Traffic Impact and Access Study

Mt. Wayte Plaza Redevelopment
Mt. Wayte Avenue and Franklin Street

Framingham, Massachusetts

Prepared for

FRAMINGHAM FRANKLIN LLC

February 10th, 2014

Prepared by

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers

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Green International Affiliates, Inc.
239 Littleton Road
Westford, MA 01886
978-923-0400

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1.0 Introduction And Executive Summary

This report provides a traffic analysis of a proposed redevelopment of the existing Mt. Wayte Plaza situated in Framingham, Massachusetts. This mixed-used commercial redevelopment is located at the southwest quadrant of Mt. Wayte Avenue and Franklin Street, approximately 1.1 miles north of Route 126 and Route 135 in downtown Framingham. The project location is shown on Figure 1 with respect to the general area including downtown Framingham and Framingham State University. The current plaza includes an approximately 50,000-square foot building containing a variety of commercial uses and a 2,000-square foot vacant gas station. The project would replace the gas station with a new building and increase the size of the plaza by approximately 28,950 square feet of retail commercial space. Access for the plaza will continue via three of the existing five curb cuts as is shown in the currently proposed site plan (Figure 2): south of the Mt. Wayte Avenue and Franklin Street intersection; on Franklin Street about 170 feet northwest of Day Hill Road; and between the project site and an existing adjacent plaza. The existing two curb cuts closest to the Franklin Street/Mt. Wayte Avenue intersection are proposed to be closed.

The analysis and evaluation in this report includes traffic volumes, safety data and review, and analysis of the roadway/site access interface. The guidelines of the Massachusetts Executive Office of Energy and Environmental Affairs (EOEEA), the Massachusetts Department of Transportation (MassDOT), and the Institute of Transportation Engineers (ITE) were used for completing this traffic impact and access study. The report's content contains descriptions of existing characteristics of the abutting roadway network, current traffic conditions, estimated traffic impacts and access-egress characteristics of the development.

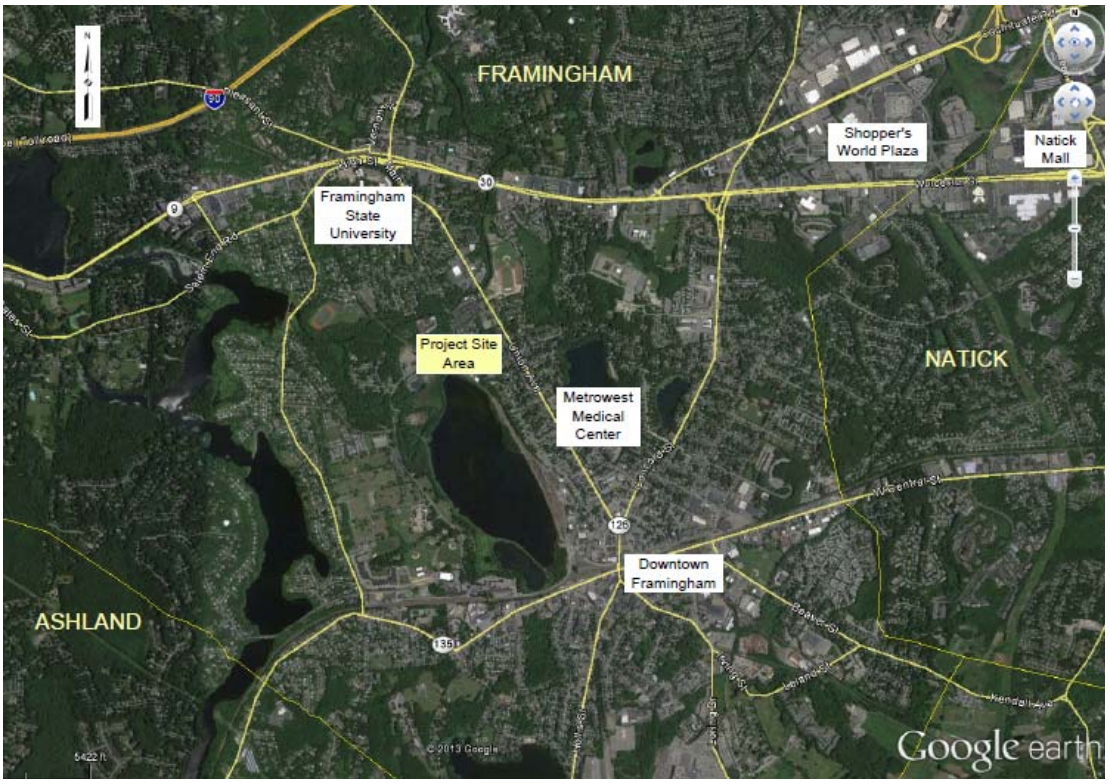


Figure 1. Overall Project Area

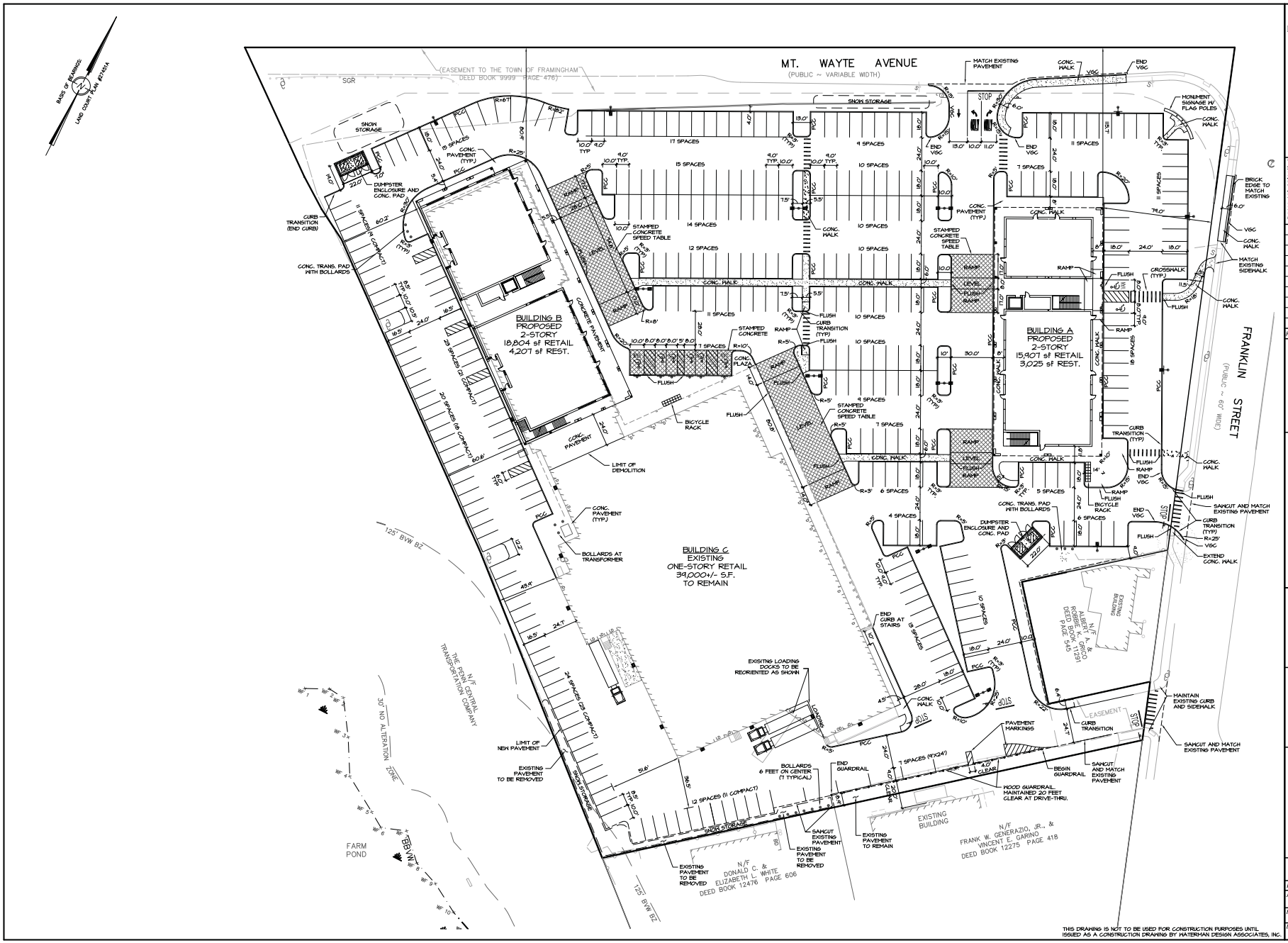


Figure 2. Proposed Site Plan

Existing Conditions

The study area analyzed includes Franklin Street and Mt. Wayte Avenue and their respective intersections with Maple Street and Union Avenue, and the intersections of Franklin Street and Mt. Wayte Avenue with each other and with three of the project's five existing site drives.

Franklin Street and Mt. Wayte Avenue are both two-way, two lane roadways classified as urban collector roadways under Framingham jurisdiction. The two roads meet at a signalized intersection at the northern corner of the project site. The site drive intersections with each of these roads are unsignalized with Mt. Wayte Avenue or Franklin Street running "free" and with the site drive exits implicitly running under STOP control. Union Avenue is a two-way, two lane roadway classified as minor arterial roadway under Framingham jurisdiction. Union Avenue intersects Mt. Wayte Avenue approximately 1,000 feet northwest of the project site.

Based on recently obtained traffic data, daily traffic volume on Franklin Street southeast of Day Hill Road and the project site was observed to carry approximately 8,220 vehicles per day (vpd) on a weekday and about 4,560 vpd on a Saturday. Mt. Wayte Avenue experienced volumes of approximately 16,460 vpd on a weekday and 11,490 vpd on a Saturday southwest of the project site drive along Mt. Wayte Avenue. Morning peak hour traffic on Franklin Street was also found to represent approximately 8.3% of the daily traffic volume while observations indicate that afternoon peak hour is 8.7% of the daily flow. The evaluation of the intersections indicated that the signalized intersections within the study area currently operate at Levels of Service (LOS) 'B', 'C' or 'D' during the peak periods; that the site drives along Franklin Street operate at LOS 'A' for Franklin Street and 'B' for the site drives and for Day Hill Road during peak periods; and that the site drive at Mt. Wayte Avenue operates at LOS 'D' to 'F' for vehicles exiting left from the site, at LOS 'B' to 'C' for vehicles exiting right out from the site and at LOS 'A' for traffic on Mt. Wayte Avenue.

Mt. Wayte Plaza is the location of an existing 50,000 square foot building, approximately 38% of which is currently occupied. A 2,000 square foot gas station on the site at the corner of Franklin Street and Mt. Wayte Avenue is currently vacant.

Future Conditions

The future condition analysis involved estimating the future No-Build and Build traffic conditions. The No-Build condition assumes fully occupying the existing plaza including the currently unused gas station. The future Build condition includes redevelopment and expansion of the existing plaza. The analysis of the proposed redevelopment focused on the year 2020. Figure 2 illustrates the currently proposed plan. The redevelopment includes the removal of the existing gas station and its two associated drives, and the modifications to the site to include three buildings housing a total of 80,943 square feet of retail/mixed commercial space. Two connections from the sidewalk adjacent to the site are proposed, and pedestrian access within the site includes marked and raised crosswalks in addition to above-grade walkways.

Forecasts of the proposed development were based on models published by the Institute of Transportation Engineers (ITE) and based on observations of similar land uses. Based on the ITE models, the amount of trips accessing the site was estimated by adding nearly 28,950 feet of retail and mixed-commercial space to the No-Build case and removing the existing gas station that is presumed to be occupied in the No-Build case. The proposed redevelopment of the site would generate approximately

290 additional vehicle trip-ends over the course of a typical 24 hour weekday over that of the No-Build scenario (Table 1.1). Over the 24-hour period, approximately 145 additional vehicle trips would enter the site and 145 additional trips exit the site. On a typical Saturday, approximately 1,272 vehicle trip-ends will be added to the network compared to the No-Build scenario; about 636 trips will be expected to each enter and exit the site within a 24-hour Saturday period. A greater proportion of traffic is expected to enter the site during weekday AM peak hour and a greater proportion of traffic is expected to exit the site during a typical weekday PM or Saturday midday peak hour, which is true regardless whether or not the plaza is expanded.

Table 1.1 – Summary of Additional Trips in Build Scenario

Time Period	Total Additional Trips from No-Build to Build
Weekday 24 Hours	290
AM Peak Hour	-47
PM Peak Hour	35
Saturday 24 Hours	133
Sat. Peak Hour	196

In addition to project site related traffic, general growth in the region was taken into account through the application of a background growth rate. For comparison purposes the existing building on the site is 50,000 square feet; the full re-occupation of the retail and gas station components of this area is assumed in the No-Build case. It should be noted that many of the trips to the gas station in the No-Build case would be made by traffic already passing by the site regardless of construction.

The analysis of the proposed development examined the Build conditions and the corresponding traffic impact on local intersections. Of the total amount of trips to and from the site, it is expected that some of these trips will result from traffic already present within the roadway network. Passby trips include trips to and from the site by drivers who would drive past the site drives regardless of redevelopment, whereas diverted-link trips include trips to and from the site via diversion from traveling the roadways within the study area. Hence, volumes added to the overall roadway network will be less than the volumes provided in Table 1.1. Overall intersection Levels of Services ranging from 'B' to 'D' are estimated to occur during the peak hours at the signalized intersections, except for the intersection of Mt. Wayte Avenue at Union Avenue which will go to LOS 'E' in the No-Build and Build scenarios. Site traffic exiting at the Franklin Street drive will operate at LOS 'C', while traffic exiting left out from the Mt. Wayte Avenue exit will operate at LOS 'F'. Vehicles turning right onto Mt. Wayte Avenue will operate at LOS 'C' to 'D' depending on the time period; traffic on the main roadways at the site drives will continue to operate at LOS 'A' to 'B'. In addition to operating conditions, the evaluation of sight distances in relation to the proposed site drive location indicated that safe sight distances relative to the project would be provided.

Within the past five years Franklin Street has been widened and sidewalks along its length have been improved or added, enhancing pedestrian access to and from the site. Traffic signals were also updated at Mt. Wayte Avenue and new signals were installed at Maple Avenue.

Recommendations

While the analyses show that the proposed project can be accommodated on the study area network, several recommendations have been made to enhance the transportation system and reduce this and other project impacts. The proposed actions are as follows:

- Any proposed landscaping and signage should be low enough and/or set back sufficiently so as not to create any sight distance constraint.
- To better highlight the intended traffic control of the site drive intersections, install a STOP sign (R1-1) and a STOP bar at each of the proposed site drives at their respective approaches to Franklin Street and Mt. Wayte Avenue.
- To discourage motorists from cutting through the plaza to bypass the Mt. Wayte Avenue / Franklin Street intersection as well as to encourage slow speeds through the site, multiple speed tables/raised crosswalks are proposed within the plaza.
- To reduce the delay for vehicles exiting the site, the site drive on Mt. Wayte Avenue includes one left turn only lane and one right turn only lane.
- Mitigation is proposed to improve the traffic signal operations and enhance the safety of the intersection of Union Avenue and Mt. Wayte Avenue. During the PM peak period, regardless of the proposed redevelopment, the high-volume (> 500 vehicles per hour) northbound left movement is expected to experience significant delay. A safety hazard is also created by the inclusion of a delayed southbound movement; there is no indication of when the northbound left movement is no longer protected other than noting when southbound traffic begins to flow. Replacing one of the signal heads for the northbound approach with a four-faced signal head with a bimodal left-turn arrow will improve safety by clearly indicating when the northbound protected left-turn phase begins and ends.

