ramps.

A summary of intersection operations with proposed improvements and signal timing optimization in place is summarized below in **Table 15** and **Table 16** and vehicle queue results are summarized in **Table 17** through **Table 19**. Detailed analysis results are presented in the **Appendix**.

Analysis results presented in **Table 15** and **Table 16** indicate that signal timing modifications result in improved operations at the study intersections and offset impacts of the proposed development. Under Build (Mitigated) conditions, the proposed development generally does not result in any significant change to operations at the signalized intersection with similar or improved operations relative to No-Build conditions.

TABLE 15
SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY MORNING PEAK HOUR – MITIGATED

Intersection	Approach	2020 No-Build			2020 Build			2020 Build (Mitigated)		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c ^a	Delay	LOS
<i>Crossing Boulevard at Route 9 Eastbound Ramps</i>	Eastbound	0.59	8	A	0.64	9	A	0.64	9	A
	Northbound	0.11	21	C	0.12	22	C	0.13	22	C
	Southbound	<u>0.39</u>	<u>7</u>	<u>A</u>	<u>0.39</u>	<u>7</u>	<u>A</u>	<u>0.39</u>	<u>7</u>	<u>A</u>
	OVERALL	0.59	8	A	0.64	9	A	0.64	9	A
<i>Pleasant St Connector at Crossing Boulevard/ Site Drive</i>	Eastbound	0.50	<5	A	0.50	<5	A	0.50	<5	A
	Westbound	0.75	39	D	0.81	43	D	0.77	35	C
	Northbound	0.26	<5	A	0.28	<5	A	0.30	<5	A
	Southbound	<u>0.07</u>	<u>33</u>	<u>C</u>	<u>0.09</u>	<u>33</u>	<u>C</u>	<u>0.10</u>	<u>32</u>	<u>C</u>
OVERALL	0.75	12	B	0.81	14	B	0.77	11	B	
<i>Boston Road (Route 30) at Firmin Avenue/ Willow Street/ Valley Road</i>	Eastbound	0.76	34	C	0.77	35	C	0.82	33	C
	Westbound	0.78	47	D	0.79	48	D	0.80	40	D
	Northbound	0.07	17	B	0.07	17	B	0.07	13	B
	Southbound	0.77	32	C	0.77	32	C	0.81	28	C
	S-Eastbound	<u>0.09</u>	<u>52</u>	<u>D</u>	<u>0.09</u>	<u>52</u>	<u>D</u>	<u>0.07</u>	<u>37</u>	<u>D</u>
OVERALL	0.76	36	D	0.79	37	D	0.82	33	C	

¹Volume-to-capacity ratio

²Average control delay per vehicle (in seconds)

³Level of service

TABLE 16
SIGNALIZED INTERSECTION CAPACITY ANALYSIS RESULTS
WEEKDAY EVENING PEAK HOUR – MITIGATED

Intersection	Approach	2020 No-Build			2020 Build			2020 Build (Mitigated)		
		v/c ¹	Delay ²	LOS ³	v/c	Delay	LOS	v/c ^a	Delay	LOS
<i>Crossing Boulevard at Route 9 Eastbound Ramps</i>	Eastbound	0.31	27	C	0.31	27	C	0.45	31	C
	Northbound	0.89	41	D	0.89	41	D	0.93	44	D
	Southbound	<u>0.81</u>	<u>27</u>	<u>C</u>	<u>0.86</u>	<u>31</u>	<u>C</u>	<u>0.74</u>	<u>18</u>	<u>B</u>
	OVERALL	0.89	35	C	0.89	36	D	0.93	33	C
<i>Pleasant St Connector at Crossing Boulevard/ Site Drive</i>	Eastbound	0.38	<5	A	0.40	<5	A	0.41	<5	A
	Westbound	1.00	78	E	>1.0	>80	F	0.86	47	D
	Northbound	0.47	5	A	0.47	7	A	0.49	7	A
	Southbound	<u>0.42</u>	<u>45</u>	<u>D</u>	<u>0.54</u>	<u>52</u>	<u>D</u>	<u>0.47</u>	<u>40</u>	<u>D</u>
OVERALL	1.00	21	C	>1.0	23	C	0.86	15	B	
<i>Boston Road (Route 30) at Firmin Avenue/ Willow Street/ Valley Road</i>	Eastbound	0.41	23	C	0.41	23	C	0.43	20	B
	Westbound	0.88	42	D	0.90	44	D	0.91	40	D
	Northbound	0.49	37	D	0.48	37	D	0.49	32	C
	Southbound	0.87	42	D	0.87	42	D	0.87	39	D
	S-Eastbound	<u>0.09</u>	<u>52</u>	<u>D</u>	<u>0.09</u>	<u>52</u>	<u>D</u>	<u>0.07</u>	<u>40</u>	<u>D</u>
OVERALL	0.88	36	D	0.90	37	D	0.91	34	C	

¹Volume-to-capacity ratio

²Average control delay per vehicle (in seconds)