2.0 Existing Traffic Conditions

The following sections describe the existing transportation system in terms of physical and operational characteristics. The selection of the study area took into account the location and type of project and focused on the evaluation of the roadways and intersections in the vicinity of the site that are anticipated to be most impacted by the proposed project.

2.1 Existing Roadway Network

The study focused on the roadway network in the vicinity of the project site that patrons of and commuters working in the site will utilize, including the following intersections:

- Union Avenue at Mt. Wayte Avenue at Buckminster Street
- Franklin Street at Mt. Wayte Avenue
- Franklin Street at Maple Street
- Site Drives at Franklin Street
- Site Drive at Mt. Wayte Avenue

As part of this study, a field reconnaissance was conducted to verify physical and operational features in the study area. A description of the study roadways serving the project is as follows:

Union Avenue

Union Avenue is a two-lane, two-way road under the jurisdiction of the Town of Framingham and classified as an "Urban Minor Arterial" roadway. Union Avenue extends in a roughly north-south direction from Main Street south of Route 9 in Framingham to the roundabout on Route 126 in downtown Framingham. Union Avenue consists of one travel lane in each direction and runs in a roughly northwest-southeast direction. It provides connections to Route 126 in downtown Framingham and, under the name of Edgell Road, with Route 9 and Sudbury to the north. Near the project site, the street is at least 33 feet in width, excluding dedicated turn lanes. Depending on location, the travel lanes are about 16.5 feet in width; no shoulders are demarcated. A double yellow centerline separates the directions of flow. Union Avenue in the study area is lined with granite curb and cement concrete sidewalks along each direction of travel. Utility poles are present along the southbound side of Union Avenue and set back from the pavement by approximately two feet.

Union Avenue, looking north towards Mt. Wayte Avenue and Buckminster Street

No posted speed limits were found along Union Avenue in the vicinity of the site. The alignment of Union Avenue immediately on either side of Mt. Wayte Avenue is generally straight and level. Access is provided to a number of businesses or public areas as well as to residential areas via intersecting side streets.

Union Avenue intersects Mt. Wayte Avenue and Buckminster Street at a signalized four-legged intersection. Union Avenue forms the northern and southern legs of the intersection, Mt. Wayte Avenue forms the western leg, and Buckminster Street forms the eastern leg. The intersection abuts single family homes to the east, a used automobile dealer to the south, offices to the west and playing fields and single family homes to the north. Union Avenue has a 10-foot wide left-turn only lane on each of its approaches. Mt. Wayte Avenue has a left-through lane and a right-only lane, while Buckminster Street functions as a one-way road with no vehicles exiting to Union Avenue or Mt. Wayte Avenue. Crosswalks with perpendicular "ladder" markings traverse all four approaches.

Franklin Street

Franklin Street is a two-lane, two-way urban collector road under the jurisdiction of the Town of Framingham. Franklin Street extends in a roughly north-south direction from Main Street south of Route 9 to Howard Street one block west of Route 126 in downtown Framingham. Franklin Street is a local two-way two-lane roadway. It runs in a general northwest to southeast alignment, providing access to Main Street just south of Route 9 in Framingham and to Route 126 in downtown Framingham. The roadway is marked with a double yellow centerline separating the two travel directions. Franklin Street has a pavement width of approximately 40 feet south of Mt. Wayte Avenue and about 38-40 feet north of Mt. Wayte Avenue. The travel lanes are 12-13 feet wide and shoulders are about 2-3.5 feet wide.

Franklin Street, looking south 100 feet south of Mt. Wayte Avenue towards two site drives

Franklin Street looking north away from the project site

Franklin Street was noted to have a posted speed limit of 25 mph south of Maple Street and in the vicinity of the project site, and provides access mostly to residential areas but also to some businesses. Granite curbing separates the roadway from the cement concrete sidewalks present along each side of Franklin Street. Brick pavers are present between the curb and the sidewalk along portions of Franklin Street near and south of Mt. Wayte Avenue. Utility poles are present alongside alternating sides of Franklin Street, generally at least two feet from the edge of pavement (although one pole south of Maple Street is as close as one foot from the edge of pavement, but behind the curb). Guardrail sections

are present immediately north of and south of a bridge over a stream crossing approximately 450 feet south of Maple Street. South of the project site, Franklin Street has a posted speed limit of 30 MPH.

Within the past five years Franklin Street has undergone widening, sidewalk additions and improvements, and modifications to signalized intersections including the intersections with Maple Street and Mt. Wayte Avenue within the study area (MassDOT project 602046). Intersection descriptions reflect that of the present as of the writing of this report.

Franklin Street intersects Mt. Wayte Avenue at a signalized four-legged intersection. Franklin Street forms the northern and southern legs of the intersection and Mt. Wayte Avenue forms the eastern and western legs. To the south of the intersection lies the project site; the western quadrant of the intersection is the site of a thrift store, a parking lot for an office building lies north of the intersection, and medical offices occupy the eastern quadrant of the intersection. Brick paver crosswalks are present at each of the four approaches. The Franklin Street site drives are situated about 60, 300 feet and 480 feet southeast of the intersection. Franklin Street intersects Day Hill Road about 30 feet south of the latter site drive. The site drive closest to Mt. Wayte Avenue is unused and is situated at the unused gas station on the site.

Franklin Street intersects Maple Street at two signalized three-legged intersections separated by approximately 200 feet. Maple Street forms the western leg of the southern intersection and the northeastern leg of the northern intersection, and Franklin Street forms the northern and southern legs for both intersections. The intersections lie in a neighborhood of single family residential houses, with Mason Park situated northwest of the two intersections. At the southern intersection, brick paver crosswalks traverse the western and northern legs and a brick paver median that tapers out to about nine feet wide is also present in the northern leg.

Mt. Wayte Avenue

Mt. Wayte Avenue is a two-lane, two-way urban collector road under the jurisdiction of the Town of Framingham. The avenue provides access to Walnut Street in Framingham (although it is called Buckminster Street east of Union Avenue) to the east and with Walnut Street (nearby Route 135) in Framingham to the south. A double yellow centerline separates the directions of travel. West of Franklin Street, Mt. Wayte Avenue has a posted speed limit of 40 MPH, whereas east of Franklin Street Mt. Wayte Avenue has a posted speed limit of 30 MPH. Throughout the study area the roadway varies from 40 to 46 feet in width. Sidewalks and granite curb are present along both sides of the roadway east of Franklin Street, and utility poles are present on alternating sides of the road. West of Franklin Street granite curbing is present along both sides of the street whereas only the westbound side of the road has a sidewalk with a grass buffer space and utility poles.

Less than 200 feet southwest of the intersection is the Mt. Wayte Avenue site drive for the project site. A site drive to the unused gas station on the site is situated on Mt. Wayte Avenue some 90 feet south of Franklin Street; this drive is currently blockaded with cement concrete median barriers. Vehicles traveling in the eastbound direction on Mt. Wayte Avenue have been observed to cut through the plaza parking lot to bypass waiting at the Mt. Wayte Avenue/Franklin Street intersection, although it should be noted the plaza is currently largely empty which facilitates such cut-through traffic. It is unlikely that such cut-through traffic would be as common in a fully developed shopping center.

Mt. Wayte Avenue, looking north towards Union Avenue

Union Avenue, looking north towards Mt. Wayte Avenue and Buckminster Street.

Buckminster Street

Buckminster Street is an unmarked one-lane local road under the jurisdiction of the Town of Framingham. Buckminster Street is a one-way street, with traffic flowing in the northeast direction. Along the western side of the street a cement concrete sidewalk and granite curb are present.

Maple Street

Maple Street is a two-lane, two-way urban collector road under the jurisdiction of the Town of Framingham. Maple Street has two disjoint stretches, with the southern stretch of Maple Street intersecting Franklin Street approximately 180 feet southeast of where the northern portion of Maple Street intersects Franklin Street. Cement concrete sidewalks are separated from the roadway by brick pavers and granite curb within the study area. Utility poles are present along the westbound side of Maple Street.

Day Hill Road

Day Hill Road is a mostly unmarked, local two-way two lane road. Sixteen homes have direct access to this approximately 900-foot long roadway. Sidewalks are not present along Day Hill Road, and except for at the mouth at Franklin Street, curb is also not present.

2.2 Traffic Volumes

As part of this study, traffic volume data was obtained and used to form the basis of the traffic analysis. The data was collected during September 2013 and consisted of weekday peak period (7:00-9:00 AM and 4:00-6:00 PM) and Saturday peak period (11:00 AM – 1:00 PM) manual turning movement counts (TMC) at the study intersections noted previously. To facilitate potential signal evaluation, the count program also included two days' worth of Automatic Traffic Recorder (ATR) vehicle counts on Franklin Street south of the site and Day Hill Road and on Mt. Wayte Avenue west of the site and Franklin Street. The TMC and ATR data collected as a part of this study are included in the Appendix. One day of weekday data and one day of weekend data was collected as part of this study.

Table 2.1 summarizes the ATR data that was collected as part of this study. As indicated, the average weekday traffic volume on Franklin Street southeast of Day Hill Road and the site is approximately 8,220 vehicles per weekday and 16,460 vehicles per weekday on Mt. Wayte Avenue. Saturday volumes are 4,560 vehicles per day (vpd) on Franklin Street and 11,490 vpd on Mt. Wayte Avenue southwest of the project site drive. Franklin Street traffic volumes during peak hours are approximately 8.6% of daily traffic; Mt. Wayte Avenue volumes during peak hour range from 7.2% during AM peak hour to 9.4% of daily volumes on Saturday. On Franklin Street 69% of traffic is headed in the southbound direction during AM peak hour, 69% of traffic is headed in the northbound direction during PM peak hour, and 54% of traffic travels in the southbound direction during the Saturday peak hour. During AM peak hour 71% of traffic on Mt. Wayte Avenue travels in the eastbound direction; 66% of traffic on Mt. Wayte Avenue is headed in the westbound direction during the PM peak hour and 54% of traffic during the Saturday peak hour travels in the eastbound direction.

Table 2.1 - Summary of Observed Traffic Data

Location	ADT Weekday	Weekday AM Peak	Percent of Daily Volume	Weekday PM Peak	Percent of Daily Volume	ADT Saturday	Saturday AM Peak	Percent of Daily Volume
Franklin Street south of Day Hill Avenue	8,220	690	8.4%	720	8.7%	4,560	390	8.6%
Mt. Wayte Avenue west of Site Drive	16,460	1,180	7.2%	1,380	8.4%	11,490	1,080	9.4%

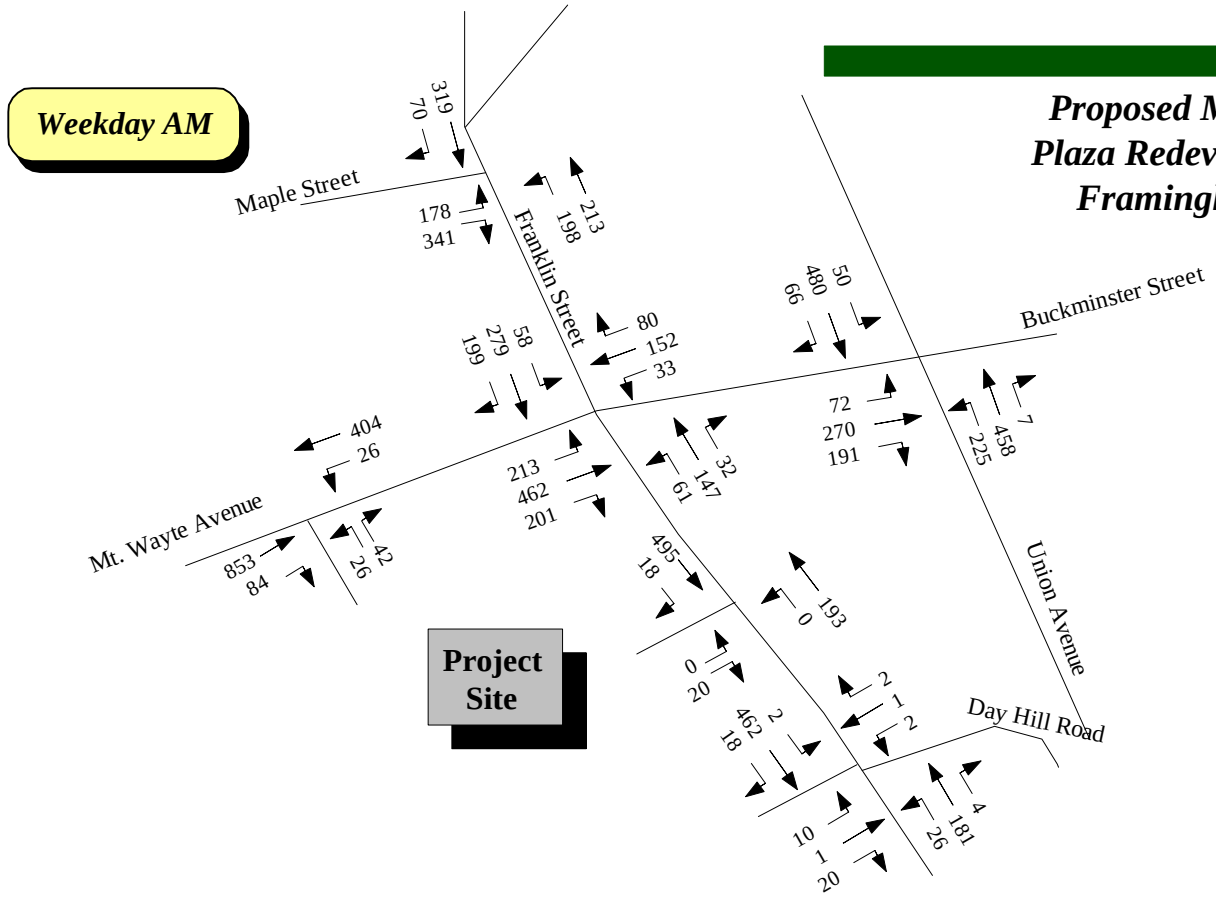
Note: Data has been rounded. September 2013 (ATR) data for current study.

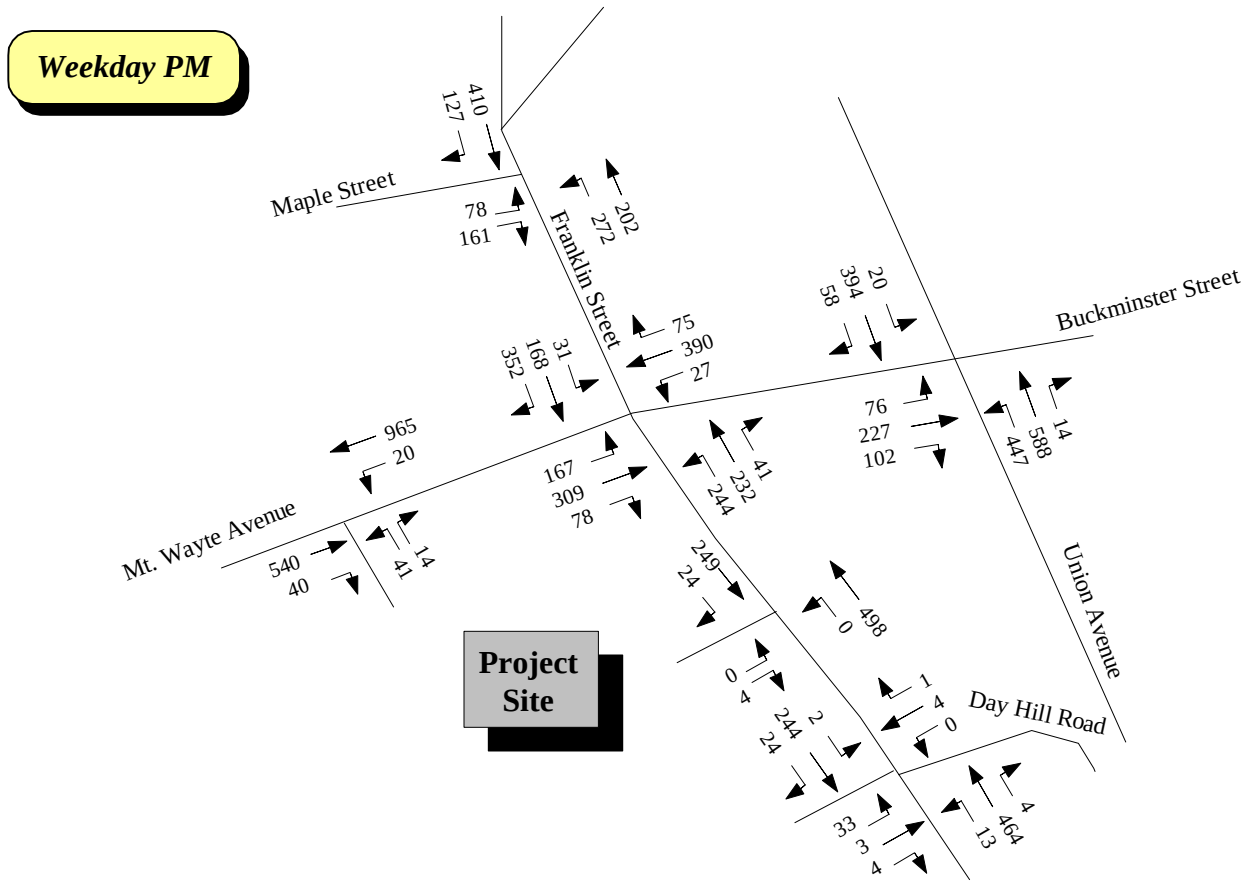
In developing the estimated average or typical volume conditions for study purposes, a review of permanent traffic count station data maintained by the Massachusetts Department of Transportation (MassDOT) was completed. This review determined the seasonal variation of traffic flow on roadways similar to the function and/or in the general region and if the data collected in the field needed to be adjusted to reflect appropriate analysis conditions. The permanent count stations maintained by MassDOT were identified and reviewed to evaluate seasonal variation (Sta. Nos. 5 and 307). Station 5 is located on Route 12 in Sterling approximately one mile north of Route 190, and Station 307 is located on Route 9 in Westborough east of the Northborough town line. Both stations indicated that September volumes tended to be between 3.4% above and 1.4% below average monthly conditions. The count data was considered to be close to existing average conditions and no seasonal adjustment factor was applied for analysis purposes. Figures 3 and 4 illustrate the estimated existing weekday morning and evening peak hour and the Saturday peak hour traffic volumes.

2.3 Crash Experience

Recent crash history for the study intersections for the most recently available three-year period at that time (2009-2011) were reviewed as part of the traffic impact update study. Crash data presented in this report was obtained from the MassDOT Crash Record System (CRS). Table 2.2 summarizes the recent crash data.

Proposed Mt. Wayte Plaza Redevelopment Framingham, MA





Not to Scale

N
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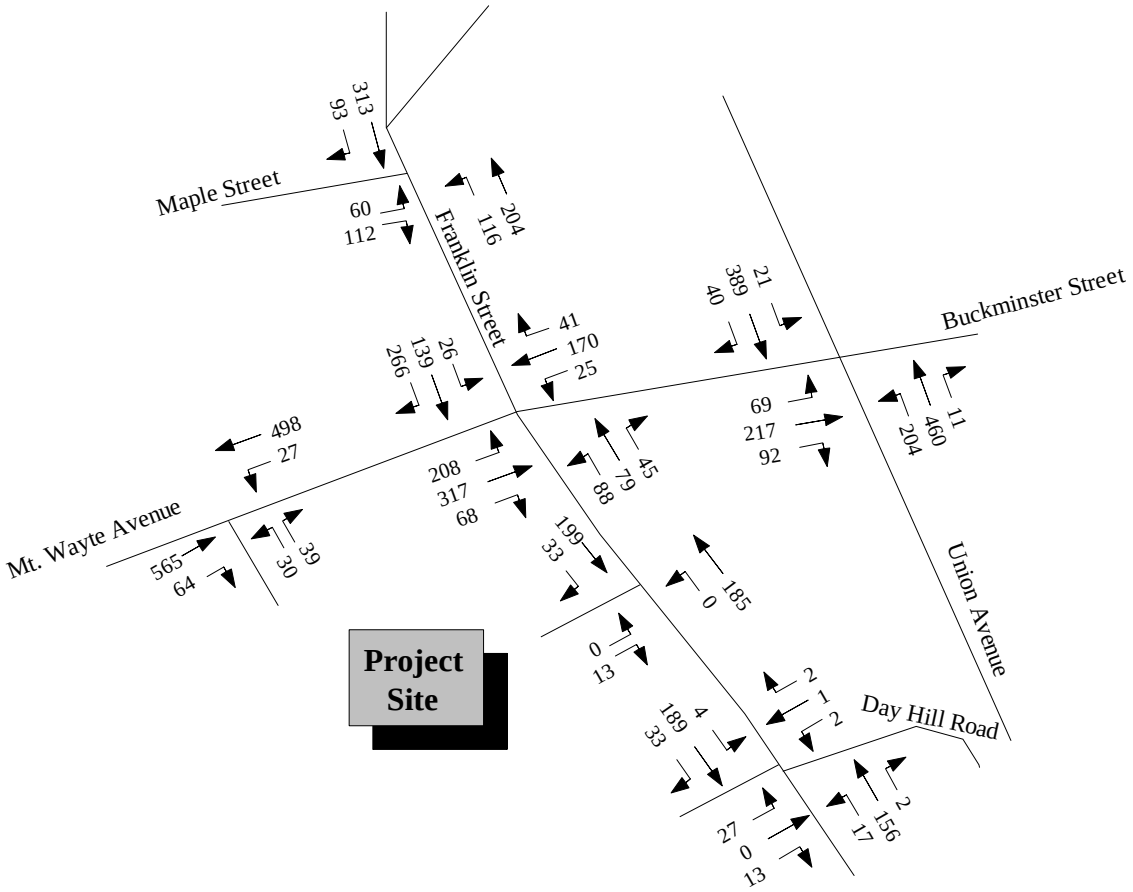
Existing Traffic Volume Networks
Figure 3

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers
239 LITTLETON ROAD SUITE 3, WESTFORD, MASSACHUSETTS
tel. (978)923-0400 fax. (978)923-0404

Proposed Mt. Wayte
Plaza Redevelopment
Framingham, MA

Saturday Peak



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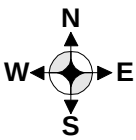

Existing Traffic Volume Networks
Figure 4

GREEN INTERNATIONAL AFFILIATES, INC.
Civil and Structural Engineers
239 LITTLETON ROAD SUITE 3, WESTFORD, MASSACHUSETTS
tel. (978)923-0400 fax. (978)923-0404

Table 2.2 - Summary of Reported Crash Data for Framingham, 2009-2011

		Crash Type						Severity			Pavement		Weather			
Location	**Total**	**AC**	**HO**	**RE**	**SS**	**SV**	**U**	**PD**	**PI**	**F**	**Dry**	**Wet[a]**	**Clear**	**Snow**	**Rain[b]**	**Peak Hour**
Site Drive on Mt. Wayte Ave	2	2	0	0	0	0	0	1	1	0	2	0	2	0	0	2
Site Drive at Franklin St at Day Hill Road	3	0	0	2	1	0	0	2	0	0	1	2	1	2	0	0
Site Drive at Franklin St south of Mt. Wayte Ave*	8	3	0	3	1	1	0	6	2	0	6	2	5	1	2	2
Franklin St at Mt. Wayte Ave	19	11	1	4	2	0	0	11	6	0	14	3	11	0	8	6
Franklin St at Maple St	7	3	1	2	0	1	0	3	4	0	5	2	5	0	1	2
Union Ave at Mt. Wayte Ave at Buckminster St	32	20	0	4	5	3	0	14	13	0	21	11	17	2	12	6

Source: MassDOT Crash Report for Framingham, 2009-2011.
Notes: AC - angle collision; HC – head-on collision; RE - rear-end collision; SS - side swipe; SV - single vehicle;
U - unspecified; PD - property damage; PI - personal injury; F - fatality
a - wet, snowy, or icy; b - rain, cloudy, or foggy
* - Drive to offices across from project site is approximately across Franklin St from the project site drive. All crashes assumed to have occurred at project site drive

Some of the relevant highlights have been noted below:

- The intersection of Union Avenue at Mt. Wayte Avenue/Buckminster Street had thirty-two (32) reported accidents during the three year study period, an average of nearly eleven (11) accidents per year. Nearly two-thirds of these reported incidents were angle collision crashes, and about one half of the accidents in which severity was reported involved personal injury. Twenty of the accidents reported at this intersection involved vehicles traveling in the southbound through (14 vehicles) or eastbound through (13 vehicles) directions.
- There were nineteen (19) reported accidents at the intersection of Franklin Street and Mt. Wayte Avenue during the three year period. An average of about six accidents occurred each year at this intersection. Angle-type collisions accounted for over one-half of all reported accidents at the intersection of Franklin Street and Mt. Wayte Avenue.
- Over the three-year study period there were seven (7) accidents reported at the intersection of Franklin Street at Maple Street.
- A total of three (3) crashes were reported at or near the site drive at the intersection of Franklin Street and Day Hill Road and two (2) crashes were reported as having occurred at the Mt. Wayte Avenue site drive during the study period. Eight (8) crashes were identified as occurring at the site drive on Franklin Street approximately 200 feet south of Mt. Wayte Avenue, which lies opposite of a drive serving medical offices.
- Over one-half of all reported accidents in the study area were of angle collision type. Over forty percent of all reported accidents involved personal injury.
- There were no fatalities reported in the vicinity of the project site in the three year analysis period.

As part of this safety review, the "crash rate" (in crashes per million entering vehicles) for the study intersections was also determined. The calculation of the crash rate accounts for the amount of traffic that enters the intersection in addition to the number of reported crashes. It relates the number of accidents at a location directly to the amount of traffic that passes through the location and becomes a more comprehensive measure for identifying potentially hazardous locations compared to simple averages. The calculated rate is compared to the District-wide averages. Intersections experiencing crash rates greater than the above averages are potentially experiencing an unusually high number or higher than expected number of crashes relative to traffic volumes at that particular location and may warrant further investigation or improvements. MassDOT District 3, which covers the study area, has an average crash rate of 0.89 crashes per MEV for signalized intersections and 0.66 crashes per MEV for unsignalized intersections.

The crash rate for the Union Avenue/Mt. Wayte Avenue intersection was calculated to be 1.45 crashes/MEV, which is above the average crash rate of 0.89 for a signalized intersection in MassDOT District 3. High side street volumes (21-29% of vehicles during peak hours exited from Mt. Wayte Avenue) and high turning volumes (the northbound left movement represents 12-24% of traffic during peak hours) contribute to the above-average crash rate. Although a delayed southbound movement exists to accommodate the sizeable number of left turns from the northbound approach, a safety hazard is increased as there is no indication of when the northbound left movement is no longer protected other than noting when southbound traffic begins to flow. The intersections of Franklin Street with Mt. Wayte Avenue and with Maple Street have crash rates below the district average (0.71 and 0.45, respectively). Two of the unsignalized site drive intersections are below that of the District 3 average crash rate: the crash rate of the site drive at Mt. Wayte Avenue is 0.09 and the crash rate of the site drive opposite Day Hill Avenue is 0.30 (Table 2.3). The site drive southeast of Mt. Wayte Avenue had a crash rate of 0.83, which is above the district average; it should be noted that six of the eight accidents reported at this intersection during the study period occurred during 2009, midway through a Franklin Street widening project (and hence a slightly different roadway layout). Also, less than 3 crashes per year were reported at the location.

Table 2.3 - Summary of Reported Crash Rates for Framingham, 2009-2011

Intersection	Type of Control	Total No. of Crashes (3 Years)	Average No. of Crashes/Yr.	Crash Rate (per MEV)
Site Drive on Mt. Wayte Ave	Unsignalized	2	0.7	0.09
Site Drive on Franklin St opp. Day Hill Road	Unsignalized	3	0.7	0.30
Site Drive on Franklin St south of Mt. Wayte Ave	Unsignalized	8	2.7	0.83
Franklin St at Mt. Wayte Ave	Signalized	19	6.3	0.71
Franklin St at Maple St	Signalized	7	2.3	0.42
Union Ave at Mt. Wayte Ave at Buckminster St	Signalized	31	10.7	1.45

Source: MassDOT Crash Report for Report for Framingham, 2009-2011.

2.4 Existing Public Transportation Network

As part of this study, the presence of nearby public transit systems was identified to better understand the potential interaction among multiple modes of travel as well as the potential roadway network

impact of commuters driving to transit stations. Based on the review, there is fixed route public transportation provided nearby the project site, within the Town of Framingham in the form of a commuter rail station and local urban bus routes.

2.4.1 Commuter Rail

The proposed project lies about 1.1 miles north of one commuter rail station along the Massachusetts Bay Transit Authority (MBTA) Framingham line.

Route 126 and Route 135 provide the key access routes between the project site and Framingham Station, situated in the town center. Framingham Station provides access to Back Bay and South Station in Boston as well as to Worcester. Service is primarily geared to the Boston commute. Given the location of the site, the distance from the nearest station and the train schedule, it is unlikely that the rail will have any influence on traffic to and from the site.

2.4.2 Bus Service

The Metrowest Regional Transit Authority (MWRTA) operates local bus routes. Route 7, the Marlborough/Southborough line, includes a stop at the intersection of Franklin Street and Mt. Wayte Avenue while the bus route itself travels along Franklin Street. The presence of a regional bus route within the study area means that some potential patrons of the plaza will arrive by bus, given the suburban nature of the region. However, the amount of trips made to and from the site via bus is expected to be small; hence a conservative estimate for vehicular trip generation has been made by assuming an insignificant amount of public transit use.

3.0 Probable Impacts Of The Project

The impact of the proposed development project on the roadway network within the study area was evaluated and the results are described in this section. For study purposes, this study used the year 2020 for the analysis year that represents a seven-year build-out timeframe from the present condition.

The mixed-use commercial development, known as Mt. Wayte Plaza, will be redeveloping an existing plaza in an area bounded by Franklin Street, Mt. Wayte Avenue and railroad tracks. As part of this proposed project, the existing vacant gas station will be removed and be replaced with nearly 19,000 square feet of retail and commercial uses, a portion of the existing 50,000-square foot main building will be renovated to become two buildings having a total of just over 62,000 square feet of mixed retail and commercial use. The existing "400 Club" restaurant abutting the site will be left intact, as it is not part of the project site. The locations of the site drives will remain unchanged, although the two drives adjacent to the gas station will be closed off and replaced with parking spaces.

3.1 No-Build Traffic Volumes

A year 2020 No-Build traffic volume network was developed by taking into account existing traffic volumes, and identifying potential area wide background traffic volume growth as well as known site specific condition (background) developments that could contribute to traffic flow on the 2020 study network.

3.1.1 Background Traffic Growth

Traffic growth and historical traffic count trends for the project's analysis area have been reviewed. The annual trends were determined by reviewing the permanent count station data (Stas. 5, 307 L, 3073, 4018, 4019) maintained by the Massachusetts Department of Transportation (MassDOT). The historical traffic data from the MassDOT permanent count stations showed a slight decrease of approximately 0.2% in annual average traffic volumes for the region between 2008 and 2012[1].