³Level of service

TABLE 17
VEHICLE QUEUE ANALYSIS SUMMARY (MITIGATED)
CROSSING BOULEVARD AT ROUTE 9 EASTBOUND RAMPS

Approach	Storage Length (feet)	2020 No-Build		2020 Build (Not Mitigated)		2020 Build (Mitigated)	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT/TH	750±	104	200	117	221	118	197
Eastbound RT	750±	<25	<25	<25	<25	<25	<25
Northbound TH/RT	1500±	<25	33	<25	33	<25	32
Southbound LT	400±	66	138	71	138	71	121
Southbound TH/RT	400±	53	111	55	109	56	96
<i>Weekday Evening Peak Hour</i>							
Eastbound LT/TH	750±	58	104	59	106	57	107
Eastbound RT	750±	<25	<25	<25	<25	<25	<25
Northbound TH/RT	1500±	326	482	326	482	300	426
Southbound LT	400±	199	475	232	529	157	245
Southbound TH/RT	400±	<25	<25	<25	<25	<25	<25

¹ Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 18
VEHICLE QUEUE ANALYSIS SUMMARY (MITIGATED)
PLEASANT STREET CONNECTOR AT CROSSING BOULEVARD/ SITE DRIVE

Approach	Storage Length (feet)	2020 No-Build		2020 Build (Not Mitigated)		2020 Build (Mitigated)	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT/TH	1,000±	<25	45	<25	49	<25	39
Eastbound RT	350±	<25	<25	<25	<25	<25	<25
Westbound LT	225±	<25	38	<25	38	<25	30
Westbound TH/RT	2,000±	138	338	167	405	162	268
Northbound LT/TH	400±	<25	<25	<25	<25	<25	<25
Northbound TH/RT	400±	<25	<25	<25	<25	<25	<25
Southbound LT/TH/RT	450±	<25	<25	<25	26	<25	25
<i>Weekday Evening Peak Hour</i>							
Eastbound LT/TH	1,000±	<25	39	<25	47	<25	37
Eastbound RT	350±	<25	<25	<25	<25	<25	<25
Westbound LT	225±	37	82	37	82	31	67
Westbound TH/RT	2,000±	224	445	235	455	191	339
Northbound LT/TH	400±	<25	<25	<25	207	<25	179
Northbound TH/RT	400±	122	151	122	150	105	109
Southbound LT/TH/RT	450±	38	87	49	112	42	89

¹ Average and 95th percentile queue lengths are reported in feet per lane.

TABLE 19
VEHICLE QUEUE ANALYSIS SUMMARY (MITIGATED)
BOSTON ROAD (ROUTE 30) AT FIRMIN AVENUE/WILLOW STREET/VALLEY ROAD

Approach	Storage Length (feet)	2020 No-Build		2020 Build (Not Mitigated)		2020 Build (Mitigated)	
		Average Queue Length ¹	95 th Percentile Queue Length ¹	Average Queue Length	95 th Percentile Queue Length	Average Queue Length	95 th Percentile Queue Length
<i>Weekday Morning Peak Hour</i>							
Eastbound LT	375±	198	406	198	413	165	307
Eastbound TH/RT	>2,000	318	558	326	570	272	582
Westbound LT	250±	45	154	46	158	36	107
Westbound TH/RT	1,000±	220	379	221	380	167	370
Northbound LT/TH/RT	1,000±	<25	32	<25	32	<25	25
Southbound LT/TH	>2,000	202	489	204	503	167	364
Southbound RT	300±	48	156	48	159	35	97
Southeast LT/TH/RT	>2,000	<25	31	<25	30	<25	<25
<i>Weekday Evening Peak Hour</i>							
Eastbound LT	375±	84	156	84	156	72	126
Eastbound TH/RT	>2,000	96	240	96	241	94	196
Westbound LT	250±	27	90	32	106	26	68
Westbound TH/RT	1,000±	408	914	418	931	349	708
Northbound LT/TH/RT	1,000±	48	115	48	115	36	98
Southbound LT/TH	>2,000	120	225	121	227	99	230
Southbound RT	300±	316	570	316	568	251	551
Southeast LT/TH/RT	>2,000	<25	28	<25	28	<25	<25

¹ Average and 95th percentile queue lengths are reported in feet per lane.

Analysis results presented in **Table 17** through **Table 19** indicate that proposed signal timing modifications will not only offset impacts of the proposed office expansion but will in many cases provide improved operations relative to No-Build conditions. Specifically, under Build (Mitigated) conditions, the average and 95th percentile vehicle queues at said intersections will generally be contained within available storage lanes during peak hours, an improvement relative to No-Build conditions for several movements.

6.2 CONCLUSIONS

In general, traffic associated with the proposed office expansion is not expected to materially change operations at area intersections relative to No-Build conditions. Proponent-sponsored improvements that include signal timing modifications at several of the study intersections will offset project trip impacts and will result in improved signal operations relative to No Build conditions. Likewise, proposed pedestrian crossing on Firmin Avenue at its signalized intersection with Crossing Boulevard/Site Drive intersection will provide a controlled means of pedestrian access that connects the site with its proposed new parking area.

Roadway and signal improvements as identified in this study are based on preliminary discussions and input by MassDOT; proposed site access improvements, signal timing modifications and the proposed pedestrian crossing on Firmin Avenue are subject to review and approval as part of a formal Access Permit process that will be undertaken subsequent to local project review.