The observation of fairly stable or slight reductions in traffic flows which have occurred over the past five or more years can be largely attributed to the prolonged sluggish economy. However, presuming some level of economic rebound is inevitable in the future, an assumption for growth has been incorporated into the No-Build networks. Based on the historical count station data, traffic growth rates of 0.5% per year for the first three (3) years and 1.0% per year for the following four (4) years were selected and cumulatively applied to the existing peak hour traffic volumes. These rates would presumably account for some of the more remote growth in the region as well as potential nearby residential/ business growth that could potentially result in added traffic through the study area.

3.1.2 Site-Specific Developments

In addition to background growth, research on site specific developments or uses that are likely to occur within the study time frame in the vicinity of the proposed project was completed. Based on local research via web investigation and/or contact with the Planning Board offices of municipalities in the area, it was determined that there are no substantive site specific developments in the immediate project area currently in progress that would substantively affect roadway volumes in the vicinity of the

[1] MassDOT Transportation Management System, < http://mhd.ms2soft.com/tcds/tsearch.asp?loc=Mhd&mod= >

site. Due to the fact that the other site locations researched are situated on or close to other major roadways (e.g. Route 9) whereas the project site is situated next to collector roads, predicted background traffic growth would to an extent account for additional traffic volumes in the vicinity of the proposed Mt. Wayte Plaza redevelopment resulting from these sites.

For analysis purposes, it was considered that the existing buildings on the project site would be fully reoccupied within the next seven years under the No-Build condition. It was assumed that the existing 50,000 square foot main building would be fully reoccupied by mixed commercial/retail uses, as opposed to the current proportion of 38% occupancy. It was also assumed that the gas station with associated service bays and convenience mart on the site would be reoccupied by 2020. The presumption was made that approximately 50% of gas station trips are of passby type, meaning that motorists will use the station because they are already driving past it. Using statistics published by the Institute of Transportation Engineers[2], it was estimated that in the No-Build case, an additional 75 external trips would be generated in the AM peak hour, 189 external trips be generated during the PM peak hour, and 231 additional external trips would be generated during the peak Saturday hour if the project site were to be fully occupied (Land Use Codes 820, 945). Additional trips to the fully occupied plaza are expected to be fairly local; the same distribution model is described in further detail in the Site Trip Distribution/Assignment section of the Site Generated Traffic Volumes section.

In downtown Framingham, the second and third stories of the building at 101 Concord Street are proposed to be renovated to include 24 apartment units. Due to the building's proximity to major roads such as Route 126 and Route 135 plus the fairly small size of the project it is anticipated that traffic generated by the renovated 101 Concord Street would be accounted for in the background growth rate.

A development (Danforth Green) consisting of 365 mixed housing units is proposed to be constructed in Framingham, north of Route I-90 and along the Wayland border. Considering that the location is situated relatively close to Route I-90, Route 9, and the shopping centers along Route 9, it is unlikely that the proposed Danforth Green development will have a sizeable effect on roadway volumes due to commutes to work or shopping trips.

The Hillcrest Estates is a proposed 68-home development in Ashland, anticipated to be located about one-half mile from the Hopkinton town line. The Village of the Americas is a proposed 36-unit residential development located near Route 135 near the center of Ashland that, as of the writing of this report, has not yet been approved. It is anticipated that traffic from both developments will be accounted for in the background growth rate, due to the distance of the developments from the site and their proximity to the Ashland Square Shopping Center, Route 135 and in the case of the Hillcrest Estates, Route 85.

3.1.3 No-Build Traffic Volumes

Consequently, the year 2020 No-Build traffic volumes were determined by adding seven (7) years' background traffic growth of one-half percent annually (for three years) and one percent annually (for the following four years) plus the assumption of full occupation of the site. Background traffic growth was assumed to account for traffic resulting from the other aforementioned proposed developments. The estimated year 2020 No-Build traffic volumes projected for the weekday morning and evening peak hours and the Saturday peak hour at the study intersections are shown in Figures 5 and 6, respectively.

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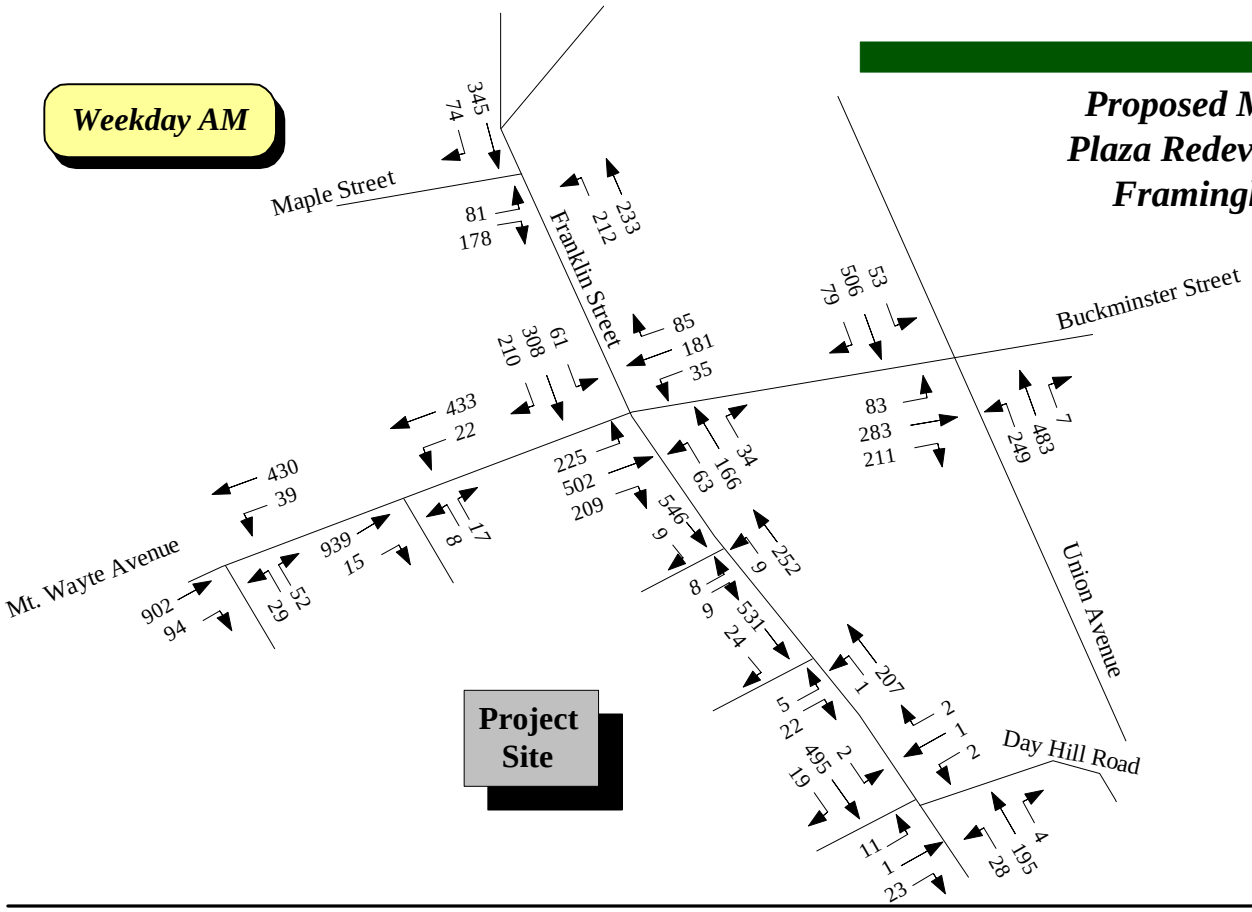
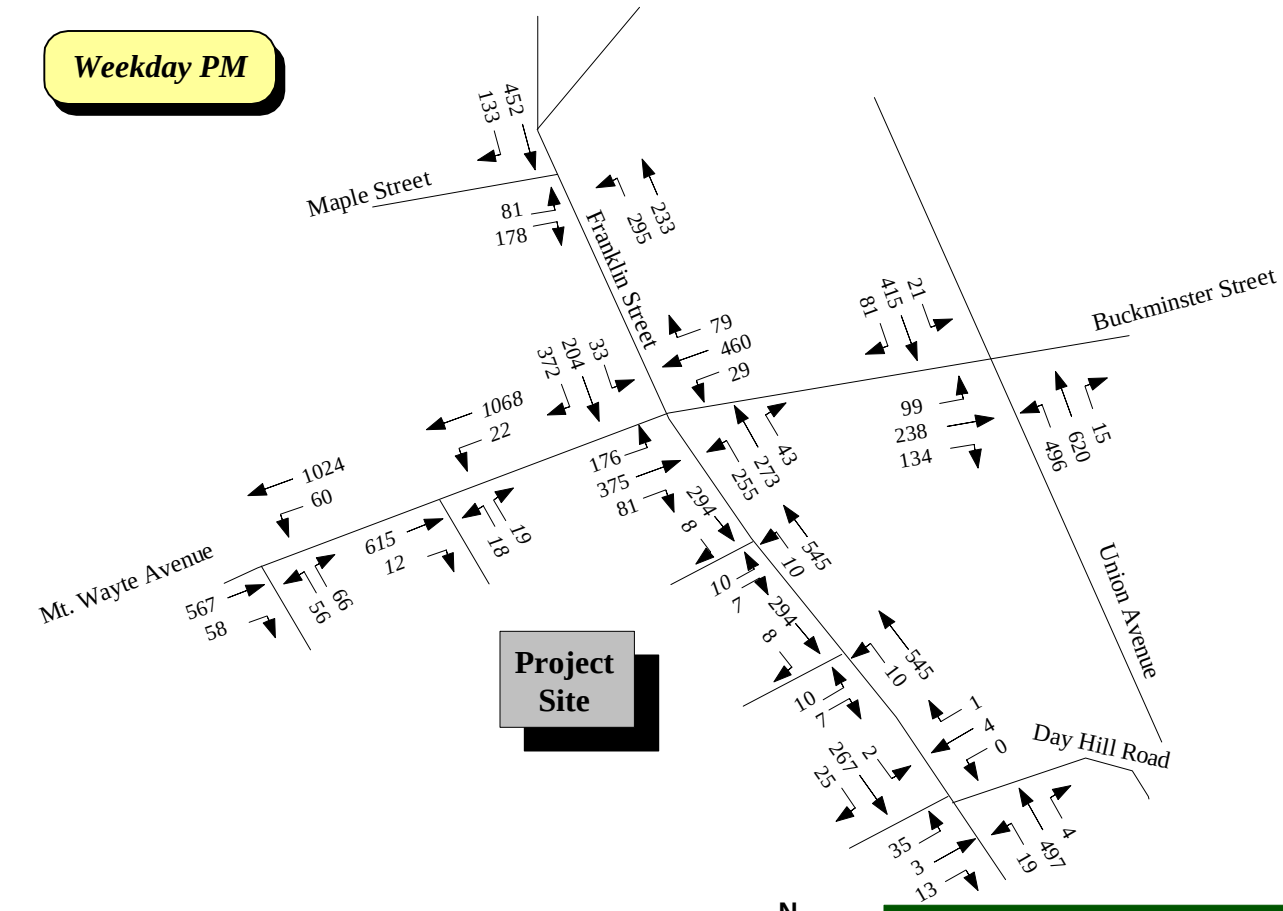
[2] Institute of Transportation Engineers, Trip Generation, 9th Edition, Washington, D.C., 2012.

Proposed Mt. Wayte Plaza Redevelopment Framingham, MA





Not to Scale
Italics represent volumes at currently unused drives

N
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Estimated 2020 No-Build Traffic Volume Networks

Figure 5

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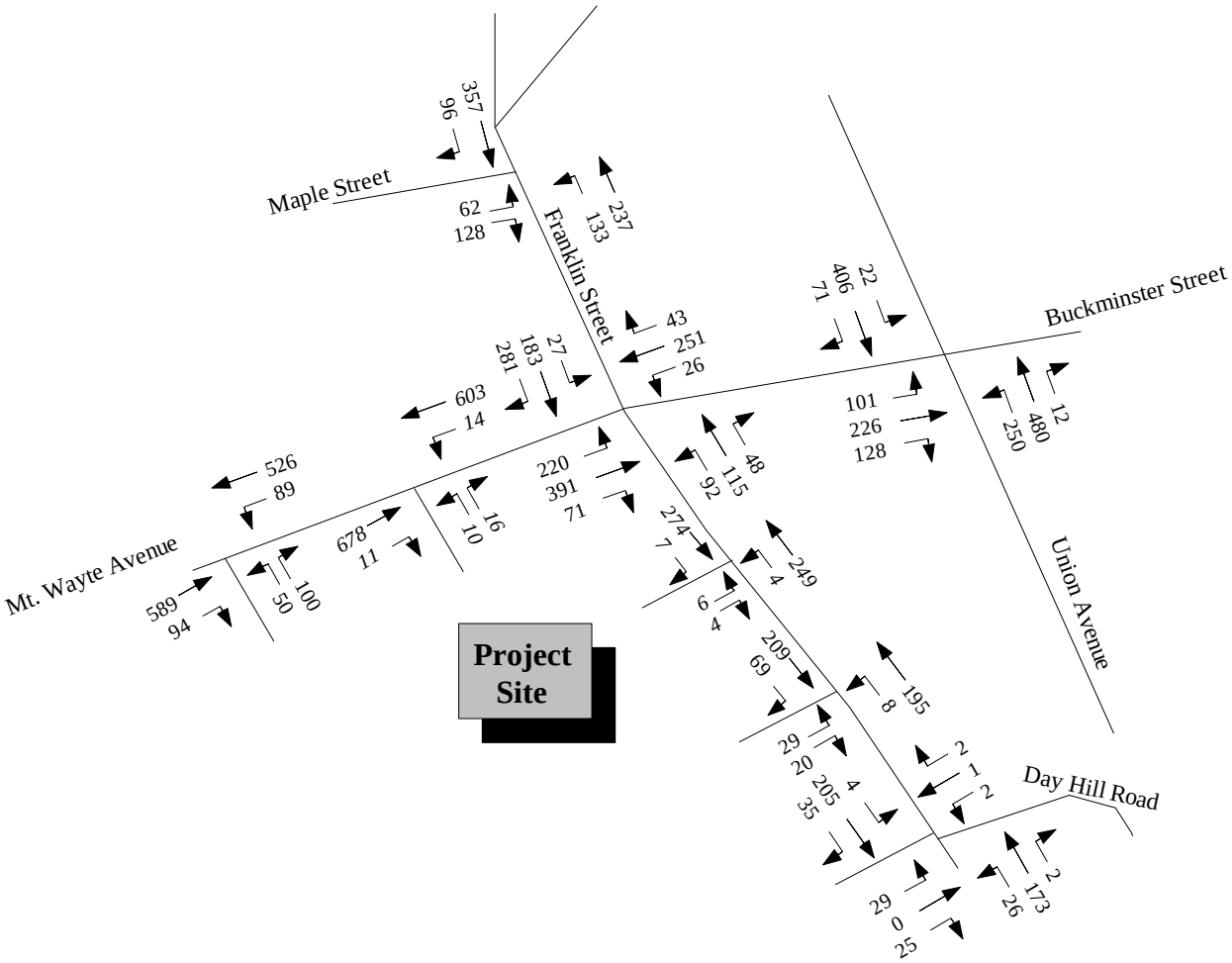
Saturday Peak



Not to Scale
Italics represent volumes at currently unused drives

N
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Estimated 2020 No-Build Traffic Volume Networks

Figure 6

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3.2 Proposed Project Description

The redevelopment of the Mt. Wayte Plaza is an expansion proposed to consist of three buildings incorporating an approximately additional 28,950 square feet (for a total of about 80,950 square feet) of retail and mixed-use commercial space at the intersection of Mt. Wayte Street and Franklin Street. Two connections from the sidewalk adjacent to the site are proposed, and pedestrian access within the site includes marked and raised crosswalks in addition to above-grade walkways. An existing but vacant gas station at the northern corner of the plaza is proposed to be removed to allow the construction of a building proposed to include retail and commercial space. Railroad tracks and Farm Pond lie to the south of the site; a restaurant (the "400 Club"), a small plaza, and single-family residences lie east of the site; medical offices lie northeast of the site; a landscaping supplier sits across Mt. Wayte Avenue from the site; and offices lie southwest of the site. The site access is proposed to use three of the five existing driveway locations.

3.3 Site Generated Traffic Volumes

In this section, an estimate of traffic to be generated by the proposed development was completed and assigned to roadways/intersections within the study area to develop the Build traffic condition, based upon the No-Build traffic volume network.

3.3.1 Site Trip Generation

In order to estimate the number of trips that could be generated by the proposed development, statistics published by the Institute of Transportation Engineers (ITE) in Trip Generation[2] for similar land uses were examined. The ITE trip generation statistics represent compilations of data from studies/projects throughout the United States collected over the past 30+ years on trip generation characteristics for different types of land uses. The data has been compiled to provide transportation analysts with guidelines in forecasting 24 hour and peak hour volumes for the specified use.

Based on a review of the ITE database and the commercial related models, LUC 820 – Shopping Center was selected as the most similar to the project type for estimating purposes for this project. Existing and proposed space within the plaza could include a range of uses including retail and commercial space. The total estimated trips generated by the project, conservatively built upon that of existing vehicle counts, are presented in Table 3.1. Detailed trip generation calculations for the proposed use are included in the Appendix.

Table 3.1 - Summary of Estimated Total Site Trip Generation

Time	In	Out	Total
Weekday	2,960	2,960	5,920
AM Peak Hour	227	157	384
PM Peak Hour	283	275	558
Saturday	4,044	4,044	8,088
Sat. Peak Hour	430	351	781

Source: ITE Trip Generation, 9th Edition, 2012, LUC 820

Due to the expansion in building space, the new proposal is estimated to generate a greater amount of traffic than the existing plaza. The amount of additional traffic generated in the Build scenario from the No-Build scenario is less than the amount of additional traffic that would be produced under the No-Build condition from the Existing condition.

Due to the retail nature of the project, not all the vehicle trips generated by the development are expected to be new trips to the roadway network. In fact, it is expected that a sizable portion of site traffic will be made up of *passby trips* and *diverted trips*. *Passby* traffic is that portion of traffic that is expected to be passing by the site whether or not the project was there and the motorist makes an intermediate stop at the site on the way to their primary destination. This type of trip could be considered an impulse trip or a planned trip along the way to the ultimate destination. For general retail uses, passby rates could be as high as 40-50% depending on the type of land use. Passby rates for banks have been shown to date to be as high as 50% with an average of 35%, and passby rates for shopping centers have been shown to be as high as 44%. However, a 25% limit is generally accepted for retail uses under MassDOT guidelines unless exceptions are specifically supported. With the application of the passby factor, the net increase in traffic on the adjacent street system will be substantially reduced. Passby volume will not affect driveway volumes.

In addition, some trips designated as *diverted-link* type will also be generated when drivers already traversing the general area around the project site divert from their certain route to enter the site, in a manner similar to that of passby traffic. Diverted-link volume will not affect driveway volumes, but will affect volumes on the adjacent roadway network within the study area. While the magnitude of diverted traffic would vary depending on the type of development, its size, tenant characteristics and location, the MassDOT guidelines limit a combination of passby and diverted trips to 25%. For this study, a factor of twenty-five percent (25%) was used in total for passby and diverted-link trips with fifteen percent (15%) applied for passby trips while ten percent (10%) was applied to diverted trips.

In summary, the project is a retail/shopping center development with a sizeable number of pass-by and diverted-link trips with lower corresponding impacts on the abutting roadway system. The redevelopment is likely to function more as a community-type center attracting trips from Framingham, and to a lesser extent the immediate border areas of surrounding communities. Taking into account the above as well as the site's location relative to regional highways and to other competing nearby retail centers, the forecasts that have been developed as part of this study, which form the basis of subsequent analysis, are considered to be conservatively high or "worst case" forecasts. The same methodology was used to produce the No-Build case and Build case projected volumes, which are presented together for comparison's sake (Table 3.2 for No-Build scenario, Table 3.3 for Build scenario).

Table 3.2 - Summary of No-Build Estimated Additional Site Traffic

Location/Approach	Trips					
	Retail [b]	Passby [c]	Diverted Linked [d]	Gas Station [e]	Passby [c]	Total Net Additional External Trips
Weekday Morning Peak Hour						
Entering	28	-4	-3	41	-21	42
Exiting	17	-3	-2	41	-21	33
Total	45	-7	-5	82	-41	75
Weekday Afternoon Peak Hour						
Entering	86	-13	-9	54	-27	92
Exiting	94	-14	-9	54	-27	98
Total	180	-27	-18	108	-54	189
Saturday Midday Peak Hour						
Entering	136	-20	-14	36	-18	120
Exiting	124	-19	-12	36	-18	111
Total	260	-39	-26	72	-36	231
Weekday Daily	2,021	-304	-202	1,302	-651	2,166
Saturday Daily	2,725	-410	-273	846	-423	2,466

Notes:
a. Source: Institute of Transportation Engineers (ITE) Trip Generation Handbook, 9th Edition, 2012.
b. ITE LUC 820 trip rate applied to 79.5 KSF of retail space minus number of No-Build trips.
c. Passby trips factor of 15% applied to retail trips and 50% of gas station trips.
d. Diverted-linked trip factor of 10% applied to retail trips.
e. ITE LUC 945 trip rate applied to 8 vehicle fuelling positions.

Table 3.3 - Summary of Build Estimated Additional Site Traffic

Location/Approach	Trips				
	Retail [b]	Passby [c]	Diverted Linked [d]	Subtracted Gas Station Trips [e]	Total Net Additional External Trips
Weekday Morning Peak Hour					
Entering	22	-3	-2	-21	-4
Exiting	13	-2	-1	-21	-11
Total	35	-5	-3	-41	-14
Weekday Afternoon Peak Hour					
Entering	69	-10	-7	-27	25
Exiting	74	-11	-7	-27	29
Total	143	-21	-14	-54	53
Saturday Midday Peak Hour					
Entering	106	-16	-11	-18	62
Exiting	99	-15	-10	-18	56
Total	205	-31	-21	-36	118
Weekday Daily	1,592	-240	-159	-651	542
Saturday Daily	2,118	-318	-212	-423	1,165

Notes:
a. Source: Institute of Transportation Engineers (ITE) Trip Generation Handbook, 9th Edition, 2012.
b. ITE LUC 820 trip rate applied to 80.943 KSF of retail space minus number of No-Build trips.
c. Passby trips factor of 15% applied to retail trips.
d. Diverted-linked trip factor of 10% applied to retail trips
e. Number of gas station (LUC 945) trips includes number of total trips generated minus passby trips

3.3.2 Site Trip Distribution/Assignment

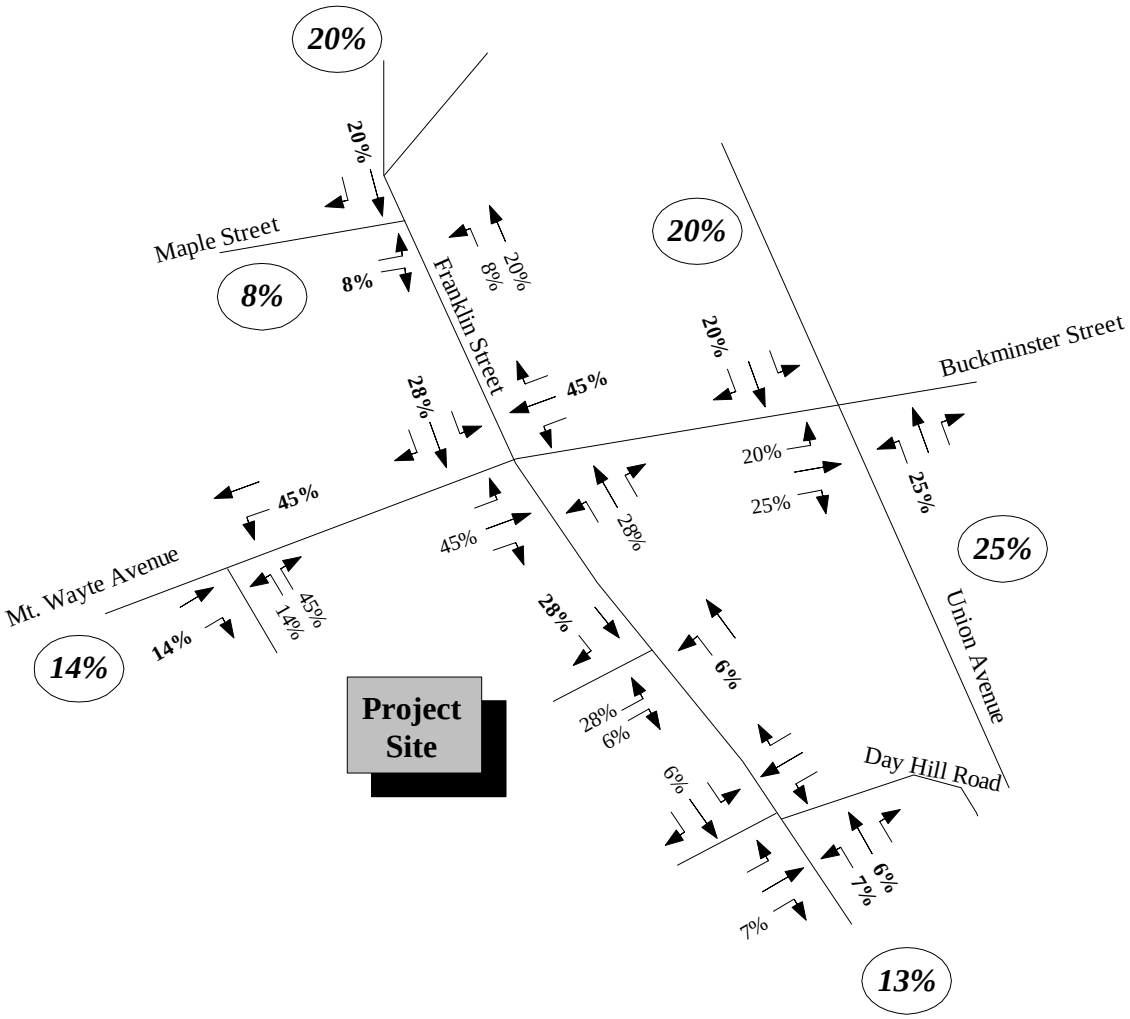
Once the number of trips projected to be generated by the development has been determined, trips are assigned to the site driveways and study area roadways based on trip distribution patterns determined for the project. For this project, an analysis of directional distribution of generated trips to and from the site was completed.

For this specific analysis, distribution patterns were completed assuming a shopping center (retail and mixed-commercial) land use. The retail-oriented trip distribution pattern took into account the region's population and travel times culminating in a modified gravity type model for new retail trips.

As a result of this analysis, the estimated percentages by direction and for each analysis period were developed. The estimated patterns for new trips by key land use are graphically presented in Figure 7.

3.3.3 Build Traffic Volumes

Trips estimated for the proposed development were assigned to the site driveways and the study area roadways using the trip distribution percentages developed for new and passby traffic for retail-generated trips. Taking into account existing roadway networks, travel distances and observed traffic conditions of the region, commutes to and from the site were assigned to either: Franklin Street north or south of the site; Mt. Wayte Avenue west of the site; Union Avenue north or south of the site; or to Maple Street northwest of the site. Peak hour site traffic volumes were then added to traffic volumes in the study area that were adjusted for background growth, in order to establish the 2020 Build condition traffic networks. Figure 8 and Figure 9 present the Build traffic volumes for the weekday morning and evening peak hours and for the Saturday peak hour, respectively. The number of new trips and passby/diverted-link trips are shown in Figure 10 and Figure 11, and further details on the assignment are included in the Appendix.



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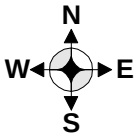

Estimated Trip Distribution Network

Figure 7

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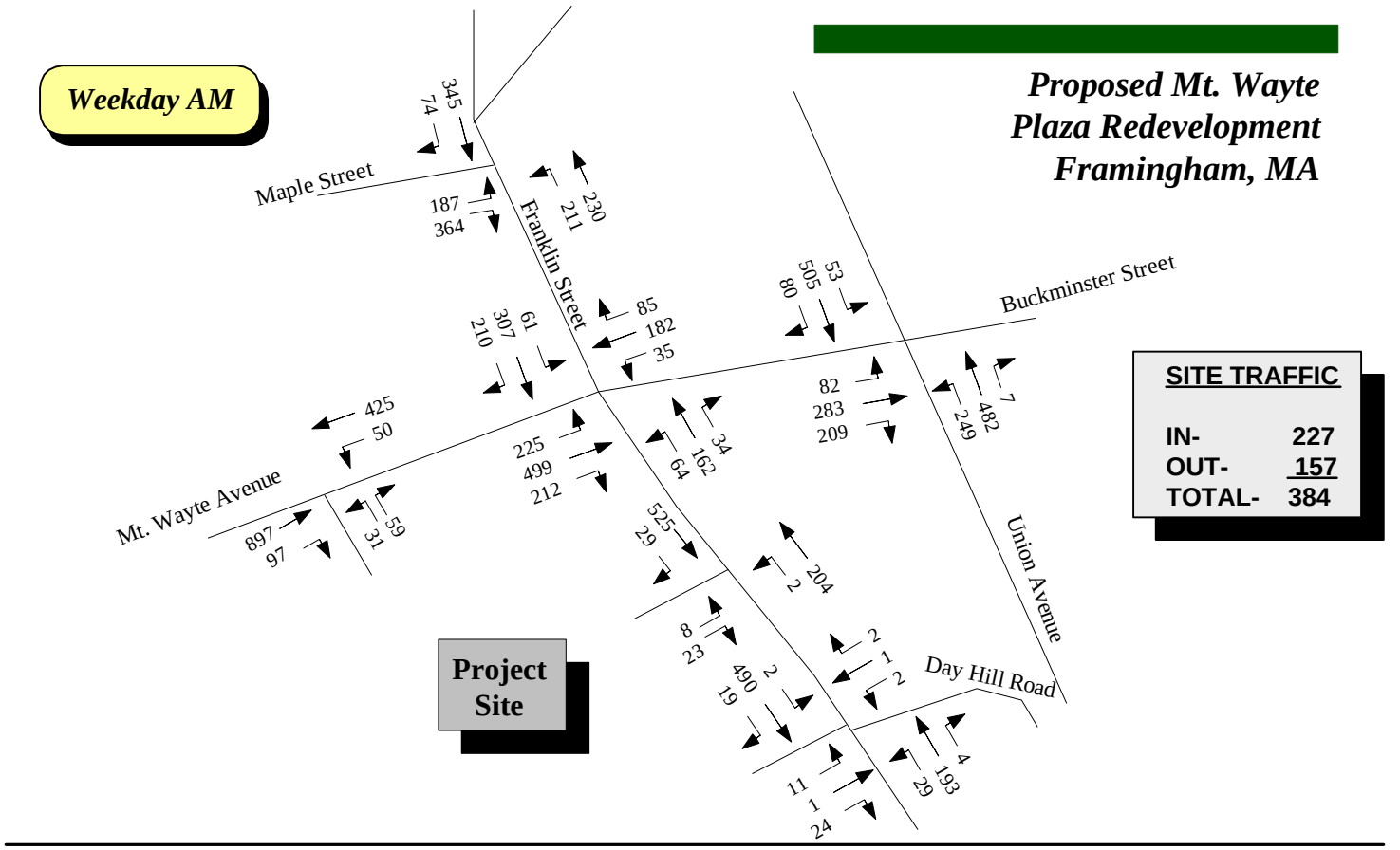

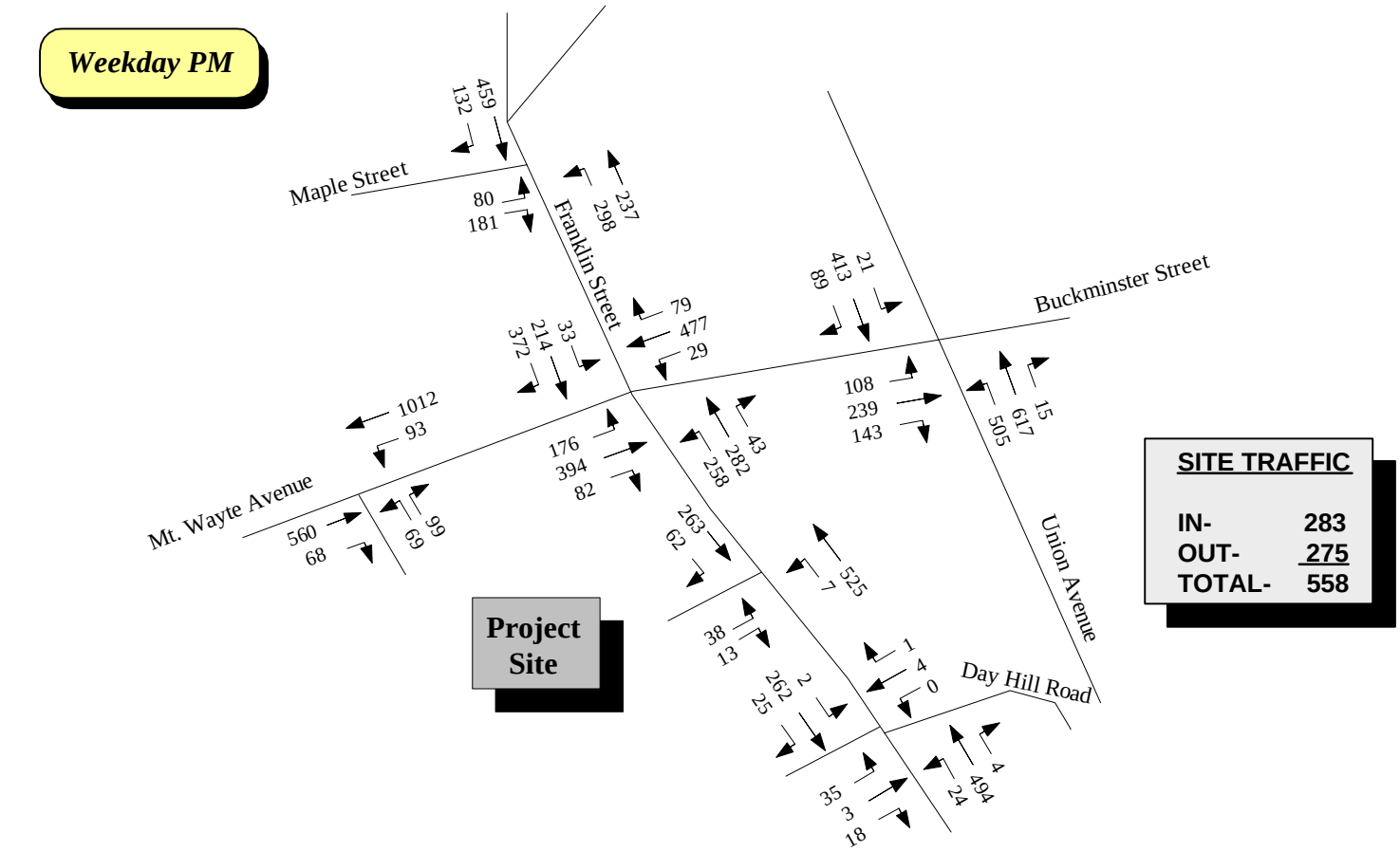

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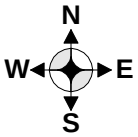

Estimated 2020 Build Traffic Volume Networks

Figure 8

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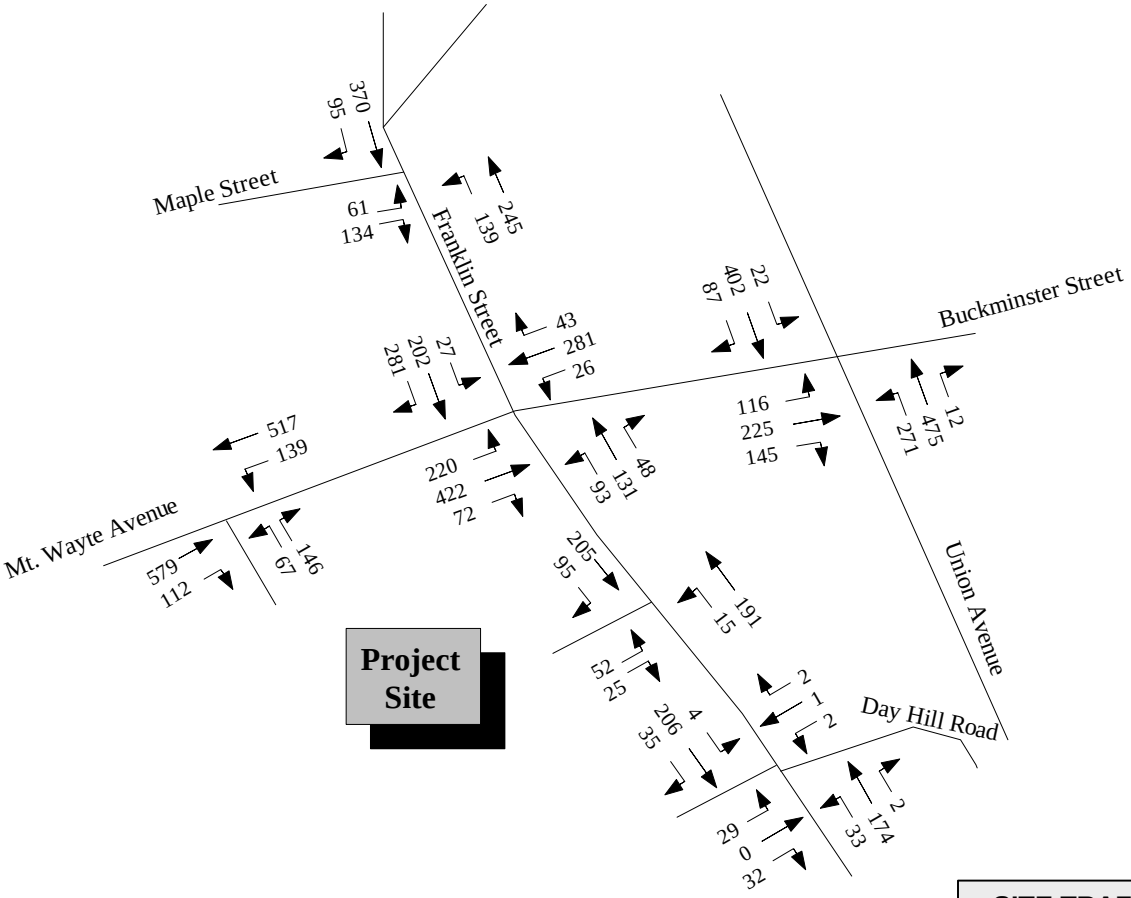
Saturday Peak



SITE TRAFFIC	
IN-	430
OUT-	351
TOTAL-	781

Not to Scale

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Estimated 2020 Build
Traffic Volume Networks
Figure 9

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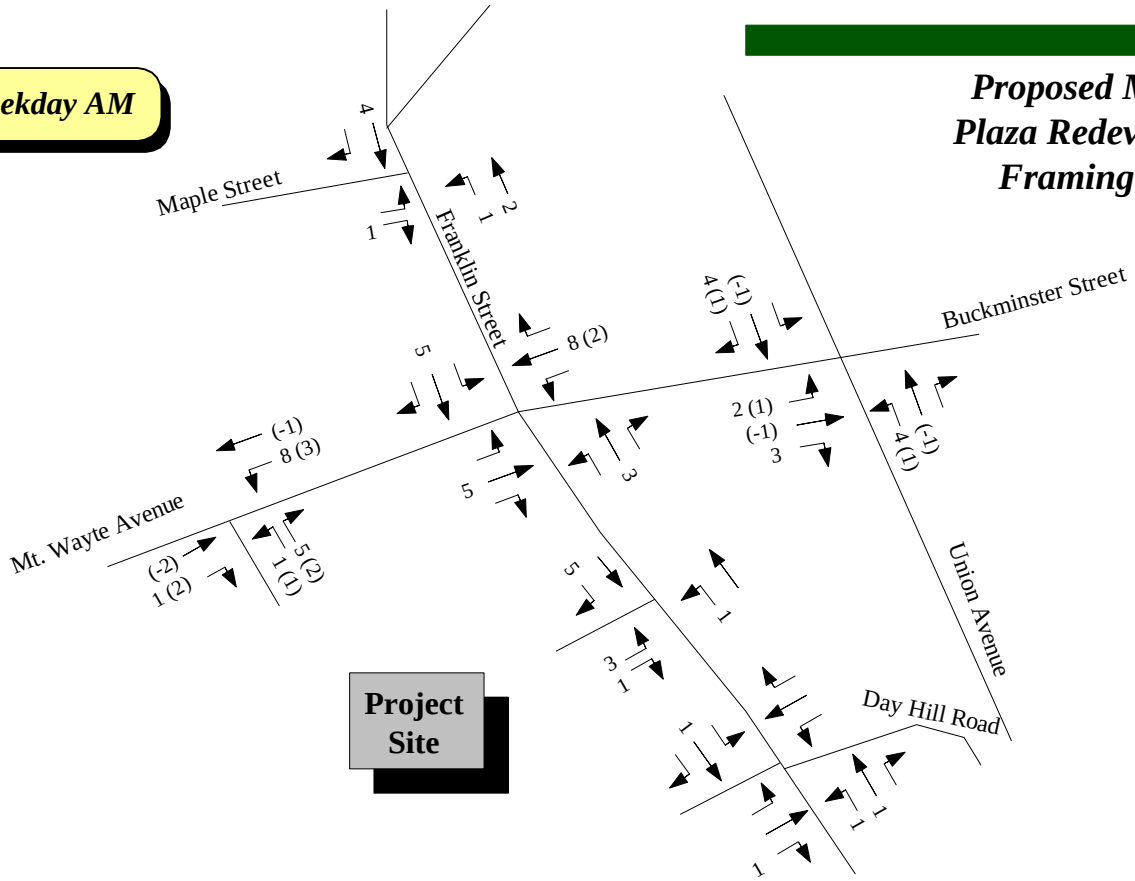
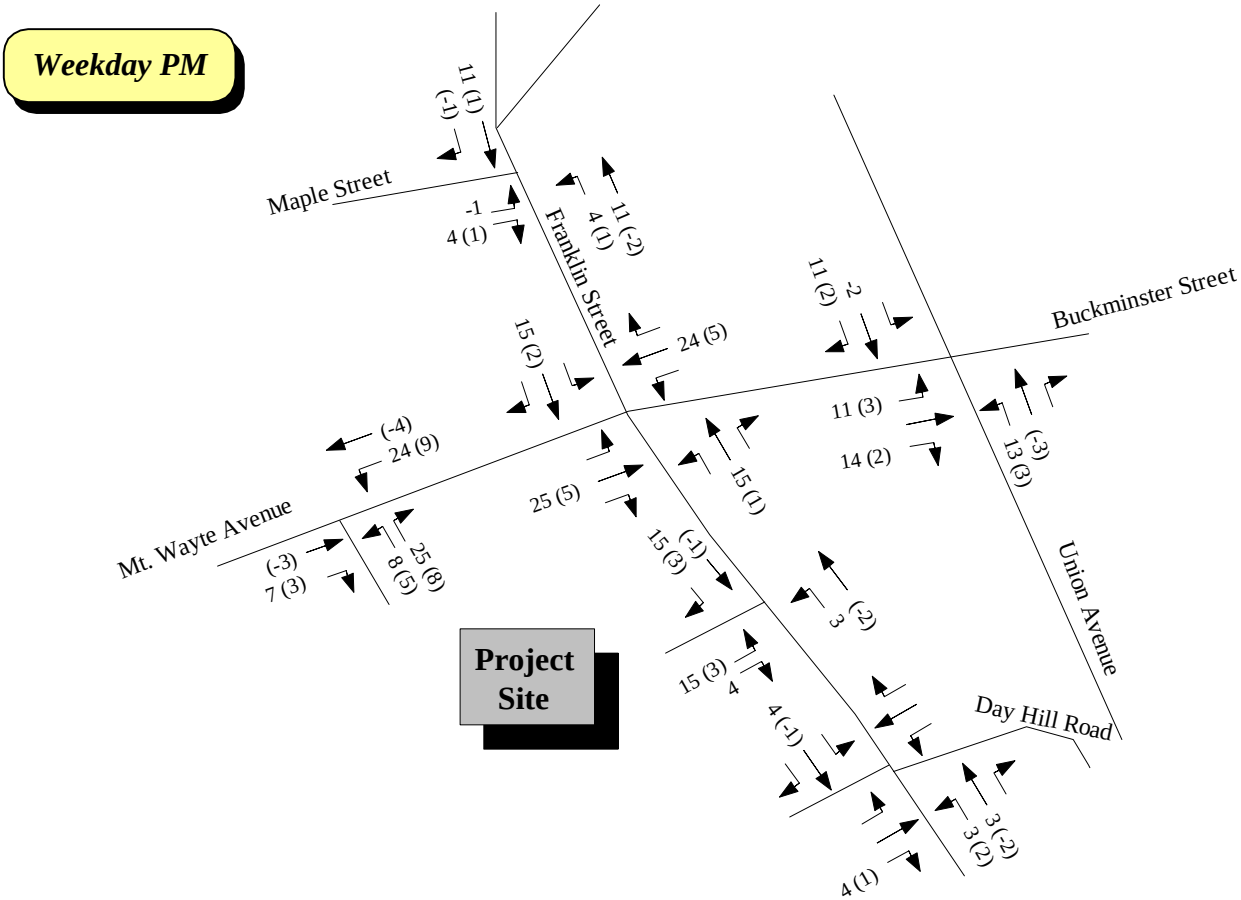
Proposed Mt. Wayte Plaza Redevelopment Framingham, MA





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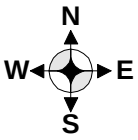
New Trips (Passby/Diverted-Link Trips)



New and Passby/Diverted-Link Build Traffic Volumes

Figure 10

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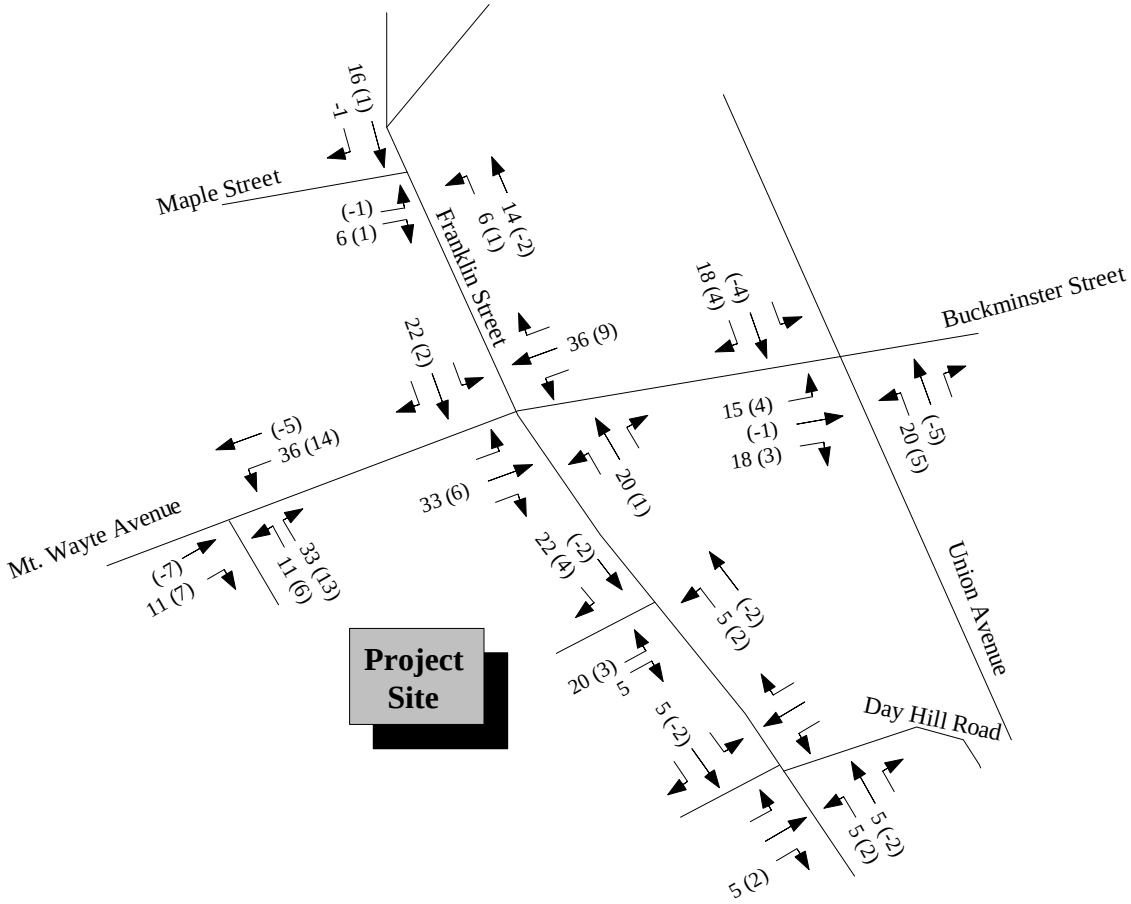
Saturday Peak



Not to Scale
New Trips (Passby/Diverted-Link Trips)

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New and Passby/Diverted-Link Build Traffic Volumes

Figure 11

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4.0 Analysis

Previous sections of this report described the current conditions of the study intersections and the development of the 2020 No-Build and 2020 Build traffic volume networks including the site generated trip forecasts. Included in this section are an examination of the volume changes, capacity/Level of Service (LOS) analyses for the study intersections under each condition and sight distances relative to the site access drives.

4.1 Traffic Volume Increases

Initially, a comparison of No-Build and Build volumes on the surrounding roadway system was completed. The proposed development based on the LUC 820 model is expected to generate a total of 290 additional vehicle trips over the course of an average weekday, as compared to the No-Build case. The weekday morning peak hour is expected to generate a total of 47 fewer trips than the No-Build case; there are large number of (albeit mostly passby) trips predicted to be made to and from the gas station in the No-Build case, a land use which will not be present in the Build scenario. The weekday evening peak hour is expected to generate 35 added total trips. Saturday traffic is expected to generate 1,272 more vehicle trips during the day, of which an additional 133 trips are predicted to occur during the midday peak hour compared to the No-Build case. These values represent the total number of trips being made to and from the site, including passby and diverted-link trips; Table 4.1 summarizes the actual changes in traffic volumes expected to occur on the roadway network from the No-Build (reoccupancy of the site) to the Build (expanded reoccupation of site) conditions.

Table 4.1 - Summary of Estimated Roadway Traffic Increases

	AM Peak Hour			PM Peak Hour			Sat Peak Hour		
	No-Build	Build	Δ in Volume	No-Build	Build	Δ in Volume	No-Build	Build	Δ in Volume
Franklin Street									
North of Mt. Wayte Avenue	1,055	1,050	-5	1,137	1,156	19	869	904	35
South of Day Hill Road	747	742	-3	800	802	2	444	453	9
Mt. Wayte Avenue									
South of Project Site	1,455	1,450	-5	1,705	1,709	4	1,259	1,275	16
Union Avenue									
North of Mt. Wayte Avenue	1,204	1,202	-2	1,236	1,248	12	1,080	1,102	22
South of Mt. Wayte Avenue	1,456	1,452	-4	1,680	1,693	13	1,276	1,305	29

The key findings in reviewing the estimated traffic increases include the following:

- Overall, the proposed project will result in small increases (up to 35 vehicles per peak hour) in roadway volumes during the weekday evening and Saturday peak hours when compared to the Future No-Build condition that presumes the full re-occupancy of the existing site.
- Small decreases (up to five vehicles per peak hour or 0.5%) in roadway volumes within the study area are expected in the Build case compared to the No-Build case. This is due to the fact that the additional 31,000 square feet or so of retail space proposed in the Build scenario will not generate as many trips to the site as will the gas station whose reoccupation is presumed in the No-Build scenario.
- Away from the site, the largest estimated volume increases due to the project will occur on Franklin Street north of Mt. Wayte Avenue and on Union Avenue south of Mt. Wayte Avenue with volume increases of 35 vehicles and 29 vehicles for the Saturday peak hour, respectively. These increases represent 4.0% and 2.3%, respectively, over the No-Build condition depending on the time period.
- In terms of percentages the greatest increase in roadway volumes is expected to be Franklin Street north of Mt. Wayte Avenue.
- Other increases in roadway volumes are expected to be between 0.2% and 2.0% from No-Build to Build scenarios.

In summary, the change in volume away from the site is expected to be fairly small. The character of the roadways serving the project will not be substantially altered as a result of this project.

4.2 Capacity/Level Of Service (LOS) Analysis

The two study intersections were examined with regard to flow rates, capacity and delay characteristics to determine the Level of Service (LOS) as described on the Highway Capacity Manual (HCM)[3] for the existing and future (No-Build and Build) traffic conditions. Level of Service is an indicator of operating conditions which occur on a given roadway feature while accommodating varying levels of traffic volumes. It is a qualitative measure that accounts for a number of operational factors including roadway geometry, speed, traffic composition, peak hour factors, travel delay, freedom to maneuver and driver expectation. When all of these measures are assessed and a Level of Service is assigned to a roadway or intersection, it is equivalent to presenting an “index” to the operational qualities of the section under study. Level of Service is classified into six levels that are designated ‘A’ through ‘F’ based on the control delay ranges they fall under. Additionally, a movement with a volume-to-capacity (v/c) ratio of over 1.00 also has a LOS of ‘F’, regardless of delay. These are presented in Table 4.2 for both signalized and unsignalized intersections.

In practice, any given roadway/intersection may operate at a wide LOS range depending upon time of day, day of week or period of year. It should be noted that for unsignalized intersections, the Level of Service is not computed for the intersection as a whole. Instead, the level of service is determined by the computed or measured control delay for each individual critical movement.

[3] Transportation Research Board, of the National Academies, Highway Capacity Manual 2010, Washington, D.C., 2010.

Table 4.2 - Level of Service Criteria for Unsignalized Intersections

Level of Service	Unsignalized Intersections Control Delay Range (sec)	Signalized Intersections Control Delay Range (sec)
A	<= 10	<= 10
B	> 10 and <= 15	> 10 and <= 20
C	> 15 and <= 25	> 20 and <= 35
D	> 25 and <= 35	> 35 and <= 55
E	> 35 and <= 50	> 55 and <= 80
F	> 50 OR v/c > 1.00	> 80 OR v/c > 1.00

The study intersections were evaluated using the Synchro 8 computer models that follow the procedures established in the HCM to complete the analysis for the signalized study intersections. Because the latest edition of the HCM does not provide methodology for evaluating signalized intersections that have an exclusive pedestrian phase or actuated intersections having approaches without vehicle detectors (i.e. approaches with maximum recall), the signalized intersections in the study area were evaluated using Synchro 8 computer models following procedures similar to those provided in the HCM. Using existing roadway features and the intersection controls, traffic operations at the study intersections were evaluated for existing as well as future conditions. Analysis results are presented in Tables 4.3-4.8 for the study intersections.

The Level of Service analysis indicated the following:

- Franklin Street, Mount Wayte Avenue, and Union Avenue have residual capacity to accommodate the new traffic at the proposed site drives.
- Traffic taking a left out from the site drive on Mt. Wayte Avenue southwest of the intersection of Mt. Wayte Avenue and Franklin Street will experience long delays in the No-Build and Build conditions. It is expected that long delays at this intersection resulting from the project will be confined within the project site, and that delays on the surrounding road network (including the study area) will experience minimal increases in delay (< 1.0 s) at each of the site drives. Entering traffic will be able to so with short to moderate delays (≤ 13.0 s) during peak hours.
- With one exception, overall delay in the Build scenario at each of the signalized intersections within the study area will increase by less than 3.5 seconds from that of the No-Build condition.
- Based on the volume/capacity ratio under current conditions during the evening peak hour, the intersection of Union Avenue with Mt. Wayte Avenue experiences long vehicle delays on the northbound left movement, and delay would increase in the future with or without the proposed project. The proposed development is not creating this condition although it will contribute to an already lengthy delay (> 55.0 s) at this intersection.

In summary, the analysis has shown that the proposed access plan will facilitate motorists entering and exiting the site in a safe and effective manner, with manageable delays for entering and generally for exiting motorists.

Table 4.3 - Summary of LOS Analysis Weekday AM Peak Hour Signalized Intersections

	Existing Conditions			Future No-Build			Future Build Conditions		
	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Union Avenue at Mt. Wayte Avenue at Buckminster Street									
Eastbound Thru/Left	0.84	45.1	D	0.87	46.8	D	0.86	46.7	D
Eastbound Right	0.40	5.6	A	0.42	5.8	A	0.42	5.8	A
Northbound Left	0.71	21.6	C	0.91	47.0	D	0.91	46.4	D
Northbound Right/Thru	0.48	11.4	B	0.52	12.5	B	0.52	12.5	B
Southbound Left	0.14	13.4	B	0.16	14.3	B	0.16	14.3	B
Southbound Right/Thru	0.71	21.9	C	0.77	25.6	C	0.77	25.6	C
OVERALL	**-**	***21.7***	***C***	**-**	***26.6***	***C***	**-**	***26.6***	***C***
Franklin Street at Maple Street (south intersection)									
Eastbound Left	0.67	54.5	D	0.47	51.5	D	0.71	57.7	E
Eastbound Right	0.66	10.5	B	0.57	13.7	B	0.67	10.6	B
Northbound Left	0.51	17.6	B	0.52	14.8	B	0.56	18.4	B
Northbound Right/Thru	0.22	13.8	B	0.22	11.1	B	0.23	16.2	B
Southbound Right/Thru/Left	0.73	41.5	D	0.74	38.2	D	0.75	42.3	D
OVERALL	**-**	***26.8***	***C***	**-**	***24.8***	***C***	**-**	***27.7***	***C***
Franklin Street at Mt. Wayte Avenue									
Eastbound Left	0.52	23.0	C	0.63	28.1	C	0.61	25.9	C
Eastbound Right/Thru	0.94	50.0	D	1.06	78.7	F	1.04	73.3	E
Westbound Left	0.54	67.4	E	0.79	113.0	F	0.80	119.7	F
Westbound Thru	0.43	35.4	D	0.52	37.4	D	0.53	38.9	D
Northbound Left	0.35	33.5	C	0.37	31.3	C	0.39	33.5	C
Northbound Right/Thru	0.34	31.0	C	0.36	28.8	C	0.36	30.2	C
Southbound Left/Thru	0.87	67.1	E	0.92	69.5	E	0.93	72.8	E
Southbound Right	0.33	14.0	B	0.34	14.3	B	0.33	13.9	B
OVERALL	**-**	***42.5***	***D***	**-**	***54.4***	***D***	**-**	***53.4***	***D***

Table 4.4 - Summary of LOS Analysis Weekday AM Peak Hour Unsignalized Intersections

	Existing Conditions			Future No-Build			Future Build Conditions		
	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Site Drive at Mt. Wayte Avenue									
Westbound Left	0.34	57.1	F	0.42	76.0	F	0.47	86.1	F
Westbound Right	0.23	23.9	C	0.28	27.2	D	0.32	28.1	D
Southbound Left	0.05	11.7	B	0.08	12.3	B	0.10	12.5	B
Site Drive at Franklin Street									
Eastbound Left	0.04	12.0	B	0.06	13.2	B	0.07	13.5	B
Northbound Left	*	0.0	A	0.00	8.7	A	0.02	8.7	A
Closed Site Drive at Mt. Wayte Avenue									
Westbound Left	-	-	-	0.04	10.6	B	-	-	-
Northbound Left/Right	-	-	-	0.14	26.1	D	-	-	-
Closed Site Drive at Franklin Street									
Northbound Left	-	-	-	0.08	8.9	A	-	-	-
Eastbound Left/Right	-	-	-	0.12	17.4	C	-	-	-
Site Drive at Franklin Street at Day Hill Road									
Eastbound Right/Thru/Left	0.08	14.2	B	0.10	14.9	B	0.10	14.8	B
Westbound Right/Thru/Left	0.03	14.3	B	0.03	15.1	C	0.03	15.4	C
Northbound Right/Thru/Left	0.03	8.7	A	0.03	8.8	A	0.03	8.8	A
Southbound Right/Thru/Left	0.00	7.7	A	0.00	7.7	A	0.00	7.7	A

* Not Calculated

Table 4.5 - Summary of LOS Analysis Weekday PM Peak Hour Signalized Intersections

	Existing Conditions			Future No-Build			Future Build Conditions		
	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Union Avenue at Mt. Wayte Avenue at Buckminster Street									
Eastbound Thru/Left	0.83	43.6	D	0.88	48.6	D	0.88	48.4	D
Eastbound Right	0.27	5.9	A	0.32	5.9	A	0.33	6.1	A
Northbound Left	1.04	67.9	F	1.29	> 120	F	1.35	> 120	F
Northbound Right/Thru	0.59	12.9	B	0.63	14.4	B	0.64	14.9	B
Southbound Left	0.07	12.6	B	0.08	13.0	B	0.08	13.4	B
Southbound Right/Thru	0.53	16.8	B	0.60	18.6	B	0.61	19.4	B
OVERALL	**-**	***31.4***	***C***	**-**	***55.0***	***E***	**-**	***61.7***	***E***
Franklin Street at Maple Street (south intersection)									
Eastbound Left	0.41	36.4	D	0.42	36.5	D	0.42	36.5	D
Eastbound Right	0.52	11.0	B	0.54	11.0	B	0.55	11.1	B
Northbound Left	0.64	20.1	C	0.70	24.7	C	0.72	25.5	C
Northbound Right/Thru	0.19	7.7	A	0.22	7.9	A	0.22	7.9	A
Southbound Right/Thru/Left	0.87	39.1	D	0.93	47.4	D	0.95	51.0	D
OVERALL	**-**	***25.6***	***C***	**-**	***29.8***	***C***	**-**	***31.4***	***C***
Franklin Street at Mt. Wayte Avenue									
Eastbound Left	0.61	29.8	C	0.75	49.2	D	0.75	50.1	D
Eastbound Right/Thru	0.50	26.5	C	0.61	32.2	C	0.64	34.1	C
Westbound Left	0.09	36.2	D	0.12	42.1	D	0.13	43.3	D
Westbound Thru	0.75	45.7	D	0.91	62.0	E	0.95	68.8	E
Northbound Left	0.74	40.1	D	0.78	42.9	D	0.79	43.8	D
Northbound Right/Thru	0.45	29.7	C	0.49	30.7	C	0.50	30.7	C
Southbound Left/Thru	0.82	72.4	E	0.83	72.2	E	0.84	72.2	E
Southbound Right	0.60	13.8	B	0.62	16.8	B	0.62	17.5	B
OVERALL	**-**	***35.3***	***D***	**-**	***42.7***	***D***	**-**	***45.0***	***D***

Table 4.6 - Summary of LOS Analysis Weekday PM Peak Hour Unsignalized Intersections

	Existing Conditions			Future No-Build			Future Build Conditions		
	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Site Drive at Mt. Wayte Avenue									
Westbound Left	0.72	118.8	F	1.28	> 120	F	1.74	> 120	F
Westbound Right	0.05	13.7	B	0.19	15.9	C	0.28	17.1	C
Southbound Left	0.03	9.2	B	0.08	9.7	A	0.10	9.8	A
Site Drive at Franklin Street									
Eastbound Left	0.01	9.8	A	0.09	15.7	C	0.16	16.9	C
Northbound Left	*	0.0	A	0.01	8.0	A	0.01	8.0	A
Closed Site Drive at Mt. Wayte Avenue									
Westbound Left	-	-	-	0.03	9.1	A	-	-	-
Northbound Left/Right	-	-	-	0.32	46.0	E	-	-	-
Closed Site Drive at Franklin Street									
Northbound Left	-	-	-	0.01	7.9	A	-	-	-
Eastbound Left/Right	-	-	-	0.04	12.9	B	-	-	-
Site Drive at Franklin Street at Day Hill Road									
Eastbound Right/Thru/Left	0.21	22.8	C	0.25	24.0	C	0.26	23.3	C
Westbound Right/Thru/Left	0.03	18.0	C	0.31	19.7	C	0.03	19.9	C
Northbound Right/Thru/Left	0.01	8.0	A	0.02	8.0	A	0.02	8.0	A
Southbound Right/Thru/Left	0.00	8.6	A	0.00	8.7	A	0.00	8.7	A

* Not calculated

Table 4.7 - Summary of LOS Analysis Saturday Peak Hour Signalized Intersections

	Existing Conditions			Future No-Build			Future Build Conditions		
	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Union Avenue at Mt. Wayte Avenue at Buckminster Street									
Eastbound Thru/Left	0.76	39.4	D	0.81	41.6	D	0.82	42.9	D
Eastbound Right	0.23	6.4	A	0.29	5.7	A	0.31	5.6	A
Northbound Left	0.47	9.7	A	0.68	17.6	B	0.75	22.8	C
Northbound Right/Thru	0.47	10.0	B	0.50	11.4	B	0.50	11.5	B
Southbound Left	0.06	11.7	B	0.06	12.5	B	0.06	12.7	B
Southbound Right/Thru	0.52	15.7	B	0.60	18.3	B	0.62	18.6	B
OVERALL	***-***	***17.0***	***B***	***-***	***19.6***	***B***	***-***	***20.9***	***C***
Franklin Street at Maple Street (south intersection)									
Eastbound Left	0.31	33.5	C	0.31	33.7	C	0.31	33.7	C
Eastbound Right	0.37	6.7	A	0.42	9.1	A	0.45	10.1	B
Northbound Left	0.24	8.0	A	0.30	8.5	A	0.32	8.7	A
Northbound Right/Thru	0.19	7.3	A	0.22	7.5	A	0.23	7.5	A
Southbound Right/Thru/Left	0.61	23.7	C	0.70	27.0	C	0.73	28.1	C
OVERALL	***-***	***16.4***	***B***	***-***	***18.1***	***B***	***-***	***18.7***	***B***
Franklin Street at Mt. Wayte Avenue									
Eastbound Left	0.49	20.5	C	0.55	23.3	C	0.57	24.8	C
Eastbound Right/Thru	0.56	22.7	C	0.60	25.1	C	0.63	26.6	C
Westbound Left	0.15	32.6	C	0.14	33.8	C	0.14	34.4	C
Westbound Thru	0.59	35.9	D	0.70	41.7	D	0.73	44.0	D
Northbound Left	0.27	21.2	C	0.32	25.4	C	0.35	26.7	C
Northbound Right/Thru	0.22	17.4	B	0.30	22.6	C	0.33	24.3	C
Southbound Left/Thru	0.62	43.3	D	0.70	50.7	D	0.73	53.3	D
Southbound Right	0.40	5.8	A	0.41	9.0	A	0.41	10.2	B
OVERALL	***-***	***23.3***	***C***	***-***	***28.2***	***C***	***-***	***30.3***	***C***

Table 4.8 - Summary of LOS Analysis Saturday Peak Hour Unsignalized Intersections

	Existing Conditions			Future No-Build			Future Build Conditions		
	v/c	Delay	LOS	v/c	Delay	LOS	v/c	Delay	LOS
Site Drive at Mt. Wayte Avenue									
Westbound Left	0.19	28.3	D	0.44	54.3	F	0.74	110.6	F
Westbound Right	0.10	13.0	B	0.23	14.9	B	0.33	16.3	C
Southbound Left	0.03	8.9	A	0.11	9.4	A	0.17	9.8	A
Site Drive at Franklin Street									
Eastbound Left	0.02	9.6	A	0.09	11.5	B	0.16	12.4	B
Northbound Left	*	0.0	A	0.01	7.9	A	0.01	8.0	A
Closed Site Drive at Mt. Wayte Avenue									
Westbound Left	-	-	-	0.02	9.3	A	-	-	-
Northbound Left/Right	-	-	-	0.12	21.8	C	-	-	-
Closed Site Drive at Franklin Street									
Northbound Left	-	-	-	0.00	7.9	A	-	-	-
Eastbound Left/Right	-	-	-	0.02	11.6	B	-	-	-
Site Drive at Franklin Street at Day Hill Road									
Eastbound Right/Thru/Left	0.12	12.3	B	0.15	12.6	B	0.16	12.6	B
Westbound Right/Thru/Left	0.02	11.3	B	0.02	11.9	B	0.02	12.1	B
Northbound Right/Thru/Left	0.01	7.8	A	0.02	7.9	A	0.03	7.9	A
Southbound Right/Thru/Left	0.00	7.5	A	0.00	7.6	A	0.00	7.6	A

* Not calculated

4.3 Sight Distance Analysis

Adequate sight distance is an important safety consideration at intersections. Sight distances were reviewed for the three major study intersections. Stopping sight distance (SSD) is the distance required for an approaching driver at a height of 3.5 feet to perceive and react accordingly to an object 2 feet high at the driveway. The values are based on a perception and reaction time of 2.5 seconds and braking distance required under wet, level pavements. Corner or intersection sight distance (CSD) is based on the time required to perceive, react, and complete desired exiting maneuver from a driveway once the driver decides to execute the maneuver.

Values for exiting sight distance represent the time to (1) turn left or right, in addition to accelerating to the operating speed of the roadway, without causing approaching vehicles to reduce speed by more than 10 mph, and (2) upon turning left, to clear the near half of the intersection without conflicting with the vehicles approaching from the left. Corner sight distance is more related to operations and to some degree, the convenience or inconvenience of oncoming motorists. When the roadway is either on an upgrade or downgrade, grade correction factors may be applied to both sight distances. Minimum

criteria are defined by the American Association of State and Highway and Transportation Officials (AASHTO)[4]. SSD relates specifically to safety. As indicated by AASHTO, if CSD meets or exceeds the SSD criteria, then there is adequate safe sight distance available for motorists to avoid collisions. Two sets of criteria can be established, based on either posted speed limit or on operating speed, the speed at or under which most motorists (85th-percentile) actually travel along a particular portion of roadway.

The posted speed limit on Franklin Street is 25 miles per hour (mph) in the vicinity of the project site, and 40 mph on Mt. Wayte Street west of the project site. Travel speeds on Franklin Street were observed to be 35-36 mph in both directions. Travel speeds on Mt. Wayte Avenue were observed to be 39-40 mph in the westbound direction and 38-40 mph in the eastbound direction. Hence, travel speeds of 35 mph are assumed on Franklin Street and 40 mph on Mt. Wayte Avenue. The recommended minimum approach SSD requirement for vehicles traveling at 35 mph and 40 mph speeds are 250 feet and 300 feet, respectively. In addition to the two site drives where turning movement counts were collected, CSD was measured at a site drive on Franklin Street located 180 feet north of Day Hill Road. The other existing site drive locations are proposed to be closed off in the future, so CSD was not measured here.

The CSD was estimated through field review. In regards to CSD, the criterion for 35 miles per hour are 390 feet for left turns and 335 feet for right turns, and the criterion for 40 miles per hour are 445 feet for left turns and 385 feet for right turns. At signalized intersections CSD is met if each approach is able to be viewed from each of the other approaches at the intersection, which is the case for the signalized intersections in the study area.

Table 4.9 summarizes the results of the evaluation. All CSD in relation to the site drives meet or exceed the criteria for posted speed limits and for estimated operating speeds.

4 American Association of State Highway and Transportation Officials (AASHTO), A Policy on Geometric Design of Highways and Streets, Washington, D.C., 2011.

Table 4.9 - Summary of Sight Distance Analysis

Location	Measured Distance (ft)	Criteria Operating Speed (ft)	Criteria Met
Site Drive at Franklin Street North of Day Hill Road		*35 MPH*	
Stopping Sight Distance			
Franklin Street Northbound	> 500	250	Yes
Franklin Street Southbound	> 500	250	Yes
Corner Sight Distance			
Site Drive Exit Turning Right			
Looking Right	> 500	335	Yes
Looking Left	500	335	Yes
Site Drive Exit Turning Left			
Looking Right	> 500	390	Yes
Looking Left	500	390	Yes
Site Drive at Franklin Street at Day Hill Road		*35 MPH*	
Stopping Sight Distance			
Franklin Street Northbound	> 500	250	Yes
Franklin Street Southbound	480	250	Yes
Corner Sight Distance			
Site Drive Exit Turning Right			
Looking Right	485	335	Yes
Looking Left	440	335	Yes
Site Drive Exit Turning Left			
Looking Right	485	390	Yes
Looking Left	440	390	Yes
Site Drive at Mt. Wayte Avenue		*40 MPH*	
Stopping Sight Distance			
Mt. Wayte Avenue Eastbound	> 500	300	Yes
Mt. Wayte Avenue Westbound	> 500	300	Yes
Corner Sight Distance			
Site Drive Turning Right			
Looking Right	> 500	385	Yes
Looking Left	460	385	Yes
Site Drive Turning Left			
Looking Right	> 500	445	Yes
Looking Left	460	445	Yes

5.0 Conclusions And Recommendations

The previous sections of this traffic report described the analysis procedures, assumptions and results of this traffic study. The roadways and intersections within the study area were seen to have the ability to accommodate the proposed development related traffic. The following summarizes the traffic analysis:

- The major streets of Franklin Street, Mt. Wayte Avenue, and Union Avenue within this area and included in this study are two lane urban collector or minor arterial (Union Avenue) roads. In general, the roadway network has and will have the capacity to accommodate additional peak vehicular demands.
- The proposed project is estimated to generate a total of 143 and 205 additional external vehicle trips during the afternoon weekday and the Saturday peak hours, respectively, with portions allocated to the west, north and south of the redevelopment area. Compared to the No-Build case, the project is expected to produce 47 fewer trips during the morning weekday peak hour. The predominant flow in the morning on weekdays is entering trips, while during the evening and during midday Saturday the peak direction is exiting vehicles.11
- There currently exist traffic problems at the northbound left-turning movement on Union Avenue at its intersection with Mt. Wayte Avenue and at the westbound approach on Mt. Wayte Avenue at Franklin Street. Compared to the No-Build scenario, the project is expected to add less than three seconds of overall delay to each of the signalized study intersections with the exception of Mt. Wayte Avenue at Union Avenue during PM peak hour. The project will not create traffic problems on the other side streets within the study area outside of the site.
- With the Full-Build and occupancy of the proposed development, motorists exiting the site drives will during the peak hours experience moderate to long delays but will experience short delays entering the site.
- The proposed site drives meet or exceed all safe sight distance conditions.

Recommendations

While the analyses show that the proposed project can be accommodated on the study area network, several recommendations have been made to enhance the transportation system and reduce this and other projects' impact. The proposed actions are as follows:

- Any proposed landscaping and signage should be low enough and/or set back sufficiently so as not to create any sight distance constraint.
- To better highlight the intended traffic control of the site drive intersections, install a STOP sign (R1-1) and a STOP bar at each of the proposed site drives at their respective approaches to Franklin Street and Mt. Wayte Avenue.
- To discourage motorists from cutting through the plaza to bypass the Mt. Wayte Avenue / Franklin Street intersection as well as to encourage slow speeds through the site, mutliple speed tables/raised crosswalks are proposed within the plaza.
- To reduce the delay for vehicles exiting the site, the site drive on Mt. Wayte Avenue includes one left turn only lane and one right turn only lane.
- Mitigation is proposed to improve the traffic signal operations and enhance the safety of the intersection of Union Avenue and Mt. Wayte Avenue. The intersection as a whole operates with decent (LOS 'B' to 'C') delays in the existing condition, but it is desirable to improve operations and safety for the northbound left movement. Currently 12-24% of vehicles at the intersection use this

movement during peak hours, and an estimated 25% of new site traffic is expected to access the site via the northbound left movement. During the PM peak period, regardless of the proposed redevelopment, the high-volume (> 500 vehicles per hour) northbound left movement is expected to experience significant delay. A safety hazard is also created by the inclusion of a delayed southbound movement; although the northbound left movement has nine seconds of protection before the start of the southbound movement, there is no indication of when the northbound left movement is no longer protected other than noting when southbound traffic begins to flow. Replacing one of the signal heads for the northbound approach with a four-faced signal head with a bimodal left-turn arrow will improve safety by clearly indicating when the northbound protected left-turn phase begins and ends. Furthermore, optimized traffic signal timings are recommended to improve traffic operations for the northbound left movement and for the intersection as a whole. A summary of the Level of Service analysis for the Build and Mitigated scenarios for the intersection of Union Avenue at Mt. Wayte Avenue is provided in Table 5.1; details of the mitigated signal timing is included in the Appendix.

Table 5.1 - Summary of Mitigated LOS Analysis Weekday PM Peak Hour Union Ave at Mt. Wayte Ave

	Future Build Conditions			**Future Build Conditions with Mitigation**		
	v/c	**Delay**	**LOS**	**v/c**	**Delay**	**LOS**
Eastbound Thru/Left	0.88	48.4	D	0.90	55.9	E
Eastbound Right	0.33	6.1	A	0.35	9.3	A
Northbound Left	1.35	> 120	F	1.16	118.2	F
Northbound Right/Thru	0.64	14.9	B	0.61	15.0	B
Southbound Left	0.08	13.4	B	0.09	24.6	C
Southbound Right/Thru	0.61	19.4	B	0.87	46.9	D
OVERALL	**-**	***61.7***	***E***	**-**	***52.6***	***D***

Appendix

- traffic volume data
- MassDOT season adjustment factors and historical growth
- crash rate calculations
- transit schedules and fares
- trip generation calculations
- traffic assignment worksheets
- level of service computation sheets